

QGIS Training Manual

QGIS Project

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Cuprins

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CAPITOLUL 1

Curs Introductiv

1.1 Cuvânt înainte

Welcome to our course! We will be showing you how to use QGIS easily and efficiently. If you are new to GIS, we will tell you what you need to get started. If you are an experienced user, you will see how QGIS fulfills all the functions you expect from a GIS program, and more!

1.1.1 Why QGIS?

As information becomes increasingly spatially aware, there is no shortage of tools able to fulfill some or all commonly used GIS functions. Why should anyone be using QGIS over some other GIS software package?

Here are only some of the reasons:

- *It's free, as in lunch.* Installing and using the QGIS program costs you a grand total of zero money. No initial fee, no recurring fee, nothing.
- *It's free, as in liberty.* If you need extra functionality in QGIS, you can do more than just hope it will be included in the next release. You can sponsor the development of a feature, or add it yourself if you are familiar with programming.
- *It's constantly developing.* Because anyone can add new features and improve on existing ones, QGIS never stagnates. The development of a new tool can happen as quickly as you need it to.
- *Extensive help and documentation is available.* If you're stuck with anything, you can turn to the extensive documentation, your fellow QGIS users, or even the developers.
- *Cross-platform.* QGIS can be installed on macOS, Windows and Linux.

Now that you know why you want to use QGIS, these exercises will make you know how.

1.1.2 Fundal

In 2008 we launched the Gentle Introduction to GIS, a completely free, open content resource for people who want to learn about GIS without being overloaded with jargon and new terminology. It was sponsored by the South African government and has been a phenomenal success, with people all over the world writing to us to tell us how they are using the materials to run University Training Courses, teach themselves GIS and so on. The Gentle Introduction is not a software tutorial, but rather aims to be a generic text (although we used QGIS in all examples) for someone learning about GIS. There is also the QGIS manual which provides a detailed functional overview of the QGIS application. However, it is not structured as a tutorial, but rather as a reference guide. At Linfiniti Consulting CC. we frequently run training courses and have realised that a third resource is needed - one that leads the reader sequentially through learning the key aspects of QGIS in a trainer-trainee format - which prompted us to produce this work.

Acest manual de instruire pune la dispoziție toate materialele necesare desfășurării unui curs de 5 zile despre QGIS, PostgreSQL și PostGIS. Cursul are un conținut structurat, fiind deopotrivă adecvat începătorilor, utilizatorilor intermediari sau avansați, și având multe exerciții cu răspunsuri complete adnotate.

1.1.3 Licență



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training course that uses this work as a text book, but you may not profit off the sales of the book itself - all such profits should be contributed back to QGIS.

1.1.4 Capitole Sponsorizate

This work is by no means a complete treatise on all the things you can do with QGIS and we encourage others to add new materials to fill any gaps. Linfiniti Consulting CC. can also create additional materials for you as a commercial service, with the understanding that all such works produced should become part of the core content and be published under the same license.

1.1.5 Autori

- Rüdiger Thiede - Rudi has written the QGIS instructional materials and parts of the PostGIS materials.
- Tim Sutton (tim@kartoza.com) - Tim has overseen and guided the project and co-authored the PostgreSQL and PostGIS parts.
- Horst Düster (horst.duester@kappasys.ch) - Horst este co-autor al părților de PostgreSQL și PostGIS
- Marcelle Sutton - Marcelle provided proof-reading and editorial advice during the creation of this work.

1.1.6 Contribuții Individuale

Introduceţi numele dvs. aici!

1.1.7 Sponsori

- Cape Peninsula University of Technology

1.1.8 Fișiere sursă și rapoarte despre probleme

Sursa acestui document se poate găsi în Depozitul Documentației QGIS de pe GitHub. Consultați GitHub.com pentru instrucțiunile de folosire a sistemului de versionare git.

În ciuda eforturilor depuse, ați putea găsi unele erori sau ați putea omite unele informații pe durata acestei instruiri. Vă rugăm să le raportați la https://github.com/qgis/QGIS-Documentation/issues.

1.1.9 Ultima versiune

You can always obtain the latest version of this document by visiting the online version which is part of the QGIS documentation website (https://www.qgis.org/resources/hub/#documentation).

Notă

The documentation website contains links to both online and PDF versions of the Training manual and other parts of the QGIS documentation.

1.2 About the exercises

Now that you know why you want to use QGIS, we can show you how.

> **Atenționare**
>
> This course includes instructions on adding, deleting and altering GIS datasets. We have provided training datasets for this purpose. Before using the techniques described here on your own data, always ensure you have proper backups!

1.2.1 How to use this tutorial

Any text that *looks like this* refers to something that you can see in the QGIS user interface.

Text that *looks* ► *like* ► *this* directs you through menus.

`This kind of text` refers to something you can type, such as a command.

`This/kind/of.text` refers to a path or filename.

`This+That` refers to a keyboard shortcut comprised of two buttons.

1.2.2 Tiered course objectives

This course caters to different user experience levels. Depending on which category you consider yourself to be in, you can expect a different set of course outcomes. Each category contains information that is essential for the next one, so it's important to do all exercises that are at or below your level of experience.

??? (Basic level) Basic

In this category, the course assumes that you have little or no prior experience with theoretical GIS knowledge or the operation of GIS software.

Limited theoretical background will be provided to explain the purpose of an action you will be performing in the program, but the emphasis is on learning by doing.

When you complete the course, you will have a better concept of the possibilities of GIS, and how to harness their power via QGIS.

??? (Moderate level) Intermediate

In this category, it is assumed that you have working knowledge and experience of the everyday uses of GIS software.

Building on the instructions for the beginner level will provide you with familiar ground, as well as to make you aware of the cases where QGIS does things slightly differently from other software you may be used to. You will also learn how to use analysis functions in QGIS.

When you complete the course, you should be comfortable with using QGIS for all of the functions you usually need for everyday use.

??? (Advanced level) Advanced

In this category, the assumption is that you are experienced with GIS software, have knowledge of and experience with spatial databases, using data on a remote server, perhaps writing scripts for analysis purposes, etc.

Building on the instructions for the other two levels will familiarize you with the approach that the QGIS interface follows, and will ensure that you know how to access the basic functions that you need. You will also be shown how to make use of the QGIS plugin system, database access, and so on.

When you complete the course, you should be well-acquainted with the everyday operation of QGIS, as well as its more advanced functions.

1.2.3 Data

The sample data that accompanies this resource is freely available and comes from the following sources:

- Streets and Places datasets from OpenStreetMap
- Property boundaries (urban and rural), water bodies from NGI
- SRTM DEM from the CGIAR CSI

Download the prepared dataset from the Training data repository and unzip the file. All the necessary data are provided in the `exercise_data` folder.

If you are an instructor, and would like to use more relevant data, you will find instructions for creating local data in the *Pregătirea Datelor pentru Exerciții* appendix.

CAPITOLUL 2

Modulul;: Crearea și Explorarea unei Hărți de Bază

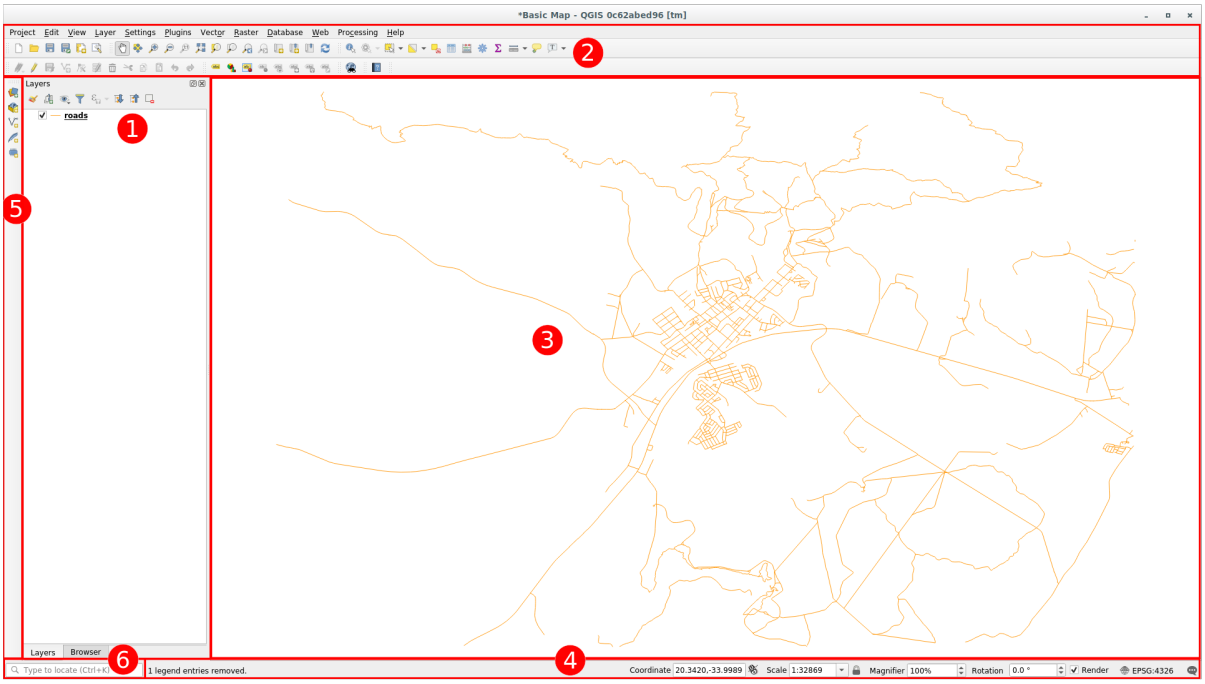
În acest modul, veți crea o hartă de bază care va fi folosită mai târziu pentru demonstrații ulterioare ale funcționalităților QGIS.

2.1 Lesson: An Overview of the Interface

Vom explora interfața cu utilizatorul QGIS, pentru a vă familiariza cu meniurile, barele de instrumente, canevasul hărții și lista de straturi care formează structura de bază a interfeței.

Scopul acestei lecții: De a înțelege noțiunile de bază ale interfeței QGIS.

2.1.1 ??? Încercați și dvs.: Elemente de bază



Elementele identificate în figura de mai sus sunt:

1. Lista Straturilor/Panoul Navigatorului
2. Bare de instrumente
3. Canevasul hărții
4. Bara de Stare
5. Bara Laterală de Instrumente
6. Bara locatorului

??? Lista Straturilor

În lista Straturi, puteți vedea o listă, în orice moment, a tuturor straturilor disponibile pentru dvs.

Extinderea obiectelor restrânse (făcând clic pe săgeata sau pe simbolul plus de lângă ei) vă va oferi mai multe informații despre aspectul stratului actual.

Hovering over the layer will give you some basic information: layer name, type of geometry, coordinate reference system and the complete path of the location on your device.

Un clic-dreapta pe un strat vă va oferi un meniu cu o mulțime de opțiuni suplimentare. Veți folosi unele dintre ele mult timp de acum înainte, așa că haideți să aruncăm o privire asupra lor!

> **Notă**
>
> Un strat vectorial este un set de date, de obicei, al unui anumit tip de obiect, cum ar fi drumuri, copaci, etc. Un strat vectorial poate consta fie în puncte, în linii sau poligoane.

??? Panoul Navigatorului

The QGIS Browser is a panel in QGIS that lets you easily navigate in your database. You can have access to common vector files (e.g. ESRI Shapefile or MapInfo files), databases (e.g. PostgreSQL, Oracle, SpatiaLite, GeoPackage or MS SQL Server) and WMS/WFS connections. You can also view your GRASS data.

If you have saved a project, the Browser Panel will also give you quick access to all the layers stored in the same path of the project file under in the  *Project Home* item.

Moreover, you can set one or more folder as **Favorites**: search under your path and once you have found the folder, right click on it and click on *Add as a Favorite*. You should then be able to see your folder in the  *Favorites* item.

Sfat

It can happen that the folders added to Favorite item have a really long name: don't worry right-click on the path and choose *Rename Favorite…* to set another name.

??? Bare de Instrumente

Your most often used sets of tools can be turned into toolbars for basic access. For example, the *Project* toolbar allows you to save, load, print, and start a new project. You can easily customize the interface to see only the tools you use most often, adding or removing toolbars as necessary via the *View* ► *Toolbars* menu.

Even if they are not visible in a toolbar, all of your tools will remain accessible via the menus. For example, if you remove the *Project* toolbar (which contains the *Save* button), you can still save your map by clicking on the *Project* menu and then clicking on *Save*.

??? Canevasul Hărții

This is where the map itself is displayed and where layers are loaded. In the map canvas you can interact with the visible layers: zoom in/out, move the map, select features and many other operations that we will deeply see in the next sections.

??? Bara de Stare

Shows you information about the current map. Also allows you to adjust the map scale, the map rotation and see the mouse cursor's coordinates on the map.

??? Bara de instrumente Laterală

By default the Side toolbar contains the buttons to load the layer and all the buttons to create a new layer. But remember that you can move all the toolbars wherever it is more comfortable for you.

??? Bara Locatorului

Within this bar you can access to almost all the objects of QGIS: layers, layer features, algorithms, spatial bookmarks, etc. Check all the different options in the locator_options section of the QGIS User Manual.

Sfat

With the shortcut `Ctrl+K` you can easily access the bar.

2.1.2 ??? Încercați și dvs.: 1

Încercați să identificați cele patru elemente enumerate pe ecranul dvs., fără a face referire la diagrama de mai sus. Vedeți dacă puteți identifica numele și funcțiile lor. Vă veți familiariza cu aceste elemente, pe măsură ce le veți folosi în următoarele zile.

Răspuns

Refer back to the image showing the interface layout and check that you remember the names and functions of the screen elements.

2.1.3 ??? Încercați și dvs.: 2

Încercați să identificați fiecare dintre aceste instrumente pe ecran. Care este scopul lor?

1. 
2. 
3. 
4.  *Render*
5. 

Notă

Dacă nici unul dintre aceste instrumente nu este vizibil pe ecran, încercați să activați unele bare de instrumente care sunt în prezent ascunse. De asemenea, rețineți că, dacă nu există suficient spațiu pe ecran, o bară de instrumente poate fi redusă prin ascunderea unora dintre instrumentele sale. Puteți vedea instrumentele ascunse, făcând clic pe butonul cu două săgeți îndreptate în dreapta, de pe oricare bară de instrumente restrânsă. Puteți vedea un balon cu numele oricărui instrument, prin trecerea un pic a mouse-ului pe deasupra unui instrument.

Răspuns

1. *Save as*
2. *Zoom to layer(s)*
3. *Invert selection*
4. *Rendering on/off*
5. *Measure line*

2.1.4 Ce urmează?

Now that you are familiar with the basics of the QGIS interface, in the next lesson we will see how to load some common data types.

2.2 Lesson: Adding your first layers

Vom porni aplicația, și vom crea o hartă de bază, pentru utilizarea în exemple și exerciții.

Scopul acestei lecții: De a începe cu un exemplu de hartă.

> **Notă**
>
> Before starting this exercise, QGIS must be installed on your computer. Also, you should have downloaded the *sample data* to use.

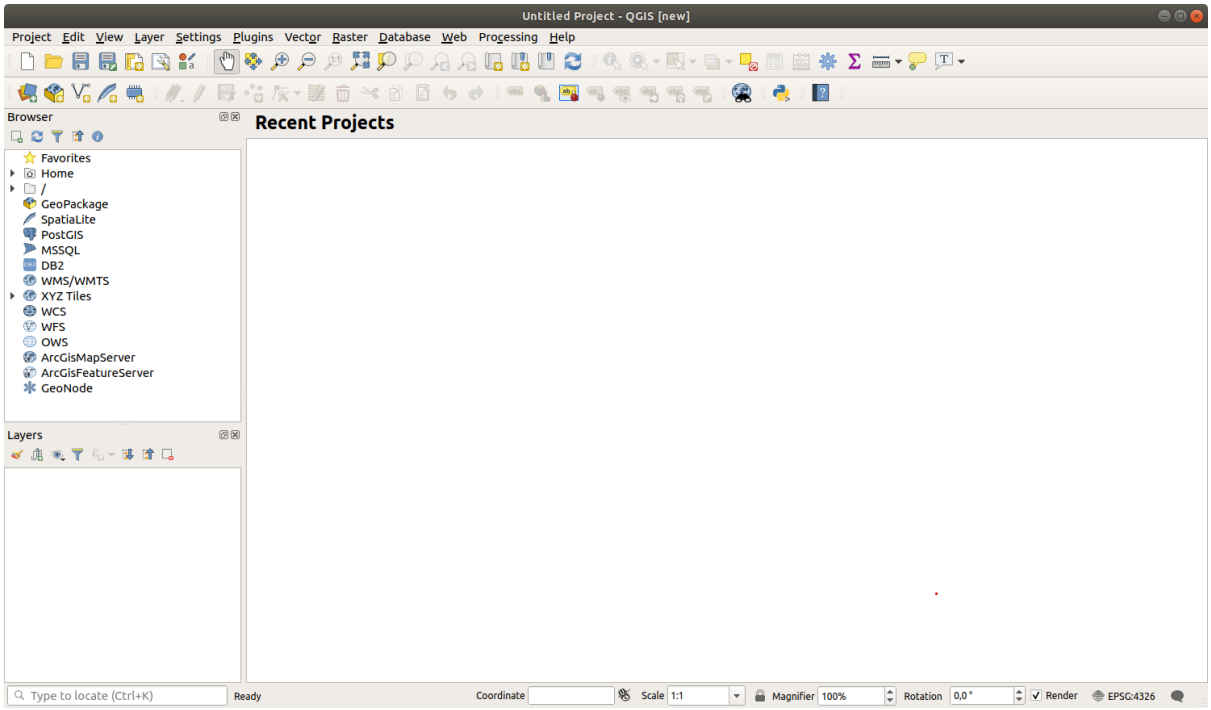
Lansați QGIS cu ajutorul scurtăturii de pe ecran, din meniul de strat, etc., în funcție de modul în care ați efectuat instalarea.

> **Notă**
>
> The screenshots for this course were taken in QGIS 3.4 running on Linux. Depending on your setup, the screens you encounter may well appear somewhat different. However, all the same buttons will still be available, and the instructions will work on any OS. You will need QGIS 3.4 (the latest version at time of writing) to use this course.

Să începem imediat!

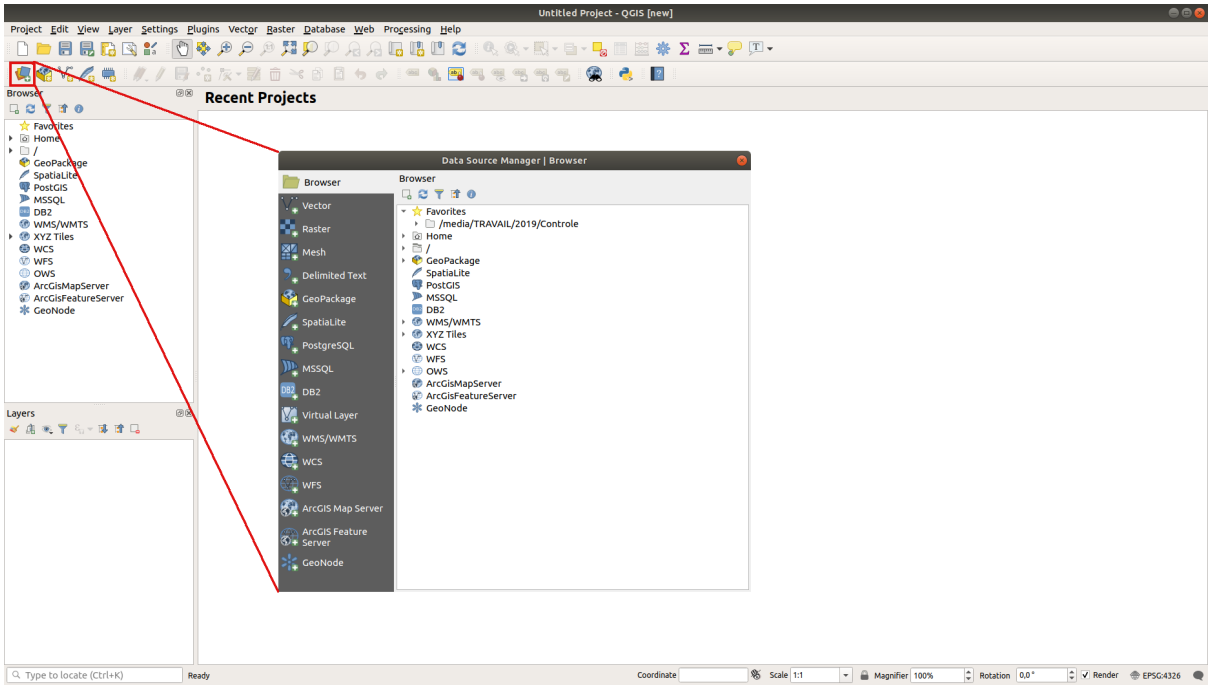
2.2.1 ??? Follow Along: Prepare a map

1. Deschideți QGIS. Veți avea o hartă nouă, albă.



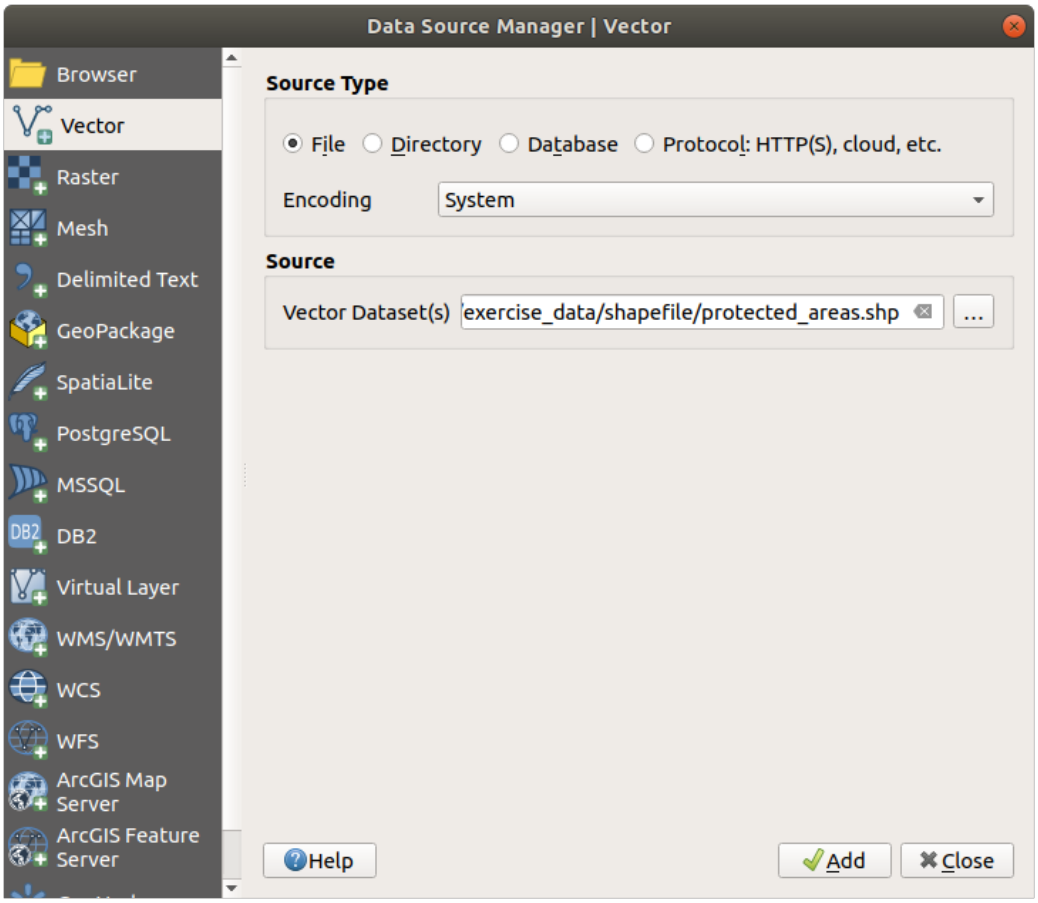
2. The *Data Source Manager* dialog allows you to choose the data to load depending on the data type. We'll use it to load our dataset: click the  Open Data Source Manager button.

   If you can't find the icon, check that the *Data Source Manager* toolbar is enabled in the *View* ► *Toolbars* menu.

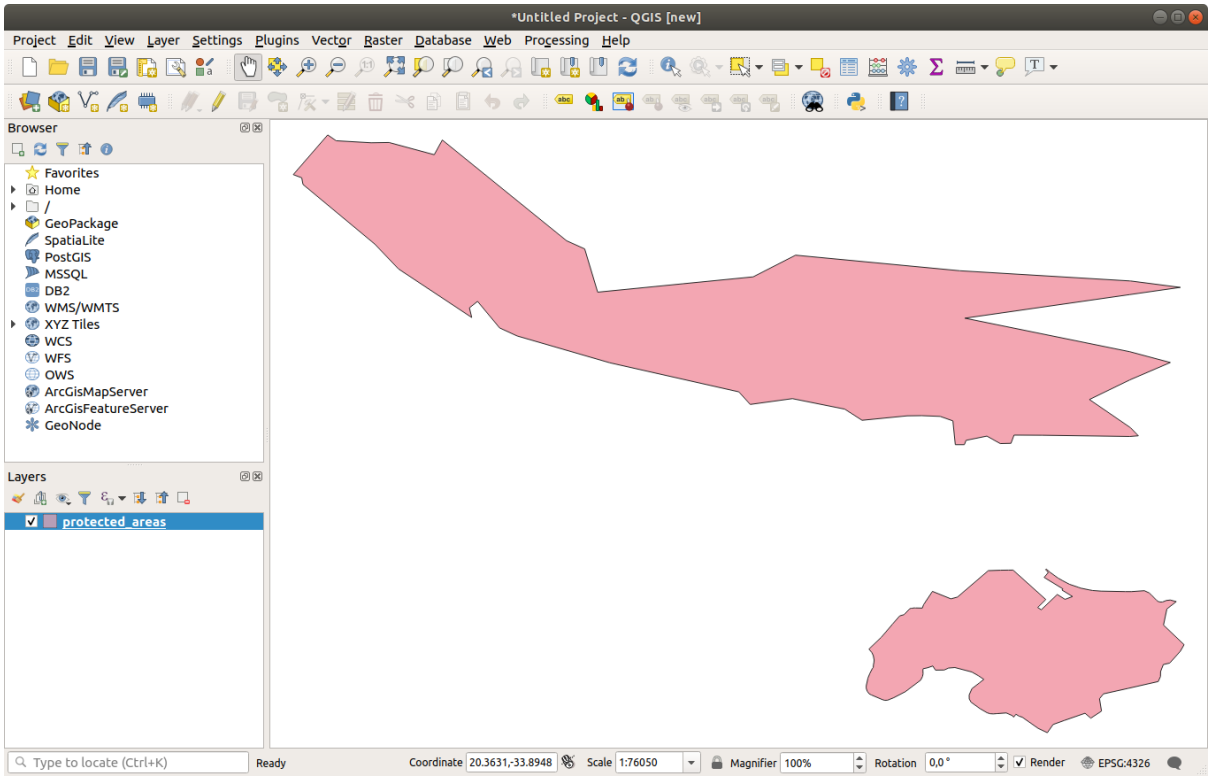


3. Load the `protected_areas.shp` vector dataset:
   1. Click on the *Vector* tab.
   2. Enable the  *File* source type.
   3. Press the … button next to *Vector Dataset(s)*.

4. Select the `exercise_data/shapefile/protected_areas.shp` file in your training directory.
5. Click *Open*. You will see the original dialog, with the file path filled in.



6. Click *Add* here as well. The data you specified will now load: you can see a `protected_areas` item in the *Layers* panel (bottom left) with its features shown in the main map canvas.



Felicitări! Aveți o hartă de bază. Acum ar fi un moment bun pentru a vă salva munca.

1. Clic pe butonul *Save As*: 
2. Save the map under a `solution` folder next to `exercise_data` and call it `basic_map.qgz`.

2.2.2 ??? Încercați și dvs.:

Repeat the steps above to add the `places.shp` and `rivers.shp` layers from the same folder (`exercise_data/shapefile`) to the map.

Răspuns

In the main area of the dialog you should see many shapes with different colors. Each shape belongs to a layer you can identify by its color in the left panel (your colors may be different from the ones in Fig. 2.1 below):

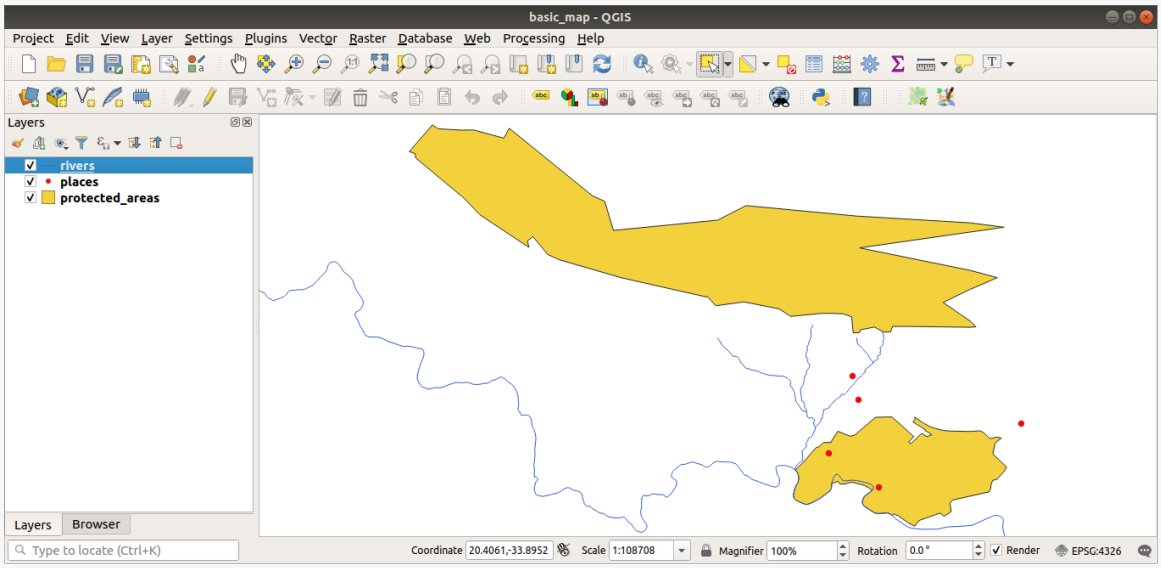


Fig. 2.1: A basic map

2.2.3 ??? Follow Along: Loading vector data from a GeoPackage Database

Databases allow you to store a large volume of associated data in one file. You may already be familiar with a database management system (DBMS) such as Libreoffice Base or MS Access. GIS applications can also make use of databases. GIS-specific DBMSes (such as PostGIS) have extra functions, because they need to handle spatial data.

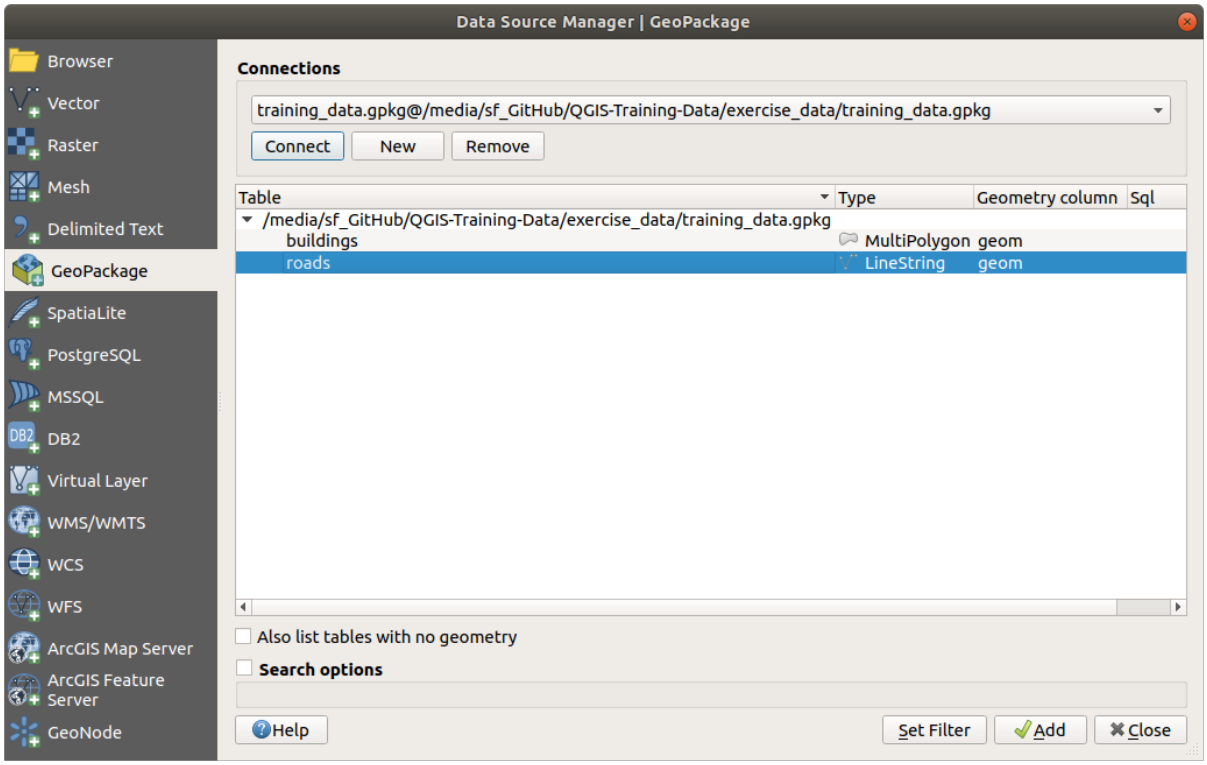
The GeoPackage open format is a container that allows you to store GIS data (layers) in a single file. Unlike the ESRI Shapefile format (e.g. the `protected_areas.shp` dataset you loaded earlier), a single GeoPackage file can contain various data (both vector and raster data) in different coordinate reference systems, as well as tables without spatial information; all these features allow you to share data easily and avoid file duplication.

In order to load a layer from a GeoPackage, you will first need to create the connection to it:

1. Click on the Open Data Source Manager button.
2. On the left click on the *GeoPackage* tab.
3. Click on the *New* button and browse to the `training_data.gpkg` file in the `exercise_data` folder you downloaded before.
4. Select the file and press *Open*. The file path is now added to the Geopackage connections list, and appears in the drop-down menu.

You are now ready to add any layer from this GeoPackage to QGIS.

1. Click on the *Connect* button. In the central part of the window you should now see the list of all the layers contained in the GeoPackage file.
2. Select the `roads` layer and click on the *Add* button.



A `roads` layer is added to the *Layers* panel with features displayed on the map canvas.

3. Click on *Close*.

Congratulations! You have loaded the first layer from a GeoPackage.

2.2.4 ??? Follow Along: Loading vector data from a SpatiaLite Database with the Browser

QGIS provides access to many other database formats. Like GeoPackage, the SpatiaLite database format is an extension of the SQLite library. And adding a layer from a SpatiaLite provider follows the same rules as described above: Create the connection –> Enable it –> Add the layer(s).

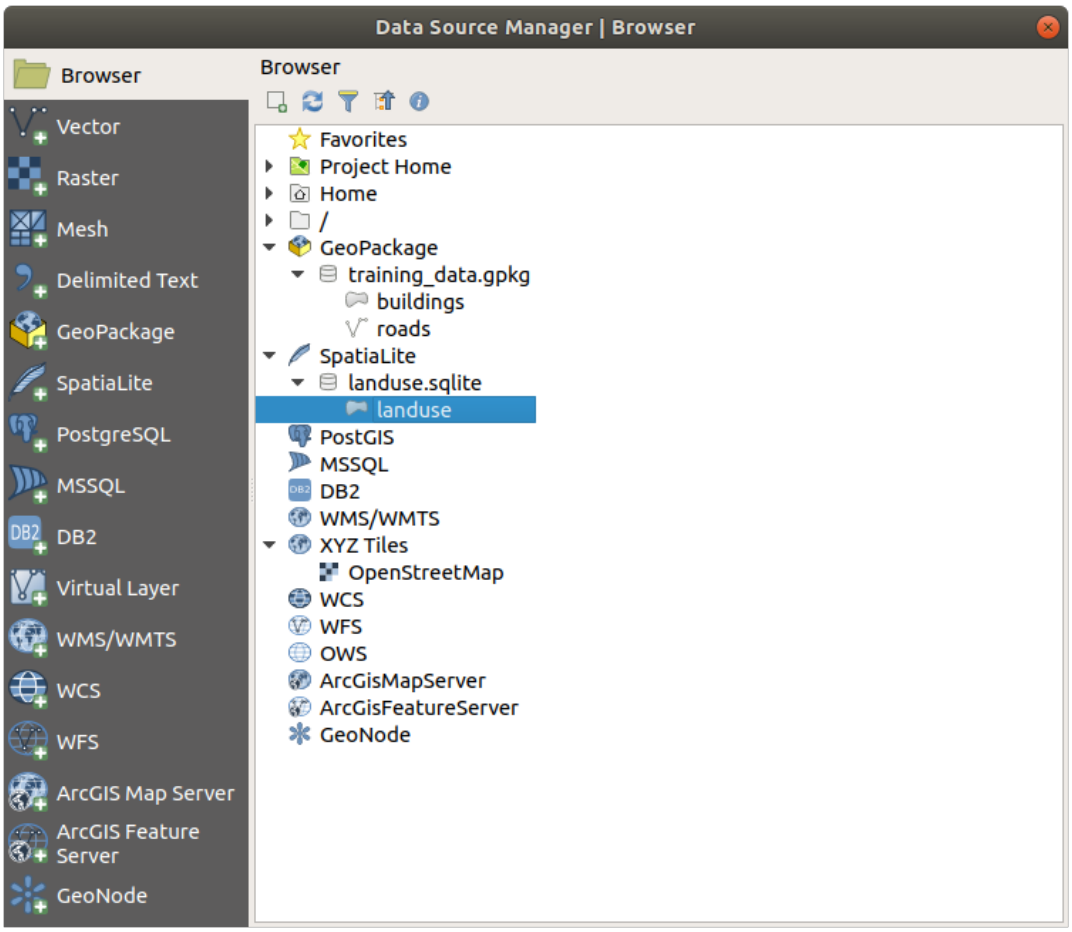
While this is one way to add SpatiaLite data to your map, let's explore another powerful way to add data: the *Browser*.

1. Click the icon to open the *Data Source Manager* window.
2. Click on the *Browser* tab.
3. In this tab you can see all the storage disks connected to your computer as well as entries for most of the tabs in the left. These allow quick access to connected databases or folders.

   For example, click on the drop-down icon next to the *GeoPackage* entry. You'll see the `training-data.gpkg` file we previously connected to (and its layers, if expanded).
4. Right-click the *SpatiaLite* entry and select *New Connection…*.
5. Navigate to the `exercise_data` folder, select the `landuse.sqlite` file and click *Open*.

   Notice that a *landuse.sqlite* entry has been added under the *SpatiaLite* one.
6. Expand the *landuse.sqlite* entry.

7. Double-click the `landuse` layer or select and drag-and-drop it onto the map canvas. A new layer is added to the *Layers* panel and its features are displayed on the map canvas.



Sfat

Enable the *Browser* panel in *View* ► *Panels* ► and use it to add your data. It's a handy shortcut for the *Data Source Manager* ► *Browser* tab, with the same functionality.

Notă

Remember to save your project frequently! The project file doesn't contain any of the data itself, but it remembers which layers you loaded into your map.

2.2.5 ??? Try Yourself: Load More Vector Data

Load the following datasets from the `exercise_data` folder into your map using any of the methods explained above:

- `buildings`
- `water`

Răspuns

Your map should have seven layers:

- `protected_areas`
- `places`
- `rivers`
- `roads`
- `landuse`
- `buildings` (taken from `training_data.gpkg`) and
- `water` (taken from `exercise_data/shapefile`).

2.2.6 Follow Along: Reordering the Layers

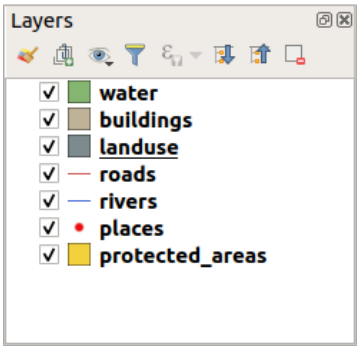
Straturile din lista de straturi sunt desenate pe hartă într-o anumită ordine. Stratul cel mai jos în listă este desenat primul, iar stratul de la vârful listei este desenat ultimul. Schimbând ordinea în care sunt prezentate în listă puteți schimba ordinea în care sunt desenate.

Notă

You can alter this behavior using the *Control rendering order* checkbox beneath the *Layer Order* panel. We will however not discuss this feature yet.

Ordinea în care straturile au fost încărcate în hartă probabil că nu este logică în acest moment. Este posibil ca stratul de străzi să fie complet ascuns deoarece alte straturi sunt deasupra lui.

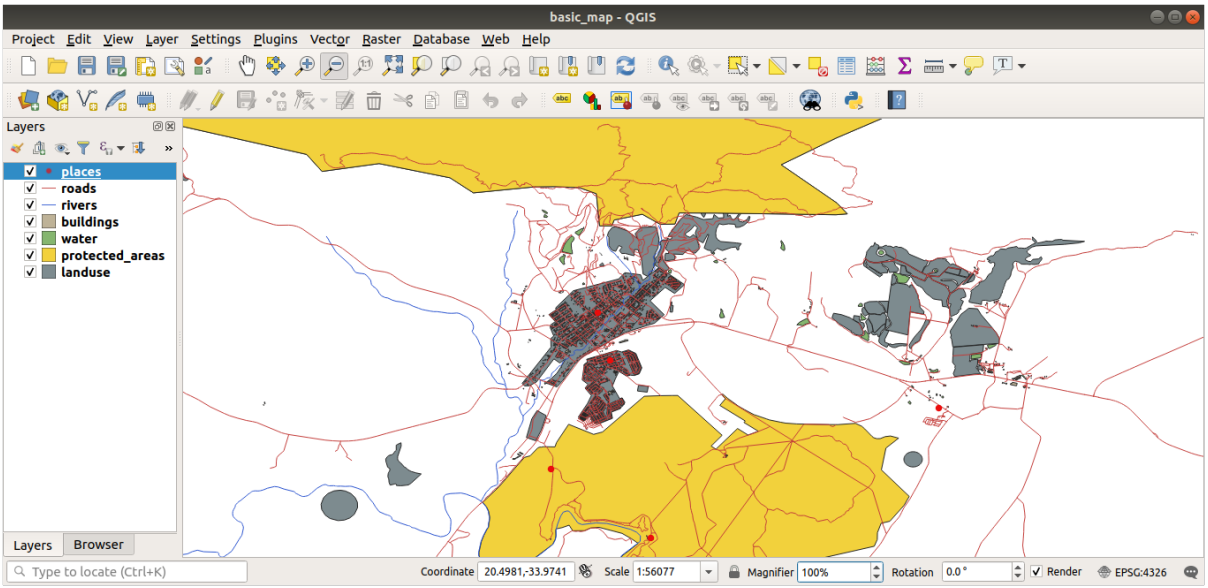
De exemplu, această ordine a straturilor…



… would result in roads and places being hidden as they run *underneath* the polygons of the landuse layer.

Pentru a rezolva această problemă:

1. Clic apoi glisați pe un strat din Lista straturilor.
2. Reordonați-le, pentru a arăta în felul următor:



Veți vedea că harta are mai mult sens, cu străzile și clădirile desenate deasupra regiunilor.

2.2.7 În concluzie

Now you've added all the layers you need from several different sources and created a basic map!

2.2.8 Ce urmează?

Now you're familiar with the basic function of the *Open Data Source Manager* button, but what about all the others? How does this interface work? Before we go on, let's take a look at some basic interaction with the QGIS interface. This is the topic of the next lesson.

2.3 Lesson: Navigating the Map Canvas

Această secțiune se va concentra asupra instrumentelor de navigație principale, folosite la navigarea pe Canevasul Hărților din QGIS. Aceste instrumente vă vor permite explorarea vizuală a straturilor, la diverse scări.

Scopul acestei lecții: Înțelegerea noțiunilor despre scara hărții și utilizarea instrumentelor Deplasare și Zoom din QGIS.

2.3.1 ??? Follow Along: Basic Navigation Tools

Before learning how to navigate within the Map Canvas, let's add some layers that we can explore during this tutorial.

1. Open a new blank project and using the steps learnt in *Create a Map*, load the previously seen `protected_areas`, `roads` and `buildings` layers to the project. The result view should look similar to the snippet in Fig. 2.2 below (colors do not matter):

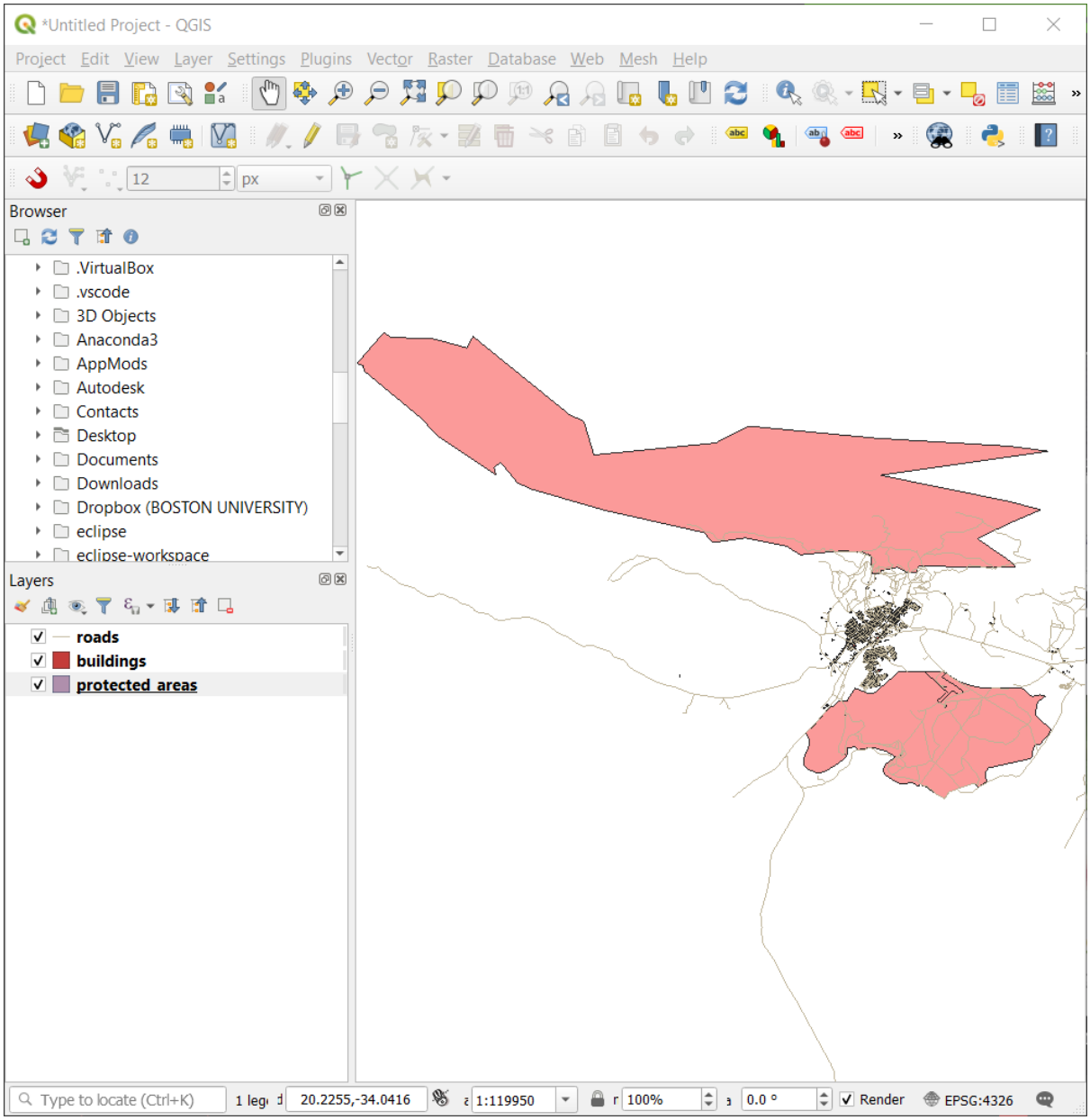


Fig. 2.2: Protected areas, roads and buildings added

Let's first learn how to use the Pan Tool.

1. In the *Map Navigation Toolbar*, make sure the Pan button is activated.
2. Move the mouse to the center of the Map Canvas area.
3. Left-click and hold, and drag the mouse in any direction to pan the map.

Next, let's zoom in and take a closer look at the layers we imported.

1. In the *Map Navigation Toolbar*, click on the Zoom In button.
2. Move your mouse to approximately the top left area of where there is the highest density of buildings and roads.
3. Left click and hold.
4. Then drag the mouse, which will create a rectangle, and cover the dense area of buildings and roads (Fig. 2.3).

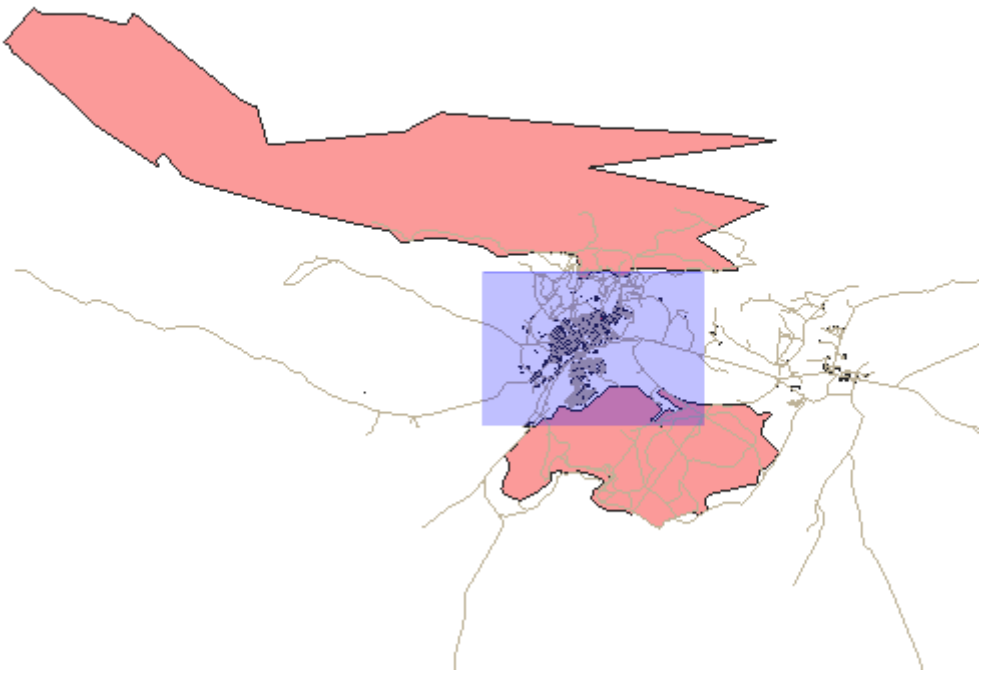
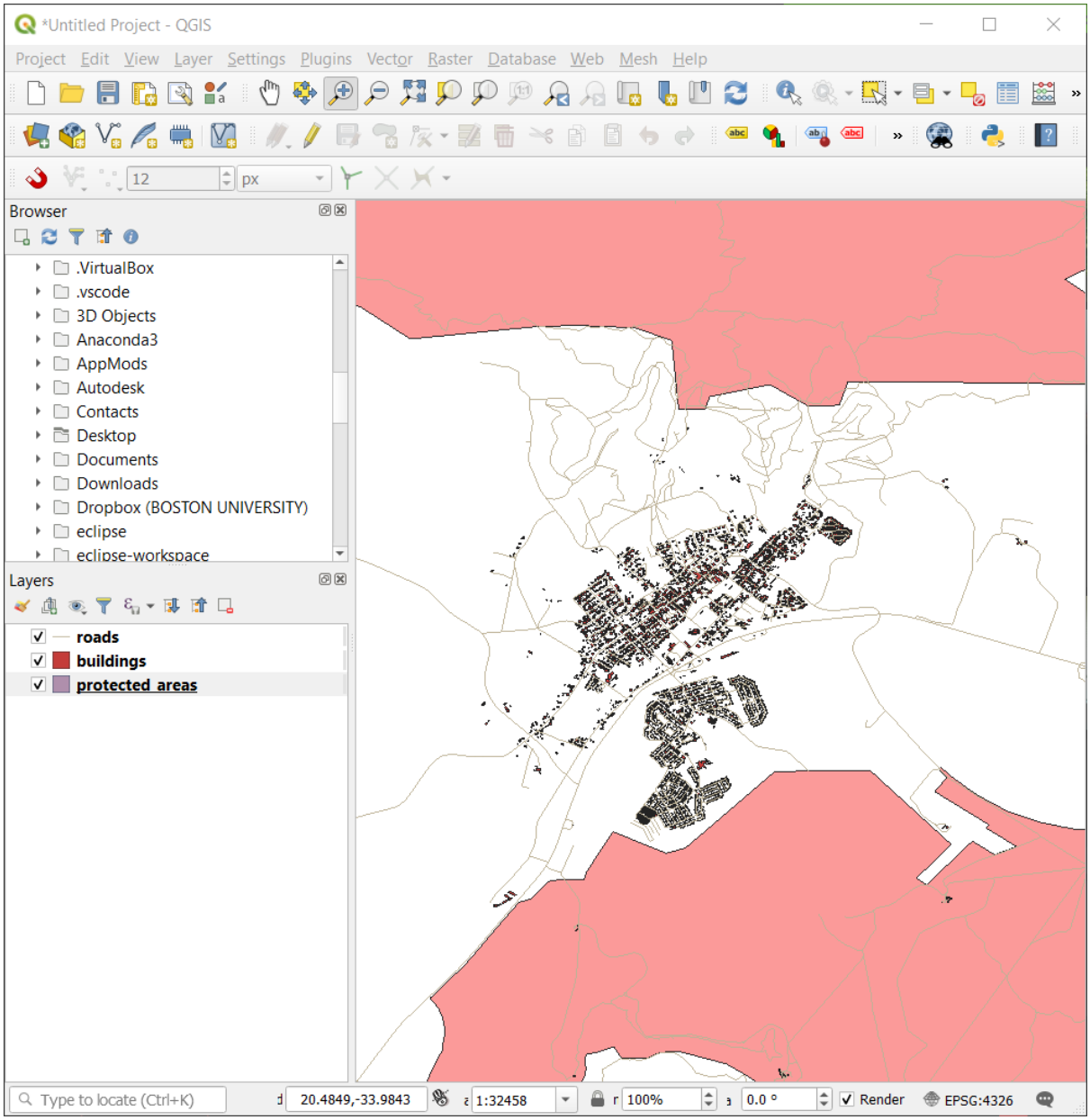


Fig. 2.3: Zoom in

5. Release the left click. This will zoom in to include the area that you selected with your rectangle.



6. To zoom out, select the Zoom Out button and perform the same action as you did for zooming in.

As you pan, zoom in, or zoom out, QGIS saves these views in a history. This allows you to backtrack to a previous view.

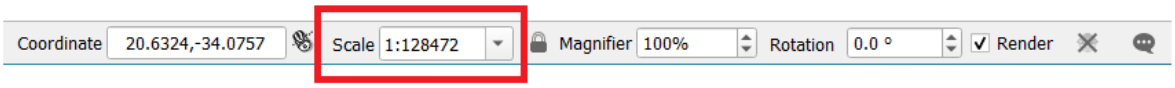
1. In the *Map Navigation Toolbar*, click on Zoom Last button to go to your previous view.

2. Click on Zoom Next button to proceed to move forward in your history.

Sometimes after exploring the data, we need to reset our view to the extent of all the layers. Instead of trying to use the Zoom Out tool multiple times, QGIS provides us with a button to do that action for us.

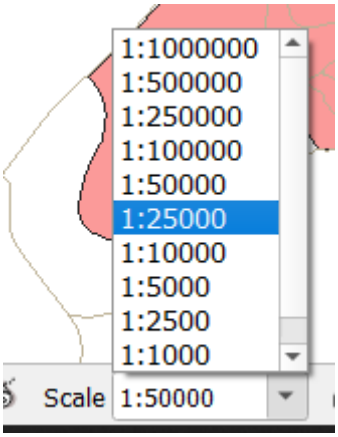
1. Click on the Zoom Full Extent button.

As you zoomed in and out, notice that the *Scale* value in the Status Bar changes. The *Scale* value represents the Map Scale. In general, the number to the right of *:* represents how many times smaller the object you are seeing in the Map Canvas is to the actual object in the real world.



You can also use this field to set the Map Scale manually.

1. In the Status Bar, click on the *Scale* text field.
2. Type in `50000` and press `Enter`. This will redraw the features in the Map Canvas to reflect the scale you typed in.
3. Alternatively, click on the options arrow of the *Scale* field to see the preset map scales.



4. Select *1:5000*. This will also update the map scale in the Map Canvas.

Now you know the basics of navigating the Map Canvas. Check out the User Manual on Zooming and Panning to learn about alternative ways of navigating the Map Canvas.

2.3.2 În concluzie

Knowing how to navigate the Map Canvas is important, as it allows one to explore and visually inspect the layers. This could be done for initial data exploration, or to validate output of a spatial analysis.

2.4 Lesson: Symbology

Simbolistica unui strat reprezintă aspectul său vizual pe hartă. Abilitățile de bază ale GIS, comparativ cu alte moduri de reprezentare a datelor cu aspecte spațiale, constă în faptul că, în GIS, aveți o reprezentare vizuală dinamică a datelor cu care lucrați.

Prin urmare, aspectul vizual al hărții (care depinde de simbolistica straturilor individuale) este foarte important. Utilizatorul final a hărților pe care le produceți, va trebui să fie capabil de a înțelege cu ușurință ceea ce reprezintă harta. La fel de important, dvs. trebuie să fiți în măsură să explorați datele cu care lucrați, iar o bună simbolistică ajută foarte mult.

Cu alte cuvinte, a avea propria simbologie nu reprezintă un lux sau doar o noțiune frumoasă. De fapt, este esențial să utilizați un GIS în mod corespunzător, pentru a produce hărți și informații pe care oamenii să le poată folosi.

Scopul acestei lecții: De a putea crea simbolistica dorită pentru orice strat vectorial.

2.4.1 ??? Follow Along: Changing Colors

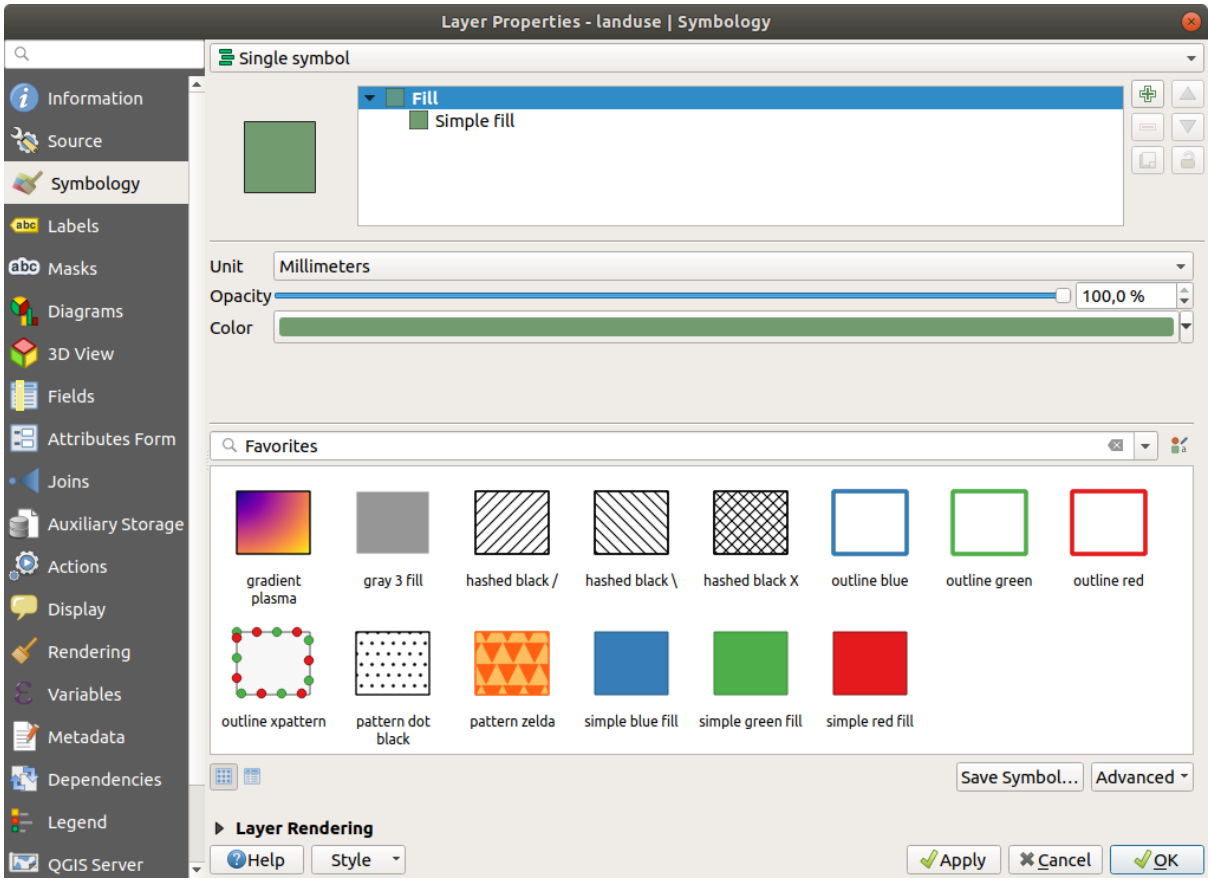
To change a layer's symbology, open its *Layer Properties*. Let's begin by changing the color of the `landuse` layer.

1. Right-click on the `landuse` layer in the layers list.
2. Select the menu item *Properties...* in the menu that appears.

> **Notă**
>
> De asemenea, în mod implicit, puteți accesa proprietățile unui strat făcând un dublu clic pe acesta, în lista Straturilor.

> **Sfat**
>
> The button at the top of the *Layers* panel will open the *Layer Styling* panel. You can use this panel to change some properties of the layer: by default, changes will be applied immediately!

3. In the *Layer Properties* window, select the *Symbology* tab:



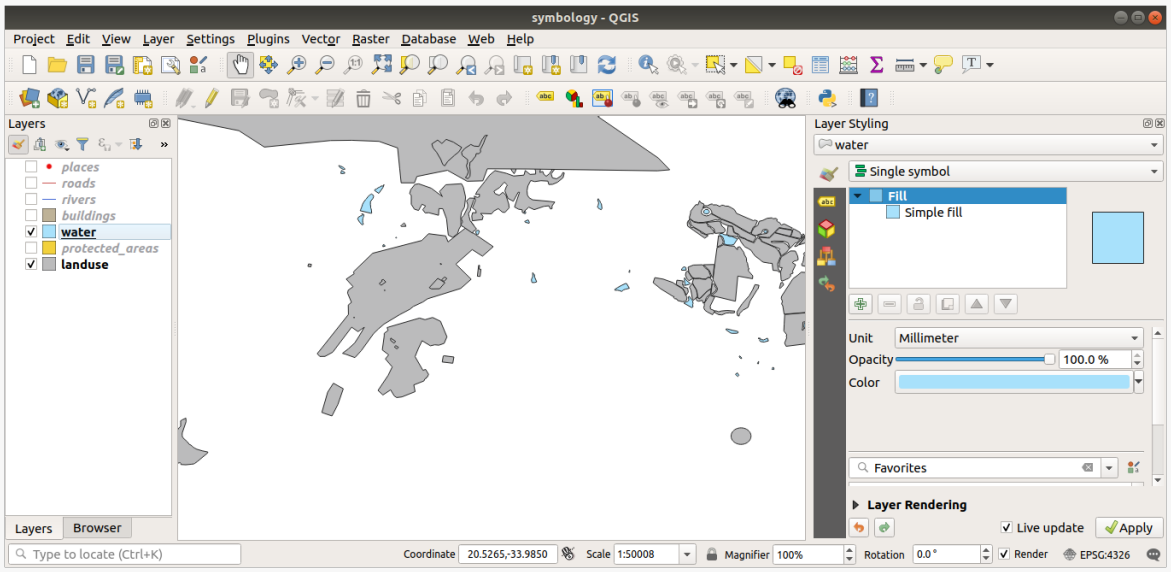
4. Click the color select button next to the *Color* label. A standard color dialog will appear.
5. Alegeți o culoare gri, apoi faceți clic pe *OK*.
6. Clic iarăși pe *OK* din fereastra *Layer Properties*, apoi veți vedea schimbarea de culoare asupra stratului.

2.4.2 ??? Încercați și dvs.:

Change the color of the `water` layer to light blue. Try to use the *Layer Styling* panel instead of the *Layer Properties* menu.

Soluție

- Verify that the colors are changing as you expect them to change.
- It is enough to select the `water` layer in the legend and then click on the  Open the Layer Styling panel button. Change the color to one that fits the water layer.



If you want to work on only one layer at a time and don't want the other layers to distract you, you can hide a layer by clicking in the checkbox next to its name in the layers list. If the box is blank, then the layer is hidden.

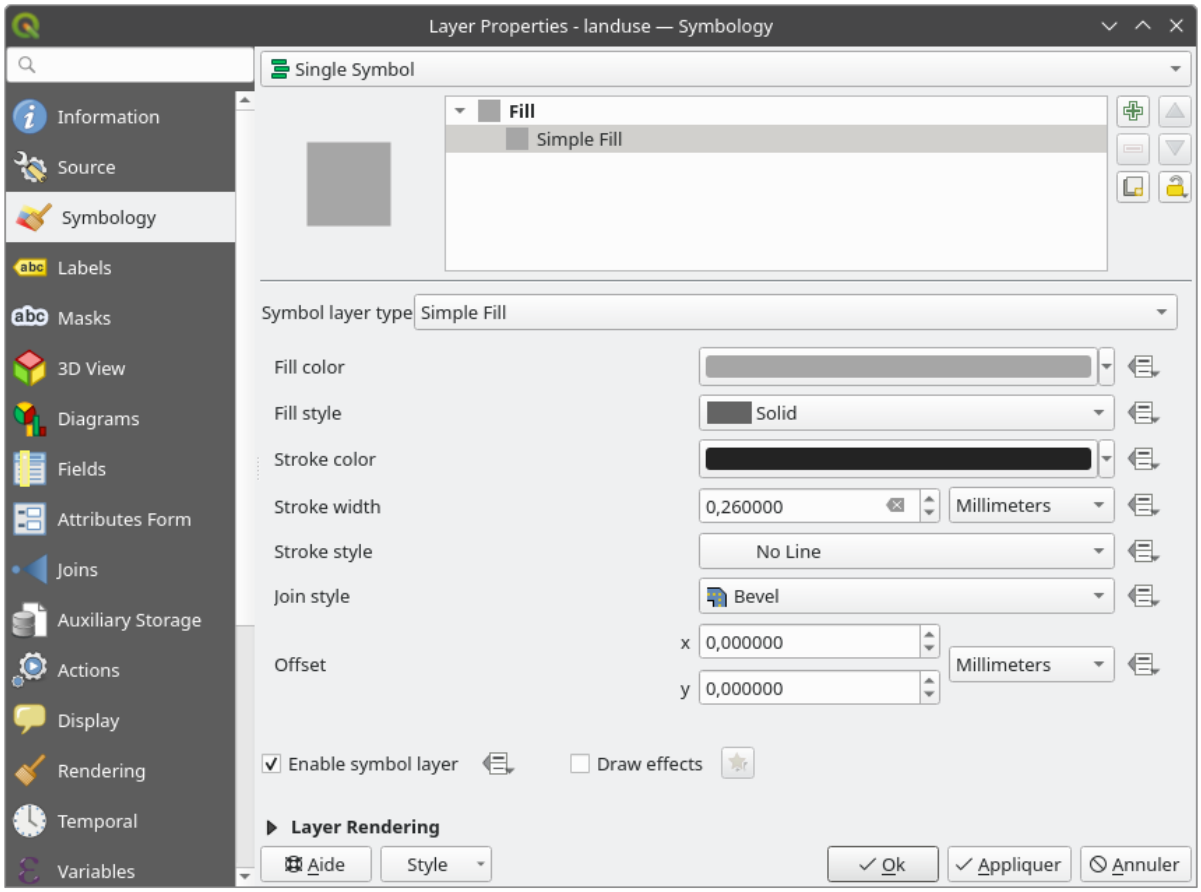
2.4.3 ??? Follow Along: Changing Symbol Structure

This is good stuff so far, but there's more to a layer's symbology than just its color. Next we want to eliminate the lines between the different land use areas so as to make the map less visually cluttered.

1. Open the *Layer Properties* window for the `landuse` layer.

   Under the  *Symbology* tab, you will see the same kind of dialog as before. This time, however, you're doing more than just quickly changing the color.

2. In the symbol layers tree, expand the *Fill* dropdown and select the *Simple fill* option.
3. Click on the *Stroke style* dropdown. At the moment, it should be showing a short line and the words *Solid Line*.
4. Change this to *No Line*.



5. Clic pe *OK*

Now the `landuse` layer won't have any lines between areas.

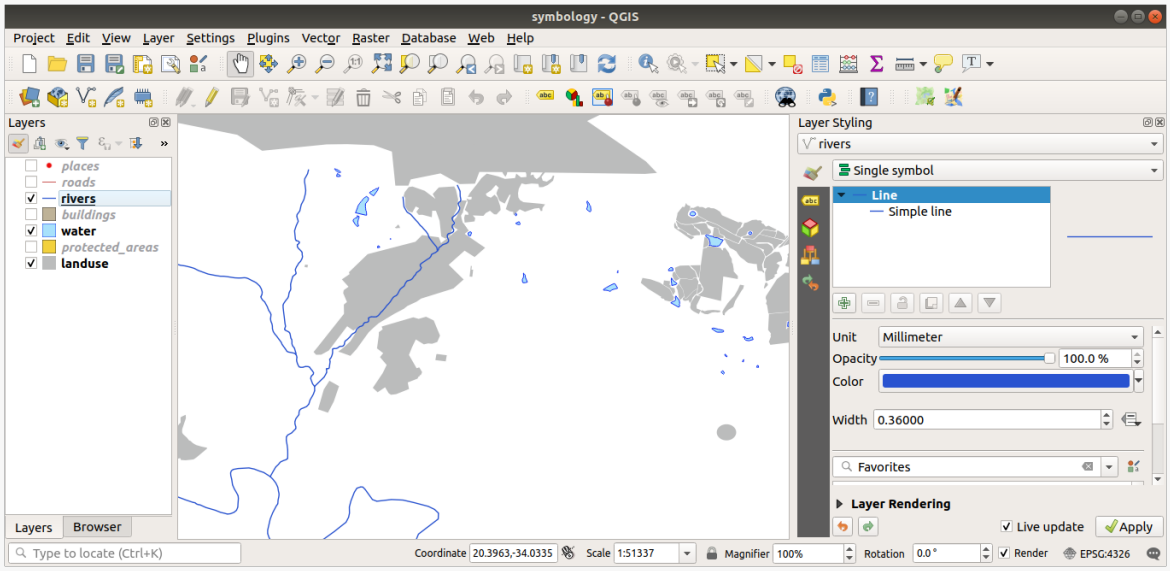
2.4.4 ??? Încercați și dvs.:

- Change the `water` layer's symbology again so that it has a darker blue outline.
- Change the `rivers` layer's symbology to a sensible representation of waterways.

Remember: you can use the  Open the Layer Styling panel button and see all the changes instantly. That panel also allows you to undo individual changes while symbolizing a layer.

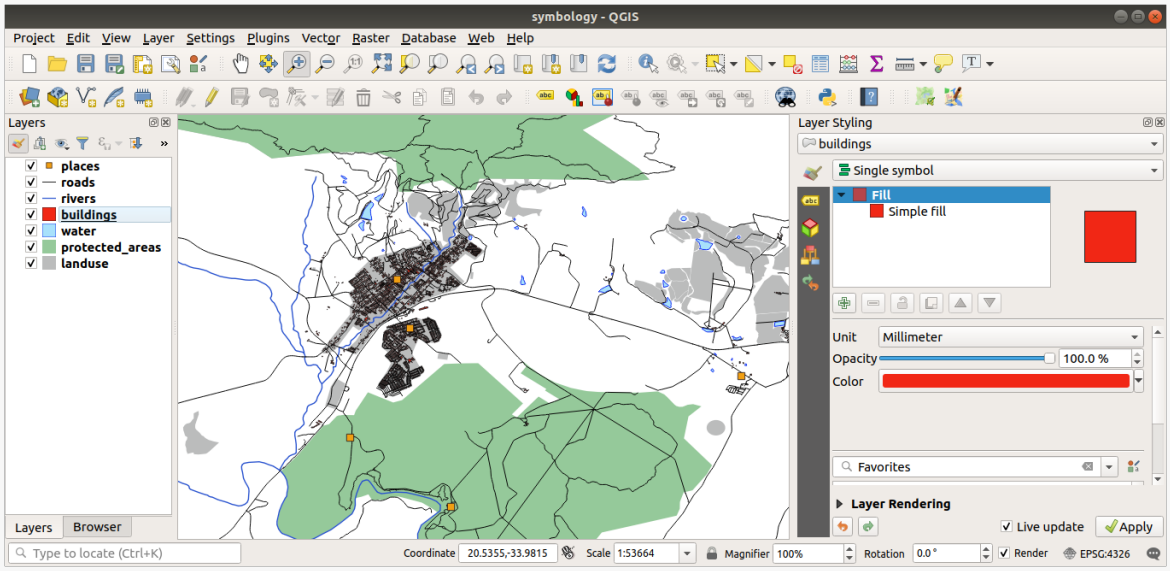
Răspuns

Your map should now look like this:



If you are a Beginner-level user, you may stop here.

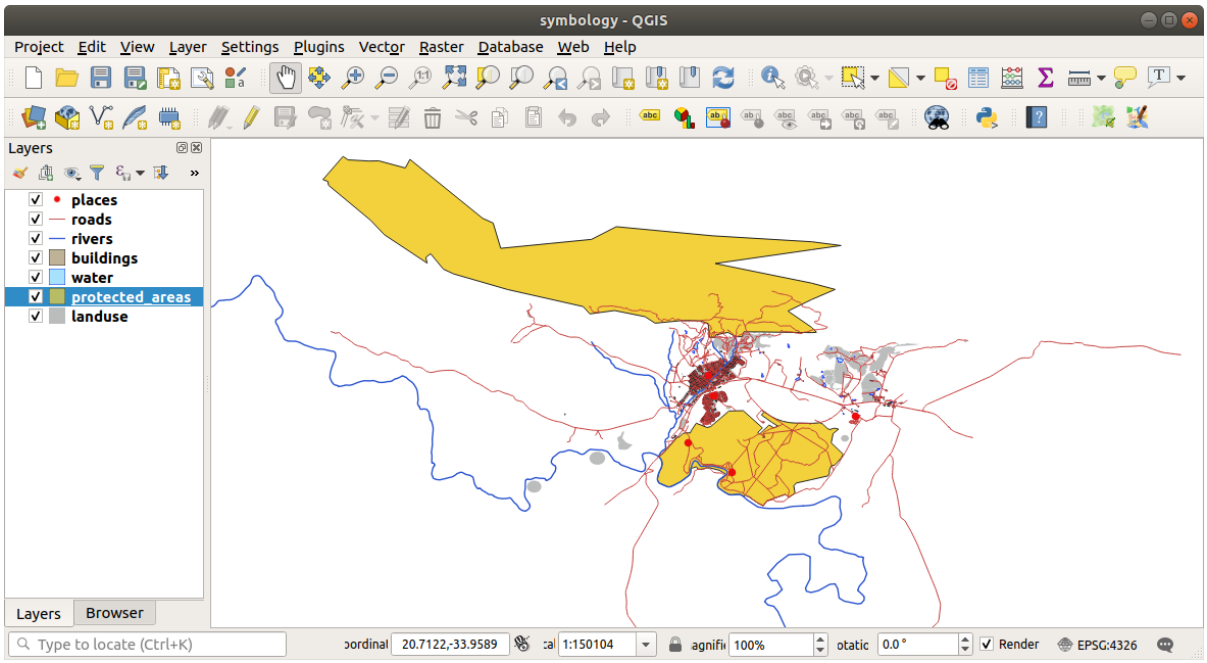
- Use the method above to change the colors and styles for all the remaining layers.
- Try using natural colors for the objects. For example, a road should not be red or blue, but can be gray or black.
- Also feel free to experiment with different *Fill style* and *Stroke style* settings for the polygons.



2.4.5 ??? Follow Along: Scale-Based Visibility

Sometimes you will find that a layer is not suitable for a given scale. For example, a dataset of all the continents may have low detail, and not be very accurate at street level. When that happens, you want to be able to hide the dataset at inappropriate scales.

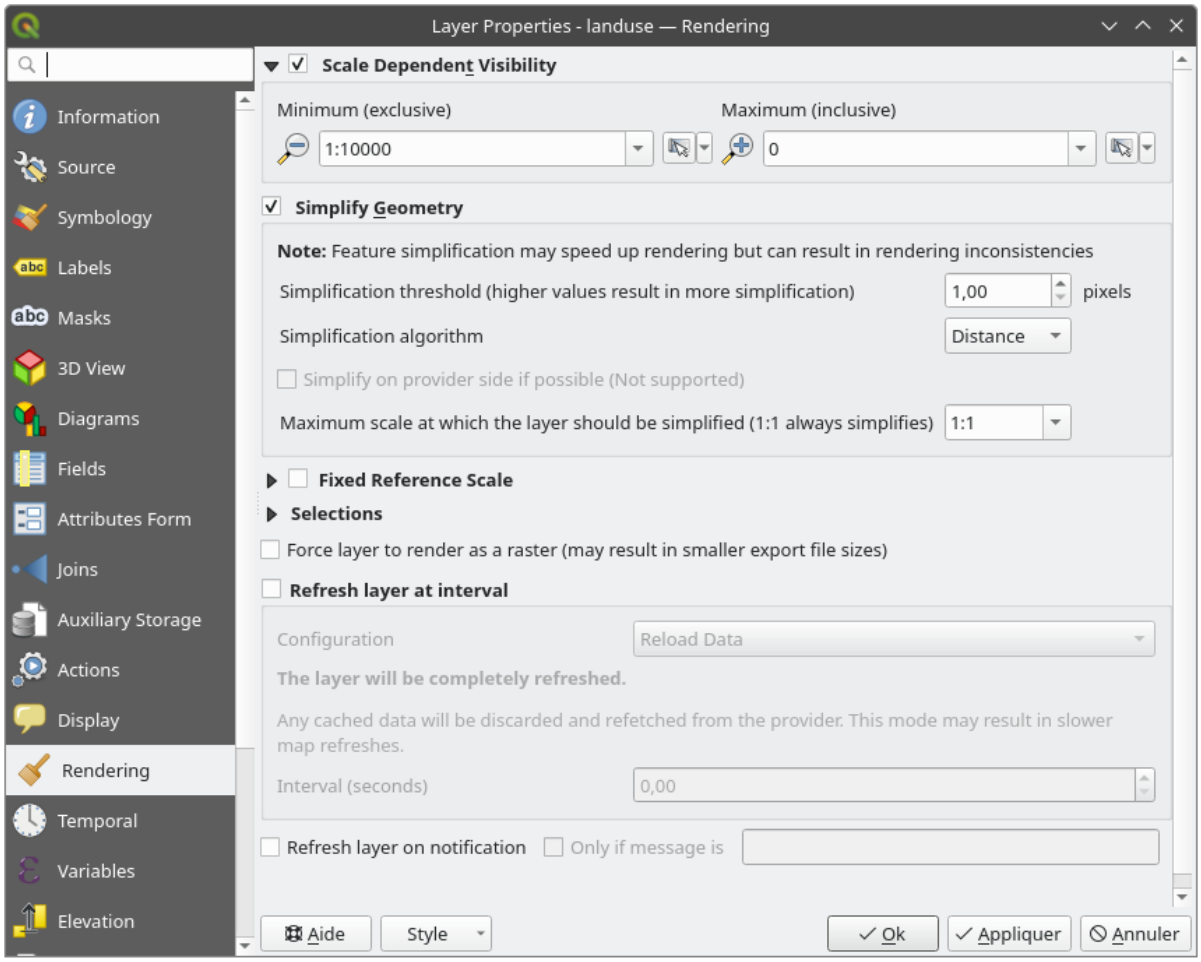
In our case, we may decide to hide the buildings from view at small scales. This map, for example…



… nu este foarte utilă. Clădirile sunt greu de distins la acea scară.

Pentru a activa randarea în funcţie de scară:

1. Open the *Layer Properties* dialog for the `buildings` layer.
2. Activate the *Rendering* tab.
3. Enable scale-based rendering by clicking on the checkbox labeled *Scale dependent visibility*:
4. Change the *Minimum* value to `1:10000`.



5. Clic pe *OK*

Test the effects of this by zooming in and out in your map, noting when the `buildings` layer disappears and reappears.

Notă

You can use your mouse wheel to zoom in increments. Alternatively, use the zoom tools to zoom to a window:

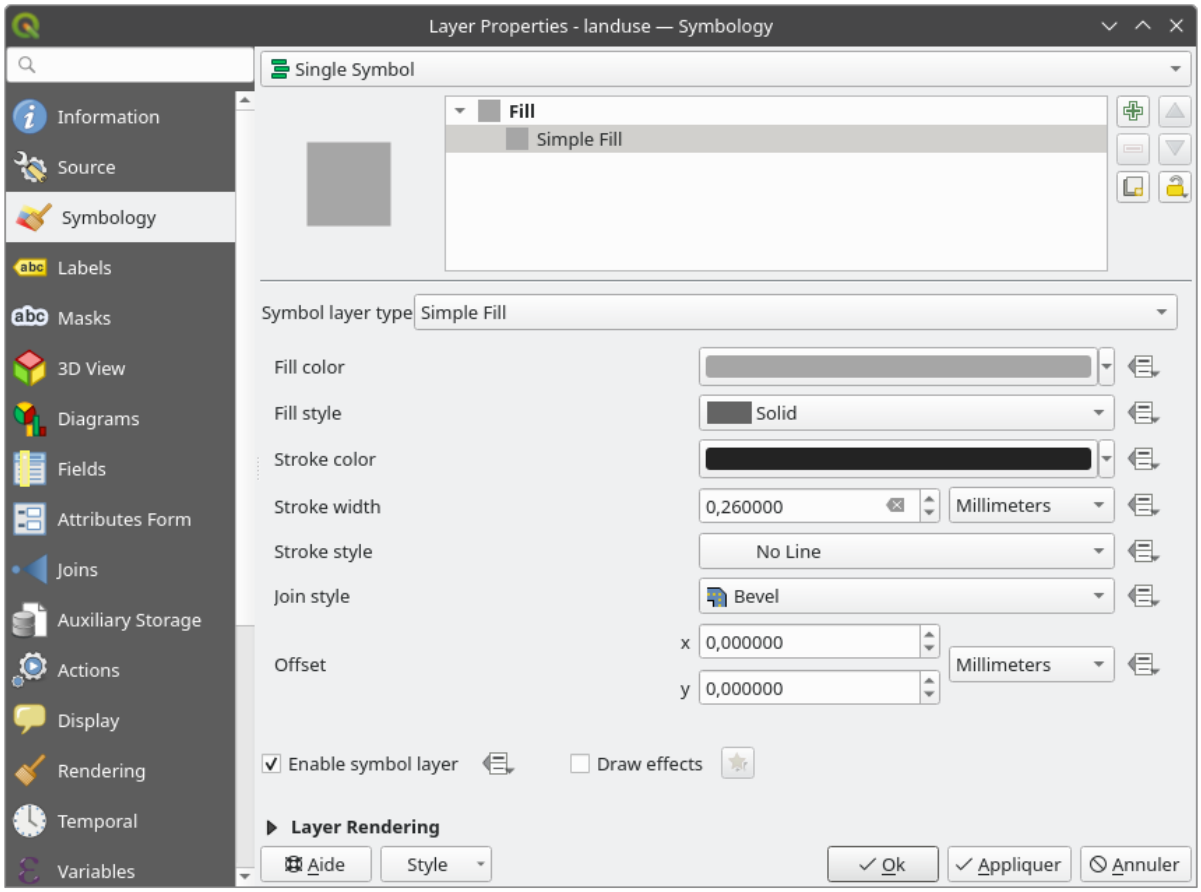


2.4.6 ??? Follow Along: Adding Symbol Layers

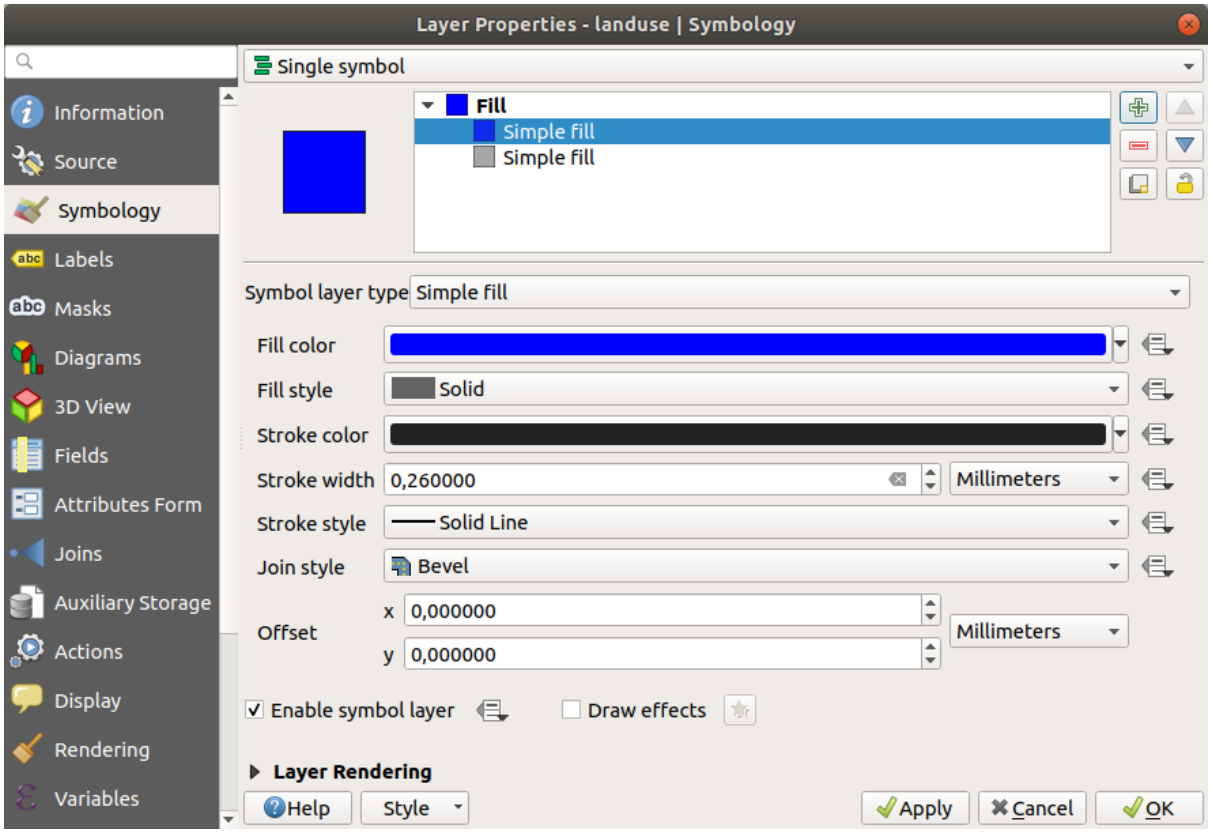
Now that you know how to change simple symbology for layers, the next step is to create more complex symbology. QGIS allows you to do this using symbol layers.

1. Go back to the `landuse` layer's symbol properties panel (by clicking *Simple fill* in the symbol layers tree).

   In this example, the current symbol has no outline (i.e., it uses the *No Line* border style).



2. Select the *Fill* level in the tree and click the Add symbol layer button. The dialog will change to look something like this, with a new symbol layer added:



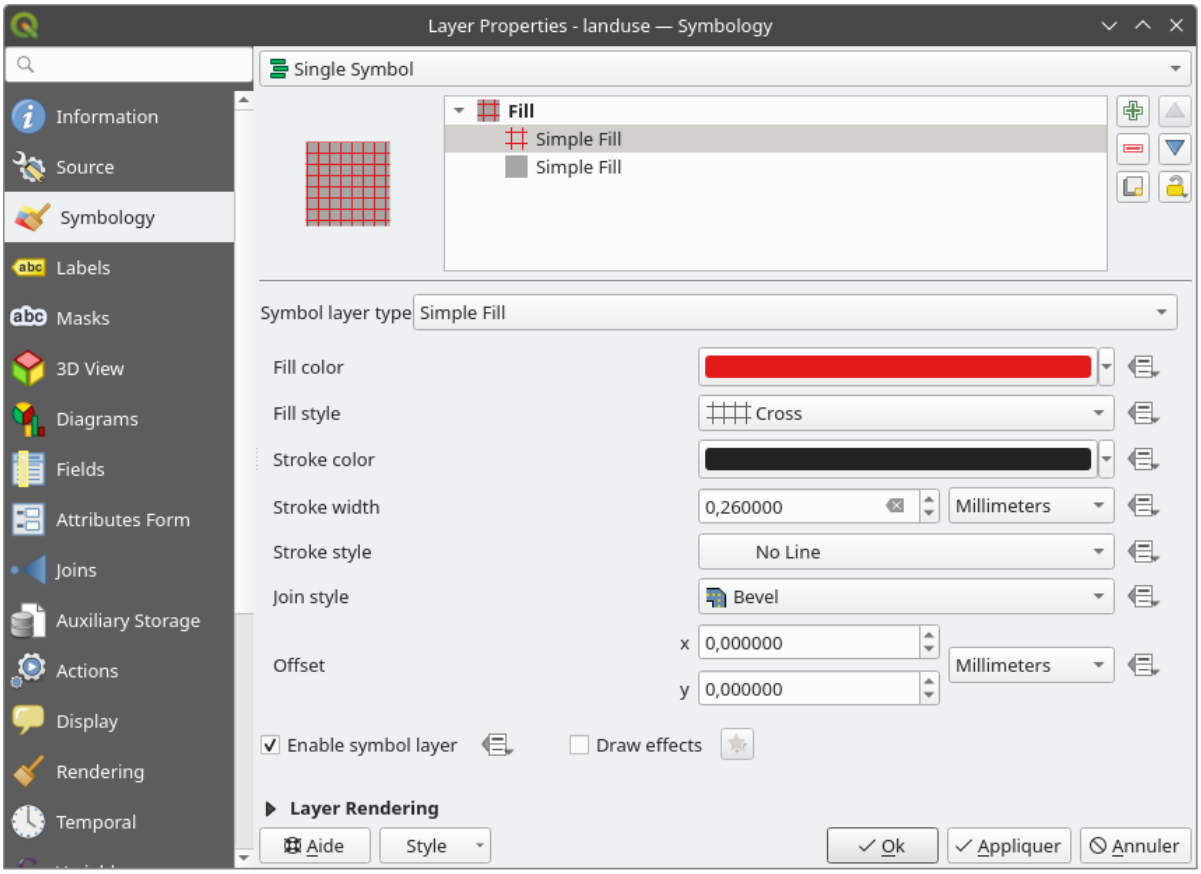
It may appear somewhat different in color, for example, but you're going to change that anyway.

Now there's a second symbol layer. Being a solid color, it will of course completely hide the previous kind of symbol. Plus, it has a *Solid Line* border style, which we don't want. Clearly this symbol has to be changed.

> **Notă**
>
> It's important not to get confused between a map layer and a symbol layer. A map layer is a vector (or raster) that has been loaded into the map. A symbol layer is part of the symbol used to represent a map layer. This course will usually refer to a map layer as just a layer, but a symbol layer will always be called a symbol layer, to prevent confusion.

With the new *Simple Fill* symbol layer selected:

1. Set the border style to *No Line*, as before.
2. Change the fill style to something other than *Solid* or *No brush*. For example:



3. Clic pe *OK*

Now you can see your results and tweak them as needed. You can even add multiple extra symbol layers and create a kind of texture for your layer that way.



It's fun! But it probably has too many colors to use in a real map…

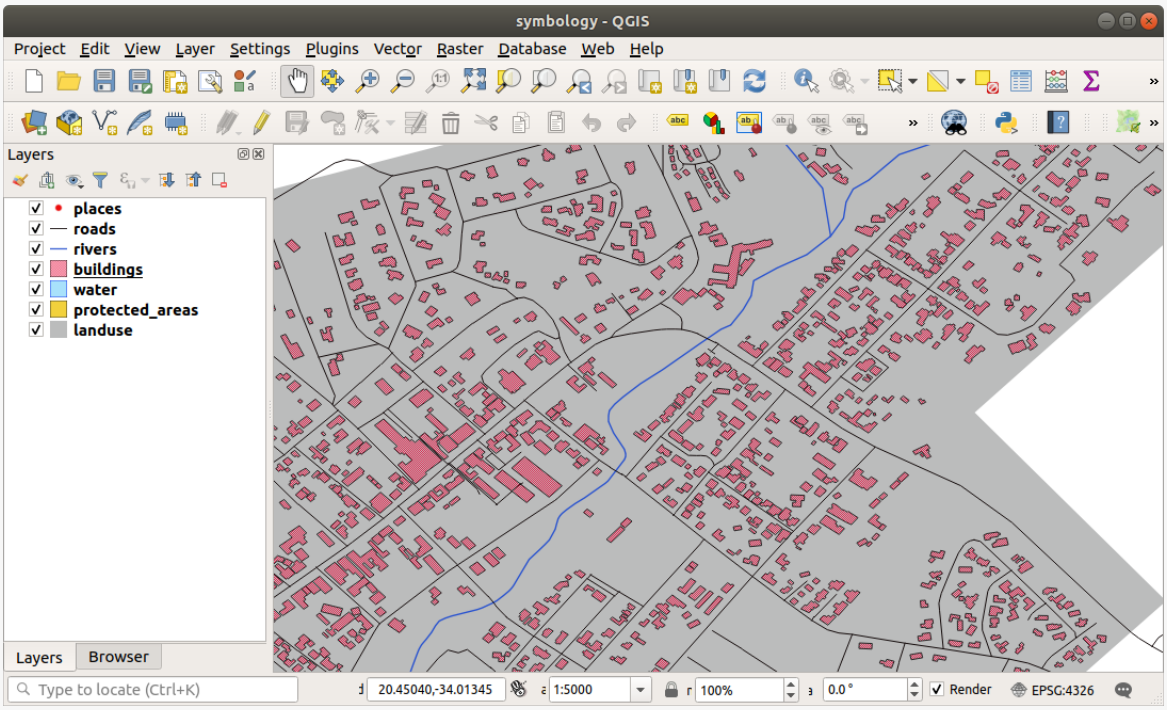
2.4.7 ??? Try Yourself:

Remembering to zoom in if necessary, create a simple, but not distracting texture for the `buildings` layer using the methods above.

Răspuns

Customize your `buildings` layer as you like, but remember that it has to be easy to tell different layers apart on the map.

Iată un exemplu:



2.4.8 ??? Follow Along: Ordering Symbol Levels

When symbol layers are rendered, they are also rendered in a sequence, similar to the way the different map layers are rendered. This means that in some cases, having many symbol layers in one symbol can cause unexpected results.

1. Give the `roads` layer an extra symbol layer (using the method for adding symbol layers demonstrated above).
2. Give the base line a *Stroke width* of `1.5` and a black color.
3. Give the new, uppermost layer a thickness of `0.8` and a white color.

Veți observa că se întâmplă acest lucru:

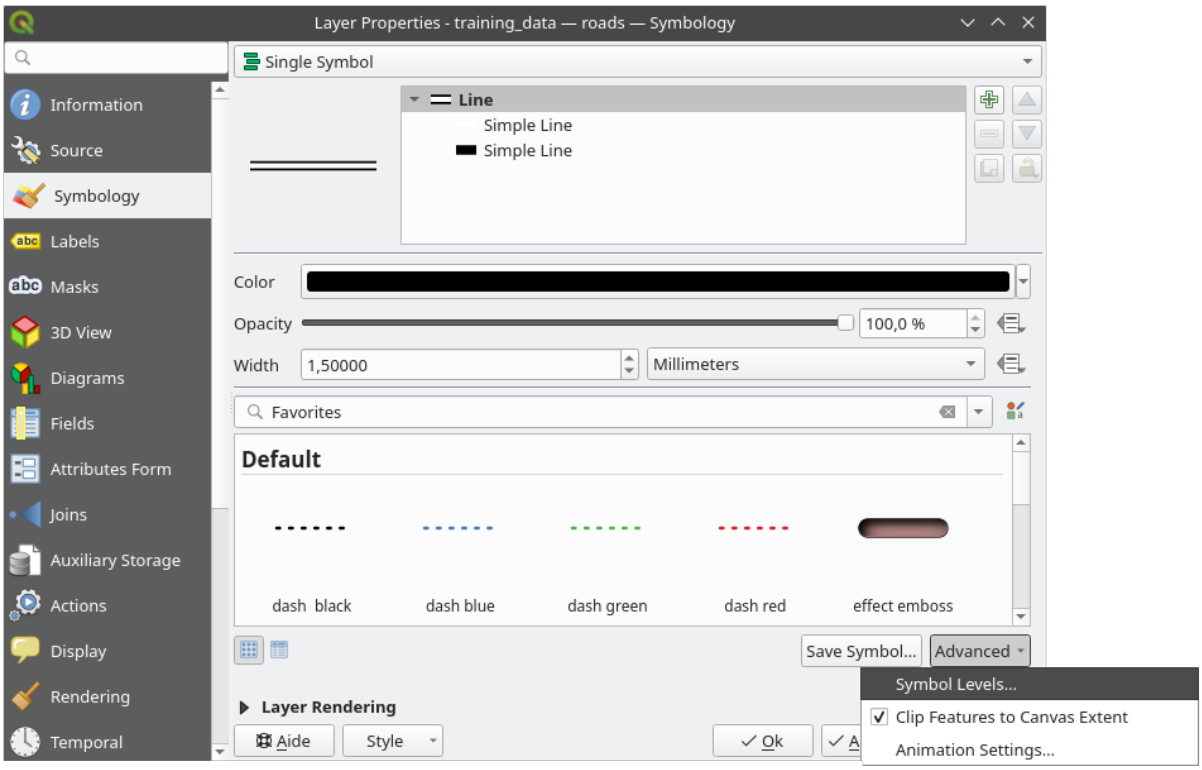


Well, roads have now a *street* like symbology, but you see that lines are overlapping each others at each cross. That's not what we want at all!

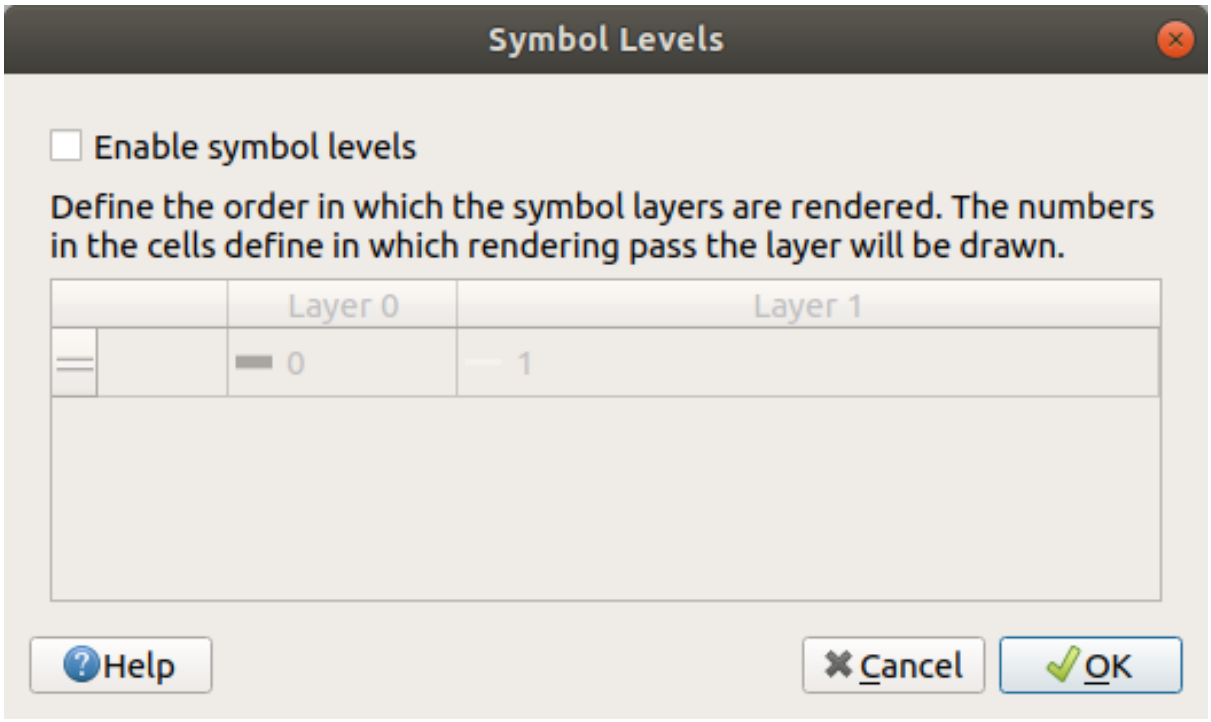
To prevent this from happening, you can sort the symbol levels and thereby control the order in which the different symbol layers are rendered.

To change the order of the symbol layers:

1. Select the topmost `Line` layer in the symbol layers tree.
2. Click *Advanced* ► *Symbol levels...* in the bottom right-hand corner of the window.

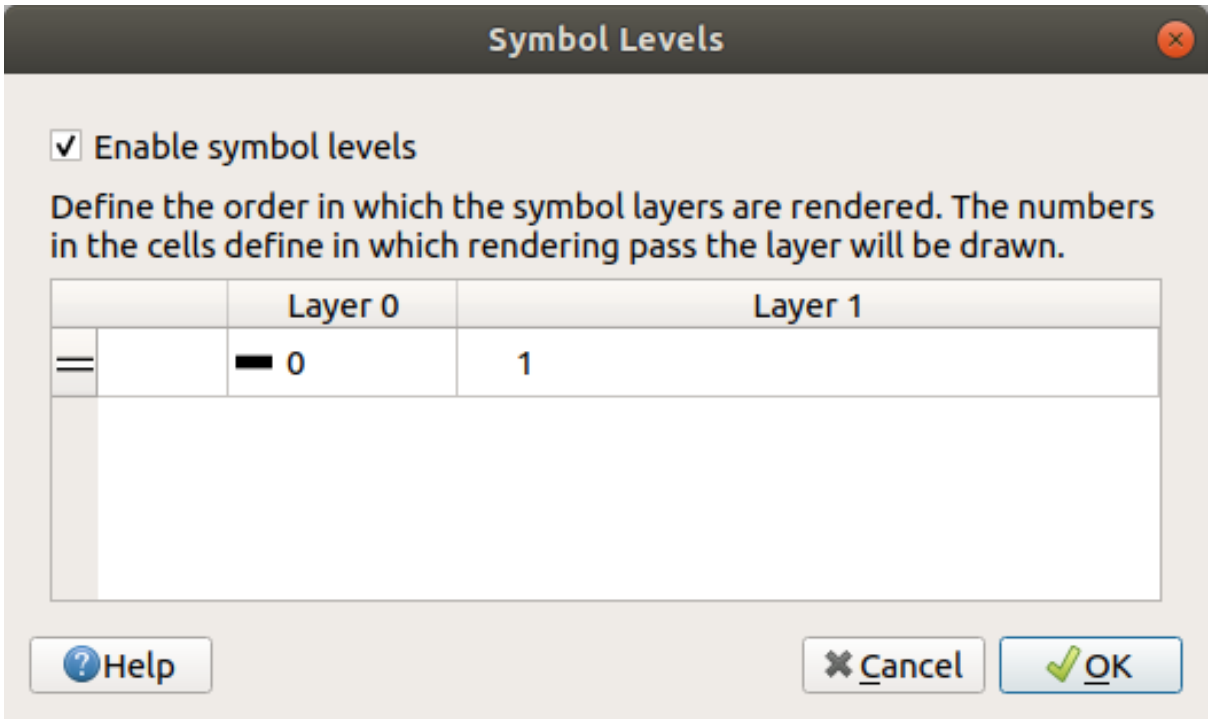


This will open a dialog like this:



3. Check  *Enable symbol levels*. You can then set the layer order of each symbol by entering the corresponding level number. 0 is the bottom layer.

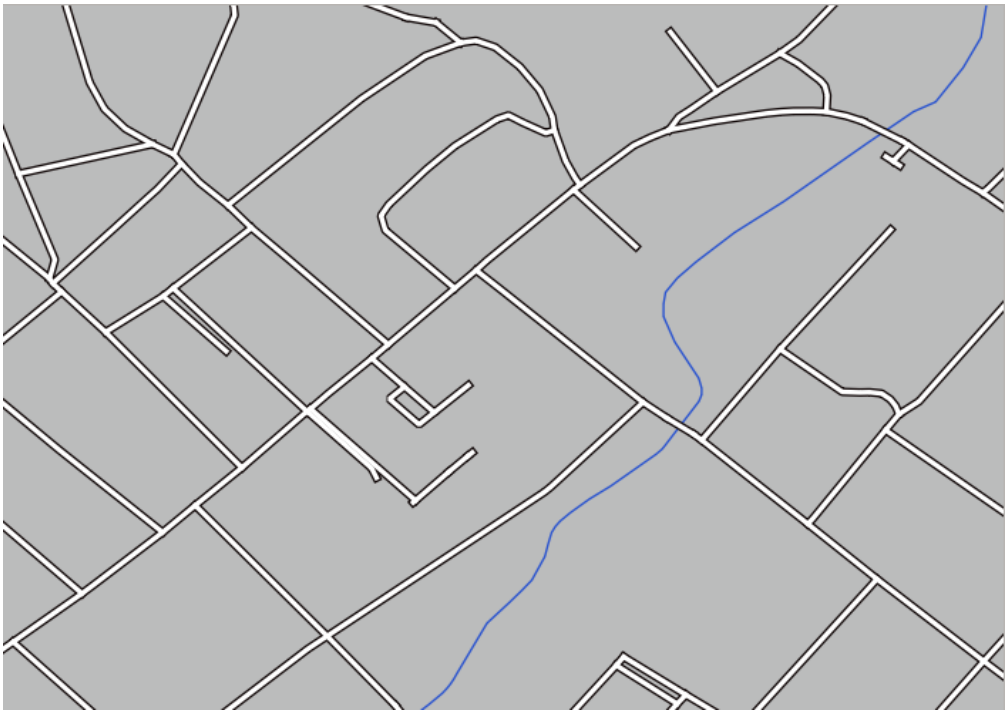
   In our case, we just want to activate the option, like this:



   This will render the white line above the thick black line borders:

4. Faceți clic pe *Ok* pentru a reveni la hartă.

   Harta va arăta acum în modul următor:



When you're done, remember to save the symbol itself so as not to lose your work if you change the symbol again in the future. You can save your current symbol style by clicking the *Save Style…* button at the bottom of the *Layer Properties* dialog. We will be using the *QGIS QML Style File* format.

Save your style in the `solution/styles/better_roads.qml` folder. You can load a previously saved style at any time by clicking the *Load Style…* button. Before you change a style, keep in mind that any unsaved style you are replacing will be lost.

2.4.9 ??? Try Yourself:

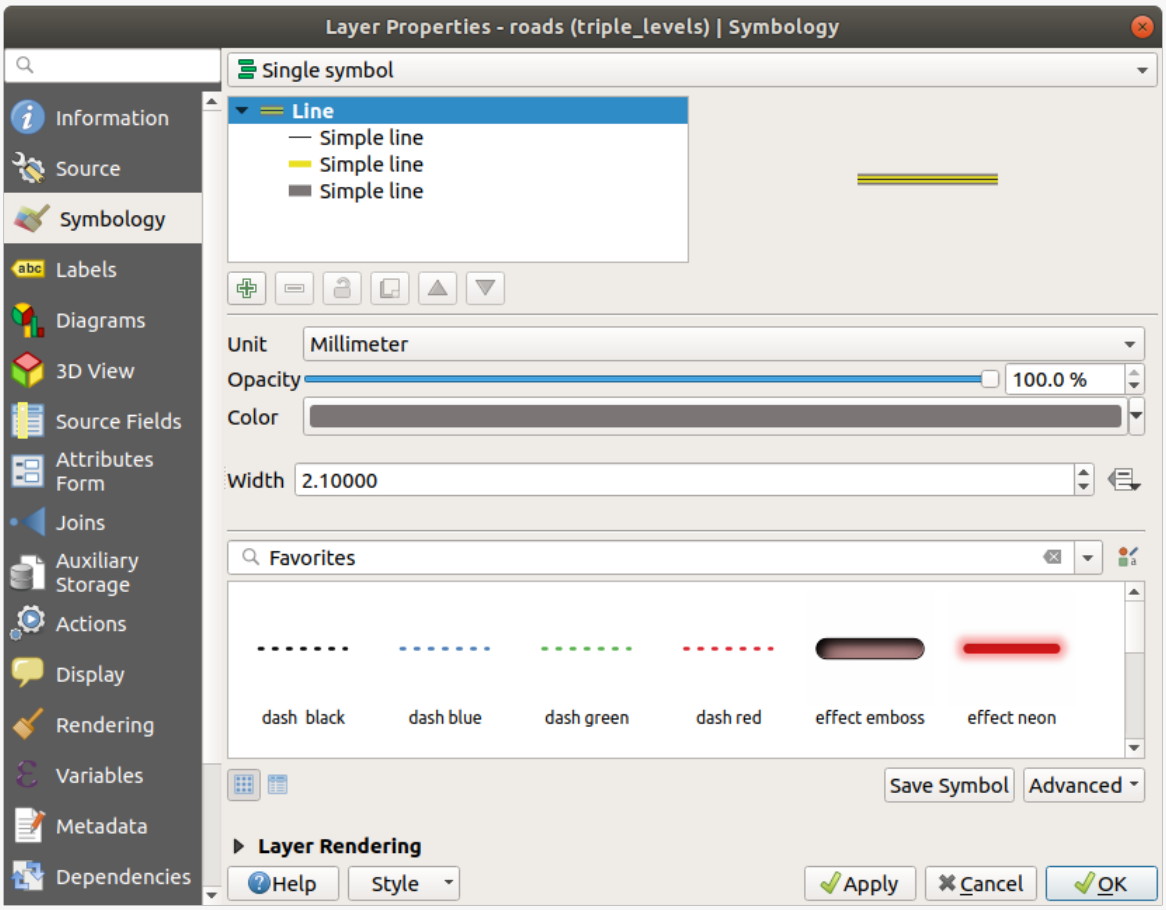
Change the appearance of the `roads` layer again.

Make the roads narrow and yellow, with a thin, pale gray outline and a thin black line in the middle. Remember that you may need to change the layer rendering order via the *Advanced* ► *Symbol levels…* dialog.



Răspuns

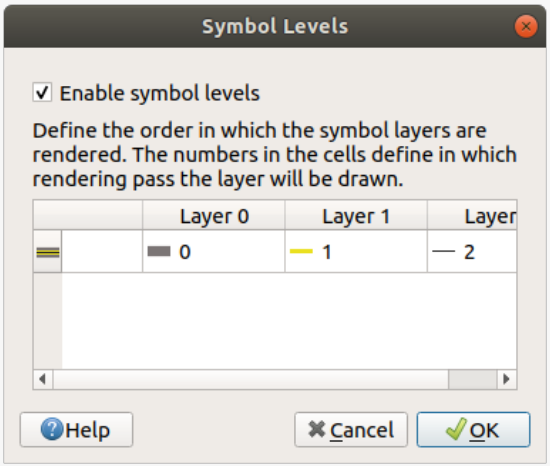
To make the required symbol, you need three symbol layers:



The lowest symbol layer is a broad, solid gray line. On top of it there is a slightly thinner solid yellow line and finally another thinner solid black line.

If your symbol layers resemble the above but you're not getting the result you want:

1. Check that your symbol levels look something like this:



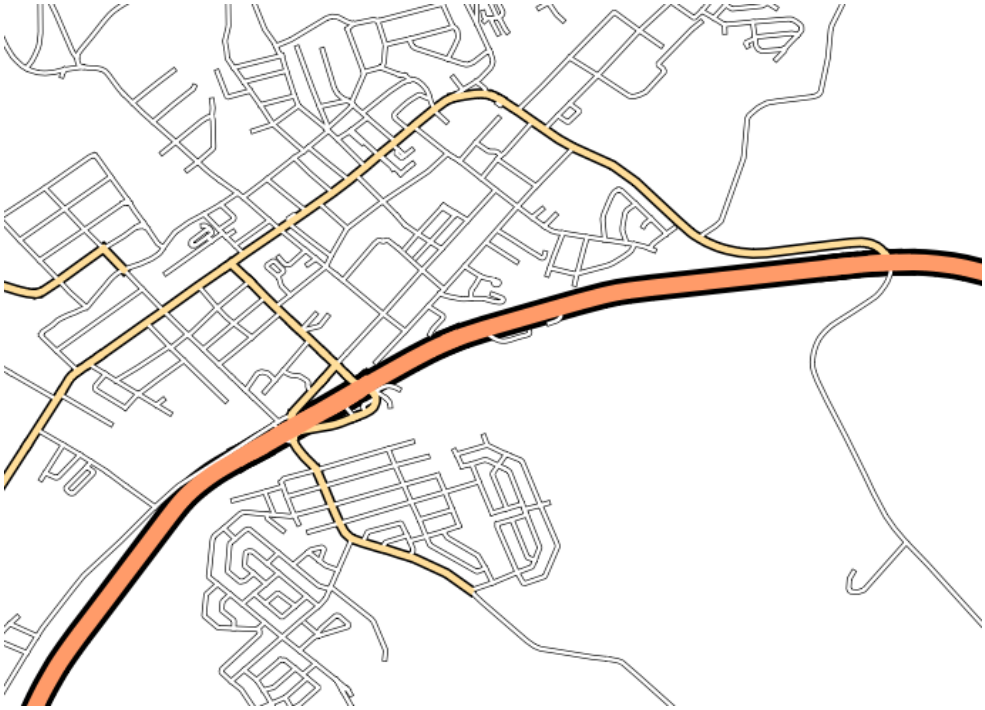
2. Now your map should look like this:



2.4.10 ??? Încercați și dvs.:

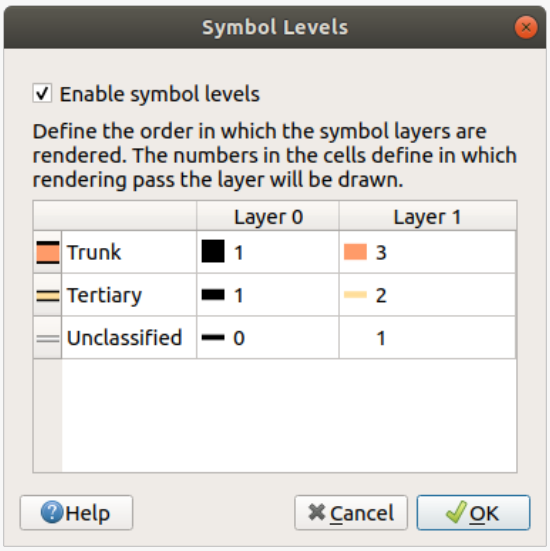
Symbol levels also work for classified layers (i.e., layers having multiple symbols). Since we haven't covered classification yet, you will work with some rudimentary pre-classified data.

1. Create a new project and add only the `roads` dataset.
2. Apply the style file `advanced_levels_demo.qml` provided in `exercise_data/styles` to the layer. This can be done through the *Style* ► *Load Style...* combobox at the bottom of the *Layer Properties* dialog.
3. Focalizați în aria Swellendam.
4. Using symbol layers, ensure that the outlines of layers flow into one another as per the image below:



Răspuns

1. Adjust your symbol levels to these values:



1. Experiment with different values to get different results.
2. Open your original map again before continuing with the next exercise.

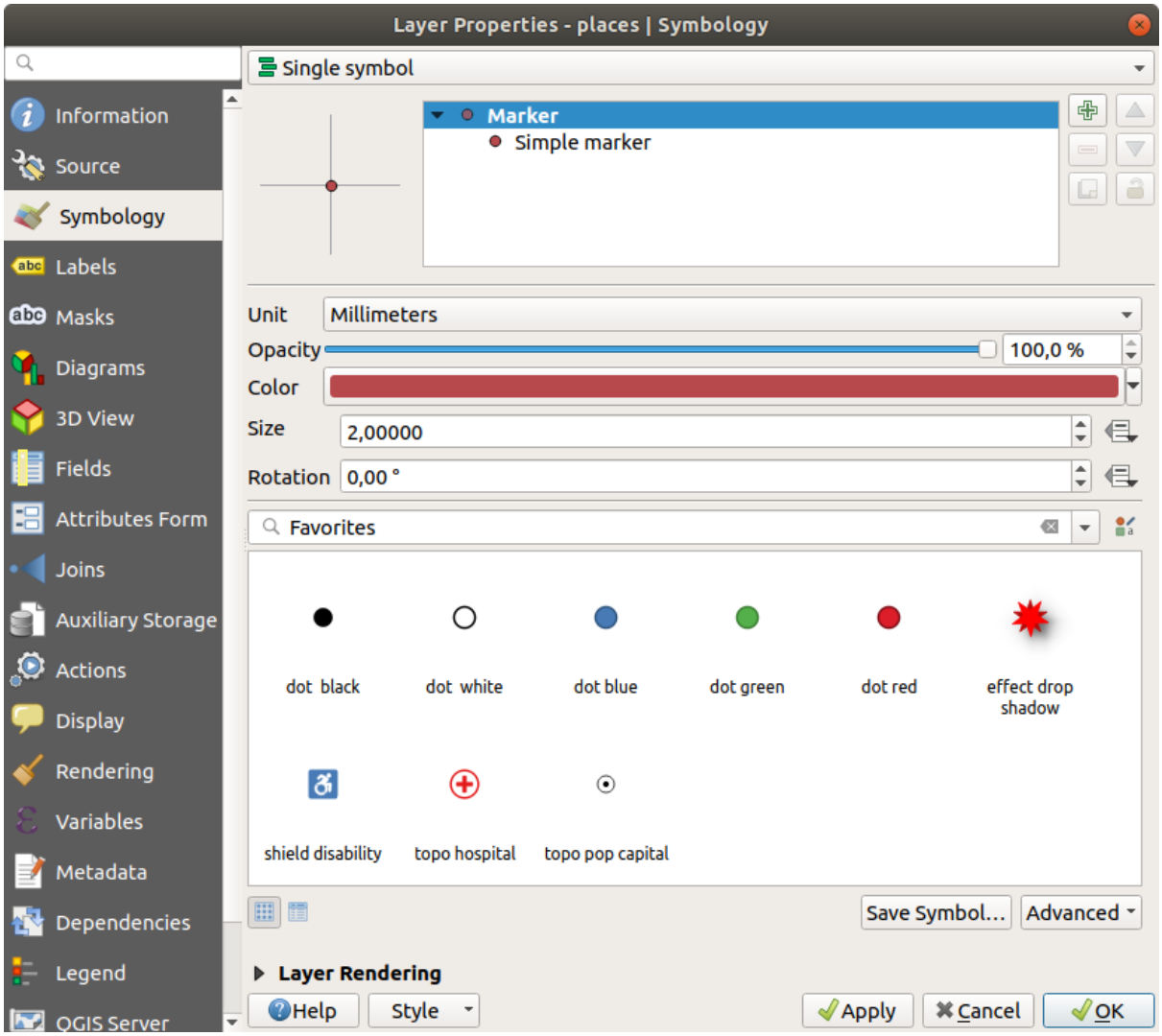
2.4.11 ??? Follow Along: Symbol layer types

In addition to setting fill colors and using predefined patterns, you can use different symbol layer types entirely. The only type we've been using up to now was the *Simple Fill* type. The more advanced symbol layer types allow you to customize your symbols even further.

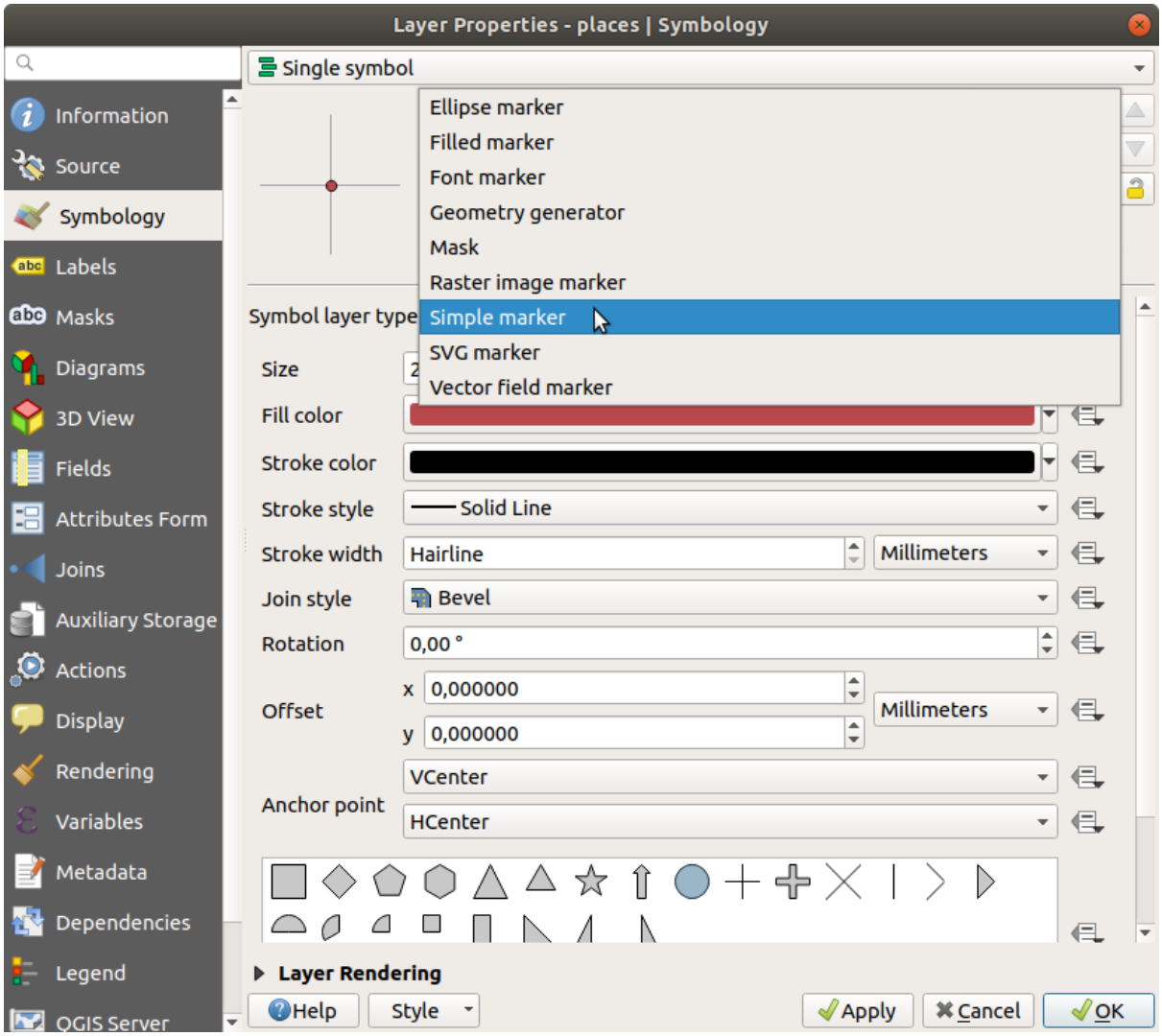
Each type of vector (point, line and polygon) has its own set of symbol layer types. First we will look at the types available for points.

Tipurile de Straturi pentru Simbolurile de tip Punct

1. Uncheck all the layers except for `places`.
2. Change the symbol properties for the `places` layer:



3. You can access the various symbol layer types by selecting the *Simple marker* layer in the symbol layers tree, then click the *Symbol layer type* dropdown:

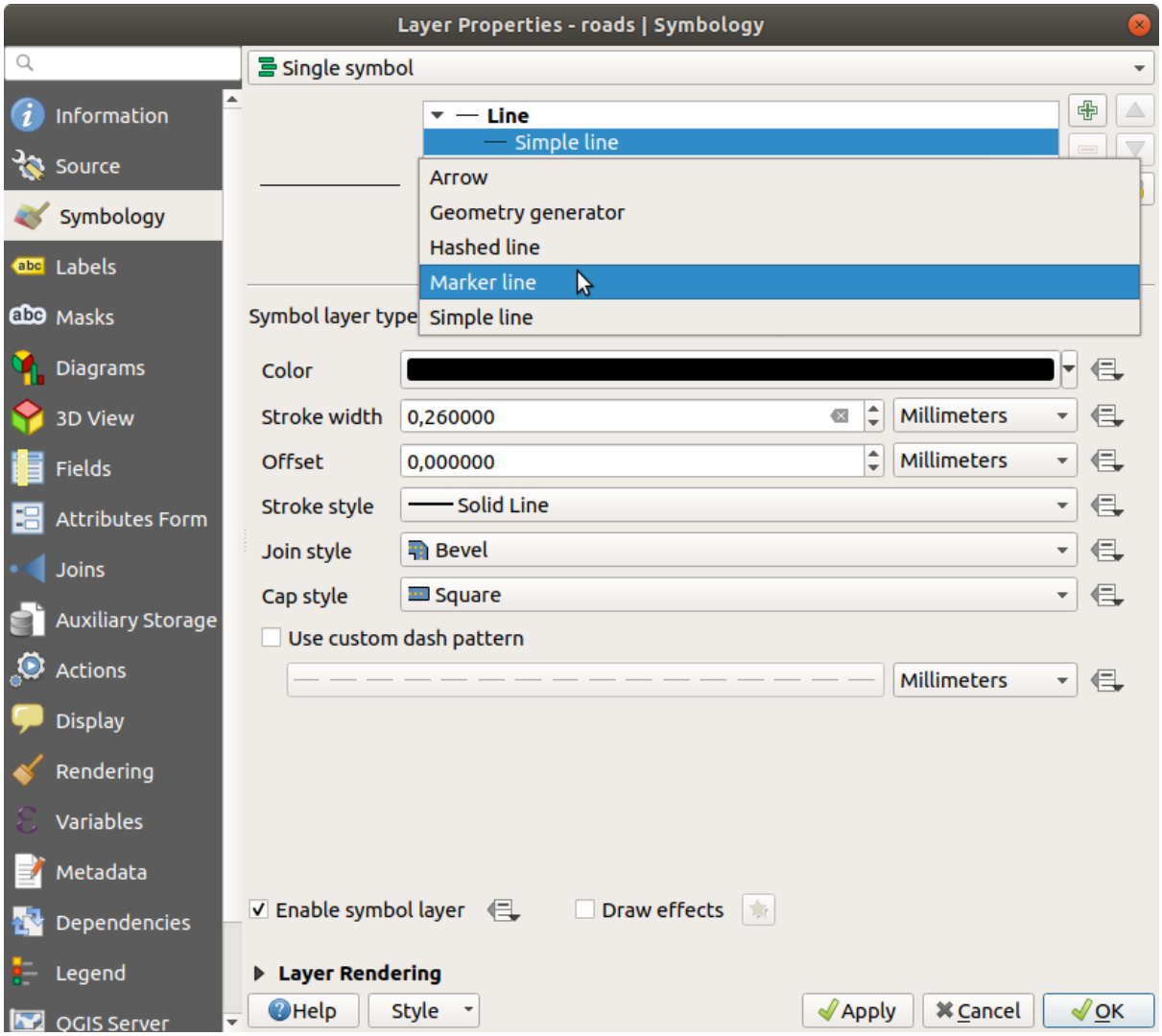


4. Investigate the various options available to you, and choose a symbol with styling you think is appropriate.
5. If in doubt, use a round *Simple marker* with a white border and pale green fill, with a *Size* of `3.00` and a *Stroke width* of `0.5`.

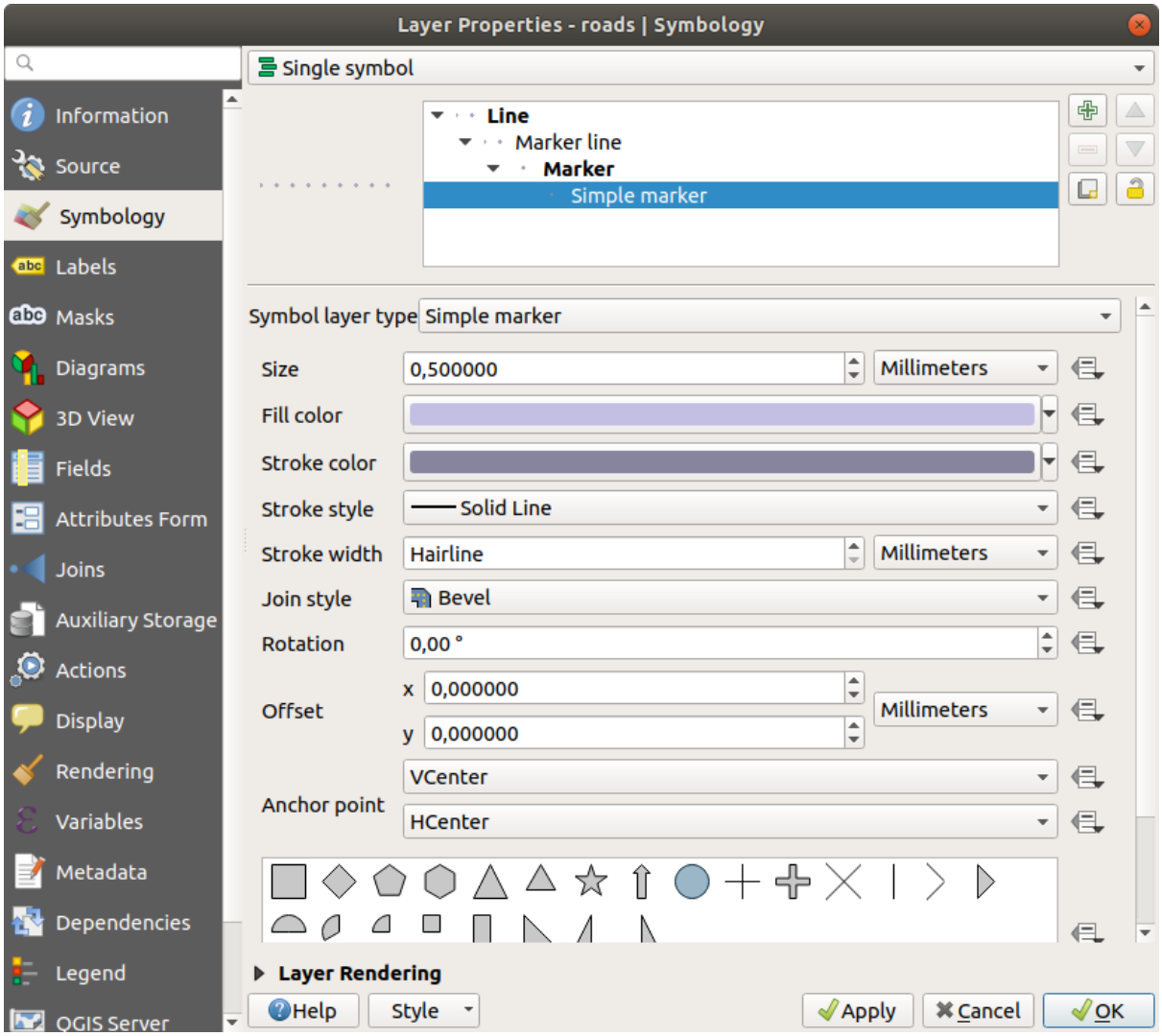
Tipurile de Straturi pentru Simbolurile de tip Linie

Pentru a vedea diferitele opțiuni disponibile pentru datele de tip linie:

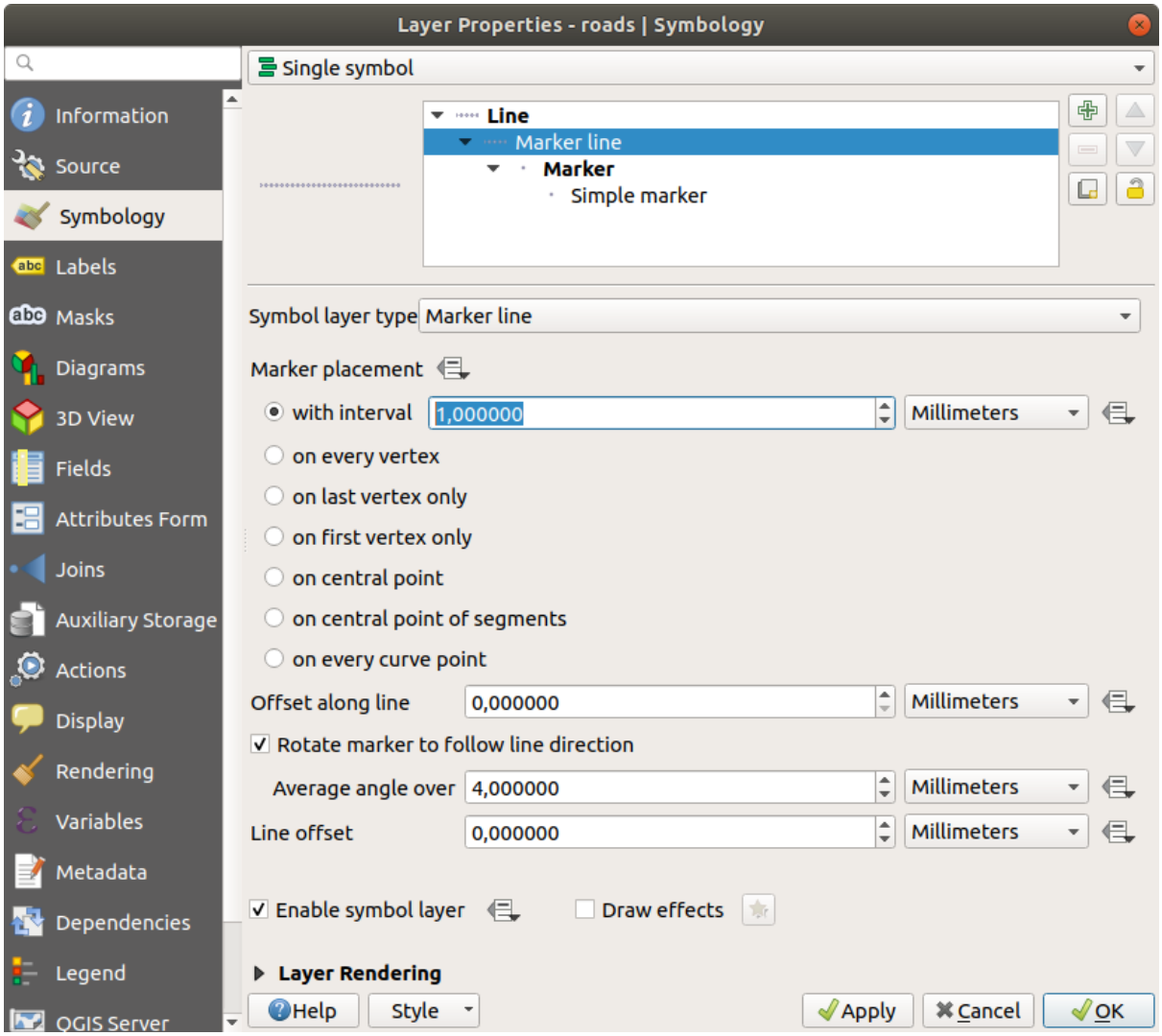
1. Change the *Symbol layer type* for the `roads` layer's topmost symbol layer to *Marker line*:



2. Select the *Simple marker* layer in the symbol layers tree. Change the symbol properties to match this dialog:



3. Select the *Marker line* layer and change the interval to `1.00`:



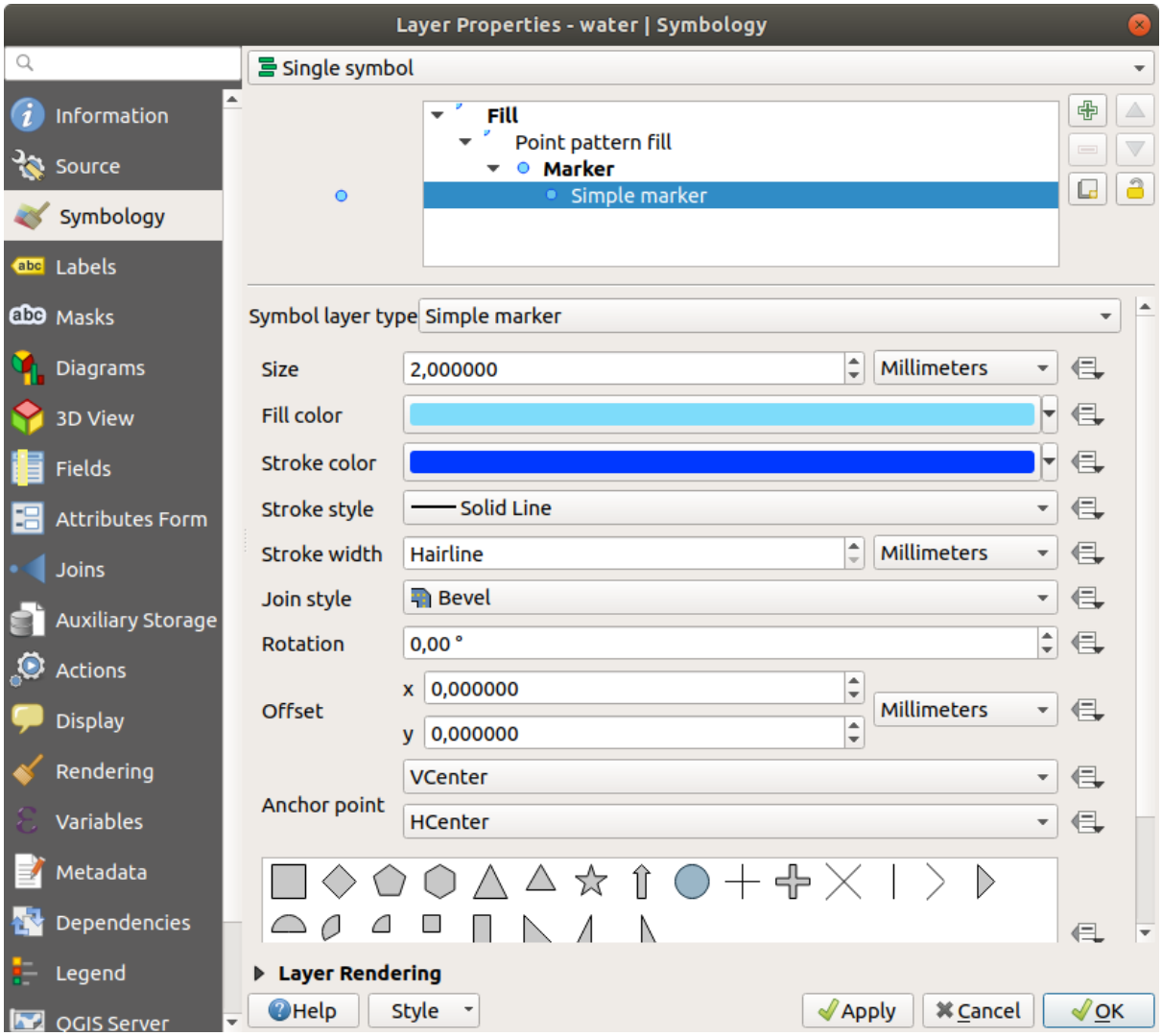
4. Ensure that the symbol levels are correct (via the *Advanced* ► *Symbol levels* dialog we used earlier) before applying the style.

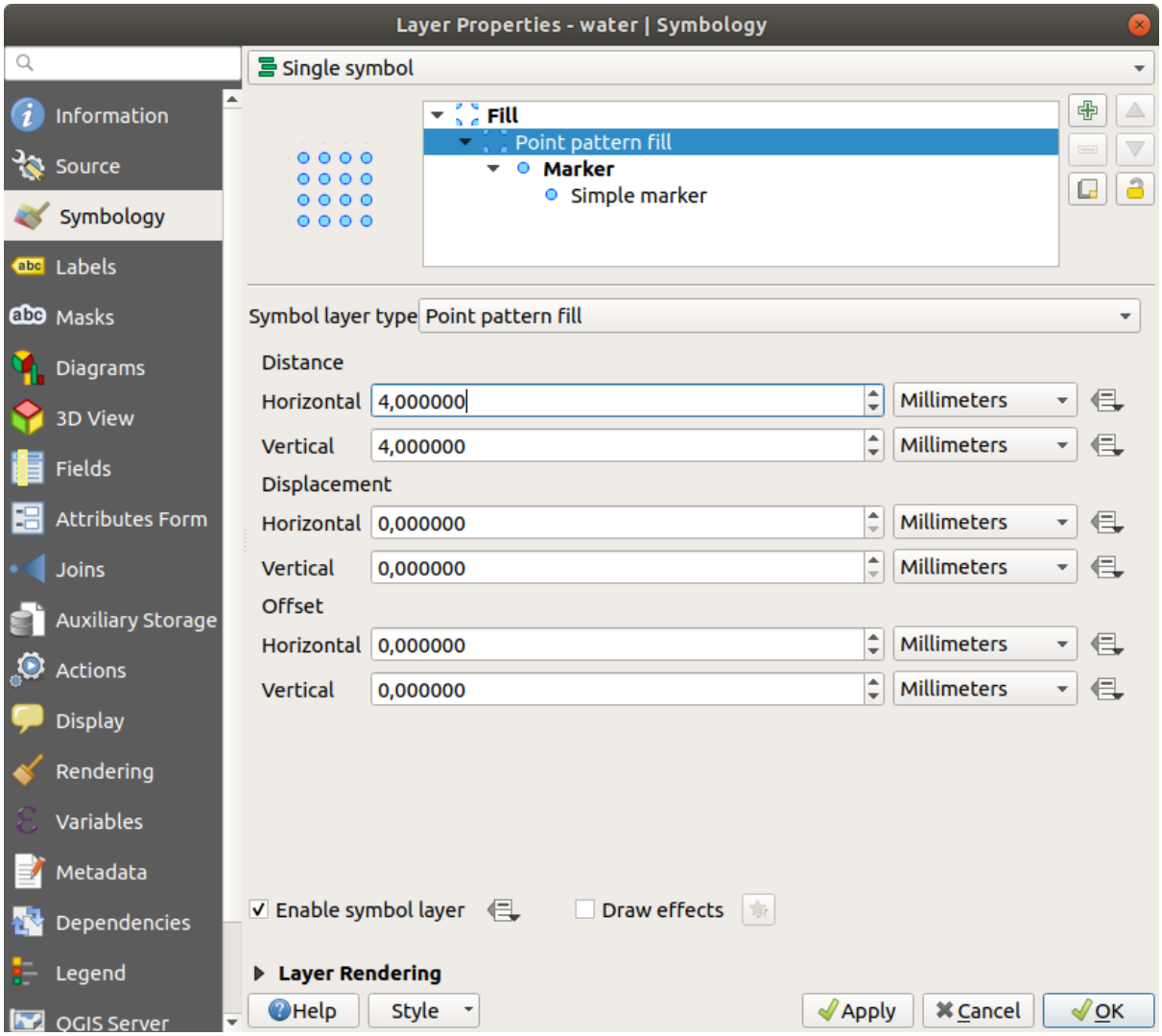
Once you have applied the style, take a look at its results on the map. As you can see, these symbols change direction along with the road but don't always bend along with it. This is useful for some purposes, but not for others. If you prefer, you can change the symbol layer in question back to the way it was before.

Tipurile de Straturi pentru Simbolurile de tip Poligon

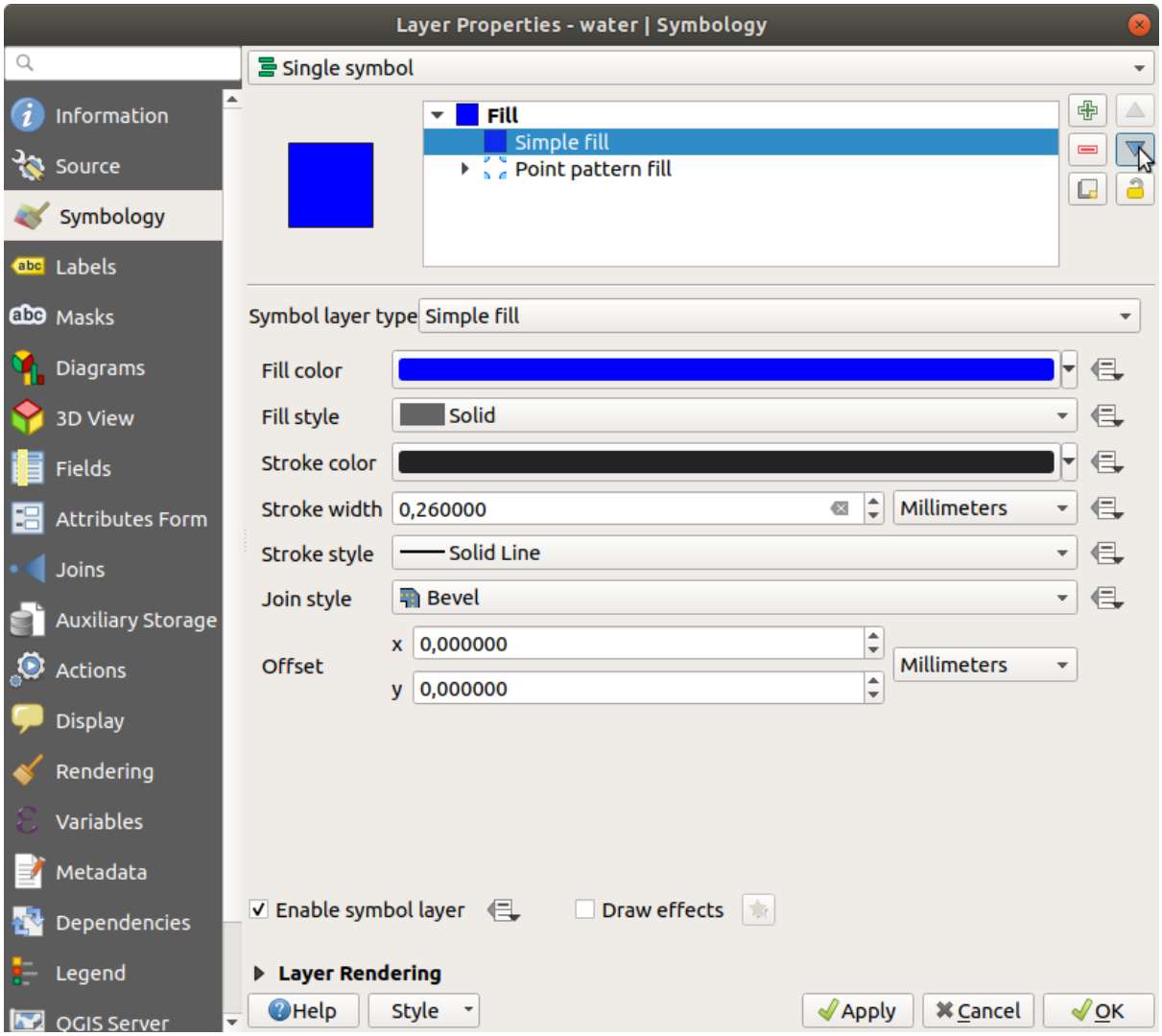
Pentru a vedea diferitele opțiuni disponibile pentru datele poligonale:

1. Change the *Symbol layer type* for the `water` layer, as before for the other layers.
2. Investigați ce pot face diferitele opțiuni din listă.
3. Alegeți una dintre ele, pe care o găsiți potrivită.
4. Dacă aveți îndoieli, utilizați *Umplere cu model din puncte*, având următoarele opțiuni:


Layer Properties - water | Symbology
Information
Source
Symbology
Labels
Masks
Diagrams
3D View
Fields
Attributes Form
Joins
Auxiliary Storage
Actions
Display
Rendering
Variables
Metadata
Dependencies
Legend
QGIS Server
Single symbol
Fill
Point pattern fill
Marker
Simple marker
Symbol layer type
Simple marker
Size
2,000000
Millimeters
Fill color
Stroke color
Stroke style
Solid Line
Stroke width
Hairline
Millimeters
Join style
Bevel
Rotation
0,00 °
Offset
x
0,000000
y
0,000000
Millimeters
Anchor point
VCenter
HCenter
Layer Rendering
Help
Style
Apply
Cancel
OK



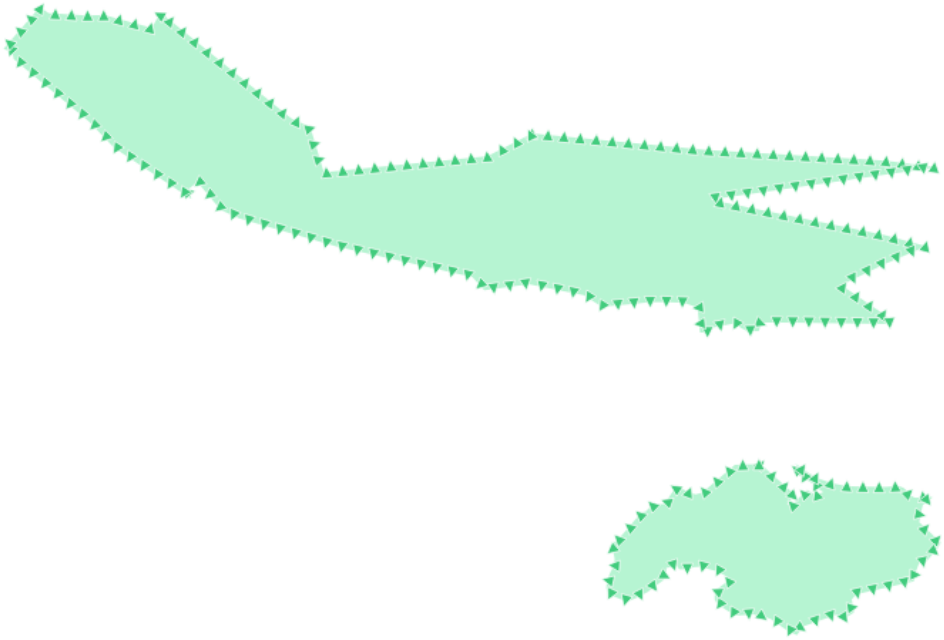
5. Adăugați un nou strat simbol, cu o *Umplere simplă*, normală.
6. Faceți-l în același albastru deschis, cu un chenar albastru mai închis.
7. Mutați-l sub stratul simbol cu modelul din puncte, cu ajutorul butonului *Move down*:



As a result, you have a textured symbol for the water layer, with the added benefit that you can change the size, shape and distance of the individual dots that make up the texture.

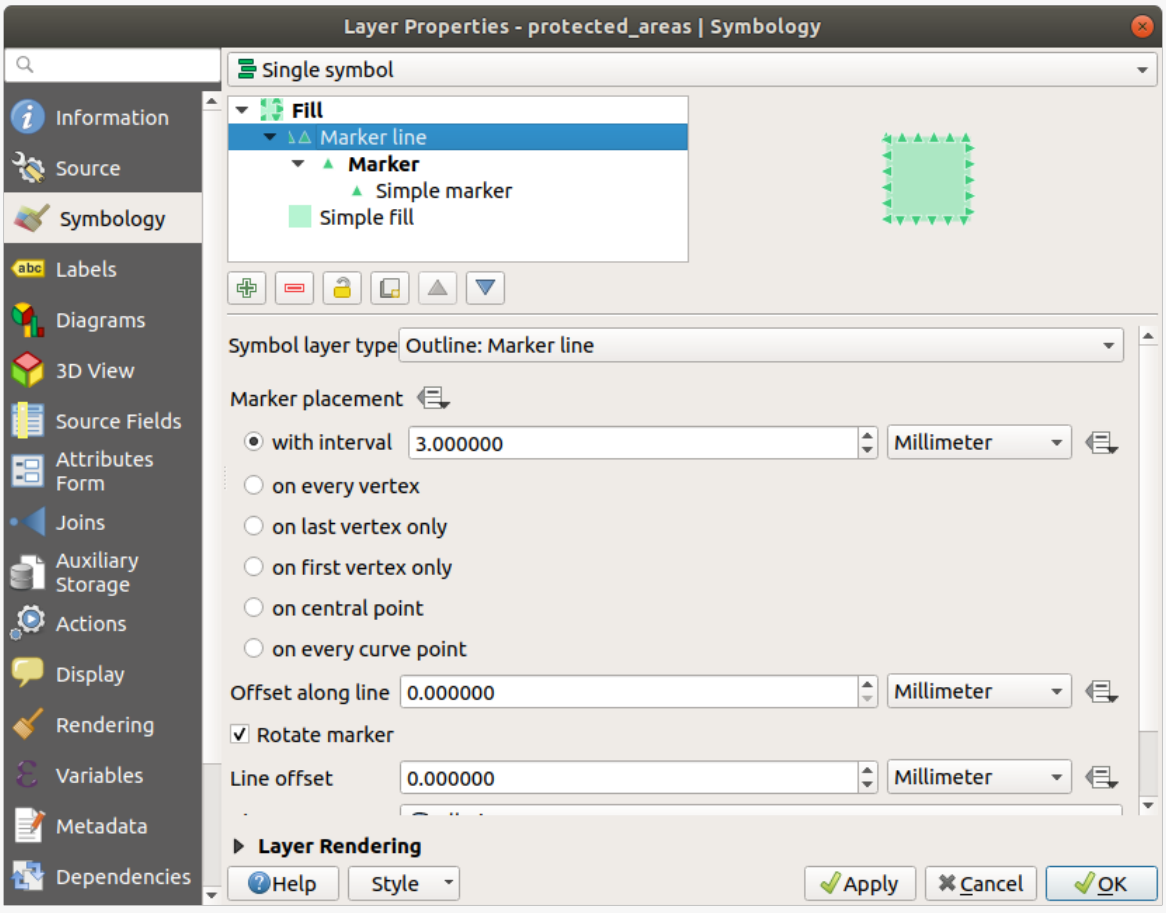
2.4.12 ??? Try Yourself:

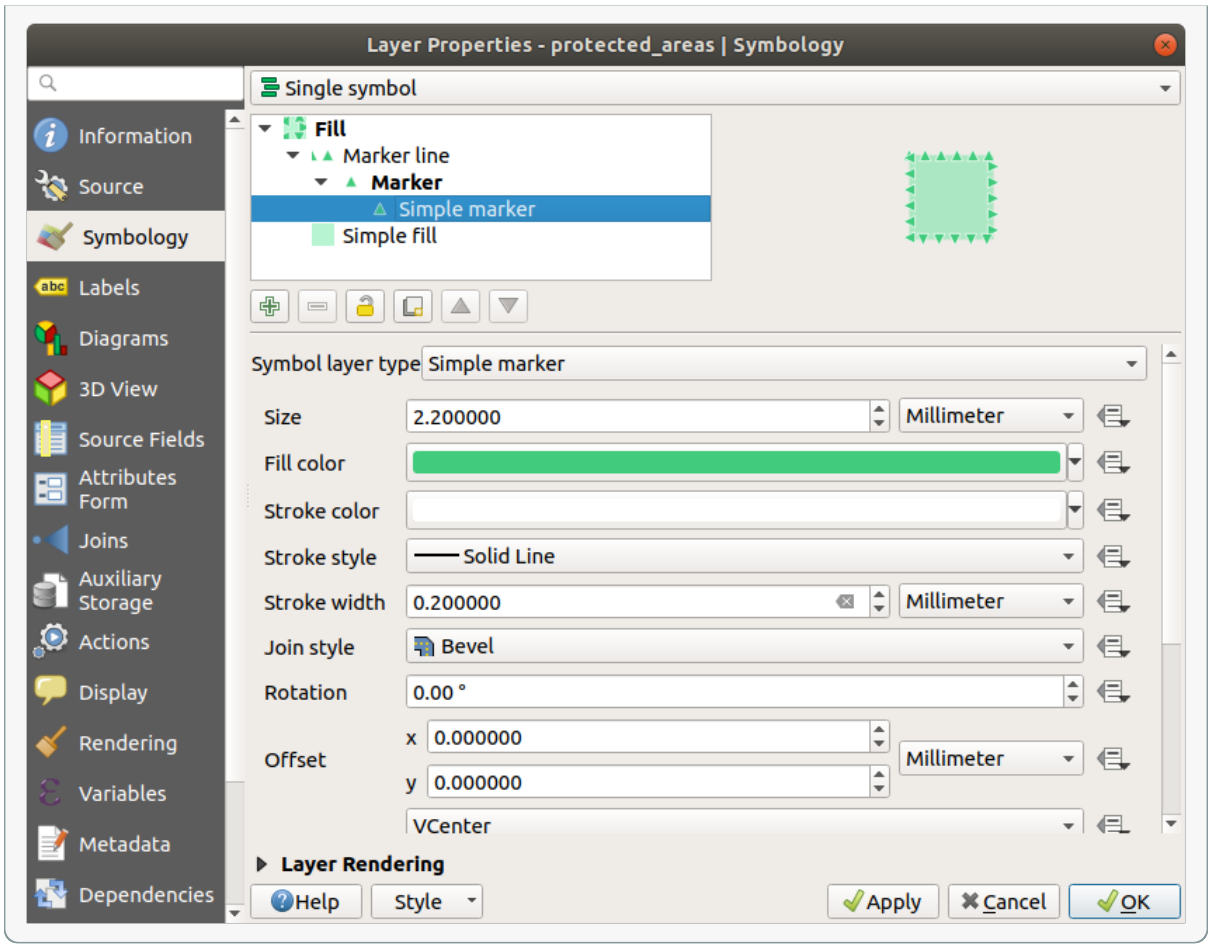
Apply a green transparent fill color to the `protected_areas` layer, and change the outline to look like this:



Răspuns

Here are examples of the symbol structure:





2.4.13 ??? Follow Along: Geometry generator symbology

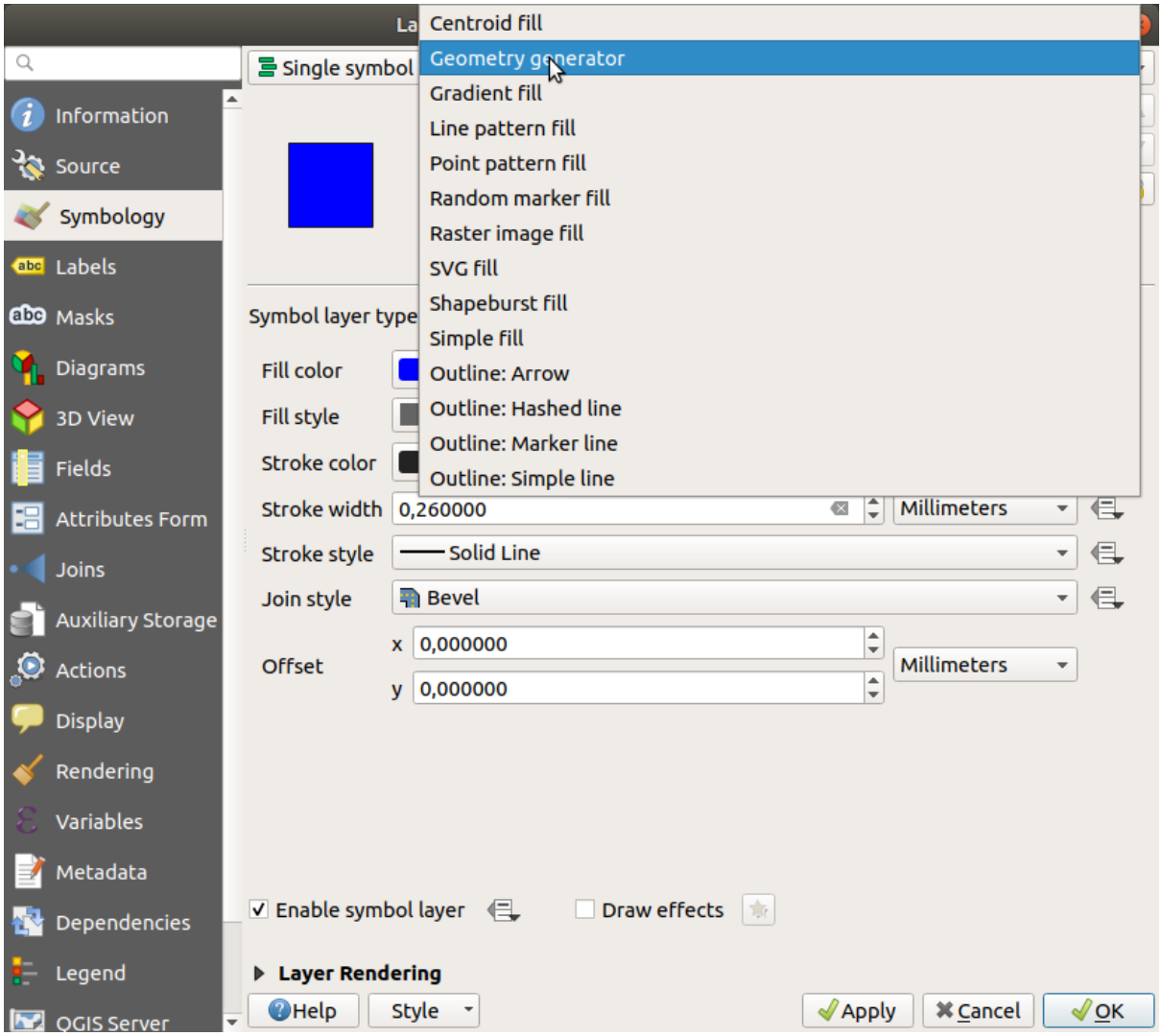
You can use the Geometry generator symbology with all layer types (points, lines and polygons). The resulting symbol depends directly on the layer type.

Very briefly, the Geometry generator symbology allows you to run some spatial operations within the symbology itself. For example you can run a real centroid spatial operation on a polygon layer without creating a point layer.

Moreover, you have all the styling options to change the appearance of the resulting symbol.

Let's give it a try!

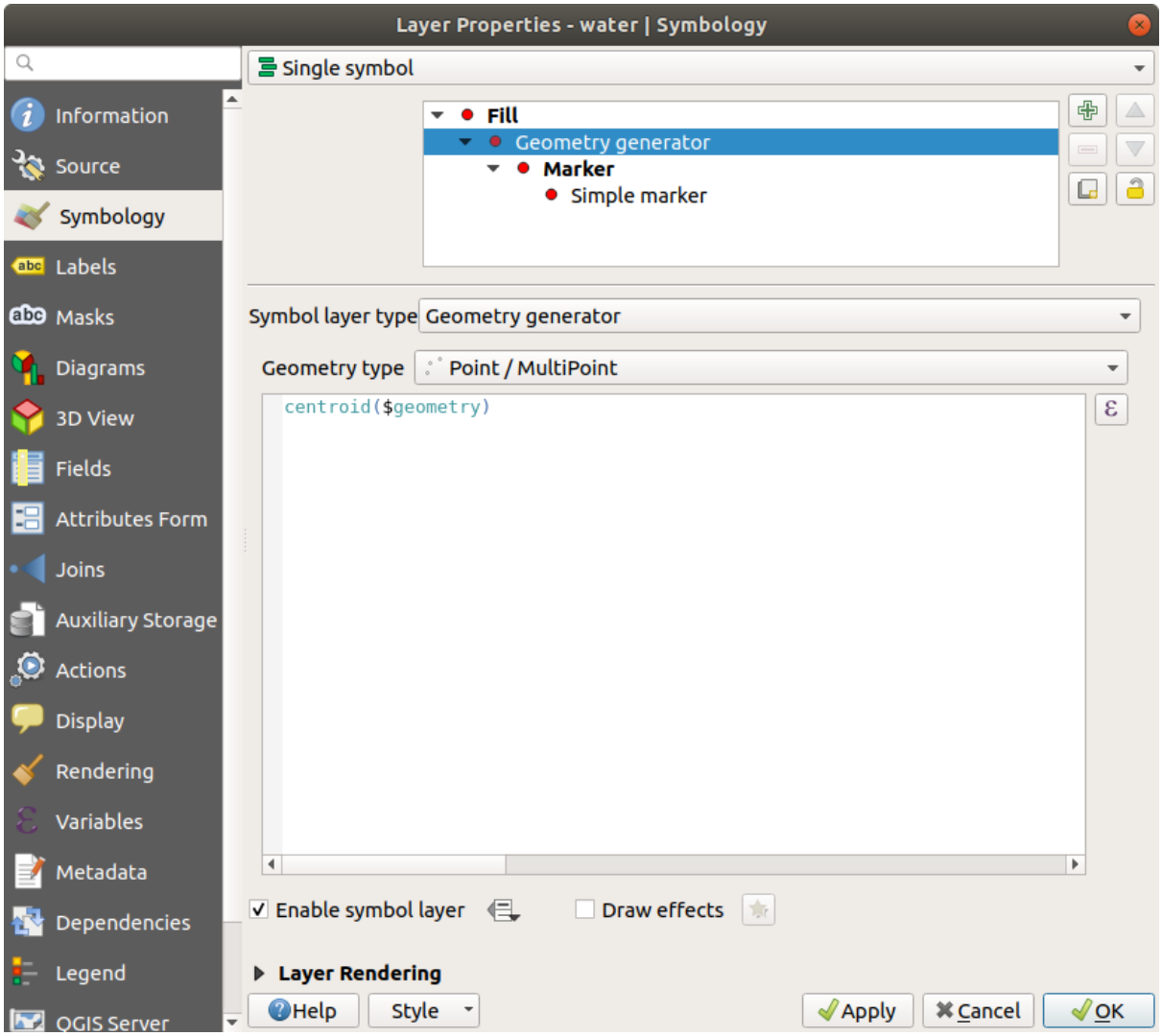
1. Select the `water` layer.
2. Click on *Simple fill* and change the *Symbol layer type* to *Geometry generator*.



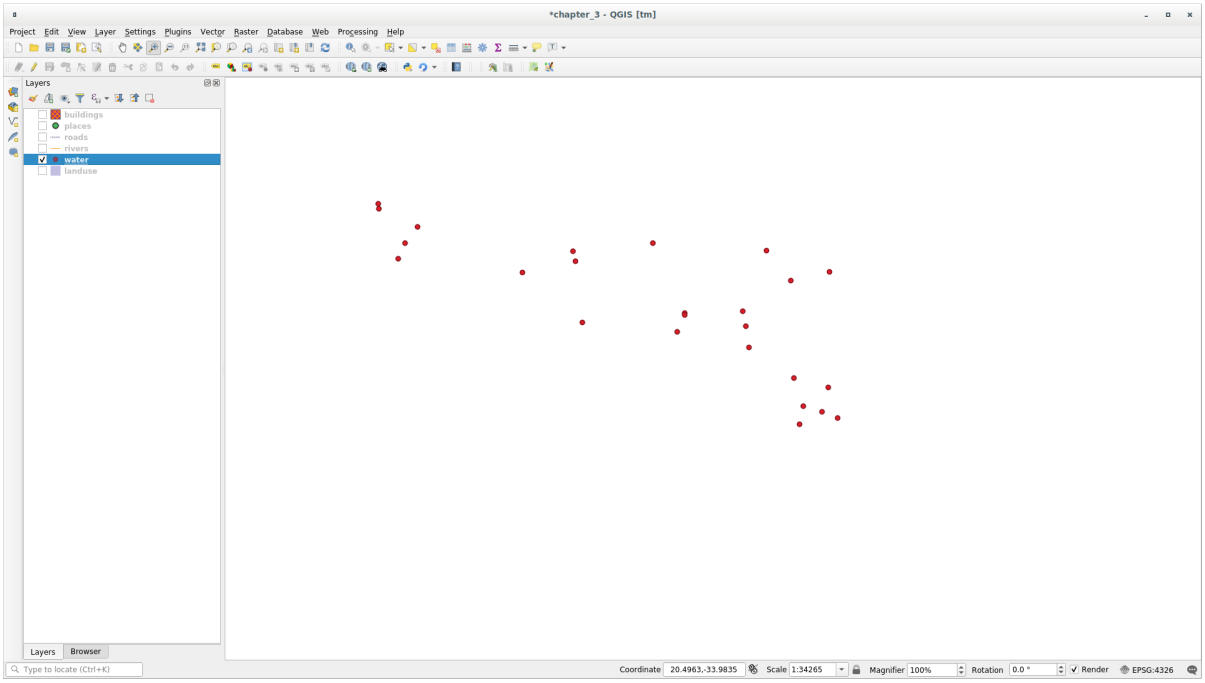
3. Before to start writing the spatial query we have to choose the Geometry Type in output. In this example we are going to create centroids for each feature, so change the Geometry Type to *Point / Multipoint*.

4. Now let's write the query in the query panel:

```
centroid($geometry)
```



5. When you click on *OK* you will see that the `water` layer is rendered as a point layer! We have just run a spatial operation within the layer symbology itself, isn't that amazing?



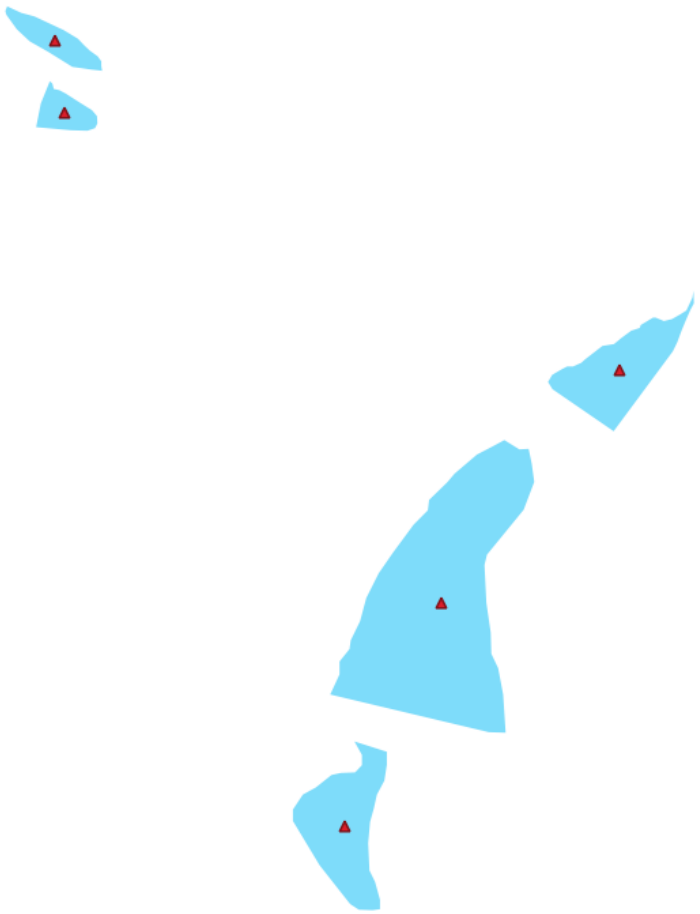
With the Geometry generator symbology you can really go over the edge of *normal* symbology.

??? Încercați și dvs.:

Geometry generator are just another symbol level. Try to add another *Simple fill* underneath the *Geometry generator* one.

Change also the appearance of the Simple marker of the Geometry generator symbology.

The final result should look like this:



Răspuns

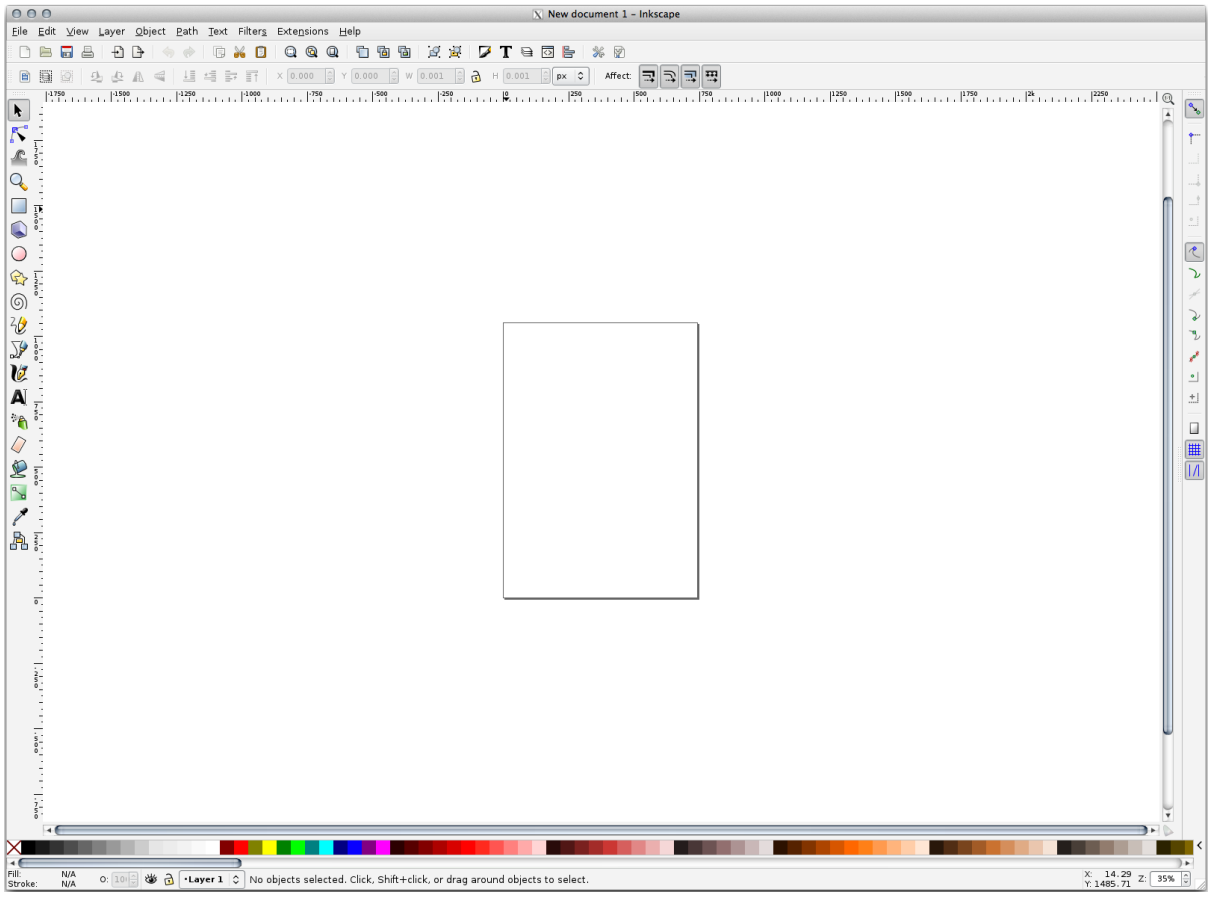
1. Click on the button to add another Symbol level.
2. Move the new symbol at the bottom of the list clicking the button.
3. Choose a good color to fill the water polygons.
4. Click on *Marker* of the Geometry generator symbology and change the circle with another shape as your wish.
5. Try experimenting other options to get more useful results.

2.4.14 ??? Follow Along: Creating a Custom SVG Fill

Notă

To do this exercise, you will need to have the free vector editing software Inkscape installed.

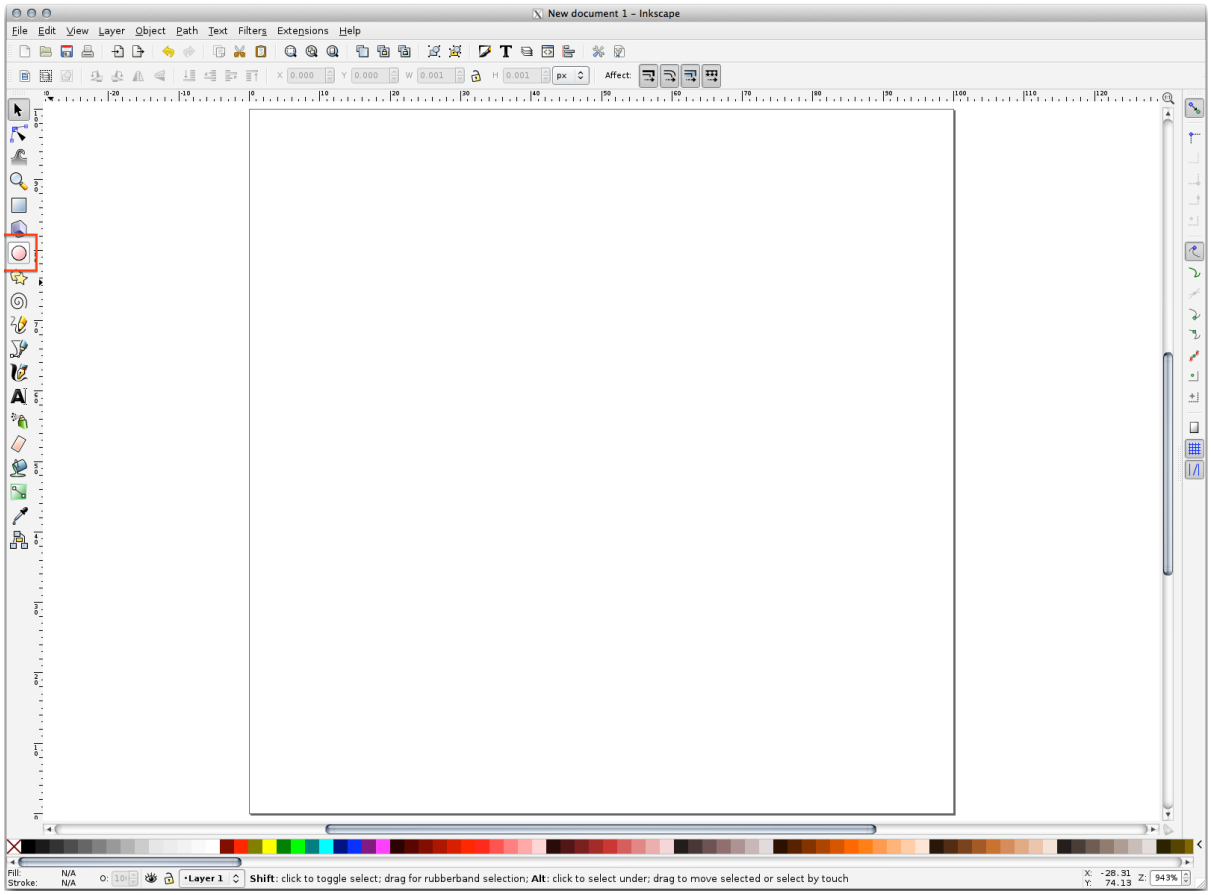
1. Start the Inkscape program. You will see the following interface:



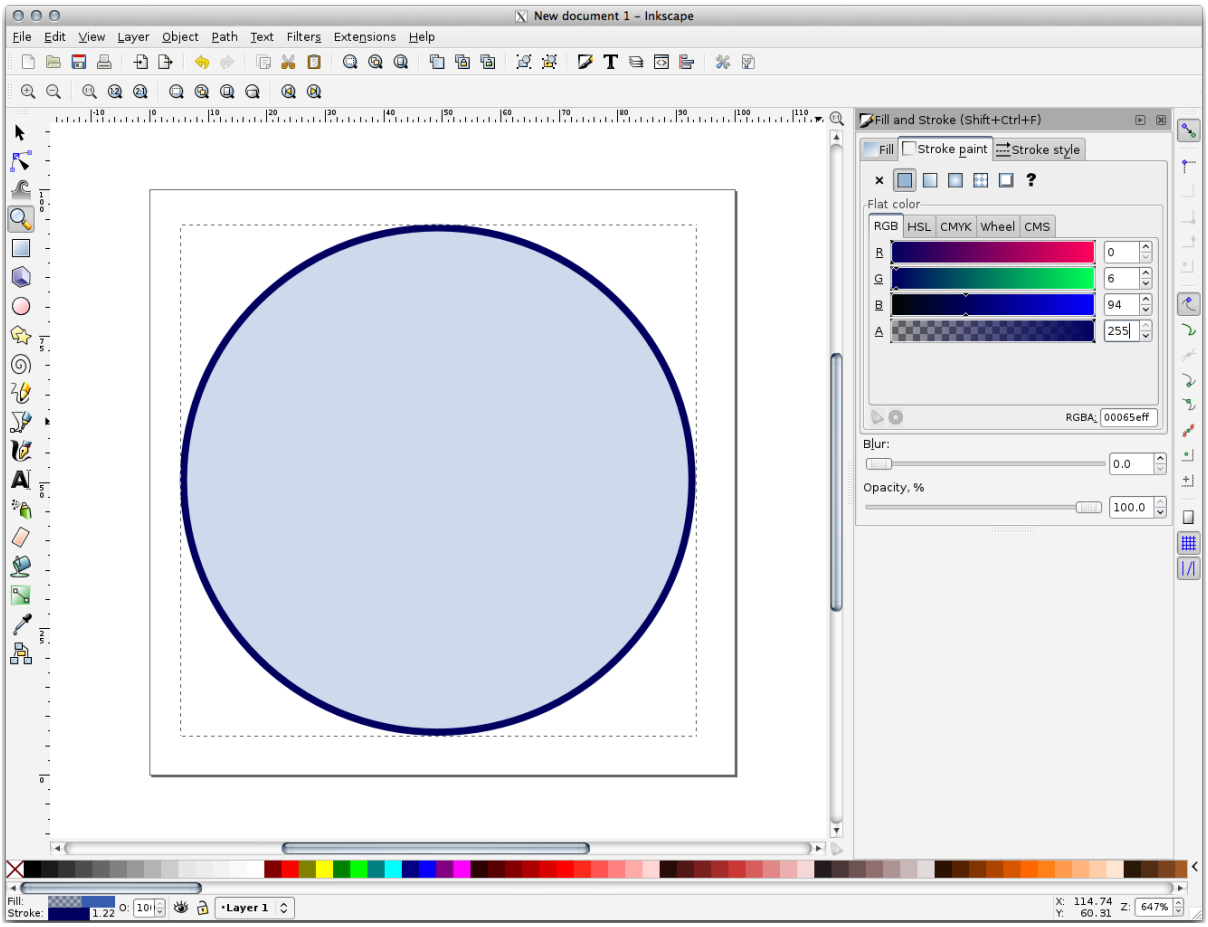
   Ar trebui să vi se pară familiar dacă ați folosit alte programe de editare a imaginilor vectoriale, cum ar fi Corel.

   În primul rând, vom schimba canevasul la o dimensiune adecvată pentru o mică textură.

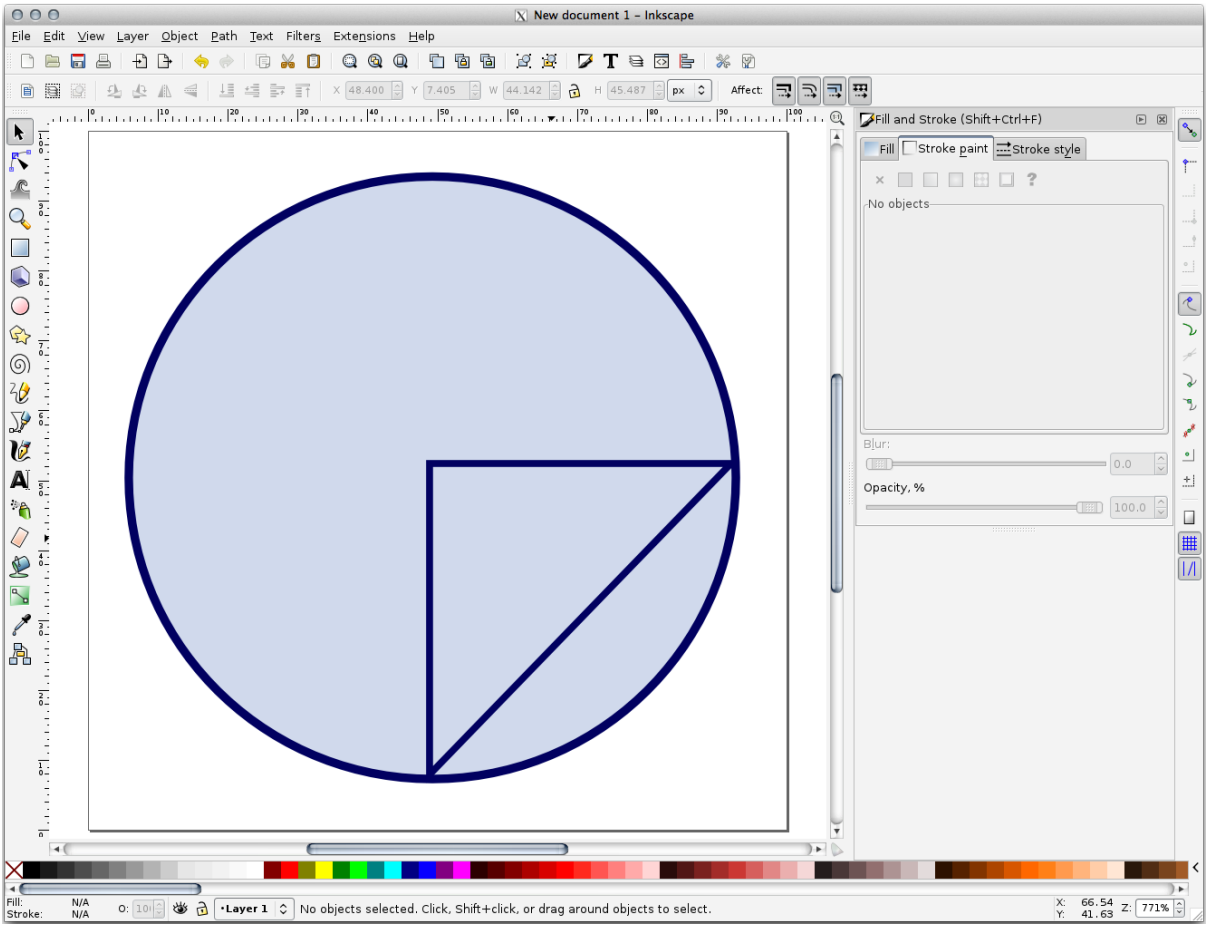
2. Click on the menu item *File* ► *Document Properties*. This will give you the *Document Properties* dialog.
3. Schimbați *Unitățile* în *px*.
4. Change the *Width* and *Height* to `100`.
5. Închideți dialogul, după încheiere.
6. Faceți clic pe elementul de meniu *View* ► *Zoom* ► *Page* pentru a vedea pagina la care lucrați.
7. Selectați instrumentul *Circle*:



8. Mențineți apăsat butonul mouse-ului și trasați pe pagină o elipsă. Pentru a transforma o elipsă într-un cerc, mențineți apăsat și butonul `Ctrl` pe durata desenării.
9. Right-click on the circle you just created and open its *Fill and Stroke* options. You can modify its rendering, such as:
    1. Stabiliți pentru culoarea de *Umplere* o culoare albastru spre gri pal,
    2. Assign to the border a darker color in *Stroke paint* tab,
    3. And reduce the border thickness under *Stroke style* tab.



10. Draw a line using the *Pencil* tool:
    1. Click once to start the line. Hold `Ctrl` to make it snap to increments of 15 degrees.
    2. Deplasați indicatorul pe orizontală și puneți un punct cu un simplu click.
    3. Click and snap to the vertex of the line and trace a vertical line, ended by a simple click.
    4. Now join the two end vertices.
    5. Change the color and width of the triangle symbol to match the circle's stroke and move it around as necessary, so that you end up with a symbol like this one:

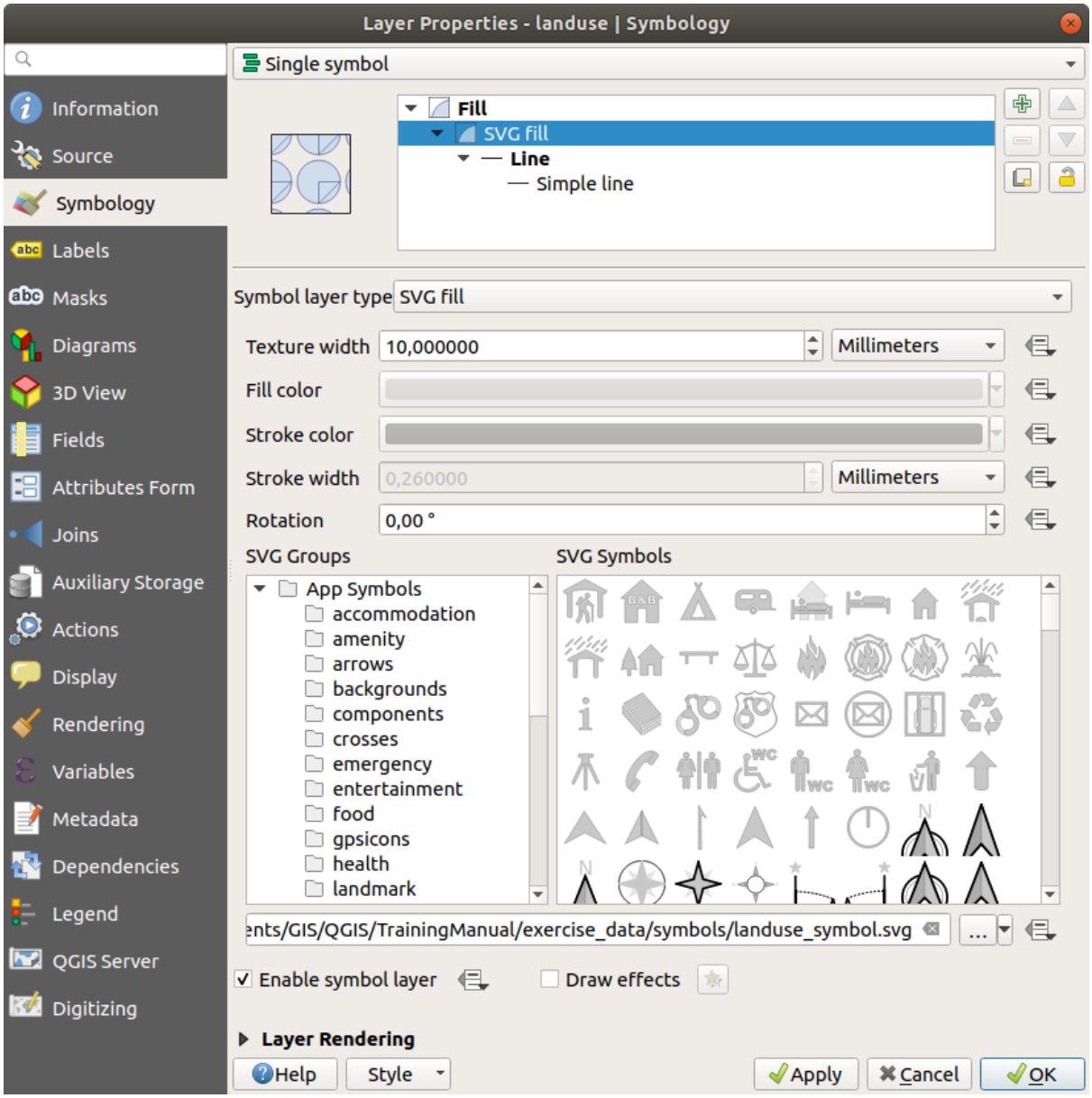


11. If the symbol you get satisfies you, then save it as `landuse_symbol` under the directory that the course is in, under `exercise_data/symbols`, as SVG file.

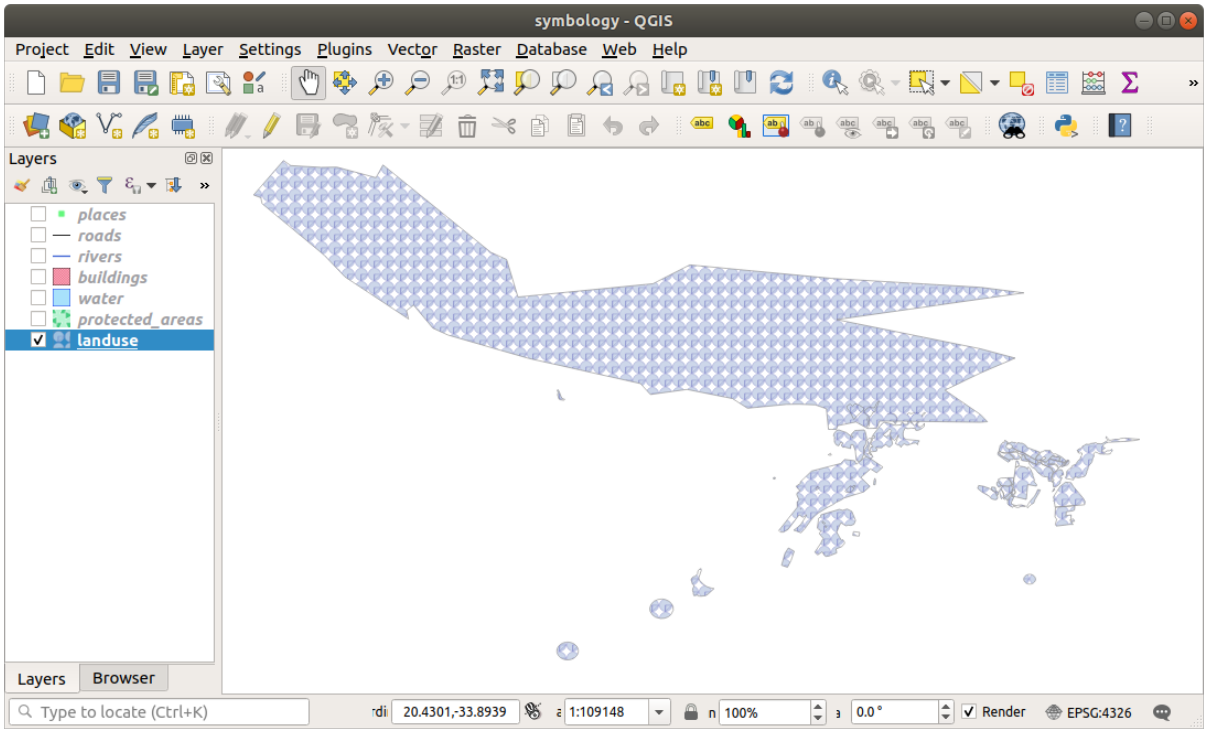
În QGIS:

1. Open the *Layer Properties* for the `landuse` layer.
2. In the  *Symbology* tab, change the symbol structure by changing the *Symbol Layer Type* to *SVG Fill* shown below.
3. Click the … button and then *Select File…* to select your SVG image.

   It's added to the symbol tree and you can now customize its different characteristics (colors, angle, effects, units…).



Once you validate the dialog, features in `landuse` layer should now be covered by a set of symbols, showing a texture like the one on the following map. If textures are not visible, you may need to zoom in the map canvas or set in the layer properties a bigger *Texture width*.



2.4.15 ??? Follow Along: Masking

Masking feature allows you to mask some symbol layer using another symbol layer or label.

In the following exercise, we want to configure rendering so that polygon labels will mask the black part of lines layer.

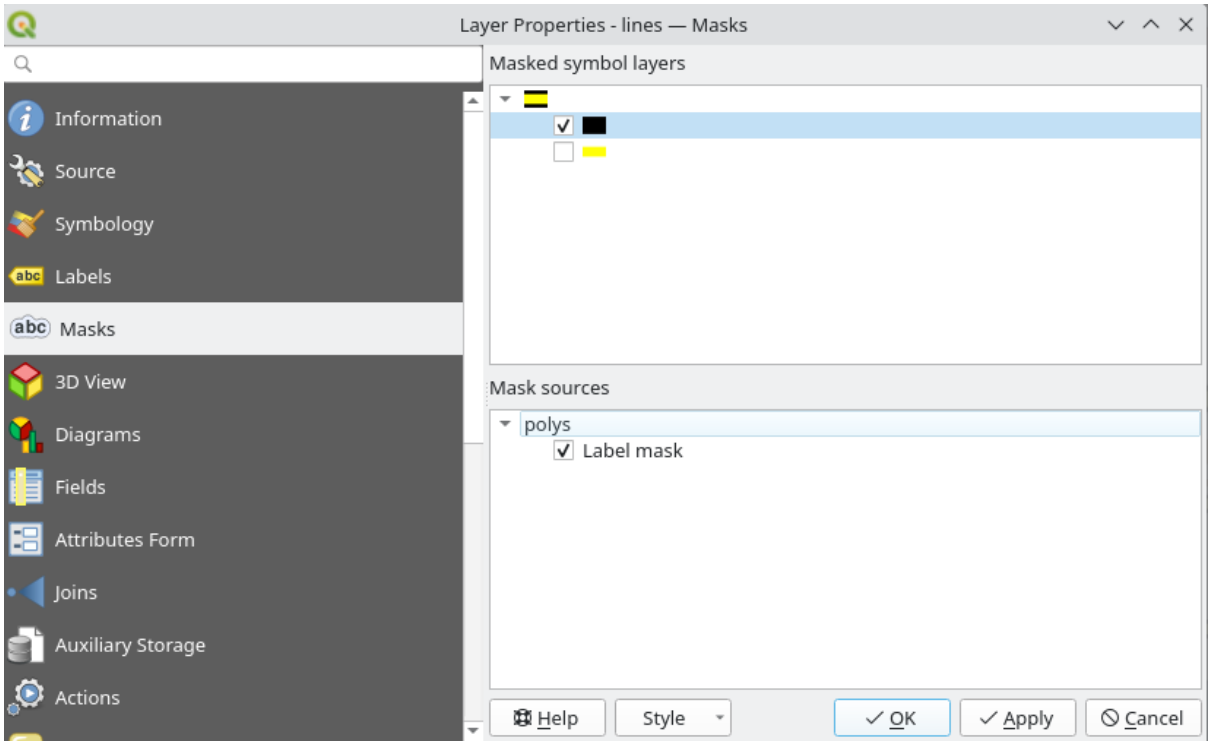
1. Load the `selective_masking.qgs` from dataset in directory `exercise_data/masking`.
2. Open the *Layer Properties* window for the `polys` layer.

   Under the *Labels* tab, you will see that *Single Labels* have already been defined.
3. From the *Labels* tab, select the *Mask* (and not *Masks* in general category list)
4. Enable label mask by checking the *Enable mask* option

   A message tells you that the now defined label mask shape can be later selected as a mask source to mask other symbol layers. Let's do that.
5. Clic pe *OK*
6. Open the *Layer Properties* window for the `lines` layer.
7. Go to the *Masks* tab
8. Click on the black line part of lines checkbox from masked symbol layers

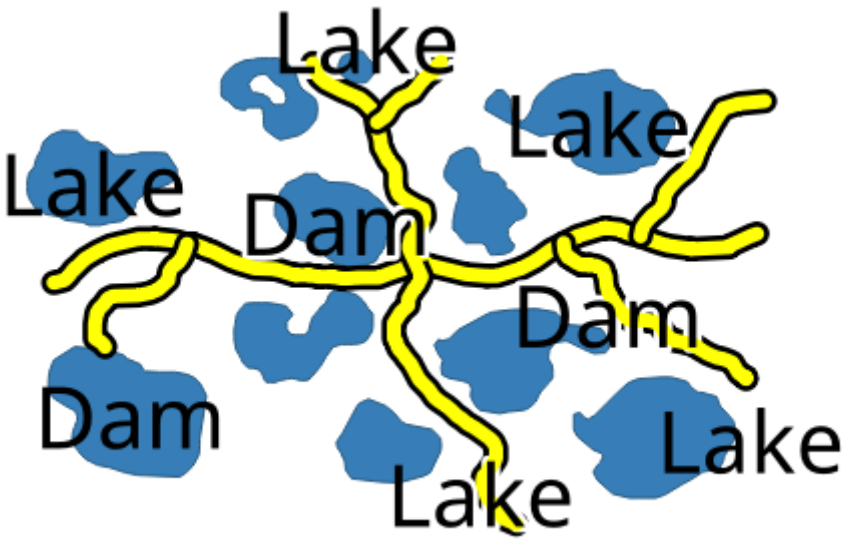
   A message warns you that you have to select both masking and masked symbol layers to be able to save masking configuration. Again, let's do that.
9. Click on `polys` *Label mask* checkbox

   The message disappears, you can now safely save your configuration.



10. Clic pe *OK*

You can see now that labels are masking the black part of lines, leaving only the yellow part.



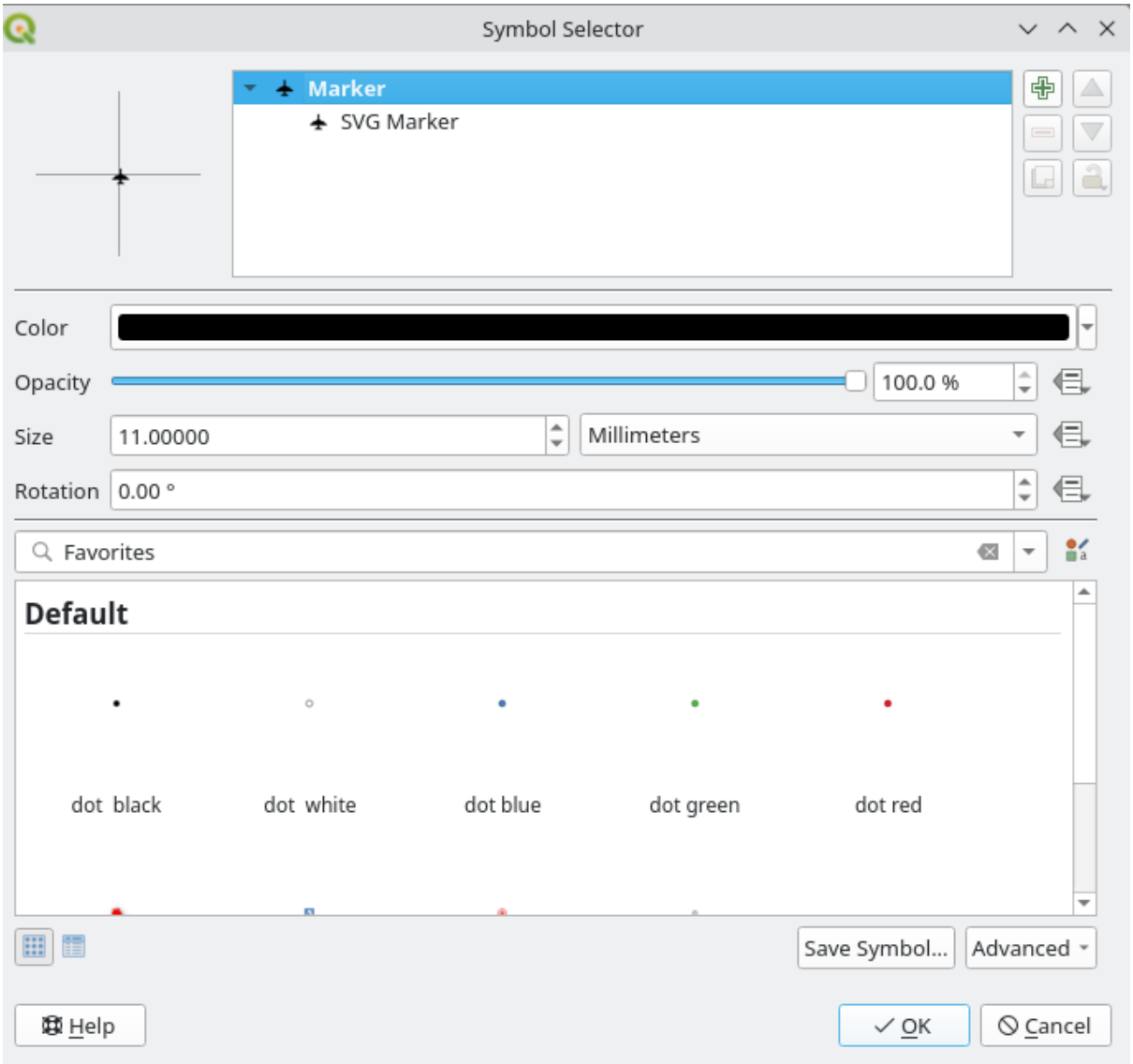
2.4.16 ??? Follow Along: Masking using points symbols

We want now to mask the black part of lines using only black planes that represent the `points` layer (i.e. `B52` and `Jet` points categories). For the sake of visibility, you can switch off `polys` layer visibility.

1. Open the *Layer Properties* window for the `points` layer.

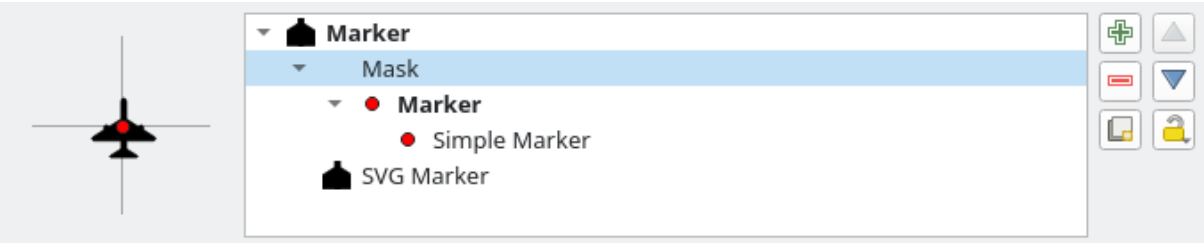
   Under the *Symbology* tab, you will see that a *Categorized* renderer has been defined with 3 different symbols depending on the `Class` field value.

2. Double click on `B52` plane icon, within the *Symbol* column



3. Click the Add symbol layer button and select the `Mask` *Symbol layer type*

   A new hierarchy `Mask` (*symbol layer*) > `Marker` (*symbol*) > `Simple Marker` (*symbol layer*) appear below the root symbol `Marker`.

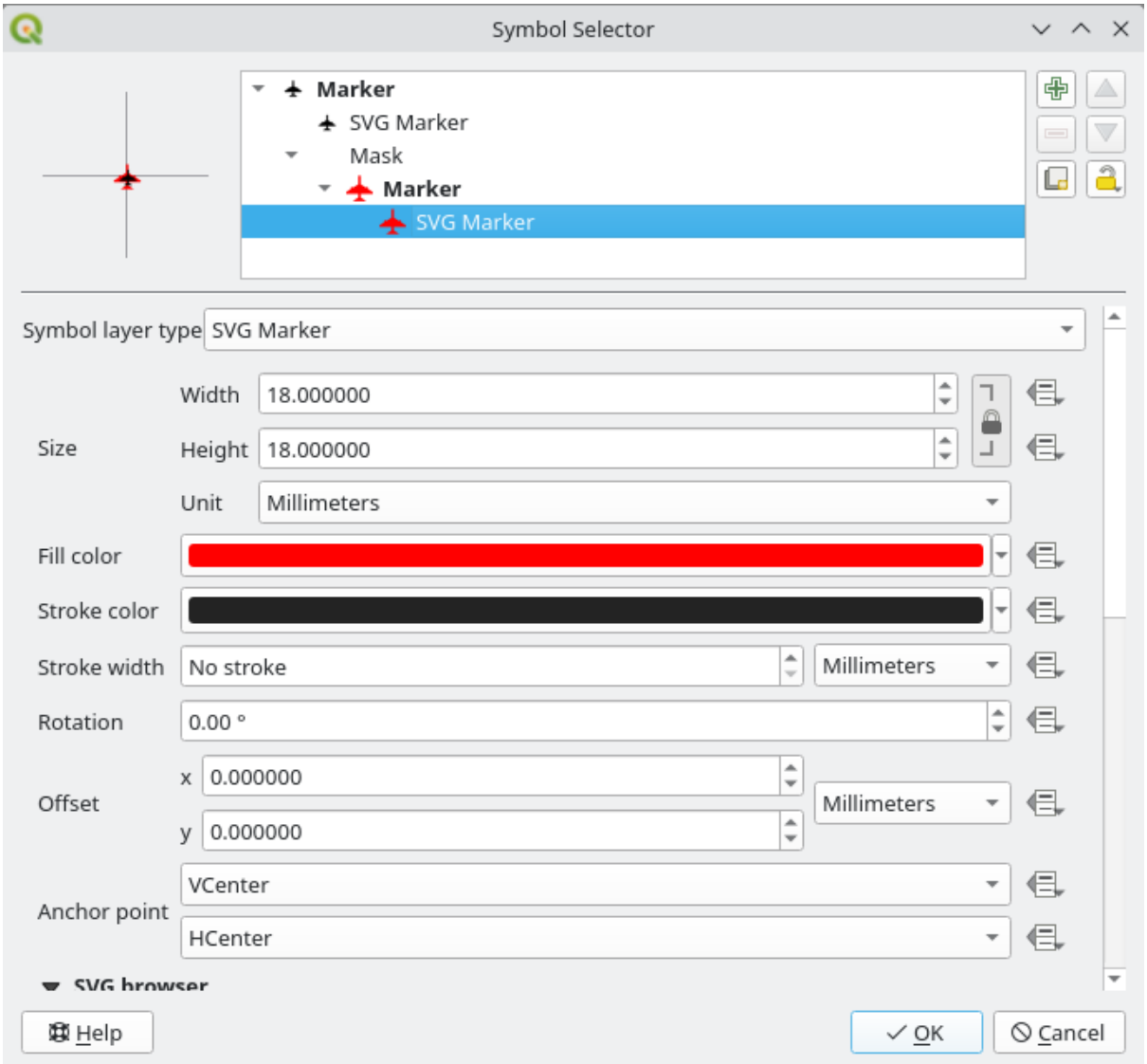


Now, let's define a mask that is identical to our plane marker but a little bit bigger.

4. Select the newly created `Simple Marker` symbol layer and change its *Symbol layer type* to `SVG marker`
5. Set the SVG file path to be the same as the already existing SVG marker, and the size to be bigger (24 millimeters is a pretty good choice for this use case).

   Mask color doesn't matter here, only the shape is used in masking. Symbol layer order is also irrelevant in that situation.

   You should get something like that:

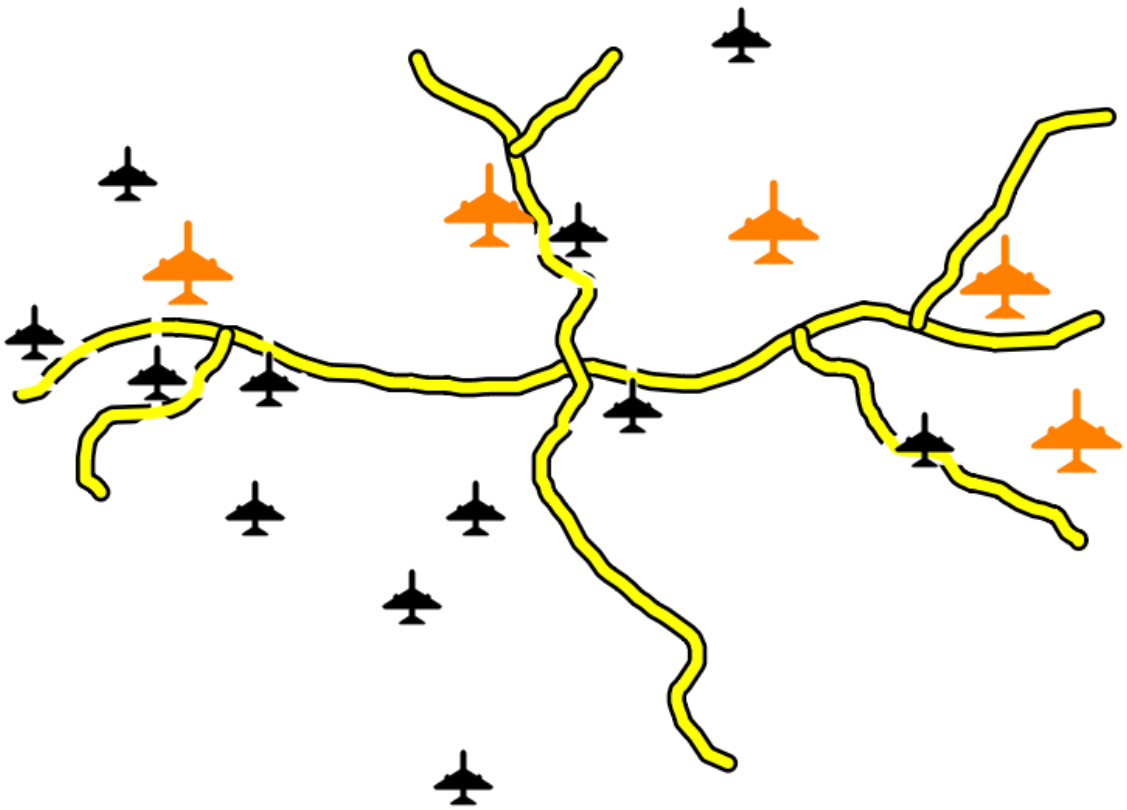


6. Repeat the same operations on `Jet` symbol.
7. Clic pe *OK*

8. Open the *Layer Properties* window for the `lines` layer.
9. Go to the *Masks* tab.

   The black line part of lines checkbox from masked symbol layers is already checked from our previous configuration.
10. Uncheck the *Label mask* `polys` checkbox and check both `B52` and `Jet` *Mask symbol layer*
11. Clic pe *OK*

You now see that black planes are masking the black part of lines, with only the yellow part visible.



2.4.17 În concluzie

Changing the symbology for the different layers has transformed a collection of vector files into a legible map. Not only can you see what's happening, it's even nice to look at!

2.4.18 Further Reading

Exemple de Hărți Aspectuoase

2.4.19 Ce urmează?

Changing symbols for whole layers is useful, but the information contained within each layer is not yet available to someone reading these maps. What are the streets called? Which administrative regions do certain areas belong to? What are the relative surface areas of the farms? All of this information is still hidden. The next lesson will explain how to represent this data on your map.

Notă

V-ați amintit recent să efectuați o salvare a hărții?

CAPITOLUL 3

Module: Classifying Vector Data

Clasificarea datelor vectoriale vă permite să atribuiți diferite simboluri entităților (diverse obiecte din același strat), în funcție de atributele lor. Acest lucru permite celui care folosește harta, să vadă cu ușurință atributele feluritelor entități.

3.1 Lesson: Vector Attribute Data

Datele vectoriale sunt, fără îndoială, cel mai comun tip de date utilizate zilnic în GIS. Modelul vectorial reprezintă locația și forma entităților geografice cu ajutorul punctelor, liniilor și poligoanelor (iar pentru datele 3D, de asemenea, cu ajutorul suprafețelor și volumelor), în timp ce celelalte proprietăți ale acestora sunt incluse ca atribute (deseori prezentate sub formă de tabel în QGIS).

Până în prezent, nici una dintre schimbările pe care le-am adus hărții nu au fost influențate de obiectele afișate. Cu alte cuvinte, toate zonele de utilizare a terenurilor și toate drumurile arată la fel. Atunci când văd o hartă, privitorii nu știu nimic despre drumurile pe care le observă; doar faptul că există un drum de o anumită formă, într-o anumită zonă.

Adevărata putere a GIS-ului constă în faptul că toate obiectele care sunt vizibile pe harta au, la rândul lor, atribute. Hărțile dintr-un GIS nu sunt doar imagini. Ele reprezintă nu numai obiectele din locații, dar, ci și informații despre aceste obiecte.

The goal for this lesson: To learn about the structure of vector data and explore the attribute data of an object

3.1.1 ??? Follow Along: Viewing Layer Attributes

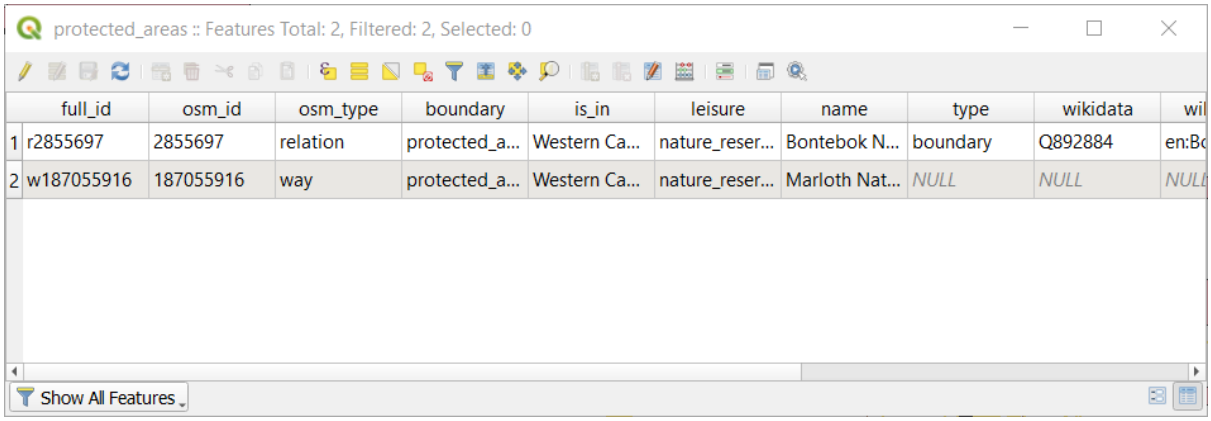
De asemenea, este important de știut că datele cu care lucrați nu reprezintă doar locul „unde” se află obiectele în spațiu, dar vă spun și **ce** sunt acele obiecte.

From the previous exercise, you should have the `protected_areas` layer loaded in your map. If it is not loaded, then you can find the `protected_areas.shp` *ESRI Shapefile* format dataset in directory `exercise_data/shapefile`.

The polygons representing the protected areas constitute the **spatial data**, but we can learn more about the protected areas by exploring the **attribute table**.

1. In the *Layers* panel, click on the `protected_areas` layer to select it.

2. In the *Layer* menu, click the  Open Attribute Table button (also accessible from top toolbars buttons). This will open a new window showing the attribute table of the `protected_areas` layer.



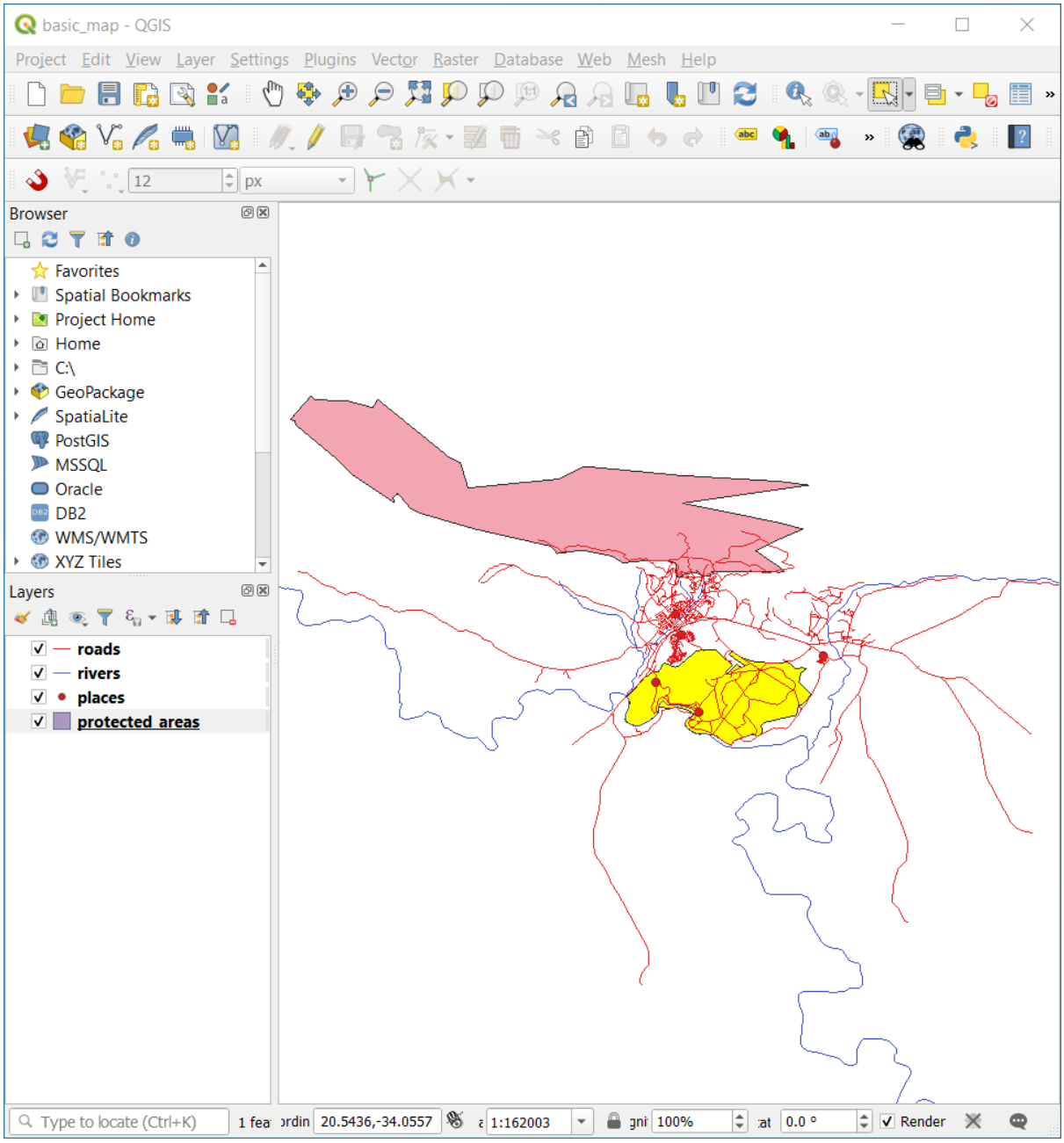
A row is called a **record** and is associated with a **feature** in the Canvas Map, such as a polygon. A column is called a **field** (or an **attribute**), and has a name that helps describe it, such as `name` or `id`. Values in the cells are known as **attribute values**. These definitions are commonly used in GIS, so it is good to become familiar with them.

In the `protected_areas` layer, there are two **features**, which are represented by the two polygons we see on the Map Canvas.

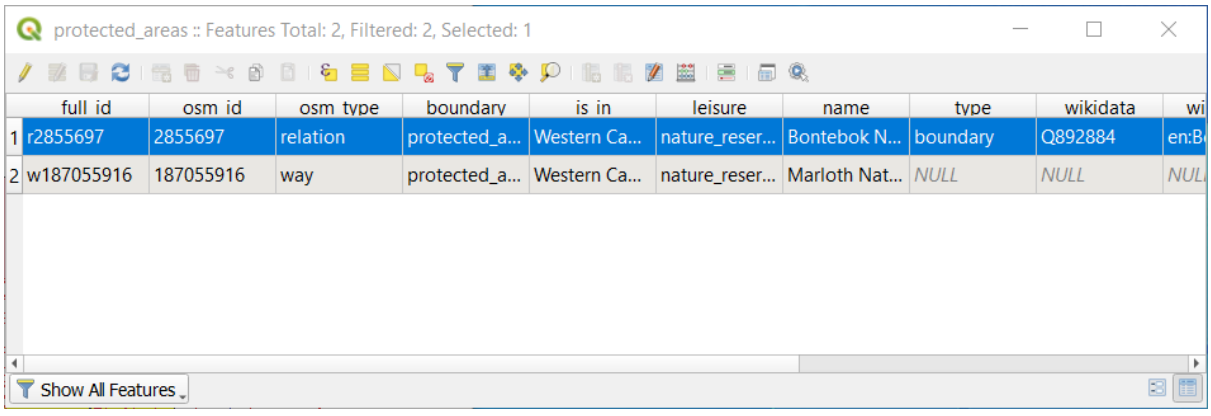
> **Notă**
>
> In order to understand what the **fields** and **attribute values** represent, one may need to find documentation (or metadata) describing the meaning of the attribute values. This is usually available from the creator of the data set.

Next, let's see how a record in the attribute table is linked to a polygon feature that we see on the Map Canvas.

1. Reveniți la fereastra QGIS principală.
2. In the *Edit* ► *Select* menu, click on the  *Select Feature(s)* button.
3. Asigurați-vă că stratul `protected_areas` este încă selectat în panoul *Straturilor*.
4. Move your mouse to the Map Canvas and left click on the smaller of the two polygons. The polygon will turn yellow indicating it is selected.

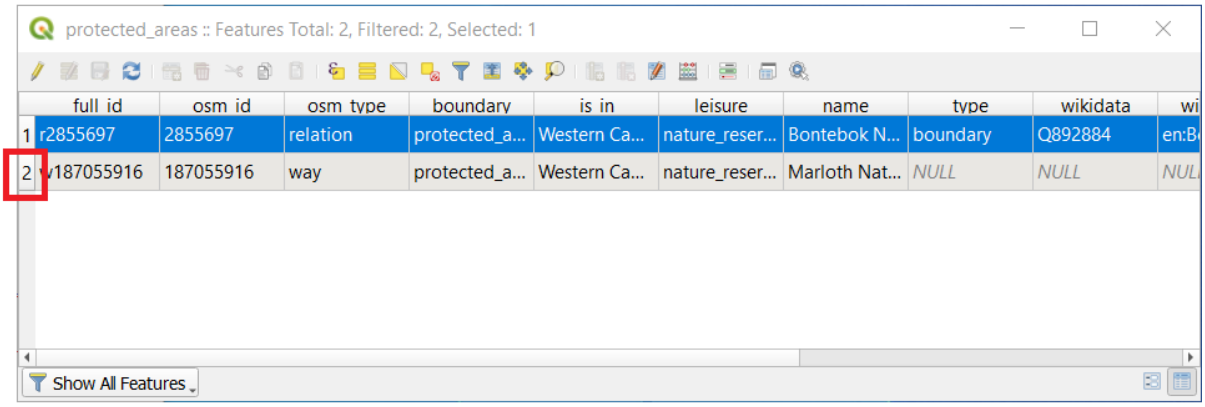


5. Go back to the *Attribute Table* window, and you should see a record (row) highlighted. These are the attribute values of the selected polygon.



De asemenea, puteți selecta o entitate folosind Tabela de Atribute.

1. In the *Attribute Table* window, on the far left, click on the row number of the record that is currently not selected.



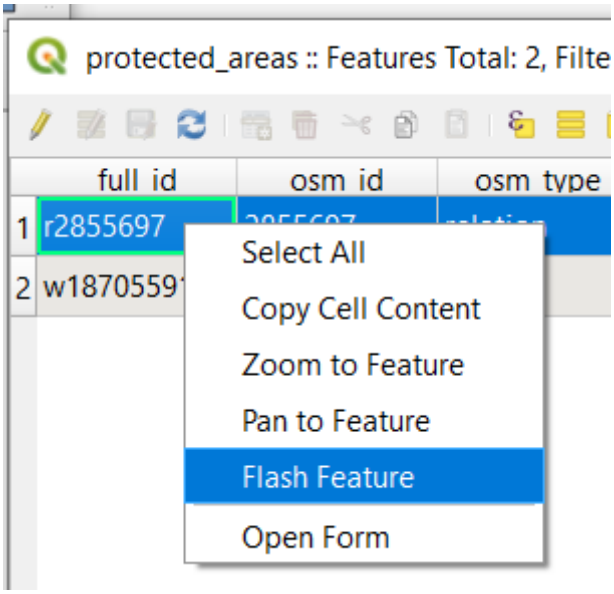
2. Go back to the main QGIS window and look at the Map Canvas. You should see the larger of the two polygons colored yellow.

3. To deselect the feature, go to the *Attribute Table* window and click on  Deselect all features from the layer button.

Sometimes there are many features shown on the Map Canvas and it might be difficult to see which feature is selected from the Attribute Table. Another way to identify the location of a feature is to use the *Flash Feature* tool.

1. In the *Attribute Table*, right-click on any cell in the row that has the attribute value `r2855697` for the field `full_id`.

2. In the context menu, click on *Flash Feature* and watch the Map Canvas.

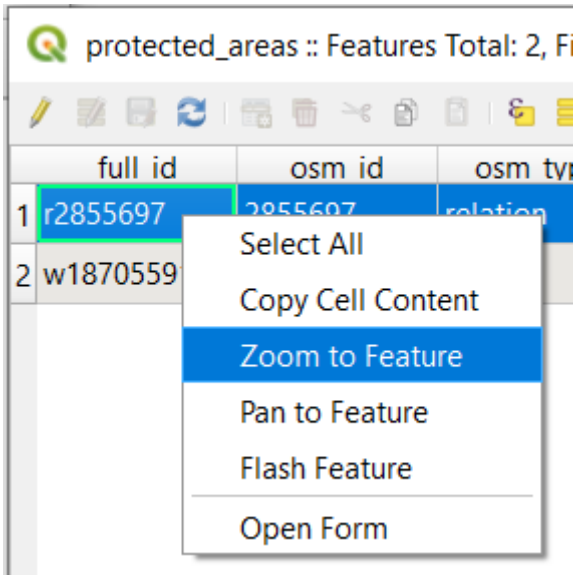


You should see the polygon flash red a few times. If you missed it, try it again.

Another useful tool is the *Zoom to Feature* tool, that tells QGIS to zoom to the feature of interest.

1. In the *Attribute Table*, right-click on any cell in the row that has the attribute value `r2855697` for the field `full_id`.

2. In the context menu, click on *Zoom to Feature*



Look at the Map Canvas. The polygon should now occupy the extent of the Map Canvas area.

Acum, puteți închide tabelul de atribute.

3.1.2 ??? Try Yourself: Exploring Vector Data Attributes

1. How many fields are available in the `rivers` layer?
2. Tell us a bit about the `town` places in your dataset.
3. Open the attribute table for the `places` layer. Which field would be the most useful to represent in label form, and why?

Răspuns

- There should be 9 fields in the `rivers` layer:
  1. Select the layer in the *Layers* panel.
  2. Right-click and choose *Open Attribute Table*, or press the button on the *Attributes Toolbar* (it can be enabled from *View* ► *Toolbars* menu).
  3. Totalizează numărul de coloane.

  A quicker approach could be to double-click the `rivers` layer, open the *Layer properties* ► *Fields* tab, where you will find a numbered list of the table's fields.
- Information about towns is available in the `places` layer. Open its attribute table as you did with the `rivers` layer: there are two features whose *place* attribute is set to `town`: *Swellendam* and *Buffeljagsrivier*. You can add comment on other fields from these two records, if you like.
- The `name` field is the most useful to show as labels. This is because all its values are unique for every object and are very unlikely to contain *NULL* values. If your data contains some *NULL* values, do not worry as long as most of your places have names.

3.1.3 În concluzie

Acum știți cum să folosiți tabelul de atribute pentru a vedea ceea ce se află, de fapt, în datele pe care îl utilizați. Orice set de date va fi util pentru dvs. numai dacă are atributele care vă interesează. Dacă știți de care atribute aveți nevoie, puteți decide rapid dacă puteți utiliza un anumit set de date, sau dacă trebuie să căutați un altul care are datele cerute.

3.1.4 Ce urmează?

Diferite atribute sunt utile pentru diferite scopuri. Unele dintre ele pot fi reprezentate direct sub formă de text, pentru ca utilizatorul sa le poată vedea. Veți afla cum să faceți acest lucru în lecția următoare.

3.2 Lesson: Labels

Etichetele pot fi adăugate pe o hartă, pentru a afișa informații despre un obiect. Orice strat vectorial poate avea etichete asociate cu el. Conținutul acestor etichete se bazează pe datele atributului unui strat.

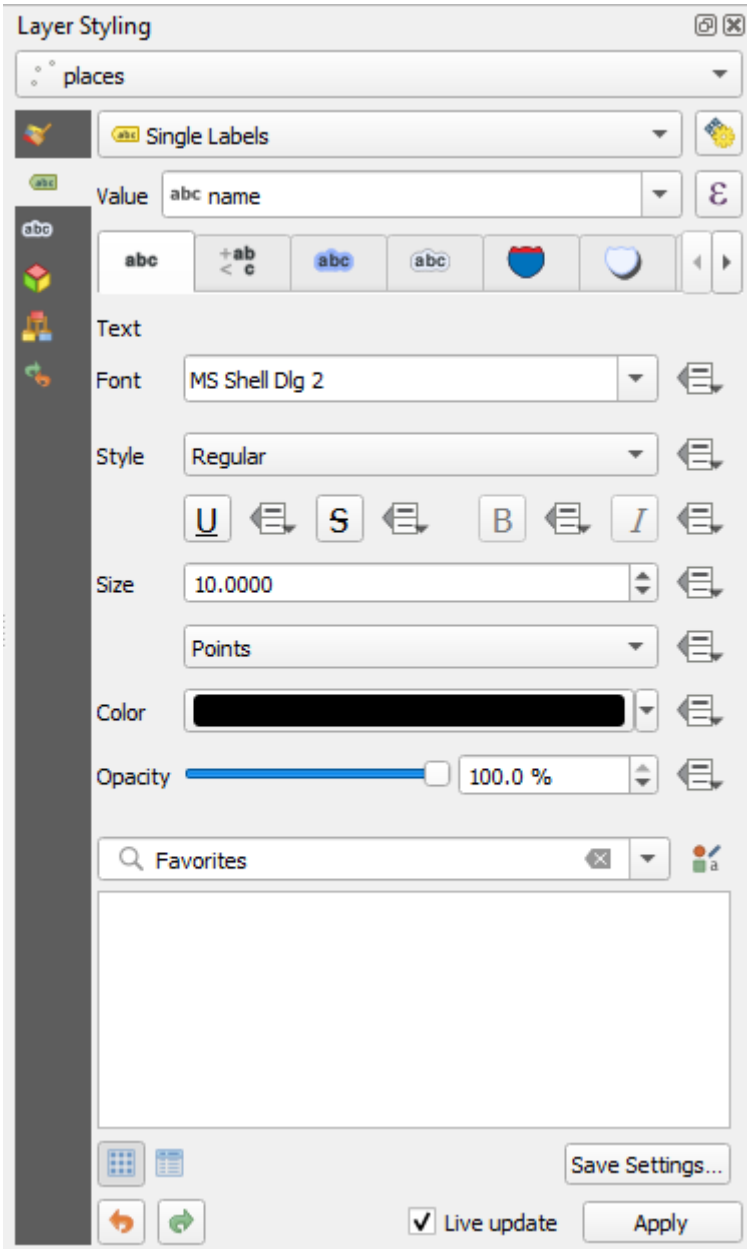
Scopul acestei lecții: De a aplica etichete folositoare și plăcute unui strat.

3.2.1 ??? Follow Along: Using Labels

First, ensure that the button is visible in the GUI:

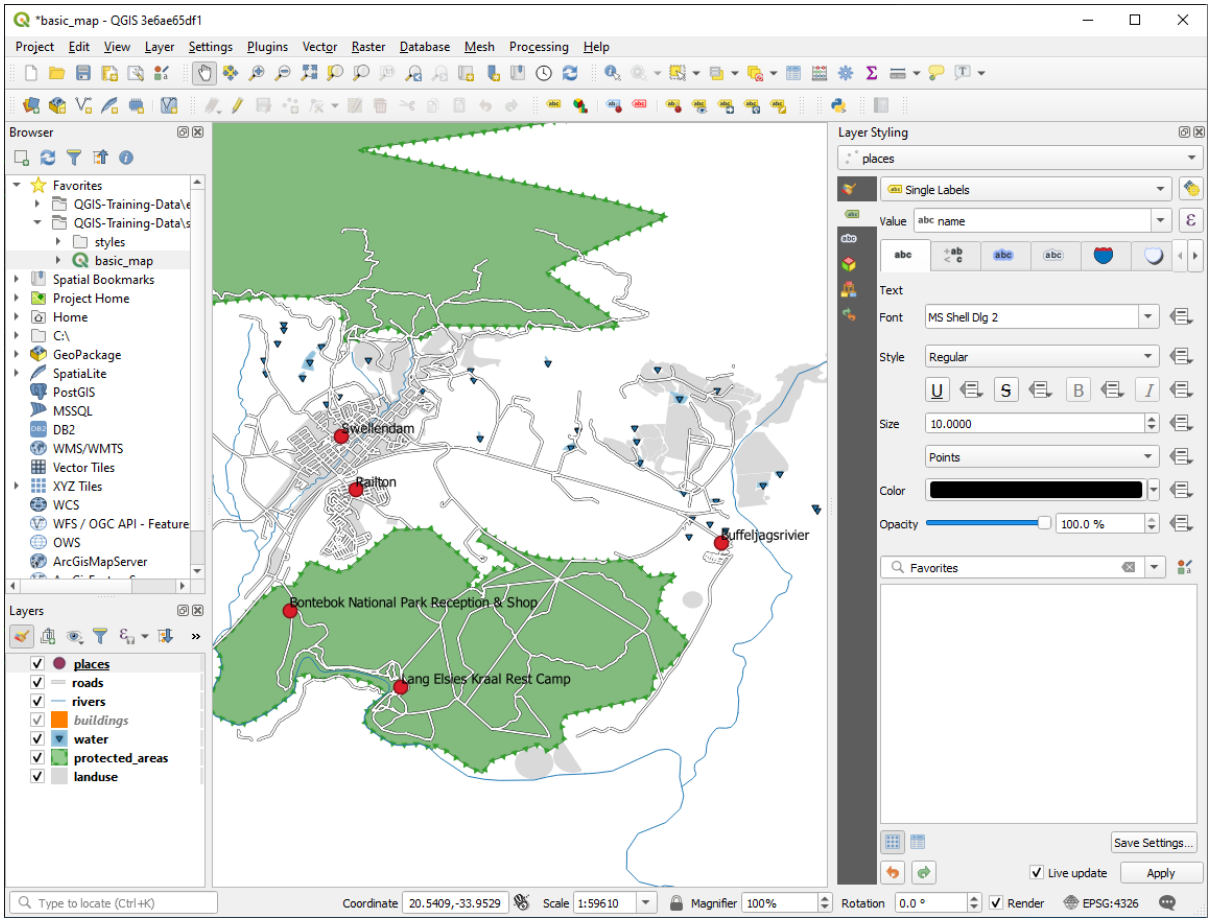
1. Go to the menu item *View* ► *Toolbars*
2. Ensure that the *Label Toolbar* item has a check mark next to it. If it doesn't, click on the *Label Toolbar* item to activate it.
3. Click on the `places` layer in the *Layers* panel so that it is highlighted
4. Click on the toolbar button to open the *Labels* tab of the *Layer Styling* panel
5. Switch from *No Labels* to *Single Labels*

   You'll need to choose which field in the attributes will be used for the labels. In the previous lesson, you decided that the `name` field was the most suitable one for this purpose.
6. Select `name` from the Value list:



7. Clic pe *Aplicare*.

Etichetele hărții ar trebui să arate astfel:



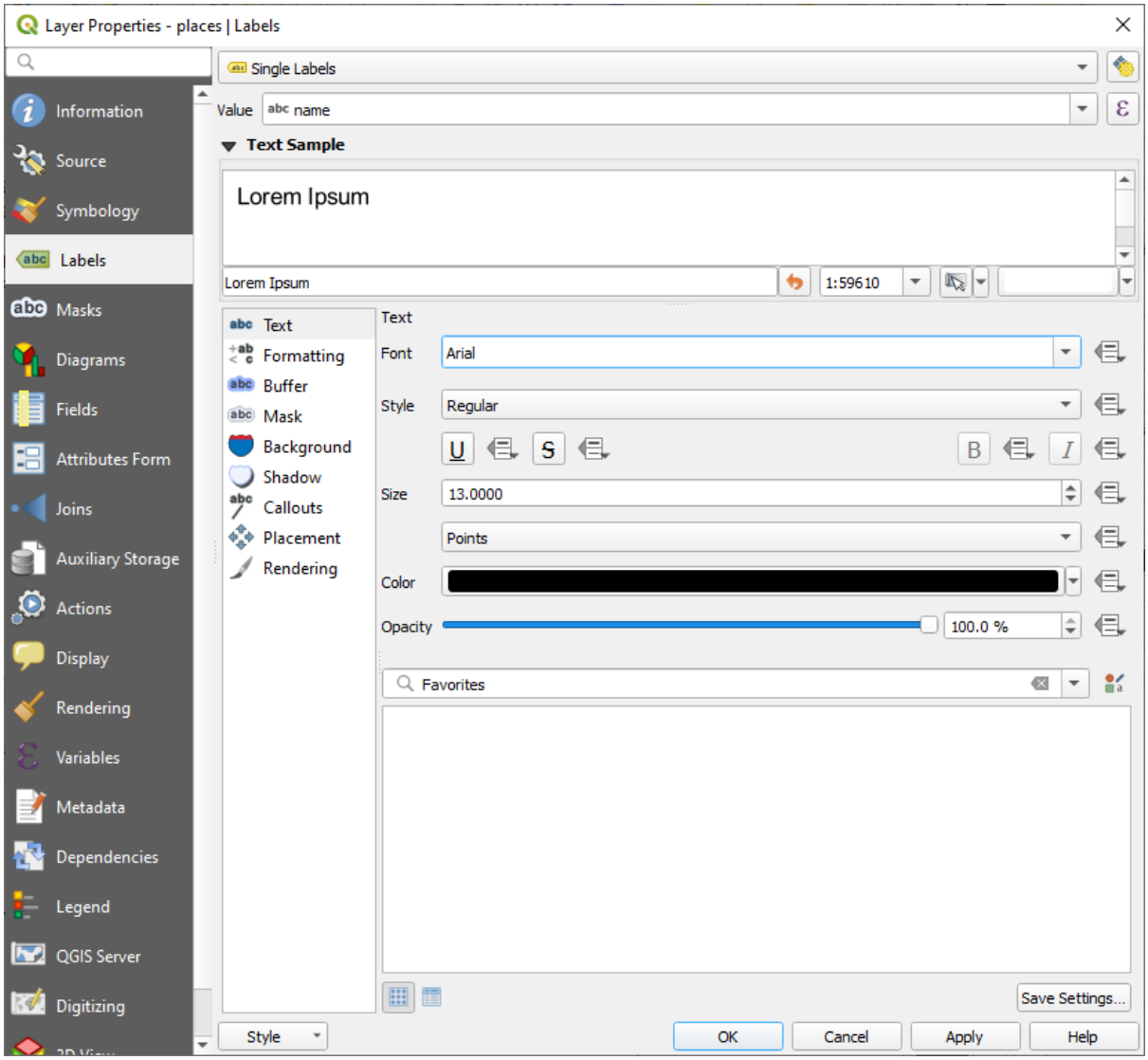
3.2.2 ??? Follow Along: Changing Label Options

Depending on the styles you chose for your map in earlier lessons, you might find that the labels are not appropriately formatted and either overlap or are too far away from their point markers.

Notă

Above, you used the abc button in the *Label Toolbar* to open the *Layer Styling* panel. As with *Symbology*, the same label options are available via both the *Layer Styling* panel and the *Layer Properties* dialog. Here, you'll use the *Layer Properties* dialog.

1. Open the *Layer Properties* dialog by double-clicking on the `places` layer
2. Select the abc *Labels* tab
3. Make sure *Text* is selected in the left-hand options list, then update the text formatting options to match those shown here:

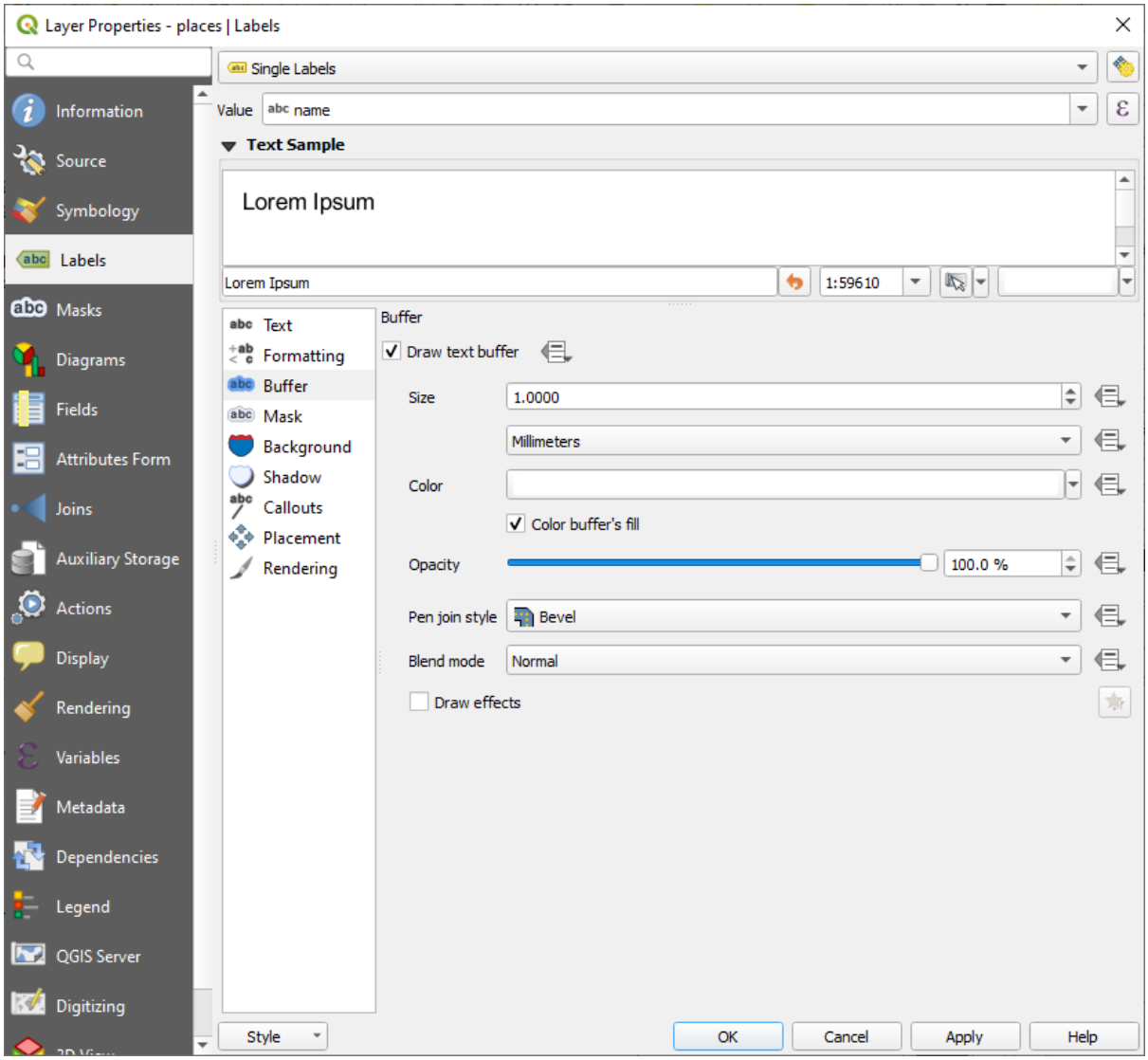


4. Clic pe *Aplicare*.

   That font may be larger and more familiar to users, but its readability is still dependent on what layers are rendered beneath it. To solve this, let's take a look at the *Buffer* option.

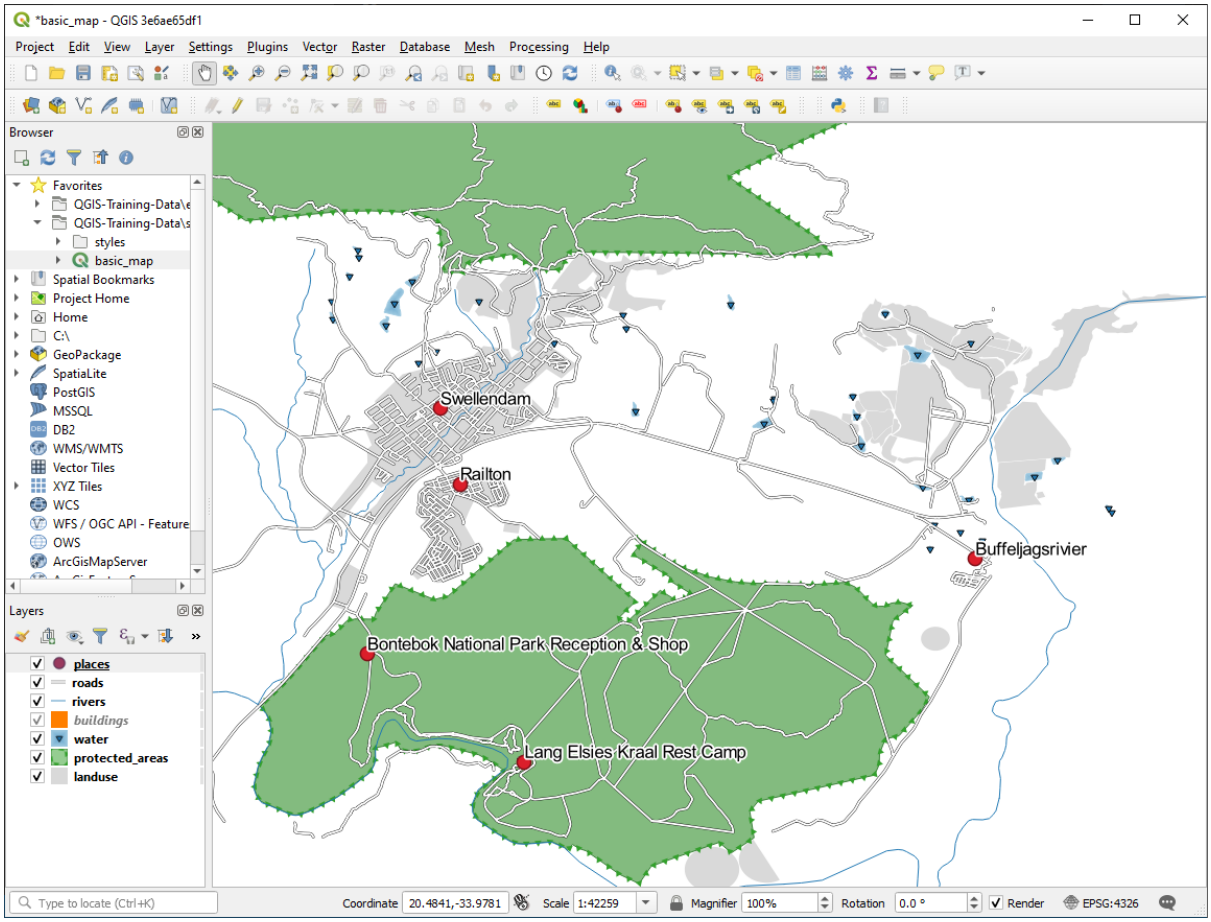
5. Select *Buffer* from the left-hand options list

6. Select the checkbox next to *Draw text buffer*, then choose options to match those shown here:



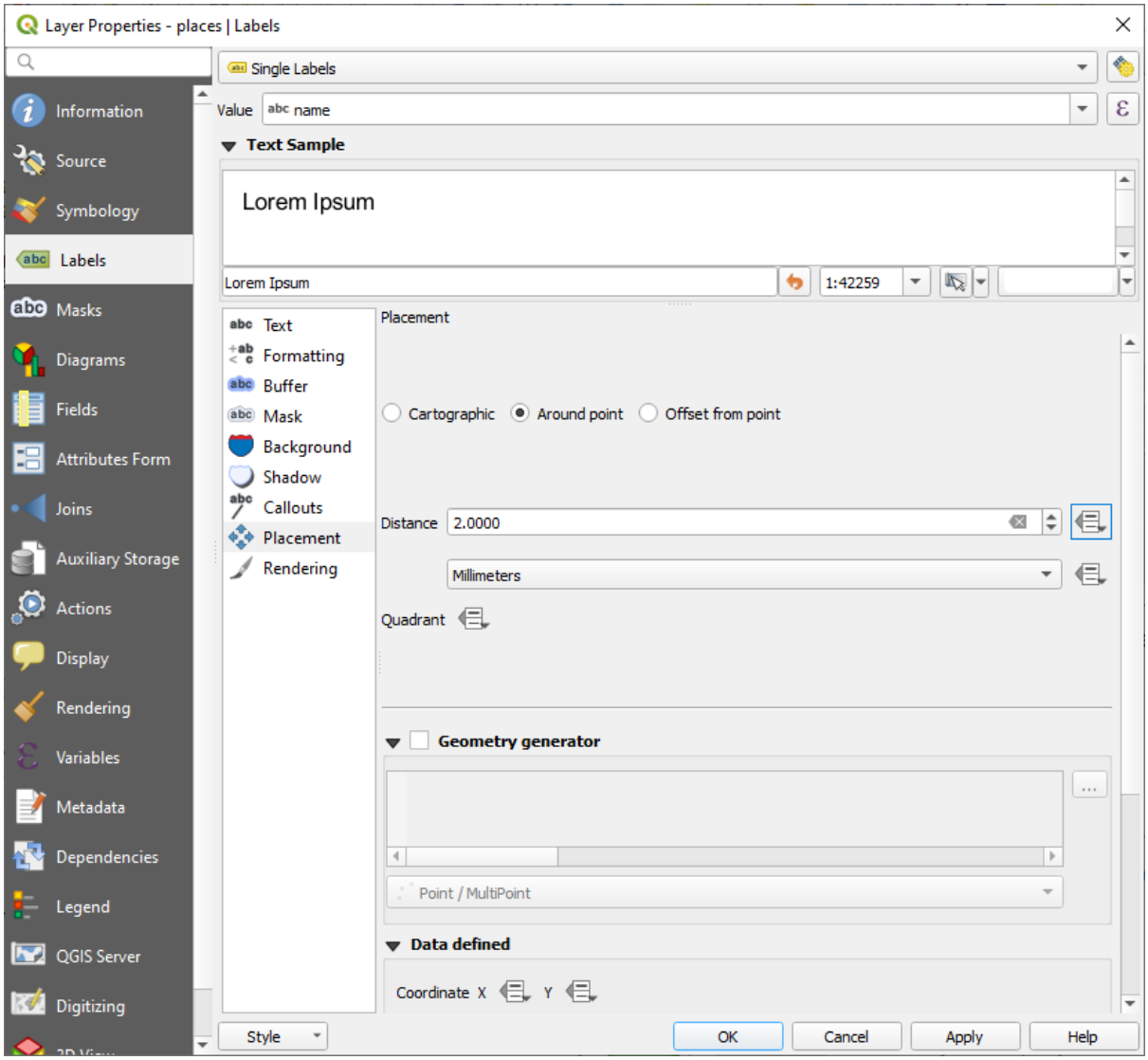
7. Clic pe *Aplicare*.

   You'll see that this adds a colored buffer or border to the place labels, making them easier to pick out on the map:



Now we can address the positioning of the labels in relation to their point markers.

8. Select *Placement* from the left-hand options list
9. Select *Around point* and change the value of *Distance* to `2.0` Millimeters:



10. Clic pe *Aplicare*.

    You'll see that the labels are no longer overlapping their point markers.

3.2.3 ??? Follow Along: Using Labels Instead of Layer Symbology

In many cases, the location of a point doesn't need to be very specific. For example, most of the points in the `places` layer refer to entire towns or suburbs, and the specific point associated with such features is not that specific on a large scale. In fact, giving a point that is too specific is often confusing for someone reading a map.

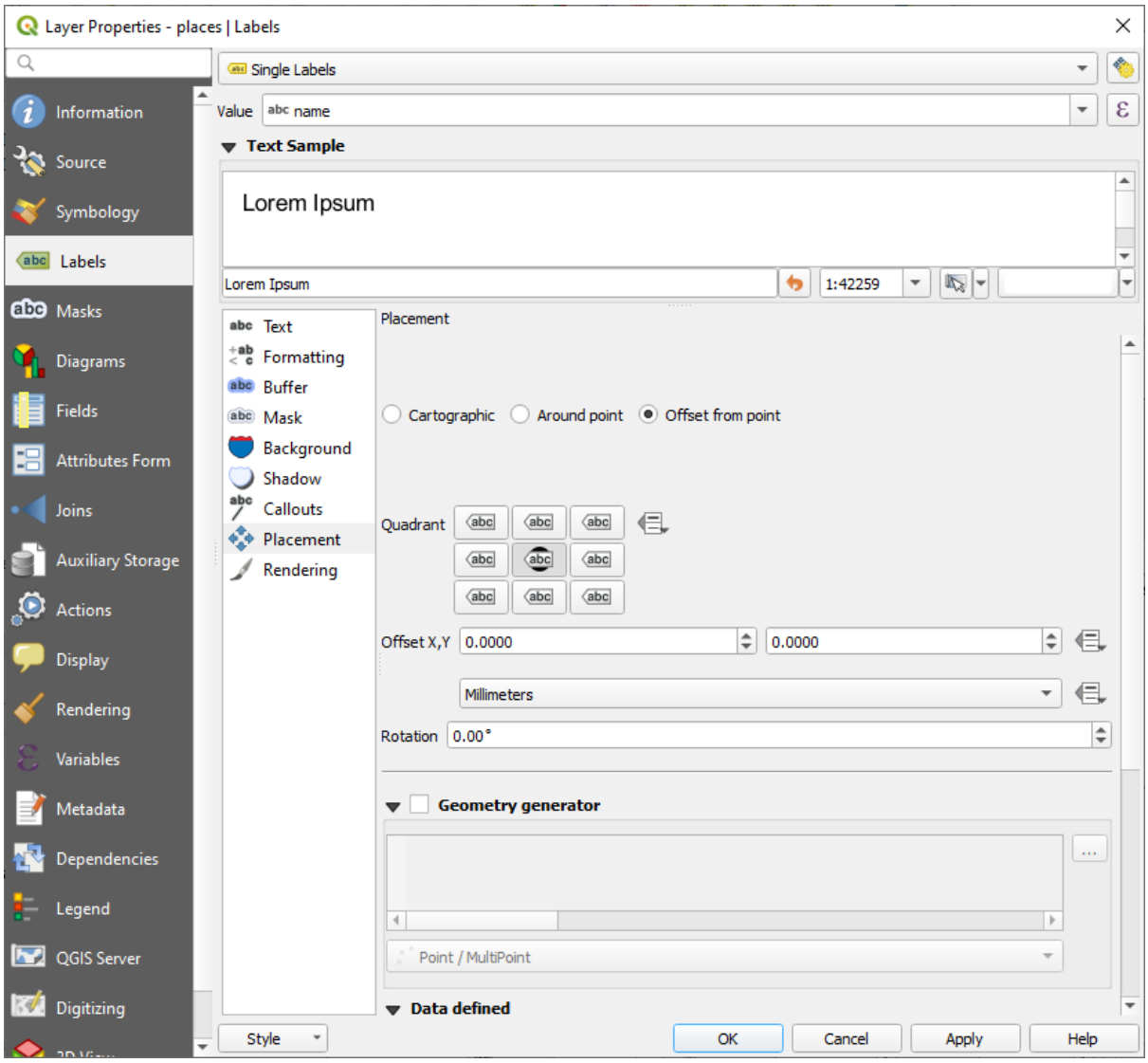
To name an example: on a map of the world, the point given for the European Union may be somewhere in Poland, for instance. To someone reading the map, seeing a point labeled *European Union* in Poland, it may seem that the capital of the European Union is therefore in Poland.

So, to prevent this kind of misunderstanding, it's often useful to deactivate the point symbols and replace them completely with labels.

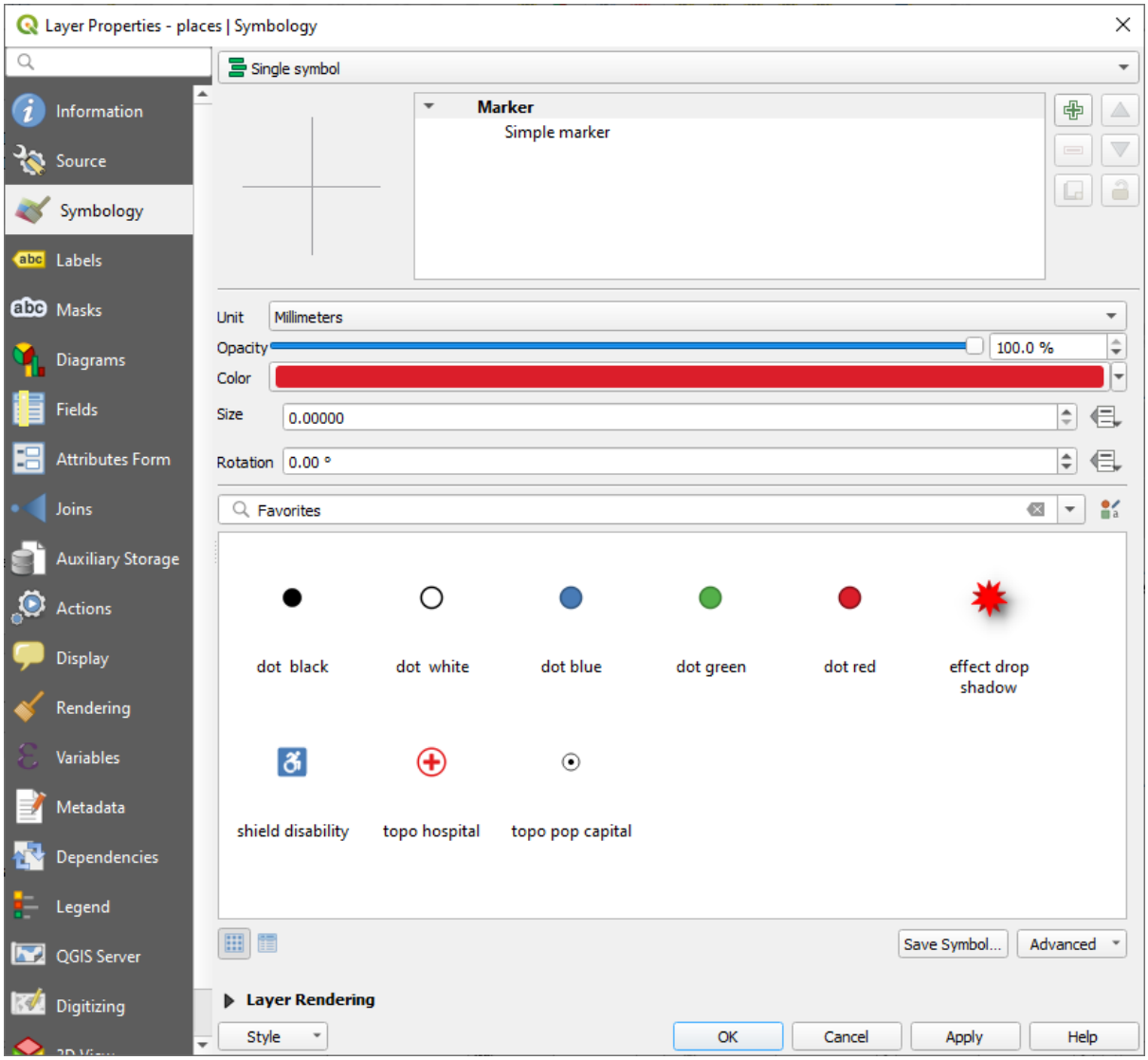
In QGIS, you can do this by changing the position of the labels to be rendered directly over the points they refer to.

1. Open the *Labels* tab of the *Layer Properties* dialog for the `places` layer
2. Select the *Placement* option from the options list
3. Click on the *Offset from point* button

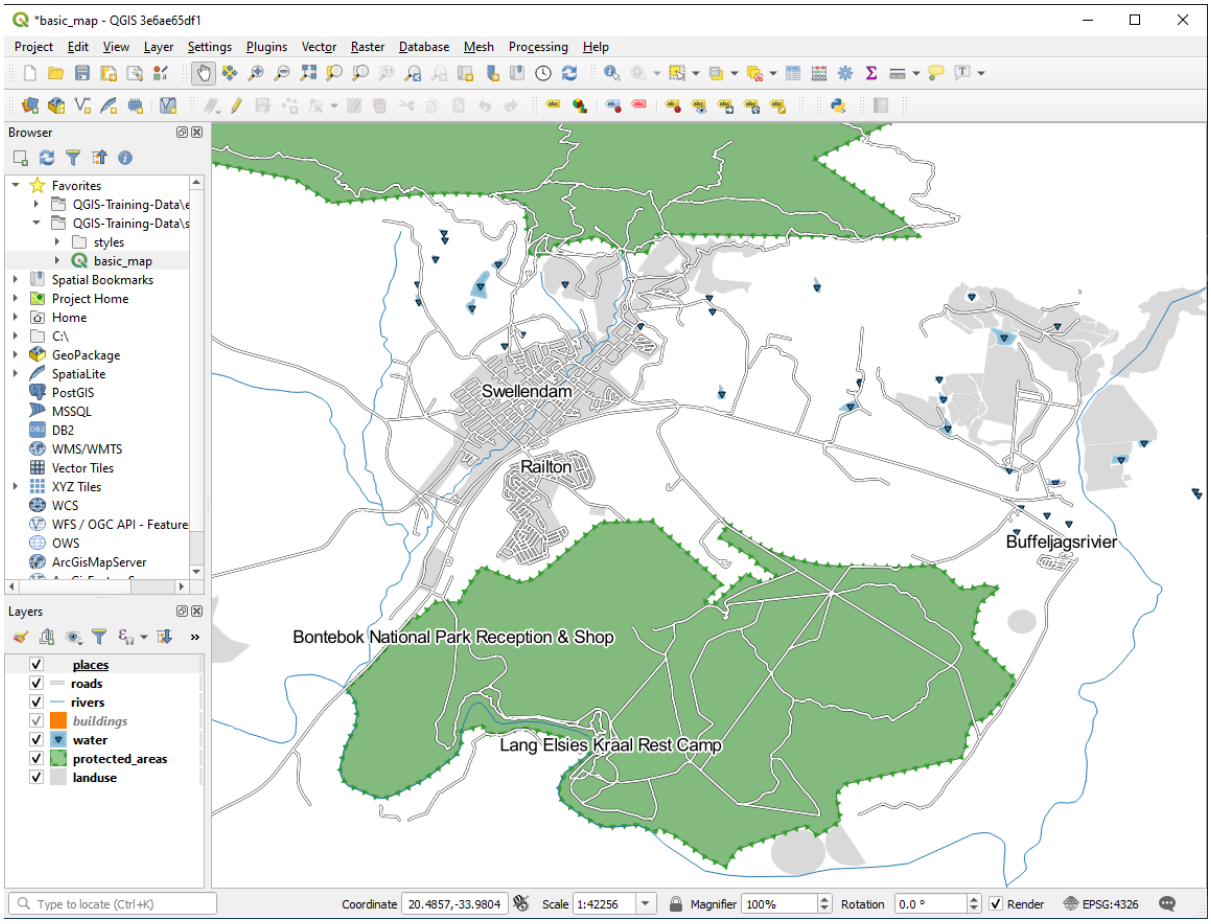
This will reveal the *Quadrant* options which you can use to set the position of the label in relation to the point marker. In this case, we want the label to be centered on the point, so choose the center quadrant:



4. Hide the point symbols by editing the layer *Symbology* as usual, and setting the size of the *Marker* size to `0.0`:



5. Click *Apply* and you'll see this result:



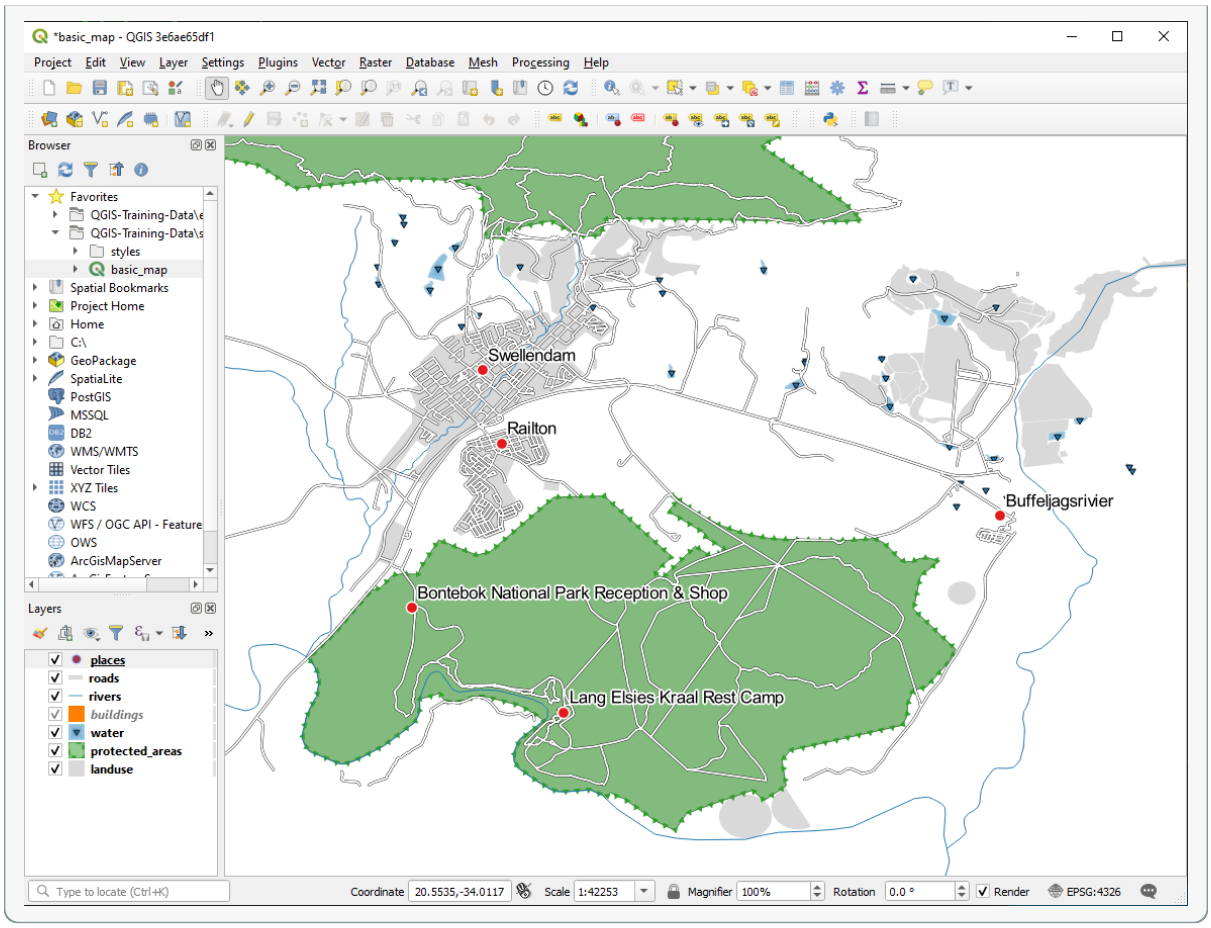
If you were to zoom out on the map, you would see that some of the labels disappear at larger scales to avoid overlapping. Sometimes this is what you want when dealing with datasets that have many points, but at other times you will lose useful information this way. There is another possibility for handling cases like this, which we'll cover in a later exercise in this lesson. For now, zoom out and click on the  button in the toolbar and see what happens.

3.2.4 ??? Try Yourself: Customize the Labels

- Reset the label and symbol settings to have a point marker and a label offset of `2.0` Millimeters.

Răspuns

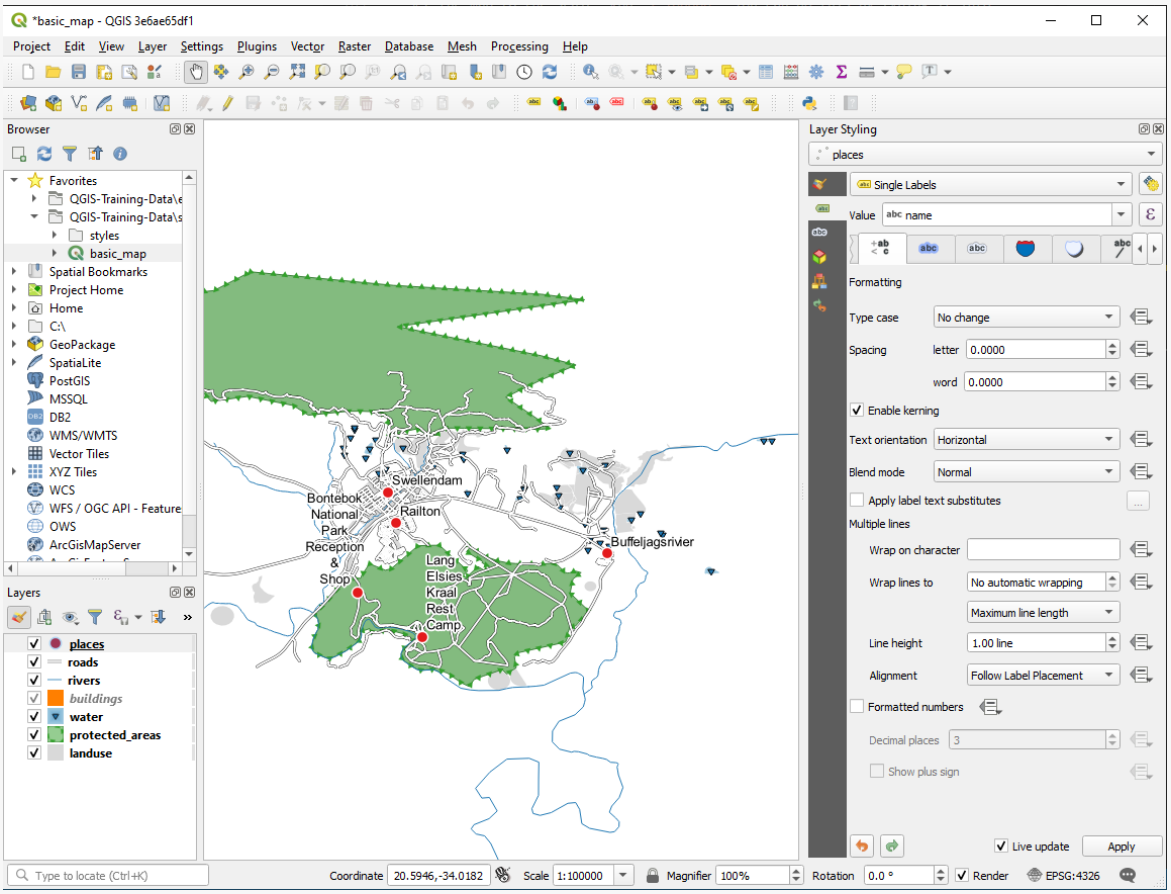
Your map should now show the marker points and the labels should be offset by 2mm. The style of the markers and labels should allow both to be clearly visible on the map:



- Set the map to the scale `1:100000`. You can do this by typing it into the *Scale* box in the *Status Bar*. Modify your labels to be suitable for viewing at this scale.

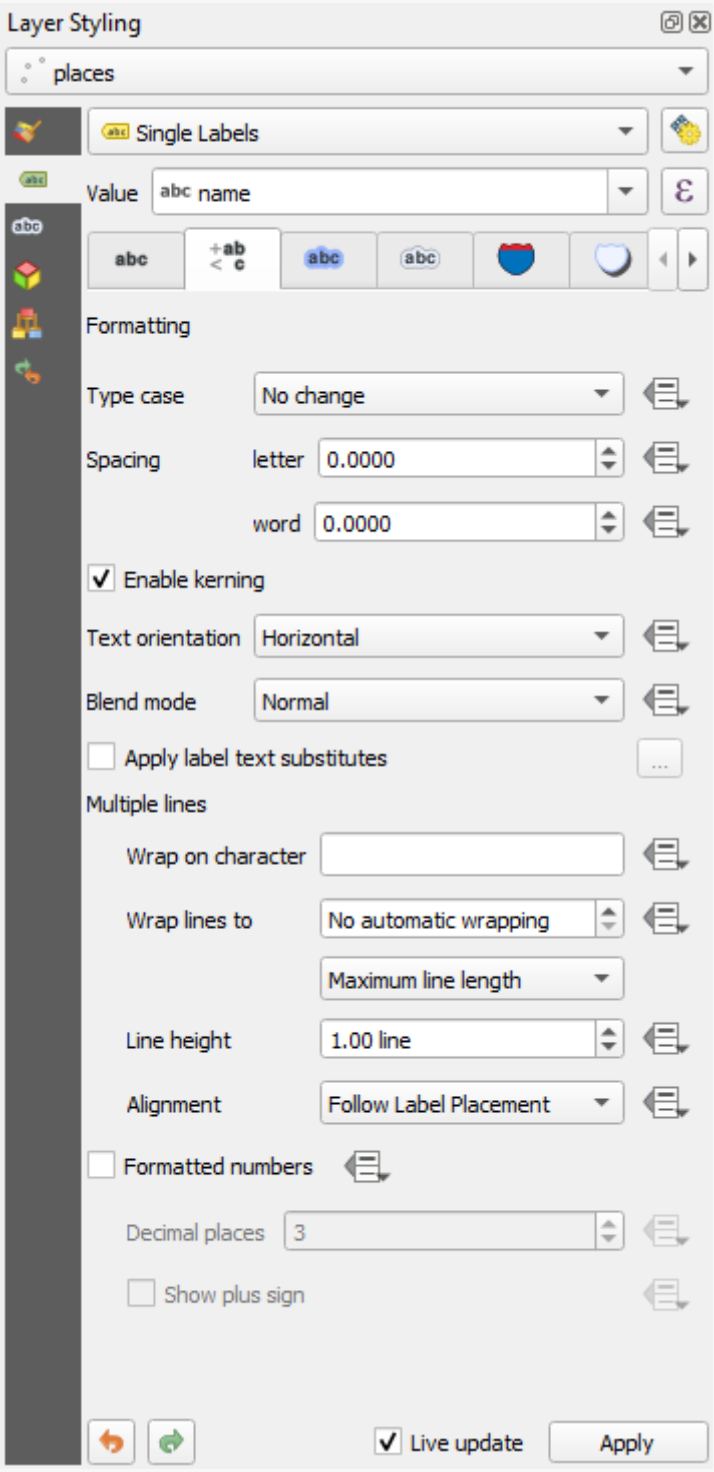
Răspuns

One possible solution has this final product:



To arrive at this result:

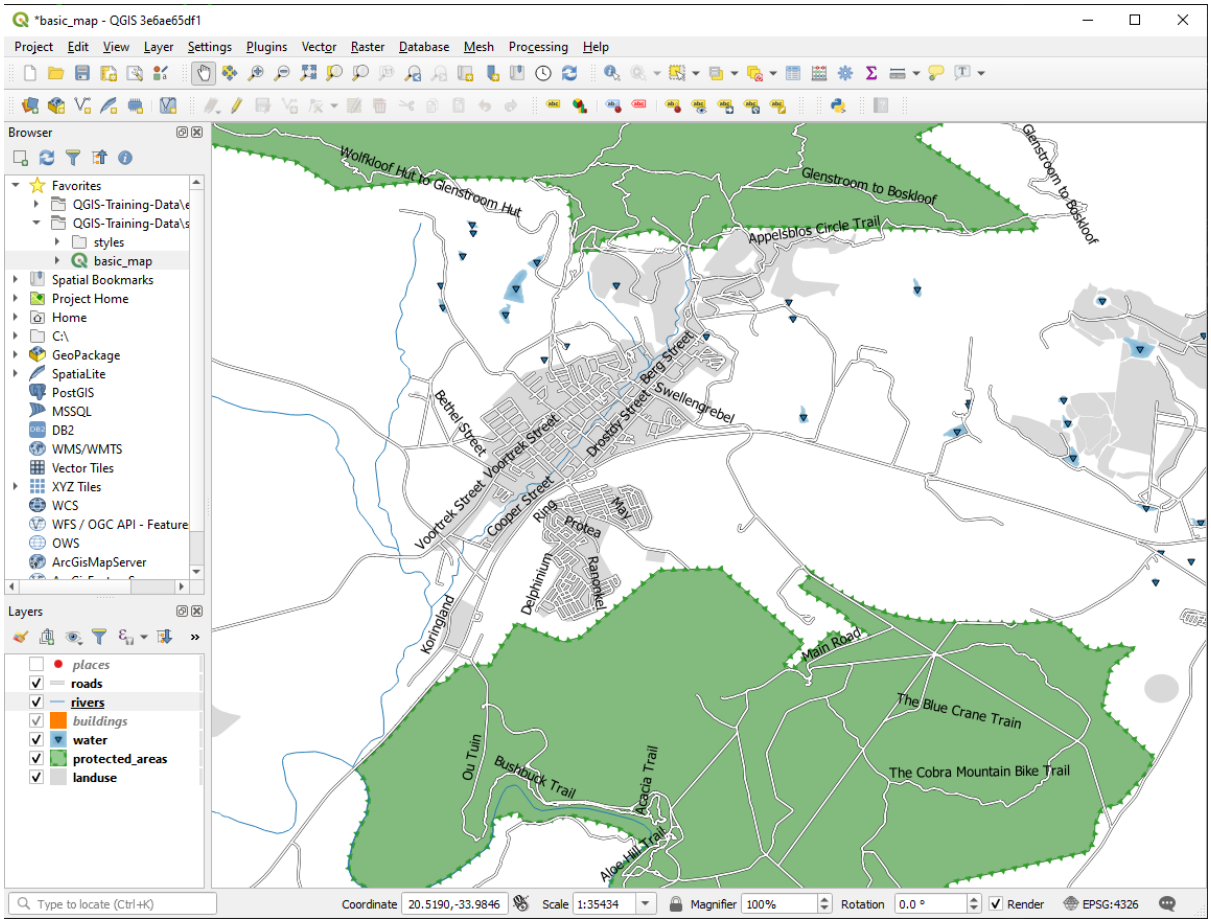
- Use a font size of `10`
- Use an around point placement distance of `1.5 mm`
- Use a marker size of `3.0 mm`
- In addition, this example uses the *Wrap on character* option:



- Enter a `space` in this field and click *Apply* to achieve the same effect. In our case, some of the place names are very long, resulting in names with multiple lines which is not very user friendly. You might find this setting to be more appropriate for your map.

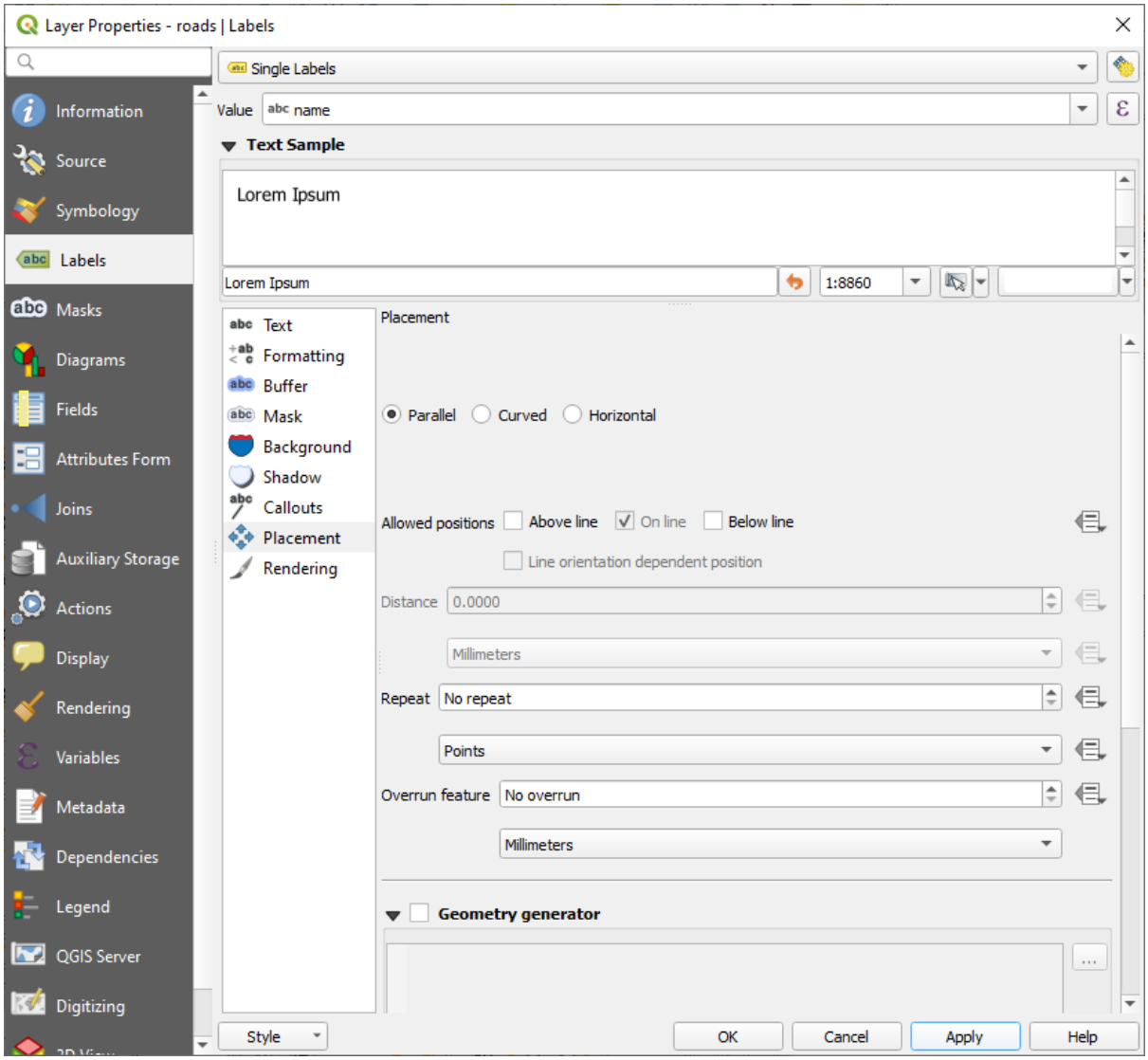
3.2.5 ??? Follow Along: Labeling Lines

Acum, după ce știm cum funcționează etichetarea, remarcăm o problemă suplimentară. Punctele și poligoanele sunt ușor de etichetat, dar ce spuneți despre linii? Dacă le etichetăm în același mod ca și pe puncte, rezultatele ar arăta astfel:



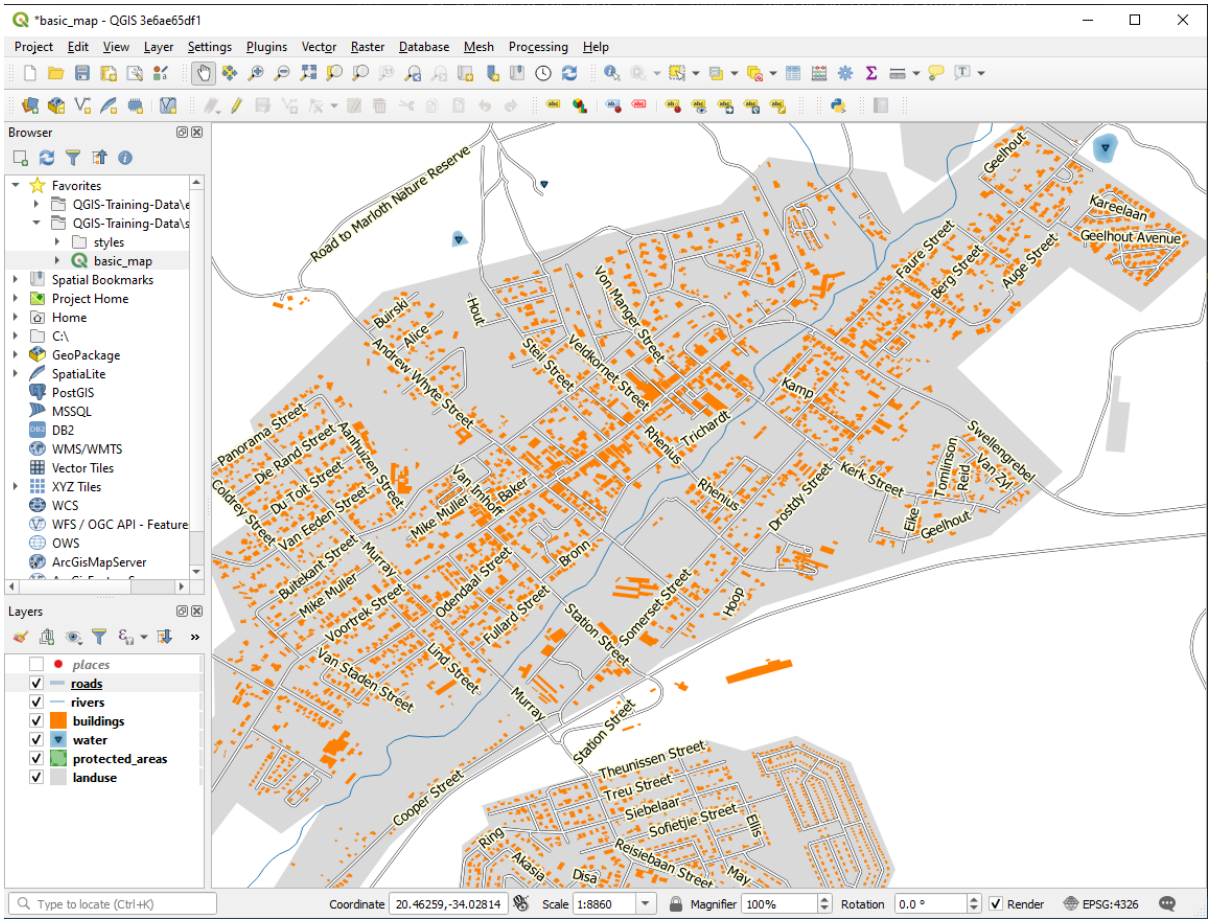
We will now reformat the `roads` layer labels so that they are easy to understand.

1. Hide the `places` layer so that it doesn't distract you
2. Activate *Single Labels* for the `roads` layer as you did above for `places`
3. Set the font *Size* to `10` so that you can see more labels
4. Zoom in on the Swellendam town area
5. In the *Labels* tab's *Placement* tab, choose the following settings:



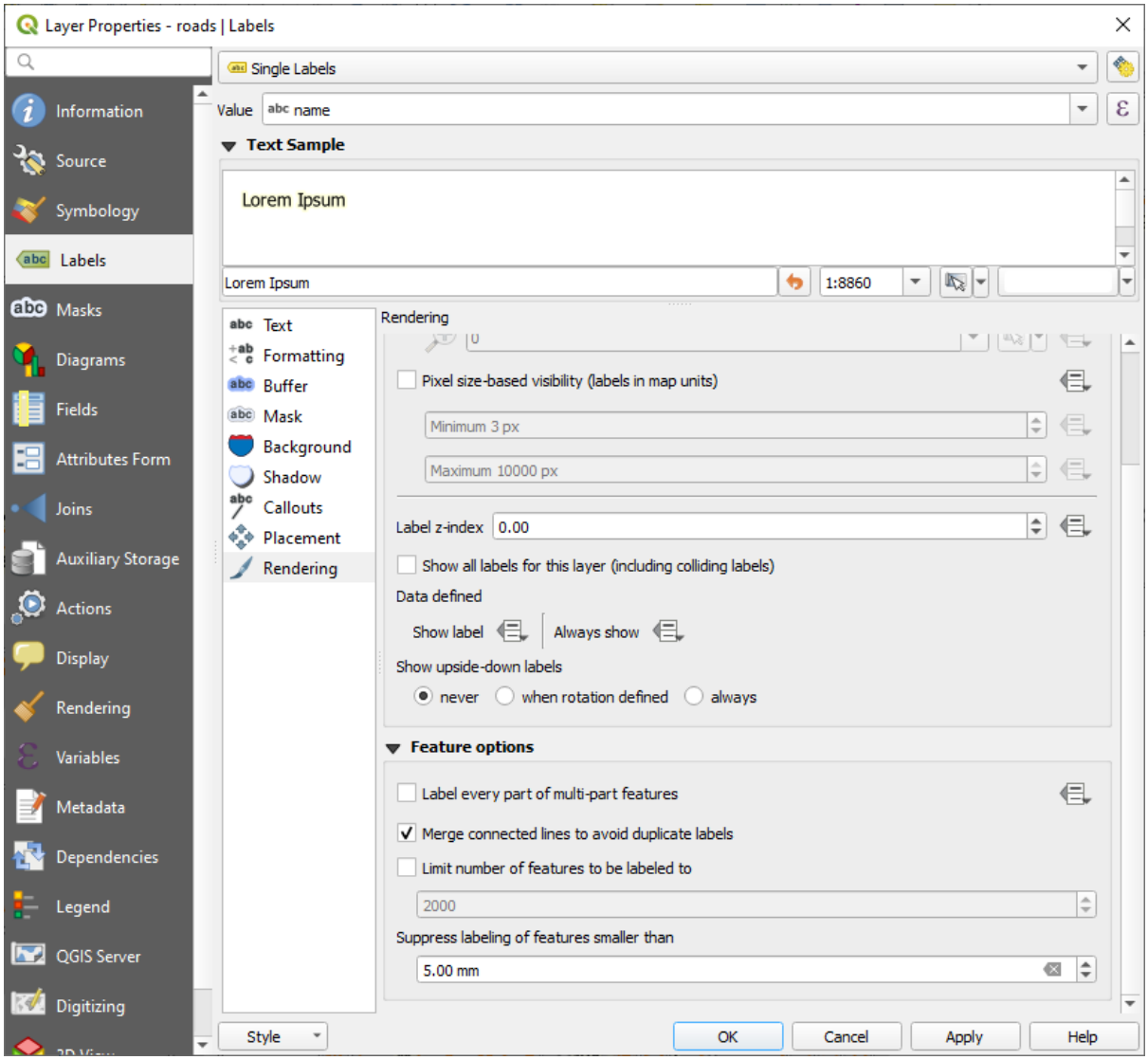
You'll probably find that the text styling has used default values and the labels are consequently very hard to read. Update the *Text* to use a dark-grey or black *Color* and the *Buffer* to use a light-yellow *Color*.

Harta va arăta aproximativ în modul următor, în funcție de scară:



You'll see that some of the road names appear more than once and that's not always necessary. To prevent this from happening:

6. In the *Labels* tab of the *Layer Properties* dialog, choose the *Rendering* option and select *Merge connected lines to avoid duplicate labels* as shown:



7. Clic pe *OK*

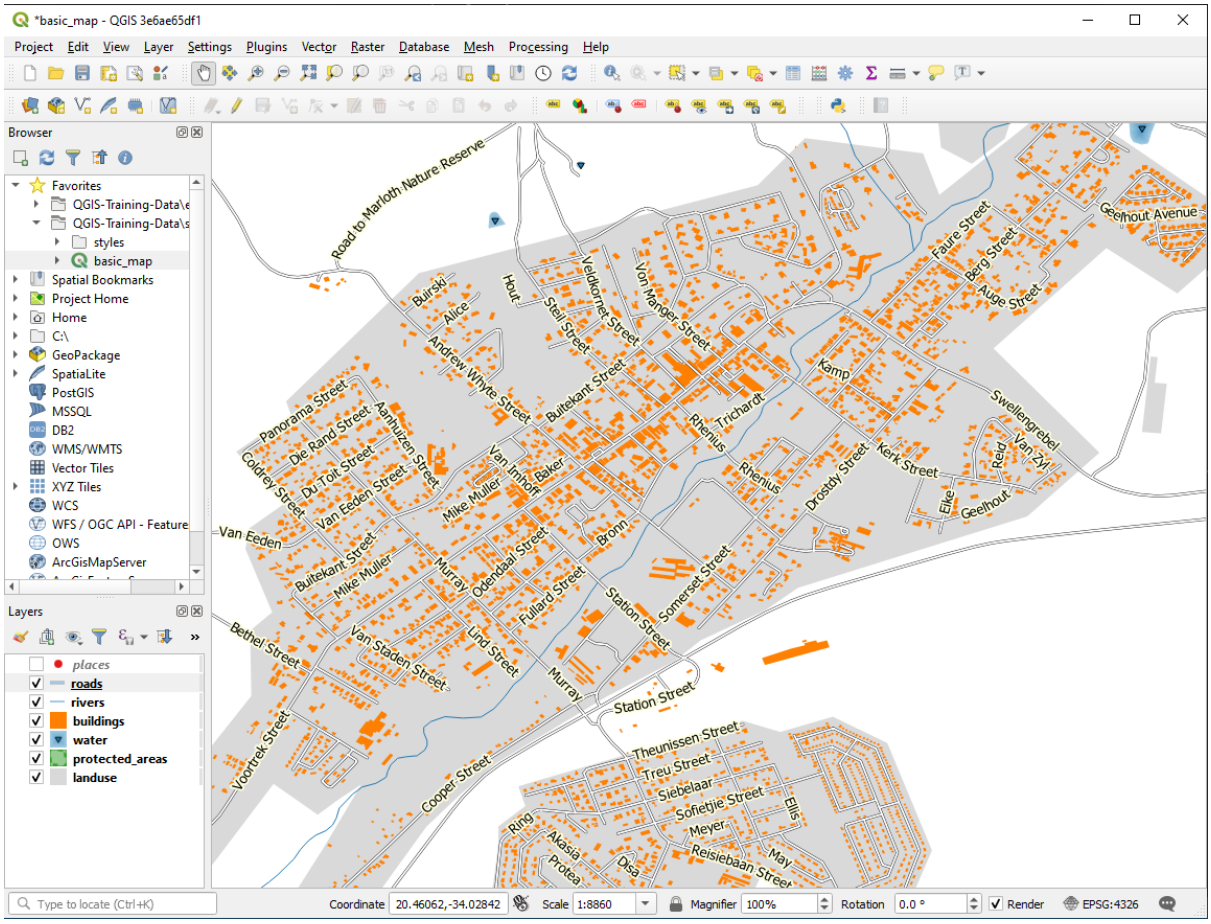
   Another useful function is to prevent labels being drawn for features too short to be of notice.

8. In the same *Rendering* panel, set the value of *Suppress labeling of features smaller than …* to `5.00 mm` and note the results when you click *Apply*

   Try out different *Placement* settings as well. As we've seen before, the *Horizontal* option is not a good idea in this case, so let's try the *Curved* option instead.

9. Select the *Curved* option in the *Placement* panel of the *Labels* tab

Iată rezultatul:

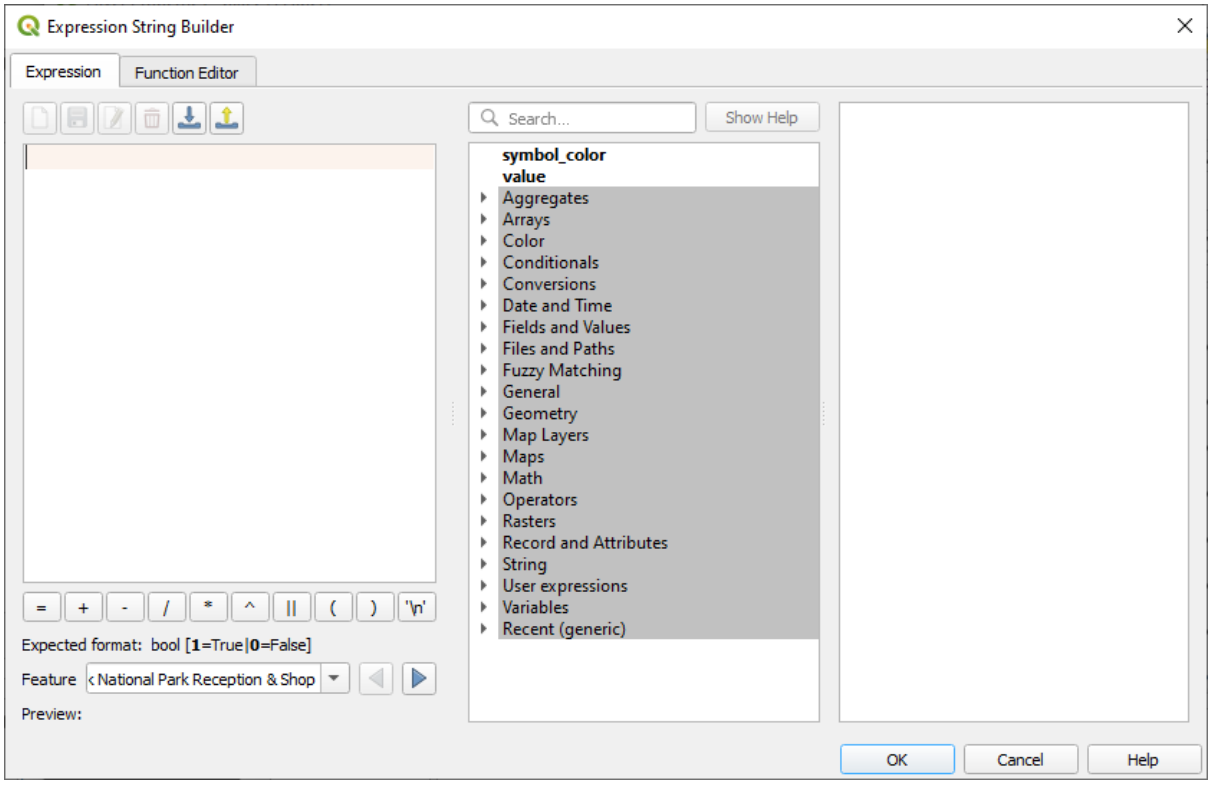


După cum se vede, unele etichete care erau vizibile anterior sunt ascunse, datorită dificultății de le face să urmeze liniile întortocheate ale străzilor și să rămână totuși lizibile. În același timp, alte etichete devin mult mai utile, întrucât urmăresc drumurile, în loc să plutească în spațiul dintre ele. Puteți decide pe care dintre aceste opțiuni să o utilizați, în funcție de ceea ce credeți că e mai util sau că arată mai bine.

3.2.6 ??? Follow Along: Data Defined Settings

1. Deactivate labeling for the `roads` layer
2. Reactivate labeling for the `places` layer
3. Open the attribute table for `places` via the  button

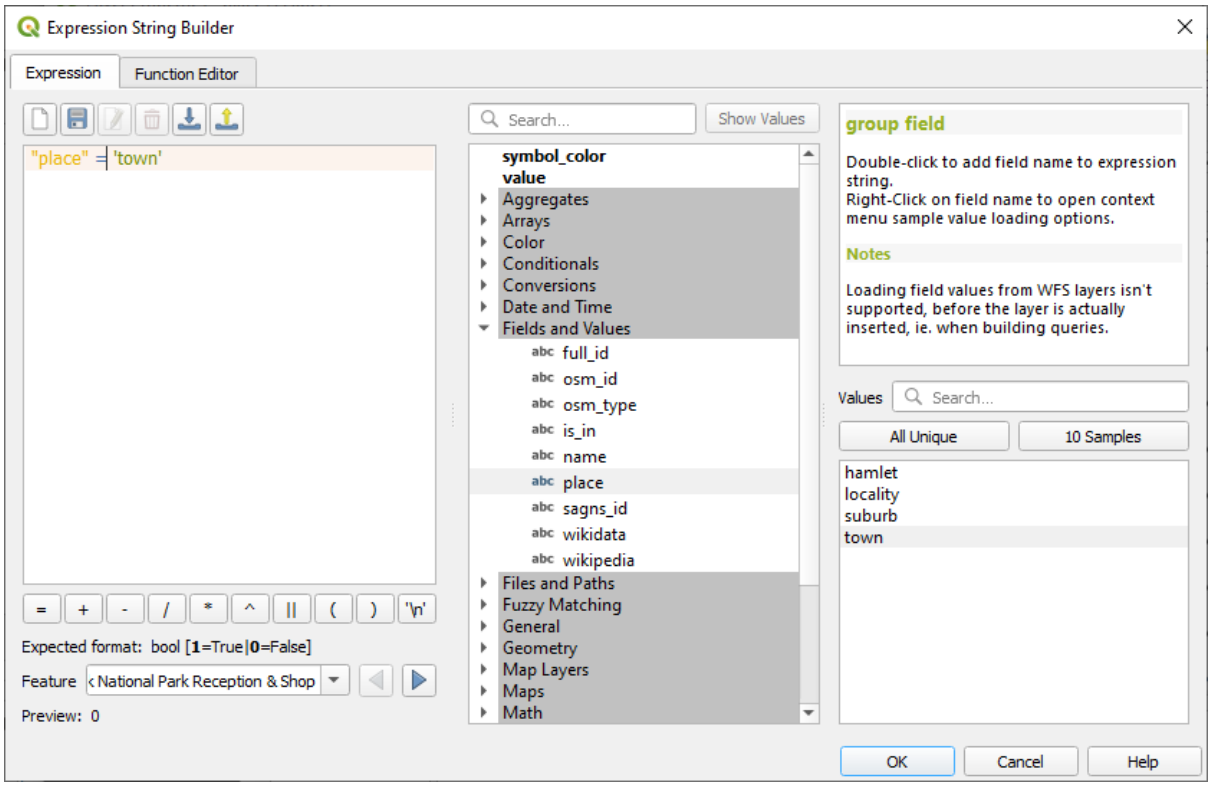
   It has one *field* which is of interest to us now: `place` which defines the type of urban area for each *record*. We can use this data to influence the label styles.
4. Navigate to the *Text* panel in the `places` *Labels* panel
5. Click the  button next to the Italic text button beneath *Style* and select *Edit…* to open the *Expression String Builder*:



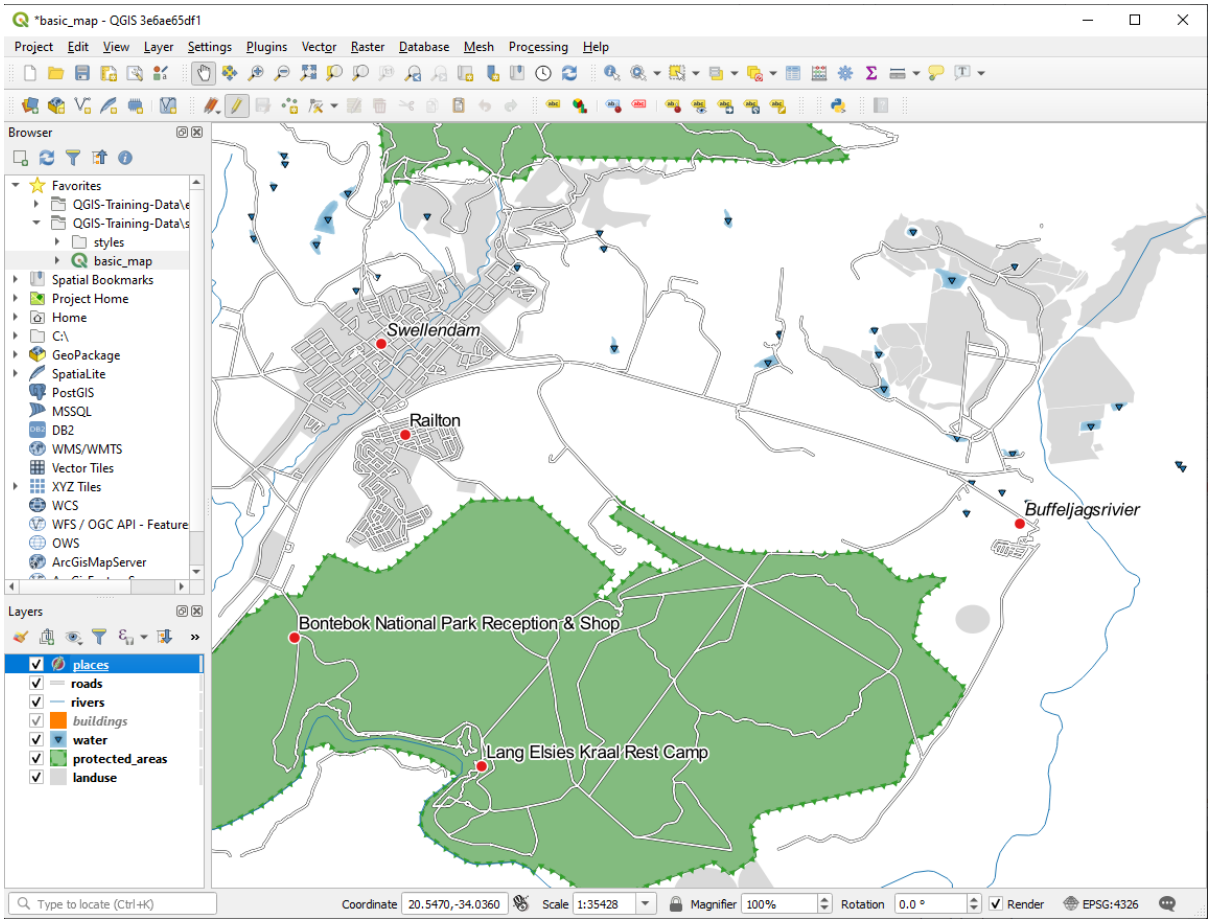
6. Under *Fields and Values*, double click on `place` and then click *All Unique*. This will list all unique values of the `place` field of this layer. Add a = in the text editor and then double click on `town`.

   Alternatively, you can type: `"place" = 'town'` directly in the text editor.

7. Click *OK* twice:



Notice that the labels for all places whose `place` field matches `town` are displayed in italics.

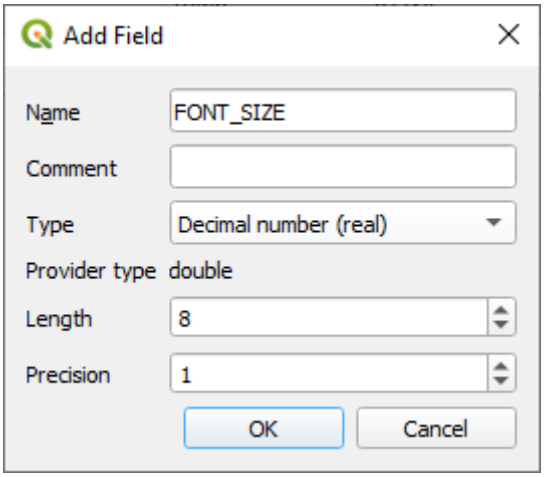


3.2.7 ??? Try Yourself: Using Data Defined Settings

Notă

We're jumping ahead a bit here to demonstrate some advanced labeling settings. At the advanced level, it's assumed that you'll know what the following means. If you don't, feel free to leave out this section and come back later when you've covered the requisite materials.

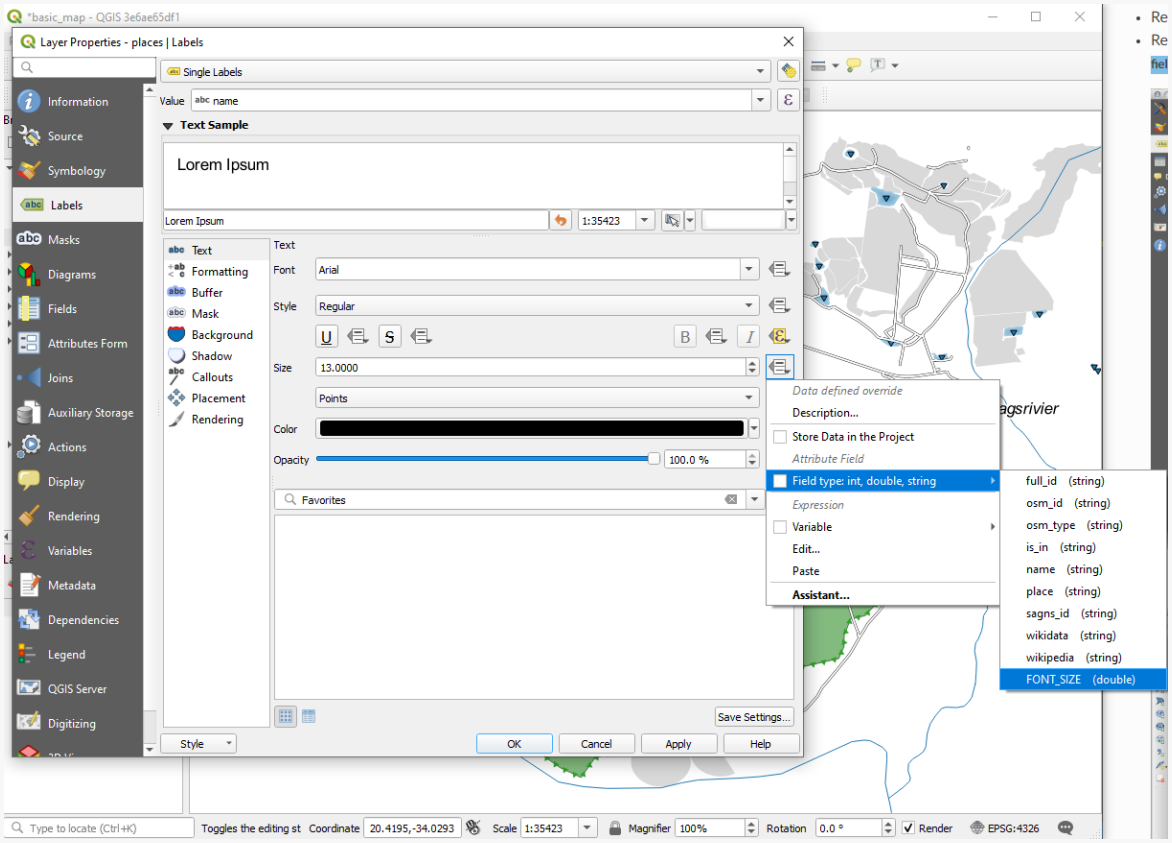
1. Open the Attribute Table for `places`
2. Enter edit mode by clicking the  button
3. Add a new column with the  button
4. Configurați-l astfel:



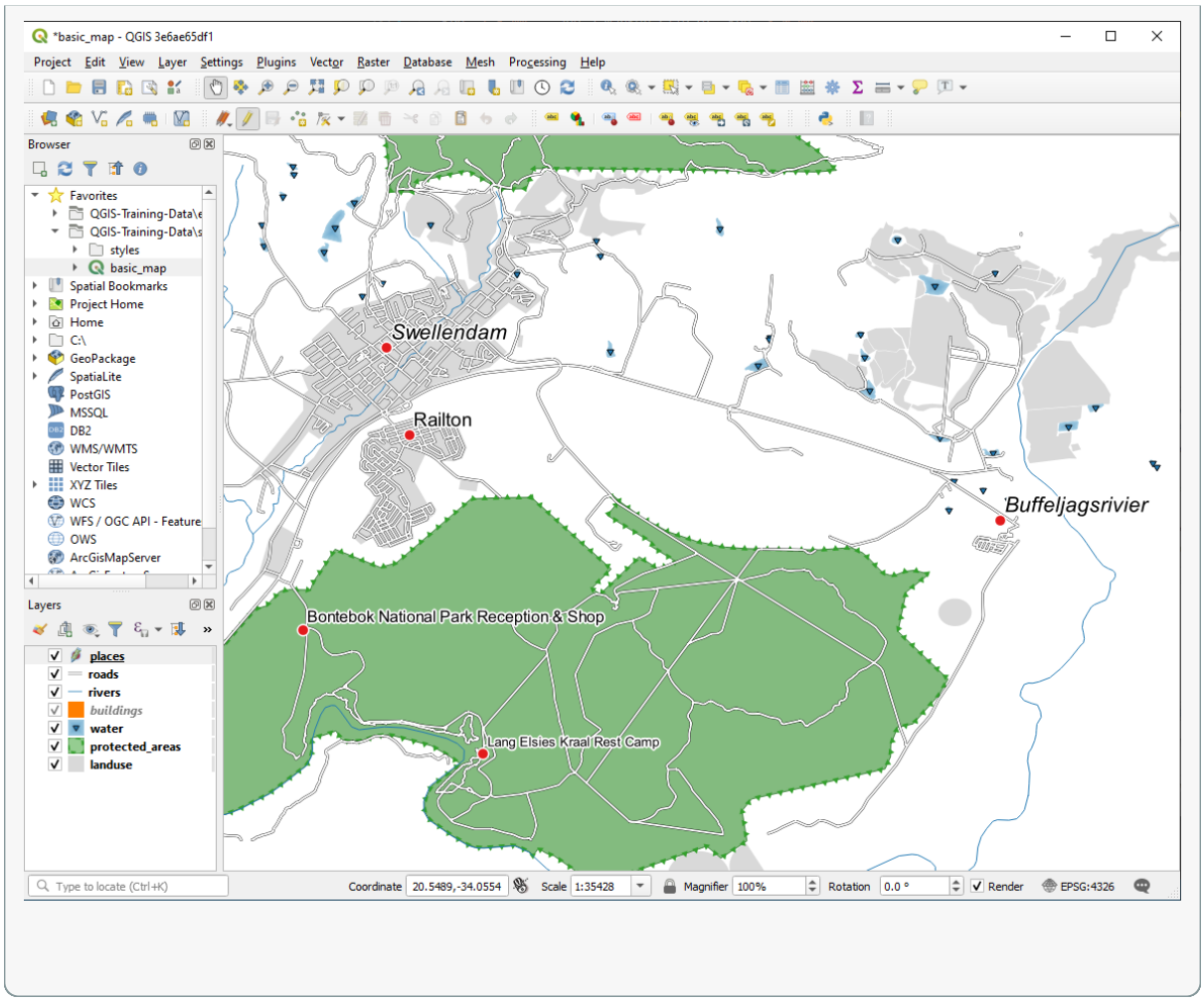
5. Use this to set custom font sizes for each different type of place (each key in the `place` field)

Răspuns

1. Still in edit mode, set the `FONT_SIZE` values to whatever you prefer. The example uses `16` for towns, `14` for suburbs, `12` for localities, and `10` for hamlets.
2. Remember to save changes and exit edit mode
3. Return to the *Text* formatting options for the `places` layer and select `FONT_SIZE` in the *Attribute field* of the font size data defined override dropdown:



Your results, if using the above values, should be this:



3.2.8 ??? Further Possibilities With Labeling

We can't cover every option in this course, but be aware that the *Label* tab has many other useful functions. You can set scale-based rendering, alter the rendering priority for labels in a layer, and set every label option using layer attributes. You can even set the rotation, XY position, and other properties of a label (if you have attribute fields allocated for the purpose), then edit these properties using the tools adjacent to the main *Layer Labeling Options* button:



(Aceste instrumente vor fi active dacă există câmpurile de atribute obligatorii și vă aflați în modul de editare.)

Simțiți-vă liberi să explorați mai multe posibilități ale sistemului de etichetare.

3.2.9 În concluzie

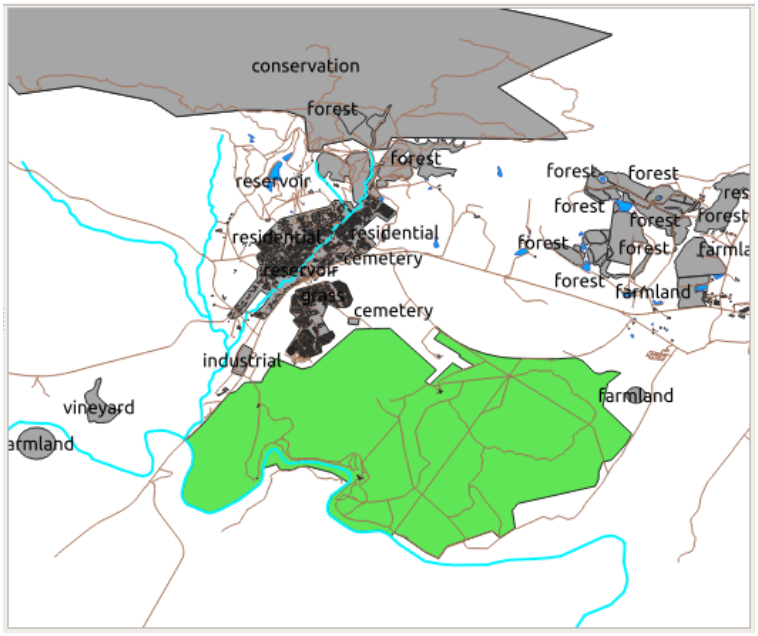
Ați învățat cum să folosiți atributele stratului, pentru a crea în mod dinamic etichetele. Acest lucru poate face harta mult mai informativă și mai elegantă!

3.2.10 Ce urmează?

Now that you know how attributes can make a visual difference for your map, how about using them to change the symbology of objects themselves? That's the topic for the next lesson!

3.3 Lesson: Classification

Labels are a good way to communicate information such as the names of individual places, but they can't be used for everything. For example, let us say that someone wants to know what each `landuse` area is used for. Using labels, you would get this:

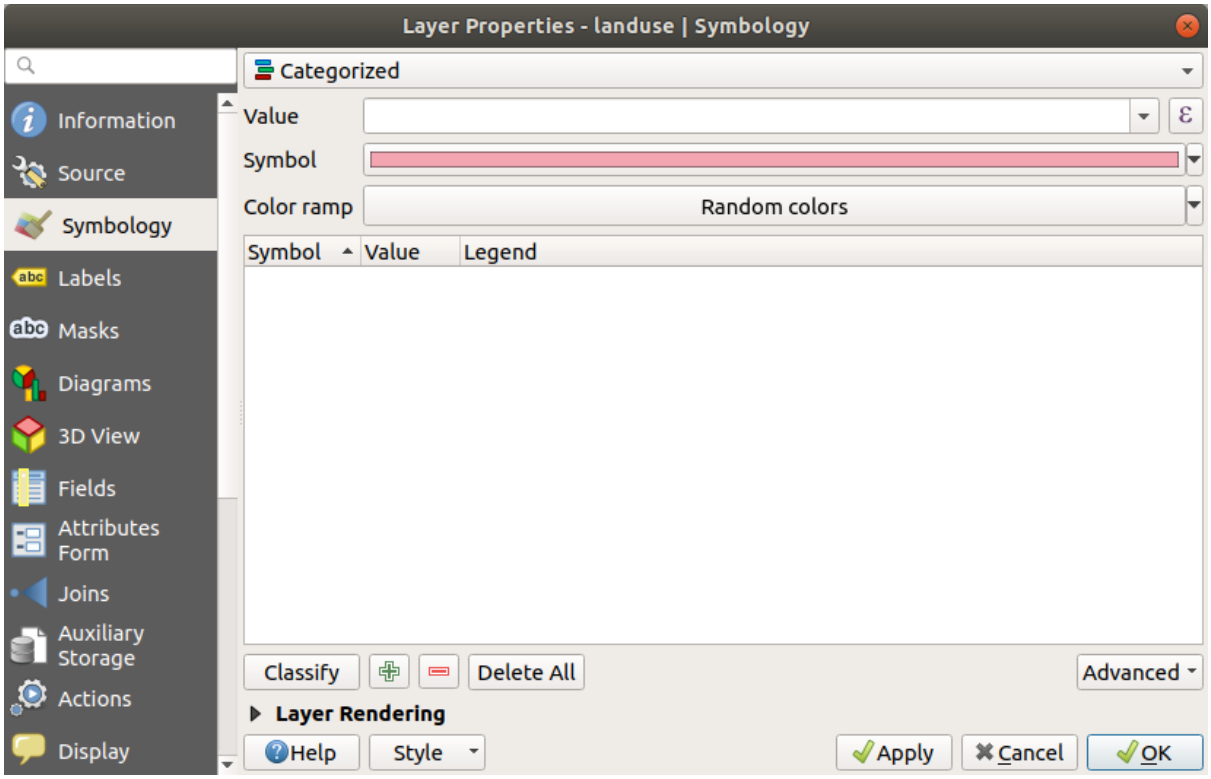


Acest lucru face etichetarea hărții dificil de înțeles, și chiar copleșitoare atunci când există suprafețe de teren cu numeroase utilizări.

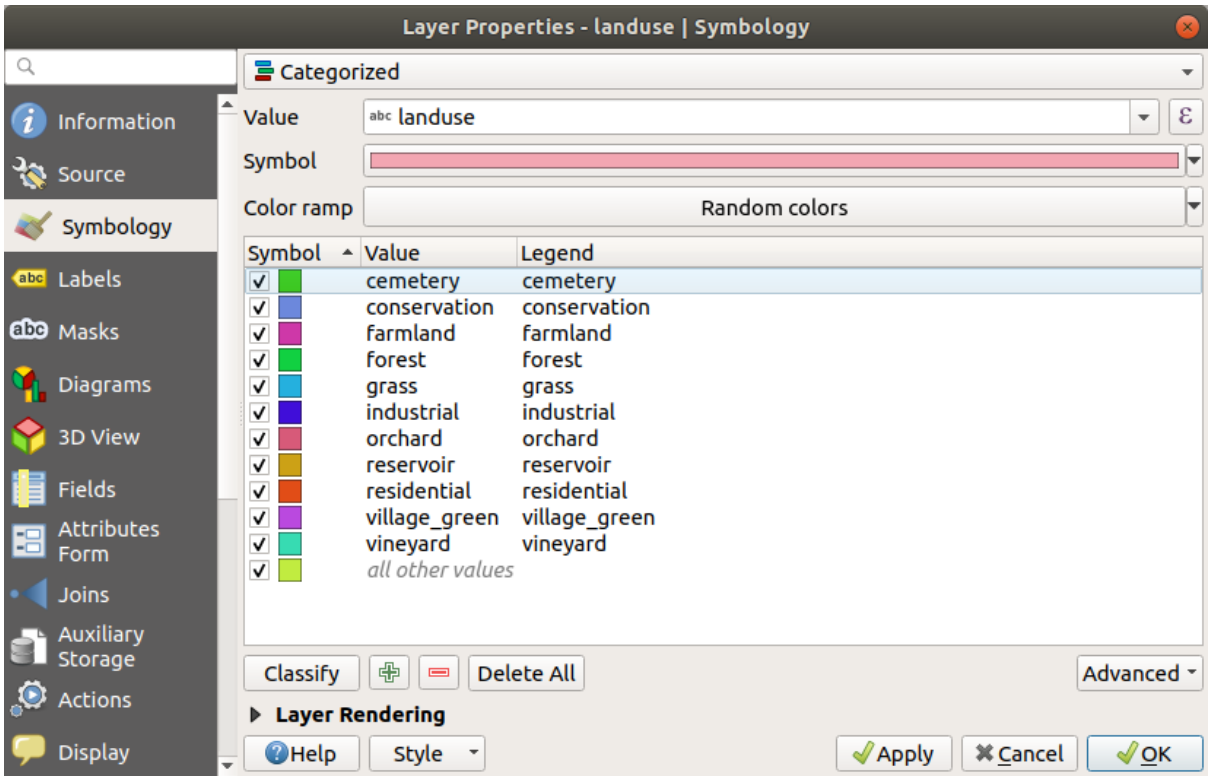
Scopul acestei lecții: De a afla cum se pot clasifica în mod eficient datele vectoriale.

3.3.1 ??? Procedați în mod similar: Clasificarea Datelor Nominale

1. Open the *Layer Properties* dialog for the `landuse` layer
2. Go to the *Symbology* tab
3. Faceți clic, în meniul cu derulare verticală, pe *Simbol Unic* și schimbați-l în *Categorisit*:

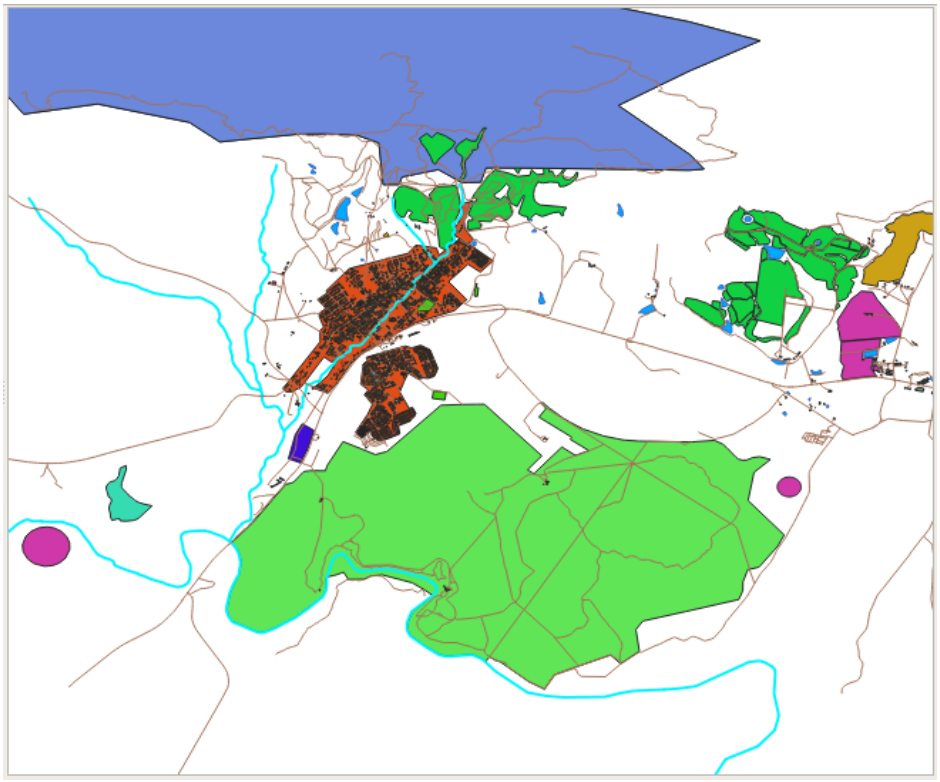


4. In the new panel, change the *Value* to `landuse` and the *Color ramp* to *Random colors*
5. Click the button labeled *Classify*

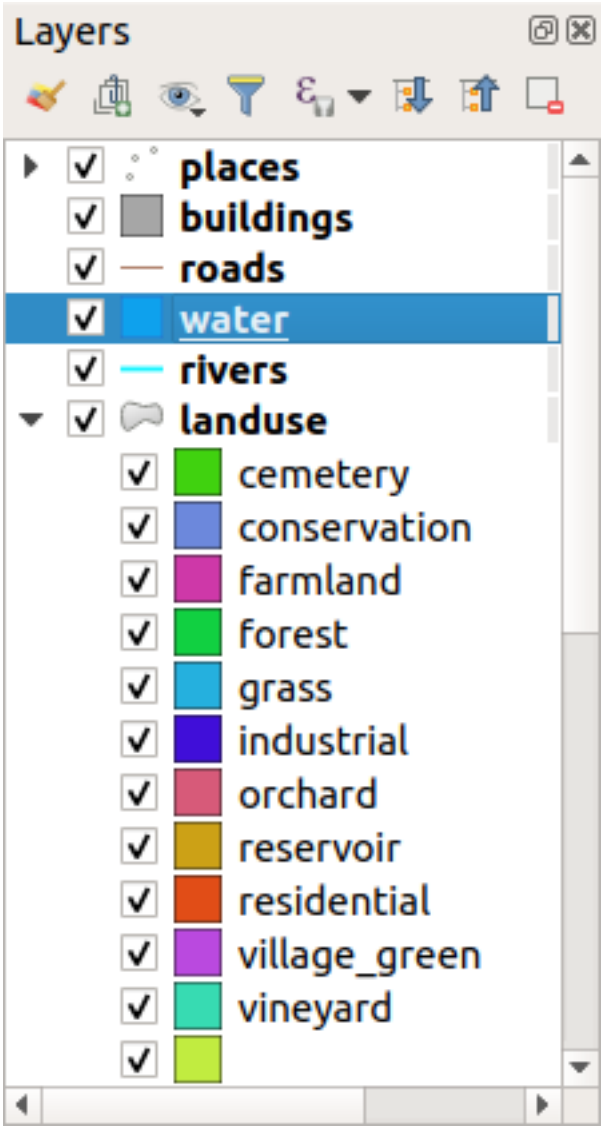


6. Clic pe *OK*

   Veți vedea ceva de genul următor:

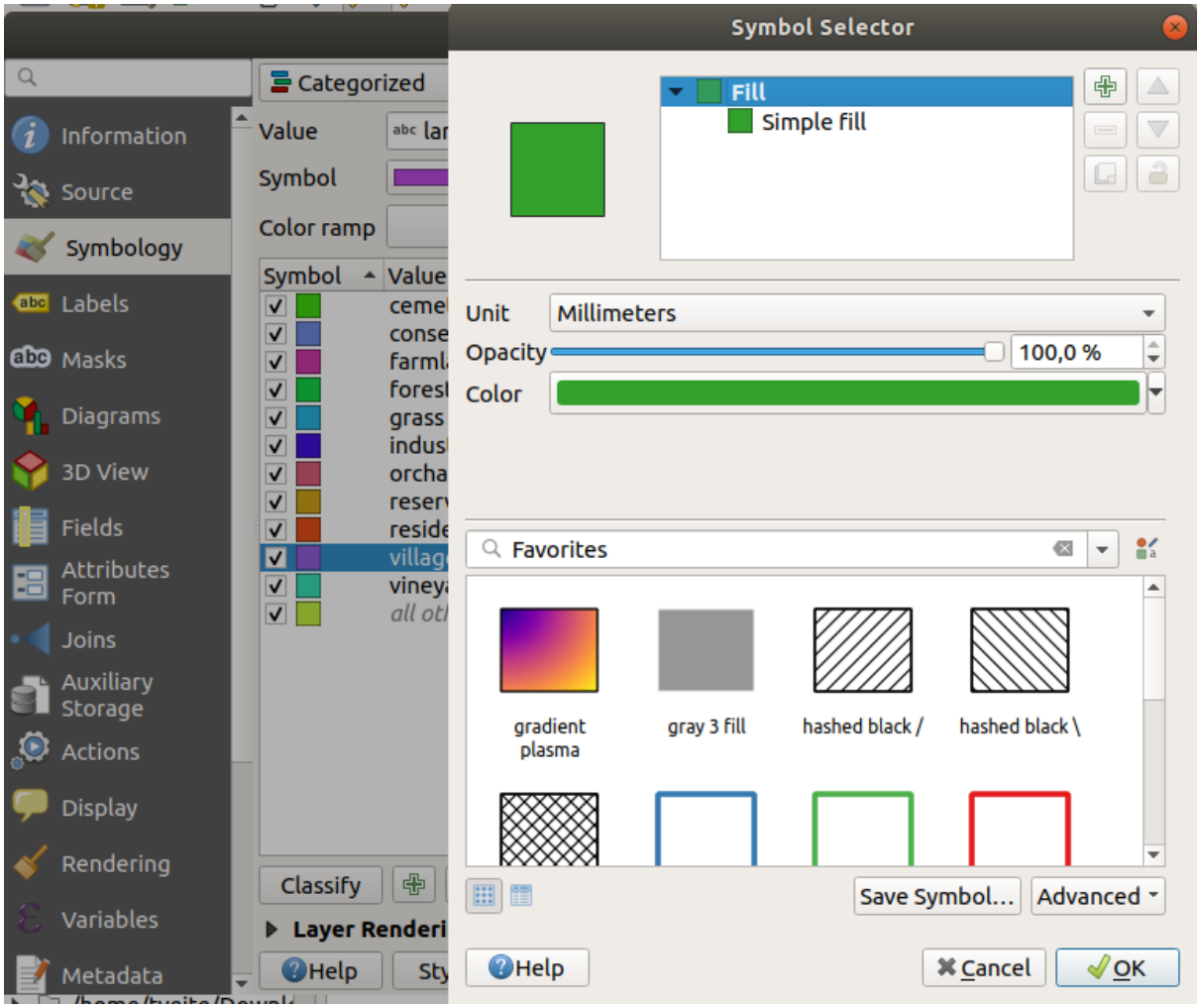


7. Click the arrow (or plus sign) next to `landuse` in the *Layers* panel, you'll see the categories explained:

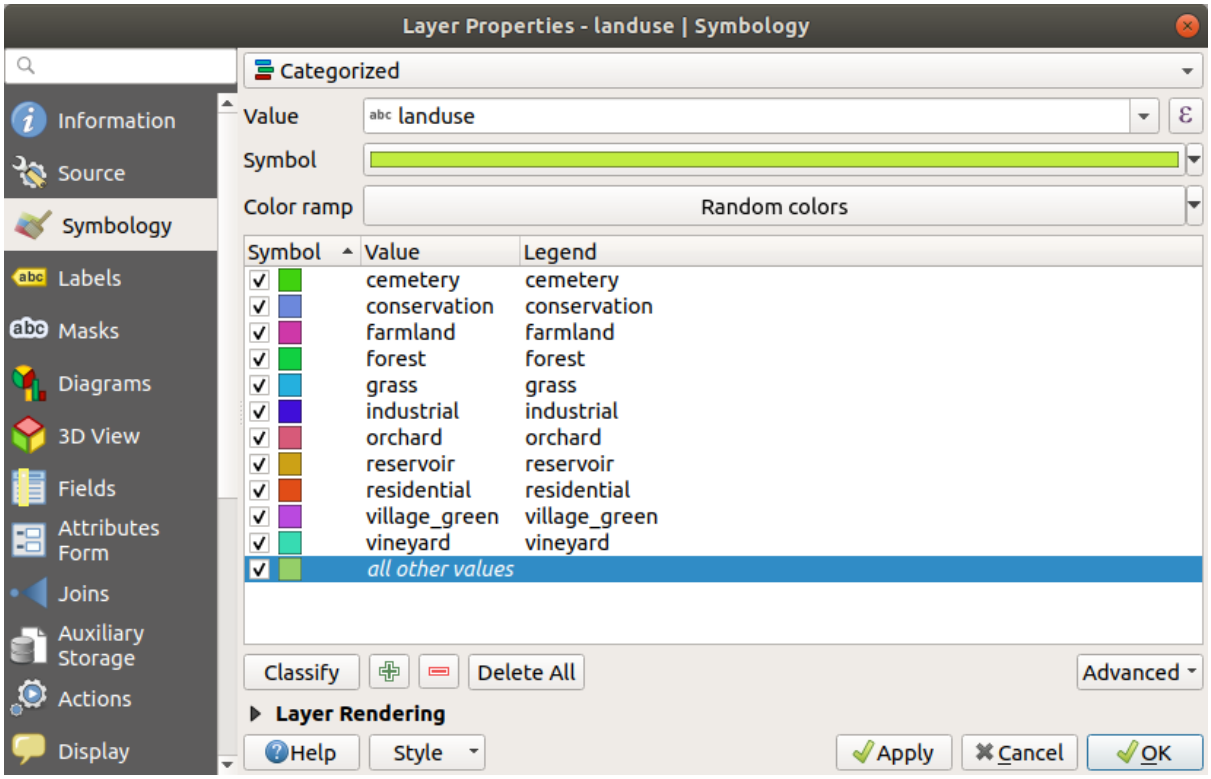


Now our landuse polygons are colored and are classified so that areas with the same land use are the same color.

8. If you wish to, you can change the symbol of each landuse area by double-clicking the relevant color block in the *Layers* panel or in the *Layer Properties* dialog:



Observați că există o categorie necompletată:



This empty category is used to color any objects which do not have a landuse value defined or which have a *NULL* value. It can be useful to keep this empty category so that areas with a *NULL* value are still represented on the map. You may like to change the color to more obviously represent a blank or *NULL* value.

Amintiți-vă să salvați harta dvs. acum, astfel încât să nu pierdeți toate modificările greu efectuate!

3.3.2 ??? Încercați și dvs.: Mai multă Clasificare

Use the knowledge you gained above to classify the `buildings` layer. Set the categorisation against the `building` field and use the *Spectral* color ramp.

Notă

Amintiți-vă să focusați într-o zonă urbană, pentru a vedea rezultatele.

3.3.3 ??? Follow Along: Ratio Classification

Există patru tipuri de clasificare: *nominal*, *ordinal*, *interval* și *raport*.

In **nominal** classification, the categories that objects are classified into are name-based; they have no order. For example: town names, district codes, etc. Symbols that are used for nominal data should not imply any order or magnitude.

- For points, we can use symbols of different shape.
- For polygons, we can use different types of hatching or different colours (avoid mixing light and dark colours).
- For lines, we can use different dash patterns, different colours (avoid mixing light and dark colours) and different symbols along the lines.

In **ordinal** classification, the categories are arranged in a certain order. For example, world cities are given a rank depending on their importance for world trade, travel, culture, etc. Symbols that are used for ordinal data should imply order, but not magnitude.

- For points, we can use symbols with light to dark colours.
- For polygons, we can use graduated colours (light to dark).
- For lines, we can use graduated colours (light to dark).

In **interval** classification, the numbers are on a scale with positive, negative and zero values. For example: height above/below sea level, temperature in degrees Celsius. Symbols that are used for interval data should imply order and magnitude.

- For points, we can use symbols with varying size (small to big).
- For polygons, we can use graduated colours (light to dark) or add diagrams of varying size.
- For lines, we can use thickness (thin to thick).

In **ratio** classification, the numbers are on a scale with only positive and zero values. For example: temperature above absolute zero (0 degrees Kelvin), distance from a point, the average amount of traffic on a given street per month, etc. Symbols that are used for ratio data should imply order and magnitude.

- For points, we can use symbols with varying size (small to big).
- For polygons, we can use graduated colours (light to dark) or add diagrams of varying size.
- For lines, we can use thickness (thin to thick).

In the example above, we used nominal classification to color each record in the `landuse` layer based on its `landuse` attribute. Now we will use ratio classification to classify the records by area.

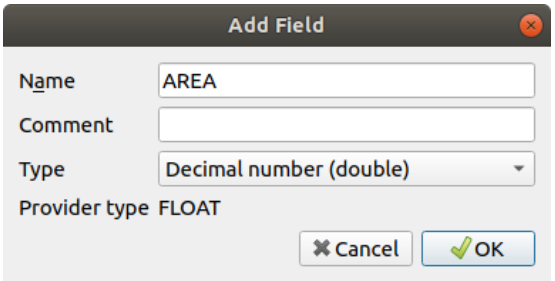
We are going to reclassify the layer, so existing classes will be lost if not saved. To store the current classification:

1. Open the layer's properties dialog
2. Click the *Save Style* ... button in the *Style* drop-down menu.
3. Select *Rename Current...*, enter `land usage` and press *OK*.

   The categories and their symbols are now saved in the layer's properties.
4. Click now on the *Add...* entry of the *Style* drop-down menu and create a new style named `ratio`. This will store the new classification.
5. Close the *Layer Properties* dialog

We want to classify the landuse areas by size, but there is a problem: they don't have a size field, so we'll have to make one.

1. Open the Attributes Table for the `landuse` layer.
2. Enter edit mode by clicking the  Toggle editing button
3. Add a new column of decimal type, called `AREA`, using the  New field button:



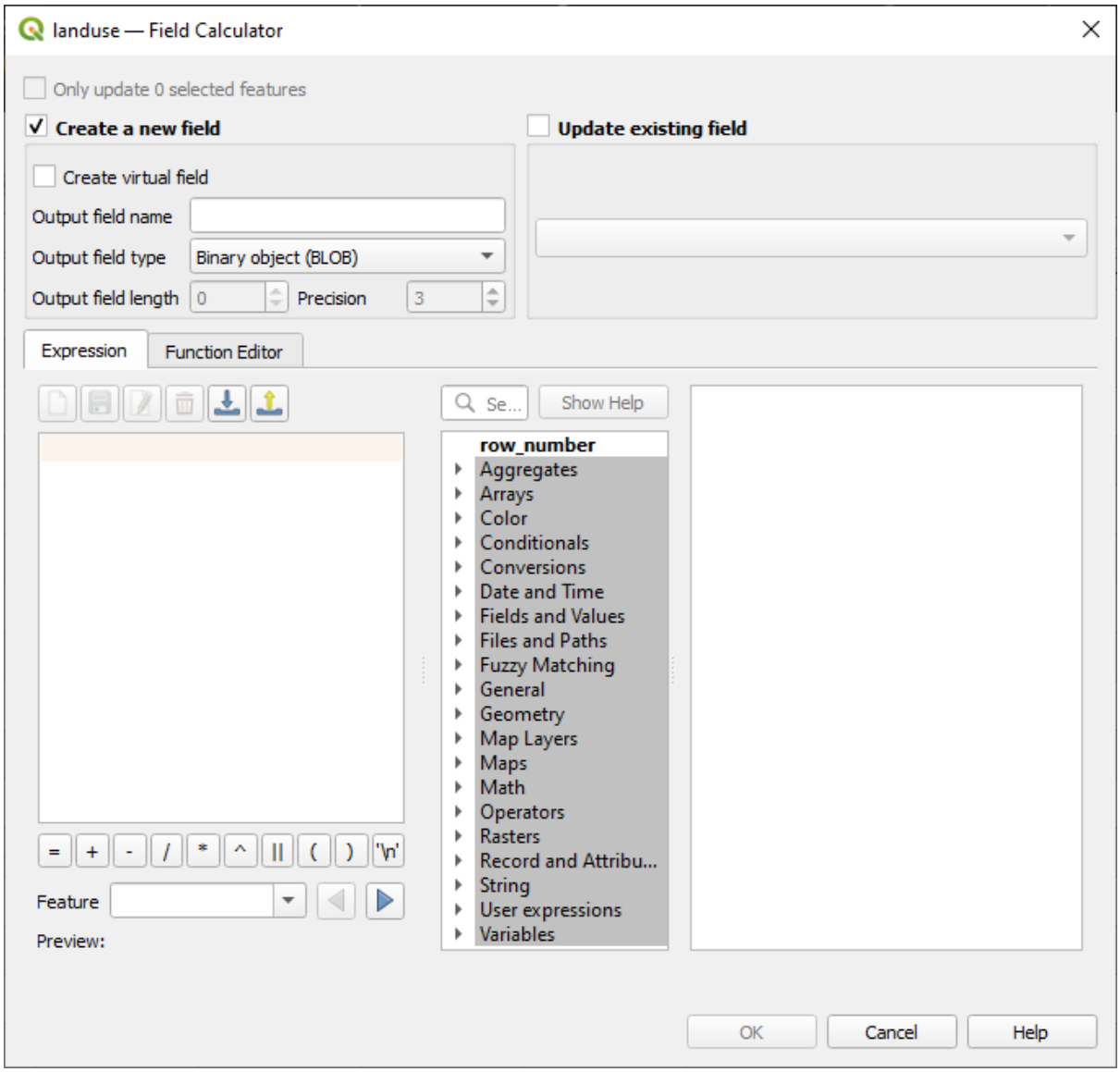
4. Clic pe *OK*

   The new field will be added (at the far right of the table; you may need to scroll horizontally to see it). However, at the moment it is not populated, it just has a lot of *NULL* values.

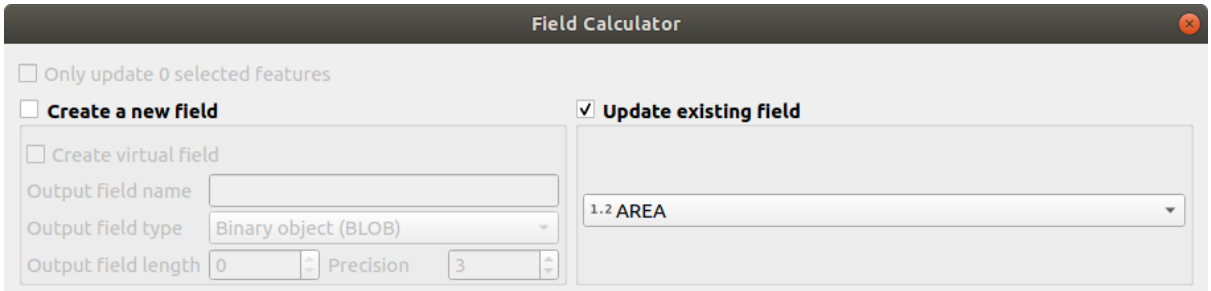
   To solve this problem, we will need to calculate the areas.

1. Open the field calculator with the  button.

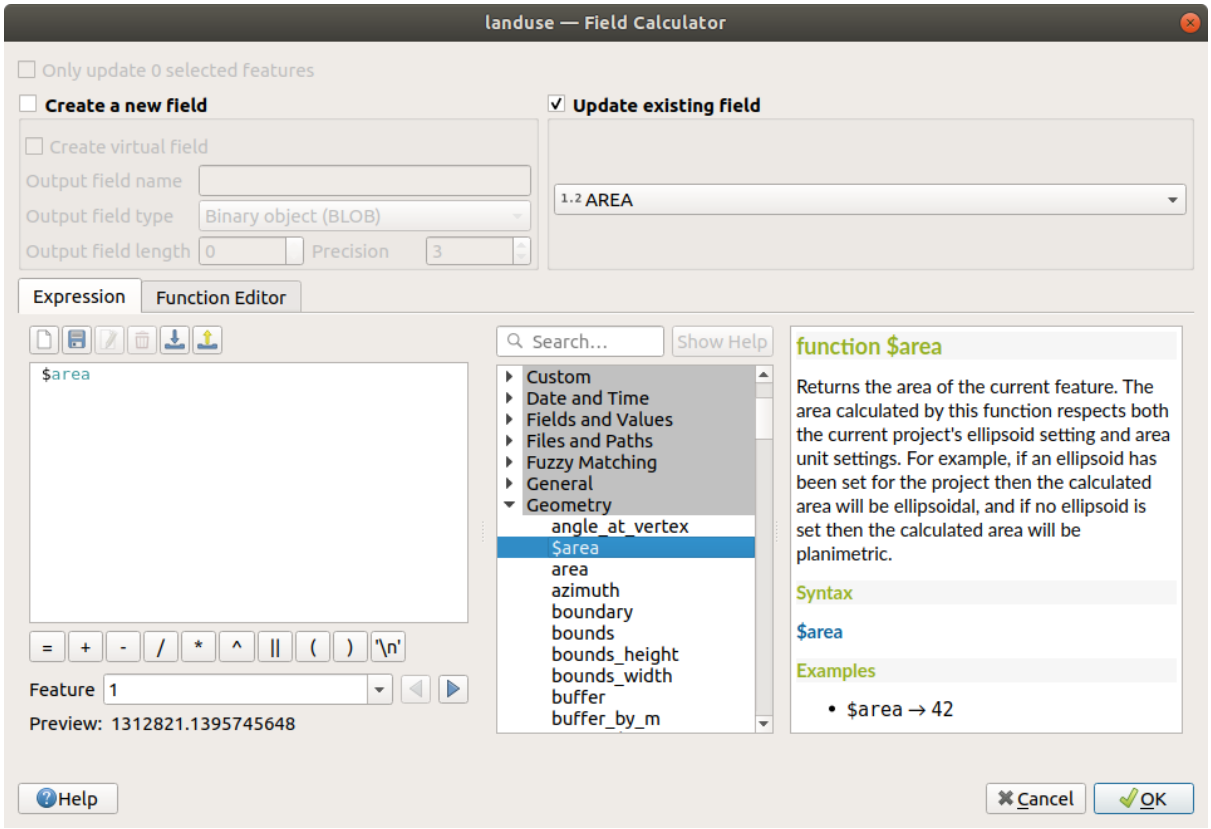
   You will get this dialog:



2. Check the  *Update existing fields*
3. Select *AREA* in the fields drop-down menu



4. Under the *Expression* tab, expand the *Geometry* functions group in the list and find *$area*
5. Double-click on it so that it appears in the *Expression* field



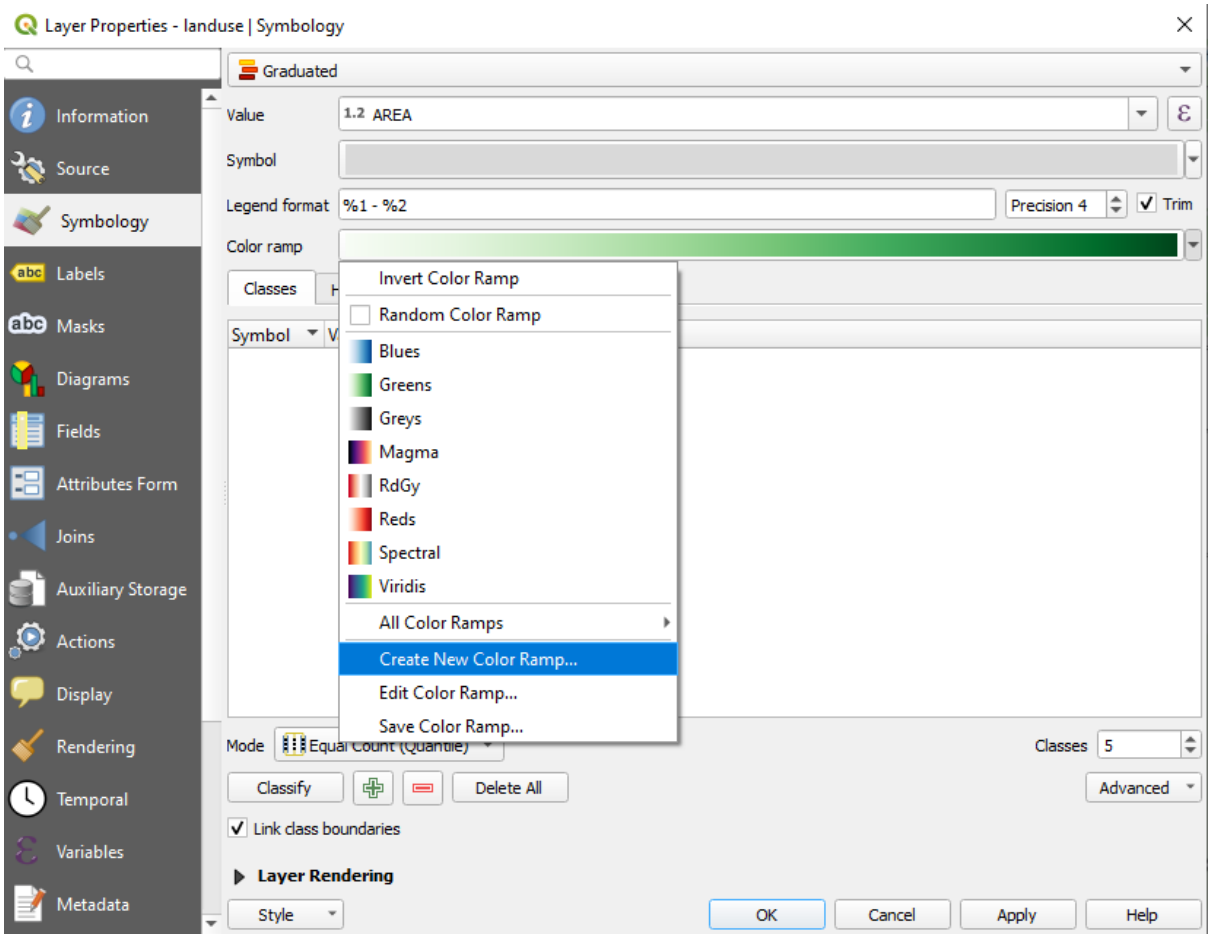
6. Clic pe *OK*
7. Scroll to the `AREA` field in the attribute table and you will notice that it is populated with values (you may need to click the column header to refresh the data).

> **Notă**
>
> These areas respect the project's area unit settings, so they may be in square meters or square degrees.

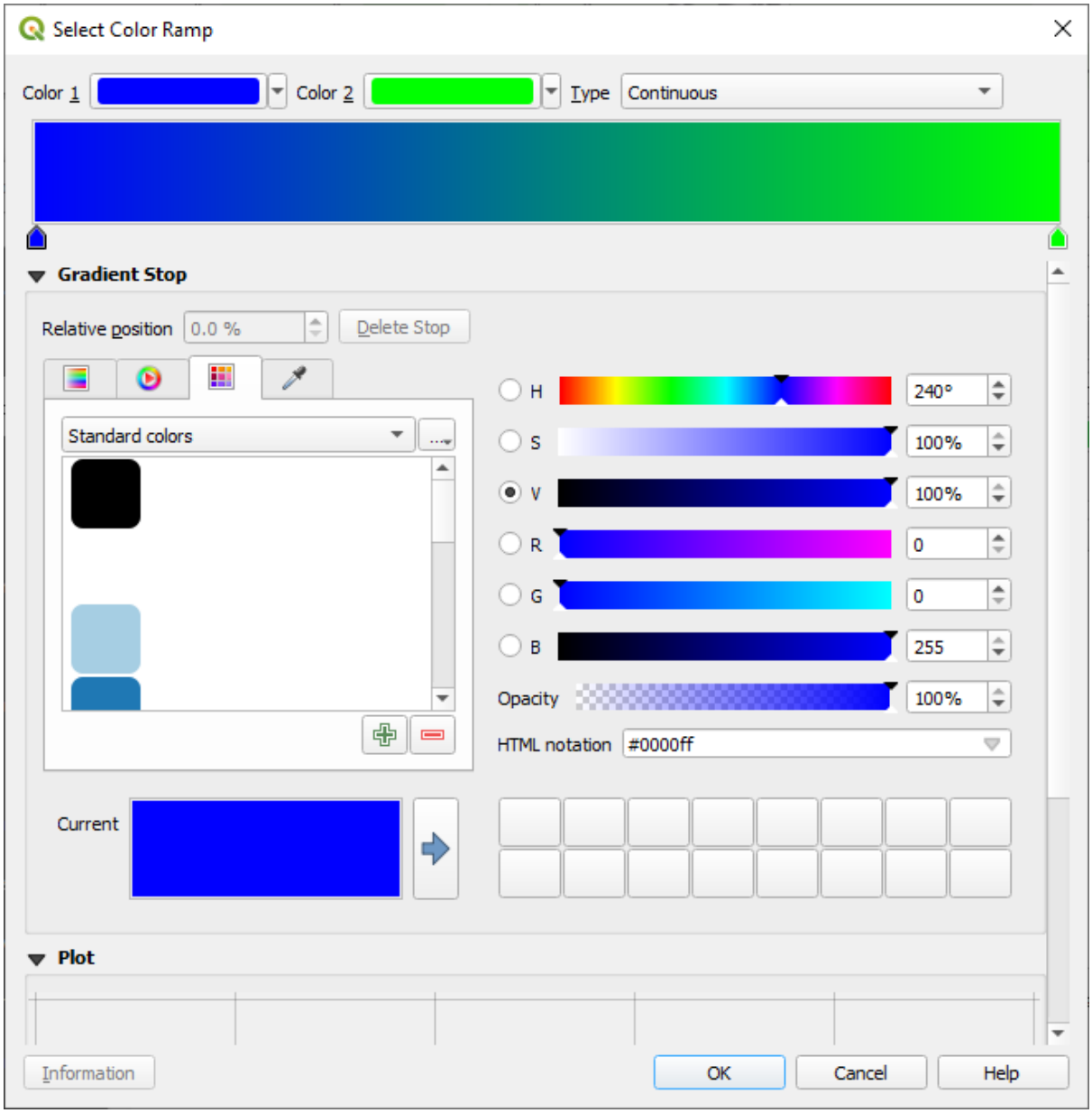
5. Press  to save the edits and exit the edit mode with  Toggle editing
6. Close the attribute table

Now that we have the data, let's use them to render the `landuse` layer.

1. Open the *Layer properties* dialog's *Symbology* tab for the `landuse` layer
2. Change the classification style from *Categorized* to *Graduated*
3. Change the *Value* to `AREA`
4. Under *Color ramp*, choose the option *Create New Color Ramp…*:



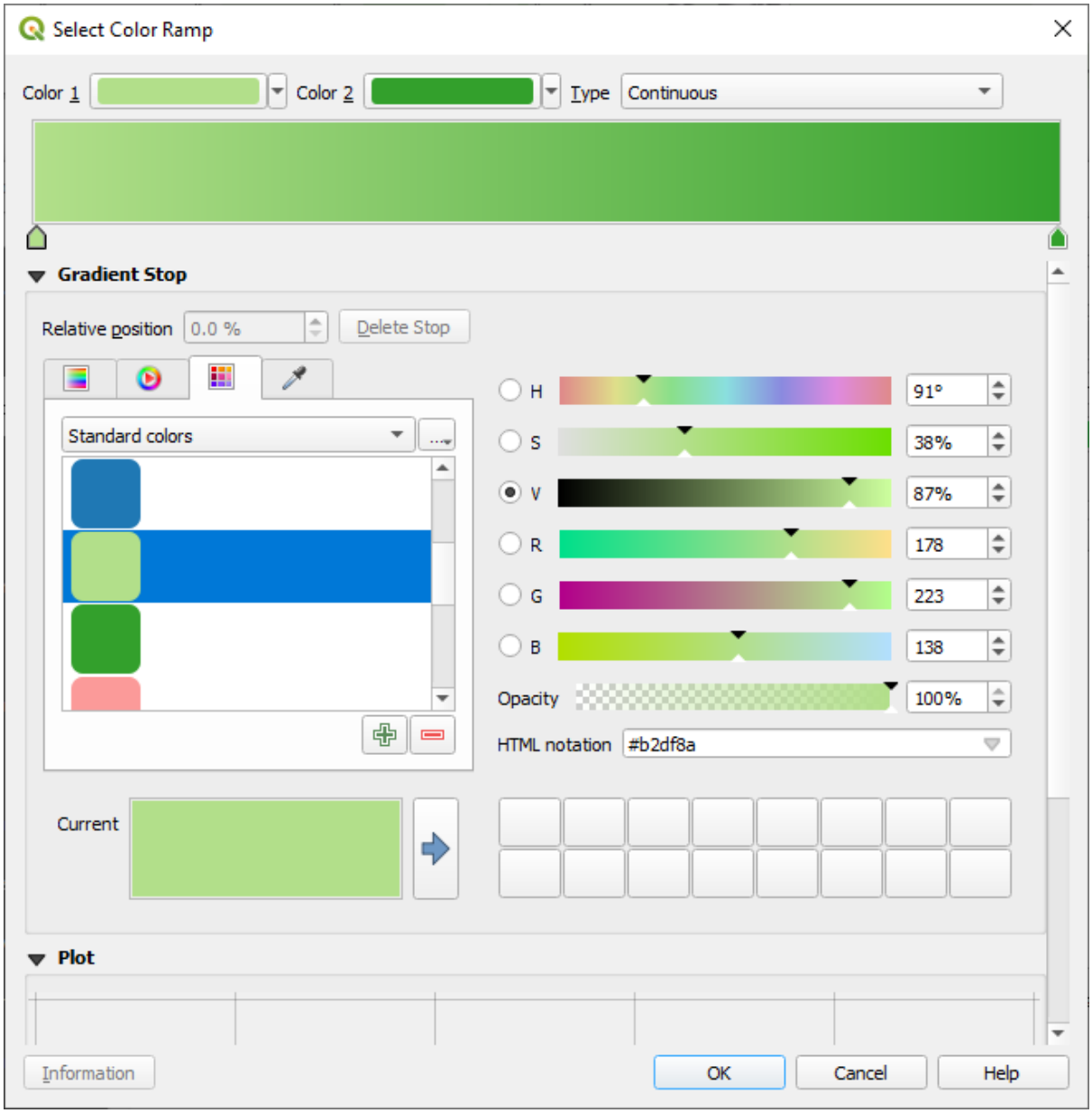
5. Choose *Gradient* (if it's not selected already) and click *OK*. You will see this:



Veți folosi acest lucru pentru a desemna *Color 1* pentru suprafețele mici și *Color 2* pentru suprafețele mari.

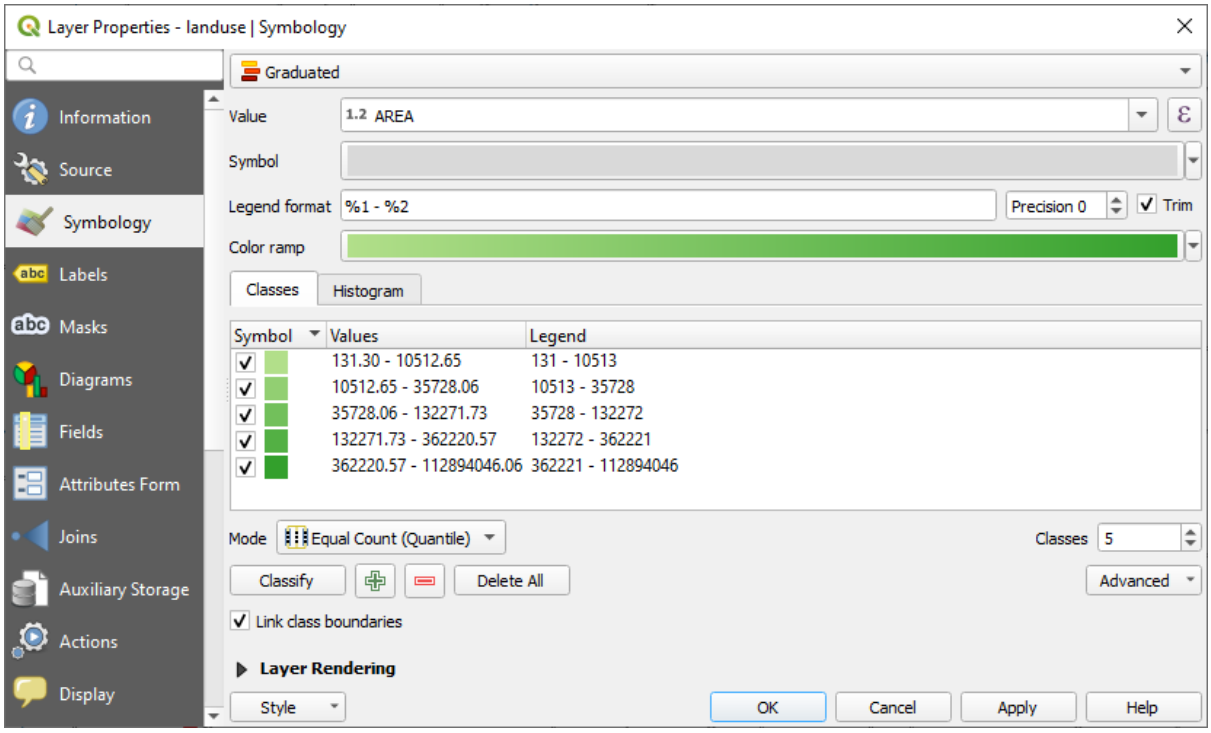
6. Choose appropriate colors

   În acest exemplu, rezultatul arată în felul următor:



7. Clic pe *OK*
8. You can save the colour ramp by selecting *Save Color Ramp...* under the *Color ramp* tab. Choose an appropriate name for the colour ramp and click *Save*. You will now be able to select the same colour ramp easily under *All Color Ramps*.
9. Under *Mode* choose  Equal Count (Quantile) .
10. Click *Classify*

    Now you will have something like this:



Lăsați totul așa cum este.

11. Clic pe *OK*

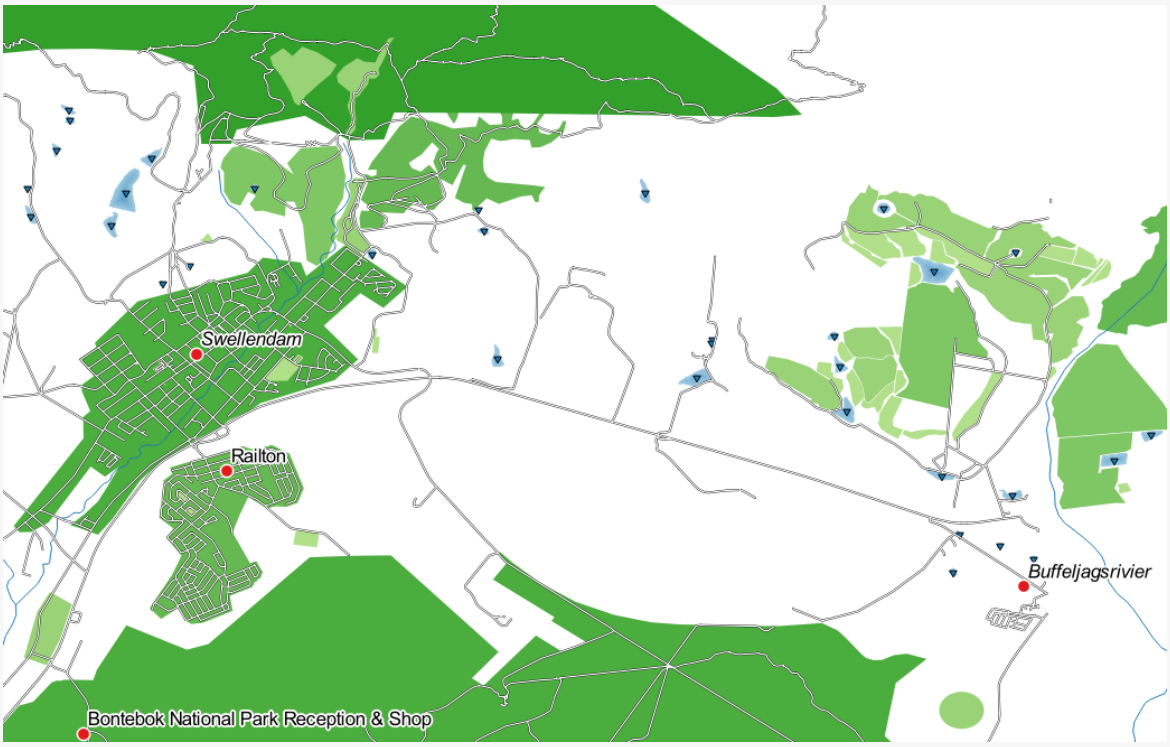


3.3.4 ??? Try Yourself: Refine the Classification

- Modificați valorile pentru *Mod* și *Clase* până când veți obține o clasificare care are sens.

Răspuns

The settings you used might not be the same, but with the values *Classes* = `6` and *Mode* = *Natural Breaks (Jenks)* (and using the same colors, of course), the map will look like this:



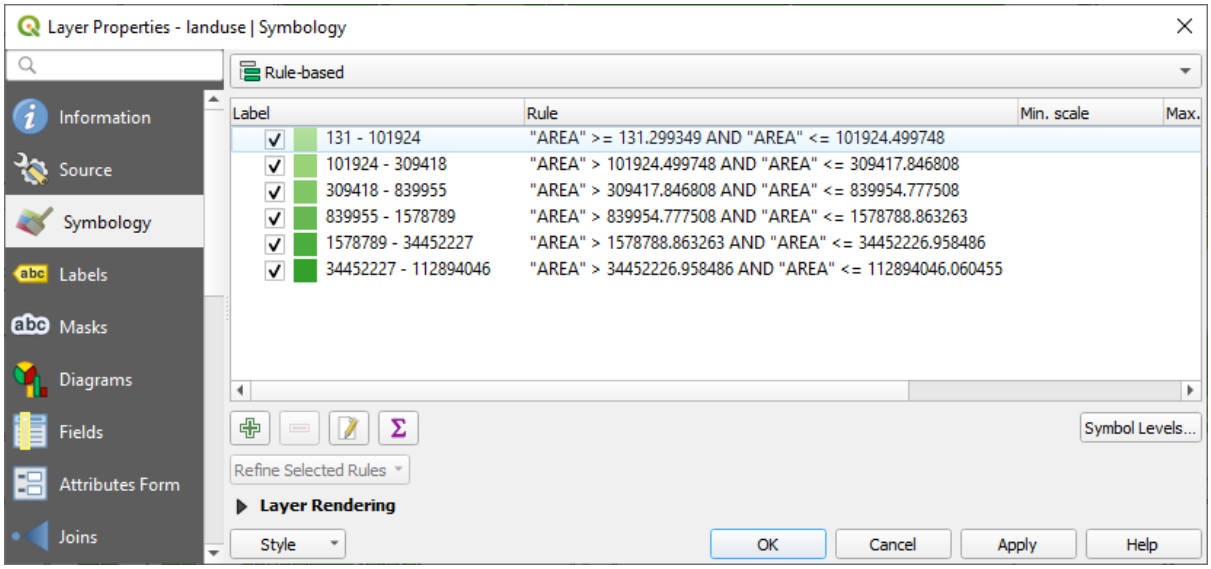
3.3.5 ??? Follow Along: Rule-based Classification

Adesea este utilă combinarea mai multor criterii pentru o clasificare, dar, din păcate, clasificarea normală ia în considerare doar un singur atribut. Acesta este cazul în care este utilă clasificarea bazată pe reguli.

In this lesson, we will represent the `landuse` layer in a way to easily identify Swellendam city from the other residential area, and from the other types of landuse (based on their area).

1. Open the *Layer Properties* dialog for the `landuse` layer
2. Switch to the *Symbology* tab
3. Switch the classification style to *Rule-based*

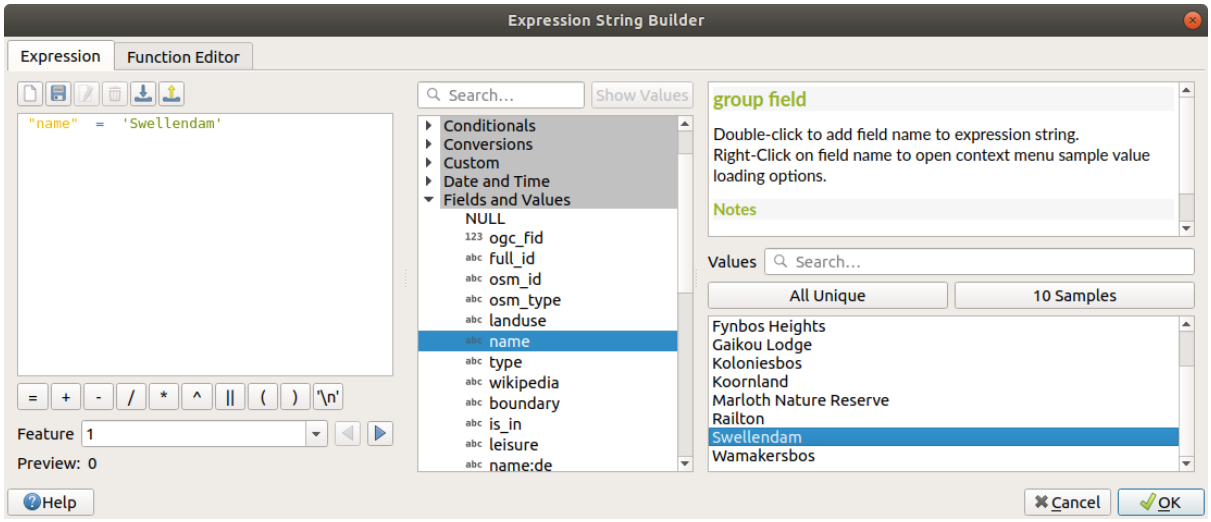
   QGIS will automatically show the rules that represent the current classification implemented for this layer. For example, after completing the exercise above, you may see something like this:



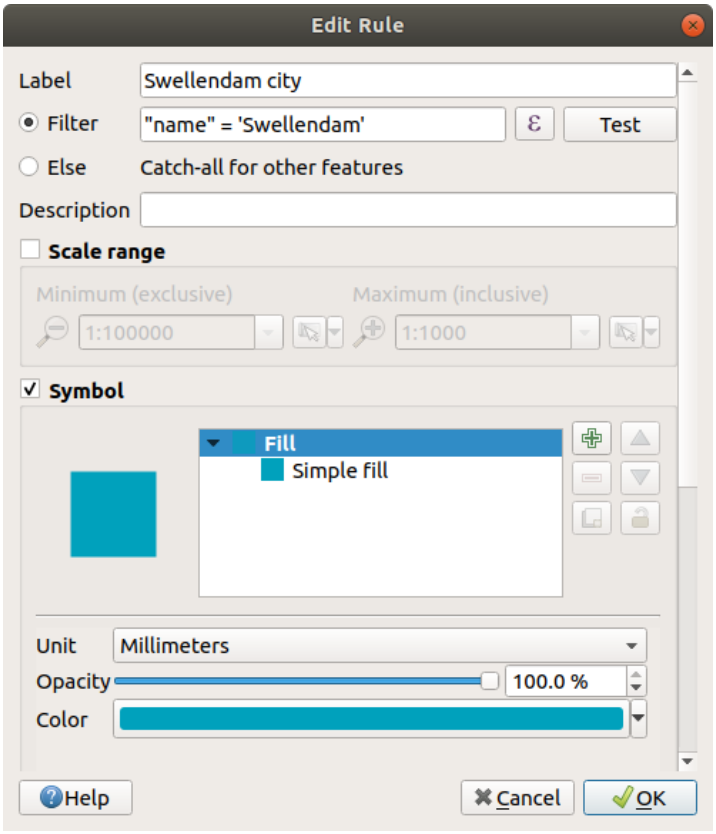
4. Click and drag to select all the rules
5. Use the Remove selected rules button to remove all of the existing rules

Let's now add our custom rules.

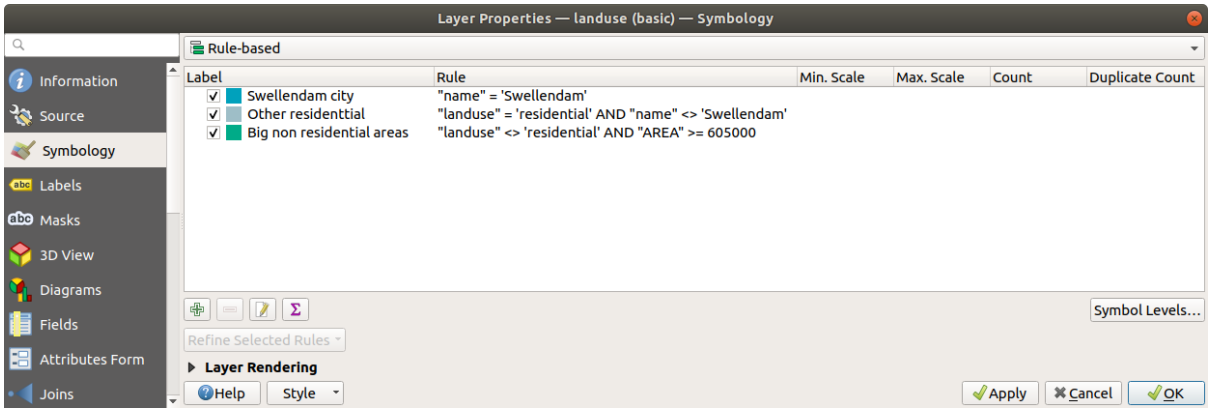
1. Click the Add rule button
2. The *Edit rule* dialog then appears
3. Enter `Swellendam city` as *Label*
4. Click the button next to the *Filter* text area to open the *Expression String Builder*
5. Enter the criterion `"name" = 'Swellendam'` and validate



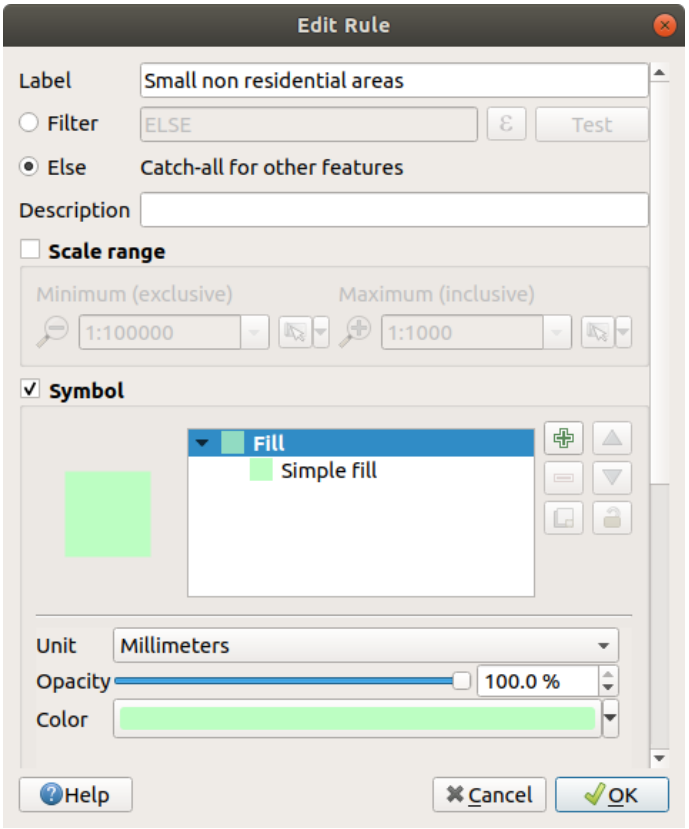
6. Back to the *Edit rule* dialog, assign it a darker grey-blue color in order to indicate the town's importance in the region and remove the border



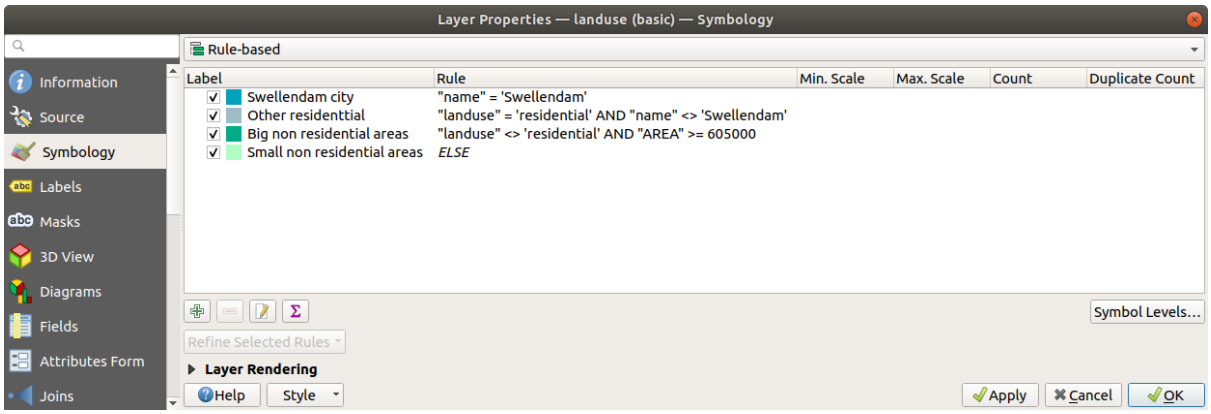
7. Apăsați pe *OK*
8. Repeat the steps above to add the following rules:
    1. **Other residential** label with the criterion `"landuse" = 'residential' AND "name" <> 'Swellendam'`. Choose a pale blue-grey *Fill color*
    2. **Big non residential areas** label with the criterion `"landuse" <> 'residential' AND "AREA" >= 605000`. Choose a mid-green color.



    These filters are exclusive, in that they exclude areas on the map (non-residential areas which are smaller than 605000 (square meters) are not included in any of the rules).
    3. We will catch the remaining features using a new rule labeled **Small non residential areas**. Instead of a filter expression, Check the  *Else*. Give this category a suitable pale green color.



Your rules should now look like this:



9. Apply this symbology

Harta dvs. va arăta în felul următor:



Acum aveți o hartă cu cele mai notabile zone rezidențiale din Swellendam și cu alte zone, non-rezidențiale, colorate în funcție de dimensiunea lor.

3.3.6 În concluzie

Simbologia ne permite să reprezentăm atributele unui strat într-un mod ușor de citit. Ne facilitează atât nouă, cât și utilizatorului hărții, înțelegerea semnificației entităților, utilizând atributele relevante alese. În funcție de problemele cu care ne confruntăm, vom aplica diferite tehnici de clasificare pentru a le rezolva.

3.3.7 Ce urmează?

Acum avem o hartă cu un aspect plăcut, dar oare cum o vom exporta din QGIS, într-un format tipăribil, ca imagine sau ca PDF? Asta e tema următoarei lecții!

CAPITOLUL 4

Module: Laying out the Maps

În acest modul, veți învăța cum să gestionați compozițiile imprimabile QGIS, dotate cu toate elementele necesare pentru a produce hărți de calitate.

4.1 Lesson: Using Print Layout

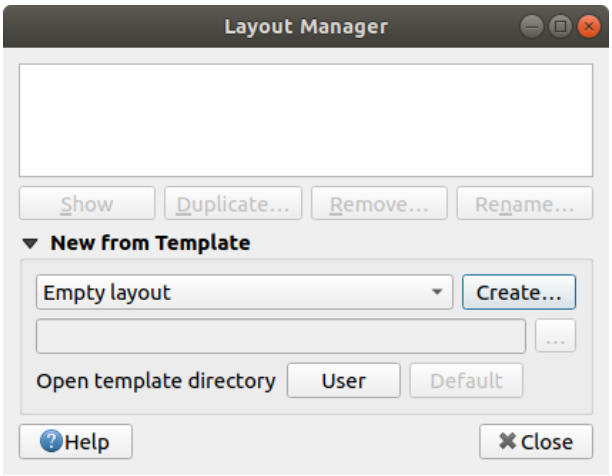
Now that you've got a map, you need to be able to print it or to export it to a document. The reason is, a GIS map file is not an image. Rather, it saves the state of the GIS program, with references to all the layers, their labels,colors, etc. So for someone who doesn't have the data or the same GIS program (such as QGIS), the map file will be useless. Luckily, QGIS can export its map file to a format that anyone's computer can read, as well as printing out the map if you have a printer connected. Both exporting and printing is handled via the *Print Layout*.

The goal for this lesson: To use the QGIS *Print Layout* to create a basic map with all the required settings.

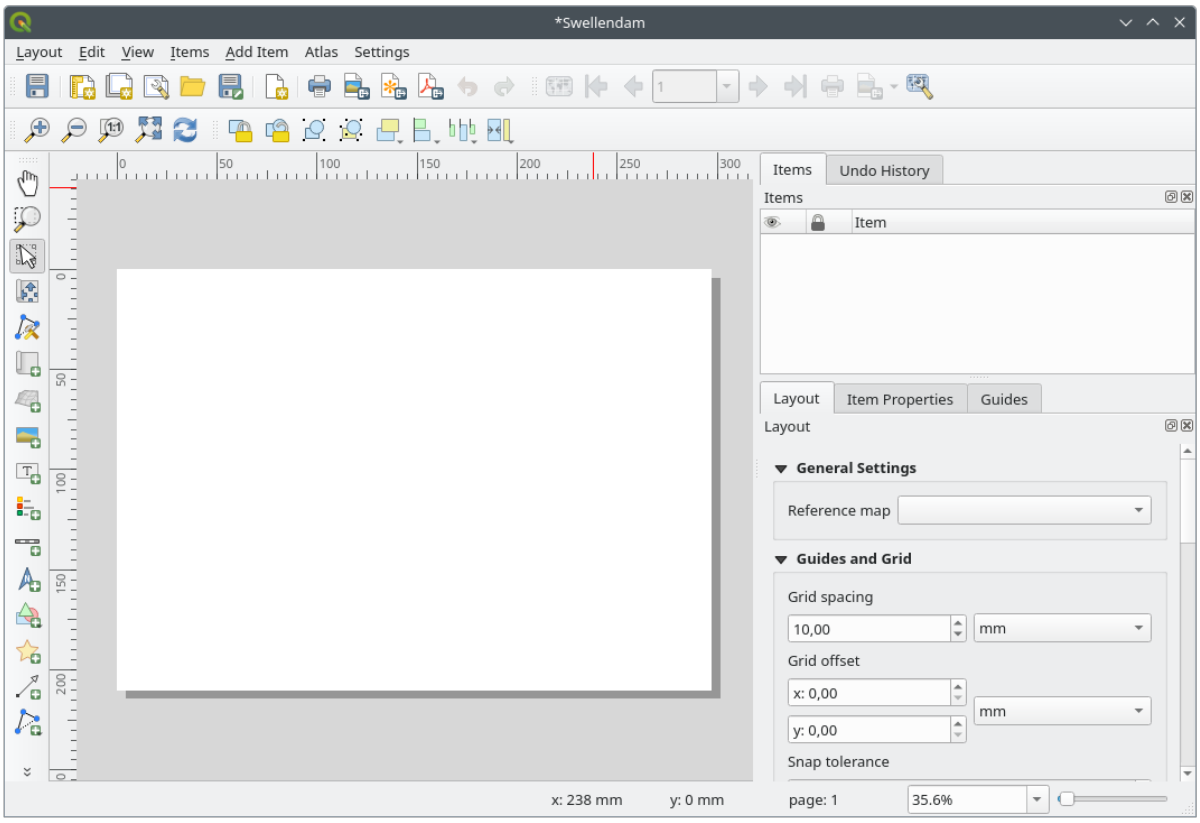
4.1.1 ??? Follow Along: The Layout Manager

QGIS allows you to create multiple maps using the same map file. For this reason, it has a tool called the *Layout Manager*.

1. Click on the *Project* ► *Layout Manager…* menu entry to open this tool. You'll see a blank *Layout manager* dialog appear.

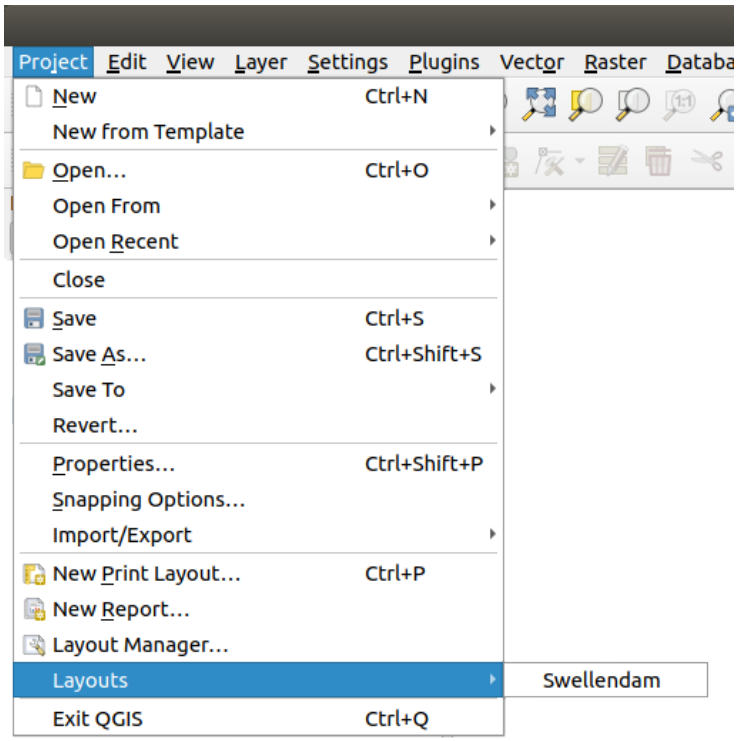


2. Under *New from Template*, select *Empty layout* and press the *Create…* button.
3. Give the new layout the name of Swellendam and click *OK*.
4. You will now see the *Print Layout* window:



You could also create this new layout via the *Project* ► *New Print Layout…* menu.

Whichever route you take, the new print layout is now accessible from the *Project* ► *Layouts* ► menu, as in the image below.



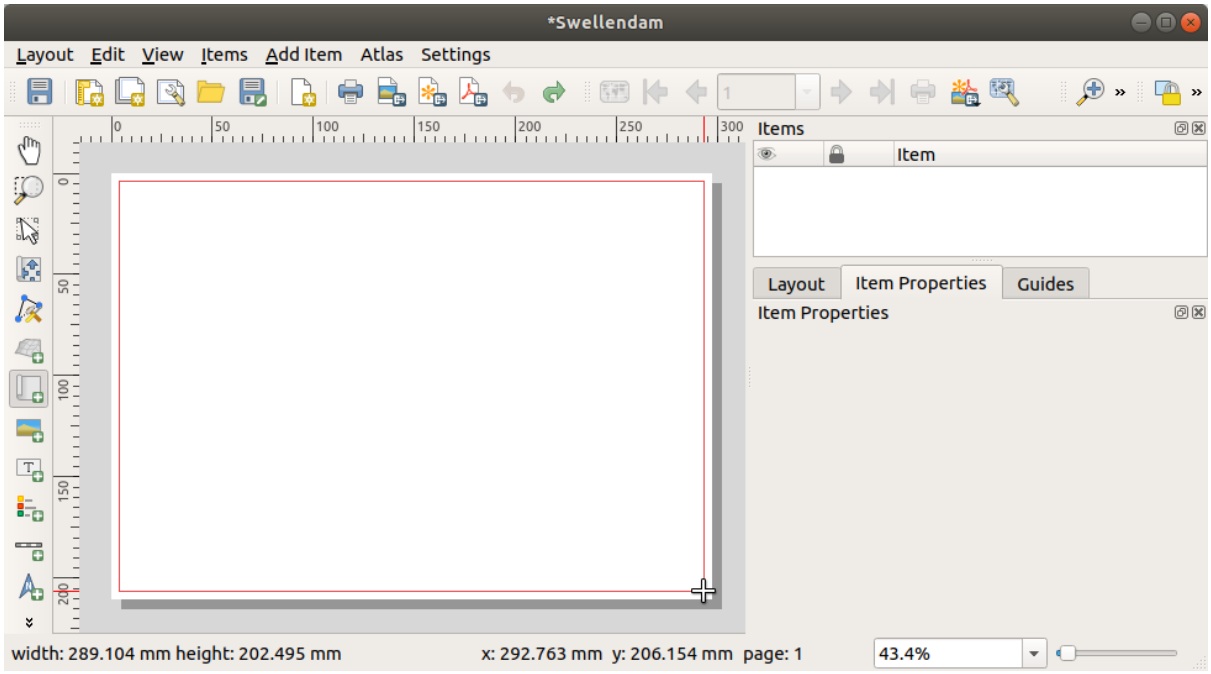
4.1.2 ??? Follow Along: Basic Map Composition

În acest exemplu, compoziția arată deja în modul dorit. Asigurați-vă că și a dvs. arată așa cum ați intenționat.

1. Right-click on the sheet in the central part of the layout window and choose *Page properties...* in the context menu.
2. Check that the values in the *Item Properties* tab are set to the following:
   - *Size*: `A4`
   - *Orientation*: `Landscape`

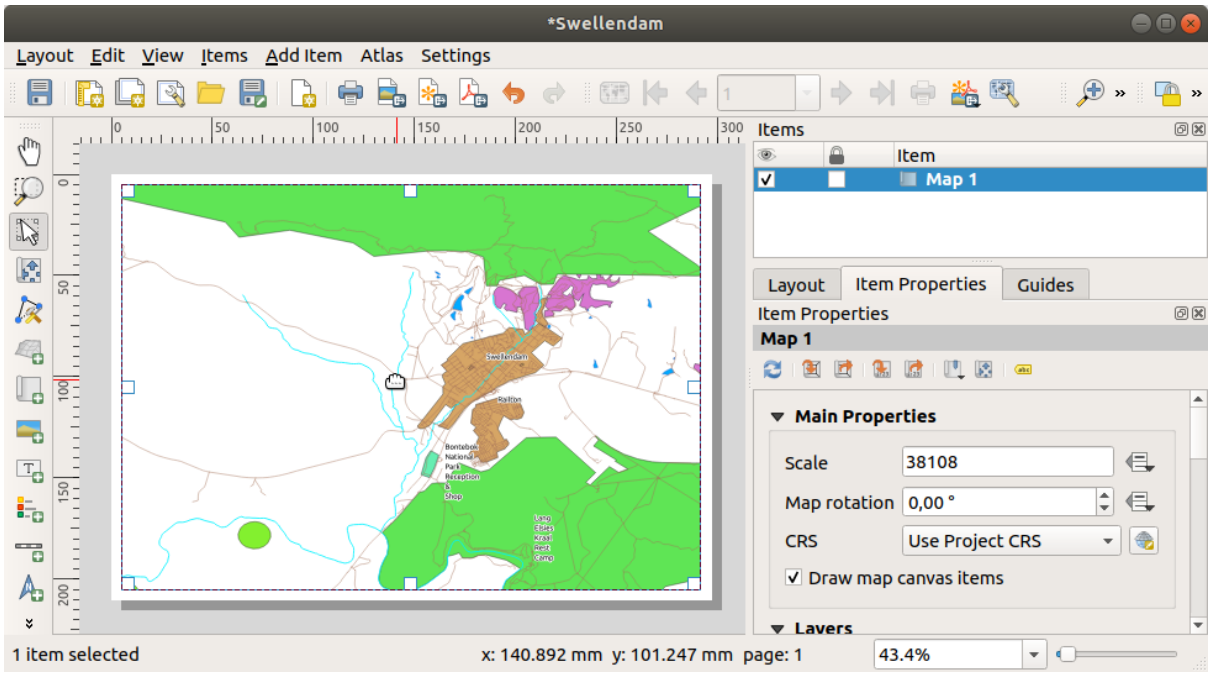
   Acum aveți aspectul paginii pe care l-ați dorit, dar această pagină este în continuare neagră. Îi lipsește în mod clar o hartă. Haideți să reparăm asta!
3. Click on the  Add Map button.

   With this tool activated, you will be able to place a map on the page.
4. Faceți clic și trasați un dreptunghi pe pagina albă:

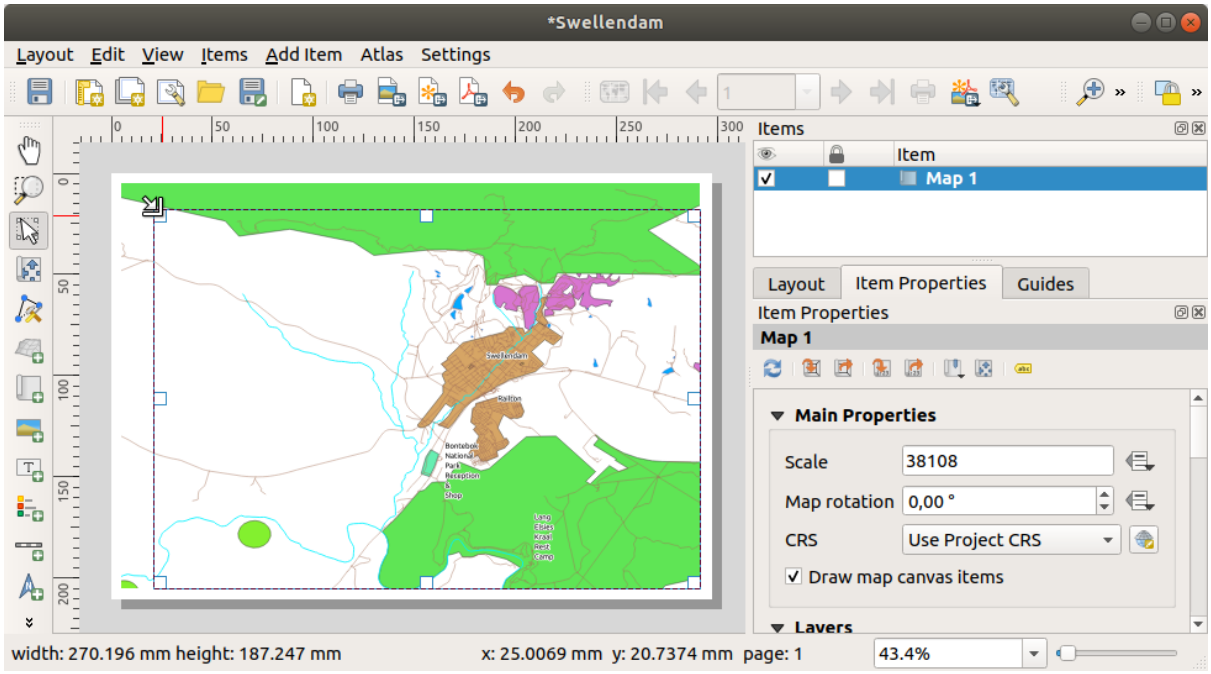


Harta va apărea pe pagină.

5. Deplasați harta făcând clic și mișcând-o după dorință:



6. Resize it by clicking and dragging the boxes on the edges:



Notă

Harta poate să prezinte un lot diferit, desigur! Acest lucru depinde de modul în care este configurat propriul proiect. Dar nu vă faceți griji! Aceste instrucțiuni sunt generale, astfel încât ele vor lucra la fel, indiferent de ceea ce se afișează pe hartă.

7. Asigurați-vă că lăsați marginile în jurul conturului, și un spațiu în partea de sus pentru titlu.
8. Măriți și micșorați pagina (dar nu și harta!) folosind aceste butoane:

9. Zoom and pan the map in the main QGIS window. You can also pan the map using the  Move item content tool.

   The map view updates as you zoom in or zoom out.

10. If, for any reason, the map view does not refresh correctly, you can force the map to refresh by clicking the  Refresh view button.

    Remember that the size and position you've given the map doesn't need to be final. You can always come back and change it later if you're not satisfied. For now, you need to ensure that you've saved your work on this map. Because a *Print Layout* in QGIS is part of the main map file, you must save your project.

11. Go to the *Layout* ►  *Save Project*. This is a convenient shortcut to the one in the main dialog.

4.1.3 ??? Follow Along: Adding a Title

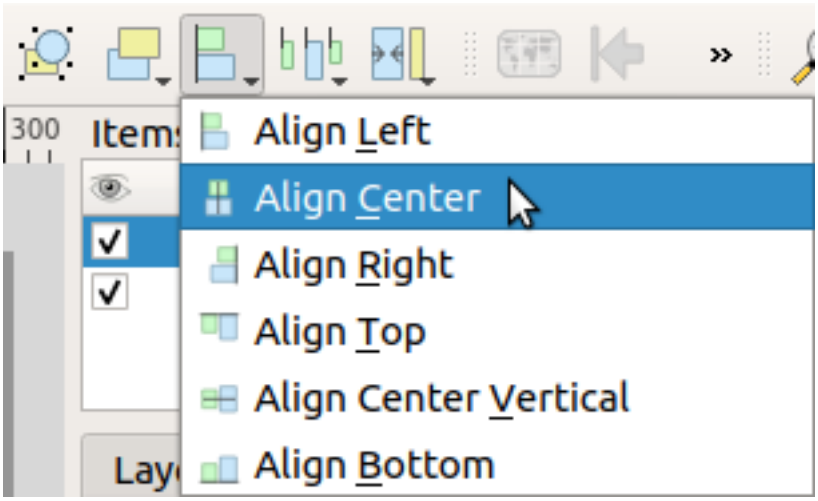
Now your map is looking good on the page, but your readers/users are not being told what's going on yet. They need some context, which is what you'll provide for them by adding map elements. First, let us add a title.

1. Click on the  Add Label button
2. Click on the page, above the map, accept the suggested values in the *New Item Properties* dialog, and a label will appear at the top of the map.
3. Redimensionați-o și puneți-o în partea centrală, de sus, a paginii. Aceasta poate fi redimensionată și mutată în același mod în care se redimensionează și se mută harta.

   Pe măsură ce mutați titlul, veți observa că liniile directoare apar pentru a vă ajuta să-l poziționați în centrul paginii.

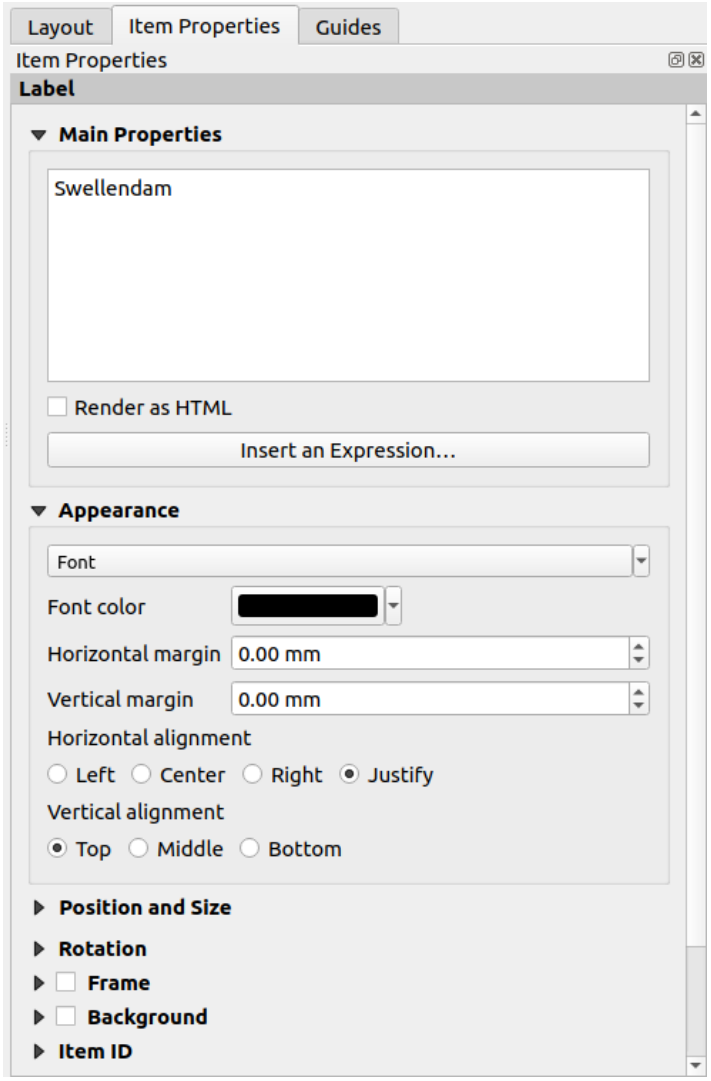
   However, there is also a tool in the Actions Toolbar to help position the title relative to the map (not the page):

   
4. Click the map to select it
5. Hold in `Shift` on your keyboard and click on the label so that both the map and the label are selected.
6. Look for the  Align selected items left button and click on the dropdown arrow next to it to reveal the positioning options and click  *Align center*:



   Now the label frame is centered on the map, but not the contents. To center the contents of the label:

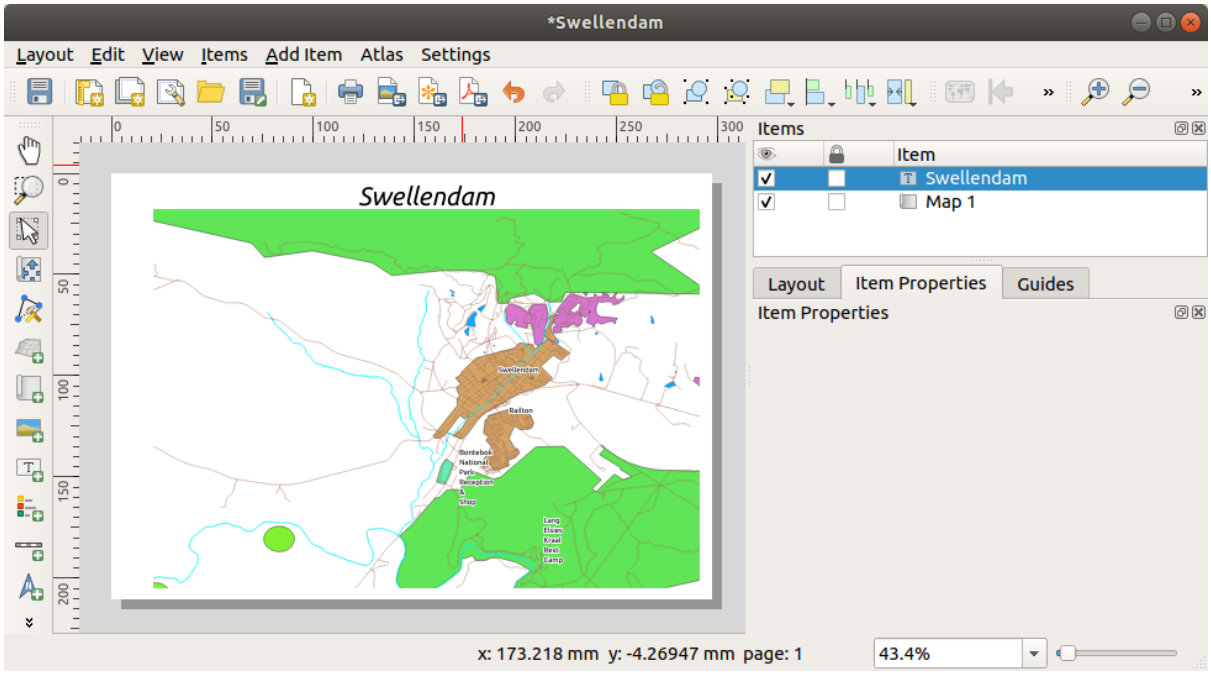
   1. Selectați eticheta făcând clic pe ea.
   2. Click on the *Item Properties* tab in the side panel of the layout window.
   3. Modificați textul etichetei în „Swellendam”:



4. Use this interface to set the font and alignment options under the *Appearance* section:
    1. Choose a large but sensible font (the example will use the default font with a size of `36`)
    2. Set the *Horizontal Alignment* to *Center*.

    De asemenea, puteți schimba culoarea fontului, dar probabil că cel mai bine este să-l păstrați negru, așa cum este în mod implicit.
5. Setarea implicită nu adăugă un cadru casetei de text a titlului. Cu toate acestea, dacă doriți să adăugați un cadru, puteți proceda astfel:
    1. În fila *Proprietăților elementului*, derulați caseta verticală până veți vedea opțiunea *Frame*.
    2. Clic pe caseta *Frame* pentru a activa cadrul. Puteți schimba culoarea cadrului și lățimea.

În acest exemplu, nu vom activa rama, așa că aceasta este pagina noastră de până acum:



To make sure that you don't accidentally move these elements around now that you've aligned them, you can lock items into place:

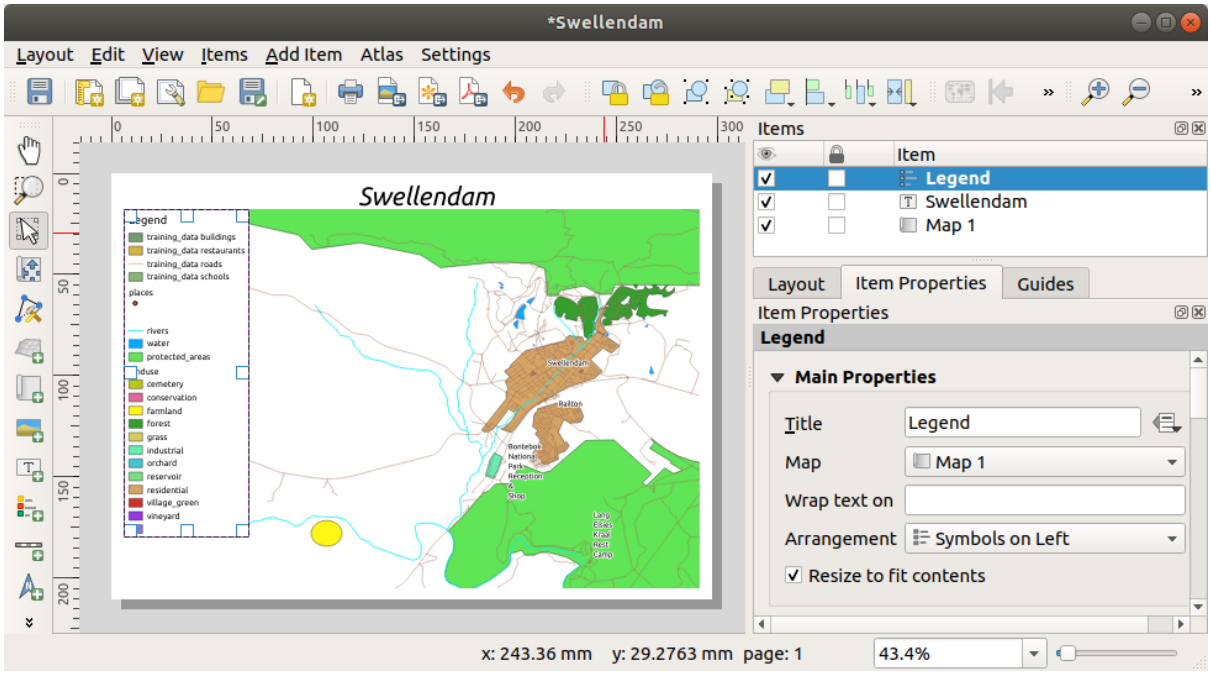
1. Select both the label and the map items
2. Click the Lock Selected Items button in the *Actions* Toolbar.

> **Notă**
>
> Click the Unlock All Items button in the *Actions* Toolbar to be able to edit the items again.

4.1.4 ??? Follow Along: Adding a Legend

The map reader also needs to be able to see what various things on the map actually mean. In some cases, like the place names, this is quite obvious. In other cases, it's more difficult to guess, like the colors of the forests. Let's add a new legend.

1. Click on the Add Legend button
2. Click on the page to place the legend, accept the suggested values in the *New Item Properties* dialog,
3. A legend is added to the layout page, showing layers symbology as set in the main dialog.
4. As usual, you can click and move the item to where you want it:



4.1.5 ??? Follow Along: Customizing Legend Items

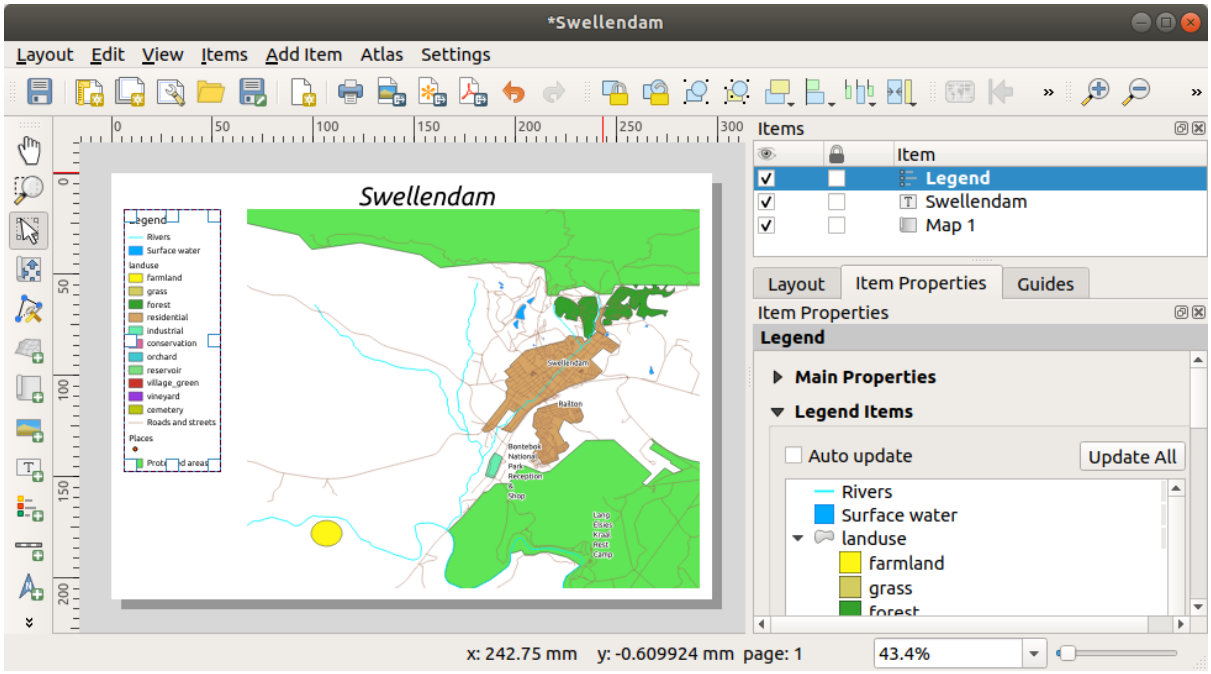
Nu este chiar totul necesar în legendă, deci, să eliminăm unele elemente nedorite.

1. In the *Item Properties* tab, you'll find the *Legend items* group.
2. Uncheck the *Auto update* box, allowing you to directly modify the legend items
3. Select the entry with *buildings*
4. Delete it from the legend by clicking the button

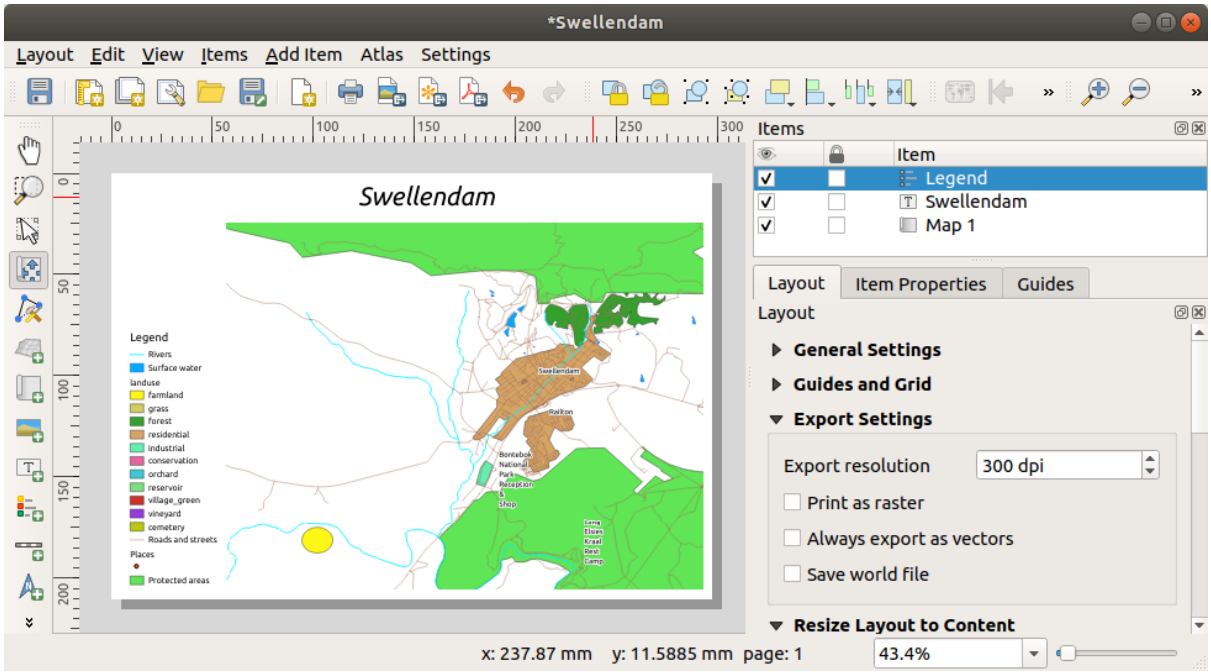
Puteți redenumi, de asemenea, elementele.

1. Selectați un strat din aceeași listă.
2. Click the Edit selected item properties button.
3. Rename the layers to `Places`, `Roads and Streets`, `Surface Water`, and `Rivers`.

You can also reorder the items:



Pe măsură ce legenda va fi probabil extinsă cu noile nume de straturi, ați putea dori să mutați și să redimensionați legenda și/sau harta. Acesta este rezultatul:



4.1.6 ??? Follow Along: Exporting Your Map

> **Notă**
>
> Ți-ai amintit să vă salvați munca adesea?

Finally the map is ready for export! You'll see the export buttons near the top left corner of the layout window:

-  Print Layout: interfaces with a printer. Since the printer options will differ depending on the model of printer that you're working with, it's probably better to consult the printer manual or a general guide to printing for more information on this topic.

  The other buttons allow you to export the map page to a file.

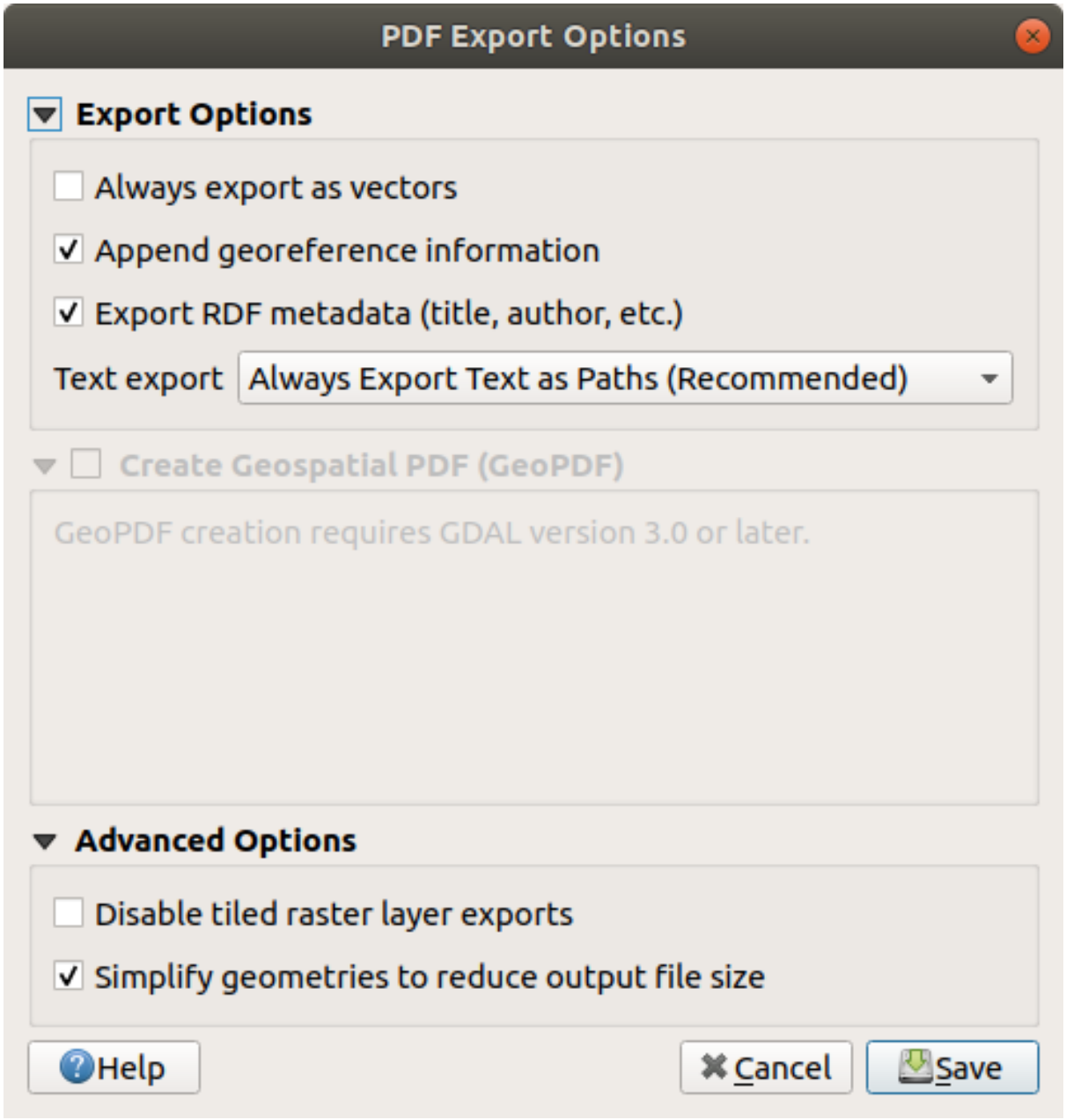
-  Export as Image: gives you a selection of various common image formats to choose from. This is probably the simplest option, but the image it creates is „dead" and difficult to edit.

-  Export as SVG: If you're sending the map to a cartographer (who may want to edit the map for publication), it's best to export as an SVG. SVG stands for „Scalable Vector Graphic", and can be imported to programs like Inkscape or other vector image editing software.

-  Export as PDF: If you need to send the map to a client, it's most common to use a PDF, because it's easier to set up printing options for a PDF. Some cartographers may prefer PDF as well, if they have a program that allows them to import and edit this format.

Pentru scopurile noastre, vom folosi PDF.

1. Click the  Export as PDF button
2. Choose a save location and a file name as usual. The following dialog will show up.



3. You can safely use the default values now and click *Save*.

   QGIS will proceed to the map export and push a message on top of the print layout dialog as soon as it finishes.

4. Click the hyperlink in the message to open the folder in which the PDF has been saved in your system's file manager

5. Open it and see how your layout looks.

   Everything is OK? Congratulations on your first completed QGIS map project!

6. Anything unsatisfying? Go back to the QGIS window, do the appropriate modifications and export again.

7. Remember to save your project file.

4.1.7 În concluzie

Now you know how to create a basic static map layout. We can go a step further and create a map layout that adapts dynamically, with more layout items.

4.2 Lesson: Creating a Dynamic Print Layout

Now that you have learned to create a basic map layout we go a step further and create a map layout that adapts dynamically to our map extent and to the page properties, e.g. when you change the size of the page. Also, the date of creation will adapt dynamically.

4.2.1 ??? Follow Along: Creating the dynamic map canvas

1. Load the ESRI Shapefile format datasets `protected_areas.shp`, `places.shp`, `rivers.shp` and `water.shp` into the map canvas and adapt its properties to suit your own convenience.
2. After everything is rendered and symbolized to your liking, click the  New Print Layout icon in the *Project* toolbar or choose *Project* ►  *New Print Layout*. You will be prompted to choose a title for the new print layout.
3. We want to create a map layout consisting of a header and a map of the region near Swellendam, South Africa. The layout should have a margin of 7.5 mm and the header should be 36mm high.
4. Create a map item called `main map` on the canvas and go to the *Layout* panel. Scroll down to the *Variables* section and find the *Layout* part. Here we set some variables you can use all over the dynamic print layout. Go to the *Layout* panel and scroll down to the *Variables* section. The first variable will define the margin. Press the  button and type in the name `sw_layout_margin`. Set the value to `7.5`. Press the  button again and type in the name `sw_layout_height_header`. Set the value to `36`.
5. Now you are ready to create the position and the size of the map canvas automatically by means of the variables. Make sure that your map item is selected, go to the *Item Properties* panel, scroll down to and open the *Position and Size* section. Click the  Data defined override for *X* and from the *Variables* entry, choose `@sw_layout_margin`.
6. Click the  Data defined override for *Y*, choose *Edit…* and type in the formula:

```
to_real(@sw_layout_margin) + to_real(@sw_layout_height_header)
```

7. You can create the size of the map item by using the variables for *Width* and *Height*. Click the  Data defined override for *Width* and choose *Edit …* again. Fill in the formula:

```
@layout_pagewidth - @sw_layout_margin * 2
```

Click the  Data defined override for *Height* and choose *Edit ….* Here fill in the formula:

```
@layout_pageheight - @sw_layout_height_header - @sw_layout_margin * 2
```

8. We will also create a grid containing the coordinates of the main canvas map extent. Go to *Item Properties* again and choose the *Grids* section. Insert a grid by clicking the  button. Click on *Modify grid …* and set the *Interval* for *X*, *Y* and *Offset* according to the map scale you chose in the QGIS main canvas. The *Grid type Cross* is very well suited for our purposes.

4.2.2 ??? Follow Along: Creating the dynamic header

1. Insert a rectangle which will contain the header with the Add Shape button. In the *Items* panel enter the name `header`.
2. Again, go to the *Item Properties* and open the *Position and Size* section. Using Data defined override, choose the `sw_layout_margin` variable for *X* as well as for *Y*. *Width* shall be defined by the expression:

   ```
   @layout_pagewidth - @sw_layout_margin * 2
   ```

   and *Height* by the `sw_layout_height_header` variable.
3. We will insert a horizontal line and two vertical lines to divide the header into different sections using the Add Node Item. Create a horizontal line and two vertical lines and name them `Horizontal line`, `Vertical line 1` `Vertical line 2`.
   1. For the horizontal line:
      1. Set *X* to the variable `sw_layout_margin`
      2. Set the expression for *Y* to:

         ```
         @sw_layout_margin + 8
         ```

      3. Set the expression for *Width* to:

         ```
         @layout_pagewidth -  @sw_layout_margin * 3 - 53.5
         ```

   2. For the first vertical line:
      1. Set the expression for *X* to:

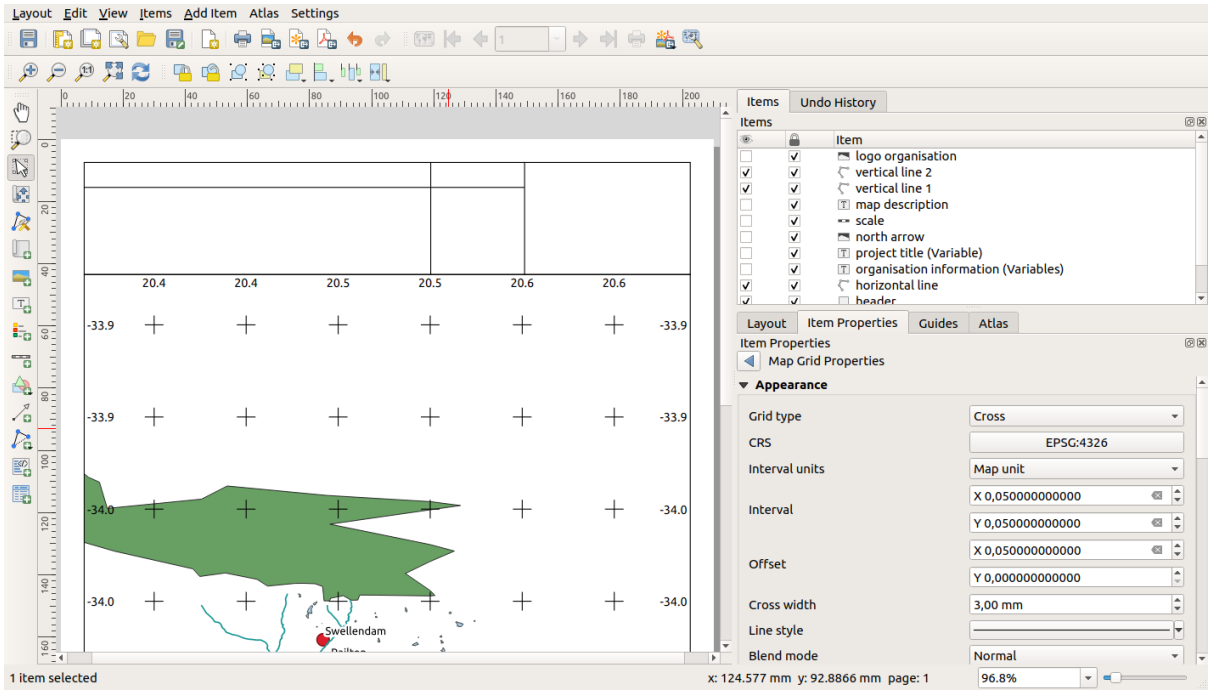
         ```
         @layout_pagewidth - @sw_layout_margin * 2 - 53.5
         ```

      2. Set *Y* to the variable `sw_layout_margin`
      3. The height must be the same as the header we created, so set *Height* to the variable `sw_layout_height_header`.
   3. The second vertical line is placed to the left of the first one.
      1. Set the expression for *X* to:

         ```
         @layout_pagewidth - @sw_layout_margin * 2 - 83.5
         ```

      2. Set *Y* to the variable `sw_layout_margin`
      3. The height shall be the same as the other vertical line, so set *Height* to the variable `sw_layout_height_header`.

   The figure below shows the structure of our dynamic layout. We will fill the areas created by the lines with some elements.



4.2.3 ??? Follow Along: Creating labels for the dynamic header

1. The title of your QGIS project can be included automatically. The title is set in the *Project Properties*. Insert a label with the Add Label button and enter the name `project title (variable)`. In the *Main Properties* of the *Items Properties* Panel enter the expression:

```
[%@project_title%]
```

   Set the position of the label.

   1. For *X*, use the expression:

```
@sw_layout_margin + 3
```

   2. For *Y*, use the expression:

```
@sw_layout_margin + 0.25
```

   3. For *Width*, use the expression:

```
@layout_pagewidth - @sw_layout_margin *2 - 90
```

   4. Enter `11.25` for *Height*

   Under *Appearance* set the Font size to 16 pt.

2. The second label will include a description of the map you created. Again, insert a label and name it `map description`. In the *Main Properties* enter the text `map description`. In the *Main Properties* we will also include:

```
printed on: [%format_date(now(),'dd.MM.yyyy')%]
```

   Here we used two `Date and Time` functions (`now` and `format_date`).

   Set the position of the label.

   1. For *X*, use the expression:

```
@sw_layout_margin + 3
```

2. For *Y*, use the expression:

```
@sw_layout_margin + 11.5
```

3. The third label will include information about your organisation. First we will create some variables in the *Variables* menu of the *Item Properties*. Go to the *Layout* menu, click the  button each time and enter the names `o_department`, `o_name` , `o_adress` and `o_postcode`. In the second row enter the information about your organisation. We will use these variables in the *Main Properties* section.

   In *Main Properties* enter:

```
[% @o_name %]
[% @o_department %]
[% @o_adress %]
[% @o_postcode %]
```

   Set the position of the label.

   1. For *X*, use the expression:

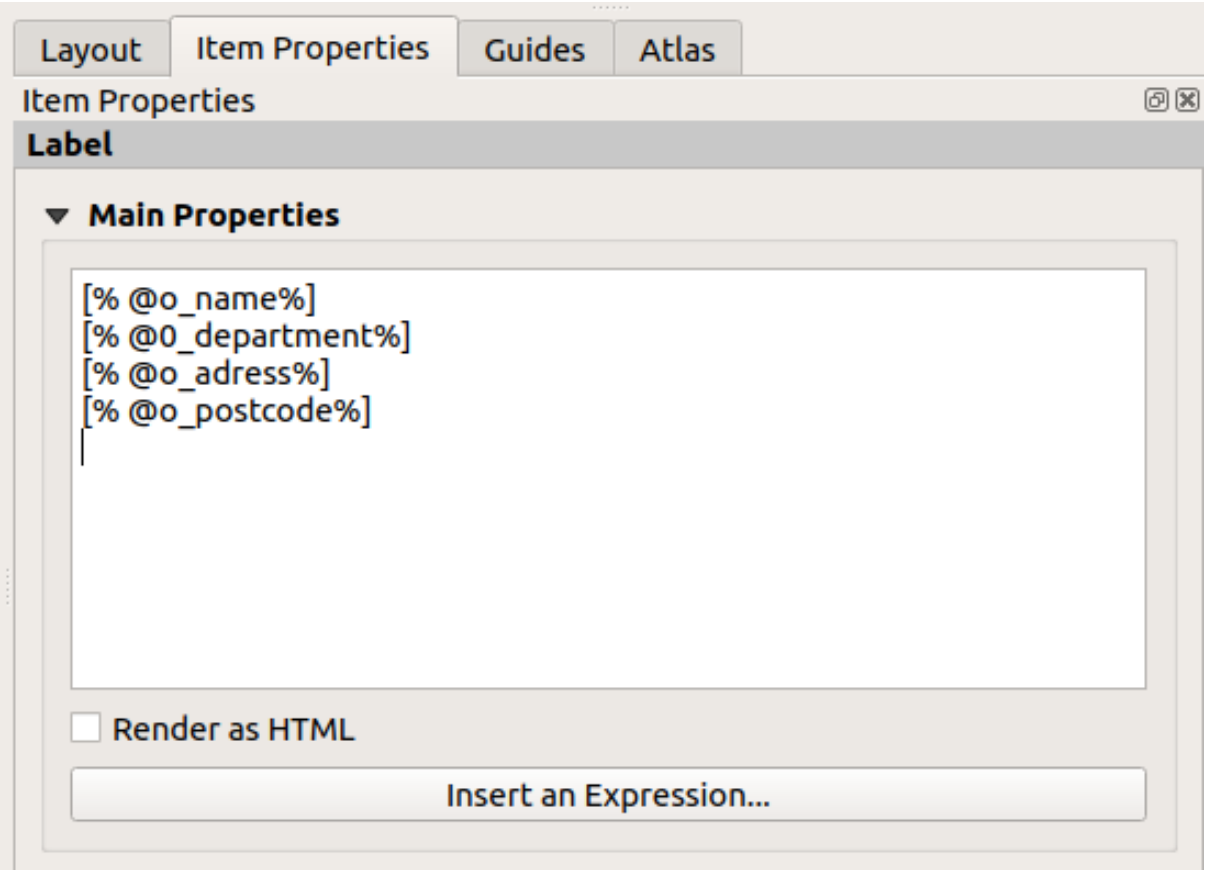
```
@layout_pagewidth - @sw_layout_margin - 49.5
```

   2. For *Y*, use the expression:

```
@sw_layout_margin + 15.5
```

   3. For *Width*, use `49.00`
   4. For *Height*, use the expression:

```
@sw_layout_height_header - 15.5
```



4.2.4 ??? Follow Along: Adding pictures to the dynamic header

1. Use the Add Picture button to place a picture above your label `organisation information`. After entering the name `organisation logo` define the position and size of the logo:
   1. For *X*, use the expression:

      ```
      @layout_pagewidth - @sw_layout_margin - 49.5
      ```

   2. For *Y*, use the expression:

      ```
      @sw_layout_margin + 3.5
      ```

   3. For *Width*, use `39.292`
   4. For *Height*, use `9.583`

   To include a logo of your organisation you have to save your logo under your home directory and enter the path under *Main Properties* ► *Image Source*.

2. Our layout still needs a north arrow. This will also be inserted by using Add North Arrow. We will use the default north arrow. Define the position:
   1. For *X*, use the expression:

      ```
      @layout_pagewidth - @sw_layout_margin * 2 - 78
      ```

   2. For *Y*, use the expression:

      ```
      @sw_layout_margin + 9
      ```

3. For *Width*, use `21.027`
4. For *Height*, use `21.157`

4.2.5 ??? Follow Along: Creating the scalebar of the dynamic header

1. To insert a scalebar in the header click on Add Scale Bar and place it in the rectangle above the north arrow. In *Map* under the *Main Properties* choose your `main map(Map 1)`. This means that the scale changes automatically according to the extent you choose in the QGIS main canvas. Choose the *Style Numeric*. This means that we insert a simple scale without a scalebar. The scale still needs a position and size.
   1. For *X*, use the expression:

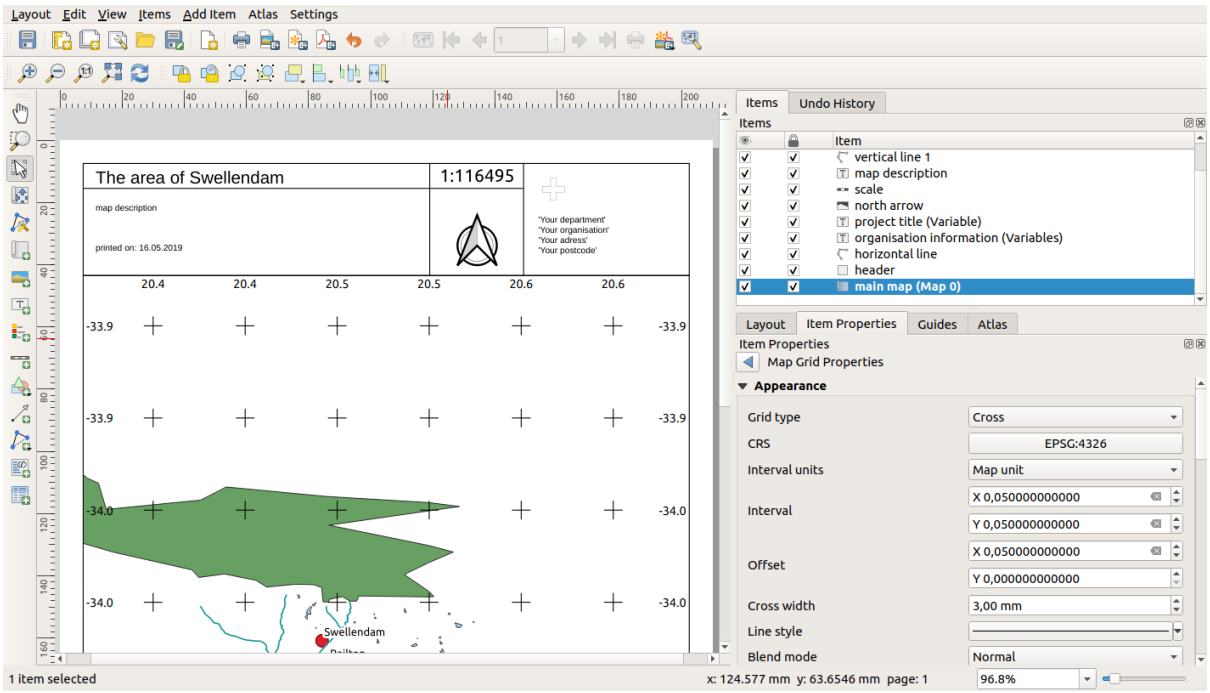
      ```
      @layout_pagewidth - @sw_layout_margin * 2 - 78
      ```

   2. For *Y*, use the expression:

      ```
      @sw_layout_margin + 1
      ```

   3. For *Width*, use `25`
   4. For *Height*, use `8`
   5. Place the `Reference point` in the center.

Congratulations! You have created your first dynamic map layout. Take a look at the layout and check if everything looks the way you want it! The dynamic map layout reacts automatically when you change the *Page Properties*. For example, if you change the page size from DIN A4 to DIN A3, click the Refresh view button and the page design is adapted.



4.2.6 Ce urmează?

On the next page, you will be given an assignment to complete. This will allow you to practice the techniques you have learned so far.

4.3 Exercițiul 1

Deschideți proiectul existent al hărții și revizuiți-l bine. Dacă ați observat mici erori sau lucruri pe care v-ar fi plăcut să le remediați mai devreme, faceți acest lucru acum.

În timp ce personalizați harta, puneți-vă întrebări. Este ușor de citit și de înțeles această hartă pentru cineva care nu este familiarizat cu datele respective? Dacă ați vedea această hartă pe Internet, pe un poster sau într-o revistă, v-ar capta atenția? V-ar interesa această hartă în cazul în care nu v-ar aparține?

If you're doing this course at a ★☆☆ Basic or ★★☆ Intermediate level, read up on techniques from the more advanced sections. If you see something you'd like to do in your map, why not try to implement it?

Dacă acest curs vă este prezentat, lectorul cursul vă poate cere să prezentați o versiune finală a hărții dvs., exportate în format PDF, pentru evaluare. Dacă urmați acest curs în mod individual, este recomandabil să vă evaluați propria hartă utilizând aceleași criterii. Harta dvs. va fi evaluată pentru aspectul general și simbolistica proprie, precum și pentru aspectul și așezarea în pagină a hărții și a elementelor. Amintiți-vă că, la evaluarea hărților, accentul se va pune întotdeauna pe *ușurința în utilizare*. Cu cât este mai frumoasă harta, cu atât este mai ușor să o înțelegeți dintr-o privire.

Personalizare plăcută!

4.3.1 În concluzie

Primele patru module v-au învățat cum să creați și să stilizați o hartă vectorială. În următoarele patru module, veți învăța cum să folosiți QGIS pentru o analiză completă GIS. Aceasta va include crearea și editarea datelor vectoriale; analiza lor; utilizarea și analiza datelor raster; și utilizarea GIS pentru a rezolva o problemă de la început până la sfârșit, utilizând atât surse de date raster cât și vectoriale.

CAPITOLUL 5

Module: Creating Vector Data

Crearea hărților folosind datele existente este doar începutul. În acest modul, veți afla cum să modificați datele vectoriale existente, și cum să creați noi seturi de date.

5.1 Lesson: Creating a New Vector Dataset

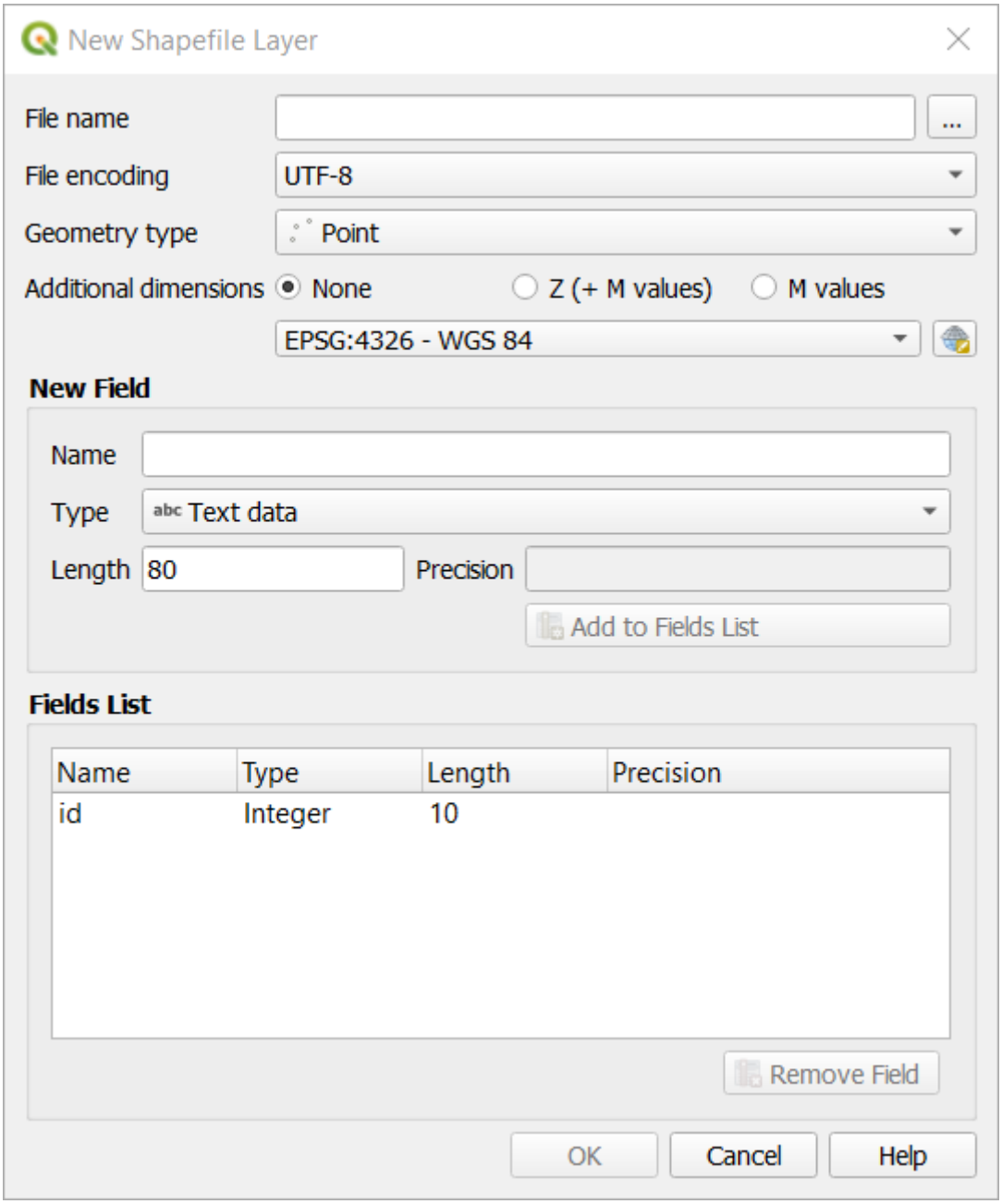
Datele pe care le utlizați trebuie să vină de undeva. Pentru aplicațiile uzuale, datele există deja; dar cu cât proiectul este mai aparte și mai specializat, cu atât scad șansele ca datele să fie disponibile. În asemenea cazuri va fi nevoie să va creați propriile date.

Scopul acestei lecții: De a crea un nou set de date vectoriale.

5.1.1 ??? Follow Along: The Layer Creation Dialog

Înainte de a adăuga date vectoriale noi veți avea nevoie de un set de date la care să le adăugați. În cazul nostru veți începe prin a creea date complet noi, mai degrabă decât să editați un set de date existent. În concluzie, va trebui să începeți prin a crea propriul set de date.

1. Open QGIS and create a new blank project.
2. Navigate to and click on the menu entry *Layer* ► *Create Layer* ► *New Shapefile Layer*. You'll be presented with the *New Shapefile Layer* dialog, which will allow you to define a new layer.

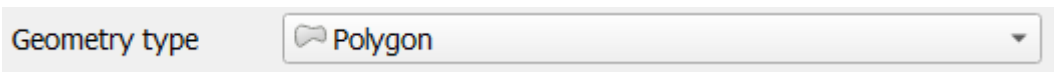


3. Click … for the *File name* field. A save dialog will appear.
4. Navigate to the `exercise_data` directory.
5. Save your new layer as `school_property.shp`.

   Este important să decideți ce fel de set de date doriți. Fiecare tip de strat vectorial este „construit diferit” în fundal, deci odată ce ați creat un strat, nu îi puteți schimba tipul.

   For the next exercise, we're going to create new features which describe areas. For such features, you'll need to create a polygon dataset.

6. For *Geometry Type*, select *Polygon* from the drop down menu:

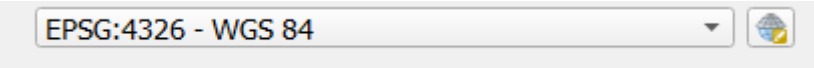


Aceasta nu are nici un impact asupra restului dialogului, dar va determina folosirea tipului corect de geometrie

care să fie utilizat la crearea setului de date vectorial.

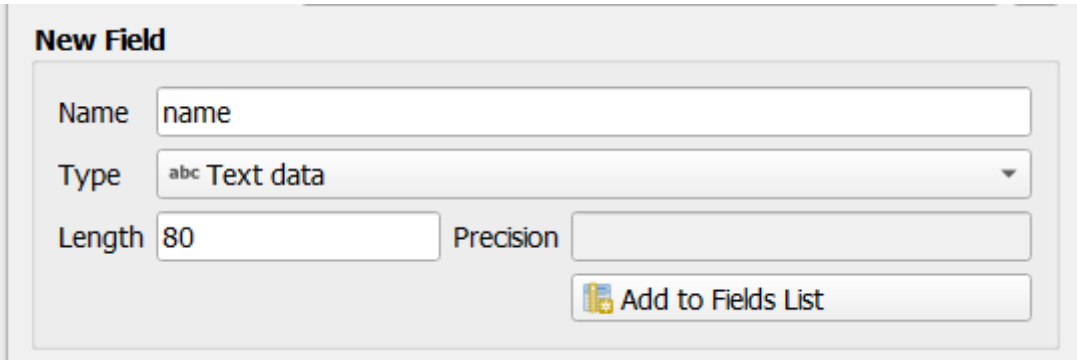
The next field allows you to specify the Coordinate Reference System, or CRS. CRS is a method of associating numerical coordinates with a position on the surface of the Earth. See the User Manual on Working with Projections to learn more.

For this example we will use the default CRS associated with this project, which is WGS84.

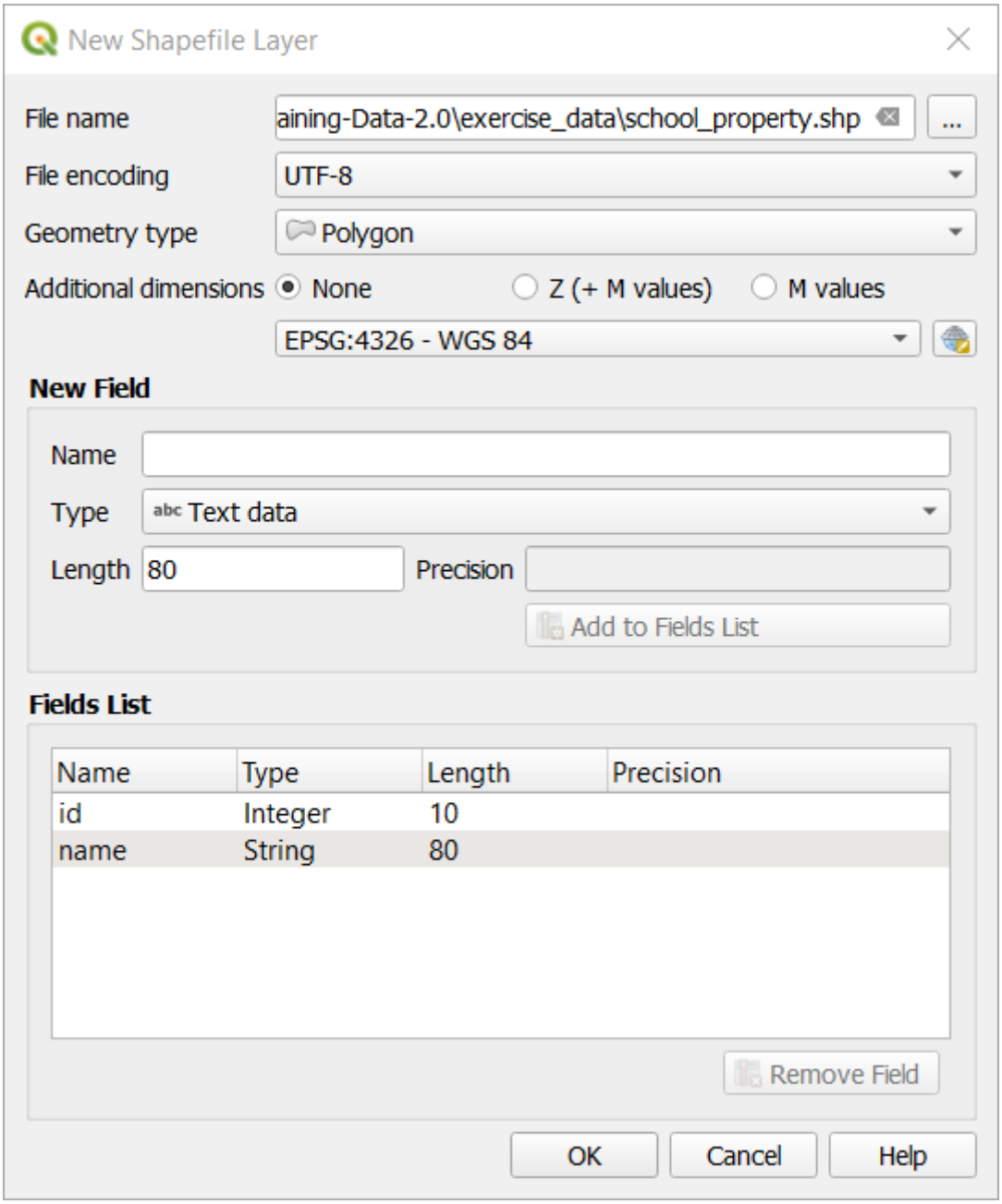


Next there is a collection of fields grouped under *New Field*. By default, a new layer has only one attribute, the `id` field (which you should see in the *Fields list*) below. However, in order for the data you create to be useful, you actually need to say something about the features you'll be creating in this new layer. For our current purposes, it will be enough to add one field called `name` that will hold `Text data` and will be limited to text length of `80` characters.

7. Replicate the setup below, then click the *Add to Fields List* button:



8. Verificați dacă dialogul dvs. arată acum astfel:



9. Clic pe *OK*

The new layer should appear in your *Layers* panel.

5.1.2 Follow Along: Data Sources

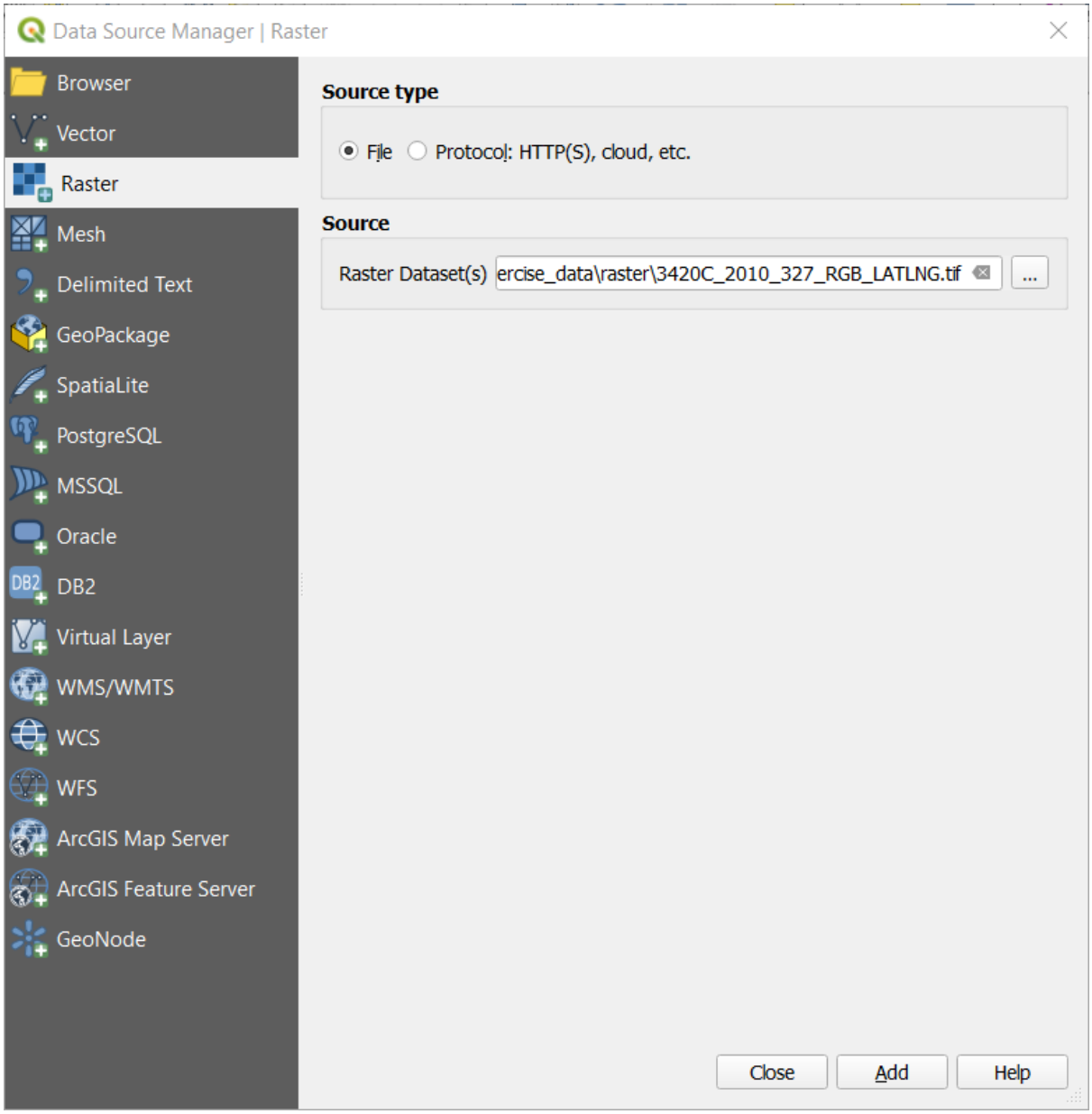
Când creați date noi, este evident necesar să se refere la obiecte care există întradevăr pe teren. De aceea, va fi nevoie să obțineți informația de undeva.

Există multe moduri de a obține date despre obiecte. De exemplu, ați putea folosi un GPS pentru a caputra puncte din lumea reală, după care să importați datele in QGIS. Sau ați putea să identificați punctele folosind un teodolit, după care să introduceți manual coordonatele pentru a crea noi entități.

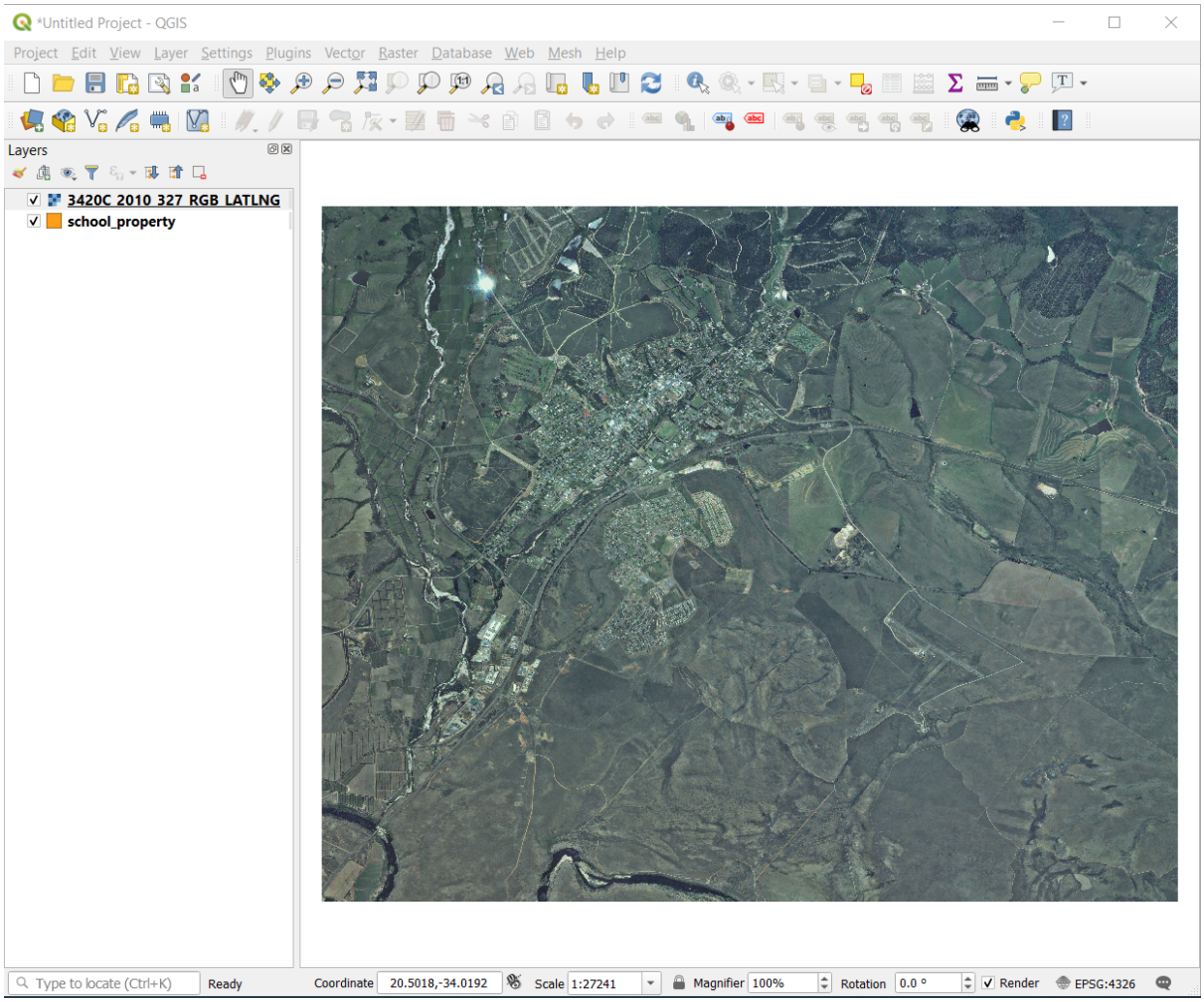
Pentru exemplul nostru, veți folosi digitizarea. Eșantioanele seturilor de date raster vă sunt puse la dispoziție, așa că va trebui să le importați după nevoie.

1. Click on Data Source Manager button.

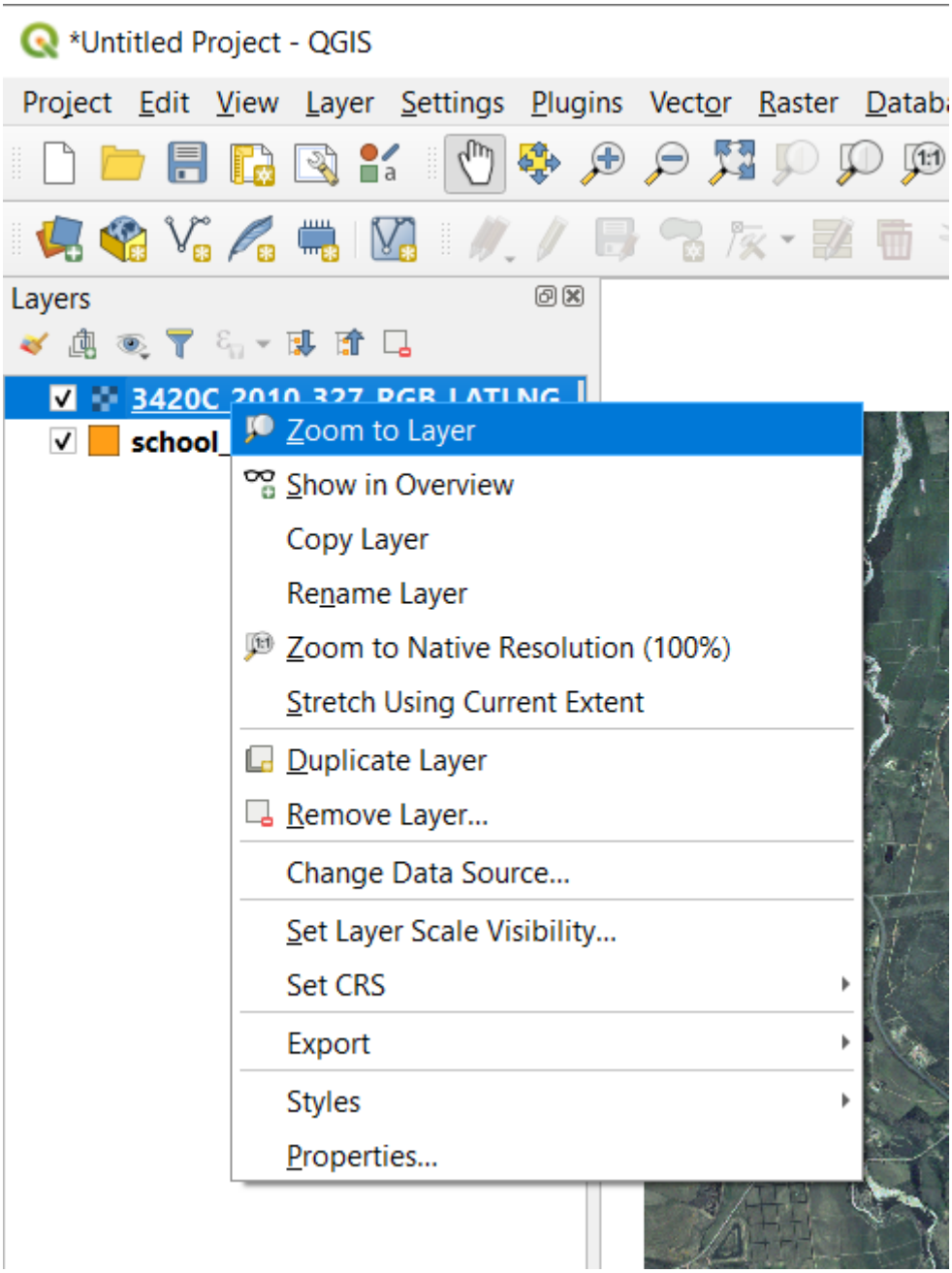
2. Select *Raster* on the left side.
3. In the *Source* panel, click on the … button:
4. Navigate to `exercise_data/raster/`.
5. Selectați fișiereul `3420C_2010_327_RGB_LATLNG.tif`.
6. Click *Open* to close the dialogue window.



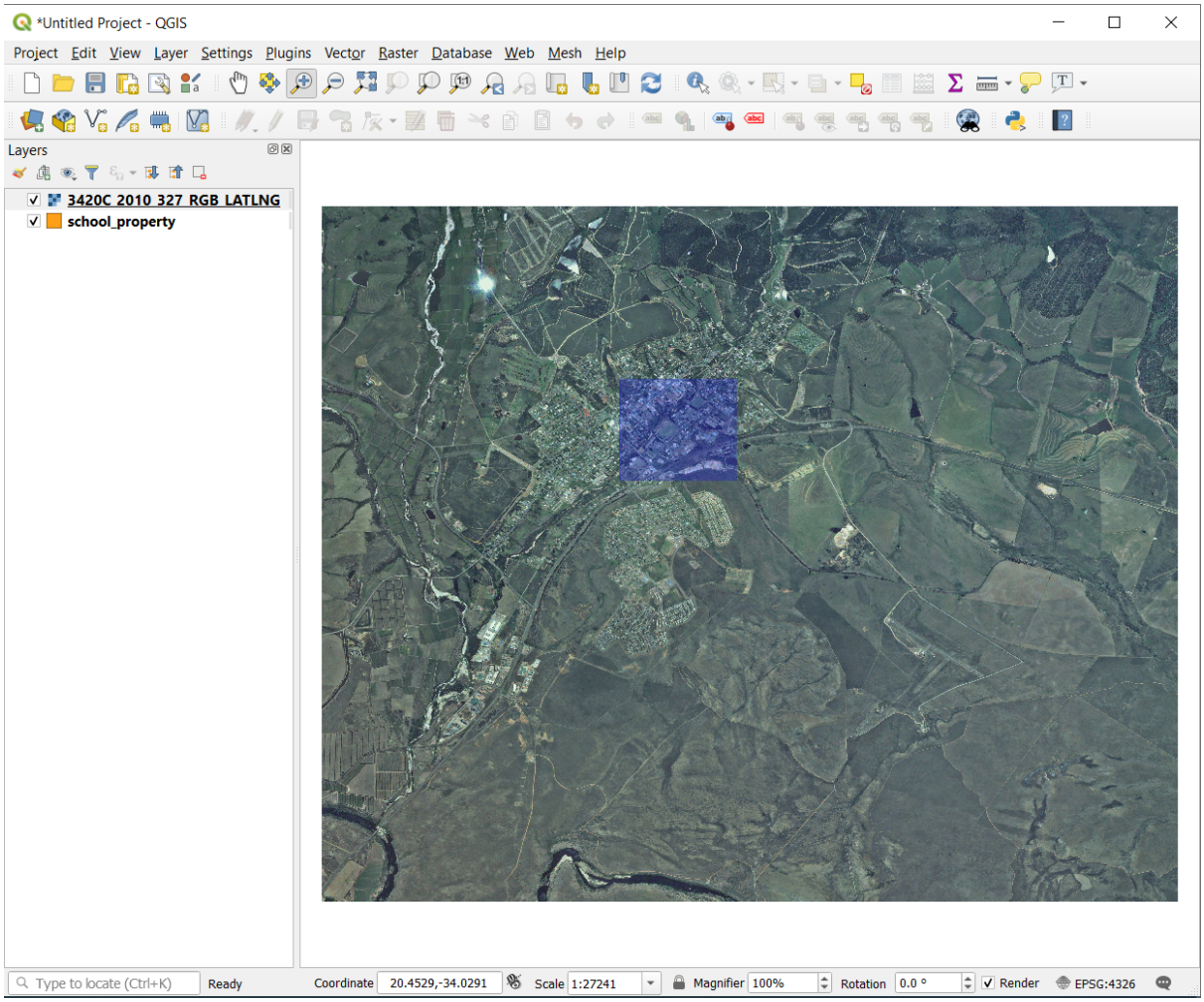
7. Click *Add* and *Close*. An image will load into your map.



8. If you don't see an aerial image appear, select the new layer, right click, and choose *Zoom to Layer* in the context menu.



9. Click on the Zoom In button, and zoom to the area highlighted in blue below:

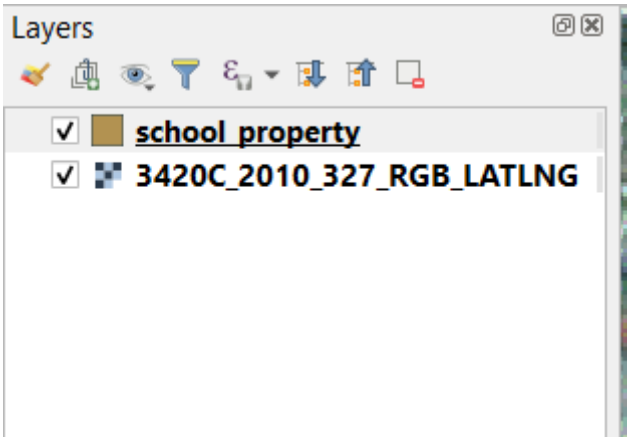


Now you are ready to digitize these three fields:



Before starting to digitize, let's move the `school_property` layer above the aerial image.

1. Select `school_property` layer in the *Layers* pane and drag it to the top.



Pentru a începe digitizarea trebuie să intrați în **modul editare**. Aplicațiile GIS cer asta în mod curent pentru a preveni

modificarea sau ștergerea accidentală a datelor importante. Modul editare este activat sau dezactivat independent pentru fiecare strat.

To enter edit mode for the `school_property` layer:

1. Click on the `school_property` layer in the *Layers* panel to select it.
2. Click on the  Toggle Editing button.

   Dacă nu puteți găsi acest buton, verificați dacă bara de instrumente *Digitizing* este activată. Ar trebui să existe un semn de selectare lângă elementul de meniu *View* ► *Toolbars* ► *Digitizing*.

   As soon as you are in edit mode, you'll see that some digitizing tools have become active:

   -  Capture Polygon
   -  Instrumentul Vertex

   Other relevant buttons are still inactive, but will become active when we start interacting with our new data.

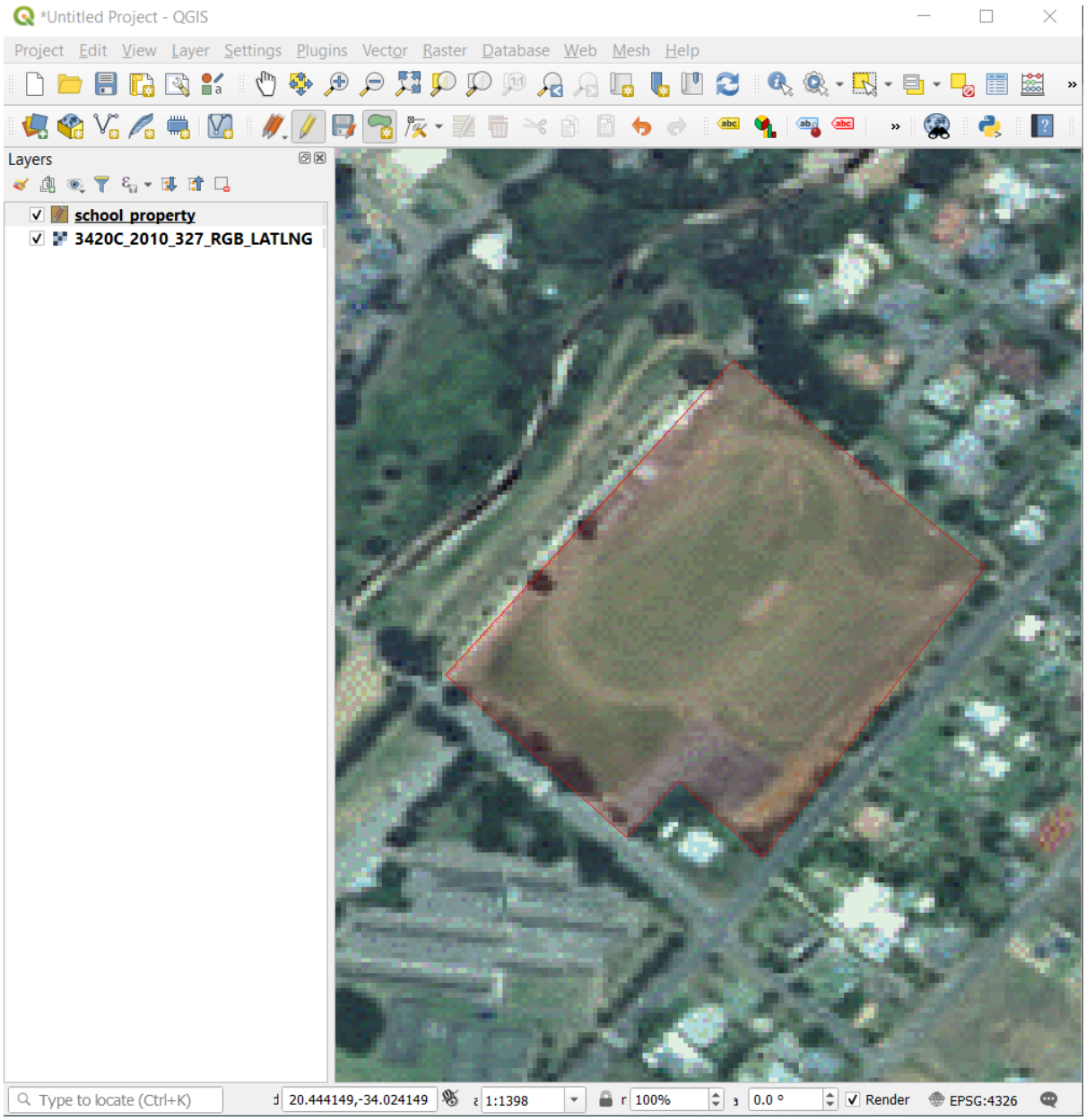
   Notice that the layer `school_property` in the *Layers* panel now has the pencil icon, indicating that it is in edit mode.
3. Click on the  Capture Polygon button to begin digitizing our school fields.

   You'll notice that your mouse cursor has become a crosshair. This allows you to more accurately place the points you'll be digitizing. Remember that even when you're using the digitizing tool, you can zoom in and out on your map by rolling the mouse wheel, and you can pan around by holding down the mouse wheel and dragging around in the map.

   Prima entitate pe care o veți digitaliza este athletics field:

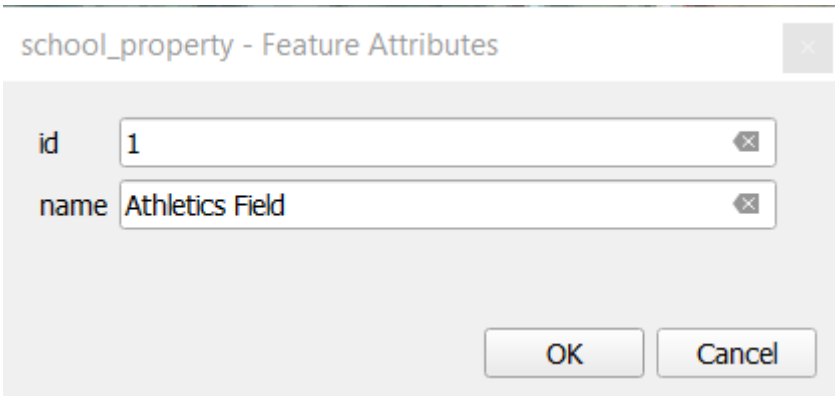


4. Începeți digitizarea făcând clic pe un punct, de-a lungul marginii câmpului.
5. Plasați mai multe puncte, făcând clic în continuare de-a lungul marginii, până când forma desenată acoperă complet câmpul.

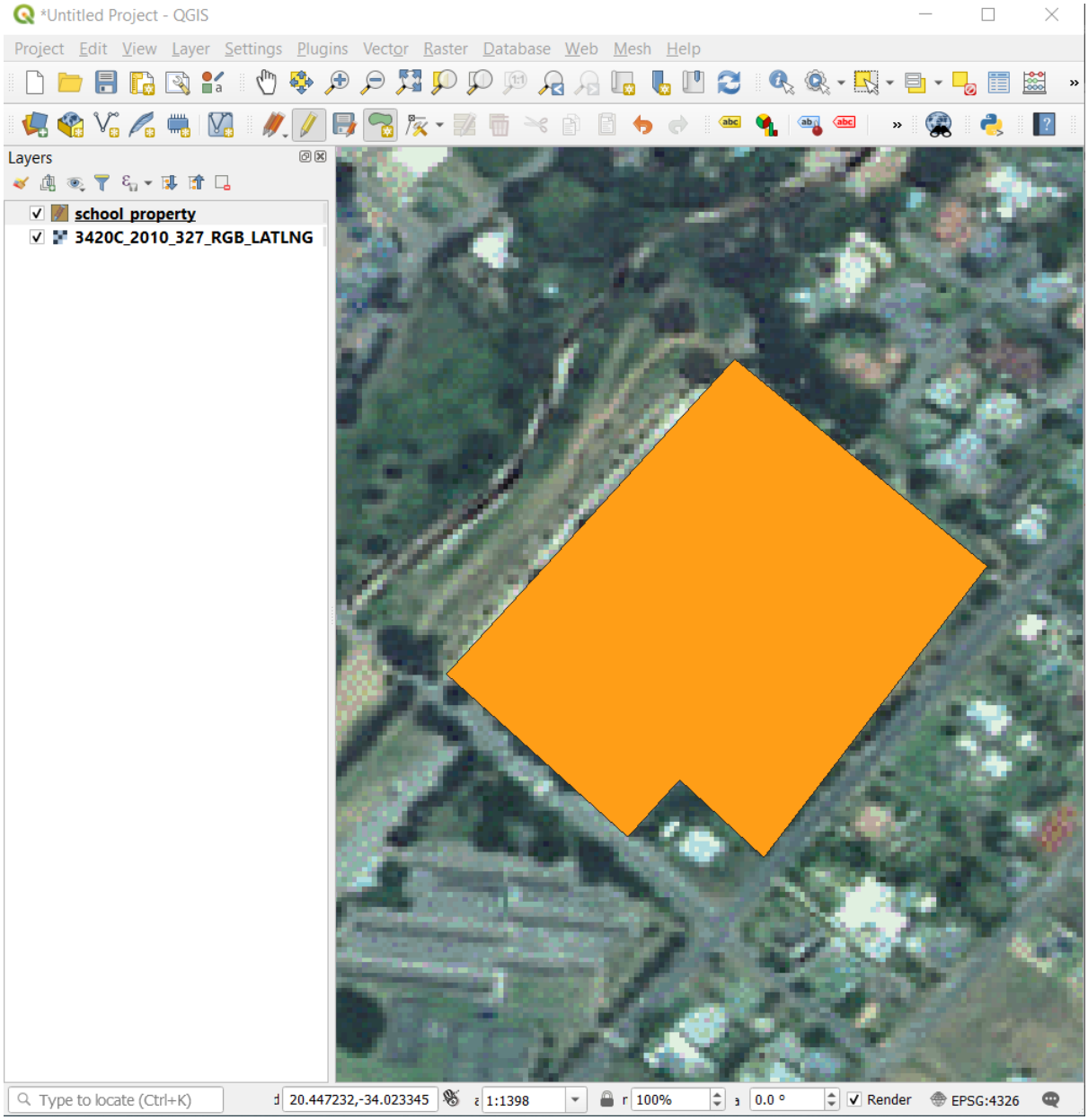


6. After placing your last point, right click to finish drawing the polygon. This will finalize the feature and show you the *Attributes* dialog.

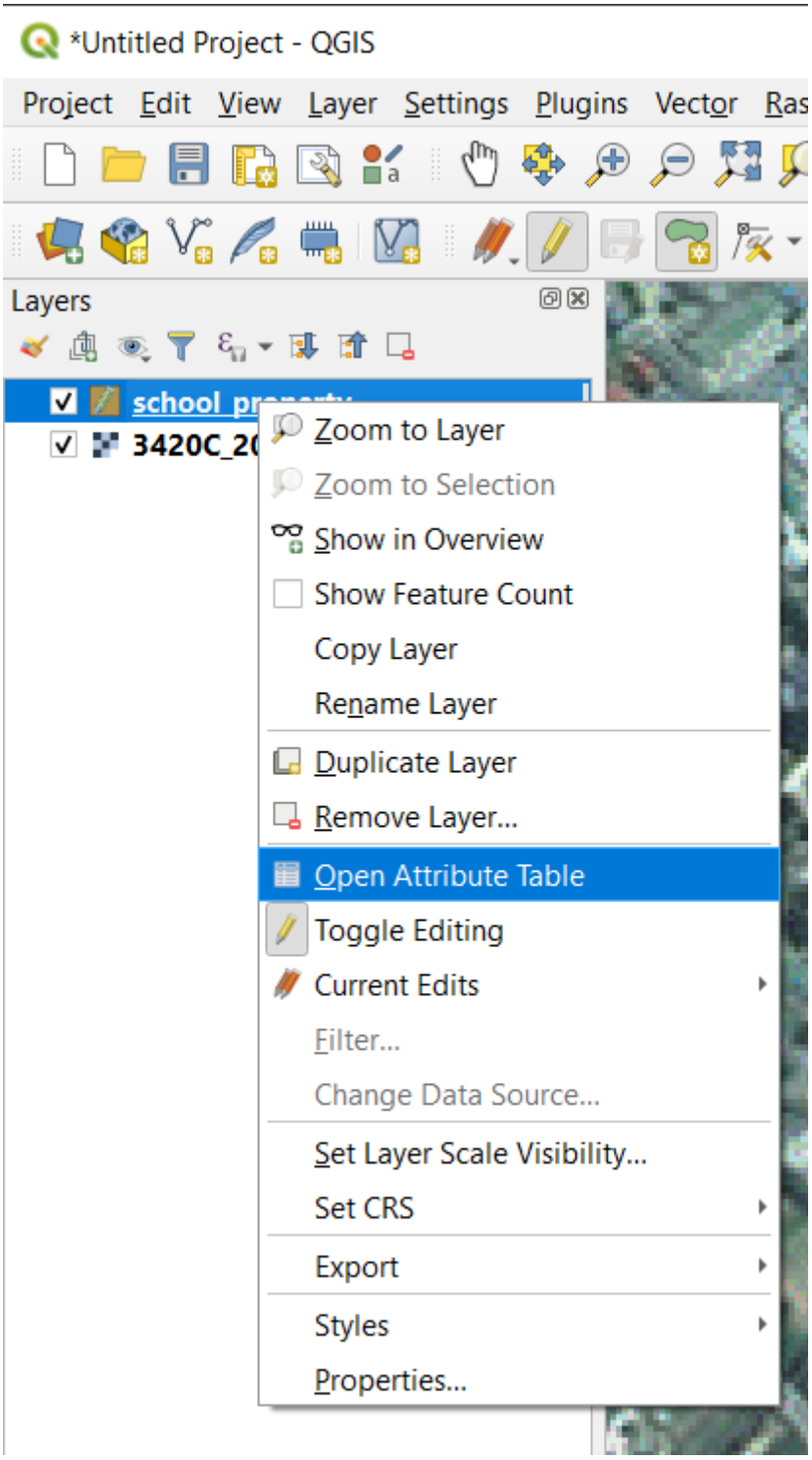
7. Completați valorile, așa cum se arată mai jos:



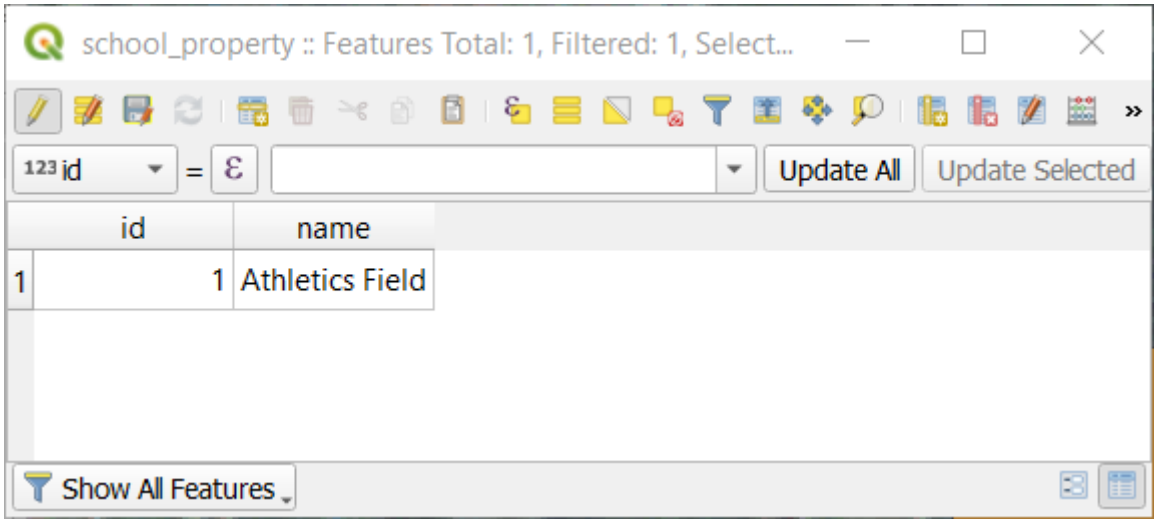
8. Click *OK*, and you have created a new feature!



9. In the *Layers* panel select the `school_property` layer.
10. Right click and choose *Open Attribute Table* in the context menu.



In the table you will see the feature you just added. While in edit mode you can update the attributes data by double click on the cell you want to update.



11. Închideți tabelul de atribute.
12. To save the new feature we just created, click on Save Edits button.

Amintiți-vă că dacă ați făcut o greșeală în timp ce digitizați o entitate, o puteți edita oricând după ce ați definitivat crearea ei. Dacă ați făcut o greșeală, continuați digitizarea până ați terminat crearea entității de mai sus. Apoi:

1. Clic pe butonul Instrumentului Vertex.
2. Hover the mouse over a vertex you want to move and left click on the vertex.
3. Move the mouse to the correct location of the vertex, and left click. This will move the vertex to the new location.





The same procedure can be used to move a line segment, but you will need to hover over the midpoint of the line segment.

If you want to undo a change, you can press the Undo button or `Ctrl+Z`.

4. Remember to save your changes by clicking the Save Edits button.
5. When done editing, click the Toggle Editing button to get out of edit mode.

5.1.3 ??? Try Yourself: Digitizing Polygons

Digitizarea școlii propriu-zise și a câmpului de sus. Utilizați această imagine pentru a vă ajuta:



Remember that each new feature needs to have a unique `id` value!

Notă

După ce ați terminat de adăugat entitățile într-un strat, nu uitați să salvați modificările și să ieșiți din modul de editare.

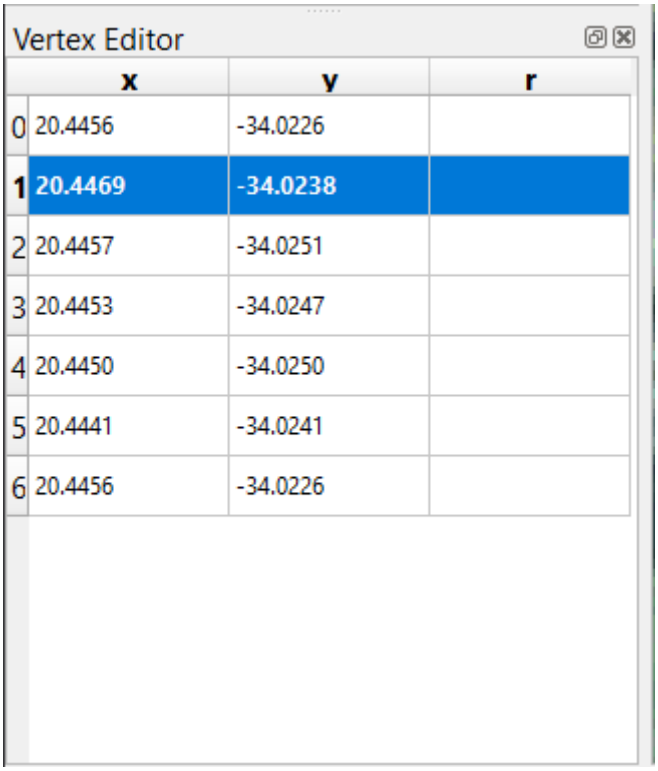
Notă

You can style the fill, outline and label placement and formatting of the `school_property` using techniques learnt in earlier lessons.

5.1.4 ??? Follow Along: Using Vertex Editor Table

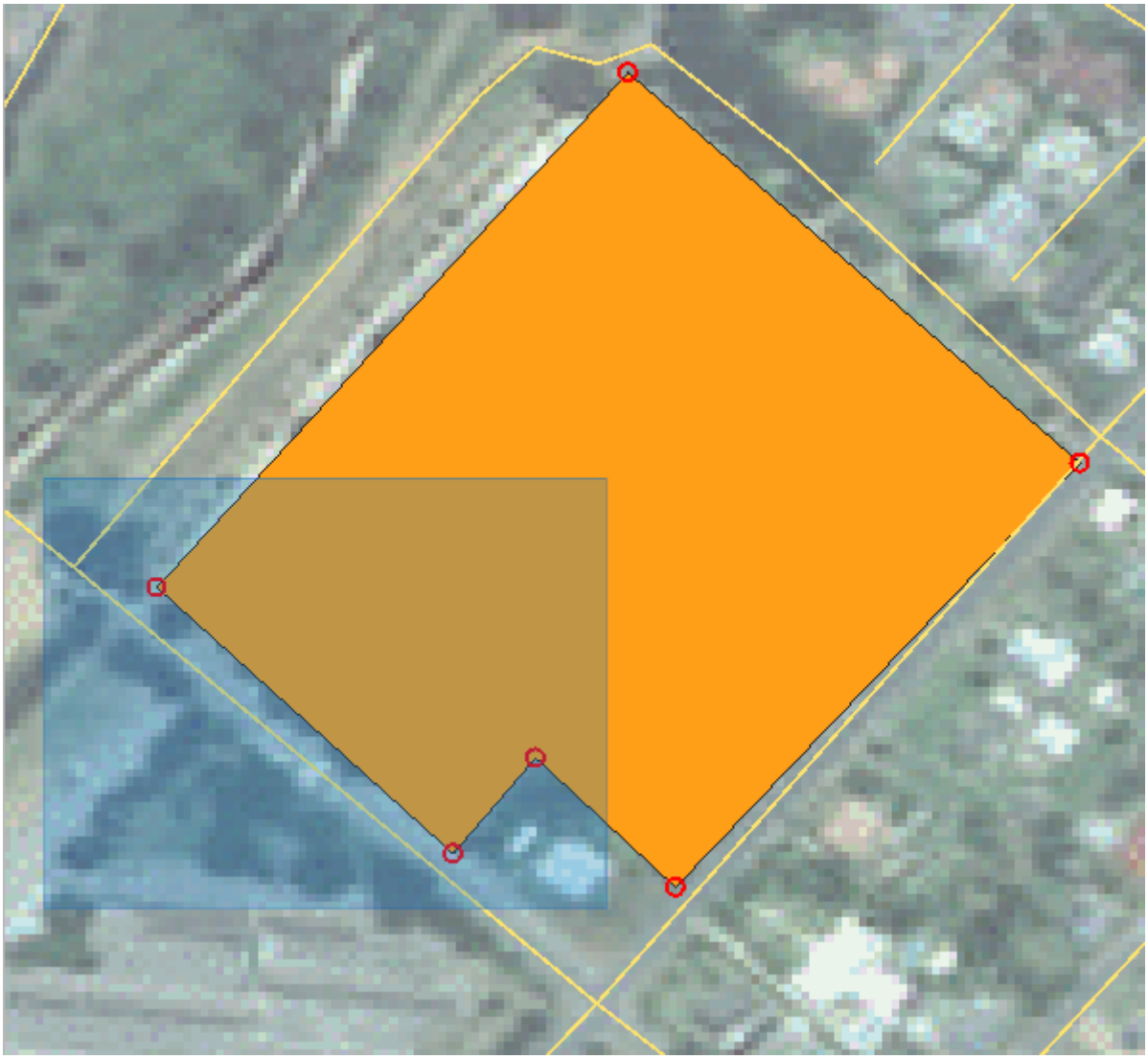
Another way to edit a feature is to manually enter the actual coordinate values for each vertex using the *Vertex Editor* table.

1. Make sure you are in edit mode on layer `school_property`.
2. If not already activated, click on  Vertex Tool button.
3. Move the mouse over one of the polygon features you created in the `school_property` layer and right click on it. This will select the feature and a *Vertex Editor* pane will appear.

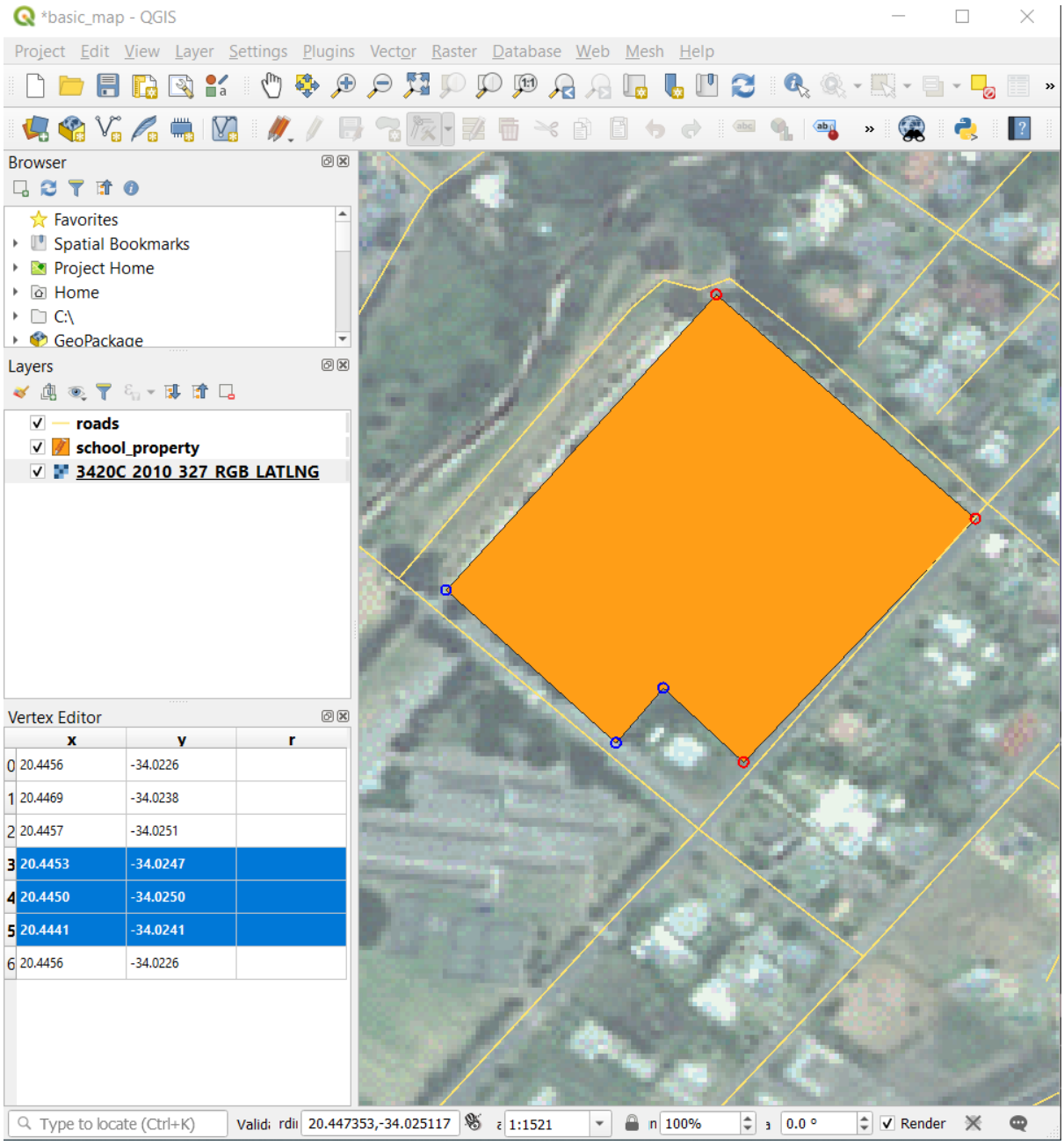


> **Notă**
>
> This table contains the coordinates for the vertices of the feature. Notice there are seven vertices for this feature, but only six are visually identified in the map area. Upon closer inspection, one will notice that row 0 and 6 have identical coordinates. These are the start and end vertices of the feature geometry, and are required in order to create a closed polygon feature.

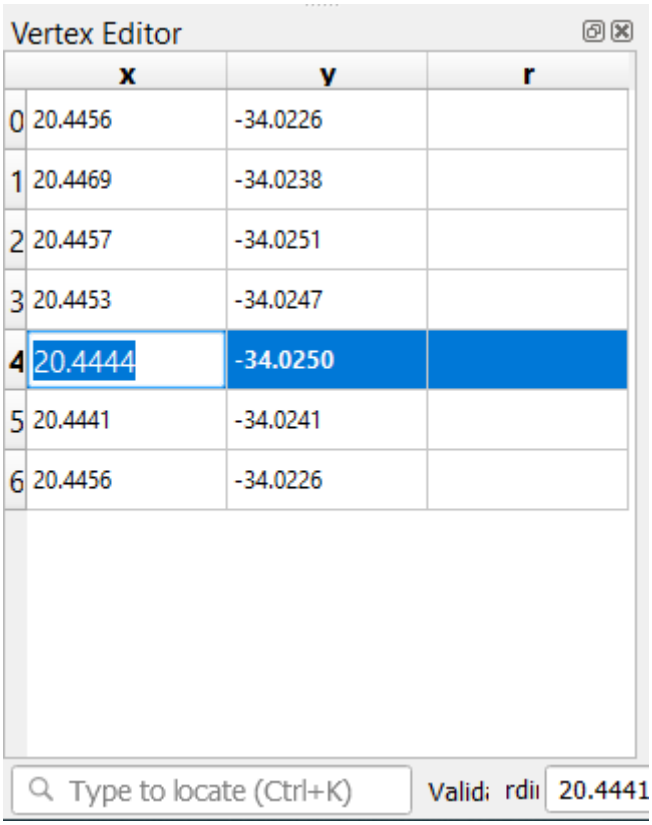
4. Click and drag a box over a vertex, or multiple vertices, of the selected feature.



The selected vertices will change to a color blue and the *Vertex Editor* table will have the corresponding rows highlighted, which contain the coordinates of the vertices.



5. To update a coordinate, double left click on the cell in the table that you want to edit and enter the updated value. In this example, the x coordinate of row `4` is updated from `20.4450` to `20.4444`.

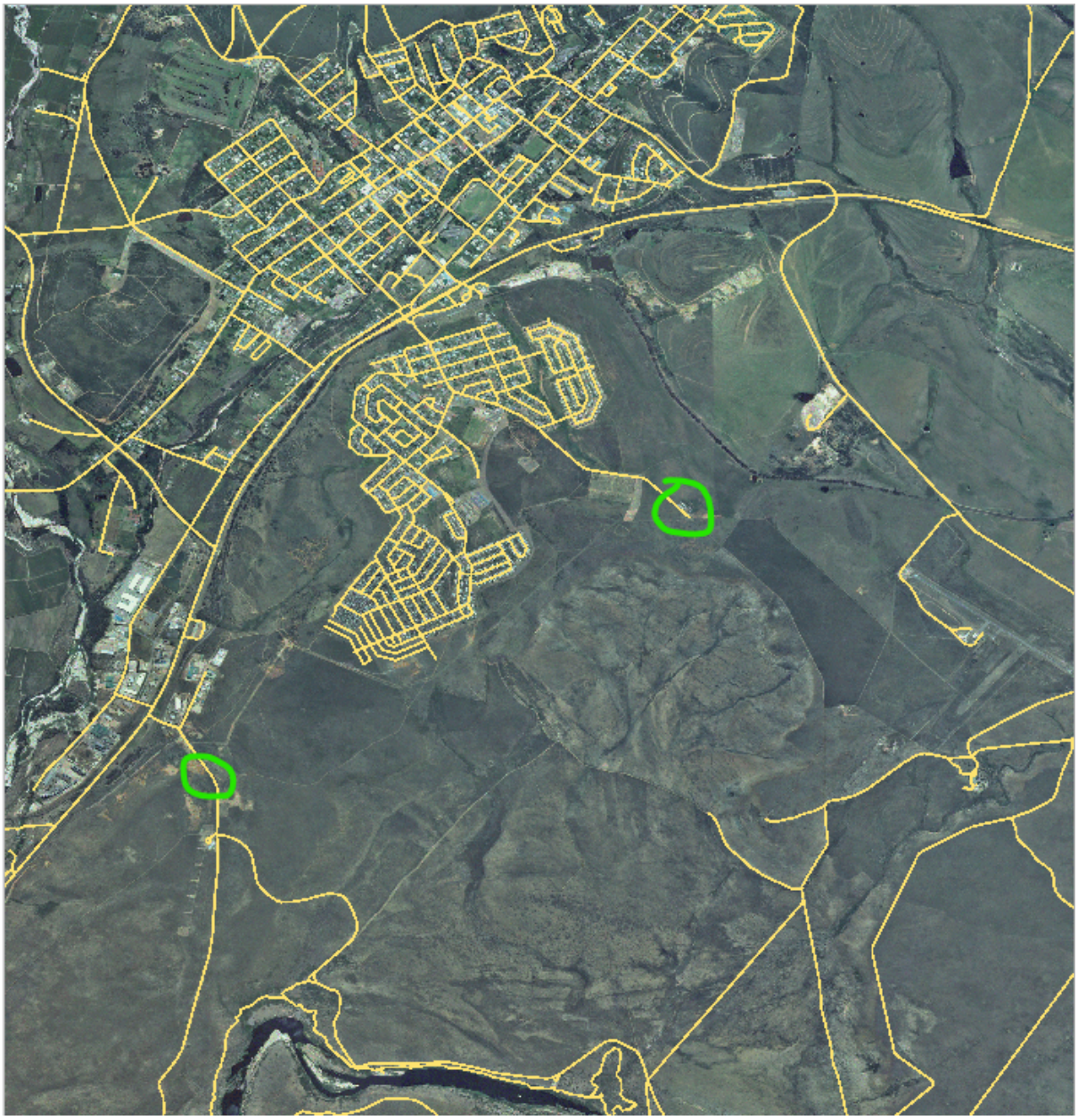


6. After entering the updated value, hit the enter key to apply the change. You will see the vertex move to the new location in the map window.

7. When done editing, click the Toggle Editing button to get out of edit mode, and save your edits.

5.1.5 ??? Try Yourself: Digitizing Lines

We are going to digitize two routes which are not already marked on the roads layer; one is a path, the other is a track. Our path runs along the southern edge of the suburb of Railton, starting and ending at marked roads:



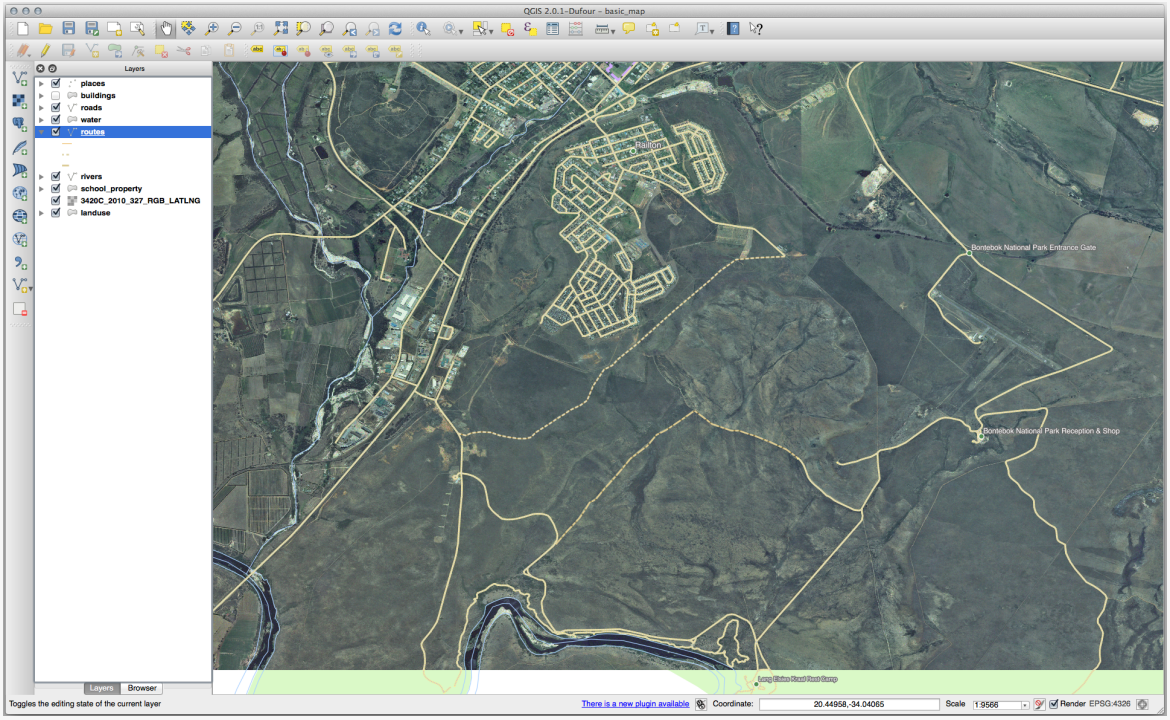
Piste este situată un pic mai departe de sud:



1. If the *roads* layer is not yet in your map, then add the `roads` layer from the GeoPackage file `training-data.gpkg` included in the `exercise_data` folder of the training data you downloaded. You can read *Follow Along: Loading vector data from a GeoPackage Database* for a how-to.
2. Create a new ESRI Shapefile line dataset called `routes.shp` in the `exercise_data` directory, with attributes `id` and `type` (use the approach above to guide you.)
3. Activate edit mode on the `routes` layer.
4. Since you are working with a line feature, click on the Add Line button to initiate line digitizing mode.
5. One at a time, digitize the path and the track on the `routes` layer. Try to follow the routes as accurately as possible, adding additional points along corners or turns.
6. Set the `type` attribute value to `path` or `track`.
7. Use the *Layer Properties* dialog to add styling to your routes. Feel free to use different styles for paths and tracks.
8. Save your edits and toggle off editing mode by pressing the Toggle Editing button.

Răspuns

The symbology doesn't matter, but the results should look more or less like this:



5.1.6 În concluzie

Acum știți cum să creați entități! Acest curs nu acoperă adăugarea entităților de tip punct, deoarece nu este neapărat necesară după ce ați lucrat cu entități mai complexe (lini și poligoane). Funționează exact la fel, cu excepția faptului că dați clic doar o singură dată unde doriți să plasați punctul, îi completați atributele ca de obicei, după care entitatea este creată.

Cunoașterea digitizării este importantă deoarece reprezintă o activitate frecventă în aplicațiile GIS.

5.1.7 Ce urmează?

Features in a GIS layer aren't just pictures, but objects in space. For example, adjacent polygons know where they are in relation to one another. This is called **topology**. In the next lesson you'll see an example of why this can be useful.

5.2 Lesson: Feature Topology

Topologia reprezintă un aspect util de straturi de date vectoriale, deoarece minimizează erorile, cum ar fi suprapunerile sau lacunele.

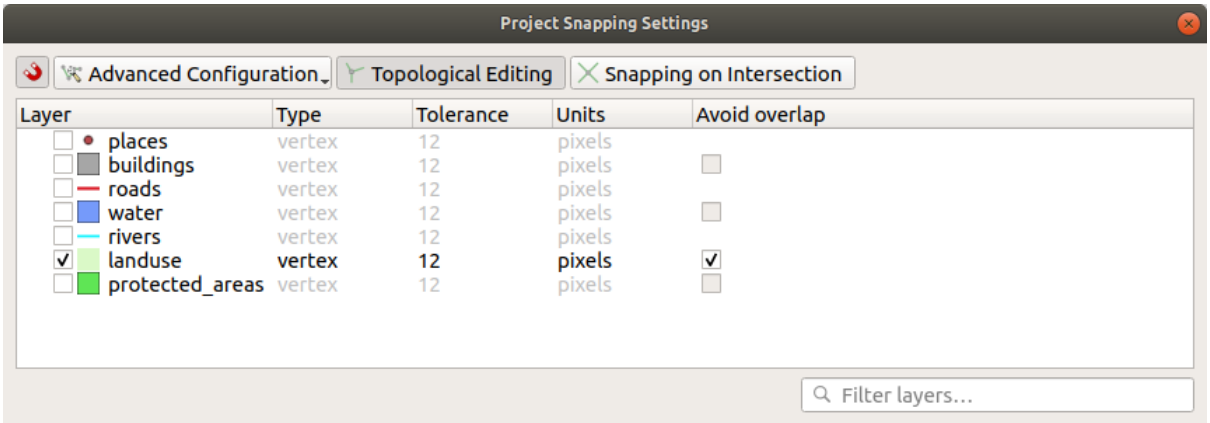
De exemplu: dacă două entități au o frontieră comună, și editați granița cu ajutorul topologiei, atunci nu va trebui să editați mai întâi un element, apoi pe celălalt, și ulterior să aliniați cu atenție frontierele, astfel încât acestea să se potrivească. În schimb, puteți edita bordurile lor comune, ambele entități schimbându-se în același timp.

Scopul acestei lecții: De a înțelege topologia, cu ajutorul exemplelor.

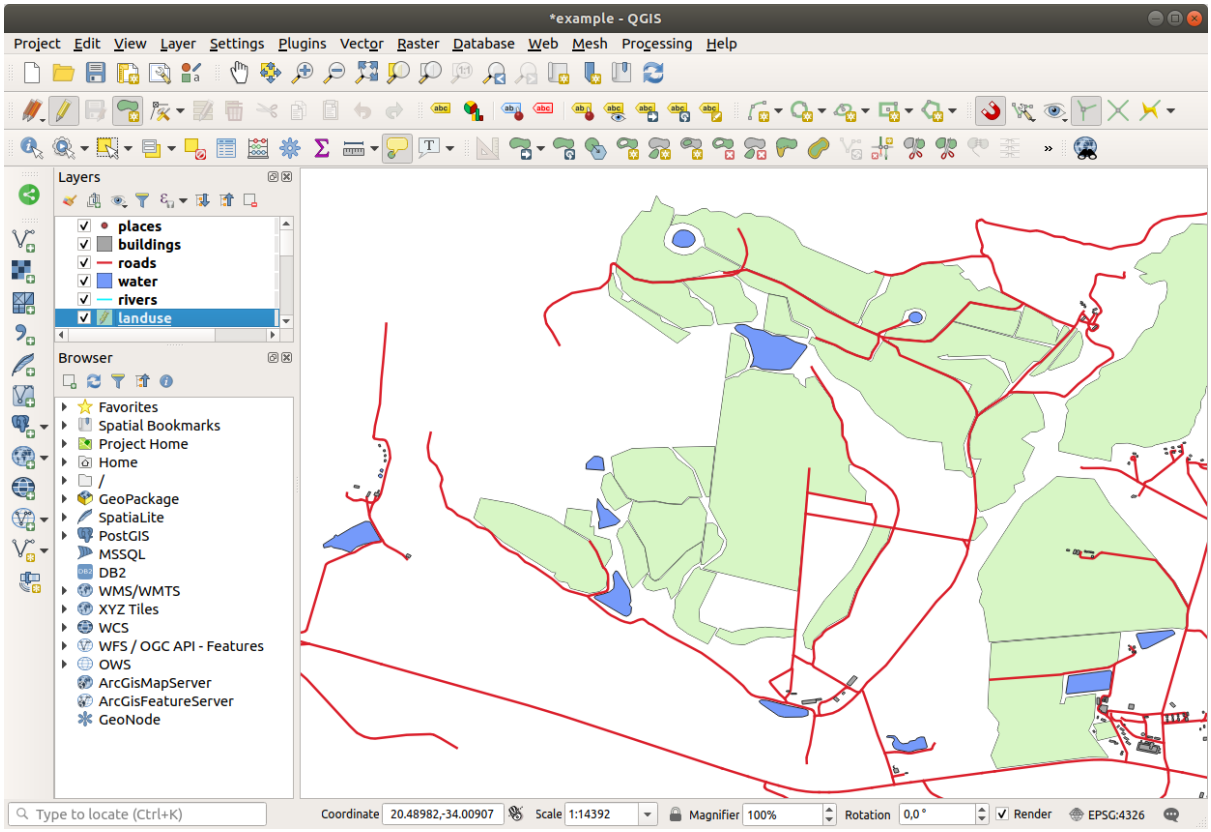
5.2.1 ??? Follow Along: Snapping

Snapping makes topological editing easier. This will allow your mouse cursor to snap to other objects while you digitize. To set snapping options:

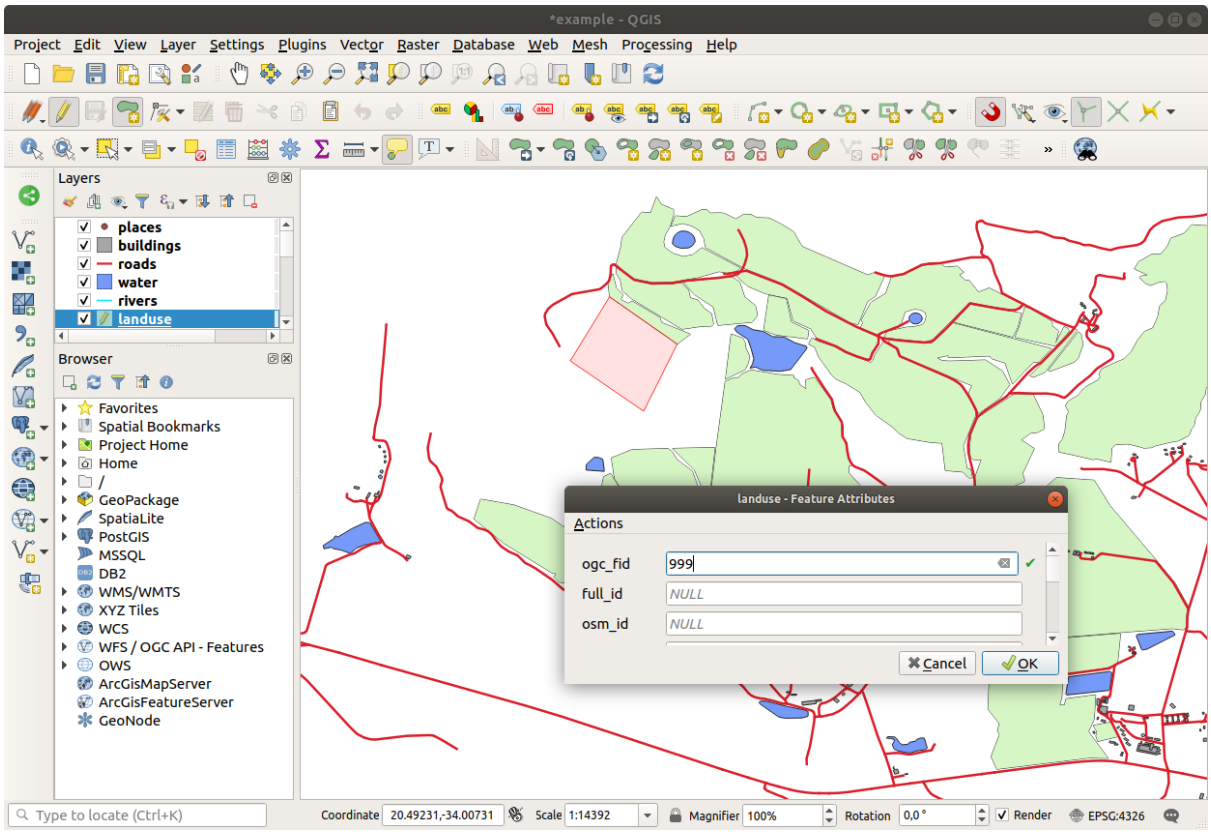
1. Navigate to the menu entry *Project* ► *Snapping Options…*.
2. Set up your *Snapping options*: enable snapping using the Enable Snapping button, choose the *Advanced Configuration*, activate the `landuse` layer with *Type vertex* and tolerance `12` pixels:



3. Make sure that the box in the *Avoid overlap* column is checked.
4. Leave the dialog.
5. Select the `landuse` layer and enter edit mode ( )
6. Check (under *View* ► *Toolbars*) that the *Advanced Digitizing* toolbar is enabled.
7. Focalizați această arie (activând straturile și etichetele, dacă este necesar):



8. Digitize this new (fictional) area shown in red:



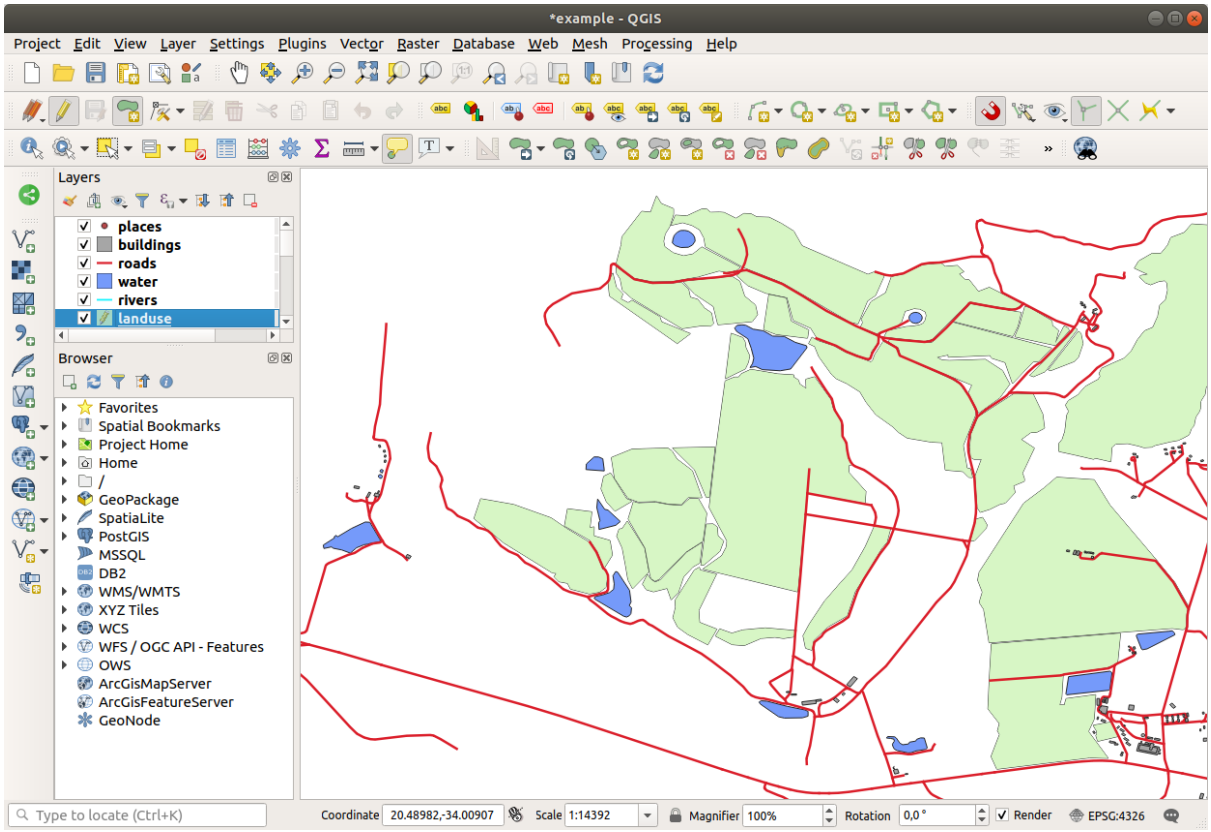
9. When prompted, give it an *OGC_FID* of `999`, but feel free to leave the other values unchanged.

If you are careful while digitizing, and allow the cursor to snap to the vertices of adjoining areas, you'll notice that there won't be any gaps between your new area and the existing adjacent areas.

10. Note the undo and redo tools in the *Advanced Digitizing* toolbar.

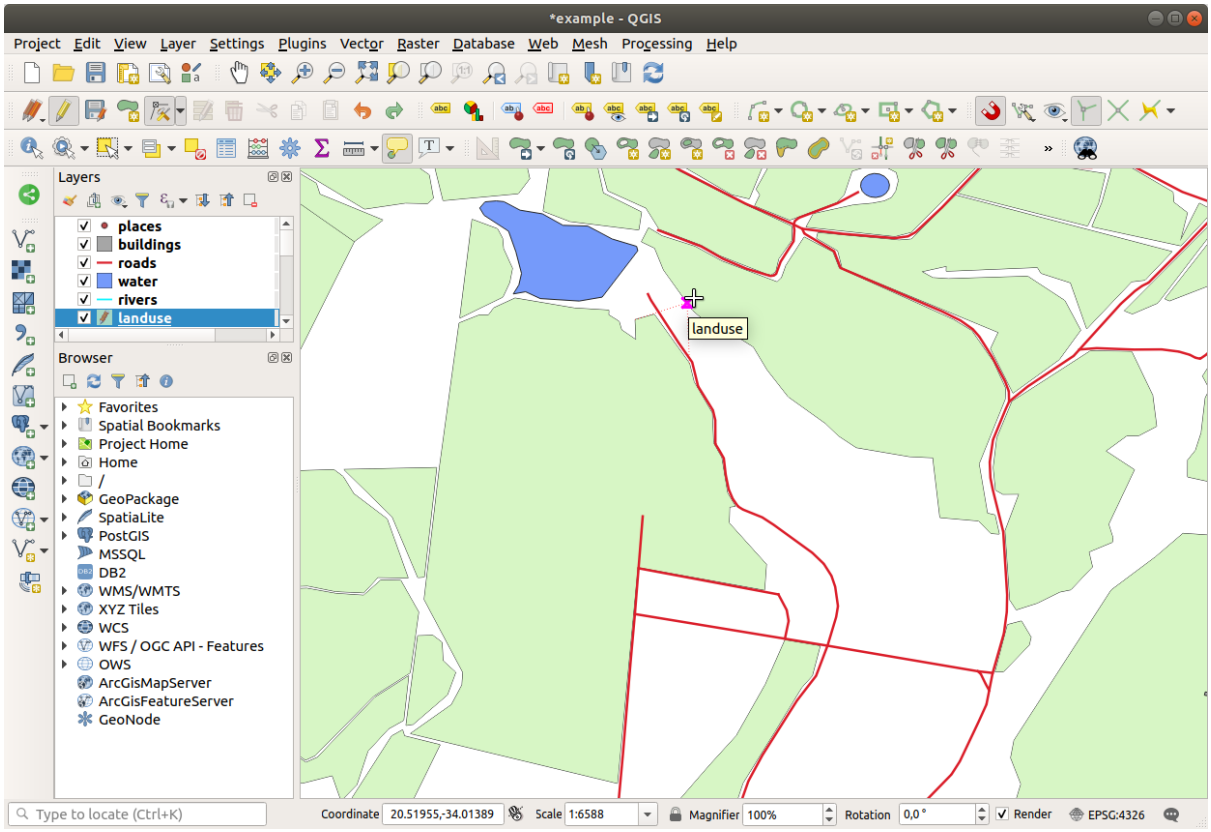
5.2.2 ??? Follow Along: Correct Topological Features

Topology features can sometimes need to be updated. In our study area, an area has been turned into forest, so the `landuse` layer need an update. We will therefore expand and join some forest features in this area:



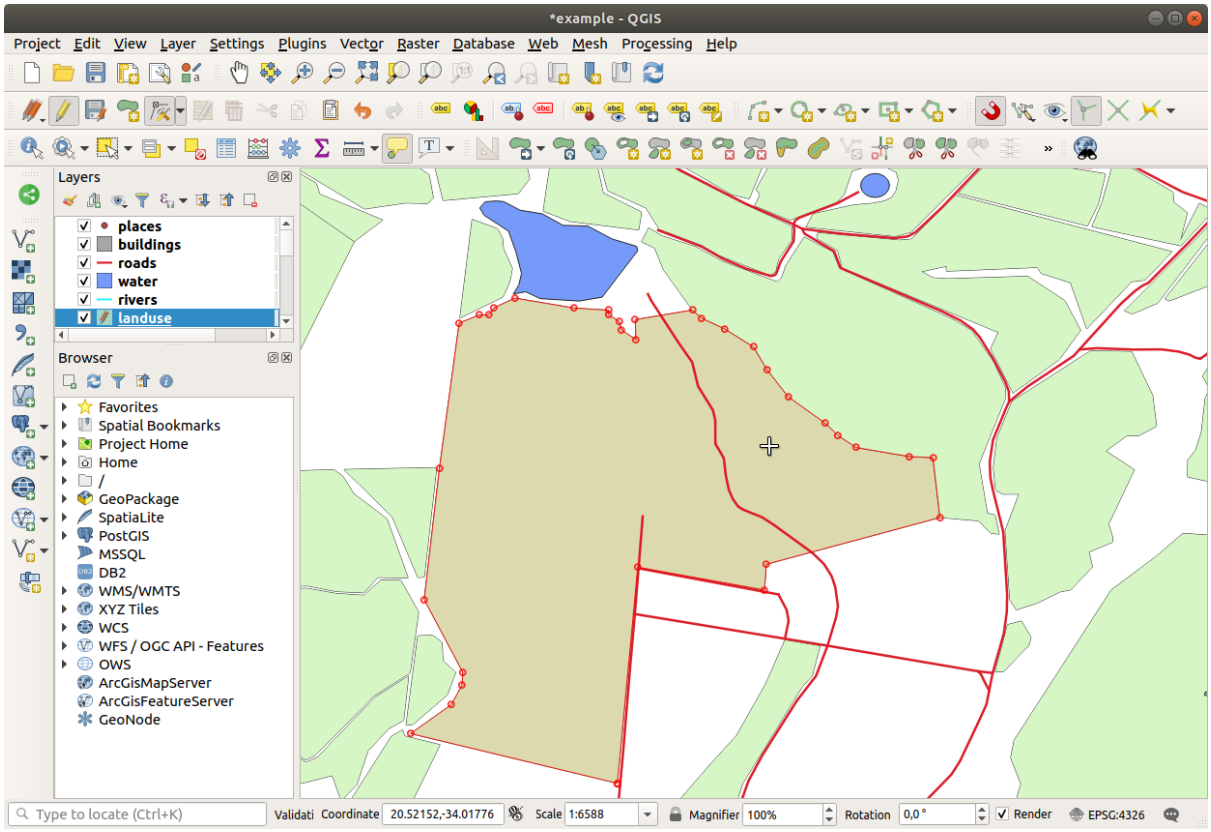
Instead of creating new polygons to join the forest areas, we are going to use the *Vertex Tool* to edit and join existing polygons.

1. Enter edit mode (if it is not active already)
2. Selectați Instrumentul Vertex.
3. Choose an area of forest, select a vertex, and move it to an adjoining vertex so that the two forest features meet:



4. Click on the other vertices and snap them into place.

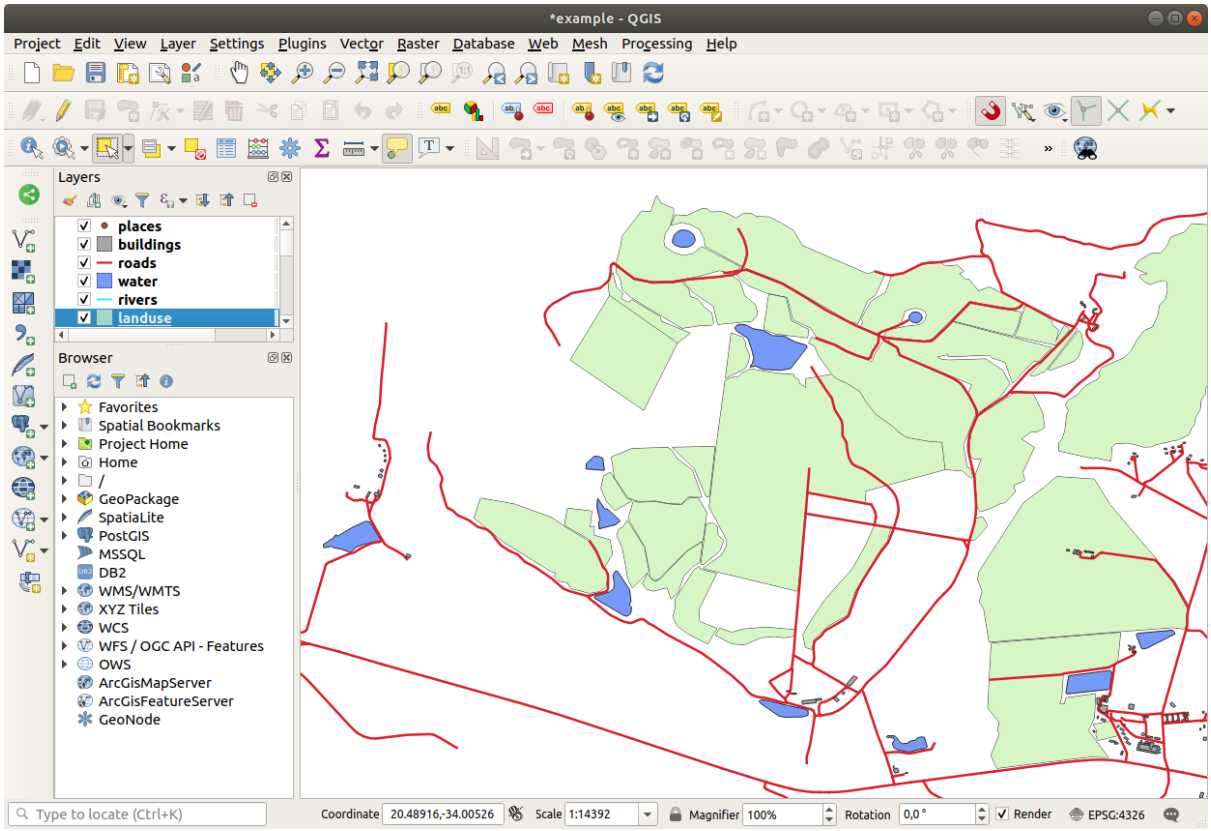
   Limitele topologic corecte vor arăta astfel:



Continuați și alăturați mai multe zone zone folosind *Instrumentul Vertex*.

You can also use the Add Polygon Feature tool to fill the gap between the two forest polygons. If you have enabled *Avoid overlap*, you don't have to add every single vertex - they will be added automatically if your new polygon overlaps the existing ones.

If you are using our example data, you should have a forest area looking something like this:

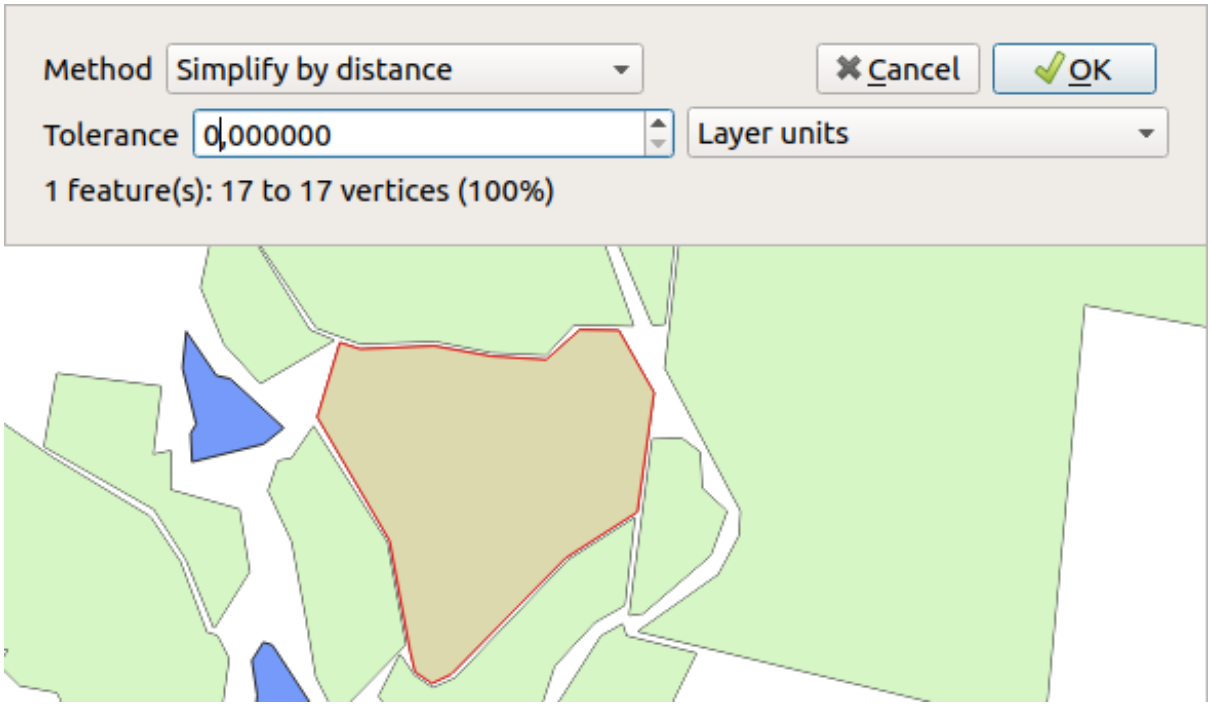


Nu vă faceți griji dacă ați îmbinat mai multe, mai puține sau zone diferite de pădure.

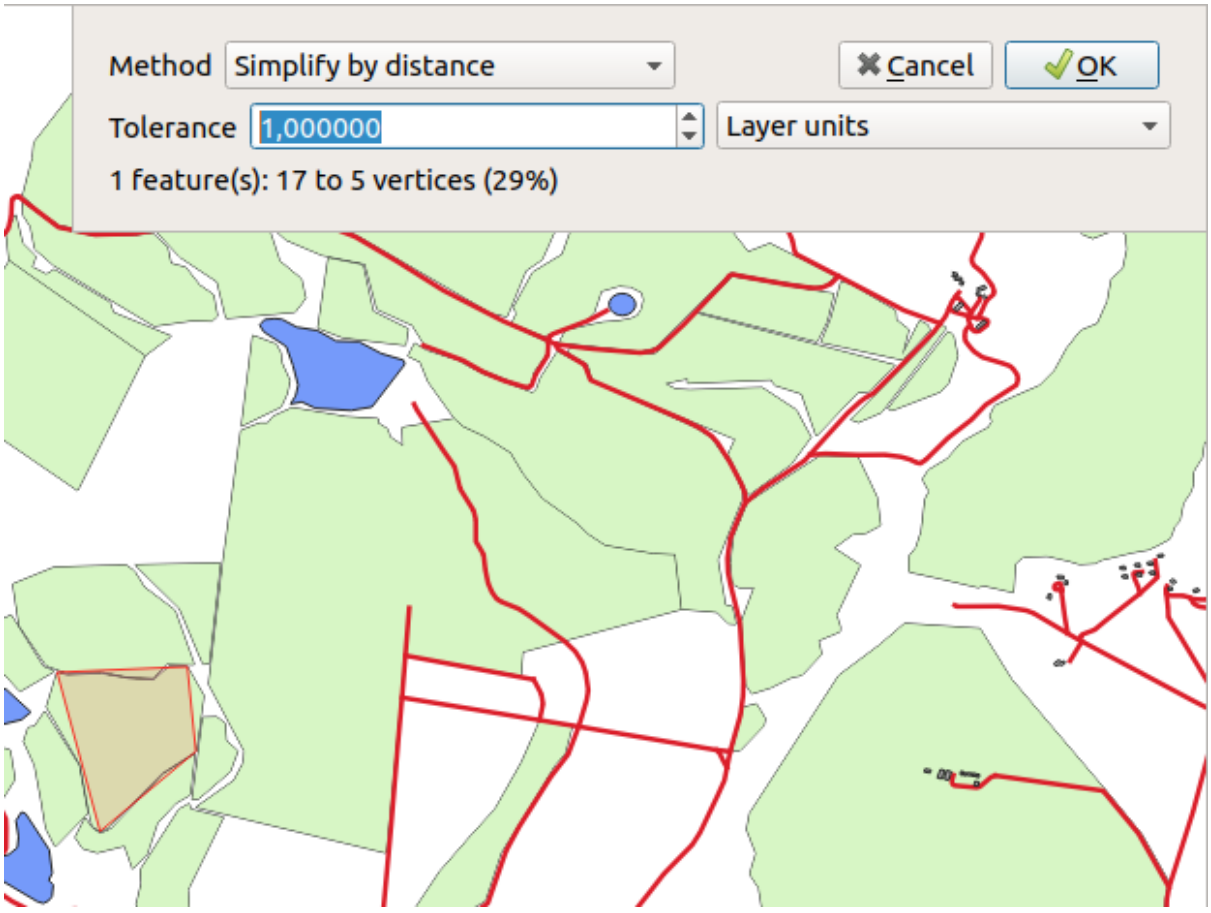
5.2.3 ??? Follow Along: Tool: Simplify Feature

Continuing on the same layer, we will test the Simplify Feature tool:

1. Faceți clic pe el pentru a-l activa.
2. Click on one of the areas which you joined using either the Vertex Tool or Add Polygon Feature tool. You will see this dialog:



3. Modify the *Tolerance* and watch what happens:



This allows you to reduce the number of vertices.

4. Clic pe *OK*

The advantage of this tool is that it provides you with a simple and intuitive interface for generalization. But notice that the tool ruins topology. The simplified polygon no longer shares boundaries with its adjacent polygons, as it should. So this tool is better suited for stand-alone features.

Înainte de a merge mai departe, setați poligonul înapoi la starea inițială, prin anularea ultimei modificări.

5.2.4 ??? Try Yourself: Tool: Add Ring

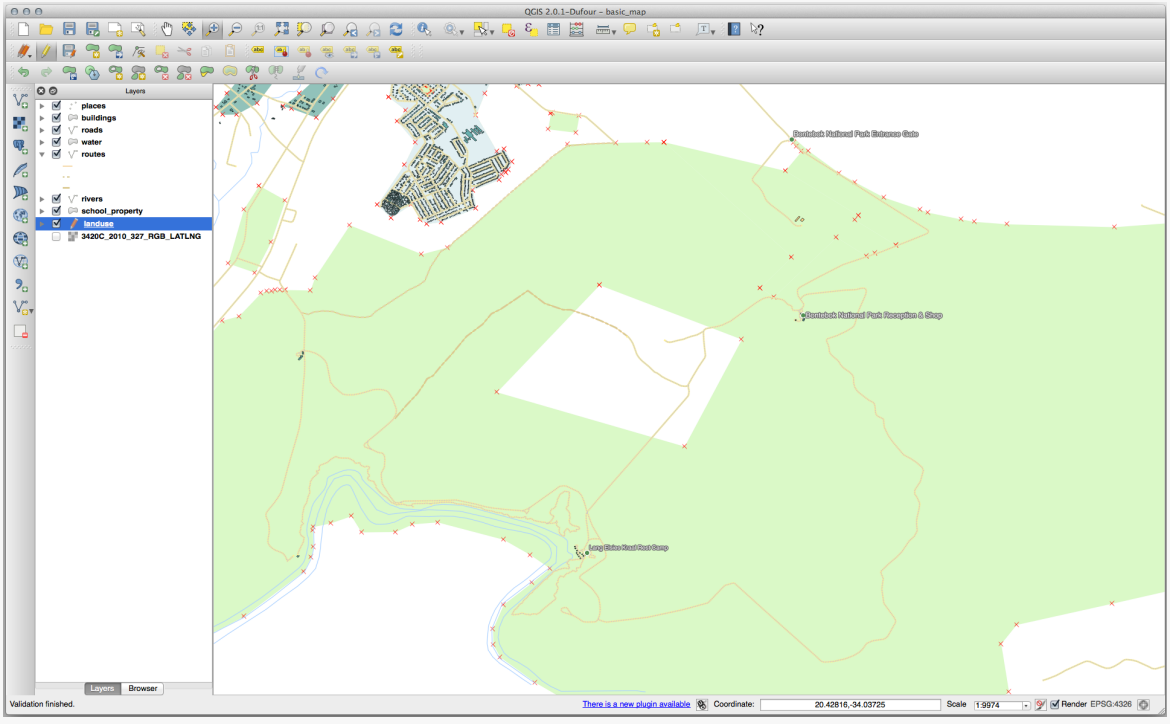
The  Add Ring tool allows you to add an interior ring to a polygon feature (cut a hole in the polygon), as long as the hole is completely contained within the polygon (touching the boundary is OK). For example, if you have digitized the outer boundaries of South Africa and you need to add a hole for Lesotho, you would use this tool.

If you experiment with the tool, you may notice that the snapping options can prevent you from creating a ring inside a polygon. So you are advised to turn off snapping before cutting a hole.

1. Disable snapping for the `landuse` layer using the  Enable Snapping button (or use the shortcut `s`).
2. Use the  Add Ring tool to create a hole in the middle of a polygon geometry.
3. Draw a polygon over the target feature, as if you were using the  Add polygon tool.
4. When you right-click, the hole will be visible.
5. Remove the hole you just created using the  Delete Ring tool. Click inside the hole to delete it.

Răspuns

The exact shape doesn't matter, but you should be getting a hole in the middle of your feature, like this one:



- Undo your edit before continuing with the exercise for the next tool.

5.2.5 ??? Try Yourself: Tool: Add Part

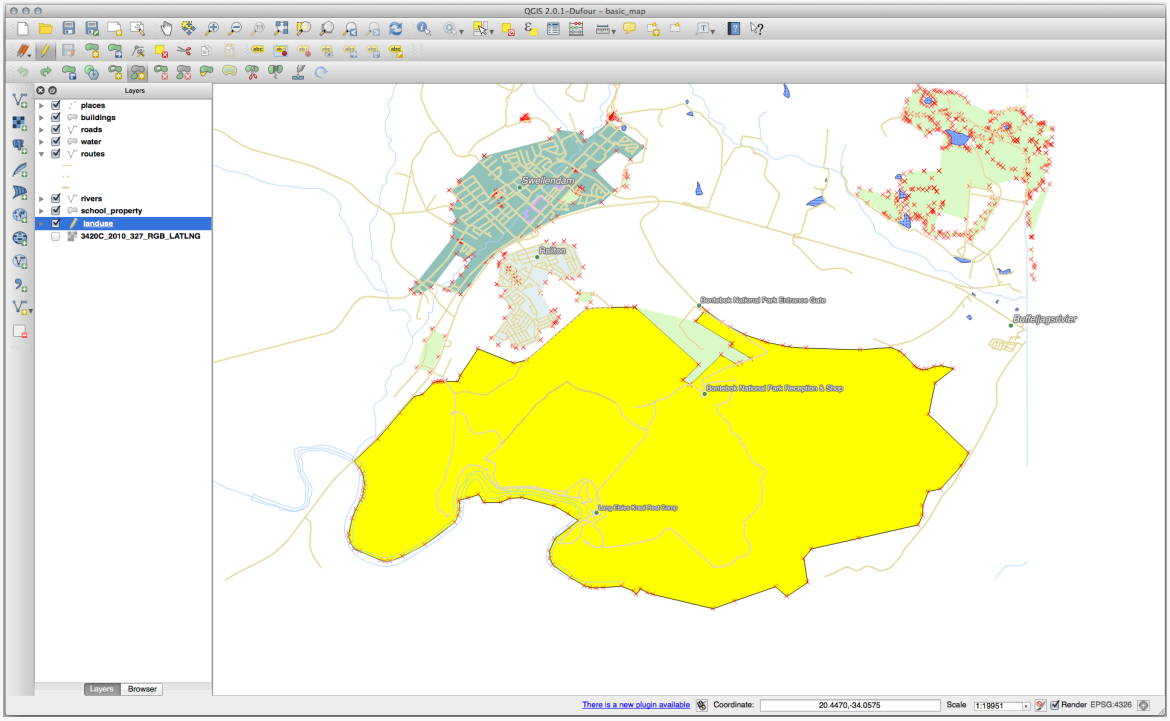
The  Add Part tool allows you to add a new part to a feature, that is not directly connected to the main feature. For example, if you have digitized the boundaries of mainland South Africa, but you haven't yet added the Prince Edward Islands, you would use this tool to create them.

1. Select the polygon to which you wish to add the part by using the  Select Features by area or single click tool.
2. Use the  Add Part tool to add an outlying area.
3. Delete the part you just created using the  Delete Part tool.

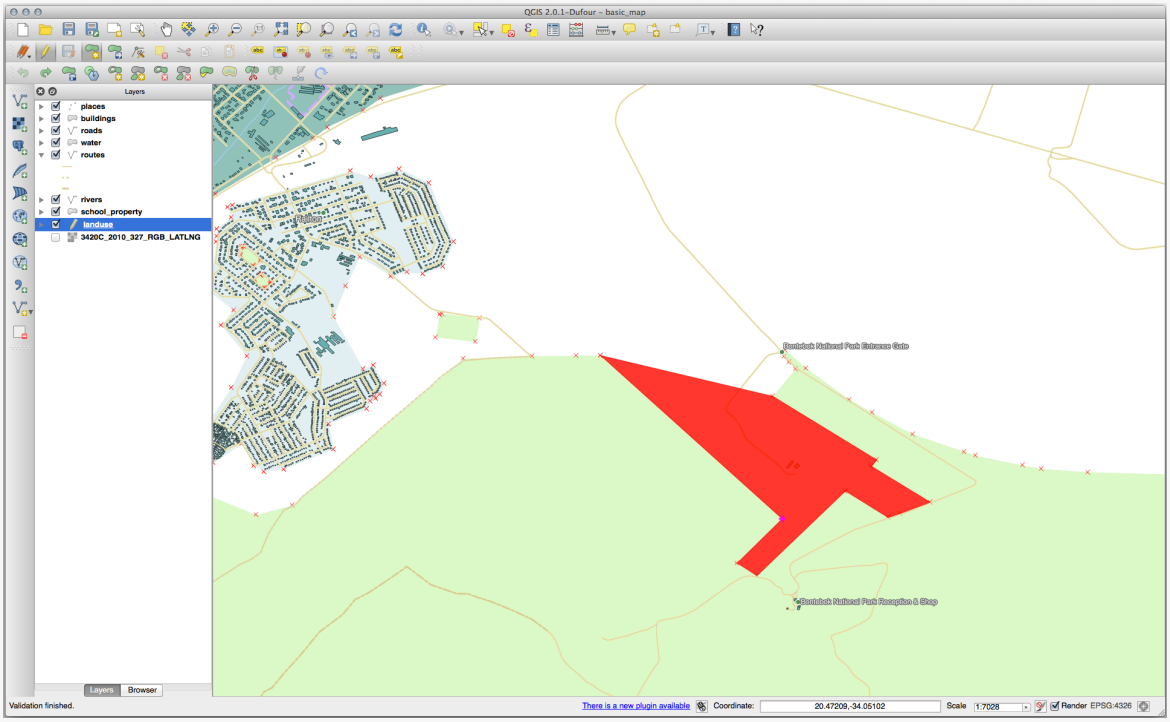
> **Notă**
>
> Click inside the part to delete it.

Răspuns

1. First select the Bontebok National Park:



2. Now add your new part:



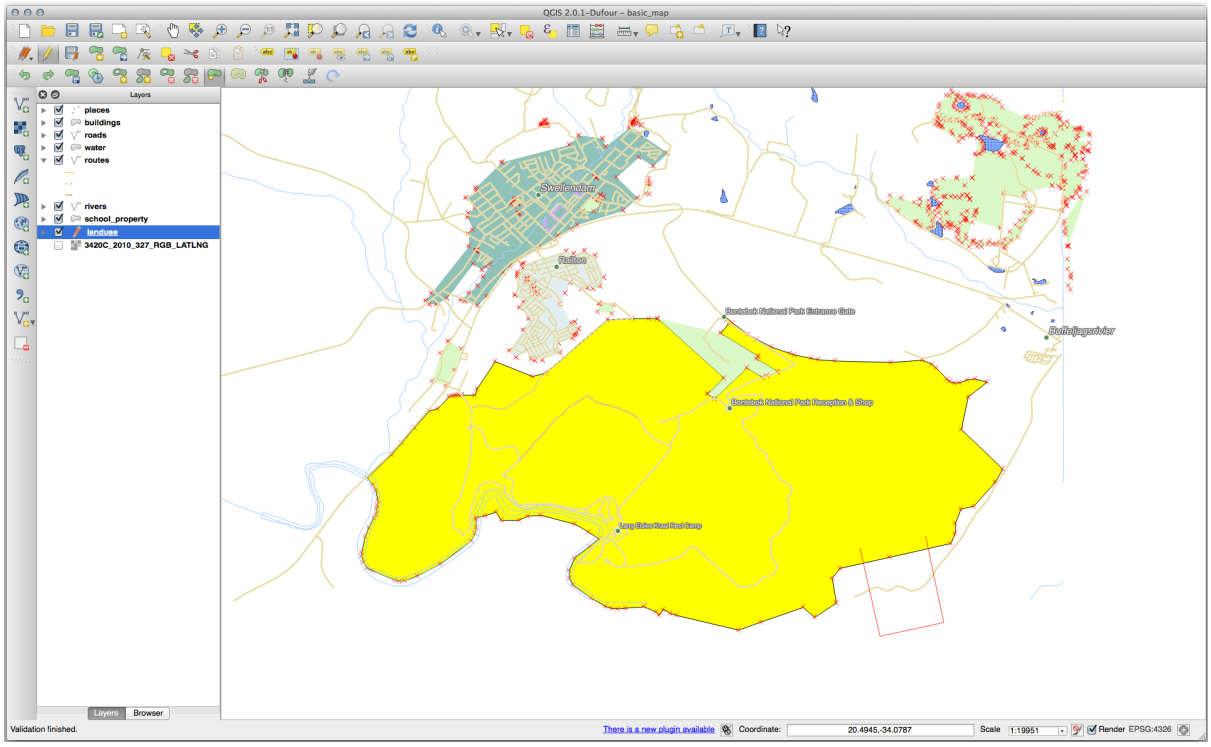
3. Undo your edit before continuing with the exercise for the next tool.

5.2.6 ??? Follow Along: Tool: Reshape Features

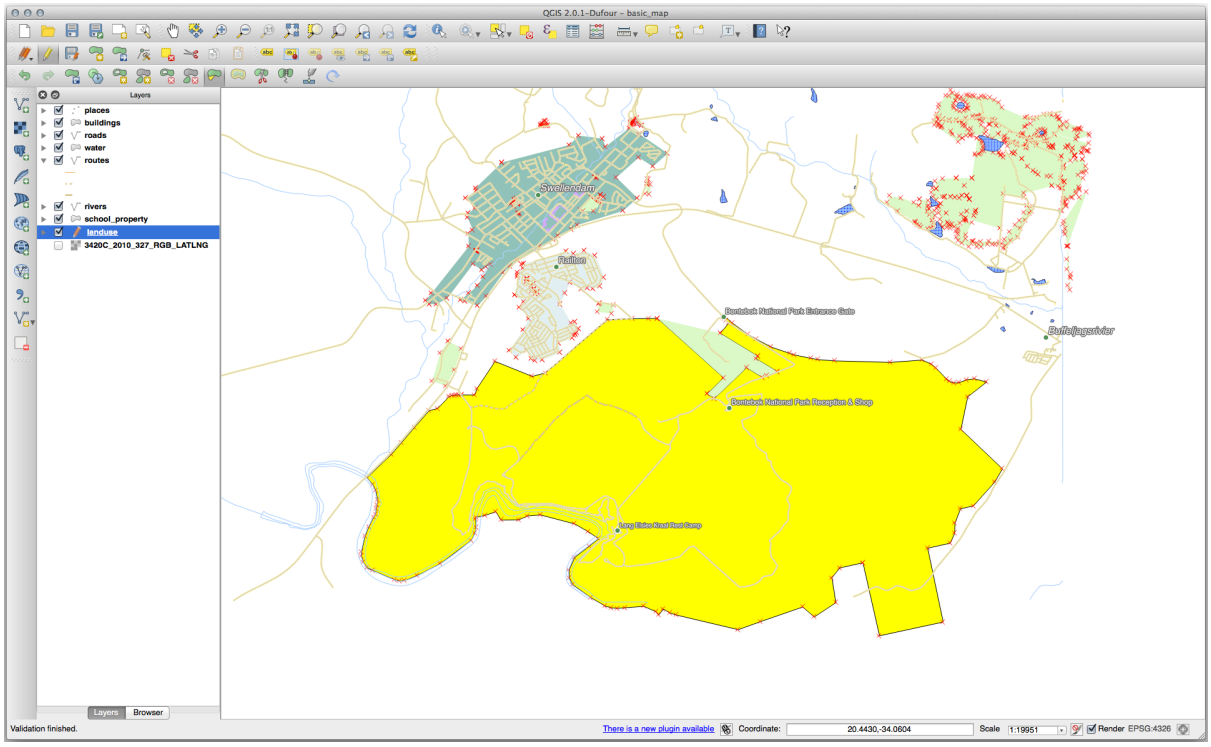
The  Reshape Features tool is used to extend a polygon feature or cut away a part of it (along the boundary).

Extindere:

1. Select the polygon using the  Select Features by area or single click tool.
2. Left-click inside the polygon to start drawing.
3. Draw a shape outside the polygon. The last vertex should be back inside the polygon.
4. Right-click to finish the shape:



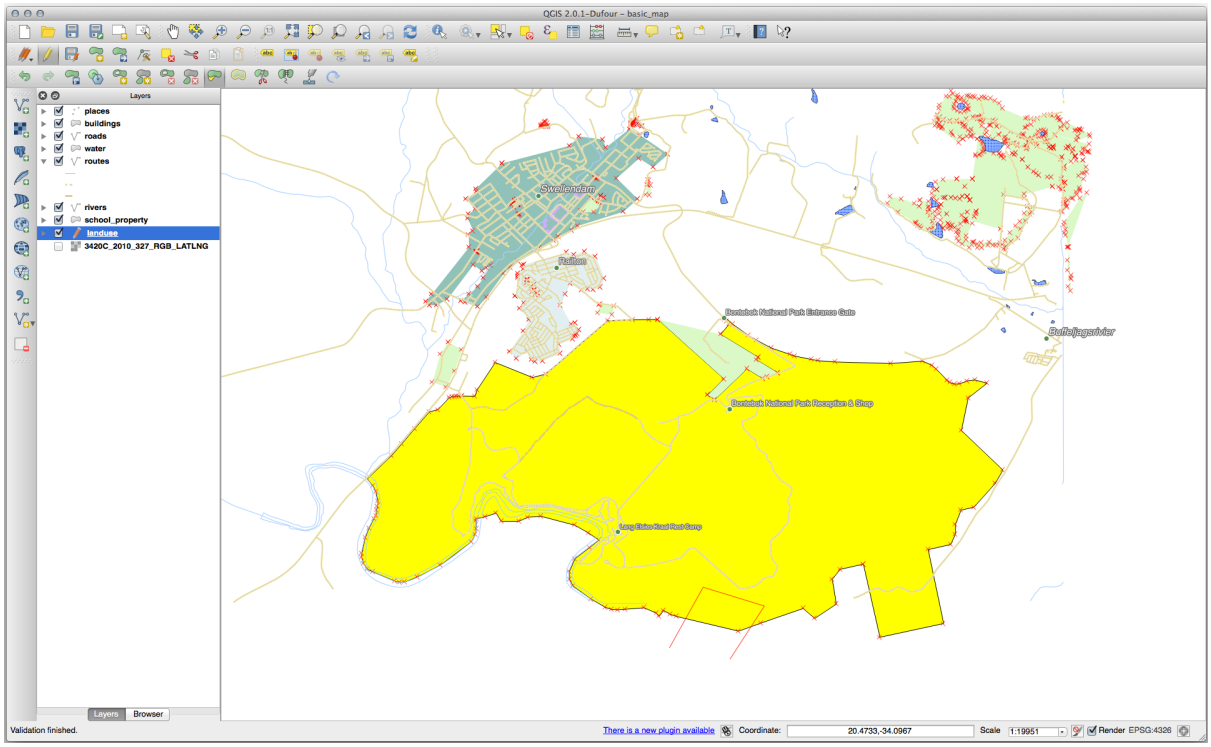
Acest lucru va genera un rezultat similar cu:



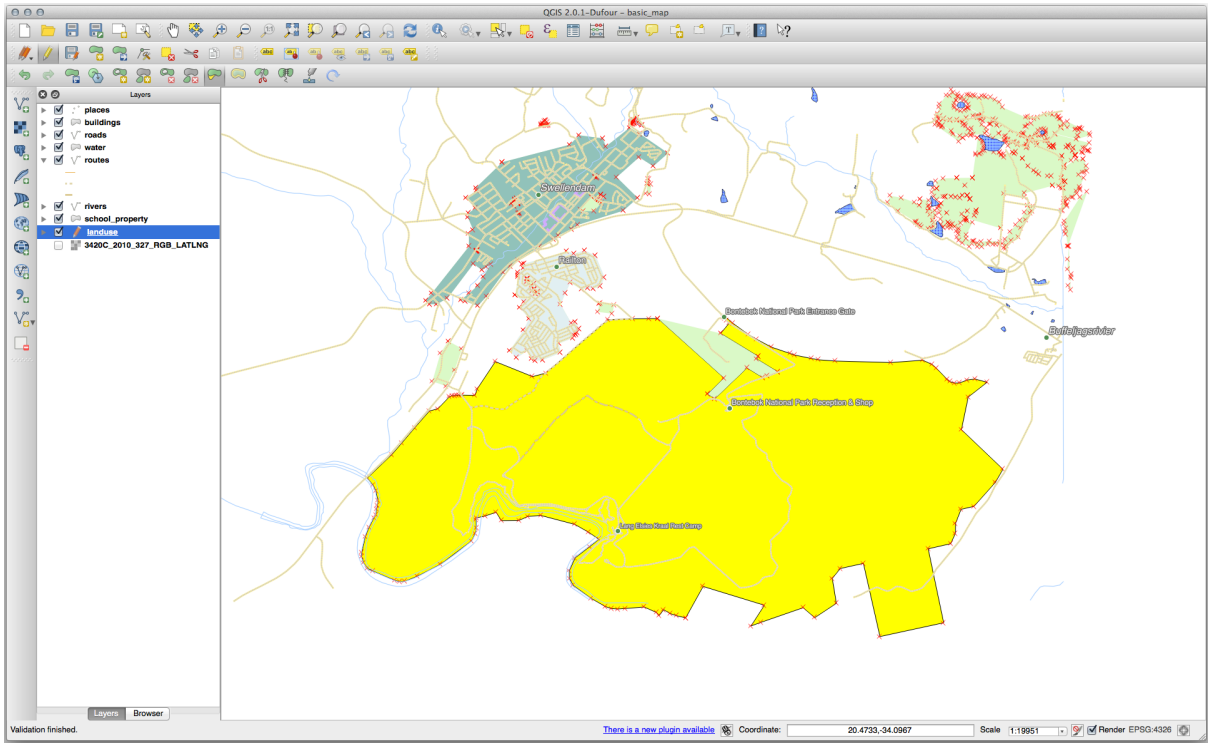
Cut away a part:

1. Select the polygon using the  Select Features by area or single click tool.
2. Faceți clic în afara poligonului.
3. Draw a shape inside the polygon. The last vertex must be back outside the polygon.

4. Right-click outside the polygon:



Iată rezultatul:

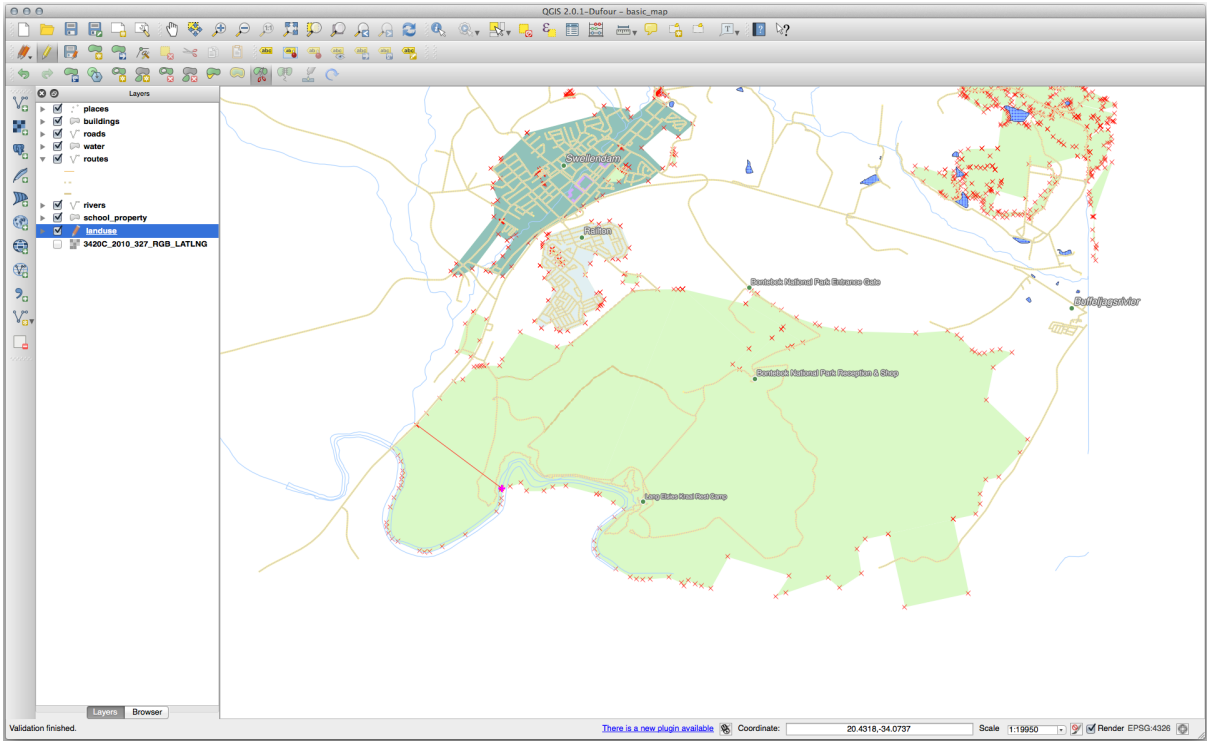


5.2.7 ??? Try Yourself: Tool: Split Features

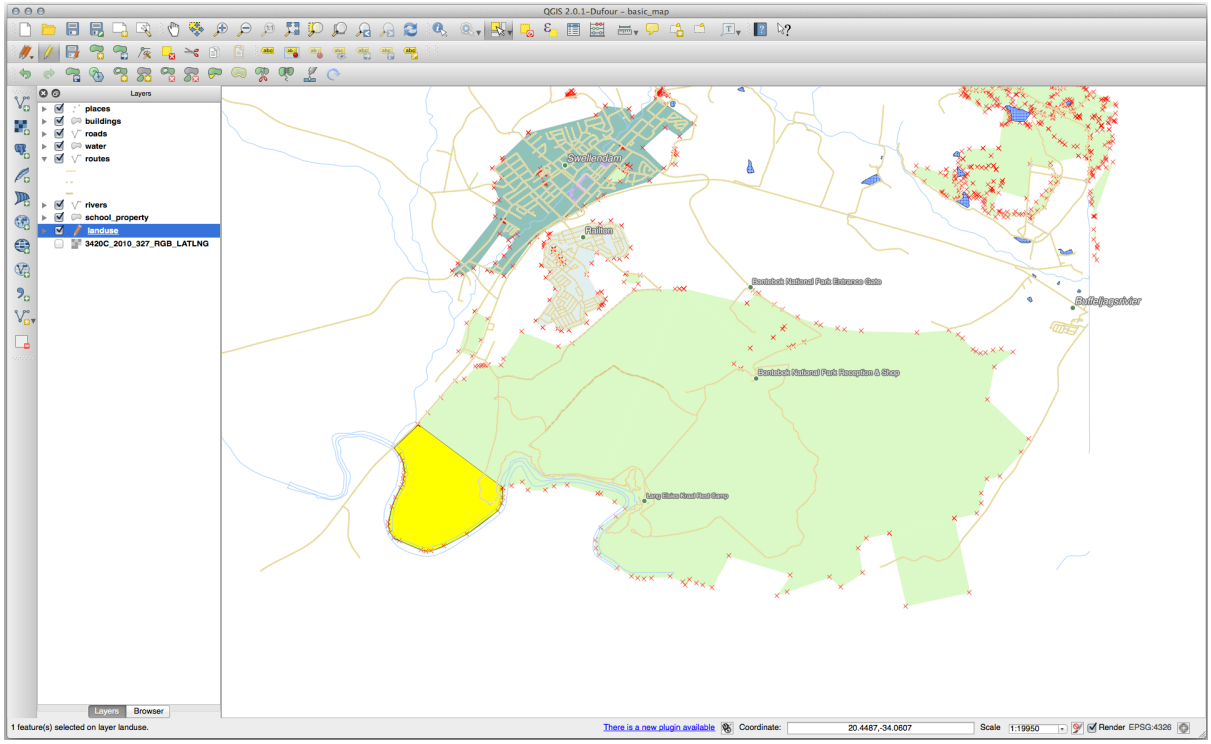
The  Split Features tool is similar to the  Reshape Features tool, except that it does not delete either of the two parts. Instead, it keeps them both.

We will use the tool to split a corner from a polygon.

1. First, select the `landuse` layer and re-enable snapping for it.
2. Select the  Split Features tool and click on a vertex to begin drawing a line.
3. Draw the bounding line.
4. Click a vertex on the „opposite" side of the polygon you wish to split and right-click to complete the line:



5. At this point, it may seem as if nothing has happened. But remember that the `landuse` layer is rendered without border lines, so the new division line will not be shown.
6. Use the  Select Features by area or single click tool to select the part you just split out; the new feature will now be highlighted:



5.2.8 ??? Try Yourself: Tool: Merge Features

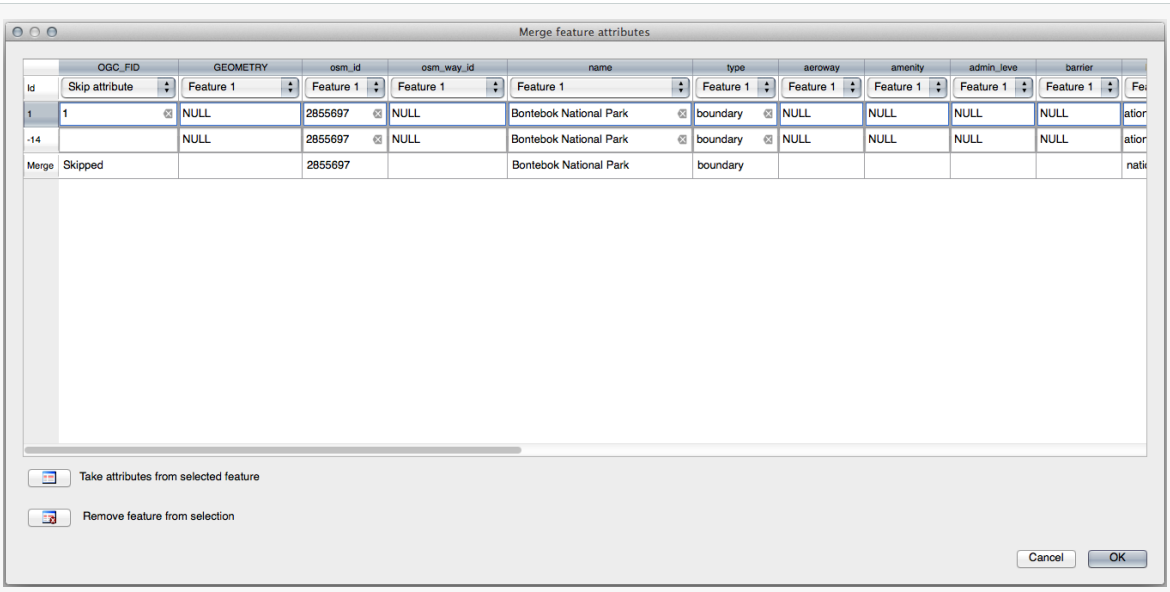
Now we will re-join the feature you just split out to the remaining part of the polygon:

1. Experiment with the Merge Selected Features and Merge Attributes of Selected Features tools.
2. Notați diferențele.

Răspuns

- Use the Merge Selected Features tool, making sure to first select both of the polygons you wish to merge.
- Use the feature with the *OGC_FID* of `1` as the source of your attributes (click on its entry in the dialog, then click the *Take attributes from selected feature* button):

If you're using a different dataset, it is highly likely that your original polygon's *OGC_FID* will not be `1`. Just choose the feature which has an *OGC_FID*.



Using the Merge Attributes of Selected Features tool will keep the geometries distinct, but give them the same attributes.

5.2.9 În concluzie

Editarea topologică este un instrument puternic, care vă permite să creați și să modificați obiectele rapid și ușor, asigurându-vă în același timp că ele rămân corecte din punct de vedere topologic.

5.2.10 Ce urmează?

Now you know how to digitize the shape of the objects easily, but adding attributes is still a bit of a headache! Next we will show you how to use forms, making attribute editing simpler and more effective.

5.3 Lesson: Forms

Atunci când adăugați prin digitizare noi date, vi se prezintă o fereastră de dialog care vă permite să completați atributele entităților. Totuși, acest dialog nu este, în mod implicit, prea aspectuos. Acest lucru poate cauza o problemă de uzabilitate, mai ales dacă aveți de creat seturi de date de mari dimensiuni, sau dacă doriți ca alte persoane să vă ajute la digitizare, aceștia descoperind repede că formularele implicite sunt confuze.

Din fericire, QGIS vă permite să creați propriile dialoguri personalizate pentru un strat. Această lecție vă arată cum.

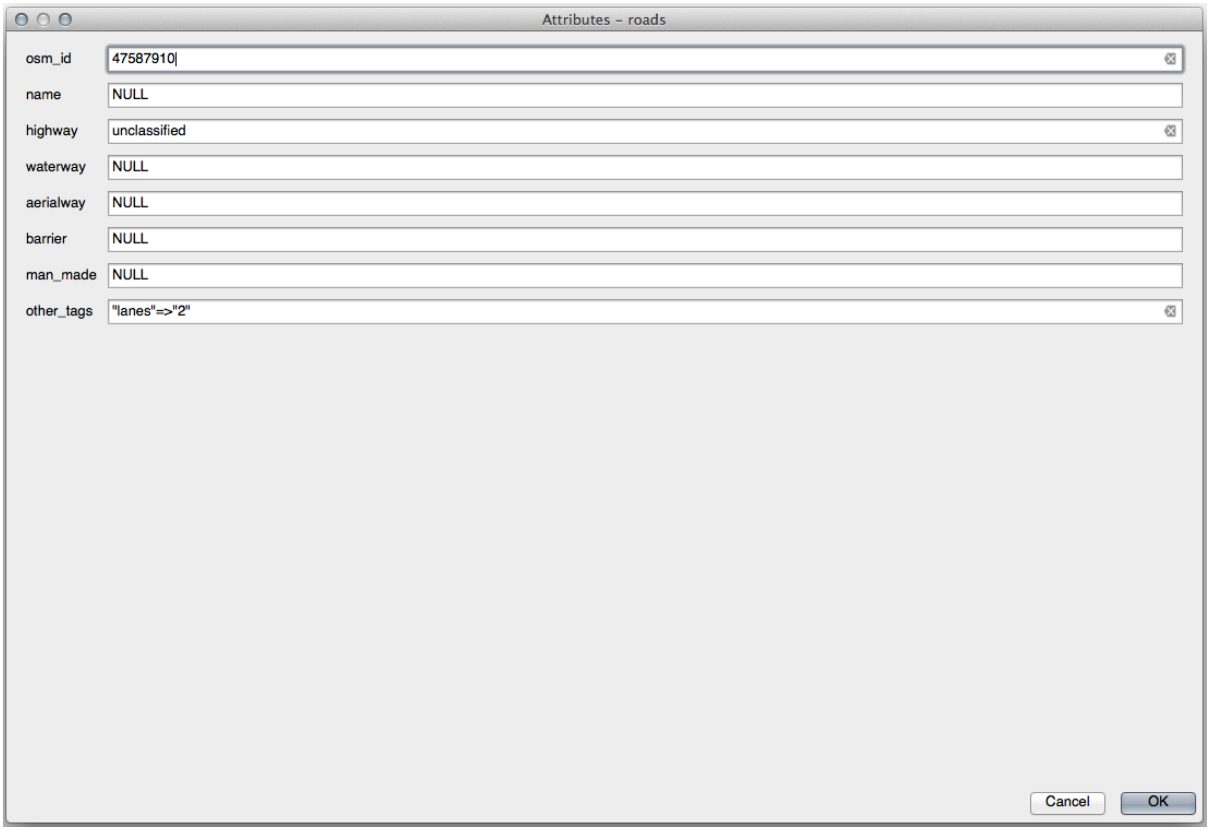
Scopul acestei lecții: De a crea un formular pentru un strat.

5.3.1 ??? Follow Along: Using QGIS» Form Design Functionality

1. Select the `roads` layer in the *Layers* panel
2. Enter *Edit Mode* as before
3. Open the `roads` layer's attribute table
4. Right-click on any cell in the table. A short menu will appear, that includes the *Open form* entry.
5. Click on it to see the form that QGIS generates for this layer

Evident, ar fi frumos să fiți în măsură să faceți acest lucru, mai degrabă, în timp ce vă uitați la hartă, decât să fie nevoie să căutați tot timpul o stradă specifică în *Tabela de Atribute*.

1. Select the `roads` layer in the *Layers* panel
2. Using the  Identify Features tool, click on any street in the map.
3. The *Identify Results* panel opens and shows a tree view of the fields values and other general information about the clicked feature.
4. At the top of the panel, check the *Auto open form for single feature results* checkbox in the  Identify Settings menu.
5. Now, click again on any street in the map. Along the previous *Identify Results* dialog, you'll see the now-familiar form:

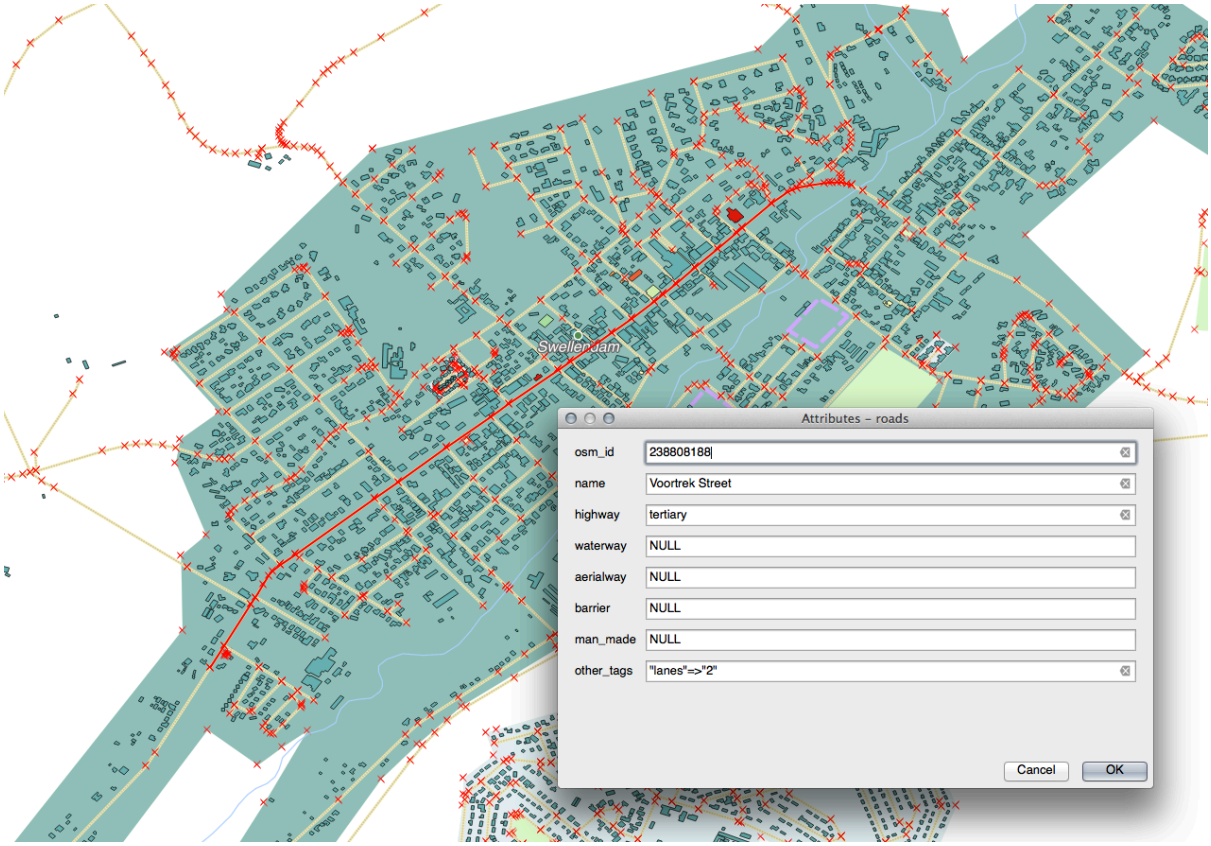


6. Each time you click on a single feature with the  Identify Features tool, its form pops up as long as the *Auto open form* is checked.

5.3.2 ??? Try Yourself: Using the Form to Edit Values

Dacă sunteți în modul de editare, puteți utiliza acest formular pentru a edita atributele unei entități.

1. Activați modul de editare (dacă nu este deja activat).
2. Using the  Identify Features tool, click on the main street running through Swellendam:

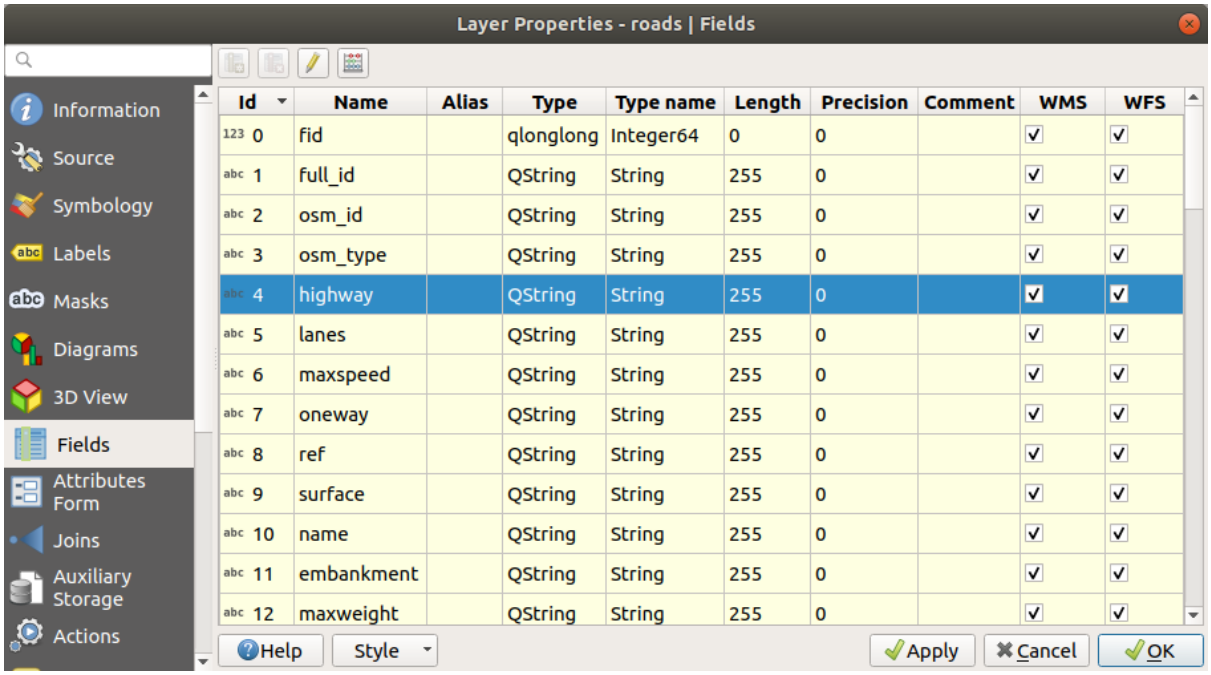


3. Edit its *highway* value to be `secondary`
4. Exit edit mode and save your edits
5. Open the *Attribute Table* and note that the value has been updated in the attributes table and therefore in the source data

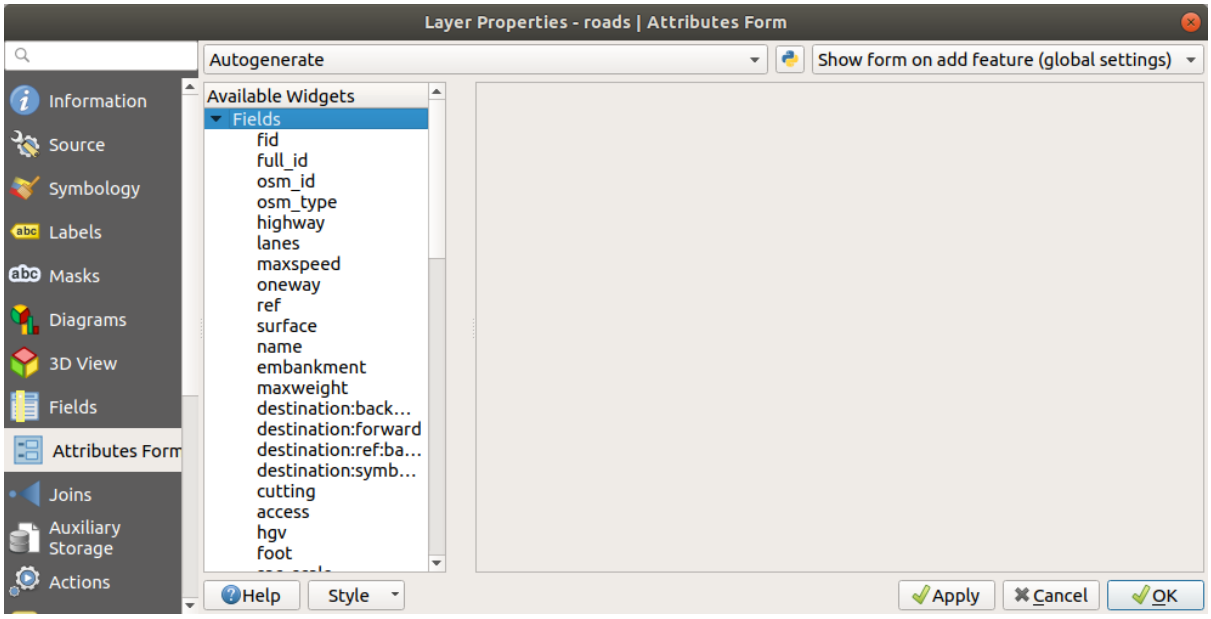
5.3.3 ??? Follow Along: Setting Form Field Types

E frumos să editați lucruri folosind un formular, dar tot trebuie să introduceți manual totul. Din fericire, formele au așa-numitele *widgets*, care vă permit să editați datele în diverse moduri.

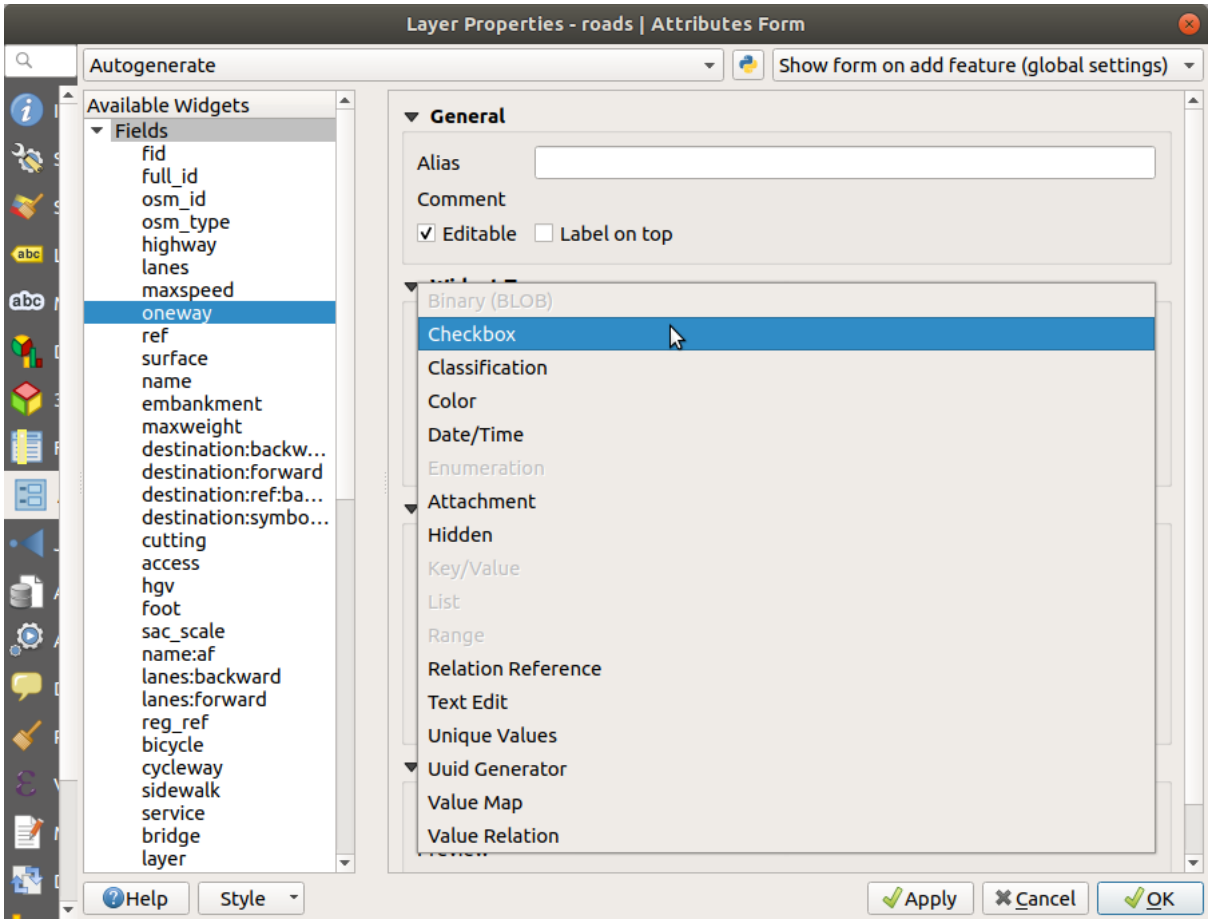
1. Open the `roads` layer's *Properties…*
2. Mergeți la fila *Câmpuri*. Veți vedea următoarele:



3. Switch to the *Attributes Form* tab. You'll see this:



4. Click on the `oneway` row and choose *Checkbox* as *Widget Type* in the list of options:



5. Clic pe *OK*
6. Enter edit mode (if the `roads` layer is not already in edit mode)
7. Click on the  Identify Features tool
8. Click on the same main road you chose earlier

You will now see that the *oneway* attribute has a checkbox next to it denoting `True` (checked) or `False` (unchecked).

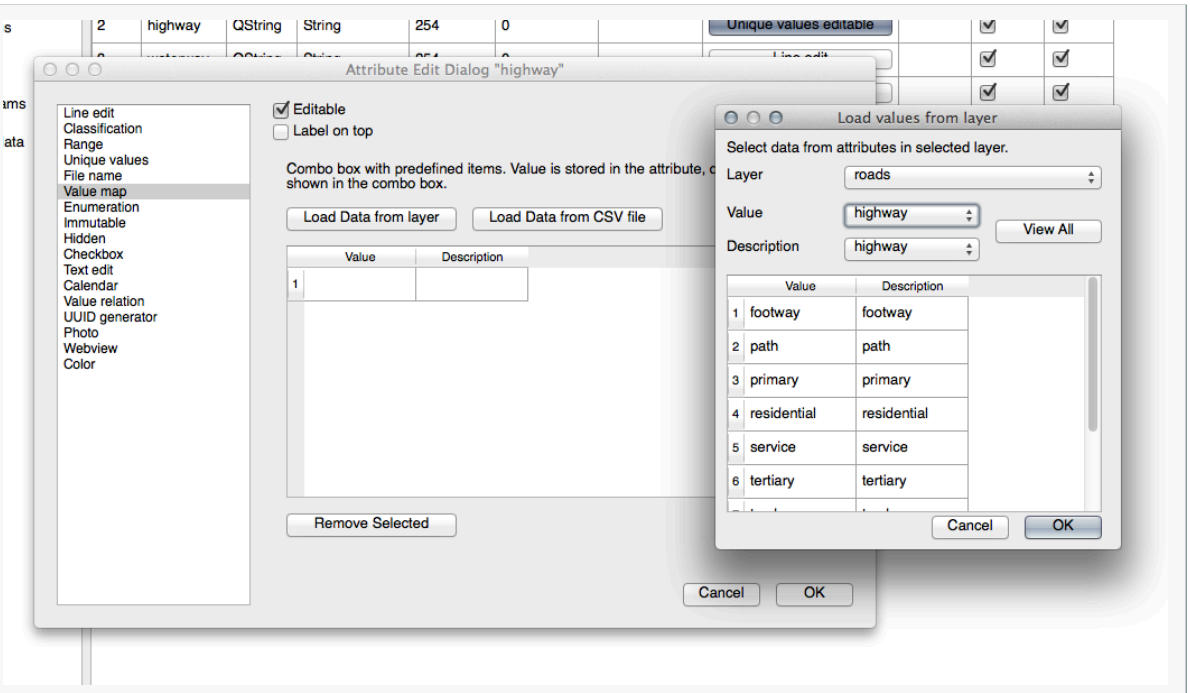
5.3.4 ??? Încercați și dvs.:

Setați un widget mai adecvat pentru câmpul *highway*.

Răspuns

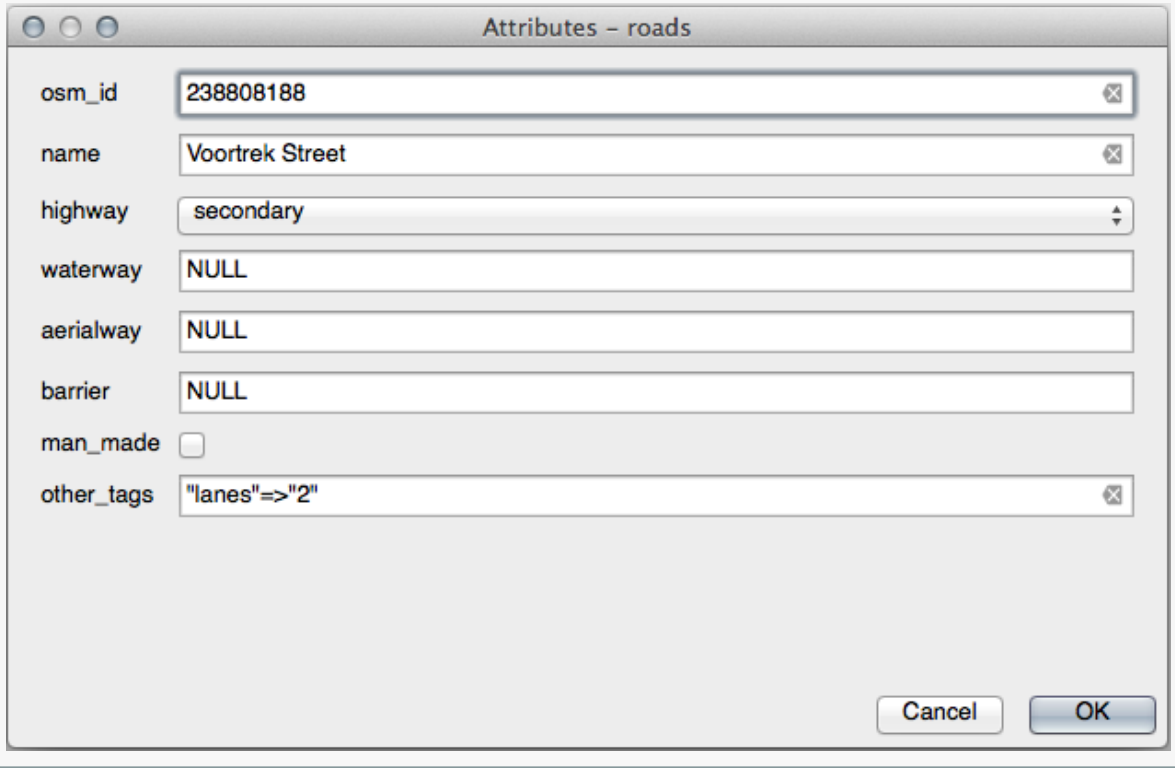
For the *TYPE*, there is obviously a limited amount of types that a road can be, and if you check the attribute table for this layer, you'll see that they are predefined.

1. Set the widget to *Value Map* and click *Load Data from Layer*.
2. Select `roads` in the *Label* dropdown and `highway` for both the *Value* and *Description* options:



3. Click *OK* three times.

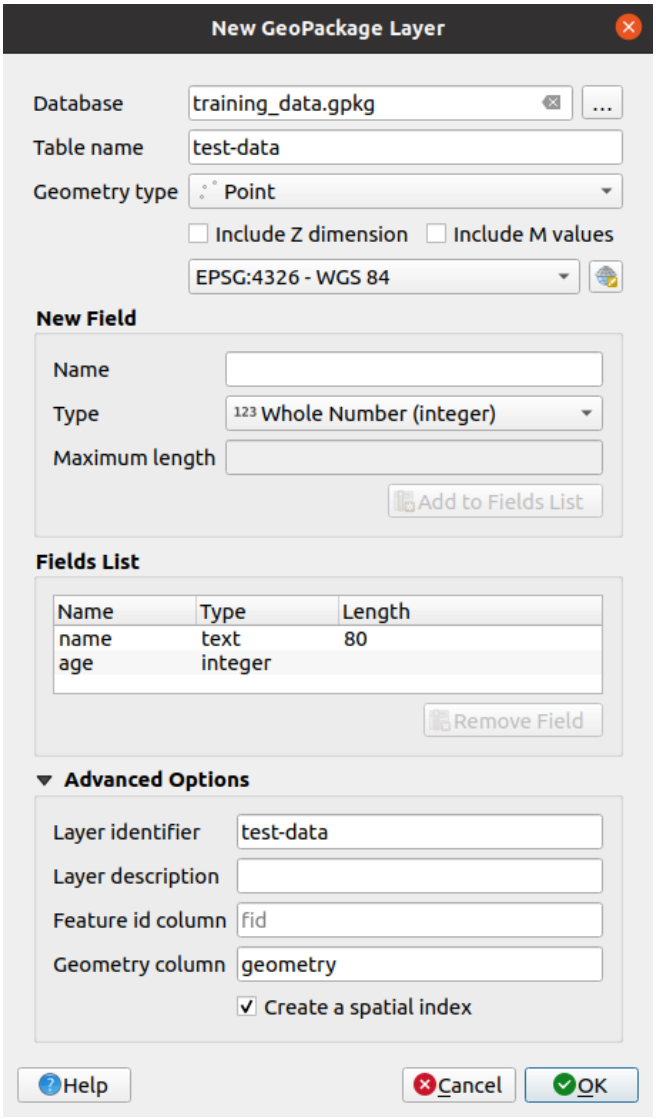
4. If you use the  Identify Features tool on a street now while edit mode is active, the dialog you get should look like this:



5.3.5 ??? Try Yourself: Creating Test Data

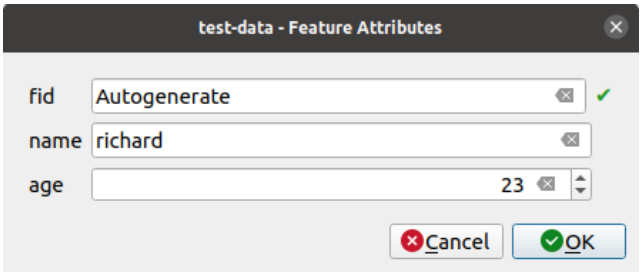
Aveți posibilitatea să proiectați, de asemenea, formularul propriu complet de la zero.

1. Create a simple point layer named `test-data` with two attributes:
   - name (text)
   - age (integer)



2. Capturați câteva puncte de pe noul strat folosind instrumentele de digitizare, așa că veți avea un pic de date cu care să operați. Ar trebui să vedeți în continuare formularul implicit, generat de QGIS, de fiecare dată când capturați un nou punct.

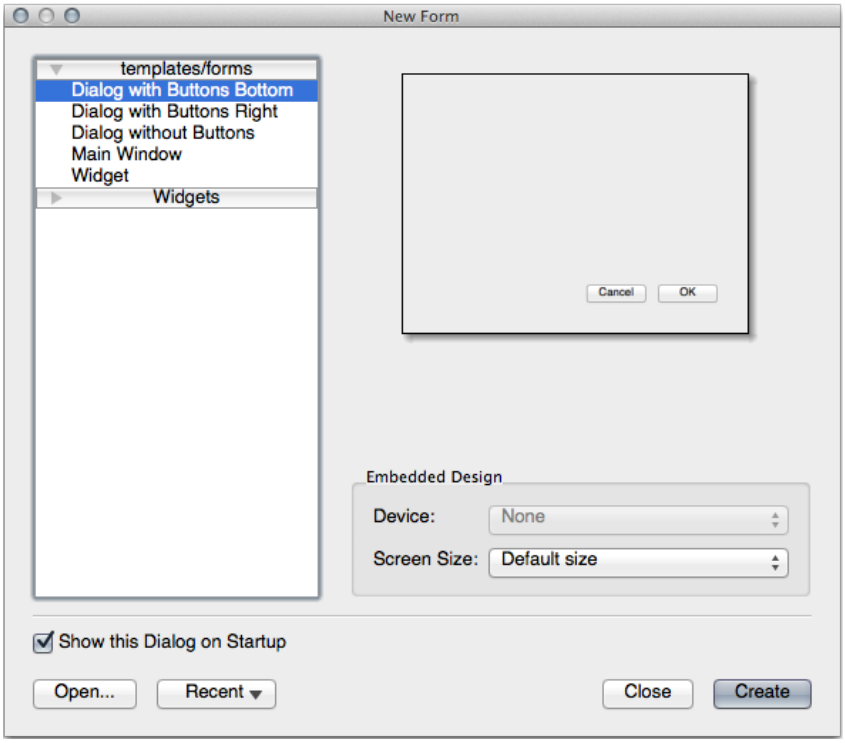
> **Notă**
>
> Este posibil să trebuiască să dezactivați Acroșarea, dacă este activată în urma acțiunilor anterioare.



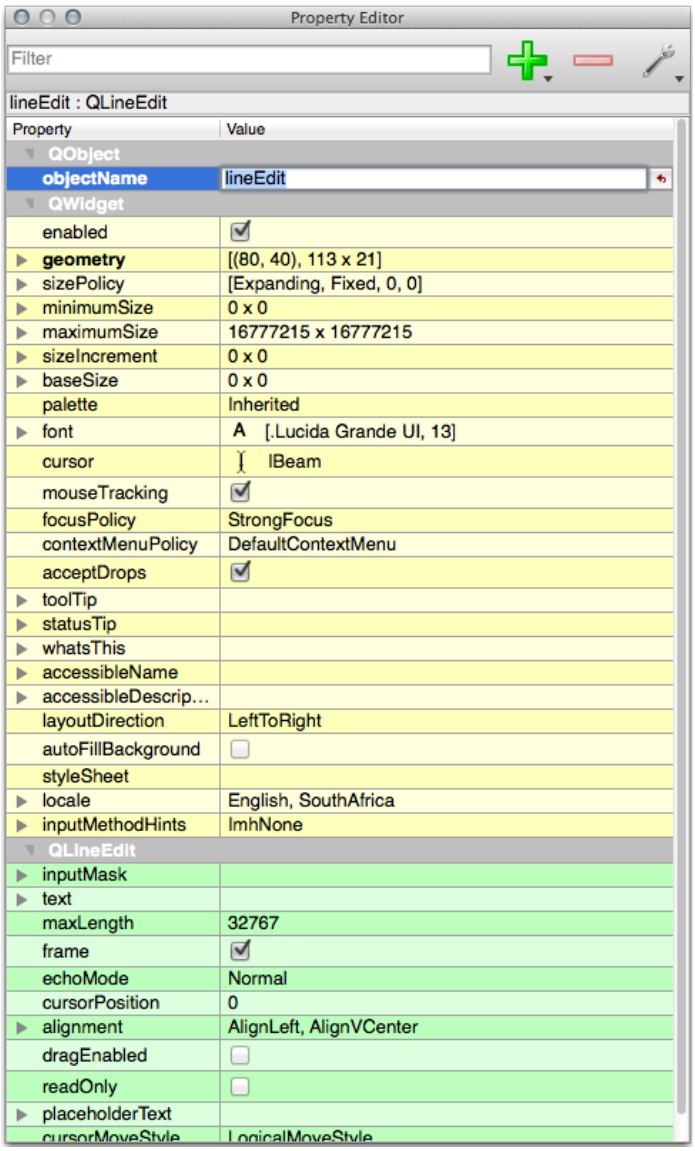
5.3.6 Follow Along: Creating a New Form

Now we want to create our own custom form for the attribute data capture phase. To do this, you need to have *QT Designer* installed (only needed for the person who creates the forms).

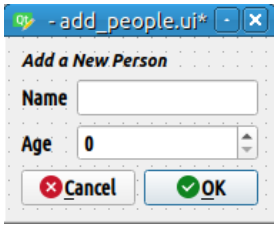
1. Start *QT Designer*.
2. În caseta de dialog care apare, creați un nou dialog:



3. Căutați *Widget Box* în partea stângă a ecranului (implicit). Aceasta conține un element denumit *Line Edit*.
4. Faceți clic și trageți acest articol în formular. Aceasta va crea o nouă *Linie de Editare* în formular.
5. Având selectat noul element de linie de editare, îi veți vedea *proprietățile* de-a lungul părții laterale a ecranului (din partea dreaptă, în mod implicit):



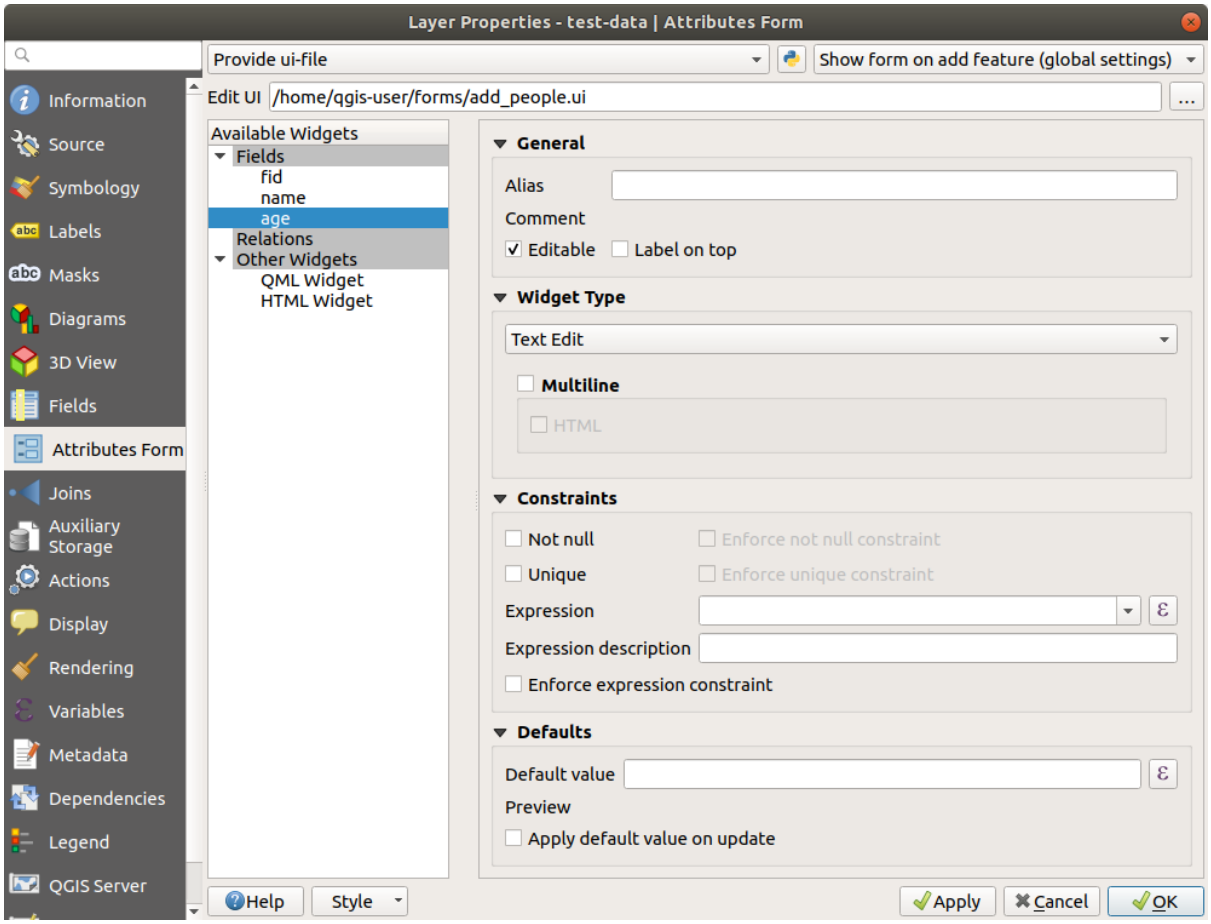
6. Set its name to `name`.
7. Using the same approach, create a new *Spin Box* and set its name to `age`.
8. Add a *Label* with the text `Add a New Person` in a bold font (look in the object *properties* to find out how to set this). Alternatively, you may want to set the title of the dialog itself (rather than adding a label).
9. Add a *Label* for your *Line Edit* and your *Spin Box*.
10. Arrange the elements to your own desire.
11. Faceți clic oriunde, în fereastra de dialog.
12. Find the *Lay Out in a Form Layout* button (in a toolbar along the top edge of the screen, by default). This lays out your dialog automatically.
13. Set the dialog's maximum size (in its properties) to `200` (width) by `150` (height).
14. Your form should now look similar to this:



15. Save your new form as `exercise_data/forms/add_people.ui`
16. When it's done saving, you can close *Qt Designer*

5.3.7 ??? Follow Along: Associating the Form with Your Layer

1. Go back to QGIS
2. Double click the `test-data` layer in the legend to access its properties.
3. Click on the *Attributes Form* tab in the *Layer Properties* dialog
4. În caseta cu lista derulantă *Attribute editor layout*, selectați *Provide ui-file*.
5. Click the ellipsis button and choose the `add_people.ui` file you just created:



6. Click *OK* on the *Layer Properties* dialog
7. Enter edit mode and capture a new point
8. Când faceți acest lucru, vă va fi prezentat dialogul personalizat (în loc de cel generic, pe care îl creează de obicei QGIS).

9. If you click on one of your points using the  Identify Features tool, you can now bring up the form by right clicking in the identify results window and choosing *View Feature Form* from the context menu.
10. If you are in edit mode for this layer, that context menu will show *Edit Feature Form* instead, and you can then adjust the attributes in the new form even after initial capture.

5.3.8 În concluzie

Folosind formularele, vă puteți face viața mai ușoară, atunci când editați sau când creați date. Prin editarea tipurilor de widget sau pin crearea unui formular cu totul nou, de la zero, puteți controla experiența cuiva care digitalizează date noi, minimizând, astfel, neînțelegerile și erorile inutile.

5.3.9 Further Reading

If you completed the advanced section above and have knowledge of Python, you may want to check out this blog entry about creating custom feature forms with Python logic, which allows advanced functions including data validation, autocompletion, etc.

5.3.10 Ce urmează?

Deschiderea unui formular o dată cu identificarea unei entități este una dintre acțiunile standard, pe care o poate efectua QGIS. Cu toate acestea, puteți efectua direct acțiunile personalizate pe care le definiți. Acesta este subiectul lecției următoare.

5.4 Lesson: Actions

Now that you have seen a default action in the previous lesson, it is time to define your own actions.

An action is something that happens when you click on a feature. It can add a lot of extra functionality to your map, allowing you to retrieve additional information about an object, for example. Assigning actions can add a whole new dimension to your map!

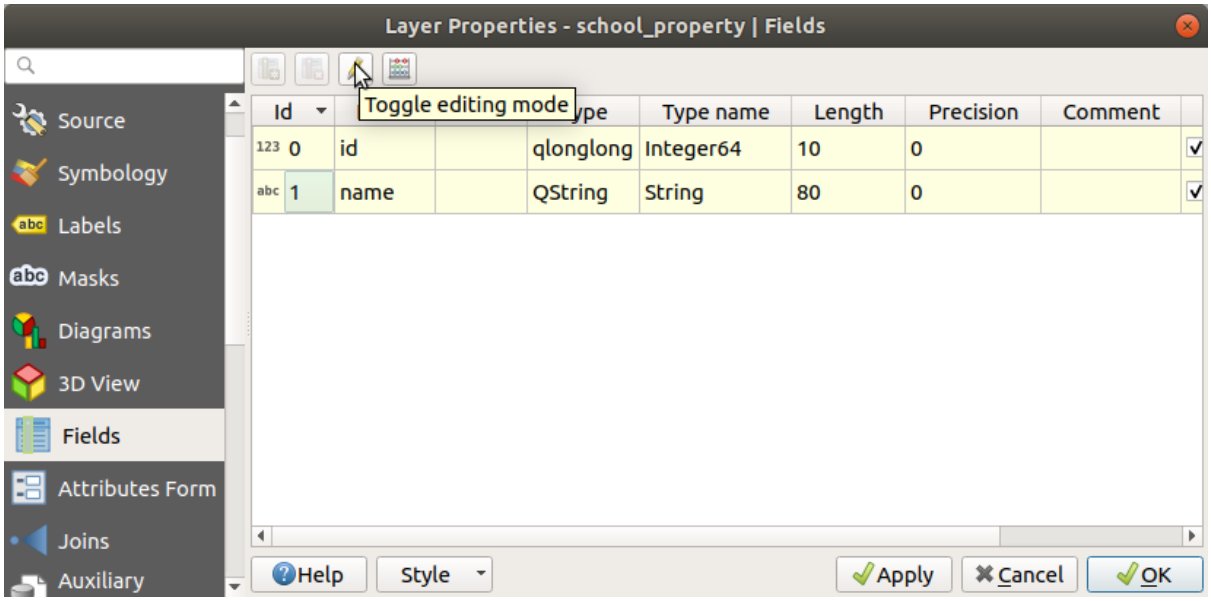
Scopul acestei lecții: De a afla cum să adăugați acțiuni particularizate.

In this lesson you will use the `school_property` layer you created previously. The sample data include photos of each of the three properties you digitized. What we are going to do is to associate each property with its image. Then we will create an action that will open the image for a property when clicking on the property.

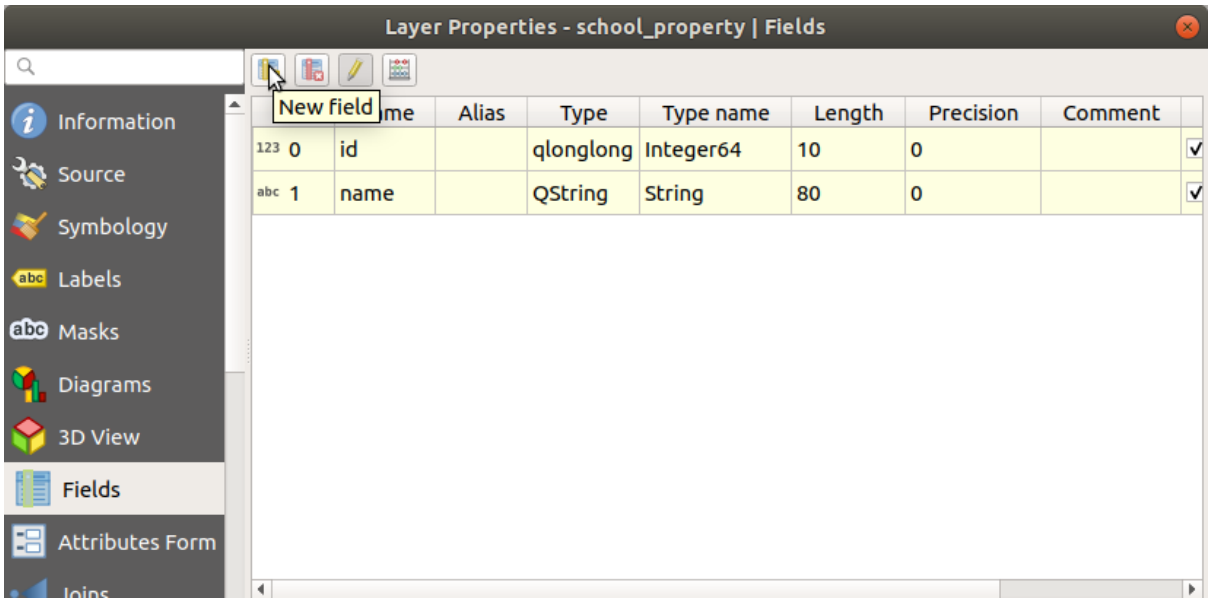
5.4.1 ??? Procedați în mod similar: Adăugarea unui Câmp pentru Imagini

The `school_property` layer has no way to associate an image with a property yet. First we will create a field for this purpose.

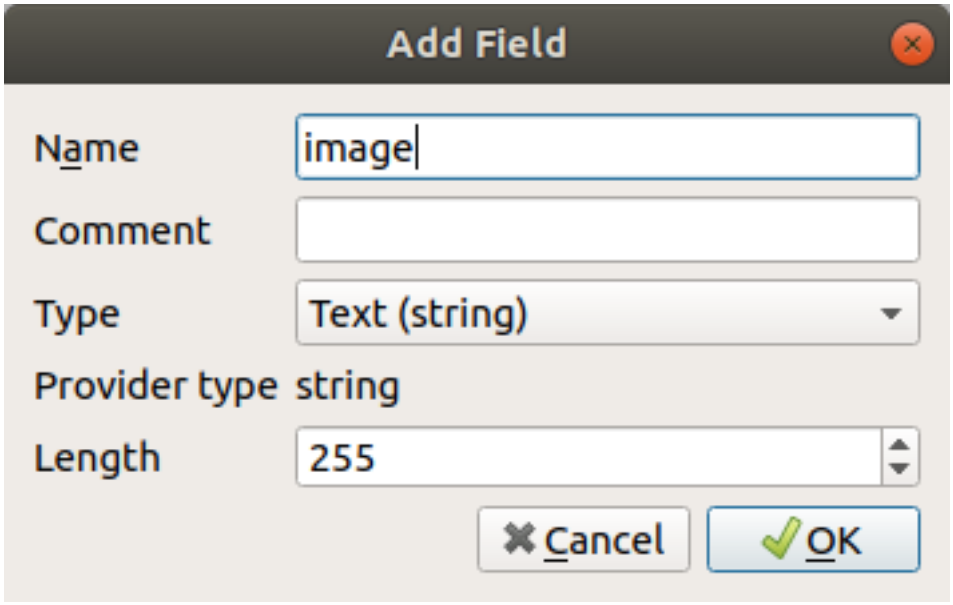
1. Deschideți dialogul *Layer Properties*.
2. Dați clic pe fila *Fields*.
3. Comutați în modul de editare:



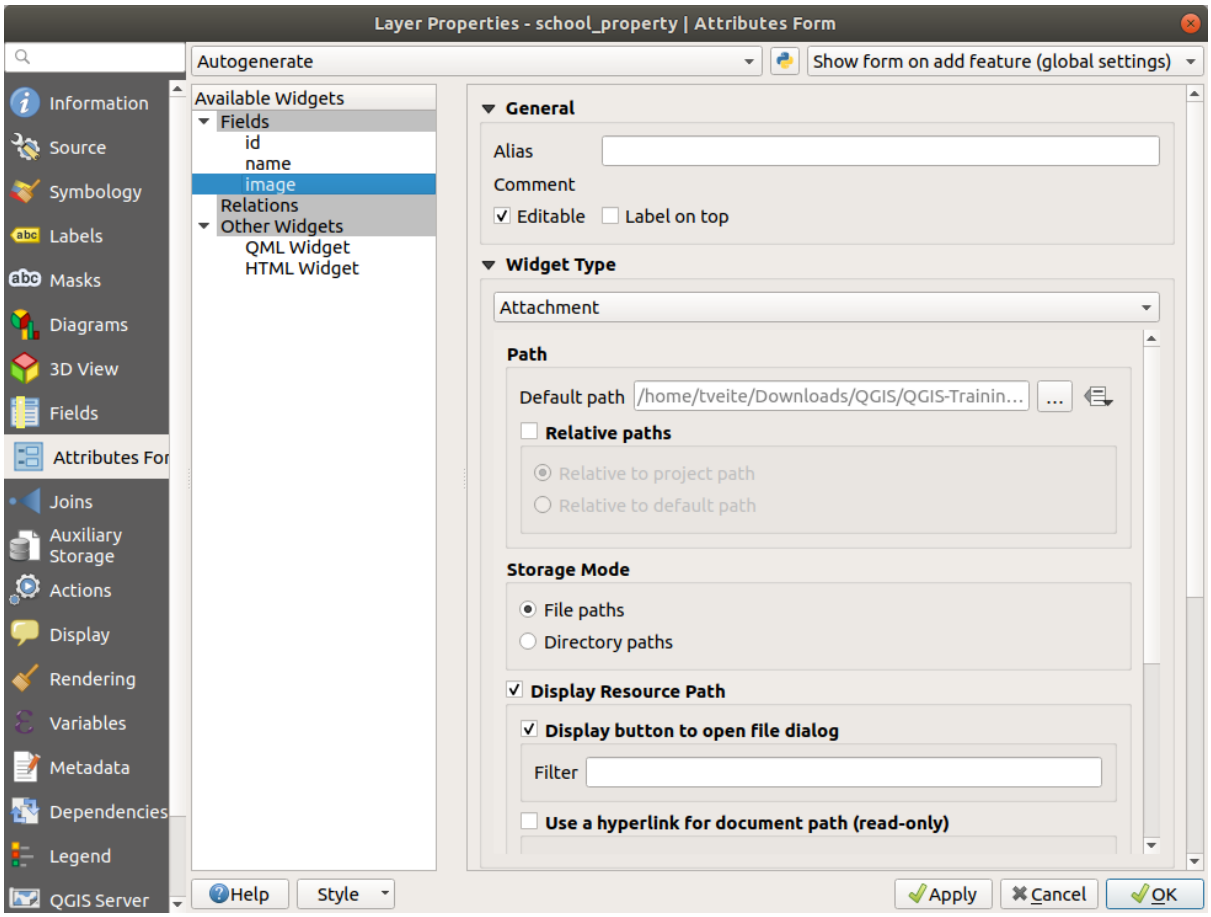
4. Adăugați o nouă coloană:



5. Introduceți valorile de mai jos:

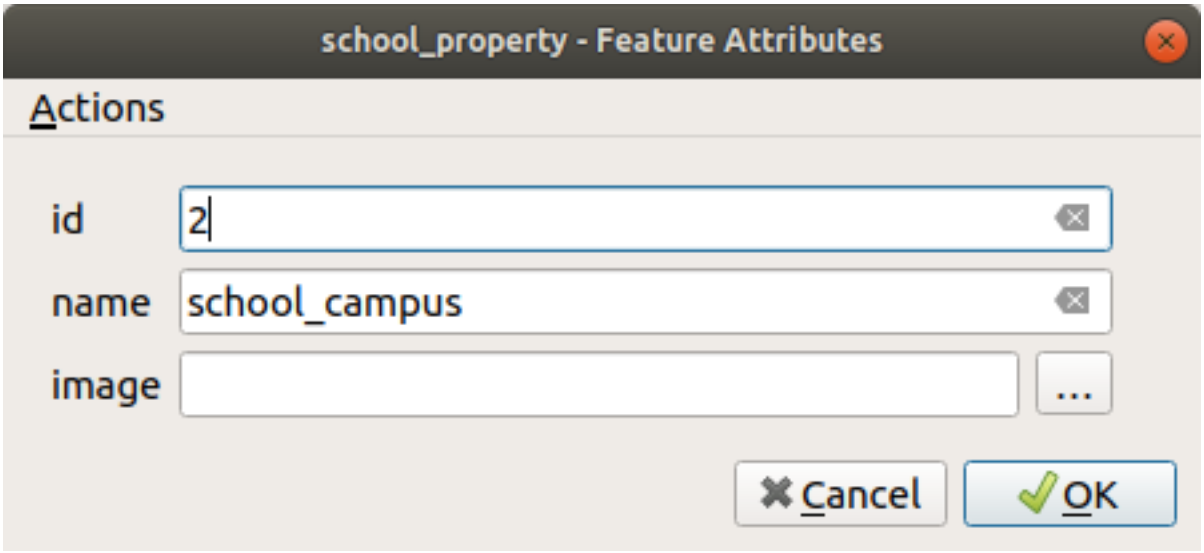


6. After the field has been created, move to the *Attributes Form* tab and select the `image` field.
7. Set *Widget Type* to *Attachment*:



8. Click *OK* in the *Layer Properties* dialog.
9. Use the  Identify Features tool to click on one of the three features in the `school_property` layer.

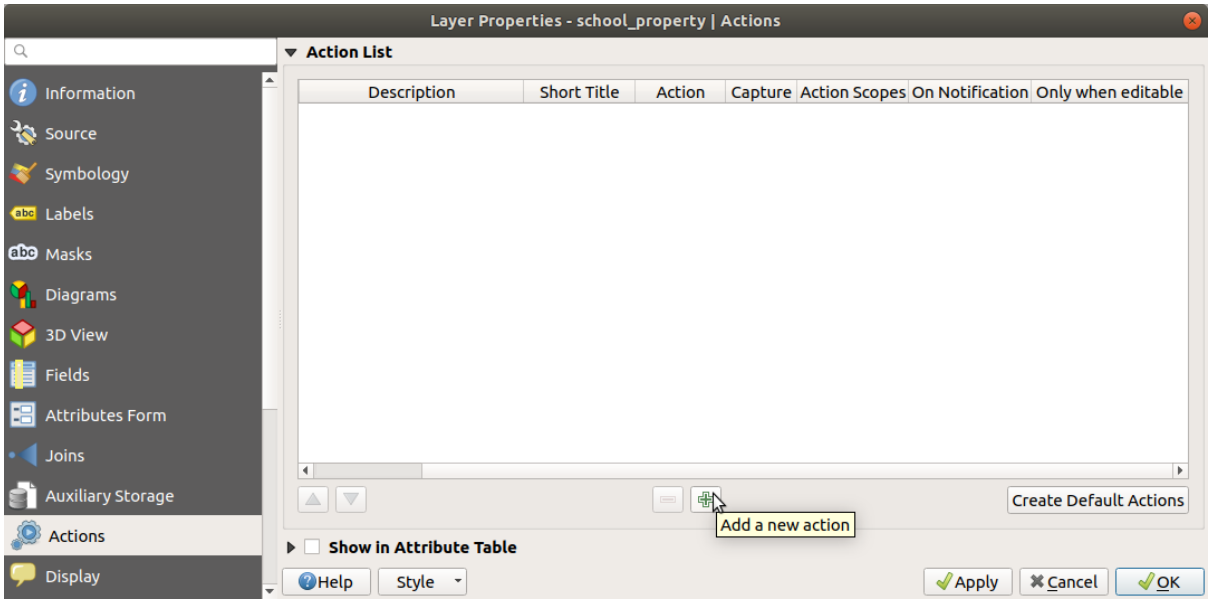
   Since you are still in edit mode, the dialog should be active and look like this:



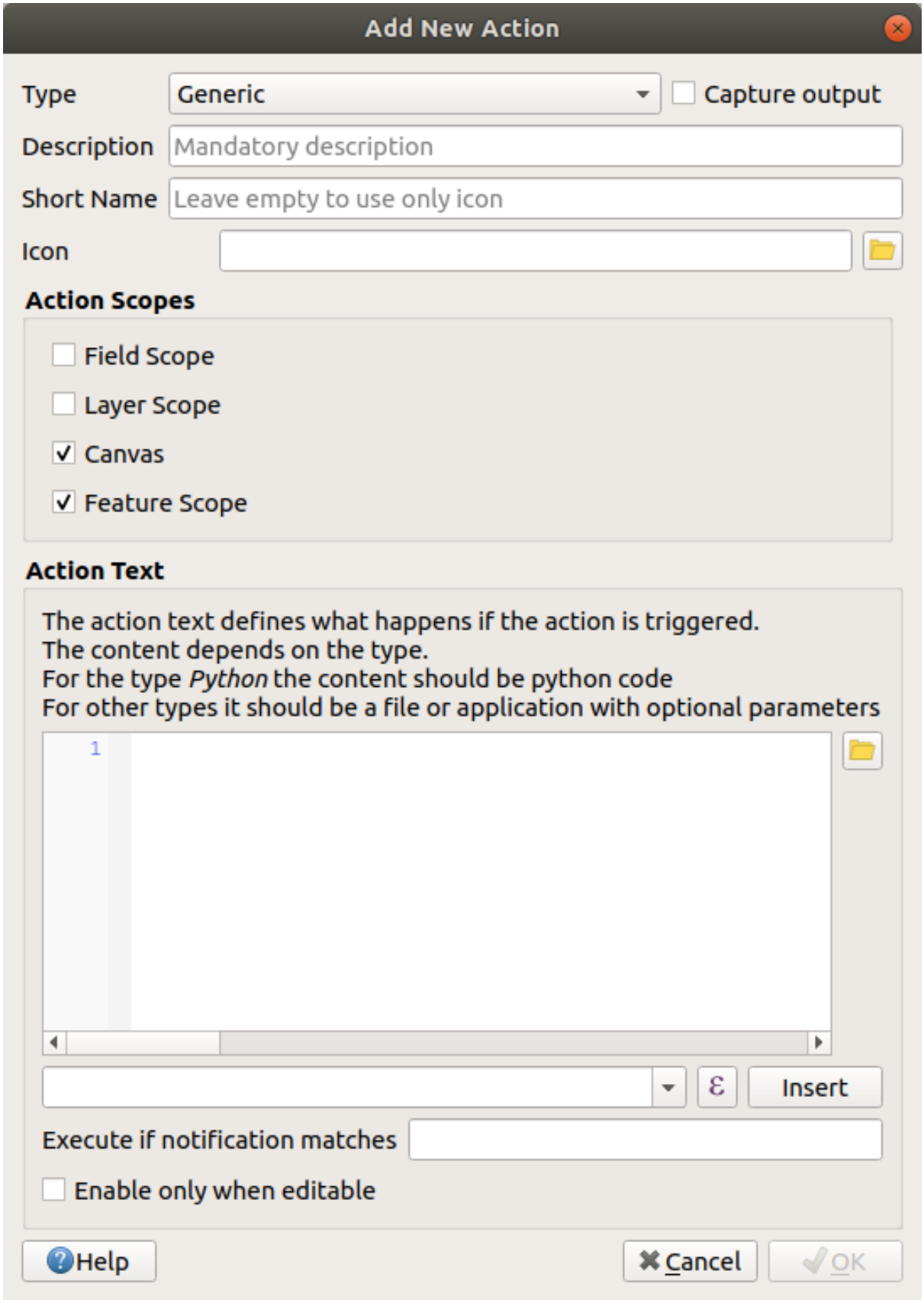
10. Clic pe butonul de răsfoire (… de lângă câmpul *imagine*).
11. Select the path for your image. The images are in `exercise_data/school_property_photos/` and are named the same as the features they should be associated with.
12. Clic pe *OK*
13. Asociați toate imaginile cu entitățile corecte folosind această metodă.
14. Salvați modificările și ieșiți din modul de editare.

5.4.2 ??? Procedați în mod similar: Crearea unei Acțiuni

1. Open the *Actions* tab for the `school_property` layer, and click on the  Add a new action button.



2. In the *Add New Action* dialog, enter the words `Show Image` into the *Description* field:



Ceea ce veți face în continuare diferă în funcție de sistemul de operare, asa că alegeți un curs adecvat:

- Windows

Dați clic pe meniul vertical *Type* și alegeți *Open*.

- Ubuntu Linux

  Under *Action*, write `eog` for the *Gnome Image Viewer*, or write `display` to use *ImageMagick*. Remember to put a space after the command!

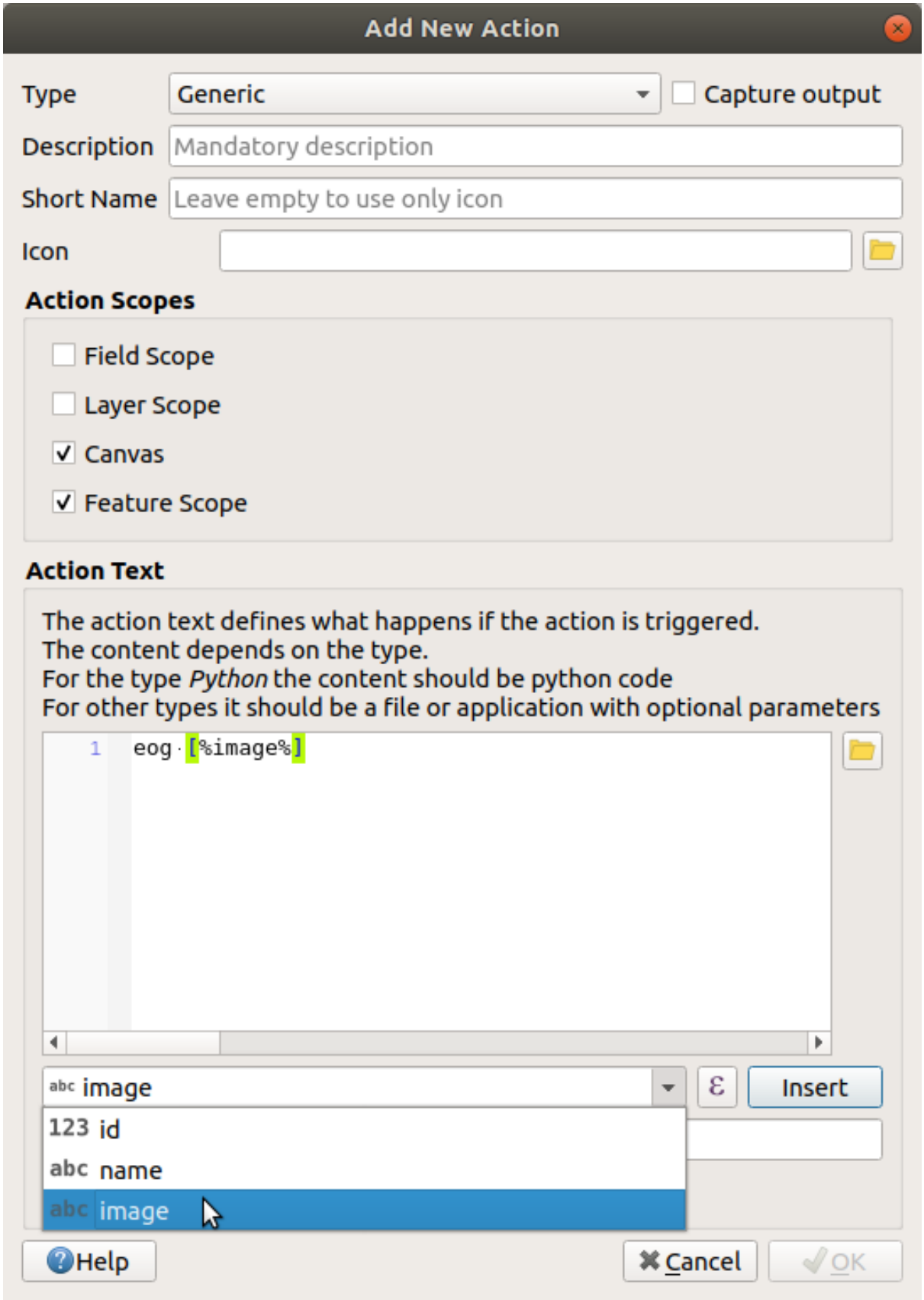
- macOS

  1. Clic pe caseta *Type*, apoi alegeți *Mac*.
  2. Under *Action*, write `open`. Remember to put a space after the command!

Now you can continue writing the command.

Vreți să deschideți imaginea, si QGIS știe unde se află. Tot ce rămâne de făcut este să îi spuneți *Action* unde se află imaginea.

3. Selectați *image* din listă:

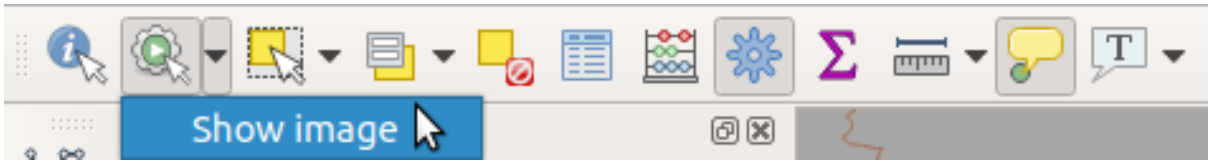


4. Click the *Insert field* button. QGIS will add the phrase `[% "image" %]` in the *Action Text* field.
5. Click the *OK* button to close the *Add New Action* dialog

6. Click *OK* to close the *Layer Properties* dialog

Now it is time to test the new action:

1. Click on the `school_property` layer in the *Layers* panel so that it is highlighted.
2. Find the  Run feature action button (in the *Attributes Toolbar*).
3. Click on the down arrow to the right of this button. There is only one action defined for this layer so far, which is the one you just created.



4. Apăsați butonul pentru a activa instrumentul.
5. Folosind acest instrument, faceți clic pe oricare din cele trei proprietăți școlare.

   The image for that property should open.

5.4.3 ??? Procedați în mod similar: Căutarea pe Internet

Let's say we are looking at the map and want to know more about the area that a farm is in. Suppose you know nothing of the area in question and want to find general information about it. Your first impulse, considering that you're using a computer right now, would probably be to Google the name of the area. So let's tell QGIS to do that automatically for us!

1. Open the attribute table for the `landuse` layer.

   We will be using the `name` field for each of our landuse areas to search Google.
2. Închideți tabelul de atribute.
3. Mergeți înapoi la *Acțiuni* în *Proprietățile Stratului*.
4. Click on the *Create Default Actions* button to add a number of pre-defined actions.
5. Remove all the actions but the *Open URL* action with the short name *Search Web* using the  Remove the selected action button below.
6. Double-click on the remaining action to edit it
7. Change the *Description* to `Google Search`, and remove the content of the *Short Name* field.
8. Make sure that *Canvas* is among the checked *Action scopes*.

   Ceea ce veți face în continuare diferă în funcție de sistemul de operare, asa că alegeți un curs adecvat:

   - Windows

     Sub *Tip*, alegeți *Deschidere*. Acest lucru va spune Windows-ului să deschidă o adresă de Internet din browser-ul implicit, cum ar fi Internet Explorer.

   - Ubuntu Linux

     Under *Action*, write `xdg-open`. This will tell Ubuntu to open an Internet address in your default browser, such as Chrome or Firefox.

   - macOS

     Under *Action*, write `open`. This will tell macOS to open an Internet address in your default browser, such as Safari.

Now you can continue writing the command

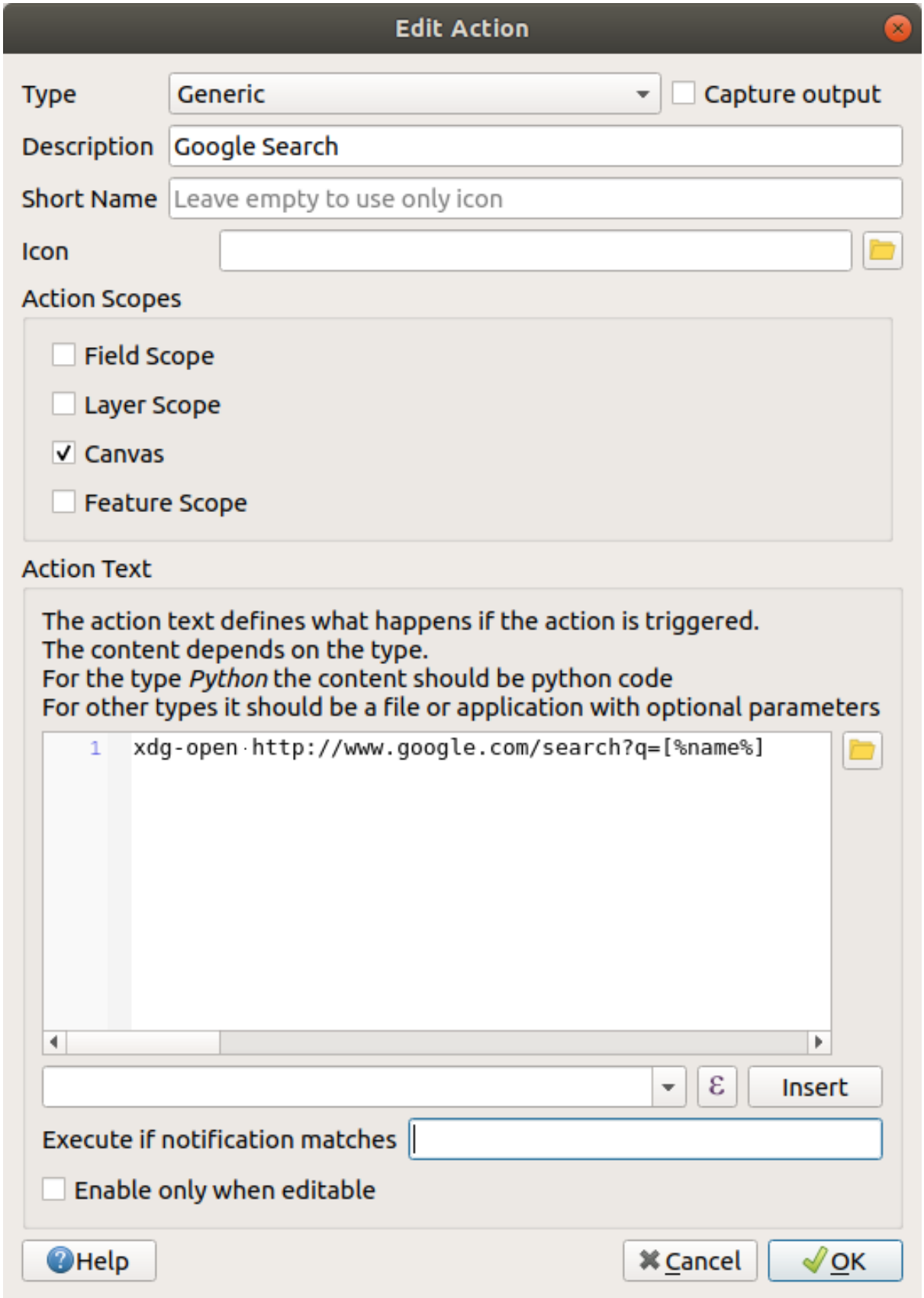
Orice comandă ați folosit mai sus, trebuie să îi spuneți ce adresă să deschidă în continuare. Vreți să accesați Google și să căutați automat o expresie.

Usually when you use Google, you enter your search phrase into the Google Search bar. But in this case, you want your computer to do this for you. The way you tell Google to search for something (if you don't want to use its search bar directly) is by giving your Internet browser the address `https://www.google.com/search?q=SEARCH_PHRASE`, where `SEARCH_PHRASE`` is what you want to search for. Since we don't know what phrase to search for yet, we will just enter the first part (without the search phrase).

9. In the *Action* field, write `https://www.google.com/search?q=`. Remember to add a space after your initial command before writing this in!

   Now you want QGIS to tell the browser to tell Google to search for the value of `name` for any feature that you could click on.

10. Selectați câmpul *name*.
11. Click *Insert* button:



What this means is that QGIS is going to open the browser and send it to the address `https://www.google.com/search?q=[% "name" %]`. `[% "name" %]` tells QGIS to use the contents of the `name` field as the phrase to search for.

So if, for example, the landuse area you click on is named `Marloth Nature Reserve`, QGIS is going to send the browser to `https://www.google.com/search?q=Marloth%20Nature%20Reserve`, which will cause your browser to visit Google, which will in turn search for „Marloth Nature Reserve”.

12. If you have not done so already, set everything up as explained above.
13. Click the *OK* button to close the *Add New Action* dialog
14. Click *OK* to close the *Layer Properties* dialog

Acum vom testa noua versiune.

1. With the `landuse` layer active in the *Layers* panel, click on the down arrow to the right of the  Run feature action button, and select the only action (`Google Search`) defined for this layer.
2. Click on any landuse area you can see on the map. Your browser will now open, and will start a Google search for the place that is recorded as that area's `name` value.

Notă

În cazul în care acțiunea nu funcționează, verificați dacă totul a fost introdus corect; erorile de introducere sunt comune pentru această activitate!

5.4.4 ??? Follow Along: Open a Webpage Directly in QGIS

Above, you've seen how to open a webpage in an external browser. There are some shortcomings with this approach in that it adds an unknowable dependency – will the end-user have the software required to execute the action on their system? As you've seen, they don't necessarily even have the same kind of base command for the same kind of action, if you don't know which OS they will be using. With some OS versions, the above commands to open the browser might not work at all. This could be an insurmountable problem.

However, QGIS sits on top of the incredibly powerful and versatile Qt library. Also, QGIS actions can be arbitrary, tokenized (i.e. using variable information based on the contents of a field attribute) Python commands!

Now you will see how to use a python action to show a web page. It is the same general idea as opening a site in an external browser, but it requires no browser on the user's system since it uses the Qt QWebView class (which is a webkit based html widget) to display the content in a pop-up window.

Let us use Wikipedia this time. So the URL you request will look like this:

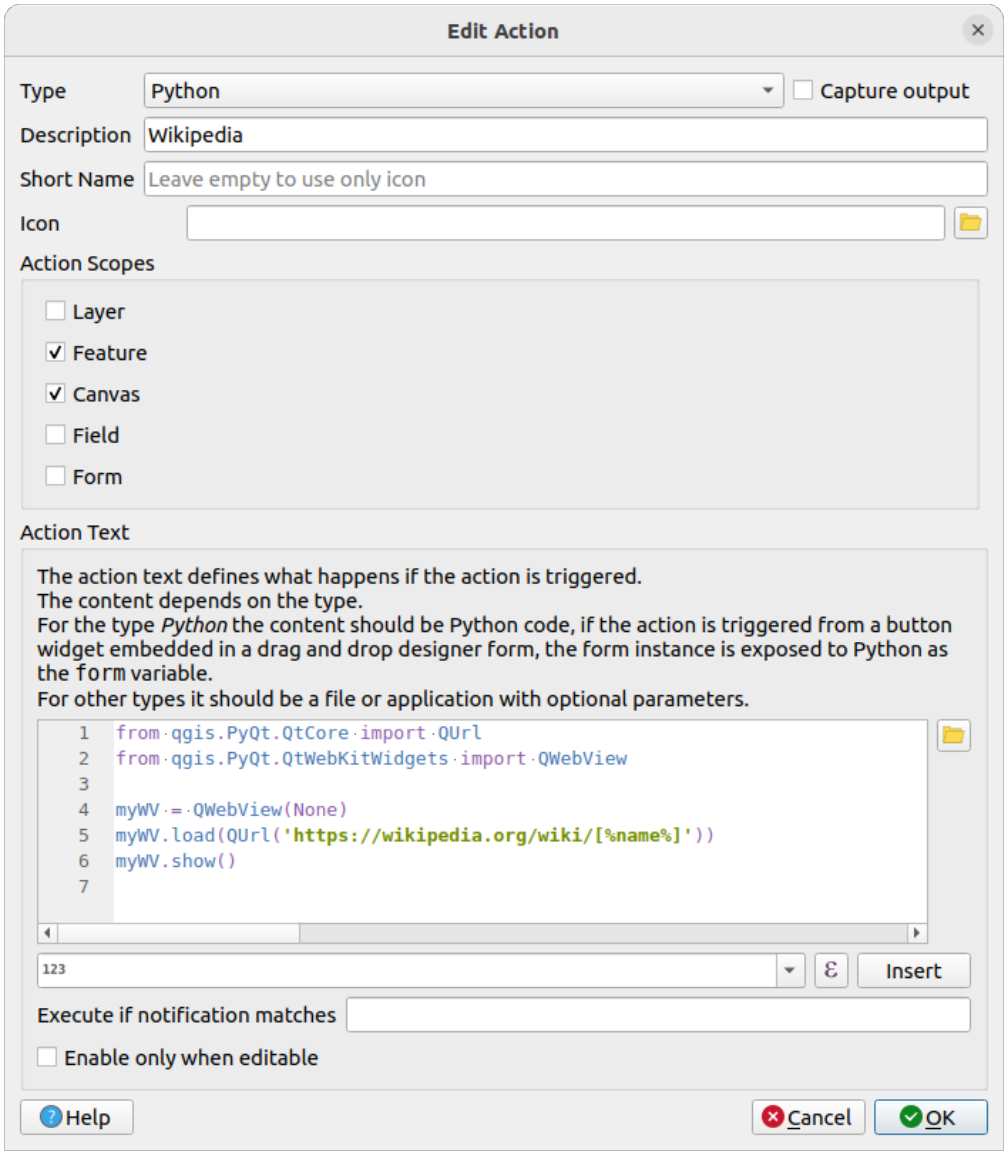
`https://wikipedia.org/wiki/SEARCH_PHRASE`

Pentru a crea acțiunea stratului:

1. Deschideți dialogul *Proprietăților Stratului* și mergeți la fila *Actions*.
2. Setați o nouă acțiune, folosind următoarele proprietăți pentru acțiune:
   - *Tip*: `Python`
   - *Descriere*: `Wikipedia`
   - *Scope*: `Feature`, `Canvas`
   - *Action Text*:

```
from qgis.PyQt.QtCore import QUrl
from qgis.PyQt.QtWebKitWidgets import QWebView

myWV = QWebView(None)
myWV.load(QUrl('https://wikipedia.org/wiki/[%name%]'))
myWV.show()
```



Aici se întâmplă mai multe lucruri:

- `[%name%]` will be replaced by the actual attribute value when the action is invoked (as before).
- The code simply creates a new `QWebView` instance, sets its URL, and then calls `show()` on it to make it visible as a window on the user's desktop.

You could also use this approach to display an image without requiring that the users have a particular image viewer on their system.

3. Try to use the methods described above to load a Wikipedia page using the Wikipedia action you just created.

5.4.5 În concluzie

Actions allow you to give your map extra functionality, useful to the end-user who views the same map in QGIS. Due to the fact that processes called can be shell commands for any operating system, as well as Python, the sky is the limit in terms of the functions you could incorporate!

5.4.6 Ce urmează?

Now that you've done all kinds of vector data creation, you will learn how to analyze the data to solve problems. That is the topic of the next module.

CAPITOLUL 6

Module: Vector Analysis

Acum, după ce ați editat câteva entități, trebuie să știți ce altceva se poate face cu ele. Având entități cu atribute este frumos, dar, în final, aceasta nu reprezintă chiar ceva care să se detașeze net față de o hartă non-GIS.

Avantajul cheie al unui GIS este: *un GIS poate răspunde întrebărilor.*

Pentru următoarele trei module, ne vom strădui să răspundem la o *întrebare de cercetare* folosind funcții GIS. De exemplu, dacă sunteți un agent imobiliar și vă aflați în căutarea unei proprietăți rezidențiale în Swellendam, care trebuie să respecte următoarele criterii:

1. Să fie situată în Swellendam.
2. Trebuie să fie la distanță de conducere rezonabilă, față de o școală (de exemplu, 1 km).
3. Trebuie să aibă mai mult de 100m pătrați în dimensiune.
4. Să fie situată sub 50m față de un drum principal.
5. Să fie situată la maximumb500m față de un restaurant.

În următoarele câteva module, vom valorifica puterea instrumentelor de analiză GIS, pentru a localiza proprietățile agricole potrivite pentru această nouă dezvoltare rezidențială.

6.1 Lesson: Reprojecting and Transforming Data

Let us talk about Coordinate Reference Systems (CRSs) again. We have touched on this briefly before, but haven't discussed what it means practically.

Scopul acestei lecții: De a reproiecta și transforma seturile de date vectoriale.

6.1.1 ??? Follow Along: Projections

The CRS that all the data, as well as the map itself are in right now is called *WGS84*. This is a very common Geographic Coordinate System (GCS) for representing data. But there's a problem, as we will see.

1. Save your current map
2. Then open the map of the world which you will find under `exercise_data/world/world.qgs`
3. Zoom in to South Africa by using the  Zoom In tool
4. Try setting a scale in the *Scale* field, which is in the *Statusbar* along the bottom of the screen. While over South Africa, set this value to `1:5 000 000` (one to five million).
5. Pan around the map while keeping an eye on the *Scale* field

Notice the scale changing? That's because you are moving away from the one point that you zoomed into at `1:5 000 000`, which was at the center of your screen. All around that point, the scale is different.

Pentru a înțelege de ce, gândiți-vă la un glob al Pământului. Acesta are linii care pornesc de la Nord înspre Sud. Aceste linii longitudinale sunt situate departe una de alta la ecuator, dar se întâlnesc la poli.

In a GCS, you are working on this sphere, but your screen is flat. When you try to represent the sphere on a flat surface, distortion occurs, similar to what would happen if you cut open a tennis ball and tried to flatten it out. What this means on a map is that the longitude lines stay equally far apart from each other, even at the poles (where they are supposed to meet). This means that, as you travel away from the equator on your map, the scale of the objects that you see gets larger and larger. What this means for us, practically, is that there is no constant scale on our map!

To solve this, let's use a Projected Coordinate System (PCS) instead. A PCS „projects" or converts the data in a way that makes allowance for the scale change and corrects it. Therefore, to keep the scale constant, we should reproject our data to use a PCS.

6.1.2 ??? Follow Along: „On the Fly" Reprojection

By default, QGIS reprojects data „on the fly". What this means is that even if the data itself is in another CRS, QGIS can project it as if it were in a CRS of your choice.

You can change the CRS of the project by clicking on the  Current projection button in the bottom right corner of QGIS.

1. In the dialog that appears, type the word `global` into the *Filter* field. A few CRSs should appear in the *Predefined Reference Systems* field below.
2. Select *WGS 84 / NSIDC EASE-Grid 2.0 Global | EPSG:6933* entry by clicking on it, and then click *OK*.

   Observați modul în care forma Africii de Sud se schimbă. Toate proiecțiile lucrează prin schimbarea formelor aparente ale obiectelor de pe Terra.
3. Zoom to a scale of `1:5 000 000` again, as before.
4. Deplasați un pic harta.

   Observați că scara rămâne la fel!

Reproiectarea „din zbor" este folosită, de asemenea, pentru a combina seturile de date aflate în diverse CRS-uri

1. Add another vector layer to your map which has the data for South Africa only. You will find it as `exercise_data/world/RSA.shp`.
2. Load it. A quick way to see its CRS is by hovering the mouse over the layer in the legend. It is `EPSG:3410`.

   Ce observați?

   The layer is visible even if it has a different CRS from the `continents` one.

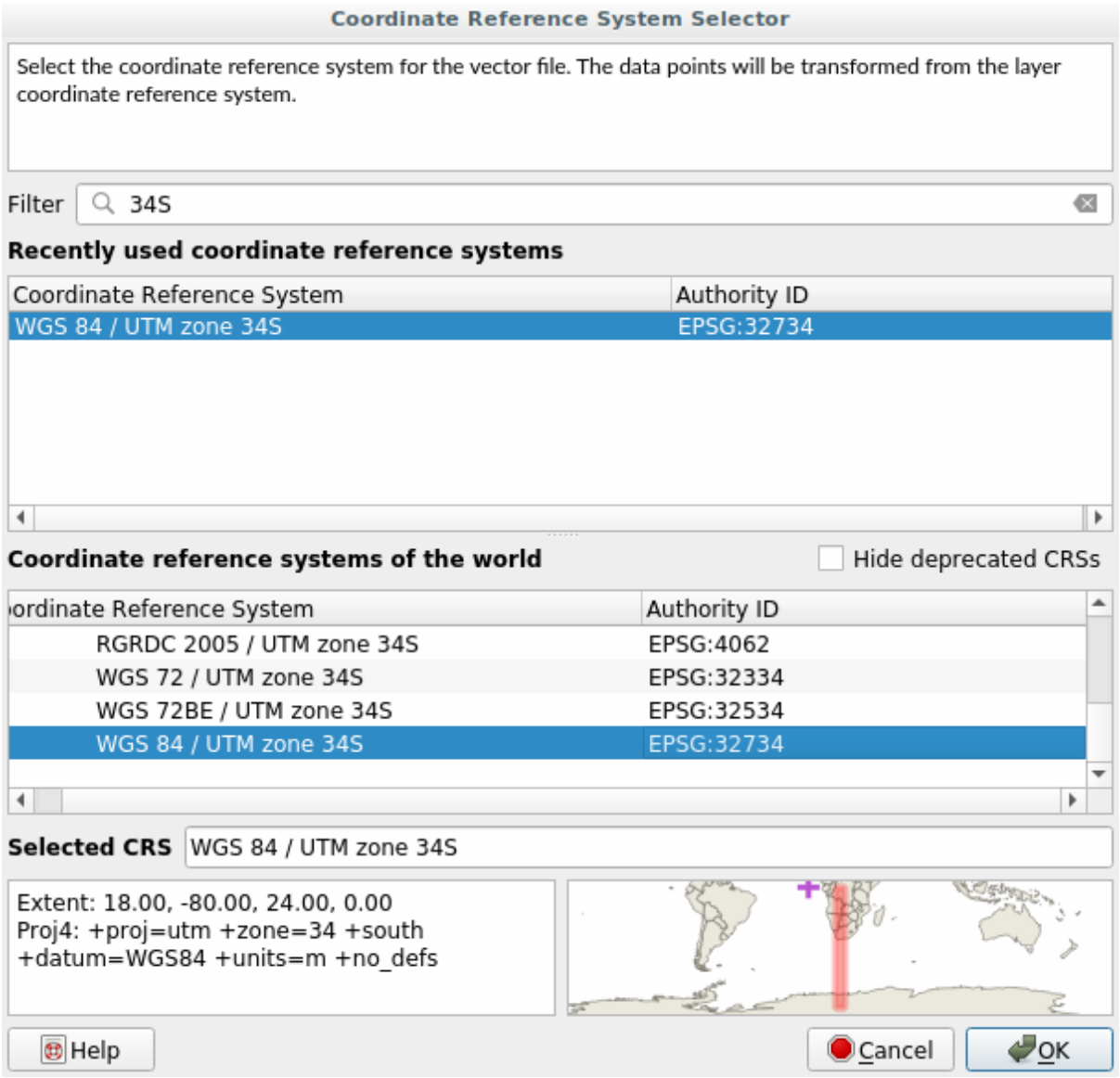
6.1.3 ??? Follow Along: Saving a Dataset to Another CRS

Sometimes you need to export an existing dataset with another CRS. As we will see in the next lesson, if you need to make distance calculations on layer, it is always better to have the layer in a projected coordinate system.

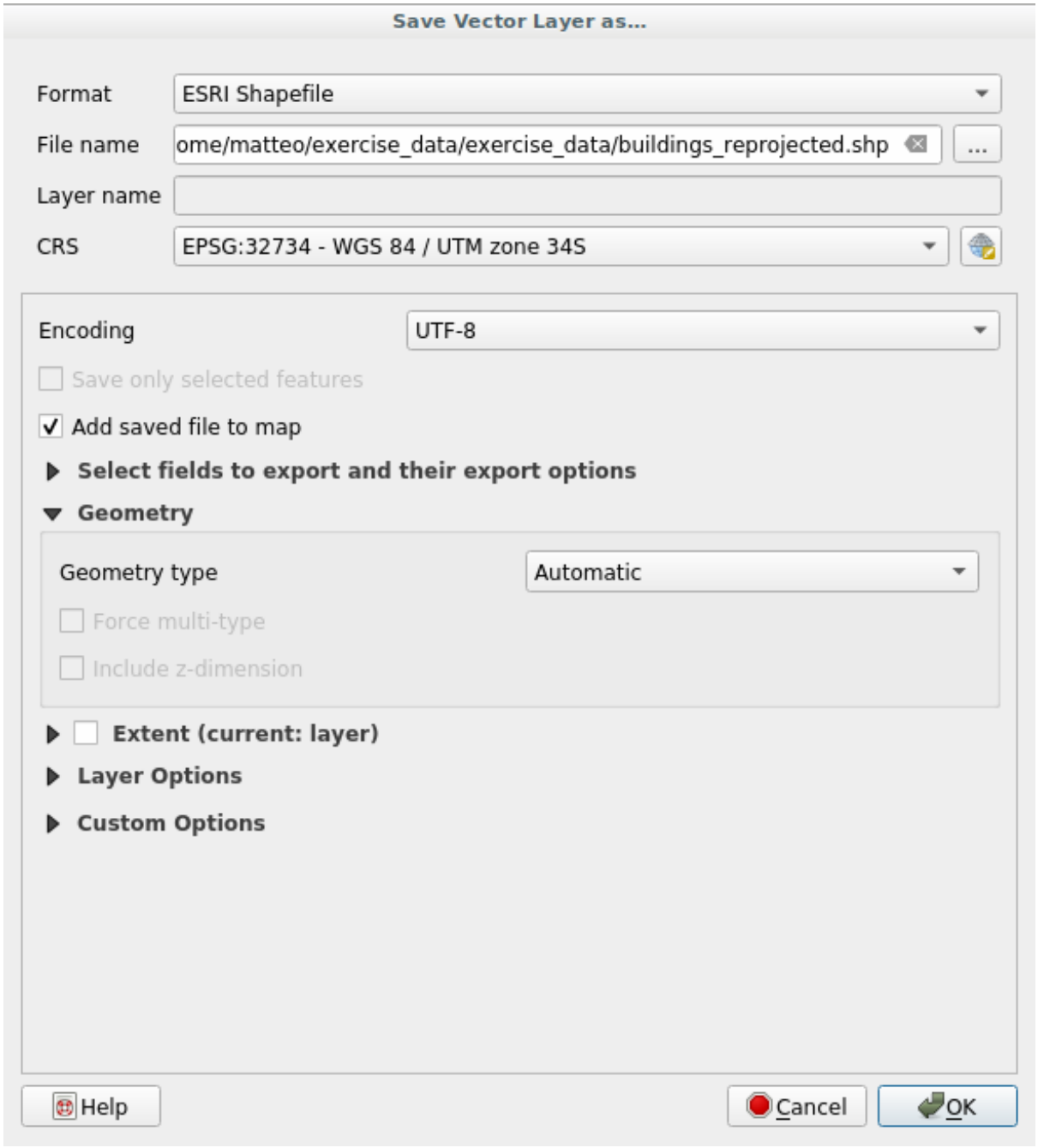
Be aware that the «on the fly» reprojection is related to the **project** and not to single layers. This means that a layer can have a different CRS from the project even if you see it in the *correct* position.

You can easily export the layer with another CRS.

1. Add the `buildings` dataset from `training_data.gpkg`
2. Right-click on the `buildings` layer in the *Layers* panel
3. Select *Export* ► *Save Features As...* in the menu that appears. You will be shown the *Save Vector Layer as...* dialog.
4. Click on the *Browse* button next to the *File name* field
5. Navigate to `exercise_data/` and specify the name of the new layer as `buildings_reprojected.shp`.
6. Change the value of the *CRS*. Only the recent CRSs used will be shown in the drop-down menu. Click on the  Select projection button next to the drop-down menu.
7. The *Coordinate Reference System Selector* dialog will appear. In its *Filter* field, search for `34S`.
8. Select *WGS 84 / UTM zone 34S | EPSG:32734* from the list



9. Leave the other options unchanged. The *Save Vector Layer as...* dialog now looks like this:



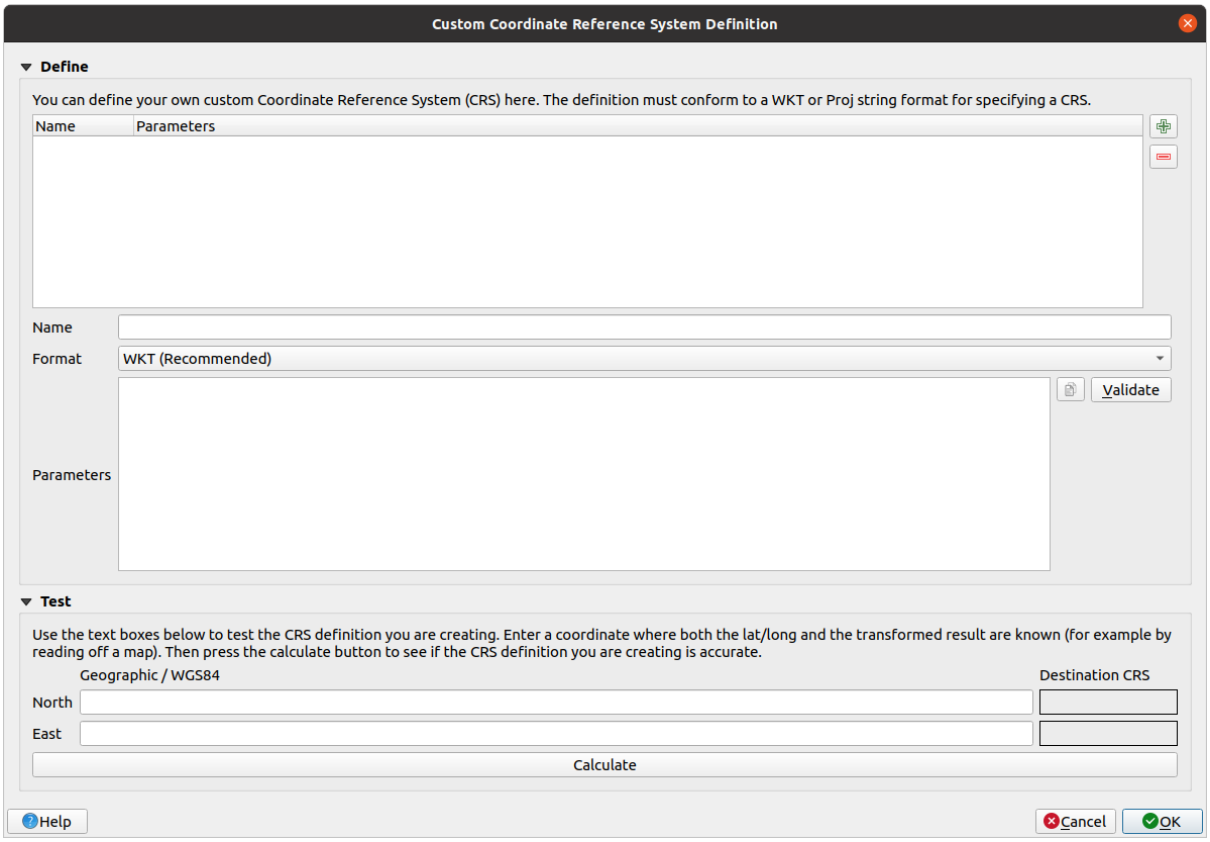
10. Clic pe *OK*

You can now compare the old and new projections of the layer and see that they are in two different CRS but they are still overlapping.

6.1.4 ??? Follow Along: Creating Your Own Projection

Există mai multe proiecții decât cele incluse în QGIS în mod implicit. De asemenea, puteți crea propriile proiecții.

1. Start a new map
2. Load the `world/oceans.shp` dataset
3. Go to *Settings* ► *Custom Projections...* and you will see this dialog.



4. Click on the Add new CRS button to create a new projection
5. O proiecție interesant de utilizat se numește `Van der Grinten I`. Introduceți această denumire în câmpul *Nume*.

   Această proiecție reprezintă Pământul pe un teren circular, în locul uneia dreptunghiulară, la fel ca majoritatea celorlalte proiecții.

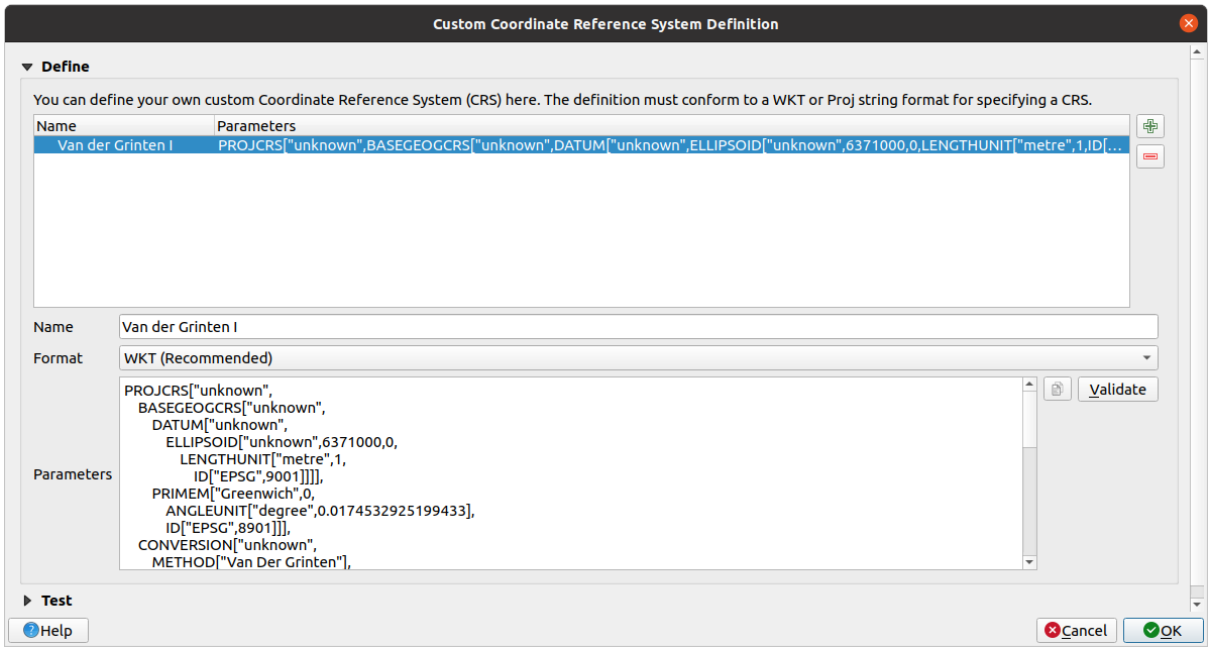
6. In *Format*, select *WKT (Recommended)*
7. Add the following string in the *Parameters* field:

```
PROJCRS["unknown",
    BASEGEOGCRS["unknown",
        DATUM["unknown",
            ELLIPSOID["unknown",6371000,0,
                LENGTHUNIT["metre",1,
                    ID["EPSG",9001]]]],
        PRIMEM["Greenwich",0,
            ANGLEUNIT["degree",0.0174532925199433],
            ID["EPSG",8901]]],
    CONVERSION["unknown",
        METHOD["Van Der Grinten"],
        PARAMETER["Longitude of natural origin",0,
```

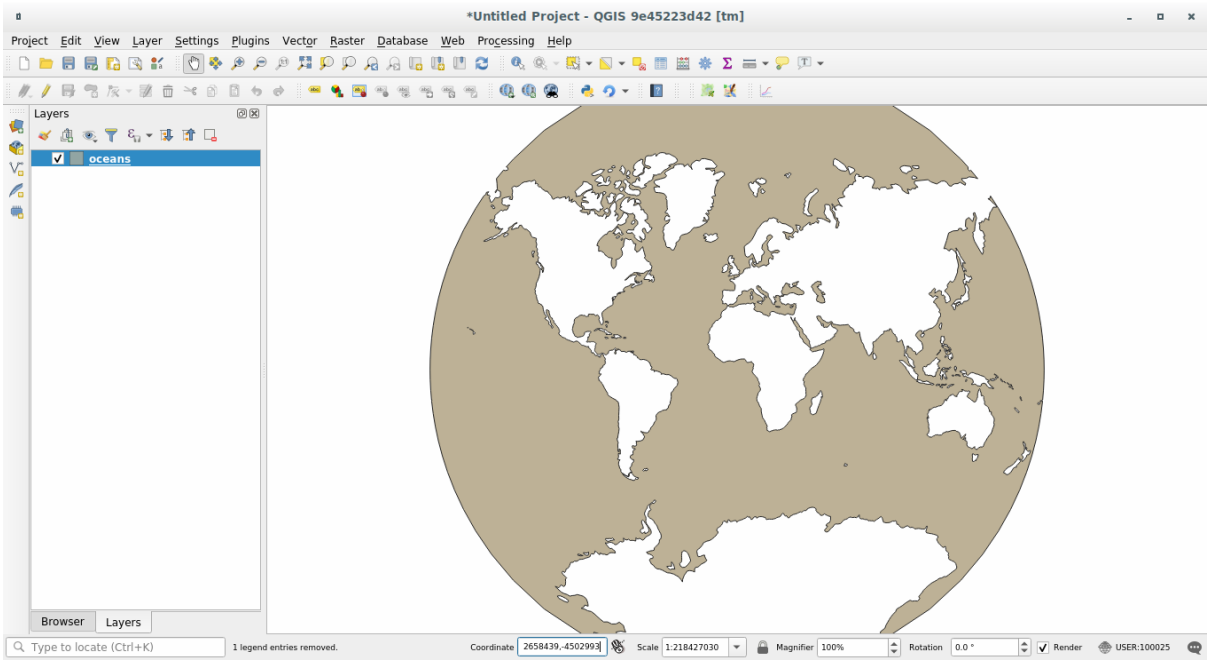
(continues on next page)

(continuare din pagina precedentă)

```
            ANGLEUNIT["degree",0.0174532925199433],
            ID["EPSG",8802]],
        PARAMETER["False easting",0,
            LENGTHUNIT["metre",1],
            ID["EPSG",8806]],
        PARAMETER["False northing",0,
            LENGTHUNIT["metre",1],
            ID["EPSG",8807]]],
    CS[Cartesian,2],
        AXIS["(E)",east,
            ORDER[1],
            LENGTHUNIT["metre",1,
                ID["EPSG",9001]]],
        AXIS["(N)",north,
            ORDER[2],
            LENGTHUNIT["metre",1,
                ID["EPSG",9001]]]]
```



8. Clic pe *OK*
9. Click on the  Current CRS button at the right of the status bar to change the project CRS
10. Choose your newly defined projection (search for its name in the *Filter* field)
11. După aplicarea acestei proiecții, harta va fi reproiectată astfel:



6.1.5 În concluzie

Diferite proiecții sunt utile pentru scopuri diferite. Prin alegerea proiecția corectă, vă puteți asigura că entitățile de pe hartă sunt reprezentate cu precizie.

6.1.6 Further Reading

Materials for the *Advanced* section of this lesson were taken from this article.

Read further information on Coordinate Reference Systems.

6.1.7 Ce urmează?

In the next lesson you will learn how to analyze vector data using QGIS» various vector analysis tools.

6.2 Lesson: Vector Analysis

Vector data can also be analyzed to reveal how different features interact with each other in space. There are many different analysis-related functions, so we won't go through them all. Rather, we will pose a question and try to solve it using the tools that QGIS provides.

Scopul acestei lecții: De a pune o întrebare și de a o rezolva folosind instrumentele de analiză.

6.2.1 ??? The GIS Process

Before we start, it would be useful to give a brief overview of a process that can be used to solve a problem. The way to go about it is:

1. Definirea Problemei
2. Obținerea Datelor
3. Analiza Problemei
4. Prezentarea Rezultatelor

6.2.2 ??? The Problem

Let's start off the process by deciding on a problem to solve. For example, you are an estate agent and you are looking for a residential property in Swellendam for clients who have the following criteria:

1. It needs to be in Swellendam
2. It must be within reasonable driving distance of a school (say 1km)
3. It must be more than 100m squared in size
4. Closer than 50m to a main road
5. Closer than 500m to a restaurant

6.2.3 ??? The Data

To answer these questions, we are going to need the following data:

1. The residential properties (buildings) in the area
2. The roads in and around the town
3. The location of schools and restaurants
4. The size of buildings

These data are available through OSM, and you should find that the dataset you have been using throughout this manual also can be used for this lesson.

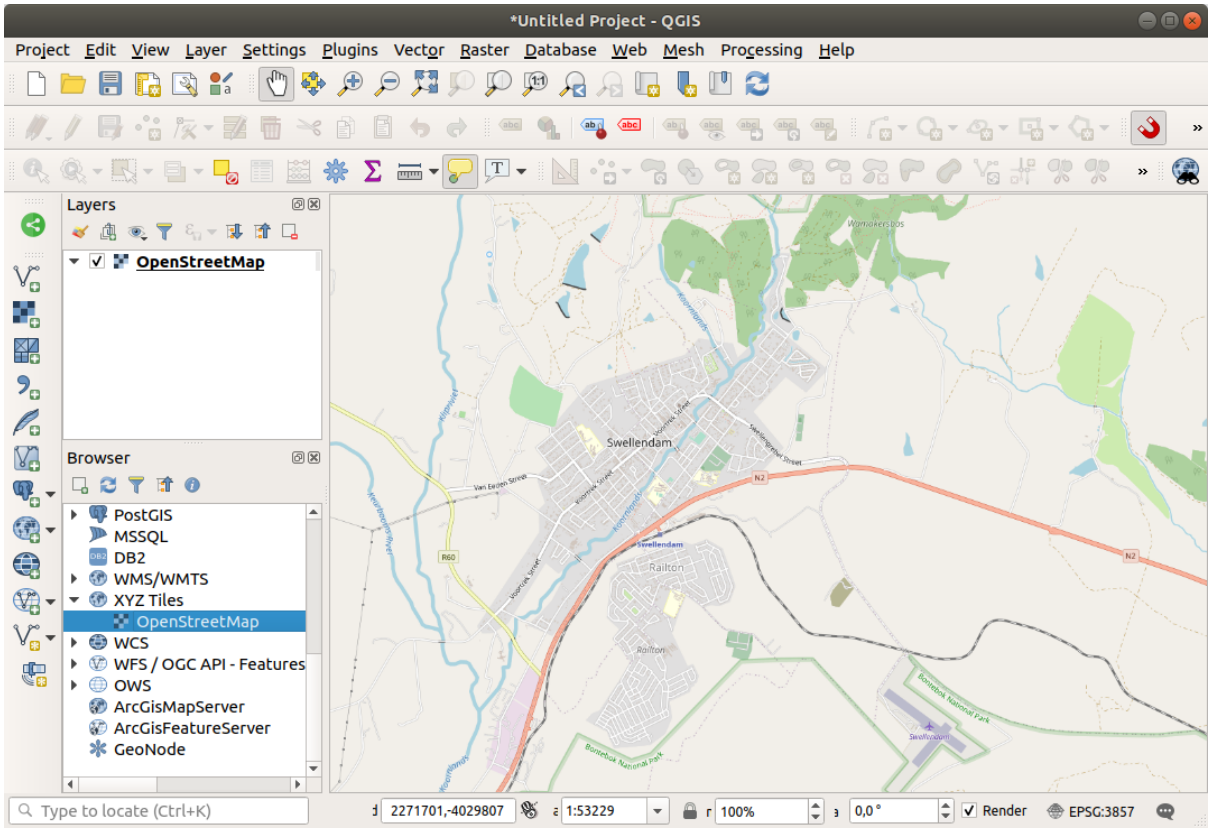
If you want to download data from another area, jump to the *Introduction Chapter* to read how to do it.

> **Notă**
>
> Although OSM downloads have consistent data fields, the coverage and detail does vary. If you find that your chosen region does not contain information on restaurants, for example, you may need to chose a different region.

6.2.4 ??? Follow Along: Start a Project and get the Data

We first need to load the data to work with.

1. Start a new QGIS project
2. If you want, you can add a background map. Open the *Browser* and load the *OSM* background map from the *XYZ Tiles* menu.



3. In the `training_data.gpkg` Geopackage database, you will find most the datasets we will use in this chapter:

    1. `buildings`
    2. `roads`
    3. `restaurants`
    4. `schools`

    Load them, and also `landuse.sqlite`.

4. Zoom to the layer extent to see Swellendam, South Africa

    Before proceeding we will filter the `roads` layer, in order to have only some specific road types to work with.

    Some roads in OSM datasets are listed as `unclassified`, `tracks`, `path` and `footway`. We want to exclude these from our dataset and focus on the other road types, more suitable for this exercise.

    Moreover, OSM data might not be updated everywhere, and we will also exclude `NULL` values.

5. Right click on the `roads` layer and choose *Filter…*.

6. In the dialog that pops up we filter these features with the following expression:

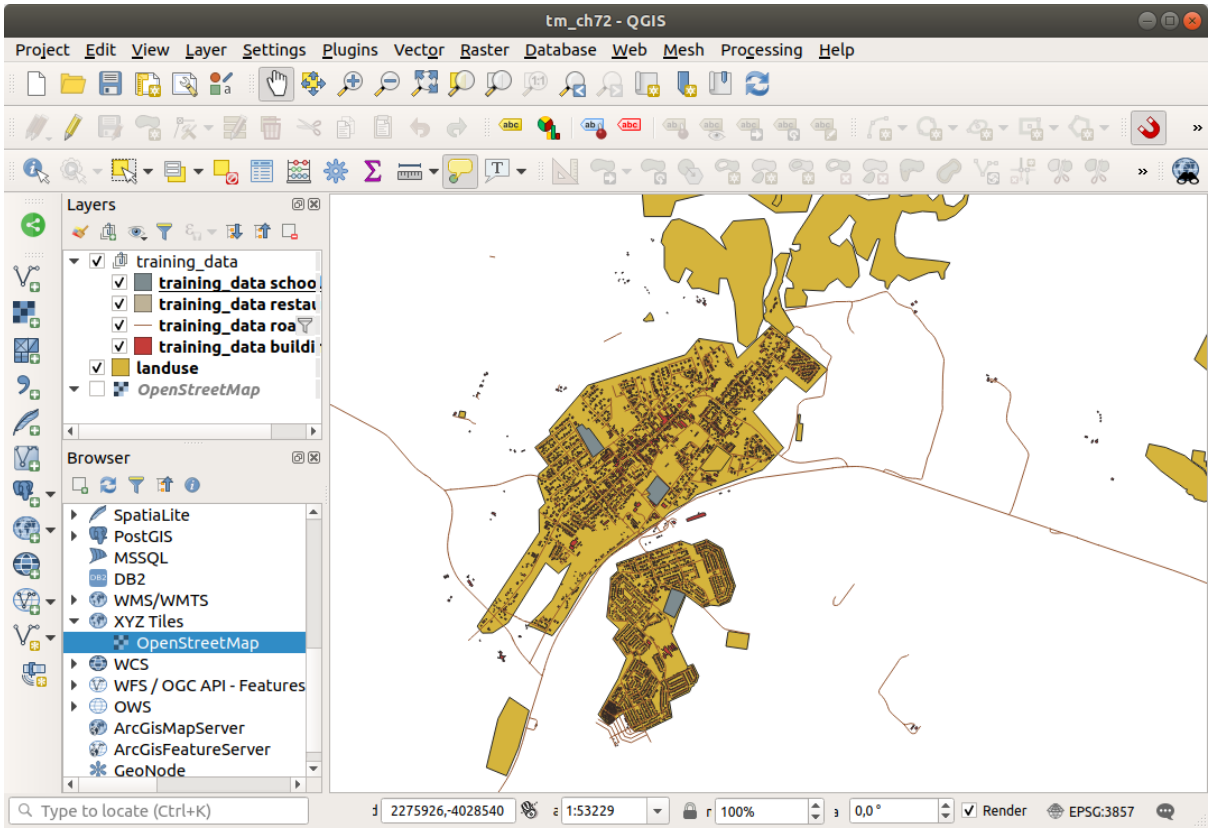
```
"highway" NOT IN ('footway', 'path', 'unclassified', 'track') AND "highway" IS␣
↪NOT NULL
```

    The concatenation of the two operators `NOT` and `IN` excludes all the features that have these attribute values in the `highway` field.

    `IS NOT NULL` combined with the `AND` operator excludes roads with no value in the `highway` field.

    Note the  icon next to the `roads` layer. It helps you remember that this layer has a filter activated, so some features may not be available in the project.

The map with all the data should look like the following one:



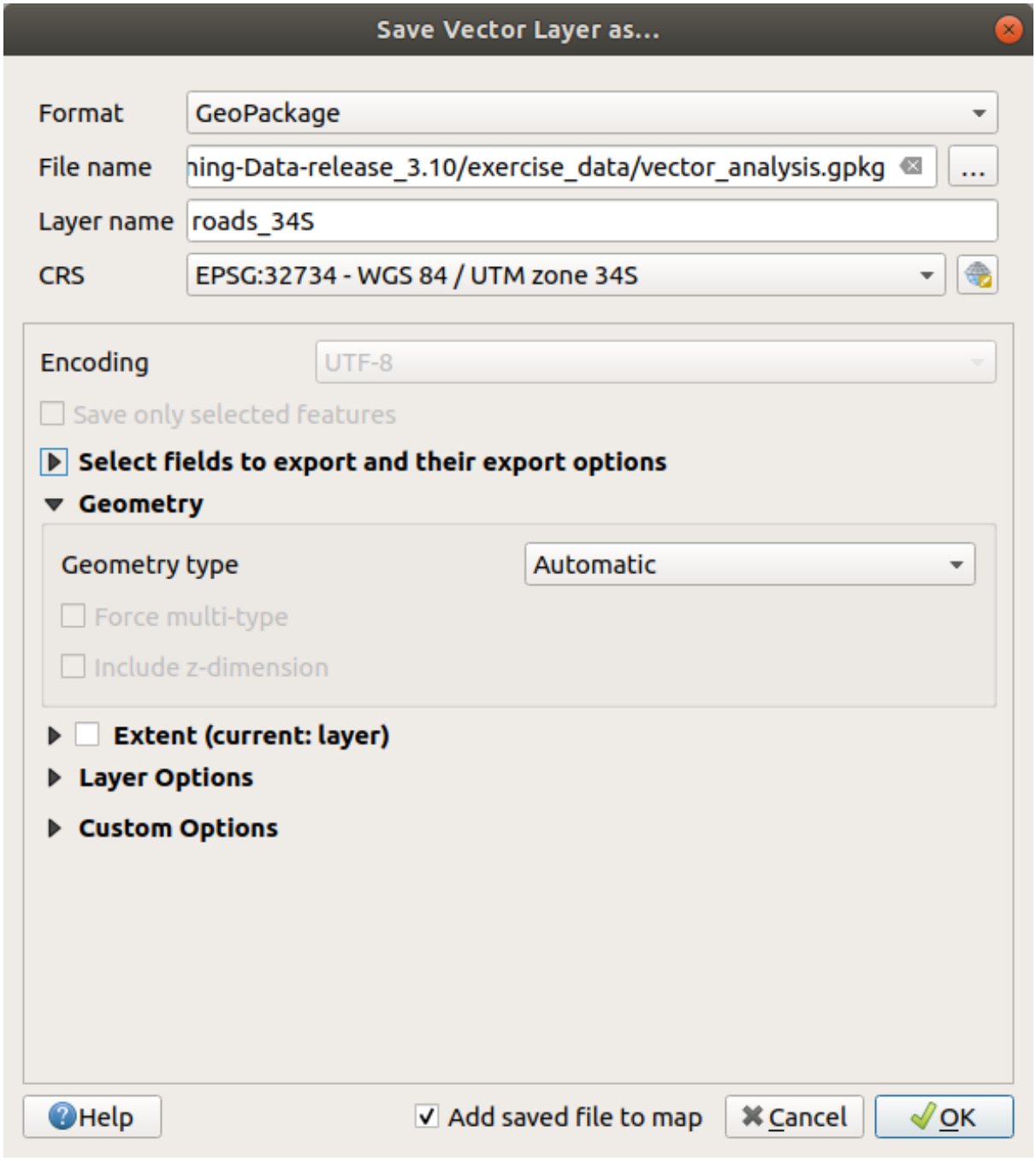
6.2.5 ??? Try Yourself: Convert Layers» CRS

Because we are going to be measuring distances within our layers, we need to change the layers» CRS. To do this, we need to select each layer in turn, save the layer to a new one with our new projection, then import that new layer into our map.

You have many different options, e.g. you can export each layer as an ESRI Shapefile format dataset, you can append the layers to an existing GeoPackage file, or you can create another GeoPackage file and fill it with the new reprojected layers. We will show the last option, so the `training_data.gpkg` will remain clean. Feel free to choose the best workflow for yourself.

> **Notă**
>
> In this example, we are using the *WGS 84 / UTM zone 34S* CRS, but you should use a UTM CRS which is more appropriate for your region.

1. Right click the `roads` layer in the *Layers* panel
2. Click *Export –> Save Features As…*
3. In the *Save Vector Layer As* dialog choose *GeoPackage* as *Format*
4. Click on … for the *File name*, and name the new GeoPackage `vector_analysis`
5. Change the *Layer name* to `roads_34S`
6. Change the *CRS* to *WGS 84 / UTM zone 34S*
7. Clic pe *OK*



This will create the new GeoPackage database and add the `roads_34S` layer.

8. Repeat this process for each layer, creating a new layer in the `vector_analysis.gpkg` GeoPackage file with `_34S` appended to the original name.

   On macOS, press the *Replace* button in the dialog that pops up to allow QGIS to overwrite the existing GeoPackage.

   > **Notă**
   >
   > When you choose to save a layer to an existing GeoPackage, QGIS will **add** that layer next to the existing layers in the GeoPackage, if no layer of the same name already exists.

9. Remove each of the old layers from the project

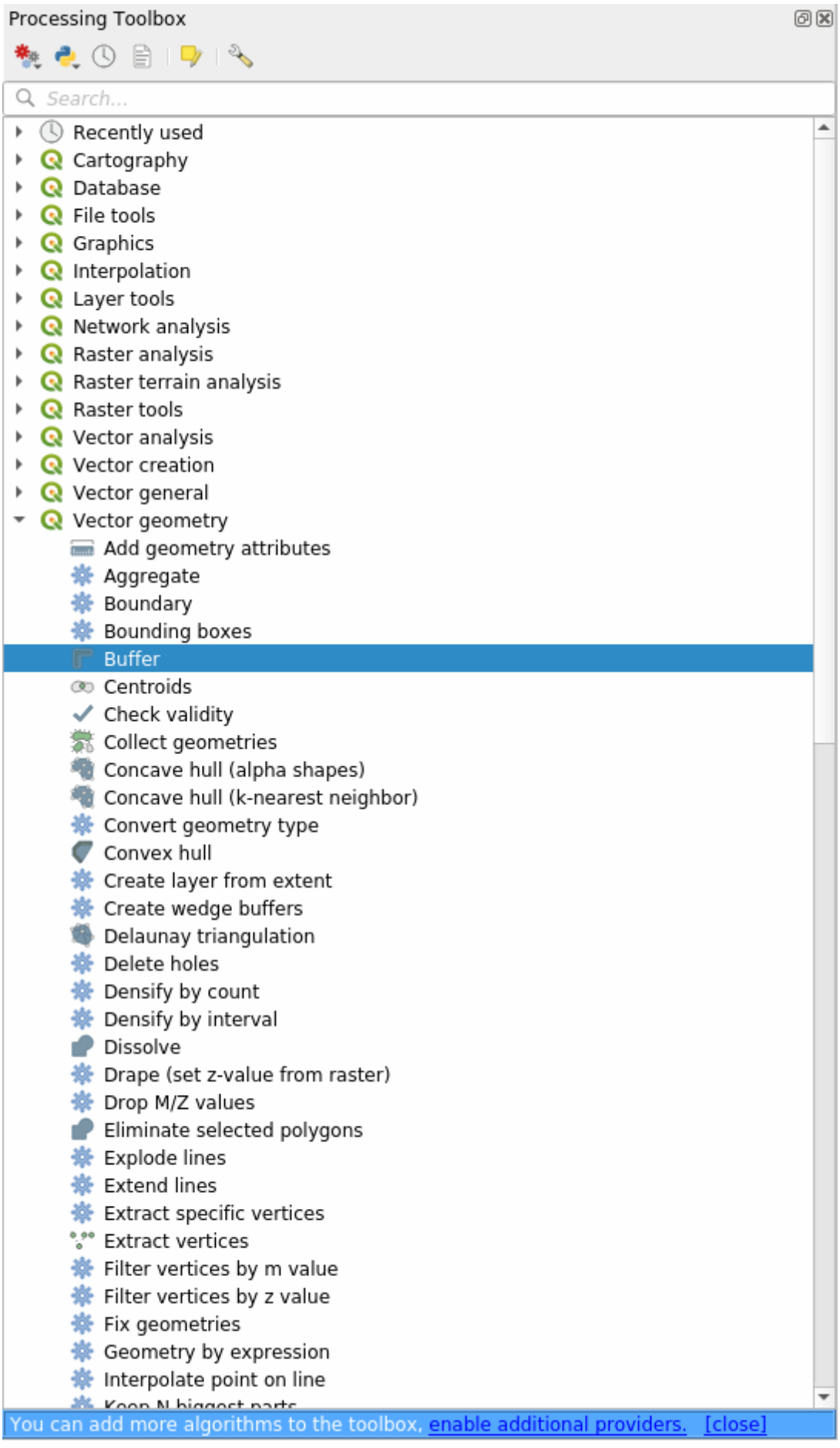
10. Once you have completed the process for all the layers, right click on any layer and click *Zoom to layer extent* to focus the map to the area of interest.

Now that we have converted OSM data to a UTM projection, we can begin our calculations.

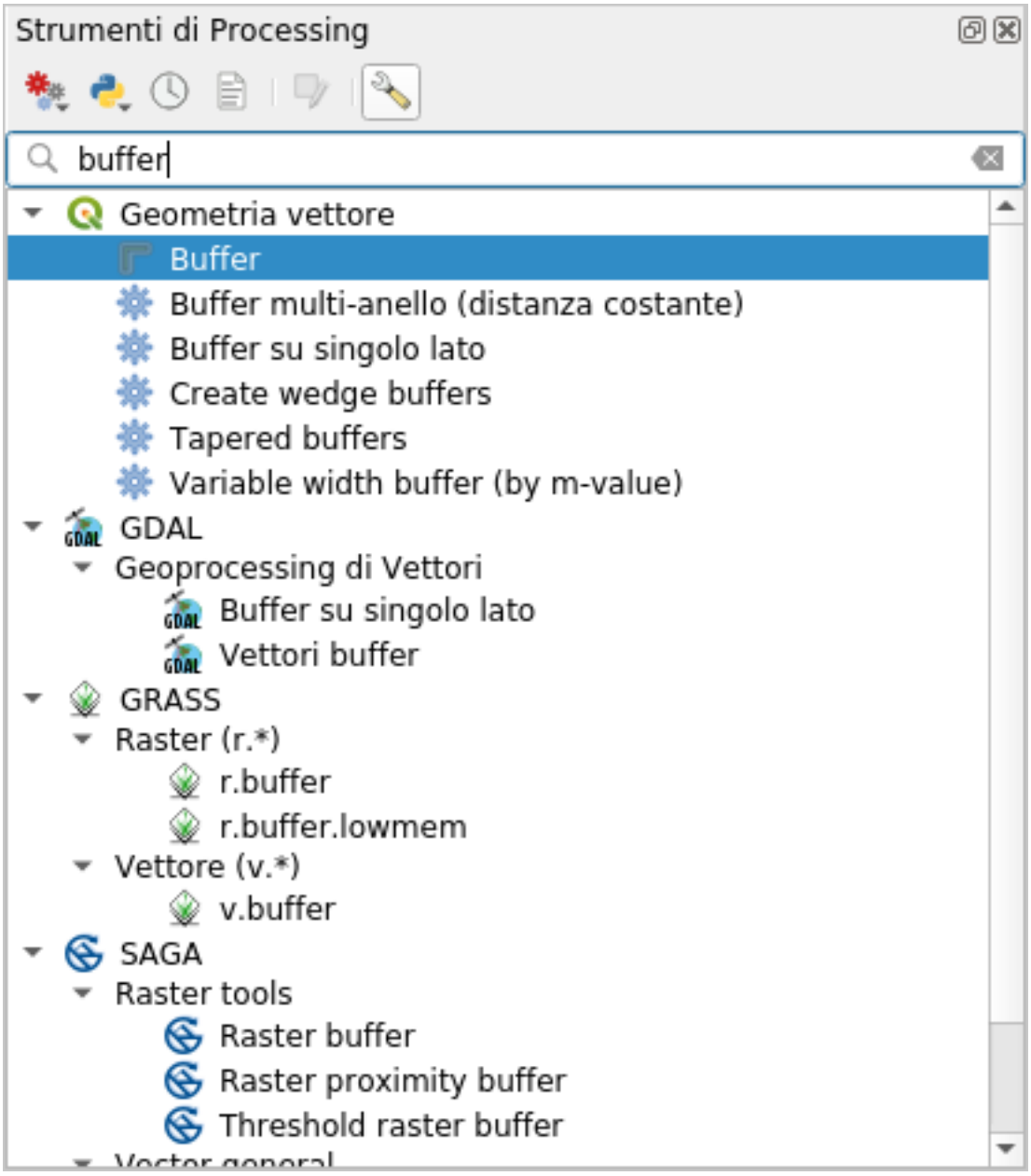
6.2.6 ??? Follow Along: Analyzing the Problem: Distances From Schools and Roads

QGIS allows you to calculate distances between any vector object.

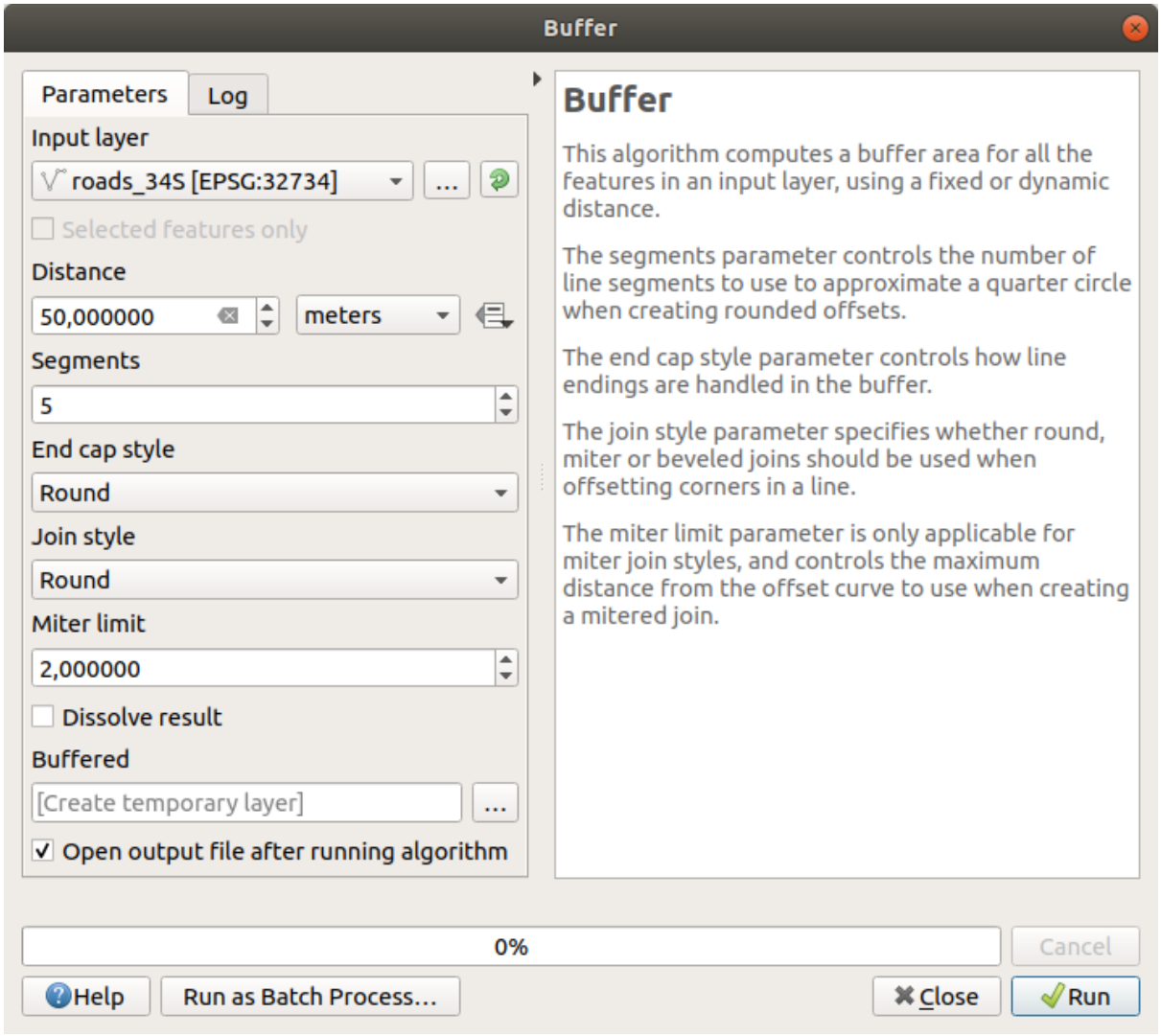
1. Make sure that only the `roads_34S` and `buildings_34S` layers are visible (to simplify the map while you're working)
2. Click on the *Processing* ► *Toolbox* to open the analytical *core* of QGIS. Basically, **all** algorithms (for vector **and** raster analysis) are available in this toolbox.
3. We start by calculating the area around the `roads_34S` by using the *Buffer* algorithm. You can find it in the *Vector Geometry* group.


Processing Toolbox
Search...
Recently used
Cartography
Database
File tools
Graphics
Interpolation
Layer tools
Network analysis
Raster analysis
Raster terrain analysis
Raster tools
Vector analysis
Vector creation
Vector general
Vector geometry
Add geometry attributes
Aggregate
Boundary
Bounding boxes
Buffer
Centroids
Check validity
Collect geometries
Concave hull (alpha shapes)
Concave hull (k-nearest neighbor)
Convert geometry type
Convex hull
Create layer from extent
Create wedge buffers
Delaunay triangulation
Delete holes
Densify by count
Densify by interval
Dissolve
Drape (set z-value from raster)
Drop M/Z values
Eliminate selected polygons
Explode lines
Extend lines
Extract specific vertices
Extract vertices
Filter vertices by m value
Filter vertices by z value
Fix geometries
Geometry by expression
Interpolate point on line
You can add more algorithms to the toolbox, enable additional providers. [close]

Or you can type `buffer` in the search menu in the upper part of the toolbox:



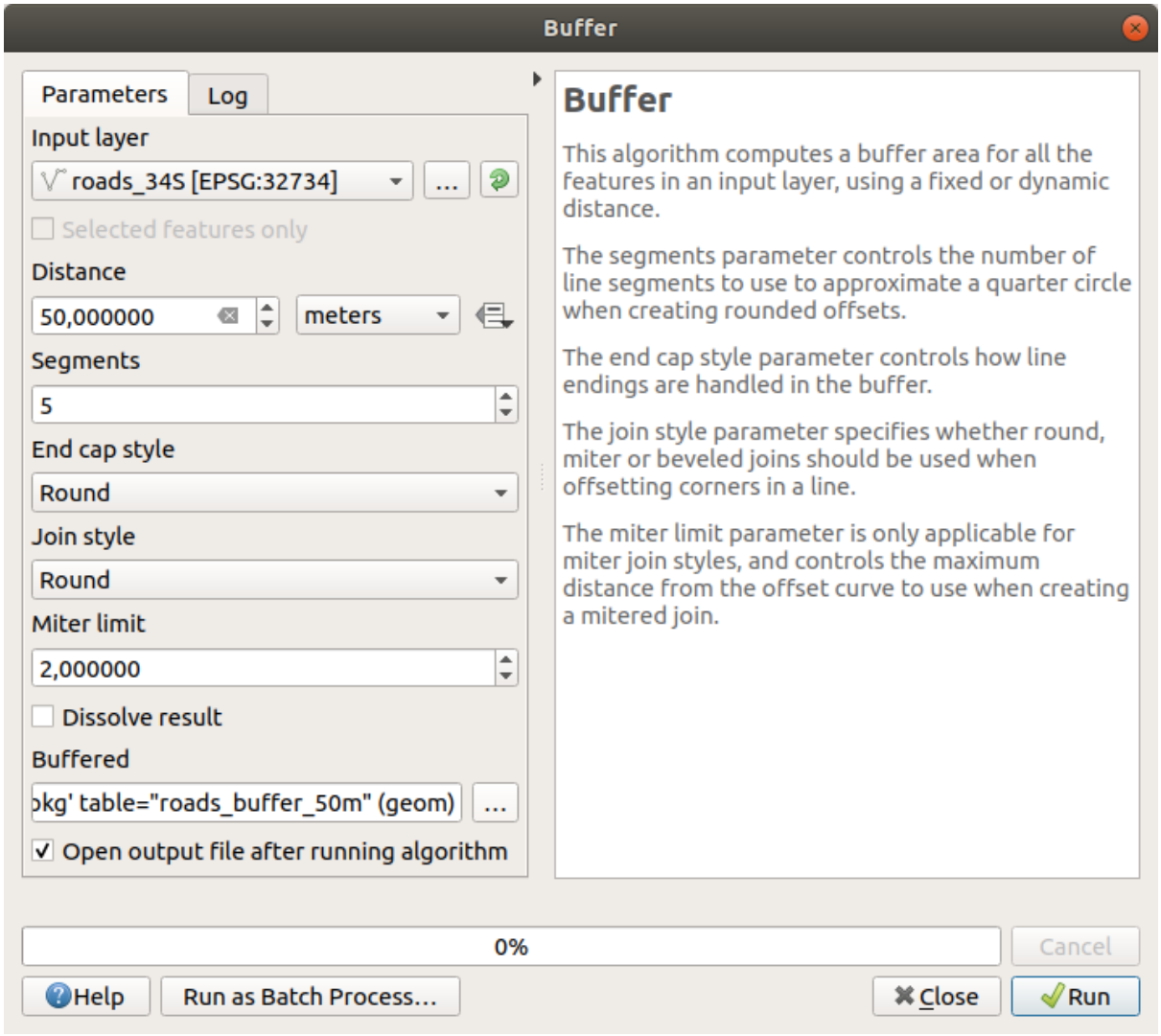
4. Double click on it to open the algorithm dialog
5. Select `roads_34S` as *Input layer*, set *Distance* to 50 and use the default values for the rest of the parameters.



6. The default *Distance* is in meters because our input dataset is in a Projected Coordinate System that uses meter as its basic measurement unit. You can use the combo box to choose other projected units like kilometers, yards, etc.

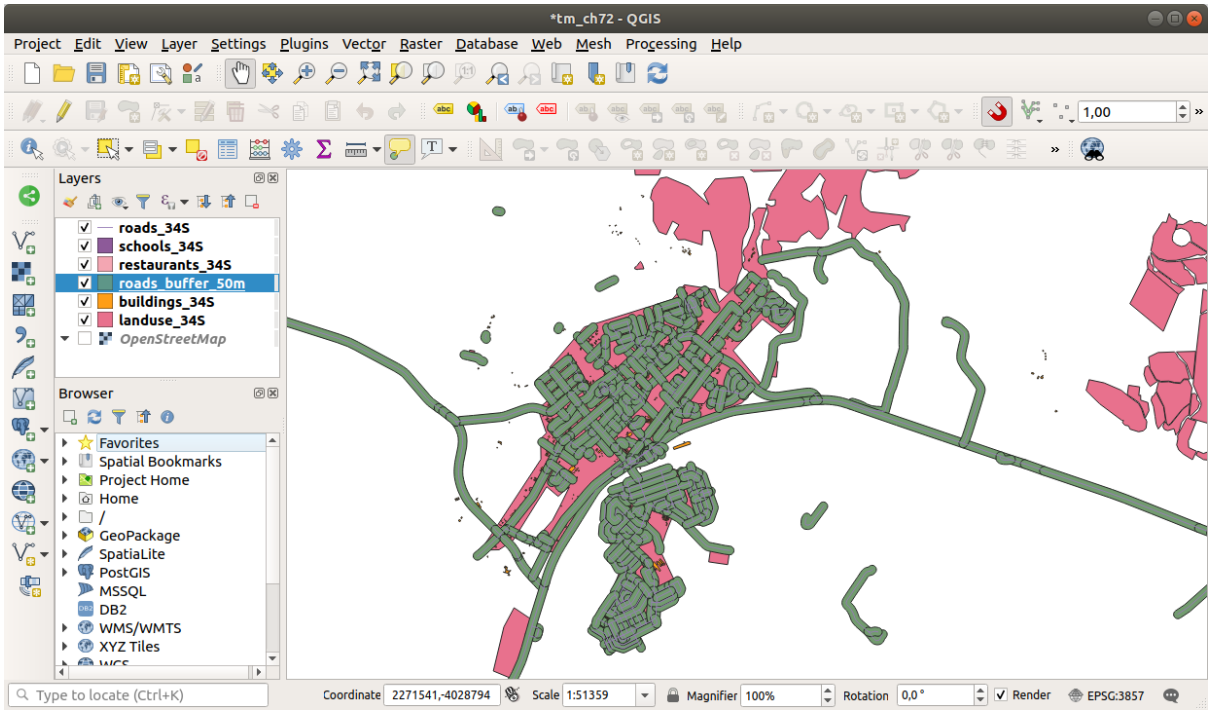
> **Notă**
>
> If you are trying to make a buffer on a layer with a Geographical Coordinate System, Processing will warn you and suggest to reproject the layer to a metric Coordinate System.

7. By default, *Processing* creates temporary layers and adds them to the *Layers* panel. You can also append the result to the GeoPackage database by:
    1. Clicking on the … button and choose *Save to GeoPackage…*
    2. Naming the new layer `roads_buffer_50m`
    3. Saving it in the `vector_analysis.gpkg` file



8. Click on *Run*, and then close the *Buffer* dialog

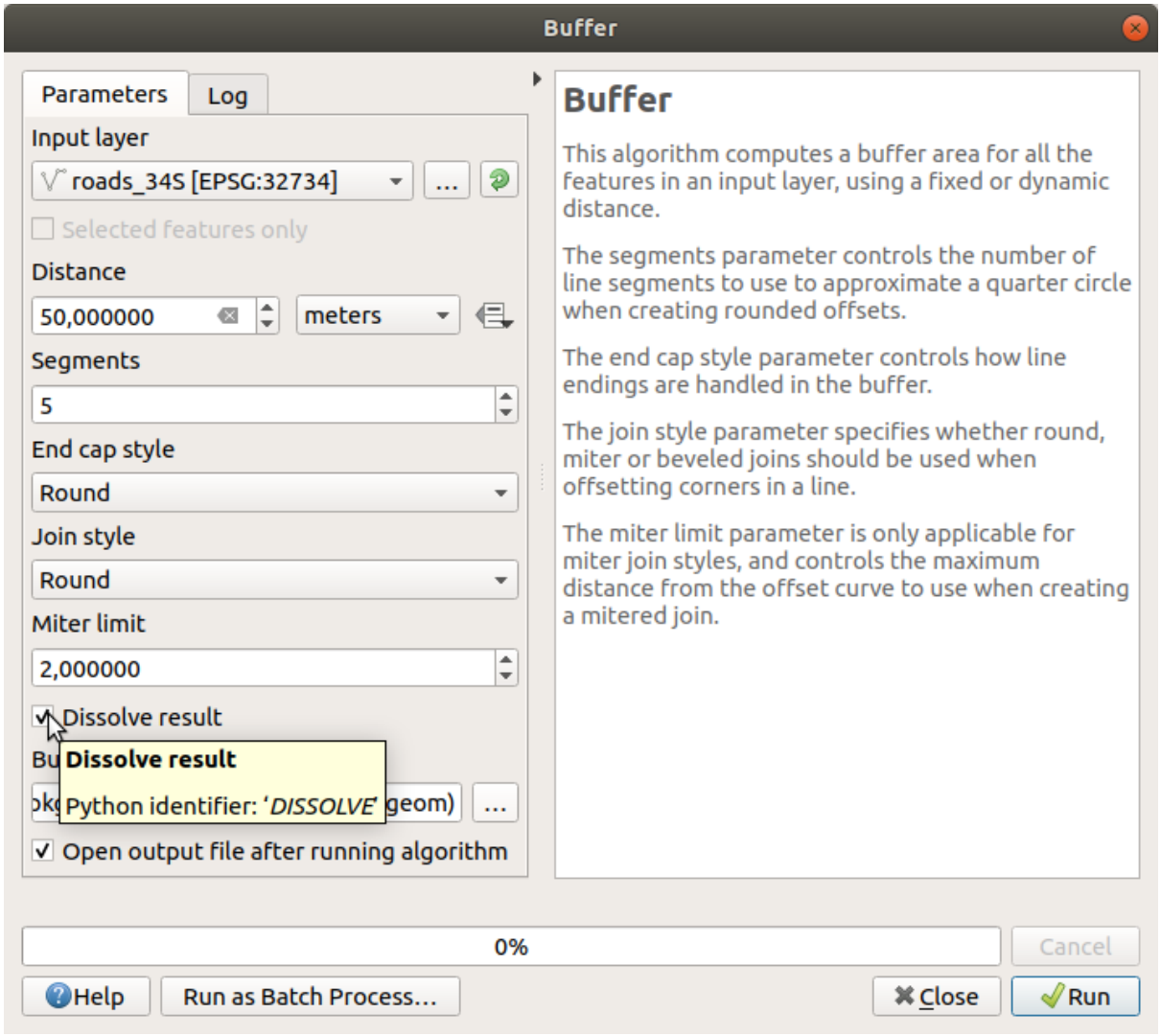
   Acum, harta dvs. va arăta în felul următor:



If your new layer is at the top of the *Layers* list, it will probably obscure much of your map, but this gives you all the areas in your region which are within 50m of a road.

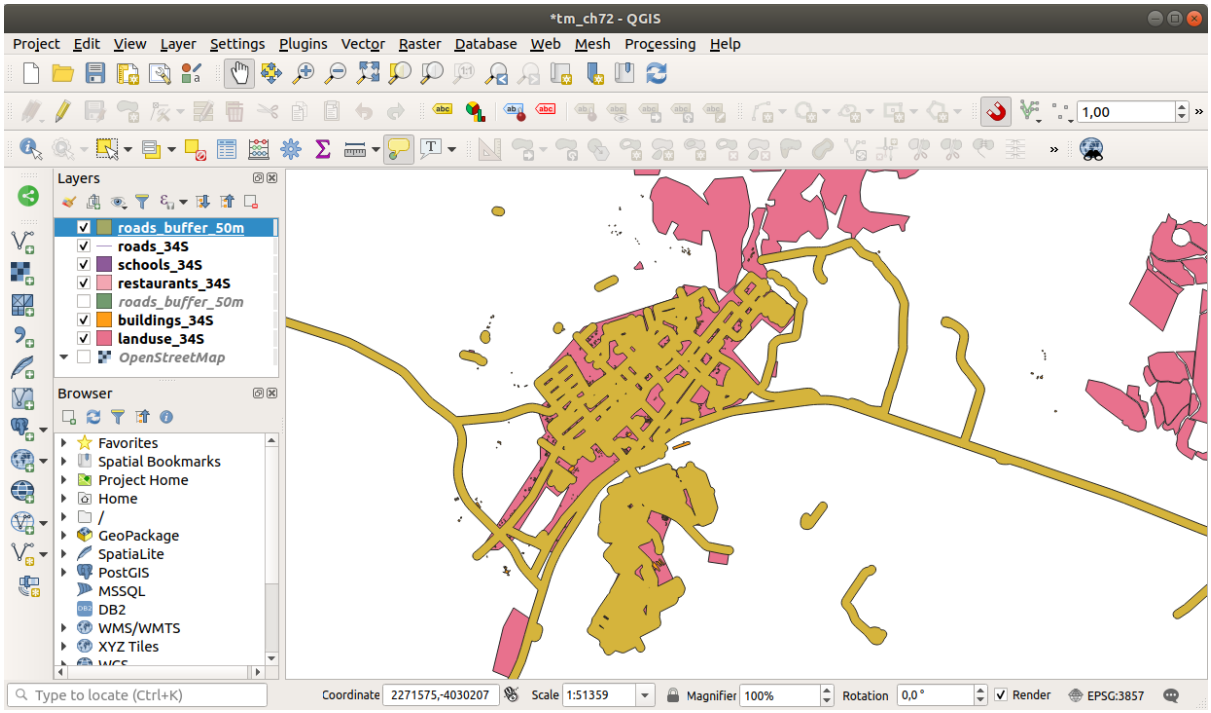
Notice that there are distinct areas within your buffer, which correspond to each individual road. To get rid of this problem:

1. Uncheck the `roads_buffer_50m` layer and re-create the buffer with *Dissolve results* enabled.



2. Save the output as `roads_buffer_50m_dissolved`
3. Click *Run* and close the *Buffer* dialog

Once you have added the layer to the *Layers* panel, it will look like this:



Acum, nu mai există subdiviziuni inutile.

Notă

The *Short Help* on the right side of the dialog explains how the algorithm works. If you need more information, just click on the *Help* button in the bottom part to open a more detailed guide of the algorithm.

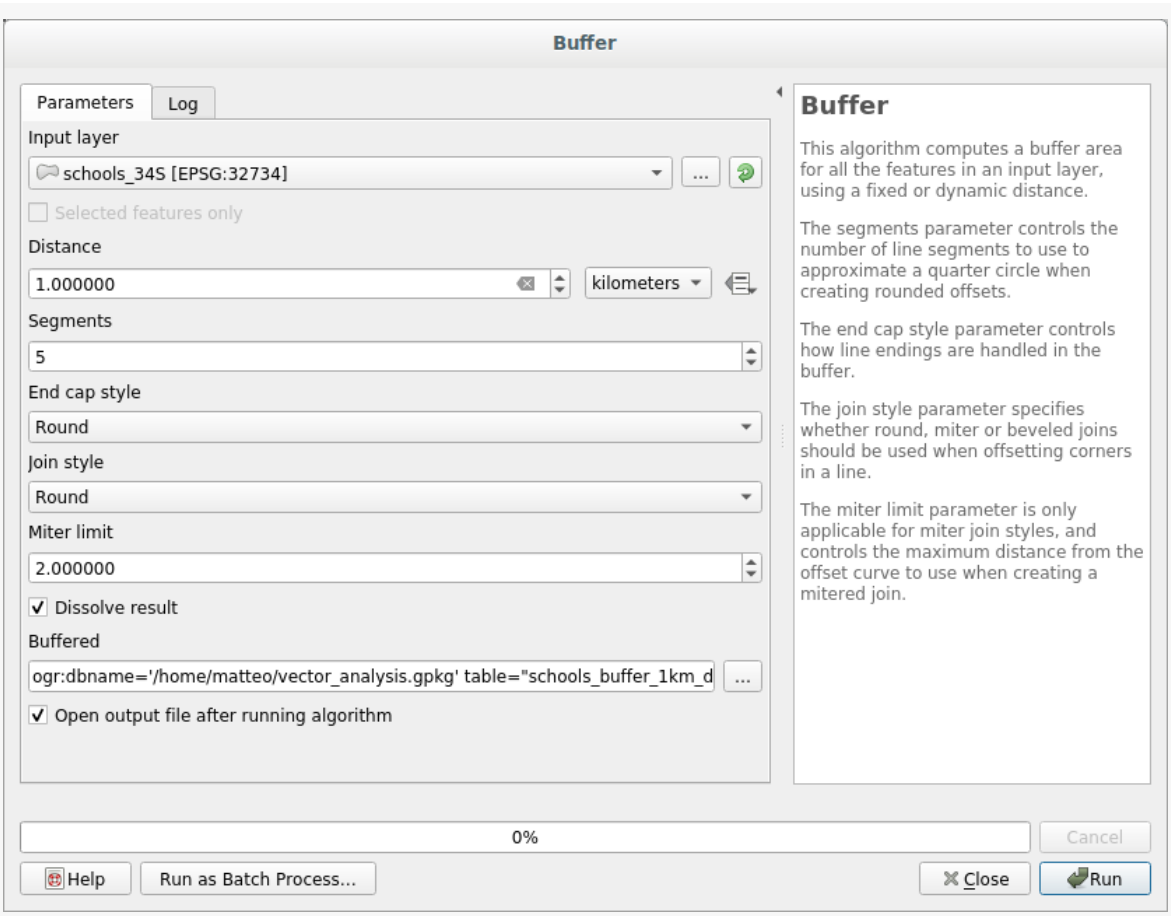
6.2.7 ??? Try Yourself: Distance from schools

Utilizați aceeași abordare de mai sus, și creați un tampon pentru școlile dumneavoastră.

It shall be `1 km` in radius. Save the new layer in the `vector_analysis.gpkg` file as `schools_buffer_1km_dissolved`.

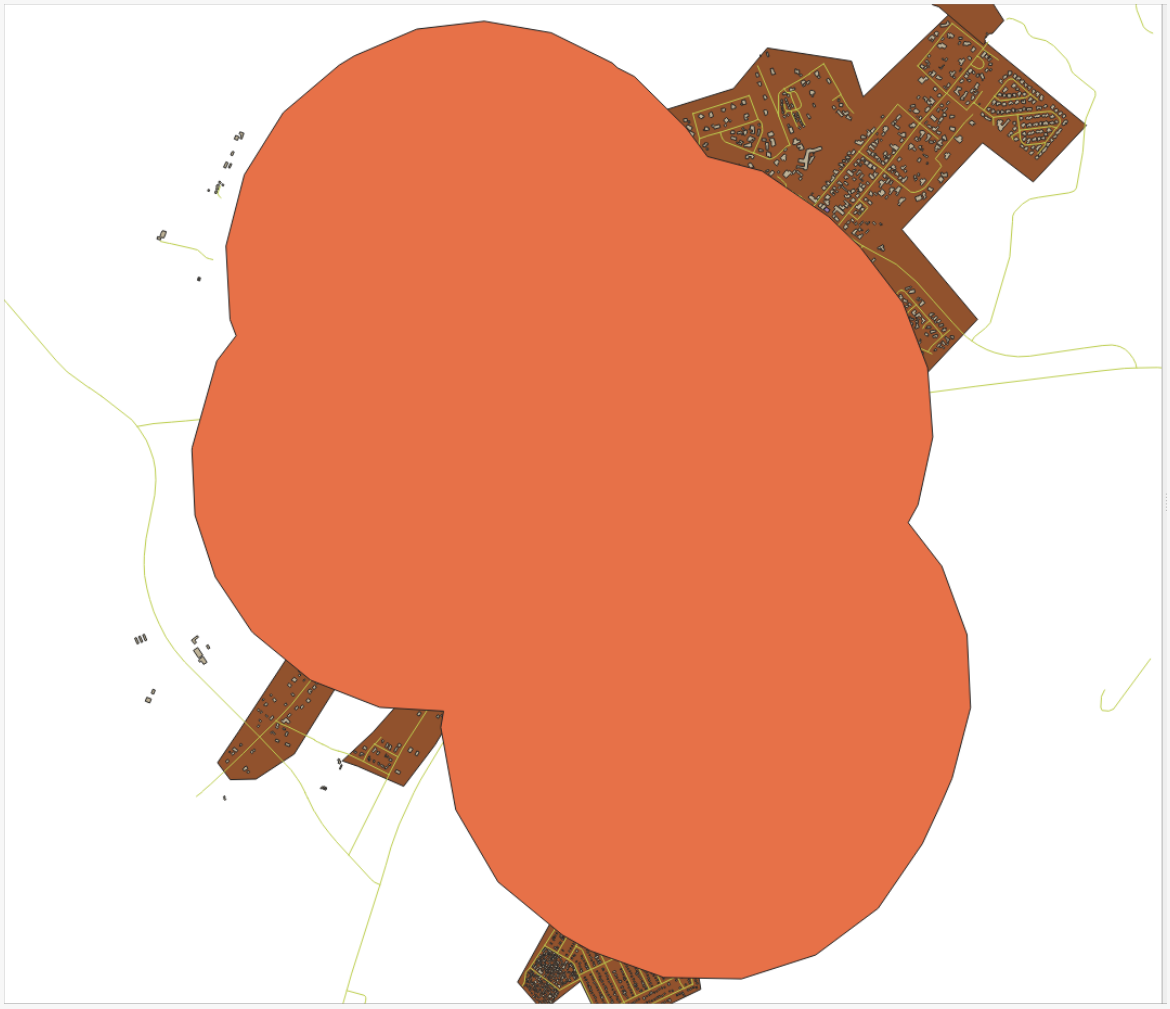
Răspuns

- Your buffer dialog should look like this:

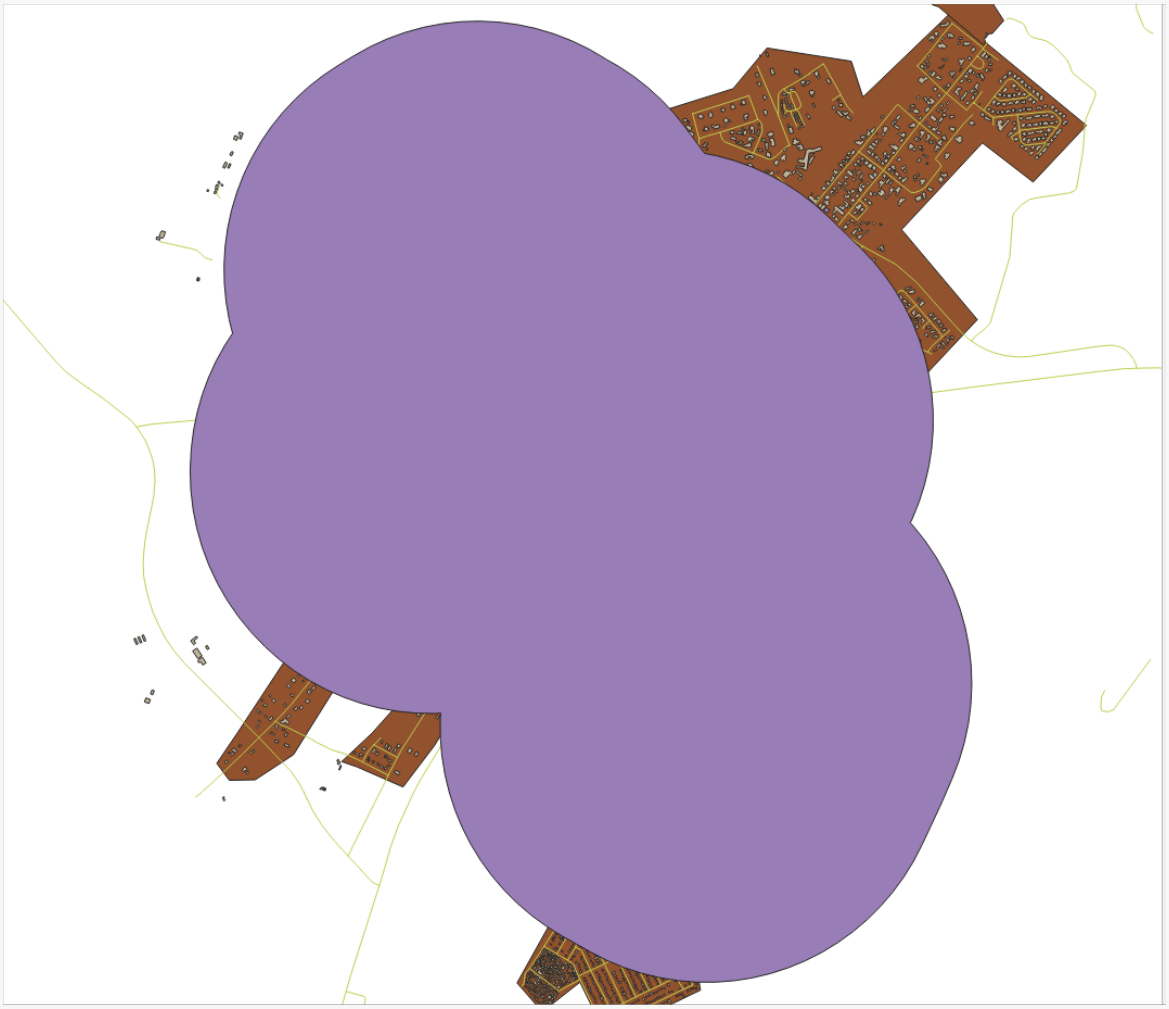


The *Buffer distance* is `1` kilometer.

- The *Segments to approximate* value is set to `20`. This is optional, but it's recommended, because it makes the output buffers look smoother. Compare this:



To this:

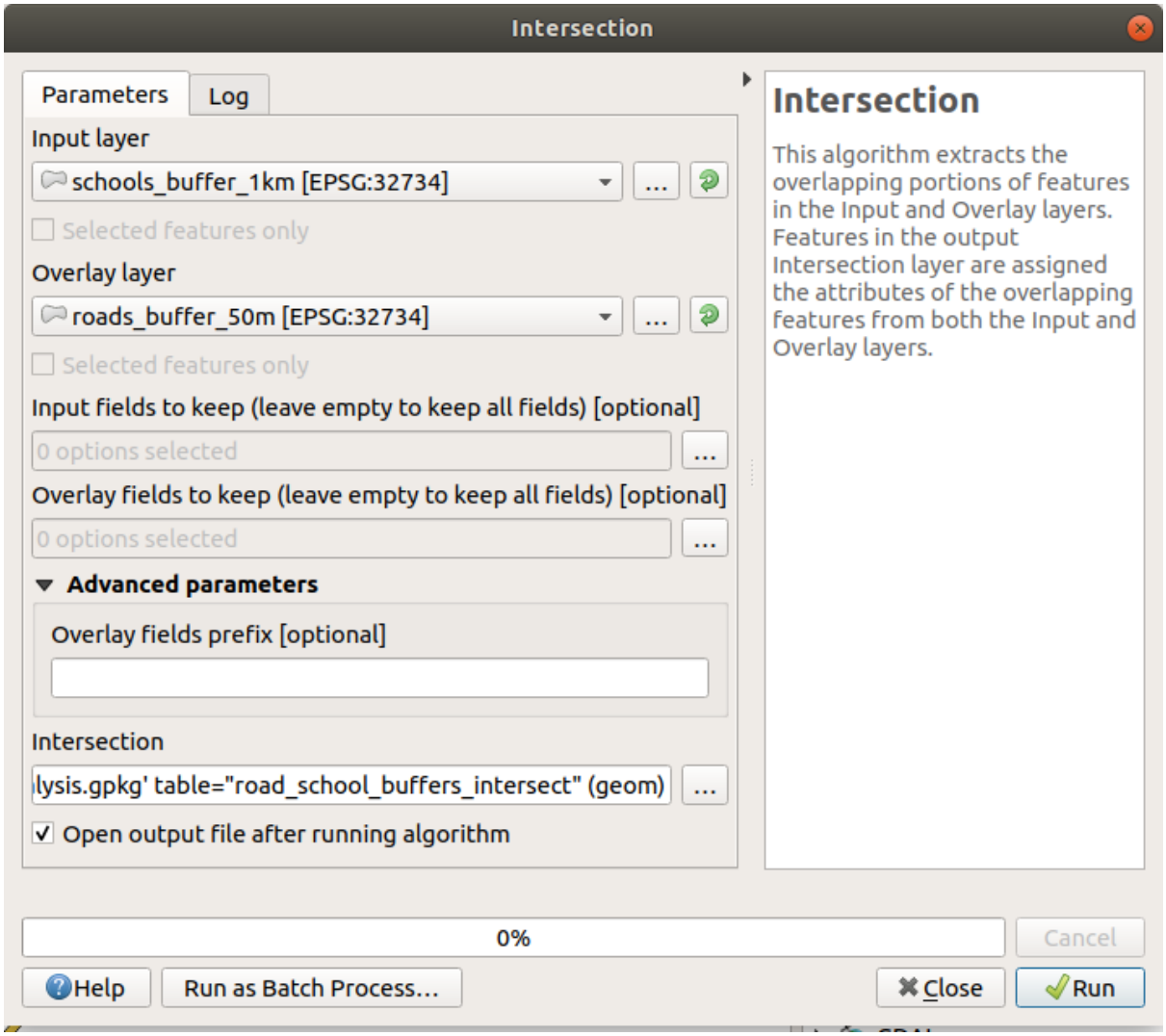


The first image shows the buffer with the *Segments to approximate* value set to `5` and the second shows the value set to `20`. In our example, the difference is subtle, but you can see that the buffer's edges are smoother with the higher value.

6.2.8 ??? Follow Along: Overlapping Areas

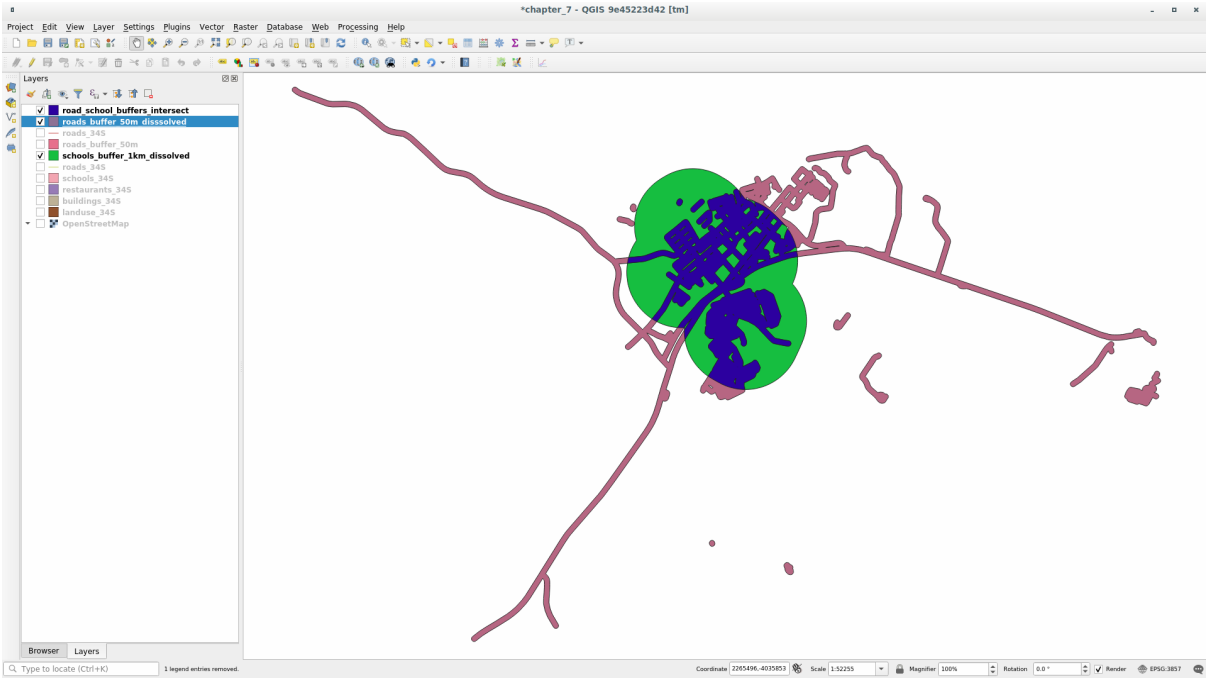
Now we have identified areas where the road is less than 50 meters away and areas where there is a school within 1 km (direct line, not by road). But obviously, we only want the areas where both of these criteria are satisfied. To do that, we will need to use the *Intersect* tool. You can find it in *Vector Overlay* group in the *Processing Toolbox*.

1. Use the two buffer layers as *Input layer* and *Overlay layer*, choose `vector_analysis.gpkg` GeoPackage in *Intersection* with *Layer name* `road_school_buffers_intersect`. Leave the rest as suggested (default).

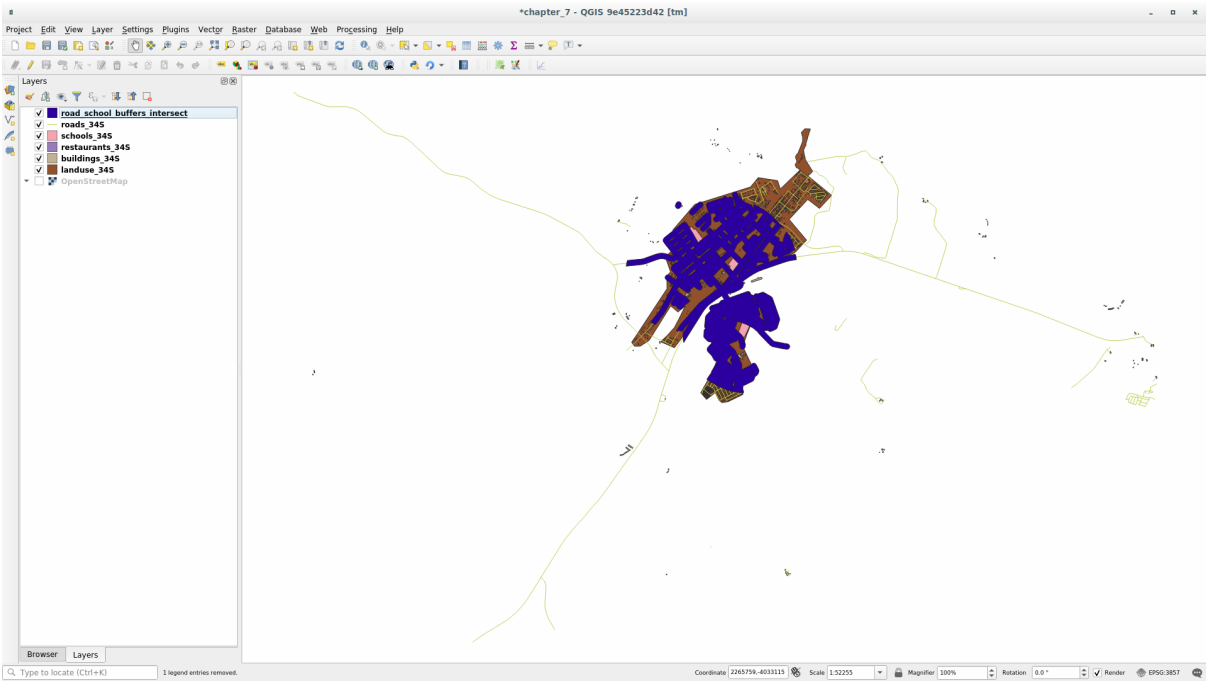


2. Clic pe *Run*

   In the image below, the blue areas are where both of the distance criteria are satisfied.



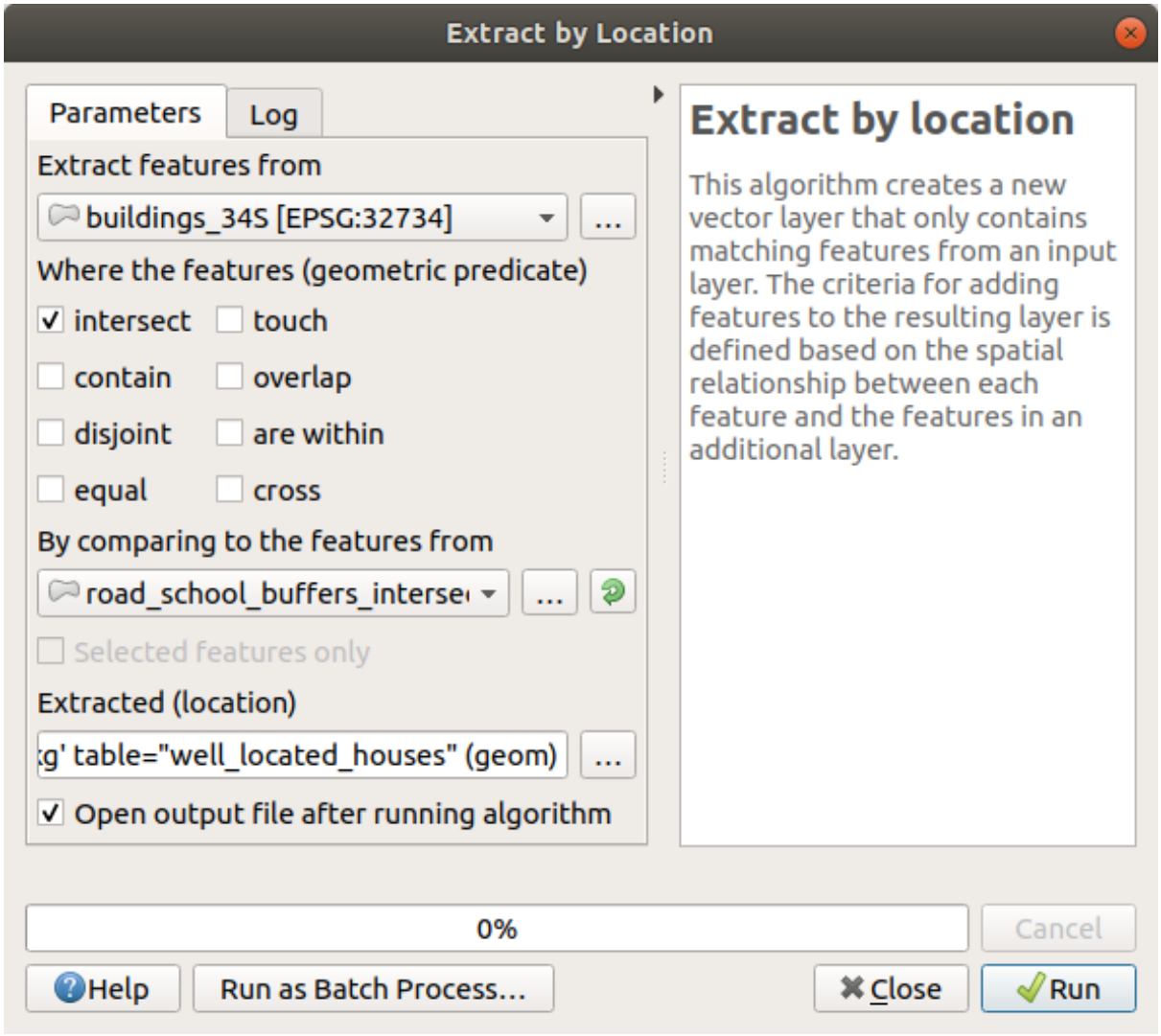
3. You may remove the two buffer layers and only keep the one that shows where they overlap, since that's what we really wanted to know in the first place:



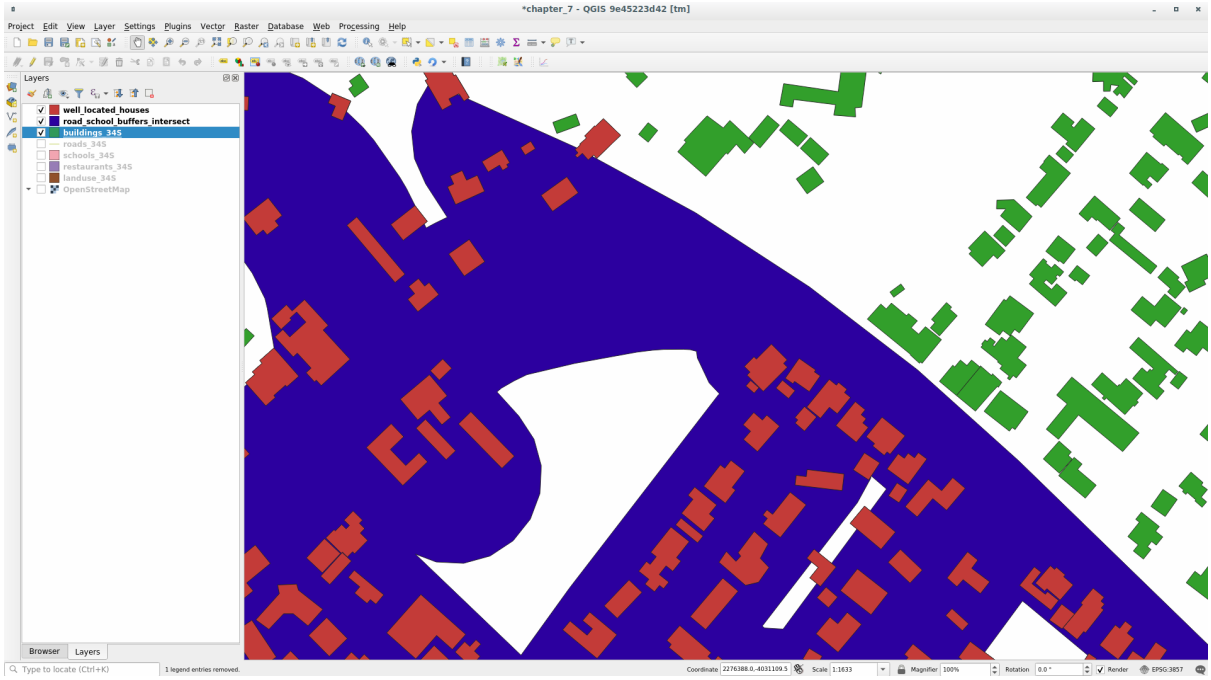
6.2.9 ??? Follow Along: Extract the Buildings

Now you've got the area that the buildings must overlap. Next, you want to extract the buildings in that area.

1. Look for the menu entry *Vector Selection* ► *Extract by location* within the *Processing Toolbox*
2. Select `buildings_34S` in *Extract features from*. Check *intersect* in *Where the features (geometric predicate)*, select the buffer intersection layer in *By comparing to the features from*. Save to the `vector_analysis.gpkg`, and name the layer `well_located_houses`.



3. Click *Run* and close the dialog
4. You will probably find that not much seems to have changed. If so, move the `well_located_houses` layer to the top of the layers list, then zoom in.



The red buildings are those which match our criteria, while the buildings in green are those which do not.

5. Now you have two separated layers and can remove `buildings_34S` from the layer list.

6.2.10 ??? Try Yourself: Further Filter our Buildings

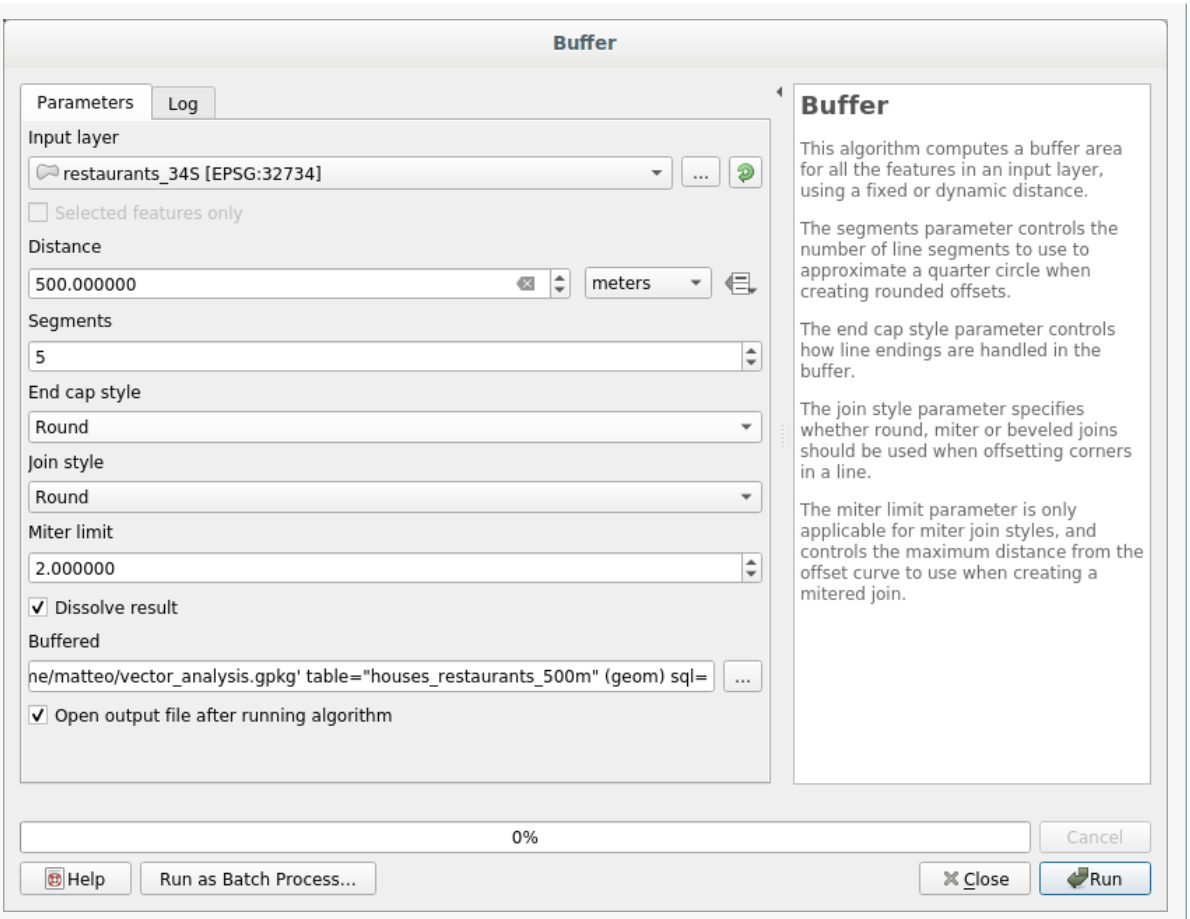
We now have a layer which shows us all the buildings within 1km of a school and within 50m of a road. We now need to reduce that selection to only show buildings which are within 500m of a restaurant.

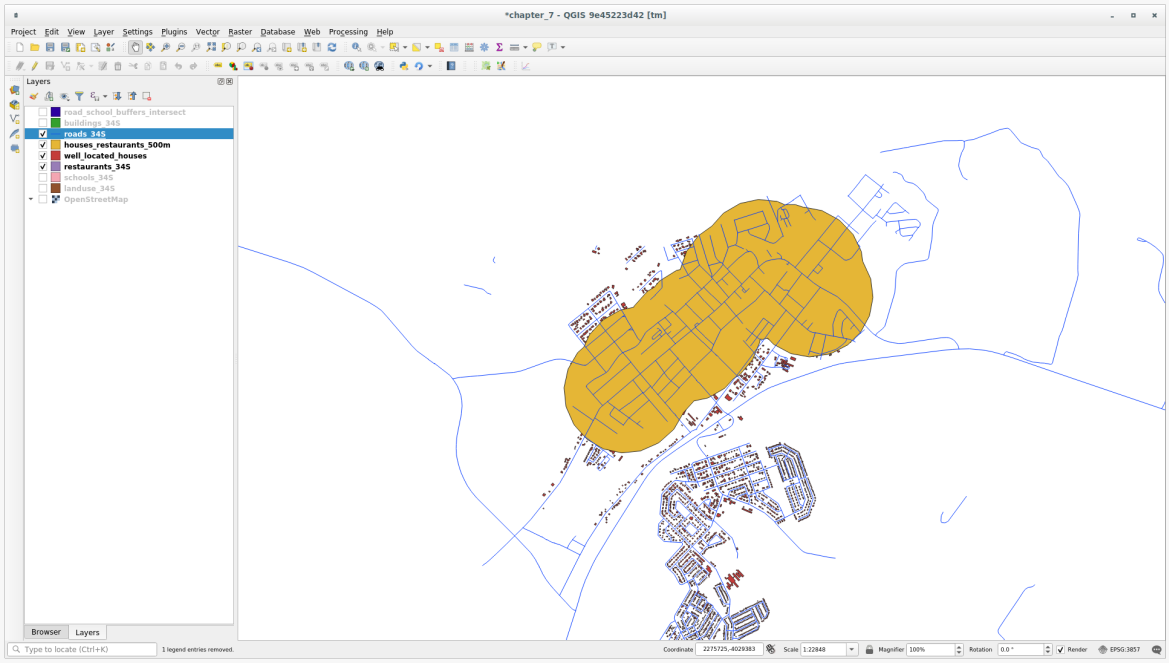
Using the processes described above, create a new layer called `houses_restaurants_500m` which further filters your `well_located_houses` layer to show only those which are within 500m of a restaurant.

Răspuns

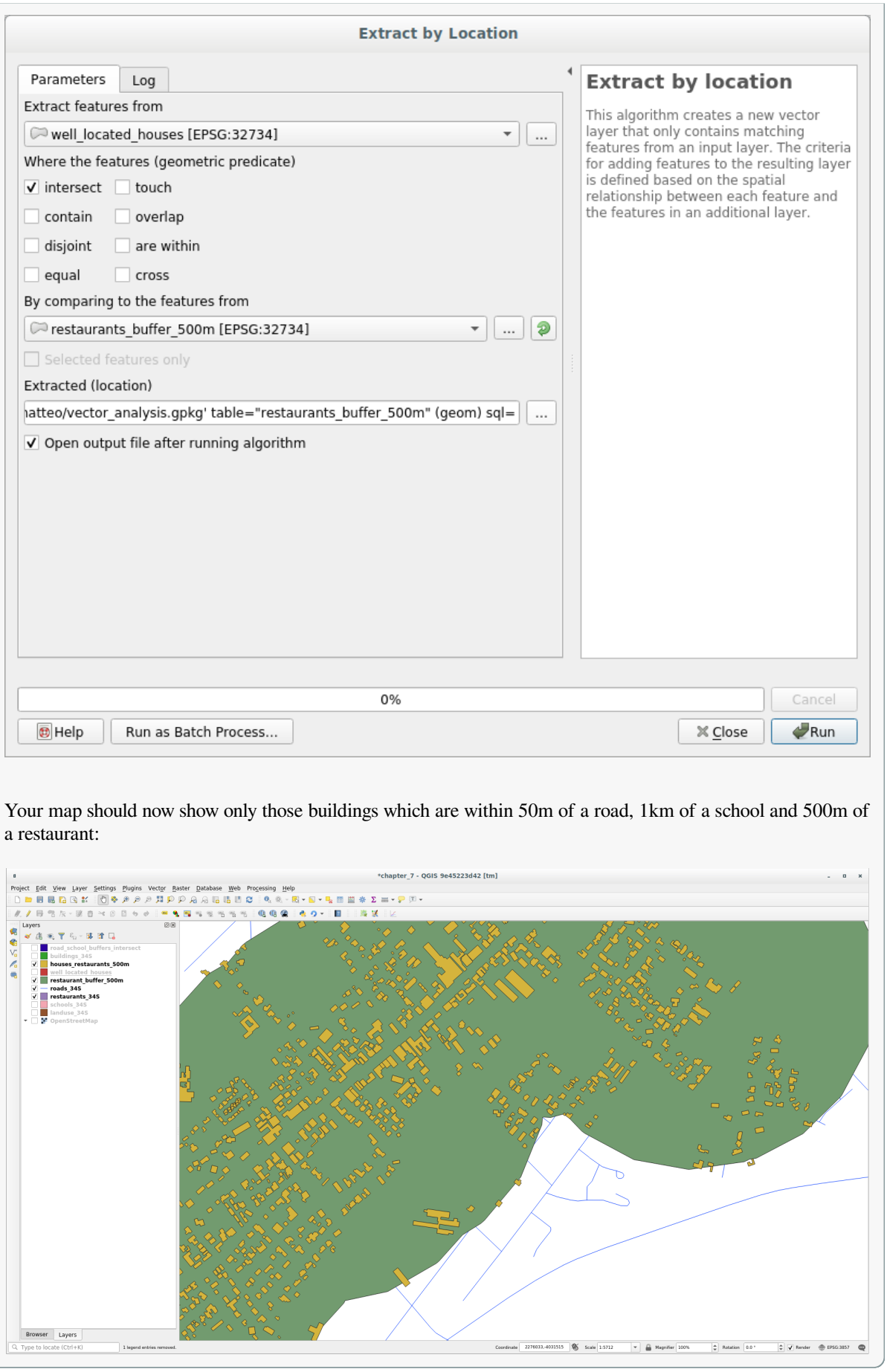
To create the new `houses_restaurants_500m` layer, we go through a two step process:

1. First, create a buffer of 500m around the restaurants and add the layer to the map:





2. Next, extract buildings within that buffer area:

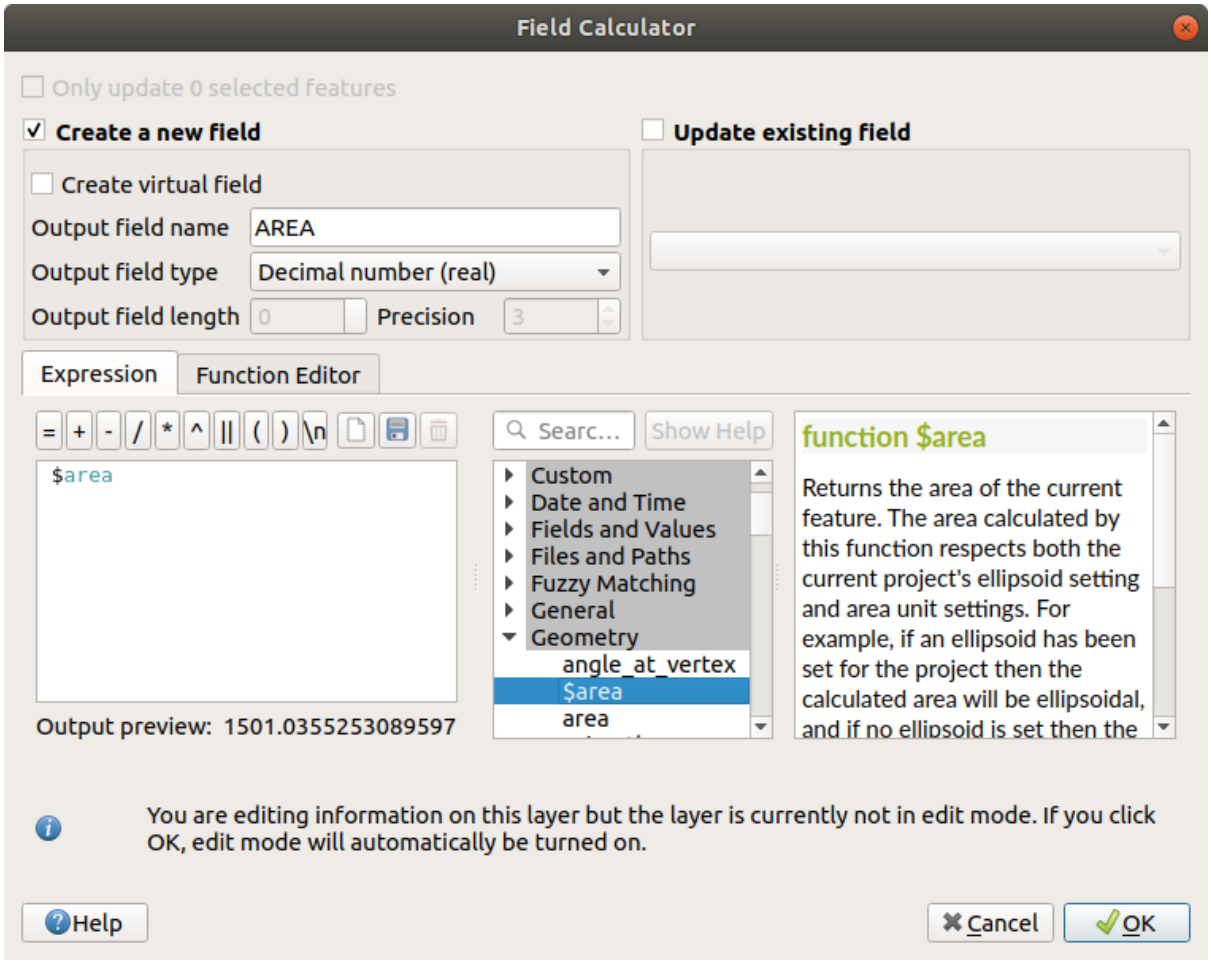


Your map should now show only those buildings which are within 50m of a road, 1km of a school and 500m of a restaurant:

6.2.11 ??? Follow Along: Select Buildings of the Right Size

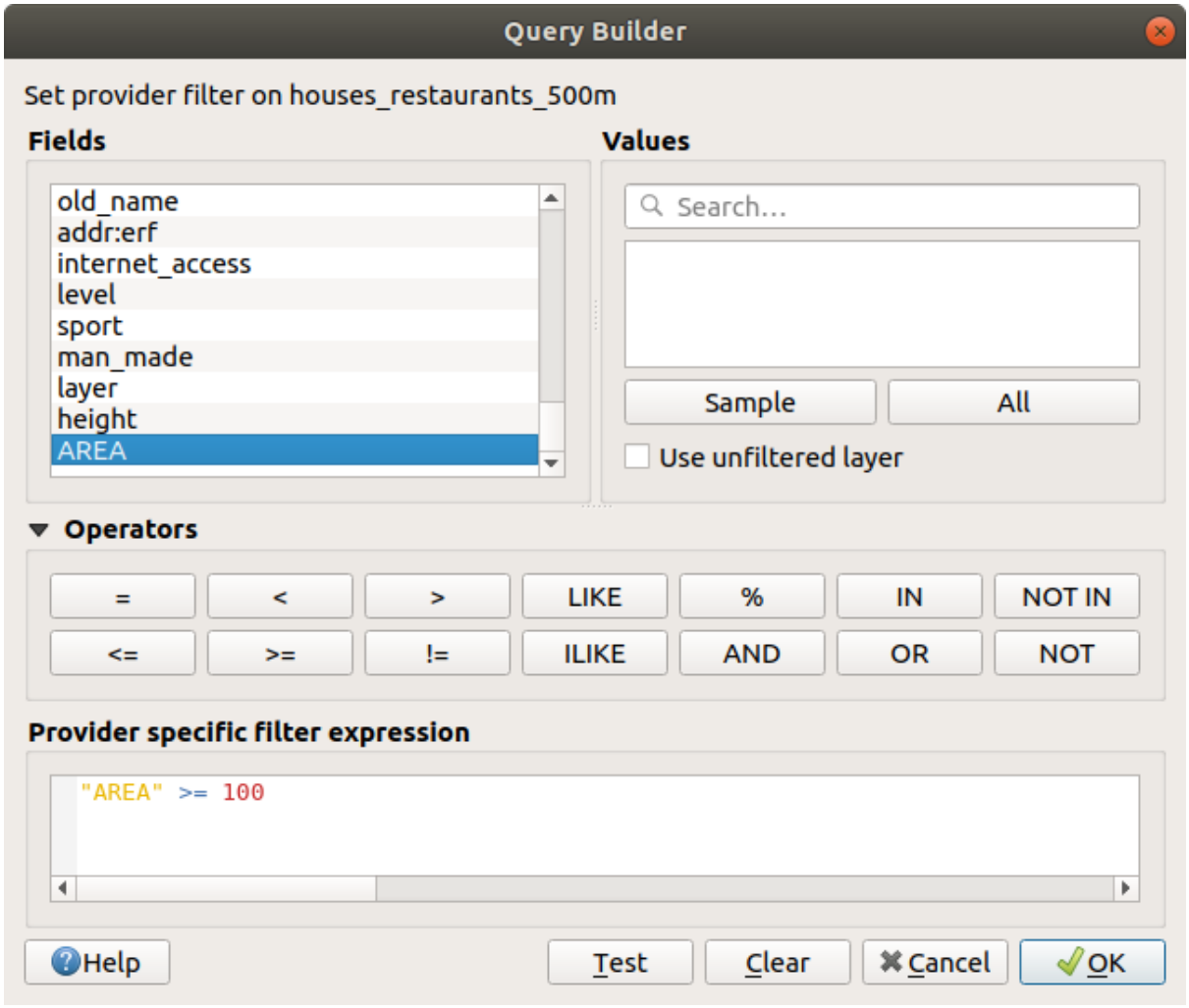
To see which buildings are of the correct size (more than 100 square meters), we need to calculate their size.

1. Select the `houses_restaurants_500m` layer and open the *Field Calculator* by clicking on the  Open Field Calculator button in the main toolbar or in the attribute table window
2. Select *Create a new field*, set the *Output field name* to `AREA`, choose *Decimal number (real)* as *Output field type*, and choose `$area` from the *Geometry* group.



   The new field `AREA` will contain the area of each building in square meters.

3. Click *OK*. The `AREA` field has been added at the end of the attribute table.
4. Click the  Toggle Editing button to finish editing, and save your edits when prompted.
5. In the *Source* tab of the layer properties, set the *Provider Feature Filter* to `"AREA >= 100`.



6. Clic pe *OK*

Your map should now only show you those buildings which match our starting criteria and which are more than 100 square meters in size.

6.2.12 ??? Încercați și dvs.:

Save your solution as a new layer, using the approach you learned above for doing so. The file should be saved within the same GeoPackage database, with the name `solution`.

6.2.13 În concluzie

Using the GIS problem solving approach together with QGIS vector analysis tools, you were able to solve a problem with multiple criteria quickly and easily.

6.2.14 Ce urmează?

In the next lesson, we will look at how to calculate the shortest distance along roads from one point to another.

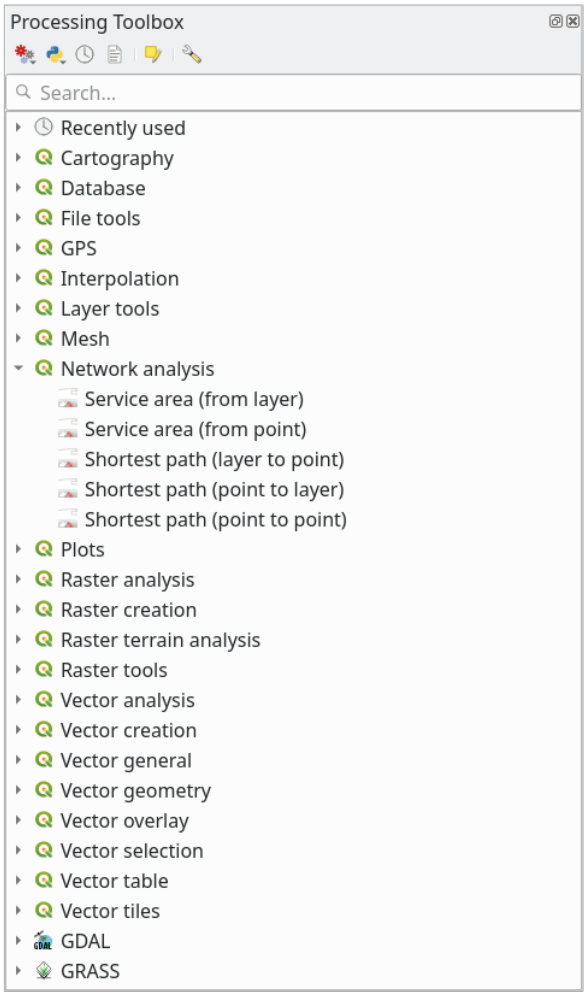
6.3 Lesson: Network Analysis

Calculating the shortest distance between two points is a common GIS task. Tools for this can be found in the *Processing Toolbox*.

The goal for this lesson: learn to use *Network analysis* algorithms.

6.3.1 ??? Follow Along: The Tools and the Data

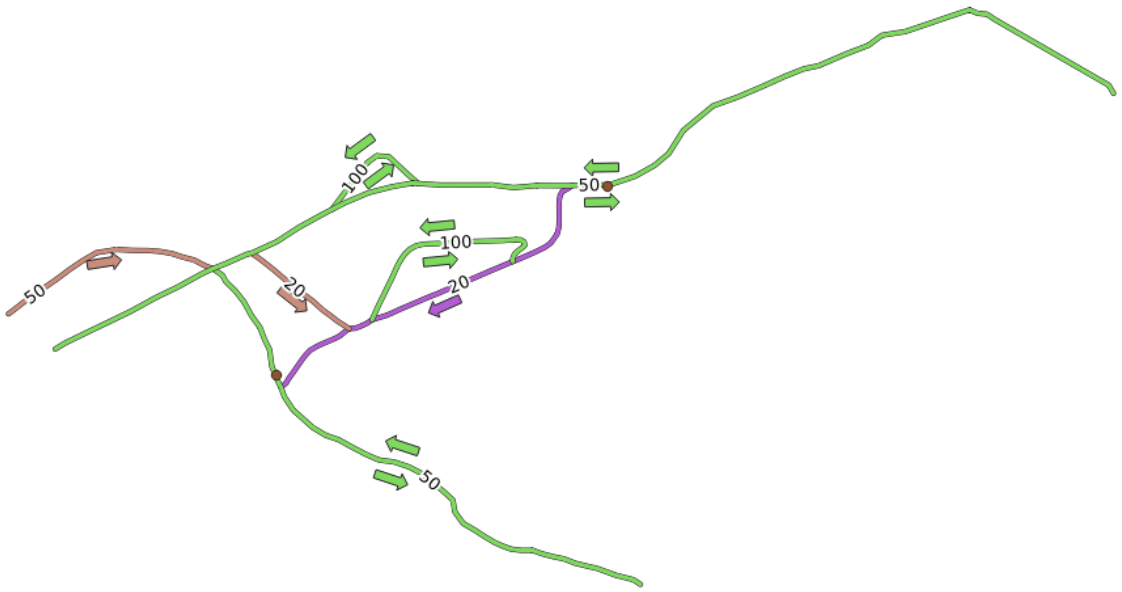
You can find all the network analysis algorithms in the *Processing* ► *Network Analysis* menu. You can see that there are many tools available:



Open the project `exercise_data/network_analysis/network.qgz`. It contains two layers:

- `network_points`
- `network_lines`

The `network_lines` layer has already a style that helps to understand the road network.



The shortest path tools provide ways to calculate either the shortest or the fastest path between two points of a network, given:

- start and end points selected on the map
- start point selected on the map and end points taken from a point layer
- start points taken from a point layer and end point selected on the map

Let's start.

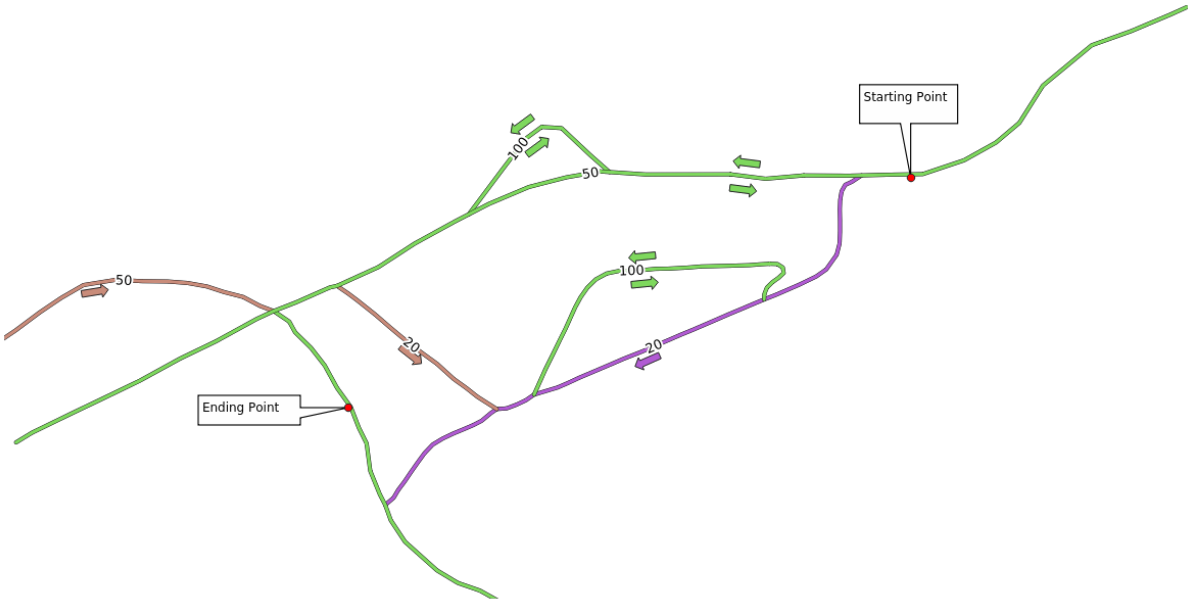
6.3.2 ??? Calculate the shortest path (point to point)

The *Network analysis* ► *Shortest path (point to point)* allows you to calculate the shortest distance between two manually selected points on the map.

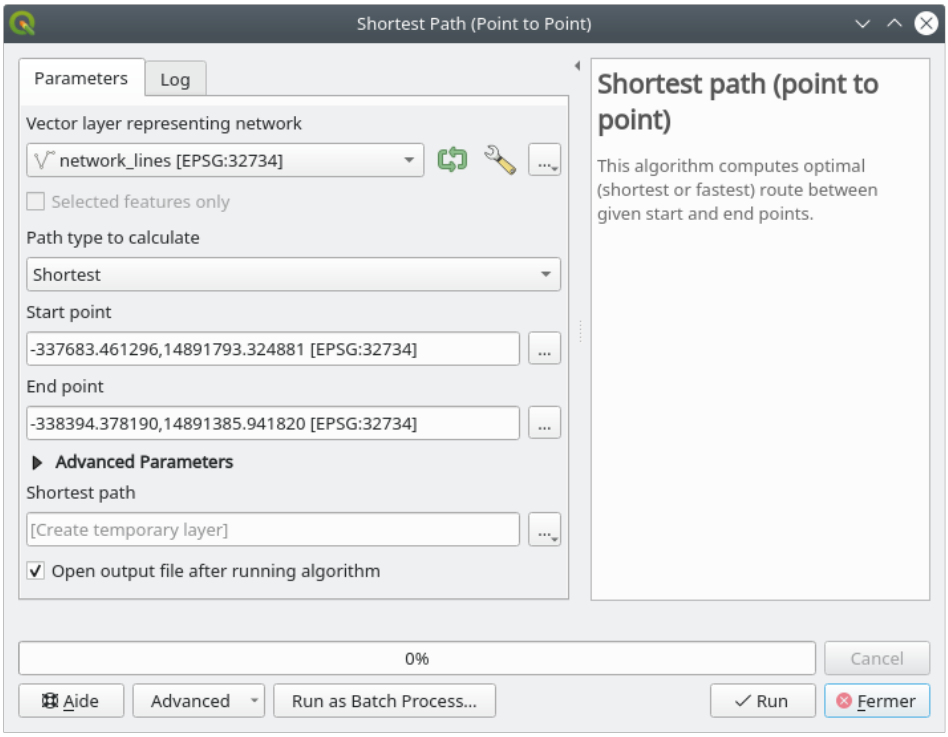
In this example we will calculate the **shortest** (not fastest) path between two points.

1. Open the *Shortest path (point to point)* algorithm
2. Select `network_lines` for *Vector layer representing network*
3. Use `Shortest` for *Path type to calculate*

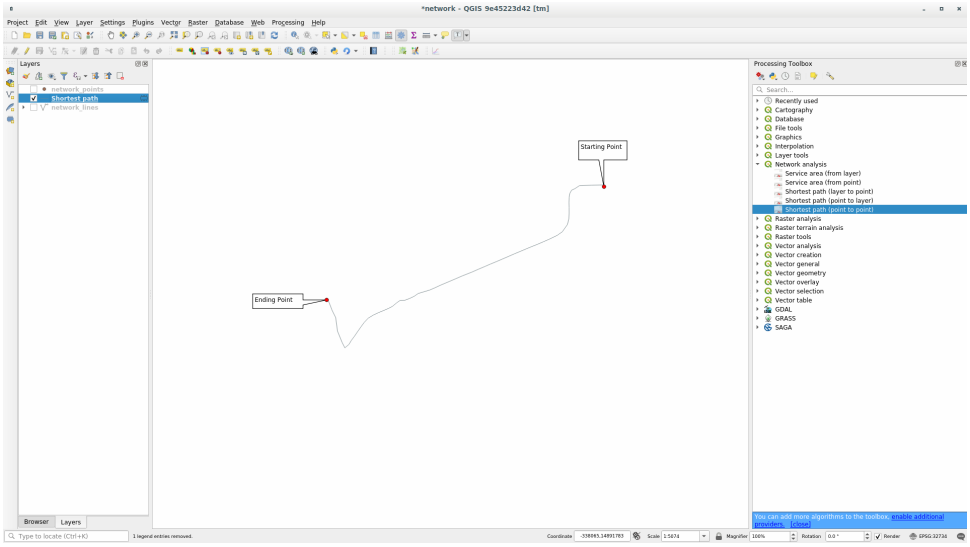
   Use these two points as starting and ending points for the analysis:



4. Click on the … button next to *Start point (x, y)* and choose the location tagged with `Starting Point` in the picture. Enable the snapping options for an accurate selection. The coordinates of the clicked point are added.
5. Do the same thing, but choosing the location tagged with `Ending point` for *End point (x, y)*
6. Click on the *Run* button:



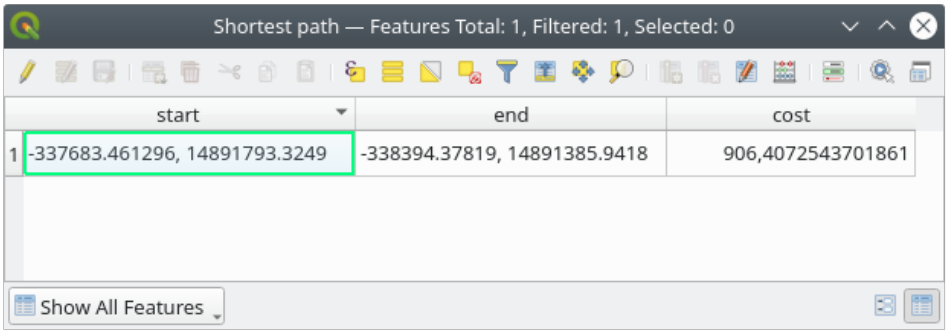
7. A new line layer is created representing the shortest path between the chosen points. Uncheck the `network_lines` layer to see the result better:



8. Open the attribute table of the output layer. It contains three fields, representing the coordinates of the start and end points and the **cost**.

   We chose `Shortest` as *Path type to calculate*, so the **cost** represent the **distance**, in layer units, between the two locations.

   In our case, the *shortest* distance between the chosen points is around `1000` meters:



Now that you know how to use the tool, feel free to test other locations.

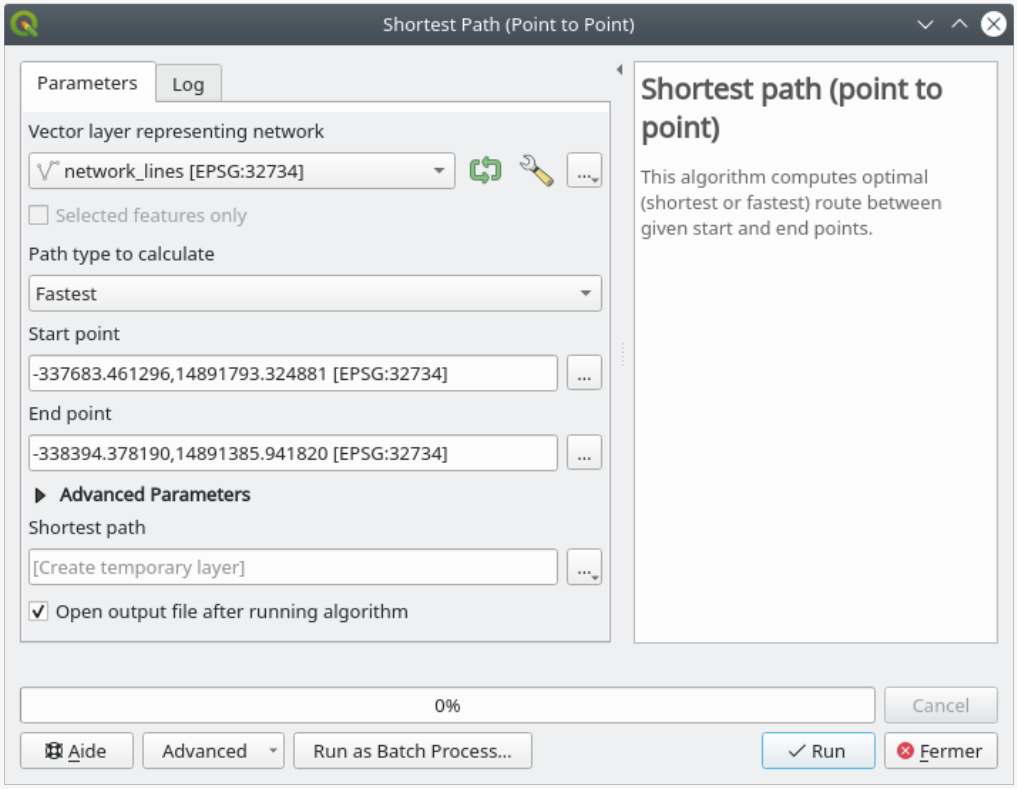
6.3.3 ??? Încercați și dvs.: Cea mai rapidă cale

With the same data of the previous exercise, try to calculate the fastest path between the two points.

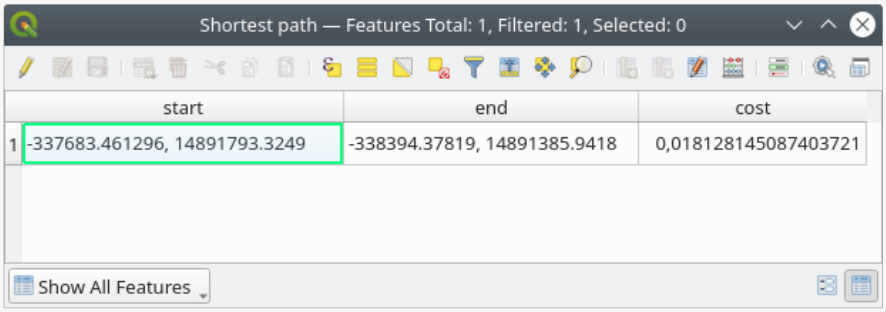
How much time do you need to go from the start to the end point?

Răspuns

1. Open *Network Analysis* ► *Shortest Path (Point to Point)* and fill the dialog as:



2. Make sure that the *Path type to calculate* is `Fastest`.
3. Click on *Run* and close the dialog.
4. Open now the attribute table of the output layer. The *cost* field contains the travel time between the two points (as fraction of hours):



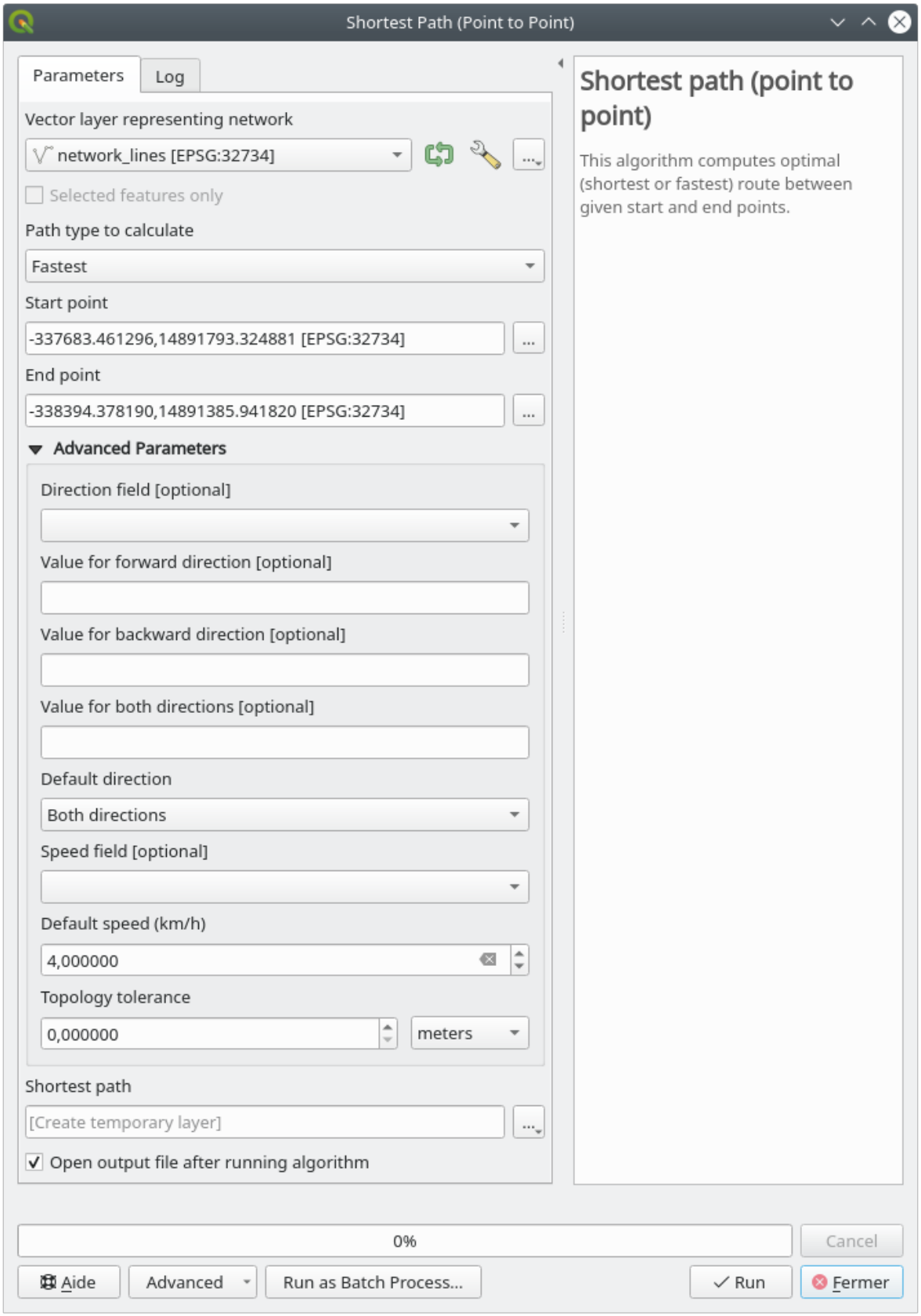
6.3.4 ??? Follow Along: Advanced options

Let us explore some more options of the Network Analysis tools. In the *previous exercise* we calculated the **fastest** route between two points. As you can imagine, the time depends on the travel **speed**.

We will use the same layers and starting and ending points of the previous exercises.

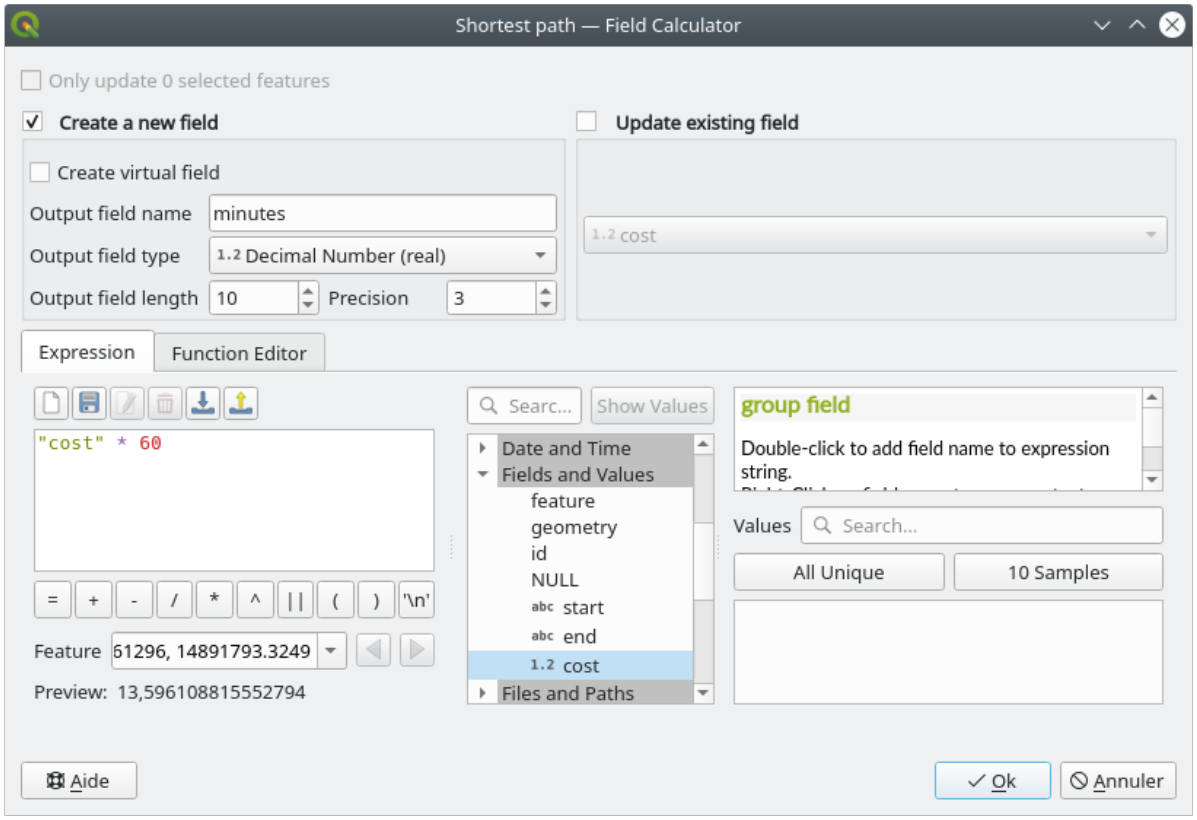
1. Open the *Shortest path (point to point)* algorithm
2. Fill the *Input layer*, *Start point (x, y)* and *End point (x, y)* as we did before
3. Choose `Fastest` as the *Path type to calculate*

4. Open the *Advanced parameter* menu
5. Change the *Default speed (km/h)* from the default `50` value to `4`



6. Click on *Run*
7. Once the algorithm is finished, close the dialog and open the attribute table of the output layer.

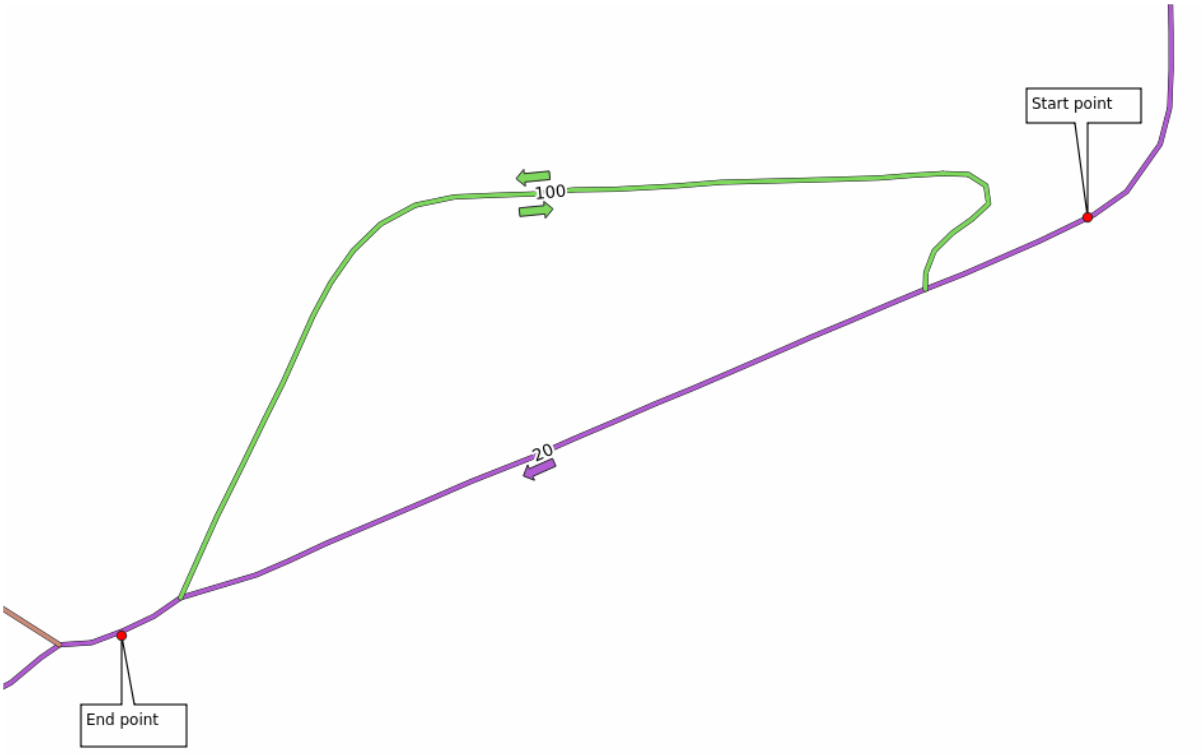
   The *cost* field contains the value according to the speed parameter you have chosen. We can convert the *cost* field from hours with fractions to the more readable *minutes* values.
8. Open the field calculator by clicking on the  icon
9. Add a new field to store the path cost in *minutes*.



That's it! Now you know how many minutes it will take to get from one point to the other one if the whole network speed is at `4 km/h`.

6.3.5 ??? Shortest path with speed limit

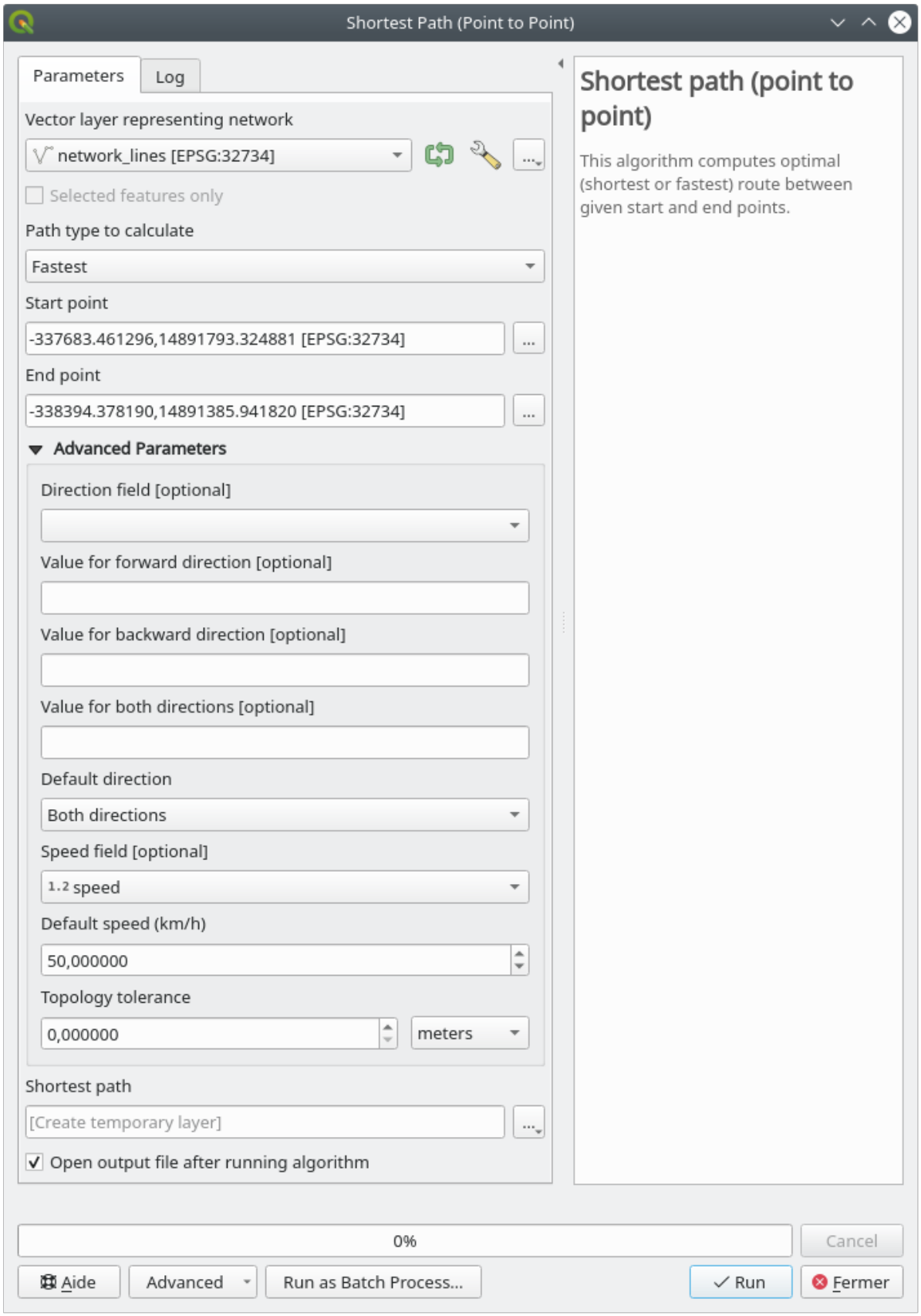
The Network analysis toolbox has other interesting options. Looking at the following map:



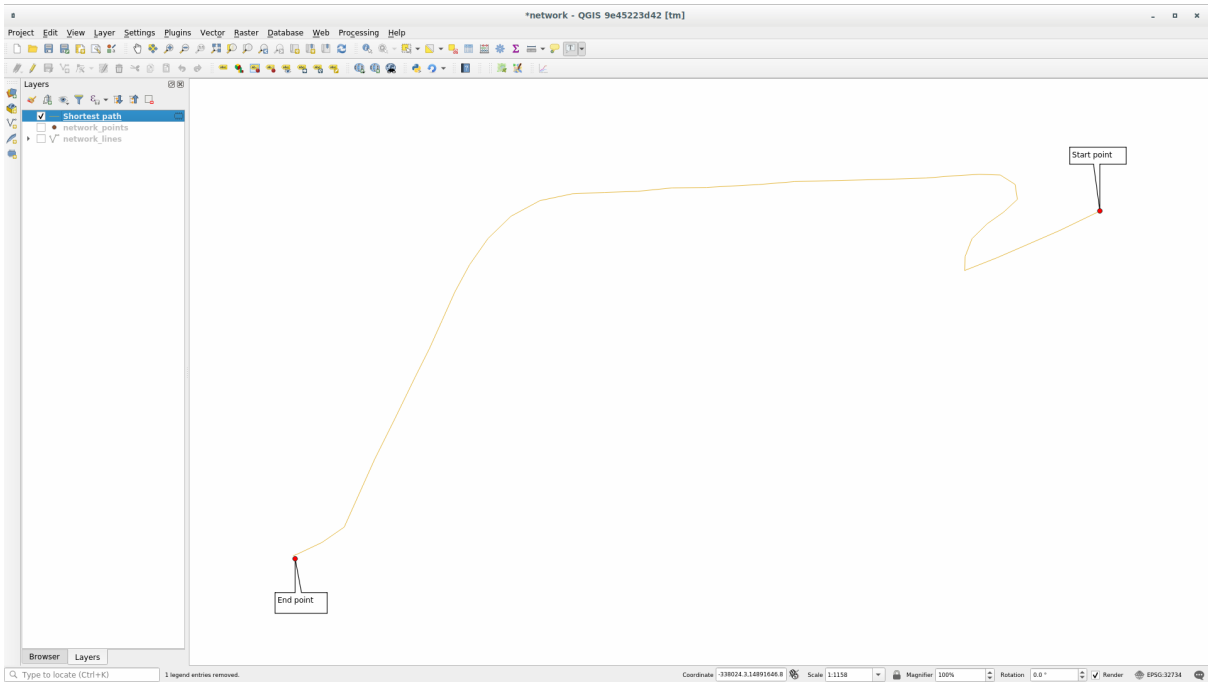
we would like to know the **fastest** route considering the **speed limits** of each road (the labels represent the speed limits in km/h). The shortest path without considering speed limits would of course be the purple path. But in that road the speed limit is 20 km/h, while in the green road you can go at 100 km/h!

As we did in the first exercise, we will use the *Network analysis* ► *Shortest path (point to point)* and we will manually choose the start and end points.

1. Open the *Network analysis* ► *Shortest path (point to point)* algorithm
2. Select `network_lines` for the *Vector layer representing network* parameter
3. Choose `Fastest` as the *Path type to calculate*
4. Select the *Start point (x, y)* and *End point (x, y)* as we did before
5. Open the *Advanced parameters* menu
6. Choose the *speed* field as the *Speed Field* parameter. With this option the algorithm will take into account the speed limits for each road.



7. Click on the *Run* button
8. Turn off the `network_lines` layer to better see the result



As you can see the fastest route does not correspond to the shortest one.

6.3.6 ??? Service area (from layer)

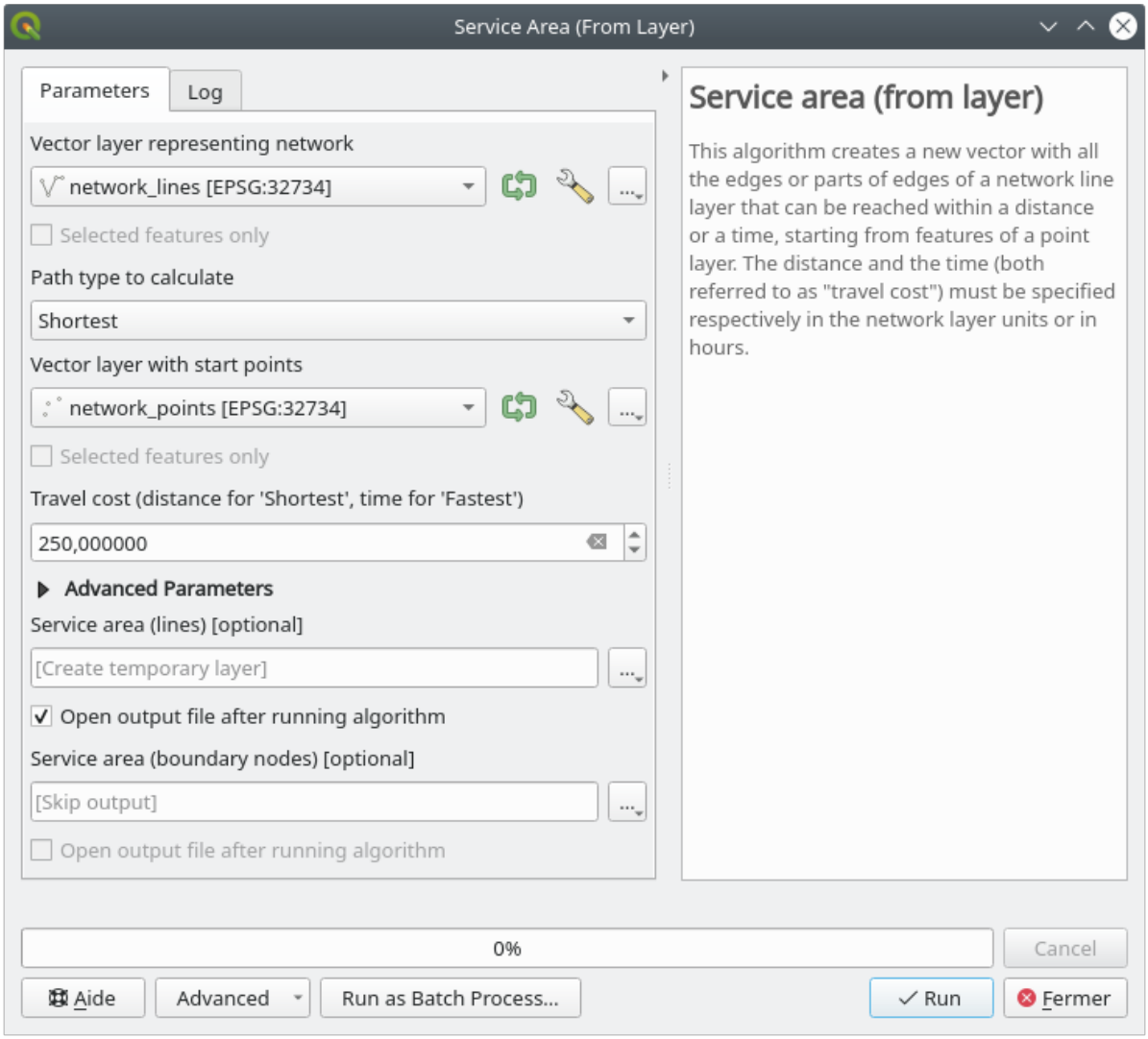
The *Network Analysis* ► *Service area (from layer)* algorithm can answer the question: given a point layer, what are all the reachable areas given a distance or a time value?

Notă

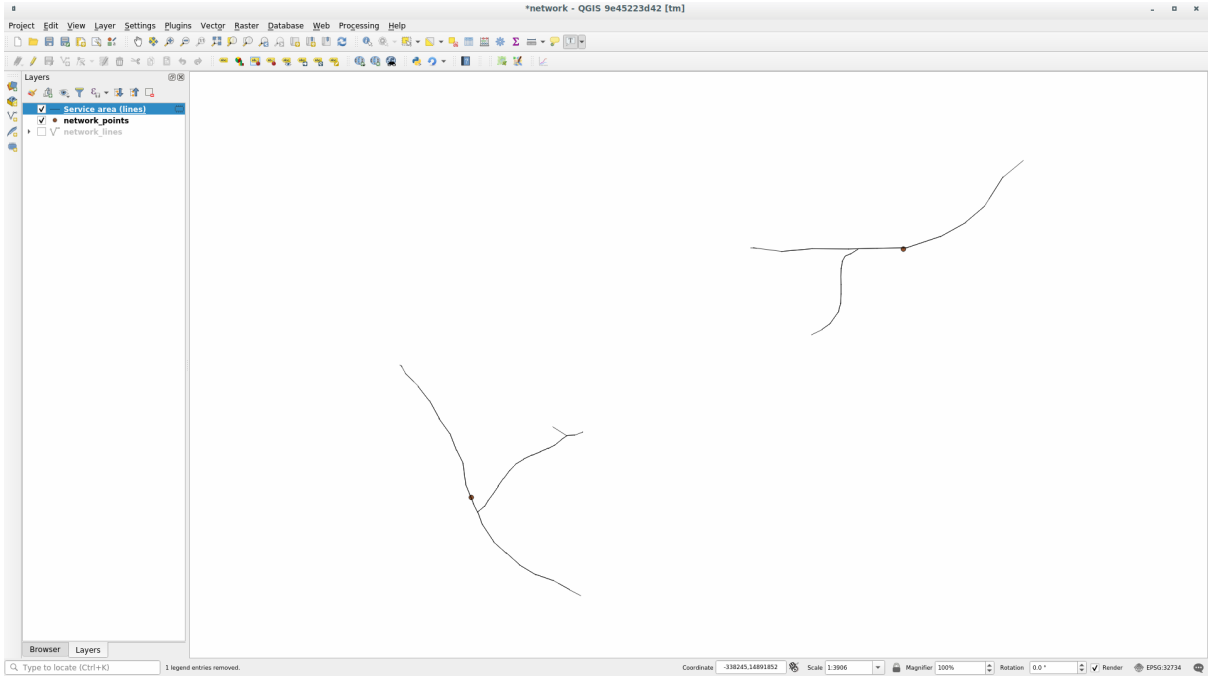
The *Network Analysis* ► *Service area (from point)* is the same algorithm, but it allows you to manually choose the point on the map.

Given a distance of `250` meters we want to know how far we can go on the network from each point of the `network_points` layer.

1. Uncheck all the layers except `network_points`
2. Open the *Network Analysis* ► *Service area (from layer)* algorithm
3. Choose `network_lines` for *Vector layer representing network*
4. Choose `network_points` for *Vector layer with start points*
5. Choose `Shortest` in *Path type to calculate*
6. Enter `250` for the *Travel cost* parameter
7. Click on *Run* and close the dialog



The output layer represents the maximum path you can reach from the point features given a distance of 250 meters:



Cool isn't it?

6.3.7 În concluzie

Now you know how to use *Network analysis* algorithm to solve shortest and fastest path problems.

We are now ready to perform some spatial statistic on vector layer data. Let's go!

6.3.8 Ce urmează?

Mai departe, veți vedea cum să rulați algoritmii statisticilor spațiale asupra seturilor de date vectoriale.

6.4 Lesson: Spatial Statistics

Notă

Lecția a fost dezvoltată de Linfiniti și S Motala (Cape Peninsula University of Technology

Spatial statistics allows you to analyze and understand what is going on in a given vector dataset. QGIS includes many useful tools for statistical analysis.

The goal for this lesson: To know how to use QGIS» spatial statistics tools within the *Processing Toolbox*.

6.4.1 ??? Follow Along: Create a Test Dataset

We will create a random set of points, to get a dataset to work with.

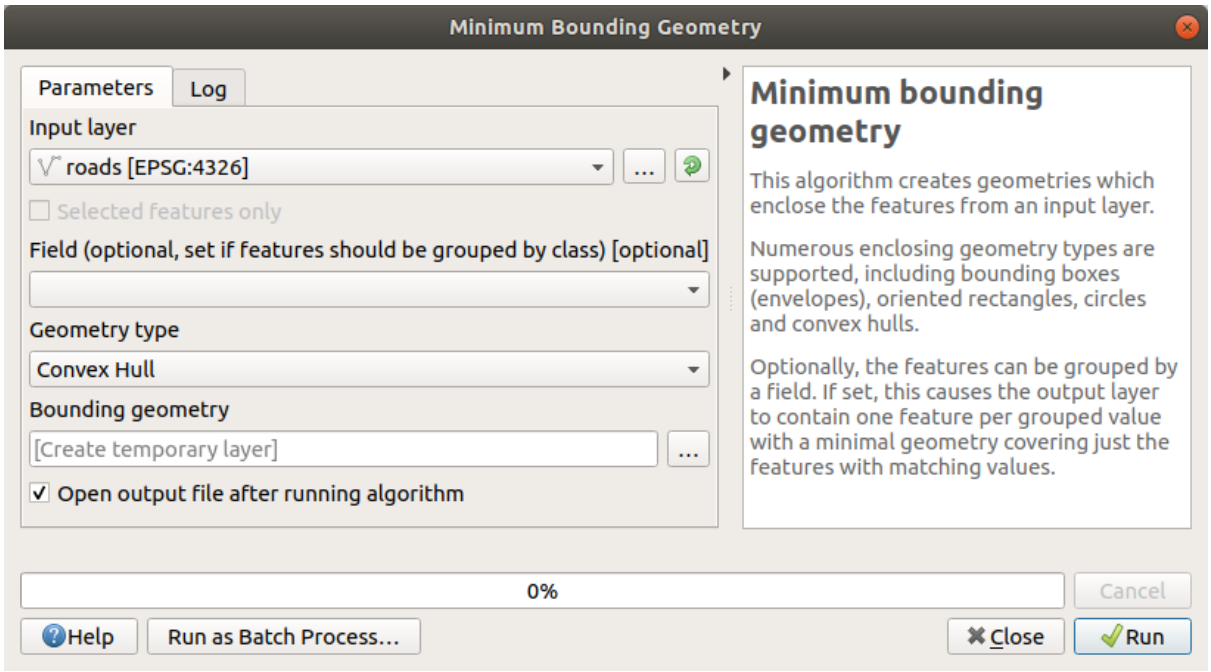
To do so, you will need a polygon dataset to define the area you want to create the points in.

We will use the area covered by streets.

1. Începere proiect nou
2. Add your `roads` dataset, as well as `srtm_41_19` (elevation data) found in `exercise_data/raster/SRTM/`.

> **Notă**
>
> You might find that the SRTM DEM layer has a different CRS to that of the roads layer. QGIS is reprojecting both layers in a single CRS. For the following exercises this difference does not matter, but feel free to reproject (as shown earlier in this module).

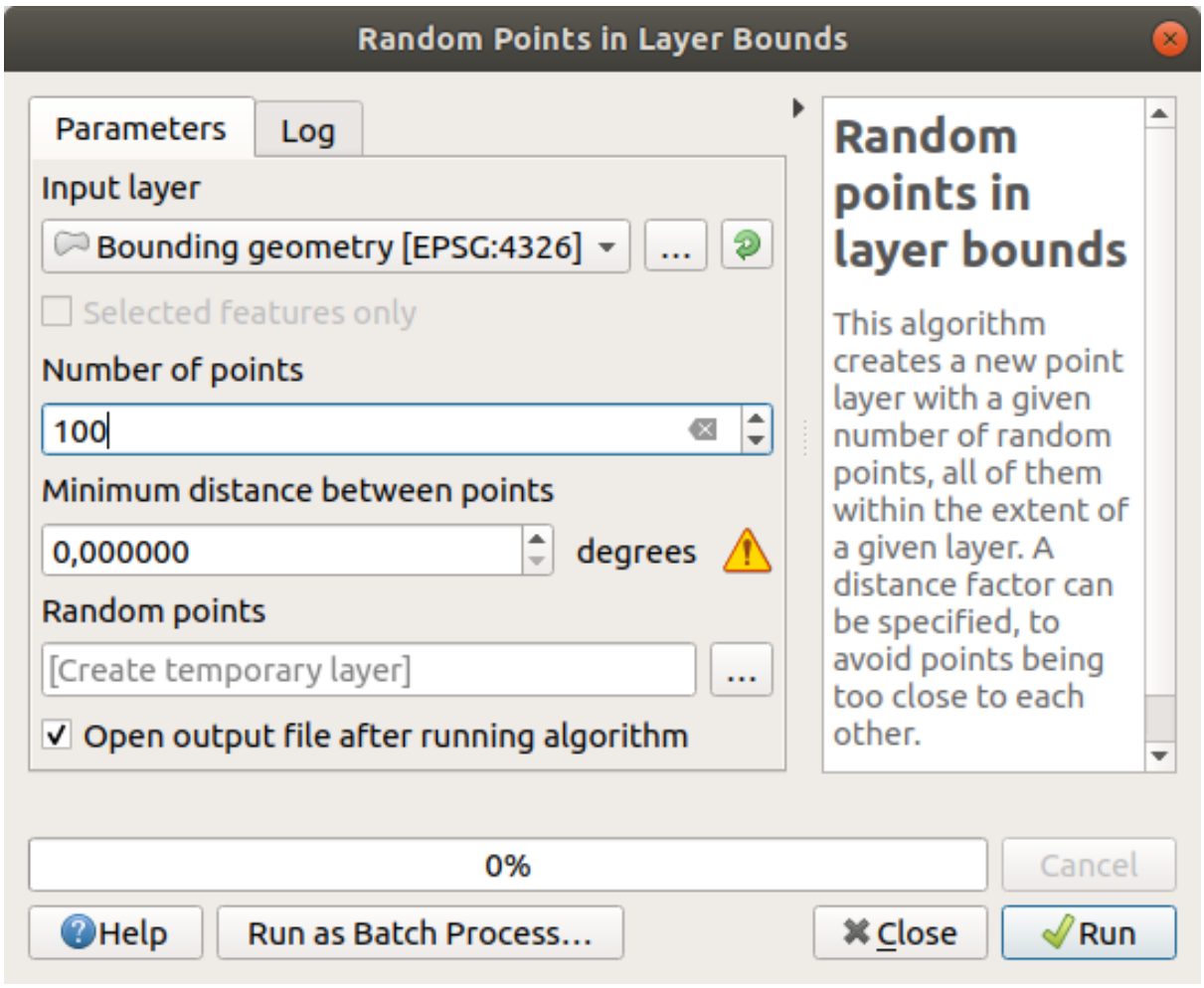
3. Open *Processing* toolbox
4. Use the *Vector Geometry* ► *Minimum bounding geometry* tool to generate an area enclosing all the roads by selecting `Convex Hull` as the *Geometry Type*:



As you know, if you don't specify the output, *Processing* creates temporary layers. It is up to you to save the layers immediately or at a later stage.

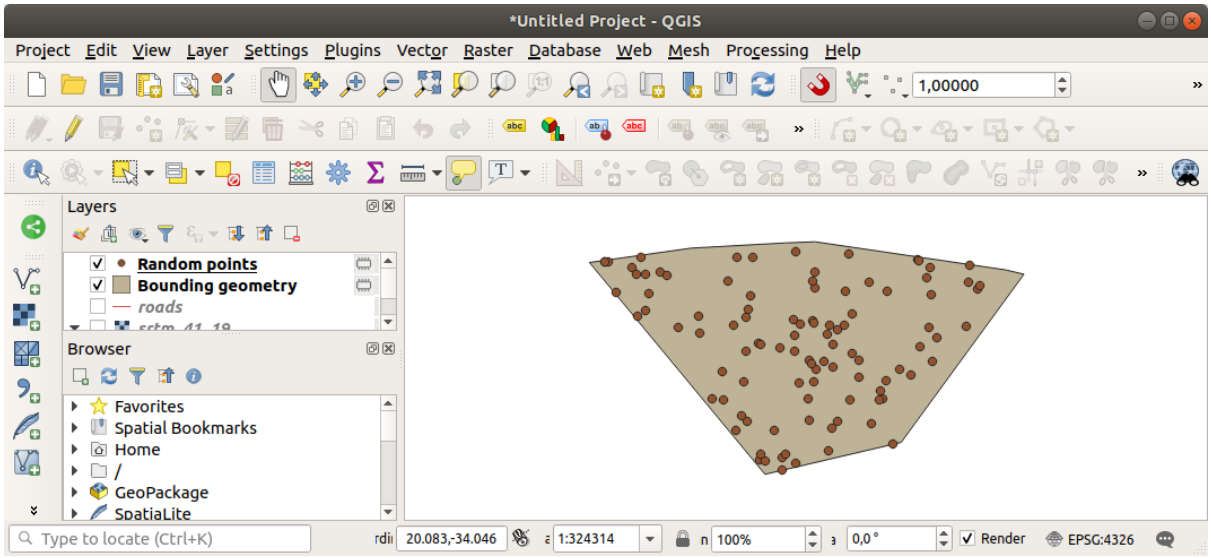
Crearea de puncte aleatorii

- Create 100 random points in this area using the tool at *Vector Creation* ► *Random points in layer bounds*, with a minimum distance of `0.0`:



> **Notă**
>
> The yellow warning sign tells you that that parameter concerns distances. The *Bounding geometry* layer is in a Geographical Coordinate System and the algorithm is just reminding you this. For this example we won't use this parameter so you can ignore it.

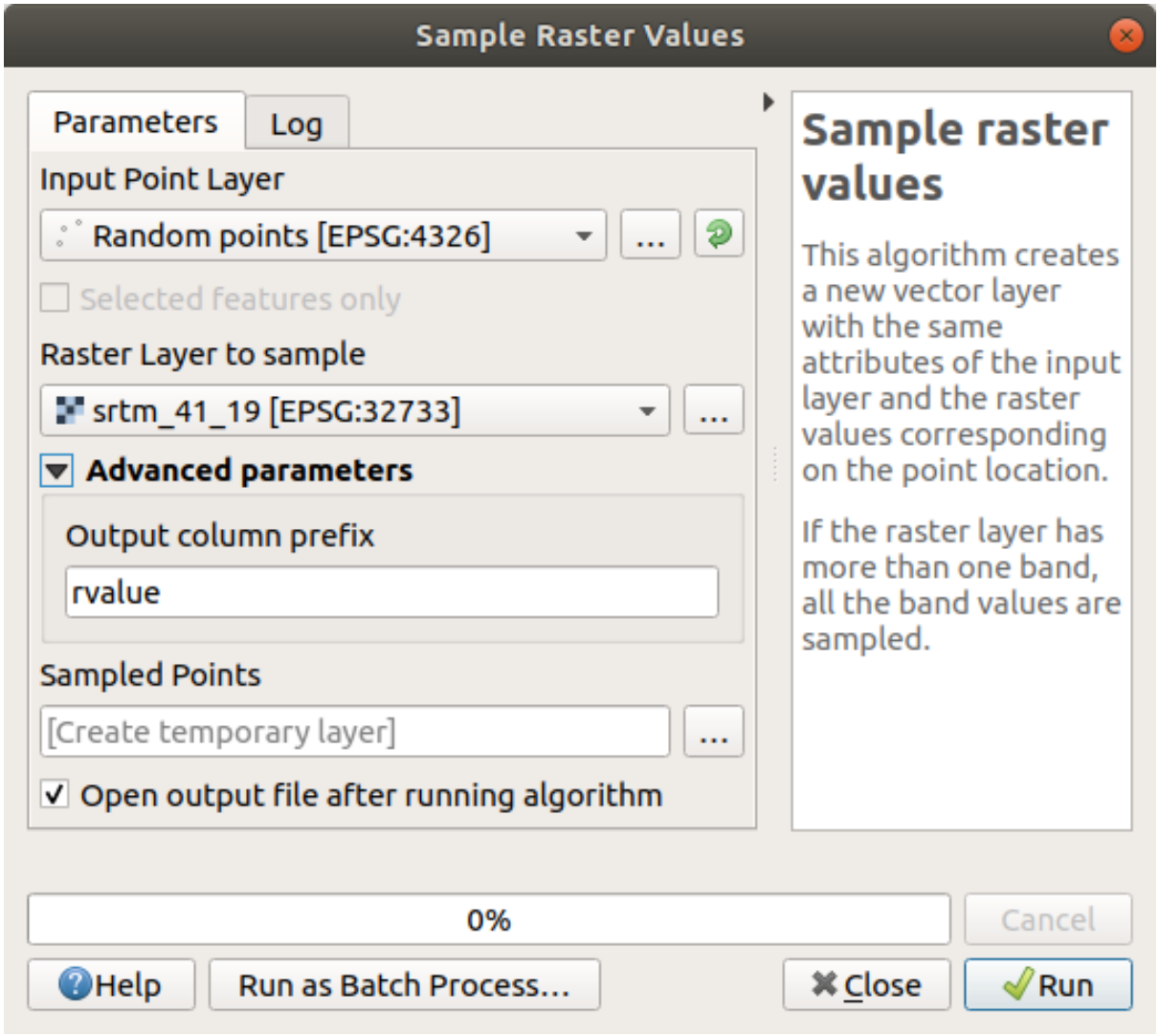
If needed, move the generated random point to the top of the legend to see them better:



Eșantionarea datelor

To create a sample dataset from the raster, you'll need to use the *Raster Analysis* ► *Sample raster values* algorithm. This tool samples the raster at the locations of the points and adds the raster values in new field(s) depending on the number of bands in the raster.

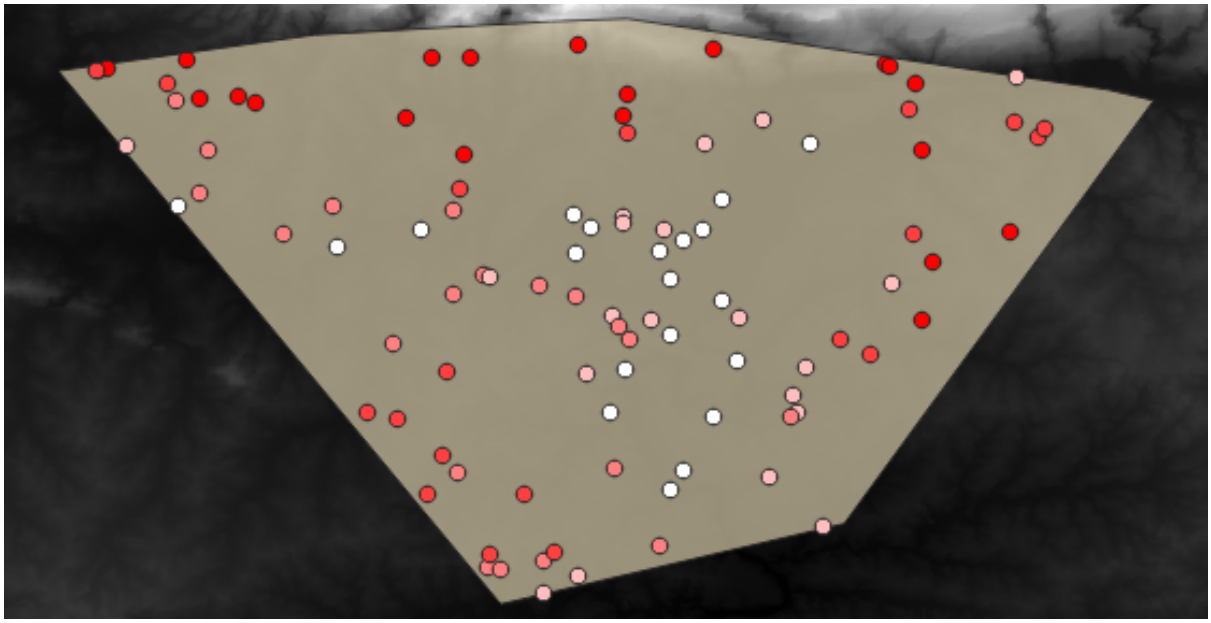
1. Open the *Sample raster values* algorithm dialog
2. Select `Random_points` as the layer containing sampling points, and the SRTM raster as the band to get values from. The default name of the new field is `rvalue_N`, where `N` is the number of the raster band. You can change the name of the prefix if you want.



3. Press *Run*

Now you can check the sampled data from the raster file in the attribute table of the `Sampled Points` layer. They will be in a new field with the name you have chosen.

Un posibil strat eșantion este prezentat aici:



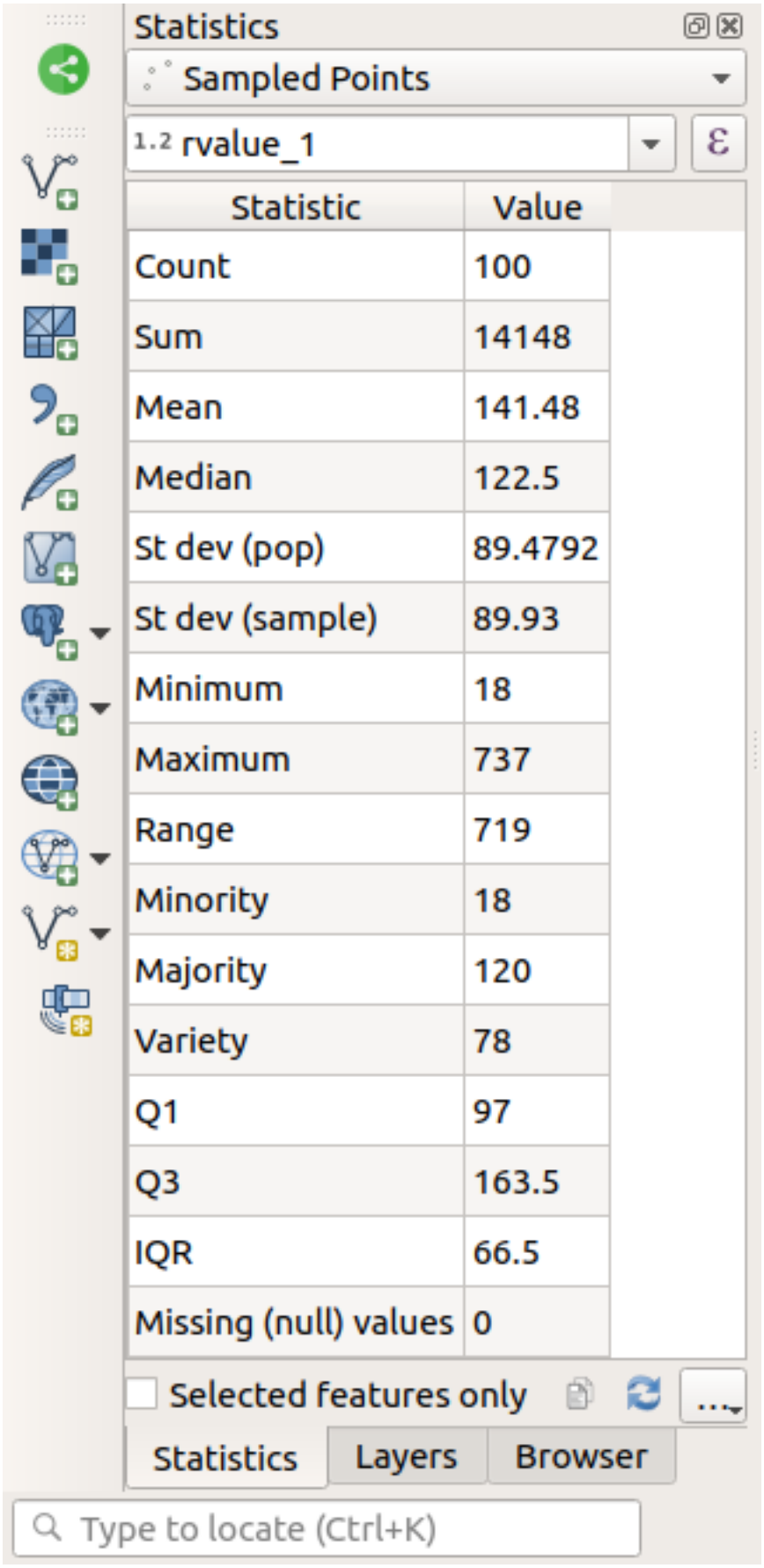
The sample points are classified using the `rvalue_1` field such that red points are at a higher altitude.

You will be using this sample layer for the rest of the statistical exercises.

6.4.2 ??? Follow Along: Basic Statistics

Obține statisticile de bază pentru acest strat.

1. Click on the Σ Show statistical summary icon in the *Attributes Toolbar*. A new panel will pop up.
2. In the dialog that appears, specify the `Sampled Points` layer as the source.
3. Select the *rvalue_1* field in the field combo box. This is the field you will calculate statistics for.
4. The *Statistics* Panel will be automatically updated with the calculated statistics:


Statistics
Sampled Points
1.2 rvalue_1
Statistic
Value
Count
100
Sum
14148
Mean
141.48
Median
122.5
St dev (pop)
89.4792
St dev (sample)
89.93
Minimum
18
Maximum
737
Range
719
Minority
18
Majority
120
Variety
78
Q1
97
Q3
163.5
IQR
66.5
Missing (null) values
0
Selected features only
Statistics
Layers
Browser
Type to locate (Ctrl+K)

> **Notă**
>
> You can copy the values by clicking on the  Copy Statistics To Clipboard button and paste the results into a spreadsheet.

5. Close the *Statistics* Panel when done

Many different statistics are available:

Număr
The number of samples/values.

Sum
The values added together.

Media
The mean (average) value is simply the sum of the values divided by the number of values.

Mediana
If you arrange all the values from smallest to greatest, the middle value (or the average of the two middle values, if N is an even number) is the median of the values.

St Dev (pop)
Abaterea standard. Oferă o indicație despre cât de strâns sunt grupate valorile în jurul mediei. Cu cât este mai mică deviația standard, cu atât mai apropiată tinde să fie media.

Minimum
Valoarea minimă.

Maximum
Valoarea maximă.

Intervalul
Diferența dintre valorile minime și maxime.

Q1
First quartile of the data.

Q3
Third quartile of the data.

Missing (null) values
The number of missing values.

6.4.3 ??? Follow Along: Compute statistics on distances between points

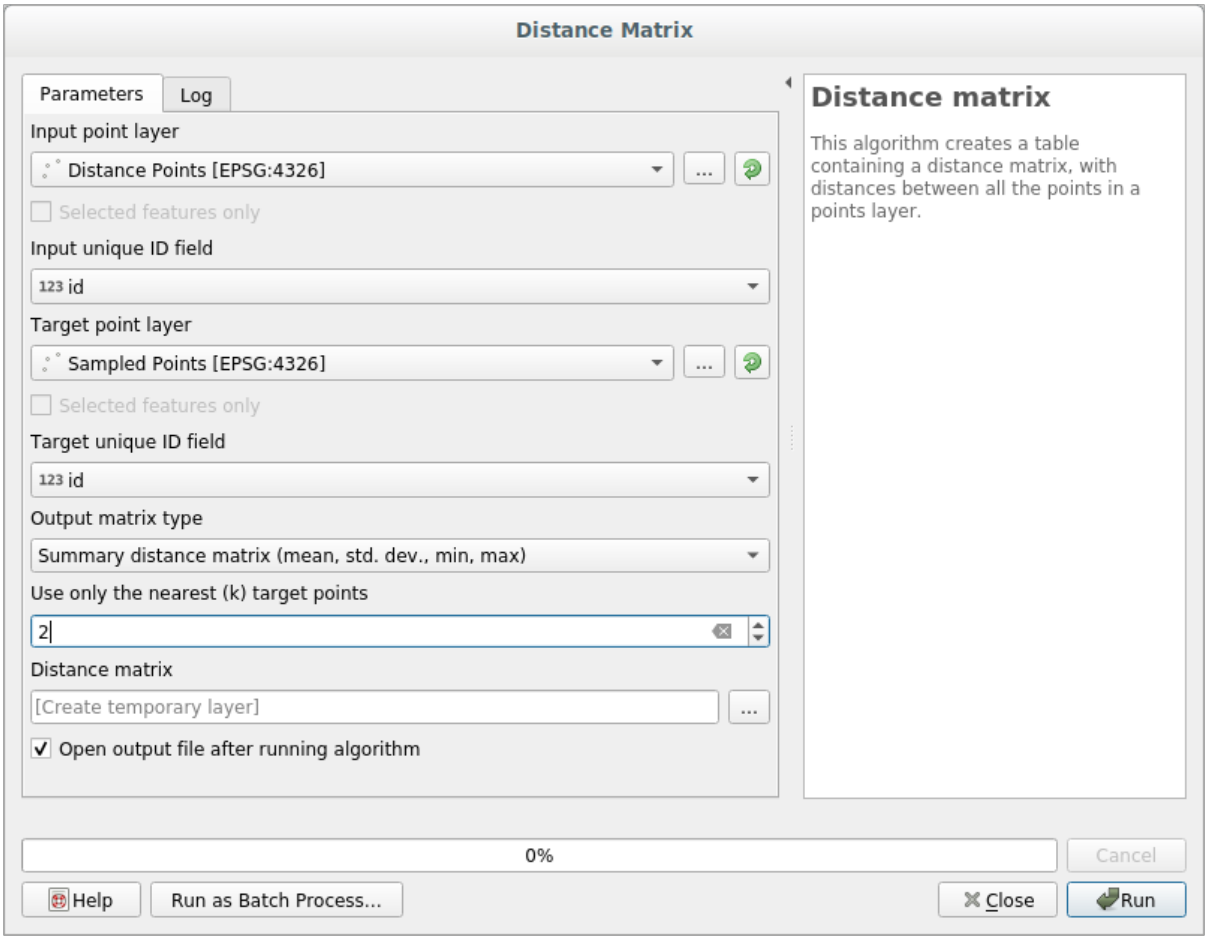
1. Create a new temporary point layer.
2. Enter edit mode, and digitize three points somewhere among the other points.

   Alternatively, use the same random point generation method as before, but specify only **three** points.
3. Save your new layer as `distance_points` in the format you prefer.

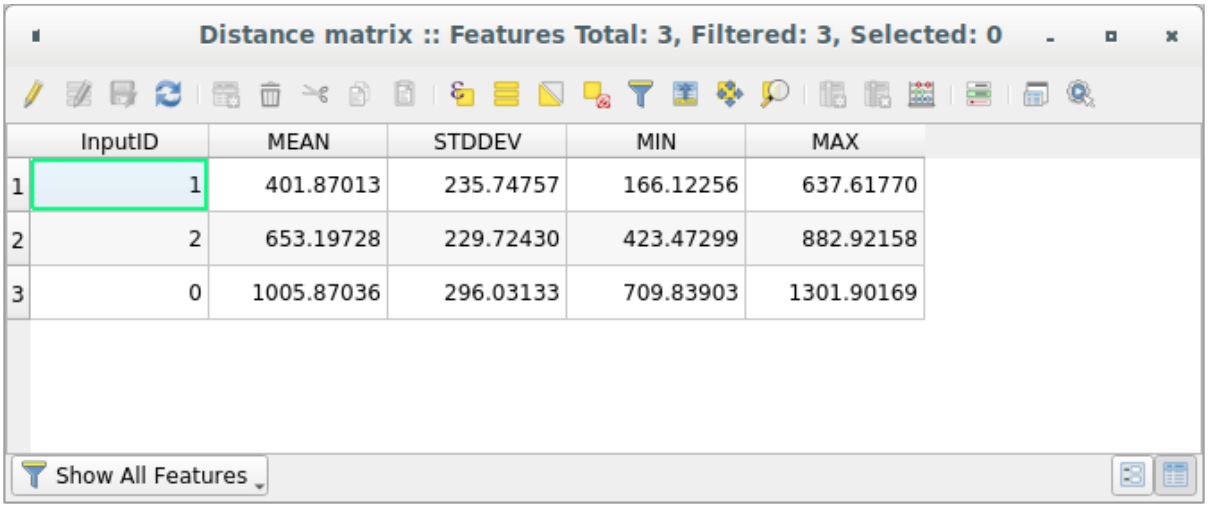
To generate statistics on the distances between points in the two layers:

1. Open the *Vector Analysis* ► *Distance matrix* tool.
2. Select the `distance_points` layer as the input layer, and the `Sampled Points` layer as the target layer.
3. Set their `id` field as unique field references
4. Change the *Output matrix type* option into *Summary distance matrix*.
5. set value of *Use only the nearest (k) target points* to `2`.

6. If you want you can save the output layer as a file or just run the algorithm and save the temporary output layer later.



7. Click *Run* to generate the distance matrix layer.
8. Open the attribute table of the generated layer: values refer to the distances between the `distance_points` features and their two nearest points in the `Sampled Points` layer:



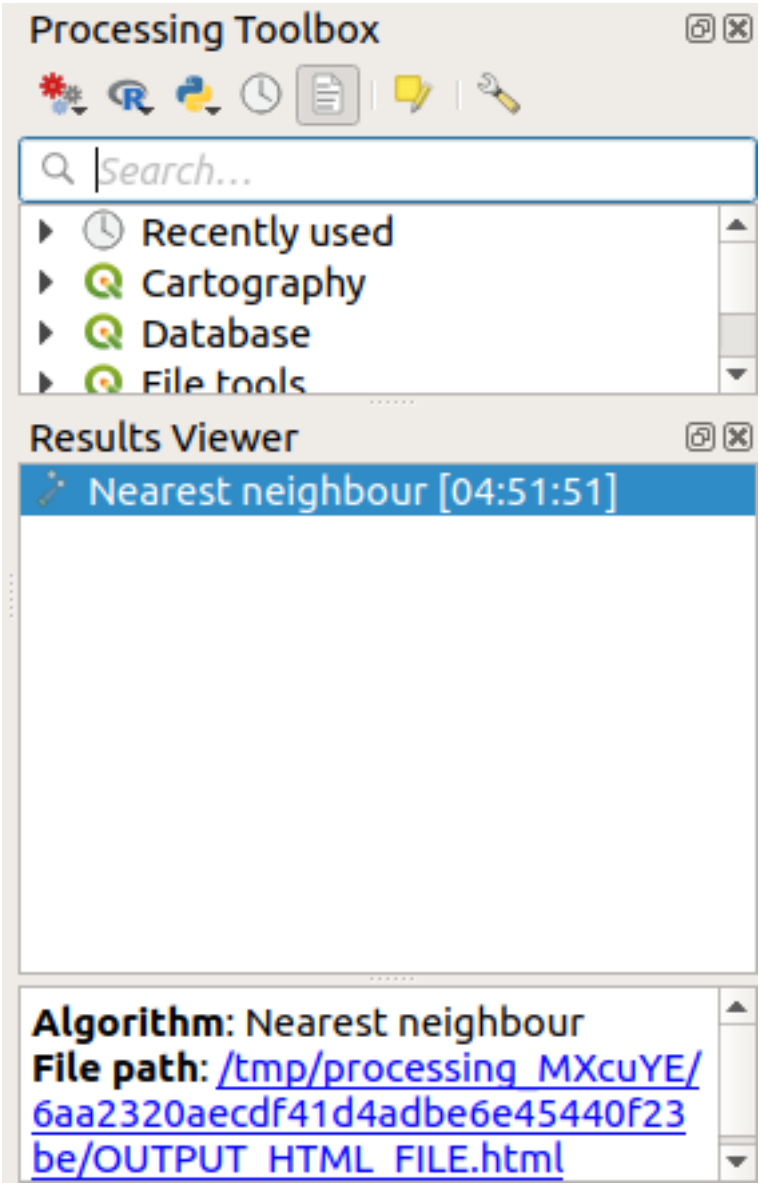
With these parameters, the *Distance Matrix* tool calculates distance statistics for each point of the input layer with respect to their two nearest points in the target layer. The fields of the output layer contain the mean, standard deviation, minimum and maximum for the calculated distances.

For further testing, you may want to modify the *Output matrix type* option or the number of target points.

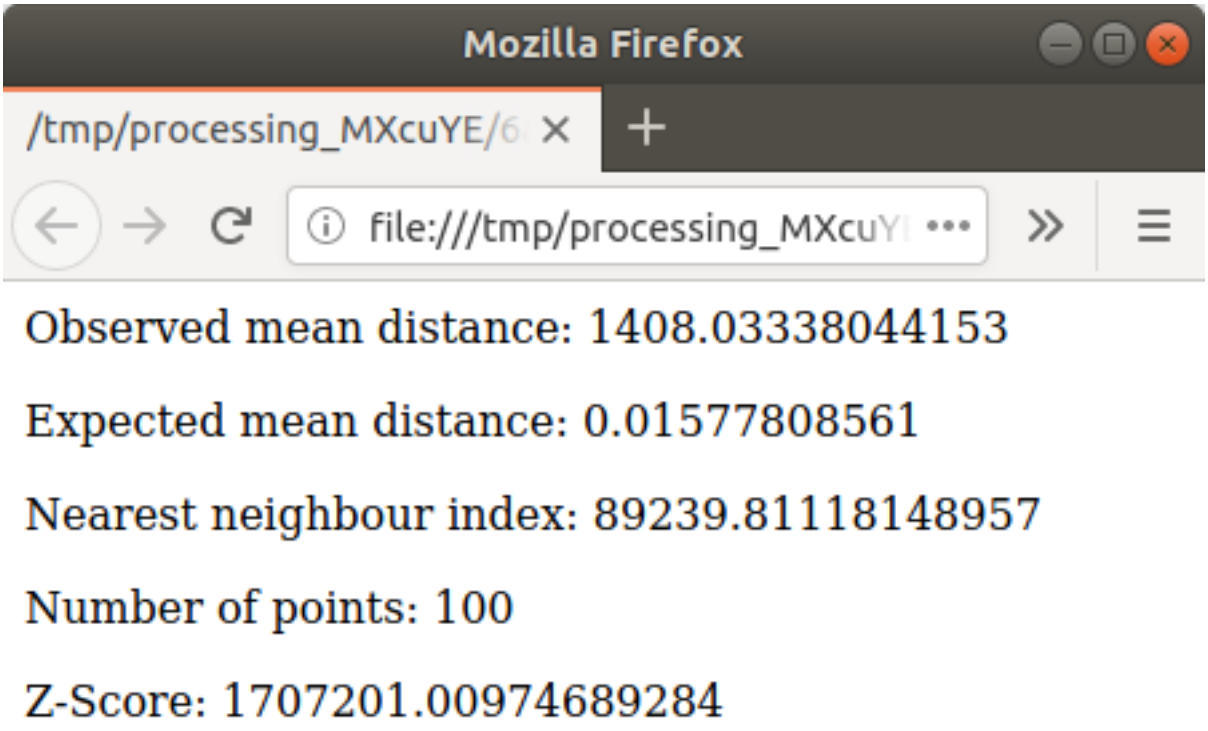
6.4.4 ??? Follow Along: Nearest Neighbor Analysis (within layer)

To do a nearest neighbor analysis of a point layer:

1. Choose *Vector analysis* ► *Nearest neighbor analysis*.
2. In the dialog that appears, select the `Random points` layer and click *Run*.
3. The results will appear in the Processing *Result Viewer* Panel.



4. Click on the blue link to open the `html` page with the results:



6.4.5 ??? Follow Along: Mean Coordinates

Pentru a obține coordonatele medii ale unui set de date:

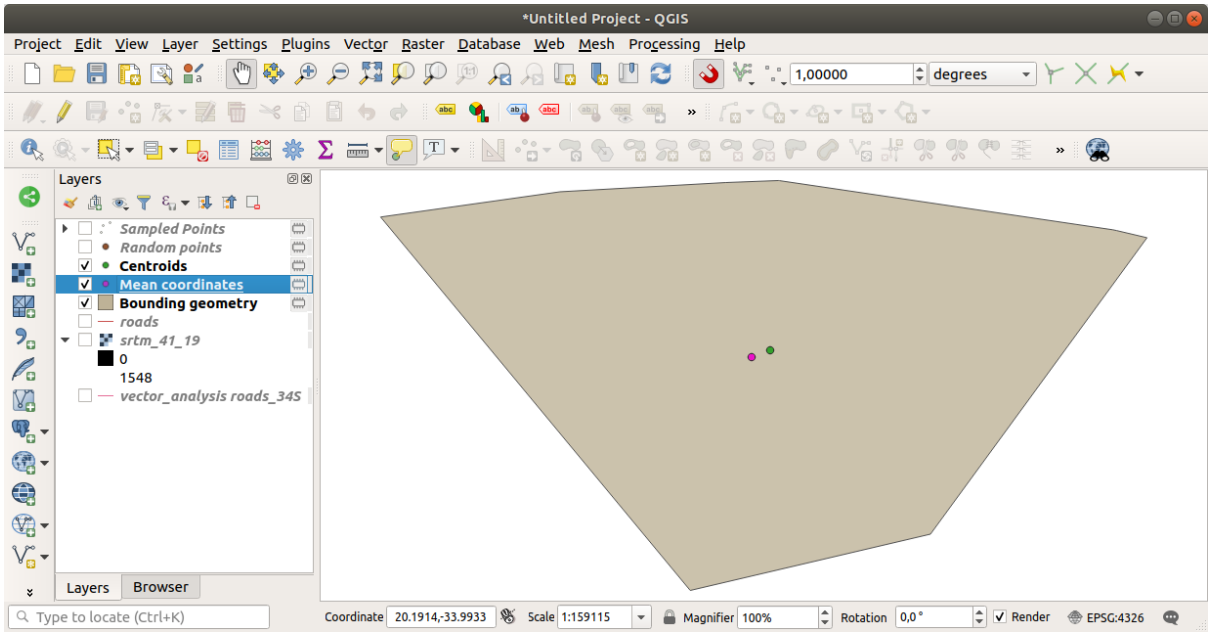
1. Start *Vector analysis* ► *Mean coordinate(s)*
2. In the dialog that appears, specify `Random points` as *Input layer*, and leave the optional choices unchanged.
3. Clic pe *Run*

Let us compare this to the central coordinate of the polygon that was used to create the random sample.

1. Start *Vector geometry* ► *Centroids*
2. In the dialog that appears, select `Bounding geometry` as the input layer.

As you can see, the mean coordinates (pink point) and the center of the study area (in green) don't necessarily coincide.

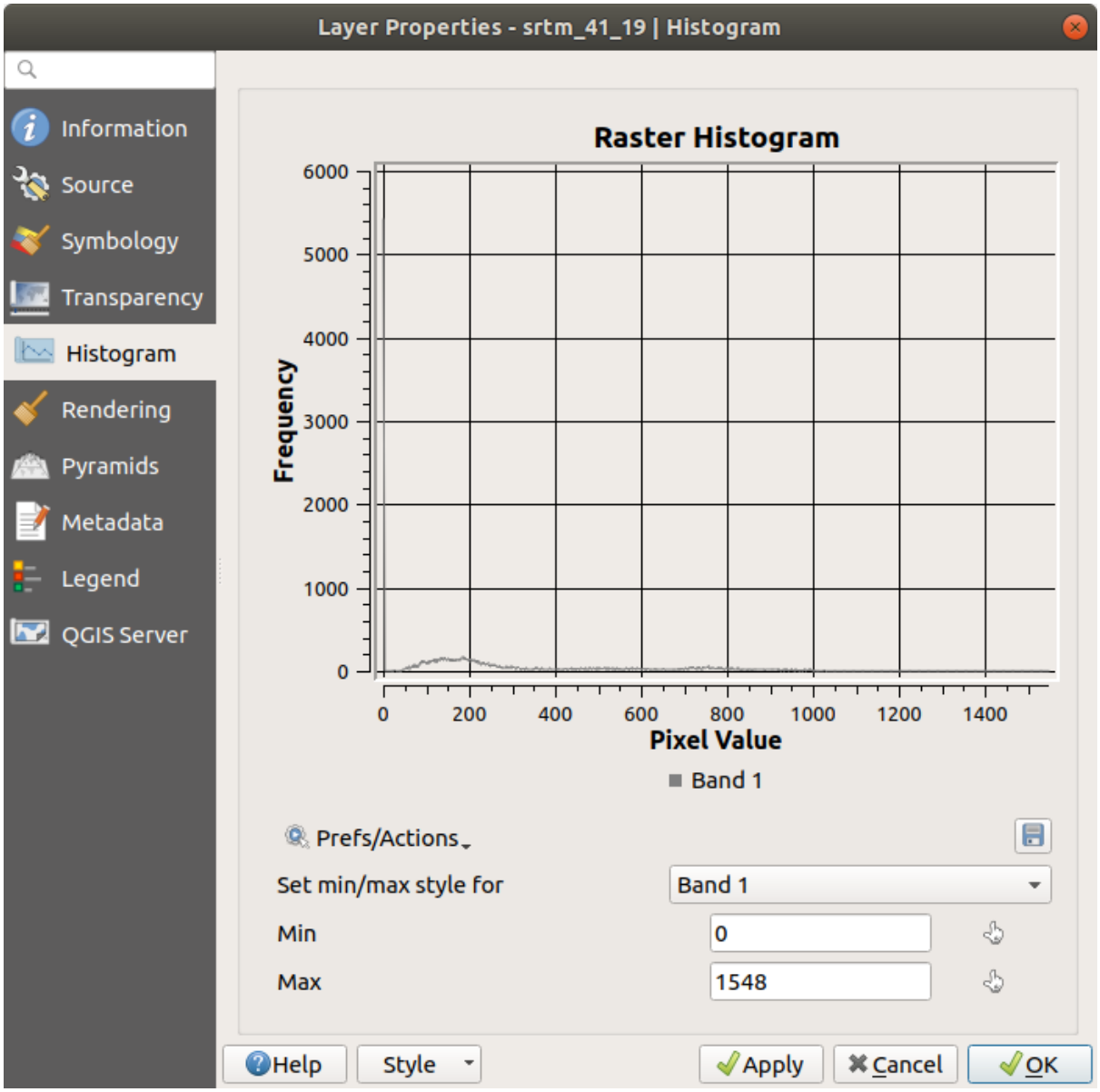
The centroid is the barycenter of the layer (the barycenter of a square is the center of the square) while the mean coordinates represent the average of all node coordinates.



6.4.6 ??? Follow Along: Image Histograms

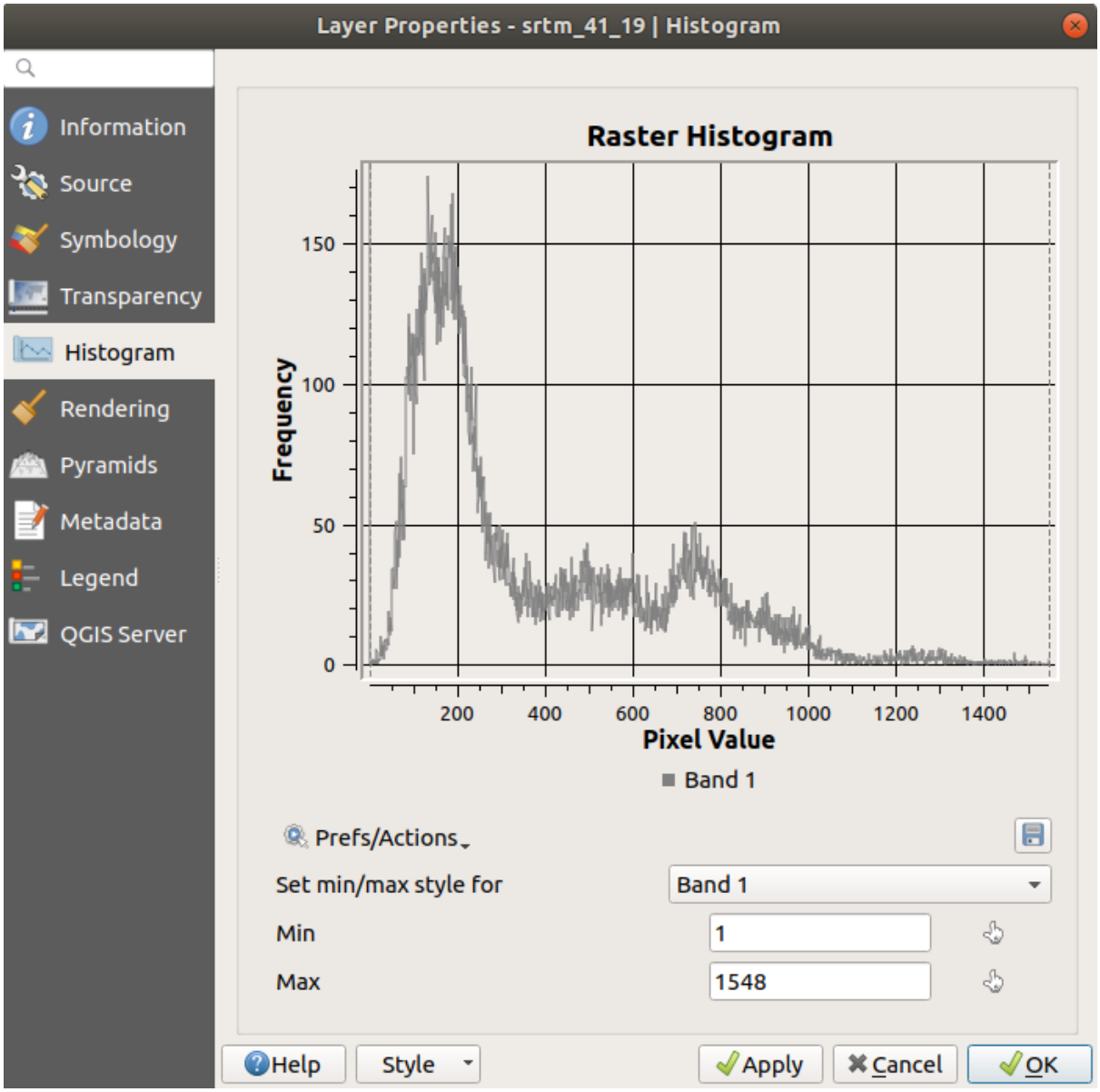
The histogram of a dataset shows the distribution of its values. The simplest way to demonstrate this in QGIS is via the image histogram, available in the *Layer Properties* dialog of any image layer (raster dataset).

1. In your *Layers* panel, right-click on the `srtm_41_19` layer
2. Select *Properties*
3. Choose the *Histogram* tab. You may need to click on the *Compute Histogram* button to generate the graphic. You will see a graph that shows the frequency distribution for the raster values.



4. The graph can be exported as an image with the Save plot button
5. You can see more detailed information about the layer in the *Information* tab (the mean and max values are estimated, and may not be exact).

The mean value is `332.8` (estimated to 324.3), and the maximum value is `1699` (estimated to 1548)! You can zoom in the histogram. Since there are a lot of pixels with value `0`, the histogram looks compressed vertically. By zooming in to cover everything but the peak at `0`, you will see more details:



Notă

If the mean and maximum values are not the same as above, it can be due to the min/max value calculation. Open the *Symbology* tab and expand the *Min / Max Value Settings* menu. Choose ◉ *Min / max* and click on *Apply*.

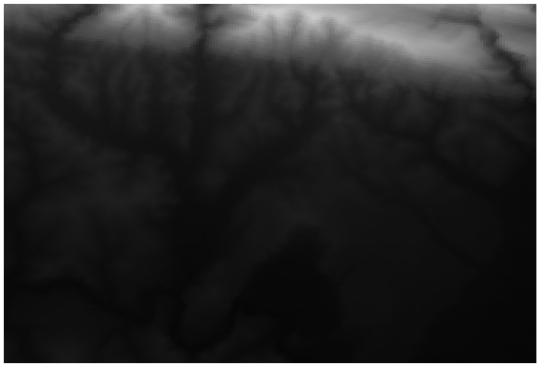
Keep in mind that a histogram shows you the distribution of values, and not all values are necessarily visible on the graph.

6.4.7 ??? Follow Along: Spatial Interpolation

Let's say you have a collection of sample points from which you would like to extrapolate data. For example, you might have access to the `Sampled points` dataset we created earlier, and would like to have some idea of what the terrain looks like.

1. To start, launch the *GDAL* ► *Raster analysis* ► *Grid (IDW with nearest neighbor searching)* tool in the *Processing Toolbox*.
2. For *Point layer* select `Sampled points`
3. Set *Weighting power* to `5.0`
4. In *Advanced parameters*, set *Z value from field* to `rvalue_1`
5. Finally click on *Run* and wait until the processing ends
6. Close the dialog

Here is a comparison of the original dataset (left) to the one constructed from our sample points (right). Yours may look different due to the random nature of the location of the sample points.





As you can see, 100 sample points aren't really enough to get a detailed impression of the terrain. It gives a very general idea, but it can be misleading as well.

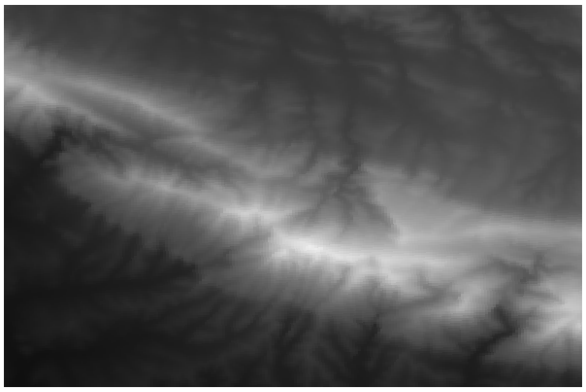
6.4.8 ??? Try Yourself: Different interpolation methods

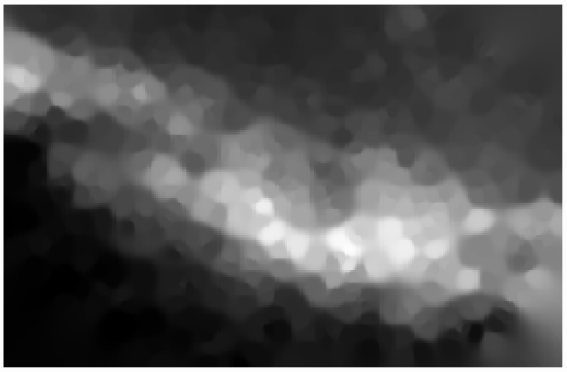
1. Use the processes shown above to create a set of 10 000 random points

   > **Notă**
   >
   > If the number of points is really big, the processing time can take a long time.

2. Use these points to sample the original DEM
3. Use the *Grid (IDW with nearest neighbor searching)* tool on this dataset.
4. Set *Power* and *Smoothing* to `5.0` and `2.0`, respectively.

Rezultatele (în funcție de poziționarea punctelor aleatorii) va arata mai mult, sau mai puțin, ca aceasta:





This is a better representation of the terrain, due to the greater density of sample points. Remember, larger samples give better results.

6.4.9 În concluzie

QGIS has a number of tools for analyzing the spatial statistical properties of datasets.

6.4.10 Ce urmează?

Now that we have covered vector analysis, why not see what can be done with rasters? That is what we will do in the next module!

CAPITOLUL 7

Modulul: Rastere

Am folosit rastere pentru digitizarea anterioară, dar datele raster pot fi folosite, de asemenea, și în mod direct. În acest modul, veți vedea cum se face acest lucru în QGIS.

7.1 Lesson: Working with Raster Data

Raster data is quite different from vector data. Vector data has discrete features with geometries constructed out of vertices, and perhaps connected with lines and/or areas. Raster data, however, is like any image. Although it may portray various properties of objects in the real world, these objects don't exist as separate objects. Rather, they are represented using pixels with different values.

During this module you are going to use raster data to supplement your existing GIS analysis.

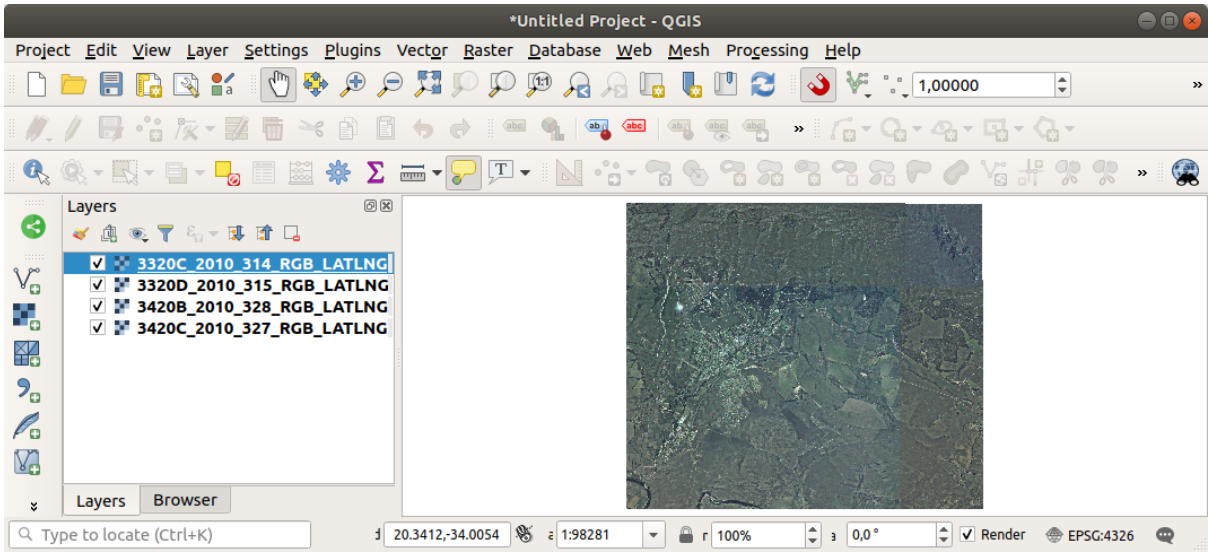
The goal for this lesson: To learn how to work with raster data in QGIS.

7.1.1 ??? Follow Along: Loading Raster Data

Raster data can be loaded with the same methods we used for vector data. However we suggest to use the *Browser* Panel.

1. Open the *Browser* Panel and expand the `exercise_data/raster` folder.
2. Load all the data in this folder:
    - `3320C_2010_314_RGB_LATLNG.tif`
    - `3320D_2010_315_RGB_LATLNG.tif`
    - `3420B_2010_328_RGB_LATLNG.tif`
    - `3420C_2010_327_RGB_LATLNG.tif`

You should see the following map:



There we have it - four aerial images covering our study area.

7.1.2 ??? Follow Along: Create a Virtual Raster

Now as you can see from this, your solution layer lies across all four images. What this means is that you are going to have to work with four rasters all the time. That's not ideal. It would be better to have one file to work with.

Luckily, QGIS allows you to do exactly this, and without needing to actually create a new raster file. You can create a **Virtual Raster**. This is also often called a *Catalog*, which explains its function. It's not really a new raster. Rather, it is a way to organize your existing rasters into one catalog: one file for easy access.

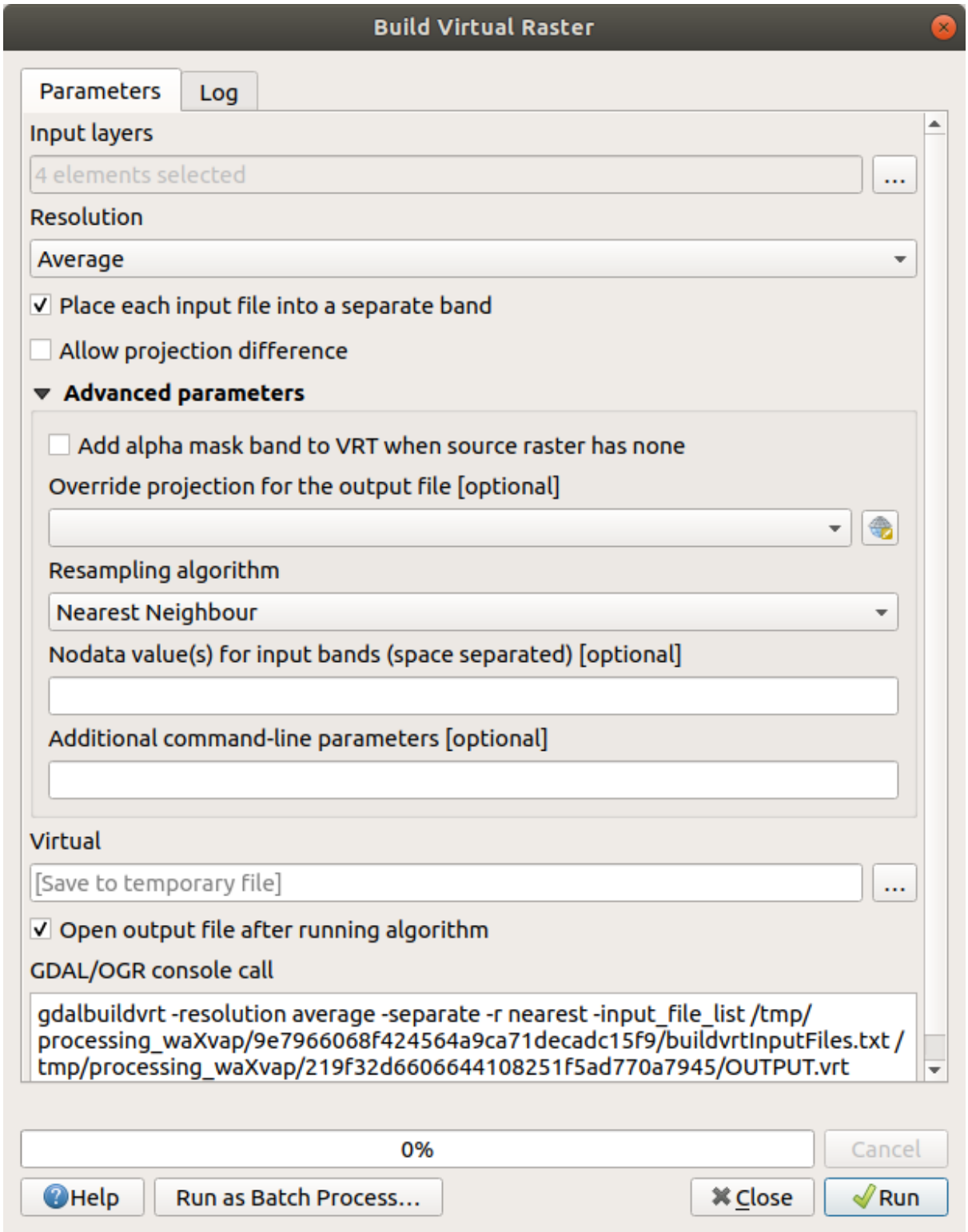
To make a catalog we will use the *Processing* ► *Toolbox*.

1. Open the *Build virtual raster* algorithm from the *GDAL* ► *Raster miscellaneous*;
2. In the dialog that appears, click on the … button next to the *Input layers* parameter and check all the layers or use the *Select All* button;
3. Uncheck *Place each input file into a separate band*. Notice the code that is generated at the bottom of the dialog under *GDAL/OGR console call*. This is the command that will be executed when you click *Run*. The text updates as you change different options in the dialog.

> **Notă**
>
> Keep in mind that you can copy and paste the text in the `OSGeo Shell` (Windows user) or `Terminal` (Linux and OSX users) to run the command. You can also create a script for each GDAL command. This is very handy when the procedure is taking a long time or when you want to schedule specific tasks. Use the *Help* button to get more help on the syntax of the command.

4. Finally click on *Run*.

> **Notă**
>
> As you know from the previous modules, *Processing* creates temporary layers by default. To save the file, click on the … button under *Virtual*.



You can now remove the original four rasters from the *Layers* Panel and leave only the output virtual catalog raster.

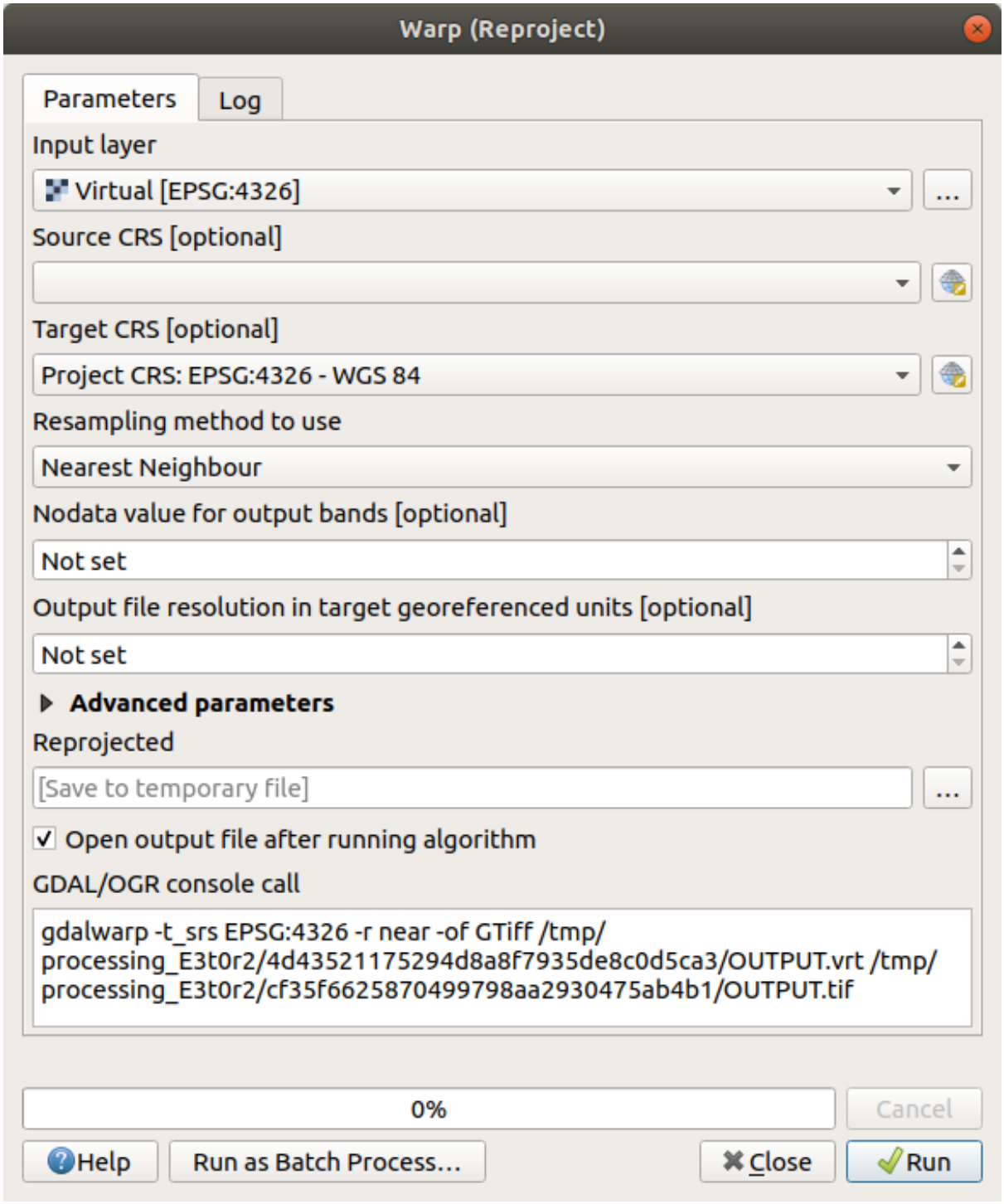
7.1.3 ??? Transforming Raster Data

The above methods allow you to virtually merge datasets using a catalog, and to reproject them „on the fly”. However, if you are setting up data that you'll be using for quite a while, it may be more efficient to create new rasters that are already merged and reprojected. This improves performance while using the rasters in a map, but it may take some time to set up initially.

Reproiectare rasterelor

Open *Warp (reproject)* from *GDAL* ► *Raster projections*.

You can also reproject virtual rasters (catalogs), enable multithreaded processing, and more.



Îmbinarea rastererelor

If you need to create a new raster layer and save it to disk you can use the merge algorithm.

Notă

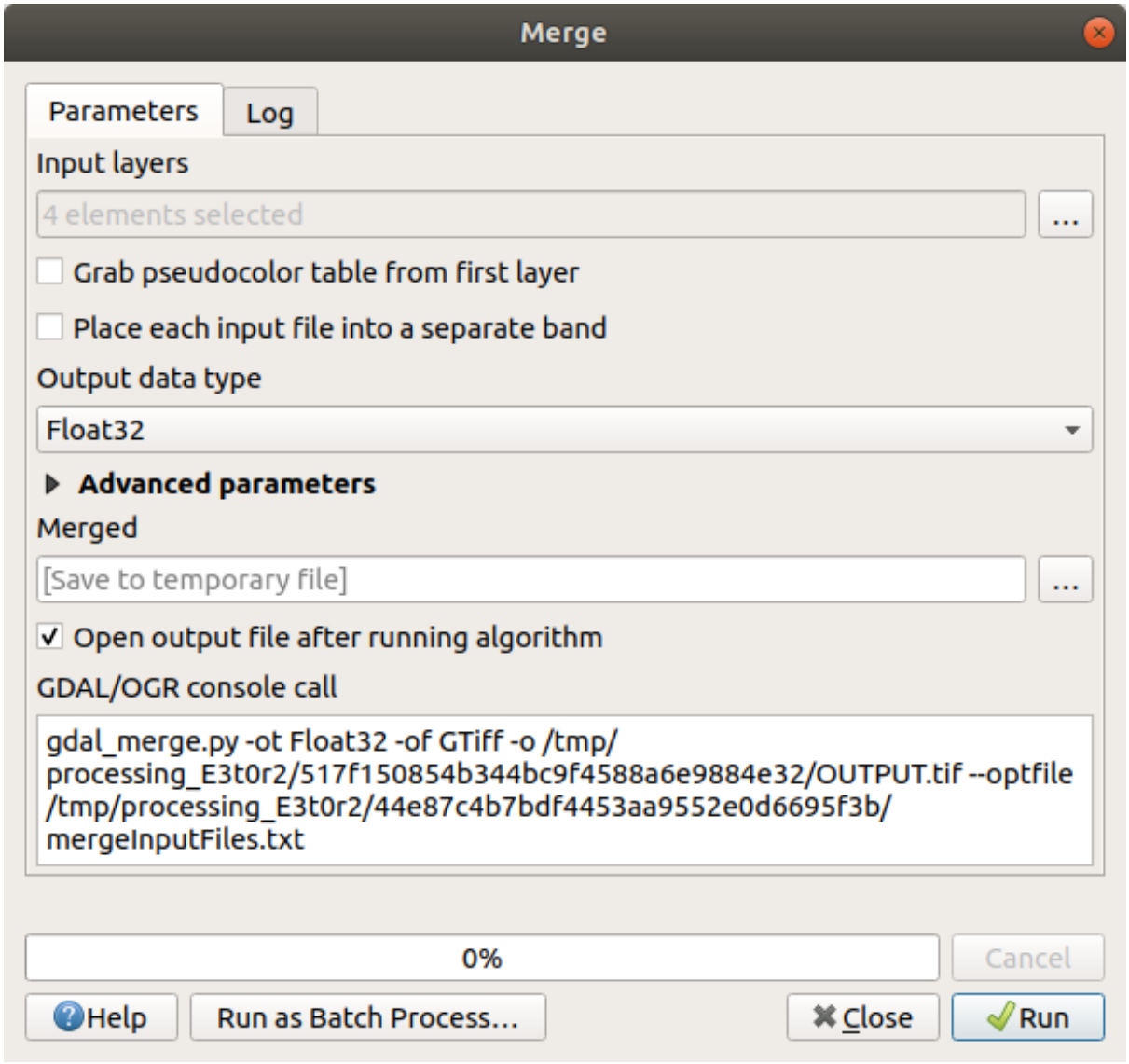
Depending on how many raster files you are merging and their resolution, the new raster file created can be really big. Consider instead to create a raster catalog as described in the *Create a Virtual Raster* section.

1. Click on the *Merge* algorithm from the *GDAL* ► *Raster miscellaneous* menu.

2. As we did for the *Create a Virtual raster*, use the … button to choose which layers you want to merge.

   You can also specify a Virtual raster as input, and then all of the rasters that it consists of will be processed.

3. If you know the GDAL library, you can also add your own options by opening the *Advanced parameters* menu.



7.1.4 În concluzie

QGIS face mai ușoară includerea datelor raster în proiectele existente.

7.1.5 Ce urmează?

Next, we'll use raster data that isn't aerial imagery, and see how symbolization is useful in the case of rasters as well.

7.2 Lesson: Changing Raster Symbology

Not all raster data are aerial photos. There are many other forms of raster data, and in many of those cases, it is essential to symbolize the them so that they becomes properly visible and useful.

Scopul acestei lecții: De a schimba simbolistica pentru un strat raster.

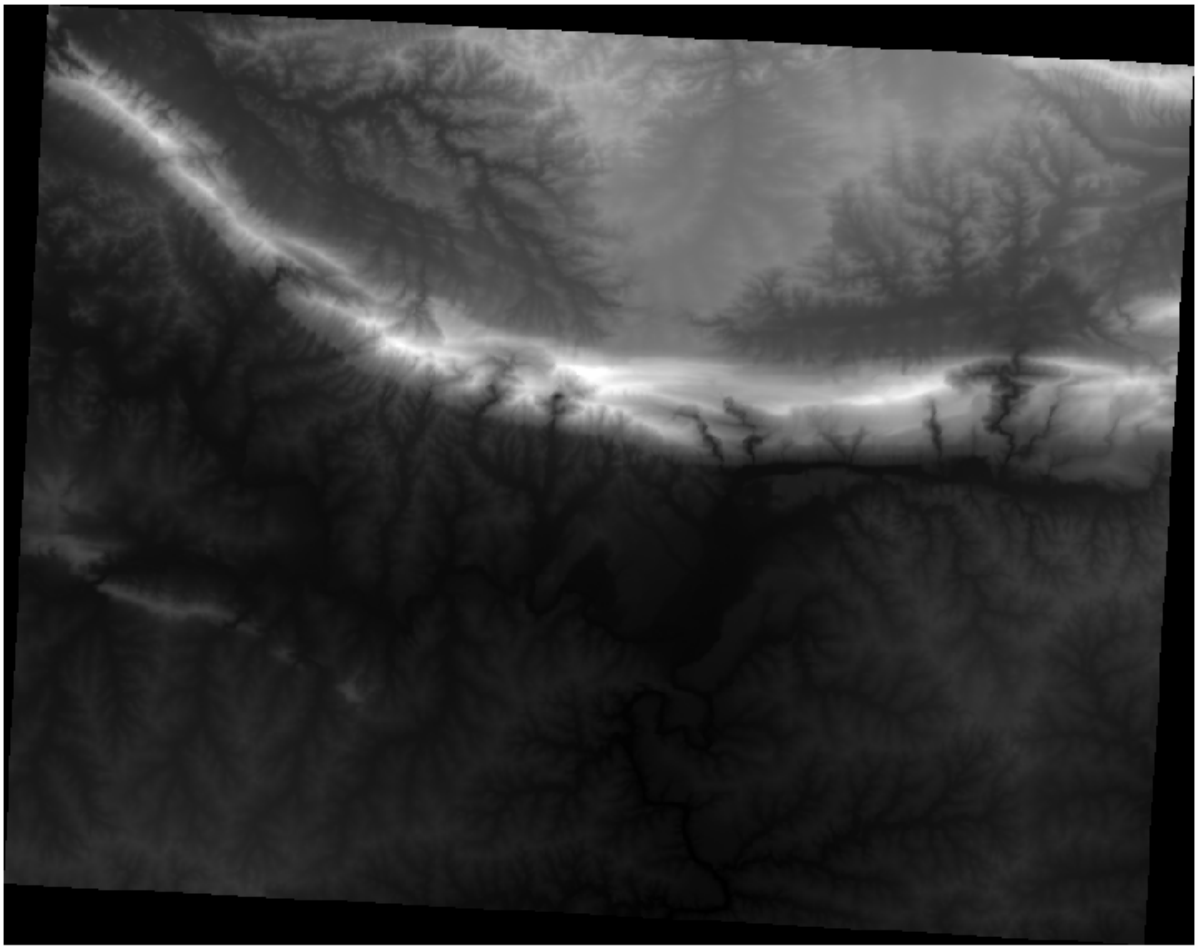
7.2.1 ??? Încercați și dvs.:

1. Use the *Browser* Panel to load `srtm_41_19.tif`, found under `exercise_data/raster/SRTM/`
2. Zoom to the extent of this layer by right-clicking on it in the *Layers panel* and selecting *Zoom to Layer*.

This dataset is a *Digital Elevation Model (DEM)*. It is a map of the elevation (altitude) of the terrain, allowing us to see where the mountains and valleys are, for example.

While each pixel of the dataset of the previous section contained color information, in a *DEM*, each pixel contains elevation values.

Once the DEM is loaded, you will notice that it is a grayscale representation:



QGIS has automatically applied a stretch to the pixel values of the image for visualization purposes, and we will learn more about how this works as we continue.

7.2.2 ??? Follow Along: Changing Raster Layer Symbology

You have two different options to change the raster symbology:

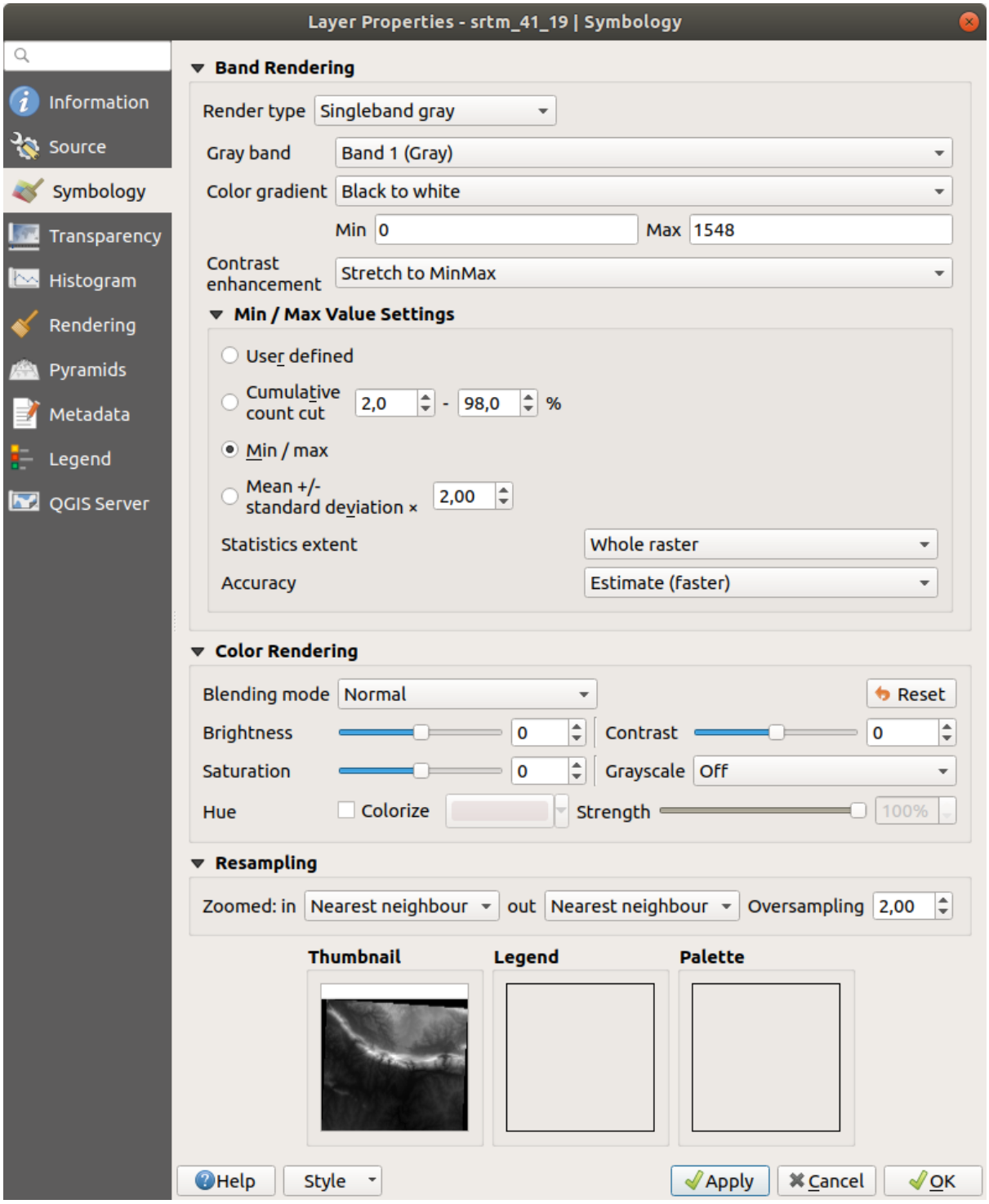
1. Within the *Layer Properties* dialog, by right-clicking on the layer in the Layer tree and selecting the *Properties* option. Then switch to the *Symbology* tab
2. By clicking on the  Open the Layer Styling panel button right above the *Layers* panel (shortcut `F7`). This will open the *Layer Styling* panel, where you can switch to the  Symbology tab.

Choose the method you prefer to work with.

7.2.3 ??? Follow Along: Singleband gray

When you load a raster file, if it is not a photo image like the ones of the previous section, the default style is set to a grayscale gradient.

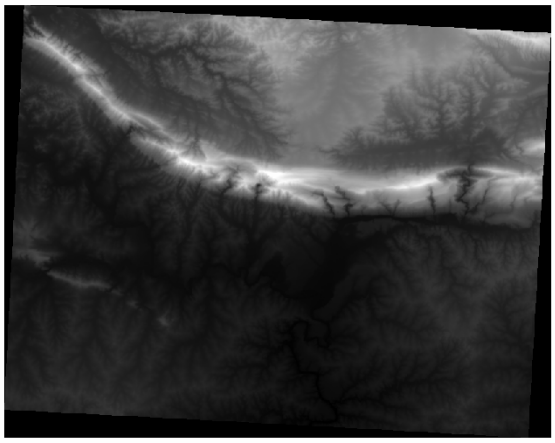
Let's explore some of the features of this renderer.



The default *Color gradient* is set to `Black to white`, meaning that low pixel values are black and while high values are white. Try to invert this setting to `White to black` and see the results.

Very important is the *Contrast enhancement* parameter: by default it is set to `Stretch to MinMax` meaning that the pixel values are stretched to the minimum and maximum values.

Look at the difference with the enhancement (left) and without (right):





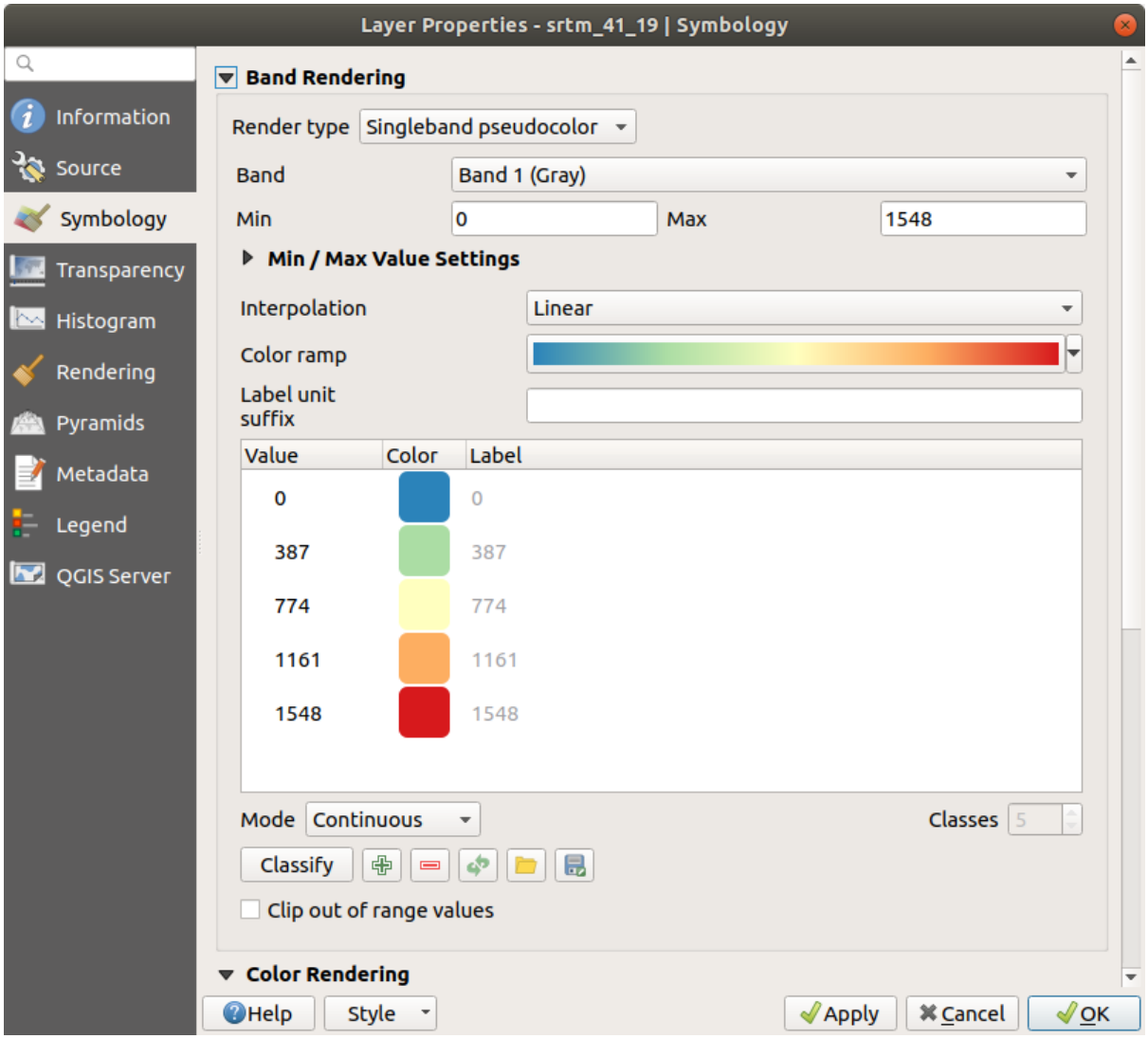
But what are the minimum and maximum values that should be used for the stretch? The ones that are currently under *Min / Max Value Settings*. There are many ways to calculate the minimum and maximum values and use them for the stretch:

1. **User Defined**: you enter the *Min* and *Max* values manually
2. **Cumulative count cut**: this is useful when you have some extreme low or high values. It *cuts* the `2%` (or the value you choose) of these values
3. **Min / max**: the *Real* or *Estimated* minimum and maximum values of the raster
4. **Mean +/- standard deviation**: the values will be calculated according to the mean value and the standard deviation

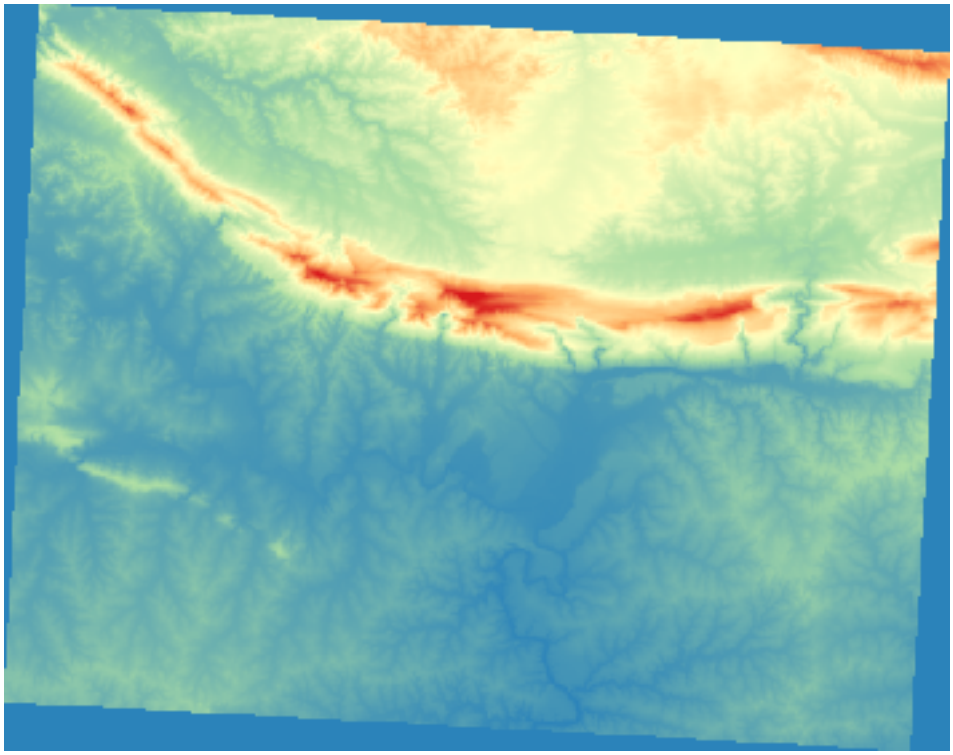
7.2.4 ??? Follow Along: Singleband pseudocolor

Grayscales are not always great styles for raster layers. Let's try to make the DEM more colorful.

- Change the *Render type* to *Singleband pseudocolor*. If you don't like the default colors loaded, select another *Color ramp*
- Click the *Classify* button to generate a new color classification
- If it is not generated automatically click on the *OK* button to apply this classification to the DEM



Veți vedea un raster care arată în felul următor:

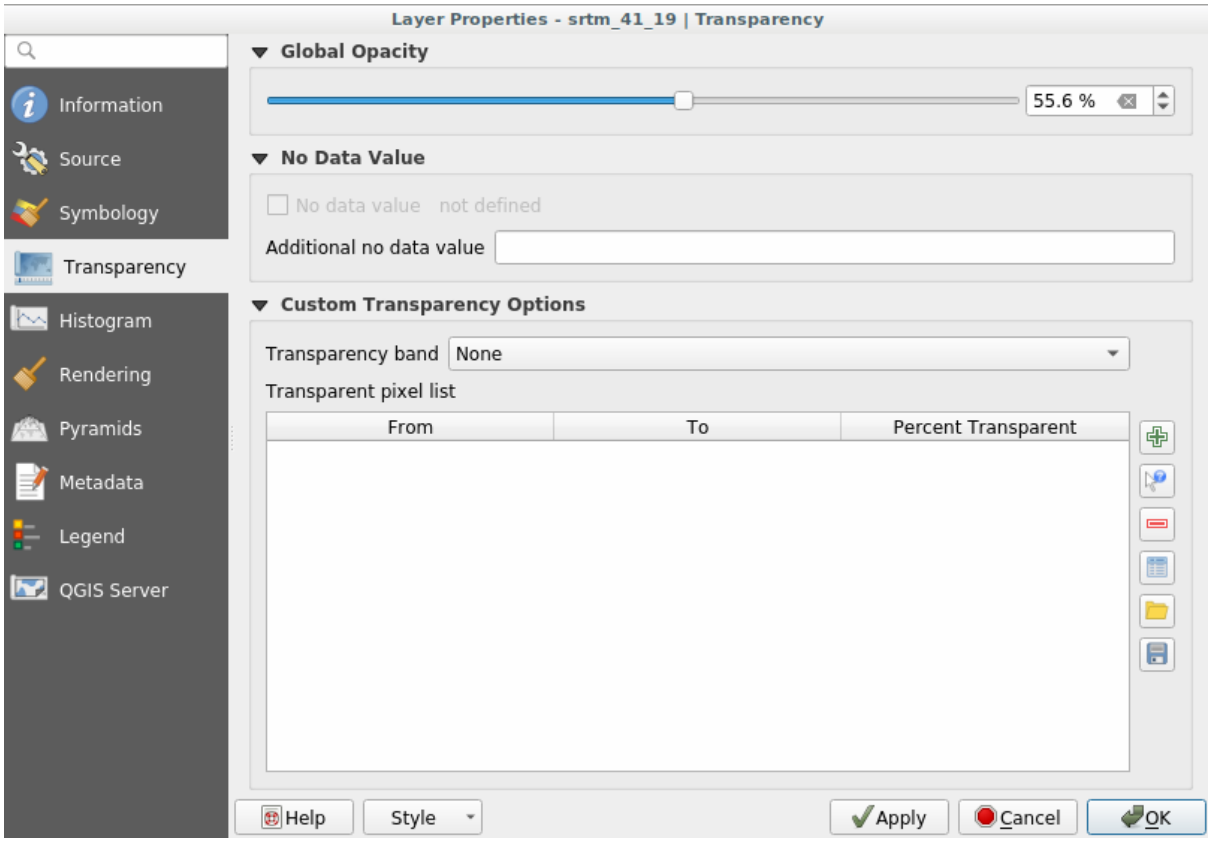


This is an interesting way of looking at the DEM. You will now see that the values of the raster are again properly displayed, going from blue for the lower areas to red for the higher ones.

7.2.5 Follow Along: Changing the transparency

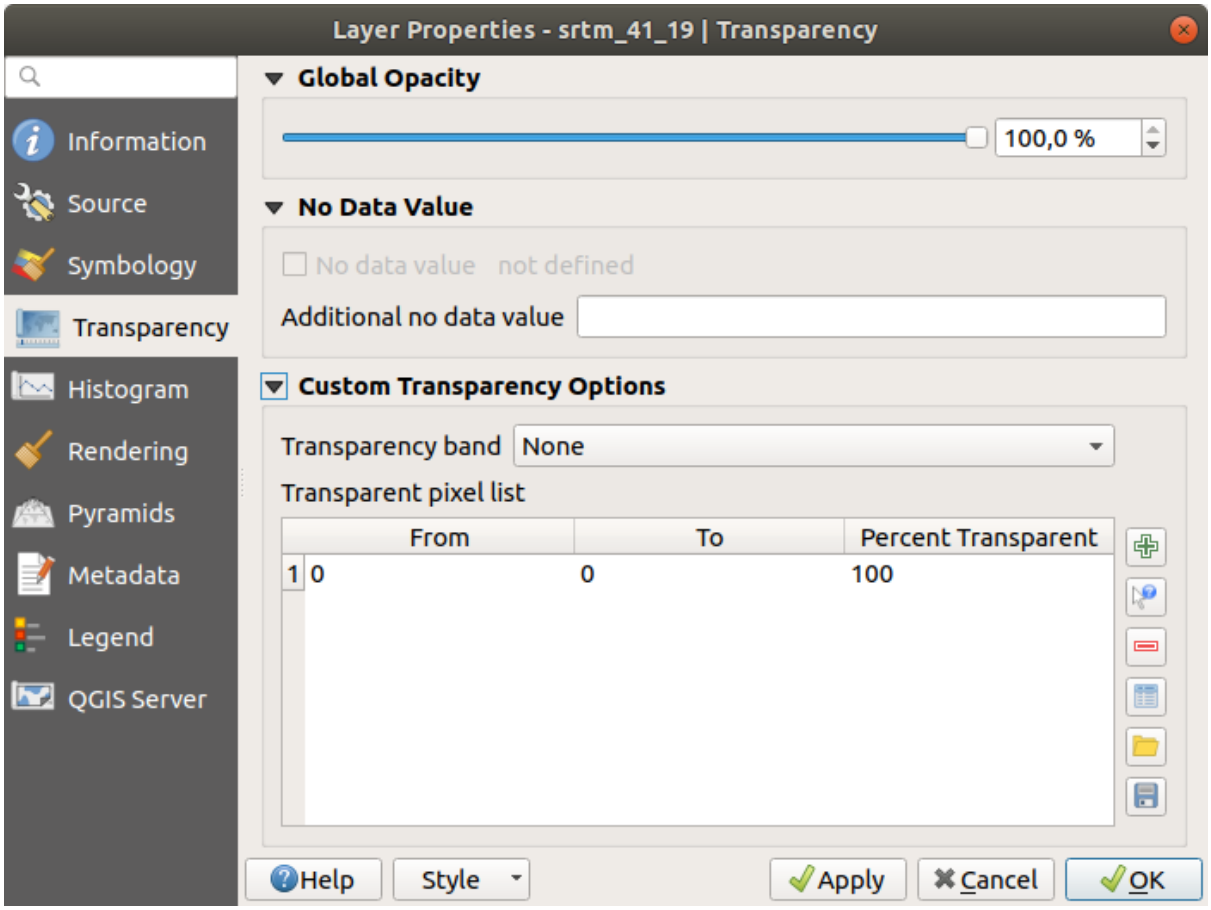
Sometimes changing the transparency of the whole raster layer can help you to see other layers covered by the raster itself and better understand the study area.

To change the transparency of the whole raster switch to the *Transparency* tab and use the slider of the *Global Opacity* to lower the opacity:

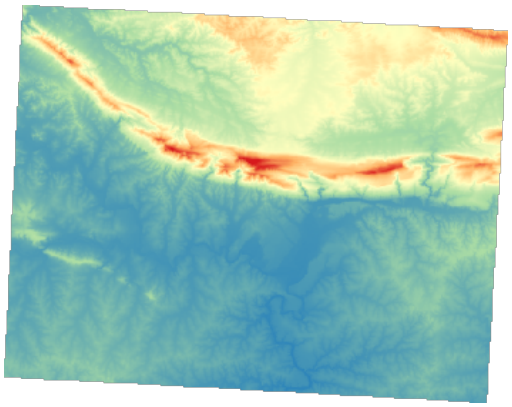


More interesting is changing the transparency for some pixel values. For example in the raster we used you can see a homogeneous color at the corners. To set these pixels as transparent, go to *Custom Transparency Options* in the *Transparency* tab.

- By clicking on the Add values manually button, you can add a range of values and set their transparency percentage
- For single values the Add values from display button is more useful
- Click on the Add values from display button. The dialog disappears, and you can interact with the map.
- Click on the homogeneous color in a corner of the DEM
- You will see that the transparency table will be filled with the clicked values:



- Click on *OK* to close the dialog and see the changes.



See? The corners are now 100% transparent.

7.2.6 În concluzie

These are some the basic functions to get you started with raster symbology. QGIS also gives you many other options, such as symbolizing a layer using paletted/unique values, representing different bands with different colors in a multispectral image, or making an automatic hillshade effect (useful only with DEM raster files).

7.2.7 Referință

The SRTM dataset was obtained from CGIAR CSI website.

7.2.8 Ce urmează?

Acum, că putem vedea datele noastre afișate corect, să investigăm modul în care putem analiza mai departe.

7.3 Lesson: Terrain Analysis

Anumite tipuri de rastere vă permit să câștigați o perspectivă mai largă asupra terenului pe care îl reprezintă. Modelele Digitale ale Elevației (DEMS) sunt deosebit de utile în această privință. În această lecție veți folosi anumite instrumente pentru analiza terenului, pentru a afla mai multe despre zona de studiu, în scopul dezvoltării rezidențiale propuse de mai devreme.

Scopul acestei lecții: De a utiliza instrumentele de analiză a terenului pentru a extrage mai multe informații despre teren.

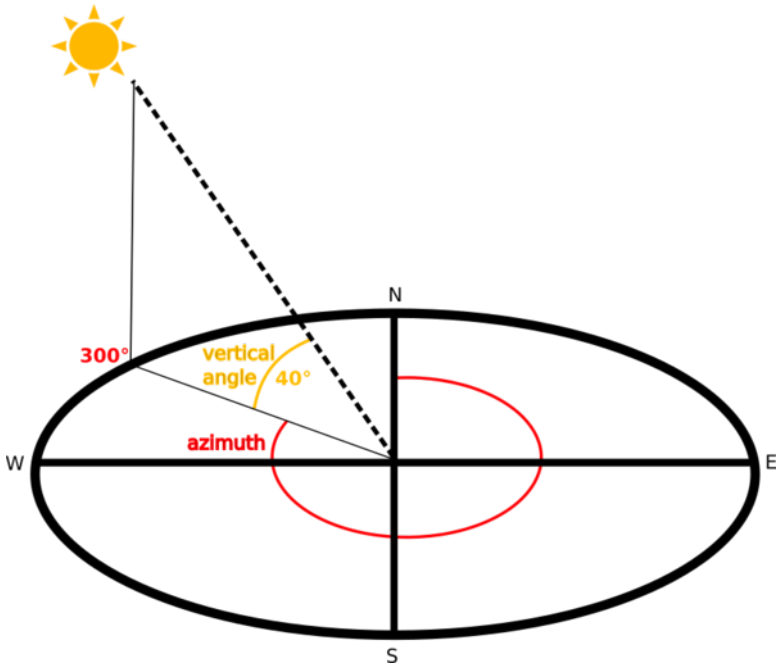
7.3.1 ??? Follow Along: Calculating a Hillshade

We are going to use the same DEM layer as in the previous lesson. If you are starting this chapter from scratch, use the *Browser* panel and load the `raster/SRTM/srtm_41_19.tif`.

The DEM layer shows you the elevation of the terrain, but it can sometimes seem a little abstract. It contains all the 3D information about the terrain that you need, but it doesn't look like a 3D object. To get a better impression of the terrain, it is possible to calculate a *hillshade*, which is a raster that maps the terrain using light and shadow to create a 3D-looking image.

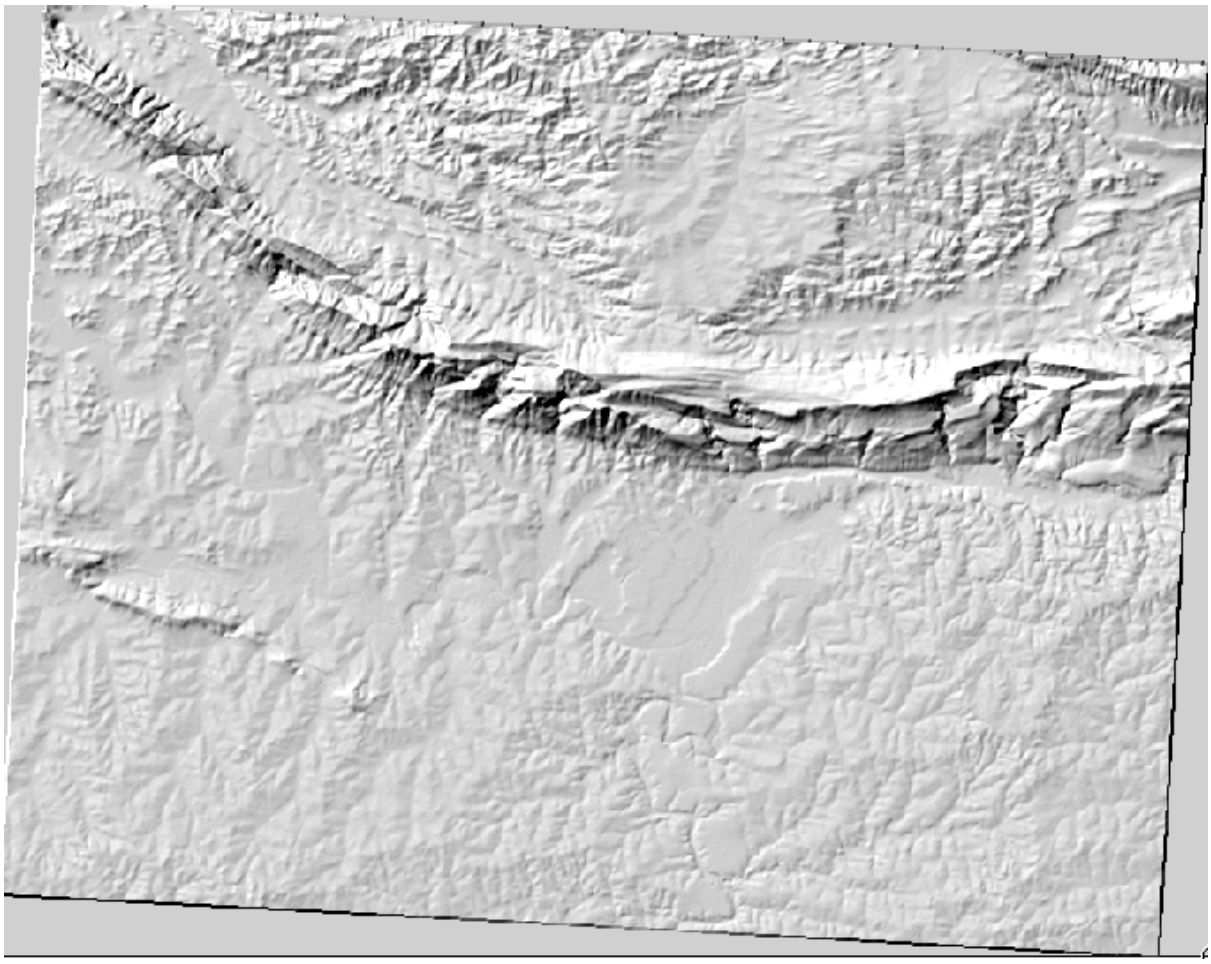
We are going to use algorithms in the *Raster* ► *Raster terrain analysis* menu.

1. Click on the *Hillshade* menu
2. The algorithm allows you to specify the position of the light source: *Azimuth* has values from 0 (North) through 90 (East), 180 (South) and 270 (West), while the *Vertical angle* sets how high the light source is (0 to 90 degrees).
3. We will use the following values:
   - *Z factor* at `1.0`
   - *Azimuth (horizontal angle)* at `300.0°`
   - *Vertical angle* at `40.0°`



4. Save the file in a new folder `exercise_data/raster_analysis/` with the name `hillshade.tif`
5. Finally click on *Run*

You will now have a new layer called `hillshade` that looks like this:



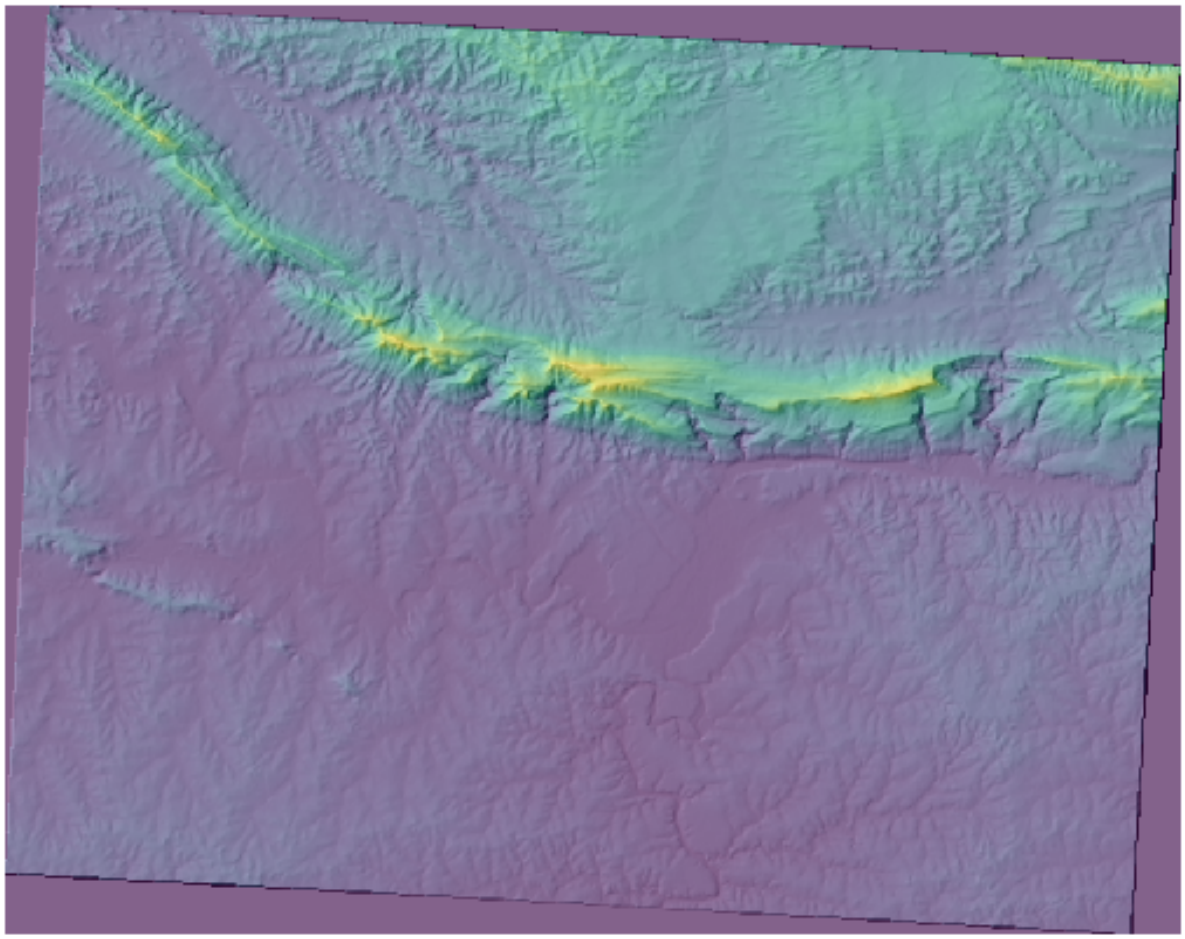
That looks nice and 3D, but can we improve on this? On its own, the hillshade looks like a plaster cast. Can't we use it together with our other, more colorful rasters somehow? Of course we can, by using the hillshade as an overlay.

7.3.2 ??? Follow Along: Using a Hillshade as an Overlay

Umbra versanților poate furniza informații foarte utile despre lumina solară, la un moment dat al zilei. Ea poate fi, de asemenea, utilizată în scopuri estetice, pentru a face harta să arate mai bine. Cheia pentru acest lucru este setarea reliefului de a fi în cea mai mare parte transparent.

1. Change the symbology of the original `srtm_41_19` layer to use the *Pseudocolor* scheme as in the previous exercise
2. Hide all the layers except the `srtm_41_19` and `hillshade` layers
3. Click and drag the `srtm_41_19` to be beneath the `hillshade` layer in the *Layers* panel
4. Set the `hillshade` layer to be transparent by clicking on the *Transparency* tab in the layer properties
5. Set the *Global opacity* to `50%`.

   You'll get a result like this:



6. Switch the `hillshade` layer off and back on in the *Layers* panel to see the difference it makes.

Using a hillshade in this way, it's possible to enhance the topography of the landscape. If the effect doesn't seem strong enough to you, you can change the transparency of the `hillshade` layer; but of course, the brighter the hillshade becomes, the dimmer the colors behind it will be. You will need to find a balance that works for you.

Remember to save the project when you are done.

7.3.3 Follow Along: Finding the best areas

Think back to the estate agent problem, which we last addressed in the *Vector Analysis* lesson. Let us imagine that the buyers now wish to purchase a building and build a smaller cottage on the property. In the Southern Hemisphere, we know that an ideal plot for development needs to have areas on it that:

- are north-facing
- with a slope of less than 5 degrees
- But if the slope is less than 2 degrees, then the aspect doesn't matter.

Let's find the best areas for them.

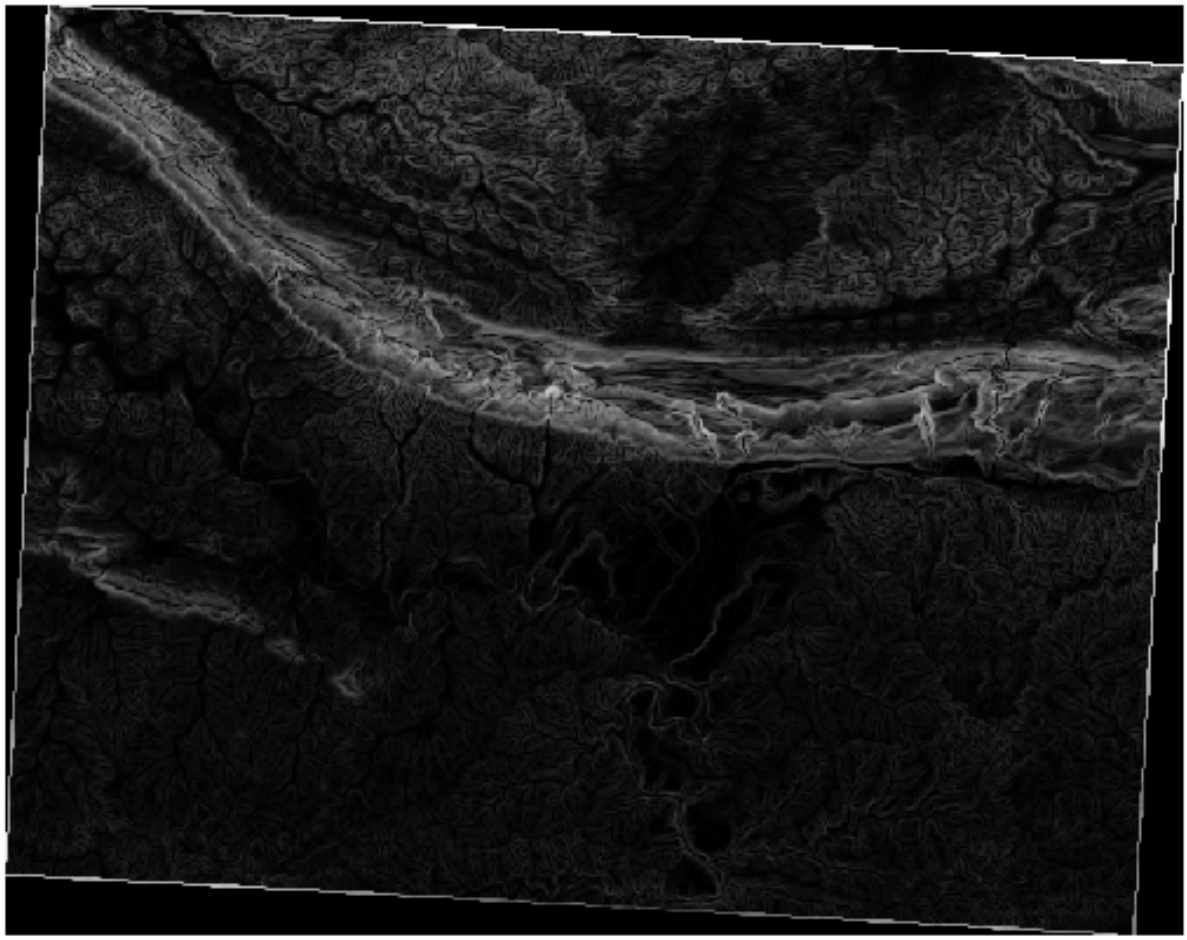
7.3.4 ??? Follow Along: Calculating the Slope

Slope informs about how steep the terrain is. If, for example, you want to build houses on the land there, then you need land that is relatively flat.

To calculate the slope, you need to use the *Slope* algorithm of the *Processing* ► *Raster terrain analysis*.

1. Open the algorithm
2. Choose `srtm_41_19` as the *Elevation layer*
3. Keep the *Z factor* at `1.0`
4. Save the output as a file with the name `slope.tif` in the same folder as the `hillshade.tif`
5. Click on *Run*

Now you'll see the slope of the terrain, each pixel holding the corresponding slope value. Black pixels show flat terrain and white pixels, steep terrain:



7.3.5 ??? Try Yourself: Calculating the aspect

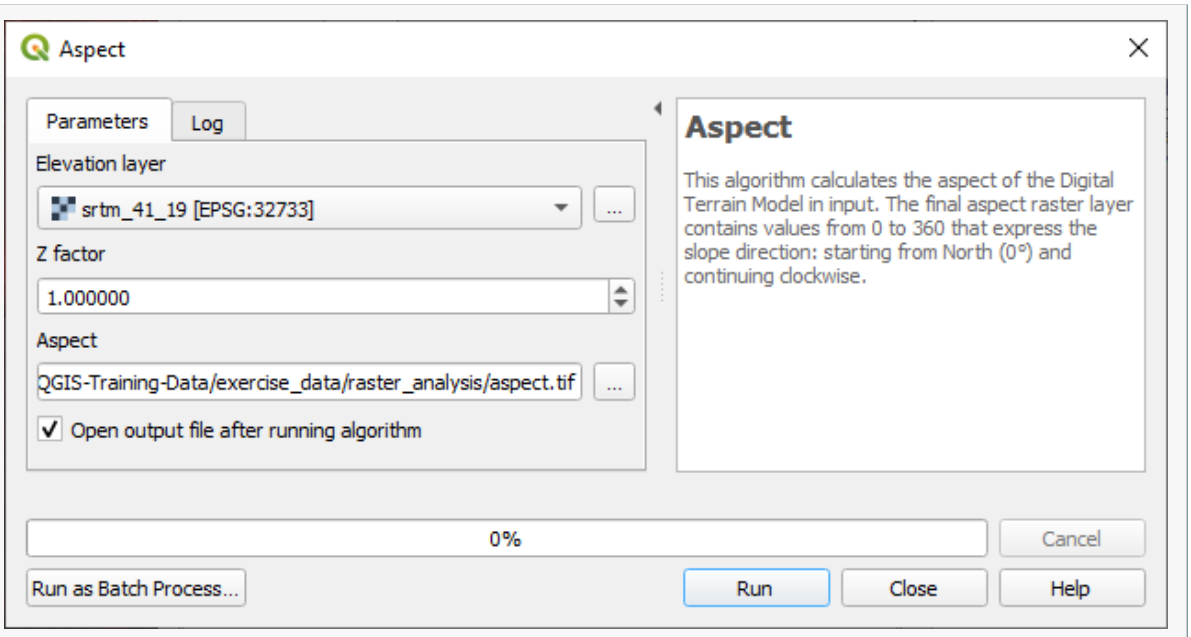
Aspect is the compass direction that the slope of the terrain faces. An aspect of 0 means that the slope is North-facing, 90 East-facing, 180 South-facing, and 270 West-facing.

Since this study is taking place in the Southern Hemisphere, properties should ideally be built on a north-facing slope so that they can remain in the sunlight.

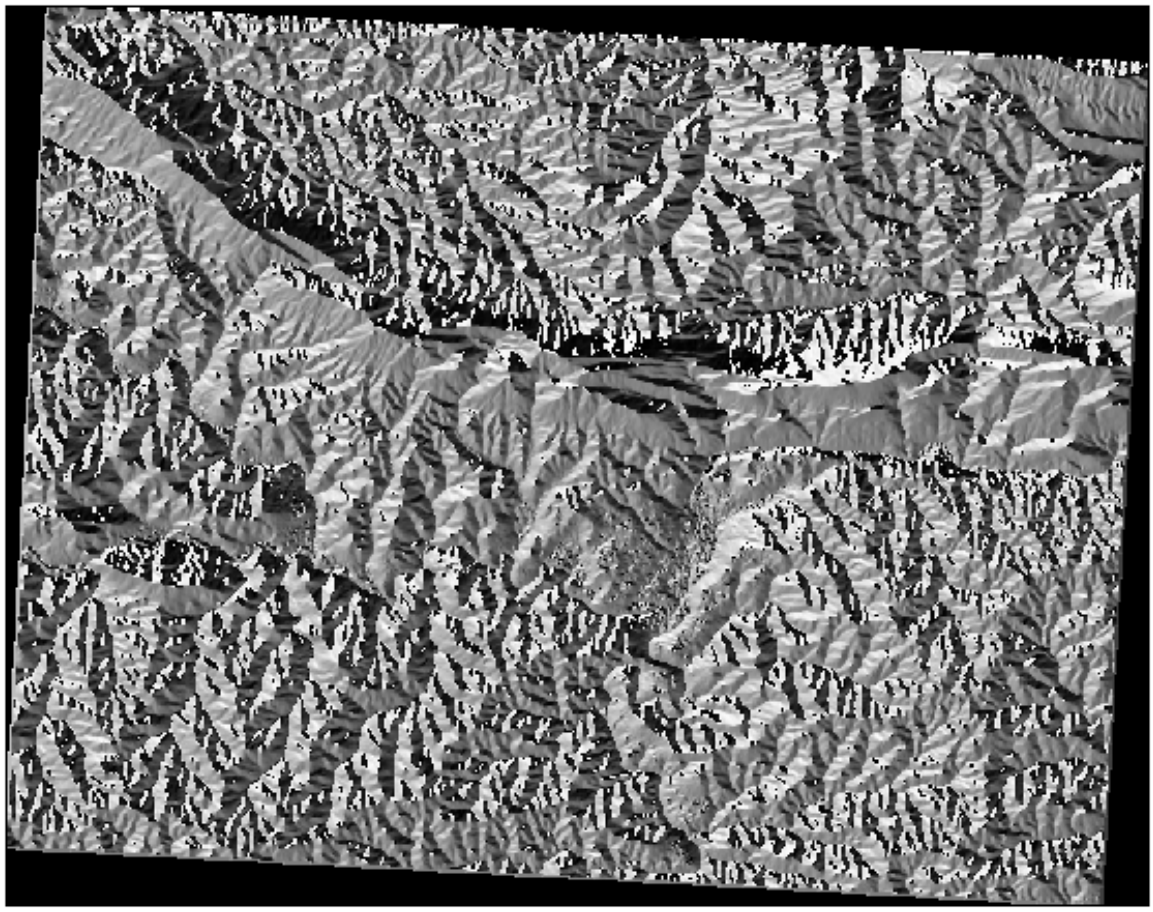
Use the *Aspect* algorithm of the *Processing* ► *Raster terrain analysis* to get the `aspect.tif` layer saved along with the `slope.tif`.

Răspuns

Set your *Aspect* dialog up like this:


Aspect
Parameters
Log
Elevation layer
srtm_41_19 [EPSG:32733]
Z factor
1.000000
Aspect
QGIS-Training-Data/exercise_data/raster_analysis/aspect.tif
Open output file after running algorithm
Aspect
This algorithm calculates the aspect of the Digital Terrain Model in input. The final aspect raster layer contains values from 0 to 360 that express the slope direction: starting from North (0°) and continuing clockwise.
0%
Cancel
Run as Batch Process...
Run
Close
Help

Your result:



7.3.6 ??? Follow Along: Finding the north-facing aspect

Now, you have rasters showing you the slope as well as the aspect, but you have no way of knowing where ideal conditions are satisfied at once. How could this analysis be done?

Răspunsul se află cu ajutorul: *Calculatorului raster*.

QGIS has different raster calculators available:

- *Raster* ► *Calculator Raster*
- In processing:
  - *Analiză Raster* ► *Calculator raster*
  - *GDAL* ► *Raster miscellaneous* ► *Raster calculator*
  - *SAGA* ► *Raster calculus* ► *Raster calculator*

Each tool is leading to the same results, but the syntax may be slightly different and the availability of operators may vary.

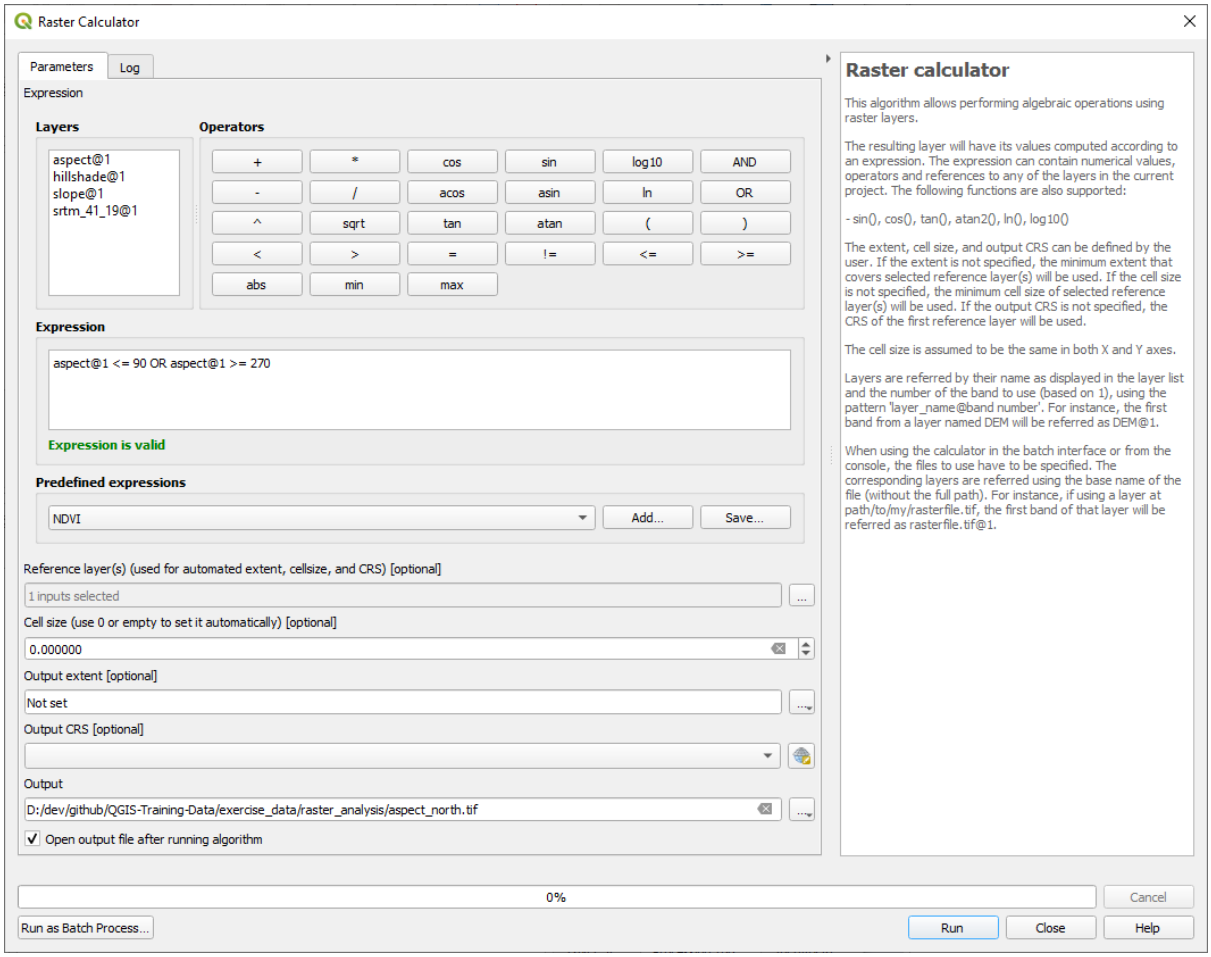
We will use *Raster Analysis* ► *Raster calculator* in the *Processing Toolbox*

1. Open the tool by double clicking on it.
   - The upper left part of the dialog lists all the loaded raster layers as `name@N`, where `name` is the name of the layer and `N` is the band.
   - In the upper right part you will see a lot of different operators. Stop for a moment to think that a raster is an image. You should see it as a 2D matrix filled with numbers.
2. North is at 0 (zero) degrees, so for the terrain to face north, its aspect needs to be greater than 270 degrees or less than 90 degrees. Therefore the formula is:

   ```
   aspect@1 <= 90 OR aspect@1 >= 270
   ```

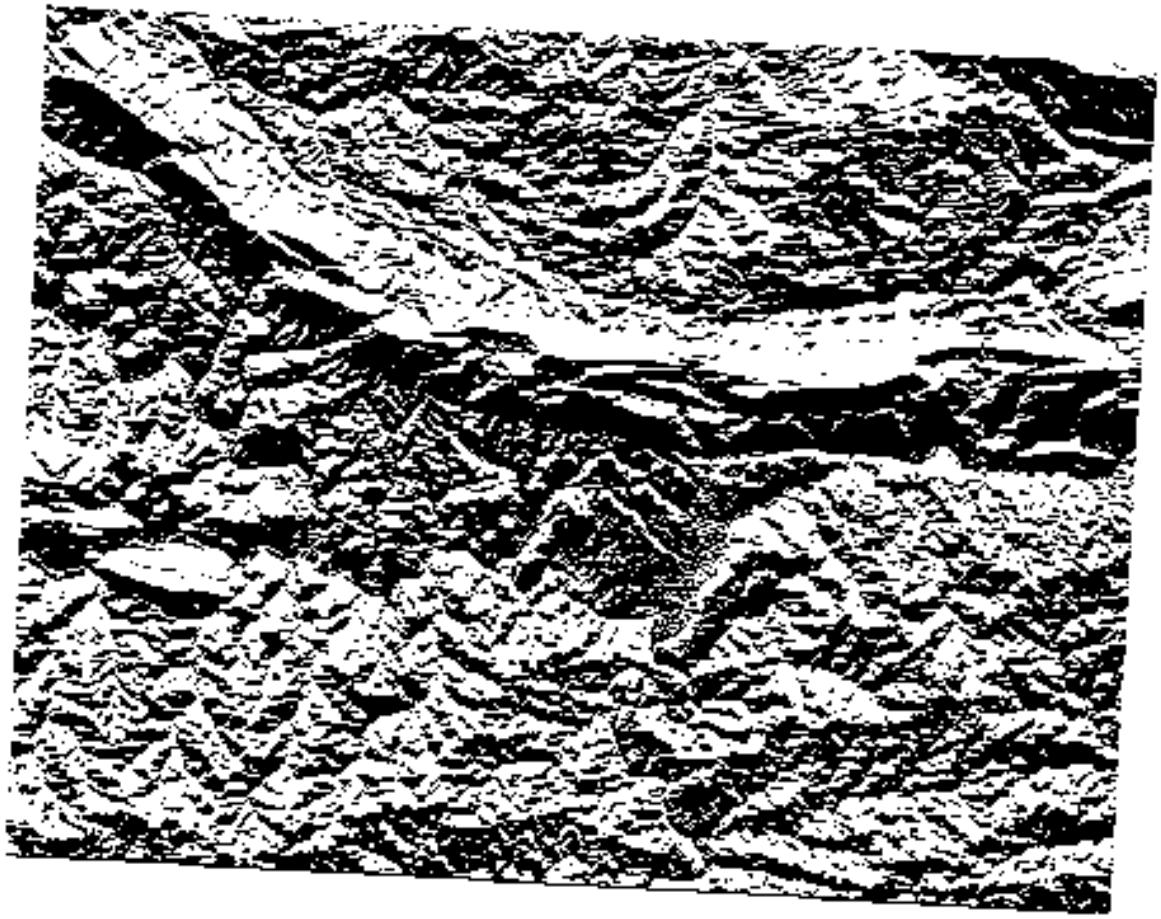
3. Now you have to set up the raster details, like the cell size, extent and CRS. This can be done manually or it can be automatically set by choosing a `Reference layer`. Choose this last option by clicking on the … button next to the *Reference layer(s)* parameter.
4. In the dialog, choose the `aspect` layer, because we want to obtain a layer with the same resolution.
5. Save the layer as `aspect_north.tif`.

   The dialog should look like:



6. Finally click on *Run*.

Rezultatul va fi acesta:



The output values are `0` or `1`. What does it mean? For each pixel in the raster, the formula we wrote returns whether it matches the conditions or not. Therefore the final result will be **False** (0) and **True** (1).

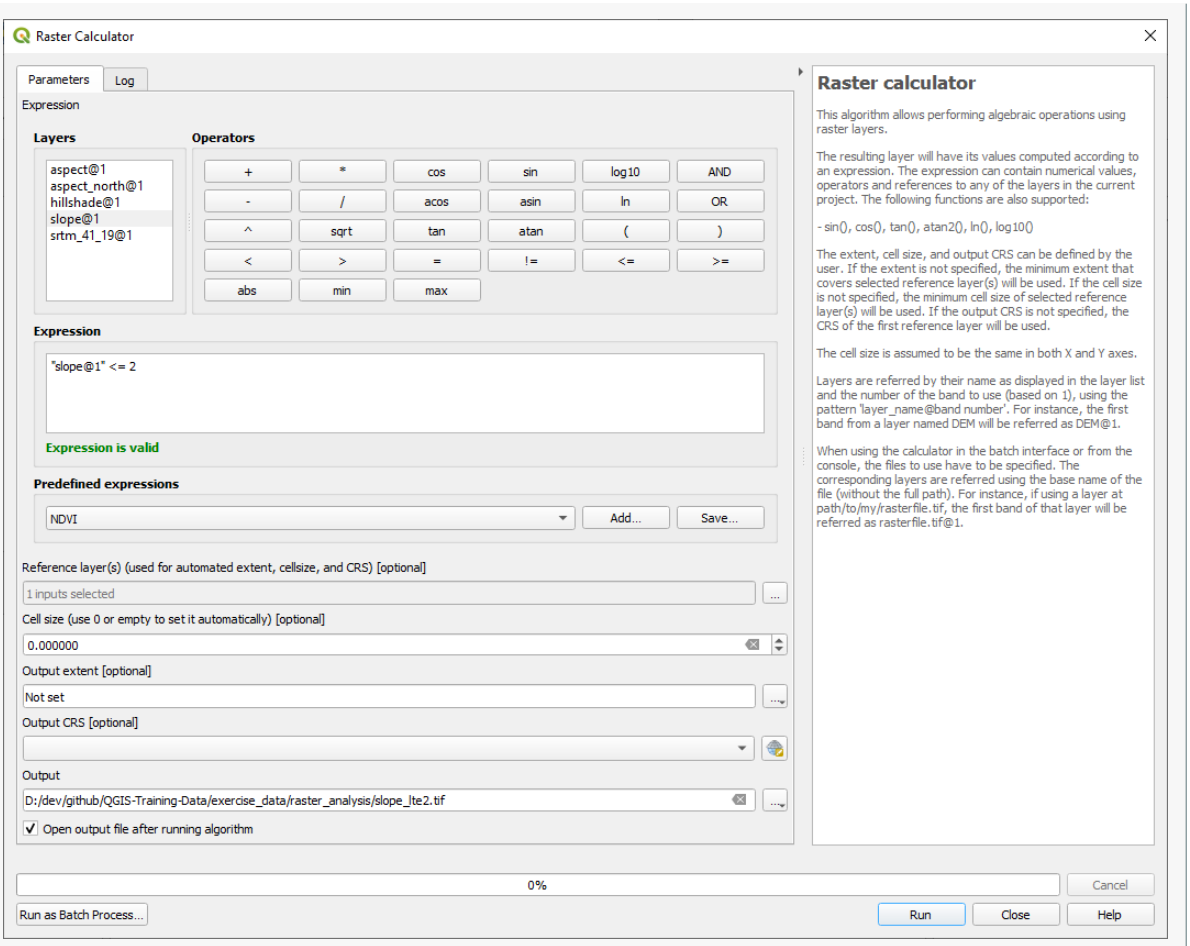
7.3.7 ??? Try Yourself: More criteria

Now that you have done the aspect, create two new layers from the DEM.

- The first shall identify areas where the slope is less than or equal to `2` degrees
- The second is similar, but the slope should be less than or equal to `5` degrees.
- Save them under `exercise_data/raster_analysis` as `slope_lte2.tif` and `slope_lte5.tif`.

Răspuns

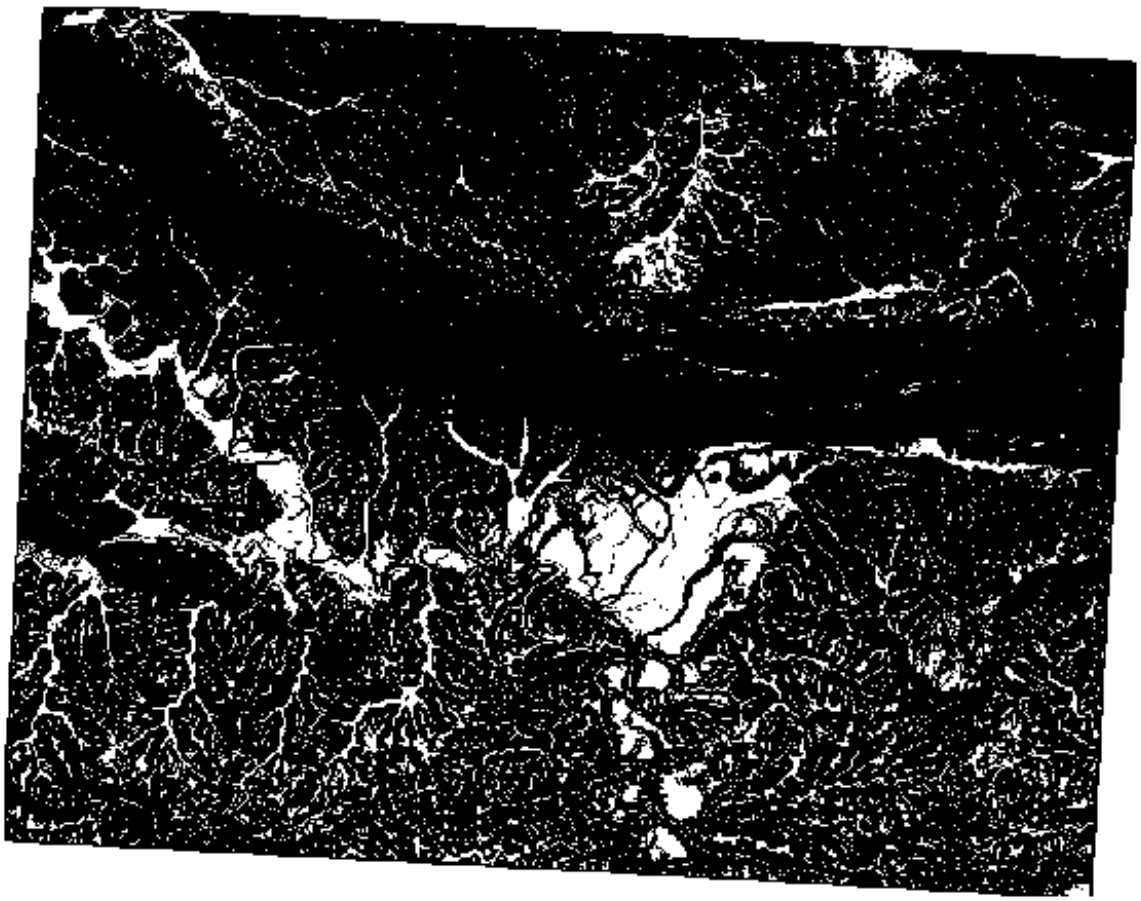
- Set your *Raster calculator* dialog up with:
- the following expression: `slope@1 <= 2`
- the `slope` layer as the *Reference layer(s)*



- For the 5 degree version, replace the `2` in the expression and file name with `5`.

Your results:

- 2 degrees:



- 5 degrees:



7.3.8 ??? Follow Along: Combining Raster Analysis Results

Now you have generated three raster layers from the DEM:

- `aspect_north`: terrain facing north
- `slope_lte2`: slope equal to or below 2 degrees
- `slope_lte5`: slope equal to or below 5 degrees

Where the condition is met, the pixel value is `1`. Elsewhere, it is `0`. Therefore, if you multiply these rasters, the pixels that have a value of `1` for all of them will get a value of `1` (the rest will get `0`).

The conditions to be met are:

- at or below 5 degrees of slope, the terrain must face north
- at or below 2 degrees of slope, the direction that the terrain faces does not matter.

Therefore, you need to find areas where the slope is at or below five degrees `AND` the terrain is facing north, `OR` the slope is at or below 2 degrees. Such terrain would be suitable for development.

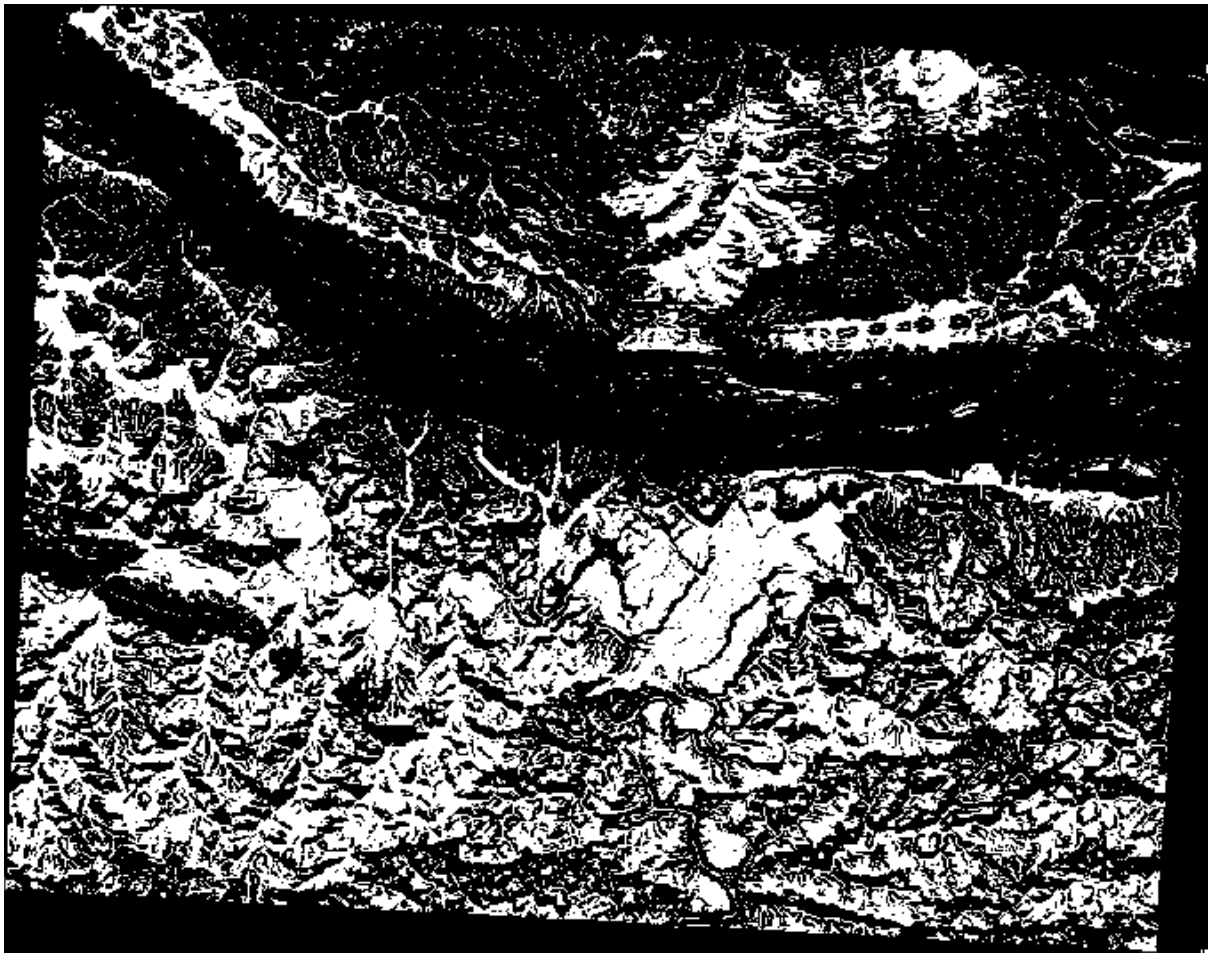
Pentru a calcula zonele care îndeplinesc aceste criterii:

1. Open the *Raster calculator* again
2. Use this expression in *Expression*:

```
( aspect_north@1 = 1 AND slope_lte5@1 = 1 ) OR slope_lte2@1 = 1
```

3. Set the *Reference layer(s)* parameter to `aspect_north` (it does not matter if you choose another - they have all been calculated from `srtm_41_19`)
4. Save the output under `exercise_data/raster_analysis/` as `all_conditions.tif`
5. Click *Run*

Rezultatul:



Sugestie

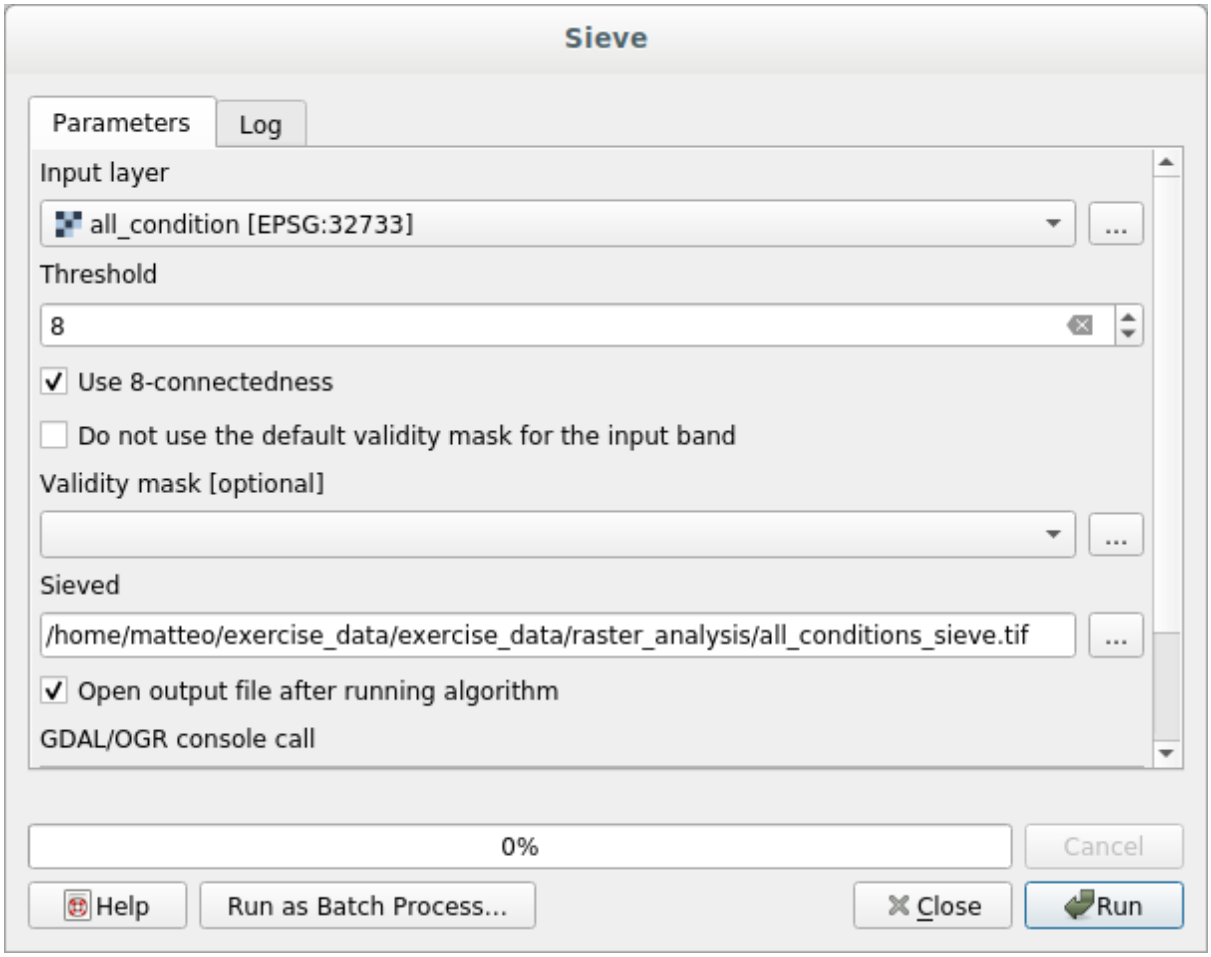
The previous steps could have been simplified using the following command:

```
((aspect@1 <= 90 OR  aspect@1 >= 270) AND slope@1 <= 5) OR slope@1 <= 2
```

7.3.9 [?][?][?] Follow Along: Simplifying the Raster

As you can see from the image above, the combined analysis has left us with many, very small areas where the conditions are met (in white). But these aren't really useful for our analysis, since they are too small to build anything on. Let us get rid of all these tiny unusable areas.

1. Open the *Sieve* tool (*GDAL* ► *Raster Analysis* in the *Processing Toolbox*)
2. Set the *Input file* to `all_conditions`, and the *Sieved* to `all_conditions_sieve.tif` (under `exercise_data/raster_analysis/`).
3. Set the *Threshold* to 8 (minimum eight contiguous pixels), and check *Use 8-connectedness*.

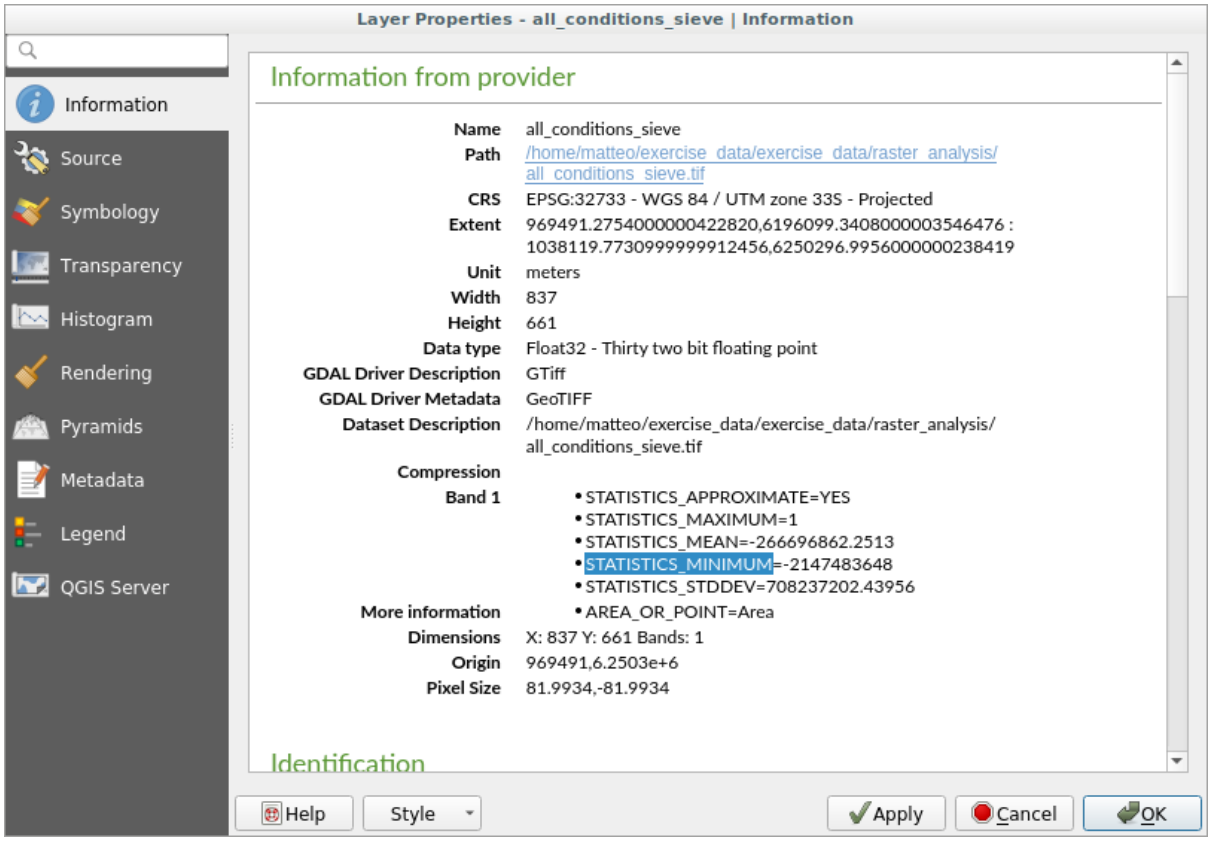


Once processing is done, the new layer will be loaded.



What is going on? The answer lies in the new raster file's metadata.

4. View the metadata under the *Information* tab of the *Layer Properties* dialog. Look the `STATISTICS_MINIMUM` value:



This raster, like the one it is derived from, should only feature the values `1` and `0`, but it has also a very large negative number. Investigation of the data shows that this number acts as a null value. Since we are only after areas that weren't filtered out, let us set these null values to zero.

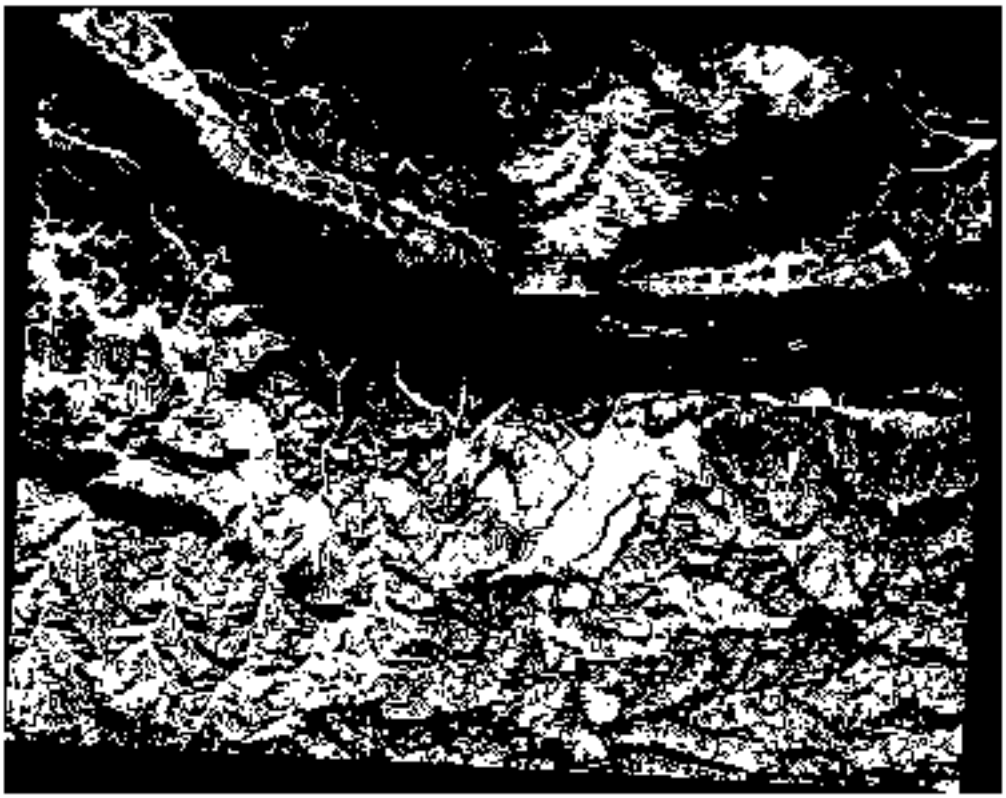
5. Open the *Raster Calculator*, and build this expression:

```
(all_conditions_sieve@1 <= 0) = 0
```

This will maintain all non-negative values, and set the negative numbers to zero, leaving all the areas with value `1` intact.

6. Save the output under `exercise_data/raster_analysis/` as `all_conditions_simple.tif`.

Rezultatul dvs. arată în felul următor:



This is what was expected: a simplified version of the earlier results. Remember that if the results you get from a tool aren't what you expected, viewing the metadata (and vector attributes, if applicable) can prove essential to solving the problem.

7.3.10 ??? Follow Along: Reclassifying the Raster

We have used the *Raster calculator* to do calculations on raster layers. There is another powerful tool that we can use to extract information from existing layers.

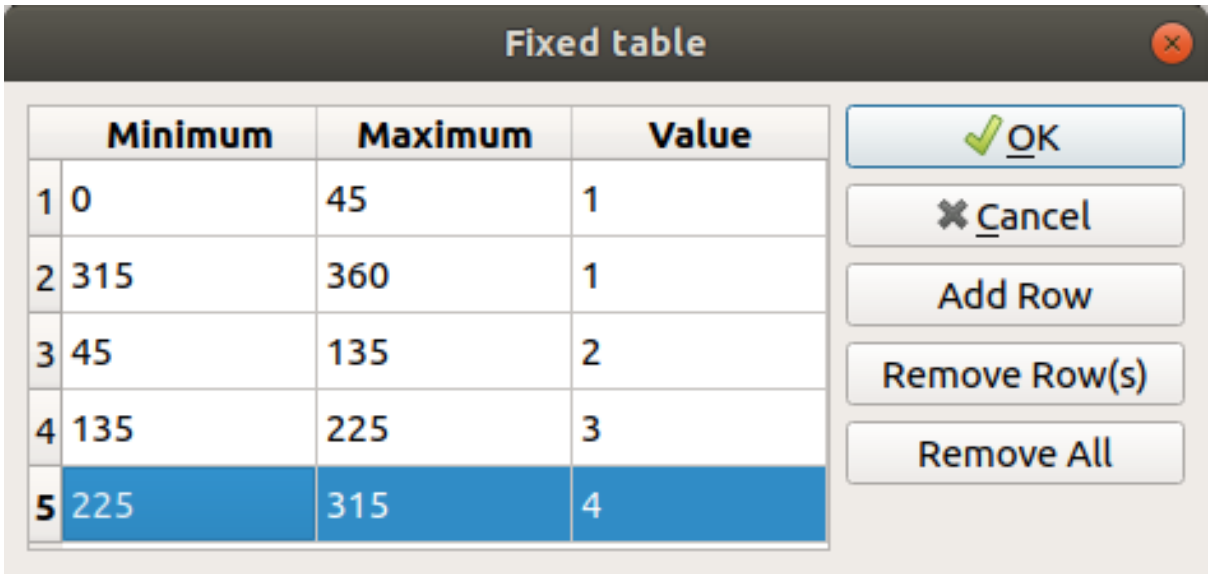
Back to the `aspect` layer. We know now that it has numerical values within a range from 0 through 360. What we want to do is to *reclassify* this layer to other discrete values (from 1 to 4), depending on the aspect:

- 1 = North (from 0 to 45 and from 315 to 360);
- 2 = East (from 45 to 135)
- 3 = South (from 135 to 225)
- 4 = West (from 225 to 315)

This operation can be achieved with the raster calculator, but the formula would become very very large.

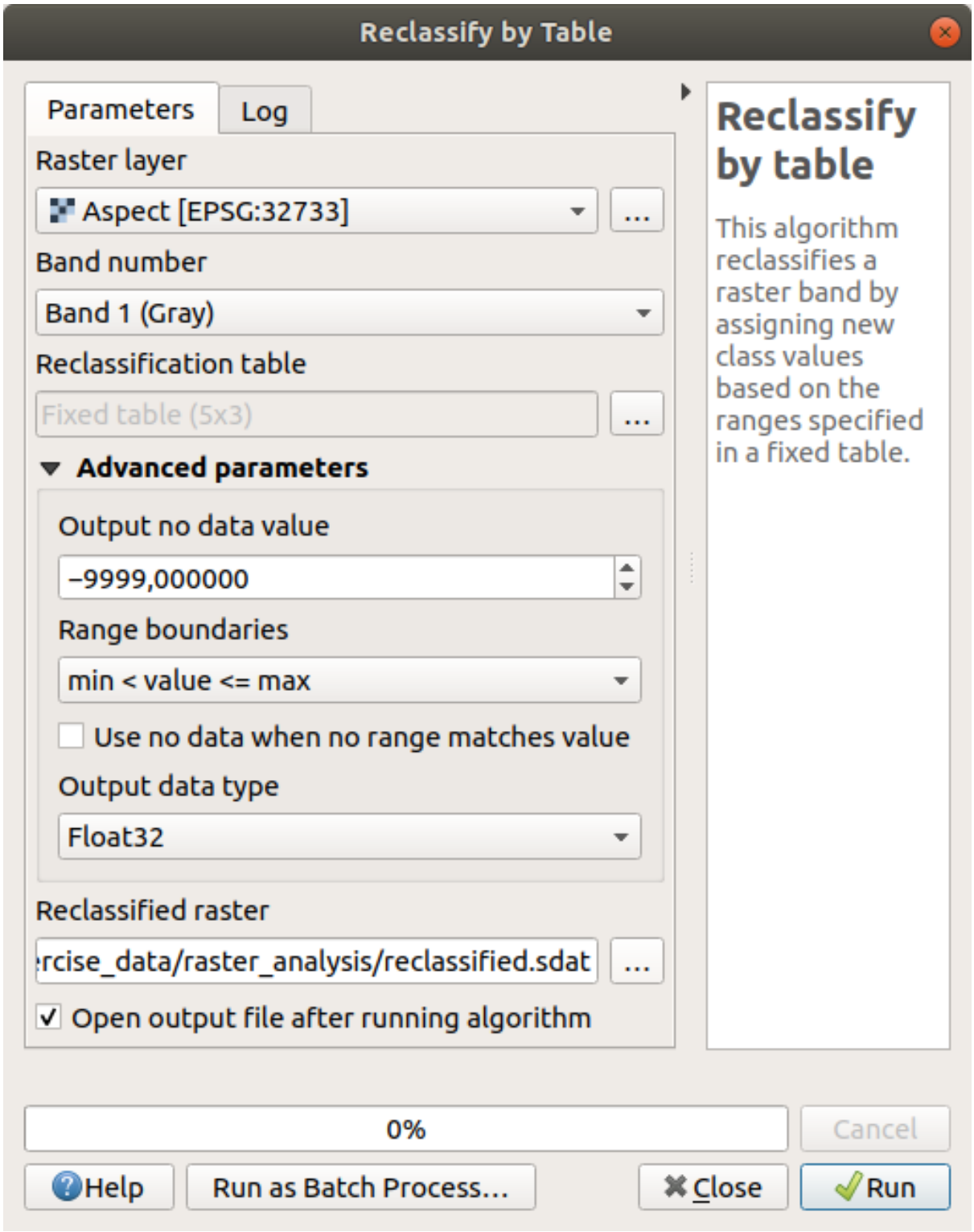
The alternative tool is the *Reclassify by table* tool in *Raster analysis* in the *Processing Toolbox*.

1. Open the tool
2. Choose `aspect` as the *Raster layer*
3. Click on the … of *Reclassification table*. A table-like dialog will pop up, where you can choose the minimum, maximum and new values for each class.
4. Click on the *Add row* button and add 5 rows. Fill in each row as the following picture and click *OK*:



   The method used by the algorithm to treat the threshold values of each class is defined by the *Range boundaries*.

5. Save the layer as `reclassified.tif` in the `exercise_data/raster_analysis/` folder



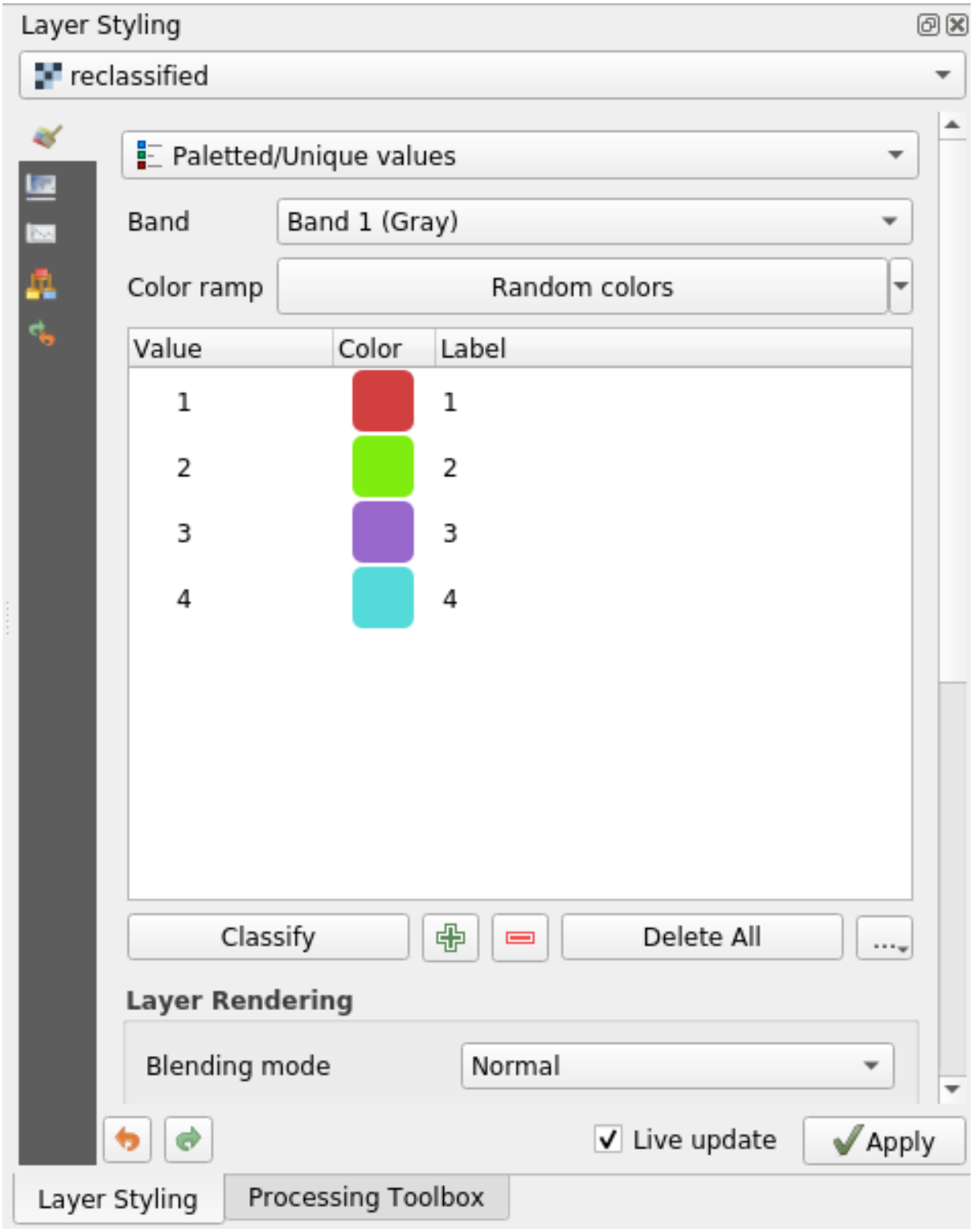
6. Click on *Run*

If you compare the native `aspect` layer with the `reclassified` one, there are not big differences. But by looking at the legend, you can see that the values go from `1` to `4`.

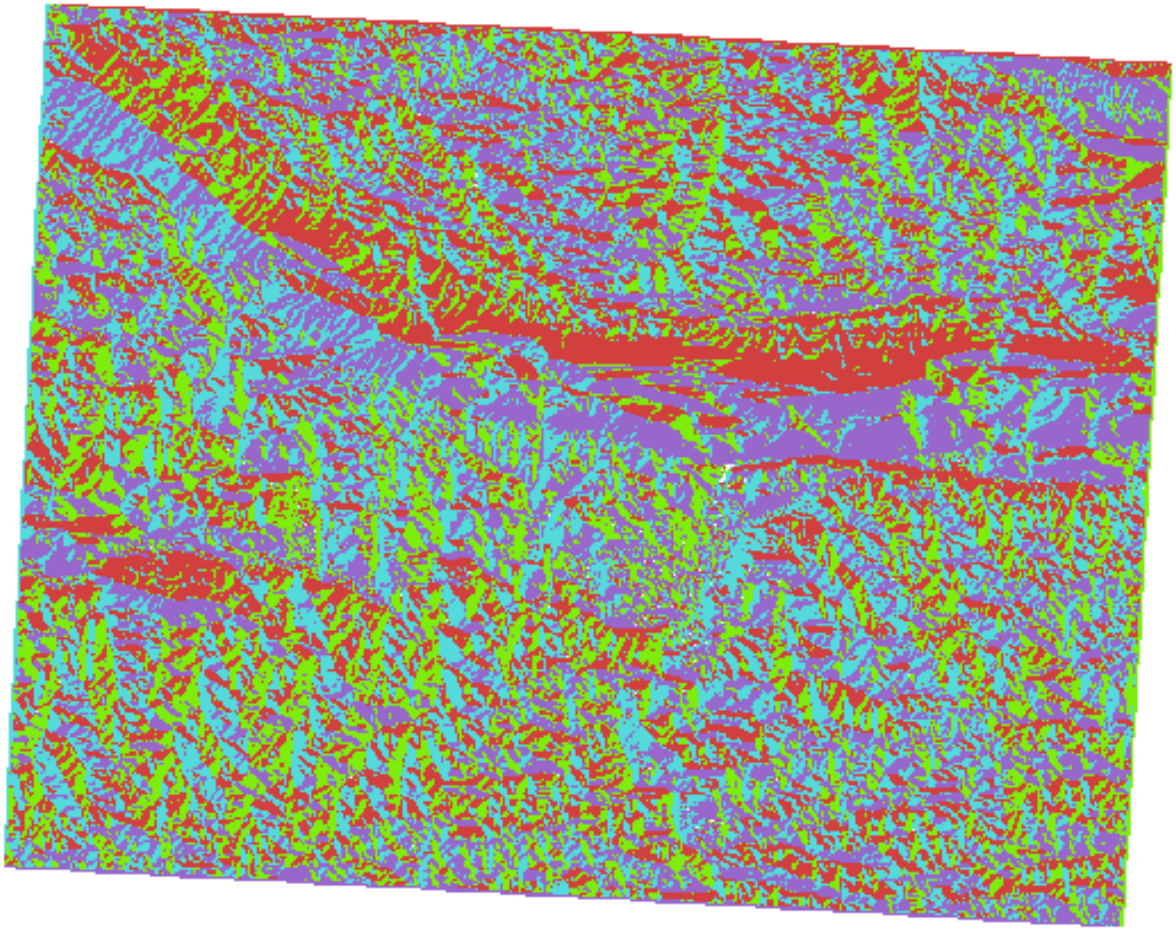
Let us give this layer a better style.

1. Open the *Layer Styling* panel
2. Choose *Paletted/Unique values*, instead of *Singleband gray*

3. Click on the *Classify* button to automatically fetch the values and assign them random colors:



The output should look like this (you can have different colors given that they have been randomly generated):



With this reclassification and the paletted style applied to the layer, you can immediately differentiate the aspect areas.

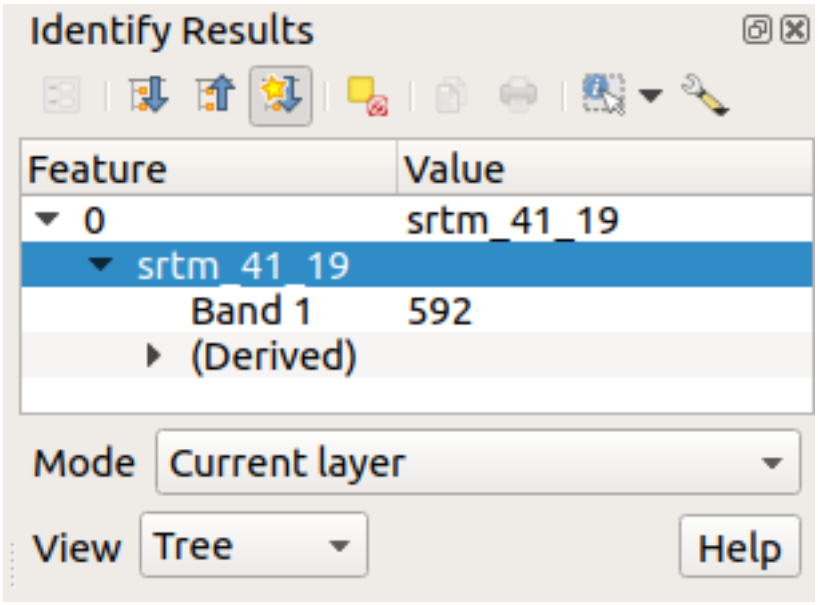
7.3.11 ??? Follow Along: Querying the raster

Unlike vector layers, raster layers don't have an attribute table. Each pixel contains one or more numerical values (singleband or multiband rasters).

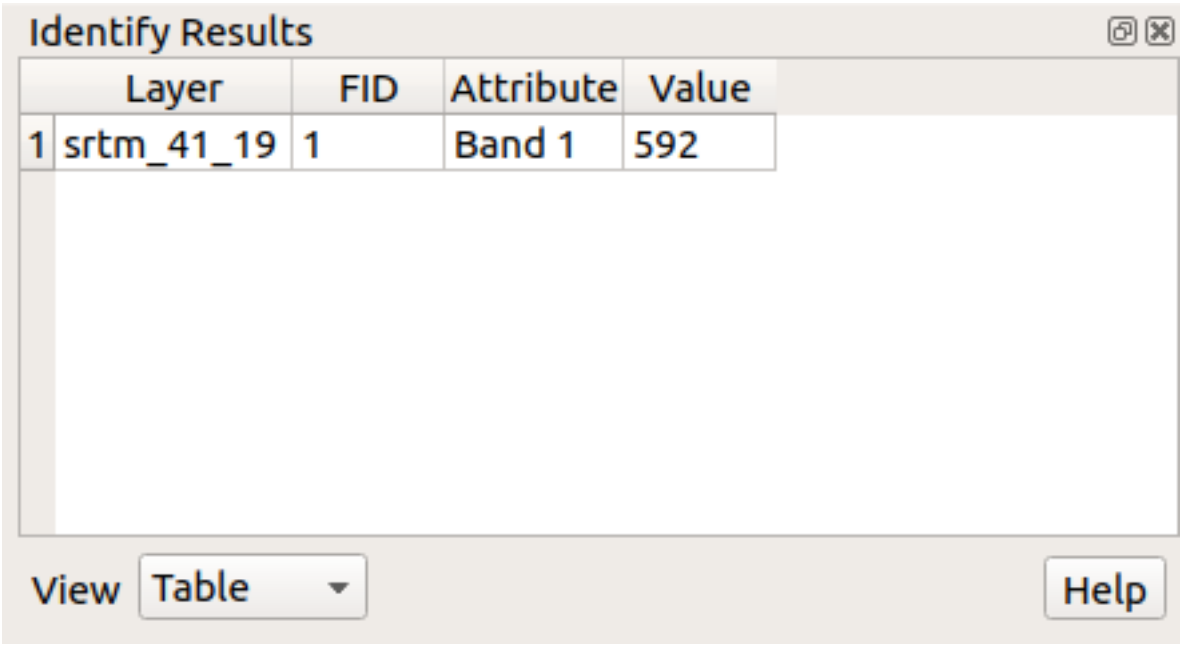
All the raster layers we used in this exercise consist of just one band. Depending on the layer, pixel values may represent elevation, aspect or slope values.

How can we query the raster layer to get the value of a pixel? We can use the Identify Features button!

1. Select the tool from the Attributes toolbar.
2. Click on a random location of the `srtm_41_19` layer. *Identify Results* will appear with the value of the band at the clicked location:

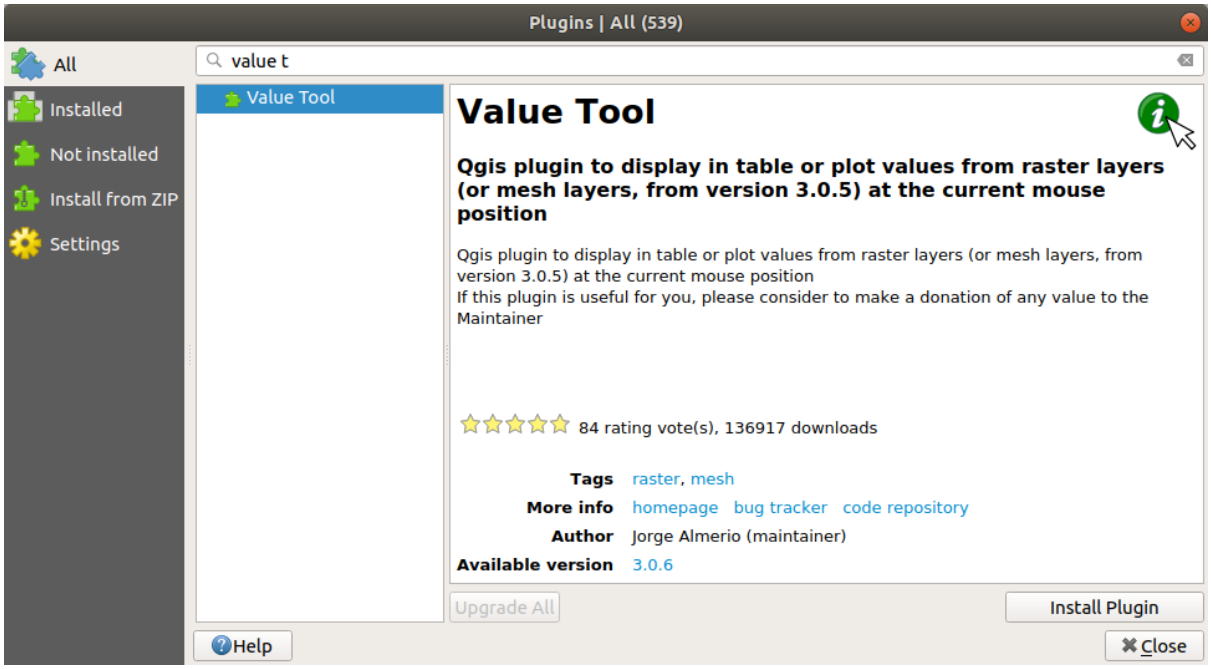


3. You can change the output of the *Identify Results* panel from the current `tree` mode to a `table` one by selecting *Table* in the *View* menu at the bottom of the panel:



Clicking each pixel to get the value of the raster could become annoying after a while. We can use the *Value Tool* plugin to solve this problem.

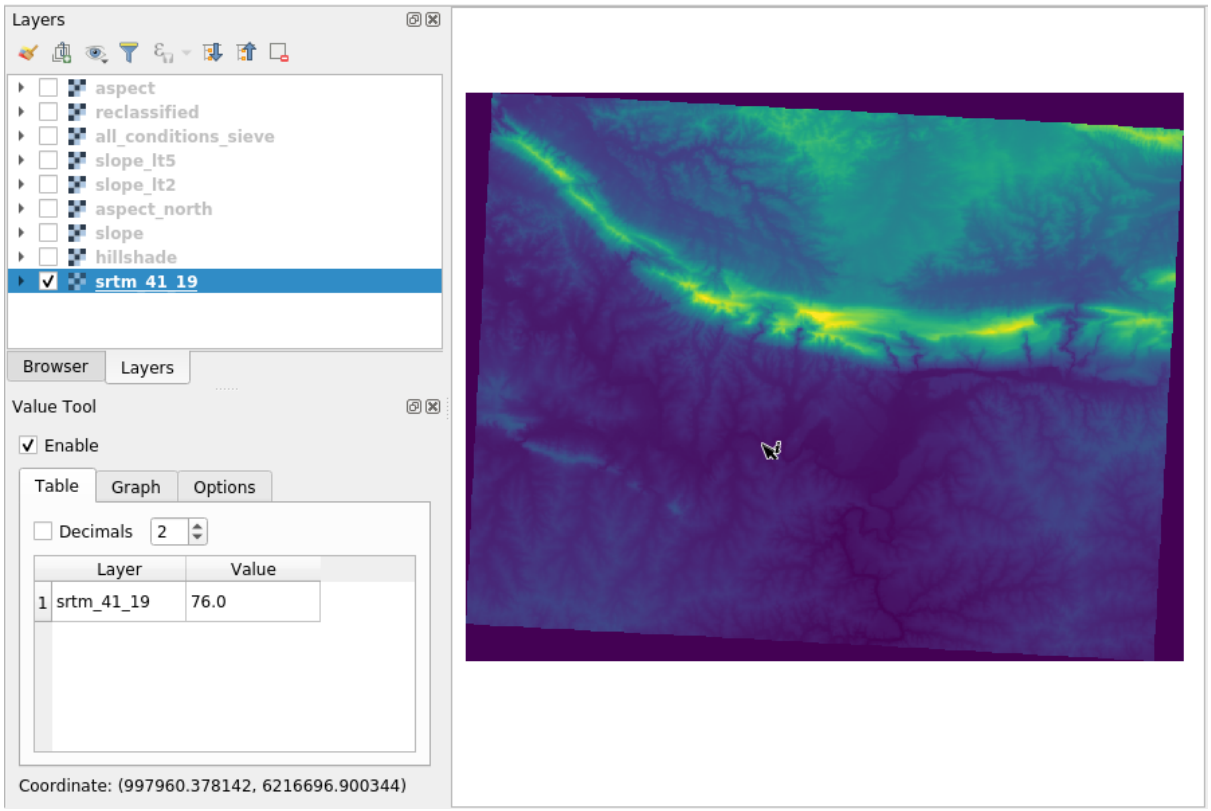
1. Go to *Plugins* ► *Manage/Install Plugins...*
2. In the *All* tab, type `value t` in the search box
3. Select the *Value Tool* plugin, press *Install Plugin* and then *Close* the dialog.



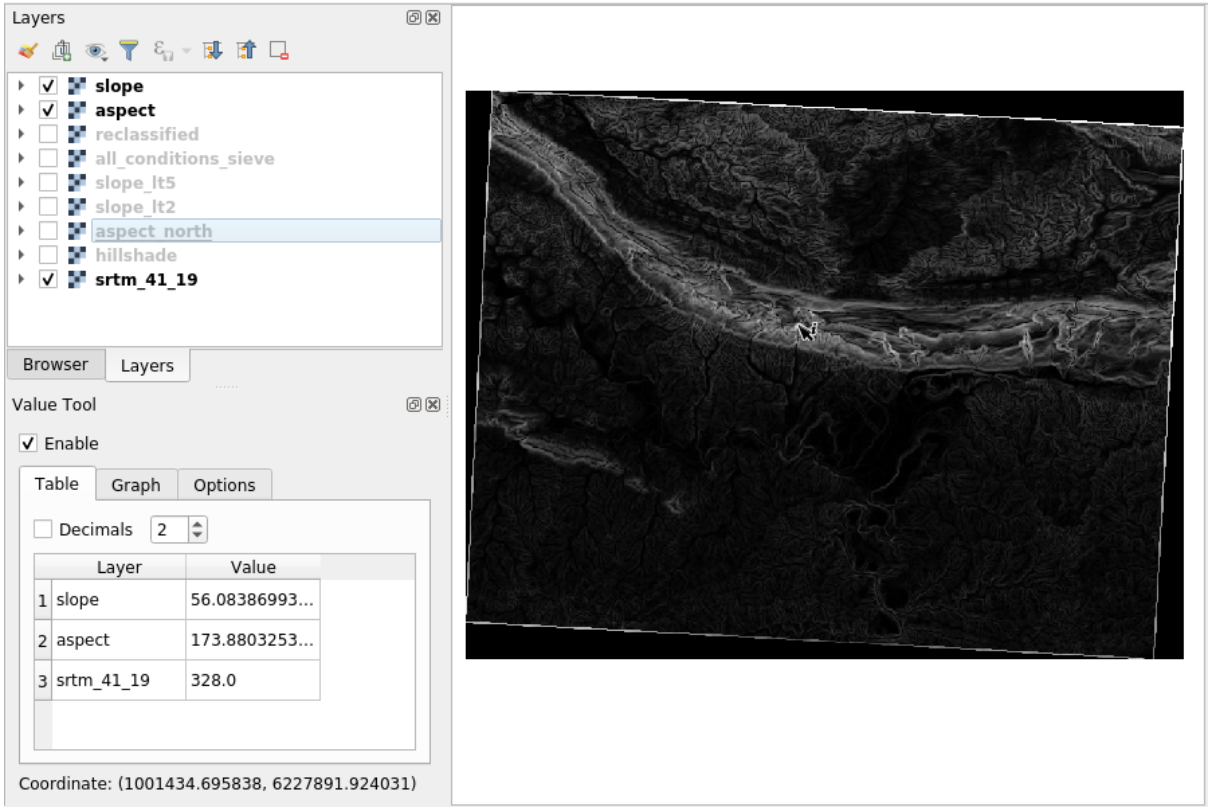
The new *Value Tool* panel will appear.

> **Sfat**
>
> If you close the panel you can reopen it by enabling it in the *View* ► *Panels* ► *Value Tool* or by clicking on the icon in the toolbar.

4. To use the plugin just check the *Enable* checkbox and be sure that the `srtm_41_19` layer is active (checked) in the *Layers* panel.
5. Move the cursor over the map to see the value of the pixels.



6. But there is more. The Value Tool plugin allows you to query **all** the active raster layers in the *Layers* panel. Set the `aspect` and `slope` layers active again and hover the mouse on the map:



7.3.12 În concluzie

You've seen how to derive all kinds of analysis products from a DEM. These include hillshade, slope and aspect calculations. You've also seen how to use the raster calculator to further analyze and combine these results. Finally you learned how to reclassify a layer and how to query the results.

7.3.13 Ce urmează?

Now you have two analyses: the vector analysis which shows you the potentially suitable plots, and the raster analysis that shows you the potentially suitable terrain. How can these be combined to arrive at a final result for this problem? That's the topic for the next lesson, starting in the next module.

CAPITOLUL 8

Module: Completing the Analysis

Aveți acum două jumătăți ale unei analize: o parte vector și o parte raster. În acest modul, veți afla cum să le combinați. Veți încheia analiza și veți prezenta rezultatele finale.

8.1 Lesson: Raster to Vector Conversion

Conversia între formatele raster și cele vectoriale, vă permite să faceți uz atât de datele raster cât și de cele vectoriale, atunci când rezolvați o problemă GIS, precum și utilizarea diferitelor metode unice de analiză, pentru aceste două forme de date geografice. Acest lucru crește flexibilitatea atunci când luați în calcul sursele de date și metodele de procesare pentru rezolvarea unei probleme GIS.

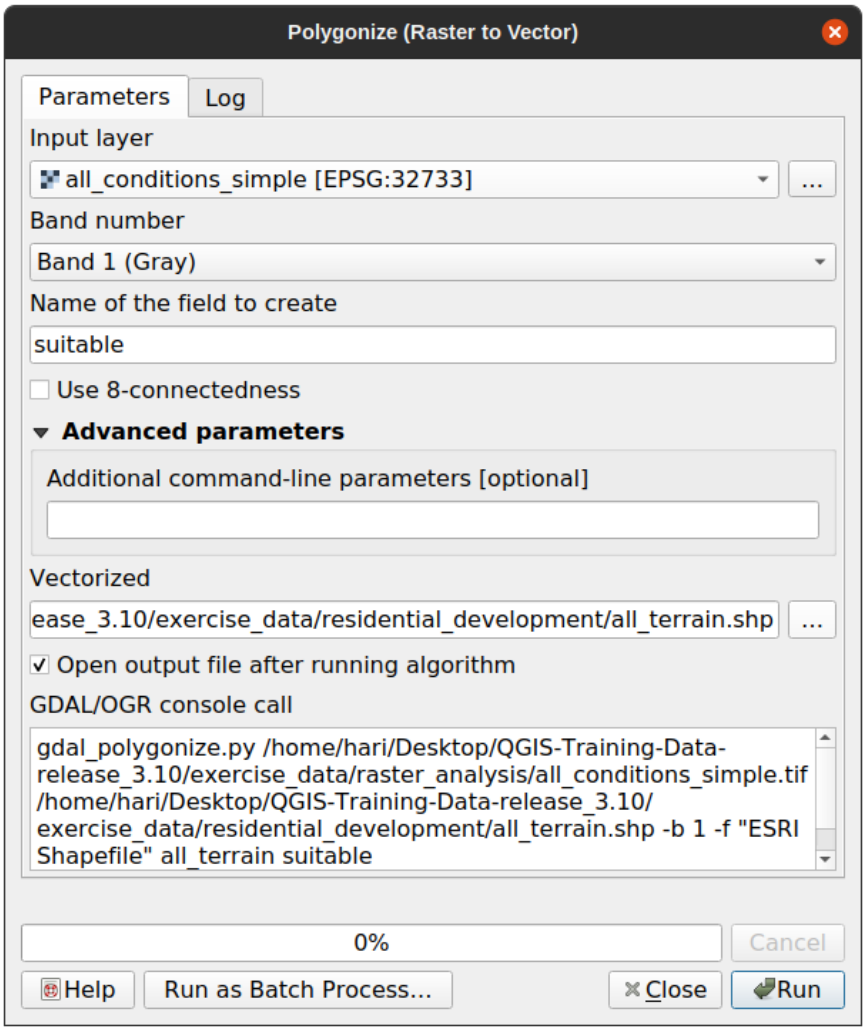
Pentru a combina analiza raster cu cea vectorială, trebuie să convertiți un tip de date în altul. Haideți să convertim rasterul rezultat din lecția anterioară într-un vector.

Scopul acestei lecții: De a obține rezultatul raster într-un vector, care să poată fi utilizat pentru a completa analiza.

8.1.1 ??? Follow Along: The *Raster to Vector* Tool

Start with the map from the last module, `raster_analysis.qgs`. There you should have the `all_conditions_simple.tif` calculated during the previous exercises.

- Clic pe *Raster* ► *Conversion* ► *Polygonize (Raster to Vector)*. Va apărea fereastra de dialog a instrumentului.
- Setați-l astfel:



- Change the field name (describing the values of the raster) to `suitable`.
- Save the layer under `exercise_data/residential_development` as `all_terrain.shp`.

Now you have a vector file which contains all the values of the raster, but the only areas you're interested in are those that are suitable; i.e., those polygons where the value of *suitable* is `1`. You can change the style of this layer if you want to have a clearer visualization of it.

8.1.2 ??? Try Yourself:

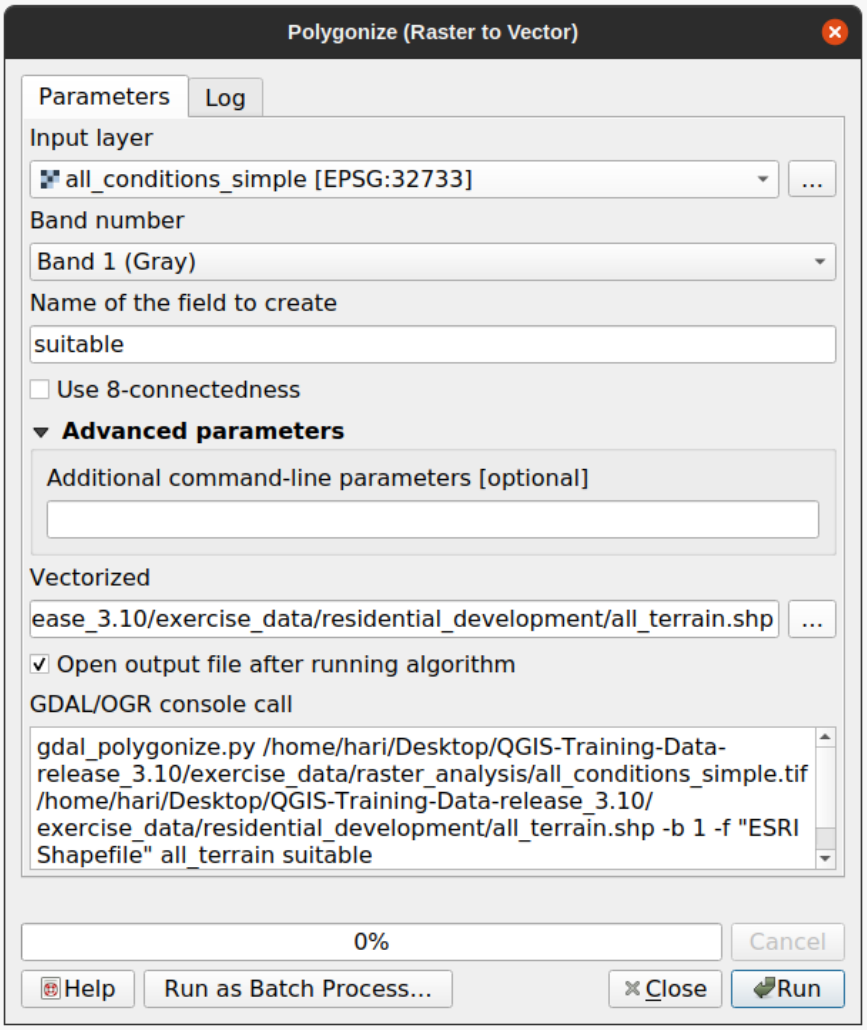
Consultați înapoi la modulul de analiză vectorială.

- Create a new vector file that contains only the polygons where *suitable* has the value of `1`.
- Save the new file under `exercise_data/residential_development/` as `suitable_terrain.shp`.

Răspuns

1. Open the *Query Builder* by right-clicking on the `all_terrain` layer in the *Layers* panel, and selecting the *Properties* ► *Source* tab.
2. Then build the query `"suitable" = 1`.

3. Click *OK* to filter out all the polygons where this condition isn't met. When viewed over the original raster, the areas should overlap perfectly:

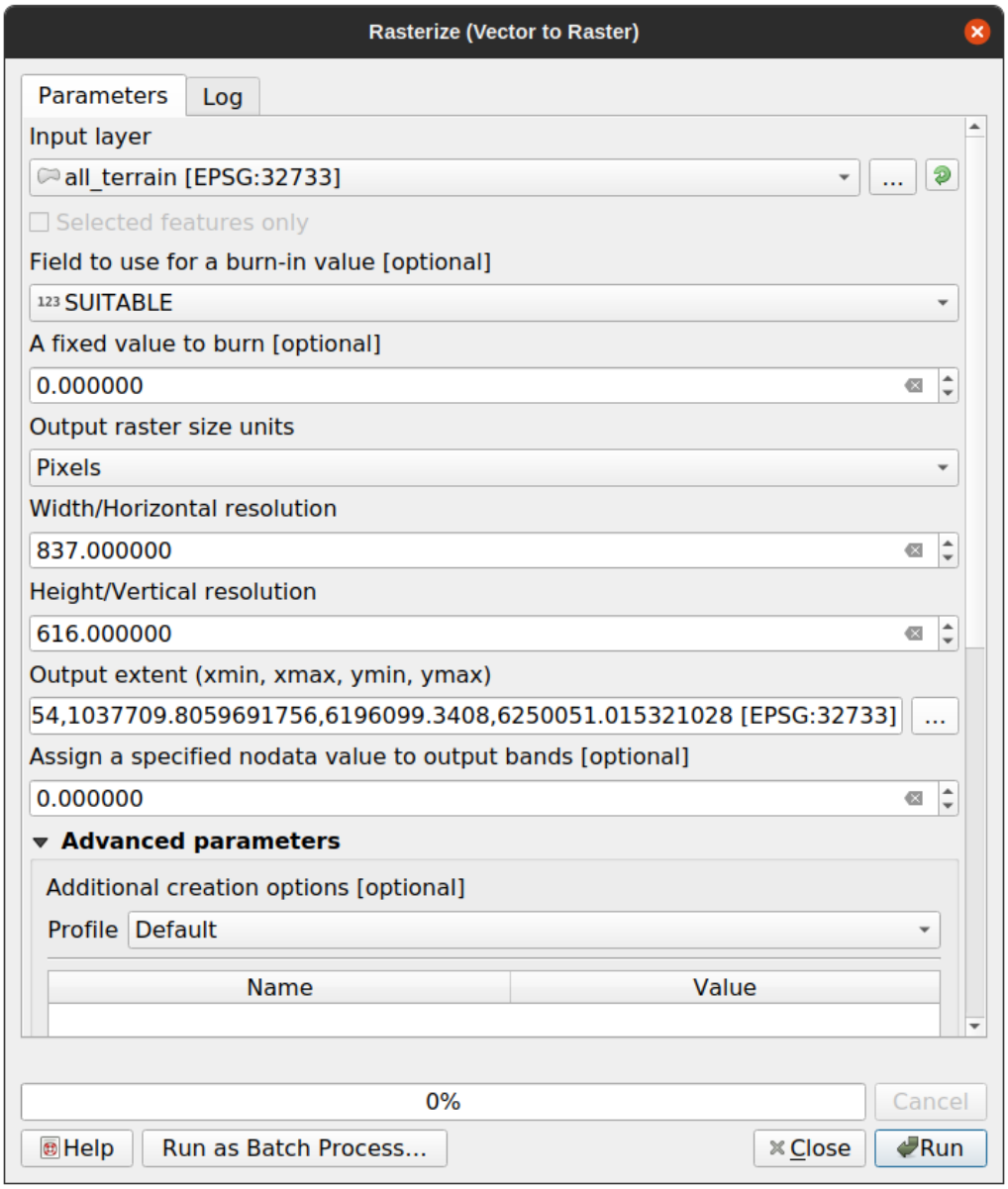


4. You can save this layer by right-clicking on the `all_terrain` layer in the *Layers* panel and choosing *Save As…*, then continue as per the instructions.

8.1.3 ??? Follow Along: The *Vector to Raster* Tool

Although unnecessary for our current problem, it's useful to know about the opposite conversion from the one performed above. Convert to raster the `suitable_terrain.shp` vector file you just created in previous step.

- Clic pe *Raster* ► *Conversion* ► *Rasterize (Vector to Raster)* pentru a lansa acest instrument, apoi setați-l ca în imaginea de mai jos:



- *Input layer* is `all_terrain`.
- Field name is *suitable*.
- *Output raster size units* is *Pixels*.
- *Width* and *Height* are `837` and `661`, respectively.
- Get the *Output extent* from the `all_terrain` layer.
- Set output file *Rasterized* to `exercise_data/residential_development/raster_conversion.tif`.

Notă

Dimensiunea imaginii de ieșire este specificată aici pentru a fi similară cu cea a rasterului original, care a fost vectorizat. Pentru a vizualiza dimensiunile unei imagini, deschideți-i metadatele (fila *Metadata* din *Proprietățile Stratului*).

- Clic pe *OK*, în fereastra de dialog, pentru a începe procesul de conversie.

- Atunci când ați încheiat, evaluați succesul prin compararea noului raster cu cel original. Cele două ar trebui să se potrivească exact, pixel cu pixel.

8.1.4 În concluzie

Conversia între formatele raster și cele vectoriale vă permite să extindeți aplicabilitatea datelor, și nu trebuie să ducă la degradarea datelor.

8.1.5 Ce urmează?

Acum, că avem rezultatele analizei de teren disponibile în format vectorial, ele pot fi folosite pentru a rezolva problema clădirii pe care ar trebui să o propunem în scopul dezvoltării rezidențiale.

8.2 Lesson: Combining the Analyses

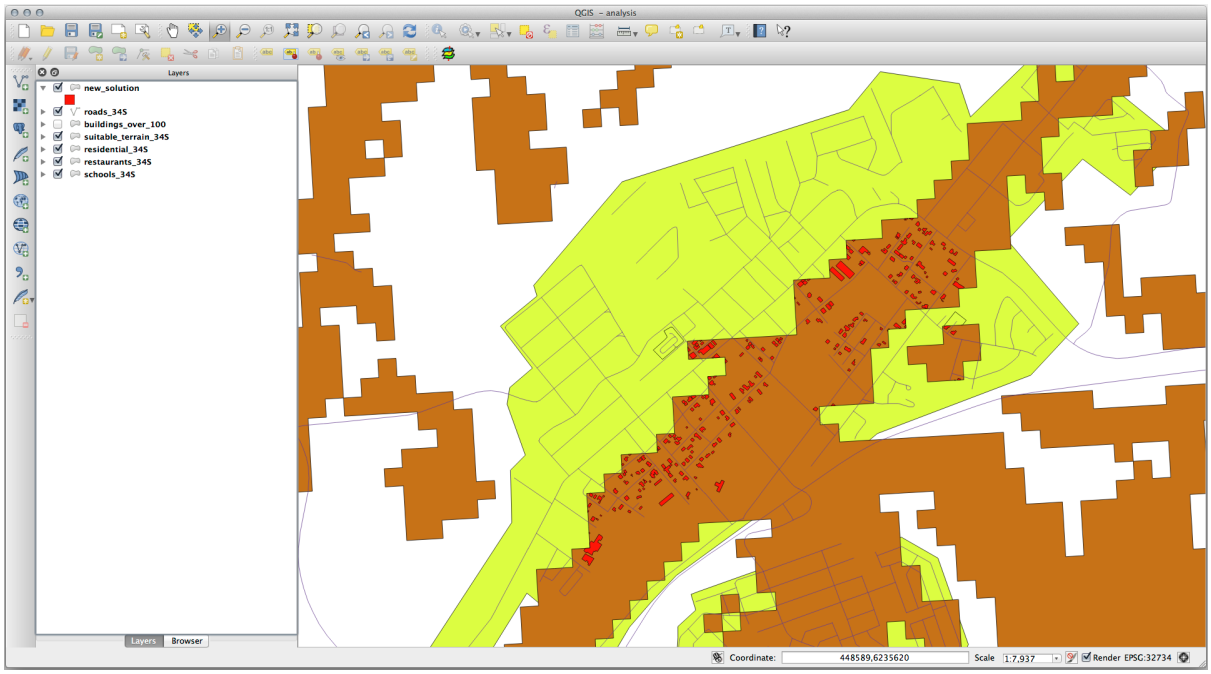
Folosind rezultatele vectorizate ale analizei raster, veți putea selecta numai acele clădiri de pe terenul potrivit.

Scopul acestei lecții: De a utiliza terenul vectorizat rezultat la selectarea terenurilor adecvate.

8.2.1 ??? Try Yourself:

1. Save your current map (`raster_analysis.qgs`).
2. Open the map which you created during the vector analysis earlier (you should have saved the file as `analysis.qgs`).
3. In the *Layers* panel, enable these layers:
   - `hillshade`,
   - `solution` (or `buildings_over_100`)
4. In addition to these layers, which should already be loaded in the map from when you worked on it before, also add the `suitable_terrain.shp` dataset.
5. If you are missing some layers, you should find them in `exercise_data/residential_development/`
6. Use the *Intersection* tool (*Vector* ► *Geoprocessing Tools*) to create a new vector layer called `new_solution.shp` which contains only those buildings which intersect the `suitable_terrain` layer.

Ar trebui să aveți de acum un strat care prezintă anumite clădiri din soluția dvs., cum ar fi:



8.2.2 ??? Try Yourself: Inspecting the Results

Look at each of the buildings in your `new_solution` layer. Compare them with the `suitable_terrain` layer by changing the symbology for the `new_solution` layer so that it has outlines only. What do you notice about some of the buildings? Are they all suitable just because they intersect with the `suitable_terrain` layer? Why or why not? Which ones would you deem to be unsuitable?

Răspuns

You may notice that some of the buildings in your `new_solution` layer have been „sliced" by the *Intersection* tool. This shows that only part of the building - and therefore only part of the property - lies on suitable terrain. We can therefore sensibly eliminate those buildings from our dataset.

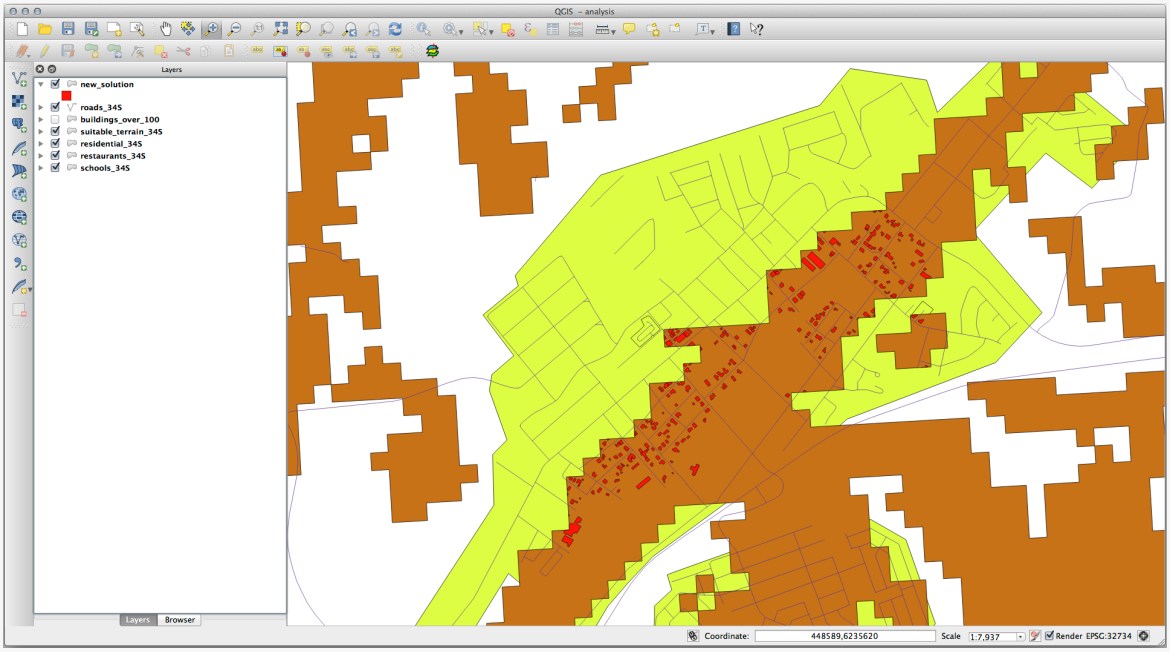
8.2.3 ??? Try Yourself: Refining the Analysis

Puteți vedea din rezultate, că unele clădirile care au fost incluse nu au fost cu adevărat adecvate, astfel încât să putem rafina acum analiza.

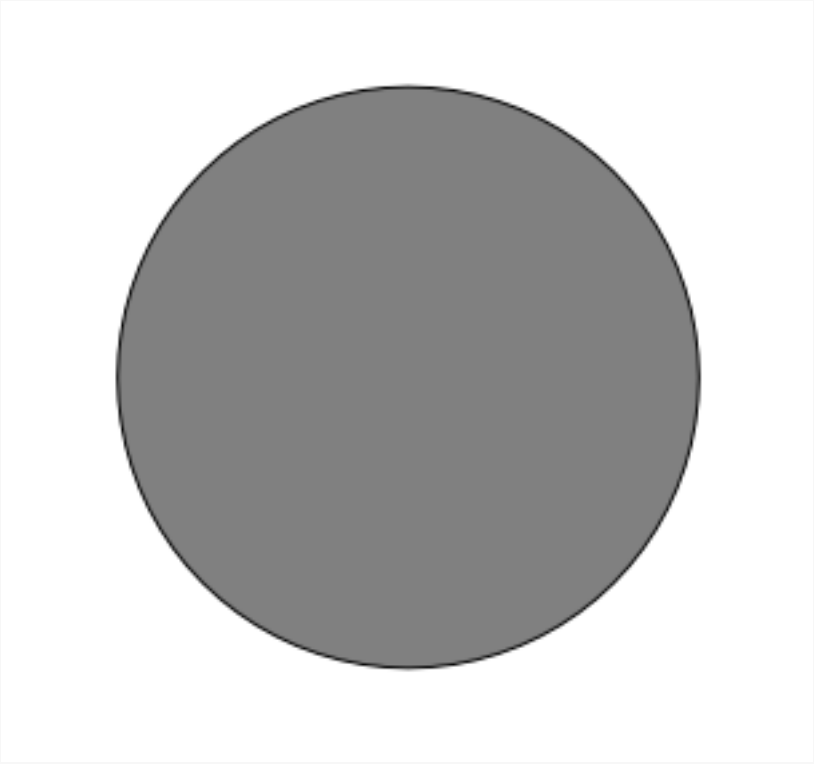
We want to ensure that our analysis returns only those buildings which fall entirely within the `suitable_terrain` layer. How would you achieve this? Use one or more Vector Analysis tools and remember that our buildings are all over 100m squared in size.

Răspuns

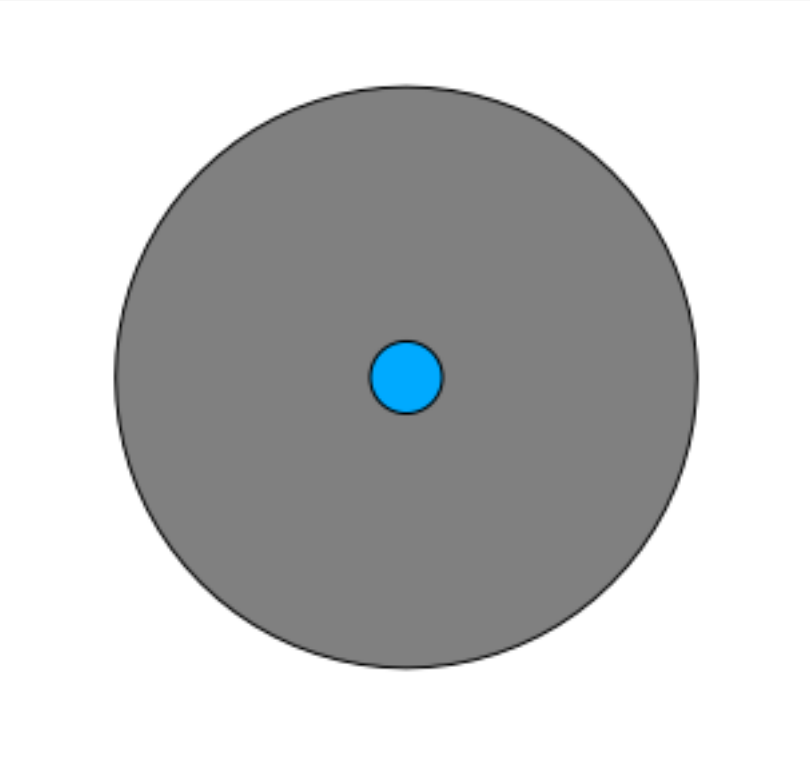
At the moment, your analysis should look something like this:



Consider a circular area, continuous for 100 meters in all directions.



If it is greater than 100 meters in radius, then subtracting 100 meters from its size (from all directions) will result in a part of it being left in the middle.

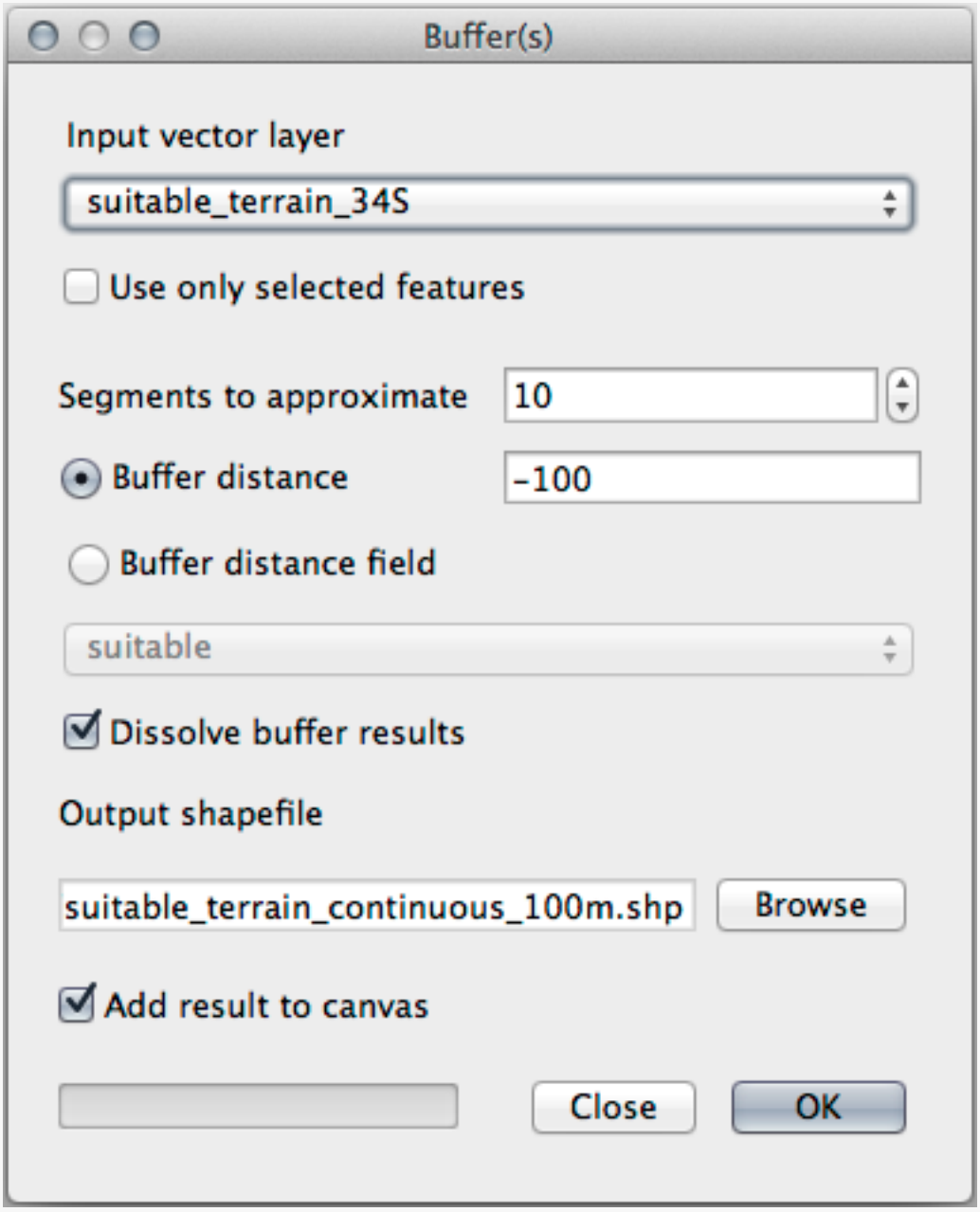


Therefore, you can run an *interior buffer* of 100 meters on your existing `suitable_terrain` vector layer. In the output of the buffer function, whatever remains of the original layer will represent areas where there is suitable terrain for 100 meters beyond.

To demonstrate:

1. Go to *Vector* ► *Geoprocessing Tools* ► *Buffer(s)* to open the Buffer(s) dialog.

2. Setați-l astfel:

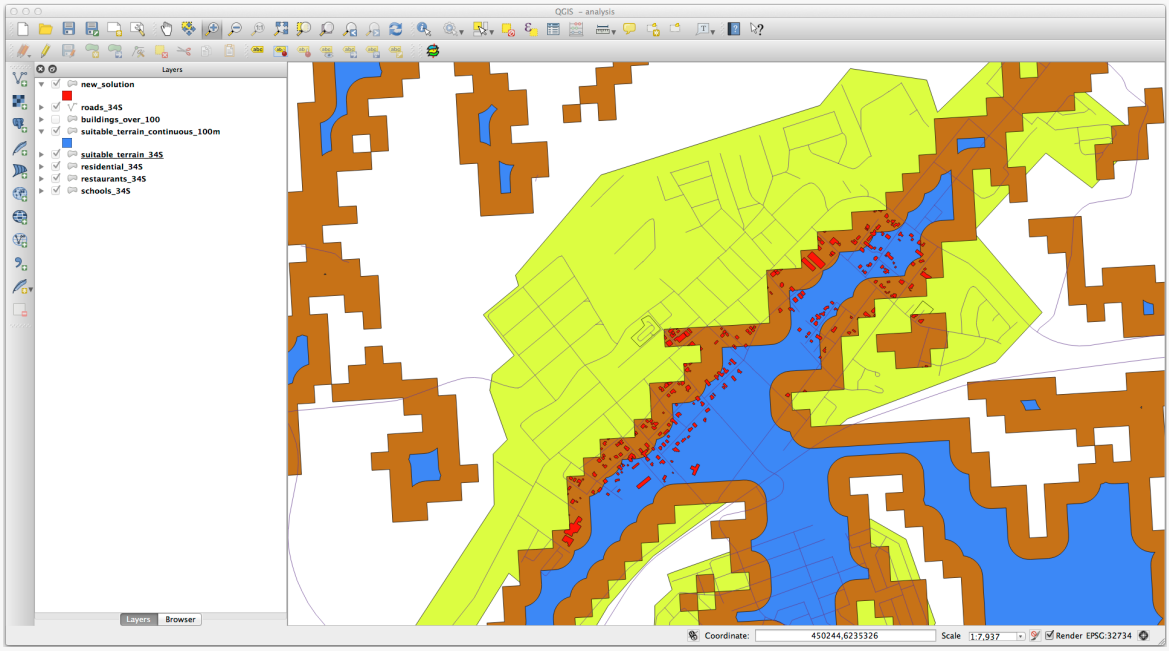


3. Use the `suitable_terrain` layer with `10` segments and a buffer distance of `-100`. (The distance is automatically in meters because your map is using a projected CRS.)

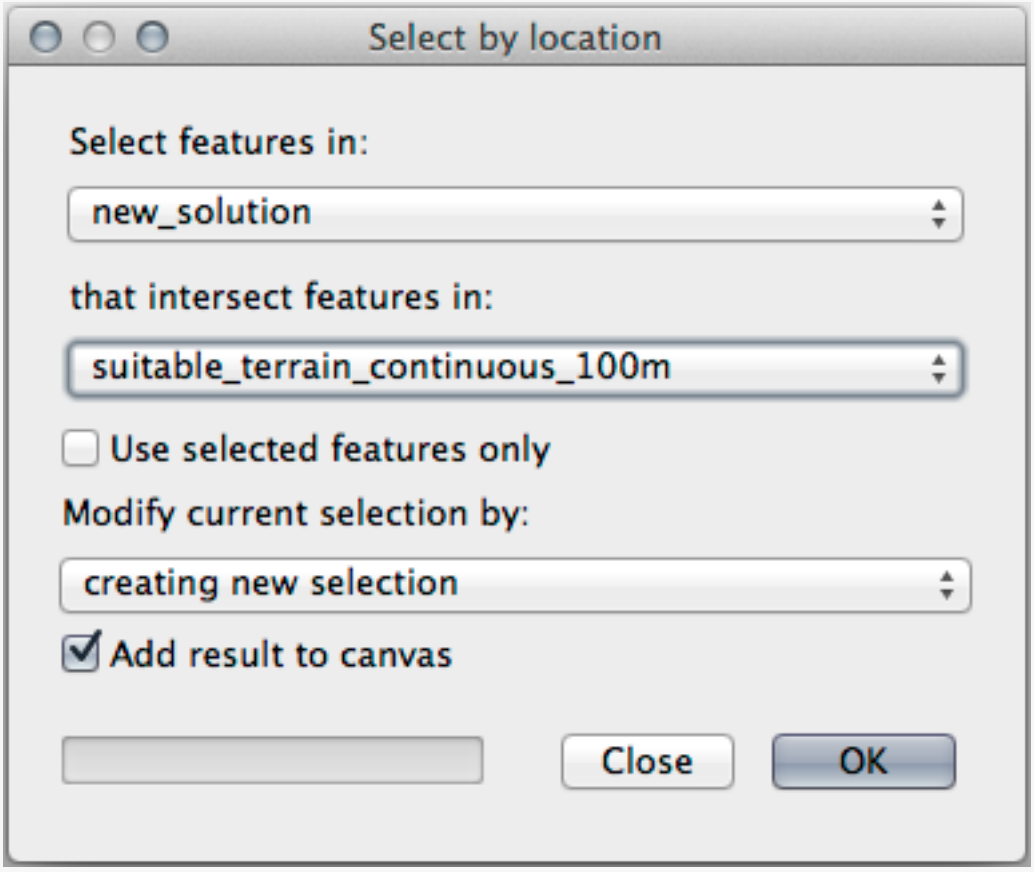
4. Save the output in `exercise_data/residential_development/` as `suitable_terrain_continuous100m.shp`.

5. If necessary, move the new layer above your original `suitable_terrain` layer.

   Your results will look like something like this:

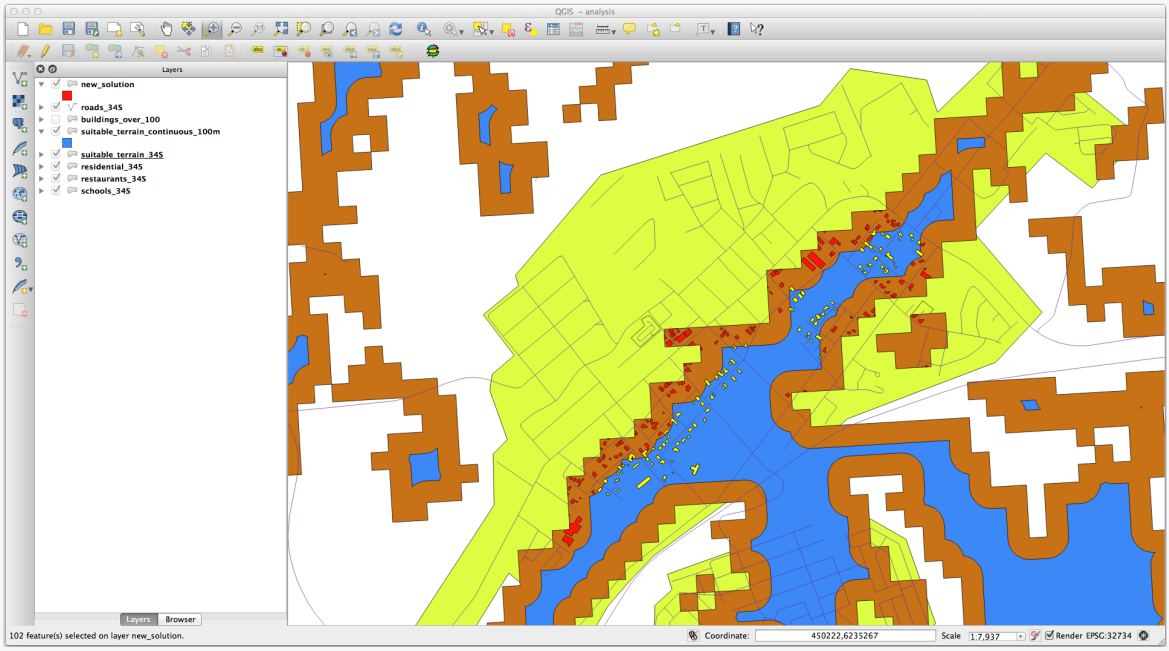


6. Now use the *Select by Location* tool (*Vector* ► *Research Tools* ► *Select by location*).
7. Set up like this:



8. Select features in `new_solution` that intersect features in `suitable_terrain_continuous100m.shp`.

   This is the result:



The yellow buildings are selected. Although some of the buildings fall partly outside the new `suitable_terrain_continuous100m` layer, they lie well within the original `suitable_terrain` layer and therefore meet all of our requirements.

9. Save the selection under `exercise_data/residential_development/` as `final_answer.shp`.

8.2.4 În concluzie

Ați răspuns acum la întrebarea de cercetare originală, și v-ați conturat deja o opțiune (argumentată și susținută de o analiză) care poate sta la baza unei recomandări cu privire la proprietatea de dezvoltat.

8.2.5 Ce urmează?

Mai departe, vom prezenta aceste rezultate ca parte a celei de-a doua dvs. misiuni.

8.3 Exercițiu

Folosind compozitorul de hărți, creați o nouă hartă care reprezintă rezultatele analizei dumneavoastră. Includeți următoarele straturi:

- `places` (with labels),
- `hillshade`,
- `solution` (or `new_solution`),
- `roads` and
- either `aerial_photos` or `DEM`.

Scrieți un scurt text explicativ, însoțitor. Includeți în acest text criteriile care au fost luate în considerare pentru achiziția și dezvoltarea ulterioară a casei, precum și recomandările dvs. de utilizare a clădirilor.

8.4 Lesson: Supplementary Exercise

În această lecție, veți efectua o analiză GIS completă în QGIS.

Notă

Lesson developed by Linfiniti Consulting (South Africa) and Siddique Motala (Cape Peninsula University of Technology)

8.4.1 Definirea Problemei

You are tasked with finding areas in and around the Cape Peninsula that are suitable habitats for a rare fynbos plant species. The extent of your area of investigation covers Cape Town and the Cape Peninsula between Melkbosstrand in the north and Strand in the south. Botanists have provided you with the following preferences exhibited by the species in question:

- It grows on east facing slopes
- It grows on slopes with a gradient between 15% and 60%
- It grows in areas that have a total annual rainfall of > 1000 mm
- It will only be found at least 250 m away from any human settlement
- The area of vegetation in which it occurs should be at least 6000 m^2 in area

As a student at the University, you have agreed to search for the plant in four different suitable areas of land. You want those four suitable areas to be the ones that are closest to the University of Cape Town where you live. Use your GIS skills to determine where you should go to look.

8.4.2 Conturarea unei Soluții

The data for this exercise can be found in the `exercise_data/more_analysis` folder.

You are going to find the four suitable areas that are closest to the University of Cape Town.

The solution will involve:

1. Analyzing a DEM raster layer to find the east facing slopes and the slopes with the correct gradients
2. Analyzing a rainfall raster layer to find the areas with the correct amount of rainfall
3. Analyzing a zoning vector layer to find areas that are away from human settlement and are of the correct size

8.4.3 Follow Along: Setting up the Map

1. Click on the  Current CRS button in the lower right corner of the screen. Under the *CRS* tab of the dialog that appears, use the „Filter” tool to search for „33S”. Select the entry *WGS 84 / UTM zone 33S* (with EPSG code `32733`).
2. Clic pe *OK*

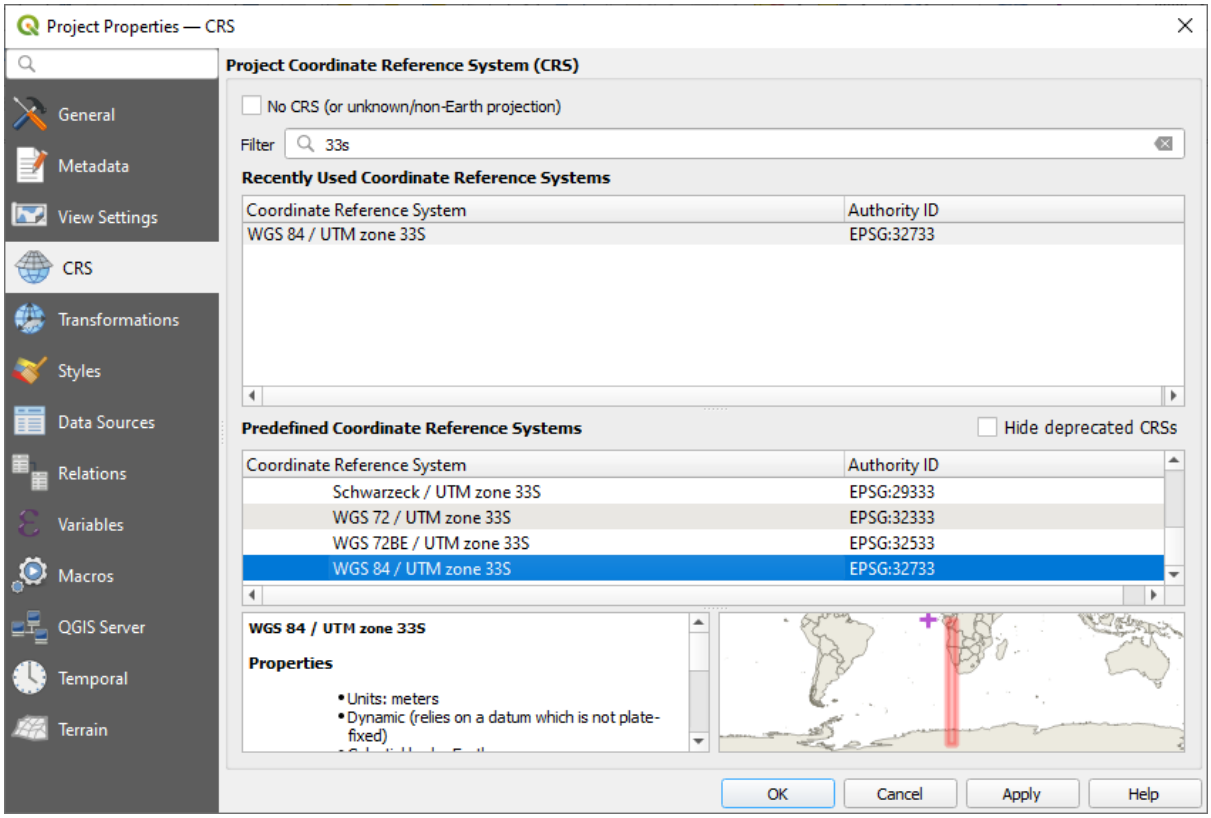


Fig. 8.1: Setting up the CRS

3. Save the project file by clicking on the Save Project toolbar button, or use the *Project* ► *Save As…* menu item.

   Save it in a new directory called `Rasterprac`, that you should create somewhere on your computer. You will save whatever layers you create in this directory as well. Save the project as `your_name_fynbos.qgs`.

8.4.4 Încărcarea Datelor în Hartă

In order to process the data, you will need to load the necessary layers (street names, zones, rainfall, DEM, districts) into the map canvas.

Pentru vectori...

1. Click on the Open Data Source Manager button in the *Data Source Manager Toolbar*, and enable the *Vector* tab in the dialog that appears, or use the *Layer* ► *Add Layer* ► *Add Vector Layer…* menu item
2. Ensure that *File* is selected
3. Click on the … button to browse for vector dataset(s)
4. In the dialog that appears, open the `exercise_data/more_analysis/Streets` directory
5. Selectați fișierul `Street_Names_UTM33S.shp`
6. Clic pe *Deschidere*.

   The dialog closes and shows the original dialog, with the file path specified in the text field next to *Vector dataset(s)*. This allows you to ensure that the correct file is selected. It is also possible to enter the file path in this field manually, should you wish to do so.

7. Click *Add*. The vector layer will be loaded into your map. Its color is automatically assigned. You will change it later.
8. Rename the layer to `Streets`
    1. Right-click on it in the *Layers* panel (by default, the pane along the left-hand side of the screen)
    2. Click *Rename* in the dialog that appears and rename it, pressing the `Enter` key when done
9. Repeat the vector adding process, but this time select the `Generalised_Zoning_Dissolve_UTM33S.shp` file in the `Zoning` directory.
10. Rename it to `Zoning`.
11. Load also the vector layer `admin_boundaries/Western_Cape_UTM33S.shp` into your map.
12. Rename it to `Districts`.

For rasters...

1. Click on the  Open Data Source Manager button and enable the  *Raster* tab in the dialog that appears, or use the *Layer* ► *Add Layer* ►  *Add Raster Layer…* menu item
2. Ensure that  *File* is selected
3. Navigate to the appropriate file, select it, and click *Open*
4. Do this for each of the following two raster files, `DEM/SRTM.tif` and `rainfall/reprojected/rainfall.tif`
5. Rename the SRTM raster to `DEM` and the rainfall raster to `Rainfall` (with an initial capital)

8.4.5 Modificarea ordinii straturilor

Click and drag layers up and down in the *Layers* panel to change the order they appear in on the map so that you can see as many of the layers as possible.

Now that all the data is loaded and properly visible, the analysis can begin. It is best if the clipping operation is done first. This is so that no processing power is wasted on computing values in areas that are not going to be used anyway.

8.4.6 Găsires Districtelor Corecte

Due to the aforementioned area of investigation, we need to limit our districts to the following ones:

- `Bellville`
- `Cape`
- `Goodwood`
- `Kuils River`
- `Mitchells Plain`
- `Simon Town`
- `Wynberg`

1. Right-click on the `Districts` layer in the *Layers* panel.
2. In the menu that appears, select the *Filter…* menu item. The *Query Builder* dialog appears.
3. You will now build a query to select only the candidate districts:

1. In the *Fields* list, double-click on the `NAME_2` field to make it appear in the *SQL where clause* text field below
2. Click the *IN* button to append it to the SQL query
3. Open the brackets
4. Click the *All* button below the (currently empty) *Values* list.

   After a short delay, this will populate the *Values* list with the values of the selected field (`NAME_2`).
5. Double-click the value `Bellville` in the *Values* list to append it to the SQL query.
6. Add a comma and double-click to add `Cape` district
7. Repeat the previous step for the remaining districts
8. Close the brackets

Fig. 8.2: Query builder

The final query should be (the order of the districts in the brackets does not matter):

```
"NAME_2" in ('Bellville', 'Cape', 'Goodwood', 'Kuils River',
             'Mitchells Plain', 'Simon Town', 'Wynberg')
```

Notă

You can also use the `OR` operator; the query would look like this:

```
"NAME_2" = 'Bellville' OR "NAME_2" = 'Cape' OR
"NAME_2" = 'Goodwood' OR "NAME_2" = 'Kuils River' OR
"NAME_2" = 'Mitchells Plain' OR "NAME_2" = 'Simon Town' OR
"NAME_2" = 'Wynberg'
```

1. Click *OK* twice.

   The districts shown in your map are now limited to those in the list above.

8.4.7 Decuparea Rasterelor

Acum, că aveți o zonă de interes, puteți decupa rasterele după ea.

1. Open the clipping dialog by selecting the menu item *Raster* ► *Extraction* ► *Clip Raster by Mask Layer…*
2. In the *Input layer* dropdown list, select the `DEM` layer
3. In the *Mask layer* dropdown list, select the `Districts` layer
4. Scroll down and specify an output location in the *Clipped (mask)* text field by clicking the … button and choosing *Save to File…*
   1. Navigate to the `Rasterprac` directory
   2. Enter a file name - `DEM_clipped.tif`
   3. Save
5. Make sure that *Open output file after running algorithm* is checked
6. Click *Run*

   After the clipping operation has completed, leave the *Clip Raster by Mask Layer* dialog open, to be able to reuse the clipping area

7. Select the `Rainfall` raster layer in the *Input layer* dropdown list and save your output as `Rainfall_clipped.tif`
8. Do not change any other options. Leave everything the same and click *Run*.
9. After the second clipping operation has completed, you may close the *Clip Raster by Mask Layer* dialog
10. Save the map

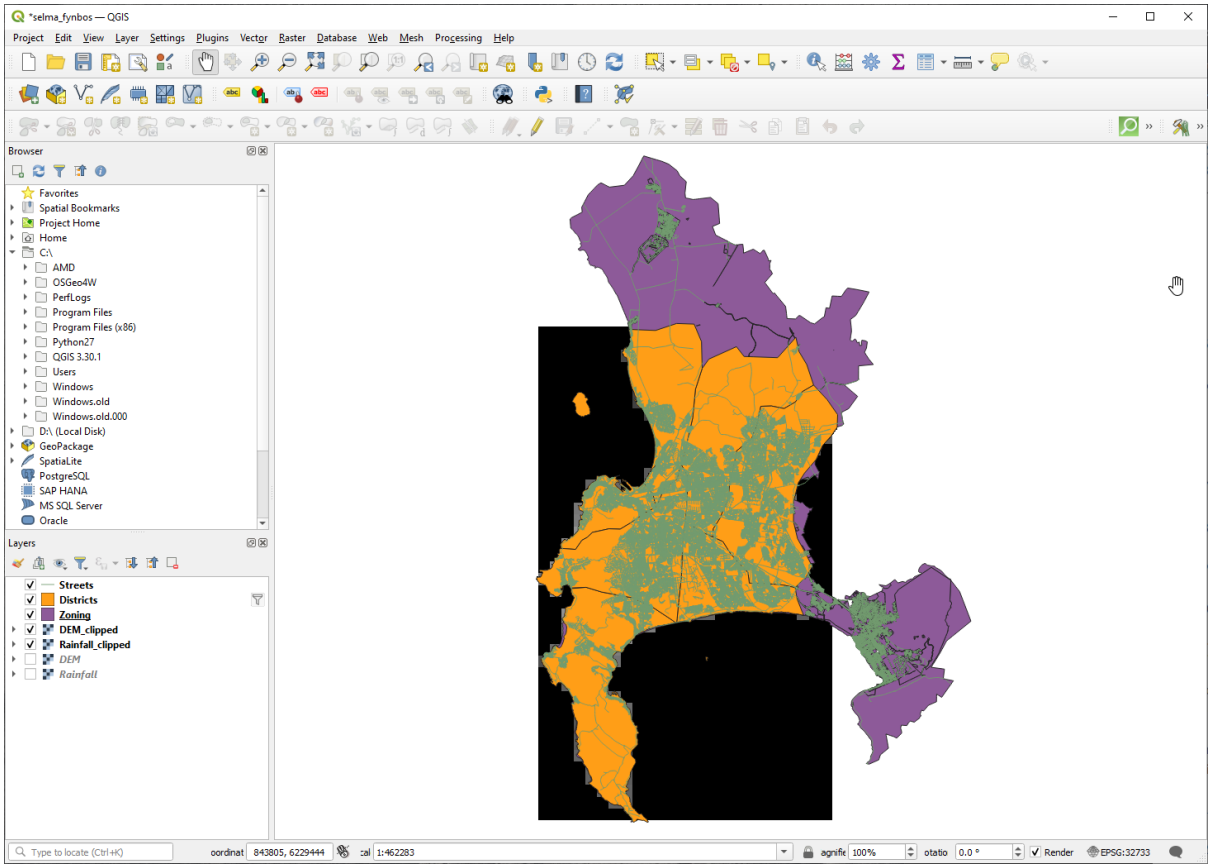


Fig. 8.3: Map view with filtered vector, clipped raster and reordered layers

Align the rasters

For our analysis we need the rasters to have the same CRS and they have to be aligned.

First we change the resolution of our rainfall data to 30 meters (pixel size):

1. In the *Layers* panel, ensure that `Rainfall_clipped` is the active layer (i.e., it is highlighted by having been clicked on)
2. Click on the *Raster* ► *Projections* ► *Warp (Reproject)…* menu item to open the *Warp (Reproject)* dialog
3. Under *Resampling method to use*, select *Bilinear (2x2 kernel)* from the drop down menu
4. Set *Output file resolution in target georeferenced units* to `30`
5. Scroll down to *Reprojected* and save the output in your `rainfall/reprojected` directory as `Rainfall30.tif`.
6. Make sure that  *Open output file after running algorithm* is checked

Fig. 8.4: Warp (Reproject) Rainfall_clipped

Then we align the DEM:

1. In the *Layers* panel, ensure that `DEM_clipped` is the active layer (i.e., it is highlighted by having been clicked on)
2. Click on the *Raster* ► *Projections* ► *Warp (Reproject)…* menu item to open the *Warp (Reproject)* dialog
3. Under *Target CRS*, select *Project CRS: EPSG:32733 - WGS 84 / UTM zone 33S* from the drop down menu
4. Under *Resampling method to use*, select *Bilinear (2x2 kernel)* from the drop down menu
5. Set *Output file resolution in target georeferenced units* to `30`
6. Scroll down to *Georeferenced extents of output file to be created*. Use the button to the right of the text box to select *Calculate from Layer* ► *Rainfall30*.
7. Scroll down to *Reprojected* and save the output in your `DEM/reprojected` directory as `DEM30.tif`.
8. Make sure that  *Open output file after running algorithm* is checked

Pentru a vedea în mod corespunzător ce se întâmplă, simbolistica pentru straturi trebuie să fie schimbată.

8.4.8 Schimbarea simbologiei straturilor vectoriale

1. In the *Layers* panel, right-click on the `Streets` layer
2. Select *Properties* from the menu that appears
3. Switch to the *Symbology* tab in the dialog that appears
4. Click on the *Line* entry in the top widget
5. Select a symbol in the list below or set a new one (color, transparency, …)
6. Click *OK* to close the *Layer Properties* dialog. This will change the rendering of the `Streets` layer.
7. Follow a similar process for the `Zoning` layer and choose an appropriate color for it

8.4.9 Schimbarea simbologiei straturilor raster

Simbologia straturilor raster este oarecum diferită.

1. Open the *Properties* dialog for the `Rainfall30` raster layer
2. Switch to the *Symbology* tab. You'll notice that this dialog is very different from the version used for vector layers.
3. Expand *Min/Max Value Settings*
4. Ensure that the button *Mean +/- standard deviation* is selected
5. Make sure that the value in the associated box is `2.00`
6. For *Contrast enhancement*, make sure it says *Stretch to MinMax*
7. For *Color gradient*, change it to *White to Black*
8. Clic pe *OK*



Fig. 8.5: Raster symbology

The `Rainfall30` raster, if visible, should change colors, allowing you to see different brightness values for each pixel

9. Repeat this process for the `DEM30` layer, but set the standard deviations used for stretching to `4.00`

8.4.10 Curățarea hărții

1. Remove the original `Rainfall` and `DEM` layers, as well as `Rainfall_clipped` and `DEM_clipped` from the *Layers* panel:
   - Clic-dreapta pe aceste straturi apoi selectați *Remove*.

   > **Notă**
   >
   > Acest lucru nu va elimina datele de pe dispozitivul de stocare, doar le va scoate din harta dvs.

2. Save the map
3. You can now hide the vector layers by unchecking the box next to them in the *Layers* panel. This will make the map render faster and will save you some time.

8.4.11 Crearea reliefului

In order to create the hillshade, you will need to use an algorithm that was written for this purpose.

1. In the *Layers* panel, ensure that `DEM30` is the active layer (i.e., it is highlighted by having been clicked on)
2. Click on the *Raster* ► *Analysis* ► *Hillshade…* menu item to open the *Hillshade* dialog
3. Scroll down to *Hillshade* and save the output in your `Rasterprac` directory as `hillshade.tif`
4. Make sure that *Open output file after running algorithm* is checked
5. Click *Run*
6. Așteptați să se termine prelucrarea.

Fig. 8.6: Raster analysis Hillshade

The new `hillshade` layer has appeared in the *Layers* panel.

1. Right-click on the `hillshade` layer in the *Layers* panel and bring up the *Properties* dialog
2. Click on the *Transparency* tab and set the *Global Opacity* slider to `20%`
3. Clic pe *OK*
4. Note the effect when the transparent hillshade is superimposed over the clipped DEM. You may have to change the order of your layers, or click off the `Rainfall30` layer in order to see the effect.

8.4.12 Panta

1. Click on the *Raster* ► *Analysis* ► *Slope…* menu item to open the *Slope* algorithm dialog
2. Select `DEM30` as *Input layer*
3. Check *Slope expressed as percent instead of degrees*. Slope can be expressed in different units (percent or degrees). Our criteria suggest that the plant of interest grows on slopes with a gradient between 15% and 60%. So we need to make sure our slope data is expressed as a percent.
4. Specify an appropriate file name and location for your output.
5. Make sure that *Open output file after running algorithm* is checked

6. Click *Run*

Fig. 8.7: Raster analysis Slope

The slope image has been calculated and added to the map. As usual, it is rendered in grayscale. Change the symbology to a more colorful one:

1. Open the layer *Properties* dialog (as usual, via the right-click menu of the layer)
2. Click on the *Symbology* tab
3. Where it says *Singleband gray* (in the *Render type* dropdown menu), change it to *Singleband pseudocolor*
4. Choose *Mean +/- standard deviation x* for *Min / Max Value Settings* with a value of `2.0`
5. Select a suitable *Color ramp*
6. Click *Run*

8.4.13 Try Yourself: Aspect

Use the same approach as for calculating the slope, choosing *Aspect…* in the *Raster* ► *Analysis* menu.

Remember to save the project periodically.

8.4.14 Reclasificarea rasterelor

1. Choose *Raster* ► *Raster calculator…*
2. Specify your `Rasterprac` directory as the location for the *Output layer* (click on the … button), and save it as `slope15_60.tif`
3. Ensure that the *Open output file after running algorithm* box is selected.

   In the *Raster bands* list on the left, you will see all the raster layers in your *Layers* panel. If your Slope layer is called `slope`, it will be listed as `slope@1`. Indicating band 1 of the slope raster.
4. The slope needs to be between `15` and `60` degrees.

   Using the list items and buttons in the interface, build the following expression:

```
(slope@1 > 15) AND (slope@1 < 60)
```

5. Alegeți o locație pentru câmpul *Output layer* și numele de fișier corespunzător.
6. Clic pe *Run*



Fig. 8.8: Raster calculator Slope

Now find the correct aspect (east-facing: between `45` and `135` degrees) using the same approach.

1. Build the following expression:

```
(aspect@1 > 45) AND (aspect@1 < 135)
```

You will know it worked when all of the east-facing slopes are white in the resulting raster (it's almost as if they are being lit by the morning sunlight).

Find the correct rainfall (greater than `1000` mm) the same way. Use the following expression:

```
Rainfall30@1 > 1000
```

Now that you have all three criteria each in separate rasters, you need to combine them to see which areas satisfy all the criteria. To do so, the rasters will be multiplied with each other. When this happens, all overlapping pixels with a value of `1` will retain the value of `1` (i.e. the location meets the criteria), but if a pixel in any of the three rasters has the value of `0` (i.e. the location does not meet the criteria), then it will be `0` in the result. In this way, the result will contain only the overlapping areas that meet all of the appropriate criteria.

8.4.15 Combinarea rasterelor

1. Open the *Raster Calculator* (*Raster* ► *Raster Calculator…*)
2. Build the following expression (with the appropriate names for your layers):

   ```
   [aspect45_135] * [slope15_60] * [rainfall_1000]
   ```

3. Set the output location to the `Rasterprac` directory
4. Name the output raster `aspect_slope_rainfall.tif`
5. Ensure that *Open output file after running algorithm* is checked
6. Click *Run*

The new raster now properly displays the areas where all three criteria are satisfied.

Save the project.



Fig. 8.9: Map view where all three criteria are satisfied

The next criterion that needs to be satisfied is that the area must be `250` m away from urban areas. We will satisfy this requirement by ensuring that the areas we compute are inside rural areas, and are `250` m or more from the edge of the area. Hence, we need to find all rural areas first.

8.4.16 Găsirea zonele rurale

1. Hide all layers in the *Layers* panel
2. Unhide the `Zoning` vector layer
3. Right-click on it and bring up the *Attribute Table* dialog. Note the many different ways that the land is zoned here. We want to isolate the rural areas. Close the Attribute table.
4. Right-click on the `Zoning` layer and select *Filter…* to bring up the *Query Builder* dialog
5. Build the following query:

   ```
   "Gen_Zoning" = 'Rural'
   ```

   See the earlier instructions if you get stuck.
6. Click *OK* to close the *Query Builder* dialog. The query should return one feature.

Query builder Zoning

You should see the rural polygons from the `Zoning` layer. You will need to save these.

1. In the right-click menu for `Zoning`, select *Export* ► *Save Features As…*.
2. Save your layer under the `Rasterprac` directory
3. Name the output file `rural.shp`
4. Clic pe *OK*
5. Save the project

Now you need to exclude the areas that are within `250m` from the edge of the rural areas. Do this by creating a negative buffer, as explained below.

8.4.17 Crearea unui tampon negativ

1. Click the menu item *Vector* ► *Geoprocessing Tools* ► *Buffer…*
2. In the dialog that appears, select the `rural` layer as your input vector layer (*Selected features only* should not be checked)
3. Set *Distance* to `-250`. The negative value means that the buffer will be an internal buffer. Make sure that the units are meters in the dropdown menu.
4. Check  *Dissolve result*
5. In *Buffered*, place the output file in the `Rasterprac` directory, and name it `rural_buffer.shp`
6. Click *Save*
7. Click *Run* and wait for the processing to complete
8. Închideți dialogul *Buffer*.

   Make sure that your buffer worked correctly by noting how the `rural_buffer` layer is different from the `rural` layer. You may need to change the drawing order in order to observe the difference.
9. Remove the `rural` layer
10. Save the project

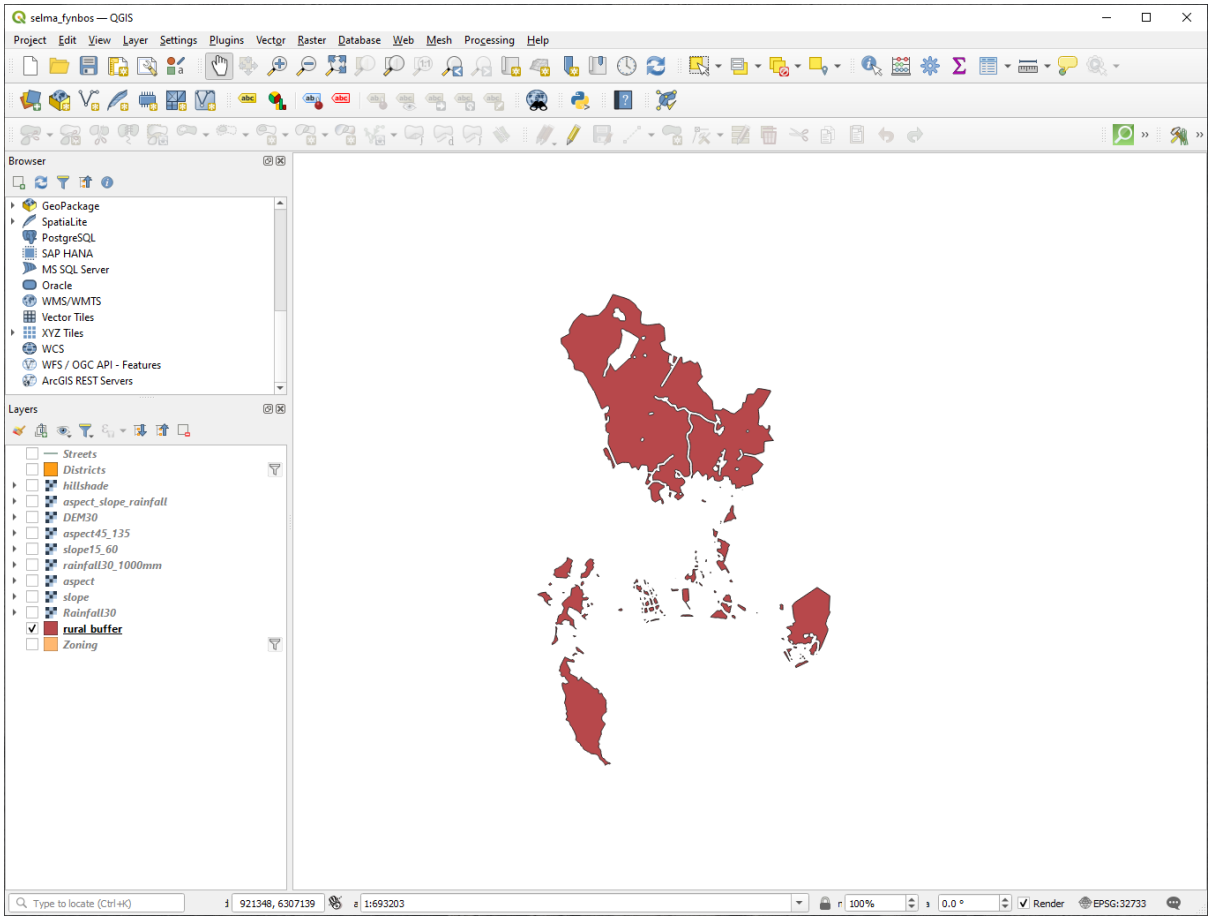


Fig. 8.10: Map view with rural buffer

Now you need to combine your `rural_buffer` vector layer with the `aspect_slope_rainfall` raster. To combine them, we will need to change the data format of one of the layers. In this case, you will vectorize the raster, since vector layers are more convenient when we want to calculate areas.

8.4.18 Vectorizarea rasterului

1. Click on the menu item *Raster* ► *Conversion* ► *Polygonize (Raster to Vector)…*
2. Select the `aspect_slope_rainfall` raster as *Input layer*
3. Set *Name of the field to create* to `suitable` (the default field name is `DN` - Digital number data)
4. Save the output. Under *Vectorized*, select *Save file as*. Set the location to `Rasterprac` and name the file `aspect_slope_rainfall_all.shp`.
5. Ensure that *Open output file after running algorithm* is checked
6. Click *Run*
7. Close the dialog when processing is complete

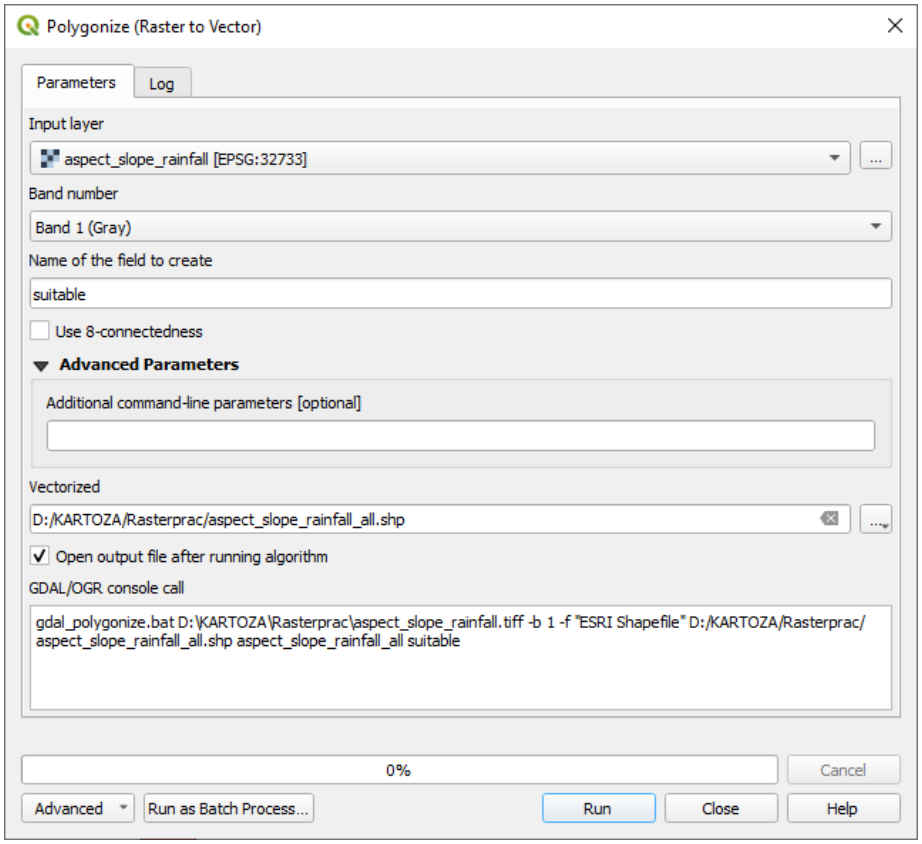


Fig. 8.11: Raster to Vector

All areas of the raster have been vectorized, so you need to select only the areas that have a value of `1` in the `suitable` field. (Digital Number.

1. Open the *Query Builder* dialog (right-click - *Filter…*) for the new vector layer
2. Build this query:

```
"suitable" = 1
```

3. Clic pe *OK*
4. After you are sure the query is complete (and only the areas that meet all three criteria, i.e. with a value of `1` are visible), create a new vector file from the results, using the *Export* ► *Save Features As…* in the layer's right-click menu
5. Save the file in the `Rasterprac` directory
6. Name the file `aspect_slope_rainfall_1.shp`
7. Remove the `aspect_slope_rainfall_all` layer from your map
8. Save your project

When we use an algorithm to vectorize a raster, sometimes the algorithm yields what is called „Invalid geometries", i.e. there are empty polygons, or polygons with mistakes in them, that will be difficult to analyze in the future. So, we need to use the *Fix Geometry* tool.

8.4.19 Fixing geometry

1. In the *Processing Toolbox*, search for `Fix geometries`, and *Execute...* it
2. For the *Input layer*, select `aspect_slope_rainfall_1`
3. Under *Fixed geometries*, select *Save file as*, and save the output to `Rasterprac` and name the file `fixed_aspect_slope_rainfall.shp`.
4. Ensure that  *Open output file after running algorithm* is checked
5. Click *Run*
6. Close the dialog when processing is complete

Now that you have vectorized the raster, and fixed the resulting geometry, you can combine the aspect, slope, and rainfall criteria with the distance from human settlement criteria by finding the intersection of the `fixed_aspect_slope_rainfall` layer and the `rural_buffer` layer.

8.4.20 Determining the Intersection of vectors

1. Click the menu item *Vector* ► *Geoprocessing Tools* ► *Intersection...*
2. In the dialog that appears, select the `rural_buffer` layer as *Input layer*
3. For the *Overlay layer*, select the `fixed_aspect_slope_rainfall` layer
4. In *Intersection*, place the output file in the `Rasterprac` directory
5. Name the output file `rural_aspect_slope_rainfall.shp`
6. Click *Save*
7. Click *Run* and wait for the processing to complete
8. Close the *Intersection* dialog.

   Make sure that your intersection worked correctly by noting that only the overlapping areas remain.
9. Save the project

The next criteria on the list is that the area must be greater than `6000` m^2. You will now calculate the polygon areas in order to identify the areas that are the appropriate size for this project.

8.4.21 Calculați aria pentru fiecare poligon

1. Open the new vector layer's right-click menu
2. Select *Open attribute table*
3. Click the  Toggle editing button in the top left corner of the table, or press `Ctrl+e`
4. Click the  Open field calculator button in the toolbar along the top of the table, or press `Ctrl+i`
5. In the dialog that appears, make sure that  *Create new field* is checked, and set the *Output field name* to `area` The output field type should be a decimal number (real). Set *Precision* to `1` (one decimal).
6. In the *Expression* area, type:

   ```
   $area
   ```

   This means that the field calculator will calculate the area of each polygon in the vector layer and will then populate a new integer column (called `area`) with the computed value.

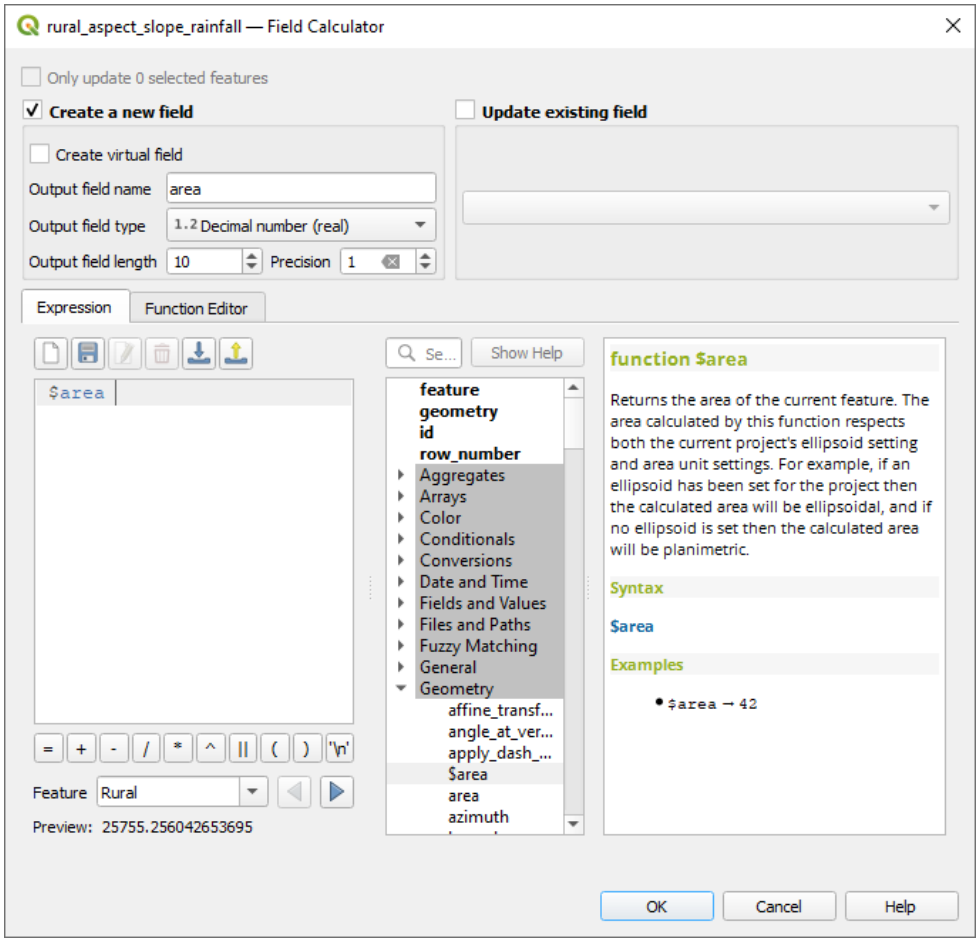


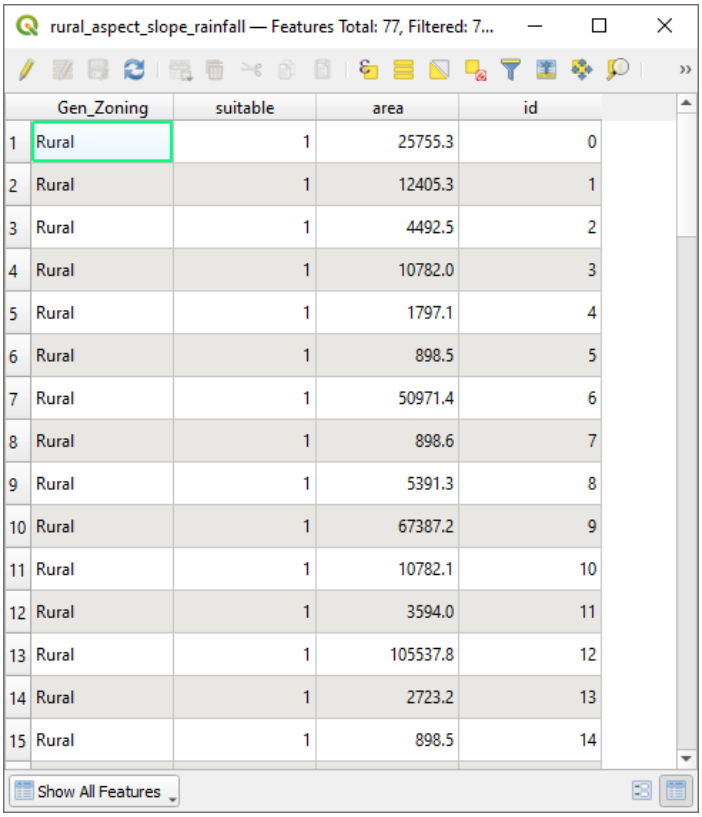
Fig. 8.12: Calculatorul de Câmpuri

7. Clic pe *OK*
8. Do the same thing for another new field called `id`. In *Field calculator expression*, type:

```
$id
```

   Acest lucru ne asigură că fiecare poligon are un ID unic, în scop de identificare.

9. Click  Toggle editing again, and save your edits if prompted to do so



	Gen_Zoning	suitable	area	id
1	Rural	1	25755.3	0
2	Rural	1	12405.3	1
3	Rural	1	4492.5	2
4	Rural	1	10782.0	3
5	Rural	1	1797.1	4
6	Rural	1	898.5	5
7	Rural	1	50971.4	6
8	Rural	1	898.6	7
9	Rural	1	5391.3	8
10	Rural	1	67387.2	9
11	Rural	1	10782.1	10
12	Rural	1	3594.0	11
13	Rural	1	105537.8	12
14	Rural	1	2723.2	13
15	Rural	1	898.5	14

Fig. 8.13: Attribute table with area and id columns

8.4.22 Selectarea zonelor cu o dimensiune dată

Acum, că ariile sunt cunoscute:

1. Build a query (as usual) to select only the polygons that are larger than `6000` m^2. The query is:

```
"area" > 6000
```

2. Save the selection in the `Rasterprac` directory as a new vector layer called `suitable_areas.shp`.

You now have the suitable areas that meet all of the habitat criteria for the rare fynbos plant, from which you will pick the four areas that are nearest to the University of Cape Town.

8.4.23 Digitize the University of Cape Town

1. Create a new vector layer in the `Rasterprac` directory as before, but this time, use *Point* as *Geometry type* and name it `university.shp`
2. Ensure that it is in the correct CRS (`Project CRS:EPSG:32733 - WGS 84 / UTM zone 33S`)
3. Finish creating the new layer (click *OK*)
4. Hide all layers except the new `university` layer and the `Streets` layer.
5. Add a background map (OSM):
    1. Go to the *Browser* panel and navigate to *XYZ Tiles* ► *OpenStreetMap*
    2. Drag and drop the `OpenStreetMap` entry to the bottom of the *Layers* panel

    Using your internet browser, look up the location of the University of Cape Town. Given Cape Town's unique topography, the university is in a very recognizable location. Before you return to QGIS, take note of where the university is located, and what is nearby.

6. Ensure that the `Streets` layer clicked on, and that the `university` layer is highlighted in the *Layers* panel
7. Navigate to the *View* ► *Toolbars* menu item and ensure that *Digitizing* is selected. You should then see a toolbar icon with a pencil on it (Toggle editing). This is the *Toggle Editing* button.
8. Click the *Toggle editing* button to enter *edit mode*. This allows you to edit a vector layer
9. Click the Add Point Feature button, which should be nearby the Toggle editing button
10. With the *Add feature* tool activated, left-click on your best estimate of the location of the University of Cape Town
11. Supply an arbitrary integer when asked for the `id`
12. Clic pe *OK*
13. Click the Save Layer Edits button
14. Click the *Toggle editing* button to stop your editing session
15. Save the project

8.4.24 Find the locations that are closest to the University of Cape Town

1. Go to the *Processing Toolbox*, locate the *Join Attributes by Nearest* algorithm (*Vector general* ► *Join Attributes by Nearest*) and execute it
2. *Input layer* should be `university`, and *Input layer 2* `suitable_areas`
3. Set an appropriate output location and name (`Joined layer`)
4. Set the *Maximum nearest neighbors* to `4`
5. Ensure that *Open output file after running algorithm* is checked
6. Leave the rest of the parameters with their default values
7. Click *Run*

The resulting point layer will contain four features - they will all have the location of the university and its attributes, and in addition, the attributes of the nearby suitable areas (including the `id`), and the distance to that location.

1. Open the attribute table of the result of the join
2. Note the `id` of the four nearest suitable areas, and then close the attribute table
3. Open the attribute table of the `suitable_areas` layer
4. Build a query to select the four suitable areas closest to the university (selecting them using the `id` field)

Acesta este răspunsul final la întrebarea.

For your submission, create a fully labeled layout that includes the semi-transparent hillshade layer over an appealing raster of your choice (such as the DEM or the slope raster, for example). Also include the university and the `suitable_areas` layer, with the four suitable areas that are closest to the university highlighted. Follow all the best practices for cartography in creating your output map.

CAPITOLUL 9

Module: Plugins

Plugin-uri vă permit extinderea funcționalității QGIS. În acest modul, vi se arată cum să activați și să utilizați plugin-uri.

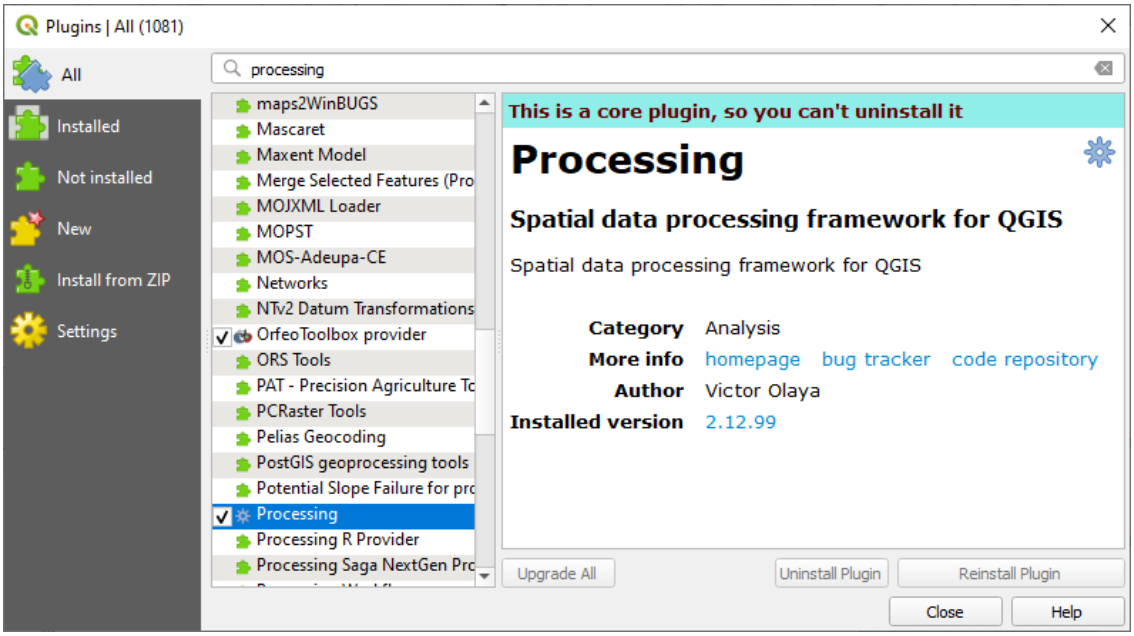
9.1 Lesson: Installing and Managing Plugins

Pentru a începe să utilizați plugin-uri, trebuie să știți cum să le descărcați, să le instalați și să le activați. Pentru a face acest lucru, veți învăța cum să utilizați *Instalatorul de Plugin-uri* și *Managerul de Plugin-uri*.

Scopul acestei lecții: Pentru a înțelege și pentru a utiliza sistemul de plugin-uri QGIS.

9.1.1 ??? Follow Along: Managing Plugins

1. Pentru a deschide *Plugin Manager*, faceți clic pe elementul de meniu *Plugins* ► *Manage and Install Plugins*.
2. În fereastra de dialog care apare, identificați plugin-ul *Processing*:

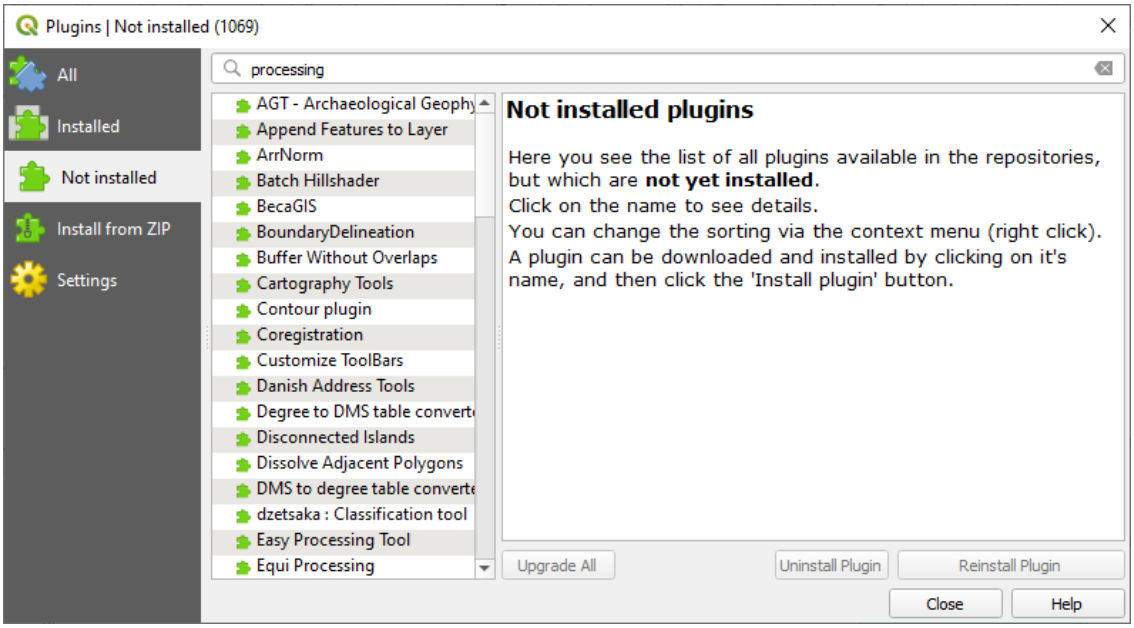


3. Click in the box next to this plugin and uncheck it to deactivate it.
4. Clic *Close*.
5. Looking at the menu, you will notice that the *Processing* menu is is now gone. This means that many of the processing functions you have been using before have disappeared! For example look at the *Vector* ► and *Raster* ► menus. This is because they are part of the *Processing* plugin, which needs to be activated to use them.
6. Open the *Plugin Manager* again and reactivate the *Processing* plugin by clicking in the checkbox next to it.
7. *Close* the dialog. The *Processing* menu and functions should be available again.

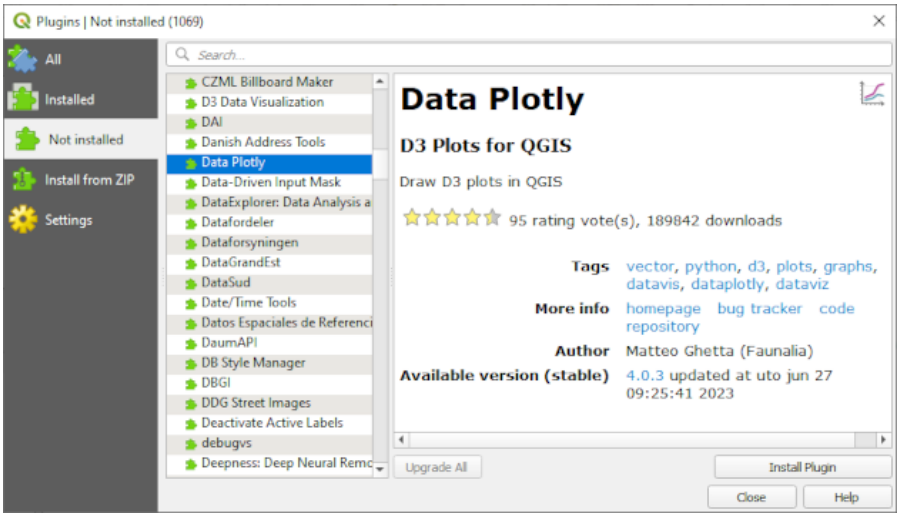
9.1.2 ??? Follow Along: Installing New Plugins

The list of plugins that you can activate and deactivate draws from the plugins that you currently have installed. To install new plugins:

1. Select the *Not Installed* option in the *Plugin Manager* dialog. The plugins available for you to install will be listed here. This list will vary depending on your existing system setup.



2. Find information about the plugin by selecting it in the list



3. Install the one(s) you are interested in by clicking the *Install Plugin* button below the plugin information panel.

Notă

if the plugin has some error it will be listed in the *Invalid* tab. You can then contact the plugin owner to fix the problem.

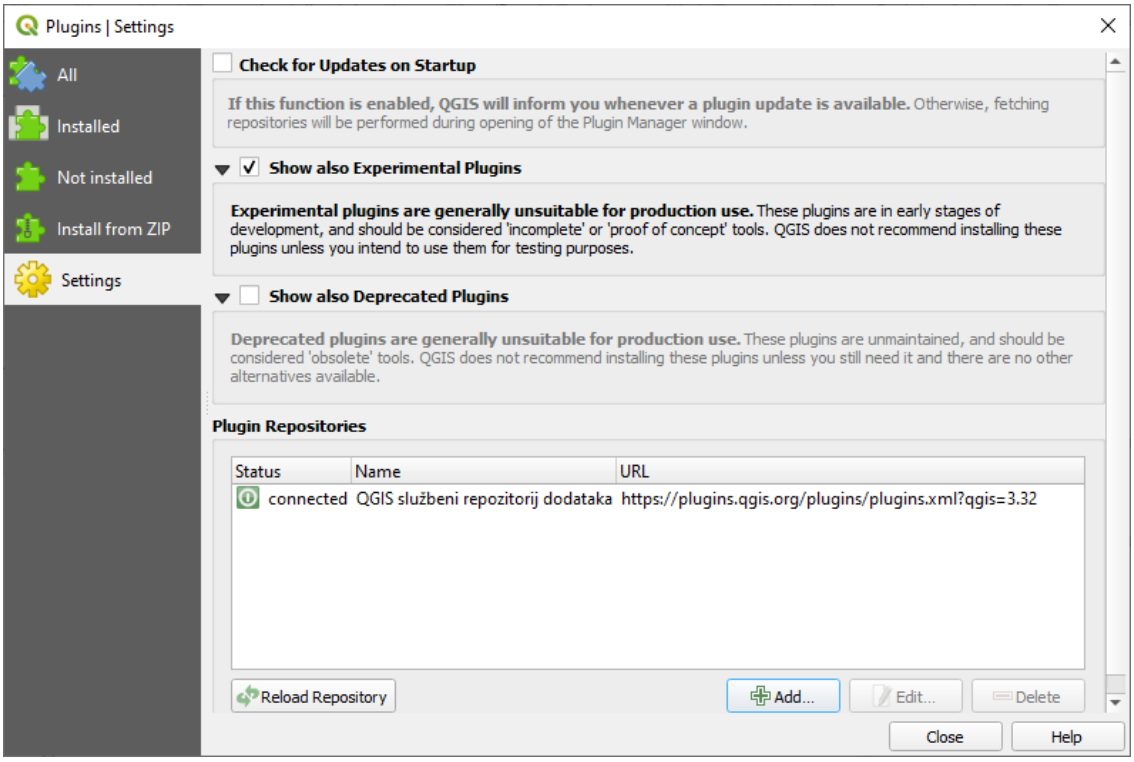
9.1.3 ??? Follow Along: Configuring Additional Plugin Repositories

Plugin-urile care sunt disponibile pentru instalare depind de *depozitele* configurate pentru utilizare.

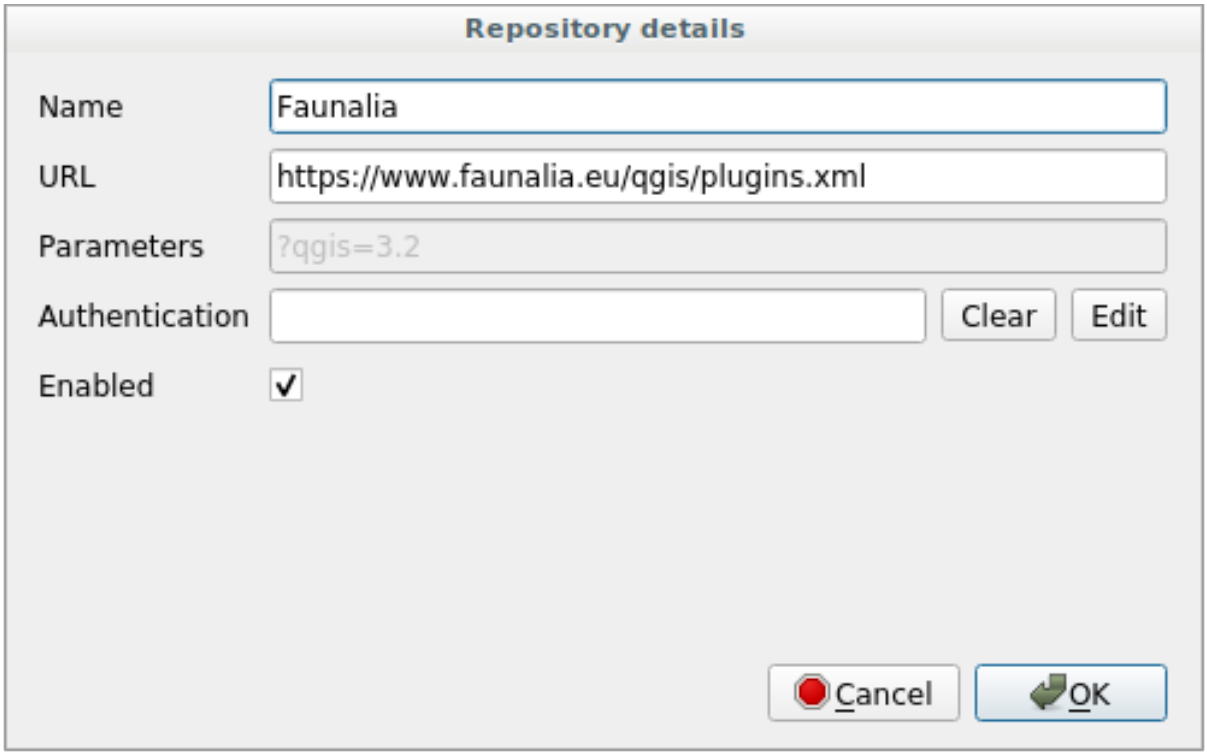
QGIS plugins are stored online in repositories. By default, only the official repository is active, meaning that you can only access plugins that are published there. Given the diversity of available tools, this repository should meet most of your needs.

Este posibil, totuși, să încercați mai multe plugin-uri decât cele implicite. În primul rând, ați vrea să configurați depozite suplimentare. Pentru a face acest lucru:

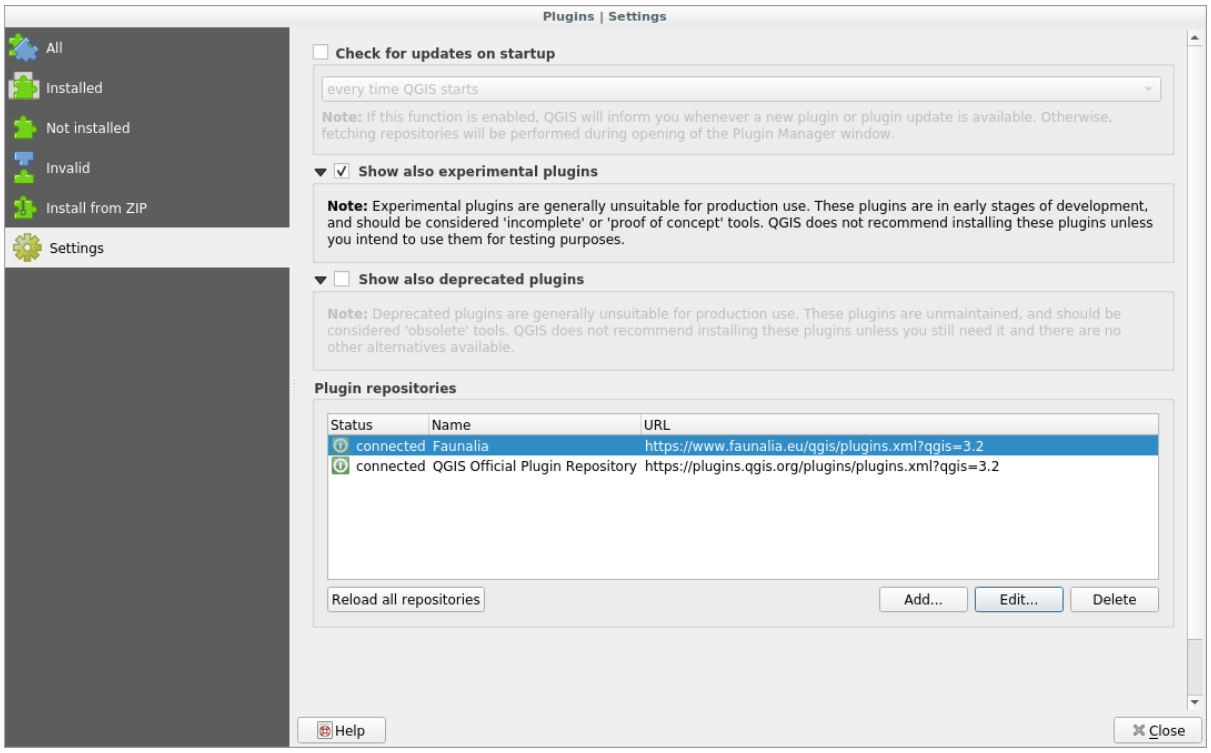
1. Open the *Settings* tab in the *Plugin Manager* dialog



2. Clic pe butonul *Adăugare*, pentru a găsi și a adăuga un nou depozit.
3. Furnizați un Nume și Adresa URL pentru noul depozit pe care doriți să-l configurați și asigurați-vă că este selectată caseta *Enabled*.



4. Veți vedea acum noul depozit de plugin-uri, enumerat în lista Depozitelor configurate pentru Plugin-uri



5. Puteți selecta, de asemenea, opțiunea de a afișa Plugin-urile Experimentale, prin alegerea *Show also experimental plugins*
6. If you now switch back to the *Not Installed* tab, you will see that additional plugins are available for installation.
7. To install a plugin, click on it in the list and then on the *Install plugin* button.

9.1.4 În concluzie

Installing plugins in QGIS should be straightforward and effective!

9.1.5 Ce urmează?

Mai departe, vă vom prezenta câteva plugin-uri utile ca exemple.

9.2 Lesson: Useful QGIS Plugins

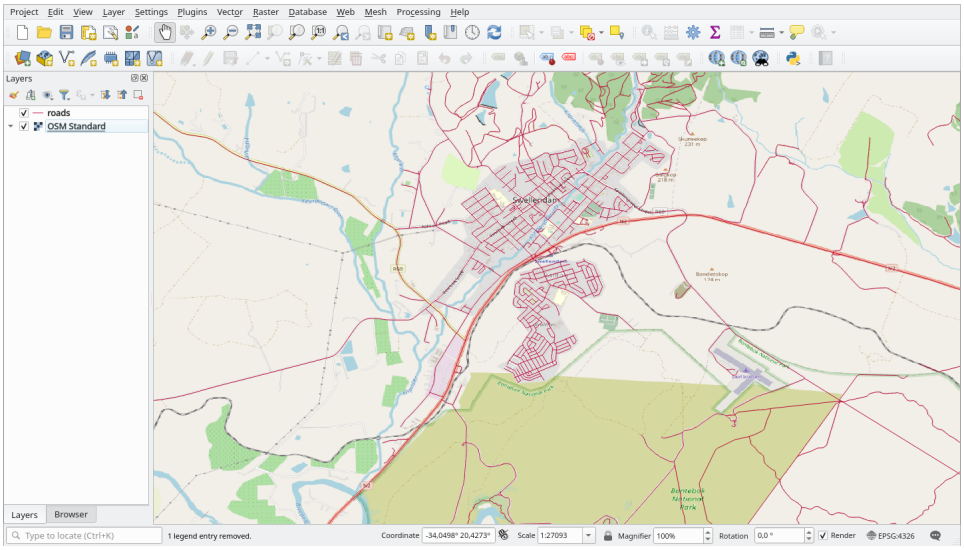
Acum, că puteți instala, activa și dezactiva plugin-uri, să vedem cum vă poate ajuta în practică acest lucru, privind la câteva exemple de plugin-uri utile.

Scopul acestei lecții: De a vă familiariza cu interfața plugin-urilor și de a face cunoștință cu unele plugin-uri utile.

9.2.1 ??? Follow Along: The QuickMapServices Plugin

The QuickMapServices plugin is a simple and easy to use plugin that adds base maps to your QGIS project. It has many different options and settings. Let's start to explore some of its features.

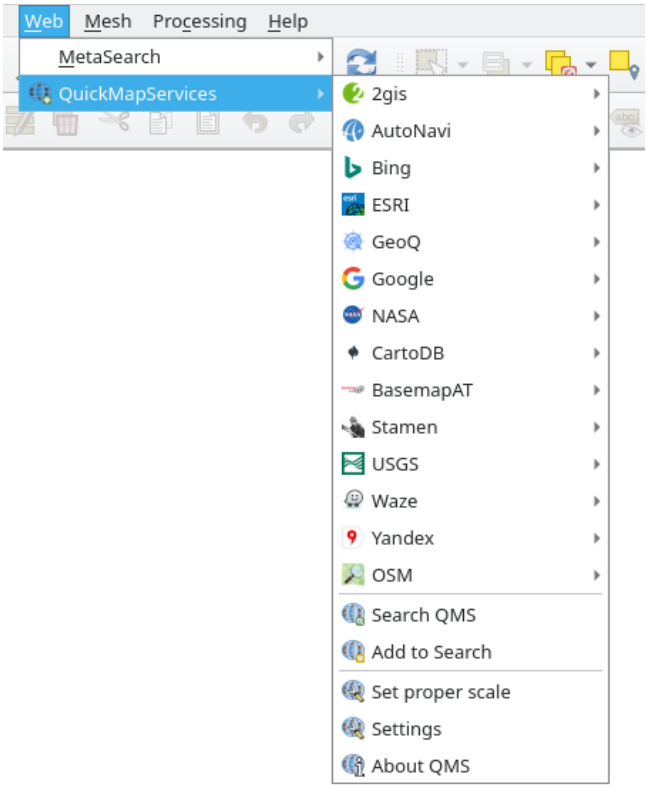
1. Start a new map and add the `roads` layer from the `training_data` Geopackage.
2. Install the **QuickMapServices** plugin.
3. Click on *Web* ► *QuickMapServices*. The first menu lists different map providers (`OSM`, `NASA`) with available maps.
4. Click on an entry and you would load the base map into your project.



Nice! But one of the main strengths of QMS is to provide access to many data providers. Let's add them.

1. Click on *Web* ► *QuickMapServices* ► *Settings*
2. Go to the *More services* tab.
3. Read carefully the message of this tab and if you agree click on the *Get Contributed pack* button.
4. Click *Save*.

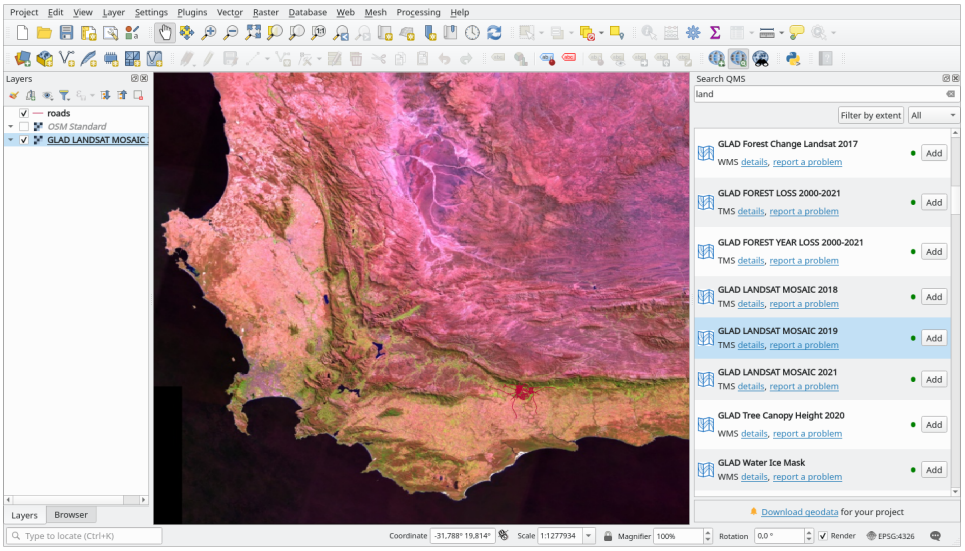
5. Reopen the *Web* ► *QuickMapServices* menu you will see that more providers are available.



6. Choose the one that best fits your needs, and load the data in the project!

It is also possible to search trough the now available data providers

1. Open the plugin's search tab by clicking on *Web* ► *QuickMapServices* ► *Search QMS*. This option of the plugin allows you to filter the available base maps by the current extent of the map canvas or using a search word.
2. Click on the *Filter by extent* and you should see one service available. If no service is found, zoom out and pan around the world (or your location) or search with a keyword.
3. Click on the *Add* button next to a returned dataset to load it.
4. The base map will be loaded and you will have a background for the map.



9.2.2 ??? Follow Along: The QuickOSM Plugin

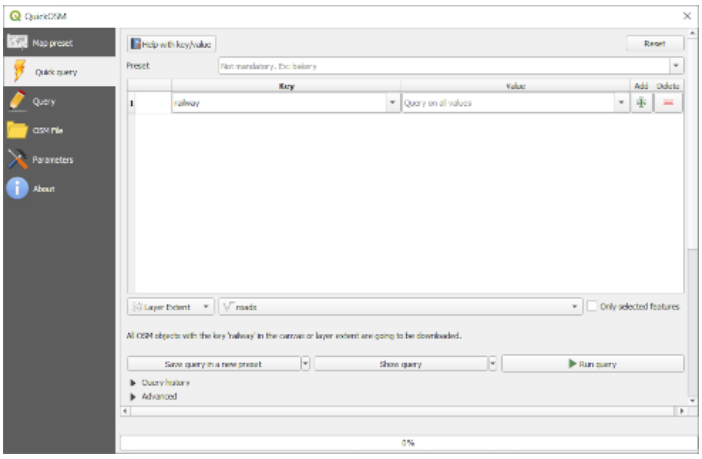
With an incredible simple interface, the QuickOSM plugin allows you to download OpenStreetMap data.

??? Follow Along: Using the Quick Query

1. Start a new empty project and add the `roads` layer from the `training_data` GeoPackage.
2. Install the **QuickOSM** plugin. The plugin adds two new buttons in the QGIS Toolbar and is accessible in the *Vector* ► *QuickOSM* menu.
3. Open the QuickOSM dialog. The plugin has many different tabs: we will use the *Quick Query* one.
4. You can download specific features by selecting a generic *Key* or be more specific and choose a specific *Key* and *Value* pair.

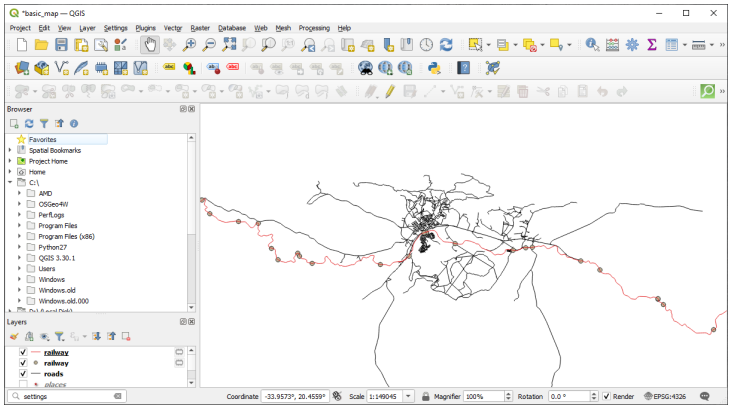
> **Sfat**
>
> if you are not familiar with the *Key* and *Value* system, click on the *Help with key/value* button. It will open a web page with a complete description of this concept of OpenStreetMap.

5. Look for `railway` in the *Key* menu and let the *Value* be empty: so we are downloading all the `railway` features without specifying any values.
6. Select *Layer Extent* in the next drop-down menu and choose `roads`.
7. Click on the *Run query* button.



After some seconds the plugin will download all the features tagged in OpenStreetMap as `railway` and load them directly into the map.

Nothing more! All the layers are loaded in the legend and are shown in the map canvas.



Atenționare

QuickOSM creates temporary layer when downloading the data. If you want to save them permanently, click on the icon next to the layer and choose the options you prefer. Alternatively you can open the *Advanced* menu in QuickOSM and choose where to save the data in the *Directory* menu.

Follow Along: The QuickOSM Query engine

The quickest way to download data from QuickOSM plugin is using the *Quick query* tab and set some small parameters. But if you need some more specific data?

If you are an OpenStreetMap query master you can use QuickOSM plugin also with your personal queries.

QuickOSM has an incredible data parser that, together with the amazing query engine of Overpass, lets you download data with your specific needs.

For example: we want to download the mountain peaks that belongs into a specific mountain area known as Dolomites.

You cannot achieve this task with the *Quick query* tab, you have to be more specific and write your own query. Let's try to do this.

1. Începere proiect nou
2. Open the QuickOSM plugin and click on the *Query* tab.
3. Copy and paste the following code into the query canvas:

```
  <!--
This shows all mountains (peaks) in the Dolomites.
You may want to use the "zoom onto data" button. =>
-->
<osm-script output="json">
<!-- search the area of the Dolomites -->
<query type="area">
  <has-kv k="place" v="region"/>
  <has-kv k="region:type" v="mountain_area"/>
  <has-kv k="name:en" v="Dolomites"/>
</query>
<print mode="body" order="quadtile"/>
<!-- get all peaks in the area -->
<query type="node">
  <area-query/>
  <has-kv k="natural" v="peak"/>
</query>
<print mode="body" order="quadtile"/>
<!-- additionally, show the outline of the area -->
```

(continues on next page)

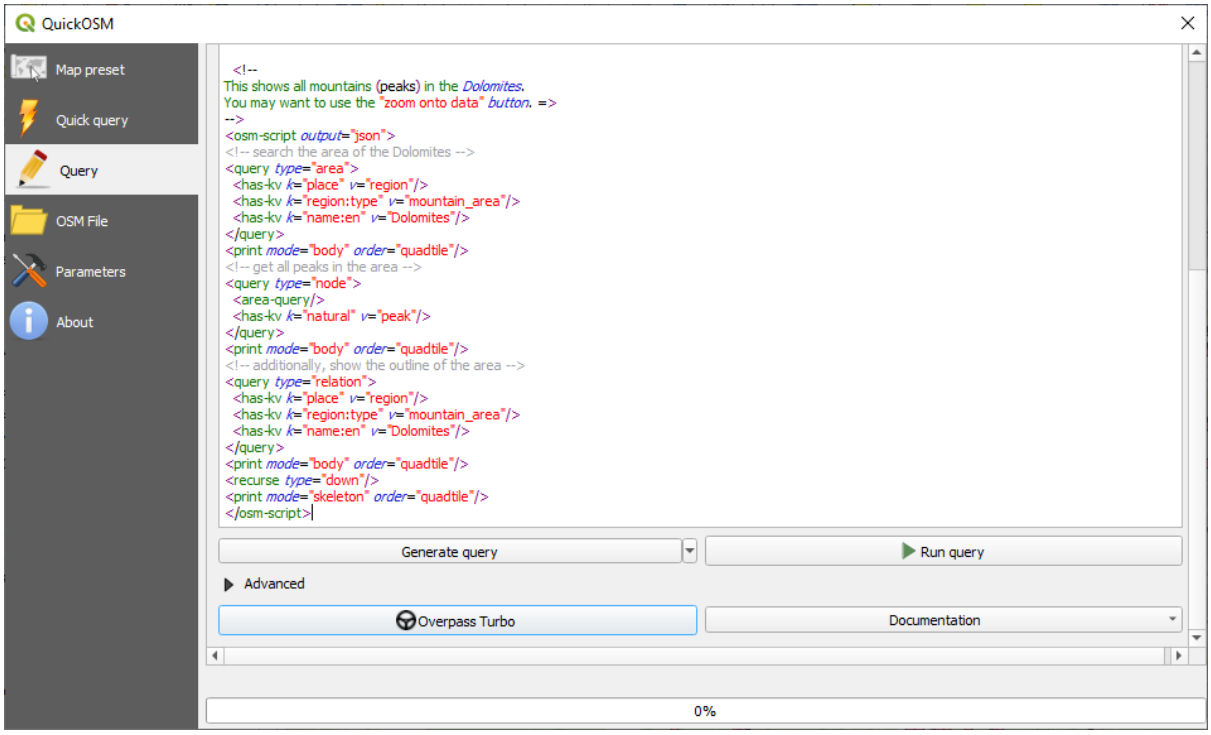
(continuare din pagina precedentă)

```
<query type="relation">
  <has-kv k="place" v="region"/>
  <has-kv k="region:type" v="mountain_area"/>
  <has-kv k="name:en" v="Dolomites"/>
</query>
<print mode="body" order="quadtile"/>
<recurse type="down"/>
<print mode="skeleton" order="quadtile"/>
</osm-script>
```

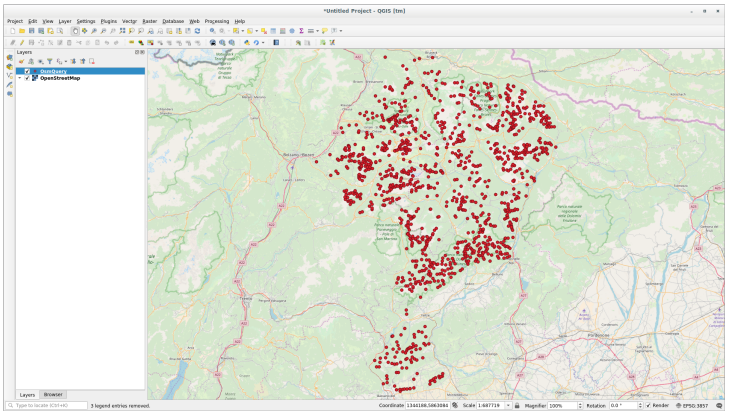
Notă

This query is written in a `xml` like language. If you are more used to the `Overpass QL` you can write the query in this language.

4. And click on *Run Query*:



The mountain peaks layer will be downloaded and shown in QGIS:



You can write complex queries using the Overpass Query language. Take a look at some example and try to explore the query language.

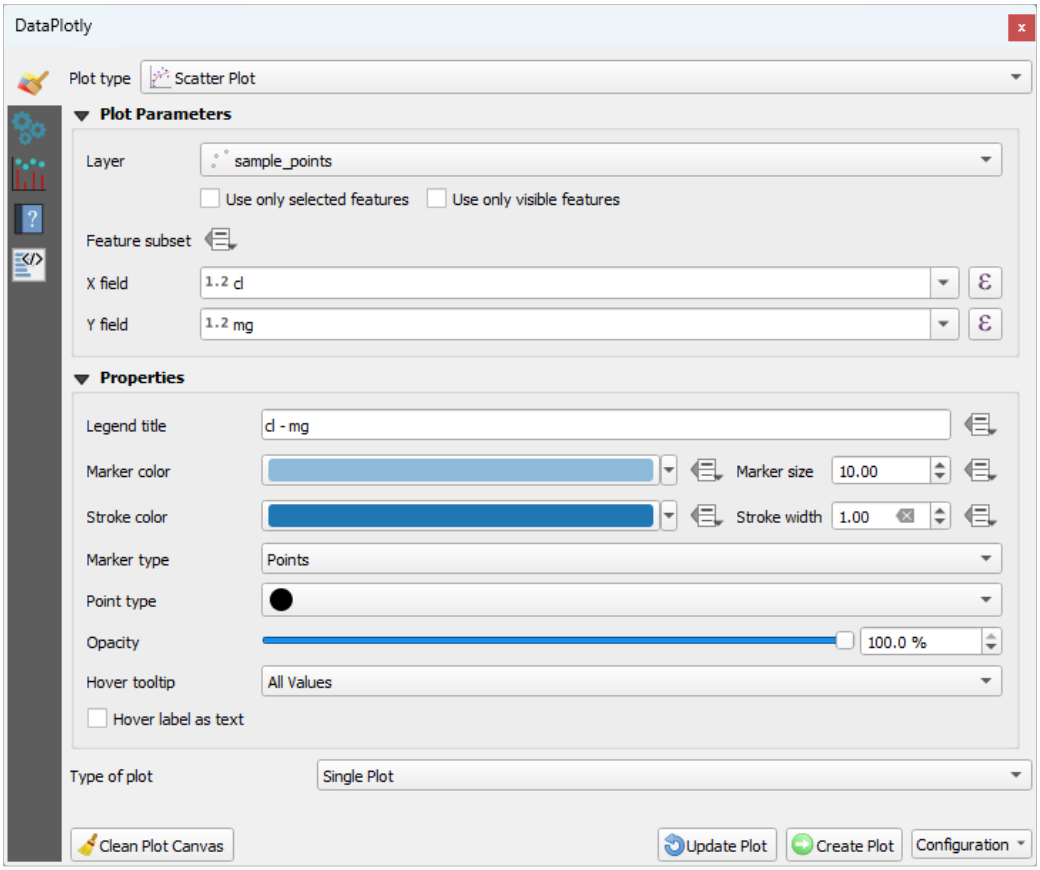
9.2.3 ??? Follow Along: The DataPlotly Plugin

The **DataPlotly** plugin allows you to create D3 plots of vector attributes data thanks to the plotly library.

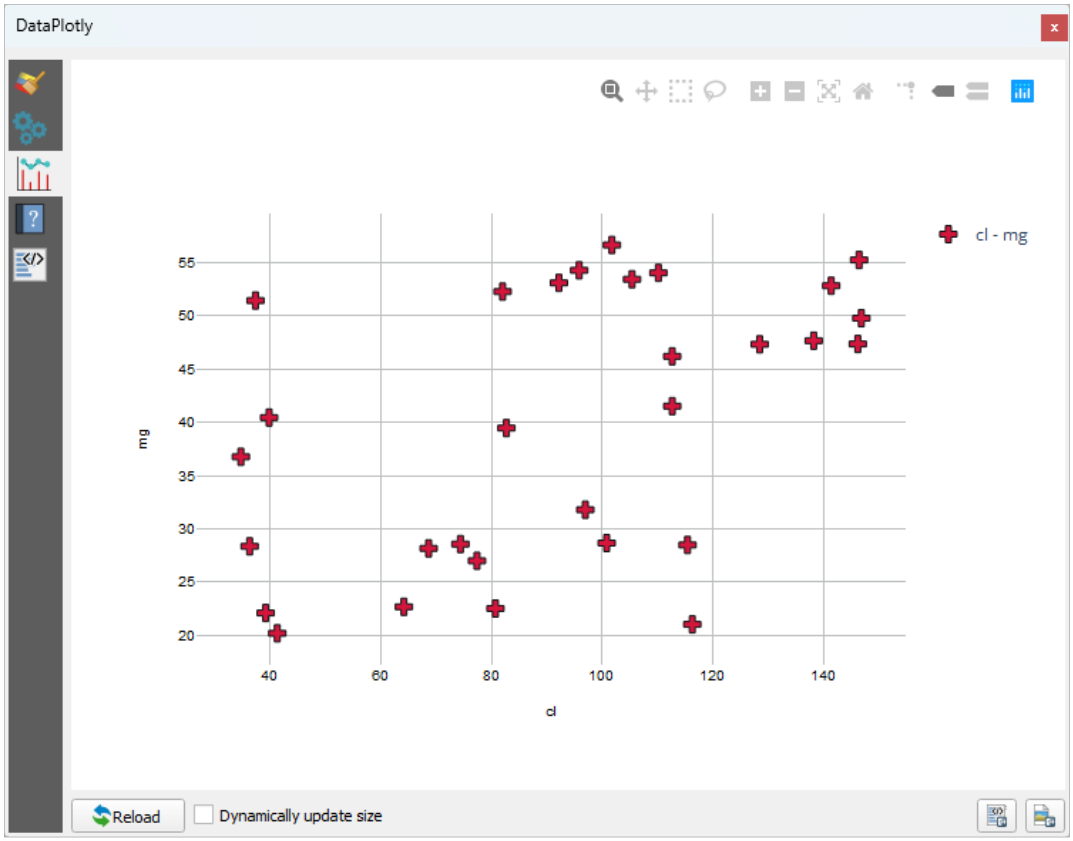
1. Începere proiect nou
2. Load the `sample_points` layer from the `exercise_data/plugins` folder
3. Install the plugin following the guidelines described in *??? Follow Along: Installing New Plugins* searching *Data Plotly*
4. Open the plugin by clicking on the new icon in the toolbar or in the *Plugins* ► *Data Plotly* menu

In the following example we are creating a simple `Scatter Plot` of two fields of the `sample_points` layer. In the DataPlotly Panel:

1. Choose `sample_points` in the Layer filter, *cl* for the *X Field* and *mg* for the *Y Field*:



2. If you want you can change the colors, the marker type, the transparency and many other settings: try to change some parameters to create the plot below.



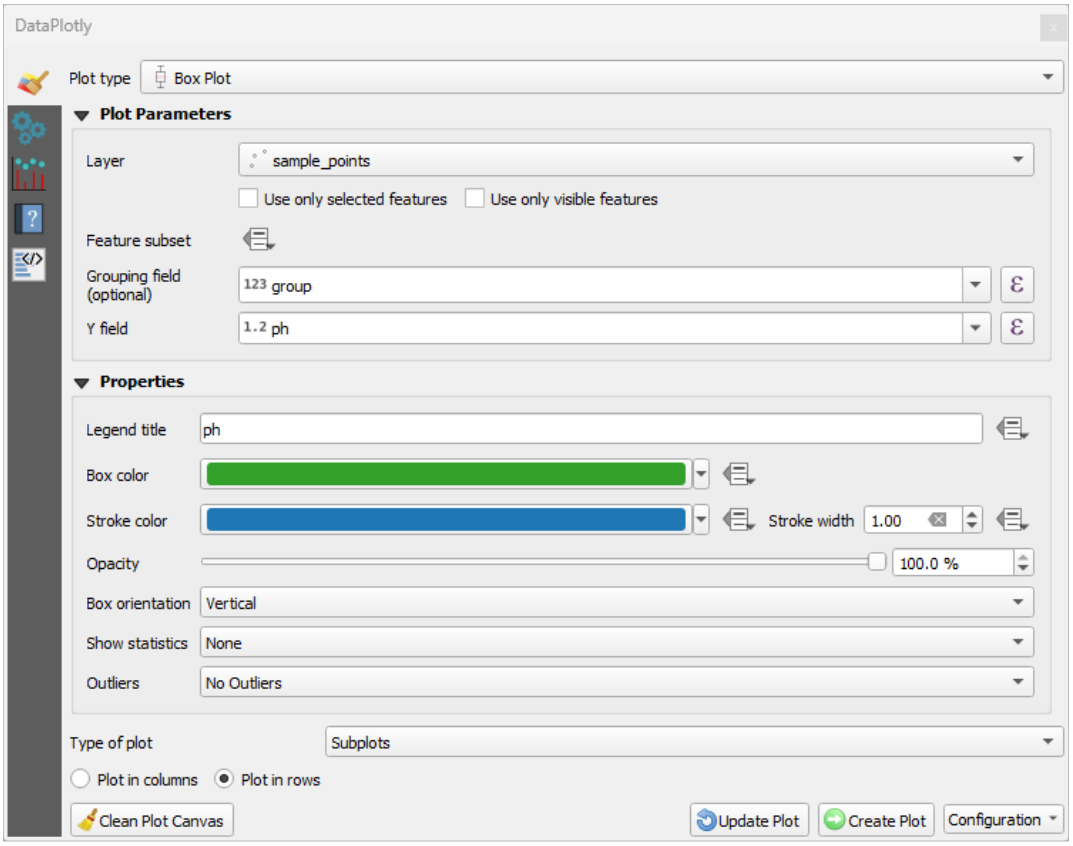
3. Once you have set all the parameters, click on the *Create Plot* button to create the plot.

The plot is interactive: this means you can use all the upper buttons to resize, move, or zoom in/out the plot canvas. Moreover, each element of the plot is interactive: by clicking or selecting one or more point on the plot, the corresponding point(s) will be selected in the plot canvas.

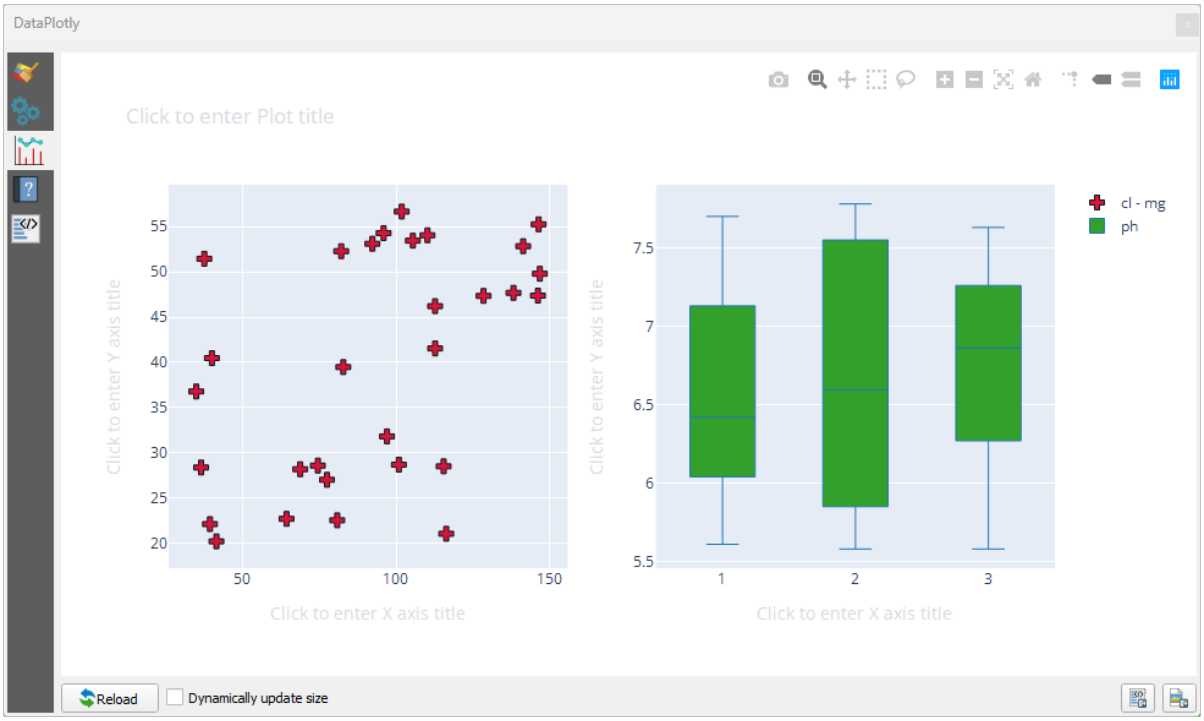
You can save the plot as a `png` static image or as an `html` file by clicking on the  or on the  button in the lower right corner of the plot.

There is more. Sometimes it can be useful to have two (or more) plots showing different plot types with different variables on the same page. Let's do this!

1. Go back to the main plot settings tab by clicking on the  button in the upper left corner of the plugin panel
2. Change the *Plot Type* to *Box Plot*
3. Choose *group* as *Grouping Field* and *ph* as *Y Field*
4. In the lower part of the panel, change the *Type of Plot* from *SinglePlot* to *SubPlots* and let the default option *Plot in Rows* selected.



5. Once done click on the *Create Plot* button to draw the plot



Now both scatter plot and box plot are shown in the same plot page. You still have the chance to click on each plot item and select the corresponding features in the map canvas.

Sfat

Each plot has its own manual page available in the  tab. Try to explore all the plot types and see all the other settings available.

9.2.4 În concluzie

Sunt disponibile multe plugin-uri utile pentru QGIS. Folosind instrumentele încorporate, pentru instalarea și gestionarea acestor plugin-uri, puteți găsi noi plugin-uri și să efectuați o utilizare optimă a acestora.

9.2.5 Ce urmează?

Apoi, vom analiza modul de utilizare al straturilor care sunt găzduite pe servere aflate la distanță, în timp real.

CAPITOLUL 10

Module: Online Resources

Atunci când se analizează sursele de date pentru o hartă, nu este necesar să vă limitați la datele pe care le-ați salvat pe computerul la care lucrați. Există surse de date online, pe care le puteți încărca atât timp cât sunteți conectat la Internet.

În acest modul, vom acoperi cele două tipuri de servicii GIS bazate pe web: Servicii Web Mapping (WMS) și Servicii Web Feature (WFS).

10.1 Lesson: Web Mapping Services

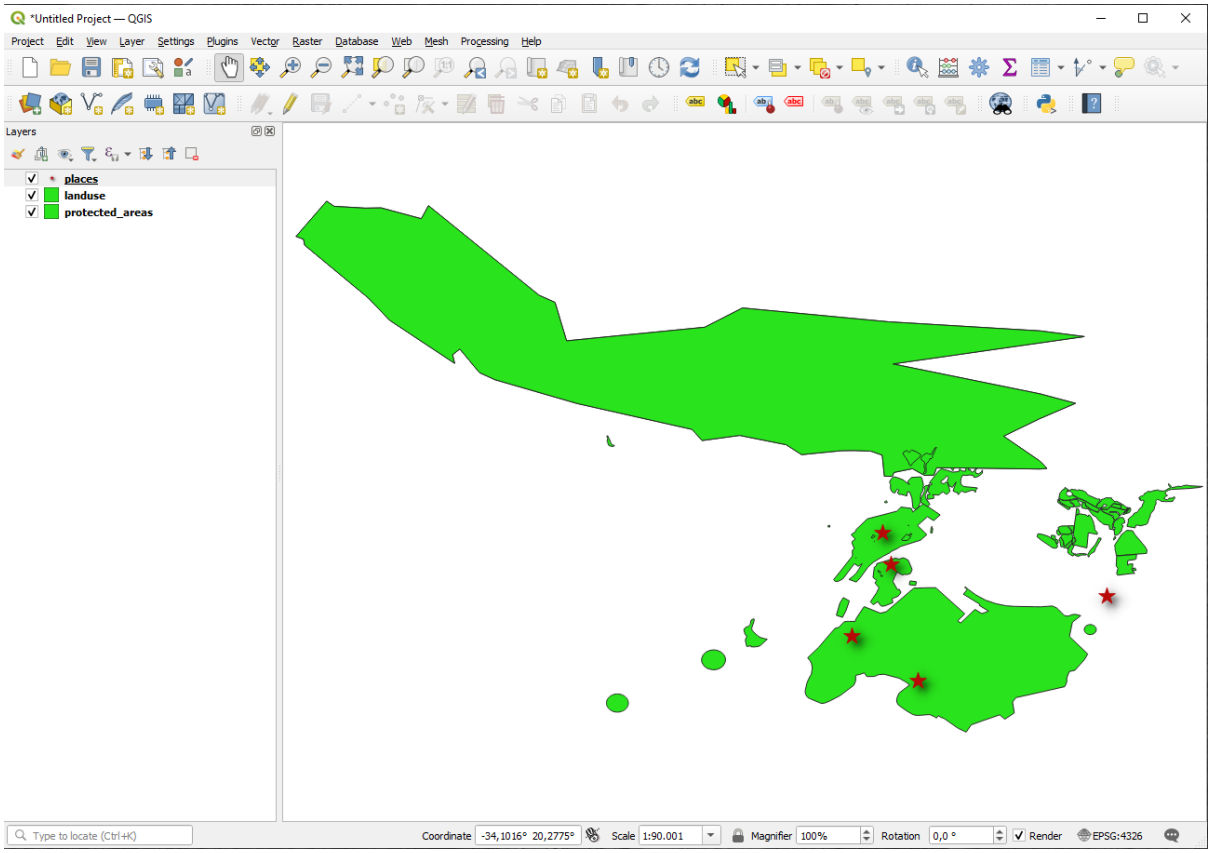
Un Serviciu de Cartografiere Web (WMS) este un serviciu găzduit pe un server aflat la distanță. Similar unui site web, îl puteți accesa, atât timp cât aveți o conexiune la server. Cu ajutorul QGIS, puteți încărca un WMS direct în harta existentă.

Din lecția despre plugin-uri, ne amintim că este posibilă încărcarea unei noi imagini raster, spre exemplu, de la Google. Totuși, aceasta este o tranzacție once-off: o dată ce ați descărcat imaginea, aceasta nu se mai schimbă. Un WMS este diferit prin faptul că este un serviciu live, care se va actualiza automat, la deplasarea sau mărirea hărții.

Scopul acestei lecții: De a folosi un WMS și de a-i înțelege limitările.

10.1.1 ??? Follow Along: Loading a WMS Layer

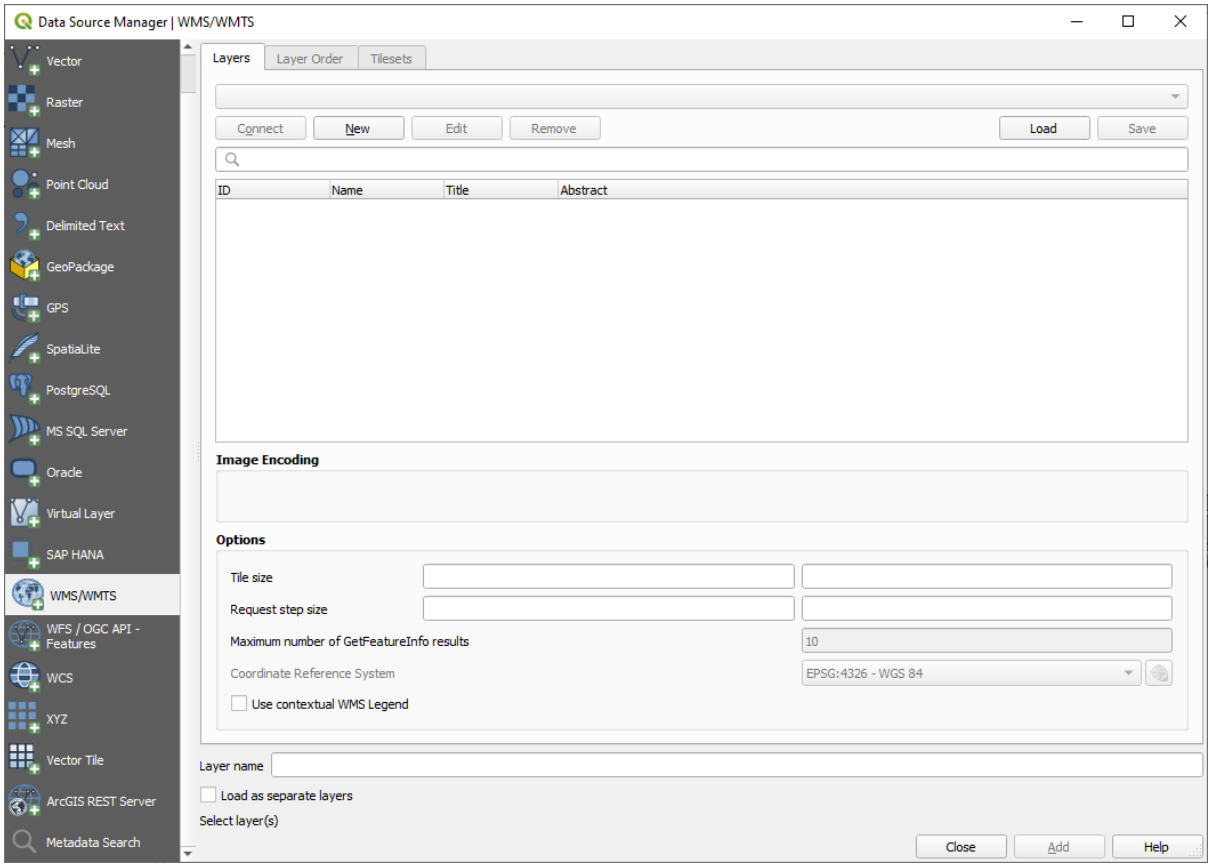
For this exercise, you can either use the basic map you made at the start of the course, or just start a new map and load some existing layers into it. For this example, we used a new map and loaded the original `places`, `landuse` and `protected_areas` layers and adjusted the symbology:



1. Încărcați aceste straturi într-o nouă hartă, sau folosiți harta originală doar cu aceste straturi vizibile.

2. Before starting to add the WMS layer, deactivate „on the fly" projection (*Project* ► *Properties…* ► *CRS* tab, check *No CRS (or unknown/non-Earth projection)*. This may cause the layers to no longer overlap properly, but don't worry: we'll fix that later.

3. To add WMS layers, click on the  button to open the *Data Source Manager* dialog and enable the  *WMS/WMTS* tab.

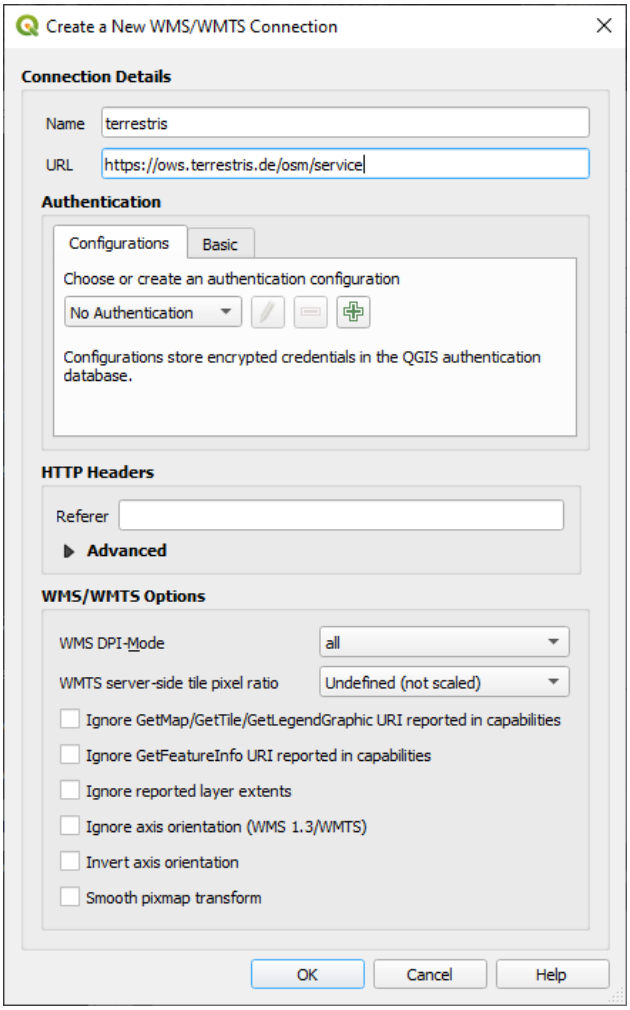


Remember how you connected to a SpatiaLite or GeoPackage database at the beginning of the course. The `landuse`, `buildings`, and `roads` layers are stored in a database. To use those layers, you first needed to connect to the database. Using a WMS is similar, with the exception that the layers are on a remote server.

4. Pentru a crea o nouă conexiune la un WMS, faceți clic pe butonul *New*.

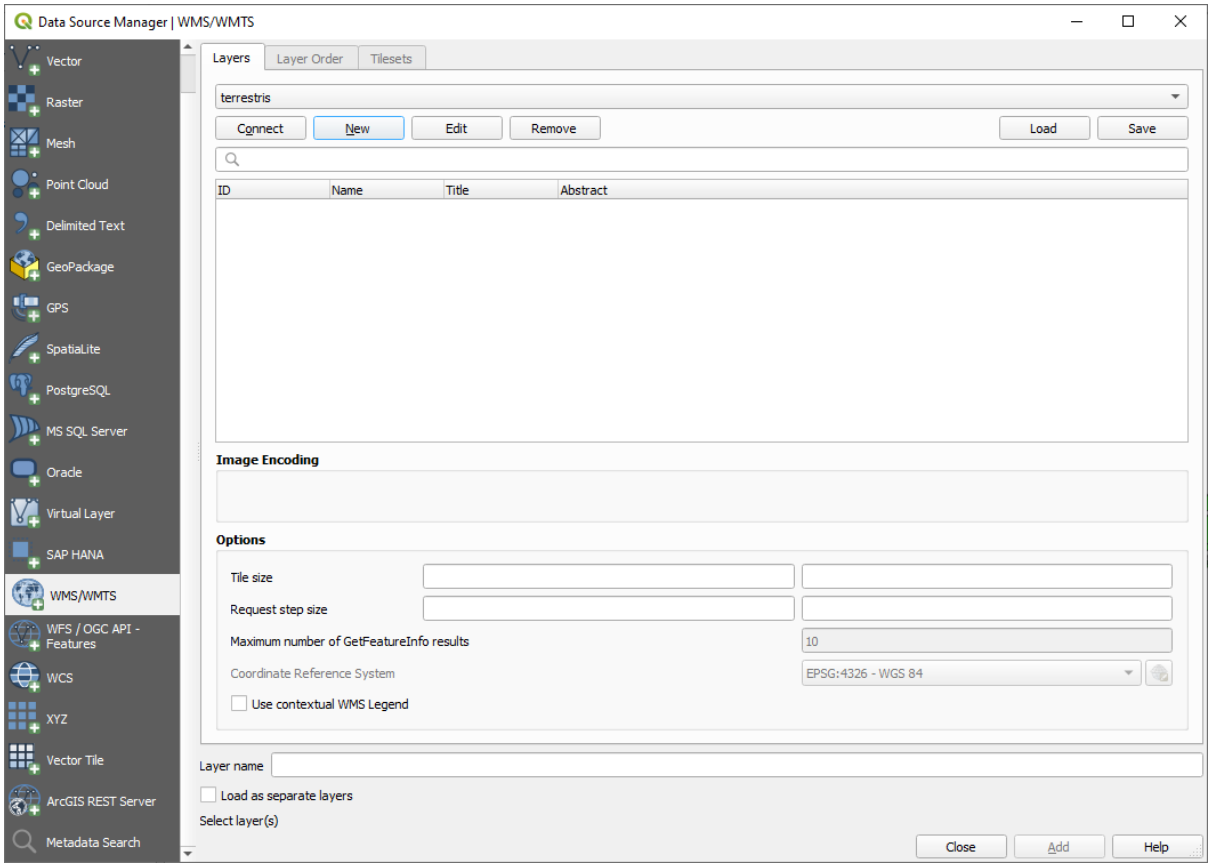
   You'll need a WMS address to continue. There are several free WMS servers available on the Internet. One of these is terrestris, which makes use of the OpenStreetMap dataset.

5. Pentru a face uz de acest WMS, setați-l în dialogul curent, astfel:

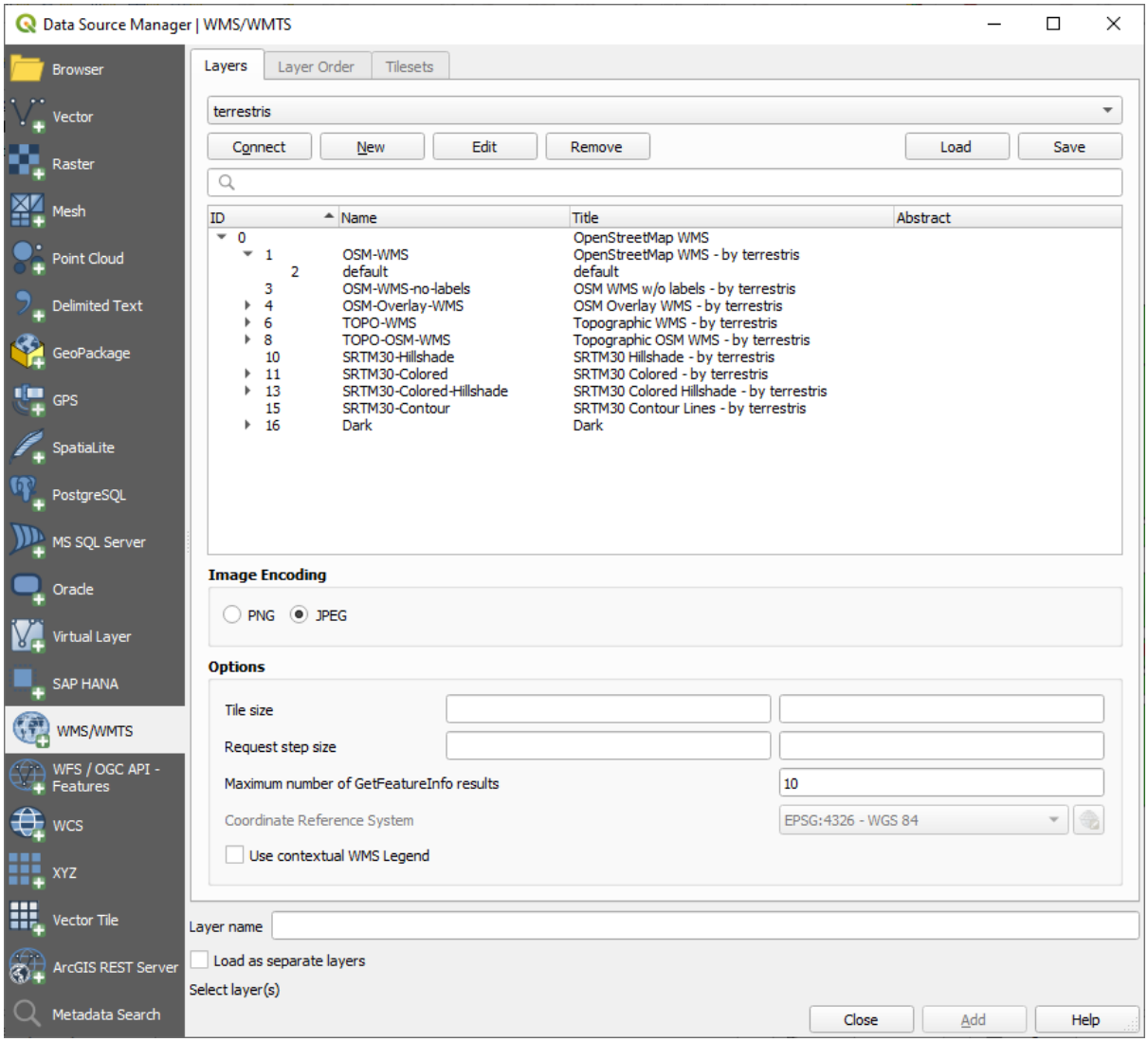


- The value of the *Name* field should be `terrestris`.
- The value of the *URL* field should be `https://ows.terrestris.de/osm/service`.

6. Faceți clic pe *Ok*. Ar trebui să vedeți listat noul server WMS:

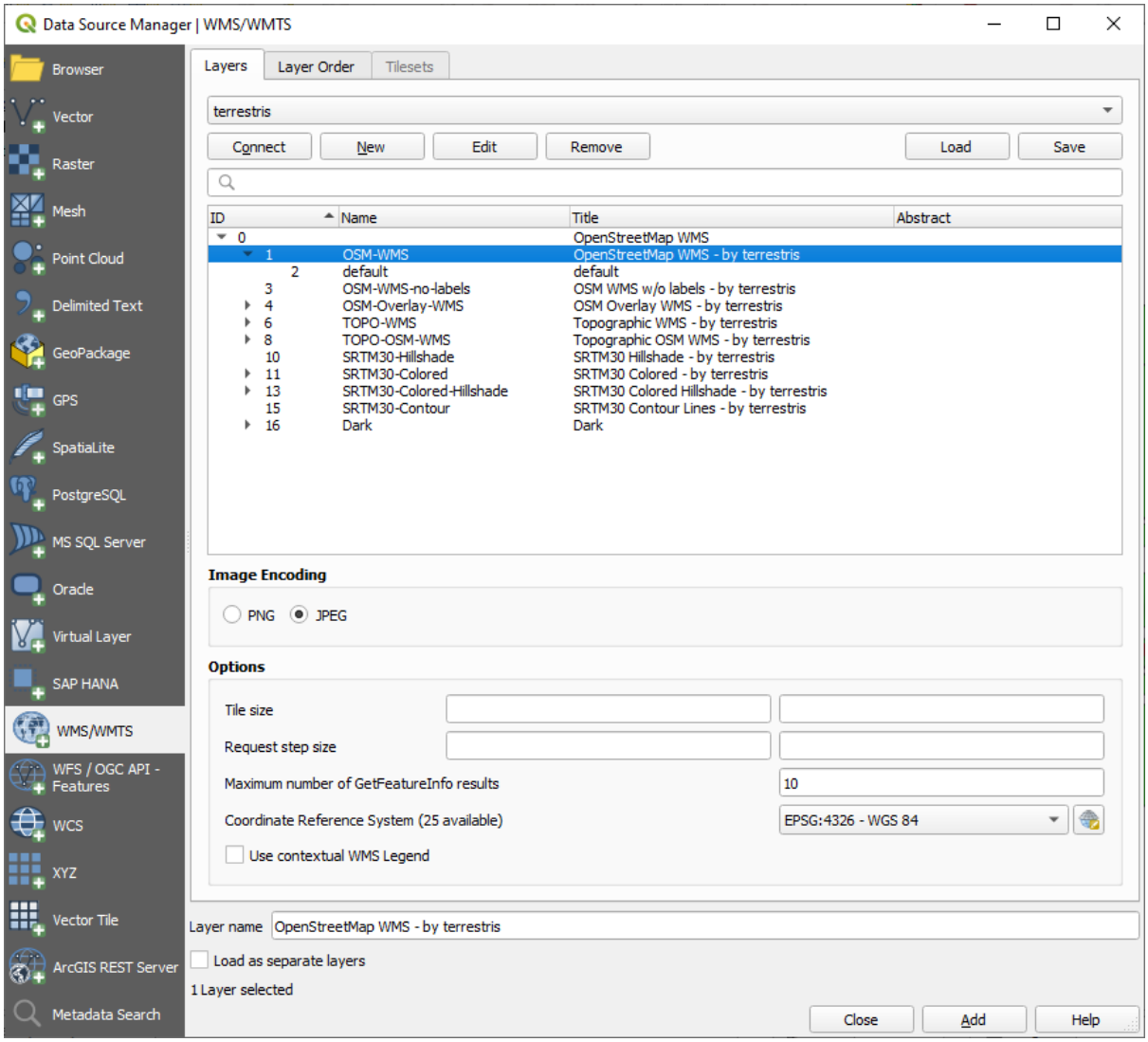


7. Faceți clic pe *Conectare*. În lista de mai jos, ar trebui să vedeți încărcate acum, aceste noi intrări:



Acestea sunt toate straturile găzduite de acest server WMS.

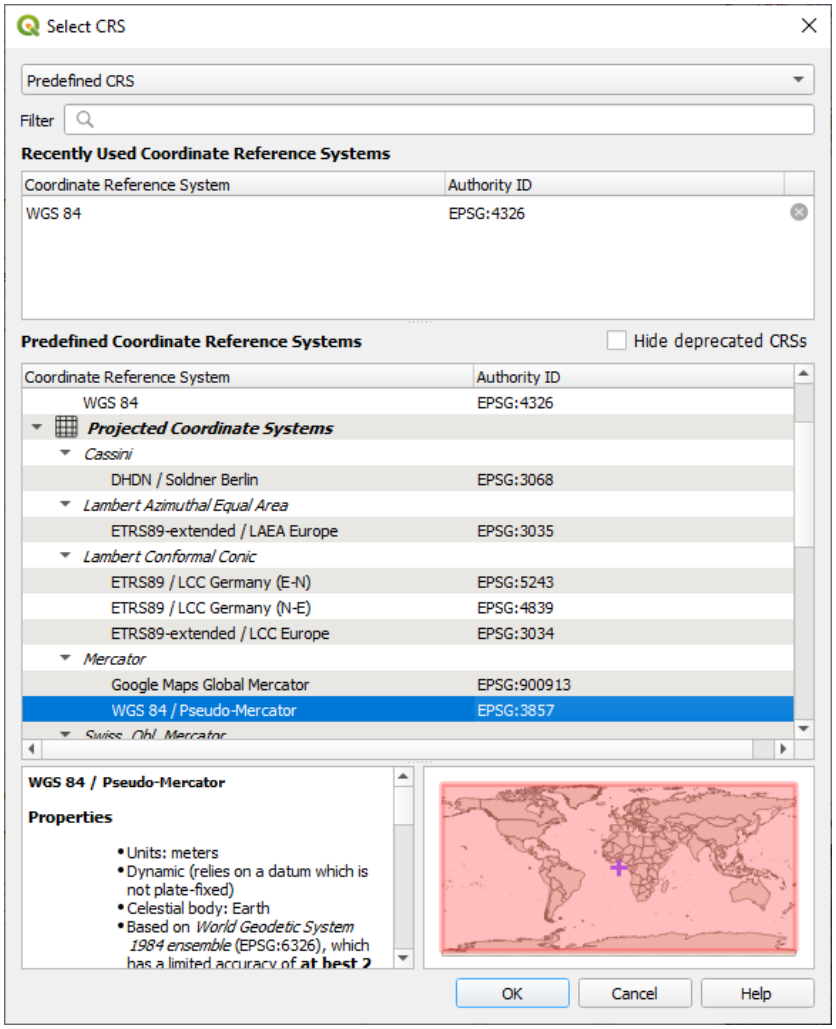
8. Click once on the `OSM-WMS` layer. This will display the default *Coordinate Reference System* in use and the number of CRSes supported by the dataset:



Since we're not using `EPSG:4326 - WGS 84` for our map, let's find one that meets our needs.

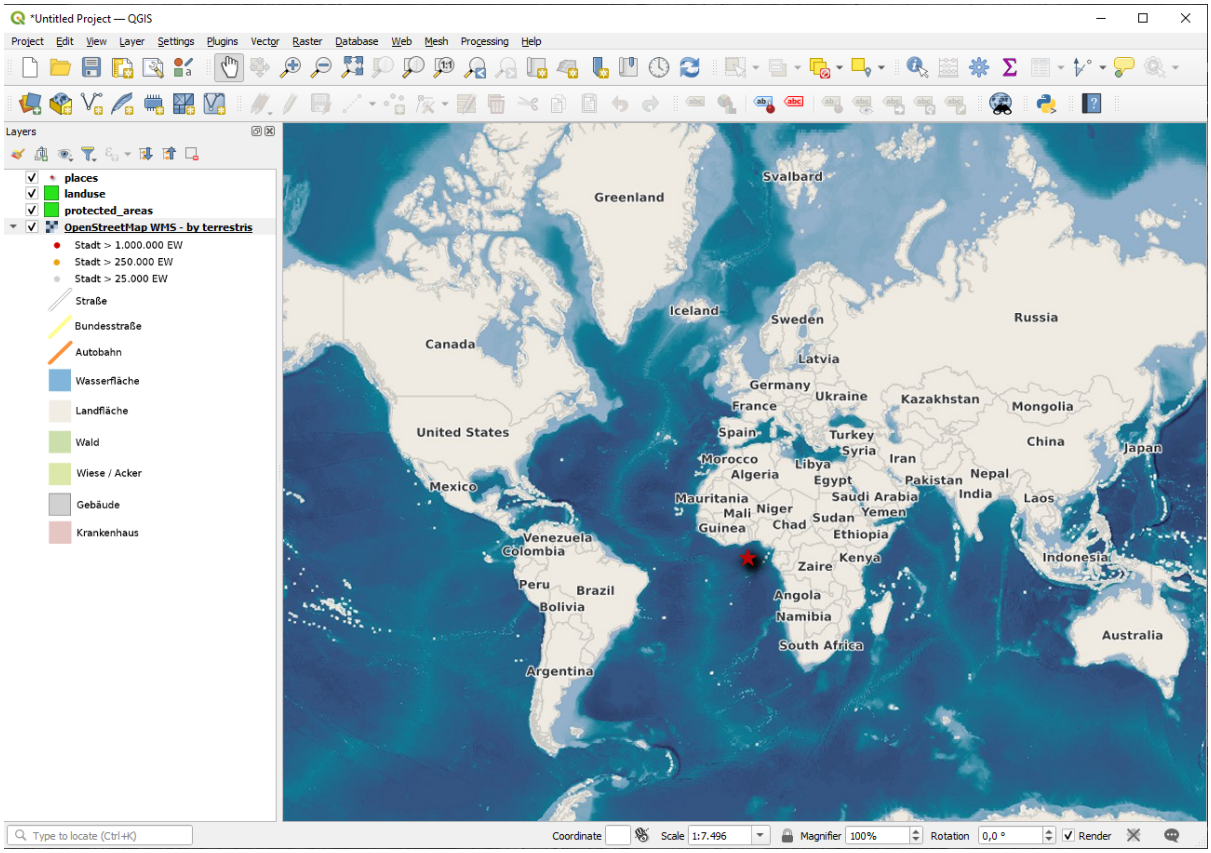
1. Click the 

button. You will see a standard *Coordinate Reference System Selector* dialog showing all the CRS the data is published with.
2. We want a *projected* CRS, so let's choose *WGS 84 / Pseudo-Mercator* with `EPSG:3857`. You can use the top  *Filter* widget.



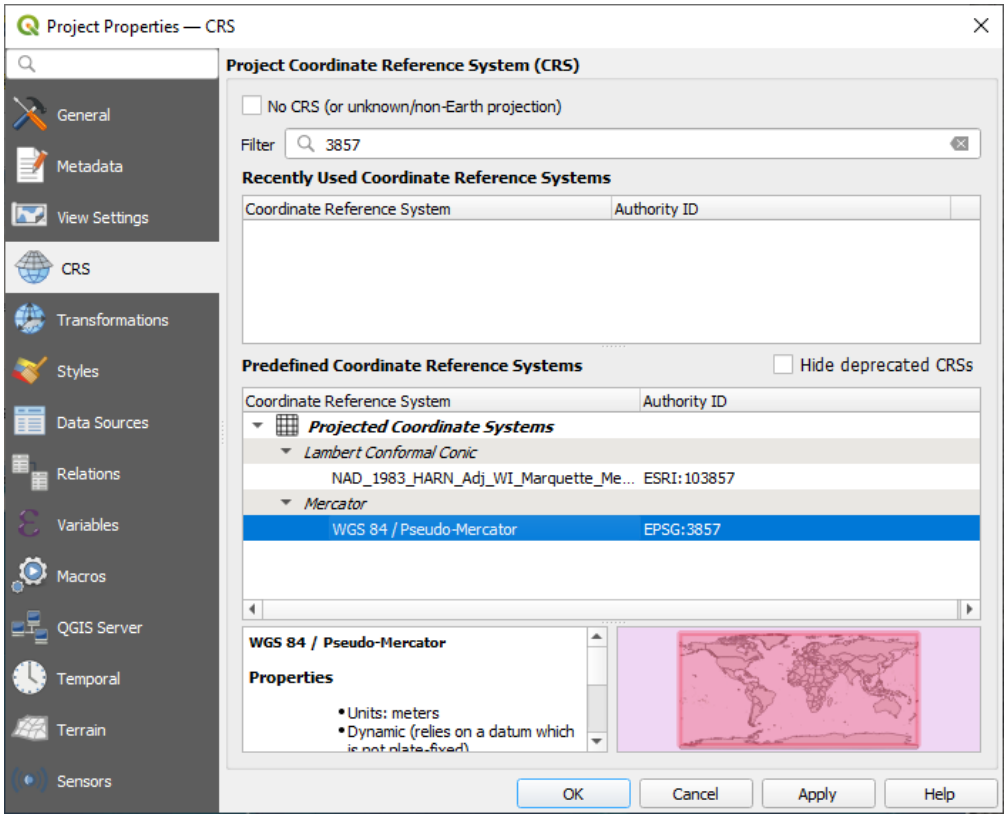
1. Click *OK*. The Coordinate Reference System associated with the entry has changed.

9. Click *Add* to load the layer in your project using *Layer name* (default is `OpenStreetMap WMS - by terrestris`).
10. Close the *Data Source Manager* dialog if not done automatically
11. In the *Layers* panel, click and drag it to the bottom of the list.
12. Zoom out in order to get a global view of the layers. You will notice that your layers aren't located correctly (near west of Africa). This is because „on the fly" projection is disabled.



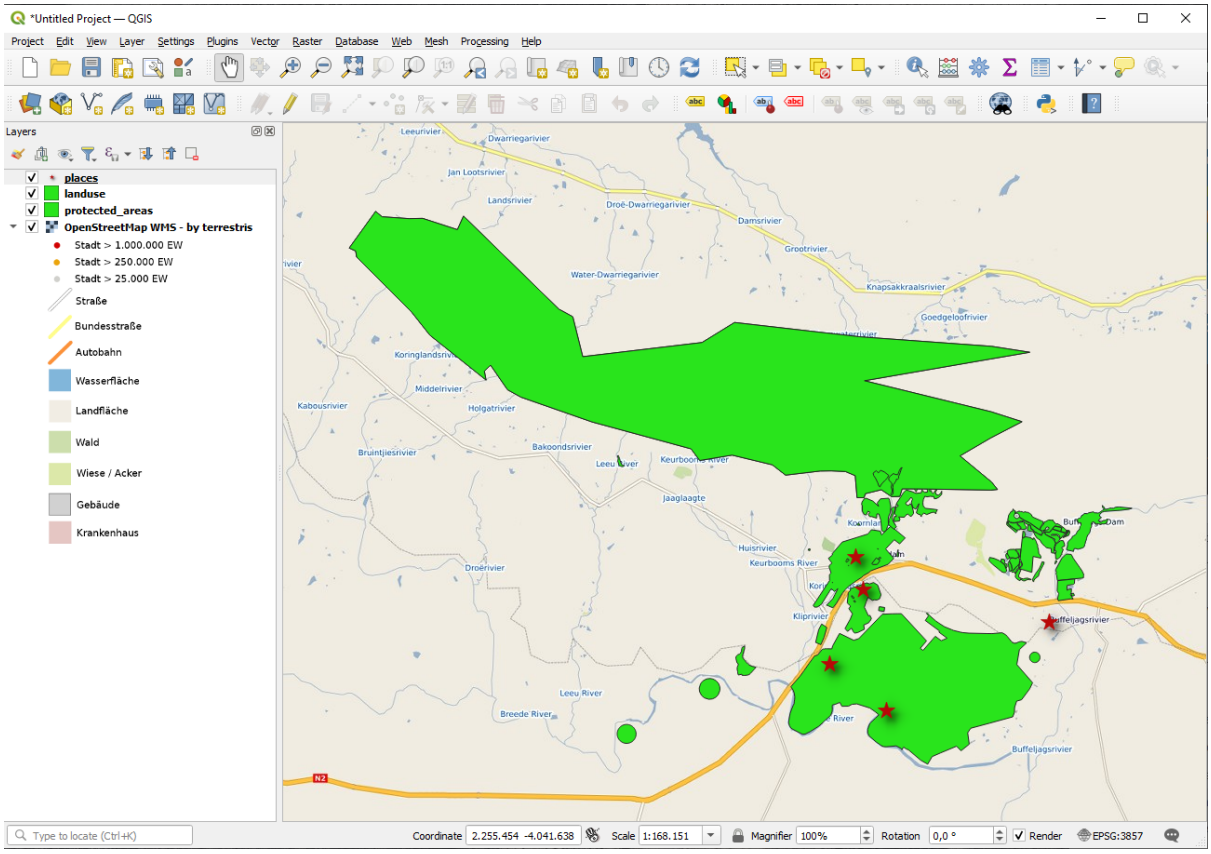
13. Let's enable the reprojection again, but using the same projection as the `OpenStreetMap WMS` layer, which is *WGS 84 / Pseudo Mercator*.

    1. Open the *Project* ► *Properties...* ► *CRS* tab
    2. Uncheck *No CRS (or unknown/non-Earth projection)*
    3. Alegeți *WGS 84 / Pseudo Mercator* din listă.



4. Clic pe *OK*

14. Now right-click on one of your own layers in the *Layers* panel and click *Zoom to layer(s)*. You should see the Swellendam area:



Notă cum se suprapun străzile stratului WMS cu propriile noastre străzi. Ăsta e un semn bun!

Natura și limitele WMS

By now you may have noticed that this WMS layer actually has many features in it. It has streets, rivers, nature reserves, and so on. What's more, even though it looks like it's made up of vectors, it seems to be a raster, but you can't change its symbology. Why is that?

This is how a WMS works: it's a map, similar to a normal map on paper, that you receive as an image. What usually happens is that you have vector layers, which QGIS renders as a map. But using a WMS, those vector layers are on the WMS server, which renders it as a map and sends that map to you as an image. QGIS can display this image, but can't change its symbology, because all that is handled on the server.

This has several advantages, because you don't need to worry about the symbology. It's already worked out, and should be nice to look at on any competently designed WMS.

On the other hand, you can't change the symbology if you don't like it, and if things change on the WMS server, then they'll change on your map as well. This is why you sometimes want to use a Web Feature Service (WFS) instead, which gives you vector layers separately, and not as part of a WMS-style map.

This will be covered in the next lesson, however. First, let's add another WMS layer.

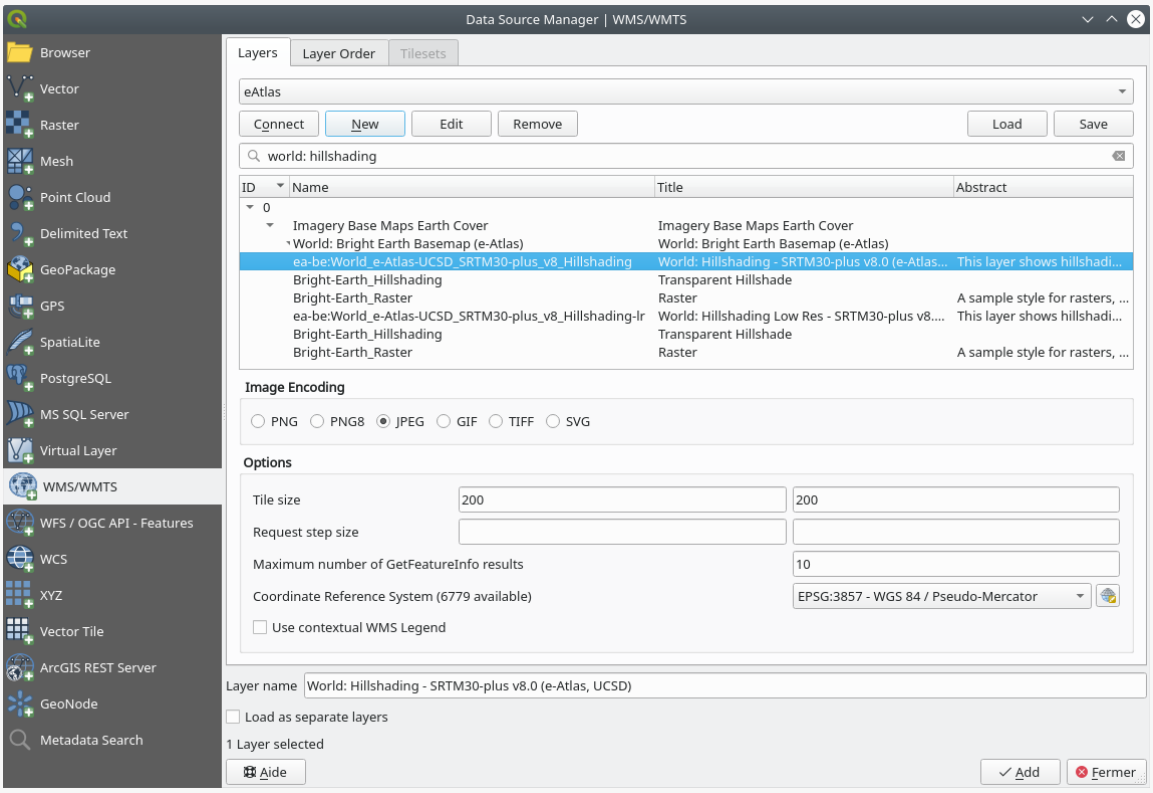
10.1.2 ??? Încercați și dvs.:

1. Add the `eAtlas` WMS server at this URL: `https://maps.eatlas.org.au/maps/wms`
2. Load a `World: Hillshading` layer into the map.
3. You might want to set its *Encoding* to *JPEG* and its *Tile size* option to `200` by `200`, so that it loads faster.
4. Your map should look like this (you may need to re-order the layers, and apply some transparency):



Răspuns

1. Go to the Data Source Manager, WMS / WMTS tab and create a new connection entry
2. Use the  text box to filter the list of layers and select the corresponding layer
3. Remember to check/turn its CRS into *EPSG:3857 - WGS 84 / Pseudo Mercator* as the rest of the map.



4. After the layer is loaded, you can modify its *Opacity* value (under the *Transparency* properties tab)

10.1.3 ??? Încercați și dvs.:

O parte din dificultatea de a folosi WMS, este de a găsi un server bun (și gratuit).

- Find a new WMS at directory.spatineo.com (or elsewhere online). It must not have associated fees or restrictions, and must have coverage over the Swellendam study area.

  Amintiți-vă că pentru un WMS aveți nevoie doar de URL-ul său (și, de preferință, un fel de descriere).

Răspuns

Spatineo is one of many places you can search for a OGC data. Type in the text area a name, keyword, location of your interest to see if you get some working results. For this lesson, you might want to filter the results to include WMS only.

You may notice that many WMS servers are not always available. Sometimes this is temporary, sometimes it is permanent. An example of a WMS server that worked at the time of writing is the *MapServer Demonstration Server* WMS at https://demo.mapserver.org/cgi-bin/wms?SERVICE=WMS&VERSION=1.3.0&REQUEST=GetCapabilities. It does not require fees or have access constraints, and it is global. Therefore, it does satisfy the

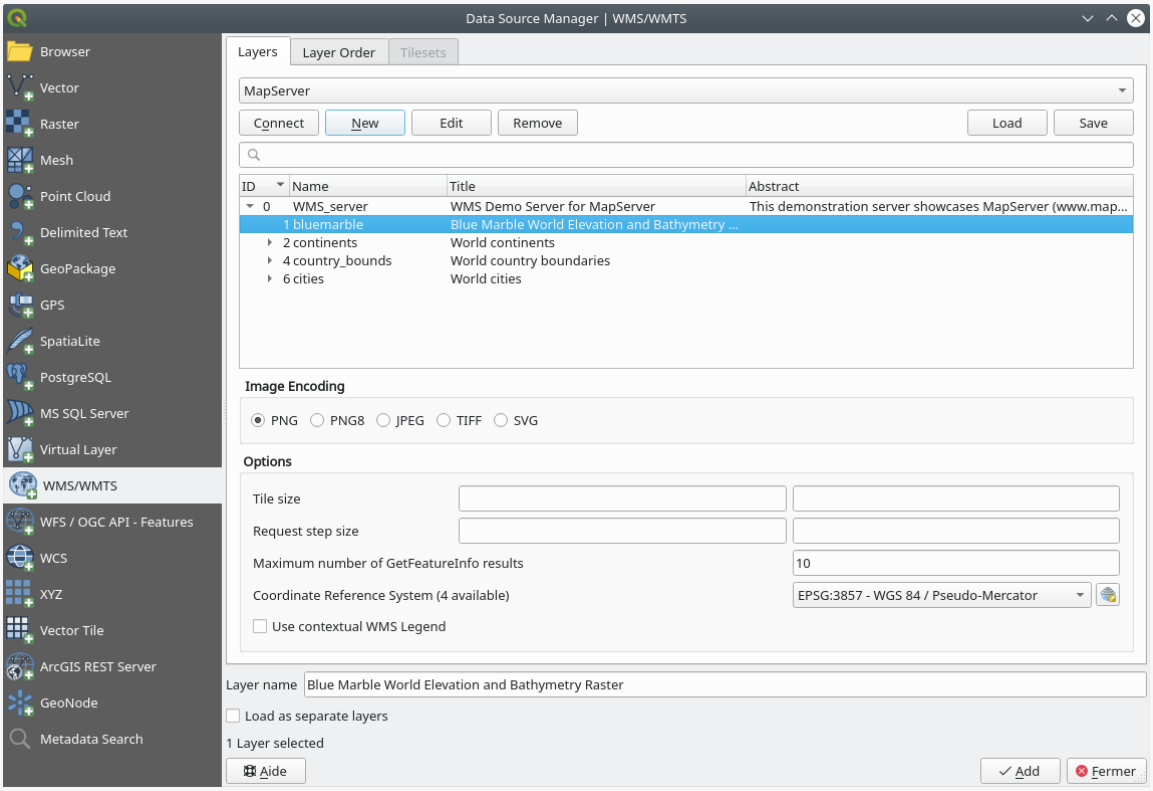
requirements. Keep in mind, however, that this is merely an example. There are many other WMS servers to choose from.

10.1.4 ??? Încercați și dvs.:

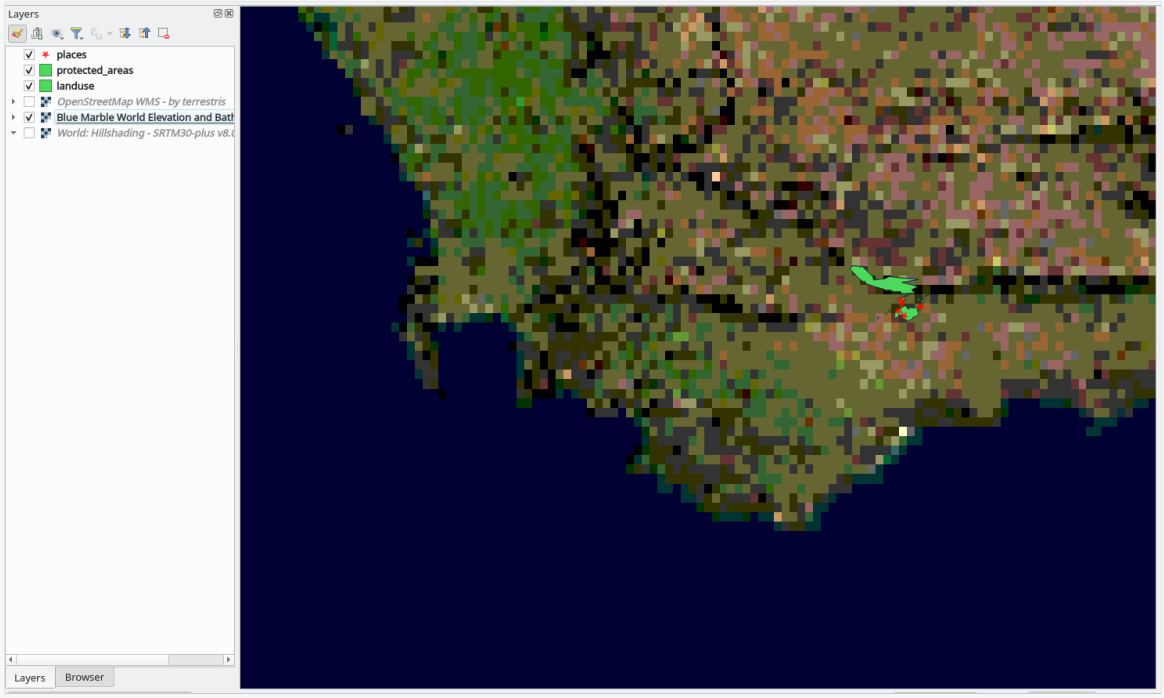
- Add the `bluemarble` layer from the *MapServer Demonstration Server*. Is that a suitable dataset for our study area?

Răspuns

1. Hide all other WMS layers to prevent them from rendering unnecessarily in the background.
2. Use the same approach as before to add the new server and the appropriate layer as hosted on that server:



3. If you zoom into the Swellendam area, you'll notice that this dataset has a low resolution:



Therefore, it's better not to use this data for the current map. The Blue Marble data is more suitable at global or national scales

10.1.5 În concluzie

Folosind un WMS, puteți adăuga hărți inactive ca fundaluri pentru datele hărților existente.

10.1.6 Further Reading

- Spatineo Directory
- OpenStreetMap.org list of WMS servers

10.1.7 Ce urmează?

Now that you've added an inactive map as a backdrop, you'll be glad to know that it's also possible to add features (such as the other vector layers you added before). Adding features from remote servers is possible by using a Web Feature Service (WFS). That's the topic of the next lesson.

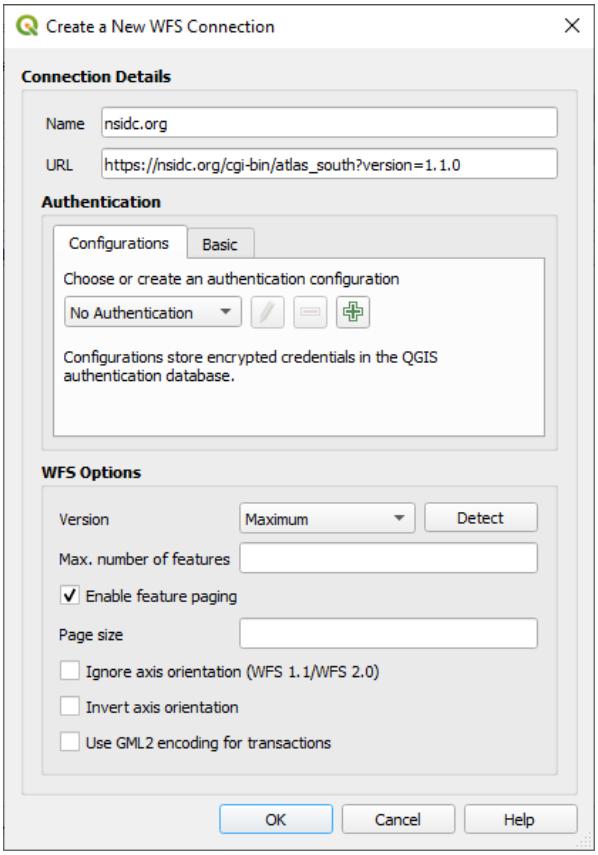
10.2 Lesson: Web Feature Services

Un Serviciu Web Feature (WFS) pune la dispoziție utilizatorilor date GIS în formate care pot fi încărcate direct în QGIS. Spre deosebire de un WMS, care oferă doar o hartă pe care nu o puteți edita, un WFS oferă acces direct la entități.

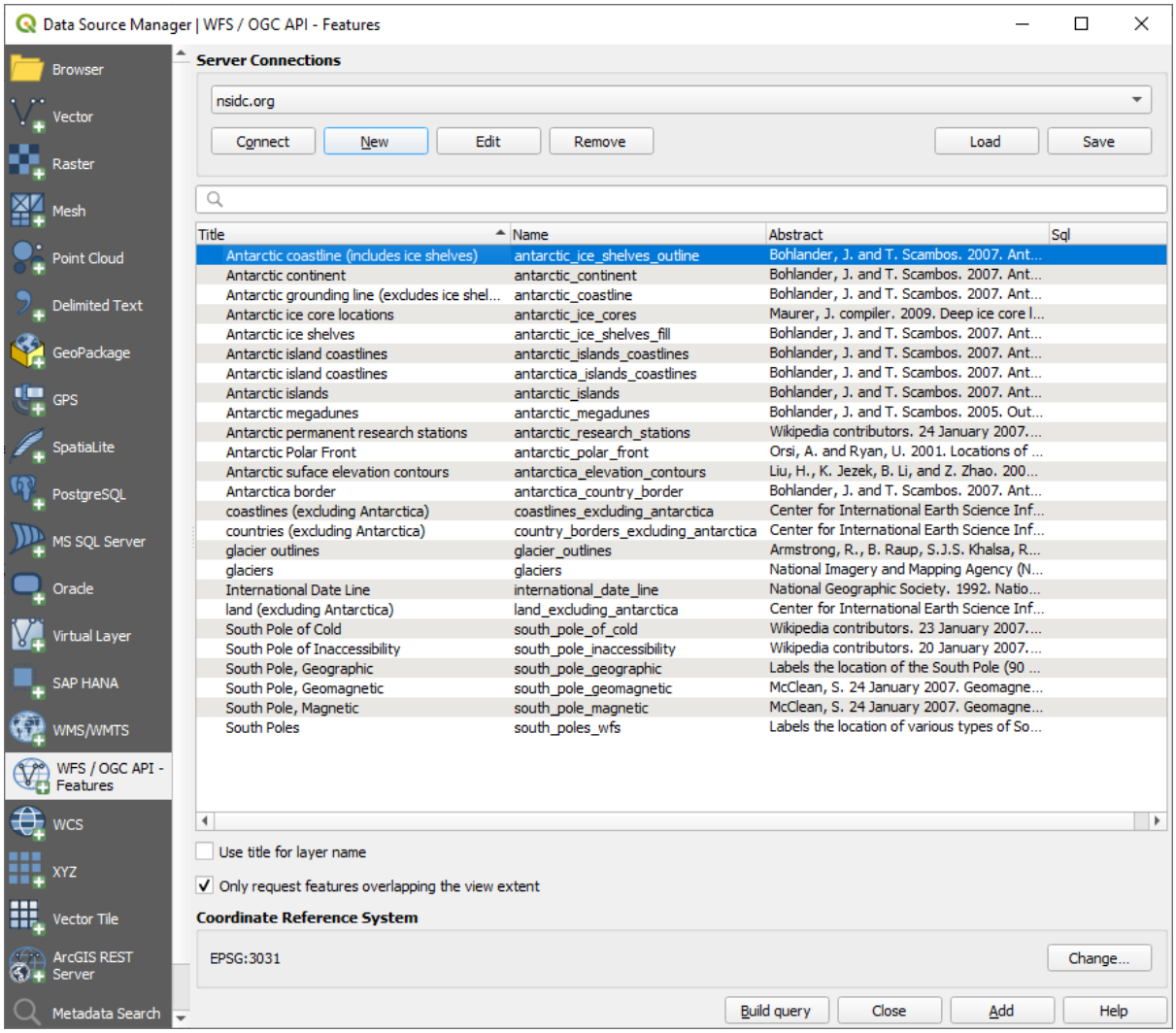
Scopul acestei lecții: De a folosi un WFS și de a-i înțelege cum diferă de un WMS.

10.2.1 ??? Follow Along: Loading a WFS Layer

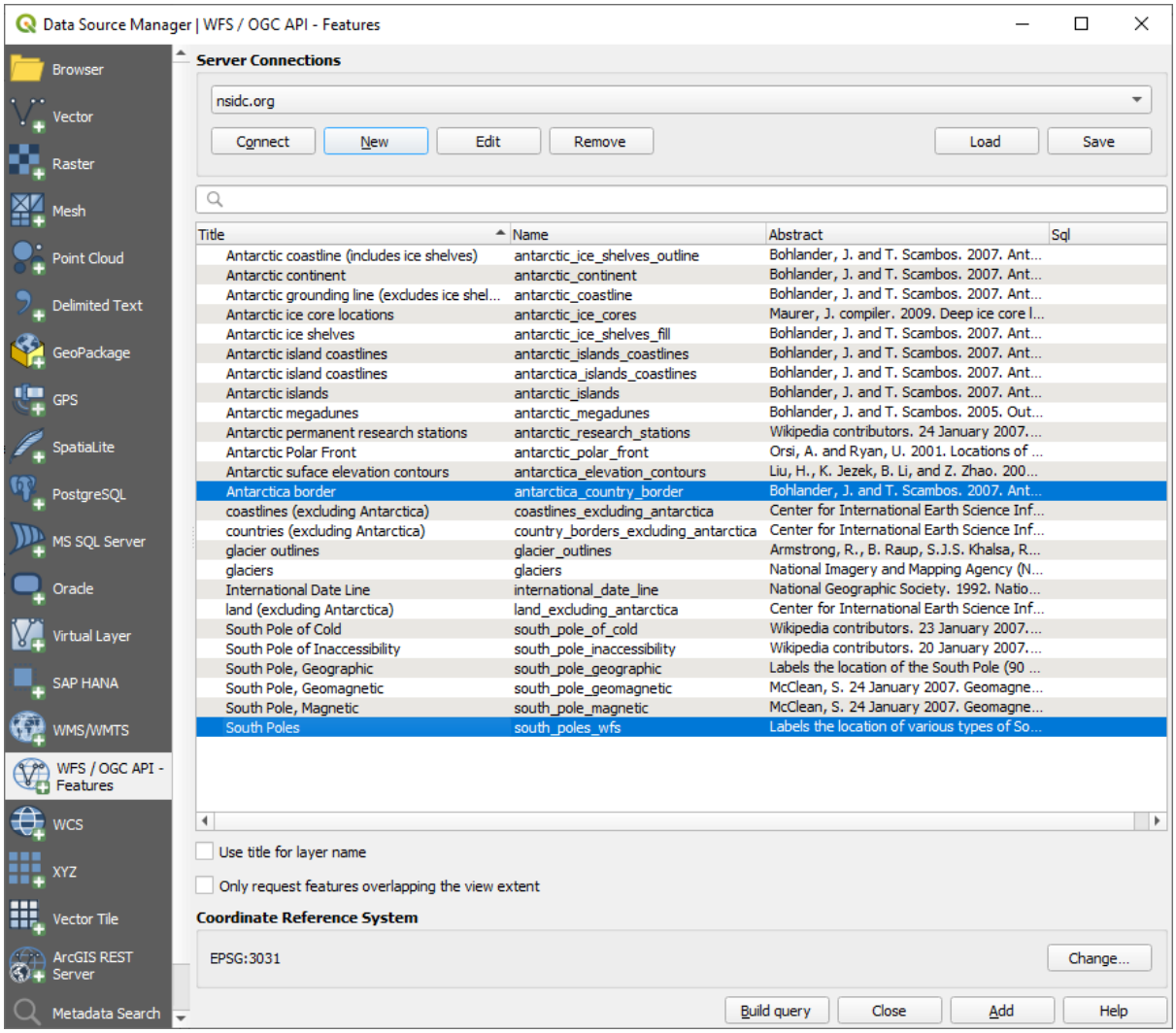
1. Începeți o nouă hartă. Aceasta are scop demonstrativ și nu va fi salvată.
2. Click the  Open Data Source Manager button.
3. Enable the  *WFS / OGC API - Features* tab.
4. Clic pe butonul *New*.
5. În caseta de dialog care apare, introduceți `nsidc.org` la *Nume* și `https://nsidc.org/cgi-bin/atlas_south?version=1.1.0` la *URL*.



6. Clic *OK*, apoi noua conexiune va apărea în *Conexiunile serverului*.
7. Clic pe *Connect*. Va apărea o listă a straturilor disponibile:

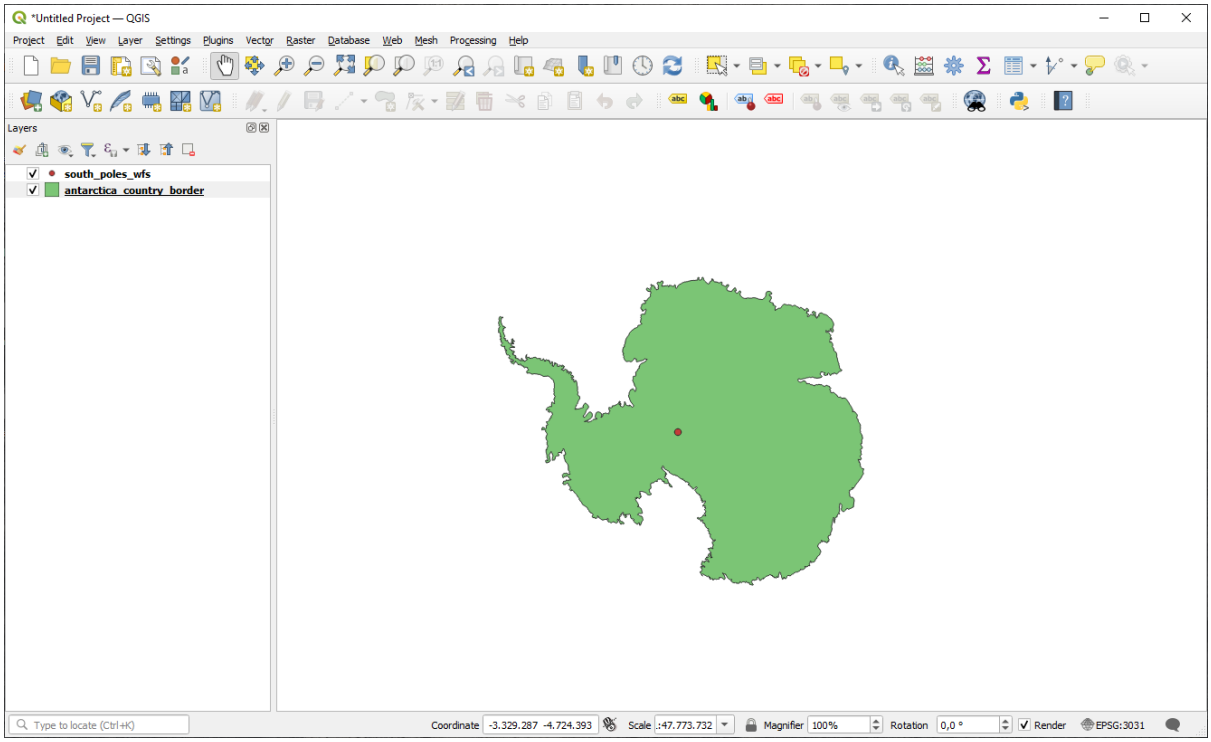


8. Uncheck the *Only request features overlapping the view extent* option below the layers list, since your current map canvas may not cover our area of interest: Antarctica.
9. Find the layer `antarctica_country_border`. You can use the *Filter* box at the top.
10. Faceți clic pe strat pentru a-l selecta.
11. Find and select also the layer `south_poles_wfs`. You might need to hold `Ctrl`.



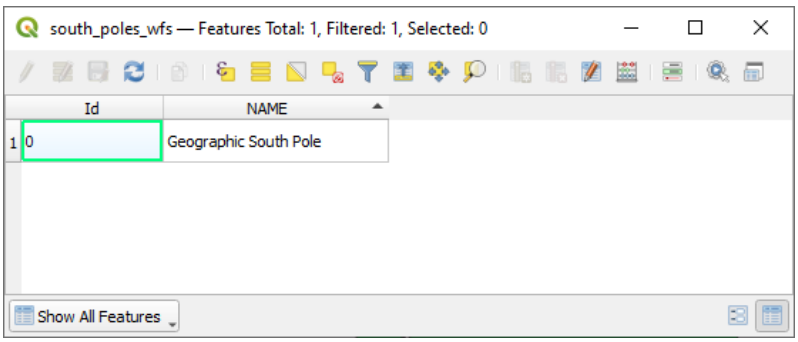
12. Clic pe *Add*.

    It may take a while to load the layers. When they are loaded, they will appear in the map, showing the outlines of Antarctica and a few points over.

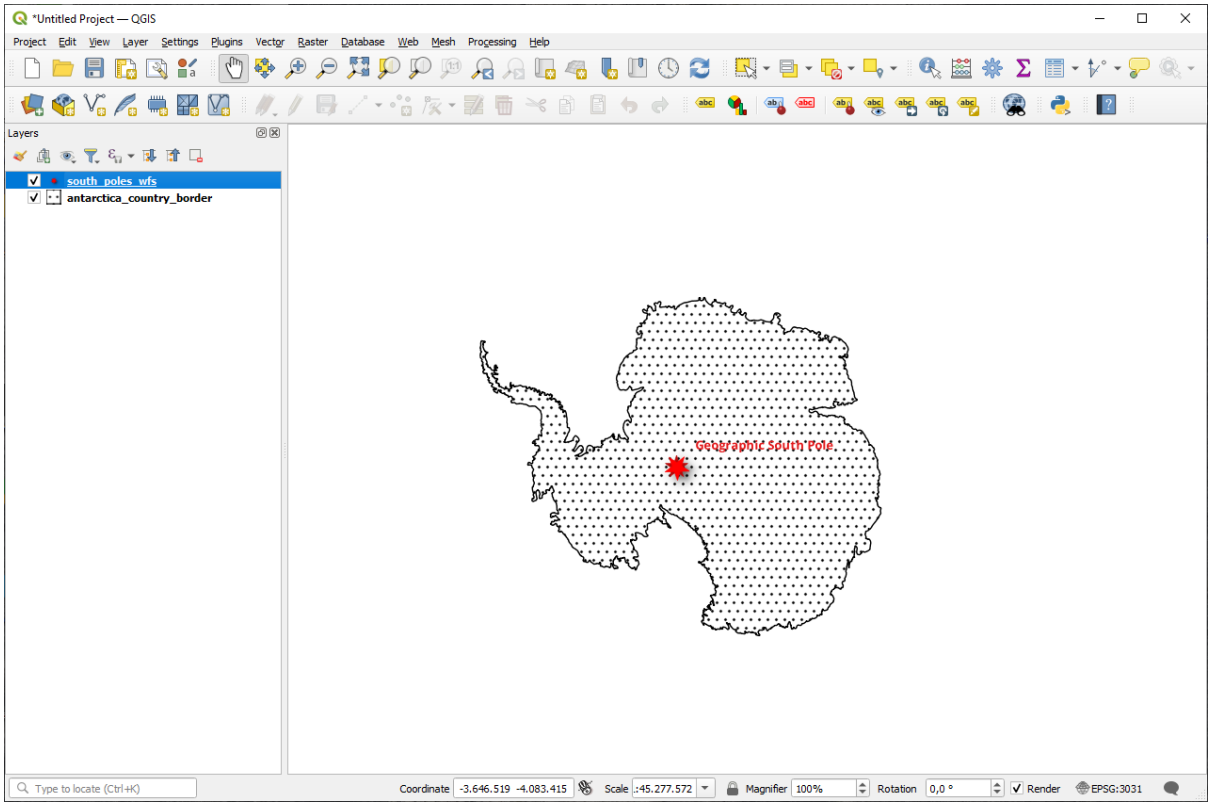


How is this different from having a WMS layer?

13. Select any of the layers and you'll notice that feature selection and attribute table tools are enabled. These are vector layers.
14. Select the `south_poles_wfs` layer and open its attribute table. You should see this:



De vreme ce punctele au atribute, putem să le punem etichete și să le schimbăm simbolistica. Iată un exemplu:



Diferențe între straturile WMS

Un Serviciu Web Feature întoarce stratul însuși, nu doar o hartă redată pentru acesta. Asta vă dă acces direct la date, însemnând că puteți să schimbați simbologia și puteți rula funcții analitice. Cu toate acestea, costul este transmiterea unui volum mai mare de date. Asta va fi evident dacă straturile pe care le încărcați au forme complexe, multe atribute sau multe entități; sau chiar dacă doar încărcați multe straturi. Din această cauză straturile WFS au nevoie de regulă de mult timp pentru a se încărca.

10.2.2 ??? Follow Along: Querying a WFS Layer

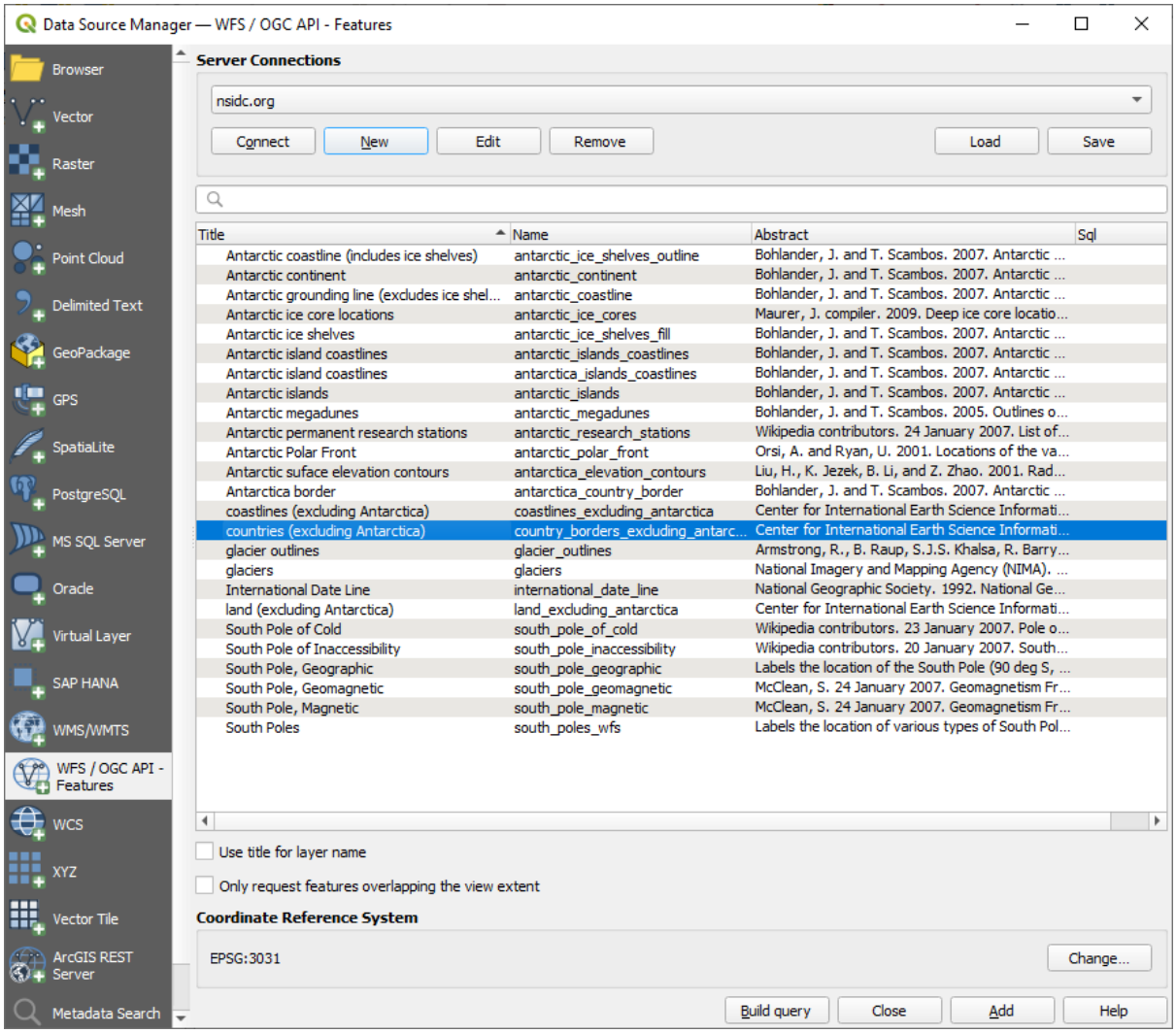
Deși este posibil să interogați un strat WFS după încărcare, este de regulă mai eficient să îl interogați înainte de a-l încărca. În felul acesta cereți doar entitățile pe care le doriți, ceea ce înseamnă că utilizați o bandă mai mică.

For example, on the WFS server we're currently using, there is a layer called `countries (excluding Antarctica)`. Let's say that we want to know where South Africa is relative to the `south_poles_wfs` layer (and perhaps also the `antarctica_country_border` layer) that's already been loaded.

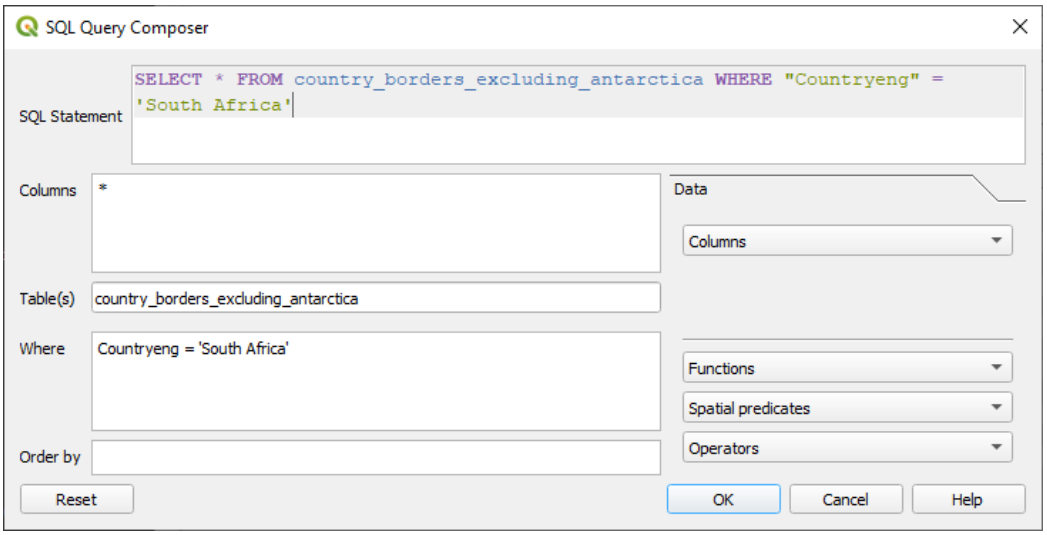
There are two ways to do this. You can load the whole `countries ...` layer, and then build a query as usual once it's loaded. However, transmitting the data for all the countries in the world and then only using the data for South Africa seems a bit wasteful of bandwidth. Depending on your connection, this dataset can take several minutes to load.

Alternativa este de a construi o interogare ca pe un filtru, chiar înainte de încărcarea stratului de pe server.

1. Enable the *WFS / OGC API Features* tab in the *Data Source Manager* dialog
2. Connect to the server we used before and you should see the list of available layers.
3. Find and double-click the `countries (excluding Antarctica)` layer. The layer name is `country_borders_excluding_antarctica`. You can also select the layer and press *Build query* button at the bottom of the dialog:

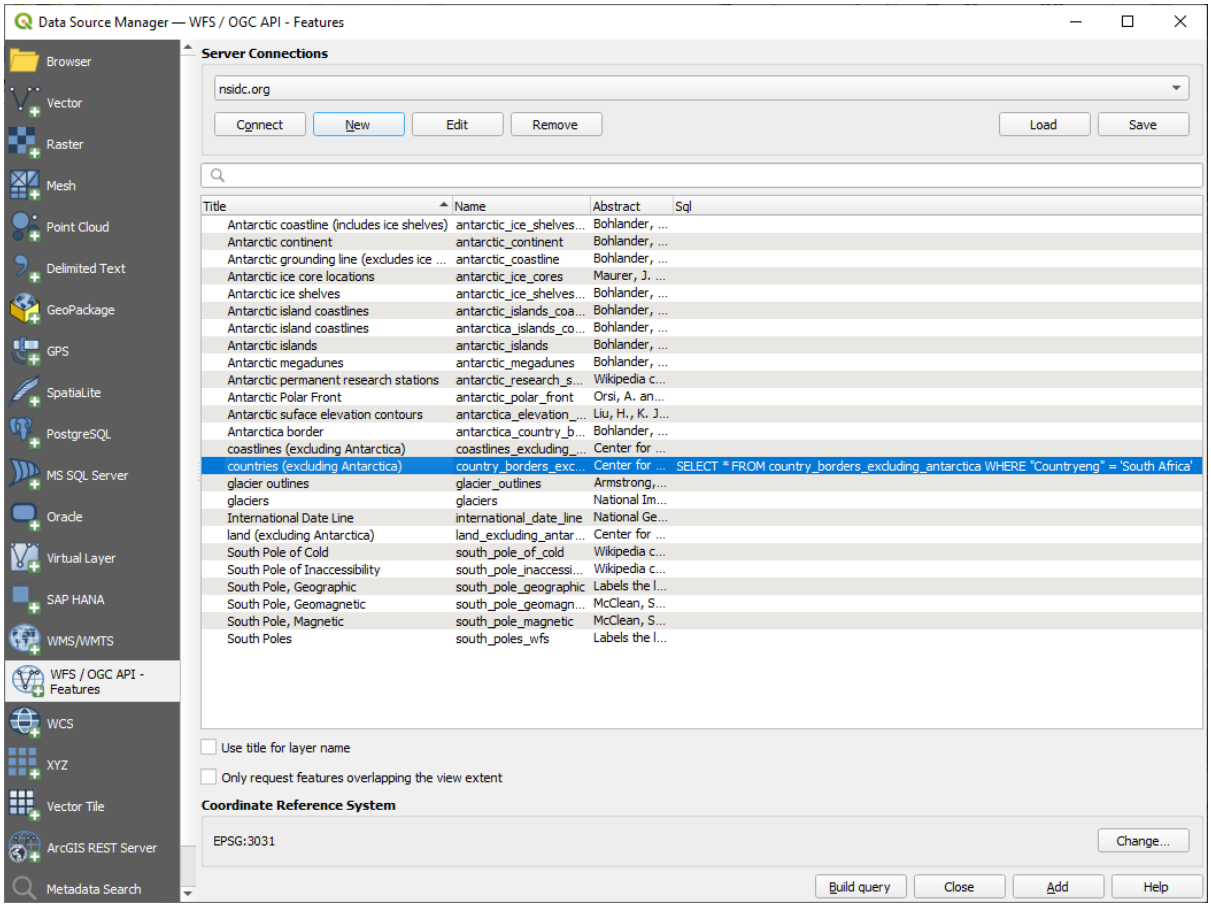


4. In the dialog that appears, type the following `SELECT * FROM country_borders_excluding_antarctica WHERE "Countryeng" = 'South Africa'` query in the *SQL Statement* box.

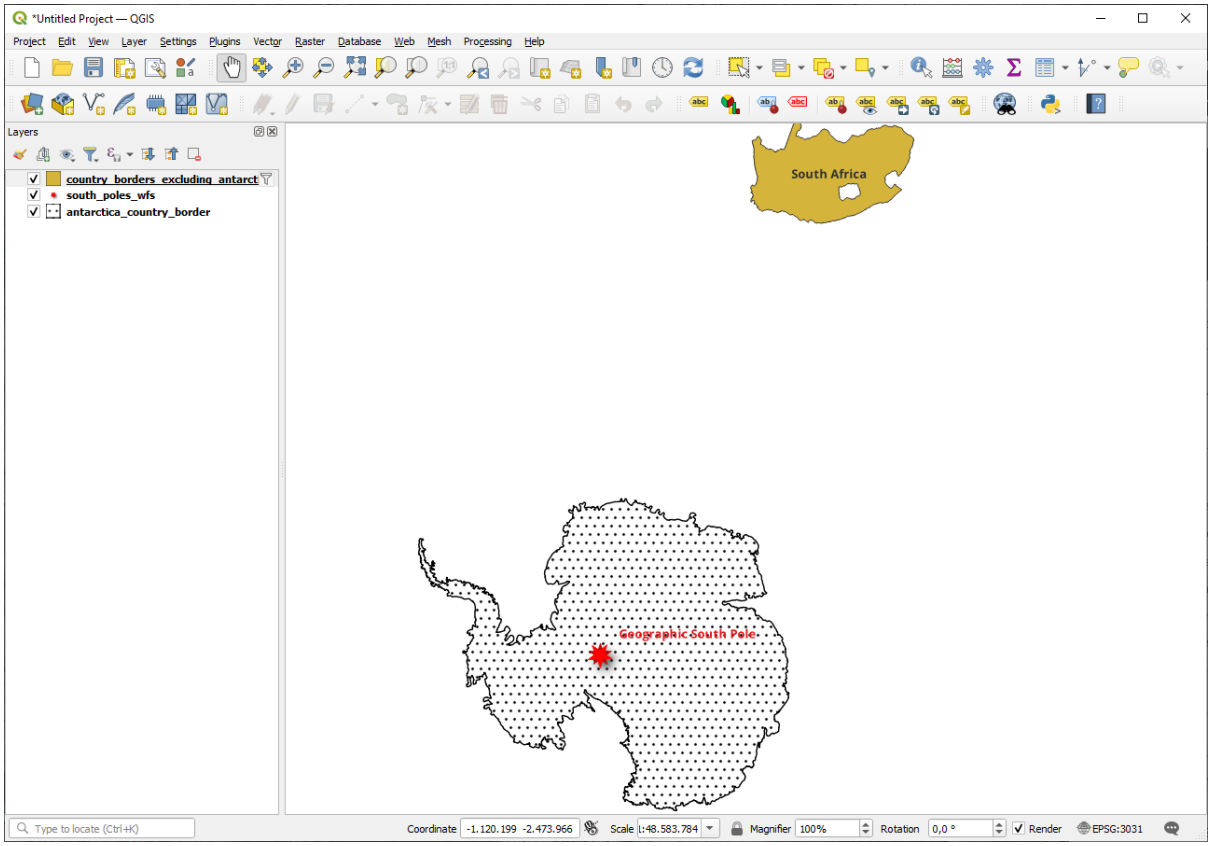


5. Press *OK*.

6. The expression used will appear as the *Sql* value of the target layer:



7. Click *Add* with the layer selected as above. Only the country with the `Countryeng` value of `South Africa` will load from that layer:



Did you notice the  icon next to the `country_borders_excluding_antarctica` layer? It indicates that the loaded layer is filtered and does not display in the project all of its features.

8. Dacă ați încercat ambele metode, veți observa că această variantă este mult mai rapidă decât încărcarea tuturor țărilor înaintea filtrării!

Note cu privire la disponibilitatea WFS

Este o raritate să găsiți un WFS care să pună la dispoziție caracteristicile dorite dacă acestea sunt foarte specifice. Motivul pentru care cele mai multe servicii Web Feature sunt relativ rare este pentru că necesită transmiterea unui volum mare de date pentru a descrie complet o entitate. În concluzie nu este foarte rentabilă găzduirea unui WFS în comparație cu un WMS, care trimite doar imagini.

Cel mai comun tip de WFS pe care îl veți întâlni va fi deci probabil într-o rețea local sau chiar pe propriul calculator, mai degrabă decât in Internet.

10.2.3 În concluzie

Straturile WFS sunt de preferat față de straturile WMS dacă aveți nevoie de acces direct la atributele si geometriile acestora. Cu toate acestea, ținând cont de volumul de date care trebuie descărcat (ceea ce duce la probleme de viteză și de asemenea la lipsa de servere WFS disponibile publicului larg) nu este întotdeauna posibil să folosiți un WFS în loc de un WMS.

10.2.4 Ce urmează?

În continuare, vom vedea cum se utilizează QGIS Server pentru a furniza servicii OGC.

CAPITOLUL 11

Module: QGIS Server

Acest modul a fost publicat de Tudor Bărăscu.

În acest capitol vom examina modul de instalare și utilizare a serverului QGIS.

Pentru a afla mai multe despre QGIS Server, citiți QGIS-Server-manual.

11.1 Lesson: Install QGIS Server

The goal for this lesson: To learn how to install **QGIS Server** on Debian Stretch. With negligible variations you can also follow it for any Debian based distribution like Ubuntu and its derivatives.

> **Notă**
>
> In Ubuntu you can use your regular user, prepending `sudo` to commands requiring admin permissions. In Debian you can work as admin (`root`), without using `sudo`.

11.1.1 ??? Follow Along: Install from packages

In this lesson we're going to do only the install from packages as shown here .

Instalați Serverul QGIS cu:

```
apt install qgis-server --no-install-recommends --no-install-suggests

# if you want to install server plugins, also:
apt install python3-qgis
```

QGIS Server should be used in production without QGIS Desktop (with the accompanying X Server) installed on the same machine.

11.1.2 ??? Follow Along: QGIS Server Executable

The QGIS Server executable is `qgis_mapserv.fcgi`. You can check where it has been installed by running `find / -name 'qgis_mapserv.fcgi'` which should output something like `/usr/lib/cgi-bin/qgis_mapserv.fcgi`.

Optionally, if you want to do a command line test at this time you can run the `/usr/lib/cgi-bin/qgis_mapserv.fcgi --version` command which should output something like:

```
QGIS 3.44.4 'Solothurn' (108203c541e)
QGIS code revision 108203c541e
Qt version 5.15.3
Python version 3.11.10
GDAL/OGR version 3.11.0
PROJ version 9.6.2
EPSG Registry database version v12.013 (2025-05-26)
GEOS version 3.13.0-CAPI-1.19.0
SQLite version 3.49.2
OS Ubuntu 24.04
```

We'll see later on how to make WMS requests.

11.1.3 ??? HTTP Server Configuration

In order to access on the installed QGIS server from an Internet Browser we need to use an HTTP server. The Apache HTTP Server installation process is detailed in httpserver section.

Notă

If you installed QGIS Server without running an X Server (included in Linux Desktop) and if you also want to use the `GetPrint` command then you should install a fake X Server and tell QGIS Server to use it. You can do that by following the Xvfb installation process.

11.1.4 ??? Follow Along: Create another virtual host

Let's create another Apache virtual host pointing to QGIS Server. You can choose whatever name you like (`coco.bango`, `super.duper.training`, `example.com`, etc.) but for simplicity sake we're going to use `myhost`.

- Let's set up the `myhost` name to point to the localhost IP by adding `127.0.0.1 x` to the `/etc/hosts` with the following command: `sh -c "echo '127.0.0.1 myhost' >> /etc/hosts"` or by manually editing the file with `gedit /etc/hosts`.
- We can check that `myhost` points to the localhost by running in the terminal the `ping myhost` command which should output:

```
qgis@qgis:~$ ping myhost
PING myhost (127.0.0.1) 56(84) bytes of data.
64 bytes from localhost (127.0.0.1): icmp_seq=1 ttl=64 time=0.024 ms
64 bytes from localhost (127.0.0.1): icmp_seq=2 ttl=64 time=0.029 ms
```

- Let's try if we can access QGIS Server from the `myhost` site by doing: `curl http://myhost/cgi-bin/qgis_mapserv.fcgi` or by accessing the url from your Debian box browser. You will probably get:

```
<!DOCTYPE HTML PUBLIC "-//IETF//DTD HTML 2.0//EN">
<html><head>
<title>404 Not Found</title>
</head><body>
```

(continues on next page)

(continuare din pagina precedentă)

```
<h1>Not Found</h1>
<p>The requested URL /cgi-bin/qgis_mapserv.fcgi was not found on this server.</p>
<hr>
<address>Apache/2.4.25 (Debian) Server at myhost Port 80</address>
</body></html>
```

- Apache doesn't know that he's supposed to answer requests pointing to the server named `myhost`. In order to setup the virtual host the simplest way would be to make a `myhost.conf` file in the `/etc/apache2/sites-available` directory that has the same content as `qgis.demo.conf` except for the `ServerName` line that should be `ServerName myhost`. You could also change where the logs go as otherwise the logs for the two virtual hosts would be shared but this is optional.
- Let's now enable the virtual host with `a2ensite myhost.conf` and then reload the Apache service with `service apache2 reload`.
- If you try again to access the http://myhost/cgi-bin/qgis_mapserv.fcgi url you'll notice everything is working now!

11.1.5 În concluzie

You learned how to install different QGIS Server versions from packages, how to configure Apache with QGIS Server, on Debian based Linux distros.

11.1.6 Ce urmează?

Now that you've installed QGIS Server and it's accessible through the HTTP protocol, we need to learn how to access some of the services it can offer. The topic of the next lesson is to learn how to access QGIS Server WMS services.

11.2 Lesson: Serving WMS

The data used for this exercise are available in the `qgis-server-tutorial-data` subdirectory of the *training data* you downloaded. For convenience and to avoid possible permissions problems, we will assume that these files are stored in `/home/qgis/projects` directory. Hence, adapt the following instructions to your path.

Datele demo conțin un proiect QGIS denumit `world.qgs`, care este pregătit deja pentru a fi expus de către serverul QGIS. Dacă doriți să utilizați propriul proiect sau să aflați cum se poate pregăti un proiect, consultați secțiunea Creatingwmsfromproject.

Notă

Acest modul prezintă adresele URL, astfel încât audiența să poată distinge cu ușurință parametri și valorile acestora. În timp ce formatul normal este:

```
...&field1=value1&field2=value2&field3=value3
```

acest tutorial folosește:

```
&field1=value1
&field2=value2
&field3=value3
```

Pasting them into Mozilla Firefox works properly but other web browsers like Chrome may add unwanted spaces between the `field:parameter` pairs. So, if you encounter this issue you can either use Firefox or modify the URLs so that they're in one line format.

Let's make a WMS GetCapabilities request in the web browser or with curl:

```
http://qgisplatform.demo/cgi-bin/qgis_mapserv.fcgi
?SERVICE=WMS
&VERSION=1.3.0
&REQUEST=GetCapabilities
&map=/home/qgis/projects/world.qgs
```

In the Apache config from the previous lesson the `QGIS_PROJECT_FILE` variable sets the default project to `/home/qgis/projects/world.qgs`. However, in the above request we made use of the **map** parameter to be explicit and to show it can be used to point at any project. If you delete the **map** parameter from the above request QGIS Server will output the same response.

By pointing any WMS client to the `GetCapabilities` URL, the client gets in response an XML document with metadata of the Web Map Server's information, e.g. what layers does it serve, the geographical coverage, in what format, what version of WMS etc.

As QGIS is also a ogc-wms you can create a new WMS server connection with the help of the above GetCapabilities url. See the *Lesson: Web Mapping Services* or the ogc-wms-servers section on how to do it.

By adding the `countries` WMS layer to your QGIS project you should get an image like the one below:

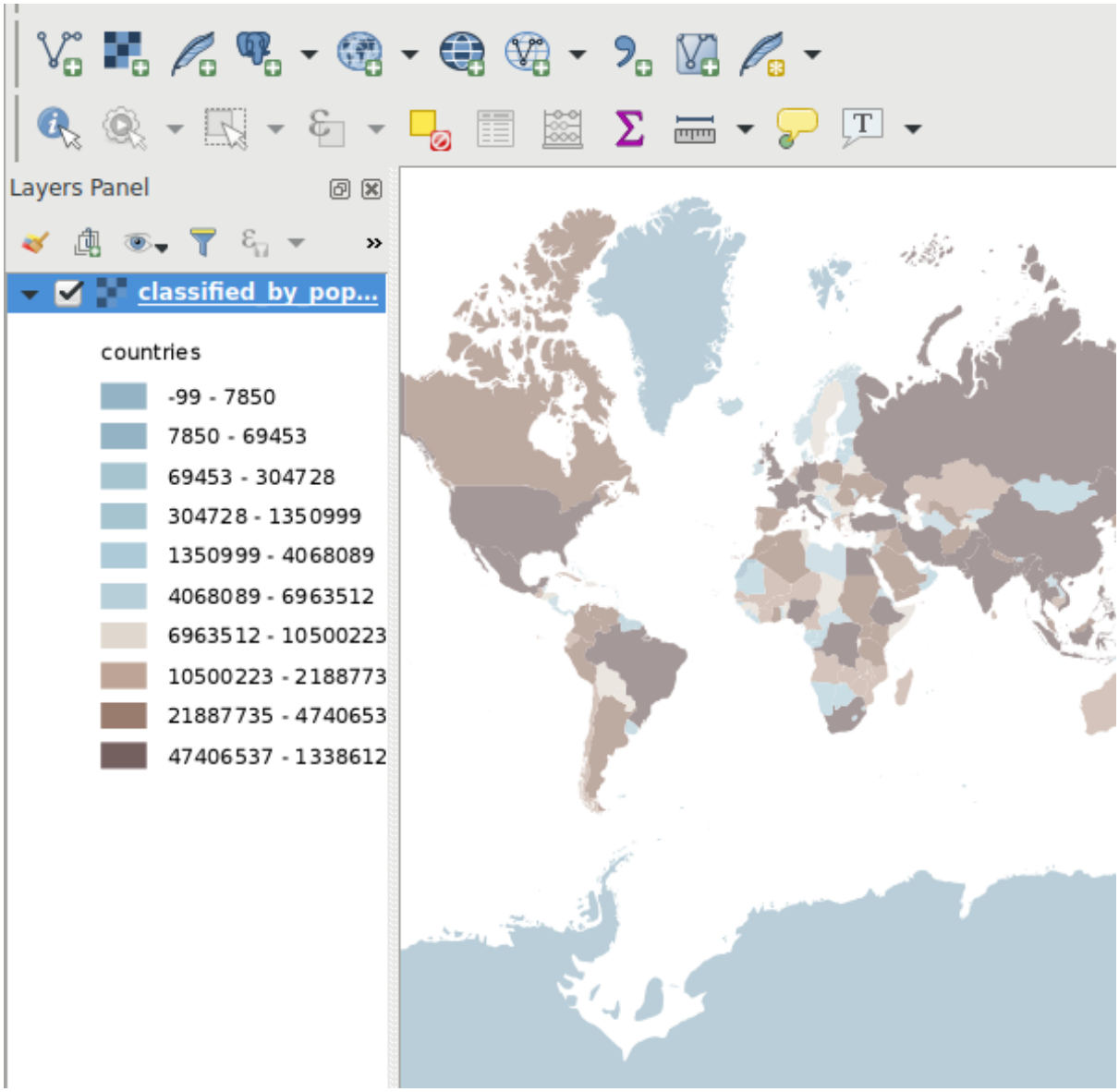


Fig. 11.1: QGIS Desktop consuming the QGIS Server countries layer WMS service

Notă

QGIS Server serves layers that are defined in the `world.qgs` project. By opening the project with QGIS you can see there are multiple styles for the countries layer. QGIS Server is also aware of this and you can choose the style you want in your request. The `classified_by_population` style was chosen in the above image.

11.2.1 Jurnalizarea

When you're setting up a server, the logs are always important as they show you what's going on. We have setup in the `*.conf` file the following logs:

- QGIS Server log at `/logs/qgisserver.log`
- `qgisplatform.demo` Apache access log at `qgisplatform.demo.access.log`
- `qgisplatform.demo` Apache error log at `qgisplatform.demo.error.log`

The log files are simply text files so you can use a text editor to check them out. You can also use the `tail` command in a terminal: `sudo tail -f /logs/qgisserver.log`.

This will continuously output in the terminal what's written in that log file. You can also have three terminals opened for each of the log files like so:

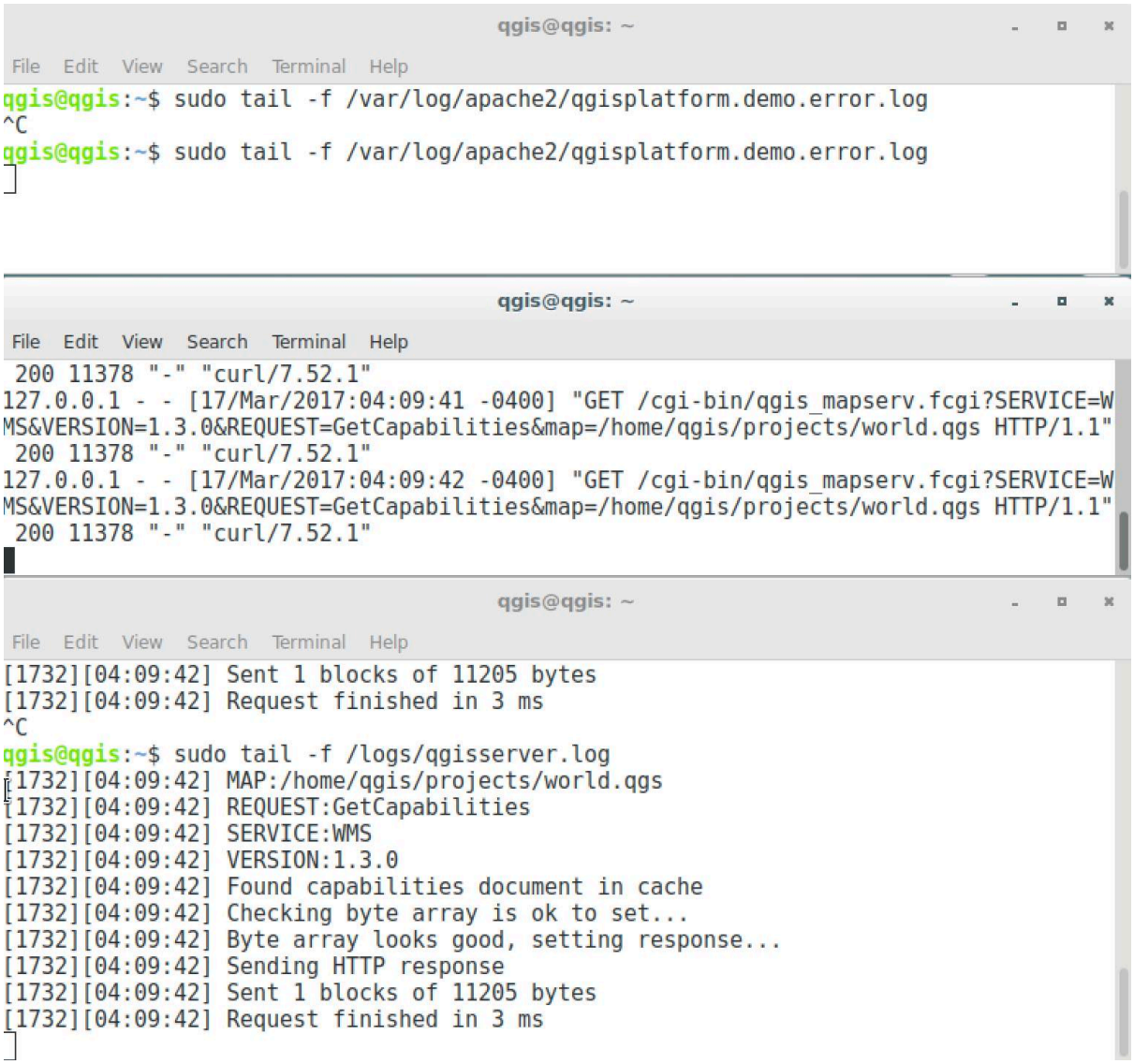


Fig. 11.2: Using the `tail` command to visualise QGIS Server logs output

When you use QGIS Desktop to consume the QGIS Server WMS services you will see all the requests QGIS sends to the Server in the access log, the errors of QGIS Server in the QGIS Server log etc.

Notă

- If you look at the logs in the following sections you should get a better understanding on what's happening.
- By restarting Apache while looking in the QGIS Server log you can find some extra pointers on how things work.

11.2.2 GetMap requests

In order to display the `countries` layer, QGIS Desktop, like any other WMS client, is using `GetMap` requests.

A simple request looks like:

```
http://qgisplatform.demo/cgi-bin/qgis_mapserv.fcgi
?MAP=/home/qgis/projects/world.qgs
&SERVICE=WMS
&VERSION=1.3.0
&REQUEST=GetMap
&BBOX=-432786,4372992,3358959,7513746
&SRS=EPSG:3857
&WIDTH=665
&HEIGHT=551
&LAYERS=countries
&FORMAT=image/jpeg
```

The above request should output the following image:

Figure: simple GetMap request to QGIS Server

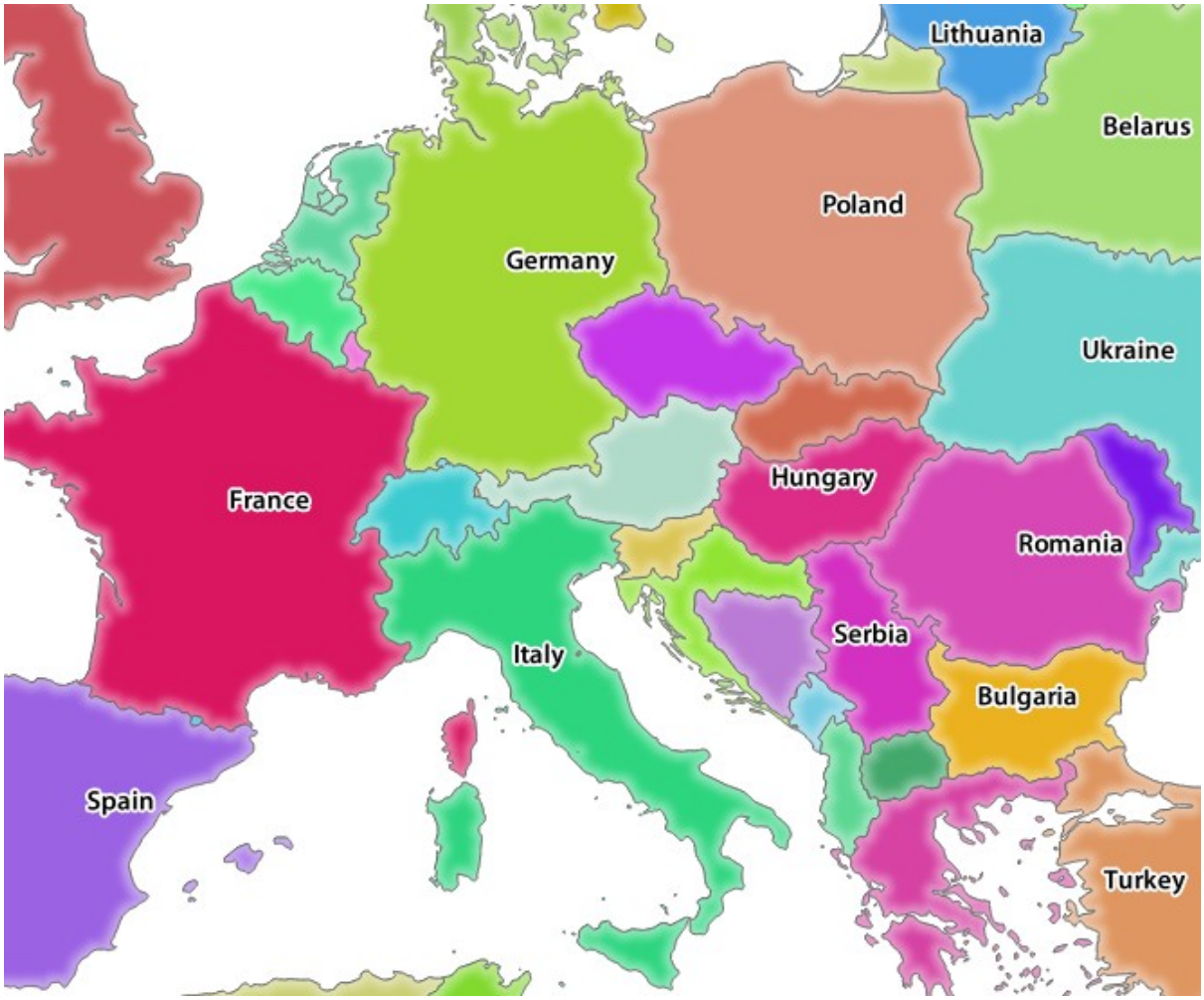


Fig. 11.3: Qgis Server response after a simple GetMap request

11.2.3 ??? Try Yourself: Change the Image and Layers parameters

Based on the request above, let's replace the `countries` layer with another.

In order to see what other layers are available you could open up the `world.qgs` project in QGIS and look at its contents. Keep in mind though that the WMS clients don't have access to the QGIS project, they just look at the capabilities document contents.

Also, there's a configuration option so that some of the layers existing in the QGIS project are ignored by QGIS when serving the WMS service.

So, you could look at the layer list when you point QGIS Desktop to the `GetCapabilities` URL or you could try yourself finding other layer names in the `GetCapabilities` XML response.

One of the layer names that you could find and works is `countries_shapeburst`. You may find others but keep in mind some may not be visible at such a small scale so you could get a blank image as response.

You can also play around with others parameters from above, like changing the returned image type to `image/png`.

11.2.4 ??? Follow Along: Use Filter, Opacities and Styles parameters

Let's do another request that adds another layer, some basic parameters, **FILTER** and **OPACITIES**, but also uses the standard STYLES parameter.

```
http://qgisplatform.demo/cgi-bin/qgis_mapserv.fcgi
?MAP=/home/qgis/projects/world.qgs
&SERVICE=WMS
&VERSION=1.3.0
&REQUEST=GetMap
&BBOX=-432786,4372992,3358959,7513746
&SRS=EPSG:3857
&WIDTH=665
&HEIGHT=551
&FORMAT=image/jpeg
&LAYERS=countries,countries_shapeburst
&STYLES=classified_by_name,blue
&OPACITIES=255,30
&FILTER=countries:"name" IN ( 'Germany' , 'Italy' )
```

The above request should output the following image:

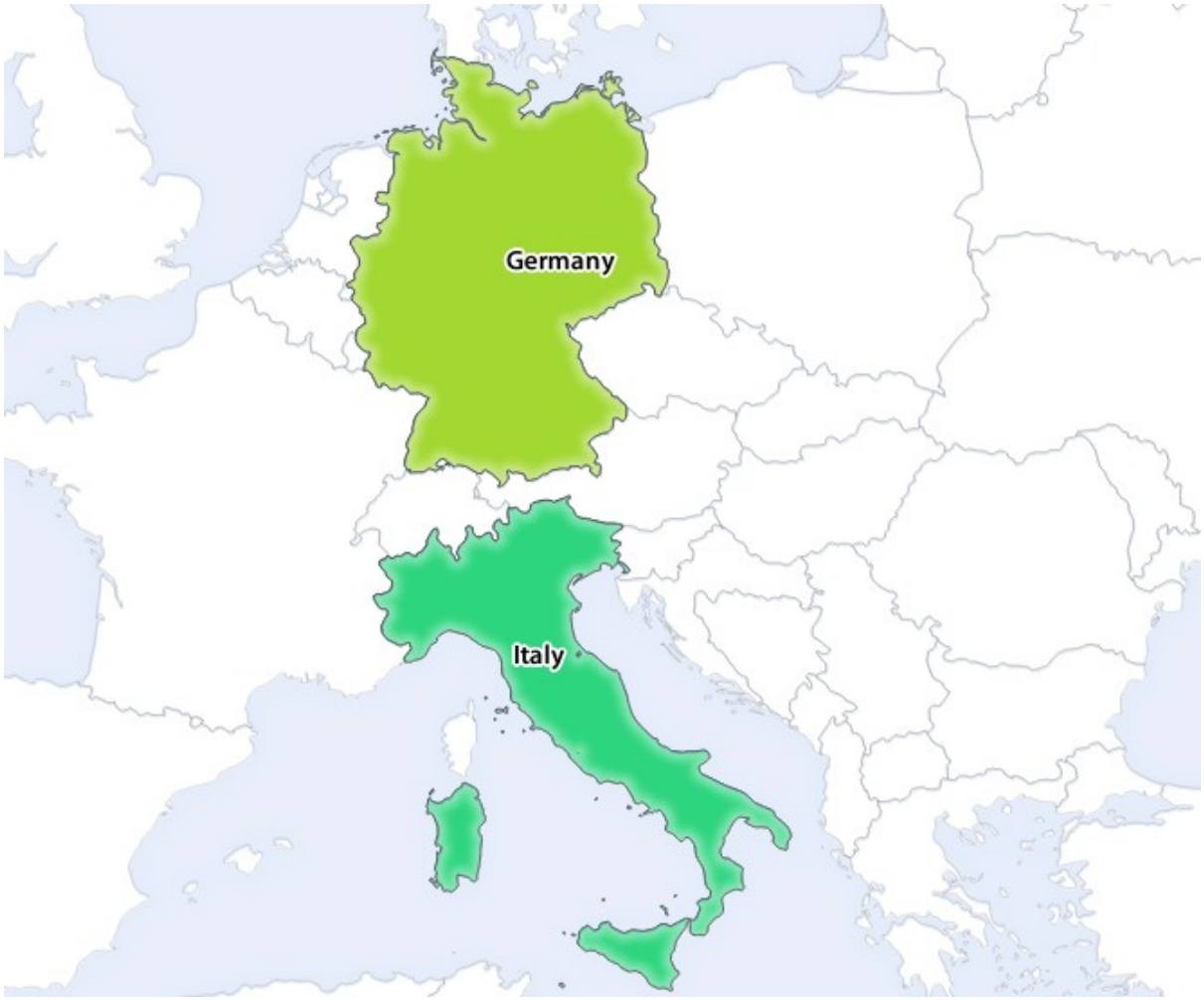


Fig. 11.4: Response to a GetMap request with FILTER and OPACITIES parameters

As you can see from the above image, among other things, we told QGIS Server to render only **Germany** and **Italy** from the countries layer.

11.2.5 ??? Follow Along: Use Redlining

Let's do another GetMap request that makes use of the redlining feature and of the **SELECTION** parameter detailed in the Basics section:

```
http://qgisplatform.demo/cgi-bin/qgis_mapserv.fcgi
?MAP=/home/qgis/projects/world.qgs
&SERVICE=WMS
&VERSION=1.3.0
&REQUEST=GetMap
&BBOX=-432786,4372992,3358959,7513746
&SRS=EPSG:3857
&WIDTH=665
&HEIGHT=551
&LAYERS=countries,countries_shapeburst
&FORMAT=image/jpeg
&HIGHLIGHT_GEOM=POLYGON((590000 6900000, 590000 7363000, 2500000 7363000, 2500000␣
↪6900000, 590000 6900000))
&HIGHLIGHT_SYMBOL=<StyledLayerDescriptor><UserStyle><Name>Highlight</Name>
↪<FeatureTypeStyle><Rule><Name>Symbol</Name><LineSymbolizer><Stroke><SvgParameter␣
↪name="stroke">%233a093a</SvgParameter><SvgParameter name="stroke-opacity">1</
↪SvgParameter><SvgParameter name="stroke-width">1.6</SvgParameter></Stroke></
↪LineSymbolizer></Rule></FeatureTypeStyle></UserStyle></StyledLayerDescriptor>
&HIGHLIGHT_LABELSTRING=QGIS Tutorial
&HIGHLIGHT_LABELSIZE=30
&HIGHLIGHT_LABELCOLOR=%23000000
&HIGHLIGHT_LABELBUFFERCOLOR=%23FFFFFF
&HIGHLIGHT_LABELBUFFERSIZE=3
&SELECTION=countries:171,65
```

Pasting the above request in your web browser should output the following image:



Fig. 11.5: Response to a request with the REDLINING feature and SELECTION parameter

You can see from the above image that the countries with the 171 and 65 ids were highlighted in yellow (Romania and France) by using the **SELECTION** parameter and we used the **REDLINING** feature to overlay a rectangle with the **QGIS Tutorial** label.

11.2.6 GetPrint requests

One very nice feature of QGIS Server is that it makes use of the QGIS Desktop print layouts. You can learn about it in the wms_getprint section.

If you open the `world.qgs` project with QGIS Desktop you will find a print layout named `Population distribution`. A simplified `GetPrint` request that exemplifies this amazing feature is:

```
http://qgisplatform.demo/cgi-bin/qgis_mapserv.fcgi
?map=/home/qgis/projects/world.qgs
&SERVICE=WMS
&VERSION=1.3.0&
REQUEST=GetPrint
&FORMAT=pdf
&TRANSPARENT=true
&SRS=EPSG:3857
&DPI=300
&TEMPLATE=Population distribution
&map0:extent=-432786,4372992,3358959,7513746
&LAYERS=countries
```

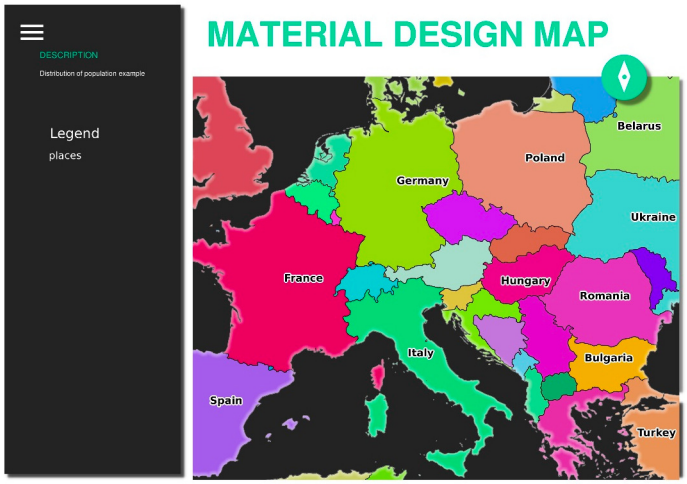


Fig. 11.6: Shows the pdf resulted from the above GetPrint request

Naturally, it's hard to write your `GetMap`, `GetPrint` etc. requests.

QGIS Web Client or QWC is a Web client project that can work alongside QGIS Server so that you can publish your projects on the Web or help you create QGIS Server requests for a better understanding about the possibilities.

O puteți instala în felul următor:

- As user `qgis` go to the home directory with `cd /home/qgis`.
- Download the QWC project from here and unzip it.
- Make a symbolic link to the `/var/www/html` directory as it's the `DocumentRoot` that we've setup in the virtual host configuration. If you unzipped the archive under `/home/qgis/Downloads/QGIS-Web-Client-master` we can do that with `sudo ln -s /home/qgis/Downloads/QGIS-Web-Client-master /var/www/html/`.
- Access http://qgisplatform.demo/QGIS-Web-Client-master/site/qgiswebclient.html?map=/home/qgis/projects/world.qgs from your Web browser.

Now you should be able to see the Map as in the following figure:



Fig. 11.7: QGIS Web Client consuming the world.qgs project

If you click the Print button in QWC you can interactively create `GetPrint` requests. You can also click the `?` icon in the QWC to access the available help so that you can better discover the QWC possibilities.

11.2.7 În concluzie

You learned how use QGIS Server to provide WMS Services.

11.2.8 Ce urmează?

În continuare, vom vedea cum se utilizează QGIS ca interfață pentru faimosul GIS GRASS.

CAPITOLUL 12

Module: GRASS

GRASS (Sistem de Suport pentru Analiza Resurselor Geografice) este un GIS bine-cunoscut, cu sursă deschisă, și cu o gamă largă de funcții utile. Acesta a fost lansat în 1984, și a cunoscut multe îmbunătățiri și funcționalități suplimentare de atunci. QGIS vă permite să faceți uz direct de puternicele instrumente GIS din Grass.

12.1 Lesson: GRASS Setup

Using GRASS in QGIS requires you to think of the interface in a slightly different way. Remember that you're not working in QGIS directly, but working in GRASS *via* QGIS. Hence, make sure you have installed QGIS Desktop with Grass support.

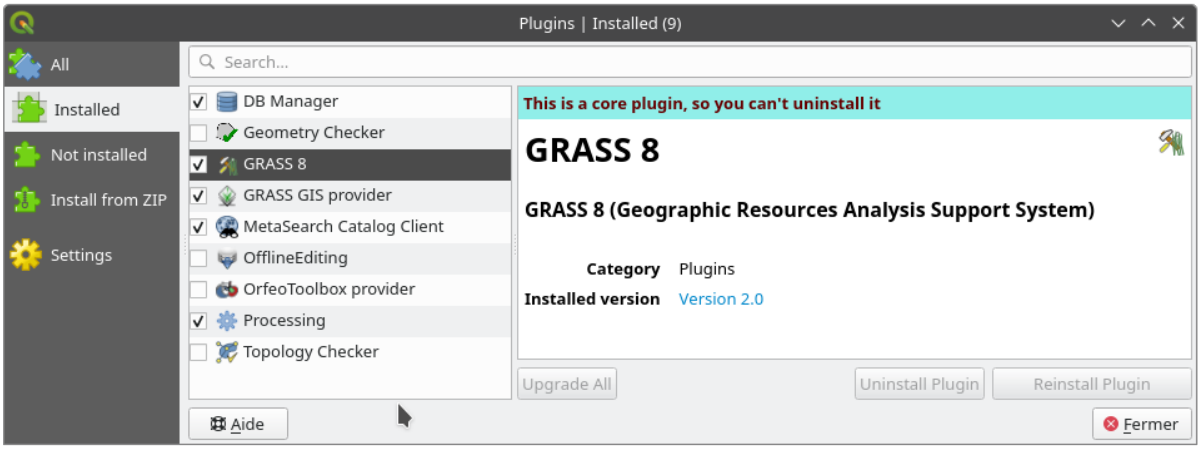
To open a QGIS session with GRASS available on Windows you have to click on the `QGIS Desktop with GRASS` icon.

Scopul acestei lecții: Pentru a începe un proiect GRASS în QGIS.

12.1.1 ??? Follow Along: Start a New GRASS Session

To launch GRASS from within QGIS, you need to activate it as with any other plugin:

1. First, open a new QGIS project.
2. In the *Plugin Manager*, enable *GRASS 8* in the list:



The GRASS toolbar and the GRASS panel will appear:

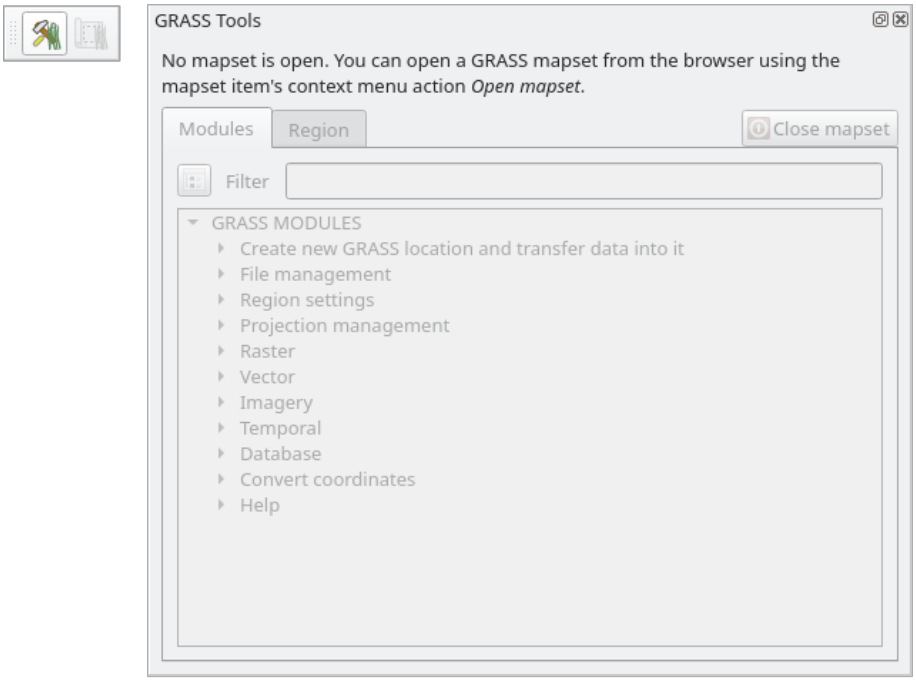


Fig. 12.1: GRASS Toolbar and Panel

The GRASS panel is not active because, before you can use GRASS, you need to create a `Mapset`. GRASS always works in a database environment, which means that you need to import all the data you want to use into a GRASS database.

The GRASS database has a straightforward structure, even if at a first look it seems very complicated. The most important thing you should know is that the upper level of the database is the `Location`. Each `Location` can contain different `Mapset`: in **every** `Mapset` you will find the `PERMANENT` Mapset because it is created by default by GRASS. Each `Mapset` contains the data (raster, vector, etc) in a particular structure, but don't worry, GRASS will take care of this for you.

Just remember: `Location` contains `Mapset` that contains the data. For more information visit the GRASS website.

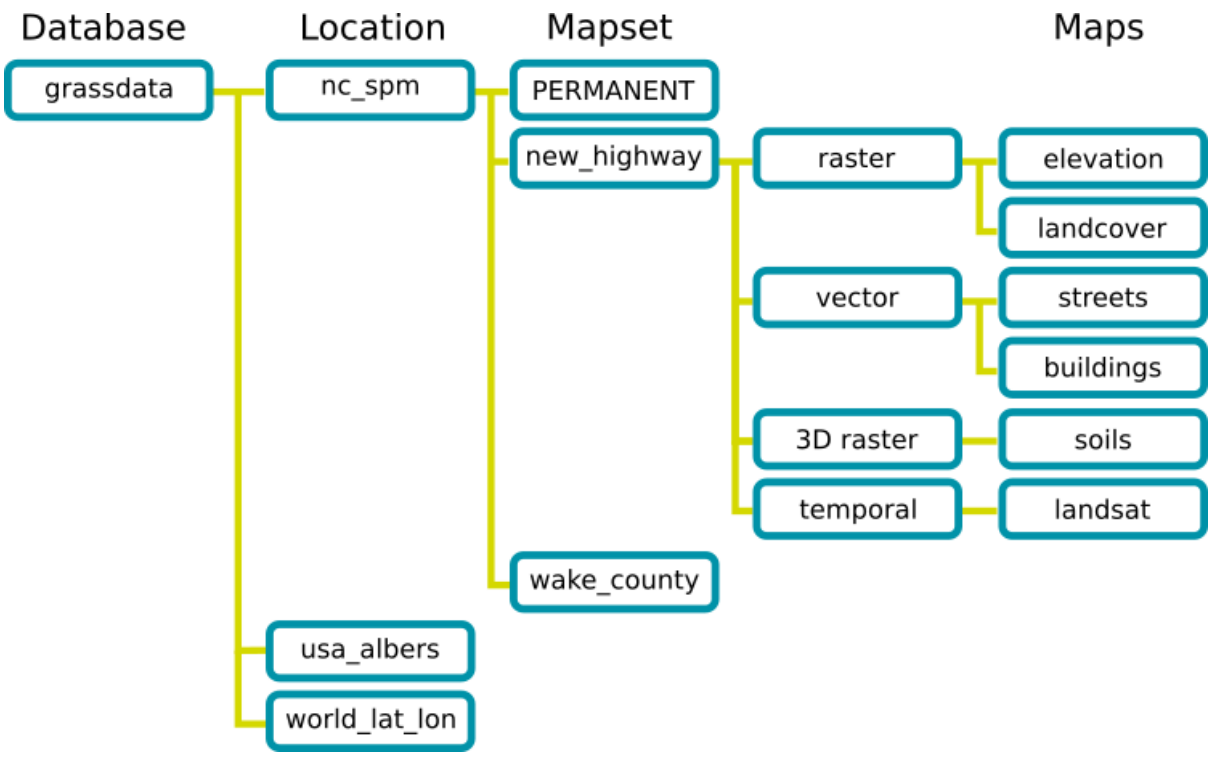
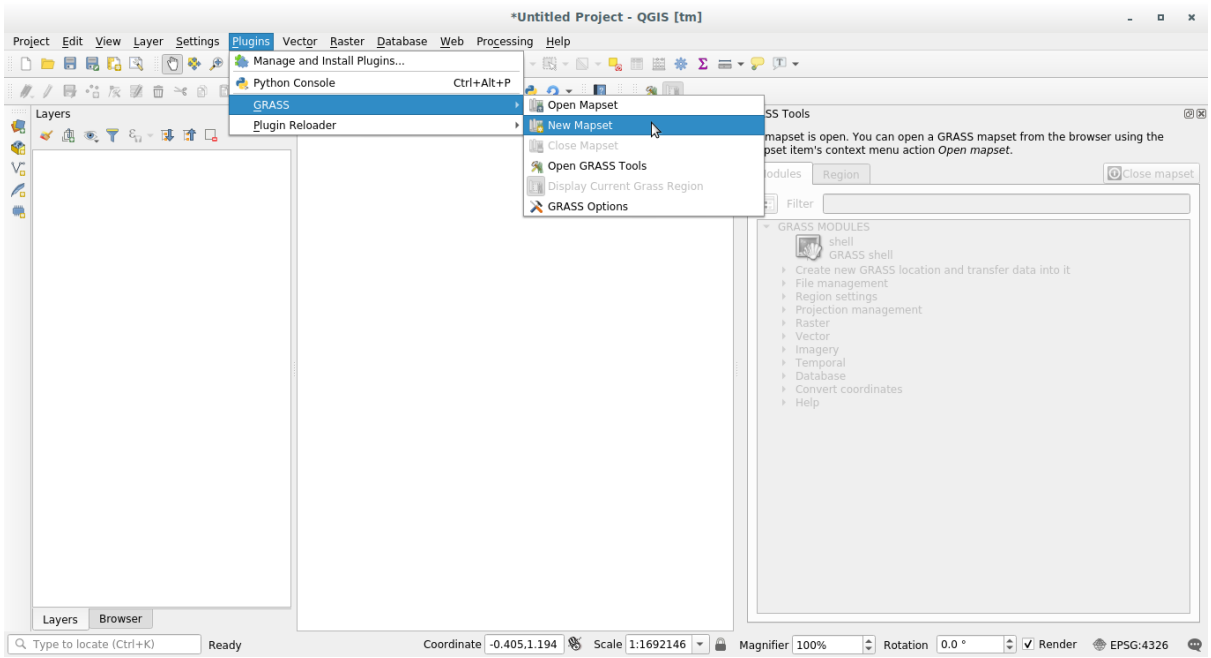


Fig. 12.2: GRASS database structure (from GRASS docs)

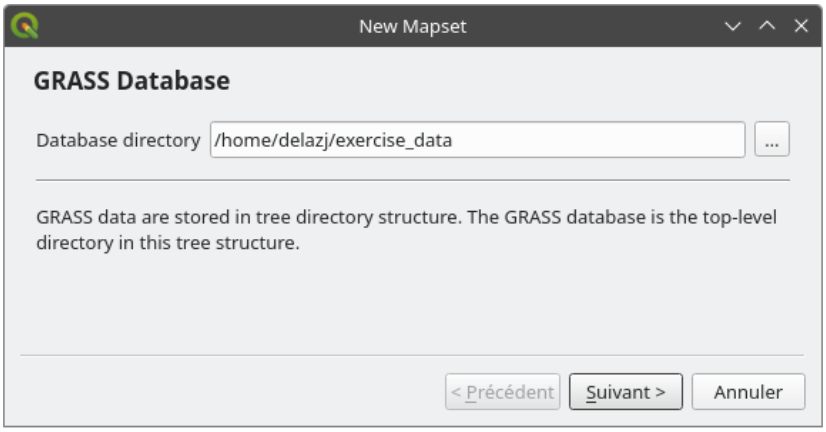
12.1.2 ??? Follow Along: Start a New GRASS Project

1. Click on the *Plugins* ► *GRASS* ► *New Mapset* menu:



   You'll be asked to choose the location of the GRASS database.

2. Setați-l ca director care va fi utilizat de către GRASS pentru instalarea bazei de date:



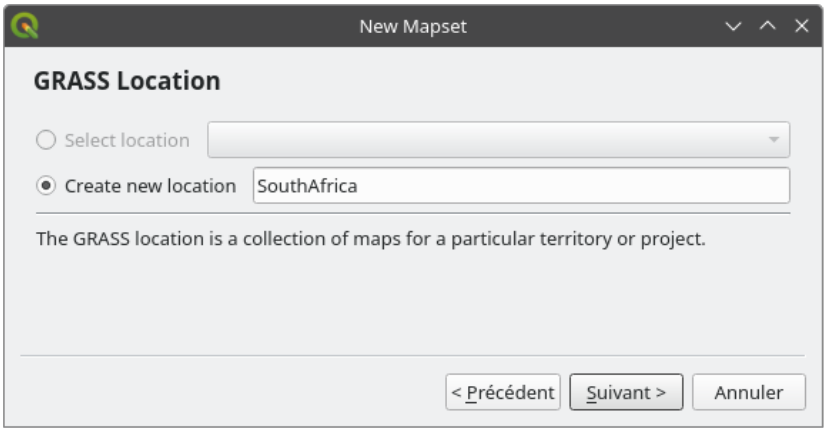
3. Clic pe *Next*.

GRASS needs to create a `Location`, which describes the maximum extent of the geographic area you'll be working in, also known as Grass `Region`.

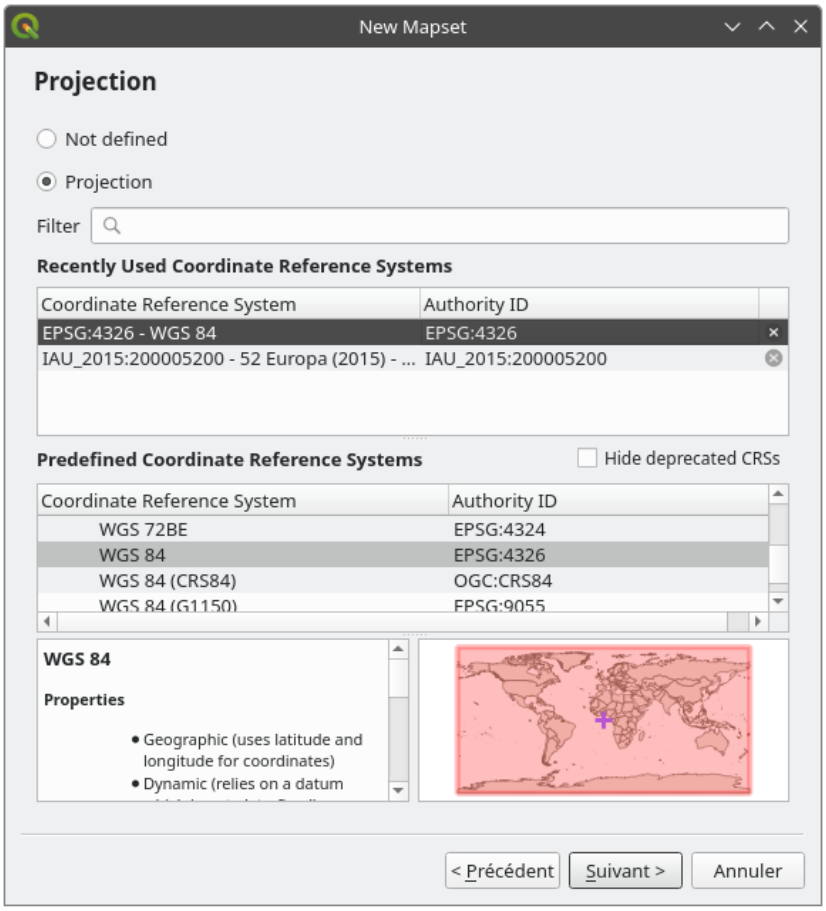
Notă

the Region is extremely important for GRASS because it describes the area in which all layers will be taken into account for GRASS. Everything that is outside will not be considered. Don't worry, you can always change the extent of the GRASS Region after the Location has been created

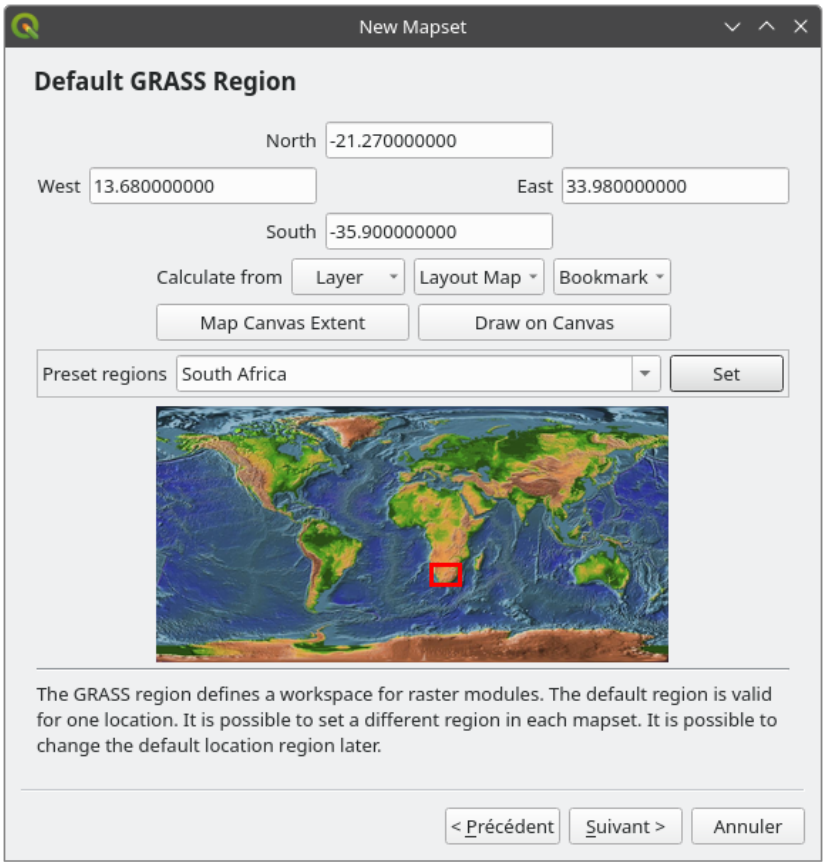
1. Call the new location `SouthAfrica`:



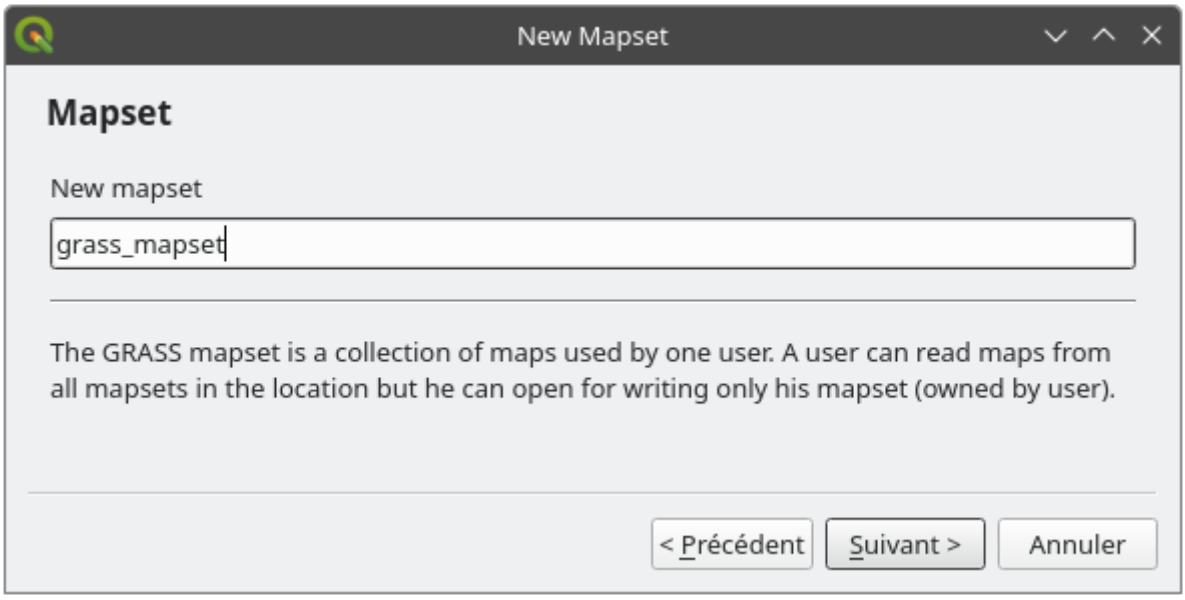
2. Clic pe *Next*.
3. We'll be working with `WGS 84`, so search for and select this CRS:



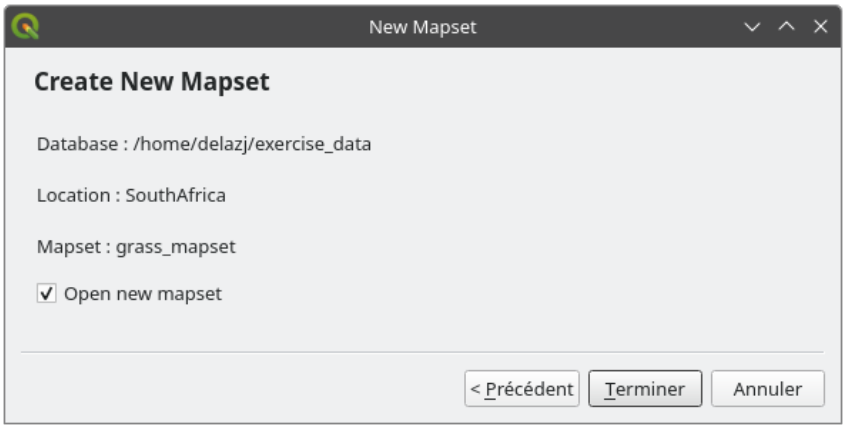
4. Clic pe *Next*.
5. Now select the region `South Africa` from the dropdown and click *Set*:



6. Clic pe *Next*.
7. Creați un set de hărți, care este fișierul hărții cu care veți lucra.



Once you're done, you'll see a dialog asking with a summary of all the information entered.



8. Clic *Finish*.
9. Clic pe *OK*, în dialogul de încheiere cu succes.

You will see that the GRASS Panel will become active and you can start to use all GRASS tools.

12.1.3 ??? Follow Along: Loading Vector Data into GRASS

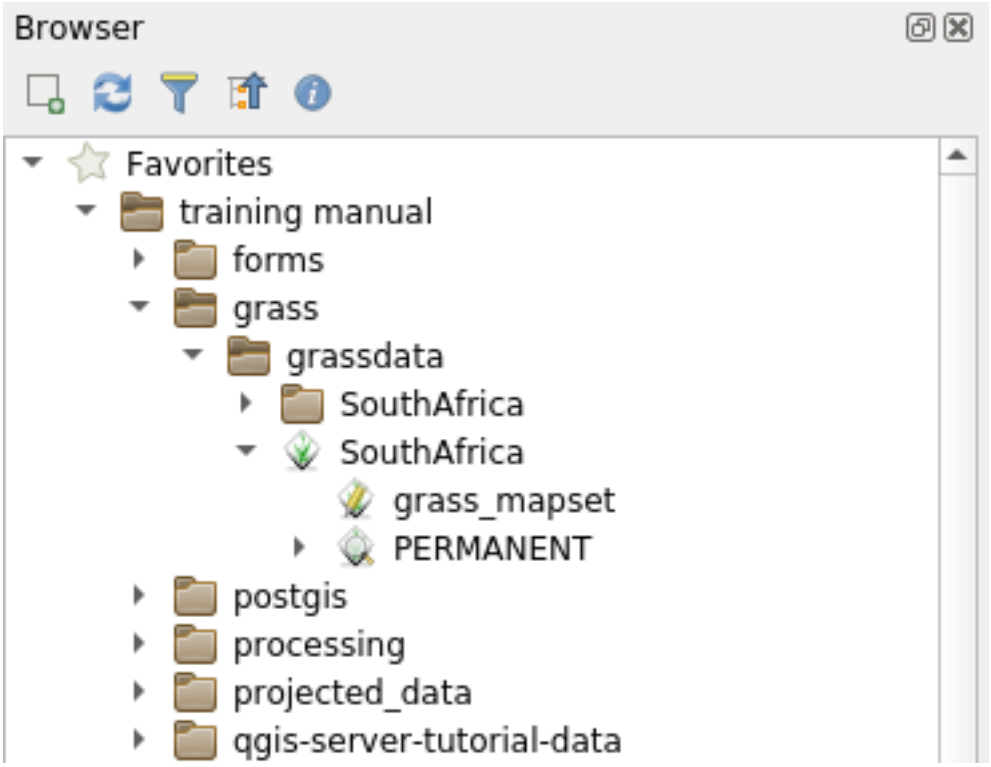
You have now a blank map and before you can start to use all the GRASS tools you have to load data into the GRASS database, specifically into the `Mapset`. You cannot use GRASS tools with layer that are not loaded into a GRASS `Mapset`.

There are many different ways to load data in the GRASS database. Let's start with the first one.

??? Follow Along: Load data using the QGIS Browser

In section *??? Panoul Navigatorului* we saw that the easiest and quickest way to load the data in QGIS is the Browser Panel.

GRASS data are recognized from the QGIS Browser as *real* GRASS data and you can notice it because you will see the GRASS icon next to the GRASS Mapset. Moreover you will see the  icon next to the Mapset that is opened.



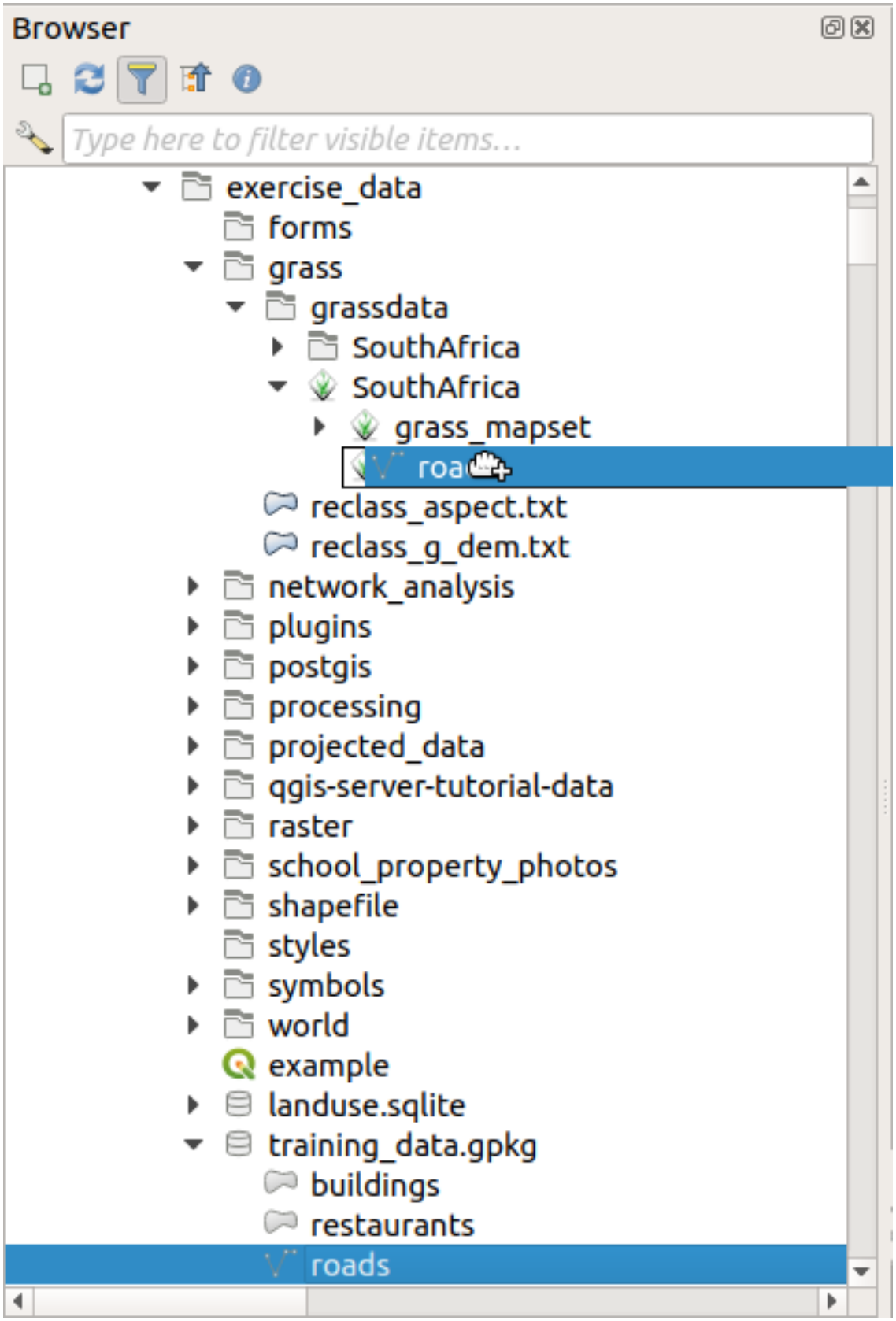
Notă

You will see a replication of the GRASS Location as normal folder: GRASS `Mapset` data are those within the folder

You can easily **drag and drop** layers from a folder to the GRASS Mapset.

Let's try to import the `roads` layer into the `grass_mapset` Mapset of the `SouthAfrica` Location.

Go to the Browser, and simply drag the `roads` layer from the `training_data.gpkg` GeoPackage file into the `grass_mapset` Mapset.



That's it! If you expand the Mapset you will see the imported `roads` layer. You can now load in QGIS the imported layer like all the other layers.

Sfat

You can also load layers from the Layer Legend Panel to Mapset in the Browser Panel. This will speed up incredibly your workflow!

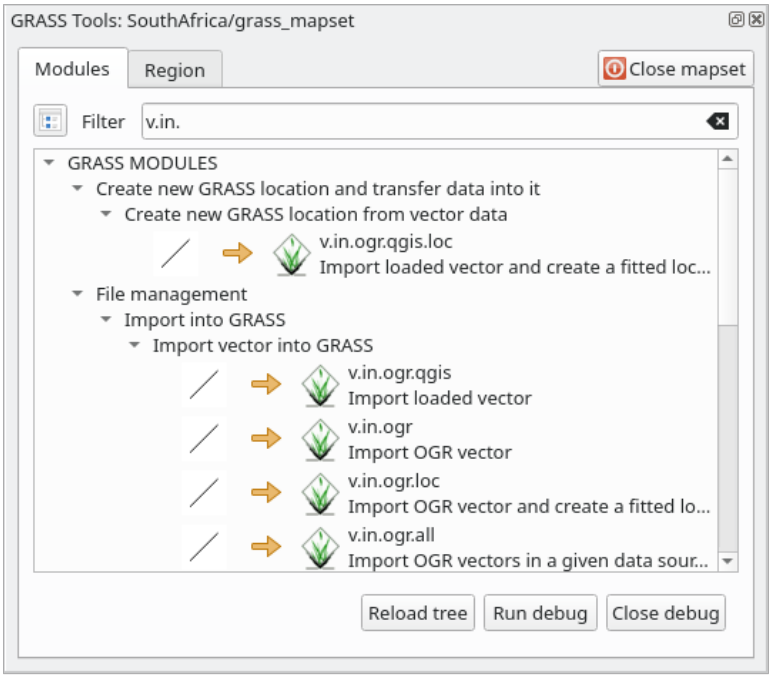
Follow Along: Load data using the GRASS Panel

We will use now the *long* method to load the `rivers.shp` layer into the same Mapset.

1. Load data into QGIS as usual. Use the `rivers.shp` dataset (found in the `exercise_data/shapefile/` folder)
2. As soon as it is loaded, click on the *Filter* box of the `GRASS Panel` and find the vector import tool by entering the term `v.in.ogr.qgis` (available under *File management* ► *Import into GRASS* ► *Import vector into GRASS*):

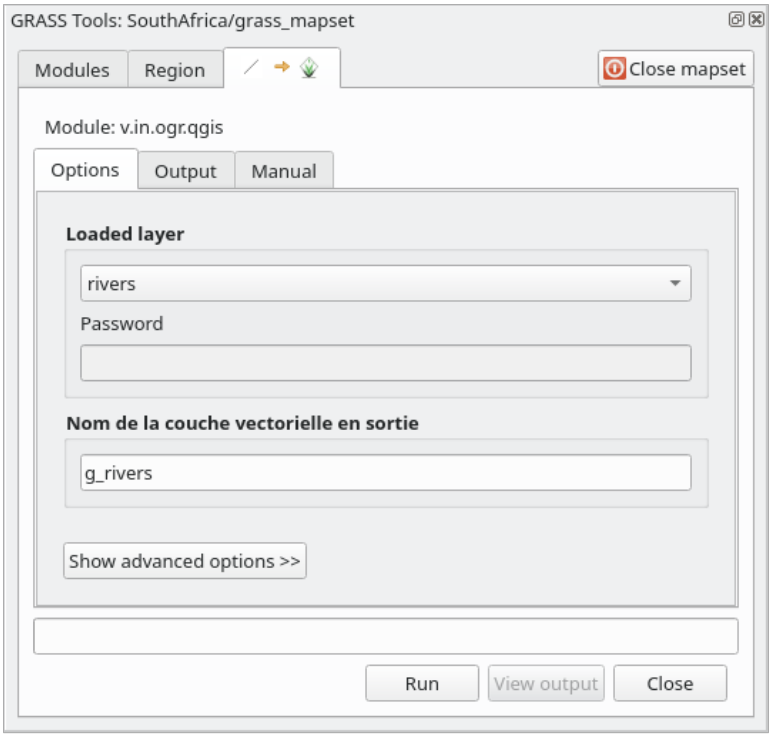
Atenționare

There are 2 similar tools: `v.in.ogr.qgis` and `v.in.ogr.qgis.loc`. We are looking for the **first** one.



The `v` stands for *vector*, `in` means a function to import data into the GRASS database, `ogr` is the software library used to read vector data, and `qgis` means that the tool will look for a vector from among the vectors already loaded into QGIS.

3. Once you've found this tool, click on it to bring up the tool itself. Choose the `rivers` layer in the *Loaded Layer* box and type and name it `g_rivers` to prevent confusion:



Notă

★★★ Note the extra import options provided under *Advanced Options*. These include the ability to add a WHERE clause for the SQL query used for importing the data.

4. Faceți clic pe *Run* pentru a începe importul.
5. După finalizare, dați clic pe butonul *View output* pentru a vedea noul strat GRASS importat în hartă.
6. Închideți primul instrument de import (dați clic pe butonul *Close* imediat în dreapta de *View output*), după care închideți fereastra *GRASS Tools*.
7. Remove the original `rivers` layer.

Acum ați rămas doar cu stratul GRASS importat, așa cum este afișat în harta dvs. din QGIS.

12.1.4 ??? Follow Along: Loading Raster Data into GRASS

You can import a raster layer in the same ways we imported vector layers.

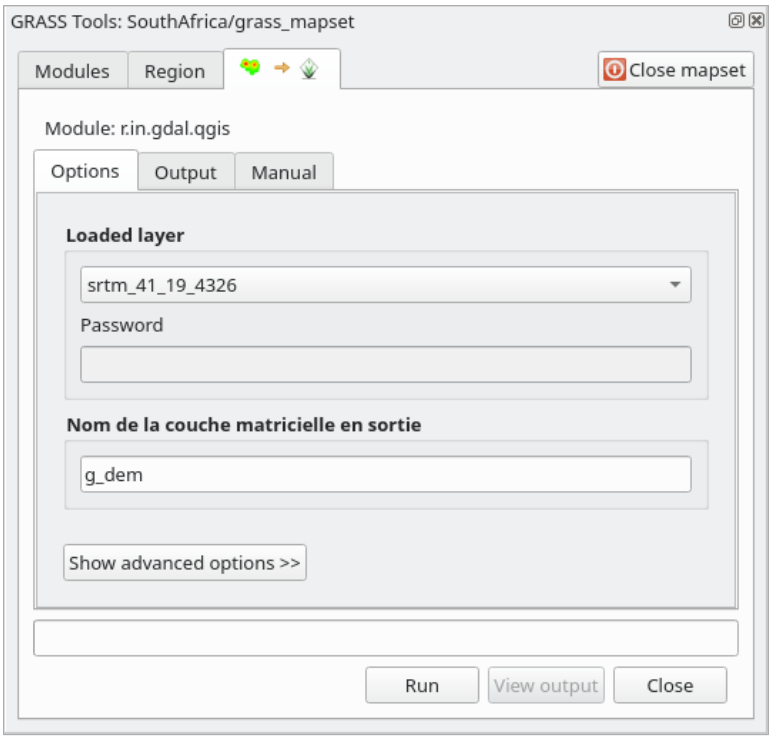
We are going to import in the GRASS Mapset the layer `srtm_41_19_4326.tif`.

Notă

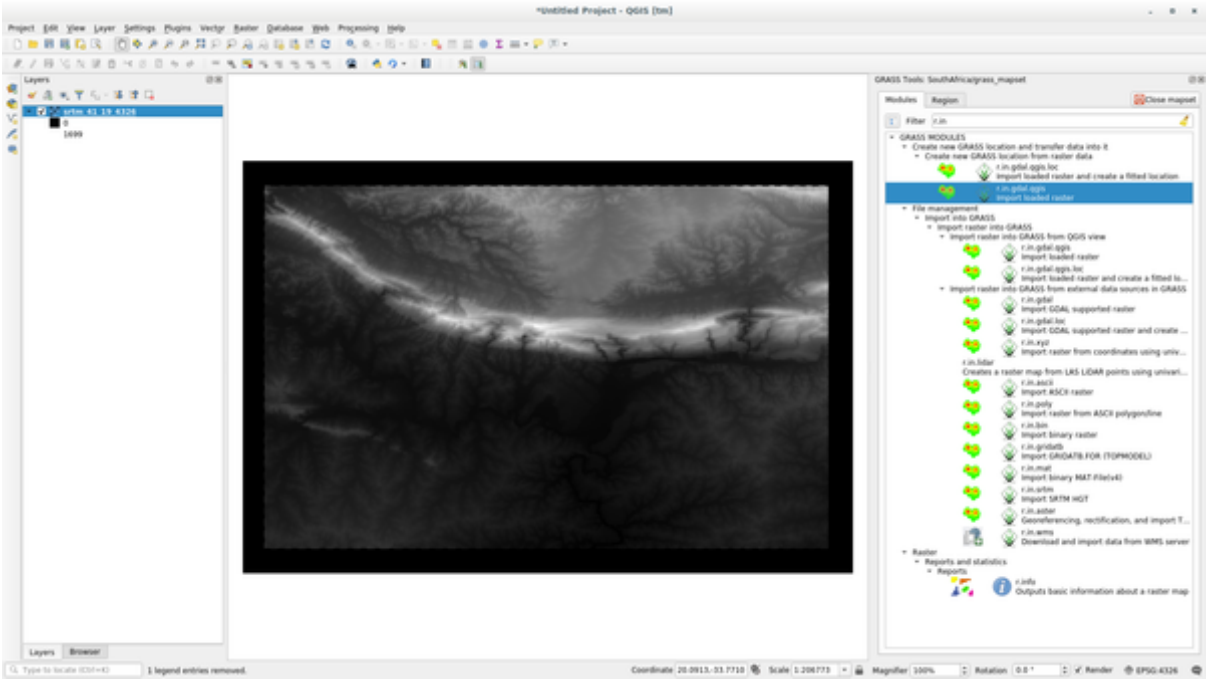
the raster layer is already in the correct CRS, `WGS 84`. If you have layers in different CRS you must reproject them in the same CRS of the GRASS Mapset

1. Load the `srtm_41_19_4326.tif` layer in QGIS
2. Deschideți iarăși dialogul *Instrumentelor GRASS*.
3. Click on the *Modules* tab.

4. Search for `r.in.gdal.qgis` (available under *File management* ► *Import into GRASS* ► *Import raster into GRASS* ► *Import raster into GRASS from QGIS view*) and double click the tool to open the tool's dialog.
5. Set it up so that the input layer is `srtm_41_19_4326.tif` and the output is `g_dem`.



6. Clic pe *Run*
7. Când procesul s-a încheiat, faceți clic pe *Vizualizare rezultat*.
8. *Închideți* fila curentă, apoi *Închideți* întregul dialog.



9. You may now remove the original `srtm_41_19_4326.tif` layer.

12.1.5 ??? Try Yourself: Add Layers to Mapset

Try to import in the GRASS Mapset the vector layers `water.shp` and `places.shp` from the `exercise_data/shapefile/` folder. As we did for `rivers` rename the imported layer as `g_water` and `g_places` to avoid confusion

Răspuns

You can add layers (both vector and raster) into a GRASS Mapset by drag and drop them in the Browser (see *??? Follow Along: Load data using the QGIS Browser*) or by using the `v.in.gdal.qgis` for vector and `r.in.gdal.qgis` for raster layers.

12.1.6 ??? Open an existing GRASS Mapset

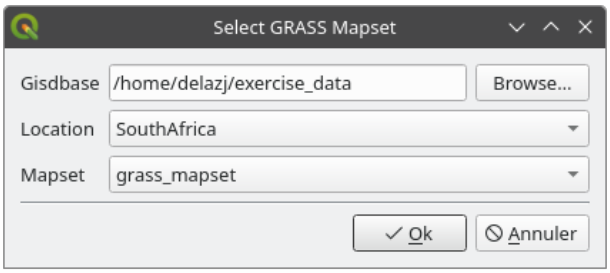
If you have an existing GRASS Mapset you can easily reopen it in another session of QGIS.

You have several method to open a GRASS Mapset, let's explore some of them.

Let's close the Mapset by clicking on the *Close Mapset* button of the *GRASS Tools* window.

??? Follow Along: Using the GRASS plugin

1. Click on the *Plugins* ► *GRASS* ► *Open Mapset* menu.
2. Browse to the GRASS database folder: be careful! You must choose the parent folder, not the GRASS Mapset one. Indeed GRASS will read all the `Locations` of the database and all the `Mapsets` of each `Location`:



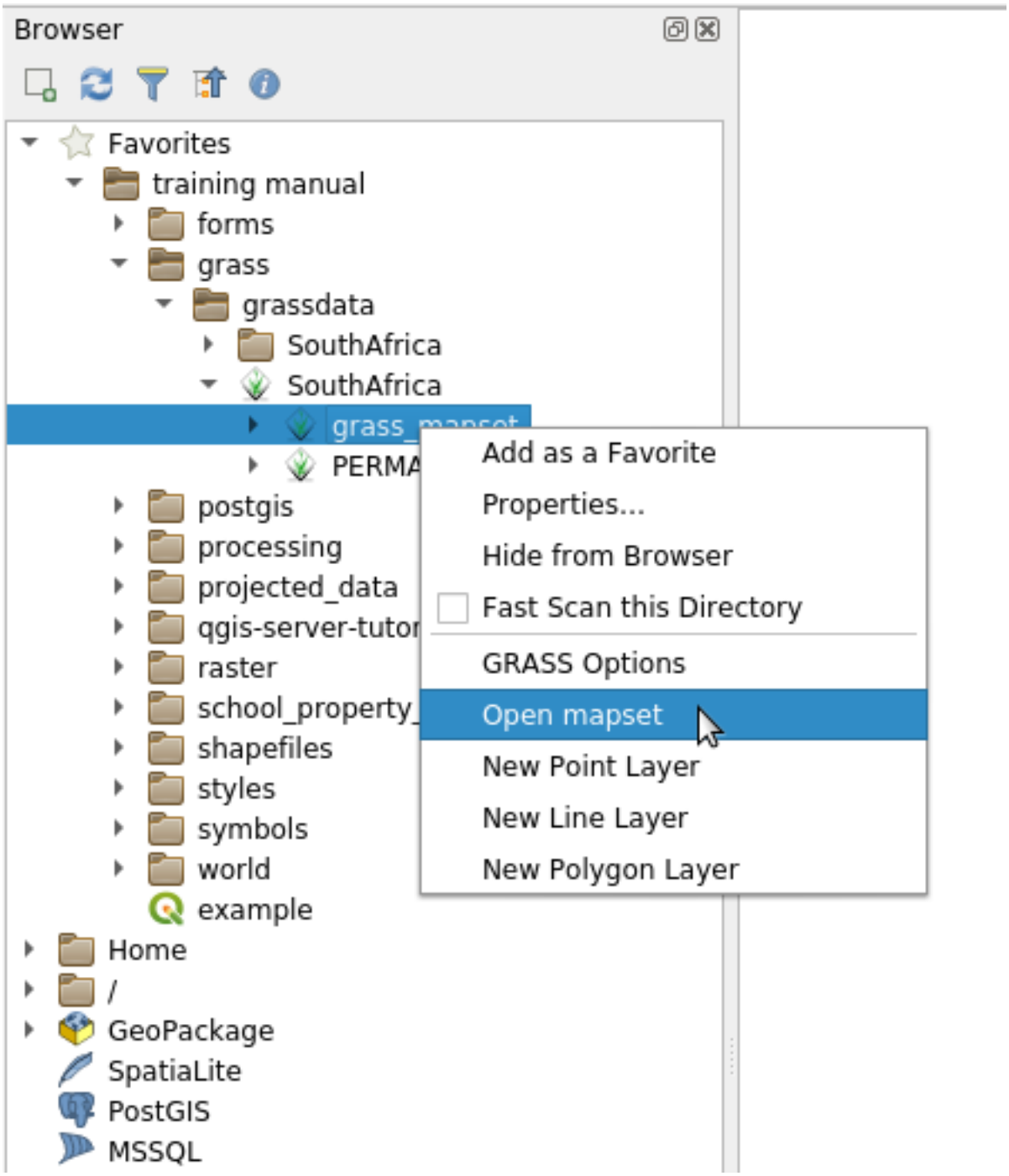
3. Choose the `Location` `SouthAfrica` and the `Mapset` `grass_mapset` that we have created before.

That's it! The GRASS Panel will become active meaning that the Mapset has been correctly opened.

??? Follow Along: Using the QGIS Browser

Even faster and easier is opening a `Mapset` using the QGIS Browser:

1. Close the Mapset (if it is open) by clicking on the *Close Mapset* button of the *GRASS Tools* window.
2. In the QGIS Browser, browse to the folder of the GRASS database.
3. Right click on the Mapset (remember, the Mapset has the GRASS icon next to it). You will see some options.
4. Click on *Open mapset*:



The Mapset is now open and ready to use!

Sfat

Right click on a GRASS Mapset offers you a lot of different settings. Try to explore them and see all the useful options.

12.1.7 În concluzie

Fluxul de lucru GRASS pentru asimilarea datelor este ușor diferit de metoda QGIS pentru că GRASS încarcă datele într-o structură de bază de date spațială. Cu toate acestea, utilizând QGIS ca interfață, puteți ușura setarea unui mapset GRASS prin utilizarea straturilor existente QGIS ca surse de date pentru GRASS.

12.1.8 Ce urmează?

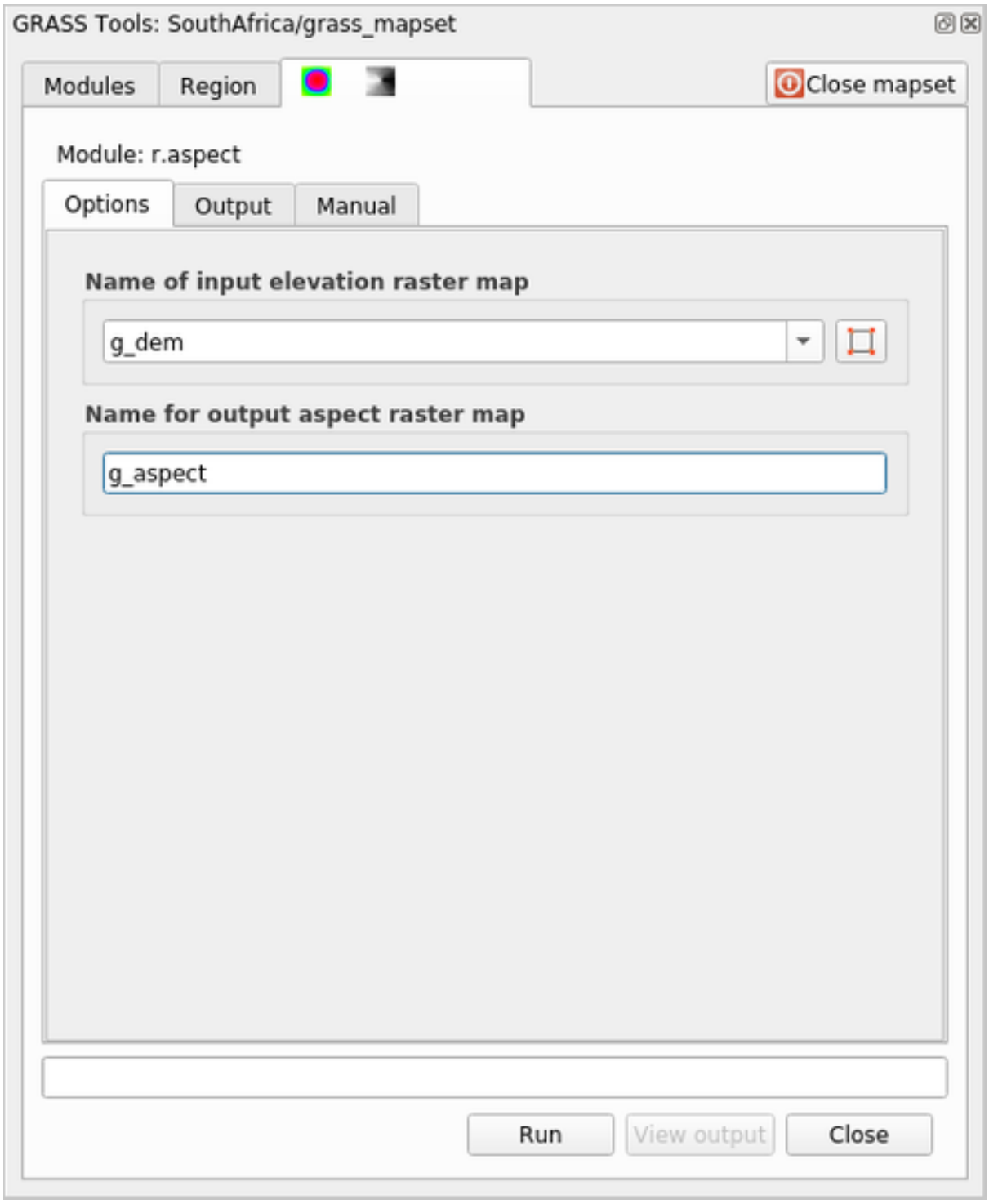
Acum, o dată ce datele sunt importate în GRASS, ne putem uita la operațiunile avansate de analiză pe care le oferă GRASS.

12.2 Lesson: GRASS Tools

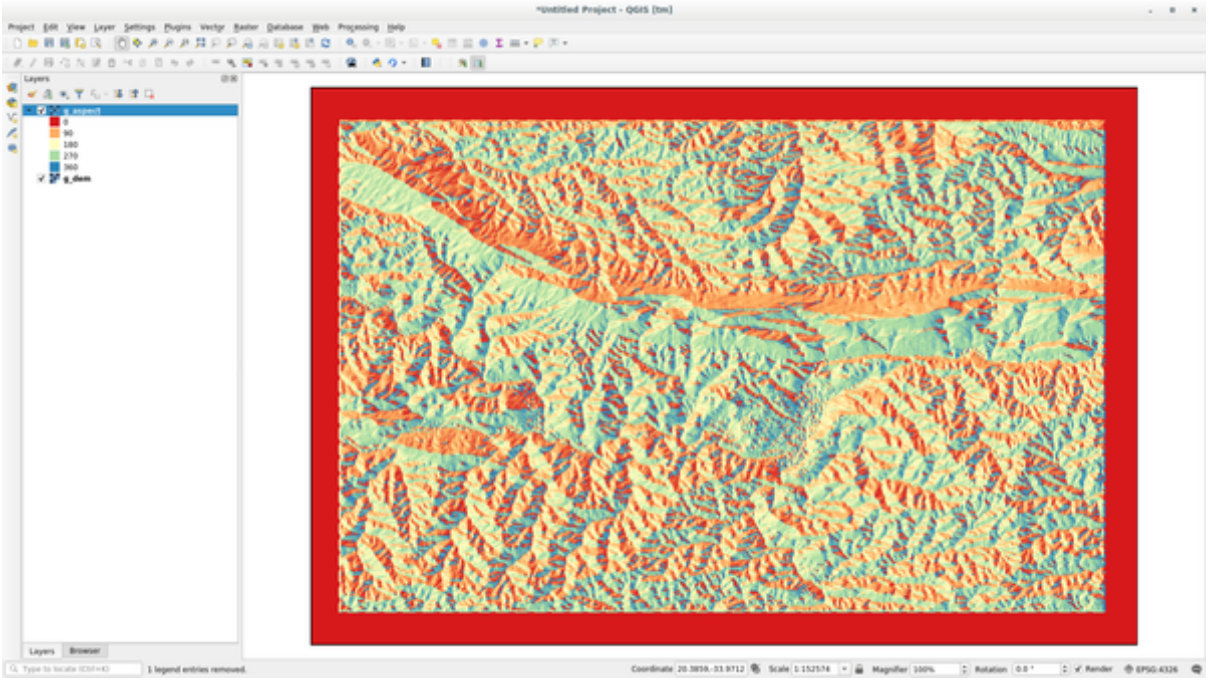
În această lecție vom prezenta o selecție de instrumente pentru a vă oferi o idee despre capabilitățile GRASS.

12.2.1 ??? Procedați în mod similar: Crearea unei hărți a expoziției versanților

1. Open the *GRASS Tools* tab
2. Load the `g_dem` raster layer from the *grass_mapset* Mapset
3. Look for the *r.aspect* module by searching for it in the *Filter* field of the *Modules List* tab
4. Open the tool and set it up like this and click on the *Run* button:



5. When the process is finished click on *View Output* to load the resulting layer in the canvas:

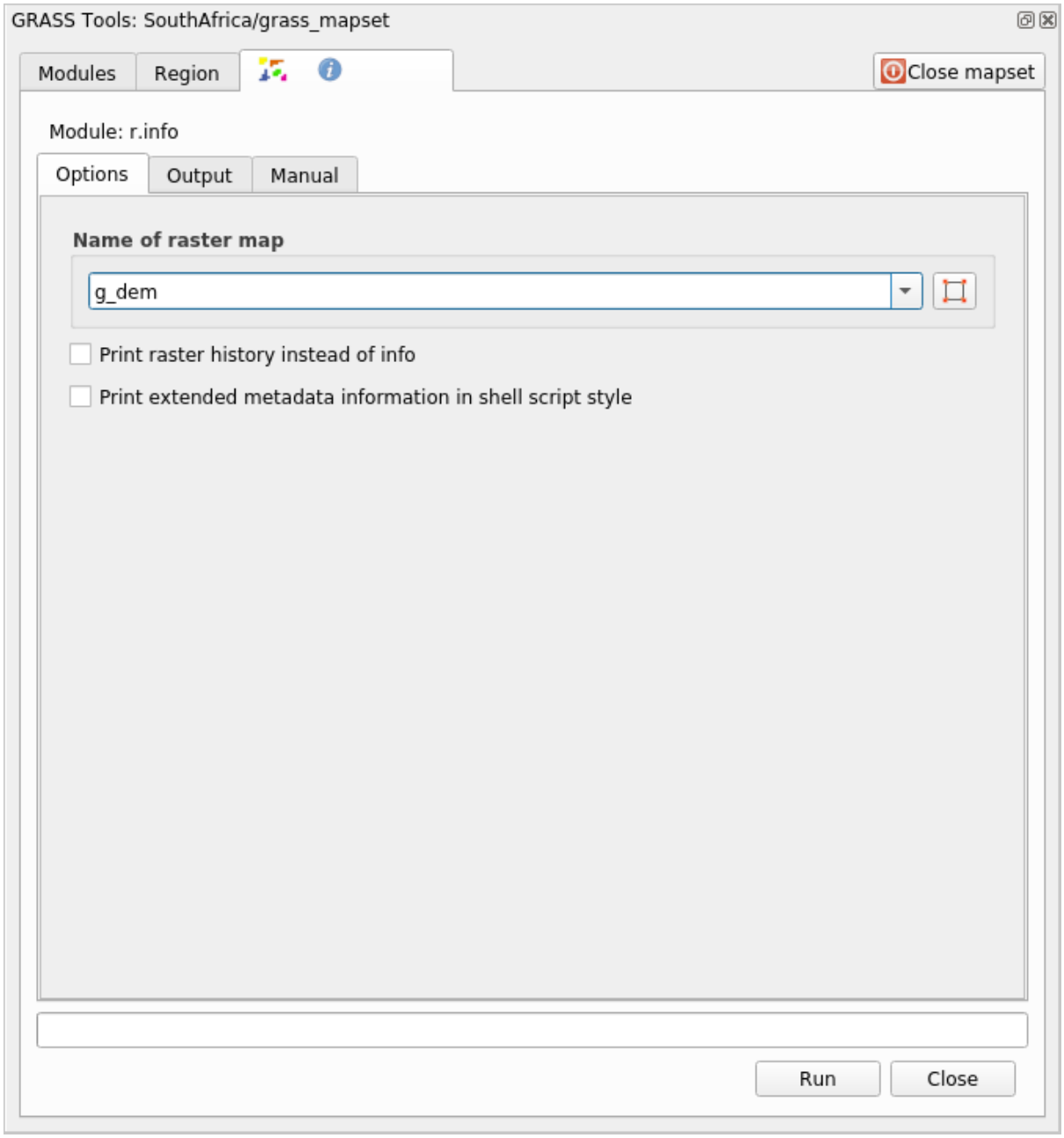


The `g_aspect` layer is stored within the *grass_mapset* Mapset so you can remove the layer from the canvas and reload it whenever you want.

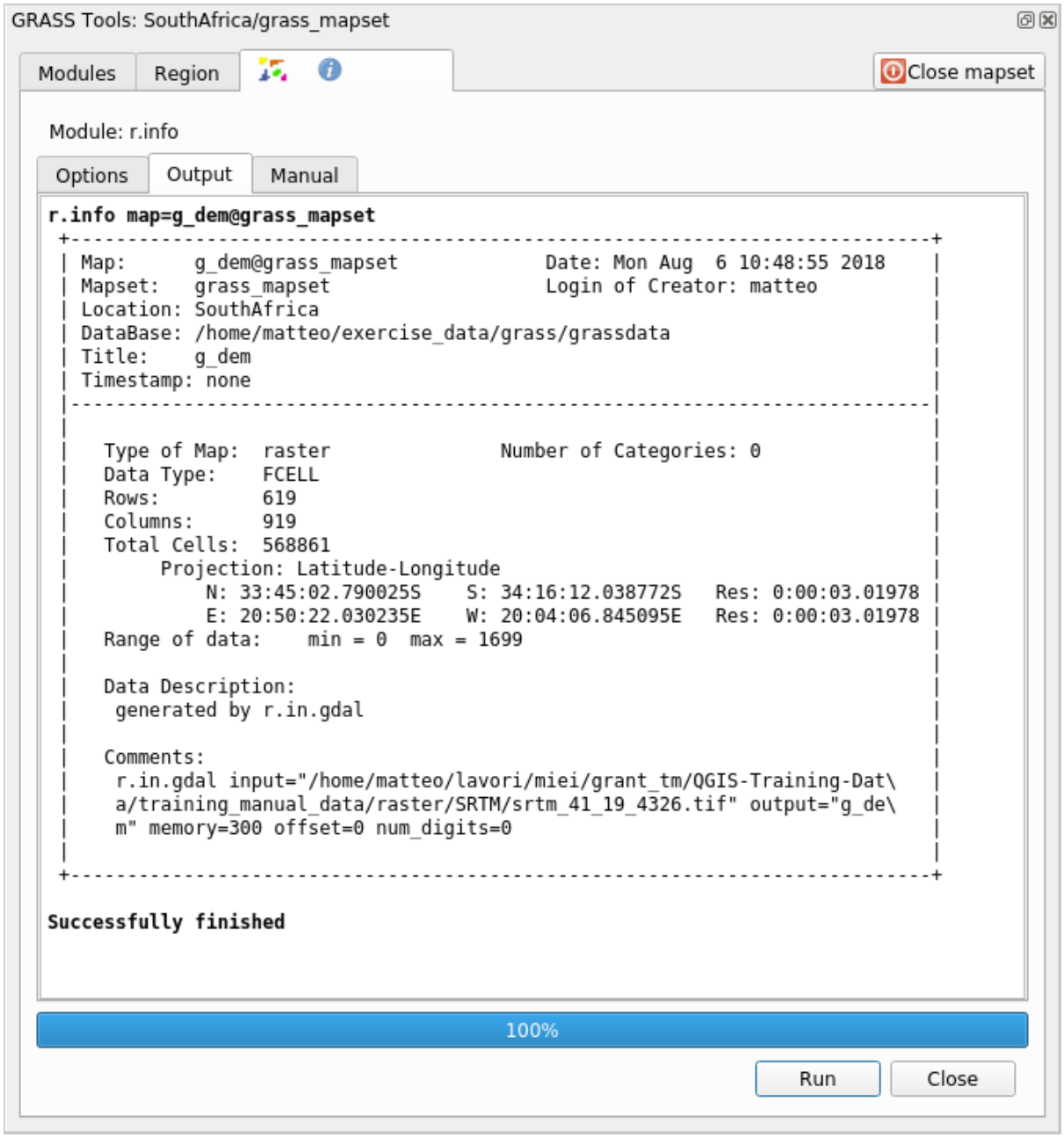
12.2.2 ??? Follow Along: Get basic statistic of raster layer

We want to know some basic statistics of the `g_dem` raster layer.

1. Open the *GRASS Tools* tab
2. Load the `g_dem` raster layer from the *grass_mapset* Mapset
3. Look for the *r.info* module by searching for it in the *Filter* field of the *Modules List* tab
4. Set up the tool like this and click on *Run*:



5. Within the Output tab you will see some raster information printed, like the path of the file, the number of rows and columns and other useful information:



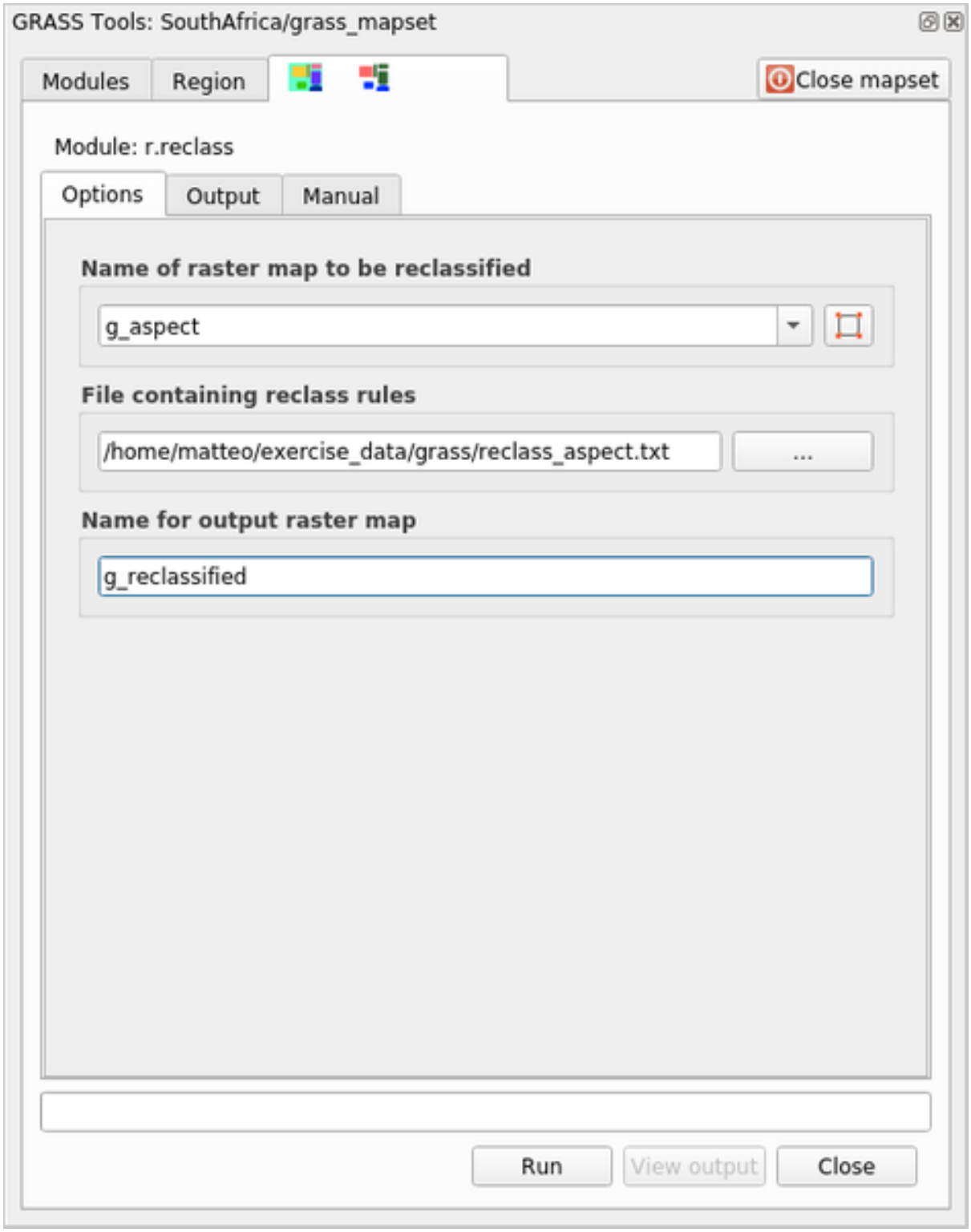
12.2.3 ??? Follow Along: The Reclass Tool

Reclassifying a raster layer is a very useful task. We just created the `g_aspect` layer from the `g_dem` one. The value range gets from 0 (North) passing through 90 (East), 180 (South), 270 (West) and finally to 360 (North again). We can reclassify the `g_aspect` layer to have just 4 **categories** following specific *rules* (North = 1, East = 2, South = 3 and West = 4).

Grass reclassify tool accepts a `txt` file with the defined rules. Writing the rules is very simple and the GRASS Manual contains very good description.

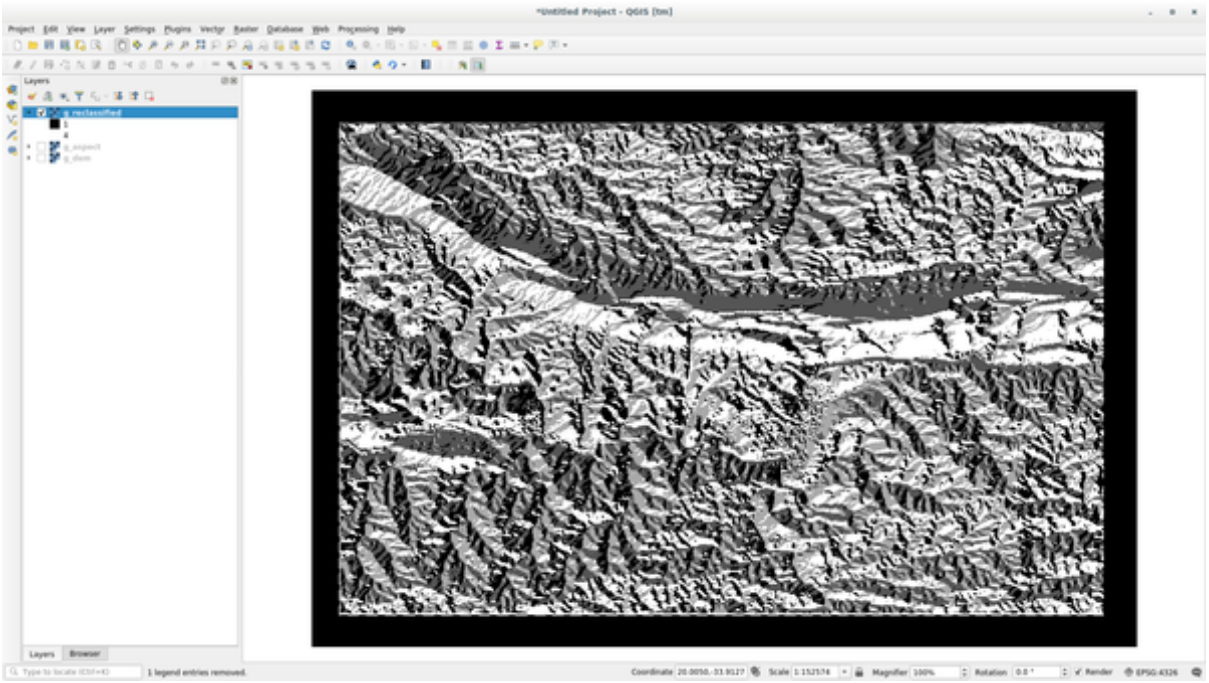
> **Sfat**
>
> Each GRASS tool has its own Manual tab. Take the time to read the description of the tool you are using to don't miss some useful parameters

1. Load the `g_aspect` layer or, if you don't have create it, go back to the *Procedați în mod similar: Crearea unei hărți a expoziției versanților* section.
2. Look for the *r.reclass* module by searching for it in the *Filter* field of the *Modules List* tab
3. Open the tool and set it up like the following picture. The file containing the rules is in the `exercise_data/grass/` folder, named `reclass_aspect.txt`.
4. Click on *Run* and wait until the process is finished:



5. Click on *View Output* to load the reclassified raster in the canvas

   The new layer is made up by just 4 values (1, 2, 3, and 4) and it is easier to manage and to process.



Sfat

Open the `reclass_aspect.txt` with a text editor to see the rules and to start becoming used to them. Moreover, take a deep look at the GRASS manual: a lot of different examples are pointed out.

12.2.4 ??? Încercați și dvs.: Reclasificare după propriile reguli

Try to reclassify the `g_dem` layer into 3 new categories:

- from 0 to 1000, new value = 1
- from 1000 to 1400, new value = 2
- from 1400 to the maximum raster value, new value = 3

Răspuns

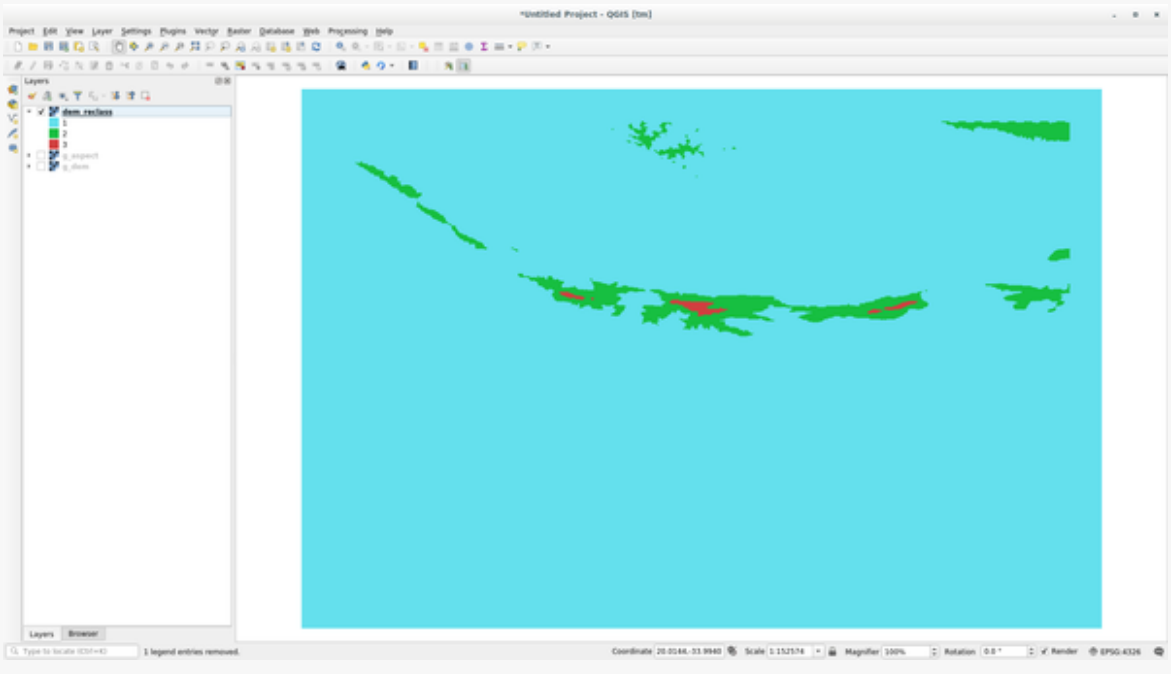
To discover the maximum value of the raster run the `r.info` tool: in the console you will see that the maximum value is 1699. You are now ready to write the rules.

1. Open a text editor and add the following rules:

```
0 thru 1000 = 1
1000 thru 1400 = 2
1400 thru 1699 = 3
```

2. Save the file as `my_rules.txt` file and close the text editor.
3. Run the `r.reclass` tool: choose the `g_dem` layer and load the file containing the rules you just have saved.

4. Click on *Run* and then on *View Output*. You can change the colors and the final result should look like the following picture:



12.2.5 ??? Follow Along: The Mapcalc Tool

The Mapcalc tools is similar to the Raster Calculator of QGIS. You can perform mathematical operation on one or more raster layers and the final result will be a new layer with the calculated values.

The aim of the next exercise is to extract the values greater than 1000 from the `g_dem` raster layer.

1. Look for the *r.mapcalc* module by searching for it in the *Filter* field of the *Modules List* tab.
2. Startați instrumentul.

   The *Mapcalc* dialog allows you to construct a sequence of analyses to be performed on a raster, or collection of rasters. You will use these tools to do so:

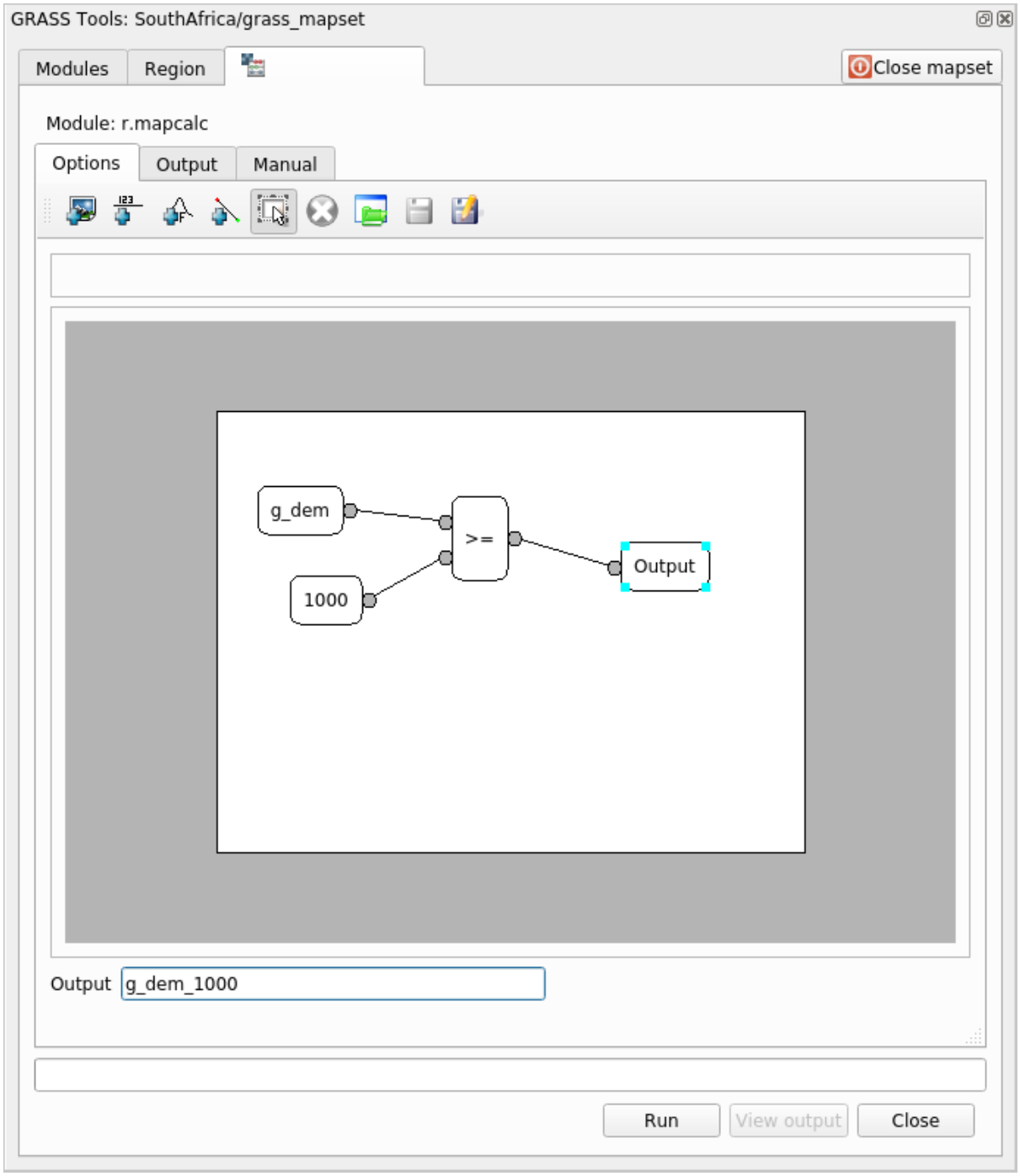


   În ordine, acestea sunt:

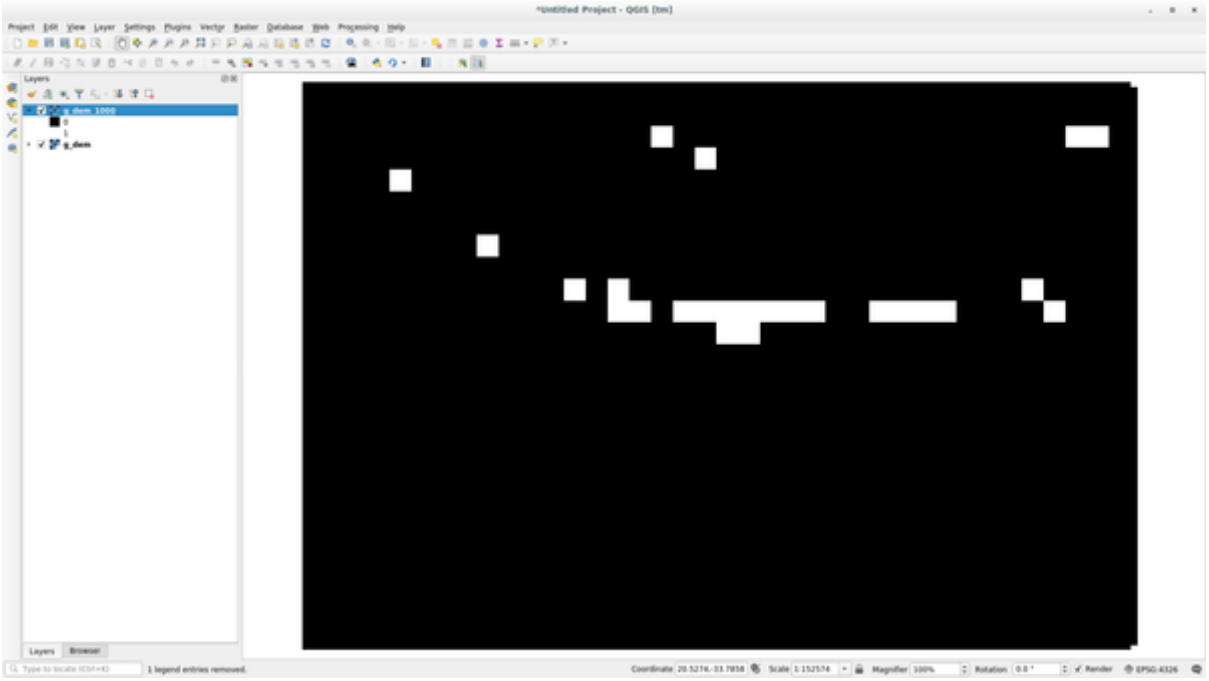
   - *Add map*: Add a raster file from your current GRASS mapset.
   - *Add constant value*: Add a constant value to be used in functions, 1000 in this case
   - *Add operator or function*: Add an operator or function to be connected to inputs and outputs, we will use the operator `greater equals than`
   - *Add connection*: Connect elements. Using this tool, click and drag from the red dot on one item to the red dot on another item. Dots that are correctly connected to a connector line will turn gray. If the line or dot is red, it is not properly connected!
   - *Select item*: Select an item and move selected items.
   - *Delete selected item*: Removes the selected item from the current mapcalc sheet, but not from the mapset (if it is an existing raster)

- *Open*: Open an existing file with the operation defined
- *Save*: Save all the operation in a file
- *Save as*: Save all the operations as a new file on the disk.

3. Using these tools, construct the following algorithm:



4. Click on *Run* and then on *View output* to see the output displayed in your map:



This shows all the areas where the terrain is higher than 1000 meters.

> **Sfat**
>
> You can also save the formula you have created and load it in another QGIS project by clicking on the last button on the GRASS Mapcalc toolbar.

12.2.6 În concluzie

În această lecție, am acoperit doar câteva dintre numeroasele instrumente GRASS. Pentru a explora capacitățile GRASS, deschideți dialogul *Instrumentelor GRASS*, apoi derulați până la *Lista Modulelor*. Sau, pentru o abordare mai structurată, căutați în fila *Modules Tree*, care prezintă instrumentele organizate după tip.

CAPITOLUL 13

Module: Assessment

Folosiți datele dvs pentru această secţiune. Veți avea nevoie de:

- un set de date vectoriale al punctelor de interes, cu numele punctelor și multiple categorii
- un set vectorial cu datele drumurilor
- un set vectorial cu date poligonale despre utilizarea terenurilor (folosind limitele de proprietate)
- o imagine a spectrului vizibil (cum ar fi o fotografie aeriană)
- a DEM (downloadable from the CGIAR-CSI if you don't have your own)

13.1 Crearea unei hărți de bază

Înainte de a orice, aveți nevoie de o hartă de bază, care va asigura un context pentru rezultatele analizei dvs.

13.1.1 Adăugarea unui strat de tip punct

- Adăugați stratul de tip punct. În funcție de nivelul la care urmați cursul, efectuați doar ceea ce este listat în secțiunea corespunzătoare de mai jos:

???

- Etichetați punctele în conformitate cu un atribut unic, cum ar fi numele locurilor. Utilizați un font mic pentru a nu scoate în evidență etichetele. Informațiile trebuie să fie disponibile, dar nu ar trebui să fie principalele entități de pe hartă.
- Clasificați punctele în culori diferite, pe baza unei categorii. De exemplu, categoriile ar putea include „destinație turistică", „secție de poliție" și „centrul orașului".

???

- Do the same as the ★☆☆ section.
- Clasificați dimensiunea punctului după importanță: cu cât mai semnificativă e o entitate, cu atât mai mare este punctul. Cu toate acestea, nu depășiți o dimensiune a punctului de `2.00`.
- Entităților care nu sunt localizate într-un singur punct (cum ar fi un nume de provincie/regiune, sau un nume de oraș, la o scară mai mare), nu le atribuiți nici un punct.

???

- Nu folosiți deloc simboluri punctiforme pentru a simboliza stratul. În schimb, folosiți etichetele centrate pe puncte; simbolurile punctiforme nu ar trebui să aibă o dimensiune.
- Folosiți *Setări definite cu ajutorul datelor* pentru a stiliza etichetele în categorii semnificative.
- Adăugați coloanele corespunzătoare pentru datele atributelor, dacă este necesar. Când faceți acest lucru, nu creați date fictive - mai degrabă, utilizați *Calculatorul de Câmpuri* pentru a popula noile coloane, pe baza valorilor existente în setul de date.

13.1.2 Adăugarea stratului de tip linie

- Adăugați stratul rutier și apoi schimbați-i simbolistica. Nu etichetați drumurile.

???

- Alegeți pentru simbolistica drumului o linie lată, de culoare deschisă. De asemenea, adăugați-i o oarecare transparență.

???

- Creați un simbol cu straturi multiple pentru simboluri. Simbolul rezultat ar trebui să arate ca un drum adevărat. Aveți posibilitatea să utilizați un simbol simplu pentru aceasta; de exemplu, o linie neagră, cu o linie solidă, albă și subțire în centru. Simbolul ar putea arăta chiar și mai elaborat, totuși, harta rezultată nu ar trebui să arate prea încărcată.
- Dacă setul dvs. de date are o densitate mare de drumuri la scara la care doriți să prezentați harta, atunci, ar trebui să aveți două straturi rutiere: unul cu un simbol mai complex, și altul cu un simbol mai simplu, pentru scări mai mici. (Utilizați vizibilitatea în funcție de scară, pentru a se face trecerea la scara adecvată.)
- Toate mqrcajele ar trebui să aibă straturi multiple cu simboluri. Utilizați simbolurile pentru a le afișa corect.

???

- Do the same as in the ★★☆ section above.
- În plus, drumurile ar trebui să fie clasificate. Atunci când se utilizează simboluri de teren realiste, fiecare tip de drum ar trebui să aibă un simbol adecvat; de exemplu, o autostradă ar trebui să apară cu două benzi pentru fiecare sens.

13.1.3 Adăugarea stratului de tip poligon

- Adăugați stratul de folosință a terenurilor și schimbați-i simbolistica.

???

- Clasificați stratul conform utilizării terenului. Folosiți culori solide.

???

- Clasificați stratul conform utilizării terenurilor. Dacă este cazul, includeți straturi simbol, diferite tipuri de simboluri, etc. Aveți grijă ca rezultatele să aibă intensitate redusă și să arate uniform, cu toate acestea. Țineți minte că acesta va fi parte a unui fundal!

???

- Utilizați clasificarea bazata pe reguli pentru a clasifica utilizarea terenurilor în categorii generale, cum ar fi „urban”, „rural”, „rezervație naturală”, etc.

13.1.4 Crearea fundalului raster

- Creați o reliefare din DEM, și utilizați-o ca o suprapunere pentru o versiune clasificată a DEM-ului în sine. Ați putea folosi, de asemenea, plugin-ul *Relief* (după cum se arată în lecția despre plugin-uri).

13.1.5 Finalizarea hărții de bază

- Utilizând resursele de mai sus, creați o hartă de bază folosind unele straturi sau pe toate. Această hartă ar trebui să includă toate informațiile de bază necesare pentru a orienta utilizatorul, și să fie vizual unificată / „simplă”.

13.2 Analiza datelor

- Căutați o proprietate care îndeplinește anumite criterii.
- Puteți decide cu privire la propriile criterii, pe care le trebuie să le documentați.
- Iată unele indicații pentru aceste criterii:
  - proprietatea țintă ar trebui să aibă (un) anumit tip(uri) de utilizare a terenului
  - ar trebui să fie la o anumită distanță de drumuri, sau să fie traversată de un drum
  - ar trebui să fie la o anumită distanță de unele categorii de puncte, cum ar fi un spital, de exemplu

13.2.1 ??? / ???

- Includeți analiza raster în rezultatele dvs. Luați în considerare cel puțin o proprietate derivată din raster, cum ar fi aspectul sau panta acestuia.

13.3 Harta Finală

- Utilizați *Compoziții Imprimabile* pentru a crea o hartă finală, care încorporează rezultatele analizei dvs.
- Includeți această hartă într-un document, împreună cu criteriile documentate. Dacă harta a devenit prea ocupată vizual, datorită strat(ului) adăugat, deselectați straturile care vă sunt cel mai puțin necesare.
- Harta dvs. trebuie să includă un titlu și o legendă.

CAPITOLUL 14

Module: Forestry Application

În modulele 1 până la 13, ați învățat deja destul de multe despre lucrul în QGIS. Dacă vă interesează să aflați despre unele utilizări forestiere ale GIS, urmând acest modul veți avea posibilitatea de a aplica ceea ce ați învățat, și, în plus, vi se vor prezenta câteva noi instrumente utile.



Dezvoltarea acestui modul a fost sponsorizată de Uniunea Europeană.

14.1 Lesson: Forestry Module Presentation

Utilizarea acestui modul pentru silvicultură necesită cunoștințele acumulate în modulele de la 1 la 11 din acest manual de formare. Exercițiile din următoarele lecții presupun că aveți abilitatea de a face multe dintre operațiunile de bază din QGIS, iar instrumentele care nu au mai fost utilizate înainte sunt prezentate acum în detaliu.

În plus, modulul urmează un nivel de bază de-a lungul lecțiilor, astfel încât, dacă aveți experiență anterioară cu QGIS, puteți urma instrucțiunile fără probleme.

Rețineți că trebuie să descărcați un pachet de date suplimentare pentru acest modul.

14.1.1 Datele Eșantion pentru Silvicultură

Notă

The sample data used in this module is part of the training manual data set and is available in the `exercise_data\forestry\` folder.

The forestry related sample data (forestry map, forest data), has been provided by the EVO-HAMK forestry school. The datasets have been modified to adapt to the lessons needs.

The general sample data (aerial images, LiDAR data, basic maps) has been obtained from the National Land Survey of Finland open data service, and adapted for the purposes of the exercises. The open data file download service can be accessed in English here.

Atenționare

În ceea ce privește restul manualului de instruire, acest modul include instrucțiuni privind adăugarea, ștergerea și modificarea seturilor de date GIS. V-am furnizat seturile de date de instruire în acest scop. Înainte de a utiliza tehnicile descrise aici asupra datelor dvs., asigurați-vă întotdeauna că aveți copiile de rezervă corespunzătoare!

14.2 Lesson: Georeferencing a Map

O activitate silvică obișnuită constă în actualizarea informațiilor pentru zonele forestiere. Este posibil ca informațiile anterioare pentru acea zonă să aibă o vechime de mai mulți ani, să fi fost colectate în mod analogic (adică, pe hârtie) sau poate că au fost digitizate, dar tot ce aveți reprezintă versiunea pe hârtie a datelor inventarului respectiv.

Cel mai probabil, v-ați dori să utilizați aceste informații în GIS, de exemplu, pentru a le compara mai târziu cu inventarele ulterioare. Acest lucru presupune că va trebui să digitizați manual informațiile, cu ajutorul softului GIS. Dar, înainte de a începe digitizarea, trebuie făcuți pași importanți, cum ar fi scanarea și georeferențierea hârtii de hârtie.

Scopul acestei lecții: De a afla cum să utilizați instrumentul de Georeferențiere din QGIS.

14.2.1 ??? Scan the map

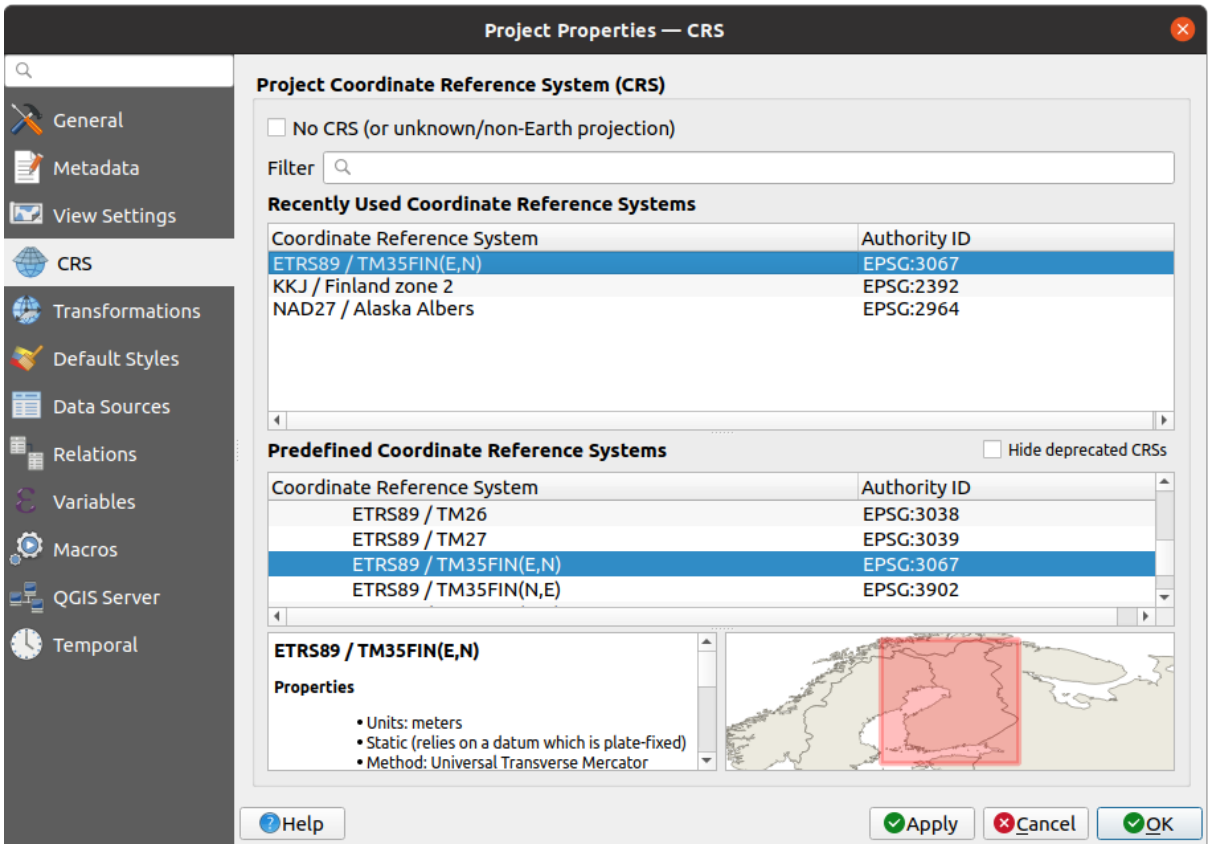
Prima activitate constă în scanarea hârtii. Dacă harta dvs. este prea mare, atunci o puteți scana pe porțiuni, dar rețineți că pentru fiecare parte va trebui să reluați acțiunile de preprocesare și georeferențiere. Din acest motiv, este recomandabil să împărțiți harta în cel mai mic număr de porțiuni posibile.

If you are going to use a different map that the one provided with this manual, use your own scanner to scan the map as an image file, a resolution of 300 DPI will do. If your map has colors, scan the image in color so that you can later use those colors to separate information from your map into different layers (for ex., forest stands, contour lines, roads…).

For this exercise you will use a previously scanned map, you can find it as `rautjarvi_map.tif` in the data folder `exercise_data/forestry`

14.2.2 ??? Follow Along: Georeferencing the scanned map

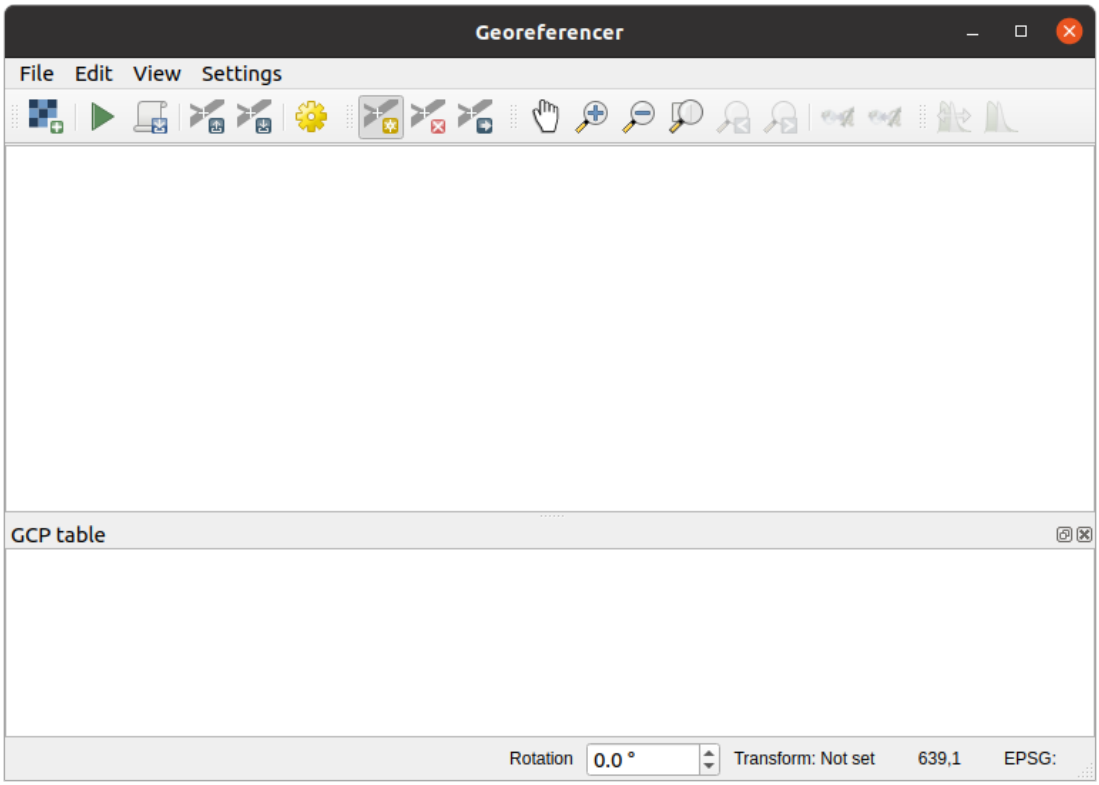
1. Open QGIS and set the project's CRS to `EPSG:3067 - ETRS89 / TM35FIN(E,N)` in *Project* ► *Properties* ► *CRS*, which is the currently used CRS in Finland.



2. Save the QGIS project as `map_digitizing.qgs`.

You will use the georeferencing tool from QGIS named *Georeferencer*. To georeference the map:

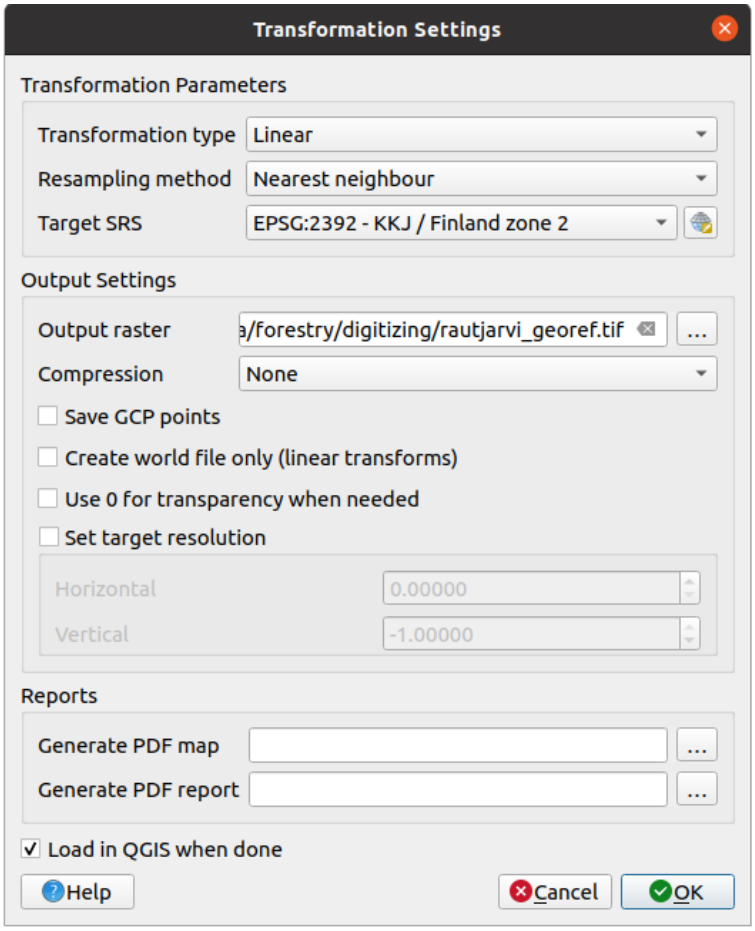
1. Open the georeference tool, *Layer* ► *Georeferencer*....



2. Add the map image file, `rautjarvi_map.tif`, as the image to georeference, *File* ► *Open raster*.
3. Clic pe *OK*

Ulterior ar trebui să definiți setările de transformare pentru georeferențierea hărții:

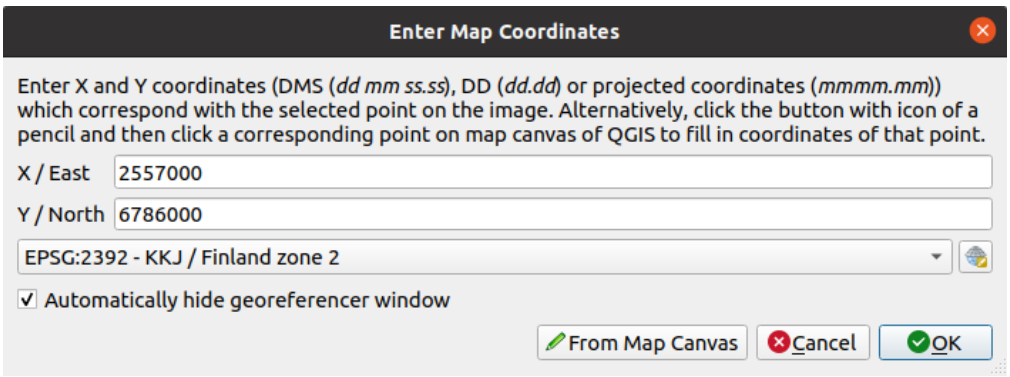
1. Deschideți *Settings* ► *Transformation settings*.
2. Set the *Transformation type* to `Linear` and the *Resampling method* to `Nearest neighbour`.
3. Press the Select CRS button next to the *Target SRS* option and select the `EPSG:2392 - KKJ / Finland zone 2` CRS; it is the CRS that was used in Finland back in 1994 when this map was created.
4. Click the icon next to the *Output raster* box, go to the folder and create the folder `exercise_data\forestry\digitizing` and name the file as `rautjarvi_georef.tif`.
5. Check *Load in QGIS when done*
6. Leave the rest of parameters as default.



7. Clic pe *OK*

The map contains several cross-hairs marking the coordinates in the map, we will use those to georeference this image. You can use the zooming and panning tools as you usually do in QGIS to inspect the image in the Georeferencer's window.

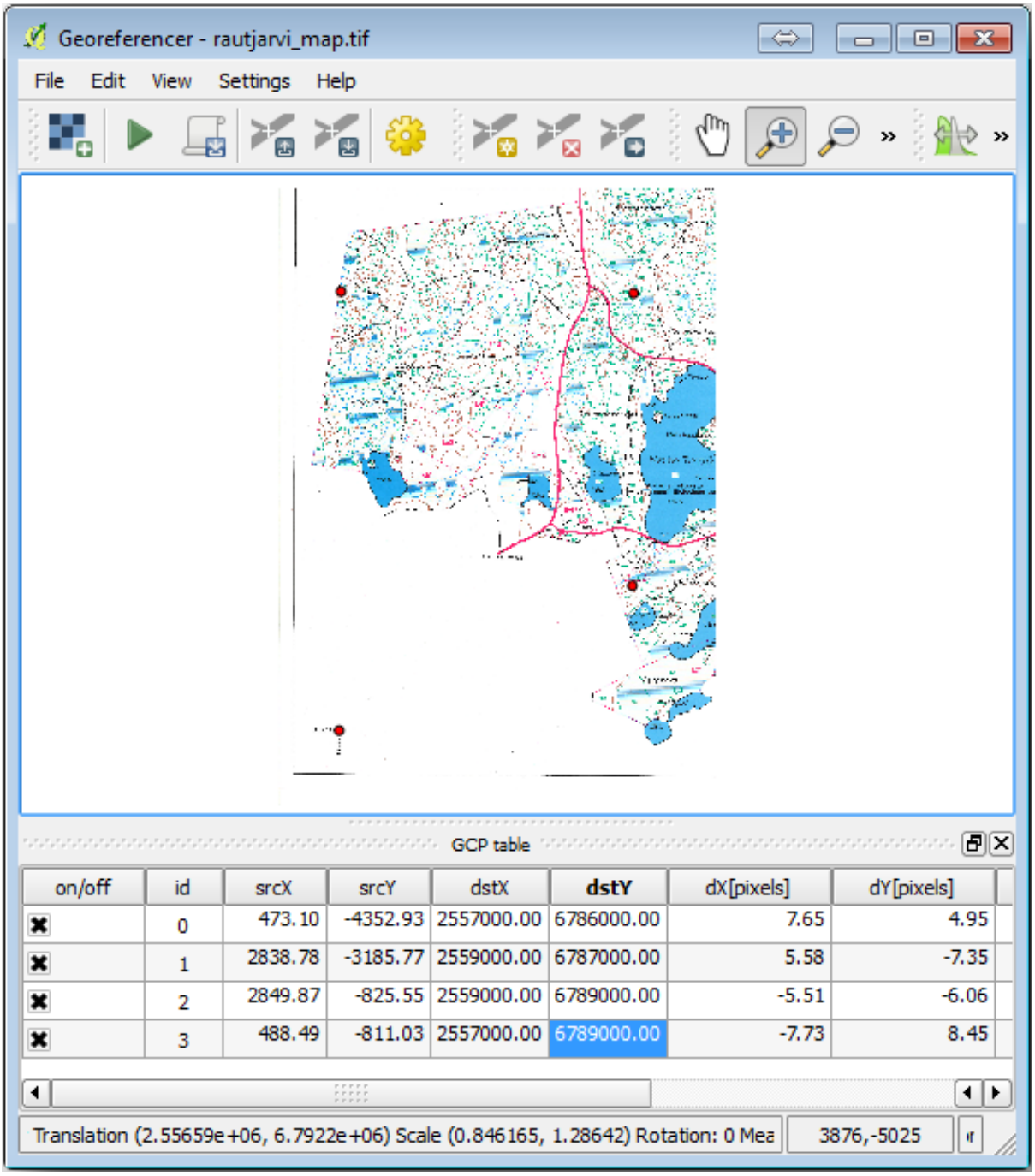
1. Zoom in to the left lower corner of the map and note that there is a cross-hair with a coordinate pair, X and Y, that as mentioned before are in `KKJ / Finland zone 2` CRS. You will use this point as the first ground control point for the georeferencing your map.
2. Selectați instrumentul *Adăugare punct*, apoi faceți clic pe intersecția firelor reticulare (deplasați și măriți după nevoie).
3. In the *Enter map coordinates* dialogue write the coordinates that appear in the map (X: 2557000 and Y: 6786000) and their CRS (`EPSG:2392 - KKJ / Finland zone 2`)



4. Clic pe *OK*

Prima coordonată de georeferențiat deja este gata.

5. Look for other black cross-hairs in the image, they are separated 1000 meters from each other both in North and East direction. You should be able to calculate the coordinates of those points in relation to the first one.
6. Zoom out in the image and move to the right or the top until you find other cross-hair, and estimate how many kilometres you have moved. Try to get ground control points as far from each other as possible.
7. Digitize at least three more ground control points in the same way you did the first one. You should end up with something similar to this:



With already three digitized ground control points you will be able to see the georeferencing error as a red line coming out of the points. The error in pixels can be seen also in the *GCP table* in the *dX[pixels]* and *dY[pixels]* columns. The error in pixels should not be higher than 10 pixels. If it is, you should review the points you have digitized and the coordinates you have entered to find what the problem is. You can use the image above as a guide.

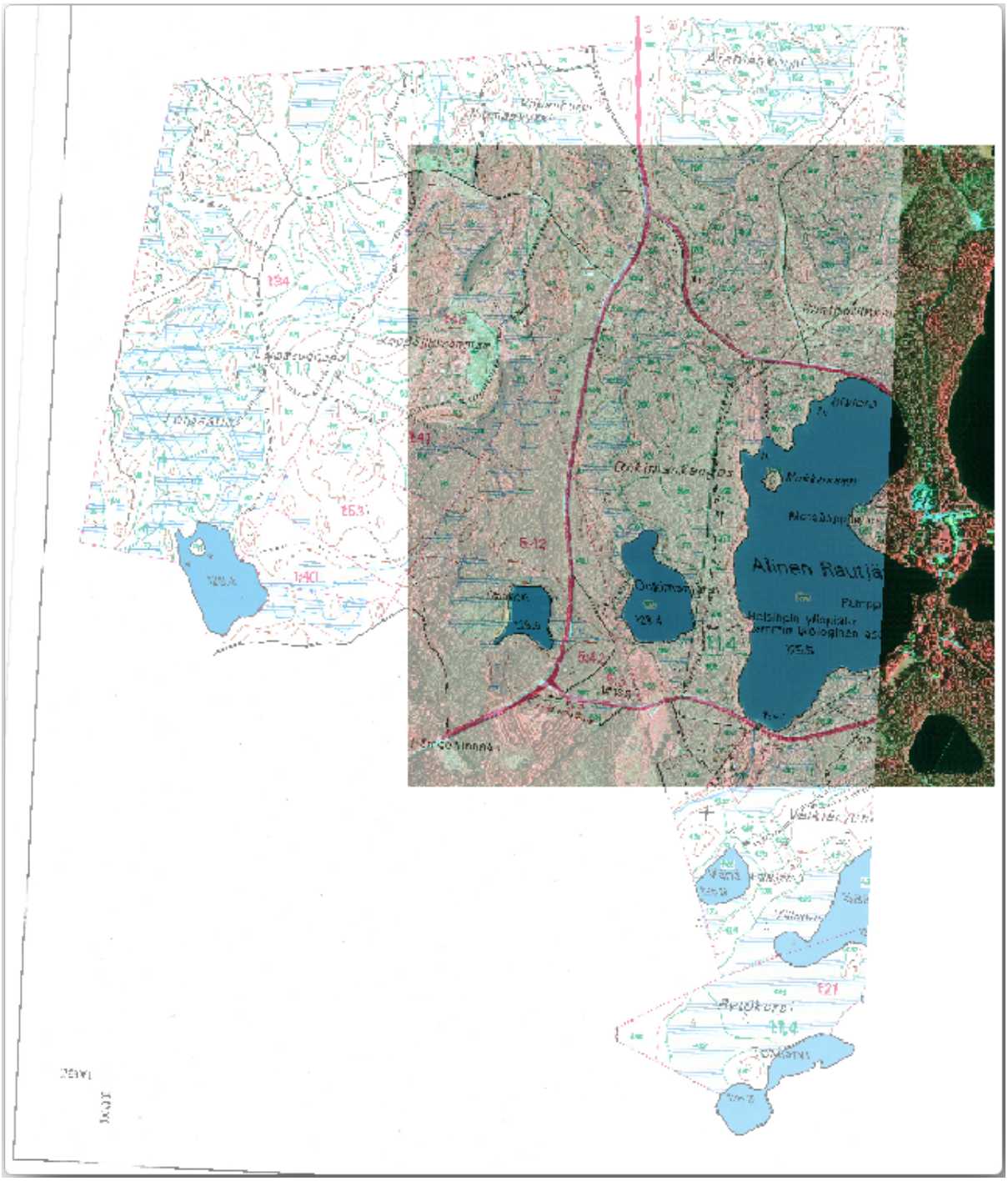
Once you are happy with your control points, you can save them for later use:

1. Go to *File* ► *Save GCP points as…*
2. In the folder `exercise_data\forestry\digitizing`, name the file `rautjarvi_map.tif.points`.

Finally, georeference your map:

1. Go to *File* ► *Start georeferencing*.
2. Note that you named the file already as `rautjarvi_georef.tif` when you edited the Georeferencer settings.

   Now you can see the map in QGIS project as a georeferenced raster. Note that the raster seems to be slightly rotated, but that is simply because the data is in `KKJ / Finland zone 2` and your project is in `ETRS89 / TM35FIN(E,N)`.
3. To check that your data is properly georeferenced, you can
   1. Open the aerial image in the `exercise_data\forestry` folder, named `rautjarvi_aerial.tif`.
   2. Your map and this image should match quite well: set the map transparency to 50% and compare it to the aerial image.



4. Salvați modificările proiectului QGIS, apoi veți continua din acest punct cu lecția următoare.

14.2.3 În concluzie

You have now georeferenced a paper map, making it possible to use it as a map layer in QGIS.

14.2.4 Ce urmează?

In the next lesson, you will digitize the forest stands in your map as polygons and add the inventory data to them.

14.3 Lesson: Digitizing Forest Stands

Unless you are going to use your georeferenced map as a simple background image, the next natural step is to digitize elements from it. You have already done so in the exercises about creating vector data in *Lesson: Creating a New Vector Dataset*, when you digitized the school fields. In this lesson, you are going to digitize the forest stands» borders that appear in the map as green lines but instead of doing it using an aerial image, you will use your georeferenced map.

Scopul acestei lecții: Învățarea unei tehnici pentru a ajuta activitatea de digitizare a arboretului forestier și, în cele din urmă, adunarea din acesta a datelor de inventar.

14.3.1 ??? Follow Along: Extracting the Forest Stands Borders

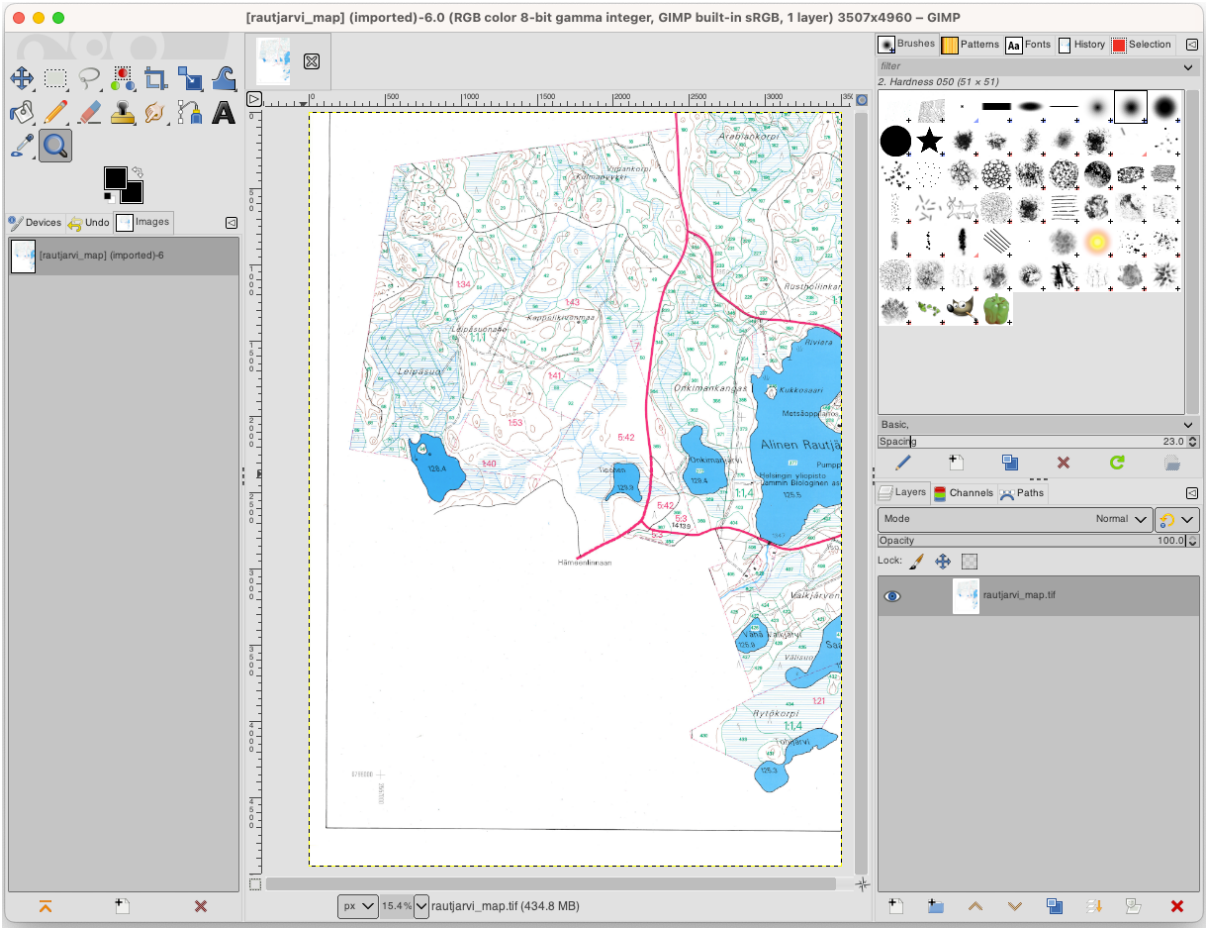
Open your `map_digitizing.qgs` project in QGIS, that you saved from the previous lesson.

O dată ce ați scanat și georeferențiat harta, ați putea începe digitizarea, folosind imaginea drept ghid. Acesta ar fi, probabil, cel mai potrivit mod de lucru, atunci când imaginea pe care trebuie să o digitizați reprezintă, de fapt, o fotografie aeriană.

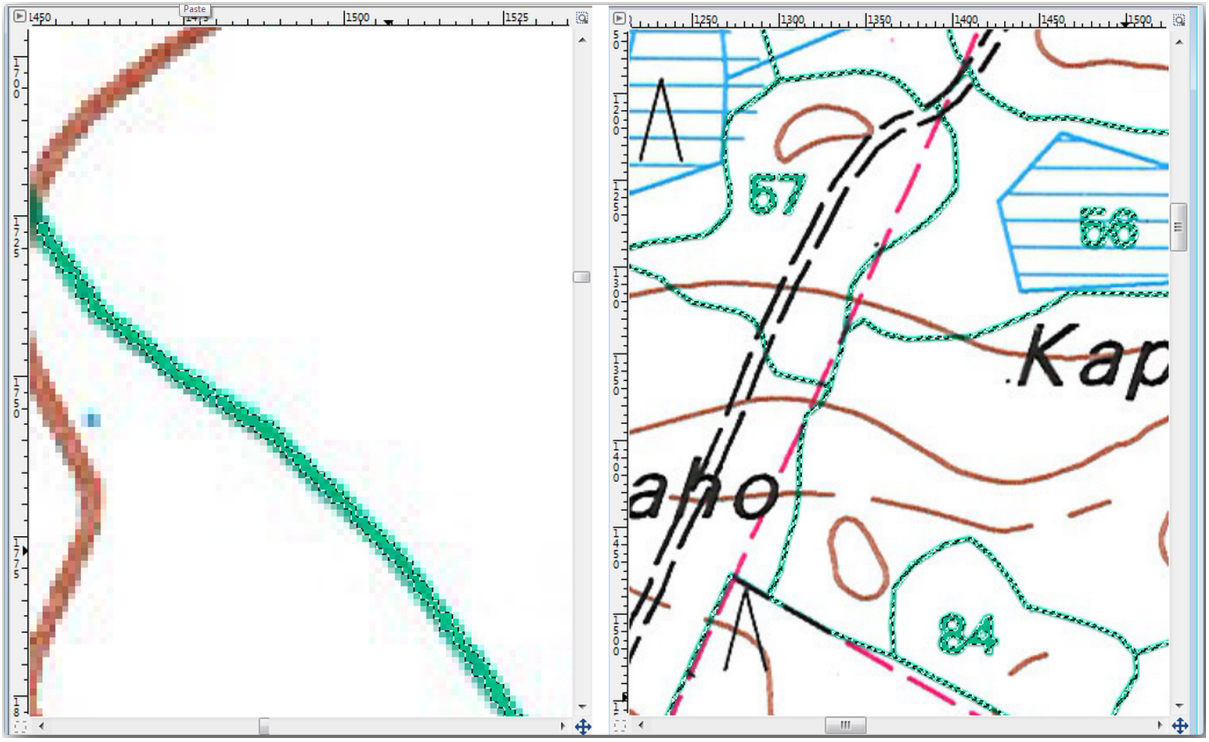
If what you are using to digitize is a good map, as it is in our case, it is likely that the information is clearly displayed as lines with different colors for each type of element. Those colors can be relatively easy extracted as individual images using an image processing software like GIMP. Such separate images can be used to assist the digitizing, as you will see below.

Primul pas va fi de a utiliza GIMP la obținerea unei imagini care conține doar pâlcuri de pădure, reprezentate de toate acele linii verzui pe care le puteți vedea în harta originală, scanată:

1. Deschideți GIMP (dacă nu l-ați instalat încă, descărcați-l de pe internet sau cereți-l profesorului dvs.).
2. Open the original map image, *File* ► *Open*, `rautjarvi_map.tif` in the `exercise_data/forestry` folder. Note that the forest stands are represented as green lines (with the number of the stand also in green inside each polygon).

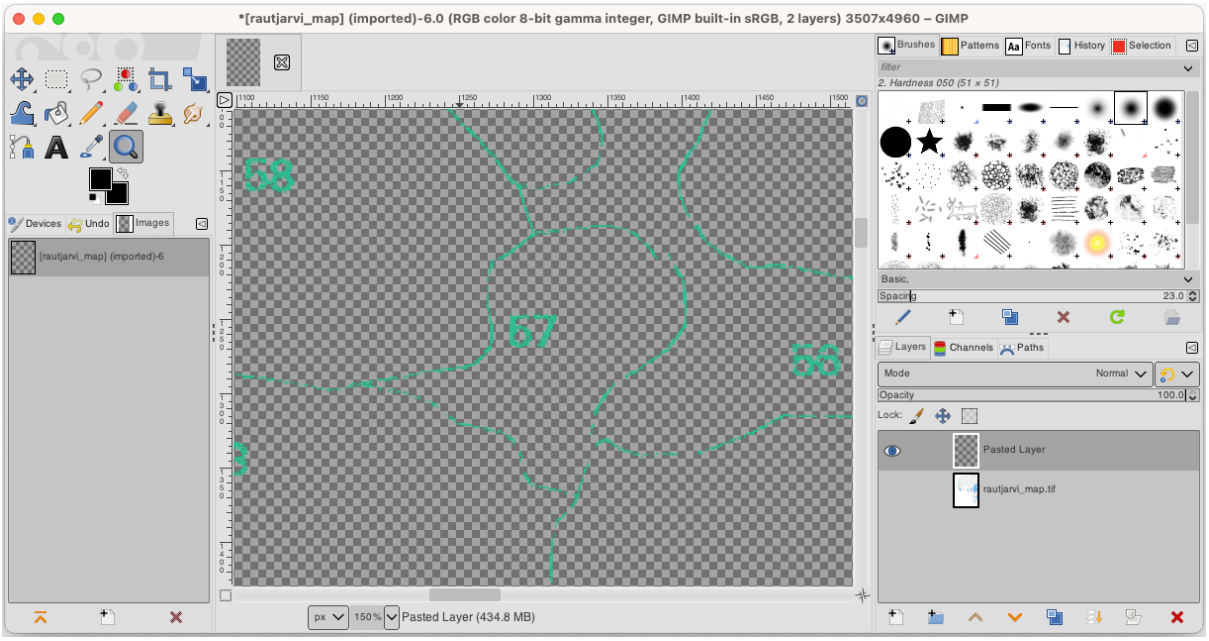


3. Acum puteți selecta pixelii din imagine, care reprezintă limitele parcelelor forestiere (pixelii verzui):
    1. Deschideți instrumentul *Select* ► *By color*.
    2. With the tool active, zoom into the image (`Ctrl` + mouse wheel) so that a forest stand line is close enough to differentiate the pixels forming the line. See the left image below.
    3. Faceți clic și glisați cursorul mouse-ului în partea din mijloc a liniei, astfel încât instrumentul va colecta valorile câtorva dintre culorile pixelilor.
    4. Eliberați butonul mouse-ului și așteptați câteva secunde. Din întreaga imagine vor fi selectați pixelii care se potrivesc culorilor colectate de către instrument.
    5. Micșorați, pentru a vedea cum au fost selectați pixelii verzui din întreaga imagine.
    6. Dacă rezultatul nu vă mulțumește, repetați operațiunea de clic și glisare.
    7. Pixelii selectați de către dumneavoastră ar trebui să arate în genul imaginii din dreapta-jos.



4. O dată ce ați terminat selecția, trebuie să o copiați sub forma unui nou strat, care se va salva ulterior ca fișier de tip imagine:

    1. Copy (`Ctrl+C` or *Edit* ► *Copy*) the selected pixels.
    2. And paste the pixels directly as a new layer (*Edit* ► *Paste as* ► *New Layer*). GIMP will display the pasted pixels as a new layer (`Pasted Layer`) in the *Layers* panel.
    3. Click the „eye” icon next to the original image layer to switch it off, so that only the `Pasted Layer` is visible:



5. Finally, select *File* ► *Export As…*, set *Select File Type (By Extension)* as a *TIFF image*, select the `digitizing` folder and name it `rautjarvi_map_green.tif`. Select no compression when asked.

Ați putea face același proces cu alte elemente din imagine, de exemplu, extrăgând liniile negre care reprezintă drumurile, sau cele maro care reprezintă liniile de contur ale terenului. Dar pentru noi, arboretul forestier este suficient.

14.3.2 ??? Try Yourself: Georeference the Green Pixels Image

Ca și în lecția anterioară, trebuie să georeferențiați această nouă imagine pentru a o putea folosi cu restul de date.

Note that you don't need to digitize the ground control points anymore because this image is basically the same image as the original map image, as far as the Georeferencer tool is concerned. Here are some things you should remember:

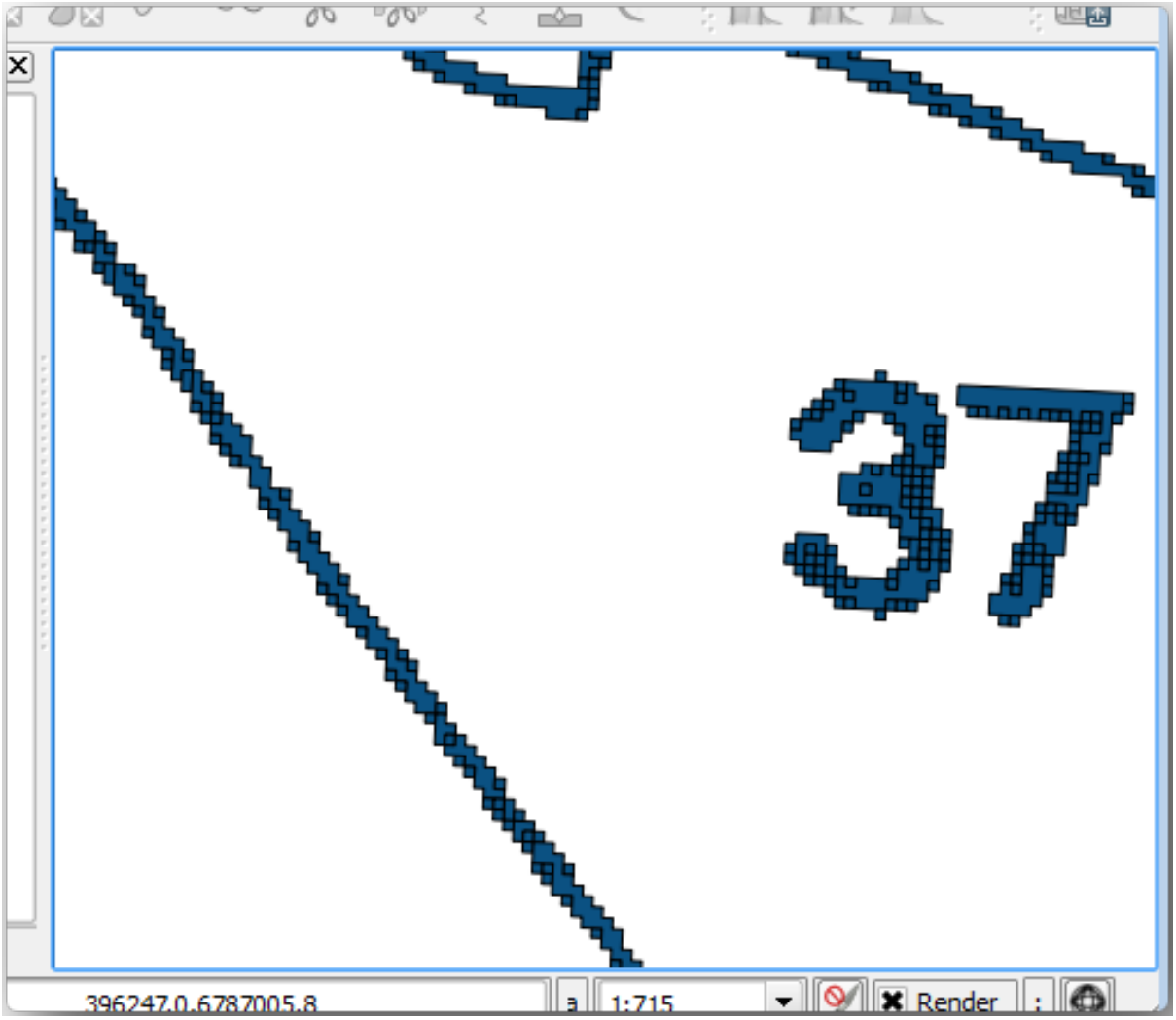
- This image is also, of course, in `KKJ / Finland zone 2` CRS.
- Ar trebui să utilizați punctele de control din teren salvate, *Fișier* ► *Încărcare puncte GCP*.
- Amintiți-vă să revizuiți *Setările de Transformare*.
- Name the output raster as `rautjarvi_green_georef.tif` in the `digitizing` folder.

Verificați dacă noul raster se potrivește cu harta originală.

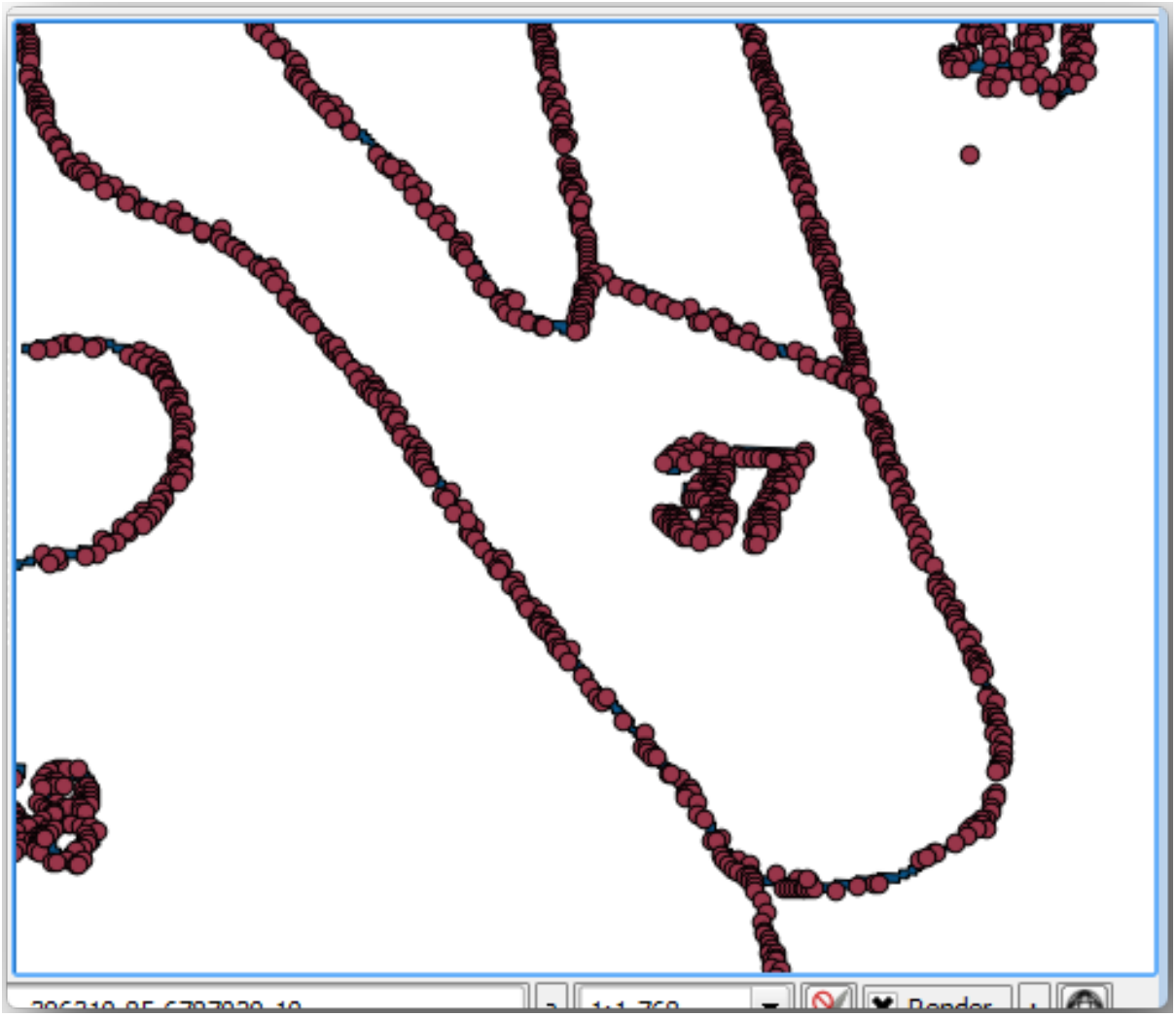
14.3.3 ??? Follow Along: Creating Supporting Points for Digitizing

Având în vedere instrumentele de digitizare din QGIS, v-ați putea gândi că ar fi de ajutor acroșarea la pixelii verzi, pe durata digitizării. Exact acest lucru îl veți face în continuare: veți crea puncte din acei pixeli, pentru a le folosi mai târziu ca ghidaje în digitizarea arboretelor forestiere, când se vor utiliza instrumentele de acroșare disponibile în QGIS.

1. Folosiți instrumentul *Raster* ► *Conversie* ► *Poligonizare (Din Raster în Vector)* pentru a vectoriza liniile verzi în poligoane. Dacă nu vă mai amintiți cum se efectuează acest lucru, puteți să reexaminați *Lesson: Raster to Vector Conversion*.
2. Save as `rautjarvi_green_polygon.shp` inside the `digitizing` folder.
3. Măriți și analizați forma poligoanelor. Veți obține ceva de genul:



4. Next option to get points out of those polygons is to get their centroids:
   1. Open *Vector* ► *Geometry Tools* ► *Centroids…*.
   2. Set *Input Layer* to `rautjarvi_green_polygon` (the polygon layer you have just created)
   3. Set *Centroids* output to `green_centroids.shp` file within the folder `digitizing`
   4. Check *Open output file after running algorithm*
   5. Press *Run*. This will calculate the centroids for the polygons as a new layer and add it to the project.

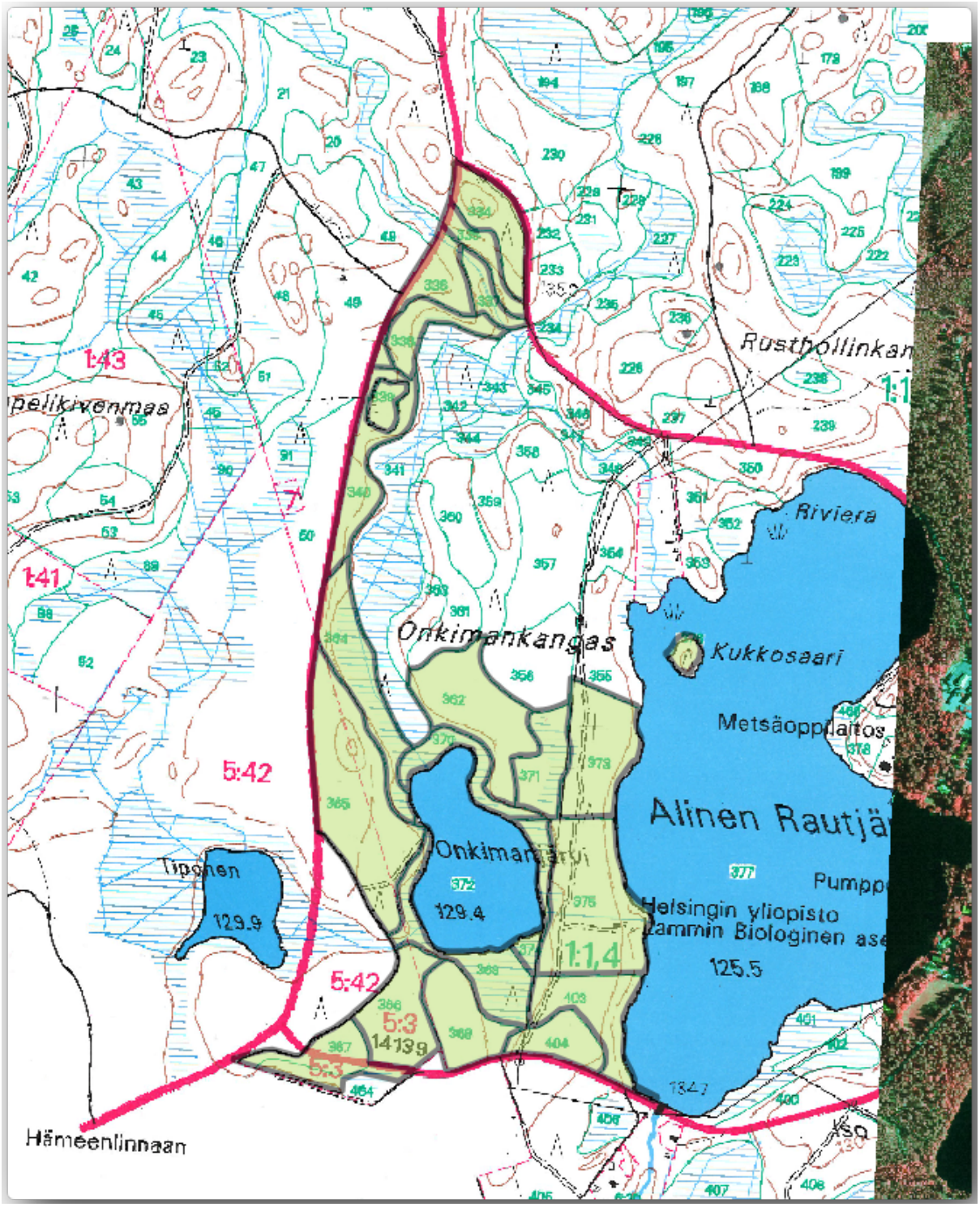


5. Now you can remove the `rautjarvi_green_polygon` layer from the TOC.
6. Change the symbology of the centroids layer as follows:
    1. Open the *Layer Properties* for `green_centroids`.
    2. Mergeți la fila *Simbologiei*.
    3. Set *Size* to `1.00` and choose *Map Units*

It is not necessary to differentiate points from each other, you just need them to be there for the snapping tools to use them. You can use those points now to follow the original lines much easily than without them.

14.3.4 ??? Follow Along: Digitize the Forest Stands

Now you are ready to start with the actual digitizing work. You would start by creating a vector file of *polygon type*, but for this exercise, there is a shapefile with part of the area of interest already digitized. You will just finish digitizing the half of the forest stands that are left between the main roads (wide pink lines) and the lake:

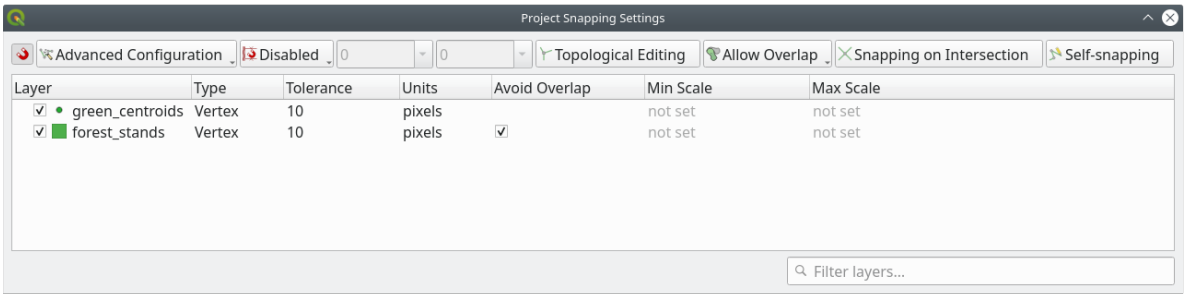


1. Go to the `digitizing` folder using your file manager browser.

2. Drag and drop the `forest_stands.shp` vector file to your map.
3. Change the new layer's symbology so that it will be easier to see the polygons that have already been digitized.
    1. Set *Fill color* to green - and change the *Opacity* to `50%`.
    2. Select *Simple Fill* and set *Stroke width* to `1.00 mm`.

Acum, așa cum vă amintiți de la modulele din trecut, trebuie să configurați și activați opțiunile de acroșare:

1. Mergeți la *Proiect* ► *Opțiuni de acroșare…*
2. Press Enable Snapping and select *Advanced Configuration*
3. Check the `green_centroids` and `forest_stands` layers
4. Set *Type* for each layer to *Vertex*
5. Set *Tolerance* for each layer to `10`
6. Set *Units* for each layer to *pixels*
7. Check *Avoid Overlap* for the `forest_stands` layer
8. Press *Topological editing*
9. Choose *Follow Advanced Configuration*
10. Close the pop-up



    With these snapping settings, whenever you are digitizing and get close enough to one of the points in the centroids layer or any vertex of your digitized polygons, a pink square will appear on the point that will be snapped to.

11. Finally, turn off the visibility of all the layers except `forest_stands` and `rautjarvi_georef`. Make sure that the map image has not transparency any more.

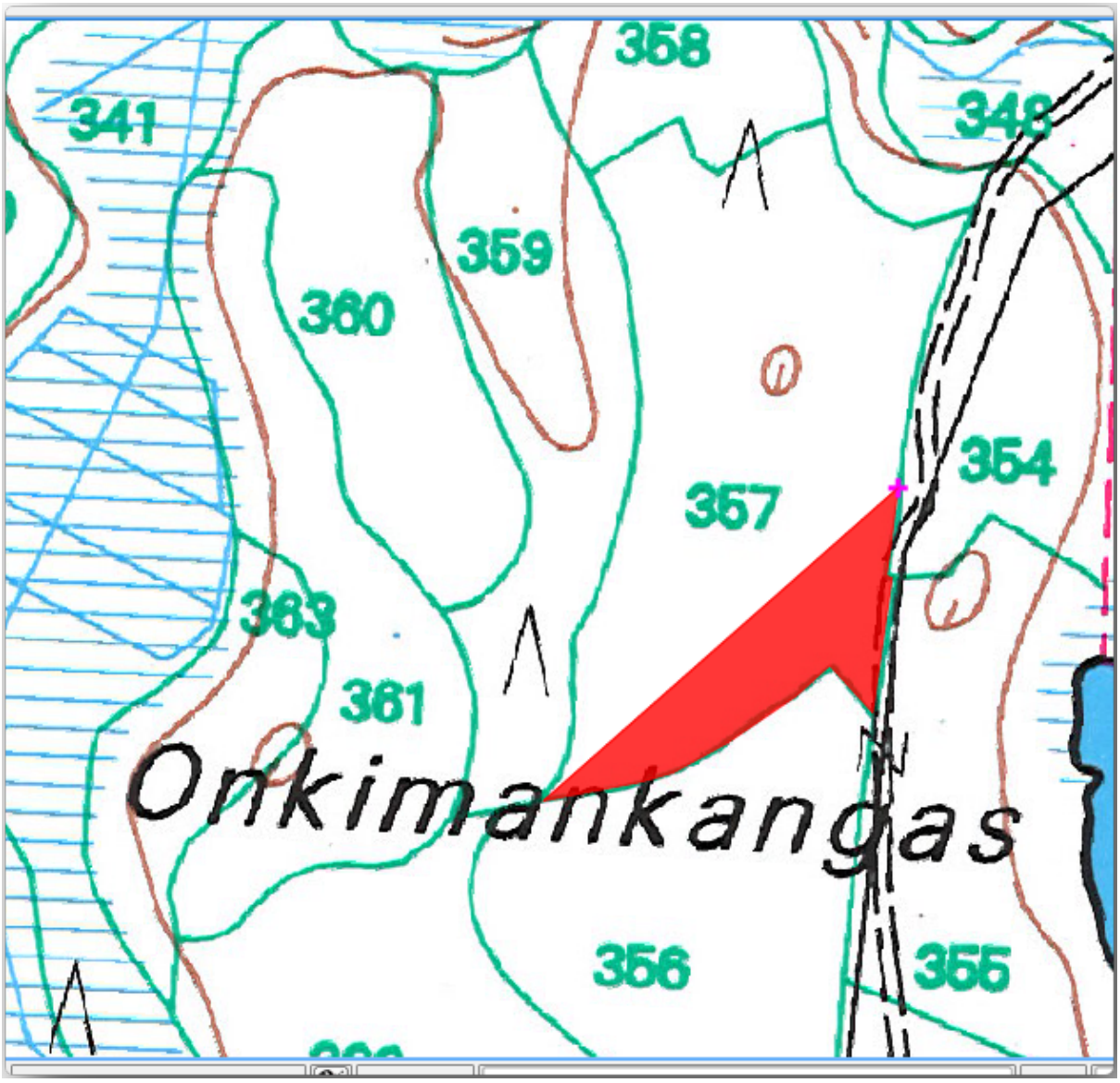
A few important things to note before you start digitizing:

- Nu încercați să fiți prea exacți în digitizarea frontierelor.
- If a border is a straight line, digitize it with just two nodes. In general, digitize using as few nodes as possible.
- Zoom in to close ranges only if you feel that you need to be accurate, for example, at some corners or when you want a polygon to connect with another polygon at a certain node.
- Folosiți butonul din mijloc al mouse-ului pentru a mări/micșora și deplasa, pe durata digitizării.
- Digitizați doar un singur poligon la un moment dat.
- După digitizarea unui poligon, scrieți id-ul pâlcului de pădure pe care îl puteți vedea în hartă.

Acum puteți începe digitizarea:

1. Locate the forest stand number `357` in the map window.
2. Select the `forest_stands` layer.

3. Click the  Toggle Editing button to enable editing
4. Select  Add Polygon Feature tool.
5. Start digitizing the stand `357` by connecting some of the dots. Note the pink crosses indicating the snapping.

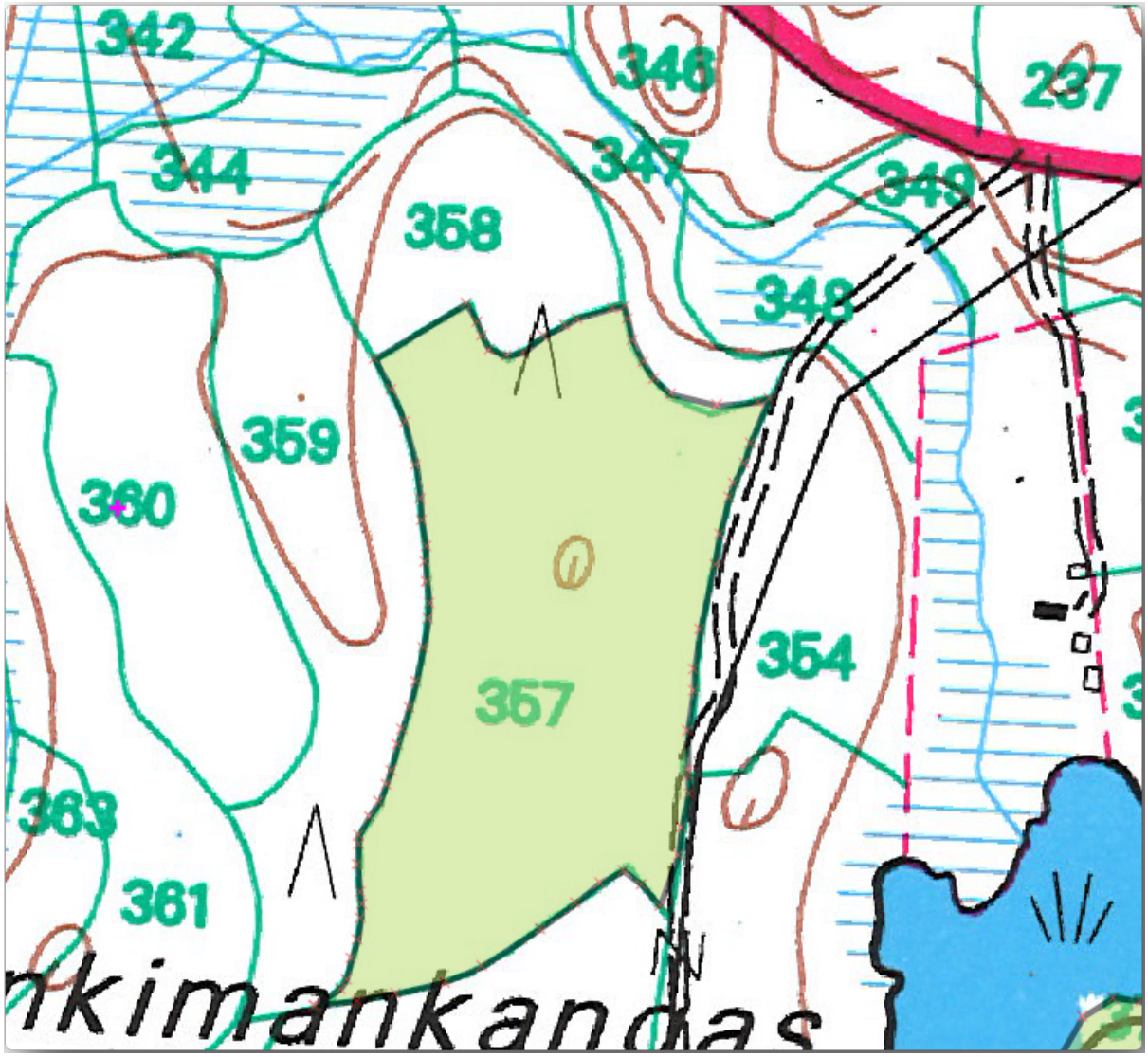


When you are done:

1. Right click to end digitizing that polygon.
2. Enter the forest stand *ID* within the form (in this case `357`).
3. Clic pe *OK*

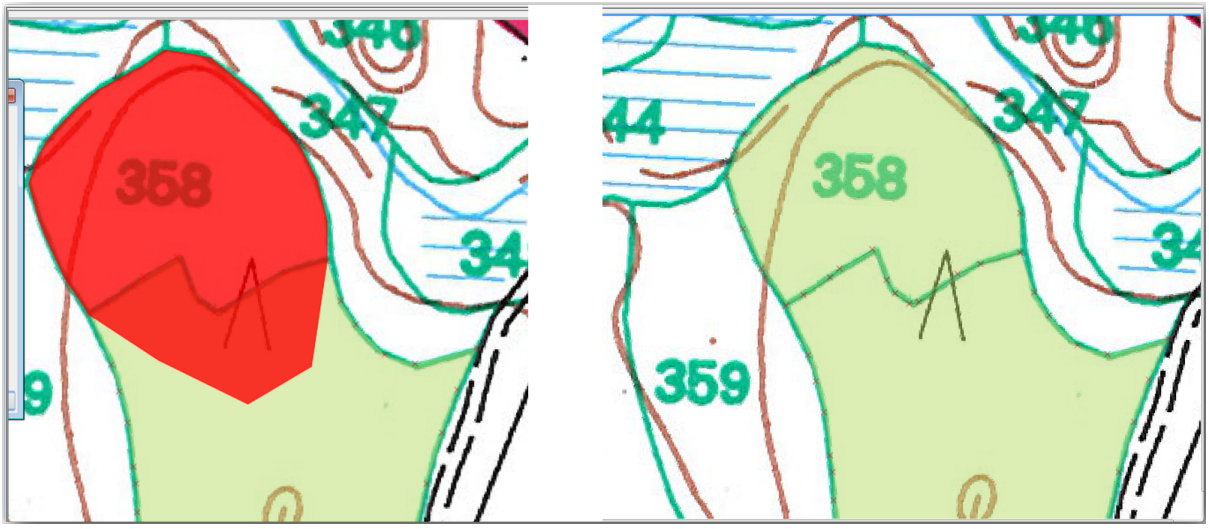
If a form did not appear when you finished digitizing the polygon, go to *Settings* ► *Options* ► *Digitizing* and make sure that the *Suppress attribute form pop-up after feature creation* is not checked.

Poligonul dvs. digitizat va arăta astfel:



Now for the second polygon, pick up the stand number 358. Make sure that *Avoid Overlap* is checked for the `forest_stands` layer (as shown above). This option ensures polygons do not overlap. So, if you digitize over an existing polygon, the new polygon will be trimmed to meet the border of the existing polygons. You can use this option to automatically obtain a common border.

1. Începeți digitizarea standului 358 la unul dintre colțurile comune cu pâlcul 357.
2. Continue normally until you get to the other common corner for both stands.
3. Finally, digitize a few points inside polygon 357 making sure that the common border is not intersected. See left image below.
4. Clic-dreapta pentru a termina editarea pâlcului de pădure 358.
5. Enter the *ID* as `358`.
6. Click *OK*. Your new polygon should have a common border with the stand 357 as you can see in the image below.



The part of the polygon that was overlapping the existing polygon has been automatically trimmed and you are left with a common border - as you intended it to be.

14.3.5 Try Yourself: Finish Digitizing the Forest Stands

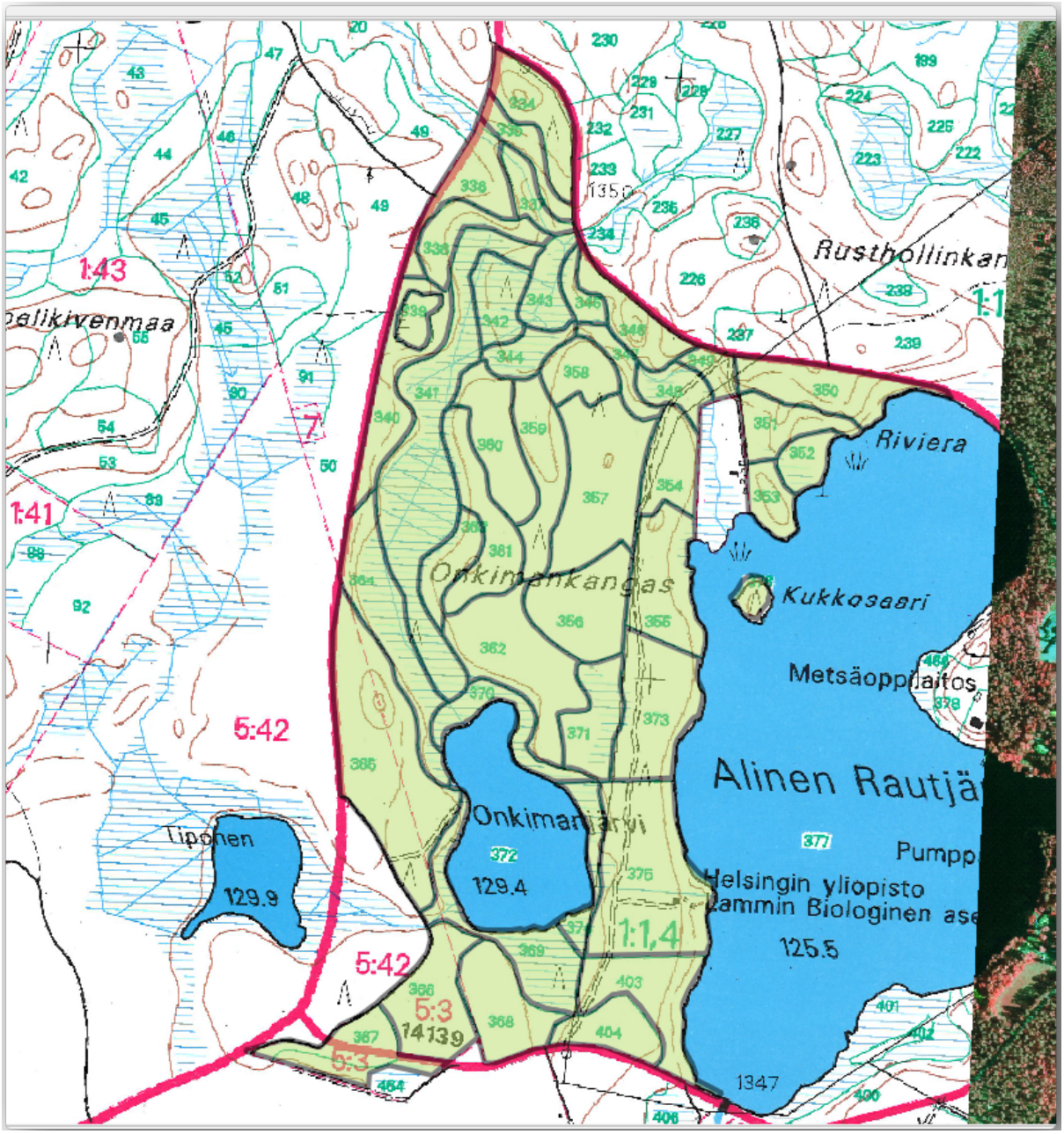
Now you have two forest stands ready. And a good idea on how to proceed. Continue digitizing on your own until you have digitized all the forest stands that are limited by the main road and the lake.

It might look like a lot of work, but you will soon get used to digitizing the forest stands. It should take you about 15 minutes.

During the digitizing you might need to edit or delete nodes, split or merge polygons. You learned about the necessary tools in *Lesson: Feature Topology*, now is probably a good moment to go read about them again.

Remember that having *Enable topological editing* activated, allows you to move nodes common to two polygons so that the common border is edited at the same time for both polygons.

Rezultatul dvs. va arăta în felul următor:

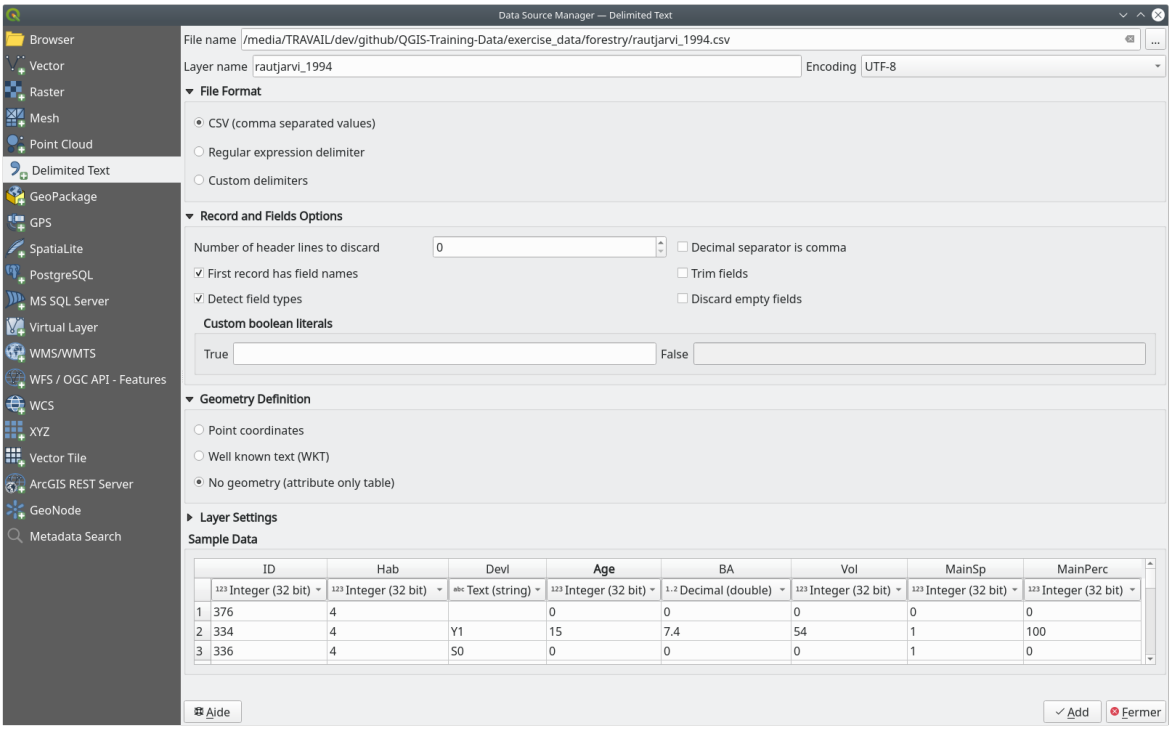


14.3.6 ??? Follow Along: Joining the Forest Stand Data

It is possible that the forest inventory data you have for you map is also written in paper. In that case, you would have to first write that data to a text file or a spreadsheet. For this exercise, the information from the inventory for 1994 (the same inventory as the map) is ready as a comma separated text (csv) file.

1. Open the `rautjarvi_1994.csv` file from the `exercise_data\forestry` directory in a text editor and note that the inventory data file has an attribute called *ID* that has the numbers of the forest stands. Those numbers are the same as the forest stands ids you have entered for your polygons and can be used to link the data from the text file to your vector file. You can see the metadata for this inventory data in the file `rautjarvi_1994_legend.txt` in the same folder.
2. Now add this file into the project:

1. Use the Add Delimited Text Layer tool. This is accessed via *Layer* ► *Add Layer* ► *Add Delimited Text Layer*….
2. Set details in the dialog as follows:



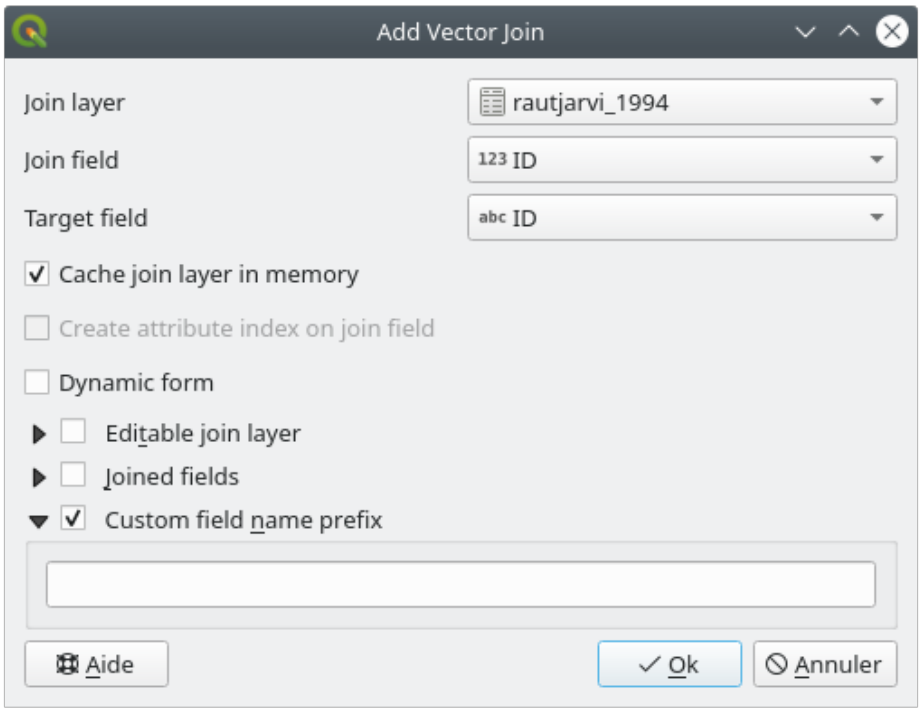
3. Press *Add* to load the formatted `csv` file in the project.

3. To link the data from the `.csv` file with the digitized polygons, create a join between the two layers:
   1. Open the Layer Properties for the `forest_stands` layer.
   2. Mergeți la fila *Îmbinări*.
   3. Click Add new join on the bottom of the dialog box.
   4. Select `rautjarvi_1994.csv` as the *Join layer*
   5. Set the *Join* field to *ID*
   6. Set the *Target* field to *ID*
   7. Faceți clic pe *Ok* de două ori.

The data from the text file should be now linked to your vector file. To see what has happened, select the `forest_stands` layer and use Open Attribute Table. You can see that all the attributes from the inventory data file are now linked to your digitized vector layer.

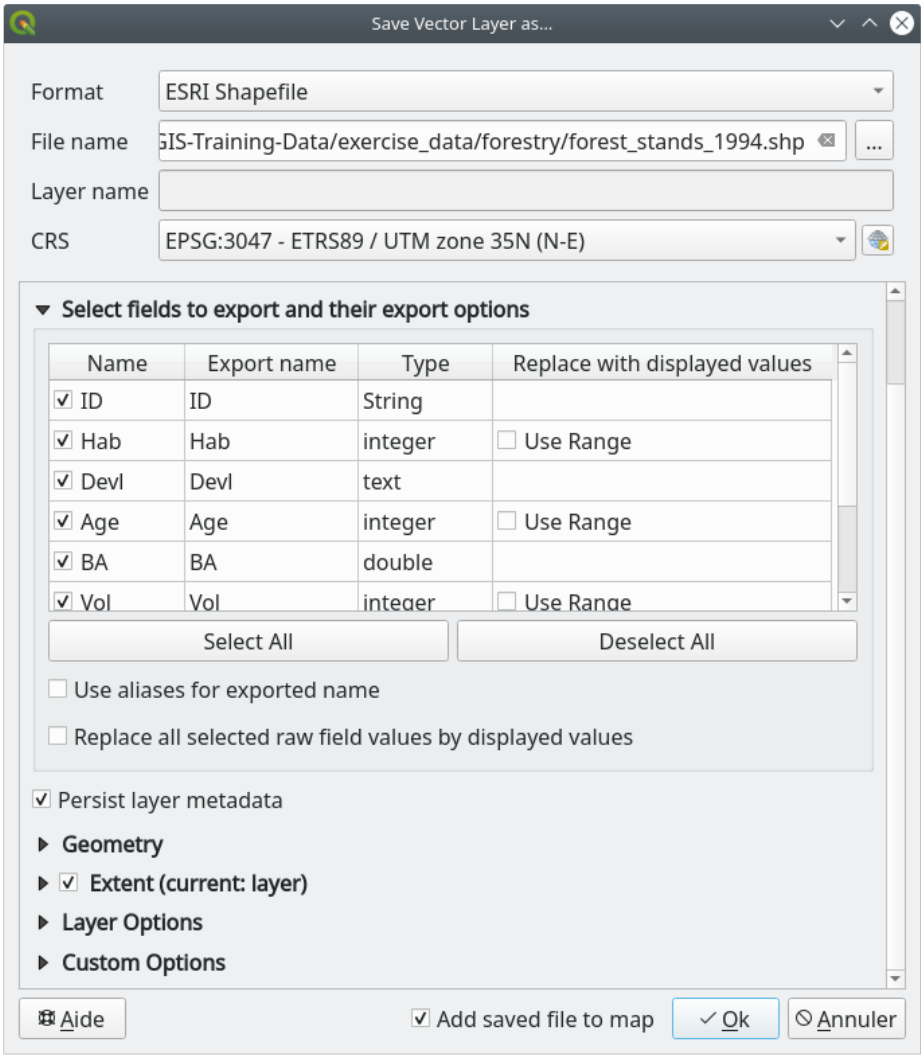
You will see that the field names are prefixed with `rautjarvi_1994_`. To change this:

1. Open the Layer Properties for the `forest_stands` layer.
2. Mergeți la fila *Îmbinări*.
3. Select `rautjarvi_1994` as the *Join Layer*
4. Click the Edit selected join button to enable editing
5. Under *Custom field name prefix* remove the prefix name



The data from the `.csv` file is just linked to your vector file. To make this link permanent, so that the data is actually recorded to the vector file you need to save the `forest_stands` layer as a new vector file. To do this:

1. Right click on `forest_stands` layer
2. Choose *Export* ► *Save Features As...*
3. Set *Format* to *ESRI Shapefile*
4. Set file name to `forest_stands_1994.shp` under the `forestry` folder
5. To include the new file as a layer in the project, check *Add saved file to map*



14.3.7 Try Yourself: Adding Area and Perimeter

To finish gathering the information related to these forest stands, you might calculate the area and the perimeter of the stands. You calculated areas for polygons in *Lesson: Supplementary Exercise*. Go back to that lesson if you need to and calculate the areas for the forest stands. Name the new attribute `Area` and make sure that the values calculated are in hectares. You could also do the same for the perimeter.

Now your `forest_stands_1994` layer is ready and packed with all the available information.

Save your project to keep the current map layers in case you need to come back later to it.

14.3.8 În concluzie

It has taken a few clicks of the mouse but you now have your old inventory data in digital format and ready for use in QGIS.

14.3.9 Ce urmează?

You could start doing different analysis with your brand new dataset, but you might be more interested in performing analysis in a dataset more up to date. The topic of the next lesson will be the creation of forest stands using current aerial photos and the addition of some relevant information to your dataset.

14.4 Lesson: Updating Forest Stands

Now that you have digitized the information from the old inventory maps and added the corresponding information to the forest stands, the next step is to create the inventory of the current state of the forest.

You will digitize new forest stands using an aerial photo. As with the previous lesson, you will use an aerial Color Infrared (CIR) photograph. This type of imagery, where the infrared light is recorded instead of the blue light, is widely used to study vegetated areas.

După digitizarea pâlcurilor de pădure, veți adăuga informații, cum ar fi noile constrângeri rezultate din reglementările de conservare.

The goal for this lesson: To digitize a new set of forest stands from CIR aerial photographs and add information from other datasets.

14.4.1 ??? Comparing the Old Forest Stands to Current Aerial Photographs

The National Land Survey of Finland has an open data policy that allows you downloading a variety of geographical data like aerial imagery, traditional topographic maps, DEM, LiDAR data, etc. The service can be accessed in English here. The aerial image used in this exercise has been created from two orthorectified CIR images downloaded from that service (M4134F_21062012 and M4143E_21062012).

1. Open QGIS and set the project's CRS to *ETRS89 / ETRS-TM35FIN* in *Project* ► *Properties...* ► *CRS*
2. Add the CIR image `rautjarvi_aerial.tif` to the project:
    1. Go to the `exercise_data\forestry\` folder using your file manager browser
    2. Drag and drop the file `rautjarvi_aerial.tif` onto your project
3. Save the QGIS project as `digitizing_2012.qgs`

Imaginile CIR sunt din 2012. Puteți compara pâlcurile care au fost create în 1994 cu aproape 20 de ani mai târziu.

1. Add the `forest_stands_1994.shp` layer created in the previous lesson:
    1. Go to the `exercise_data\forestry\` folder using your file manager browser
    2. Drag and drop the file `forest_stands_1994.shp` onto your project
2. Set the symbology for the layer so that you can see through your polygons:
    1. Right click `forest_stands_1994`
    2. Select *Properties*
    3. Go to the  *Symbology* tab
    4. Set *Fill color* to transparent fill

5. Set *Stroke color* to purple
6. Set *Stroke width* to `0.50 mm`

3. Examinați modul în care vechiul pâlc forestier poate fi interpretat vizual (sau nu) ca o pădure omogenă.
4. Focalizați și deplasați-vă în jurul zonei. Veți observa, probabil, că unele dintre pâlcurile vechi de pădure ar putea corespunde încă cu imaginea, pe când altele nu.

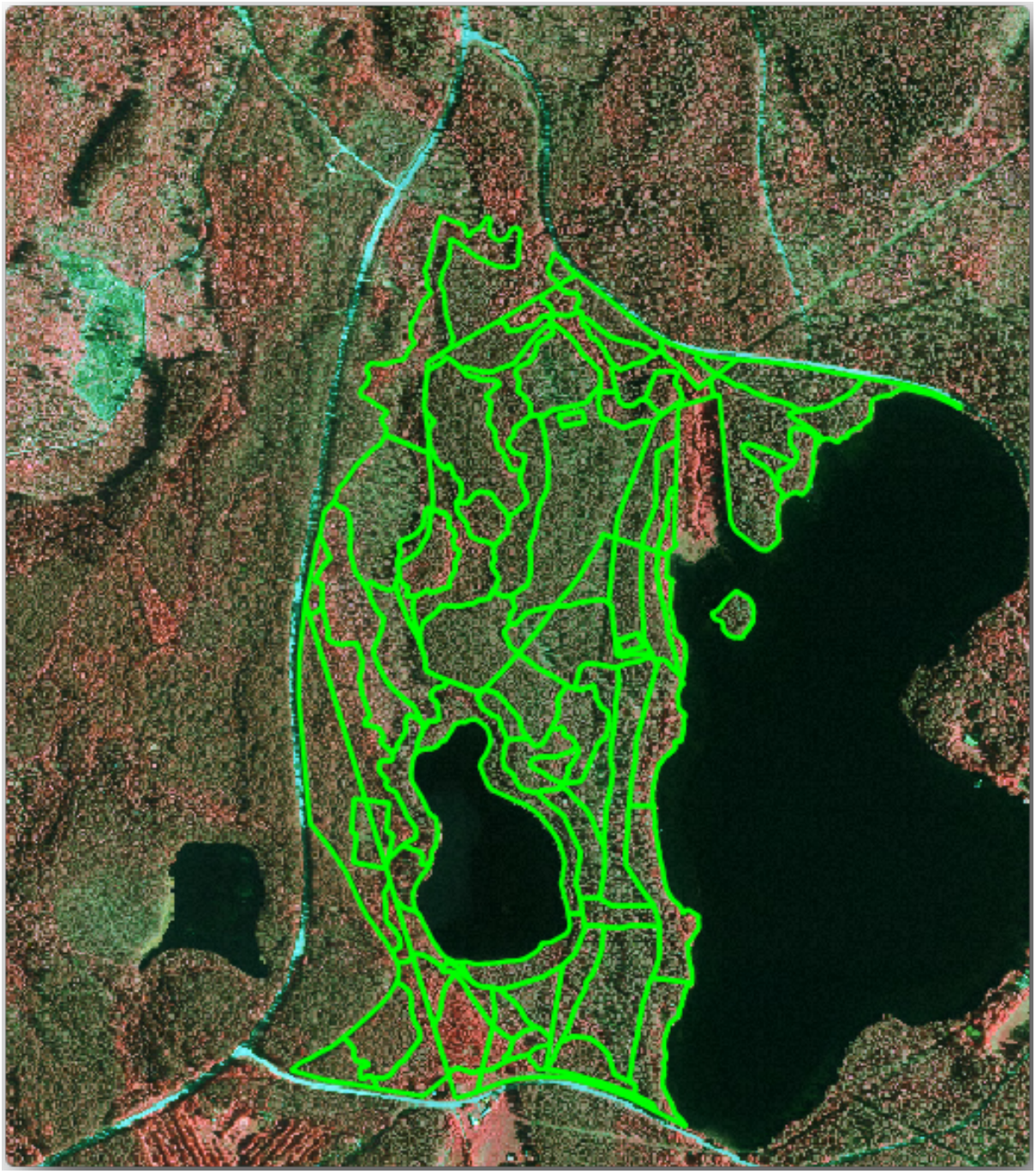
   This is a normal situation, as some 20 years have passed and different forest operations have been carried out (harvesting, thinning…). It is also possible that the forest stands looked homogeneous back in 1992 to the person who digitized them but as time has passed some forest has developed in different ways. It is also possible that that forest inventory priorities back then were different from those of today.

Apoi, veți crea noi pâlcuri de pădure pentru această imagine, fără a le utiliza pe cele vechi. Mai târziu, le puteți compara pentru a vedea diferențele.

14.4.2 ??? Interpreting the CIR Image

Let's digitize the same area that was covered by the old inventory, limited by the roads and the lake. You don't have to digitize the whole area, as in the previous exercise you can start with a vector file that already contains most of the forest stands.

1. Remove the layer `forest_stands_1994`
2. Add the file `exercise_data\forestry\forest_stands_2012.shp` to the project
3. Set the styling of this layer so that the polygons have no fill and the borders are visible
   1. Open *Properties* dialog of the `forest_stands_2012` layer
   2. Go to the *Symbology* tab
   3. Set *Fill color* to transparent fill
   4. Set *Stroke color* to green
   5. Set *Stroke width* to `0.50 mm`



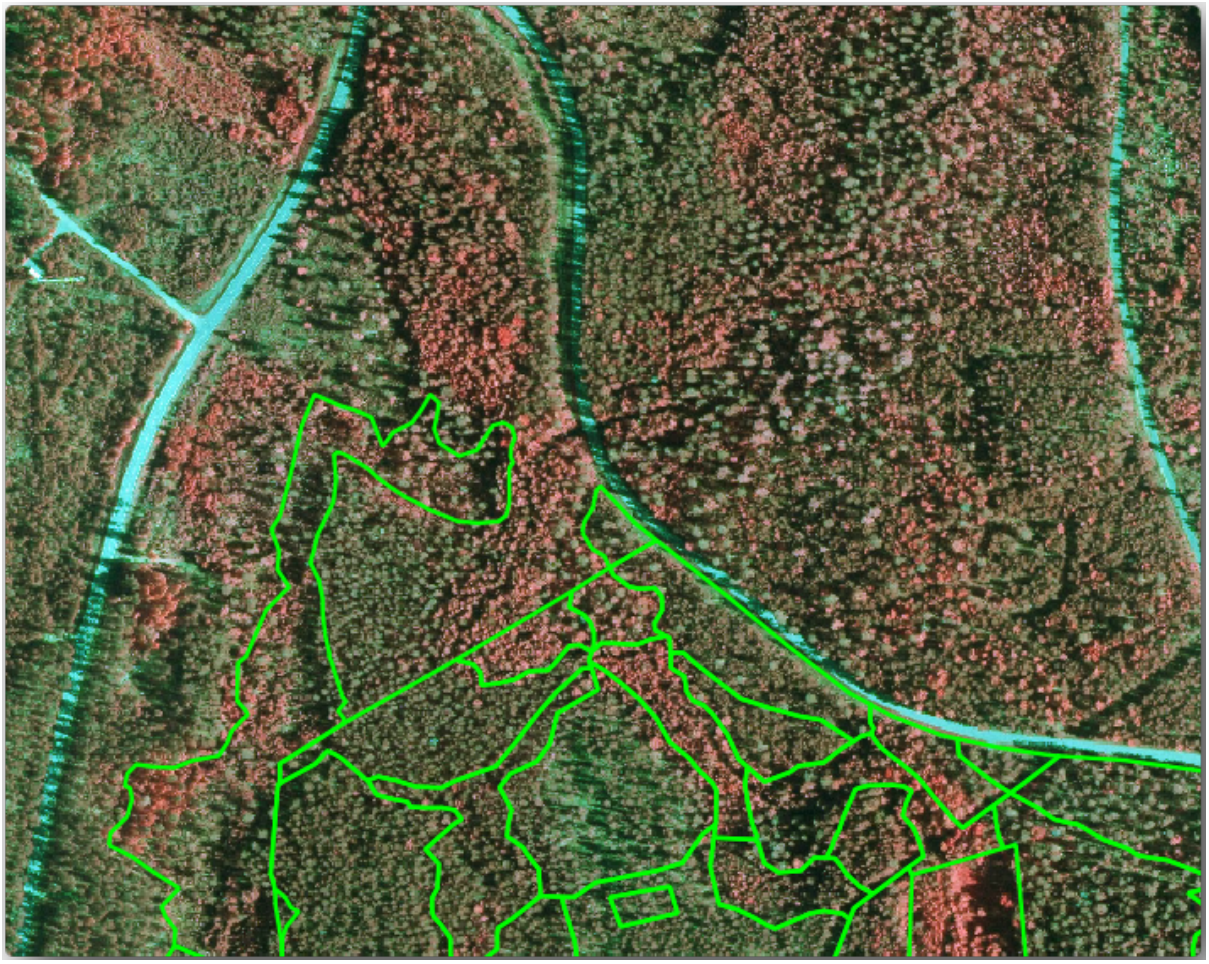
You can see that the northern section of the inventory area is still missing. Your task is to digitize the missing forest stands.

Before you start, spend some time reviewing the forest stands already digitized and the corresponding forest in the image. Try to get an idea about how the stands borders are decided, it helps if you have some forestry knowledge.

Some points to consider:

- Which forests have deciduous species (in Finland these are mostly birch forests) and which ones have conifers (in this area these are pine or spruce)? In CIR images, deciduous species usually show up as a bright red color whereas conifers show as a dark green color.

- How old is the forest? The size of the tree crowns can be identified in the imagery.
- How dense are the different forest stands? A forest stand where a thinning operation has recently been done would show spaces between the tree crowns and should be easy to differentiate from other forest stands around it.
- Zonele albăstrui indică terenuri virane, drumuri și zone urbane, culturi care nu au ajuns să crească, etc.
- Don't use zooms too close to the image when trying to identify forest stands. A scale between 1:3 000 and 1:5 000 should be enough for this imagery. See the image below (1:4000 scale):



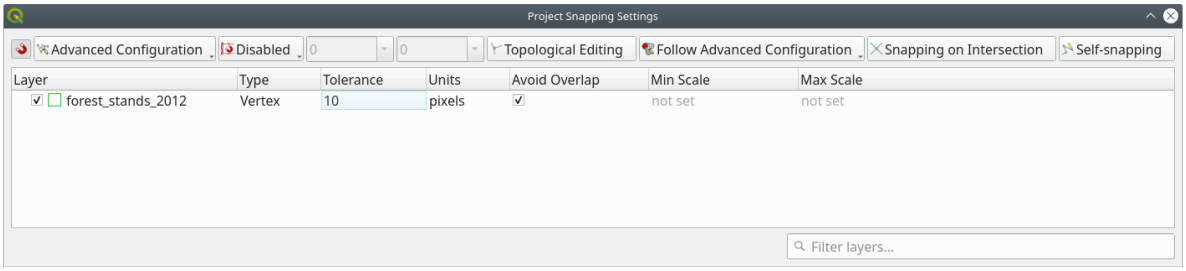
14.4.3 ??? Try Yourself: Digitizing Forest Stands from CIR Imagery

When digitizing the forest stands, you should try to get forest areas that are as homogeneous as possible in terms of tree species, forest age, stand density… Don't be too detailed though, or you will end up making hundreds of small forest stands - and that would not be useful at all. You should try to get stands that are meaningful in the context of forestry, not too small (at least 0.5 ha) but not too big either (no more than 3 ha).

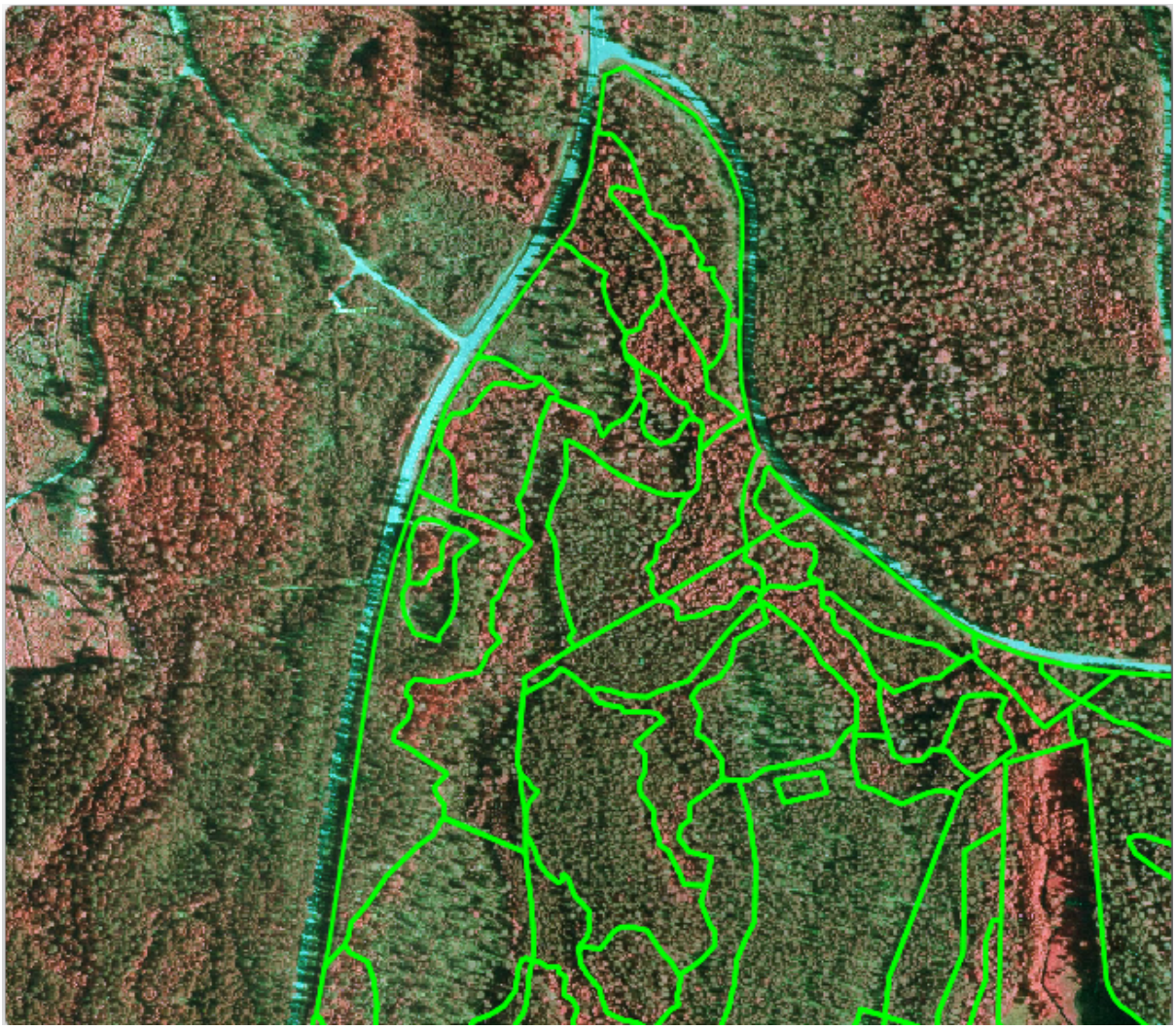
With these points in mind, you can now digitize the missing forest stands.

1. Set up the snapping and topology options:
    1. Mergeți la *Proiect* ► *Opțiuni de acroșare…*
    2. Press Enable Snapping and select *Advanced Configuration*
    3. Check the `forest_stands_2012` layer
        1. Set *Type* to *Vertex*

2. Set *Tolerance* to `10`
3. Set *Units* to *pixels*
4. Check the box under *Avoid Overlap*
5. Press *Topological editing*
6. Choose *Follow Advanced Configuration*
7. Close the pop-up



2. Select the `forest_stands_2012` layer on the Layers list
3. Click the Toggle Editing button to enable editing
4. Start digitizing using the same techniques as in the previous lesson. The only difference is that you don't have any point layer that you are snapping to. For this area you should get around 14 new forest stands. While digitizing, fill in the `StandID` field with numbers starting at `901`.
5. Când veți definitiva, stratul dvs. ar trebui să arate în felul următor:



Now you have a new set of polygons showing the different forest stands in 2012 - as interpreted from the CIR images. However, you are missing the forest inventory data. For that you will need to visit the forest and get some sample data that you will use to estimate the forest attributes for each of the forest stands. You will see how to do that in the next lesson.

You can add some extra information about conservation regulations that need to be taken into account for this area.

14.4.4 ??? Follow Along: Updating Forest Stands with Conservation Information

For the area you are working in, there are some conservation regulations that must be taken into account when doing the forest planning:

- Two locations of a protected species of Siberian flying squirrel (Pteromys volans) have been identified. According to the regulation, an area of 15 meters around the spots must be left untouched.
- A riparian forest of special interest that is growing along a stream in the area must be protected. In a visit to the field, it was found that 20 meters to both sides of the stream must be protected.

You have a vector file containing the information about the squirrel locations and another containing the digitized stream running from the North area towards the lake.

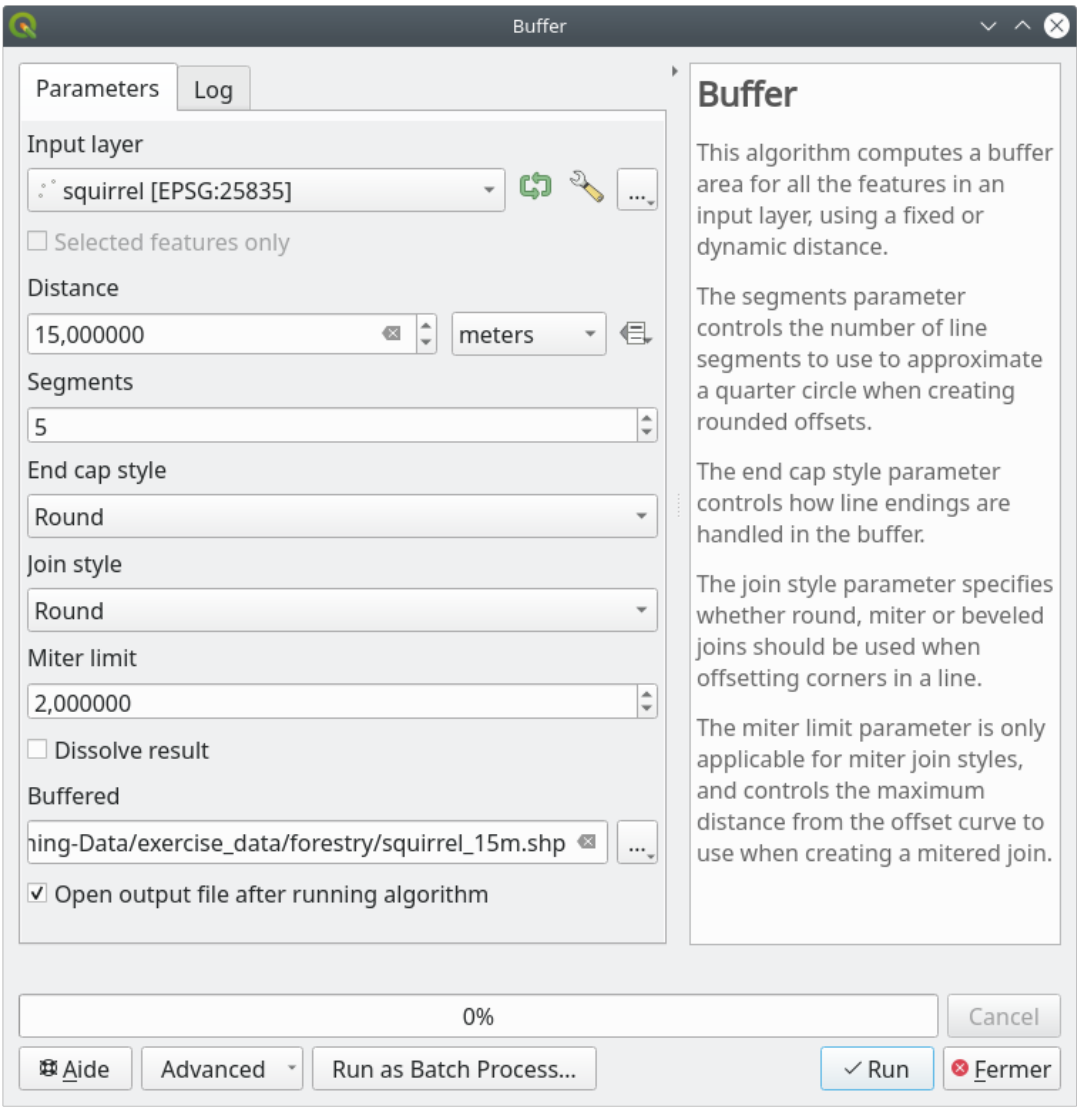
1. From the `exercise_data\forestry\` folder, add the `squirrel.shp` and `stream.shp` files to the project.

2. Use the Open Attribute Table tool to view the `squirrel` layer

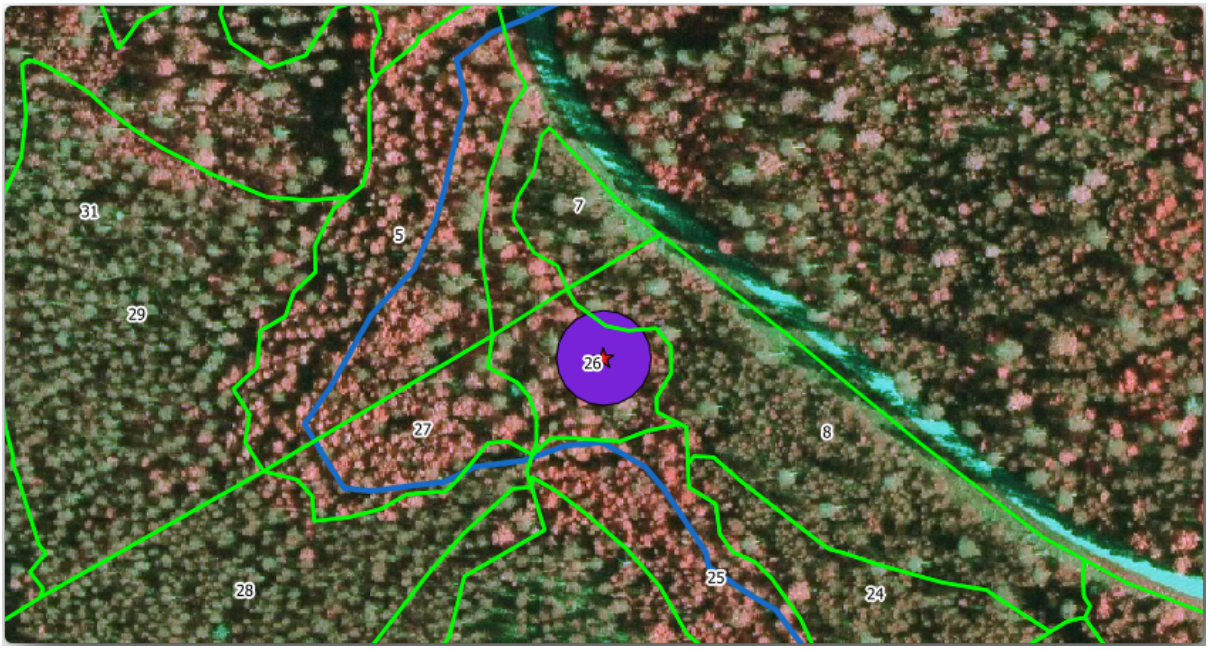
   You can see that there are two locations that are defined as Siberian flying squirrel, and that the area to be protected is indicated by a distance of 15 meters from the locations.

Let's more accurately delimitate that area to protect. We will create a buffer around the point locations, using the protection distance.

1. Deschideți *Vector* ► *Geoprocessing Tools* ► *Buffer*.
2. Set *Input layer* to `squirrel`
3. Set *Distance* to `15 meters`
4. Set *Buffered* to `exercise_data\forestry\squirrel_15m.shp`
5. Check *Open output file afer running algorithm*
6. Click *Run*
7. Once the process is completed, click *Close*



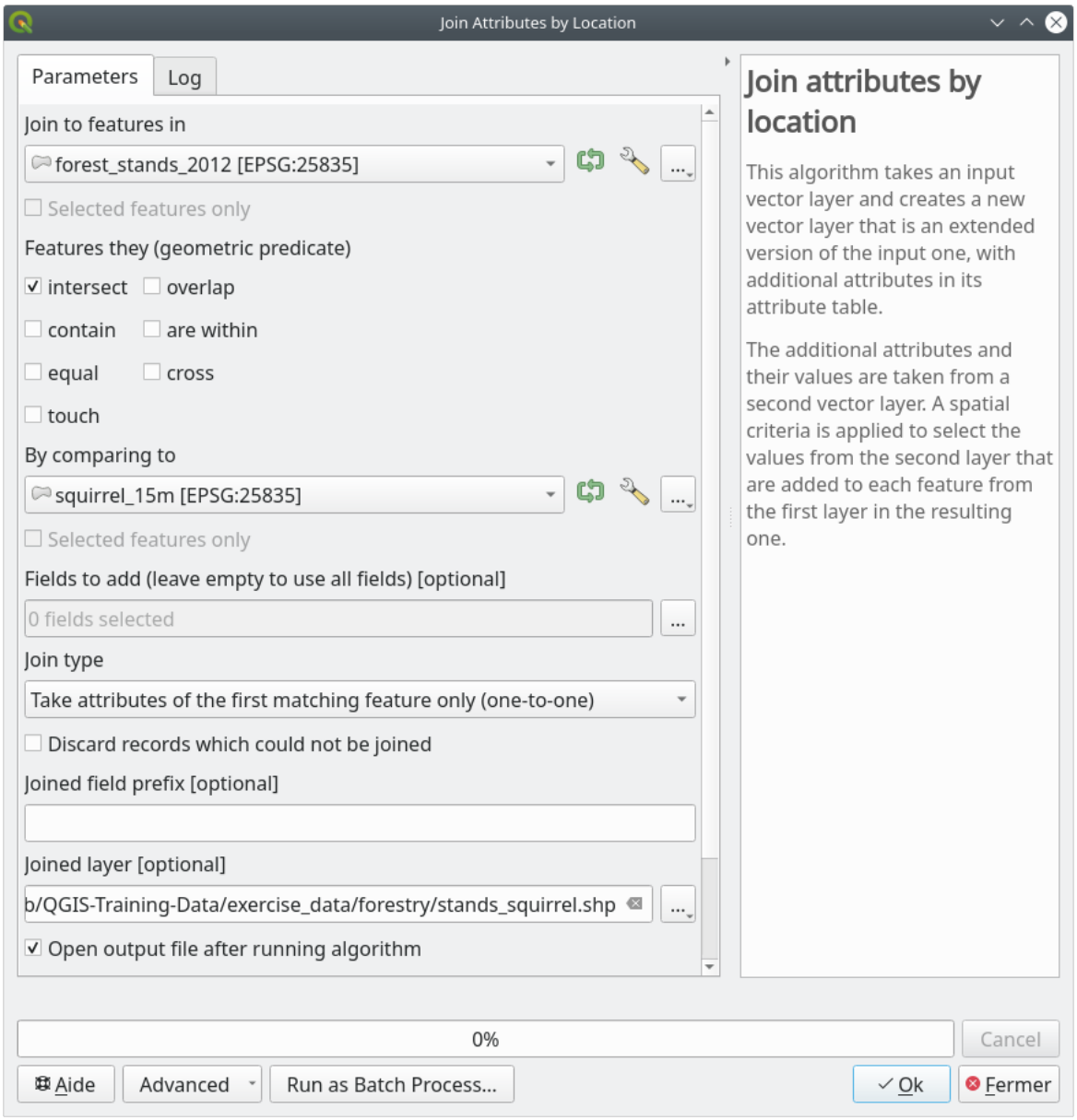
If you zoom in to the location in the northern part of the area, you will notice that the buffer area extends over two neighbouring stands. This means that whenever a forest operation takes place in that stand, the protected location should also be taken into account.



For the protection of the squirrels locations, you are going to add a new attribute (column) to your new forest stands that will contain information about locations that have to be protected. This information will then be available whenever a forest operation is planned, and the field team will be able to mark the area that has to be left untouched before the work starts.

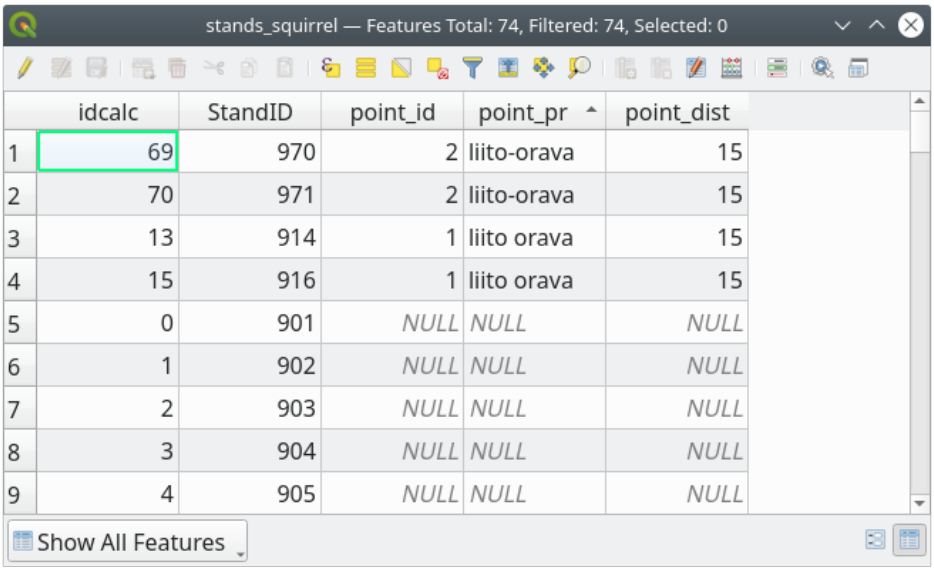
To join the information about the squirrels to your forest stands, you can use the *Join attributes by location* algorithm:

1. Deschideți *Vector* ► *Managementul Datelor* ► *Îmbină atributele după locație*.
2. Set *Join to features in* to `forest_stands_2012`
3. In *Geometric predicate*, check *intersect*
4. Set *By comparing to* to `squirrel_15m`
5. Set *Join type* as *Take attributes of the first matching feature only (one-to-one)*
6. Leave unchecked *Discard records which could not be joined*
7. Set *Joined layer* to `exercise_data\forestry\stands_squirrel.shp`
8. Check *Open output file afer running algorithm*
9. Click *Run*
10. Once the process is completed, you can *Close* the dialog.



Now you have a new forest stands layer, `stands_squirrel.shp` showing the protection information for the Siberian flying squirrel.

1. Open the attribute table of the `stands_squirrel` layer
2. Sort the table by clicking on *point_pr* field in the table header.



	idcalc	StandID	point_id	point_pr	point_dist
1	69	970	2	liito-orava	15
2	70	971	2	liito-orava	15
3	13	914	1	liito orava	15
4	15	916	1	liito orava	15
5	0	901	NULL	NULL	NULL
6	1	902	NULL	NULL	NULL
7	2	903	NULL	NULL	NULL
8	3	904	NULL	NULL	NULL
9	4	905	NULL	NULL	NULL

You can see that there are some forest stands that have the information about the protection locations. The information in the forest stands data will indicate to the forest manager that there are protection considerations to be taken into account. Then he or she can get the location from the `squirrel` dataset, and visit the area to mark the corresponding buffer around the location so that the operators in the field can avoid disturbing the squirrels environment.

14.4.5 ??? Try Yourself: Updating Forest Stands with Distance to the Stream

Following the same approach as for the protected squirrel locations you can now update your forest stands with protection information related to the stream. A few points:

- Remember the buffer is `20` meters around the stream
- You want to have all the protection information in the same vector file, so use `stands_squirrel.shp` as the base layer
- Name your output as `forest_stands_2012_protect.shp`

Once the process is completed, open the attribute table of the output layer and confirm that you have all the protection information for the riparian forest stands associated with the stream.

When you are happy with the results, save your QGIS project.

14.4.6 În concluzie

You have seen how to interpret CIR images to digitize forest stands. Of course it would take some practice to make more accurate stands and usually using other information like soil maps would give better results, but you know now the basis for this type of task. And adding information from other datasets resulted to be quite a trivial task.

14.4.7 Ce urmează?

The forest stands you digitized will be used for planning forestry operations in the future, but you still need to get more information about the forest. In the next lesson, you will see how to plan a set of sampling plots to inventory the forest area you just digitized, and get the overall estimate of forest parameters.

14.5 Lesson: Systematic Sampling Design

Ați digitizat deja un set de poligoane care reprezintă arboretul, totuși, încă nu aveți informații despre pădure. Pentru aceasta, puteți programa o achiziție de date pentru a inventaria întreaga pădure și pentru a-i estima parametrii. În această lecție veți crea un set sistematic de suprafețe de probă.

Atunci când începeți planificarea inventarului forestier, este important să vă definiți în mod clar obiectivele, tipurile de suprafețe de probă care vor fi utilizate, precum și datele care vor fi colectate în vederea atingerii obiectivelor. Pentru fiecare caz în parte, acestea vor depinde de tipul pădurii și de scopul managementului; ar trebui să fie planificate cu atenție de către cineva cu cunoștințe forestiere. În această lecție, veți crea un inventar teoretic, bazat pe un design sistematic al suprafețelor de probă.

Scopul acestei lecții: Crearea planului sistematic al suprafețelor de probă, pentru o vedere de ansamblu a zonei de pădure.

14.5.1 Inventarierea Pădurii

There are several methods to inventory forests, each of them suiting different purposes and conditions. For example, one very accurate way to inventory a forest (if you consider only tree species) would be to visit the forest and make a list of every tree and their characteristics. As you can imagine this is not commonly applicable except for some small areas or some special situations.

The most common way to find out about a forest is by sampling it, that is, taking measurements in different locations at the forest and generalizing that information to the whole forest. These measurements are often made in *sample plots* that are smaller forest areas that can be easily measured. The sample plots can be of any size (for ex. 50 m2, 0.5 ha) and form (for ex. circular, rectangular, variable size), and can be located in the forest in different ways (for ex. randomly, systematically, along lines). The size, form and location of the sample plots are usually decided following statistical, economical and practical considerations. If you have no forestry knowledge, you might be interested in reading this Wikipedia article.

14.5.2 ??? Follow Along: Implementing a Systematic Sampling Plot Design

For the forest you are working with, the manager has decided that a systematic sampling design is the most appropriate for this forest and has decided that a fixed distance of 80 meters between the sample plots and sampling lines will yield reliable results (for this case, +- 5% average error at a probability of 68%). Variable size plots has been decided to be the most effective method for this inventory, for growing and mature stands, but a 4 meters fixed radius plots will be used for seedling stands.

În practică, trebuie pur și simplu să reprezentăm suprafețele de probă sub formă de puncte, care vor fi folosite ulterior de către echipele din teren:

1. Open your `digitizing_2012.qgs` project from the previous lesson.
2. Remove all the layers except `forest_stands_2012`.
3. Salvați proiectul în `forest_inventory.qgs`

Acum trebuie să creați o rețea dreptunghiulară de puncte separate, aflate la 80 de metri unul de altul:

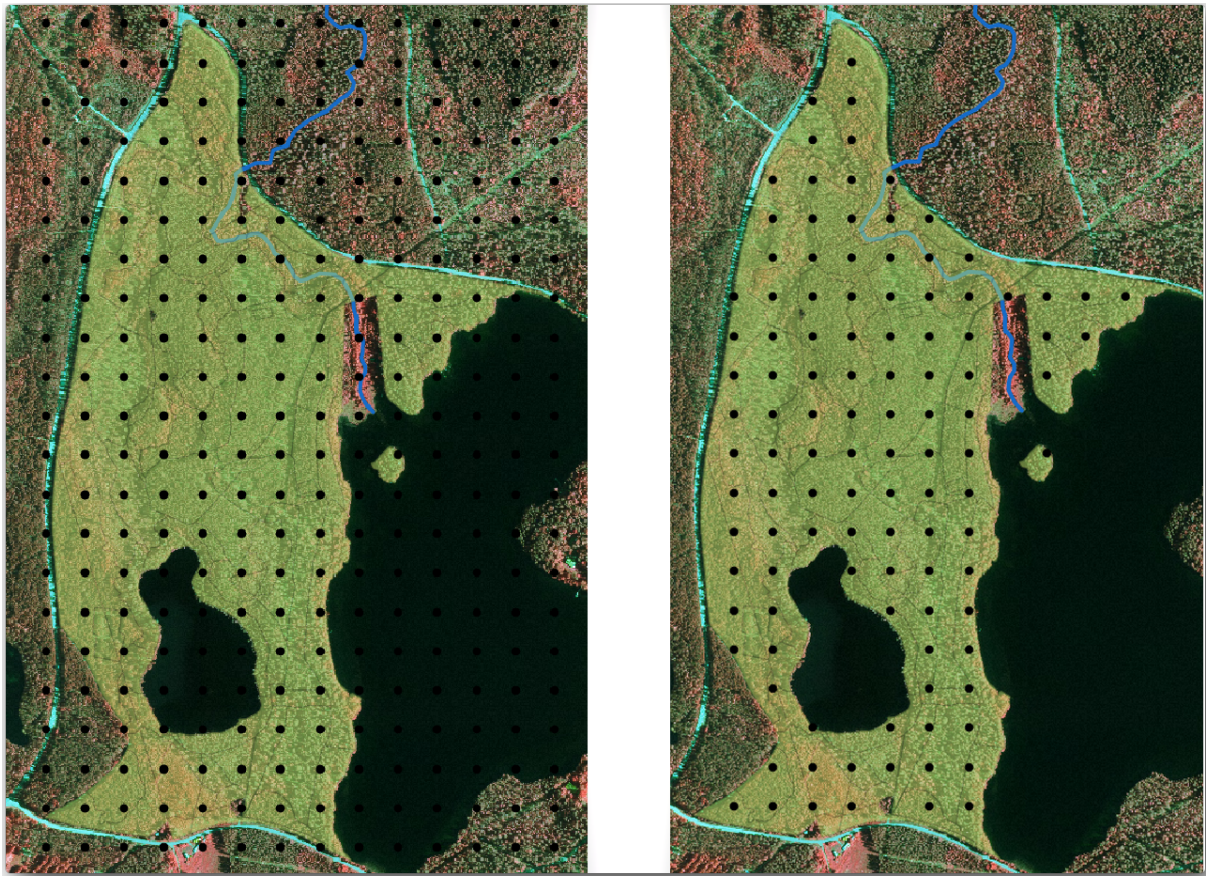
1. Open *Vector* ► *Research Tools* *Regular points*.

2. Press the drop-down button next to the *Input extent* field and from the *Calculate from Layer* menu, select `forest_stands_2012`.
3. In the *Point spacing/count* settings, enter `80 meters`.
4. Check the *Use point spacing* box to indicate that the value represents the distance between the points.
5. Under *Regular points*, save the output as `systematic_plots.shp` in the `forestry\sampling\` folder.
6. Check *Open output file after running algorithm*.
7. Press *Run*.

Notă

The suggested *Regular points* creates the systematic points starting in the upper-left corner of the extent of the selected polygon layer. If you want to add some randomness to this regular points, you could use a randomly calculated number between 0 and 80 (80 is the distance between our points), and then write it as the *Initial inset from corner (LH side)* parameter in the tool's dialog.

Observați că instrumentul a folosit întreaga extindere a stratului de arboret, pentru a genera o grilă dreptunghiulară de puncte. Însă, vă interesează doar acele puncte care se află în interiorul suprafeței de pădure (a se vedea imaginile de mai jos):



1. From the Processing toolbox, open *GDAL* ► *Vector geoprocessing* ► *Clip vector by mask layer*.
2. Select `systematic_plots` as the *Input layer*.
3. Set `forest_stands_2012` as the *Mask layer*.

4. Save the *Clipped (mask)* result as `systematic_plots_clip.shp` in the `forestry\sampling\` folder.
5. Check *Open output file after running algorithm*.
6. Press *Run*.

You have now the points that the field teams will use to navigate to the designed sample plots locations. You can still prepare these points so that they are more useful for the field work. At the least you will have to add meaningful names for the points and export them to a format that can be used in their GPS devices.

Let's start with the naming of the sample plots. If you check the *Attribute table* for the plots inside the forest area, you can see that you have the default *id* field automatically generated by the *Regular points* tool. Label the points to see them in the map and consider if you could use those numbers as part of your sample plot naming:

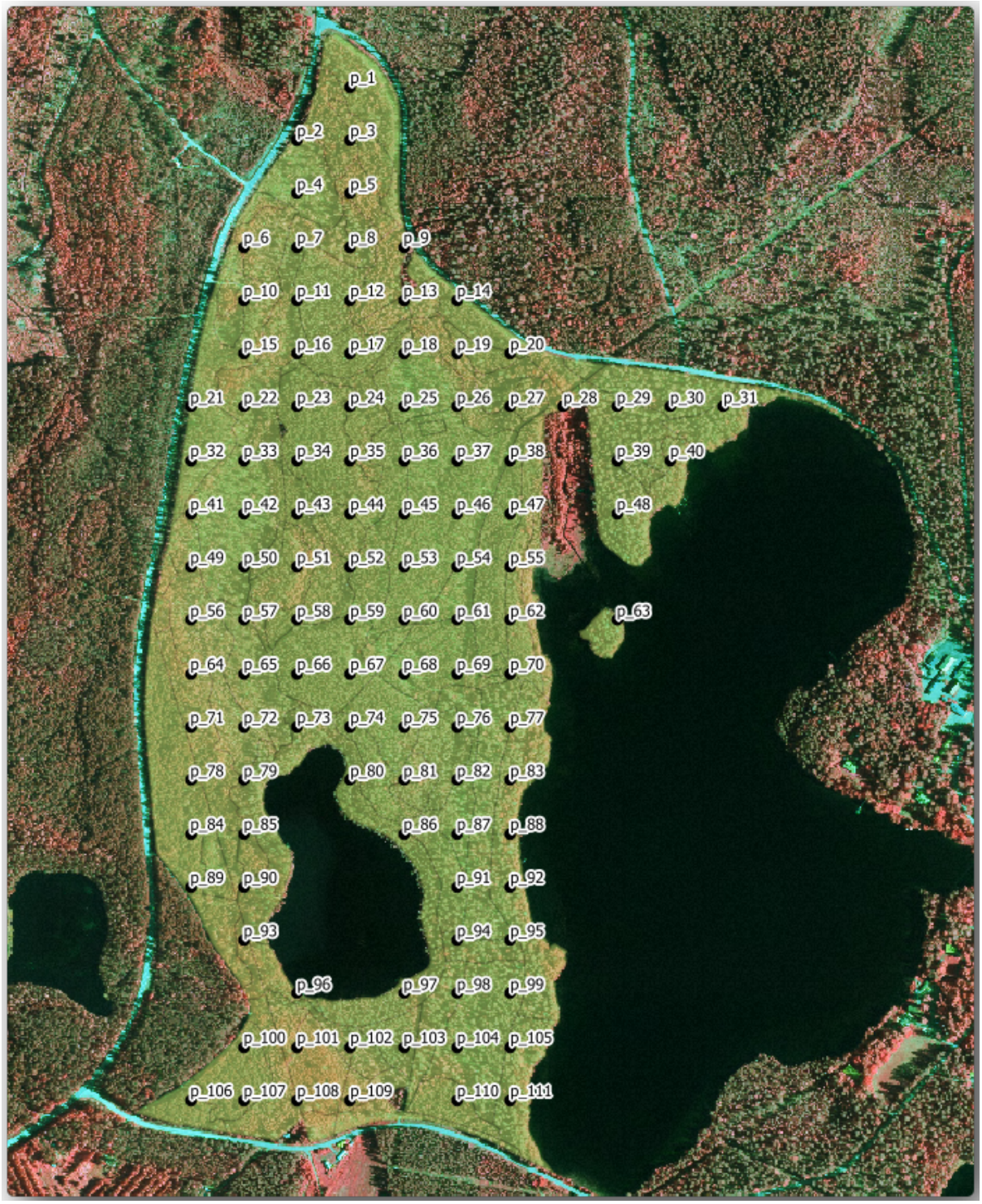
1. Open the *Layer Properties* ► *Labels* for the `systematic_plots_clip` layer.
2. Turn the top menu into *Single Labels*.
3. For the *Value* entry, select the field `id`.
4. Go to the *Buffer* tab, check the *Draw text buffer* and set the buffer *Size* to `1`.
5. Clic pe *OK*

Acum, priviți etichetele de pe hartă. Puteți vedea că punctele au fost create și numerotate mai întâi de la vest înspre est și apoi de la nord înspre sud. Dacă priviți iarăși la tabela de atribute, veți observa că ordinea din tabel urmează, de asemenea, acest model. Numai dacă aveți un alt motiv pentru a denumi suprafețele de probă într-un mod diferit, modul de denumire Vest-Est/Nord-Sud urmează o ordine logică și reprezintă o opțiune bună.

Nevertheless, the number values in the `id` field are not so good. It would be better if the naming would be something like `p_1, p_2...`. You can create a new column for the `systematic_plots_clip` layer:

1. Go to the *Attribute table* for `systematic_plots_clip`.
2. Enable the  edit mode.
3. Open the  Field calculator:
    1. Check *Create a new field*
    2. Enter `Plot_id` as *Output field name*
    3. Set the *Output field type* to *Text (string)*.
    4. In the *Expression* field, write, copy or construct this formula `concat('P_', @row_number )`. Remember that you can also double click on the elements inside the *Function list*. The `concat` function can be found under *String* and `@row_number` is under the *Variables* group.
4. Clic pe *OK*
5. Dezactivați modul de editare și salvați modificările.

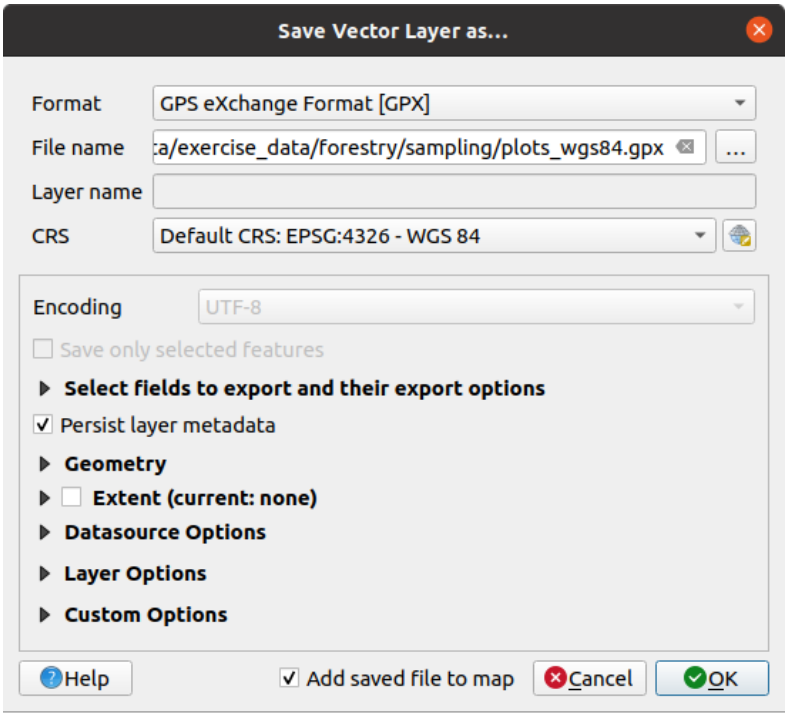
Now you have a new column with plot names that are meaningful to you. For the `systematic_plots_clip` layer, change the field used for labeling to your new `Plot_id` field.


p_1
p_2
p_3
p_4
p_5
p_6
p_7
p_8
p_9
p_10
p_11
p_12
p_13
p_14
p_15
p_16
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p_111

14.5.3 ??? Follow Along: Exporting Sample Plots as GPX format

The field teams will be probably using a GPS device to locate the sample plots you planned. The next step is to export the points you created to a format that your GPS can read. QGIS allows you to save your point and line vector data in GPS eXchange Format (GPX), which is an standard GPS data format that can be read by most of the specialized software. You need to be careful with selecting the CRS when you save your data:

1. Right-click `systematic_plots_clip` layer and select *Export* ► *Save features as…*.



2. În *Format* selectați *GPS eXchange Format [GPX]*.
3. Save the output *File name* as `plots_wgs84.gpx` in the `forestry\sampling\` folder.
4. În *CRS* alegeți *CRS-ul Selectat*.
5. Browse for *EPSG:4326 - WGS 84*.

> **Notă**
>
> The GPX format accepts only this CRS, if you select a different one, QGIS will give no error but you will get an empty file.

6. Clic pe *OK*
7. In the dialog that opens, select only the `waypoints` layer (the rest of the layers are empty).

The inventory sample plots are now in a standard format that can be managed by most of the GPS software. The field teams can now upload the locations of the sample plots to their devices. That would be done by using the specific devices own software and the `plots_wgs84.gpx` file you just saved. Other option would be to use the *GPS Tools* plugin but it would most likely involve setting the tool to work with your specific GPS device. If you are working with your own data and want to see how the tool works you can find out information about it in the section working_gps in the **QGIS User Manual**.

Salvați acum proiectul dvs. QGIS.

14.5.4 În concluzie

You just saw how easily you can create a systematic sampling design to be used in a forest inventory. Creating other types of sampling designs will involve the use of different tools within QGIS, spreadsheets or scripting to calculate the coordinates of the sample plots, but the general idea remains the same.

14.5.5 Ce urmează?

In the next lesson you will see how to use the Atlas capabilities in QGIS to automatically generate detailed maps that the field teams will be using to navigate to the sample plots assigned to them.

14.6 Lesson: Creating Detailed Maps with the Atlas Tool

Proiectarea sistematică de eșantionare este gata, iar echipele de teren și-au încărcat coordonatele GPS în dispozitivele de navigare. Există, de asemenea, un formular pentru date, în care se vor colecta informațiile măsurate pentru fiecare schiță. Pentru a găsi mai ușor drumul spre fiecare parcelă, s-au solicitat o serie de hărți detaliate, în cazul în care unele informații din teren pot fi văzute în mod clar, împreună cu un subset mic de schițe și câteva informații despre zonă. Puteți utiliza instrumentul Atlas pentru a genera automat o serie de hărți, având un format comun.

Scopul acestei lecții: Aflați cum să utilizați instrumentul Atlas în QGIS, pentru a genera hărți tipăribile detaliate, în scopul sprijinirii activității de inventariere în teren.

14.6.1 ??? Follow Along: Preparing the Print Layout

Înainte de a putea automatiza hărțile detaliate ale zonei forestiere și schițele noastre de eșantionare, trebuie să creăm un șablon cu toate elementele pe care le considerăm utile în munca de teren. Desigur, cea mai importantă va fi o stilizare corectă, dar, după cum ați văzut mai înainte, va trebui să adăugați și o mulțime de alte elemente care completează harta tipărită.

1. Deschideți proiectul QGIS din lecția anterioară `forest_inventory.qgs`. Ar trebui să aveți cel puțin următoarele straturi:
   - `forest_stands_2012` (with a 50% transparency, green fill and darker green border lines)
   - `systematic_plots_clip`
   - `rautjarvi_aerial`
2. Salvați proiectul sub un nume nou, `map_creation.qgs`.

To create a printable map, remember that you use the *Layout Manager*:

1. Open *Project* ► *Layout Manager…*.
2. In the *Layout manager* dialog:
   1. Under *New from template*, press the *Create…* button next to the *Empty layout* entry
   2. Name your print layout `forest_map`.
   3. Press *OK*. A new print layout is created and opened, showing a blank paper.
3. In the print Layout window, ensure properties are set for an A4 paper:
   1. Right-click over the paper and select *Page properties*. The *Page properties* panel is open on the right side of the layout.
   2. Asigurați-vă că *Dimensiunea* este *A4*.
   3. Asigurați-vă că *Orientarea* este *Peisaj*.

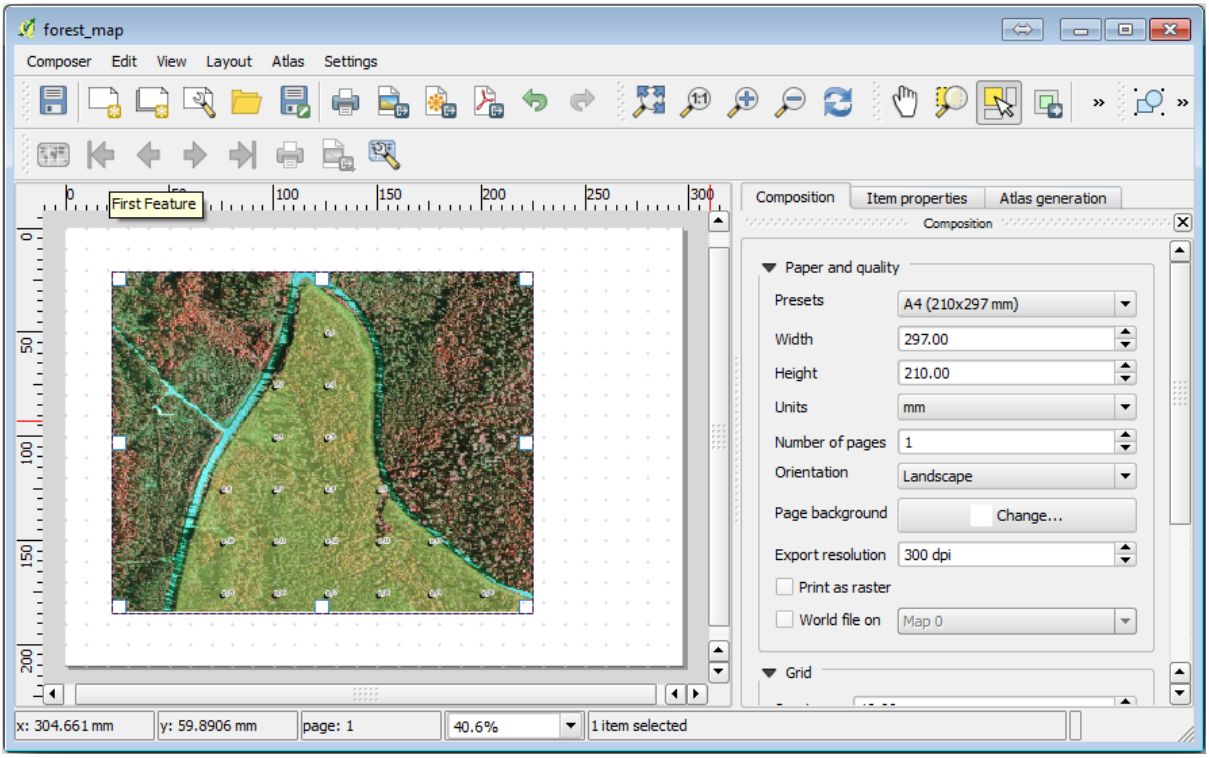
4. Enable the *Layout* tab next to the *Page properties* panel and set *Export resolution* to `300 dpi`.

Composing a map is easier if you make use of the canvas grid to position the different elements. Review the settings for the layout grid:

1. In the *Layout* tab expand the *Guides and Grid* region.
2. Check that *Grid spacing* is set to `10 mm` and that *Snap tolerance* is set to `5 px`.

Trebuie să activați folosirea grilei:

1. Deschideți meniul :menuselection:`Vizualizare
2. Bifați *Afișarea grilei*.
3. Bifați *Acroșare la grilă*.
4. Notice that options for using *Guides* are checked by default, which allows you to see guiding lines when you are moving elements in the layout.
5. Now you can start to add elements to your layout. Add first a map element so you can review how the map canvas looks as you will be making changes in the layers symbology:
    1. Click on the  Add Map button.
    2. Țineți apăsat butonul stâng al mouse-ului și trasați un dreptunghi în care să încadrați cea mai mare parte a hărții.



Observați modul în care cursorul mouse-ului se acroșează la grila canevasului. Utilizați această funcție atunci când adăugați alte elemente. Dacă doriți să aveți mai multă acuratețe, schimbați setările de *Spațiere* ale grilei. Dacă dintr-un motiv oarecare nu mai doriți acroșarea la grilă la un moment dat, puteți întotdeauna bifa sau debifa meniul *Vizualizare*.

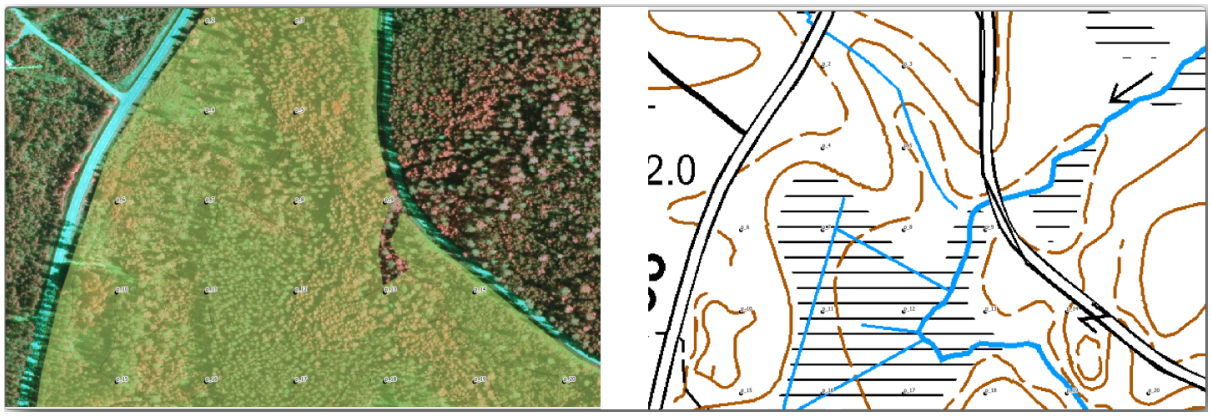
14.6.2 Follow Along: Adding Background Map

Leave the layout open but go back to the map. Let's add some background data and create some styling so that the map content is as clear as possible.

1. Add the background raster `basic_map.tif` that you can find in the `exercise_data\forestry\` folder.
2. If prompted select the *ETRS89 / ETRS-TM35FIN* CRS for the raster.

   După cum puteți vedea, harta de fundal este deja stilizată. Acest tip de raster cartografic gata de utilizare este foarte frecvent. El este creat din date vectoriale, stilizate într-un format standard și stocate ca un raster, așa că nu trebuie să vă îngrijoreze obținerea unui rezultat bun.
3. Acum măriți schițele dvs., astfel încât să puteți vedea doar aproximativ patru sau cinci linii de parcele.

The current styling of the sample plots is not the best:



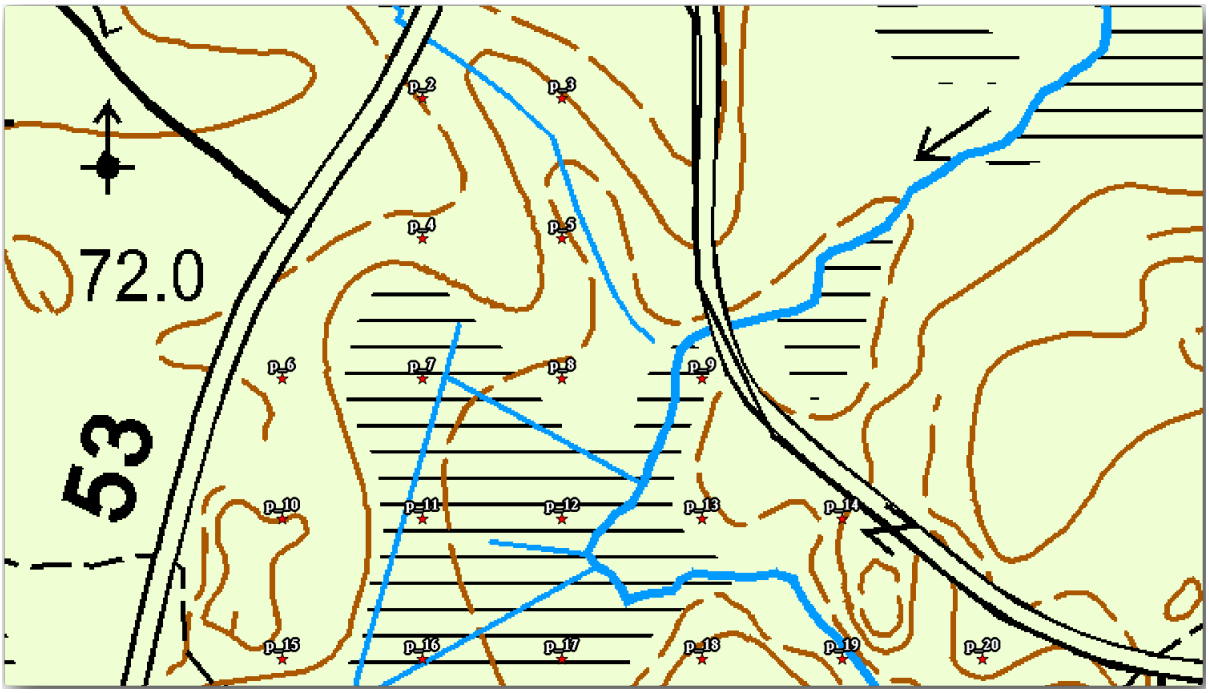
While during the last exercises, the white buffer was OK on top of the aerial image, now that the background image is mostly white you barely can see the labels. But how does it look in the print layout? Let's check it:

1. Go to the print layout window.
2. Use the  Select/Move item button to select the map element in the layout.
3. Mergeți la fila *Proprietățile itemului* tab.
4. Click on  *Set map extent to match main canvas extent*.
5. If you need to refresh the element, click on  *Update map preview*.

Obviously this is not good enough; you want to make the plot numbers as clearly visible as possible for the field teams.

14.6.3 Try Yourself: Changing the Symbology of the Layers

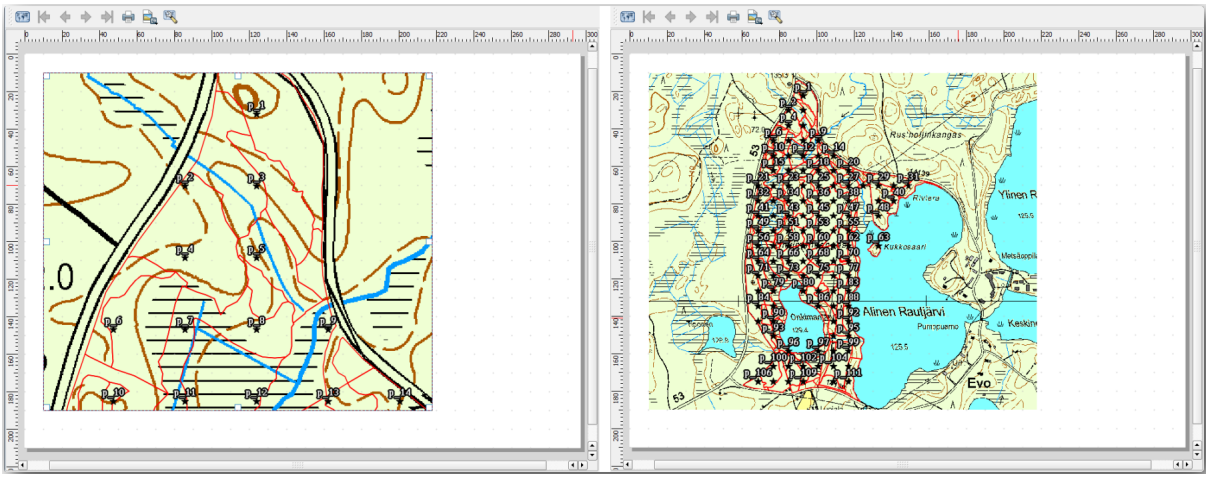
Ați exersat simbologia cu *Modulul;: Crearea și Explorarea unei Hărți de Bază*, și etichetarea cu *Module: Classifying Vector Data*. Reveniți la aceste module dacă trebuie să vă reamintiți unele dintre opțiunile și instrumentele disponibile. Scopul dvs. este de a afișa locațiile loturilor și numele lor cât mai clar, dar întotdeauna să fie posibilă vizualizarea elementelor din fundalul hărții. Vă puteți orienta după această imagine:



You will use later the the green styling of the `forest_stands_2012` layer. In order to keep it, and have a visualization of it that shows only the stand borders:

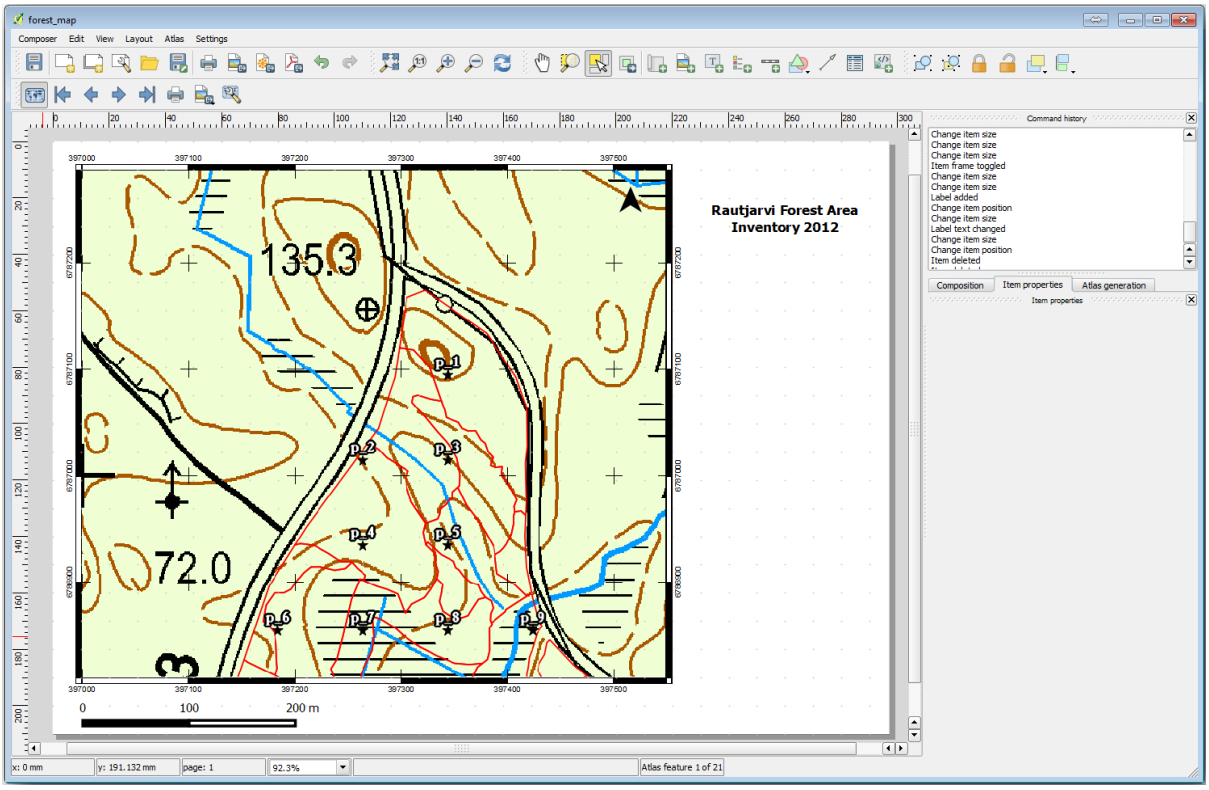
1. Right click on `forest_stands_2012` and select *Duplicate*
2. Obțineți un nou strat numit `forest_stands_2012 copy` pe care îl puteți utiliza pentru a defini un stil diferit, de ex.: fără umplere și cu margini roșii.

   Acum aveți două vizualizări diferite ale parcelelor împădurite și puteți decide pe care să o afișați pentru harta dvs. detaliată.
3. Go back to the print layout window often to see what the map would look like. For the purposes of creating detailed maps, you are looking for a symbology that looks good not at the scale of the whole forest area (left image below) but at a closer scale (right image below). Remember to use Update map preview and *Set map extent to match main canvas extent* whenever you change the zoom in your map or the layout.



14.6.4 Try Yourself: Create a Basic Map Template

1. Once you have a symbology you are happy with, you are ready to add some more information to your printed map. Add at least the following elements:
   - Titlu.
   - O scară grafică.
   - Cadrul grilei pentru harta dvs.
   - Coordonate situate pe părțile laterale ale grilei.
2. You have created a similar layout already in *Module: Laying out the Maps*. Go back to that module as you need. You can look at this example image for reference:



3. Exportați harta dvs. ca o imagine și priviți-o.
   1. *Compoziției* ► *Exportare ca Imagine…*.
   2. Use for example the *JPG format*.

Iată cum va arăta atunci la tipărire.

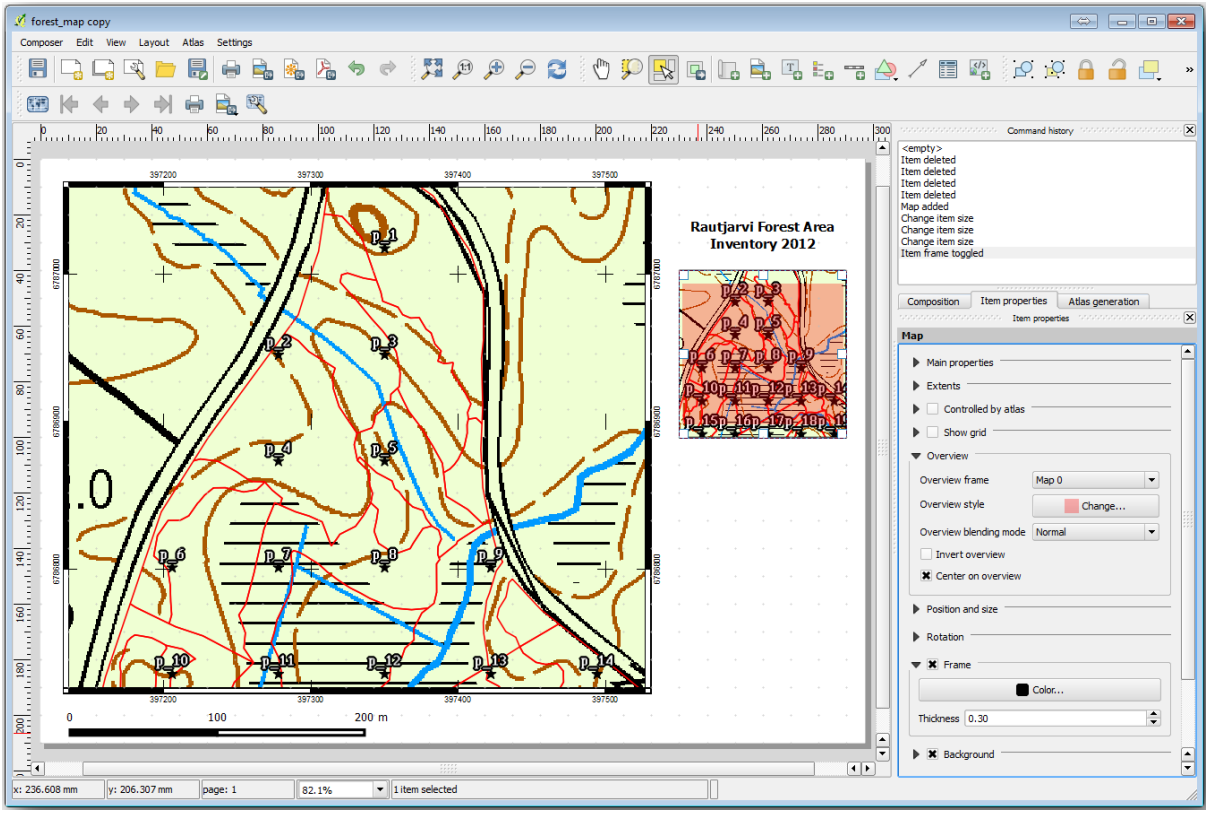
14.6.5 Follow Along: Adding More Elements to the Print Layout

Așa cum probabil ați observat în imaginea hărții șablon propusă, există o mulțime de loc în partea dreaptă a canevasului. Haideți să vedem ce altceva ar putea merge acolo. Pentru scopul hărții noastre, o legendă nu este cu adevărat necesară, dar o imagine de ansamblu a hărții și niște casete de text ar putea adăuga valoare hărții.

Harta de ansamblu va ajuta echipele de teren să plaseze harta detaliată în interiorul suprafeței generală a pădurii:

1. Adăugați un alt element de hartă pe canevas, chiar sub textul din titlu.
2. În fila *Proprietăților elementului*, deschideți caseta cu derulare verticală *Overview*.

3. Puneți *Overview frame* pe *Map 0*. Acest lucru creează un dreptunghi umbrit deasupra hărții mici, care reprezintă extinderea vizibilă în harta mai mare.
4. Check also the *Frame* option with a black color and a *Thickness* of `0.30`.



Notice that your overview map is not really giving an overview of the forest area which is what you want. You want this map to represent the whole forest area and you want it to show only the background map and the `forest_stands_2012` layer, and not display the sample plots. And also you want to lock its view so it does not change anymore whenever you change the visibility or order of the layers.

1. Go back to the map, but don't close the *Print Layout*.
2. Right click the `forest_stands_2012` layer and click on *Zoom to Layer Extent*.
3. Deactivate all layers except for `basic_map` and `forest_stands_2012`.
4. Expand the Manage map themes tool on the *Layers* panel and select *Add theme*.
5. Name it `basic_overview`.
6. Go back to the print layout.
7. With the small map selected, click the *Set map extent to match main canvas extent* to set its extents to what you can see in the map window.
8. Lock the view for the overview map by checking *Follow map theme* and selecting `basic_overview` under *Main properties*.

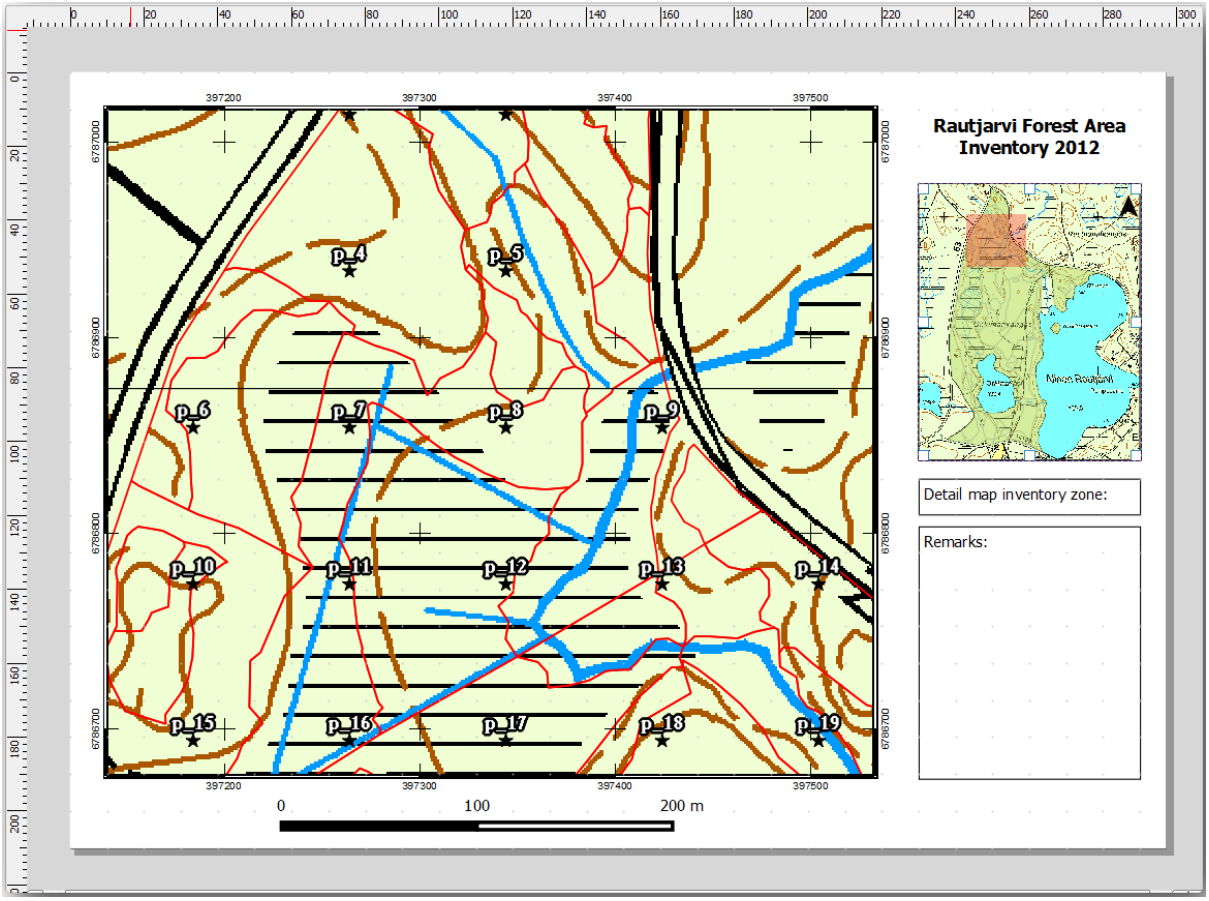
Now your overview map is more what you expected and its view will not change anymore. But, of course, now your detail map is not showing anymore the stand borders nor the sample plots. Let's fix that:

1. Mergeți din nou la fereastra hărții și selectați straturile pe care le doriți să fie vizibile (`systematic_plots_clip`, `forest_stands_2012 copy` și `Basic_map`).
2. Transfocați iarăși, pentru a avea vizibile doar câteva linii ale parcelelor.
3. Go back to the *Print Layout* window.

4. Select the bigger map in your layout.
5. In *Item properties* click on *Update preview* and *Set map extent to match main canvas extent*.

Observați că numai harta mai mare afișează vizualizarea curentă a hărții, iar harta mai mică de ansamblu păstrează aceeași vedere pe care ați blocat-o.

Rețineți, de asemenea, că o vedere de ansamblu afișează un cadru umbrit pentru extinderea prezentată în harta detaliată.



Șablonul hărții dvs. este aproape gata. Adăugați în hartă cele două casete de text de mai jos, una conținând textul «Zona detaliată a hărții:», iar cealaltă «Observații:». Plasați-le așa cum se vede în imaginea de mai sus.

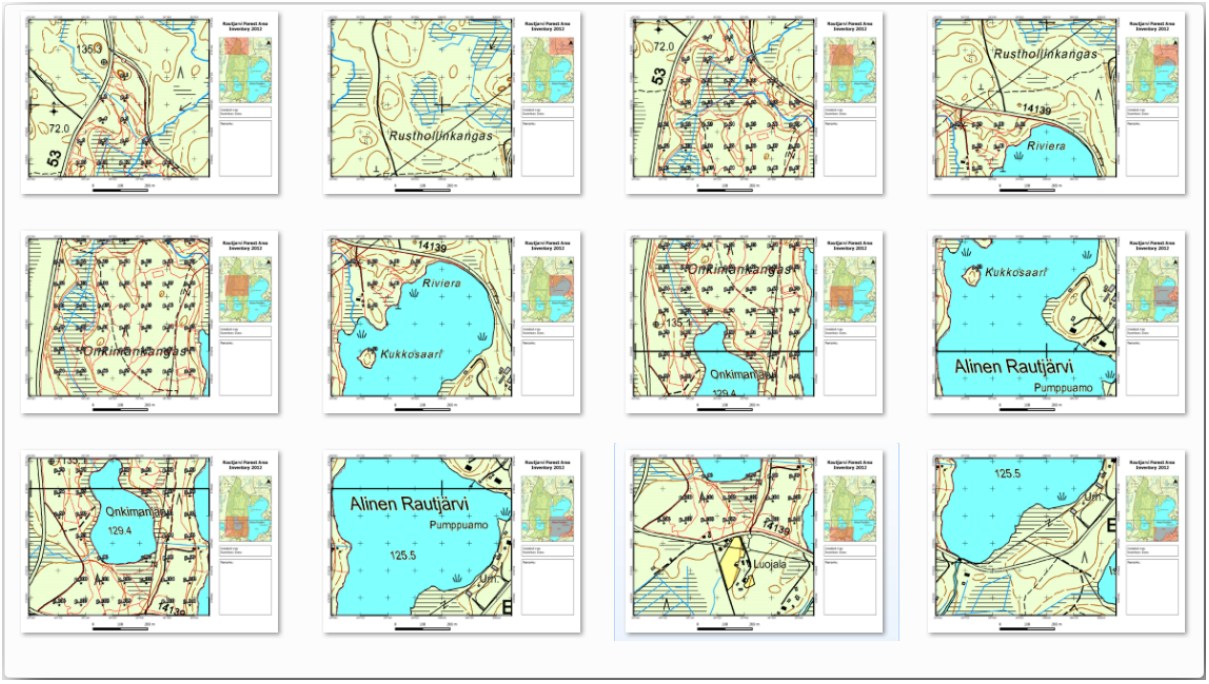
Puteți adăuga, de asemenea, o săgeată a Nordului la harta generală:

1. Select the  Add North Arrow tool.
2. Click and drag a rectangle at the upper right corner of the overview map.
3. In *Item properties* Check *SVG image*
4. Browse *SVG Browser* ► *SVG Groups* for an arrow image.
5. Under *Image rotation*, check the *Sync with map* and select *Map 1* (the overview map).
6. Redimensionați imaginea săgeții la o dimensiune care arată bine pe hărțile mici.

The basic map layout is ready, now you want to make use of the Atlas tool to generate as many detail maps in this format as you consider necessary.

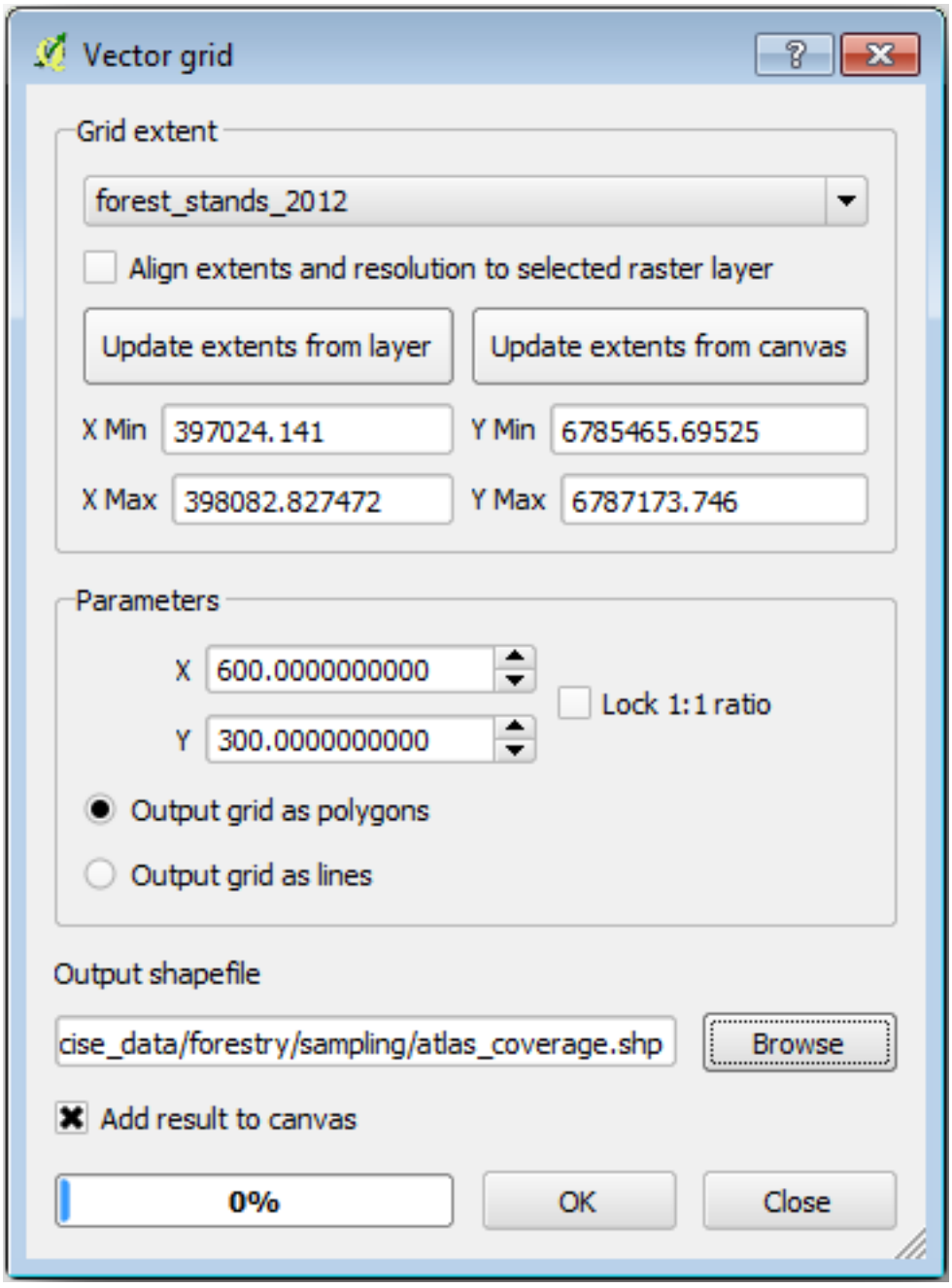
14.6.6 ??? Follow Along: Creating an Atlas Coverage

Acoperirea Atlasului reprezintă doar un strat vectorial care va fi folosit pentru a genera hărțile detaliate, o hartă pentru fiecare entitate din aria de acoperire. Pentru a vă face o idee despre aceasta, iată un set complet de hărți detaliate pentru zona de pădure:



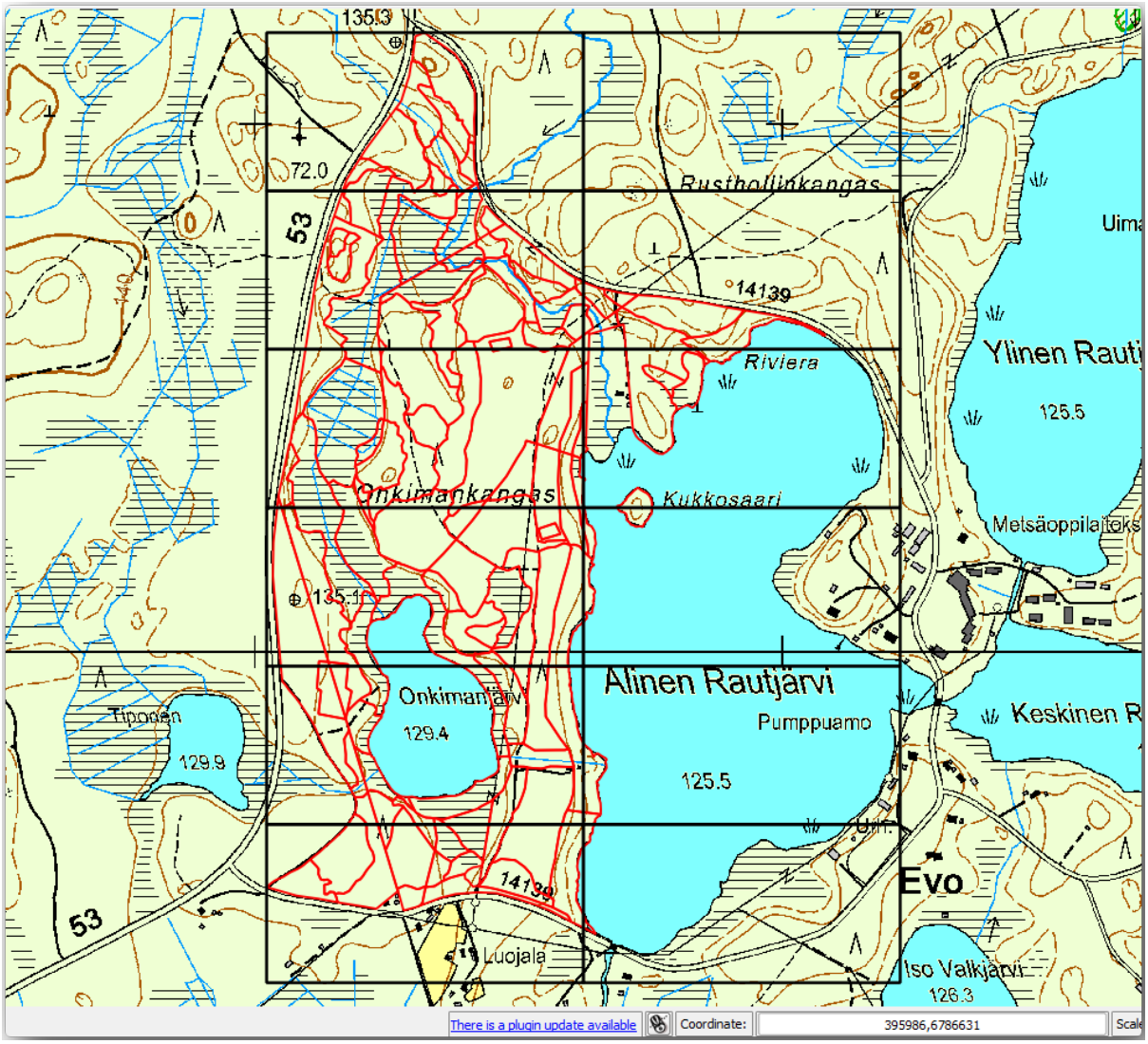
Acoperirea poate fi orice strat existent, dar, de obicei, are mai mult sens crearea unuia în acest scop specific. Haideți să creăm o rețea de poligoane care acoperă zona de pădure:

1. In the QGIS map view, open *Vector* ► *Research Tools* ► *Create grid*.
2. Setați instrumentul așa cum se arată în această imagine:



3. Salvați rezultatul ca `atlas_coverage.shp`.
4. Style the new `atlas_coverage` layer so that the polygons have no filling.

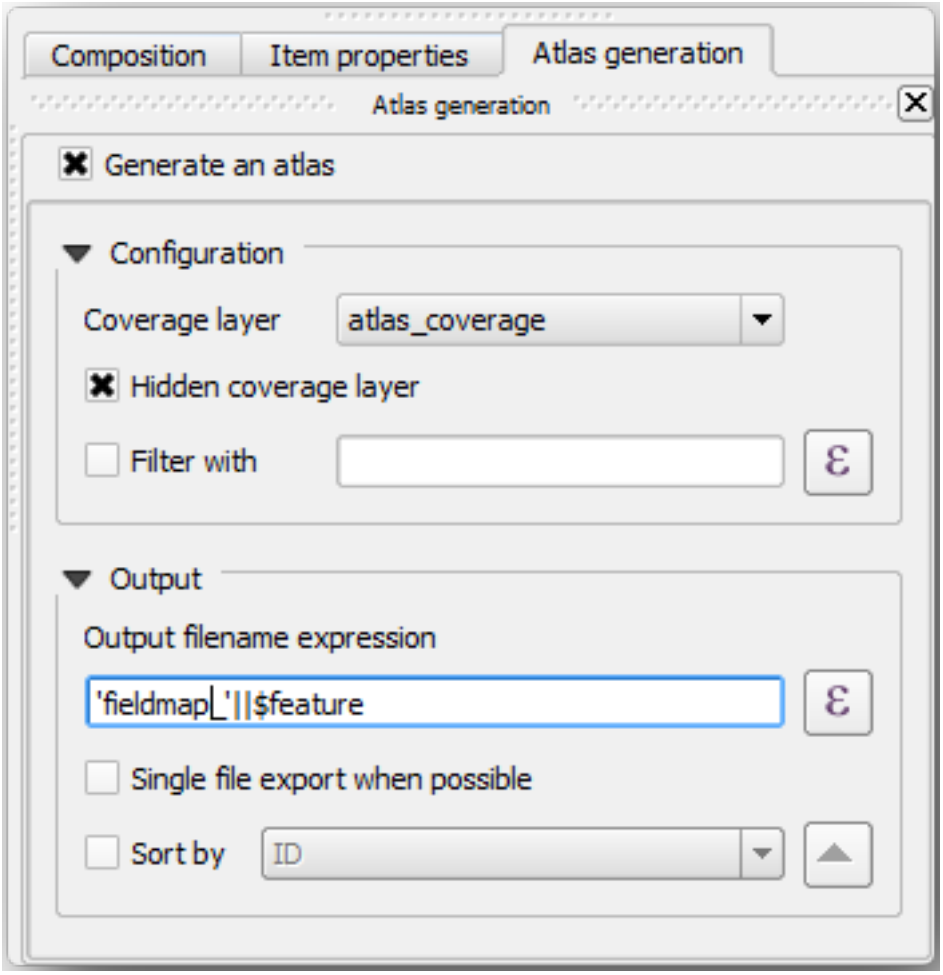
Noile poligoane acoperă întreaga zonă de pădure și vă conferă o idee despre ceea ce va conține fiecare hartă (creată din fiecare poligon).



14.6.7 ??? Follow Along: Setting Up the Atlas Tool

Ultimul pas este de a crea instrumentul Atlas:

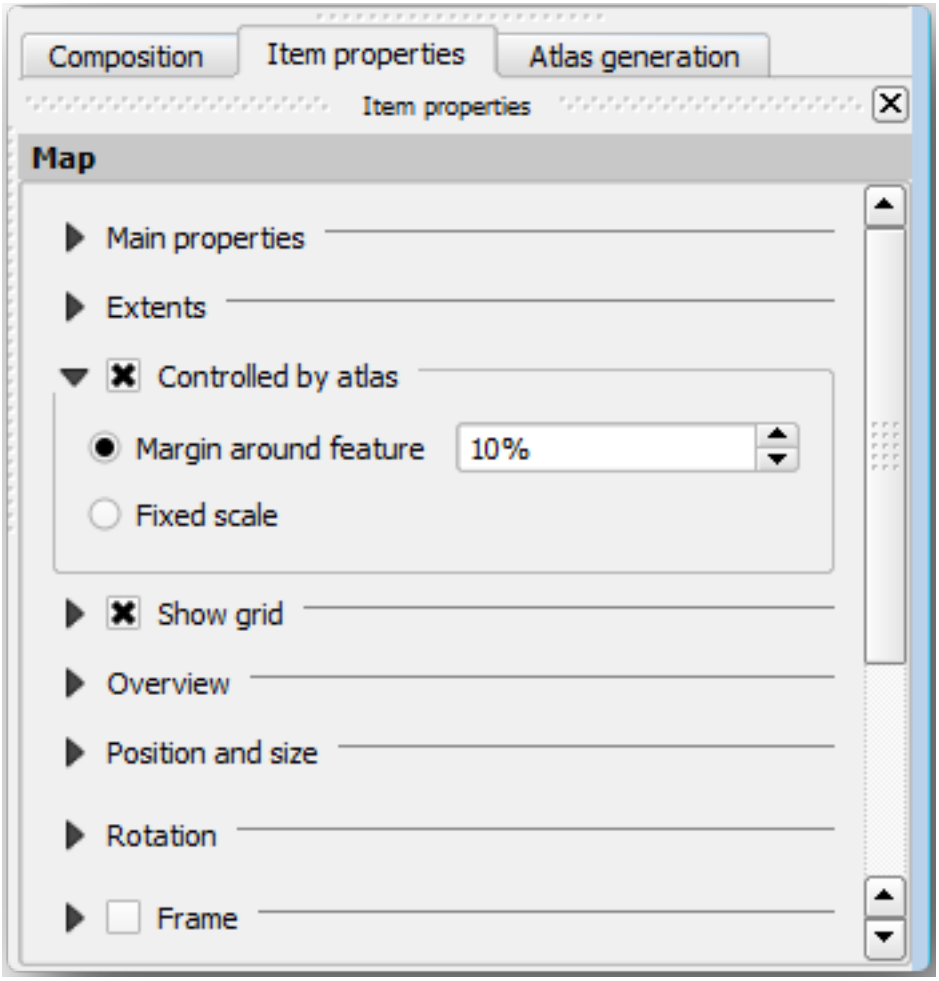
1. Go back to the print layout.
2. În panoul din dreapta, mergeți la fila *Atlas generation*.
3. Setați opțiunile după cum urmează:



That tells the Atlas tool to use the features (polygons) inside `atlas_coverage` as the focus for every detail map. It will output one map for every feature in the layer. The *Hidden coverage layer* tells the Atlas to not show the polygons in the output maps.

Mai trebuie să fie făcut un lucru. Trebuie să indicați Atlasului care element va fi actualizat pentru fiecare hartă de ieșire. Până acum, probabil că ați ghicit că harta care urmează a fi schimbată pentru fiecare entitate, este cea pe care ați pregătit-o să conțină vederile detaliate ale parcelelor eșantion, ea reprezentând elementul cel mai mare de pe canevas:

1. Select the bigger map element (`Map 0`).
2. Mergeți la fila *Proprietățile itemului* tab.
3. În listă, bifați *Controlat de atlas*.
4. And set the *Marging around feature* to `10%`. The view extent will be 10% bigger than the polygons, which means that your detail maps will have a 10% overlap.



Acum puteți utiliza instrumentul de vizualizare pentru Atlas, pentru a revizui ceea ce vor arăta hărțile:

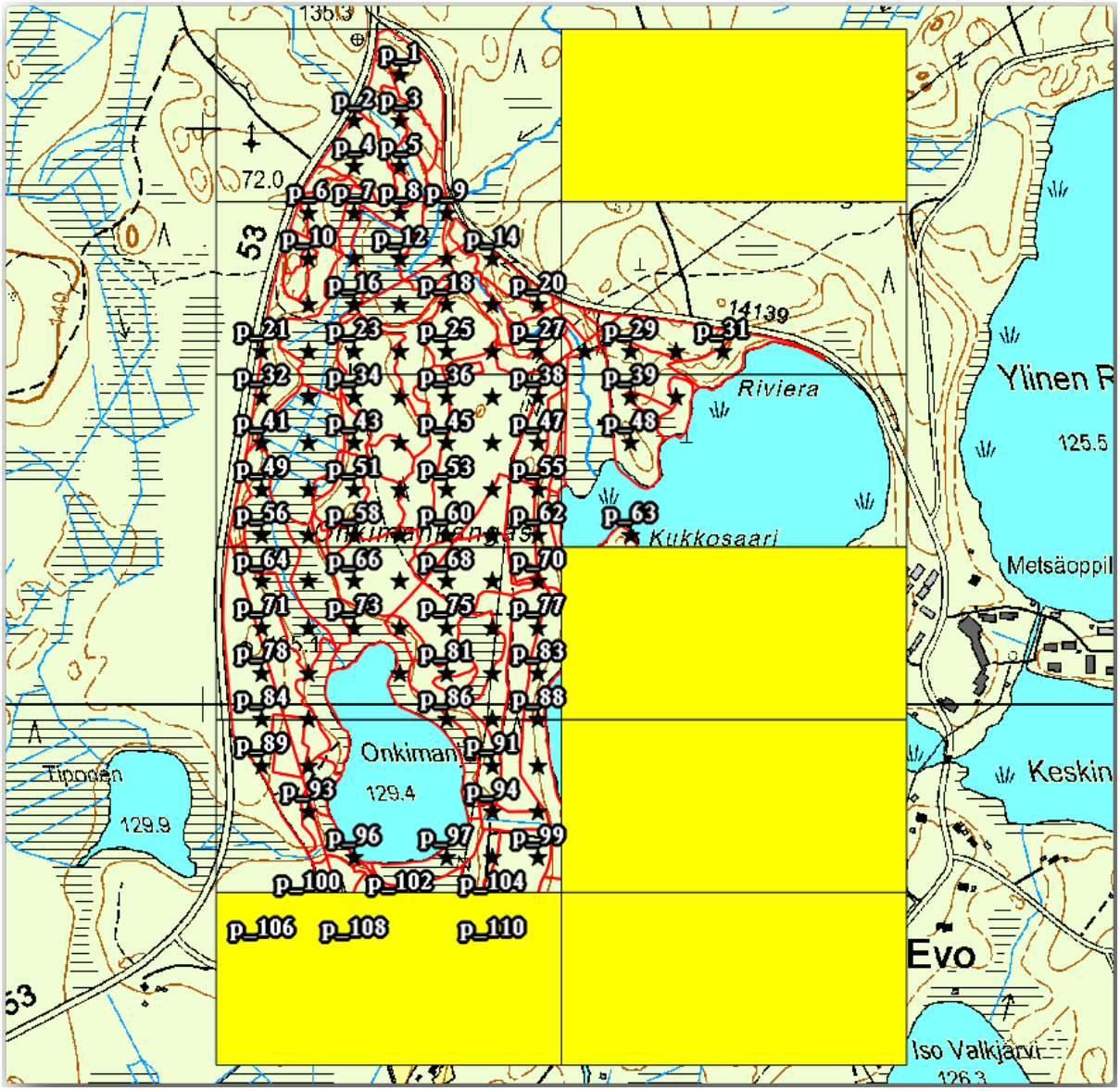
1. Activați previzualizarea Atlasului folosind butonul sau, în cazul în care bara de instrumente nu este vizibilă, via *Atlas* ► *Previzualizare Atlas*.
2. Puteți folosi săgețile din bara de instrumente a Atlasului, sau din meniul *Atlas*, pentru a vă deplasa printre hărțile care vor fi create.

Note that some of them cover areas that are not interesting. Let's do something about it and save some trees by not printing those useless maps.

14.6.8 ??? Follow Along: Editing the Coverage Layer

Pe lângă eliminarea poligoanelor pentru acele zone care nu sunt interesante, puteți personaliza, de asemenea, etichetele din harta dvs., prin generarea conținutului acestora din *Tabela de atribute* a stratului de acoperire.

1. Mergeți înapoi la vizualizarea hărții.
2. Enable editing for the `atlas_coverage` layer.
3. Selectați poligoanele care sunt evidențiate (în galben) în imaginea de mai jos.
4. Eliminați poligoanele selectate.
5. Dezactivați editarea și salvați modificările.



You can go back to the print layout and check that the previews of the Atlas use only the polygons you left in the layer.

Stratul de acoperire pe care îl utilizați, încă nu conține informații utile, pe care să le puteți folosi la personalizarea conținutului etichetelor din hartă. Primul pas este de a le crea; în acest scop puteți adăuga, de exemplu, un cod de zonă pentru zonele poligonale, și un câmp cu câteva observații pe care să le aibă în vedere echipele din teren:

1. Open the *Attribute table* for the `atlas_coverage` layer.
2. Activează editarea.
3. Folosiți calculatorul  pentru a crea și popula următoarele două câmpuri.
4. Create a field named `Zone` of type *Whole number (integer)*.
5. In the *Expression* box write/copy/construct `@row_number`.
6. Create another field named `Remarks`, of type *Text (string)* and a width of `255`.
7. In the *Expression* box write `'No remarks.'`. This will set all the default value for all the polygons.

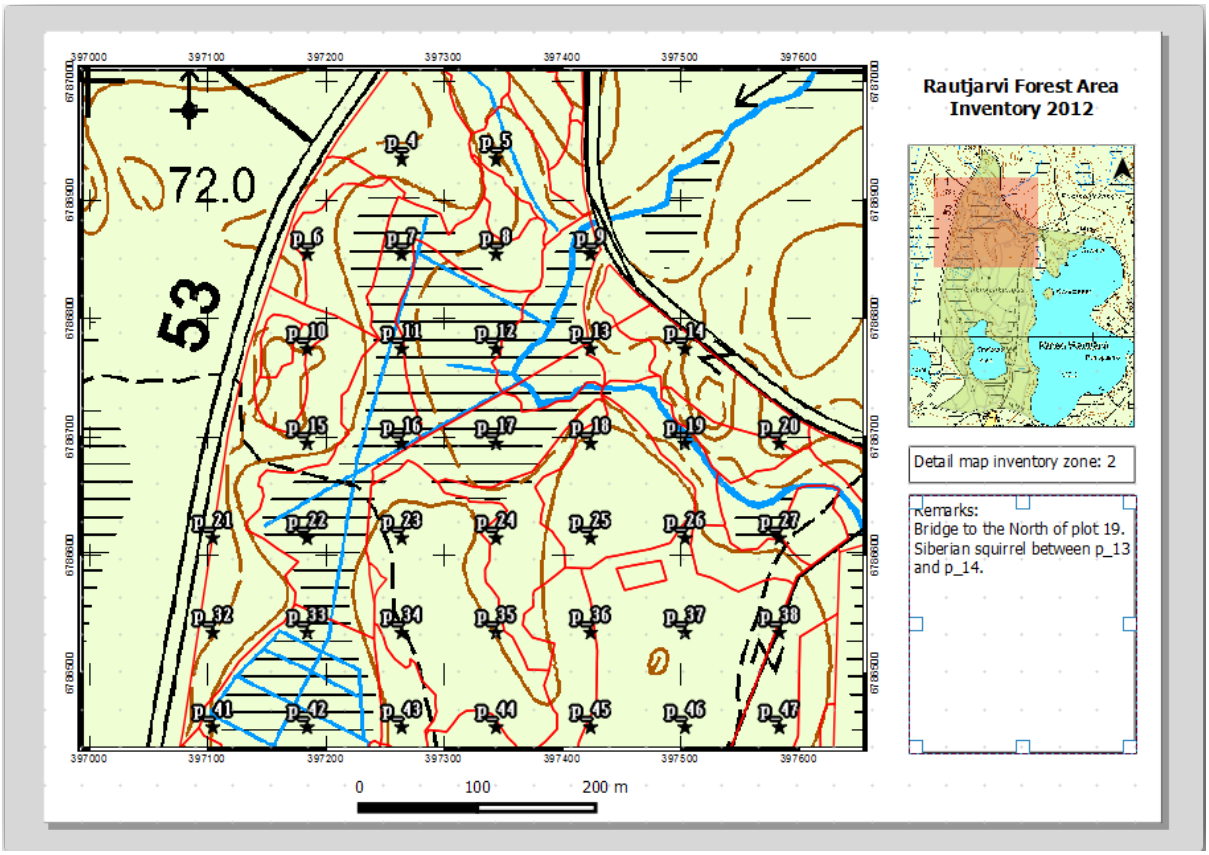
The forest manager will have some information about the area that might be useful when visiting the area. For example, the existence of a bridge, a swamp or the location of a protected species. The `atlas_coverage` layer

is probably in edit mode still, add the following text in the *Remarks* field to the corresponding polygons (double click the cell to edit it):

- For the *Zone* 2: `Bridge to the North of plot 19. Siberian squirrel between p_13 and p_14.`
- For the *Zone* 6: `Difficult to transit in swamp to the North of the lake.`
- For the *Zone* 7: `Siberian squirrel to the South East of p_94.`
- Dezactivează editarea și salvează modificările.

Almost ready, now you have to tell the Atlas tool that you want some of the text labels to use the information from the `atlas_coverage` layer's attribute table.

1. Go back to the *Print Layout*.
2. Select the text label containing `Detailed map...`.
3. Setați dimensiunea *Fontului* la `12`.
4. Duceți cursorul la sfârșitul textului din etichetă.
5. In the *Item properties* tab, inside the *Main properties* click on *Insert or Edit an Expression*....
6. In the *Function list* double-click on the field *Zone* under *Field and Values*.
7. Clic pe *OK*
8. The text inside the box in the *Item properties* should show `Detail map inventory zone: [% "Zone" %]`. Note that the `[% "Zone" %]` will be substituted by the value of the field `Zone` for the corresponding feature from the layer `atlas_coverage`.
9. Testați conținutul etichetei, prin vizualizarea unor diferite hărți din Atlas.
10. Do the same for the labels with the text `Remarks:` using the field with the zone information. You can leave a break line before you enter the expression. You can see the result for the preview of zone 2 in the image below:



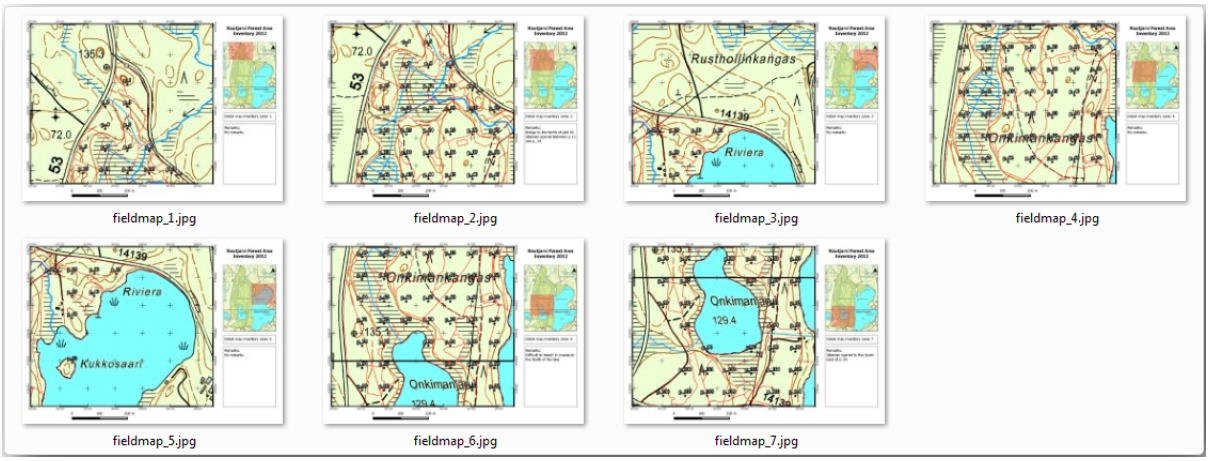
11. Utilizați previzualizarea din Atlas pentru a naviga prin toate hărțile care vor fi create în curând!

14.6.9 ??? Follow Along: Printing the Maps

Nu în ultimul rând, imprimați sau exportați hărțile în fișiere imagine sau PDF. Aveți posibilitatea să utilizați *Atlas* ► *Export Atlas as Images…* sau *Atlas* ► *Export Atlas as PDF…*. În prezent, formatul de export SVG nu funcționează în mod corespunzător și va da un rezultat slab.

Haideți să exportăm hărțile într-un singur PDF pe care îl puteți trimite la biroul teritorial pentru imprimare:

1. Mergeți la fila *Atlas generation*, în panoul din dreapta.
2. Sub *Output* bifați *Single file export when possible*. Acest lucru va pune toate hărțile împreună într-un fișier PDF; în cazul în care această opțiune nu este bifată, veți obtine câte un fișier pentru fiecare hartă.
3. Open *Layout* ► *Export as PDF…*.
4. Save the PDF file as `inventory_2012_maps.pdf` in your `exercise_data\forestry\samplig\map_creation\` folder.
5. Deschideți fișierul PDF pentru a verifica dacă totul a mers cum era de așteptat.
6. Puteți crea la fel de ușor imagini separate pentru fiecare hartă (amintiți-vă să debifați crearea unui singur fișier), unde puteți vedea miniaturile imaginilor care vor fi create:



7. In the *Print Layout*, press Save in order to save your print layout changes in the project. This also saves the project file. You can reopen the project at any time and run or edit the atlas.

   It is also possible to save your map as a layout template as `forestry_atlas.qpt` in your `exercise_data\forestry\map_creation\` folder. Use *Layout* ► *Save as Template*. You will be able to use this template again and again in other projects.

8. Close the *Print Layout* and the project.

14.6.10 În concluzie

Ați reușit să creați o hartă șablon, care poate fi folosită pentru a genera automat hărți detaliate, în scopul ușurării utilizării în teren. După cum ați observat, acest lucru nu a fost o sarcină ușoară, dar beneficiul va veni atunci când va trebui să creați hărți similare pentru alte regiuni, unde puteți utiliza șablonul pe care tocmai l-ați salvat.

14.6.11 Ce urmează?

In the next lesson, you will see how you can use LiDAR data to create a DEM and then use it to enhance your data and maps visibility.

14.7 Lesson: Calculating the Forest Parameters

Estimarea parametrilor unei păduri reprezintă scopul inventarului forestier. Continuând exemplul din lecția precedentă, vom utiliza informațiile de inventar adunate din teren pentru a calcula parametrii, mai întâi pentru întreaga pădure, iar ulterior pentru pâlcurile digitizate anterior.

Scopul acestei lecții: De a calcula parametrii forestieri la nivel general și la nivel de pâlc.

14.7.1 ??? Follow Along: Adding the Inventory Results

Echipele din teren au vizitat pădurea și, cu ajutorul informațiilor pe care le-ați furnizate dvs., au adunate informații despre fiecare parcelă de pădure.

Most often the information will be collected into paper forms in the field, then typed to a spreadsheet. The sample plots information has been condensed into a `.csv` file that can be easily open in QGIS.

Continue with the QGIS project from the lesson about designing the inventory, you probably named it `forest_inventory.qgs`.

În primul rând, adăugați măsurătorile din suprafețele de probă în proiectul dvs. QGIS:

1. Go to *Layer* ► *Add Layer* ► *Add Delimited Text Layer...*.
2. Browse to the file `systematic_inventory_results.csv` located in `exercise_data/forestry/results/`.
3. Asigurați-vă că este selectată opțiunea *Point coordinates*.
4. Set the fields for the coordinates to the *X* and *Y* fields.
5. Clic pe *OK*
6. When prompted, select *ETRS89 / ETRS-TM35FIN* as the CRS.
7. Deschideți noul *Tabel de Atribute* și aruncați o privire datelor.

You can read the type of data that is contained in the sample plots measurements in the text file `legend_2012_inventorydata.txt` located in the `exercise_data/forestry/results/` folder.

The `systematic_inventory_results` layer you just added is actually just a virtual representation of the text information in the `.csv` file. Before you continue, convert the inventory results to a real spatial dataset:

1. Right click on the `systematic_inventory_results` layer.
2. Browse to `exercise_data/forestry/results/` folder.
3. Name the file `sample_plots_results.shp`.
4. Bifați caseta *Add saved file to map*.
5. Remove the `systematic_inventory_results` layer from your project.

14.7.2 Follow Along: Whole Forest Parameters Estimation

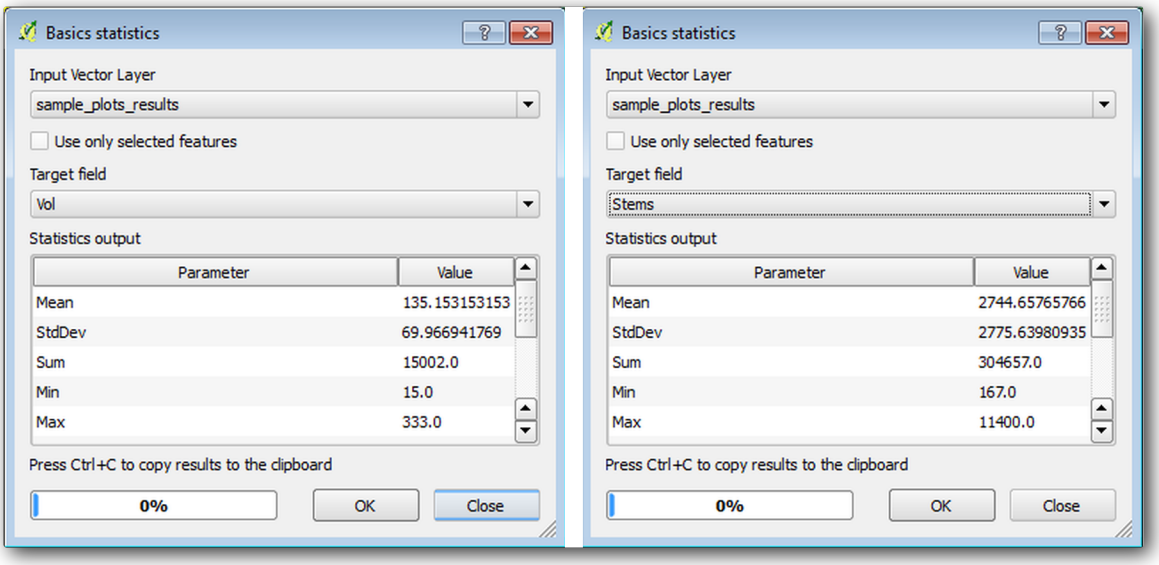
You can calculate the averages for this whole forest area from the inventory results for the some interesting parameters, like the volume and the number of stems per hectare. Since the systematic sample plots represent equal areas, you can directly calculate the averages of the volumes and number of stems per hectare from the `sample_plots_results` layer.

Puteți calcula media unui câmp dintr-un strat vectorial, folosind instrumentul *Basic statistics*:

1. Open *Vector* ► *Analysis Tools* ► *Basic statistics for Fields*.
2. Select `sample_plots_results` as the *Input Vector Layer*.
3. Select `Vol` as *Target field*.
4. Clic pe *OK*

The average volume in the forest is `135.2 m3/ha`.

You can calculate the average for the number of stems in the same way, `2745 stems/ha`.



14.7.3 Follow Along: Estimating Stand Parameters

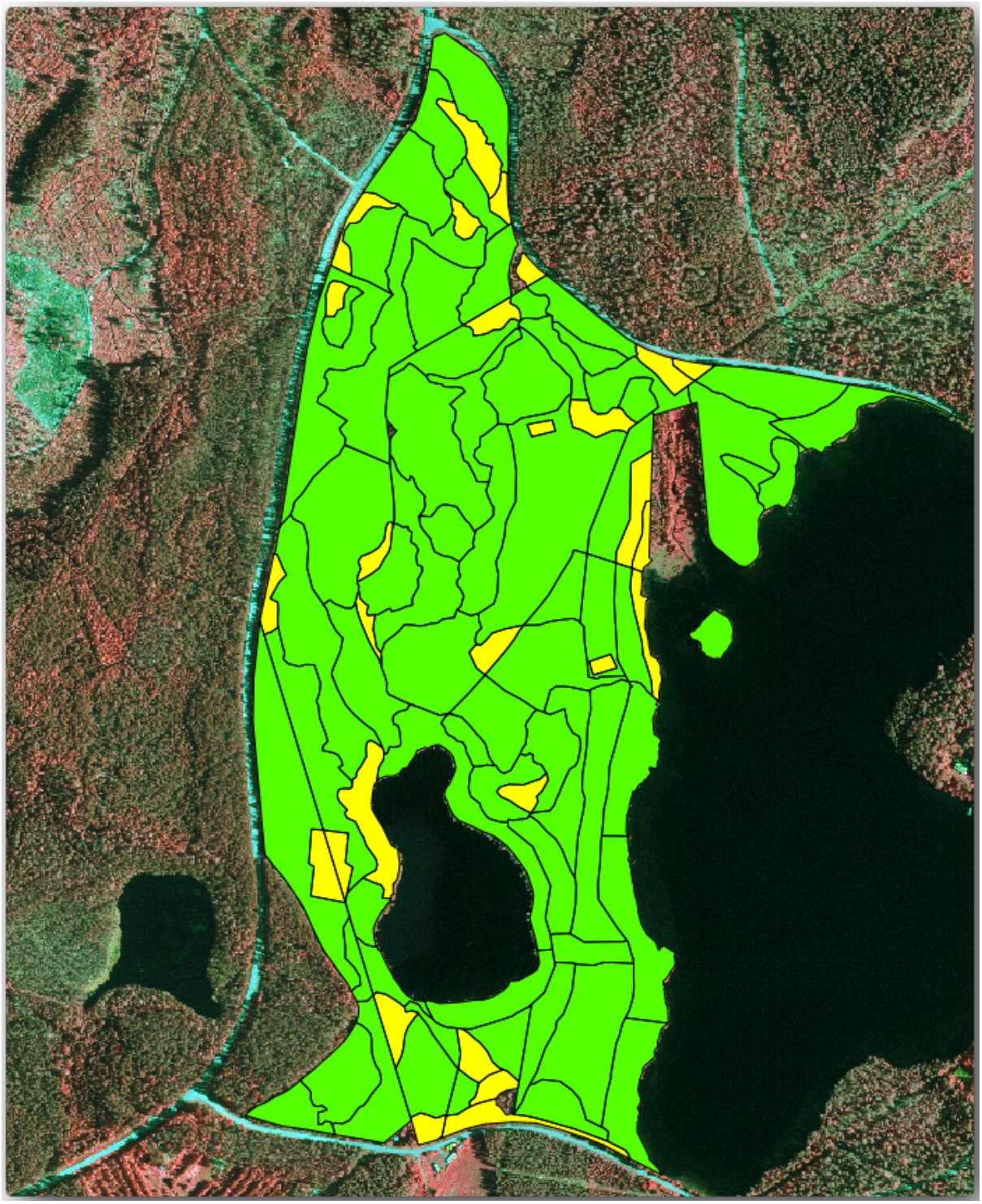
Puteți folosi același eșantion de date pentru a calcula estimări pentru diferitele pâlcuri de pădure digitizate anterior. Despre unele pâlcuri nu există date și, de aceea, pentru ele nu se vor obține informații. S-ar fi putut prevedea o culegere de date suplimentară, la momentul planificării inventarului sistematic, în cadrul căreia echipele din teren să fi efectuat măsurători. Sau, ar putut fi trimisă ulterior o echipă în teren pentru a estima pâlcurile omise, în scopul completării inventarul. Chiar și așa, veți obține informații pentru un număr bun de pâlcuri folosind doar parcelele planificate.

Trebuie să obțineți media parcelelor care se încadrează în fiecare pâlc forestier. Atunci când doriți să combinați informațiile, în funcție de locațiile relative ale acestora, veți efectua o îmbinare spațială:

1. Deschideți instrumentul *Vector* ► *Data Management* ► *Join attributes by location*.
2. Set `forest_stands_2012` as the *Target vector layer*. The layer you want the results for.
3. Set `sample_plots_results` as the *Join vector layer*. The layer you want to calculate estimates from.
4. Bifați *Take summary of intersecting features*.
5. Bifați pentru a calcula doar *Media*.

6. Name the result as `forest_stands_2012_results.shp` and save it in the `exercise_data/forestry/results/` folder.
7. La final, selectați *Keep all records…*, astfel încât să puteți verifica mai târziu care locație nu a primit informații.
8. Clic pe *OK*
9. Acceptați adăugarea noului strat la proiectul dvs. când vi se solicită.
10. Închideți instrumentul de *Îmbinare a atributelor după locație*.

Open the *Attribute table* for `forest_stands_2012_results` and review the results you got. Note that a number of forest stands have `NULL` as the value for the calculations, those are the ones having no sample plots. Select them all and view them in the map, they are some of the smaller stands:



Let's calculate now the same averages for the whole forest as you did before, only this time you will use the averages you got for the stands as the bases for the calculation. Remember that in the previous situation, each sample plot represented a theoretical stand of `80x80 m`. Now you have to consider the area of each of the stands individually instead. That way, again, the average values of the parameters that are in, for example, m3/ha for the volumes are converted to total volumes for the stands.

Trebuie să calculați mai întâi ariile pentru locații, iar apoi volumele totale și numărul de tulpini pentru fiecare dintre acestea:

1. Activați editarea în *Tabela de Atribute*.
2. Deschideți *Calculatorul de câmpuri*.

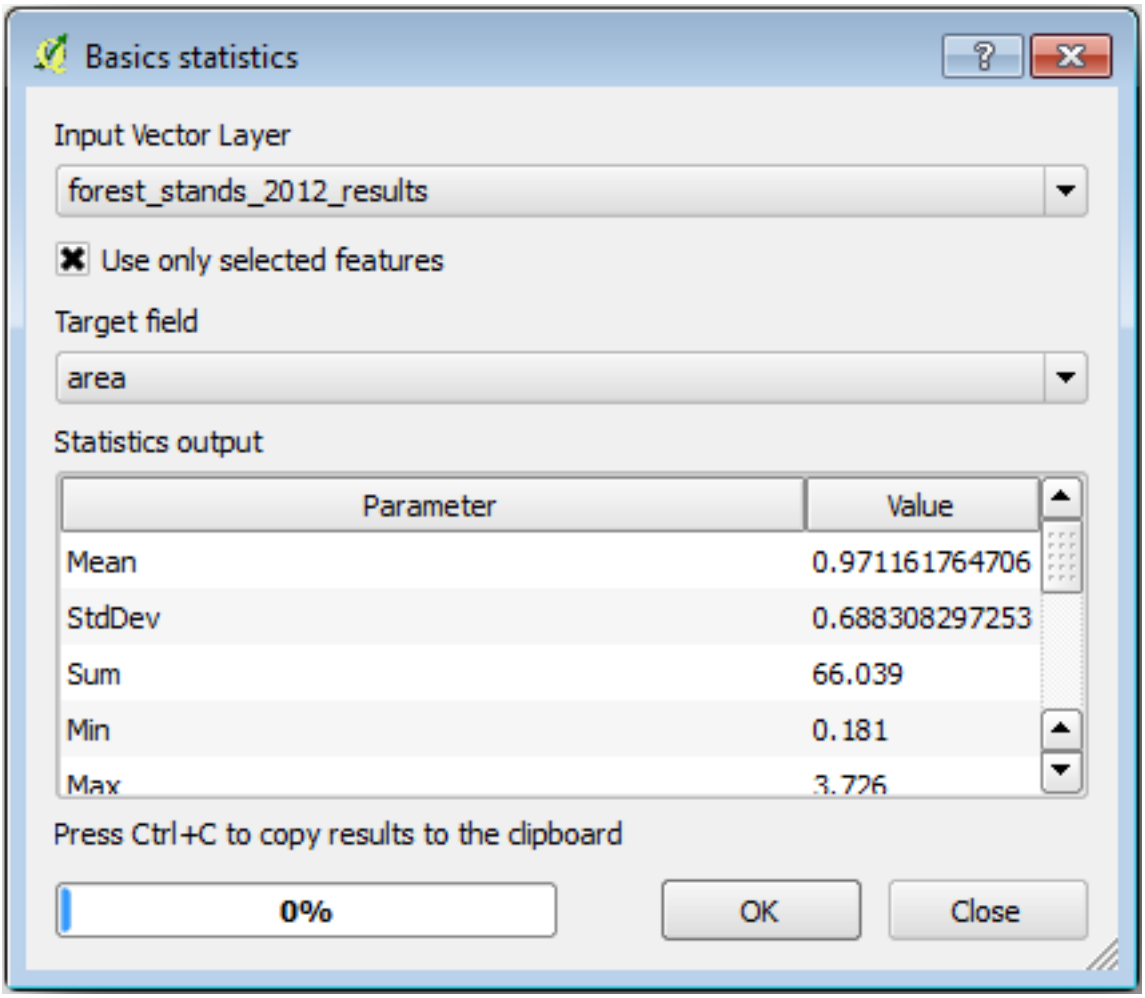
3. Create a new field called `area`.
4. Set the *Output field type* to `Decimal number (real)`.
5. Set the *Precision* to `2`.
6. In the *Expression* box, write `$area / 10000`. This will calculate the area of the forest stands in ha.
7. Clic pe *OK*

Acum calculați un câmp cu volumele totale și numărul estimat de tulpini, pentru fiecare element:

1. Name the fields `s_vol` and `s_stem`.
2. Valorile numerice din câmpurile pot fi de tip întreg sau chiar și de tip real.
3. Use the expressions `"area" * "MEANVol"` and `"area" * "MEANStems"` for total volumes and total stems respectively.
4. Închideți editările, după ce ați încheiat.
5. Dezactivați editarea.

În situația anterioară, zonele reprezentate de fiecare parcelă eșantion au fost aceleași, astfel încât a fost suficientă calcularea mediei parcelelor eșantion. Acum, pentru a calcula estimările, trebuie să împărțim suma volumelor pâlcurilor, sau numărul de tulpini, la suma suprafețelor acelor pâlcuri care conțin informații.

1. In the *Attribute table* for the `forest_stands_2012_results` layer, select all the stands containing information.
2. Open *Vector* ► *Analysis Tools* ► *Basic statistics for fields*.
3. Select the `forest_stands_2012_results` as the *Input layer*.
4. Select `area` as *Field to calculate statistics on*.
5. Check the *Selected features only*
6. Clic pe *OK*



As you can see, the total sum of the stands» areas is `66.04 ha`. Note that the area of the missing forest stands is only about `7 ha`.

In the same way, you can calculate that the total volume for these stands is `8908 m3/ha` and the total number of stems is `179594 stems`.

Folosind informațiile din pâlcurile forestiere, în locul folosirii directe a celor din parcelele eșantion, rezultă următoarele estimări medii:

- `184.9 m3/ha` and
- `2719 stems/ha`.

Salvați proiectul în `forest_inventory.qgs`.

14.7.4 În concluzie

Ați reușit să efectuați estimări pentru întreaga pădure, folosind informațiile din parcelele de probă, fără a ține seama de caracteristicile forestiere, precum și utilizând interpretarea imaginilor aeriene ale pâlcurilor forestiere. De asemenea, ați primit informații valoroase despre anumite pâlcuri, care pot fi utilizate pentru gestionarea pădurilor în anii următori.

14.7.5 Ce urmează?

În lecția următoare, veți crea mai întâi un fundal reliefat, dintr-un set de date LiDAR, care va fi folosit pentru a pregăti prezentarea pe hartă a rezultatelor forestiere, pe care tocmai le-ați calculat.

14.8 Lesson: DEM from LiDAR Data

Puteți îmbunătăți aspectul hărți folosind diverse imagini de fundal. Ați putea folosi harta de bază sau imaginile aeriene pe care le-ați utilizat înainte, dar un raster cu relieful terenului va arata mai frumos în anumite situații.

Veți folosi LAStools pentru a extrage un DEM dintr-un set de date LIDAR, și apoi să creați un raster al reliefului pe care să-l folosiți mai târziu în prezentarea hărții dvs.

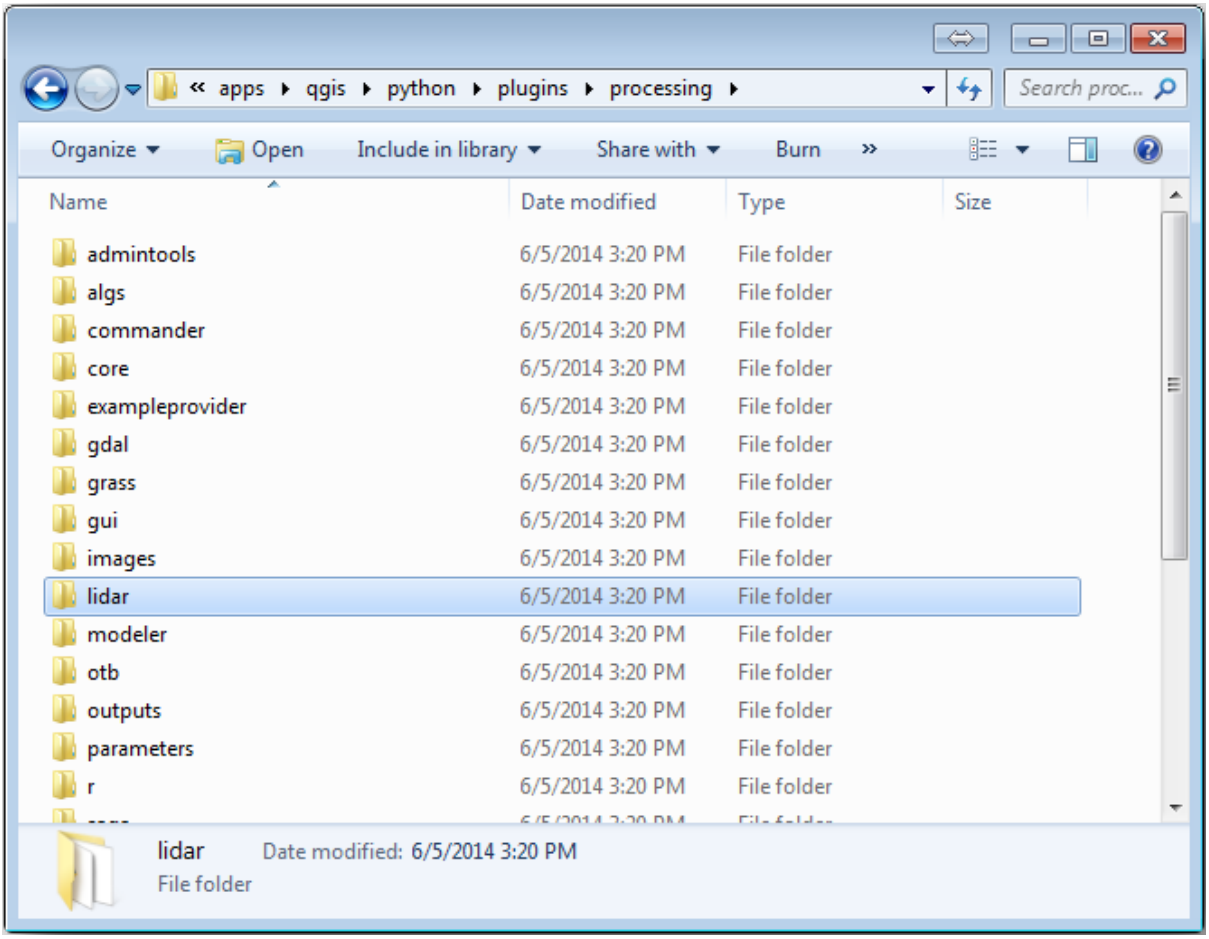
Scopul acestei lecții: Instalarea LAStools și calcularea unui DEM din datele LiDAR și dintr-un raster cu relieful.

14.8.1 ??? Follow Along: Installing Lastools

Managing LiDAR data within QGIS is possible using the Processing framework and the algorithms provided by LAStools.

Puteți obține un model de elevație digital (DEM), dintr-un nor de puncte LiDAR, iar ulterior se poate crea un raster al umbririi reliefului, care este vizual mai intuitiv în scopuri de prezentare. În primul rând, va trebui să configurați setările cadrului de lucru *Processing* pentru a lucra în mod corespunzător cu LAStools:

- Închideți QGIS, dacă ați început deja.
- Un plugin LiDAR vechi ar putea fi deja instalat în sistemul dvs., în dosarul `C:/Program Files/QGIS Valmiera/apps/qgis/python/plugins/processing/`.
- If you have a folder named `lidar`, delete it. This is valid for some installations of QGIS 2.2 and 2.4.



- Go to the `exercise_data\forestry\lidar\` folder, there you can find the file `QGIS_2_2_toolbox.zip`. Open it and extract the `lidar` folder to replace the one you just deleted.
- If you are using a different QGIS version, you can see more installation instructions in this tutorial.

Now you need to install the LAStools to your computer. Get the newest *lastools* version here and extract the content of the `lastools.zip` file into a folder in your system, for example, `C:\lastools\`. The path to the `lastools` folder cannot have spaces or special characters.

Notă

Read the `LICENSE.txt` file inside the `lastools` folder. Some of the LAStools are open source and other are closed source and require licensing for most commercial and governmental use. For education and evaluation purposes you can use and test LAStools as much as you need to.

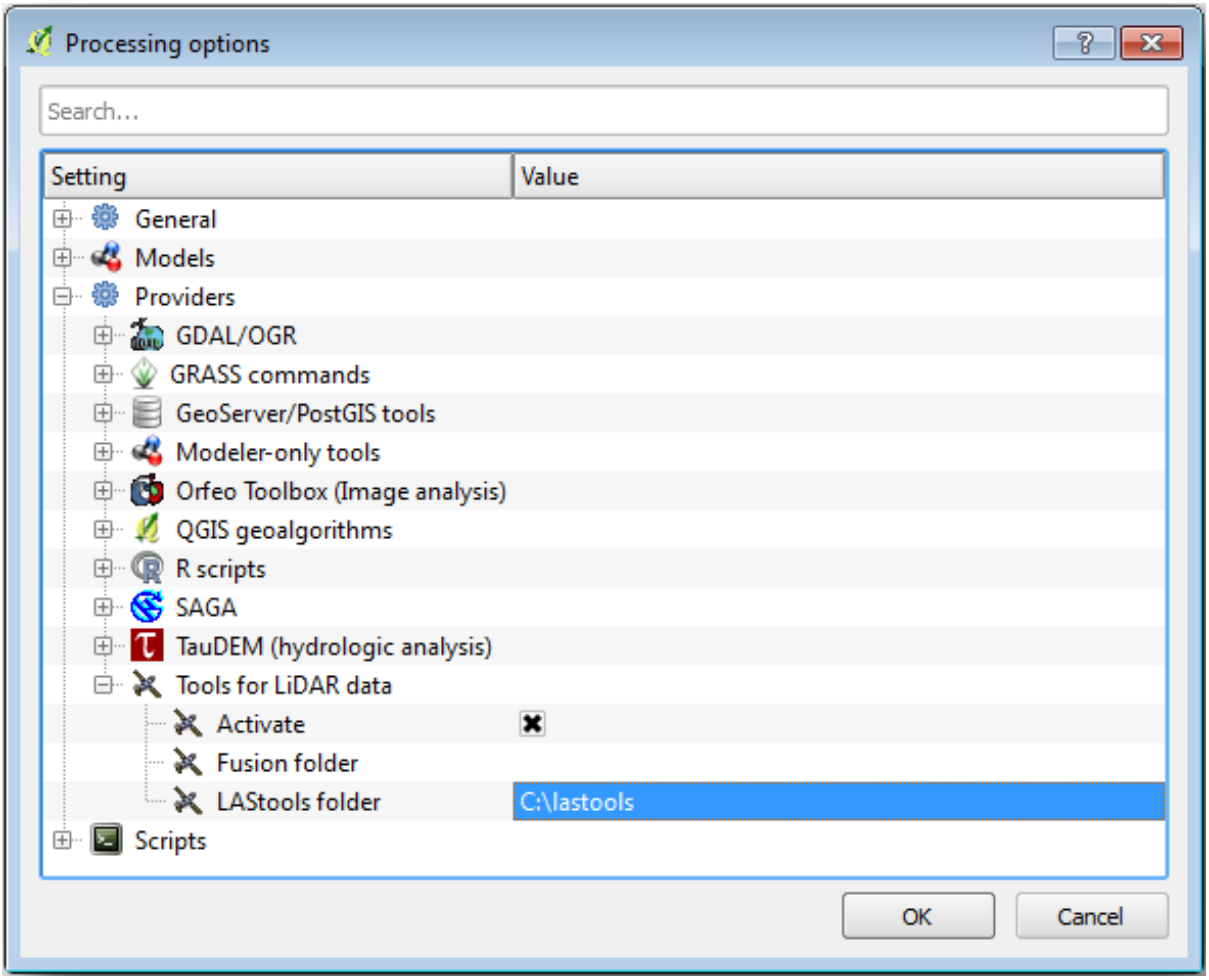
Plugin-ul și algoritmii curenți sunt de acum instalați în computerul dvs., aproape gata de utilizare, fiind nevoie doar să configurați cadrul de lucru Processing pentru a începe utilizarea lor:

- Deschideți un nou proiect în QGIS.
- Set the project's CRS to *ETRS89 / ETRS-TM35FIN*.
- Save the project as `forest_lidar.qgs`.

Pentru a seta LAStools în QGIS:

- Mergeți la *Processing* ► *Options and configuration*.
- În dialogul *Opțiunilor de procesare*, mergeți la *Furnizori* și apoi la *Instrumente pentru datele LiDAR*.
- Bifați *Activare*.

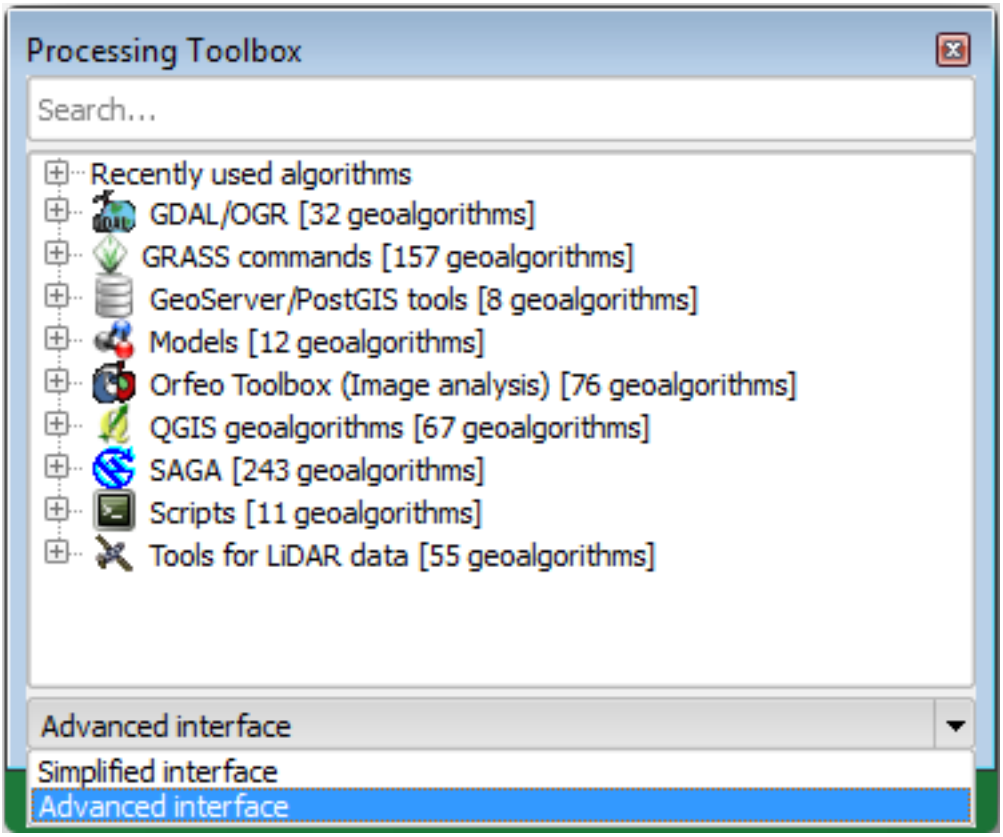
- For *LAStools folder* set `c:\lastools\` (or the folder you extracted LAStools to).



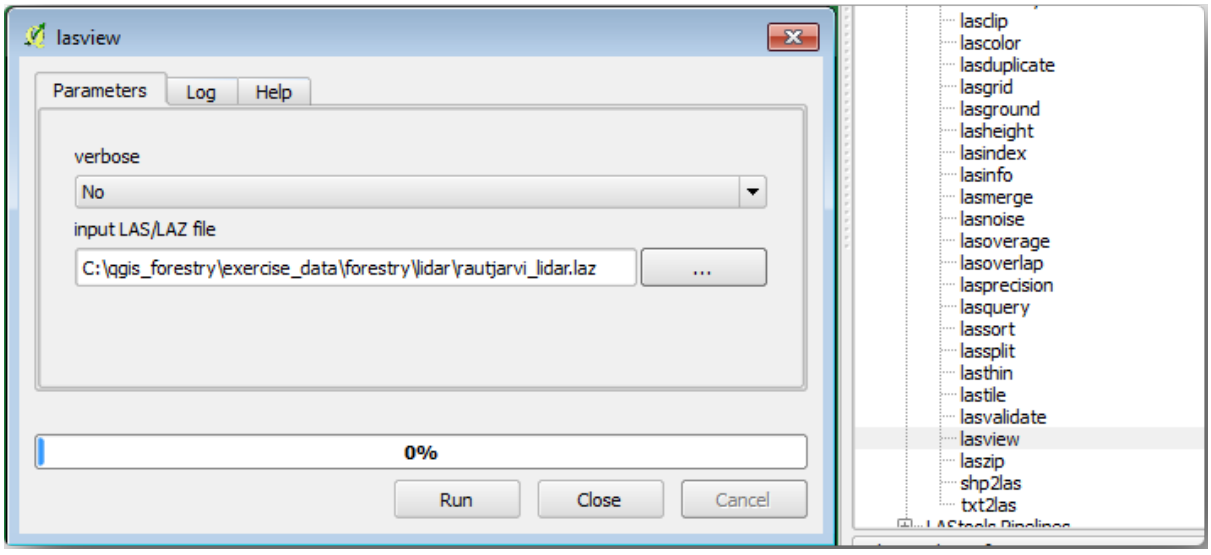
14.8.2 ??? Follow Along: Calculating a DEM with LAStools

Ați folosit deja bara de instrumente *Processing* din *Lesson: Spatial Statistics* pentru a rula câțiva algoritmi SAGA. Acum o veți utiliza pentru a rula programele LAStools:

- Deschideți *Processing* ► *Toolbox*.
- În meniul derulant din partea inferioară, selectați *Interfață avansată*.
- Ar trebui să vedeți categoria *Instrumentelor pentru datele LiDAR*.

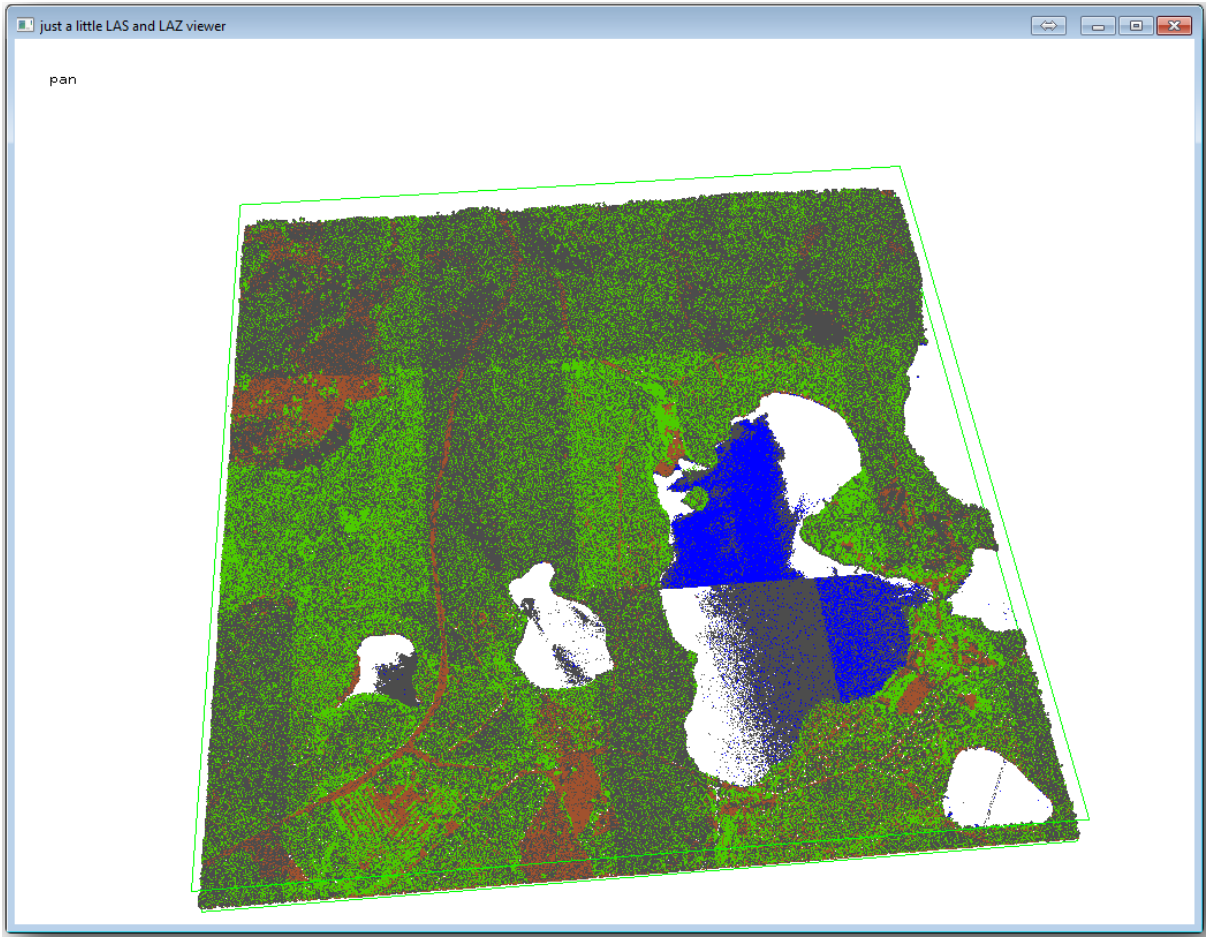


- Extindeți-o pentru a vedea instrumentele disponibile, apoi extindeți, de asemenea, categoria *LAStools* (numărul de algoritmi poate varia).
- Derulați în jos până când găsiți algoritmul *lasview*, apoi faceți dublu-clic pentru a-l deschide.
- At *Input LAS/LAZ file*, browse to `exercise_data\forestry\lidar\` and select the `rautjarvi_lidar.laz` file.



- Clic pe *Run*

Acum puteți vedea datele LiDAR în fereastra dialogului *Doar un mic vizualizator LAS și LAZ*:



Există multe alte lucruri pe care le puteți efectua în cadrul acestui vizualizator, dar pentru moment trebuie doar să faceți un clic și să glisați norul de puncte LiDAR, pentru a vedea cum arată.

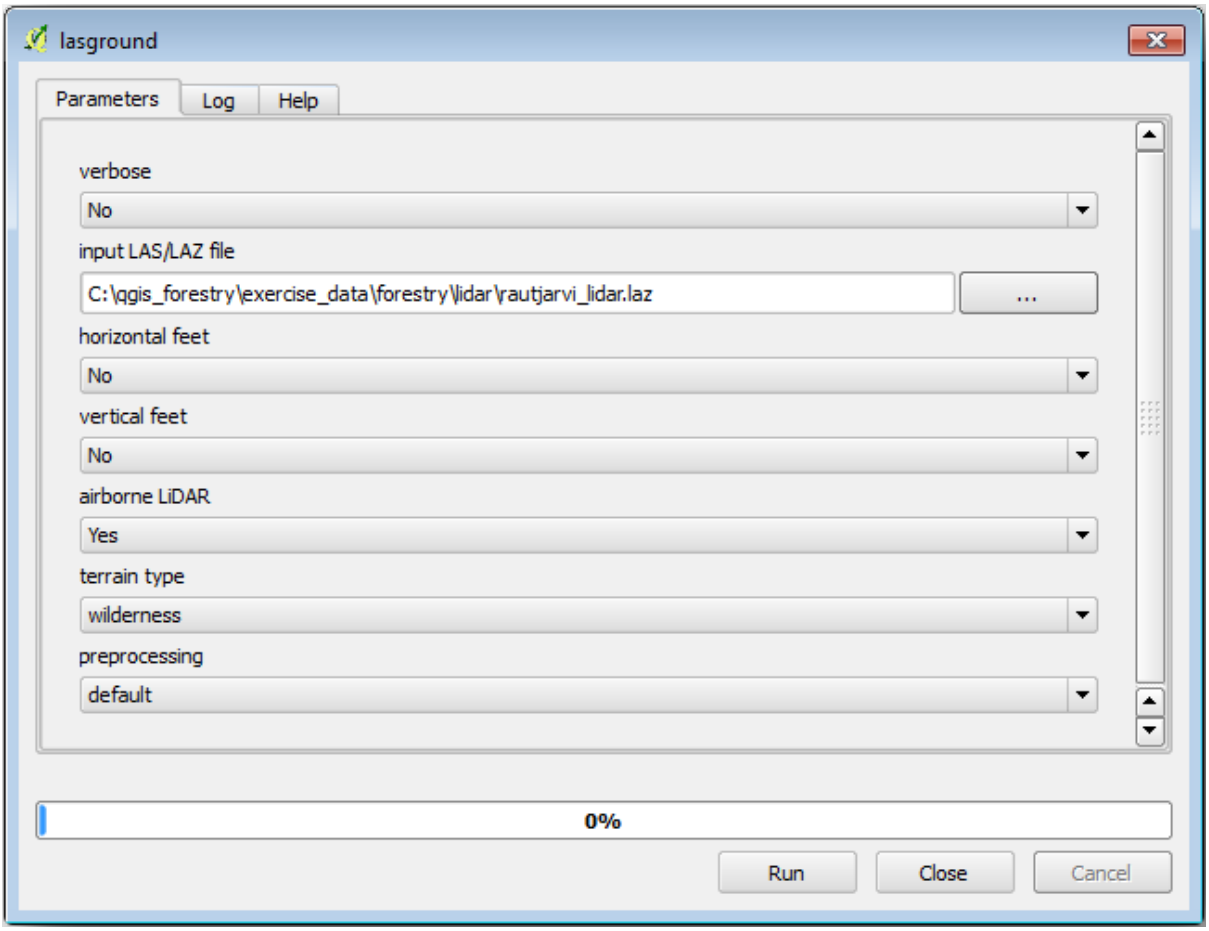
Notă

If you want to know further details on how the LAStools work, you can read the `README` text files about each of the tools, in the `C:\lastools\bin\` folder. Tutorials and other materials are available at the Rapidlasso webpage.

- Închideți vizualizatorul atunci când sunteți gata.

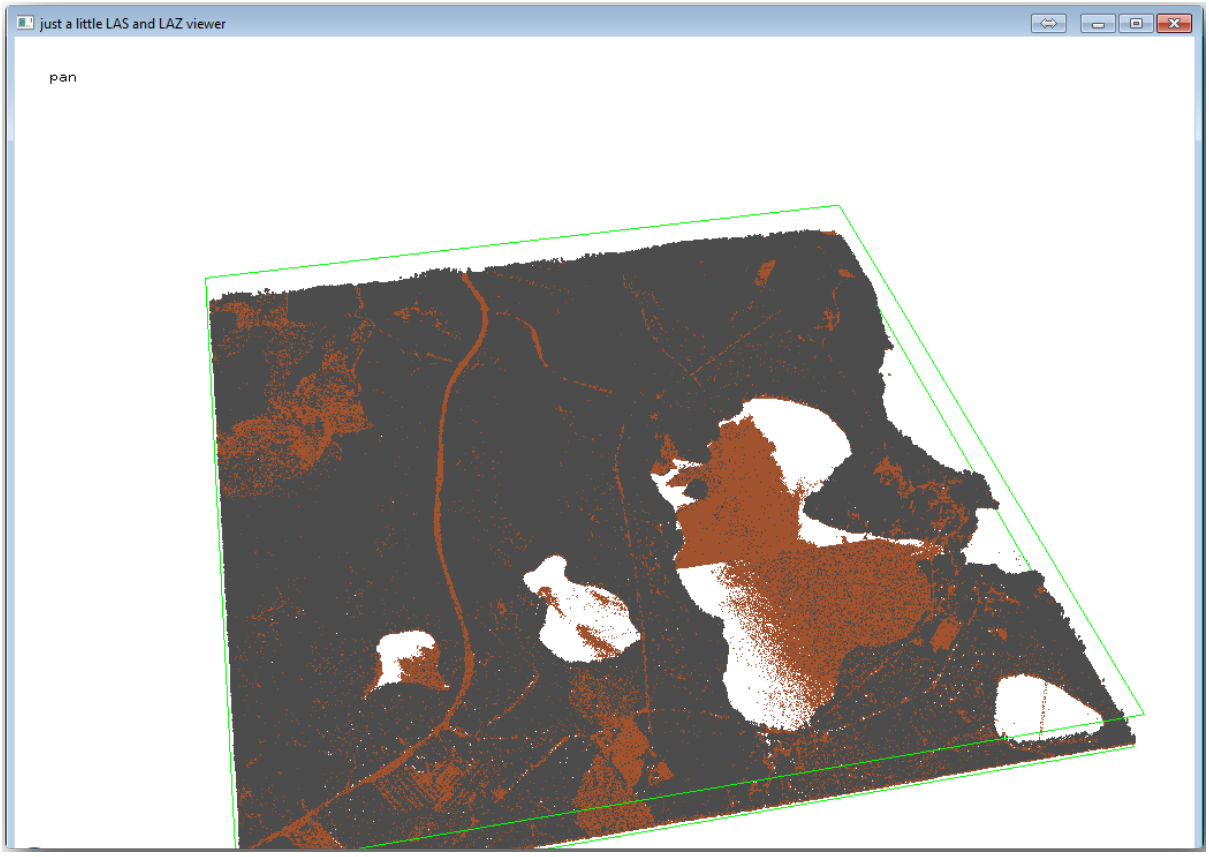
Creating a DEM with LAStools can be done in two steps, first one to classify the point cloud into *ground* and *no ground* points and then calculating a DEM using only the *ground* points.

- Mergeți înapoi la *Bara Instrumentelor de Procesare*.
- Note the *Search...* box, write `lasground`.
- Dublu clic pentru a deschide instrumentul *lasground*, apoi setați-l așa cum se arată în această imagine:



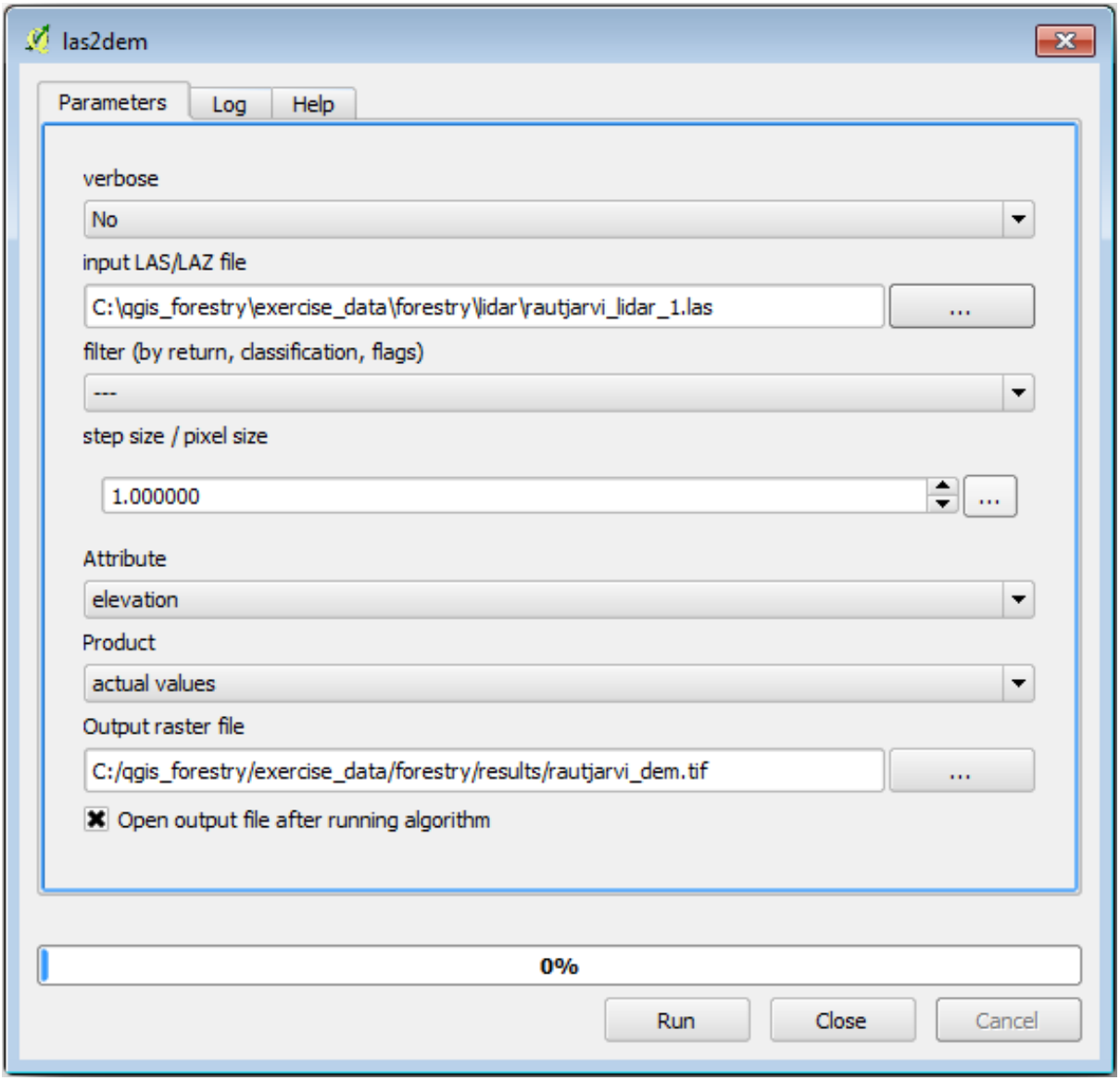
- The output file is saved to the same folder where the `rautjarvi_lidar.laz` is located and it is named `rautjarvi_lidar_1.las`.

Puteți să-l deschideți cu *lasview*,



The brown points are the points classified as ground and the gray ones are the rest, you can click the letter `g` to visualize only the ground points or the letter `u` to see only the unclassified points. Click the letter `a` to see all the points again. Check the `lasview_README.txt` file for more commands. If you are interested, also this tutorial about editing LiDAR points manually will show you different operations within the viewer.

- Închideți iarăși vizualizatorul.
- In the *Processing Toolbox*, search for `las2dem`.
- Deschideți instrumentul *las2dem*, apoi setați-l așa cum se arată în această imagine:



The result DEM is added to your map with the generic name *Output raster file*.

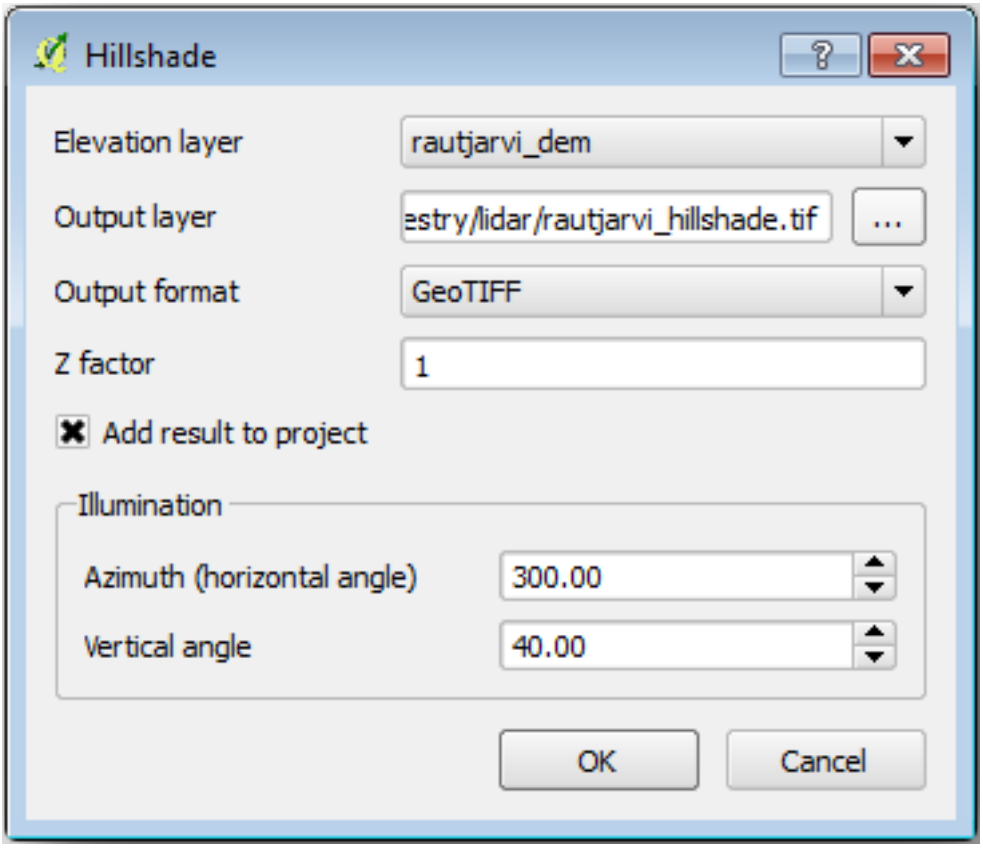
Notă

Instrumentele *lasground* și *las2dem* necesită licențiere. Le puteți utiliza chiar și în lipsa licenței, așa cum este indicat în fișierul licenței, dar veți obține diagonale în imaginile rezultate.

14.8.3 ??? Follow Along: Creating a Terrain Hillshade

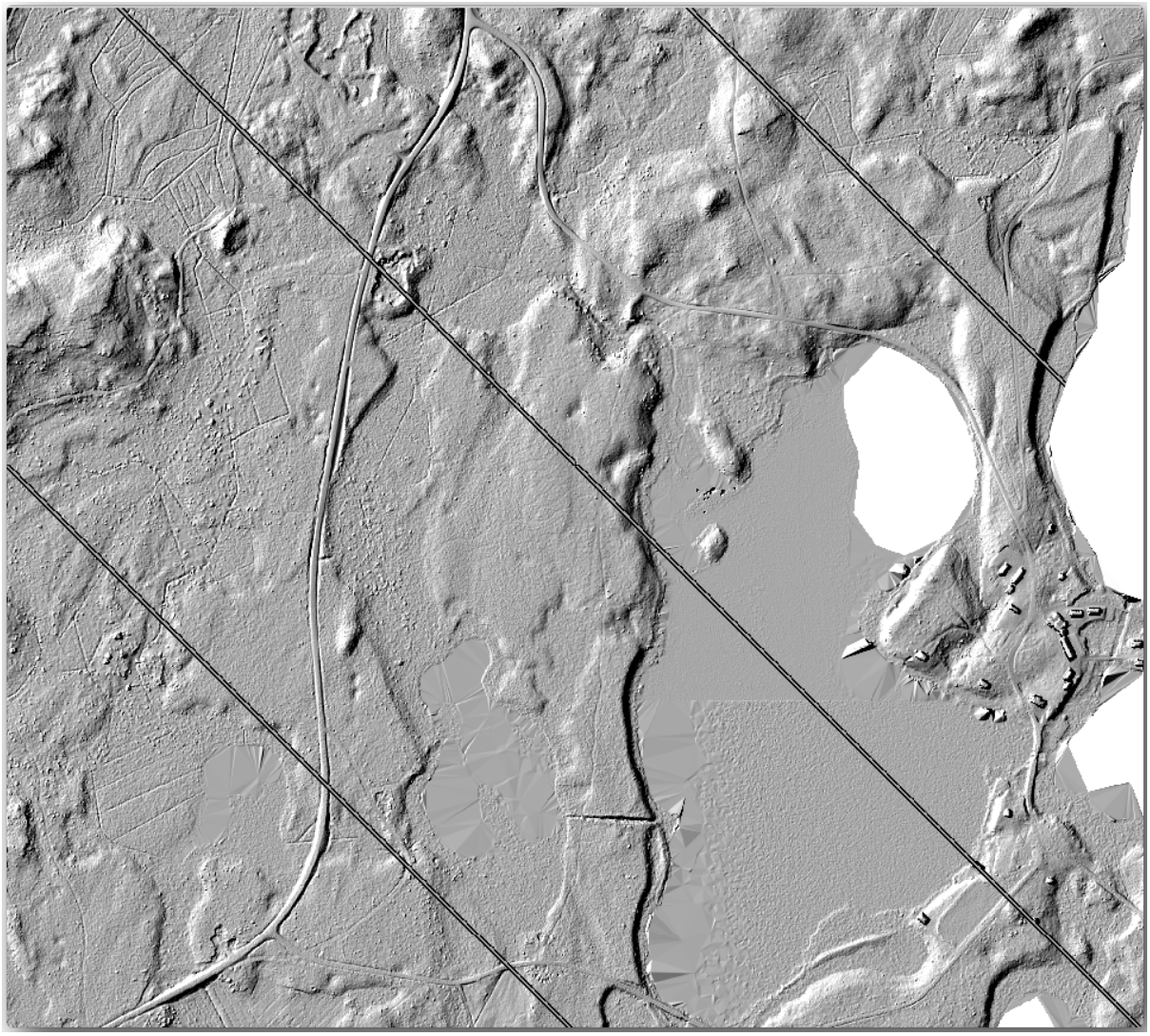
For visualization purposes, a hillshade generated from a DEM gives a better visualization of the terrain:

- Deschideți *Raster* ► *Terrain analysis* ► *Hillshade*.
- As the *Output layer*, browse to `exercise_data\forestry\lidar\` and name the file `hillshade.tif`.
- Lasă restul parametrilor la setările implicite.



- Select *ETRS89 / ETRS-TM35FIN* as the CRS when prompted.

În ciuda liniilor diagonale rămase în relieful rasterului rezultat, puteți vedea în mod clar un relief exact al zonei. Puteți vedea chiar și diferite albii săpate de curgerea apelor prin pădure.



14.8.4 În concluzie

Using LiDAR data to get a DEM, specially in forested areas, gives good results with not much effort. You could also use ready LiDAR derived DEMs or other sources like the SRTM 9m resolution DEMs. Either way, you can use them to create a hillshade raster to use in your map presentations.

14.8.5 Ce urmează?

În următorul, și ultimul pas din acest modul, veți folosi un raster rezultat și rezultatele inventarului forestier pentru a crea o prezentare pentru harta rezultatelor.

14.9 Lesson: Map Presentation

În lecțiile anterioare ați importat, sub formă de proiect GIS, un vechi inventar de pădure, l-ați actualizat, ați proiectat un inventar, ați creat hărți pentru munca de teren și ați calculat parametrii pădurii folosind măsurătorile din teren.

Adesea, pentru a prezenta rezultatele, este importantă crearea de hărți, în cadrul unui proiect GIS. O hartă care prezintă inventarul forestier va facilita înțelegerea acestuia dintr-o simplă privire, fără analiza detaliată a cifrelor.

Scopul acestei lecții: De a crea o hartă care să prezinte rezultatele inventarerii, folosind ca fundal un raster al reliefului umbrit.

14.9.1 ??? Follow Along: Preparing the Map Data

Open the QGIS project from the parameters calculations lesson, `forest_inventory.qgs`. Keep at least the following layers:

- `forest_stands_2012_results`.
- `basic_map`.
- `rautjarvi_aerial`.
- `lakes` (if you don't have it, add it from the `exercise_data\forestry\` folder).

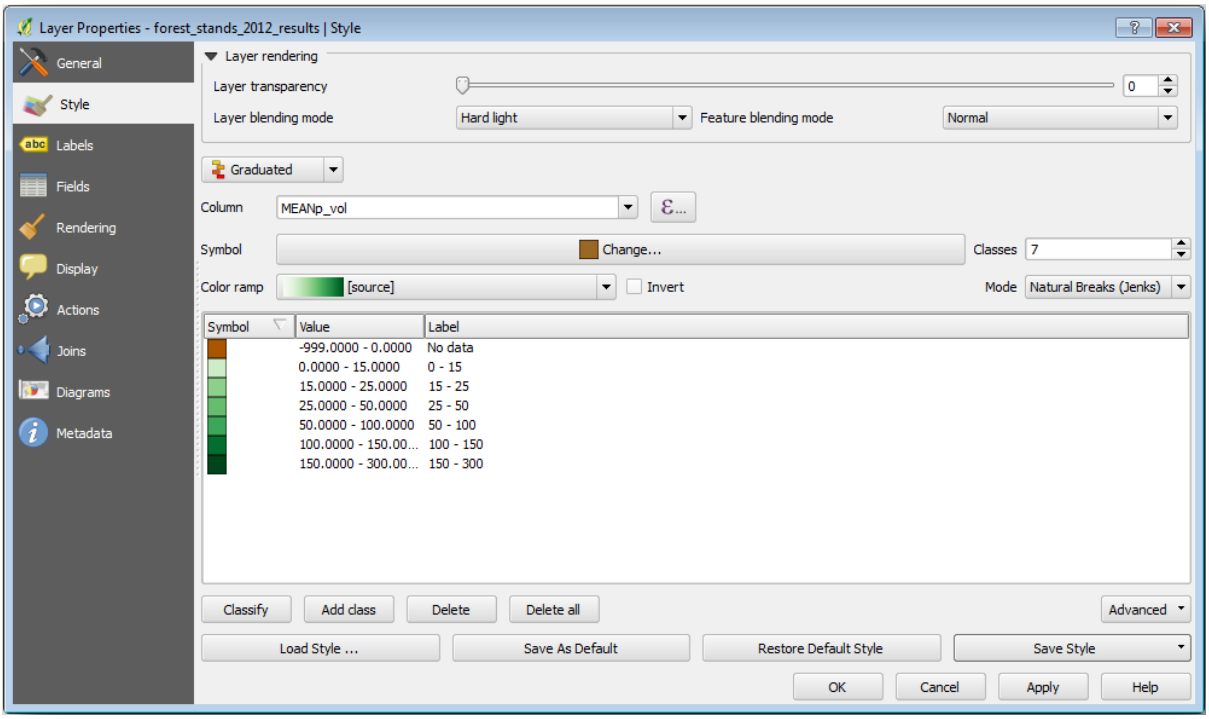
You are going to present the average volumes of your forest stands in a map. If you open the *Attribute table* for the `forest_stands_2012_results` layer, you can see the `NULL` values for the stands without information. To be able to get also those stands into your symbology you should change the `NULL` values to, for example, `-999`, knowing that those negative numbers mean there is no data for those polygons.

For the `forest_stands_2012_results` layer:

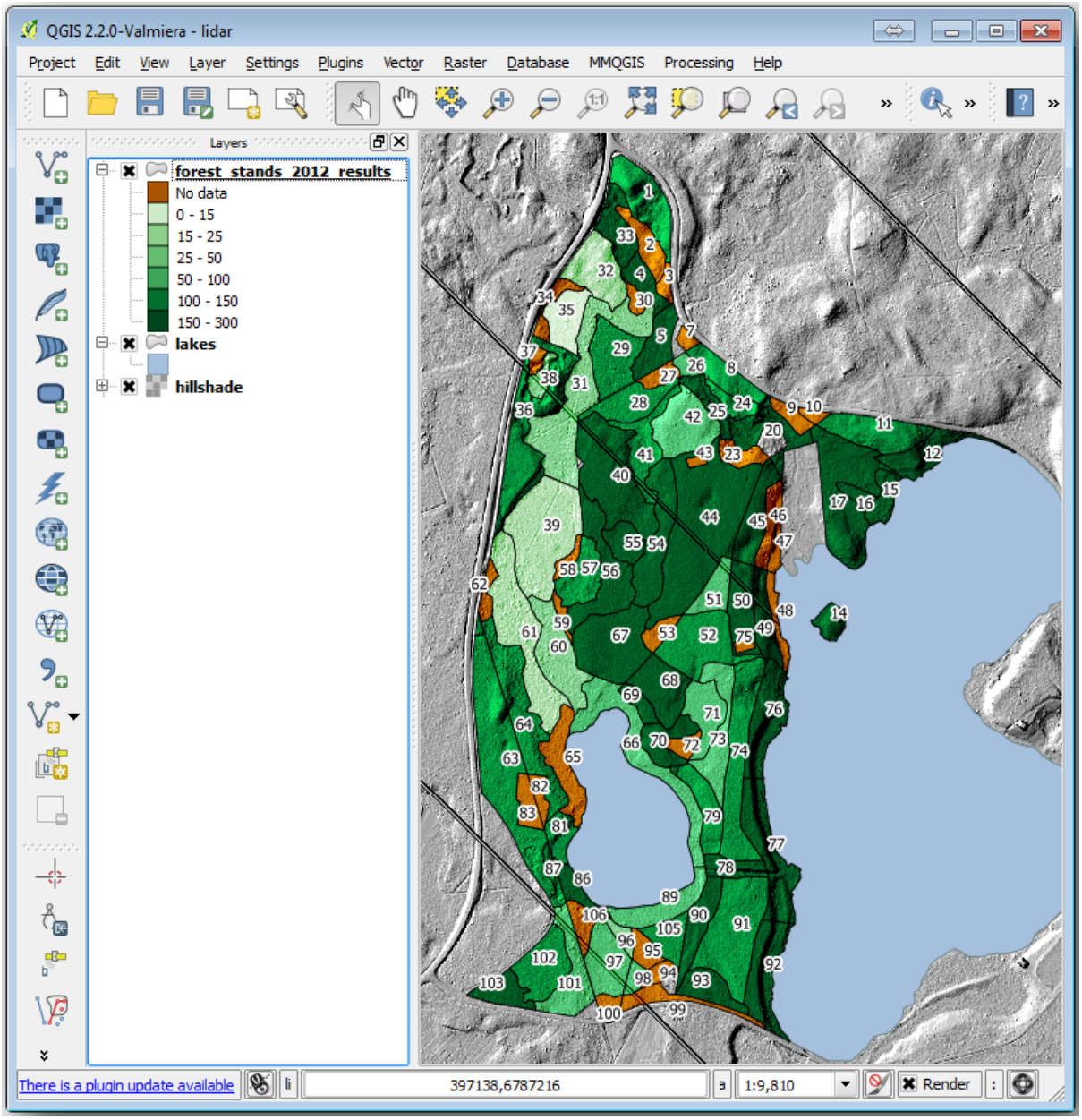
- Deschideți *Tabela sa de Atribute* și activați editarea.
- Select the polygons with `NULL` values.
- Use the calculator to update the values of the `MEANVol` field to `-999` only for the selected features.
- Dezactivați editarea și salvați modificările.

Acum puteți un stil implicit pentru acest strat:

- Mergeți la fila *Simbologiei.*
- Click on *Style* ► *Load Style…*
- Select the `forest_stands_2012_results.qml` from the `exercise_data\forestry\results\` folder.
- Clic pe *OK*

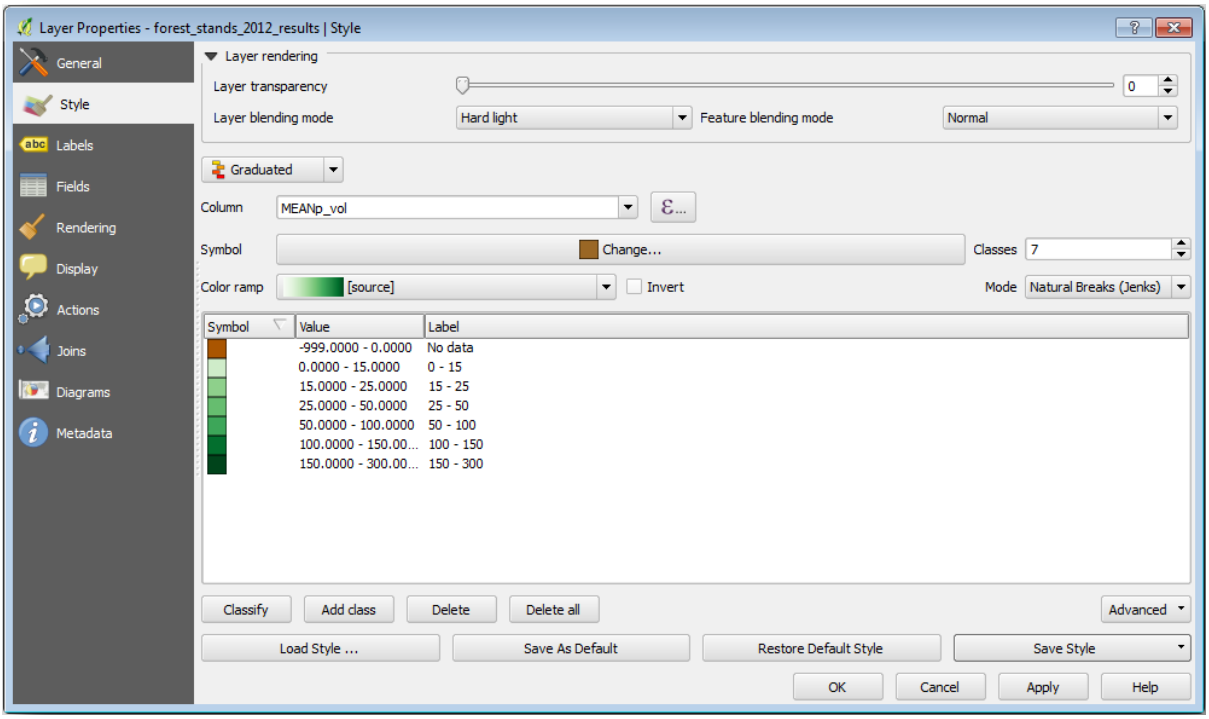


Harta dvs. va arăta în felul următor:



14.9.2 ??? Try Yourself: Try Different Blending Modes

Stilul pe care l-ați încărcat:

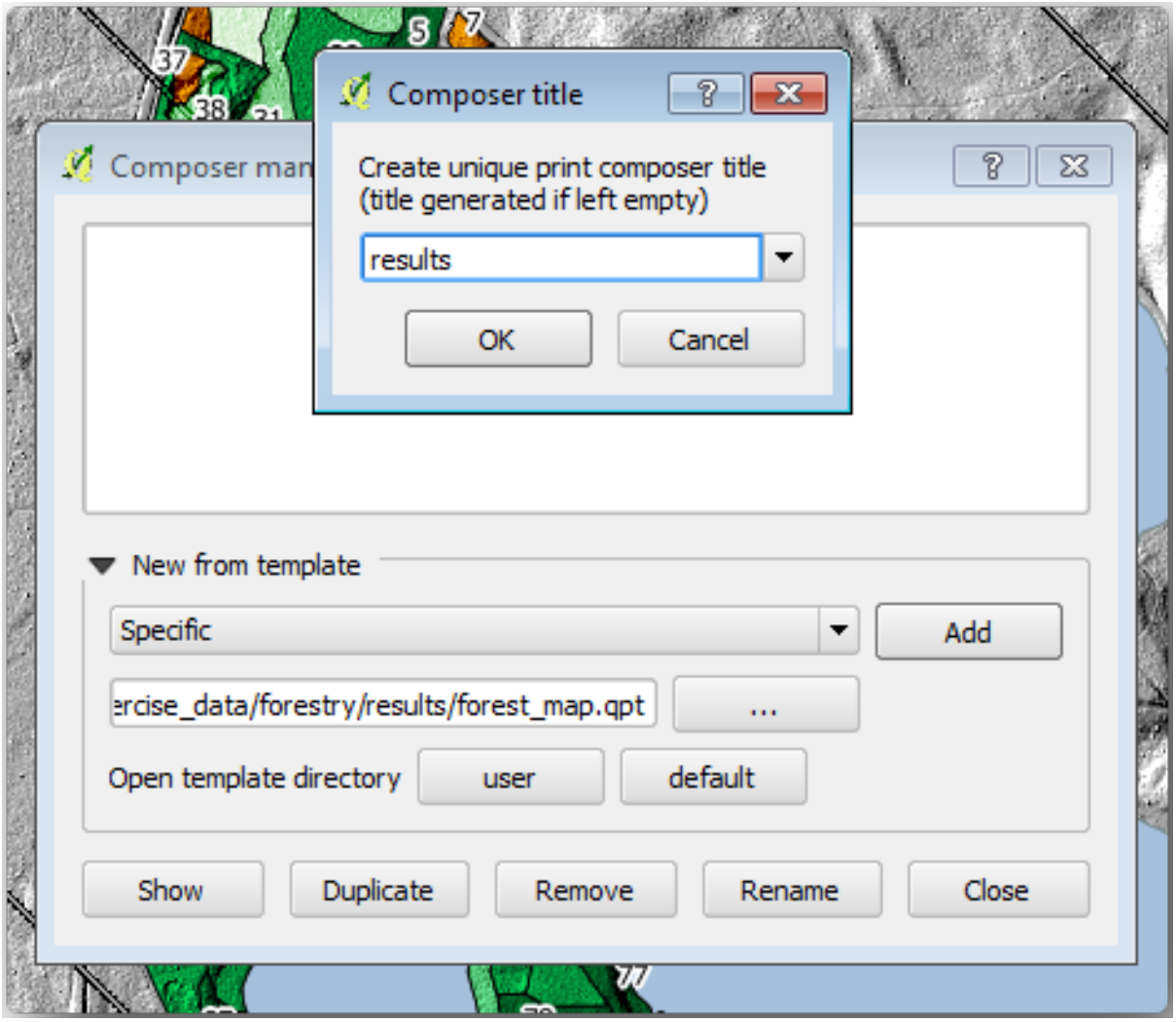


is using the *Hard light* mode for the *Layer blending mode*. Note that the different modes apply different filters combining the underlying and overlying layers, in this case the hillshade raster and your forest stands are used. You can read about these modes in the User Guide.

Încercați în diverse moduri și observați diferențele în hartă. Apoi, stabiliți unul care vă place cel mai mult pentru harta finală.

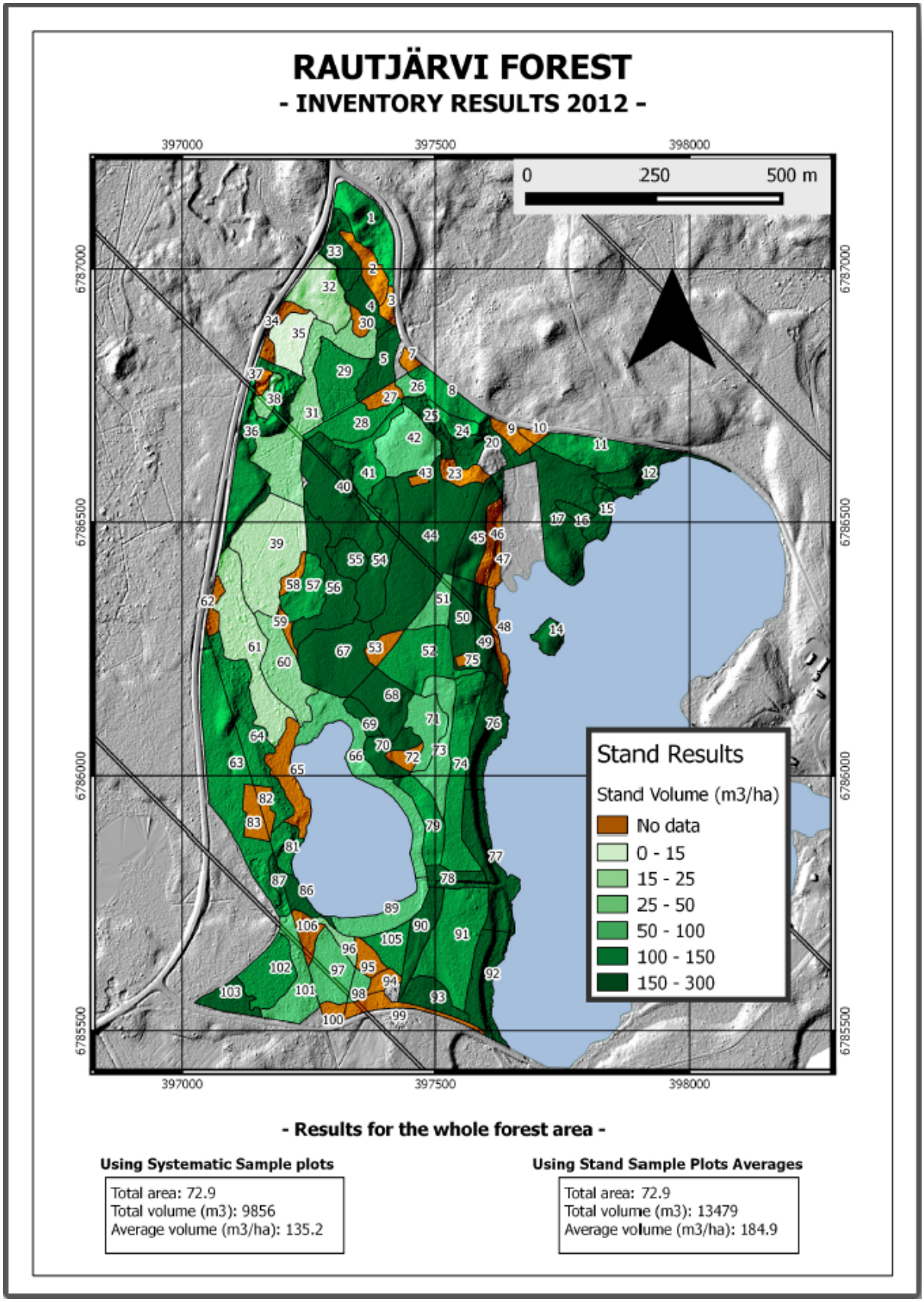
14.9.3 ??? Try Yourself: Using a Layout Template to Create the Map result

Use a template prepared in advanced to present the results. The template `forest_map.qpt` is located in the `exercise_data\forestry\results\` folder. Load it using the *Project* ► *Layout Manager*... dialog.



Open the print layout and edit the final map to get a result you are happy with.

Șablonul hărții pe care îl utilizați vă va oferi o hartă similară cu aceasta:



Salvați proiectul dumneavoastră QGIS ca referință pentru viitor.

14.9.4 În concluzie

Prin intermediul acestui modul ați văzut cum poate fi planificat și prezentat un inventar forestier de bază în QGIS. Mult mai multe analize forestiere sunt posibile în varietatea de instrumente pe care le puteți accesa, dar sperăm că acest manual va oferit un bun punct de plecare pentru a explora noi modalități de obținere a rezultatelor dorite.

CAPITOLUL 15

Module: Database Concepts with PostgreSQL

Baze de date relaționale sunt o parte importantă a oricărui sistem GIS. În acest modul, veți învăța despre Sistemele de Gestiune a Bazelor de date Relaționale (RDBMS), utilizând PostgreSQL pentru a crea o nouă bază de date în scopul stocării datelor, și veți afla despre alte funcții tipice RDBMS.

15.1 Lesson: Introduction to Databases

Înainte de a utiliza PostgreSQL, să ne asigurăm de terenul nostru prin acoperirea teoriei generale a bazelor de date. Nu va fi nevoie să introduceți codul exemplificat; acesta este prezent doar în scopuri ilustrative.

Scopul acestei lecții: De a înțelege conceptele fundamentale ale bazelor de date.

15.1.1 Ce este o bază de date?

O bază de date constă într-o colecție organizată de date, pentru una sau mai multe utilizări, de obicei în formă digitală. - *Wikipedia*

Un sistem de management al bazelor de date (DBMS) este format din software care operează bazele de date, oferind depozitare, acces, securitate, backup și alte facilități. - *Wikipedia*

15.1.2 Tabele

În bazele de date tradiționale și în bazele de date tip fișier, o tabelă este un set de elemente de date (valori) care este organizat utilând un model de coloane verticale (care sunt identificate prin numele lor) și de rânduri orizontale. O tableă are un număr specificat de coloane, dar poate avea oricâte rânduri. Fiecare rând este identificat prin valorile unui anumit subset de coloane care a fost identificat ca o potențială cheie. - *Wikipedia*

```
 id | name  | age
----+-------+-----
  1 | Tim   |  20
  2 | Horst |  88
(2 rows)
```

În bazele de date SQL, o tabelă este, de asemenea, cunoscută ca **relație.**

15.1.3 Coloane / Câmpuri

O coloană este un set de valori de date având un anume tip simplu, câte una pentru fiecare rând din tabel. Coloanele funizează structura pe baza căreia se compune fiecare rând. Termenul de câmp este utilizat interschimbabil cu coloană, deși mulți consideră că este mai corect să se utilizeze câmp (sau valoare a câmpului) când este vorba de elementul care există la intersecția dintre o coloană și un rând. - *Wikipedia*

O coloană:

```
| name  |
+-------+
| Tim   |
| Horst |
```

Un câmp:

```
| Horst |
```

15.1.4 Înregistrări

O înregistrare reprezintă informația stocată într-un rând din tabelă. Fiecare înregistrare va avea câte un câmp pentru fiecare dintre coloanele tabelei.

```
2 | Horst |  88  <-- one record
```

15.1.5 Tipuri de date

Tipurile de date restrâng tipurile de informații care pot fi stocate într-o coloană. - *Tim and Horst*

Există mai multe feluri de tipuri de date. Să ne concentrăm pe cele mai comune:

- `String` - to store free-form text data
- `Integer` - to store whole numbers
- `Real` - to store decimal numbers
- `Date` - to store Horst's birthday so no one forgets
- `Boolean` - to store simple true/false values

You can tell the database to allow you to also store nothing in a field. If there is nothing in a field, then the field content is referred to as a **«null» value**:

```
insert into person (age) values (40);

select * from person;
```

Rezultat:

```
id | name  | age
---+-------+-----
 1 | Tim   |  20
 2 | Horst |  88
 4 |       |  40  <-- null for name
(3 rows)
```

There are many more datatypes you can use - check the PostgreSQL manual!

15.1.6 Modelarea unei Baze de Date cu Adrese

Să folosim un studiu de caz simplu, pentru a vedea cum este construită o bază de date. Dorim să creăm o bază de date cu adrese.

??? Încercați și dvs.:

Notați proprietățile care alcătuiesc o adresă simplă și pe care am dori să le stocăm în baza noastră de date.

Răspuns

For our theoretical address table, we might want to store the following properties:

```
House Number
Street Name
Suburb Name
City Name
Postcode
Country
```

When creating the table to represent an address object, we would create columns to represent each of these properties and we would name them with SQL-compliant and possibly shortened names:

```
house_number
street_name
suburb
city
postcode
country
```

Structura Adresei

Propietățile care descriu o adresă sunt coloanele. Tipul de informație stocat în fiecare coloană este tipul de date al acesteia. În secțiunea următoare vom analiza tabela noastră conceptuală de adrese pentru a vedea cum o putem înbunătăți!

15.1.7 Teoria Bazelor de Date

Procesul de creare a unei baze de date presupune crearea unui model al lumii reale; luând concepte din lumea reală și reprezentându-le, ca entități, în baza de date.

15.1.8 Normalizarea

Un concept de bază al bazelor de date este evitarea duplicării / redundanței datelor. Procesul eliminării redundanței dintr-o bază de date este numit Normalizare.

Normalizarea este o metodă sistematică de garantare că structura bazei de date este potrivită pentru interogări de uz general și nu prezintă anumite caracterisitici - anomalii de inserare, modificare sau ștergere - care ar putea duce la pierderea integrității datelor. - *Wikipedia*

Există diferite tipuri de «forme» de normalizare.

Let's take a look at a simple example:

```
Table "public.people"

Column     |          Type          |                Modifiers
-----------+------------------------+-----------------------------------
 id        | integer                | not null default
           |                        | nextval('people_id_seq'::regclass)
           |                        |
 name      | character varying(50)  |
 address   | character varying(200) | not null
 phone_no  | character varying      |
Indexes:
 "people_pkey" PRIMARY KEY, btree (id)
```

```
select * from people;

id |     name      |           address            |  phone_no
---+---------------+------------------------------+-------------
 1 | Tim Sutton    | 3 Buirski Plein, Swellendam | 071 123 123
 2 | Horst Duester | 4 Avenue du Roix, Geneva     | 072 121 122
(2 rows)
```

Imaginați-vă că aveți mulți prieteni cu același nume de stradă sau oraș. Fiecare dintre aceste date sunt duplicate, consumă spațiu. Mai rău, dacă un nume de oraș se schimbă, trebuie să depuneți mult efort pentru a actualiza baza de date.

15.1.9 ??? Încercați și dvs.:

Redesign the theoretical `people` table above to reduce duplication and to normalise the data structure.

You can read more about database normalisation here

Răspuns

The major problem with the `people` table is that there is a single address field which contains a person's entire address. Thinking about our theoretical `address` table earlier in this lesson, we know that an address is made up of many different properties. By storing all these properties in one field, we make it much harder to update and query our data. We therefore need to split the address field into the various properties. This would give us a table which has the following structure:

```
id |     name      | house_no |  street_name   |    city    |   phone_no
 --+---------------+----------+----------------+------------+-----------------
 1 | Tim Sutton    |     3    | Buirski Plein  | Swellendam | 071 123 123
 2 | Horst Duester |     4    | Avenue du Roix | Geneva     | 072 121 122
```

In the next section, you will learn about Foreign Key relationships which could be used in this example to further improve our database's structure.

15.1.10 Indecși

Un index în baza de date este o structură de date care îmbunătățește viteza operațiilor de extragere de date dintr-o tabelă a bazei de date. - *Wikipedia*

Imagine you are reading a textbook and looking for the explanation of a concept - and the textbook has no index! You will have to start reading at one cover and work your way through the entire book until you find the information you need. The index at the back of a book helps you to jump quickly to the page with the relevant information:

```
create index person_name_idx on people (name);
```

Now searches on name will be faster:

```
Table "public.people"

Column    |          Type          |                Modifiers
----------+------------------------+-----------------------------------
 id       | integer                | not null default
          |                        | nextval('people_id_seq'::regclass)
          |                        |
 name     | character varying(50)  |
 address  | character varying(200) | not null
 phone_no | character varying      |
Indexes:
 "people_pkey" PRIMARY KEY, btree (id)
 "person_name_idx" btree (name)
```

15.1.11 Secvențe

O secvență este un generator de numere unice. Este utilizat în mod normal pentru a creea un identificator unic pentru o coloană a unei tabele.

In this example, id is a sequence - the number is incremented each time a record is added to the table:

```
id |     name      |           address            |  phone_no
---+---------------+------------------------------+-------------
 1 | Tim Sutton    | 3 Buirski Plein, Swellendam | 071 123 123
 2 | Horst Duster | 4 Avenue du Roix, Geneva     | 072 121 122
```

15.1.12 Diagrama Relațiilor dintre Entități

In a normalised database, you typically have many relations (tables). The entity-relationship diagram (ER Diagram) is used to design the logical dependencies between the relations. Consider our non-normalised `people` table from earlier in the lesson:

```
select * from people;

 id |     name      |           address            |  phone_no
----+---------------+------------------------------+-------------
 1  | Tim Sutton    | 3 Buirski Plein, Swellendam | 071 123 123
 2  | Horst Duster | 4 Avenue du Roix, Geneva     | 072 121 122
(2 rows)
```

With a little work we can split it into two tables, removing the need to repeat the street name for individuals who live in the same street:

```
select * from streets;

 id |     name
----+--------------
 1  | Plein Street
(1 row)
```

și:

```
select * from people;

 id |     name      | house_no | street_id |  phone_no
----+---------------+----------+-----------+-------------
  1 | Horst Duster |        4 |         1 | 072 121 122
(1 row)
```

We can then link the two tables using the «keys» `streets.id` and `people.streets_id`.

Dacă desenăm o Diagramă ER pentru aceste două tabele ar arăta cam așa:



Diagrama ER ne ajută să exprimăm relații «unul la mulți». În acest caz simbolul săgeată spune că pe o stradă pot locui mai mulți oameni.

??? Try Yourself:

Modelul nostru *people* are încă niște probleme de normalizare - încercați să îl normalizați în continuare și ilustrați-vă ideile printr-o Diagramă ER.

Răspuns

Our `people` table currently looks like this:

```
id |     name      | house_no | street_id |  phone_no
---+---------------+----------+-----------+-------------
 1 | Horst Duster |        4 |         1 | 072 121 122
```

The *street_id* column represents a «one to many» relationship between the people object and the related street object, which is in the `streets` table.

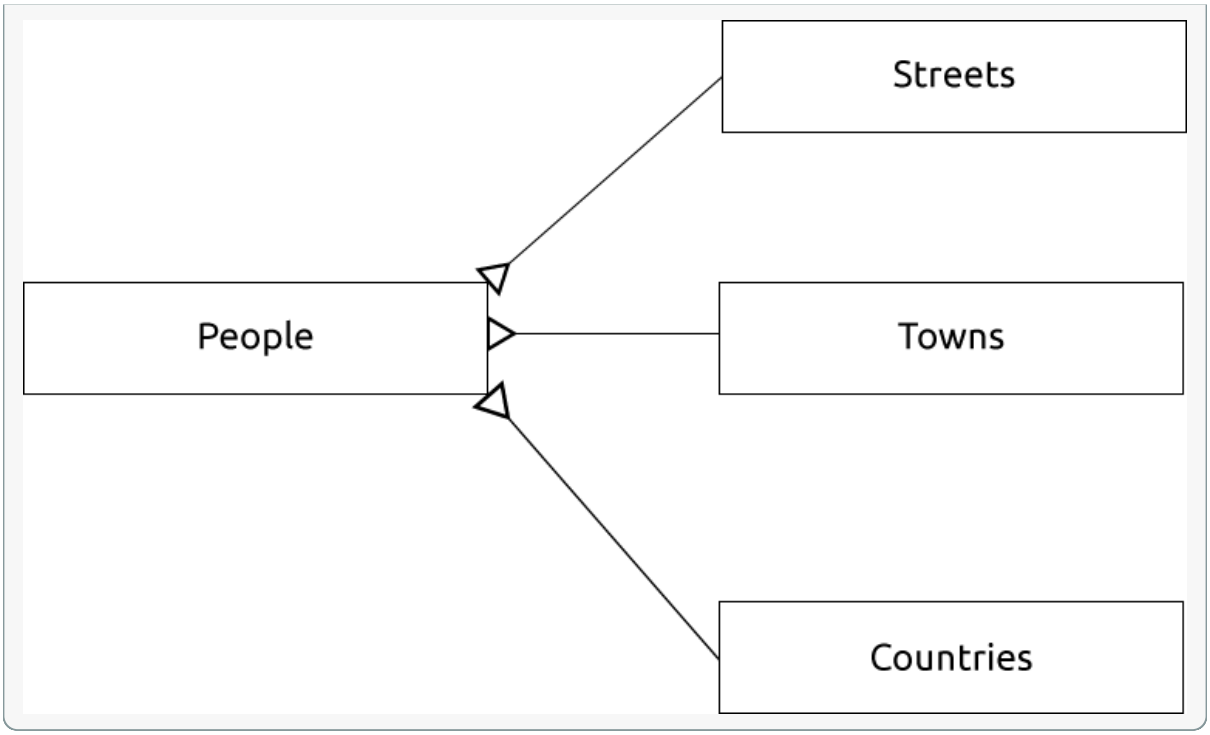
One way to further normalise the table is to split the name field into *first_name* and *last_name*:

```
id | first_name | last_name  | house_no | street_id |  phone_no
---+------------+------------+----------+-----------+------------
 1 |    Horst   |   Duster   |     4    |     1     | 072 121 122
```

We can also create separate tables for the town or city name and country, linking them to our `people` table via «one to many» relationships:

```
id | first_name | last_name | house_no | street_id | town_id | country_id
---+------------+-----------+----------+-----------+---------+------------
 1 |    Horst   |   Duster  |     4    |     1     |    2    |     1
```

An ER Diagram to represent this would look like this:



15.1.13 Constrângeri, Chei Primare și Chei Externe

A database constraint is used to ensure that data in a relation matches the modeller's view of how that data should be stored. For example a constraint on your postal code could ensure that the number falls between `1000` and `9999`.

O cheie Primară este compusă din unul sau mai multe câmpuri care fac o înregistrare unică. În mod uzual cheia primară se numește id și este o secvență.

O cheie Externă este utilizată pentru a face legătura unei înregistrări cu o altă tabelă (folosind cheia primară a acelui tabel).

În Diagramele ER, legăturile dintre tabele sunt în mod normal bazate pe chei Externe legate de chei Primare.

If we look at our people example, the table definition shows that the street column is a foreign key that references the primary key on the streets table:

```
Table "public.people"

 Column    |         Type          |  Modifiers
-----------+-----------------------+--------------------------------------
 id        | integer               | not null default
           |                       | nextval('people_id_seq'::regclass)
 name      | character varying(50) |
 house_no  | integer               | not null
 street_id | integer               | not null
 phone_no  | character varying     |
Indexes:
"people_pkey" PRIMARY KEY, btree (id)
Foreign-key constraints:
"people_street_id_fkey" FOREIGN KEY (street_id) REFERENCES streets(id)
```

15.1.14 Tranzacții

La adăugarea, modificarea sau ștergerea datelor într-o bază de date, este important ca de fiecare dată baza de dată să rămână într-o stare bună în cazul în care ceva nu merge bine. Cele mai multe baze de date pun la dispoziție o facilitate numită tranzacție. Tranzacțiile permit crearea unui moment de revenire la care vă puteți întoarce dacă modificările bazei de date nu au funcționat conform planului.

Să considerăm un scenariu în care aveți un sistem contabil. Trebuie să transferați fonduri dintr-un cont și să le adăugați în altul. Secvența de pași ar fi:

- eliminați R20 din Joe
- adăugați R20 la Anne

Dacă ceva nu merge bine în cadrul procesului (ex. pană de curent), tranzacția va reveni.

15.1.15 În concluzie

Bazele de date permit administrarea datelor într-un mod structurat utilizând structuri de cod simple.

15.1.16 Ce urmează?

Acum că am văzut cum funcționează teoretic bazele de date, să creăm o bază de date nouă pentru a implementa partea teoretică prezentată.

15.2 Lesson: Implementing the Data Model

Acum, că am acoperit toată teoria, haideți să creăm o bază de date nouă. Această bază de date va fi utilizată în exercițiile noastre din lecțiile care vor urma.

Scopul acestei lecții: De a instala soft-ul necesar și de a-l utiliza la implementarea bazei de date exemplu.

15.2.1 Instalare PostgreSQL

> **Notă**
>
> You can find PostgreSQL packages and installation instructions for your operating system at https://www.postgresql.org/download/. Please note that the documentation will assume users are running QGIS under Ubuntu.

Pe Ubuntu:

```
sudo apt install postgresql-9.1
```

Veți obține un mesaj de genul ăsta:

```
[sudo] password for qgis:
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following extra packages will be installed:
postgresql-client-9.1 postgresql-client-common postgresql-common
Suggested packages:
oidentd ident-server postgresql-doc-9.1
```

(continues on next page)

(continuare din pagina precedentă)

```
The following NEW packages will be installed:
postgresql-9.1 postgresql-client-9.1 postgresql-client-common postgresql-common
0 upgraded, 4 newly installed, 0 to remove and 5 not upgraded.
Need to get 5,012kB of archives.
After this operation, 19.0MB of additional disk space will be used.
Do you want to continue [Y/n]?
```

Apăsați `Y` și `Enter` apoi așteptați ca descărcarea și instalarea să se încheie.

15.2.2 Ajutor

PostgreSQL has very good online documentation.

15.2.3 Crearea unui utilizator pentru baza de date

Pe Ubuntu:

After the installation is complete, run this command to become the postgres user and then create a new database user:

```
sudo su - postgres
```

Introduceți parola când vi se solicită (aveți nevoie de drepturi sudo).

Now, at the postgres user's bash prompt, create the database user. Make sure the user name matches your unix login name: it will make your life much easier, as postgres will automatically authenticate you when you are logged in as that user:

```
createuser -d -E -i -l -P -r -s qgis
```

Introduceți o parolă când vi se solicită. Ar trebui să utilizați o parolă diferită pentru parola contului dumneavoastră.

Ce reprezintă aceste opțiuni?

```
-d, --createdb     role can create new databases
-E, --encrypted    encrypt stored password
-i, --inherit      role inherits privileges of roles it is a member of (default)
-l, --login        role can login (default)
-P, --pwprompt     assign a password to new role
-r, --createrole   role can create new roles
-s, --superuser    role will be superuser
```

Now you should leave the postgres user's bash shell environment by typing:

```
exit
```

15.2.4 Verificați noul cont

```
psql -l
```

Ar trebui să returneze ceva de genul următor:

```
Name      |  Owner   | Encoding | Collation  |   Ctype    |
----------+----------+----------+------------+------------+
postgres  | postgres | UTF8     | en_ZA.utf8 | en_ZA.utf8 |
template0 | postgres | UTF8     | en_ZA.utf8 | en_ZA.utf8 |
template1 | postgres | UTF8     | en_ZA.utf8 | en_ZA.utf8 |
(3 rows)
```

Type Q to exit.

15.2.5 Crearea unei baze de date

The createdb command is used to create a new database. It should be run from the bash shell prompt:

```
createdb address -O qgis
```

You can verify the existence of your new database by using this command:

```
psql -l
```

Which should return something like this:

```
Name      |  Owner   | Encoding | Collation  |   Ctype    |   Access privileges
----------+----------+----------+------------+------------+-----------------------
address   | qgis     | UTF8     | en_ZA.utf8 | en_ZA.utf8 |
postgres  | postgres | UTF8     | en_ZA.utf8 | en_ZA.utf8 |
template0 | postgres | UTF8     | en_ZA.utf8 | en_ZA.utf8 | =c/postgres:␣
↪postgres=CTc/postgres
template1 | postgres | UTF8     | en_ZA.utf8 | en_ZA.utf8 | =c/postgres:␣
↪postgres=CTc/postgres
(4 rows)
```

Type Q to exit.

15.2.6 Pornirea unei sesiuni către baza de date, din linia de comandă

Vă puteți conecta ușor la baza de date, procedând astfel:

```
psql address
```

Pentru a ieși din mediul bazei de date psql, tastați:

```
\q
```

Pentru ajutor în utilizarea liniei de comandă, tastați:

```
\?
```

Pentru ajutor în utilizarea comenzii SQL, tastați:

```
\help
```

Pentru a obține ajutor pentru o anumită comandă, tastați (de exemplu):

```
\help create table
```

See also the Psql cheat sheet.

15.2.7 Crearea Tabelelor SQL

Let's start making some tables! We will use our ER Diagram as a guide. First, connect to the address db:

```
psql address
```

Then create a `streets` table:

```
create table streets (id serial not null primary key, name varchar(50));
```

`serial` and `varchar` are **data types**. `serial` tells PostgreSQL to start an integer sequence (auto-number) to populate the `id` automatically for every new record. `varchar(50)` tells PostgreSQL to create a character field of 50 characters in length.

You will notice that the command ends with a `;` - all SQL commands should be terminated this way. When you press `Enter`, psql will report something like this:

```
NOTICE:  CREATE TABLE will create implicit sequence "streets_id_seq"
         for serial column "streets.id"
NOTICE:  CREATE TABLE / PRIMARY KEY will create implicit index
         "streets_pkey" for table "streets"
CREATE TABLE
```

That means your table was created successfully, with a primary key `streets_pkey` using `streets.id`.

Note: If you hit return without entering a `;`, then you will get a prompt like this: `address-#`. This is because PostgreSQL is expecting you to enter more. Enter `;` to run your command.

To view your table schema, you can do this:

```
\d streets
```

Which should show something like this:

```
Table "public.streets"
Column  |          Type          |            Modifiers
--------+------------------------+-----------------------------------
 id     | integer                | not null default
        |                        | nextval('streets_id_seq'::regclass)
 name   | character varying(50)  |
Indexes:
  "streets_pkey" PRIMARY KEY, btree (id)
```

To view your table contents, you can do this:

```
select * from streets;
```

Which should show something like this:

```
id | name
---+------
(0 rows)
```

După cum puteți vedea, tabela noastră este vidă, în mod curent.

Încercați și dvs.: ???

Folosiți abordarea de mai sus pentru a crea un tabel denumit people:

Adăugați câmpuri ca număr de telefon, adresă de acasă, nume etc. (acestea nu sunt toate nume valide: schimbați-le pentru a deveni valide). Asigurați-vă că îi adăugați tabelului o coloană ID cu același tip de date ca și mai sus.

Răspuns

The SQL required to create the correct people table is:

```
create table people (id serial not null primary key,
                     name varchar(50),
                     house_no int not null,
                     street_id int not null,
                     phone_no varchar null );
```

The schema for the table (enter `\\d people`) looks like this:

```
Table "public.people"

Column     |          Type          |                       Modifiers
-----------+------------------------+-------------------------------------
id         | integer                | not null default
           |                        | nextval('people_id_seq'::regclass)
name       | character varying(50)  |
house_no   | integer                | not null
street_id  | integer                | not null
phone_no   | character varying      |
Indexes:
  "people_pkey" PRIMARY KEY, btree (id)
```

For illustration purposes, we have purposely omitted the fkey constraint.

15.2.8 Crearea Cheilor în SQL

Problema cu soluția noastră de mai sus este că baza de date nu știe că oamenii și străzile au o relație logică. Pentru a exprima această relație va trebui să definim o cheie externă care face legătura cu cheia primară a tabelului de străzi.



Sunt două moduri de a face asta:

- Adăugați cheia după crearea tabelului
- Definiți cheia la momentul creării tabelului

Our table has already been created, so let's do it the first way:

```
alter table people
  add constraint people_streets_fk foreign key (street_id) references streets(id);
```

That tells the `people` table that its `street_id` fields must match a valid street `id` from the `streets` table.

The more usual way to create a constraint is to do it when you create the table:

```
create table people (id serial not null primary key,
                     name varchar(50),
                     house_no int not null,
                     street_id int references streets(id) not null,
                     phone_no varchar null);

\d people
```

After adding the constraint, our table schema looks like this now:

```
Table "public.people"

  Column   |         Type          |            Modifiers
-----------+-----------------------+---------------------------------
 id        | integer               | not null default
           |                       | nextval('people_id_seq'::regclass)
 name      | character varying(50) |
 house_no  | integer               | not null
 street_id | integer               | not null
 phone_no  | character varying     |
Indexes:
  "people_pkey" PRIMARY KEY, btree (id)
Foreign-key constraints:
  "people_streets_fk" FOREIGN KEY (id) REFERENCES streets(id)
```

15.2.9 Crearea de indecși în SQL

We want lightning fast searches on peoples names. To provide for this, we can create an index on the name column of our people table:

```
create index people_name_idx on people(name);

\d people
```

Which results in:

```
Table "public.people"

  Column   |         Type          |                       Modifiers
-----------+-----------------------+-------------------------------------
 id        | integer               | not null default nextval
           |                       | ('people_id_seq'::regclass)
 name      | character varying(50) |
 house_no  | integer               | not null
 street_id | integer               | not null
 phone_no  | character varying     |
Indexes:
 "people_pkey" PRIMARY KEY, btree (id)
 "people_name_idx" btree (name)    <-- new index added!
Foreign-key constraints:
 "people_streets_fk" FOREIGN KEY (id) REFERENCES streets(id)
```

15.2.10 Ștergerea Tabelelor în SQL

If you want to get rid of a table you can use the `DROP` command:

```
drop table streets;
```

In our current example, the above command would not work. Why not?

Răspuns

The reason the DROP command would not work in this case is because the `people` table has a Foreign Key constraint to the `streets` table. This means that dropping (or deleting) the `streets` table would leave the `people` table with references to non-existent `streets` data.

It is possible to «force» the `streets` table to be deleted by using the `CASCADE` command, but this would also delete the `people` and any other table which had a relationship to the `streets` table. Use with caution!

If you used the same `drop table` command on the `people` table, it would be successful:

```
drop table people;
```

Notă

If you actually did enter that command and dropped the `people` table, now would be a good time to rebuild it, as you will need it in the next exercises.

15.2.11 Câteva cuvinte despre pgAdmin III

Prezentăm comenzile SQL de la promptul *psql* pentru că este un mod foarte util de a învăța despre bazele de date. Cu toate acestea, există metode mai rapide și mai ușoare de a face ce am prezentat. Instalați pgAdmin III și veți putea crea, șterge, modifica etc. tabele utilizând operații «point and click» într-un GUI.

Under Ubuntu, you can install it like this:

```
sudo apt install pgadmin3
```

pgAdmin III va fi acoperit mai detaliat în alt modul.

15.2.12 În concluzie

Ați văzut cum să creați o bază de date complet nouă, pornind de la zero.

15.2.13 Ce urmează?

În continuare veți învăța cum să folosiți DBMS-ul pentru adăguarea datelor.

15.3 Lesson: Adding Data to the Model

Modelele pe care le-am creat vor trebui să fie populate de acum cu datele pe care trebuie să le conțină.

Scopul acestei lecții: De a afla cum se pot insera noi date în baza de date a modelelor.

15.3.1 Inserarea instrucțiunilor

How do you add data to a table? The sql `INSERT` statement provides the functionality for this:

```
insert into streets (name) values ('High street');
```

Mai multe lucruri de reținut:

- After the table name (`streets`), you list the column names that you will be populating (in this case only the `name` column).
- After the `values` keyword, place the list of field values.
- Șirurile de caractere ar trebui să fie citate cu ajutorul ghilimelelor simple.
- Note that we did not insert a value for the `id` column; this is because it is a sequence and will be auto-generated.
- If you do manually set the `id`, you may cause serious problems with the integrity of your database.

You should see `INSERT 0 1` if it is successful.

Puteți vedea rezultatul acțiunii dvs. de inserare selectând toate datele din tabelă:

```
select * from streets;
```

Rezultat:

```
select * from streets;
 id |    name
----+-------------
  1 | High street
(1 row)
```

Încercați și dvs.: ???

Use the `INSERT` command to add a new street to the `streets` table.

Răspuns

Comanda SQL pe care ar trebui să o utilizați arată astfel (puteți înlocui numele străzii cu un nume la alegere):

```
insert into streets (name) values ('Low Road');
```

15.3.2 Secvențierea Adăugării Datelor, Conform Constrângerilor

15.3.3 Încercați și dvs.: ???

Try to add a person object to the `people` table with the following details:

```
Name: Joe Smith
House Number: 55
Street: Main Street
Phone: 072 882 33 21
```

Notă

Reamintim că, în acest exemplu, am definit numerele de telefon ca șiruri de caractere, și nu ca numere întregi.

At this point, you should have an error report if you try to do this without first creating a record for Main Street in the `streets` table.

Ar trebui să rețneți, de asemenea, că:

- Nu puteți adăuga strada folosind-ui numele
- You can't add a street using a street `id` before first creating the street record on the `streets` table

Amintiți-vă că cele două tabele sunt legate printr-o pereche de chei: primară/externă. Aceasta înseamnă că nici o persoană validă nu pot fi creată fără a exista, de asemenea, o înregistrare de stradă validă, corespunzătoare.

Folosind cunoștințele de mai sus, adăugați noua persoană în baza de date.

Răspuns

Iată instrucțiunea SQL corectă:

```
insert into streets (name) values('Main Road');
insert into people (name,house_no, street_id, phone_no)
  values ('Joe Smith',55,2,'072 882 33 21');
```

Dacă vă uitați din nou la tabela străzilor (folosind o instrucțiune select ca cea de dinainte), veți vedea că *id-ul* intrării `Drum principal` este *2*.

De aceea am putea introduce pur și simplu numărul `2` mai sus. Chiar dacă nu vedem `Main Road` scris complet în intrarea de mai sus, baza de date va putea să-l asocieze cu valoarea *street_id* de *2*.

Dacă ați adăugat deja un nou obiect stradal, s-ar putea să descoperiți că noul `Drum Principal` are un *id* de *3* nu de *2*.

15.3.4 Selectarea datelor

V-am arătat deja sintaxa pentru selectarea înregistrărilor. Să ne uităm la câteva exemple suplimentare:

```
select name from streets;
```

```
select * from streets;
```

```
select * from streets where name='Main Road';
```

În sesiunile ulterioare vom intra în mai multe detalii cu privire la modul de selectare și de filtrare a datelor.

15.3.5 Actualizarea datelor

Ce se întâmplă dacă doriți să faceți o modificare a unor date existente? De exemplu, un nume de stradă este schimbat:

```
update streets set name='New Main Road' where name='Main Road';
```

Be very careful using such update statements - if more than one record matches your `WHERE` clause, they will all be updated!

O soluție mai bună este de a folosi cheia primară a tabelului, pentru a referenția înregistrarea care trebuie schimbată:

```
update streets set name='New Main Road' where id=2;
```

It should return `UPDATE 1`.

> **Notă**
>
> The `WHERE` statement criteria are case sensitive, `Main Road` is not the same as `Main road`.

15.3.6 Ştergere Dată

In order to delete an object from a table, use the `DELETE` command:

```
delete from people where name = 'Joe Smith';
```

Să ne uităm acum la tabela noastră de personal:

```
address=# select * from people;

 id | name | house_no | street_id | phone_no
----+------+----------+-----------+----------
(0 rows)
```

15.3.7 Încercați și dvs.: ???

Folosiți abilitățile pe care le-ați învățat pentru a adăuga câțiva prieteni noi în baza de date:

```
      name        | house_no | street_id |   phone_no
------------------+----------+-----------+--------------
Joe Bloggs        |        3 |         2 | 072 887 23 45
Jane Smith        |       55 |         3 | 072 837 33 35
Roger Jones       |       33 |         1 | 072 832 31 38
Sally Norman      |       83 |         1 | 072 932 31 32
```

15.3.8 În concluzie

Acum știți cum să adăugați date noi modelelor existente, pe care le-ați creat anterior. Amintiți-vă că, dacă doriți să adăugați noi tipuri de date, poate doriți să modificați și/sau să creați noi modele, care să conțină aceste date.

15.3.9 Ce urmează?

Acum, că ați adăugat câteva date, veți învăța cum să folosiți interogările, pentru a accesa aceste date în diferite moduri.

15.4 Lesson: Queries

When you write a `SELECT ...` command it is commonly known as a query - you are interrogating the database for information.

Scopul acestei lecții: De a afla cum să creați interogări, care vor returna informații utile.

> **Notă**
>
> If you did not do so in the previous lesson, add the following people objects to your `people` table. If you receive any errors related to foreign key constraints, you will need to add the «Main Road» object to your streets table first

```
insert into people (name,house_no, street_id, phone_no)
          values ('Joe Bloggs',3,2,'072 887 23 45');
insert into people (name,house_no, street_id, phone_no)
          values ('Jane Smith',55,3,'072 837 33 35');
insert into people (name,house_no, street_id, phone_no)
          values ('Roger Jones',33,1,'072 832 31 38');
insert into people (name,house_no, street_id, phone_no)
          values ('Sally Norman',83,1,'072 932 31 32');
```

15.4.1 Ordonarea Rezultatelor

Haideți să obținem o listă de persoane ordonate după numerele caselor lor:

```
select name, house_no from people order by house_no;
```

Rezultat:

```
     name      | house_no
---------------+----------
 Joe Bloggs    |        3
 Roger Jones   |       33
 Jane Smith    |       55
 Sally Norman  |       83
(4 rows)
```

Puteți sorta rezultatele după valorile a mai mult de o coloană:

```
select name, house_no from people order by name, house_no;
```

Rezultat:

```
     name      | house_no
---------------+----------
 Jane Smith    |       55
 Joe Bloggs    |        3
 Roger Jones   |       33
 Sally Norman  |       83
(4 rows)
```

15.4.2 Filtrare

Foarte des nu veți vedea fiecare înregistrare din baza de date - în mod special există mii de înregistrări și sunteți interesat doar de una sau două.

Iată un exemplu de filtru numeric care întoarce doar obiecte ale cărui `house_no` este mai mic de 50:

```
select name, house_no from people where house_no < 50;

     name     | house_no
  ------------+----------
   Joe Bloggs |        3
   Roger Jones |       33
  (2 rows)
```

Puteți combina filtre (definite utilizând clauza `WHERE`) cu sortare (definită folosind clauza `ORDER BY`):

```
select name, house_no from people where house_no < 50 order by house_no;

     name     | house_no
  ------------+----------
   Joe Bloggs |        3
   Roger Jones |       33
  (2 rows)
```

Puteți filtra, de asemenea, pe baza datelor de text:

```
select name, house_no from people where name like '%s%';

     name     | house_no
  ------------+----------
   Joe Bloggs |        3
   Roger Jones |       33
  (2 rows)
```

Here we used the `LIKE` clause to find all names with an `s` in them. You'll notice that this query is case-sensitive, so the `Sally Norman` entry has not been returned.

If you want to search for a string of letters regardless of case, you can do a case in-sensitive search using the `ILIKE` clause:

```
select name, house_no from people where name ilike '%r%';

      name     | house_no
  -------------+----------
   Roger Jones |       33
   Sally Norman |       83
  (2 rows)
```

That query returned every **people** object with an `r` or `R` in their name.

15.4.3 Îmbinări

Dar dacă doriți să vedeți detaliile persoanei și numele străzii în loc de ID-ul acesteia? Pentru a face asta, trebuie să legați cele două tabele într-o singură interogare. Să vedem un exemplu:

```
select people.name, house_no, streets.name
from people,streets
where people.street_id=streets.id;
```

Notă

Cu legături, veți spune întotdeauna din ce tabele se extrage informația, în aceest caz persoane și străzi. De asemenea va trebui să precizați care chei trebuie să corespundă (cheia externă și cheia primară). Dacă nu faceți această precizare, veți obține o listă cu toate combinațiile posibile de persoane și străzi, dar nu veți putea ști de fapt cine pe ce stradă locuiește!

Așa ar trebui să arate rezultatul SQL corect:

```
     name      | house_no |     name
---------------+----------+-------------
 Joe Bloggs    |        3 | Low Street
 Roger Jones   |       33 | High street
 Sally Norman  |       83 | High street
 Jane Smith    |       55 | Main Road
(4 rows)
```

Vom reveni la legături când vom creea interogări mai complexe în continuare. Pentru moment rețineți că permit o metodă simplă de a combina informații din două sau mai multe tabele.

15.4.4 Sub-Selectarea

Sub-selecțiile permit selectarea obiectelor dintr-un tabel, pe baza datelor dintr-un alt tabel de care este legat printr-o relație la cheia sa externă. În cazul nostru, dorim să găsim persoanele care locuiesc pe o anumită stradă.

În primul rând, să facem un pic de reglare a datelor noastre:

```
insert into streets (name) values('QGIS Road');
insert into streets (name) values('OGR Corner');
insert into streets (name) values('Goodle Square');
update people set street_id = 2 where id=2;
update people set street_id = 3 where id=3;
```

Haideți să aruncăm o privire rapidă la datele noastre în urma modificărilor: putem refolosi interogarea din secțiunea anterioară:

```
select people.name, house_no, streets.name
from people,streets
where people.street_id=streets.id;
```

Rezultat:

```
     name      | house_no |     name
---------------+----------+-------------
 Roger Jones   |       33 | High street
 Sally Norman  |       83 | High street
 Jane Smith    |       55 | Main Road
 Joe Bloggs    |        3 | Low Street
(4 rows)
```

Now let's show you a sub-selection on this data. We want to show only people who live in `street_id` number `1`:

```
select people.name
from people, (
    select *
    from streets
    where id=1
  ) as streets_subset
where people.street_id = streets_subset.id;
```

Rezultat:

```
     name
--------------
 Roger Jones
 Sally Norman
(2 rows)
```

Deși acesta este un exemplu foarte simplu și inutil pentru seturile de date restrânse, el ilustrează utilitatea și importanța sub-selecțiilor în cazul interogărilor efectuate asupra seturilor de date mari și complexe.

15.4.5 Agregarea Îmbinărilor

Una dintre cele mai puternice caracteristici ale unei baze de date o reprezintă capacitatea sa de a sintetiza datele din tabelele pe care le conține. Aceste sinteze sunt denumite interogări agregate. Iată un exemplu tipic, care ne spune cât de multe obiecte de tipul om sunt în tabela de personal:

```
select count(*) from people;
```

Rezultat:

```
 count
-------
     4
(1 row)
```

Dacă dorim un rezumat după numele străzii, putem proceda astfel:

```
select count(name), street_id
from people
group by street_id;
```

Rezultat:

```
 count | street_id
-------+-----------
     2 |         1
     1 |         3
     1 |         2
(3 rows)
```

Notă

Because we have not used an `ORDER BY` clause, the order of your results may not match what is shown here.

Încercați și dvs.: ???

Rezumați persoanele după numele străzii și afișați numele reale ale străzilor în loc de street_ids.

Răspuns

Iată instrucțiunea SQL corectă pe care ar trebui să o utilizați:

```
select count(people.name), streets.name
from people, streets
where people.street_id=streets.id
group by streets.name;
```

Rezultat:

```
count |    name
------+-------------
    1 | Low Street
    2 | High street
    1 | Main Road
(3 rows)
```

Veți observa că avem nume de câmpuri prefixate cu nume de tabel (de exemplu, persoane.nume și străzi.nume). Acest lucru trebuie făcut ori de câte ori numele câmpului este ambiguu (adică nu este unic în toate tabelele din baza de date).

15.4.6 În concluzie

Ați văzut cum se utilizează interogările pentru a returna datele din baza de date într-un mod care permite extragerea de informații utile.

15.4.7 Ce urmează?

Mai departe veți vedea cum să creați vizualizări, pornind de la interogările scrise.

15.5 Lesson: Views

De fiecare dată când scrieți o interogare, cheltuiți o mulțime de timp și efort pentru a o formula. Cu ajutorul vederilor, puteți salva definiția unei interogări SQL într-o «tabelă virtuală» reutilizabilă.

Scopul acestei lecții: Salvarea unei interogări sub formă de vedere.

15.5.1 Crearea unei Vederi

Puteți trata o vedere la fel ca pe o tabelă, însă datele sale provin dintr-o interogare. Haideți să efectuăm o vedere simplă, bazată pe cele de mai înainte:

```
create view roads_count_v as
  select count(people.name), streets.name
  from people, streets where people.street_id=streets.id
  group by people.street_id, streets.name;
```

As you can see the only change is the `create view roads_count_v as` part at the beginning. We can now select data from that view:

```
select * from roads_count_v;
```

Rezultat:

```
 count |    name
-------+-------------
     1 | Main Road
     2 | High street
     1 | Low Street
(3 rows)
```

15.5.2 Modificarea unei Vederi

O vizualizare nu este fixă și nu conține „date reale”. Aceasta înseamnă că o puteți modifica cu ușurință, fără a afecta vreo dată din baza de date:

```
CREATE OR REPLACE VIEW roads_count_v AS
  SELECT count(people.name), streets.name
  FROM people, streets WHERE people.street_id=streets.id
  GROUP BY people.street_id, streets.name
  ORDER BY streets.name;
```

(Acest exemplu demonstrează, de asemenea, că cea mai bună practică este de a folosi MAJUSCULE pentru toate cuvintele cheie SQL.)

You will see that we have added an `ORDER BY` clause so that our view rows are nicely sorted:

```
select * from roads_count_v;

 count |    name
-------+-------------
     2 | High street
     1 | Low Street
     1 | Main Road
(3 rows)
```

15.5.3 Eliminarea unei Vederi

Dacă nu mai aveți nevoie de vedere, o puteți șterge astfel:

```
drop view roads_count_v;
```

15.5.4 În concluzie

Vederile constau în salvarea unei interogări, urmată de accesarea rezultatelor acesteia ca și cum ar fi o tabelă.

15.5.5 Ce urmează?

Uneori, atunci când are loc o schimbare asupra datelor, veți dori ca modificările să aibă efecte în altă parte a bazei de date. Următoarea lecție vă arată cum să faceți acest lucru.

15.6 Lesson: Rules

Regulile permit „arborelui de interogare" rescrierea interogărilor primite. O utilizare comună o reprezintă implementarea vederilor, inclusiv a celor actualizabile. - *Wikipedia*

Scopul acestei lecții: De a afla cum se pot crea noi reguli pentru baza de date.

15.6.1 Crearea unei reguli de jurnalizare

Say you want to log every change of `phone_no` in your `people` table in to a `people_log` table. So you set up a new table:

```
create table people_log (name text, time timestamp default NOW());
```

In the next step, create a rule that logs every change of a `phone_no` in the `people` table into the `people_log` table:

```
create rule people_log as on update to people
  where NEW.phone_no <> OLD.phone_no
  do insert into people_log values (OLD.name);
```

Pentru a testa funcționarea regulii, haideți să modificăm un număr de telefon:

```
update people set phone_no = '082 555 1234' where id = 2;
```

Check that the `people` table was updated correctly:

```
select * from people where id=2;

 id |    name     | house_no | street_id |   phone_no
----+-------------+----------+-----------+--------------
  2 | Joe Bloggs |        3 |         2 | 082 555 1234
(1 row)
```

Now, thanks to the rule we created, the `people_log` table will look like this:

```
select * from people_log;

    name     |            time
-------------+----------------------------
 Joe Bloggs | 2014-01-11 14:15:11.953141
(1 row)
```

> **Notă**
>
> The value of the `time` field will depend on the current date and time.

15.6.2 În concluzie

Regulile vă permit adăugarea sau modificarea automată a datelor din baza de date, pentru a reflecta modificările din alte părți ale bazei de date.

15.6.3 Ce urmează?

The next module will introduce you to Spatial Database using PostgreSQL with PostGIS extension, which takes these database concepts and applies them to GIS data.

CAPITOLUL 16

Module: Spatial Database Concepts with PostGIS / PostgreSQL

Spatial Databases allow the storage of the geometries of records inside a Database as well as providing functionality for querying and retrieving the records using these Geometries. In this module we will use PostGIS, an extension to PostgreSQL, to learn how to setup a spatial database, import data into the database and make use of the geographic functions that PostGIS offers.

While working through this section, you may want to keep a copy of the **PostGIS cheat sheet** available from Boston GIS user group. Another useful resource is the online PostGIS documentation.

There are also some more extensive tutorials on PostGIS and Spatial Databases created by Boundless that are now hosted on the PostGIS's website:

- Introduction to PostGIS
- PostGIS Database Tips and Tricks

Citiți, de asemenea, PostGIS In Action.

16.1 Lesson: PostGIS Setup

Instalând funcțiile PostGIS vom putea accesa funcțiile spațiale din interiorul PostgreSQL.

Scopul acestei lecții: De a instala funcțiile spațiale, și pentru scurte demonstrații a aplicării lor.

Notă

We will assume the use of PostGIS version 2.1 or newer in this exercise. The installation and database configuration are different for older versions, but the rest of this material in this module will still work. Consult the documentation for your platform for help with installation and database configuration.

16.1.1 Instalarea sub Ubuntu

PostGIS este ușor de instalat din apt.

```
$ sudo apt install postgresql
$ sudo apt install postgis
```

Într-adevăr, este atât de ușor …

Notă

The exact versions that will be installed depend on which version of Ubuntu you are using and which repositories you have configured. After installing you can check the version by issuing a `select PostGIS_full_version();` query with psql or another tool.

To install a specific version (eg, PostgreSQL version 13 and PostGIS 3), you can use the following commands.

```
$ sudo apt install wget ca-certificates
$ sudo lsb_release -a
$ wget --quiet -O - https://www.postgresql.org/media/keys/ACCC4CF8.asc | sudo apt-
↪key add -
$ sudo sh -c 'echo "deb http://apt.postgresql.org/pub/repos/apt/ `lsb_release -cs`-
↪pgdg main" >> /etc/apt/sources.list.d/pgdg.list'
$ sudo apt-get update
$ sudo apt install postgis postgresql-13-postgis-3
```

16.1.2 Instalare sub Windows

Installing on Windows can be done from binary packages using a normal Windows installation dialogs.

First Visit the download page. Then follow this guide.

More information about installing on Windows can be found on the PostGIS website.

16.1.3 Instalarea pe Alte Platforme

The PostGIS website download has information about installing on other platforms including macOS and on other Linux distributions

16.1.4 Configurarea Bazei de Date pentru a utiliza PostGIS

După ce PostGIS este instalat, va trebui să configurați baza de date pentru a utiliza extensiile. Dacă ați instalat versiunea PostGIS > 2.0, aceasta este la fel de simplu ca și execuția următoarei comenzi în psql, folosind baza de date de adrese din exercițiul nostru anterior.

```
$ psql -d address -c "CREATE EXTENSION postgis;"
```

Notă

Depending on your version, you could find more instructions on how to spatially enable a database at https://postgis.net/docs/postgis_administration.html#create_spatial_db.

16.1.5 Funcțiile PostGIS instalate

PostGIS poate fi considerat ca o colecție de funcții din baza de date, care extind capabilitățile de bază ale PostgreSQL, astfel încât să poatădatelor spațiale. Prin «a face față», înțelegem stocarea, preluarea, interogarea și manipularea. Pentru a face acest lucru, sunt instalate o serie de funcții în baza de date.

Our PostgreSQL `address` database is now geospatially enabled, thanks to PostGIS. We are going to delve a lot deeper into this in the coming sections, but let's give you a quick little taster. Let's say we want to create a point from text. First we use the psql command to find functions relating to point. If you are not already connected to the `address` database, do so now. Then run:

```
\df *point*
```

This is the command we're looking for: `st_pointfromtext`. To page through the list, use the down arrow, then press `Q` to quit back to the psql shell.

Try running this command:

```
select st_pointfromtext('POINT(1 1)');
```

Rezultat:

```
st_pointfromtext
----------------------------------------------
0101000000000000000000F03F000000000000F03F
(1 row)
```

Trei lucruri de reținut:

- We defined a point at position 1,1 (EPSG:4326 is assumed) using `POINT(1 1)`,
- Am rulat o instrucțiune SQL, dar nu pe orice tabelă, doar pe datele introduse din promptul SQL,
- Rândul rezultat nu prea are sens.

Rândul rezultat se află în formatul OGC denumit «Well Known Binary» (WKB). Vom analiza în detaliu acest format în secțiunea următoare.

To get the results back as text, we can do a quick scan through the function list for something that returns text:

```
\df *text
```

The query we're looking for now is `st_astext`. Let's combine it with the previous query:

```
select st_astext(st_pointfromtext('POINT(1 1)'));
```

Rezultat:

```
 st_astext
------------
  POINT(1 1)
   (1 row)
```

Here, we entered the string `POINT(1,1)`, turned it into a point using `st_pointfromtext()`, and turned it back into a human-readable form with `st_astext()`, which gave us back our original string.

One last example before we really get into the detail of using PostGIS:

```
select st_astext(st_buffer(st_pointfromtext('POINT(1 1)'),1.0));
```

Care este rezultatul acestuia? S-a creat un tampon de 1 grad în jurul punctului nostru, și s-a returnat un rezultat sub formă de text.

16.1.6 Sistemele de Referință Spațială

În plus față de funcțiile PostGIS, extensia conține o colecție cu definiții ale sistemelor de referință spațială (SRS), așa cum au fost stabilite de către European Petroleum Survey Group (EPSG). Acestea sunt utilizate pentru operațiuni de conversie a sistemelor de referință și coordonate (CRS).

Putem inspecta aceste definiții SRS din baza noastră de date, pe măsură ce acestea sunt stocate în tabelele normale ale bazei de date.

First, let's look at the schema of the table by entering the following command in the psql prompt:

```
\d spatial_ref_sys
```

The result should be this:

```
Table "public.spatial_ref_sys"
   Column   |          Type           | Modifiers
 -----------+-------------------------+-----------
  srid      | integer                 | not null
  auth_name | character varying(256)  |
  auth_srid | integer                 |
  srtext    | character varying(2048) |
  proj4text | character varying(2048) |
  Indexes:
"spatial_ref_sys_pkey" PRIMARY KEY, btree (srid)
```

Puteți utiliza interogări SQL standard (așa cum am învățat din secțiunile introductive), pentru a vizualiza și manipula acest tabel - totuși, actualizarea sau ștergerea înregistrărilor nu reprezintă o idee bună dacă nu știți ce faceți.

One SRID you may be interested in is EPSG:4326 - the geographic / lat lon reference system using the WGS 84 ellipsoid. Let's take a look at it:

```
select * from spatial_ref_sys where srid=4326;
```

Rezultat:

```
srid      | 4326
auth_name | EPSG
auth_srid | 4326
srtext    | GEOGCS["WGS 84",DATUM["WGS_1984",SPHEROID["WGS
84",6378137,298.257223563,AUTHORITY["EPSG","7030"]],TOWGS84[0,
0,0,0,0,0,0],AUTHORITY["EPSG","6326"]],PRIMEM["Greenwich",0,
AUTHORITY["EPSG","8901"]],UNIT["degree",0.01745329251994328,
AUTHORITY["EPSG","9122"]],AUTHORITY["EPSG","4326"]]
proj4text | +proj=longlat +ellps=WGS84 +datum=WGS84 +no_defs
```

The `srtext` is the projection definition in well known text (you may recognise this from .prj files in your shapefile collection).

16.1.7 În concluzie

Acum aveți funcțiile PostGIS instalate în copia dvs. de PostgreSQL. Astfel, veți putea să faceți uz de funcțiile spațiale extinse ale PostGIS.

16.1.8 Ce urmează?

Mai departe, veți învăța cum se reprezintă entitățile spațiale într-o bază de date.

16.2 Lesson: Simple Feature Model

Cum putem să stocăm și să reprezentăm entitățile geografice într-o bază de date? În această lecție vom detalia una dintre abordări, Simple Feature Model, așa cum este definită de către OGC.

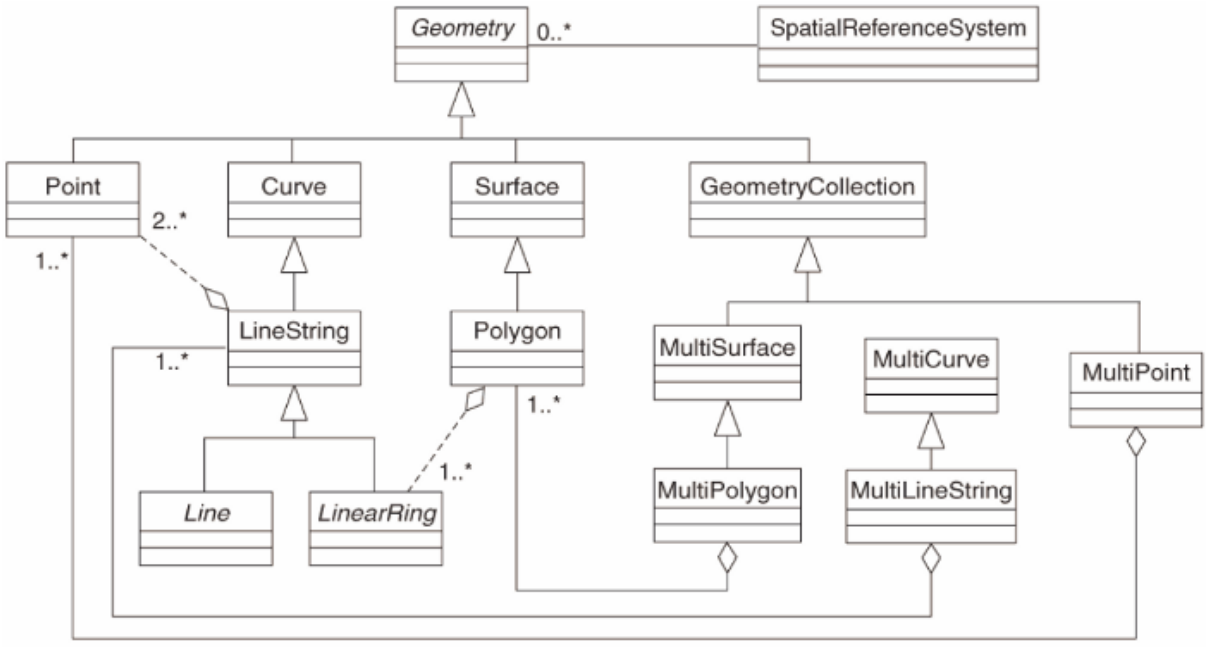
Scopul acestei lecții: De a afla ce este Modelul SFS și cum să-l folosiți.

16.2.1 Ce este OGC

Open Geospatial Consortium (OGC), o organizație internațională de voluntariat, dedicată stabilirii unor standarde, înființată în 1994. În OGC, mai mult de 370+ organizații comerciale, guvernamentale, non-profit și de cercetare la nivel mondial, colaborează într-un proces consensual deschis, încurajând dezvoltarea și implementarea standardelor pentru conținut și servicii geospațiale, prelucrarea și schimbul de date GIS. - *Wikipedia*

16.2.2 Ce este Modelul SFS

The Simple Feature for SQL (SFS) Model is a *non-topological* way to store geospatial data in a database and defines functions for accessing, operating, and constructing these data.



Modelul definește date geospațiale din tipurile Point, Linestring, și Polygon (și agregări ale acestora în obiecte Multi).

For further information, have a look at the OGC Simple Feature for SQL standard.

16.2.3 Adăugați un câmp geometric la tabelă

Let's add a point field to our people table:

```
alter table people add column geom geometry;
```

16.2.4 Adăugați o constrângere bazată pe tipul geometriei

You will notice that the geometry field type does not implicitly specify what *type* of geometry for the field - for that we need a constraint:

```
alter table people
add constraint people_geom_point_chk
    check(st_geometrytype(geom) = 'ST_Point'::text
          OR geom IS NULL);
```

Aceasta adaugă o constrângere la tabelă, astfel încât ea va accepta doar o geometrie de tip punct sau o valoare nulă.

16.2.5 ??? Încercați și dvs.:

Create a new table called cities and give it some appropriate columns, including a geometry field for storing polygons (the city boundaries). Make sure it has a constraint enforcing geometries to be polygons.

Răspuns

16.2.6 Popularea tabelei geometry_columns

At this point you should also add an entry into the `geometry_columns` table:

```
insert into geometry_columns values
  ('','public','people','geom',2,4326,'POINT');
```

Why? `geometry_columns` is used by certain applications to be aware of which tables in the database contain geometry data.

Notă

If the above `INSERT` statement causes an error, run this query first:

```
select * from geometry_columns;
```

If the column `f_table_name` contains the value `people`, then this table has already been registered and you don't need to do anything more.

The value `2` refers to the number of dimensions; in this case, two: **X** and **Y**.

The value `4326` refers to the projection we are using; in this case, WGS 84, which is referred to by the number 4326 (refer to the earlier discussion about the EPSG).

??? Încercați și dvs.:

Add an appropriate `geometry_columns` entry for your new cities layer

Răspuns

```
insert into geometry_columns values
      ('','public','cities','geom',2,4326,'POLYGON');
```

16.2.7 Adăugați o înregistare geometrică la tabelă, utilizând SQL

Now that our tables are geo-enabled, we can store geometries in them:

```
insert into people (name,house_no, street_id, phone_no, geom)
        values ('Fault Towers',
                  34,
                  3,
                  '072 812 31 28',
                  'SRID=4326;POINT(33 -33)');
```

Notă

In the new entry above, you will need to specify which projection (SRID) you want to use. This is because you entered the geometry of the new point using a plain string of text, which does not automatically add the correct projection information. Obviously, the new point needs to use the same SRID as the data-set it is being added to, so you need to specify it.

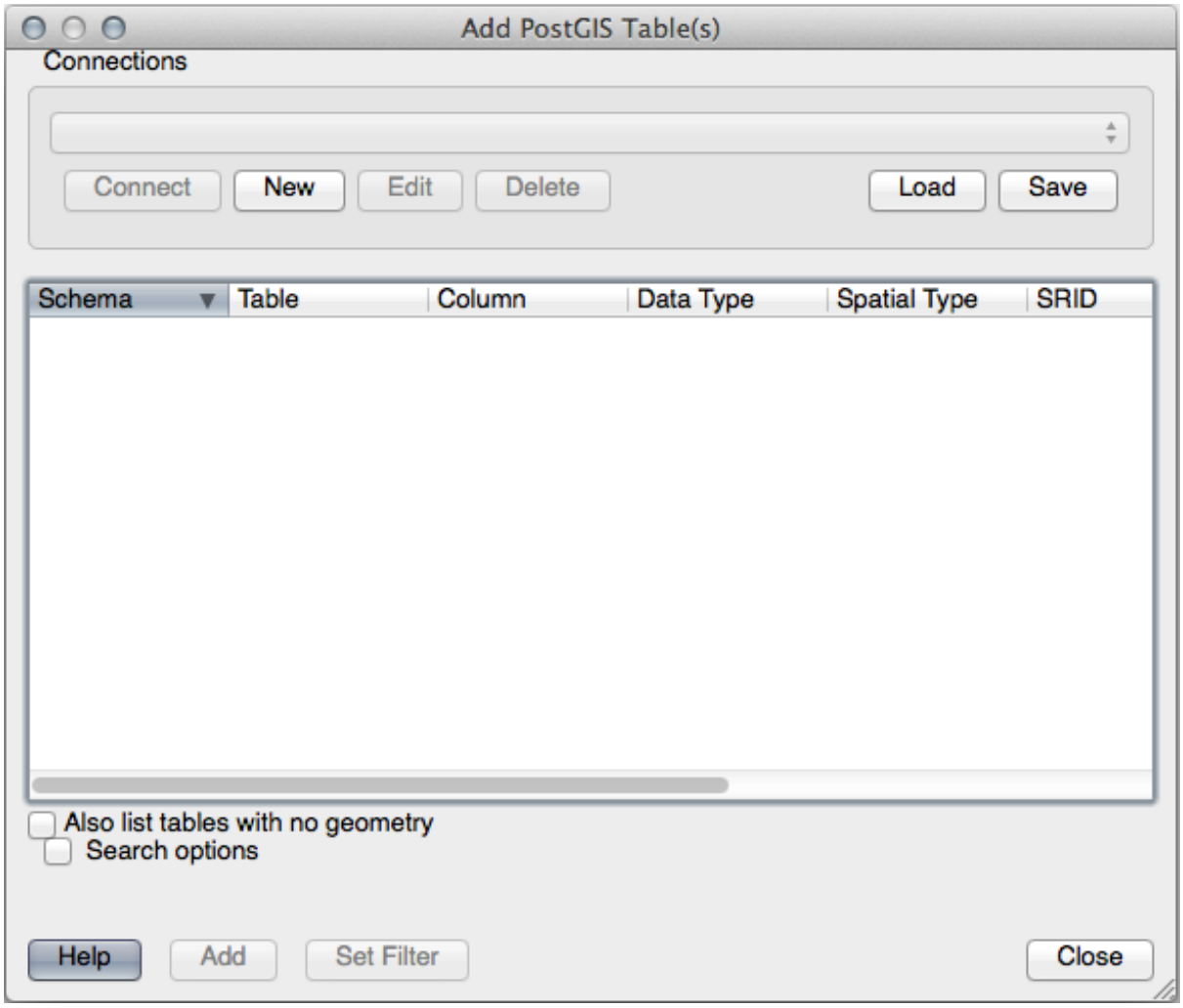
If at this point you were using a graphical interface, for example, specifying the projection for each point would be automatic. In other words, you usually won't need to worry about using the correct projection for every point you want to add if you've already specified it for that data-set, as we did earlier.

Now is probably a good time to open QGIS and try to view your `people` table. Also, we should try editing / adding / deleting records and then performing select queries in the database to see how the data has changed.

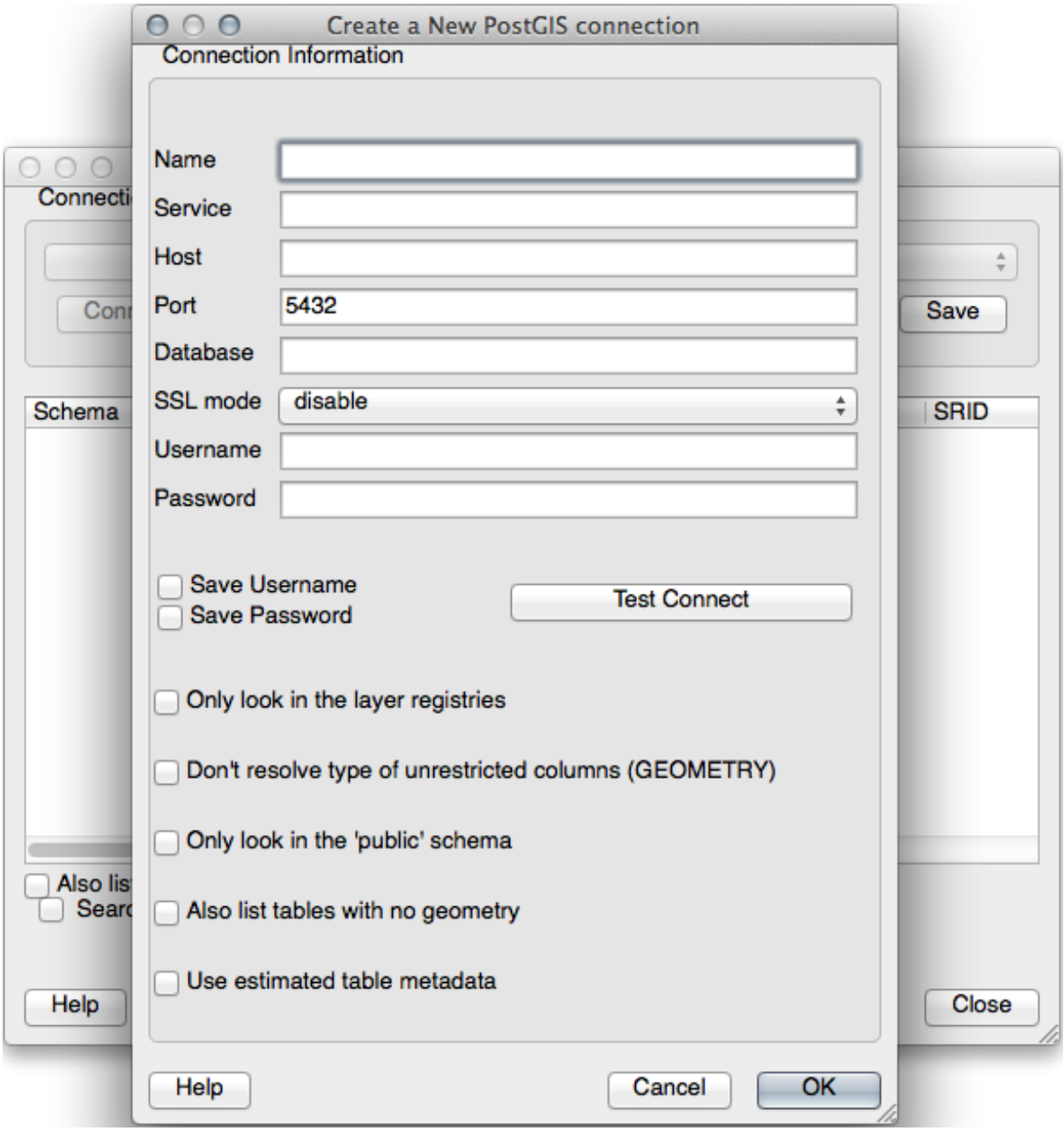
To load a PostgreSQL layer in QGIS, use the *Layer* ► *Add PostgreSQL Layers* menu option or toolbar button:



Se va deschide acest dialog:



Clic pe butonul *New* pentru a deschide acest dialog:



Apoi definiți o nouă conexiune, de exemplu.:

```
Name: myPG
Service:
Host: localhost
Port: 5432
Database: address
User:
Password:
```

To see whether QGIS has found the `address` database and that your username and password are correct, click *Test Connect*. If it works, check the boxes next to *Save Username* and *Save Password*. Then click *OK* to create this connection.

Back in the *Add PostgreSQL Layers* dialog, click *Connect* and add layers to your project as usual.

??? Try Yourself:

Formulate a query that shows a person's name, street name and position (from the geom column) as plain text.

Răspuns

```
select people.name,
       streets.name as street_name,
       st_astext(people.geom) as geometry
from   streets, people
where  people.street_id=streets.id;
```

Rezultat:

```
     name      | street_name |   geometry
---------------+-------------+---------------
 Roger Jones   | High street |
 Sally Norman  | High street |
 Jane Smith    | Main Road   |
 Joe Bloggs    | Low Street  |
 Fault Towers  | Main Road   | POINT(33 -33)
(5 rows)
```

As you can see, our constraint allows nulls to be added into the database.

16.2.8 În concluzie

Ați văzut cum să adăugați obiecte spațiale în baza de date, și cum să le puteți viziona în aplicația GIS.

16.2.9 Ce urmează?

Mai departe, veți vedea cum se importă și se exportă datele în/din baza de date.

16.3 Lesson: Import and Export

Of course, a database with no easy way to migrate data into it and out of it would not be of much use. Fortunately, there are a number of tools that will let you easily move data into and out of PostgreSQL.

16.3.1 shp2pgsql

shp2pgsql is a commandline tool to import ESRI Shapefile to the database. Under Unix, you can use the following command for importing a new PostgreSQL table:

```
shp2pgsql -s <SRID> -c -D -I <path to shapefile> <schema>.<table> | \
  psql -d <databasename> -h <hostname> -U <username>
```

Sub Windows, procesul de import trebuie efectuat în două etape:

```
shp2pgsql -s <SRID> -c -D -I <path to shapefile> <schema>.<table> > import.sql
psql psql -d <databasename> -h <hostname> -U <username> -f import.sql
```

Este posibil să întâlniți această eroare:

```
ERROR:  operator class "gist_geometry_ops" does not exist for access method
"gist"
```

This is a known issue regarding the creation *in situ* of a spatial index for the data you're importing. To avoid the error, exclude the `-I` parameter. This will mean that no spatial index is being created directly, and you'll need to create it in the database after the data have been imported. (The creation of a spatial index will be covered in the next lesson.)

16.3.2 pgsql2shp

pgsql2shp is a commandline tool to export PostgreSQL Tables, Views or SQL select queries. To do this under Unix:

```
pgsql2shp -f <path to new shapefile> -g <geometry column name> \
  -h <hostname> -U <username> <databasename> <table | view>
```

Pentru a exporta datele folosiți o interogare:

```
pgsql2shp -f <path to new shapefile> -g <geometry column name> \
  -h <hostname> -U <username> "<query>"
```

16.3.3 ogr2ogr

ogr2ogr is a very powerful tool to convert data into and from PostgreSQL to many data formats. ogr2ogr is part of the GDAL library and has to be installed separately. To export a table from PostgreSQL to GML, you can use this command:

```
ogr2ogr -f GML export.gml PG:'dbname=<databasename> user=<username>
        host=<hostname>' <Name of PostgreSQL-Table>
```

16.3.4 DB Manager

You may have noticed another option in the *Database* menu labeled *DB Manager*. This is a tool that provides a unified interface for interacting with spatial databases including PostgreSQL. It also allows you to import and export from databases to other formats. Since the next module is largely devoted to using this tool, we will only briefly mention it here.

16.3.5 În concluzie

Importing and exporting data to and from the database can be done in many various ways. Especially when using disparate data sources, you will probably use these functions (or others like them) on a regular basis.

16.3.6 Ce urmează?

Apoi, vom vedea cum se interoghează datele pe care le-am creat mai înainte.

16.4 Lecție: Interogări Spațiale

Interogările spațiale nu sunt diferite de alte interogări de baze de date. Puteți utiliza coloana de geometrie la fel ca pe orice altă coloană de baze de date. O dată cu instalarea PostGIS în baza noastră de date, avem la dispoziție funcții suplimentare pentru a interoga baza de date.

Scopul acestei lecții: De a afla cum sunt implementate funcțiile spațiale similare cu funcțiile non-spațiale „normale”.

16.4.1 Operatori Spaţiali

Când doriți să știți care puncte se află la o distanță de 2 grade față de un punct (X,Y), puteți proceda astfel cu:

```
select *
from people
where st_distance(geom,'SRID=4326;POINT(33 -34)') < 2;
```

Rezultat:

```
 id |     name      | house_no | street_id |   phone_no     |   geom
----+---------------+----------+-----------+----------------+----------------
  6 | Fault Towers |       34 |         3 | 072 812 31 28 | 01010008040C0
(1 row)
```

Notă

geom value above was truncated for space on this page. If you want to see the point in human-readable coordinates, try something similar to what you did in the section „View a point as WKT”, above.

De unde știm că interogarea de mai sus returnează toate punctele incluse în cadrul a 2 *grade*? De ce nu 2 *metri*? Sau oricare altă unitate?

Răspuns

The units being used by the example query are degrees, because the CRS that the layer is using is WGS 84. This is a Geographic CRS, which means that its units are in degrees. A Projected CRS, like the UTM projections, is in meters.

Remember that when you write a query, you need to know which units the layer's CRS is in. This will allow you to write a query that will return the results that you expect.

16.4.2 Indecși Spațiali

We also can define spatial indexes. A spatial index makes your spatial queries much faster. To create a spatial index on the geometry column use:

```
CREATE INDEX people_geo_idx
  ON people
  USING gist
  (geom);

\d people
```

Rezultat:

```
Table "public.people"
   Column    |         Type          |                 Modifiers
 ------------+-----------------------+-------------------------------------------
  id         | integer               | not null default
             |                       | nextval('people_id_seq'::regclass)
  name       | character varying(50) |
  house_no   | integer               | not null
  street_id  | integer               | not null
  phone_no   | character varying     |
  geom       | geometry              |
Indexes:
  "people_pkey" PRIMARY KEY, btree (id)
  "people_geo_idx" gist (geom)  <-- new spatial key added
  "people_name_idx" btree (name)
Check constraints:
  "people_geom_point_chk" CHECK (st_geometrytype(geom) = 'ST_Point'::text
  OR geom IS NULL)
Foreign-key constraints:
  "people_street_id_fkey" FOREIGN KEY (street_id) REFERENCES streets(id)
```

16.4.3 Încercați și dvs.: ???

Modificați tabelul orașelor, astfel încât coloana de geometrie să fie indexată spațial.

Răspuns

```
CREATE INDEX cities_geo_idx
  ON cities
  USING gist (geom);
```

16.4.4 Demo Funcții Spațiale PostGIS

În scopul demonstrării funcțiilor spațiale PostGIS , vom crea o nouă bază de date care conține câteva date (fictive).

To start, create a new database (exit the psql shell first):

```
createdb postgis_demo
```

Remember to install the postgis extensions:

```
psql -d postgis_demo -c "CREATE EXTENSION postgis;"
```

Next, import the data provided in the `exercise_data/postgis/` directory. Refer back to the previous lesson for instructions, but remember that you'll need to create a new PostGIS connection to the new database. You can import from the terminal or via DB Manager. Import the files into the following database tables:

- `points.shp` into `building`
- `lines.shp` into `road`
- `polygons.shp` into `region`

Load these three database layers into QGIS via the *Add PostGIS Layers* dialog, as usual. When you open their attribute tables, you'll note that they have both an `id` field and a `gid` field created by the PostGIS import.

Acum, că tabelele sunt importate, putem folosi PostGIS pentru a interoga datele. Mergeți înapoi în ferestra terminalului (linia de comandă) și introduceți promptul psql astfel:

```
psql postgis_demo
```

Vom demonstra unele dintre aceste expresii de selectare prin crearea unor vederi, pentru a le deschide apoi în QGIS și pentru a le observa rezultatele.

Selectare după locație

Get all the buildings in the KwaZulu region:

```
SELECT a.id, a.name, st_astext(a.geom) as point
  FROM building a, region b
    WHERE st_within(a.geom, b.geom)
    AND b.name = 'KwaZulu';
```

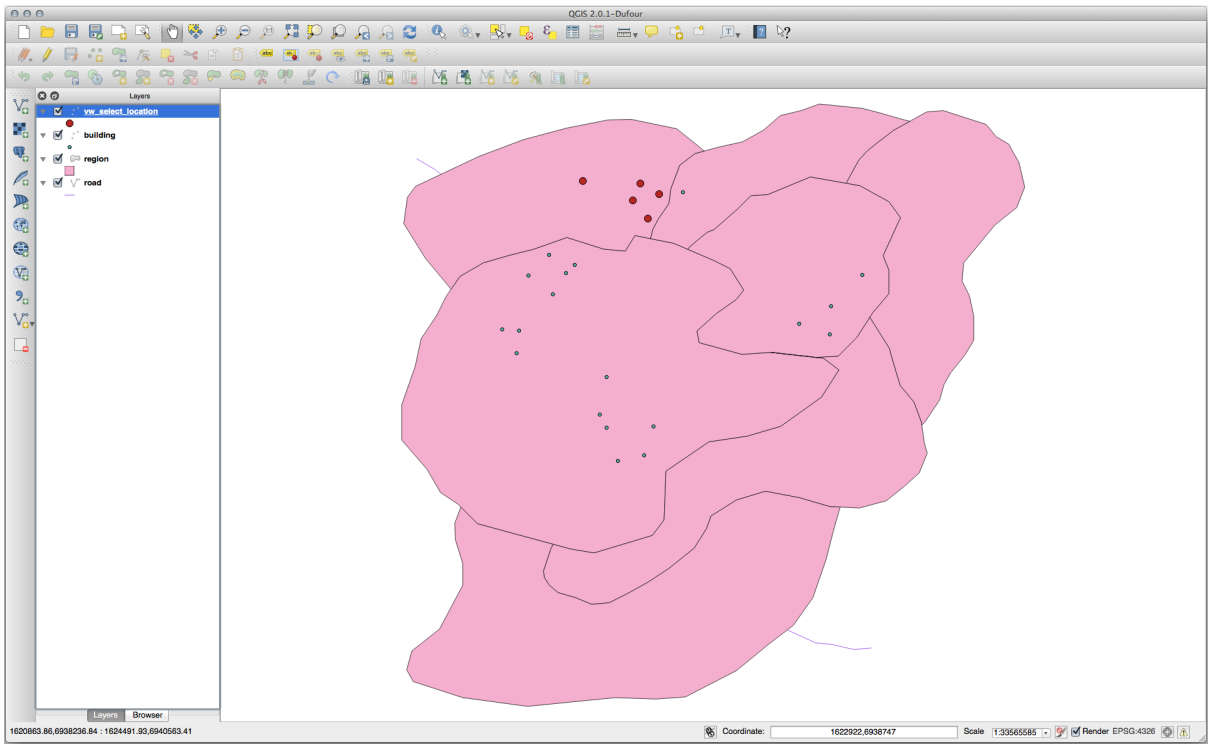
Rezultat:

```
 id | name |                  point
----+------+-----------------------------------------
 30 | York | POINT(1622345.23785063 6940490.65844485)
 33 | York | POINT(1622495.65620524 6940403.87862489)
 35 | York | POINT(1622403.09106394 6940212.96302097)
 36 | York | POINT(1622287.38463732 6940357.59605424)
 40 | York | POINT(1621888.19746548 6940508.01440885)
(5 rows)
```

Or, if we create a view from it:

```
CREATE VIEW vw_select_location AS
  SELECT a.gid, a.name, a.geom
    FROM building a, region b
      WHERE st_within(a.geom, b.geom)
      AND b.name = 'KwaZulu';
```

Adăugați vederea sub formă de strat, apoi vizualizați-o în QGIS:



Selectați vecinii

Show a list of all the names of regions adjoining the Hokkaido region:

```
SELECT b.name
  FROM region a, region b
    WHERE st_touches(a.geom, b.geom)
    AND a.name = 'Hokkaido';
```

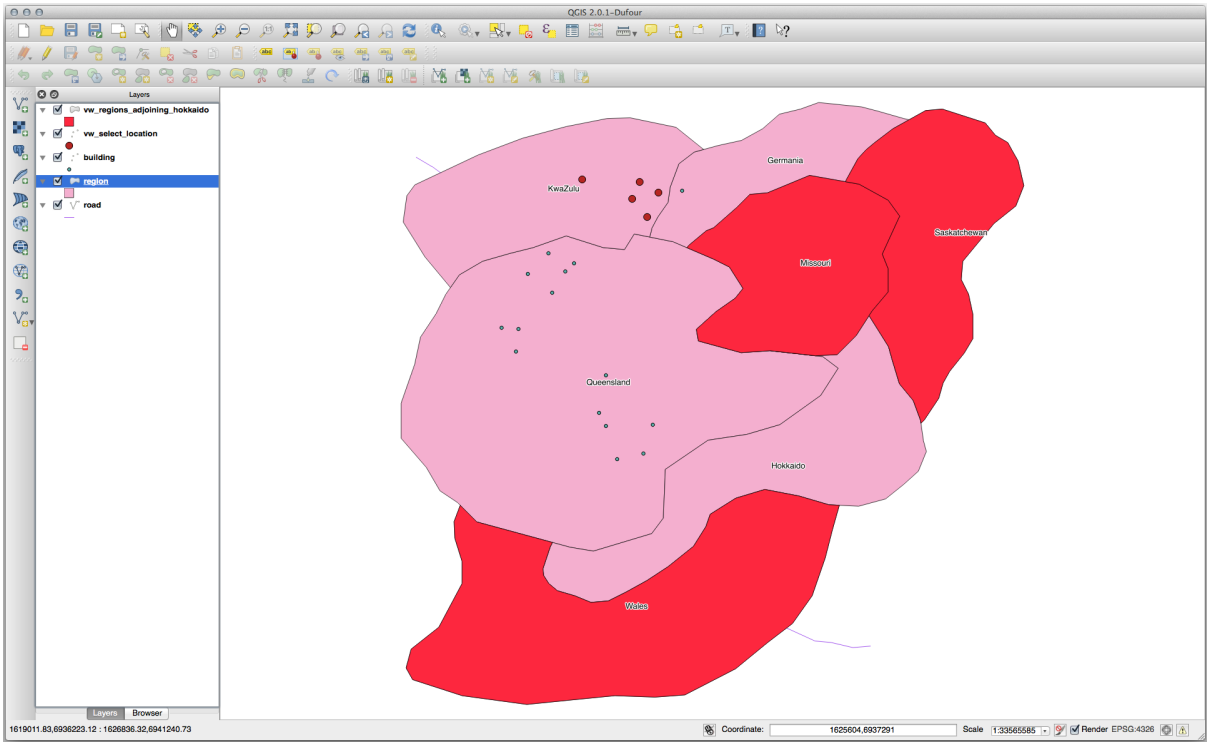
Rezultat:

```
    name
--------------
 Missouri
 Saskatchewan
 Wales
(3 rows)
```

As a view:

```
CREATE VIEW vw_regions_adjoining_hokkaido AS
  SELECT b.gid, b.name, b.geom
    FROM region a, region b
      WHERE st_touches(a.geom, b.geom)
      AND a.name = 'Hokkaido';
```

În QGIS:



Note the missing region (Queensland). This may be due to a topology error. Artifacts such as this can alert us to potential problems in the data. To solve this enigma without getting caught up in the anomalies the data may have, we could use a buffer intersect instead:

```
CREATE VIEW vw_hokkaido_buffer AS
  SELECT gid, ST_BUFFER(geom, 100) as geom
```

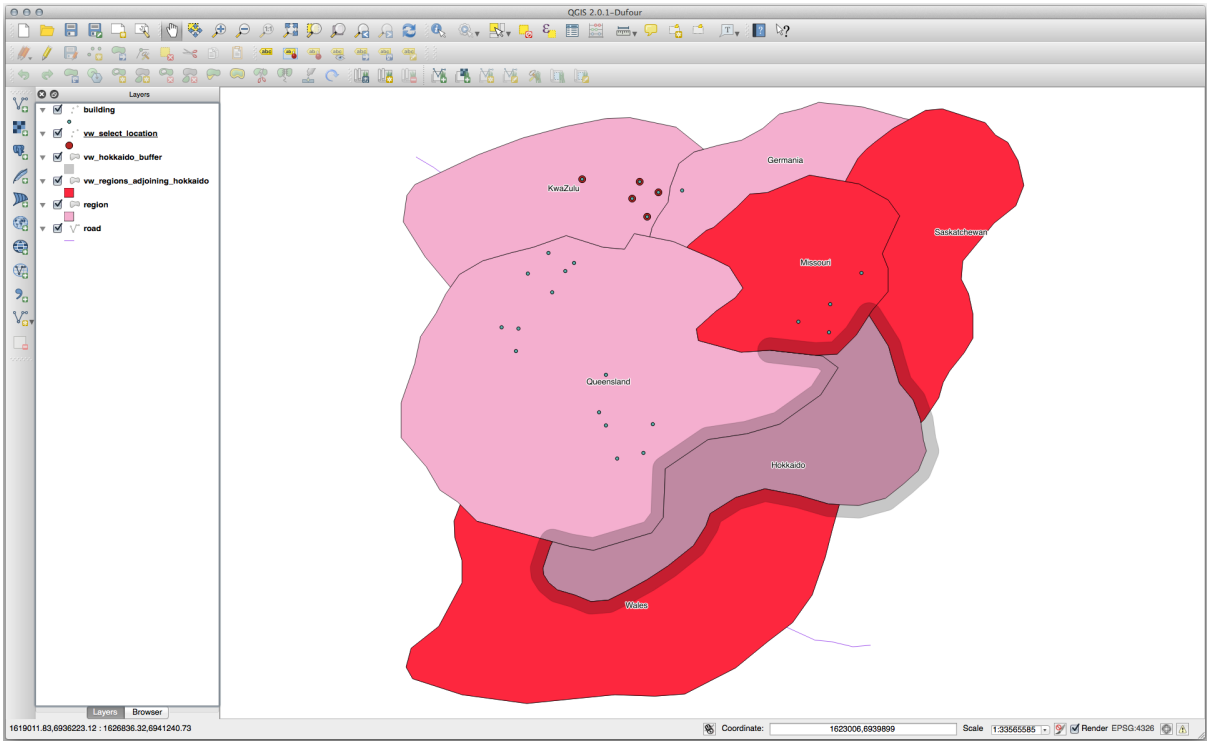
(continues on next page)

(continuare din pagina precedentă)

```
    FROM region
      WHERE name = 'Hokkaido';
```

Aceasta va crea o zonă tampon de 100 de metri în jurul regiunii Hokkaido.

Zona mai închisă este tamponul:

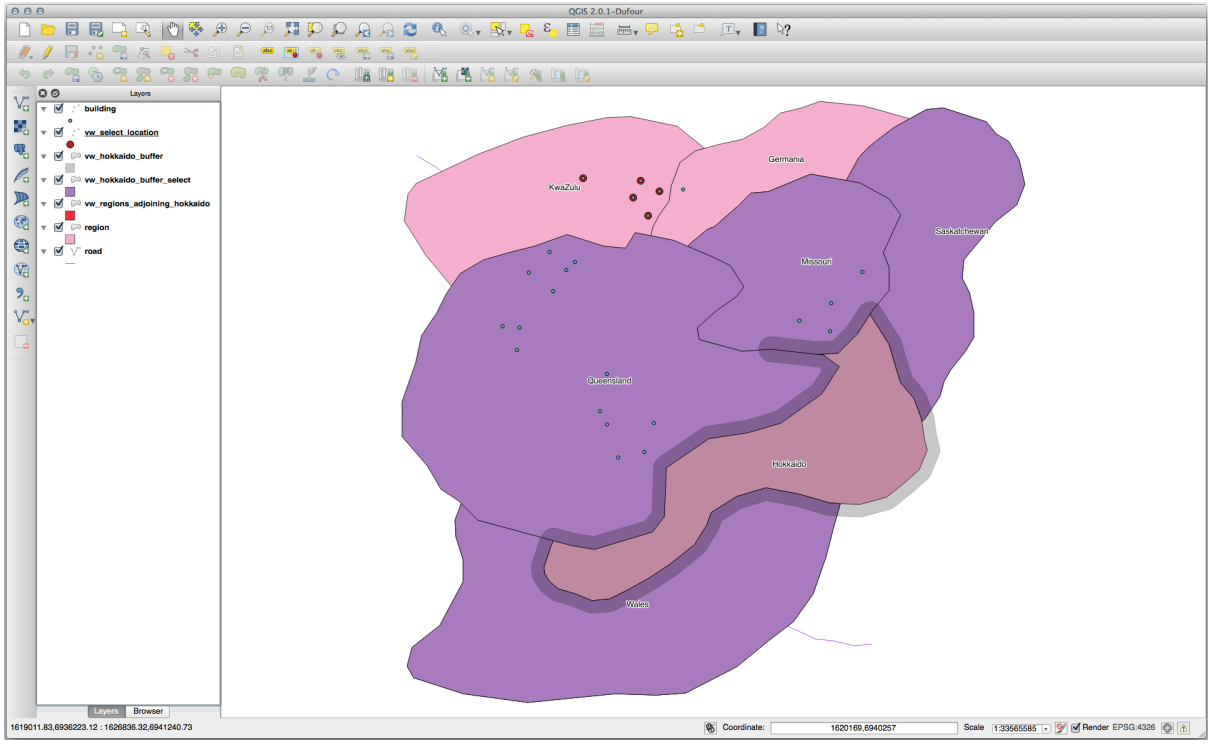


Select using the buffer:

```
CREATE VIEW vw_hokkaido_buffer_select AS
  SELECT b.gid, b.name, b.geom
    FROM
    (
      SELECT * FROM
        vw_hokkaido_buffer
    ) a,
    region b
    WHERE ST_INTERSECTS(a.geom, b.geom)
    AND b.name != 'Hokkaido';
```

In this query, the original buffer view is used as any other table would be. It is given the alias `a`, and its geometry field, `a.geom`, is used to select any polygon in the `region` table (alias `b`) that intersects it. However, Hokkaido itself is excluded from this select statement, because we don't want it; we only want the regions adjoining it.

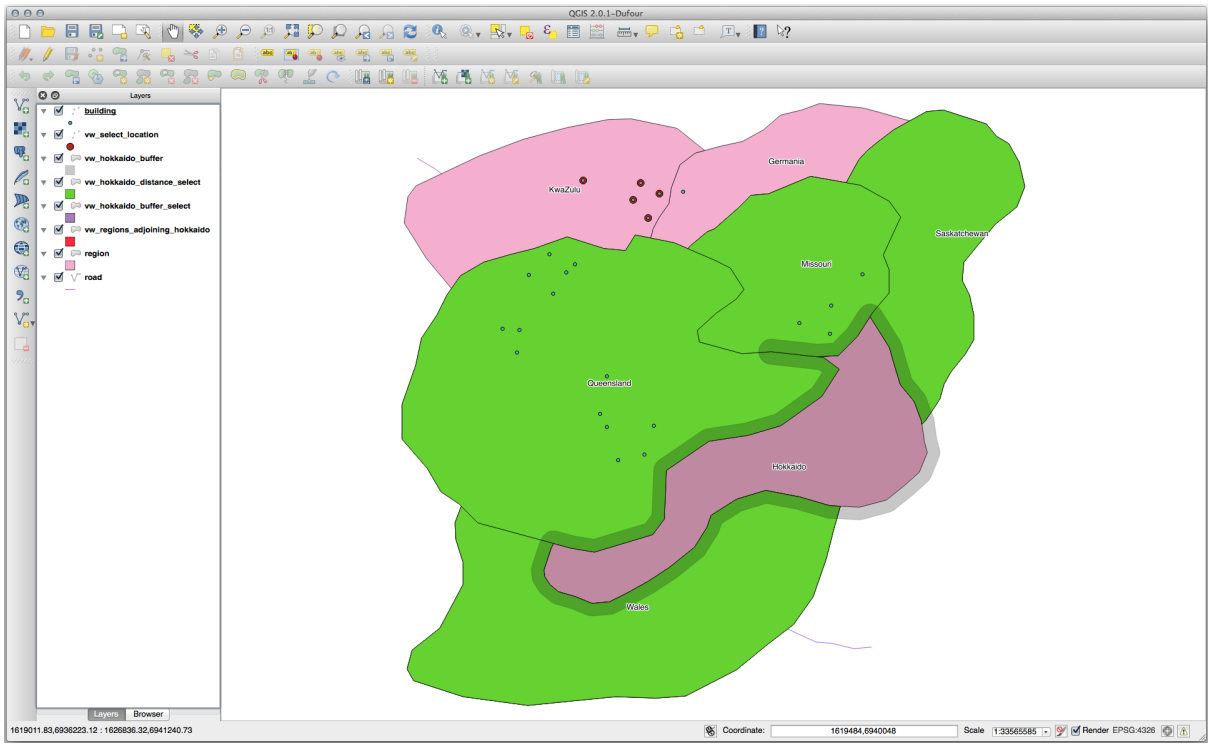
În QGIS:



It is also possible to select all objects within a given distance, without the extra step of creating a buffer:

```
CREATE VIEW vw_hokkaido_distance_select AS
  SELECT b.gid, b.name, b.geom
    FROM region a, region b
      WHERE ST_DISTANCE (a.geom, b.geom) < 100
      AND a.name = 'Hokkaido'
      AND b.name != 'Hokkaido';
```

Prin aceasta se obține același rezultat, fără a fi necesar pasul tamponului intermediar:



Selectați valorile unice

Show a list of unique town names for all buildings in the Queensland region:

```
SELECT DISTINCT a.name
  FROM building a, region b
    WHERE st_within(a.geom, b.geom)
    AND b.name = 'Queensland';
```

Rezultat:

```
  name
---------
 Beijing
 Berlin
 Atlanta
(3 rows)
```

Exemple suplimentare ...

```
CREATE VIEW vw_shortestline AS
  SELECT b.gid AS gid,
        ST_ASTEXT(ST_SHORTESTLINE(a.geom, b.geom)) as text,
        ST_SHORTESTLINE(a.geom, b.geom) AS geom
    FROM road a, building b
      WHERE a.id=5 AND b.id=22;

CREATE VIEW vw_longestline AS
  SELECT b.gid AS gid,
         ST_ASTEXT(ST_LONGESTLINE(a.geom, b.geom)) as text,
         ST_LONGESTLINE(a.geom, b.geom) AS geom
    FROM road a, building b
      WHERE a.id=5 AND b.id=22;
```

```
CREATE VIEW vw_road_centroid AS
  SELECT a.gid as gid, ST_CENTROID(a.geom) as geom
    FROM road a
      WHERE a.id = 1;

CREATE VIEW vw_region_centroid AS
  SELECT a.gid as gid, ST_CENTROID(a.geom) as geom
    FROM region a
      WHERE a.name = 'Saskatchewan';
```

```
SELECT ST_PERIMETER(a.geom)
  FROM region a
    WHERE a.name='Queensland';

SELECT ST_AREA(a.geom)
  FROM region a
    WHERE a.name='Queensland';
```

```
CREATE VIEW vw_simplify AS
  SELECT gid, ST_Simplify(geom, 20) AS geom
    FROM road;

CREATE VIEW vw_simplify_more AS
  SELECT gid, ST_Simplify(geom, 50) AS geom
    FROM road;
```

```
CREATE VIEW vw_convex_hull AS
  SELECT
    ROW_NUMBER() over (order by a.name) as id,
    a.name as town,
    ST_CONVEXHULL(ST_COLLECT(a.geom)) AS geom
    FROM building a
    GROUP BY a.name;
```

16.4.5 În concluzie

Ați văzut cum se pot interoga obiectele spațiale, cu ajutorul noilor funcții de bază de date din PostGIS.

16.4.6 Ce urmează?

Mai departe vom investiga structurile geometriilor complexe și cum să le creați cu ajutorul PostGIS.

16.5 Lesson: Geometry Construction

În această secțiune vom intra în detalii despre cum sunt construite geometriile în SQL. În realitate, probabil veți utiliza un GIS cum ar fi QGIS pentru creearea geometriilor complexe folosind instrumentele acestora; cu toate acestea, întelegerea modului cum sunt stocate poate fi utilă pentru scrierea de interogări și înțelegerea modului cum este alcătuită baza de date.

The goal of this lesson: To better understand how to create spatial entities directly in PostgreSQL.

16.5.1 Crearea Șirurilor de Linii

Going back to our `address` database, let's get our streets table matching the others; i.e., having a constraint on the geometry, an index and an entry in the `geometry_columns` table.

16.5.2 Încercați și dvs.: ???

- Modify the `streets` table so that it has a geometry column of type ST_LineString.
- Nu uitați să faceți actualizarea coloanelor de geometrie!
- De asemenea, adăugați o constrângere pentru a preveni adăugarea geometrii care nu sunt null sau de tip LINESTRINGS.
- Creați un index spațial în noua coloană de geometrie

Răspuns

```
alter table streets add column geom geometry;
alter table streets add constraint streets_geom_point_chk check
     (st_geometrytype(geom) = 'ST_LineString'::text OR geom IS NULL);
insert into geometry_columns values ('','public','streets','geom',2,4326,
     'LINESTRING');
create index streets_geo_idx
  on streets
  using gist
  (geom);
```

Now let's insert a linestring into our streets table. In this case we will update an existing street record:

```
update streets
set geom = 'SRID=4326;LINESTRING(20 -33, 21 -34, 24 -33)'
where streets.id=2;
```

Aruncați o privire la rezultatele din QGIS. (Poate fi necesar să faceți clic-dreapta pe stratul străzilor din panoul «Straturilor», apoi alegeți «Transfocare la extinderea stratului».)

Acum, creați mai multe intrări de străzi - unele în QGIS, iar altele din linia de comandă.

16.5.3 Crearea Poligoanelor

Creating polygons is just as easy. One thing to remember is that by definition, polygons have at least four vertices, with the last and first being co-located:

```
insert into cities (name, geom)
values ('Tokyo', 'SRID=4326;POLYGON((10 -10, 5 -32, 30 -27, 10 -10))');
```

Notă

Un poligon necesită acolade duble în jurul listei sale de coordonate; aceasta pentru a permite poligoane complexe având multiple zone neconectate. De exemplu

```
insert into cities (name, geom)
values ('Tokyo Outer Wards',
        'SRID=4326;POLYGON((20 10, 20 20, 35 20, 20 10),
                           (-10 -30, -5 0, -15 -15, -10 -30))'
        );
```

Dacă ați urmat acest pas, puteți verifica rezultatul prin încărcarea setului de date orașe în QGIS, deschizând tabelul de atribute al acestuia, și selectând noua intrare. Remarcați cum cele două noi poligoane se comportă ca unul singur.

16.5.4 Exercițiu: Learea Orașelor de Persoane

Pentru acest exercițiu ar trebui să faceți următoarele:

- Ștergeți toate datele din tabela de personal.
- Adăugați o coloană de cheie străină în tabela de personal, care face referire la cheia primară a tabelei orașelor.
- Utilizați QGIS pentru a captura unele orașe.
- Utilizați SQL pentru a introduce câteva înregistrări de personal, verificând că fiecare are asociate o stradă și un oraș.

Your updated people schema should look something like this:

```
\d people

Table "public.people"
   Column    |         Type          |                      Modifiers
 ------------+-----------------------+-----------------------------------------
  id         | integer               | not null
             |                       | default nextval('people_id_seq'::regclass)
  name       | character varying(50) |
  house_no   | integer               | not null
  street_id  | integer               | not null
  phone_no   | character varying     |
```

(continues on next page)

(continuare din pagina precedentă)

```
  geom      | geometry                |
  city_id   | integer                 | not null
Indexes:
  "people_pkey" PRIMARY KEY, btree (id)
  "people_name_idx" btree (name)
Check constraints:
  "people_geom_point_chk" CHECK (st_geometrytype(geom) =
                        'ST_Point'::text OR geom IS NULL)
Foreign-key constraints:
  "people_city_id_fkey" FOREIGN KEY (city_id) REFERENCES cities(id)
  "people_street_id_fkey" FOREIGN KEY (street_id) REFERENCES streets(id)
```

Răspuns

```
delete from people;
alter table people add column city_id int not null references cities(id);
```

(capture cities in QGIS)

```
insert into people (name,house_no, street_id, phone_no, city_id, geom)
   values ('Faulty Towers',
            34,
            3,
            '072 812 31 28',
            1,
            'SRID=4326;POINT(13 -15)');

insert into people (name,house_no, street_id, phone_no, city_id, geom)
   values ('IP Knightly',
            32,
            1,
            '071 812 31 28',
            1,
            'SRID=4326;POINT(18 -24)');

insert into people (name,house_no, street_id, phone_no, city_id, geom)
   values ('Rusty Bedsprings',
            39,
            1,
            '071 822 31 28',
            1,
            'SRID=4326;POINT(22 -25)');
```

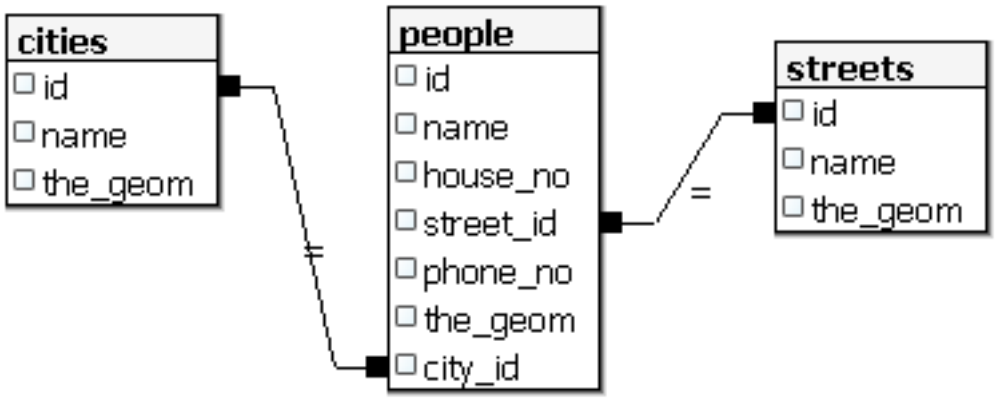
If you're getting the following error message:

```
ERROR:  insert or update on table "people" violates foreign key constraint
        "people_city_id_fkey"
DETAIL: Key (city_id)=(1) is not present in table "cities".
```

then it means that while experimenting with creating polygons for the cities table, you must have deleted some of them and started over. Just check the entries in your cities table and use any `id` which exists.

16.5.5 Analizați Schema Noastră

Acum, schrma noastră ar trebui să arate în felul următor:



16.5.6 Încercați și dvs.: ???

Creați marginile orașelor prin calucularea înfășurătorii convexe pentru toate adresele din acel oraș și calcularea unei zone tampon în jurul acesteia.

Răspuns

- Add some people in «Tokyo Outer Wards» city

```
INSERT INTO people (name, house_no, street_id, phone_no, city_id, geom)
   VALUES ('Bad Aboum',
            57,
            2,
            '073 712 31 21',
            2,
            'SRID=4326;POINT(22 18)');

INSERT INTO people (name, house_no, street_id, phone_no, city_id, geom)
   VALUES ('Pat Atra',
            59,
            2,
            '074 712 31 25',
            2,
            'SRID=4326;POINT(23 14)');

INSERT INTO people (name, house_no, street_id, phone_no, city_id, geom)
   VALUES ('Kat Herin',
            65,
            2,
            '074 722 31 28',
            2,
            'SRID=4326;POINT(29 18)');
```

- Create myPolygonTable table

```
CREATE TABLE myPolygonTable (
  id serial NOT NULL PRIMARY KEY,
  city_id int NOT NULL REFERENCES cities(id),
  geom geometry NOT NULL
);

ALTER TABLE myPolygonTable
  ADD CONSTRAINT myPolygonTable_geom_polygon_chk
  CHECK (st_geometrytype(geom) = 'ST_Polygon'::text );
```

- Create and load the convex hulls

```
INSERT INTO myPolygonTable (city_id, geom)
  SELECT * FROM
  (
    SELECT
      ROW_NUMBER() over (order by city_id)::integer AS city_id,
      ST_CONVEXHULL(ST_COLLECT(geom)) AS geom
        FROM people
        GROUP BY city_id
  ) convexHulls;
```

16.5.7 Accesul la Sub-Obiecte

With the SFS-Model functions, you have a wide variety of options to access sub-objects of SFS Geometries. When you want to select the first vertex point of every polygon geometry in the table `myPolygonTable`, you have to do this in this way:

- Transform the polygon boundary to a linestring:

```
select st_boundary(geom) from myPolygonTable;
```

- Select the first vertex point of the resultant linestring:

```
select st_startpoint(myGeometry)
from (
    select st_boundary(geom) as myGeometry
    from myPolygonTable) as foo;
```

16.5.8 Procesarea Datelor

PostGIS suportă toate funcțiile conforme standardelor OGC SFS/MM. Toate aceste funcții încep cu `ST_`.

16.5.9 Decuparea

To clip a subpart of your data you can use the `ST_INTERSECT()` function. To avoid empty geometries, use:

```
where not st_isempty(st_intersection(a.geom, b.geom))
```



```
select st_intersection(a.geom, b.geom), b.*
from clip as a, road_lines as b
where not st_isempty(st_intersection(st_setsrid(a.geom,32734),
  b.geom));
```



16.5.10 Construirea de Geometrii pornind de la Alte Geometrii

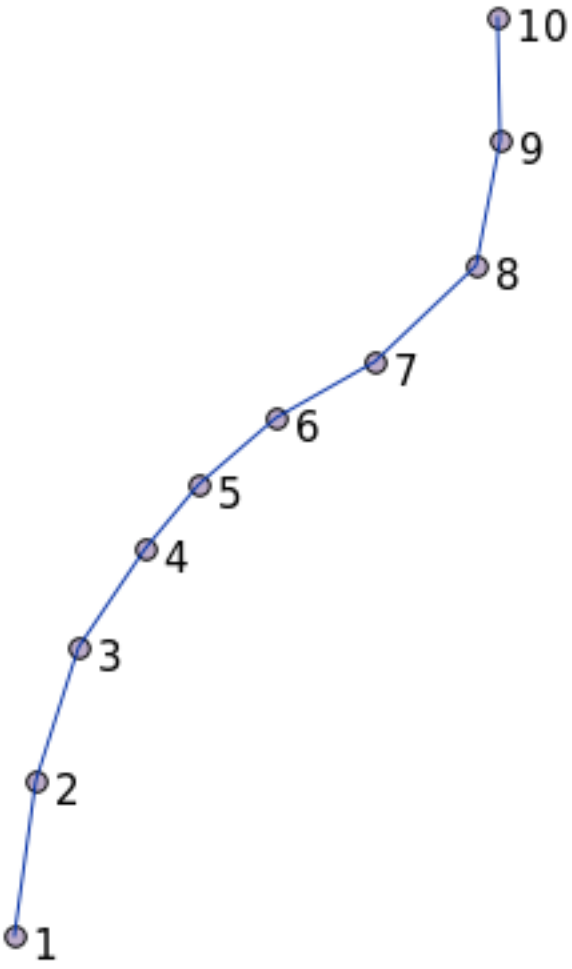
From a given point table, you want to generate a linestring. The order of the points is defined by their `id`. Another ordering method could be a timestamp, such as the one you get when you capture waypoints with a GPS receiver.



To create a linestring from a new point layer called «points», you can run the following command:

```
select ST_LineFromMultiPoint(st_collect(geom)), 1 as id
from (
  select geom
  from points
  order by id
) as foo;
```

Pentru a vedea cum funcționează fără a crea un nou strat, puteți executa această comandă în stratul «people», deși desigur nu ar avea prea mult sens în lumea reală.



16.5.11 Curățarea Geometriilor

You can get more information for this topic in this blog entry.

16.5.12 Diferențele dintre tabele

To detect the difference between two tables with the same structure, you can use the PostgreSQL keyword `EXCEPT`:

```
select * from table_a
except
select * from table_b;
```

As the result, you will get all records from `table_a` which are not stored in `table_b`.

16.5.13 Spațiile tabelelor

You can define where postgres should store its data on disk by creating tablespaces:

```
CREATE TABLESPACE homespace LOCATION '/home/pg';
```

When you create a database, you can then specify which tablespace to use e.g.:

```
createdb --tablespace=homespace t4a
```

16.5.14 În concluzie

Ați învățat cum să creeați geometrii mai complexe folosing instrucțiuni PostGIS. Rețineți că aceasta folosește la îmbunătățirea cunoștințelor pentru lucrul cu o bază de date spațială printr-o interfață GIS. În mod curent nu veți avea nevoie să folosiți aceste instrucțiuni manual, dar o înțelegere generală vă va ajuta la utilizarea unui GIS, în special dacă întâlniți erori care ar putea să pară altfel criptice.

CAPITOLUL 17

Ghidul de procesare al QGIS

Acest modul a fost publicat de Victor Olaya și Paolo Cavallini.

Cuprins:

17.1 Introducere

This guide describes how to use the QGIS processing framework. It assumes no previous knowledge of the Processing framework or any of the applications that it rely on. It assumes basic knowledge of QGIS. The chapters about scripting assume you have some basic knowledge of Python and maybe the QGIS Python API.

Acest ghid este conceput pentru studiu individual sau pentru utilizarea într-o sesiune de instruire.

Examples in this guide use QGIS 3.4. They might not work or not be available in versions other than that one.

This guide is comprised of a set of small exercises of progressive complexity. If you have never used the processing framework, you should start from the very beginning. If you have some previous experience, feel free to skip lessons. They are more or less independent of each other, and each one introduces some new concept or some new element, as indicated in the chapter title and the short introduction at the beginning of each chapter. That should make it easy to locate lessons dealing with a particular topic.

For a more systematic description of all the framework components and their usage, it is recommended to check the corresponding chapter in the user manual. Use it as a support text along with this guide.

All the exercises in this guide use the same free dataset used throughout the training manual and referenced at section *Data*. The zip file to download contains several folders corresponding to each one of the lessons in this guide. In each of them you will find a QGIS project file. Just open it and you will be ready to start the lesson.

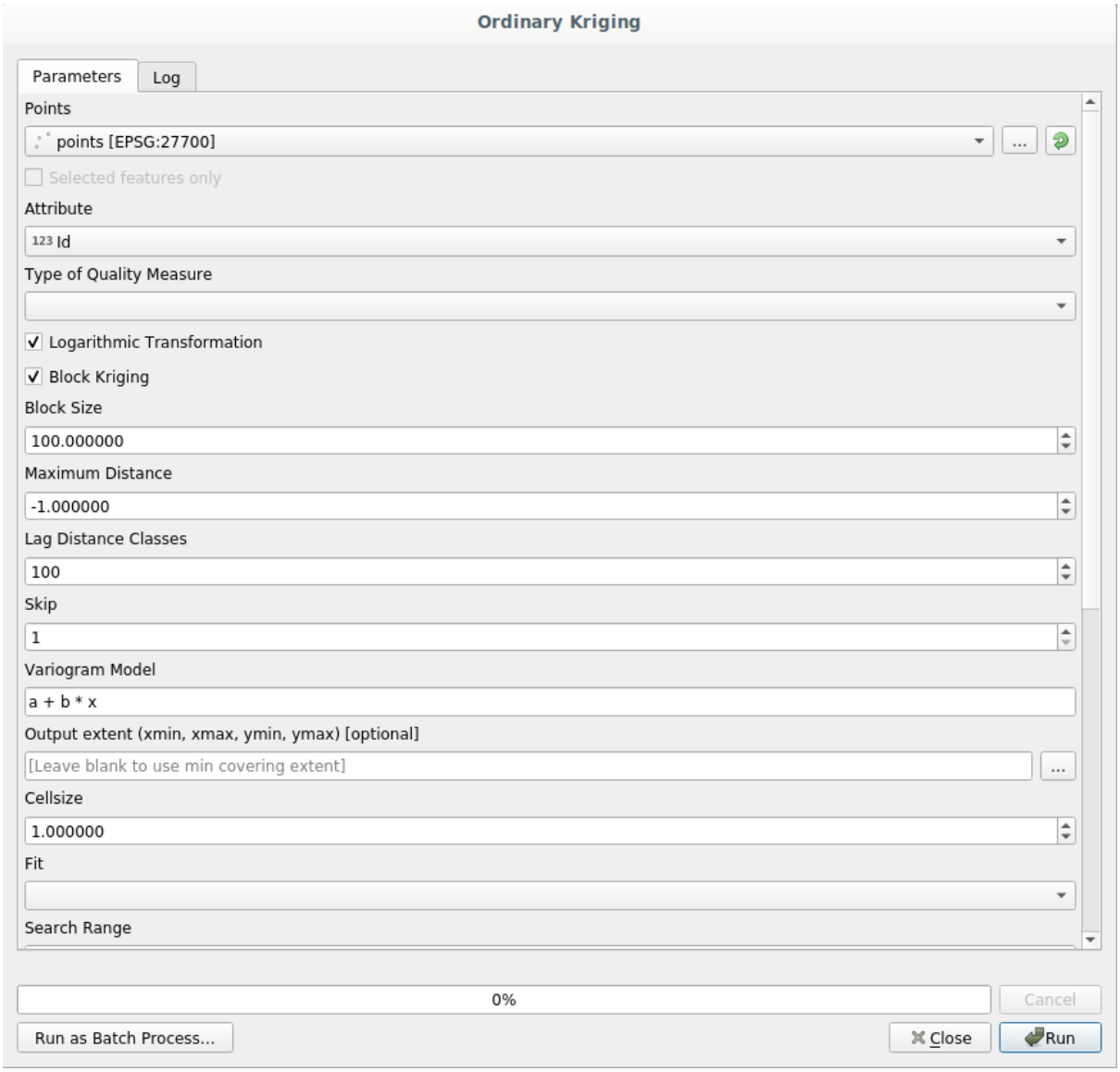
Utilizare plăcută!

17.2 Câteva lucruri importante de reținut, înainte de a începe

Just like the manual of a word processor doesn't teach you how to write a novel or a poem, or a CAD tutorial doesn't show you how to calculate the size of a beam for a building, this guide will not teach you spatial analysis. Instead, it will show you how to use the QGIS Processing framework, a powerful tool for performing spatial analysis. It is up to you to learn the required concepts that are needed to understand that type of analysis. Without them, there is no point in using the framework and its algorithms, although you might be tempted to try.

Haideți să vedem, pentru mai multă claritate, un exemplu.

Având în vedere un set de puncte și, pentru fiecare punct, o anumită valoare, cu ajutorul geoalgoritmului *Kriging* se poate calcula un strat raster. Caseta de dialog a parametrilor pentru acel modul este similară celei de mai jos.



It looks complex, right?

By reading this manual, you will learn things such as how to use that module, how to run it in a batch process to create raster layers from hundreds of points layers in a single run, or what happens if the input layer has some points selected. However, the parameters themselves are not explained. A seasoned analyst with a good knowledge of geostatistics will have no problem understanding those parameters. If you are not one of them and *sill*, *range*, or *nugget* are not familiar concepts to you, then you should not use the *Kriging* module. More than that, you are far from being ready to use the *Kriging* module, since it requires learning about concepts such as spatial autocorrelation or semivariograms,

which probably you also haven't heard before, or at least haven't studied long enough. You should first study and understand them, and then come back to QGIS to actually run it and perform the analysis. Ignoring this will result in wrong results and poor (and most likely useless) analysis.

Deși nu toți algoritmii sunt la fel de complecși ca și algoritmul kriging (unii dintre ei având o complexitate chiar mai mare!), aproape toți necesită o bună înțelegere a metodelor fundamentale de analiză, pe care se bazează. Fără acea cunoaștere, folosirea lor va conduce, cel mai probabil, la rezultate slabe.

Using geoalgorithms without having a good foundation of spatial analysis is like trying to write a novel without knowing anything about grammar or syntax, and having no knowledge about storytelling. You might get a result, but it is likely to have no value at all. Please, don't fool yourself and think that after reading this guide you are already capable of performing spatial analysis and get sound results. You need to study spatial analysis as well.

În continuare, este indicat un bun punct de referință, la care vă puteți raporta pentru a afla mai multe despre analiza datelor spațiale.

Analize geospațiale (a 3-a Ediție): Un Ghid Cuprinzător de Principii, Tehnici și Instrumente Software, Michael John De Smith, Michael F. Goodchild, Paul A. Longley

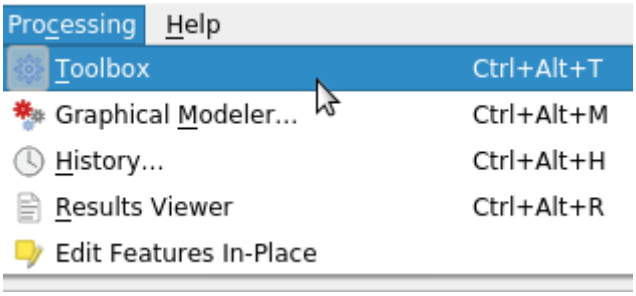
It is available online here

17.3 Inițierea cadrului de procesare

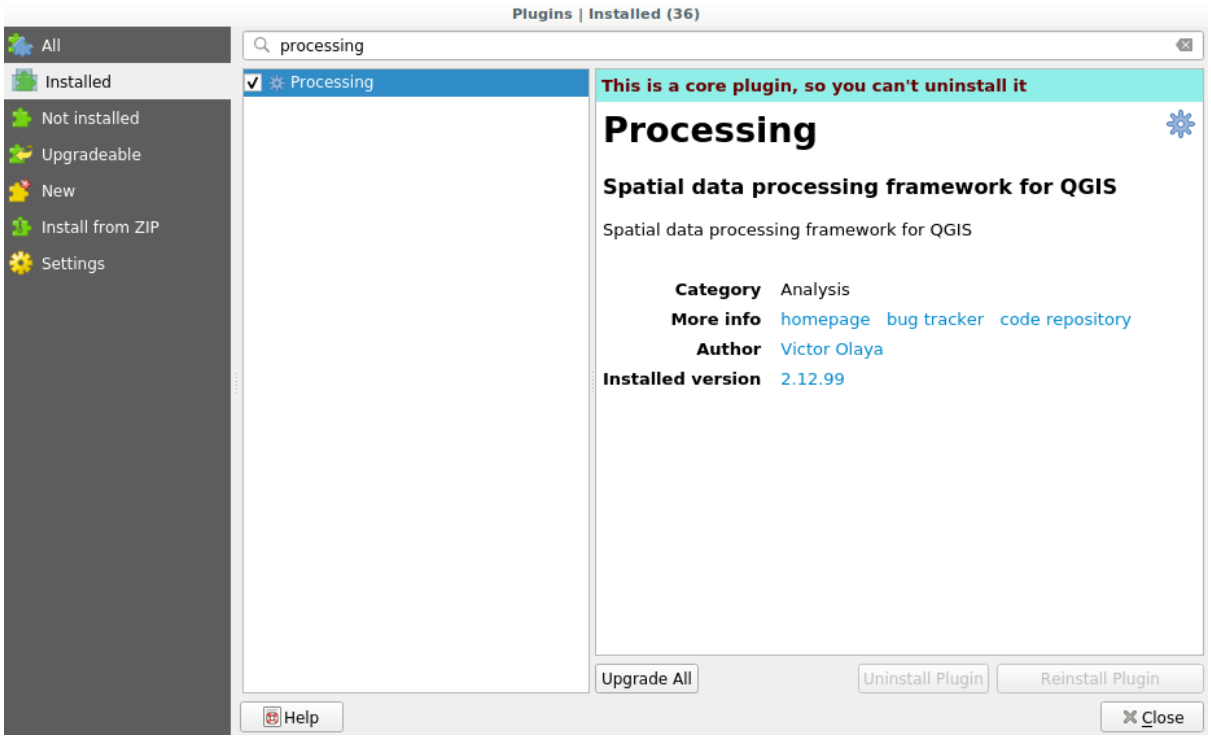
Primul lucru de făcut, înainte de a utiliza cadrul de prelucrare, este să-l configurați. Nu este mult de configurat, astfel încât aceasta este o sarcină ușoară.

Ulterior, vom vedea cum se configurează aplicațiile externe, care folosesc la extinderea listei algoritmilor disponibili, însă pentru moment vom lucra cu cadrul de lucru propriu-zis.

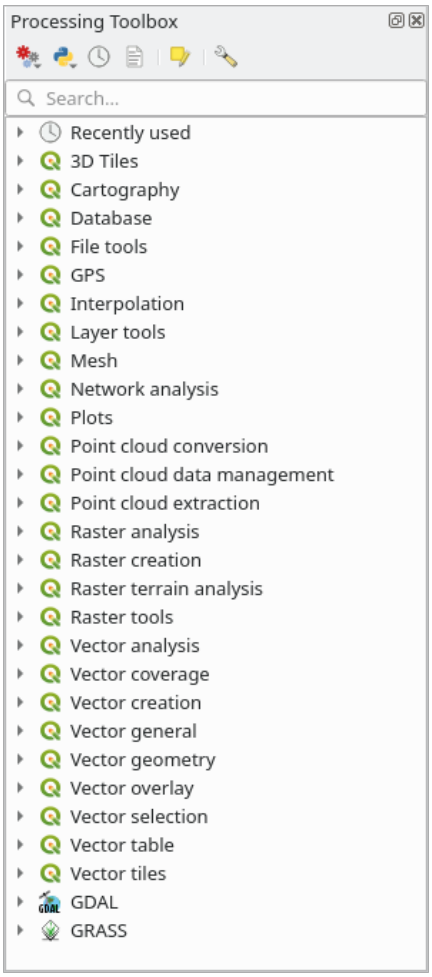
The processing framework is a core QGIS plugin, which means that it should already be installed in your system, since it is included with QGIS. In case it is active, you should see a menu called *Processing* in your menu bar. There you can access all the framework components.



Dacă nu puteți găsi acel meniu, trebuie să activați plugin-ul, din managerul de plugin-uri, și să-l activați.



Elementul principal cu care vom lucra este setul de instrumente. Faceți clic pe intrarea de meniu corespunzătoare, apoi veți vedea bara de instrumente andocată în partea dreaptă a ferestrei QGIS.



The toolbox contains a list of all the available algorithms, divided in groups called *Providers*. Providers can be (de)activated in the *Settings* ► *Options* ► *Processing*. We will discuss that dialog later in this manual.

By default, only providers that do not rely on third-party applications (that is, those that only require QGIS elements to be run) are active. Algorithms requiring external applications might need additional configuration. Configuring providers is explained in a later chapter in this manual.

Dacă ați ajuns la acest punct, acum sunteți gata de utilizare a geoalgoritmilor. Nu este nevoie să configurați nimic altceva. Putem rula deja primul nostru algoritm, lucru pe care îl vom face în lecția următoare.

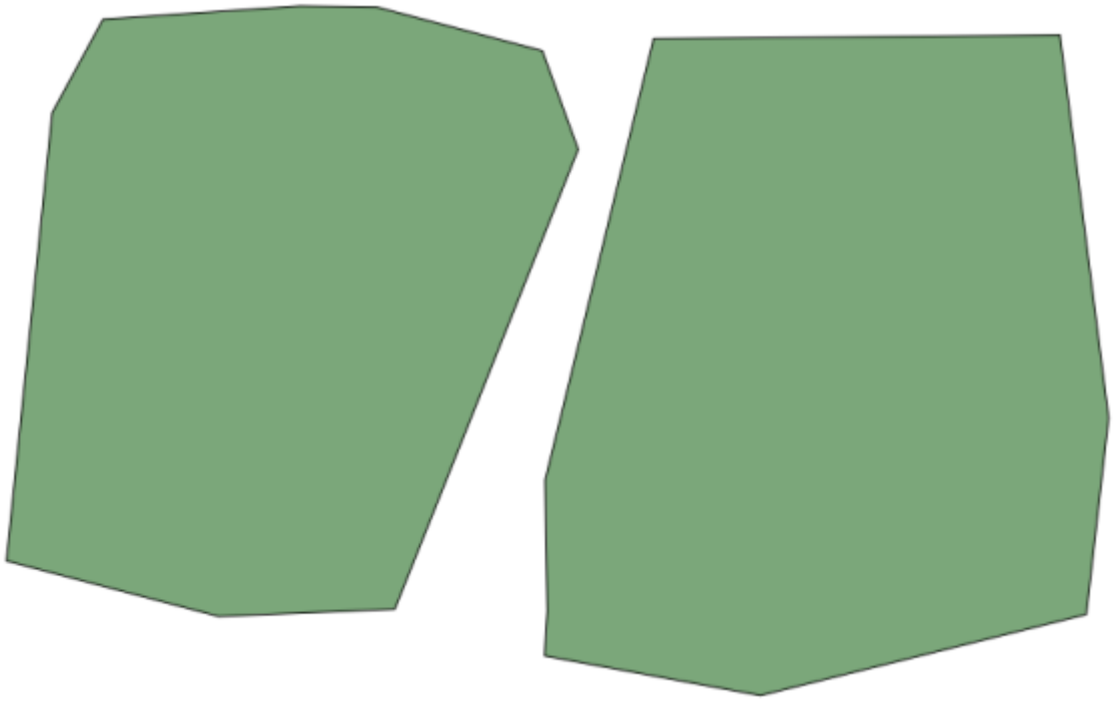
17.4 Rularea primului nostru algoritm. Setul de instrumente

Notă

În această lecție vom rula primul nostru algoritm pentru a obține un prim rezultat.

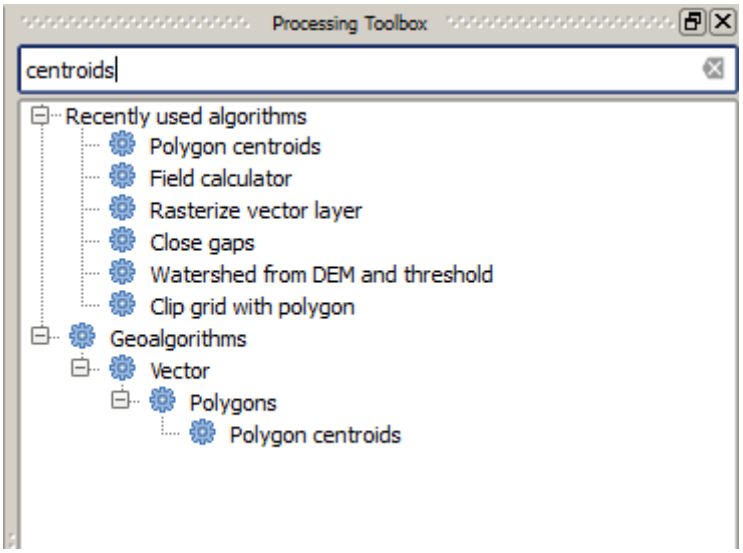
Așa cum am menționat deja, cadrul de procesare poate rula algoritmi ai altor aplicații, dar conține, de asemenea, algoritmi nativi care nu au nevoie de nici un software extern pentru a rula. Pentru a începe explorarea cadrului de procesare, vom rula unul dintre algoritmii nativi. În particular, vom calcula centroizii setului de poligoane.

În primul rând, deschideți proiectul QGIS corespunzător acestei lecții. Acesta conține doar un singur strat, cu două poligoane

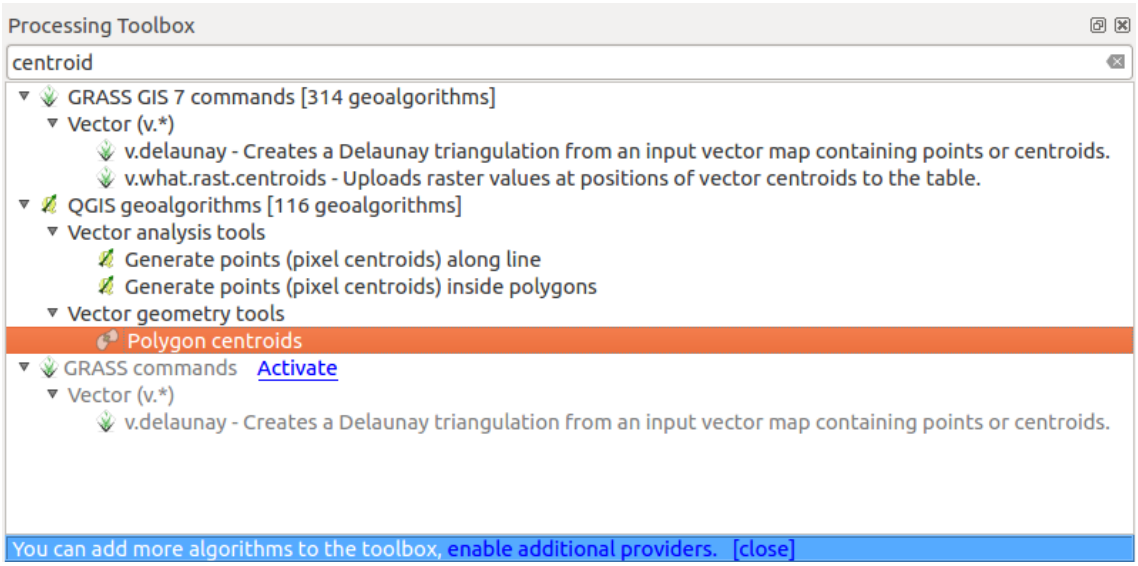


Now go to the text box at the top of the toolbox. That is the search box, and if you type text in it, it will filter the list of algorithms so just those ones containing the entered text are shown. If there are algorithms that match your search but belong to a provider that is not active, an additional label will be shown in the lower part of the toolbox.

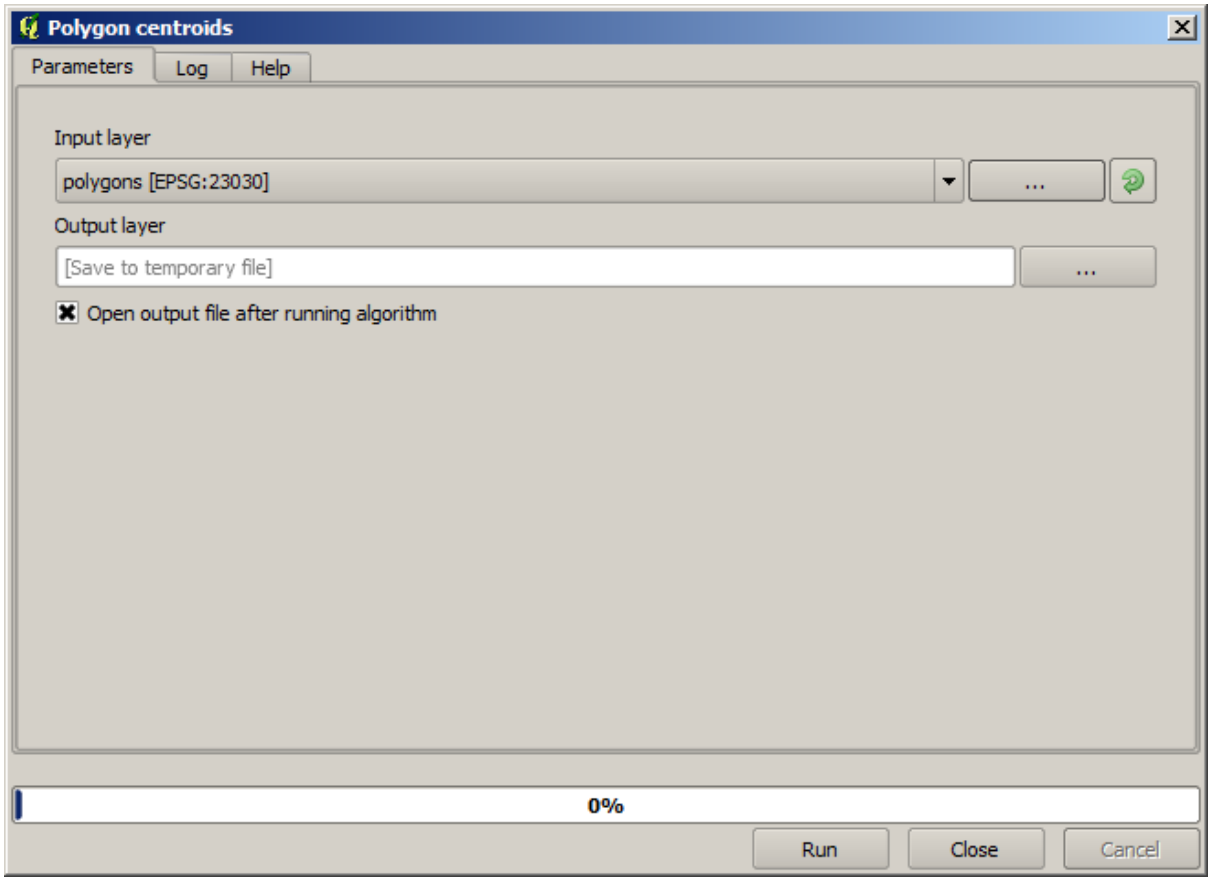
Introduceți `centroids`, după care ar trebui să vedeți ceva de genul următor:



Caseta de căutare este o modalitate foarte practică de a găsi algoritmul pe care îl căutați. În partea de jos a casetei de dialog, o etichetă suplimentară arată că există algoritmi care se potrivesc căutării dvs., dar aparțin unui furnizor care nu este activ. Dacă dați clic pe linkul din acea etichetă, lista de algoritmi va include și rezultatele de la acei furnizori inactivi, care vor fi afișate cu gri deschis. Este afișat și un link pentru activarea fiecărui furnizor inactiv. Vom vedea mai târziu cum să activăm alți furnizori.



To execute an algorithm, you just have to double-click on its name in the toolbox. When you double-click on the *Centroids* algorithm, you will see the following dialog.



Toți algoritmii au o interfață similară, care conține practic parametrii de intrare pe care trebuie să îi completați, și ieșirile pentru care trebuie să specificați unde se păstrează. În acest caz, singura intrare pe care o avem este un strat vectorial cu poligoane.

Select the `Polygons` layer as input. This also can be done by dragging and dropping the layer from the layers panel to the input box. The algorithm has a single output, which is the centroids layer. There are two options to define where a data output is saved: enter a filepath or save it to a temporary filename.

In case you want to set a destination and not save the result in a temporary file, the format of the output is defined by the filename extension. To select a format, just select the corresponding file extension (or add it if you are directly typing the filepath instead). If the extension of the filepath you entered does not match any of the supported ones, a default extension (usually `.dbf` for tables, `.tif` for raster layers and `.shp` for vector ones) will be appended to the filepath and the file format corresponding to that extension will be used to save the layer or table.

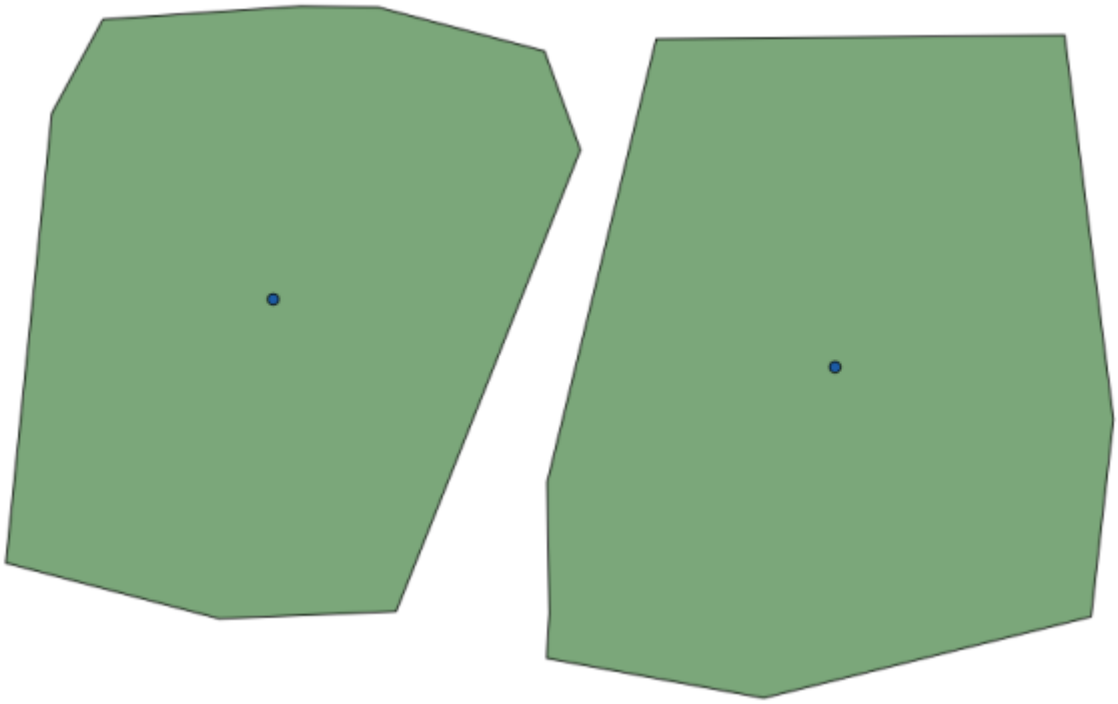
În toate exercițiile din acest ghid, vom salva rezultatele într-un fișier temporar, deoarece nu este nevoie să le salvăm pentru o utilizare ulterioară. Simțiți-vă liber să le salvați într-o locație permanentă dacă doriți.

Atenționare

O dată ce se închide QGIS, fișierele temporare vor fi șterse. În cazul unui proiect cu o ieșire generată temporar, la deschiderea ulterioară a proiectului, QGIS va semnala acest lucru, din moment ce fișierul nu mai există.

După ce ați configurat fereastra de dialog pentru algoritm, apăsați *Run* pentru a rula algoritmul.

Veți obține rezultatul următor.



Ieșirea are același CRS ca și intrarea. Geoalgoritmii presupun că toate straturile de intrare au același CRS și, de aceea, nu vor efectua nici o reproiectare. Cu excepția cazului unor algoritmi speciali (cum ar fi cei de reproiectare), ieșirile vor avea același CRS. Vom vedea în curând mai multe despre acest lucru.

Try yourself saving it using different file formats (use, for instance, `shp` and `geojson` as extensions). Also, if you do not want the layer to be loaded in QGIS after it is generated, you can check off the checkbox that is found below the output path box.

17.5 Mai multe tipuri de date și algoritmi

Notă

În această lecție vom rula mai mult de trei algoritmi, veți învăța cum să folosiți alte tipuri de intrări, și cum să configurați rezultatele pentru a fi salvate automat într-un anumit folder.

Pentru aceste lecții vom avea nevoie de o tabelă și de un strat poligonal. Vom crea un strat de puncte bazat pe coordonatele din tabel, și apoi vom contoriza numărul de puncte din fiecare poligon. Dacă deschideți proiectul QGIS corespunzător acestei lecții, veți găsi un tabel cu coordonatele X și Y, dar veți identifica nici un strat poligonal. Nu vă faceți griji, îl vom crea folosind un geoalgoritm de procesare.

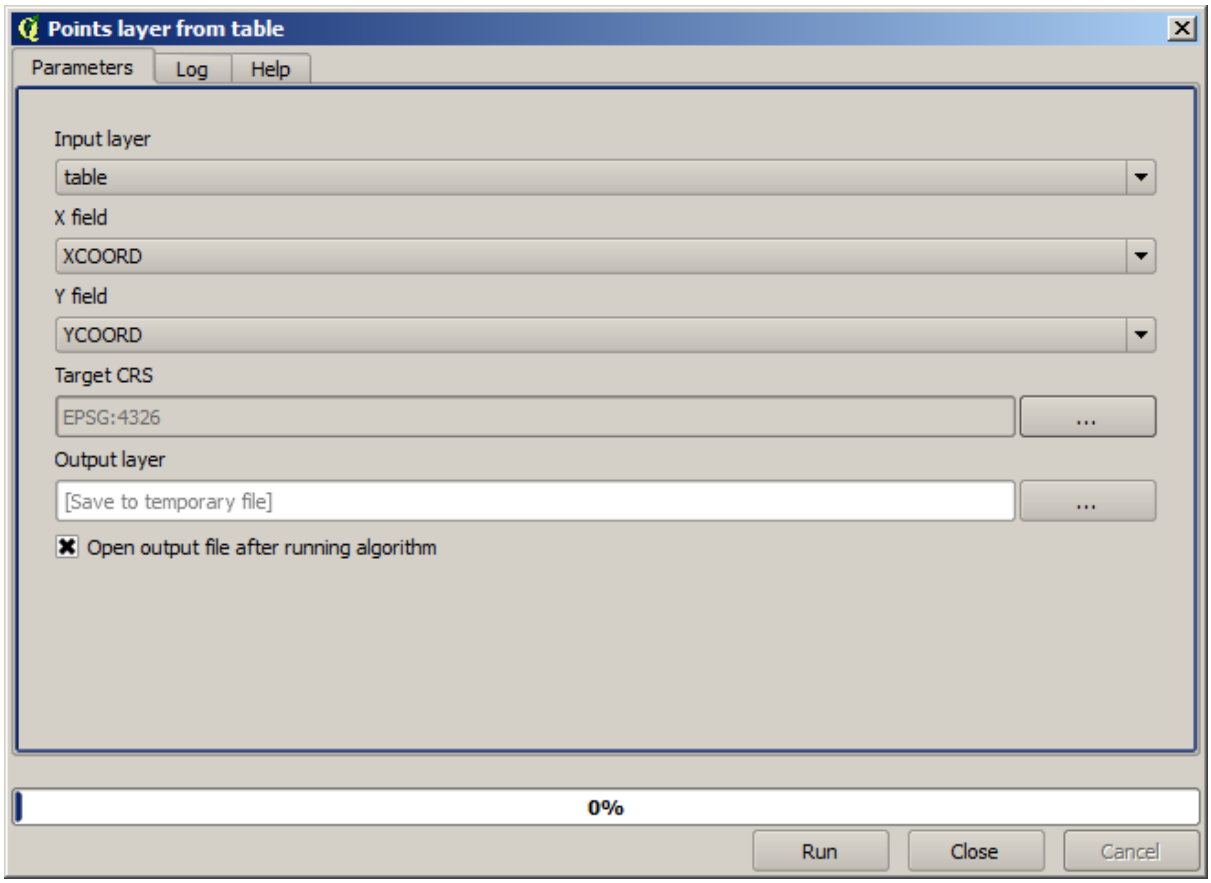
The first thing we are going to do is to create a points layer from the coordinates in the table, using the *Create points layer from table* algorithm. You now know how to use the search box, so it should not be hard for you to find it. Double-click on it to run it and get to its following dialog.

Acest algoritm, la fel ca și cel din lecția precedentă, generează doar o singură ieșire, având trei intrări:

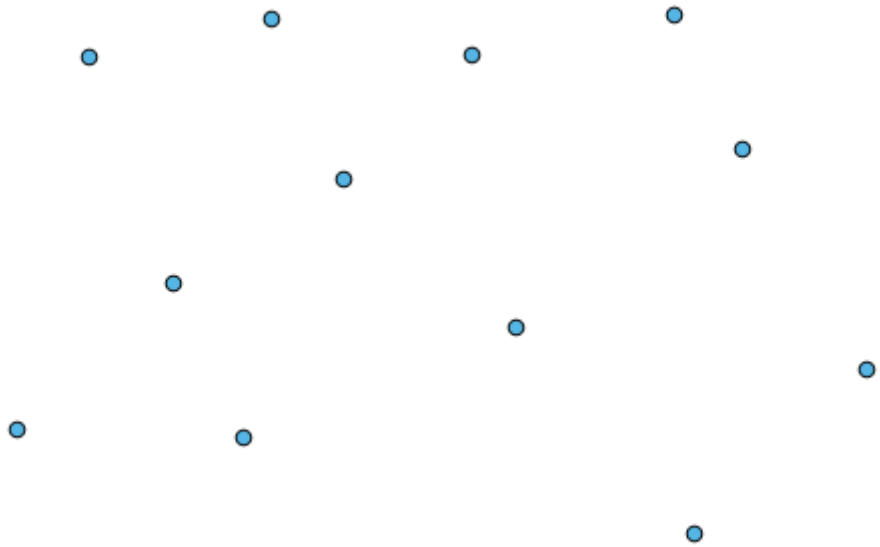
- *Tabela*: tabela cu coordonate. Ar trebui să selectați aici tabela corespunzătoare lecției.
- *X and Y fields*: these two parameters are linked to the first one. The corresponding selector will show the name of those fields that are available in the selected table. Select the `XCOORD` field for the *X* parameter, and the `YYCOORD` field for the *Y* parameter.

- *CRS*: Since this algorithm takes no input layers, it cannot assign a CRS to the output layer based on them. Instead, it asks you to manually select the CRS that the coordinates in the table use. Click on the button on the left–hand side to open the QGIS CRS selector, and select EPSG:4326 as the output CRS. We are using this CRS because the coordinates in the table are in that CRS.

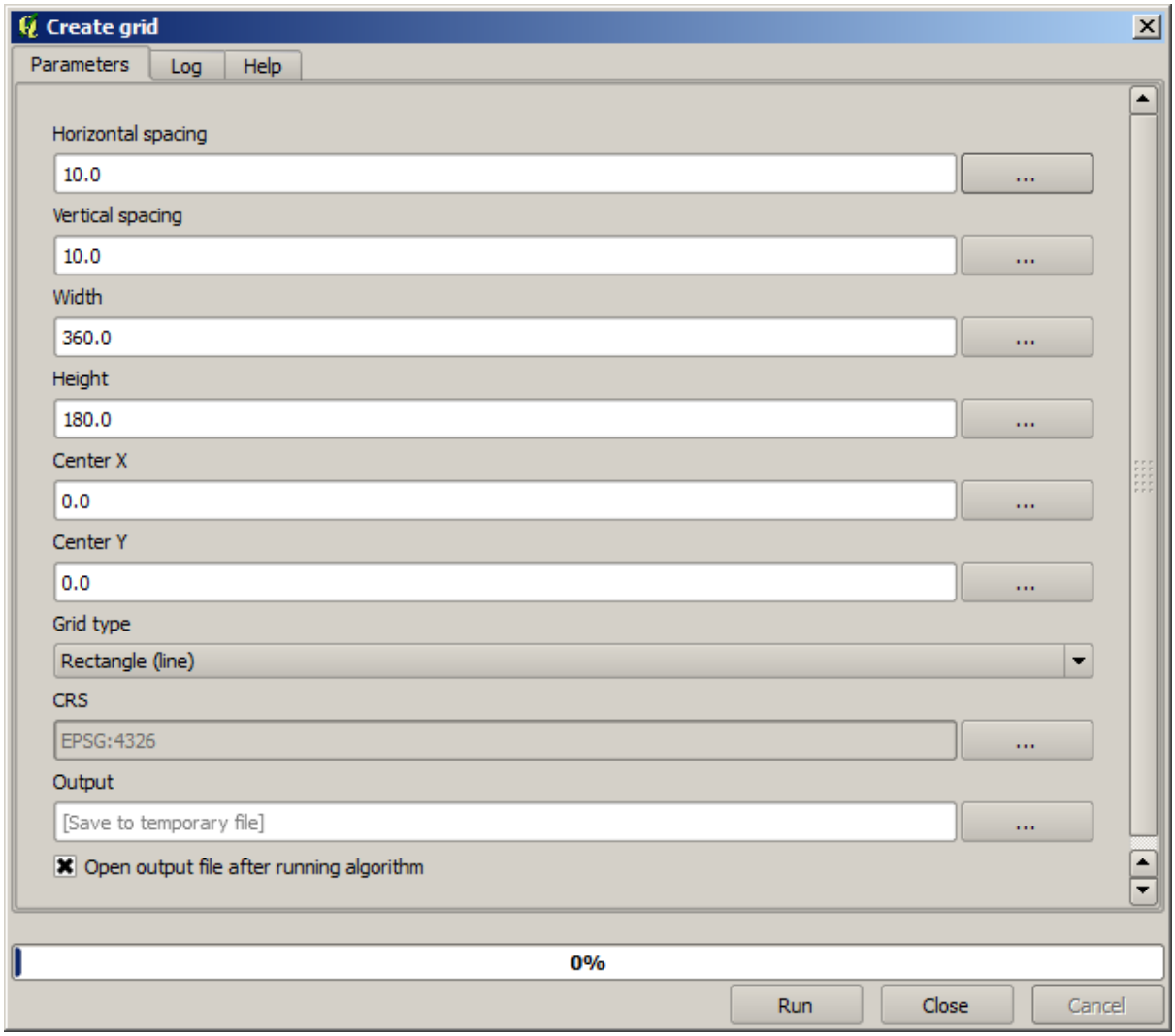
Dialogul dvs. ar trebui să arate astfel.



Now press the *Run* button to get the following layer (you may need to zoom full to reenter the map around the newly created points):



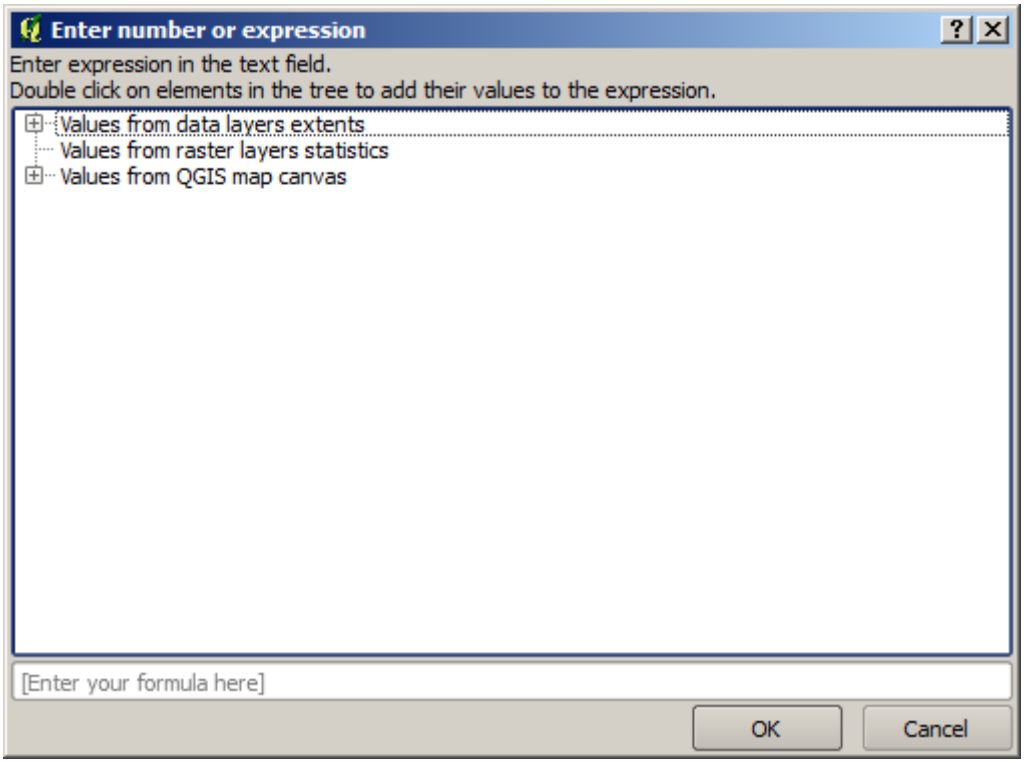
The next thing we need is the polygon layer. We are going to create a regular grid of polygons using the *Create grid* algorithm, which has the following parameters dialog.



Atenționare

The options are simpler in recent versions of QGIS; you just need to enter min and max for X and Y (suggested values: -5.696226,-5.695122,40.24742,40.248171)

The inputs required to create the grid are all numbers. When you have to enter a numerical value, you have two options: typing it directly on the corresponding box or clicking the button on the right–hand side to get to a dialog like the one shown next.



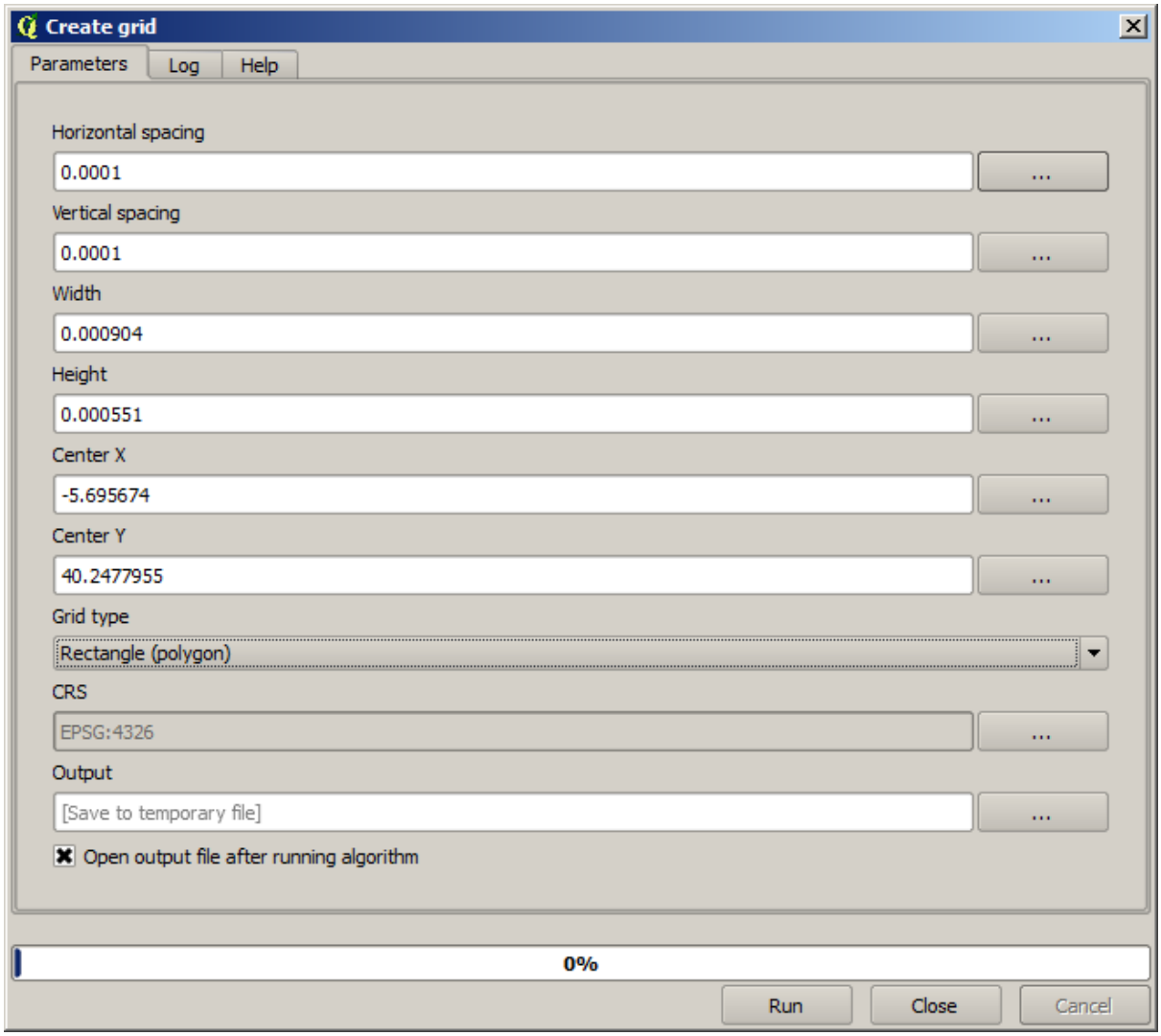
The dialog contains a simple calculator, so you can type expressions such as `11 * 34.7 + 4.6`, and the result will be computed and put in the corresponding text box in the parameters dialog. Also, it contains constants that you can use, and values from other layers available.

In this case, we want to create a grid that covers the extent of the input points layer, so we should use its coordinates to calculate the center coordinate of the grid and its width and height, since those are the parameters that the algorithm takes to create the grid. With a little bit of math, try to do that yourself using the calculator dialog and the constants from the input points layer.

Select *Rectangles (polygons)* in the *Grid type* field.

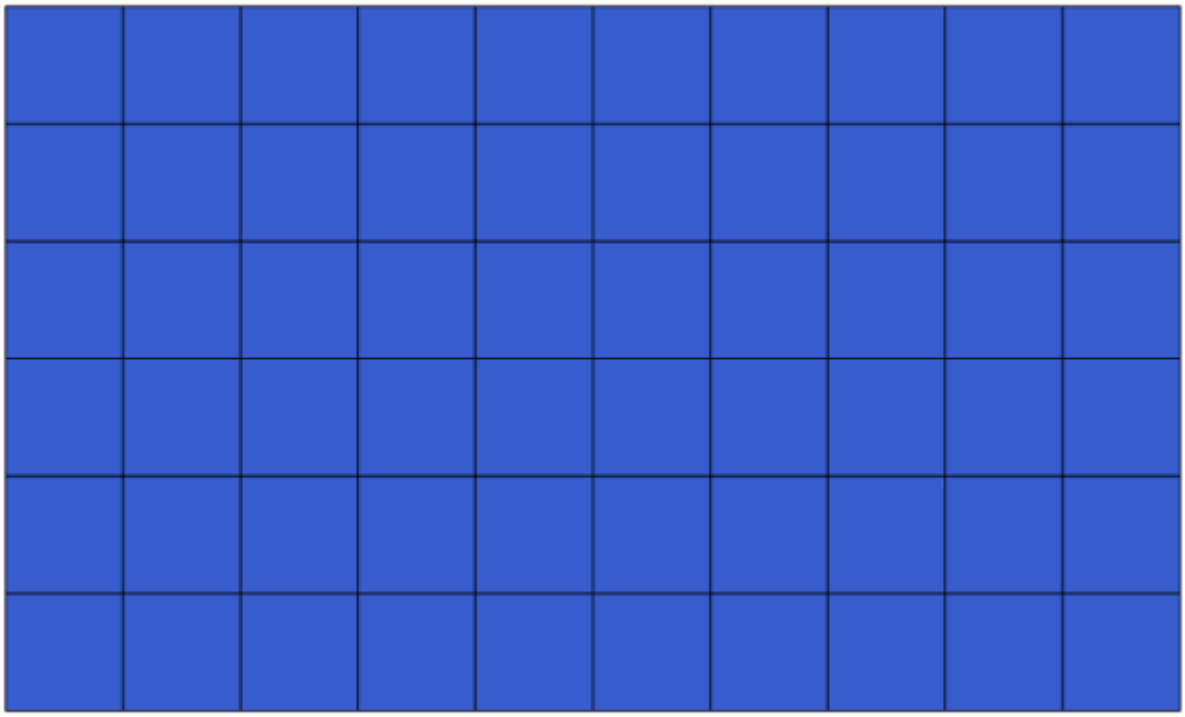
As in the case of the last algorithm, we have to enter the CRS here as well. Select EPSG:4326 as the target CRS, as we did before.

În cele din urmă, ar trebui să aveți un dialog pentru parametri de genul următor:

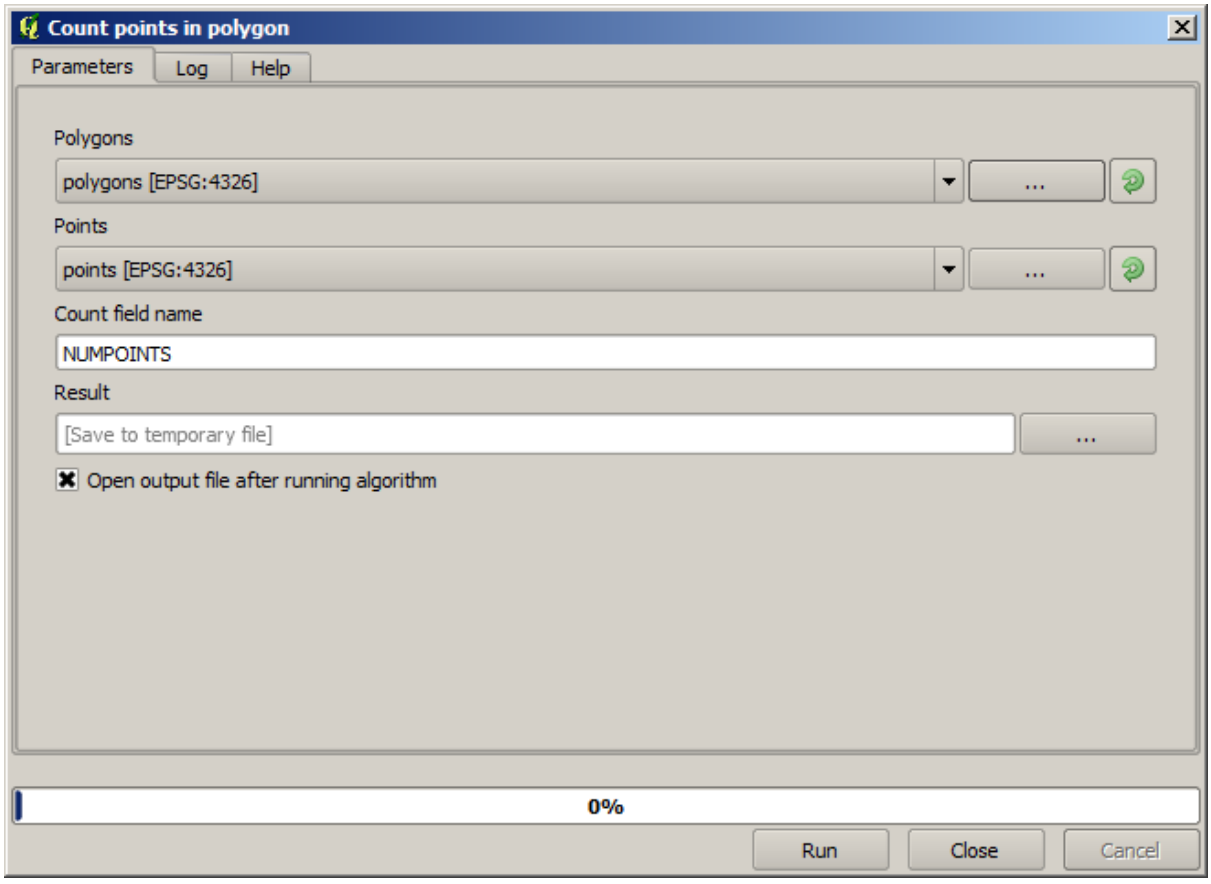


(Better add one spacing on the width and height: *Horizontal spacing*: `0.0001`, *Vertical spacing*: `0.0001`, *Width*: `0.001004`, *Height*: `0.000651`, *Center X*: `-5.695674`, *Center Y*: `40.2477955`) The case of X center is a bit tricky, see: -5.696126+((-5.695222+ 5.696126)/2)

Press *Run* and you will get the graticule layer.

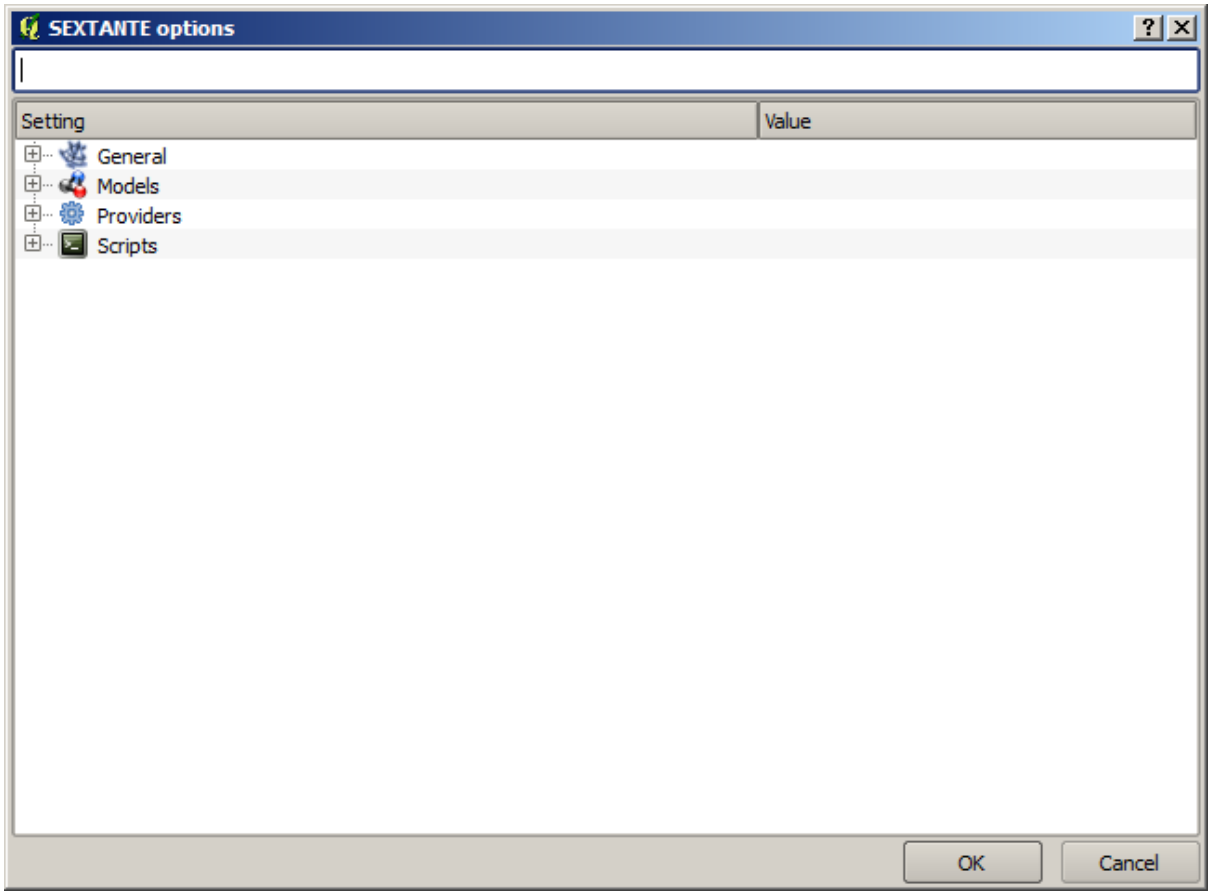


The last step is to count the points in each one of the rectangles of that graticule. We will use the *Count points in polygons* algorithm.

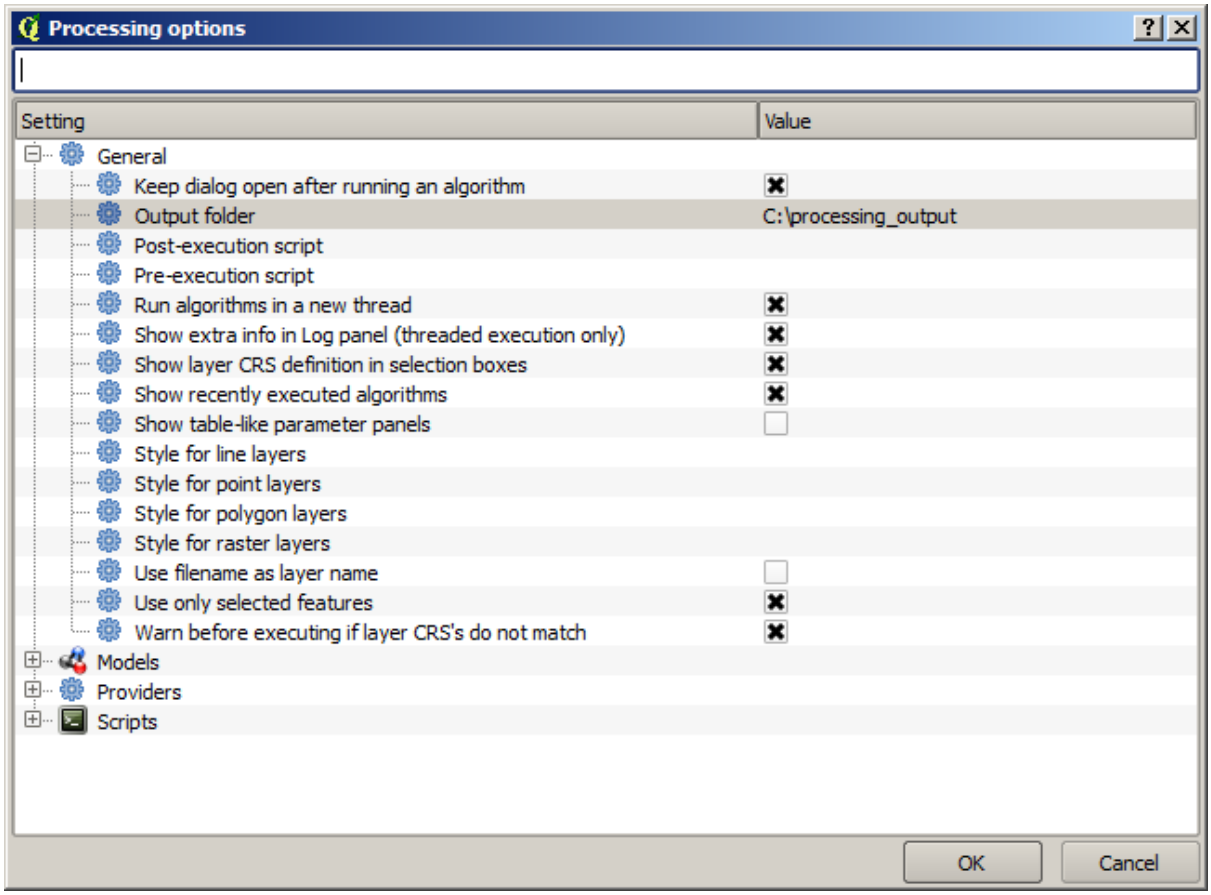


Acum avem rezultatul dorit.

Before finishing this lesson, here is a quick tip to make your life easier in case you want to persistently save your data. If you want all your output files to be saved in a given folder, you do not have to type the folder name each time. Instead, go to the processing menu and select the *Options and configuration* item. It will open the configuration dialog.



In the *Output folder* entry that you will find in the *General* group, type the path to your destination folder.



Now when you run an algorithm, just use the filename instead of the full path. For instance, with the configuration shown above, if you enter `graticule.shp` as the output path for the algorithm that we have just used, the result will be saved in `D:processing_outputgraticule.shp`. You can still enter a full path in case you want a result to be saved in a different folder.

Try yourself the *Create grid* algorithm with different grid sizes, and also with different types of grids.

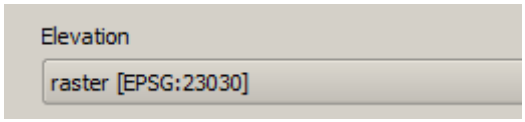
17.6 Reproiectarea CRS-urilor

Notă

În această lecție, vom discuta despre modul în care Processing utilizează CRS-urile. Vom vedea, de asemenea, un algoritm foarte util: reproiectarea.

CRS-urile sunt o mare sursă de confuzie pentru utilizatorii QGIS Processing, așa că aici sunt câteva reguli generale cu privire la modul în care pot fi gestionate de către geoalgoritmi, la crearea unui nou strat.

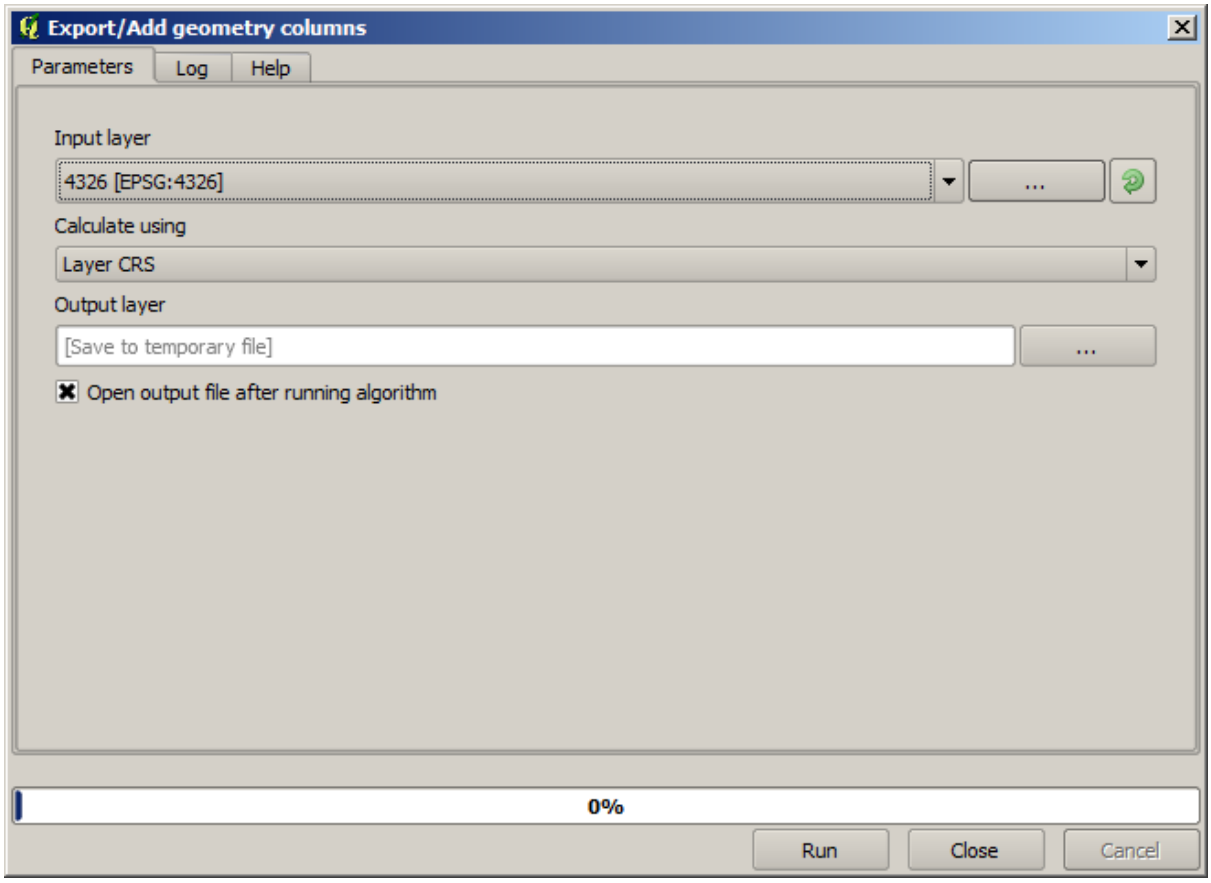
- Dacă există straturi de intrare, se va utiliza CRS-ul primului strat. Acesta este presupus a fi CRS-ul tuturor straturilor de intrare, atât timp cât este necesar ca acestea să-l aibă pe același. În cazul în care utilizați straturi cu un CRS diferit, QGIS va emite un avertisment. Observați că CRS-ul straturilor de intrare este afișat alături de numele său, în dialogul parametrilor.



- Dacă nu există niciun strat de intrare, atunci se va folosi CRS-ul proiectului, cu excepția cazului în care algoritmul conține un câmp specific pentru CRS (cum s-a întâmplat în ultima lecție cu algoritmul graticulelor)

Open the project corresponding to this lesson and you will see two layers named `23030` and `4326`. They both contain the same points, but in different CRSs (`EPSG:23030` and `EPSG:4326`). They appear in the same place because QGIS is reprojecting on the fly to the project CRS (`EPSG:4326`), but they are not actually the same layer.

Open the *Add geometry attributes* algorithm.



Acest algoritm adaugă coloane noi în tabela de atribute a unui strat vectorial. Conținutul coloanelor depinde de tipul geometriei stratului. În cazul punctelor, se vor adăuga coloane noi, conținând coordonatele X și Y ale fiecărui punct.

În lista de straturi disponibile, pe care le veți găsi în câmpul stratului de intrare, le veți vedea pe fiecare, alături de CRS-ul corespunzător. Astfel, deși apar în același loc pe canevas, ele vor fi tratate în mod diferit. Selectați stratul 4326.

The other parameter of the algorithm allows to set how the algorithm uses coordinates to calculate the new value that it will add to the resulting layers. Most algorithms do not have an option like that, and just use the coordinates directly. Select the *Layer CRS* option to just use coordinates as they are. This is how almost all geoalgorithms work.

Ar trebui să obțineți un nou strat, cu exact aceleași puncte ca și celelalte două. Dacă faceți clic dreapta pe numele stratului și îi deschideți proprietățile, veți vedea că folosește CRS-ul stratului de intrare, adică, EPSG:4326. Atunci când stratul este încărcat în QGIS, nu vi se va cere să introduceți CRS-ul stratului, atât timp cât QGIS îl cunoaște.

Dacă deschideți tabelul de atribute a noului strat, veți vedea că ea conține două noi câmpuri, cu coordonatele X și Y ale fiecărui punct.

	ID	PT_NUM_A	PT_ST_A	xcoord	ycoord
0	1	1.100000	a	-5.695426	40.248071
1	2	2.200000	b	-5.695885	40.247622
2	3	3.300000	c	-5.695406	40.247520
3	4	4.400000	a	-5.695222	40.247694
4	5	5.500000	b	-5.695642	40.248030
5	6	6.600000	a	-5.695855	40.248067
6	7	7.700000	b	-5.696049	40.248028
7	8	8.800000	c	-5.696126	40.247629
8	9	9.900000	a	-5.695961	40.247786
9	10	11.000000	b	-5.695353	40.247929
10	11	12.100000	a	-5.695595	40.247739
11	12	13.200000	b	-5.695779	40.247896

Aceste valori de coordonate sunt date în CRS-ul stratului, întrucât am ales această opțiune. Totuși, chiar dacă s-ar fi ales o altă opțiune, CRS-ul de ieșire al stratului ar fi fost același, deoarece CRS-ul de intrare este folosit pentru a seta CRS-ul stratului de ieșire. Alegerea unei alte opțiuni va face ca valorile să fie diferite, dar fără schimbarea punctului rezultat și fără ca CRS-ul stratului de ieșire să fie diferit de CRS-ul celui de intrare.

Acum, efectuați același calcul, utilizând celălalt strat. Ar trebui să găsiți stratul rezultat, randat exact în același loc ca și celelalte, având același CRS, EPSG:23030, acesta fiind CRS-ul stratului de intrare.

Dacă mergeți la tabela sa de atribute, veți vedea valori care sunt diferite de cele din primul strat pe care l-am creat.

	ID	PT_NUM_A	PT_ST_A	xcoord	ycoord
0	1	1.100000	a	270839.655869	4458983.162670
1	2	2.200000	b	270799.116425	4458934.552874
2	3	3.300000	c	270839.468187	4458921.978139
3	4	4.400000	a	270855.745301	4458940.799487
4	5	5.500000	b	270821.164389	4458979.173980
5	6	6.600000	a	270803.157564	4458983.848803
6	7	7.700000	b	270786.542791	4458980.047841
7	8	8.800000	c	270778.601980	4458935.968837
8	9	9.900000	a	270793.142411	4458952.931700
9	10	11.000000	b	270845.414756	4458967.311298
10	11	12.100000	a	270824.166376	4458946.784250
11	12	13.200000	b	270809.035643	4458964.649799

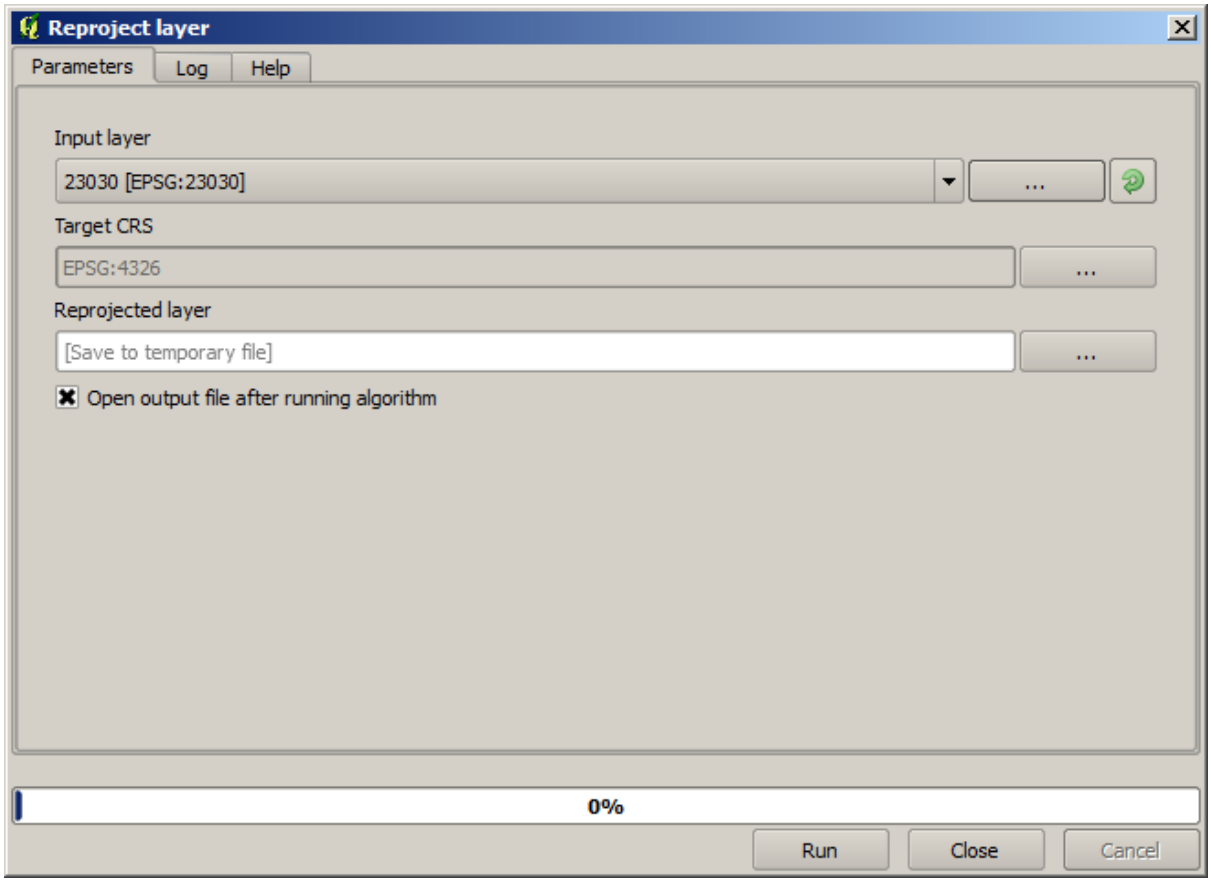
Acest lucru se datorează faptului că datele originale sunt diferite (se folosește un alt CRS), și acele coordonate sunt preluate din ea.

Ce ar trebui să învățați din asta? Ideea principală din spatele acestor exemple este aceea că geoalgoritmii folosesc stratul așa cum se află în sursa sa de date originală, ignorând complet reproiectările pe care QGIS le-ar putea efectua înainte de randare. Cu alte cuvinte, nu aveți încredere în ceea ce vedeți pe pânză, dar aveți întotdeauna în vedere faptul că vor fi utilizate datele originale. Acest lucru nu este atât de important în acest caz, din moment ce folosim doar un singur strat la un moment dat, dar într-un algoritm care are nevoie de mai multe (cum ar fi un algoritm de decupare), straturile care par să se potrivească sau să se suprapună, ar putea fi foarte departe unul față de celălalt, atât timp cât pot avea diferite CRS-uri.

Algoritmii nu realizează nici o reproiectare (cu excepția algoritmului de reproiectare pe care îl vom vedea în continuare), de aceea, trebuie ca dvs. să vă asigurați că straturile au același CRS.

Un modul interesant, care are de-a face cu CRS-ul, este cel de reproiectare. Acesta reprezintă un caz particular, deoarece are un strat de intrare (cel de reproiectat), însă nu îi va folosi CRS-ul pentru stratul de ieșire.

Open the *Reproject layer* algorithm.



Select any of the layers as input, and select EPSG:23029 as the destination CRS. Run the algorithm and you will get a new layer, identical to the input one, but with a different CRS. It will appear on the same region of the canvas, like the other ones, since QGIS will reproject it on the fly, but its original coordinates are different. You can see that by running the *Add geometry attributes* algorithm using this new layer as input, and verifying that the added coordinates are different to the ones in the attribute tables of both of the two layers that we had computed before.

17.7 Selecția

Notă

În această lecție vom vedea cum gestionează selecțiile algoritmii de procesare din straturile vectoriale care sunt utilizate ca intrare, și cum se poate crea o selecție, folosindu-se un anumit tip de algoritm.

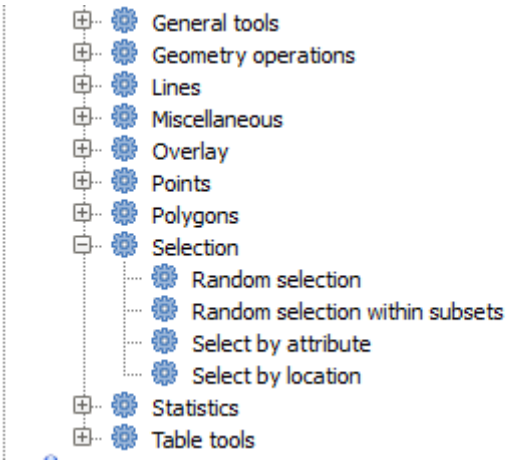
Spre deosebire de alte plugin-uri de analiză din QGIS, geoalgoritmii de procesare nu dispun de caseta de bifare pentru „Utilizare doar a entităților selectate” sau ceva similar acesteia. Comportamentul privitor la selectare este stabilit pentru întreg plugin-ul și pentru toți algoritmii, și nu pentru fiecare rulare a algoritmului. Algoritmii respectă următoarele reguli simple, atunci când se utilizează un strat vectorial.

- Dacă stratul are o selecție, vor fi utilizate numai entitățile selectate.
- Dacă nu există nici o selecție, atunci vor fi utilizate toate entitățile.

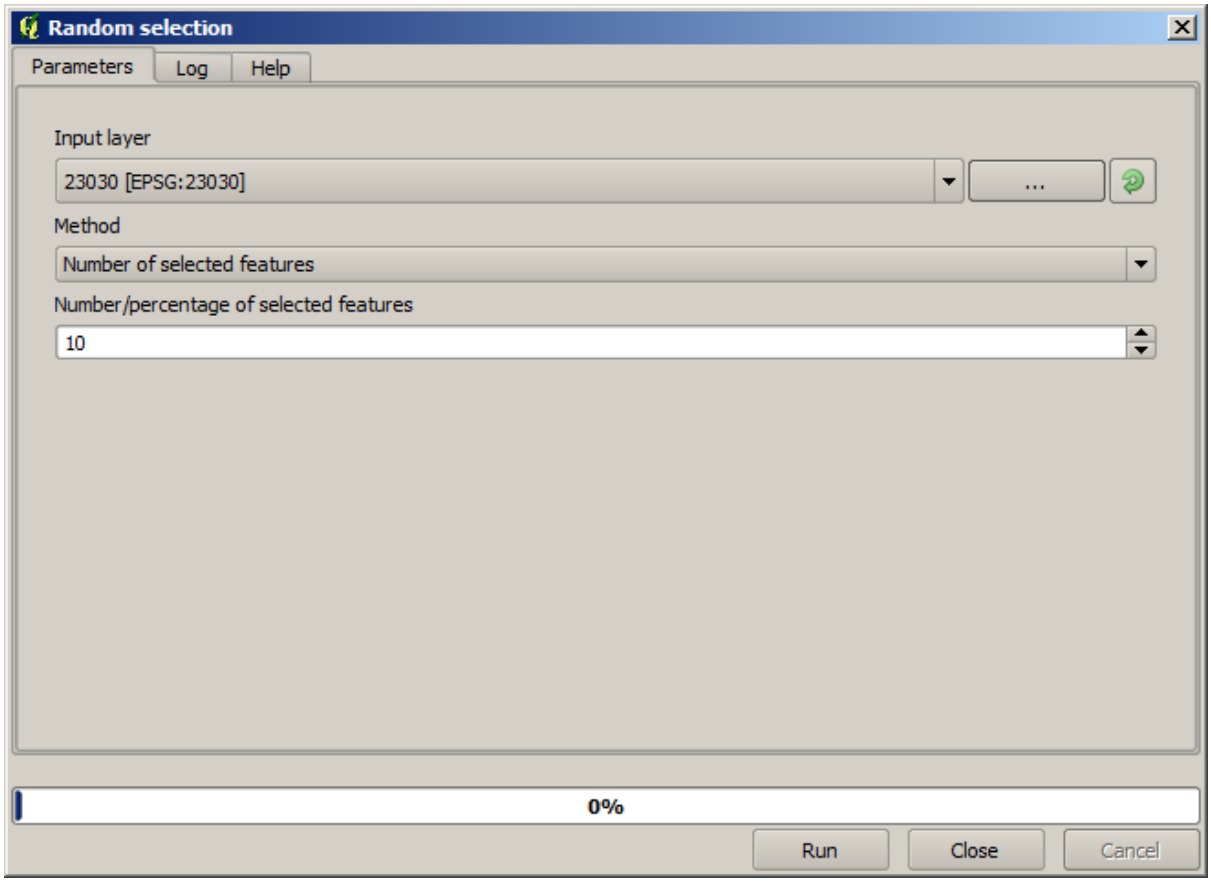
Vă rugăm să rețineți că puteți schimba acest comportament prin deselectarea meniului opțiunii relevante *Processing ► Options ► General*`.

You can test that yourself by selecting a few points in any of the layers that we used in the last chapter, and running the reprojection algorithm on them. The reprojected layer that you will obtain will contain only those points that were selected, unless there was no selection, which will cause the resulting layer to contain all points from the original layer.

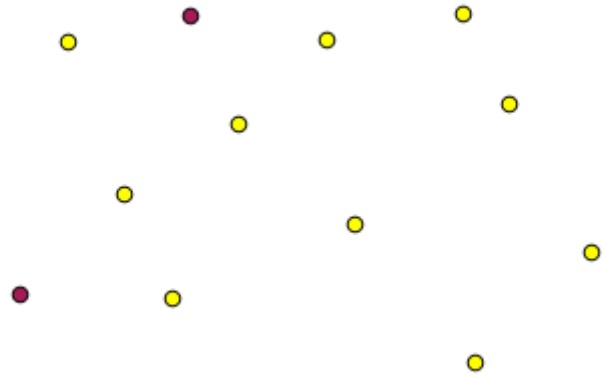
To make a selection, you can use any of the available methods and tools in QGIS. However, you can also use a geoalgorithm to do so. Algorithms for creating a selection are found in the toolbox under *Vector/Selection*



Open the *Random selection* algorithm.



Lăsând valorile implicite, se vor selecta 10 puncte din stratul curent.



Veți observa că acest algoritm nu produce nici o ieșire, dar modifică stratul de intrare (nu stratul în sine, ci selecția sa). Acesta este un comportament mai puțin frecvent, deoarece toți ceilalți algoritmi vor produce noi straturi și nu vor modifica straturile de intrare.

Since the selection is not part of the data itself, but something that only exist within QGIS, these selection algorithms only must be used selecting a layer that is open in QGIS, and not with the file selection option that you can find in the corresponding parameter value box.

The selection we have just made, like most of the ones created by the rest of the selection algorithms, can also be done manually from QGIS, so you might be wondering what is the point on using an algorithm for that. Although now this might not make much sense to you, we will later see how to create models and scripts. If you want to make a selection in the middle of a model (which defines a processing workflow), only a geoalgorithm can be added to a model, and other QGIS elements and operations cannot be added. That is the reason why some processing algorithms duplicate functionality that is also available in other QGIS elements.

By now, just remember that selections can be made using processing geoalgorithms, and that algorithms will only use the selected features if a selection exists, or all features otherwise.

17.8 Rularea unui algoritm extern

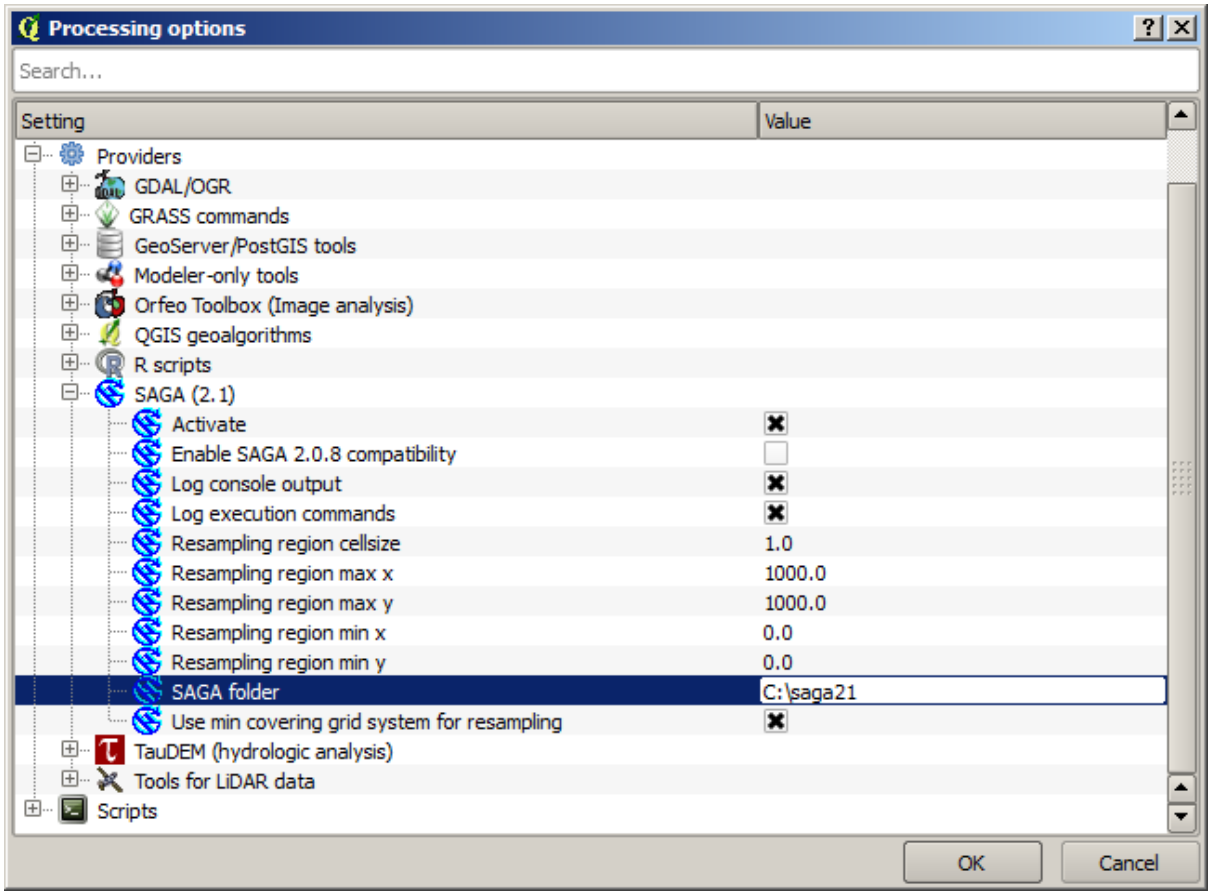
Notă

În această lecție vom vedea cum să folosim algoritmi care depind de o terță aplicație, în speță SAGA, care este unul dintre principalii furnizori de algoritmi.

All the algorithms that we have run so far are part of processing framework. That is, they are *native* algorithms implemented in the plugin and run by QGIS just like the plugin itself is run. However, one of the greatest features of the processing framework is that it can use algorithms from external applications and extend the possibilities of those applications. Such algorithms are wrapped and included in the toolbox, so you can easily use them from QGIS, and use QGIS data to run them.

Pentru a rula, unii dintre algoritmii pe care îi vedeți în vizualizarea simplificată necesită, în prealabil, instalarea unor aplicații terțe în sistemul dumneavoastră. Un furnizor de algoritm de interes special este SAGA (Sistem de Analize Geospațiale Automate). Pentru a apela în mod corect SAGA, QGIS trebuie să fie configurat în mod corespunzător. Acest lucru nu este dificil, dacă înțelegem principiul de funcționare. Fiecare aplicație externă are propria sa configurație, iar mai târziu, în același manual vom vorbi despre altele, însă acum vom discuta despre SAGA.

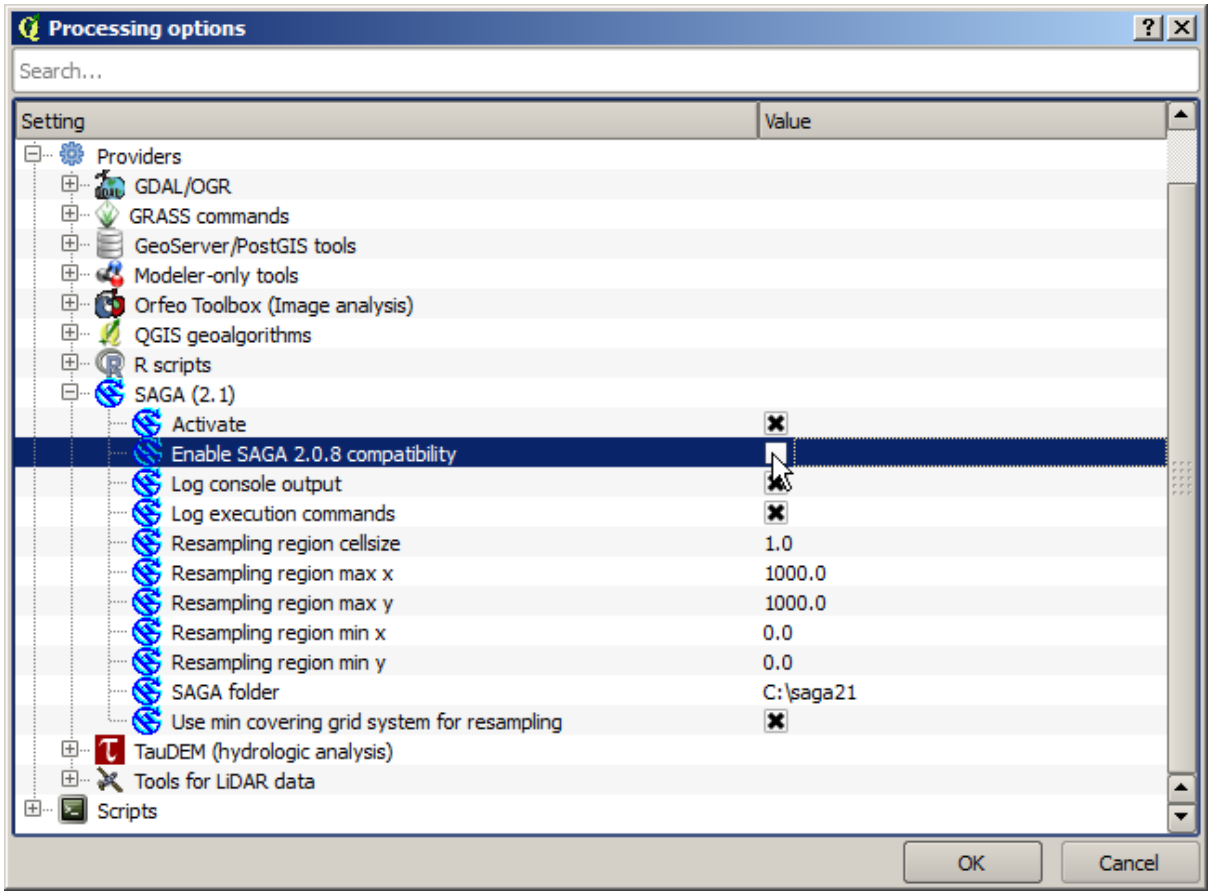
În cazul în care vă aflați pe Windows, cel mai bun mod de a lucra cu algoritmii externi este de a instala QGIS cu ajutorul programului de instalare. Acesta va avea grijă de instalarea dependențelor necesare, inclusiv SAGA, astfel că, dacă l-ați folosit, nu mai trebuie să întreprindeți altceva. Puteți deschide dialogul setărilor, apoi să mergeți la grupul *Furnizorilor/SAGA*.



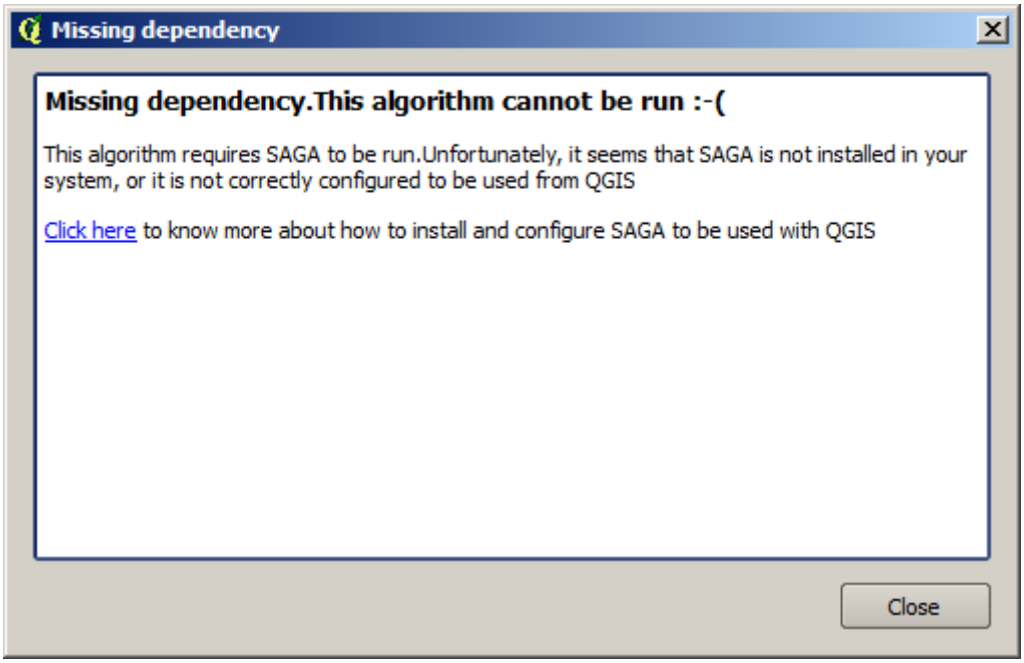
Calea către SAGA trebuie să fie deja configurată și să indice folderul în care este instalat SAGA.

Dacă ați instalat QGIS fără să folosiți programul autonom de instalare, atunci trebuie să introduceți calea către SAGA (care trebuie să fie deja instalată). Versiunea necesară este SAGA 2.1 [aceasta se schimbă în funcție de versiunile de SAGA].

In case you are using Linux, you do not have to set the path to your SAGA installation in the processing configuration. Instead, you must install SAGA and make sure that the SAGA folder is in PATH, so it can be called from the console (just open a console and type `saga_cmd` to check it). Under Linux, the target version for SAGA is also 2.1, but in some installations (such as the OSGeo Live DVD) you might have just 2.0.8 available. There are some 2.1 packages available, but they are not commonly installed and might have some issues, so if you prefer to use the more common and stable 2.0.8, you can do it by enabling 2.0.8 compatibility in the configuration dialog, under the *SAGA* group.

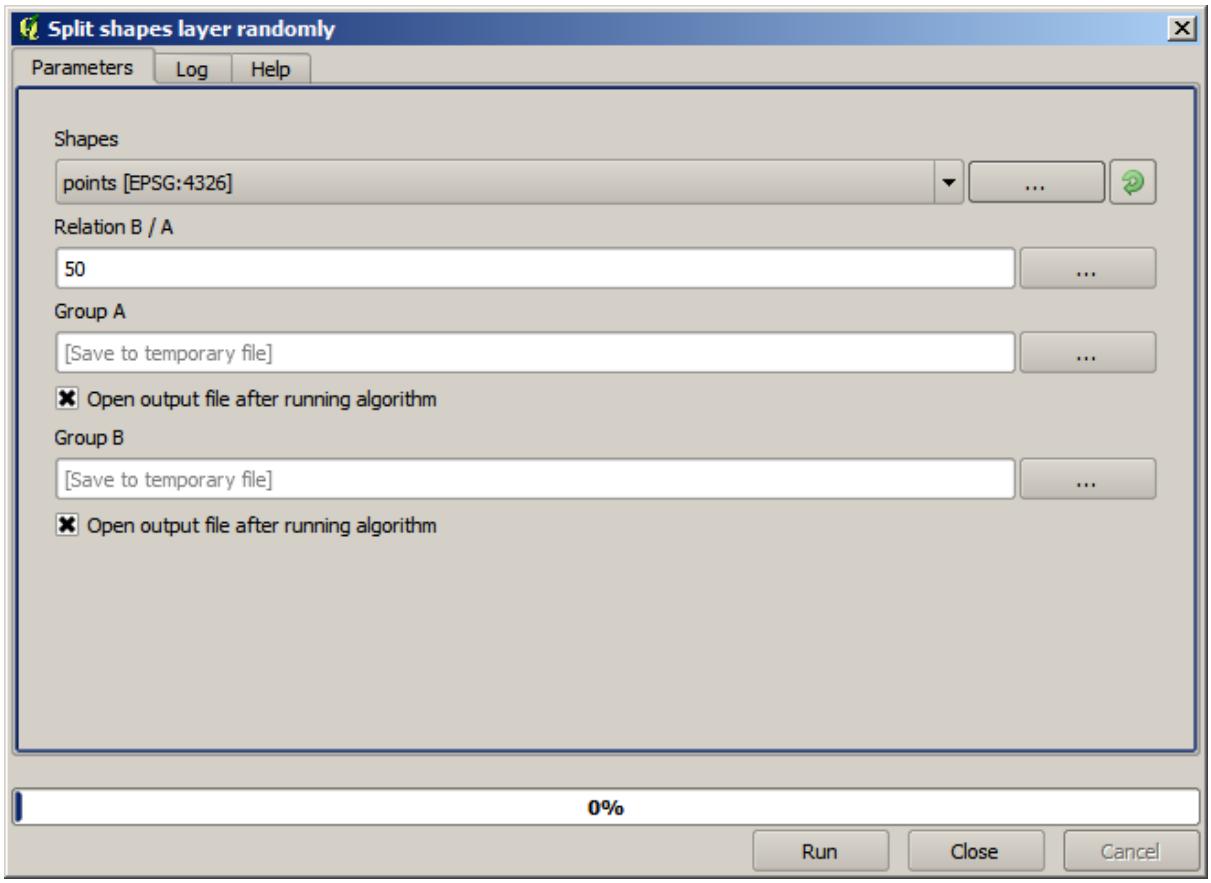


O dată ce SAGA este instalat, puteți lansa un algoritm SAGA printr-un dublu clic pe numele său, similar celorlalți algoritmi. Din moment ce folosim interfața simplificată, nu știm care dintre algoritmi se bazează pe SAGA sau pe o altă aplicație externă, dar dacă se întâmplă să rulați unul pentru care aplicația corespunzătoare nu este instalată, vi se va indica acest lucru.

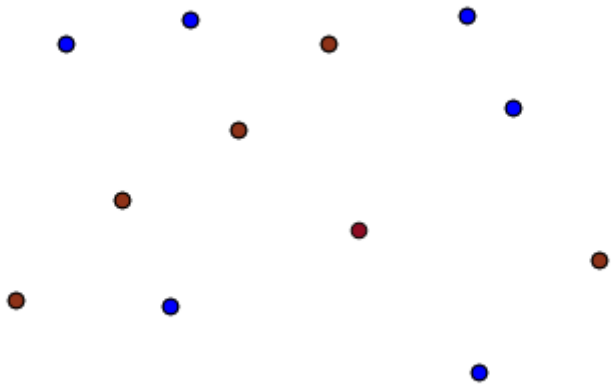


În cazul nostru, presupunând că aplicația SAGA este instalată și configurată corect, nu ar trebui să vedeți această fereastră ci, în schimb, veți obține parametrii dialogului.

Să încercăm cu un algoritm bazat pe SAGA, cel denumit *Split shapes layer randomly*.



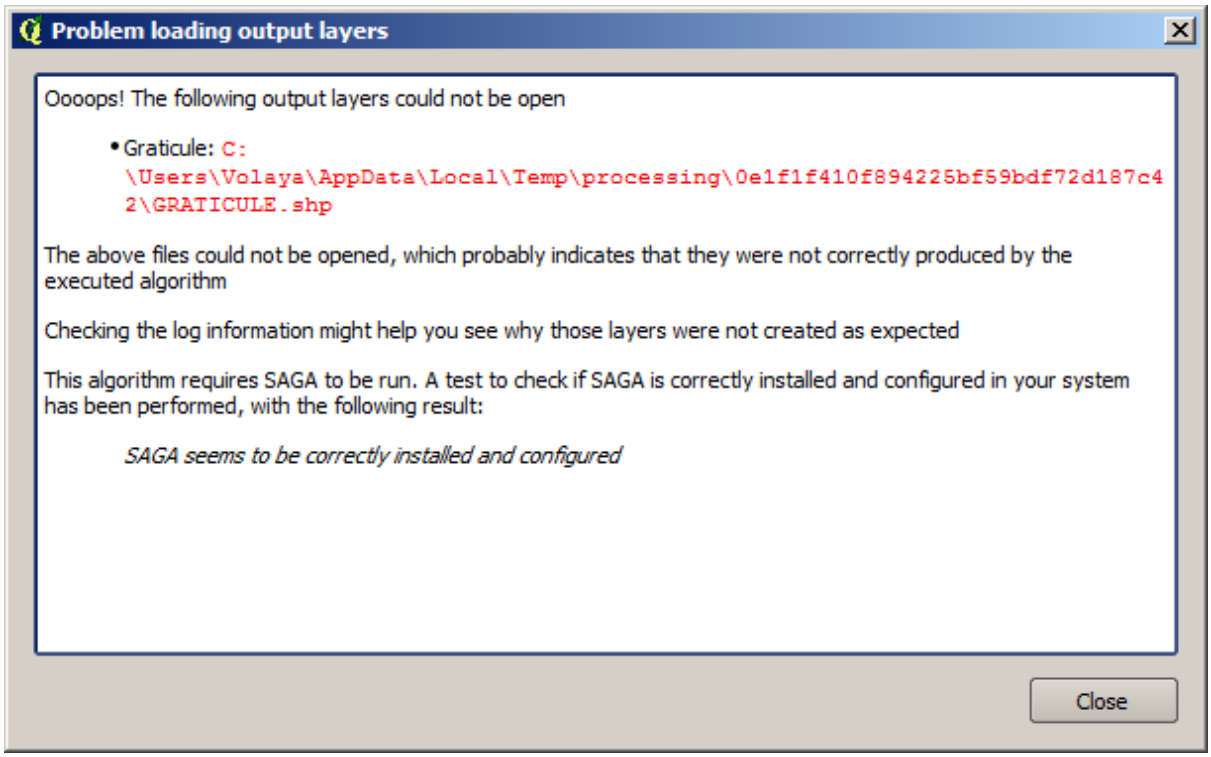
Folosind ca intrare stratul de puncte din proiectul corespunzător acestei lecții, împreună cu valorile implicite ale parametrilor, veți obține ceva de genul următor (divizarea este aleatorie, de aceea rezultatul dvs. poate fi diferit).



The input layer has been split in two layers, each one with the same number of points. This result has been computed by SAGA, and later taken by QGIS and added to the QGIS project.

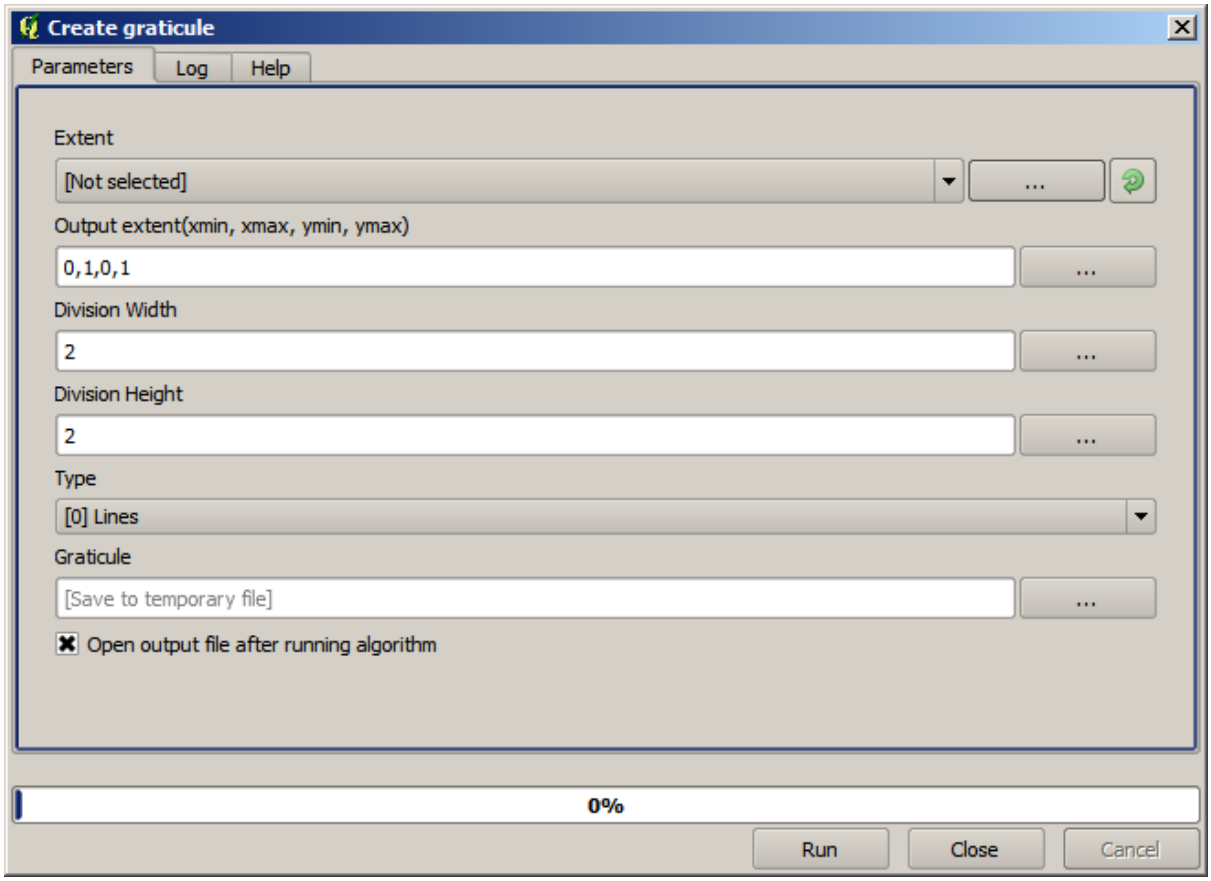
If all goes fine, you will not notice any difference between this SAGA–based algorithm and one of the others that we have previously run. However, SAGA might, for some reason, not be able to produce a result and not generate the

file that QGIS is expecting. In that case, there will be problems adding the result to the QGIS project, and an error message like this will be shown.



This kind of problems might happen, even if SAGA (or any other application that we are calling from the processing framework) is correctly installed, and it is important to know how to deal with them. Let's produce one of those error messages.

Deschideți algoritmul *Creare graticule*, și folosiți-l cu următoarele valori.



We are using width and height values that is larger than the specified extent, so SAGA cannot produce any output. In other words, the parameter values are wrong, but they are not checked until SAGA gets them and tries to create the graticule. Since it cannot create it, it will not produce the expected layer, and you will see the error message shown above.

Notă

În SAGA >= 2.2.3, comanda va ajusta în mod automat datele de intrare greșite, așa că nu veți obține o eroare. Pentru a provoca o eroare, utilizați valori negative la divizare.

Understanding this kind of problems will help you solve them and find an explanation to what is happening. As you can see in the error message, a test is performed to check that the connection with SAGA is working correctly, indicating you that there might be a problem in how the algorithm was executed. This applies not only to SAGA, but also to other external applications as well.

In the next lesson we will introduce the processing log, where information about commands run by geoalgorithms is kept, and you will see how to get more detail when issues like this appear.

17.9 Jurnalul de Procesare

Notă

Această lecție descrie procesarea jurnalului.

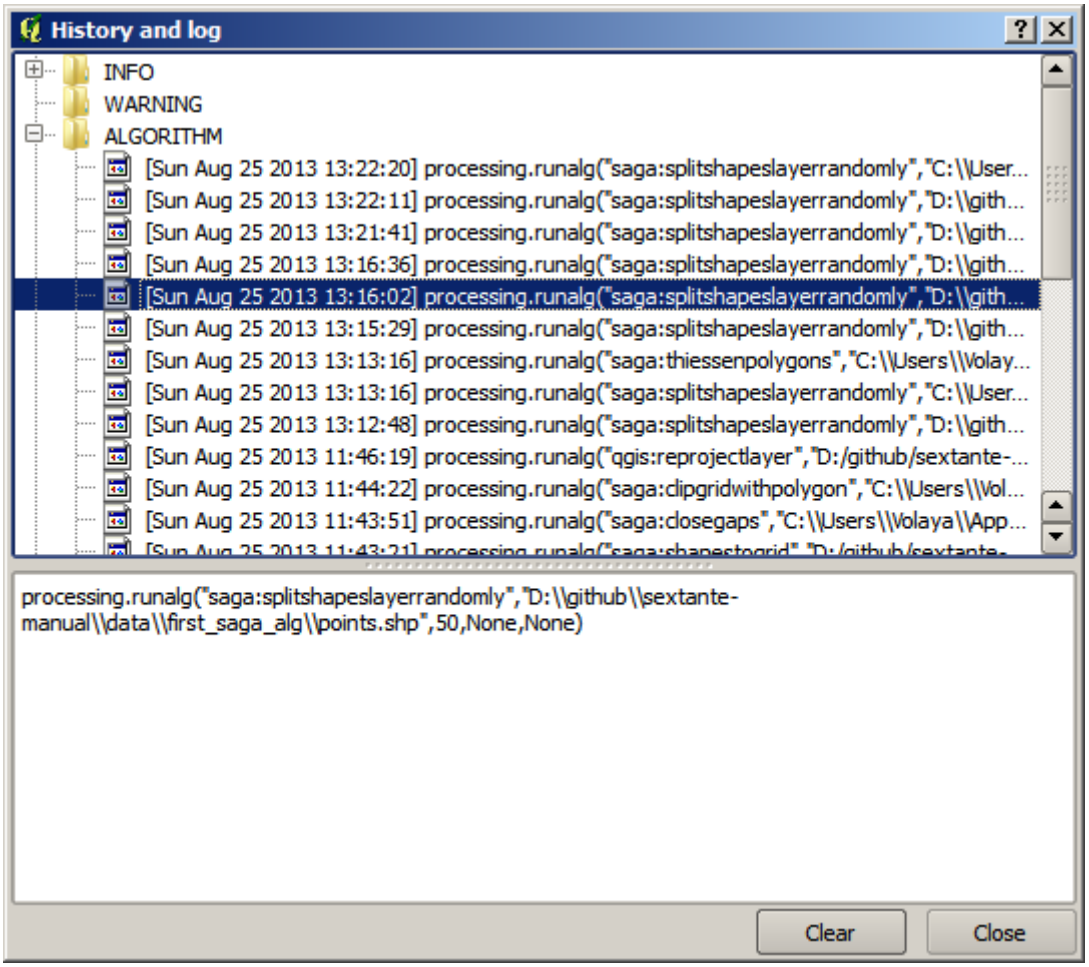
Toate analizele efectuate de cadrul de procesare se înregistrează în sistemul de jurnalizare al aplicației QGIS. Acest lucru vă permite să aflați mai multe despre istoricul utilizării uneltelor de procesare, pentru a putea depăși problemele atunci când acestea apar și, de asemenea, vă facilitează repetarea operațiunilor anterioare, întrucât sistemul de jurnalizare dispune de o anumită interactivitate.

To open the log, click on the balloon at the bottom right, on the QGIS status bar. Some algorithms might leave here information about their execution. For instance, those algorithms that call an external application usually log the console output of that application to this entry. If you have a look at it, you will see that the output of the SAGA algorithm that we just run (and that fails to execute because input data was not correct) is stored here.

Aceste informații v-ar putea fi utile, pentru a înțelege ce se întâmplă. Utilizatorii avansați vor putea să analizeze o ieșire, pentru a afla de ce a eșuat algoritmul. Dacă nu sunteți un utilizator avansat, informațiile respective vor fi utile celor care vă vor ajuta la diagnosticarea unei probleme, pentru a determina dacă a fost cauzată de instalarea unei aplicații externe sau de datele pe care le-ați introdus.

Chiar dacă un algoritm poate fi executat, în unele cazuri aceștia ar putea emite avertismente dacă rezultatul s-ar putea să nu fie corect. Un exemplu ar fi execuția unui algoritm de interpolare pe baza unui număr foarte mic de puncte, care, deși se poate desfășura, poate genera un rezultat incorect, atât timp cât ar fi trebuit să fie folosite mai multe puncte. Este foarte bune să verificați în mod regulat acest tip de avertismente, dacă nu vă sunt clare anumite aspecte ale unui algoritm.

From the *Processing* ► *History…* menu, you'll find *algorithms* that are executed, regardless of they are executed from the GUI or from the console (which will be explained later in this manual). The execution is stored in this dialog as a console call. That means that everytime you run an algorithm, a console command is added to the log, and you have the full history of your working session. Here is how that history looks like:



Acest lucru poate fi foarte util atunci când începe lucrul cu consola, pentru a afla mai multe despre sintaxa algoritmilor. Îl vom folosi când vom discuta despre modul în care se pot rula comenzile de analiză din consolă.

17.9.1 ??? Follow Along

The history is also interactive, and you can run any previous algorithm just by double-clicking on its entry. This is an easy way of replicating the work we already did before.

For instance, try the following:

1. Open the data corresponding to the first chapter of this manual and run the algorithm explained there.
2. Now go to the History dialog and locate the last algorithm in the list, which corresponds to the algorithm you have just run.
3. Double-click on it and a new result should be produced, just like when you run it using the normal dialog and calling it from the toolbox.

17.9.2 ??? Follow Along

You can also modify the algorithm.

1. Copy the algorithm call
2. Open the *Plugins* ► *Python console*
3. Paste your copy to run the analysis; change the parameters at will.
4. To display the resulting file, you may want to replace `processing.run` in the pasted command with `processing.runAndLoadResults`.

17.10 Calculatorul raster. Valorile fără-date

Notă

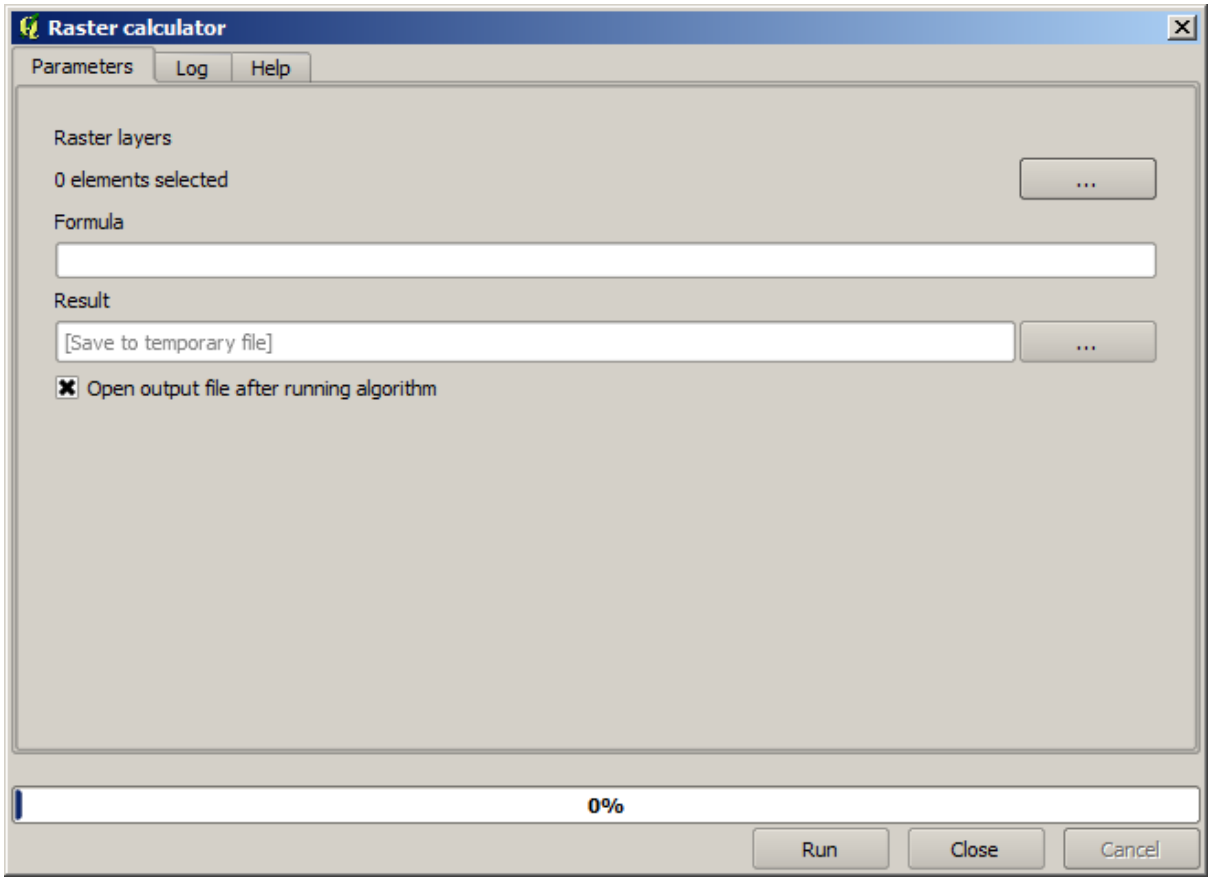
În această lecție vom vedea cum se utilizează calculatorul raster pentru a efectua unele operații asupra straturilor raster. Vom explica, de asemenea, ce sunt valorile fără-date și modul în care lucrează cu ele calculatorul și alți algoritmi

Calculatorul raster reprezintă unul dintre cei mai puternici algoritmi. Este un algoritm foarte flexibil și versatil, care poate fi folosit în diverse calcule, și care va deveni în curând o parte importantă a setului dvs. cu instrumente.

În această lecție vom efectua unele calcule, majoritatea simple, cu ajutorul calculatorului raster. Acest lucru ne va permite să observăm modul de gestionare a unor situații particulare cu care ne-am putea confrunta. Înțelegerea acestor aspecte este importantă pentru obținerea ulterioară a rezultatelor așteptate și, de asemenea, pentru deprinderea tehnicilor comune care se pot aplica.

Deschideti proiectul QGIS corespunzător acestei lecții și veți vedea că ea conține mai multe straturi raster.

Acum deschideți caseta de instrumente și caseta de dialog corespunzătoare calculatorului raster.



Notă

Interfața diferă pentru versiunile recente.

Dialogul conține 2 parametri.

- Straturile de utilizat pentru analiză. Aceasta este o intrare multiplă, ceea ce înseamnă că puteți selecta câte straturi doriți. Faceți clic pe butonul din partea dreaptă și apoi selectați straturile pe care doriți să le utilizați în dialogul care va apărea.
- Formula de aplicat. Formula folosește ca variabile straturile selectate în parametrul de mai sus, folosind litere din alfabet (`a, b, c...`) sau `g1, g2, g3...`. Adică, formula `a + 2 * b` este aceeași cu `g1 + 2 * g2` și va calcula suma valorii din primul strat plus de două ori valoarea din al doilea strat. Ordinea straturilor corespunde ordinii pe care o vedeți în dialogul de selecție.

Atenționare

Calculator ține cont de majuscule/minuscule.

Pentru a începe, vom schimba unitățile DEM-ului din metri în picioare. Formula de care avem nevoie este:

```
h' = h * 3.28084
```

Selectați DEM-ul din câmpul straturilor și introduceți `a * 3.28084` în câmpul formulei.

Atenționare

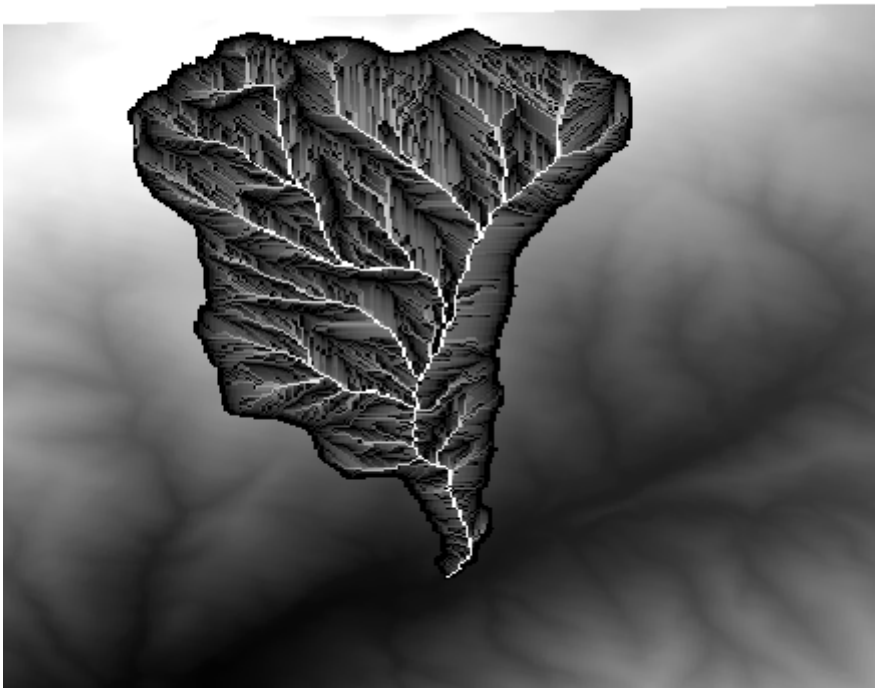
Pentru utilizatorii care nu sunt englezi: folosiți întotdeauna „.”, nu „,”.

Faceți clic pe *Run* pentru a rula algoritmul. Veți obține un strat care are același aspect cu cel al stratului de intrare, dar cu valori diferite. Stratul de intrare pe care l-am folosit are valori valide în toate celulele sale, astfel încât ultimul parametru nu are niciun efect.

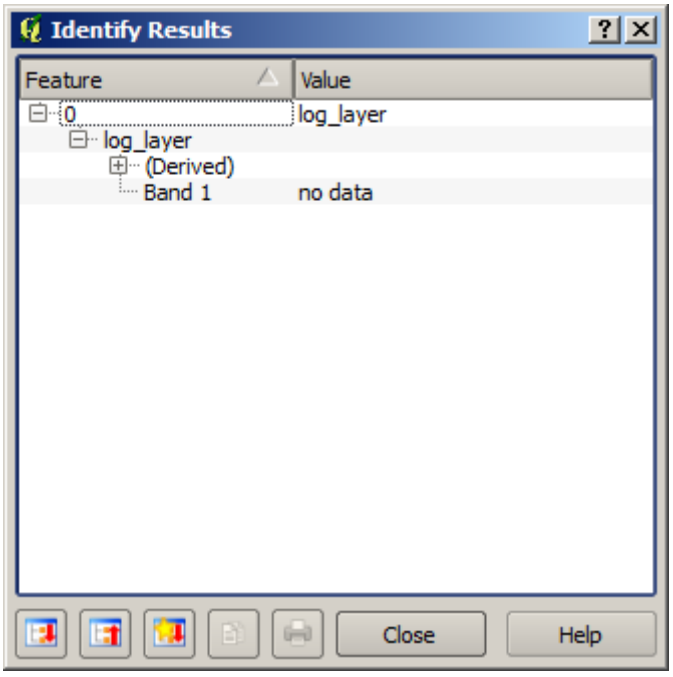
Să facem acum un alt calcul, de data aceasta pe stratul *accflow*. Acest strat conține valori ale debitului acumulat, un parametru hidrologic. Conține acele valori numai în zona unui bazin hidrografic dat, cu valori fără date în afara acestuia. După cum puteți vedea, randarea nu este foarte informativă, din cauza modului în care sunt distribuite valorile. Folosind logaritmul acestei acumulări de flux va rezulta o reprezentare mult mai informativă. O putem calcula folosind calculatorul raster.

Deschideți iarăși dialogul algoritmului, selectați stratul *accflow* ca singur strat de intrare, apoi introduceți următoarea formulă: `log(a)`.

Acesta este stratul pe care îl veți obține.



Dacă selectați instrumentul *Identificare* pentru a cunoaște valoarea unui strat într-un anumit punct, selectați stratul pe care tocmai l-am creat și faceți clic pe un punct din afara bazinului, veți vedea că acesta conține o valoare no–data.



Pentru exercițiul următor vom folosi două straturi în loc de unul și vom obține un DEM cu valori de cotă valide numai în bazinul definit în cel de-al doilea strat. Deschideți dialogul calculatorului și alegeți ambele straturi ale proiectului în câmpul straturilor de intrare. Introduceți următoarea formulă în câmpul corespunzător:

```
a/a * b
```

`a` refers to the accumulated flow layer (since it is the first one to appear in the list) and `b` refers to the DEM. What we are doing in the first part of the formula here is to divide the accumulated flow layer by itself, which will result in a value of 1 inside the basin, and a no–data value outside. Then we multiply by the DEM, to get the elevation value in those cells inside the basin (`DEM * 1 = DEM`) and the no–data value outside (`DEM * no_data = no_data`)

Acesta este stratul rezultat.



This technique is used frequently to *mask* values in a raster layer, and is useful whenever you want to perform calculations for a region other that the arbitrary rectangular region that is used by raster layer. For instance, an elevation histogram of a raster layer doesn't have much meaning. If it is instead computed using only values

corresponding to a basin (as in he case above), the result that we obtain is a meaningful one that actually gives information about the configuration of the basin.

There are other interesting things about this algorithm that we have just run, apart from the no–data values and how they are handled. If you have a look at the extents of the layers that we have multiplied (you can do it double–clicking on their names of the layer in the table of contents and looking at their properties), you will see that they are not the same, since the extent covered by the flow accumulation layer is smaller that the extent of the full DEM.

That means that those layers do not match, and that they cannot be multiplied directly without homogenizing those sizes and extents by resampling one or both layers. However, we did not do anything. QGIS takes care of this situation and automatically resamples input layers when needed. The output extent is the minimum covering extent calculated from the input layers, and the minimum cell size of their cellsizes.

In this case (and in most cases), this produces the desired results, but you should always be aware of the additional operations that are taking place, since they might affect the result. In cases when this behaviour might not be the desired, manual resampling should be applied in advance. In later chapters, we will see more about the behaviour of algorithms when using multiple raster layers.

Să încheiem această lecție cu un alt exercițiu de mascare. Urmează să calculăm panta în toate zonele cu o altitudine între 1000 și 1500 de metri.

În acest caz, nu dispunem de un strat pentru a-l utiliza drept mască, dar îl putem crea cu ajutorul calculatorului.

Pornește calculatorul folosind DEM-ul doar ca pe un strat de intrare, și următoarea formulă

```
ifelse(abs(a-1250) < 250, 1, 0/0)
```

După cum puteți vedea, putem folosi calculatorul nu numai pentru a face operații algebrice simple, ci și pentru a efectua calcule mai complexe, care implică propoziții condiționate, precum cea de mai sus.

Rezultatul are o valoare de 1 în interiorul gamei în care dorim să lucrăm, și valori fără-date în celulele din exterior.



The no-data value comes from the 0/0 expression. Since that is an undetermined value, SAGA will add a NaN (Not a Number) value, which is actually handled as a no-data value. With this little trick you can set a no-data value without needing to know what the no–data value of the cell is.

Now you just have to multiply it by the slope layer included in the project, and you will get the desired result.

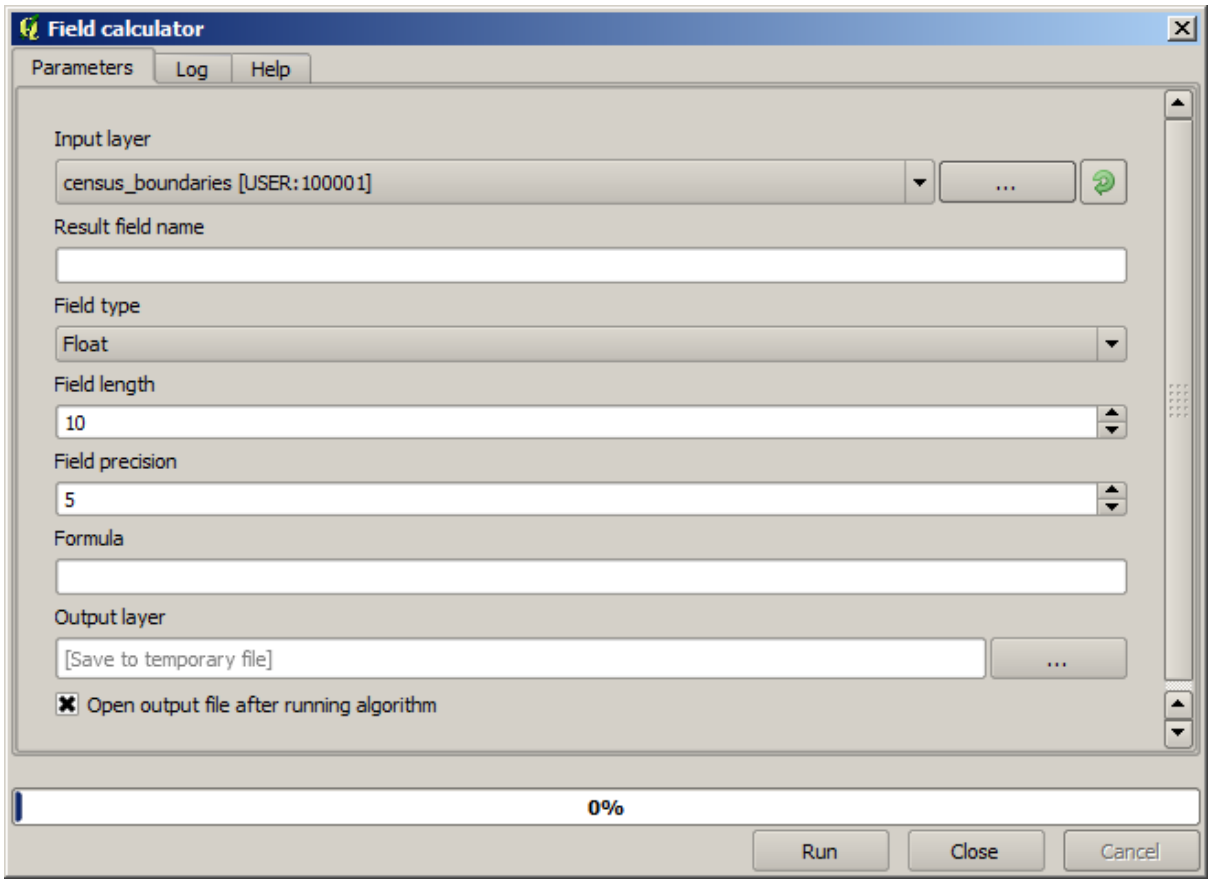
All that can be done in a single operation with the calculator. We leave that as an exercise for the reader.

17.11 Calculatorul vectorial

Notă

În această lecție vom vedea cum se vor adăuga noi atribute în stratul vectorial, pe baza unei expresii matematice, cu ajutorul calculatorului vectorial.

We already know how to use the raster calculator to create new raster layers using mathematical expressions. A similar algorithm is available for vector layers, and generates a new layer with the same attributes of the input layer, plus an additional one with the result of the expression entered. The algorithm is called *Field calculator* and has the following parameters dialog.



Notă

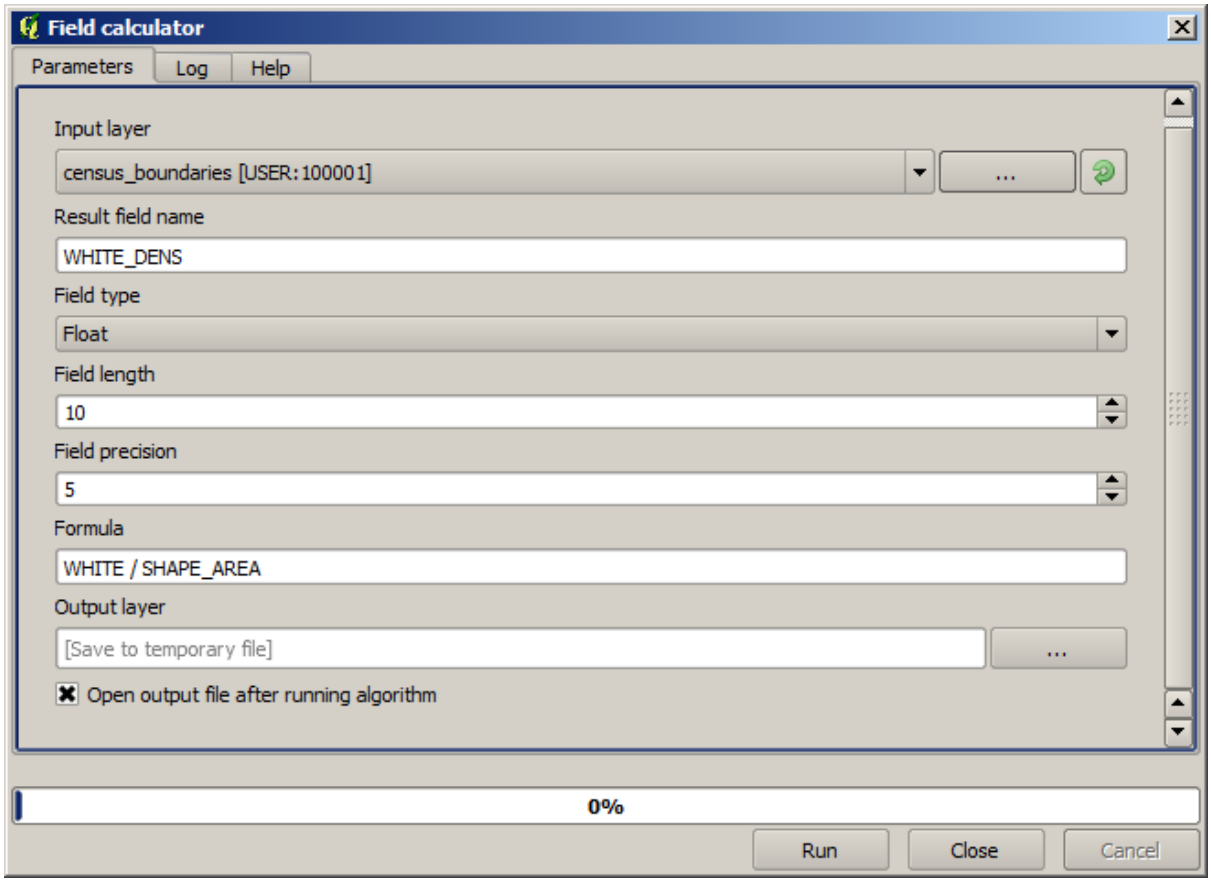
În versiunile mai noi de Processing, interfața s-a schimbat considerabil, fiind mult mai puternică și mai ușor de utilizat.

Aici sunt câteva exemple de utilizare ale acestui algoritm.

First, let's calculate the population density of white people in each polygon, which represents a census. We have two fields in the attributes table that we can use for that, namely `WHITE` and `SHAPE_AREA`. We just have to divide them and multiply by one million (to have density per square km), so we can use the following formula in the corresponding field

```
( "WHITE" / "SHAPE_AREA" ) * 1000000
```

Dialogul parametrilor trebuie completați așa cum se arată mai jos.



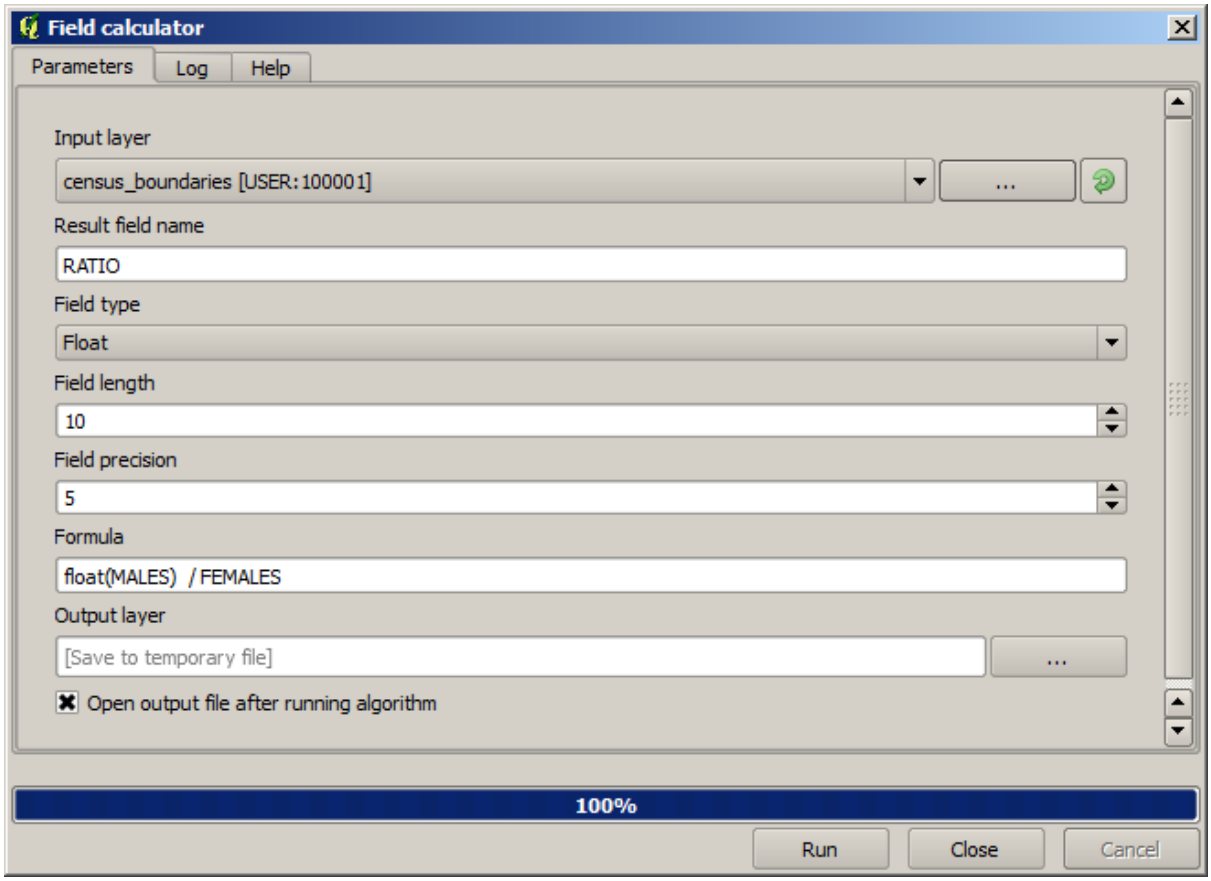
Acest lucru va genera un nou câmp denumit `WHITE_DENS`

Now let's calculate the ratio between the `MALES` and `FEMALES` fields to create a new one that indicates if male population is numerically predominant over female population.

Introduceți următoarea formulă

```
"MALES" / "FEMALES"
```

This time the parameters window should look like this before pressing the *OK* button.

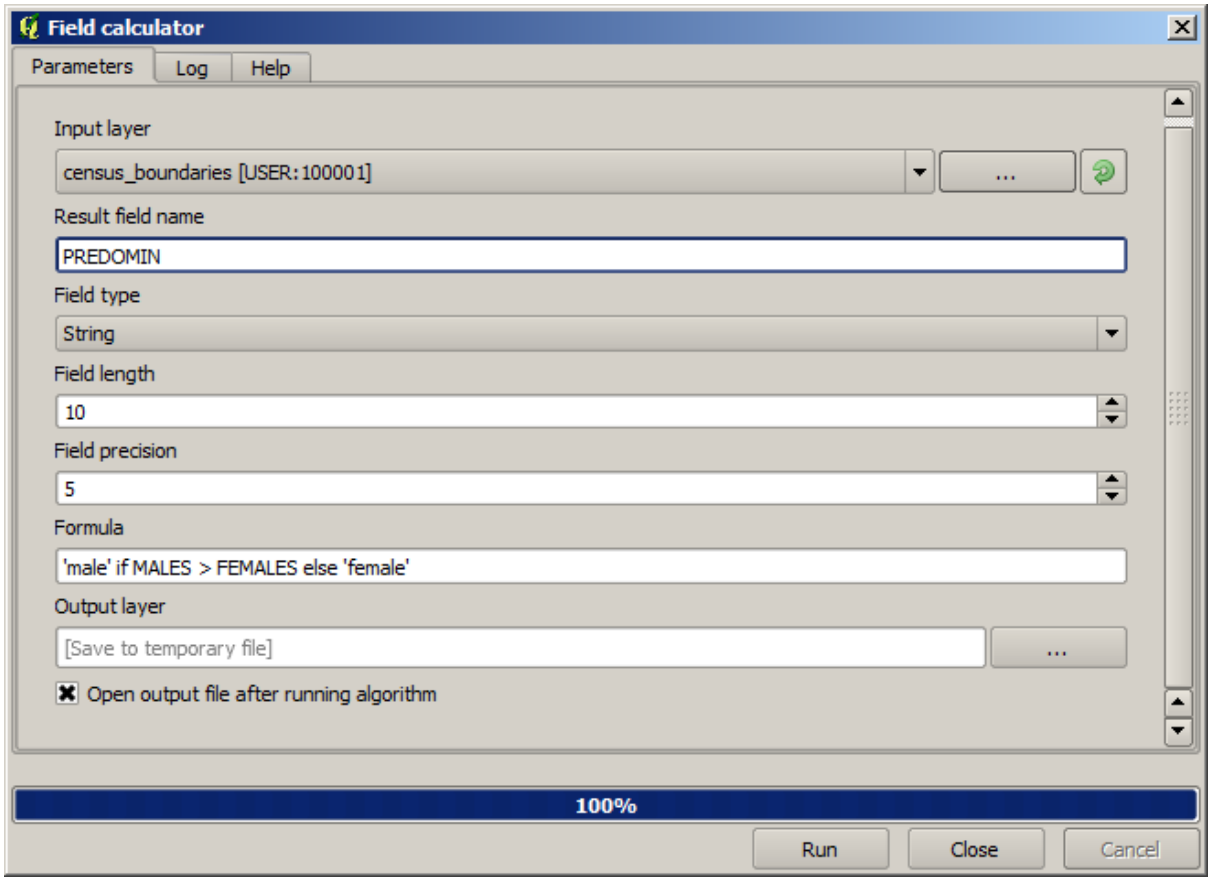


In earlier version, since both fields are of type integer, the result would be truncated to an integer. In this case the formula should be: `1.0 * "MALES" / "FEMALES"`, to indicate that we want floating point number a result.

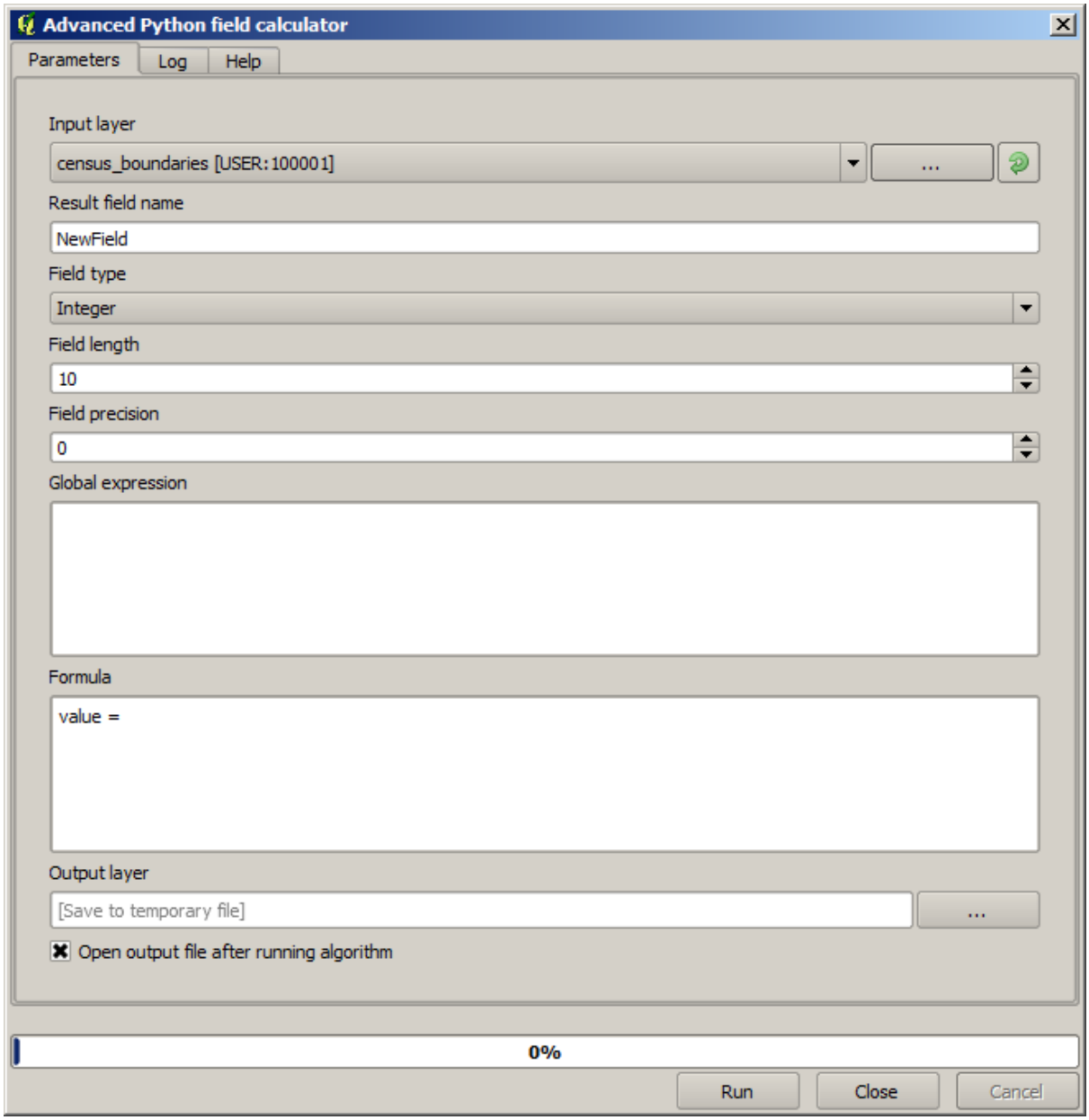
We can use conditional functions to have a new field with `male` or `female` text strings instead of those ratio value, using the following formula:

```
CASE WHEN  "MALES" > "FEMALES"  THEN 'male' ELSE 'female' END
```

Fereastra parametrilor ar trebui să arate acest lucru.



A python field calculator is available in the *Advanced Python field calculator*, which will not be detailed here



17.12 Definirea eextinderilor

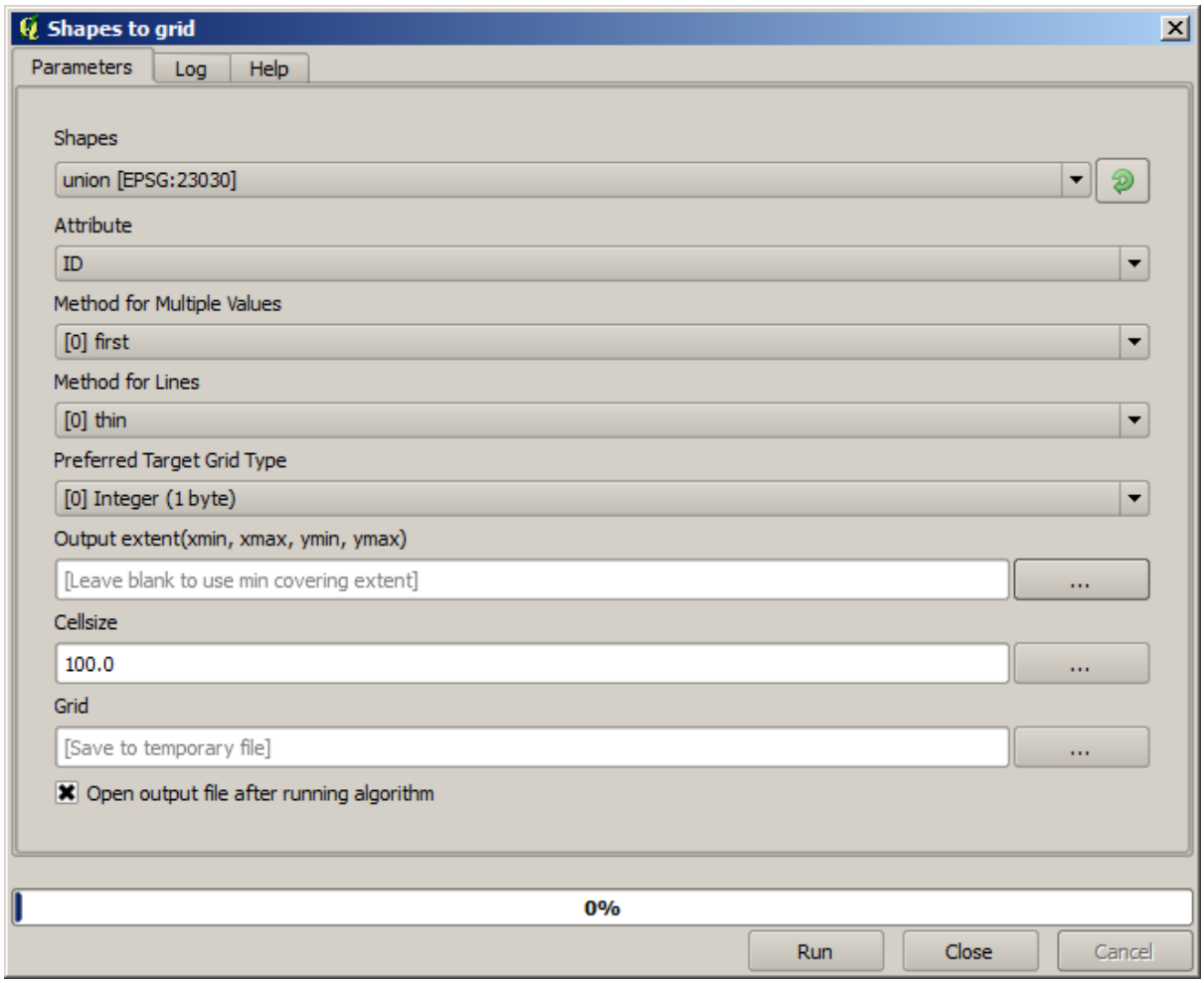
Notă

În această lecție vom vedea cum se definesc extinderile, acest lucru fiind necesar unor algoritmi, mai ales cele pentru rastere.

Unii algoritmi au nevoie de o extindere, pentru a defini zona care urmează să fie acoperită de analiză și, de obicei, pentru a defini extinderea stratului rezultat.

Atunci când este cerută o anumită extindere, aceasta poate fi definită manual, prin introducerea celor patru valori care o definesc (min X, min Y, max X, max Y), dar există și alte modalități, mai practice și mai interesante, care pot face la fel de bine acest lucru. Vom vedea toate acestea în cadrul lecției.

First, let's open an algorithm that requires an extent to be defined. Open the *Rasterize (vector to raster)* algorithm, which creates a raster layer from a vector layer.

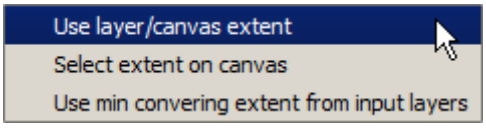


All the parameters, except for the last two ones, are used to define which layer is to be rasterized, and configure how the rasterization process should work. The two last parameters, on the other hand, define the characteristics of the output layer. That means that they define the area that is covered (which is not necessarily the same area covered by the input vector layer), and the resolution/cellsize (which cannot be inferred from the vector layer, since vector layers do not have a cellsize).

Primul lucru pe care îl puteți face este să tastați cele 4 valori de definire, prezentate anterior, separate prin virgulă.

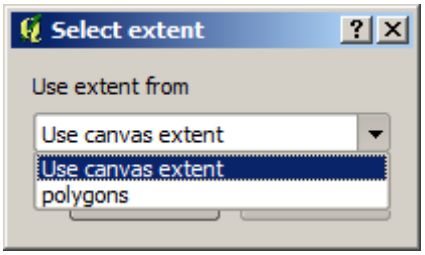


That doesn't need any extra explanation. While this is the most flexible option, it is also the less practical in some cases, and that's why other options are implemented. To access them, you have to click on the button on the right–hand side of the extent text box.



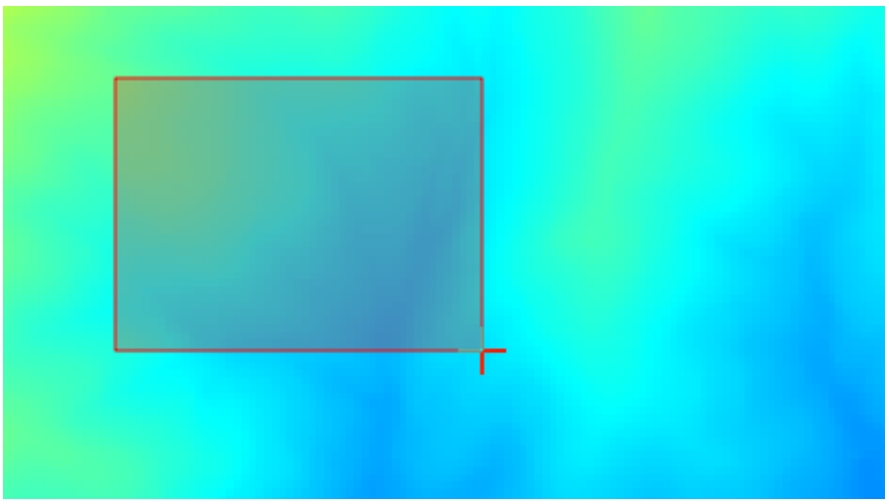
Să vedem ce poate face fiecare.

The first option is *Use layer/canvas extent*, which will show the selection dialog shown below.



Here you can select the extent of the canvas (the extent covered by the current zoom), or the extension any of the available layers. Select it and click on *OK*, and the text box will be automatically filled with the corresponding values.

The second option is *Select extent on canvas*. In this case, the algorithm dialog disappears and you can click and drag on the QGIS canvas to define the desired extent.

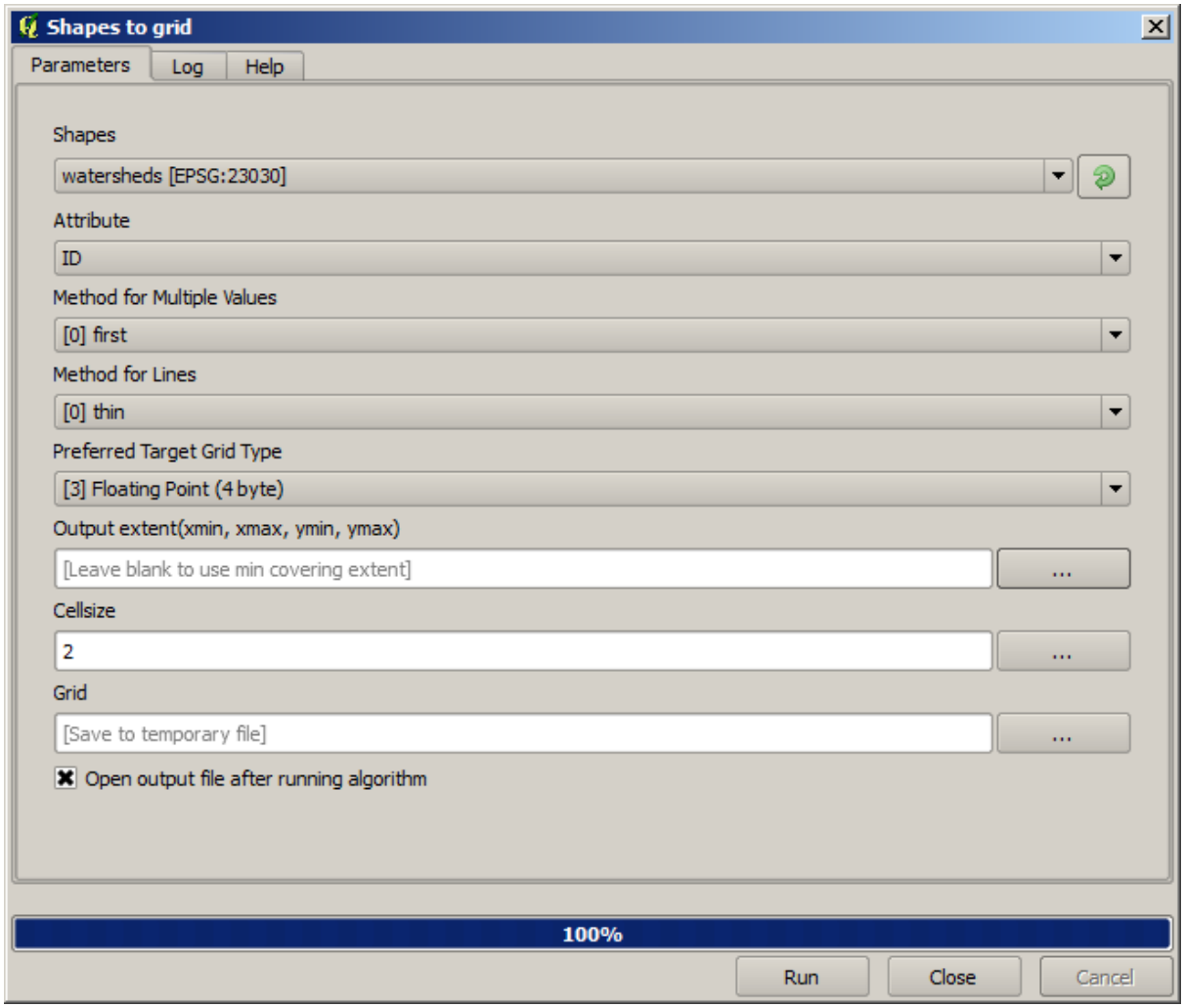


După ce eliberați butonul mouse-ului, dialogul va reapărea iar caseta de text va conține deja valorile corespunzătoare în extinderea definită.

The last option is *Use min covering extent from input layers*, which is the default option. This will compute the min covering extent of all layers used to run the algorithm, and there is no need to enter any value in the text box. In the case of a single input layer, as in the algorithm we are running, the same extent can be obtained by selecting that same input layer in the *Use layer/canvas extent* that we already saw. However, when there are several input layers, the min covering extent does not correspond to any of the input layer extent, since it is computed from all of them together.

Vom folosi această ultimă metodă pentru a executa algoritmul nostru de rasterizare.

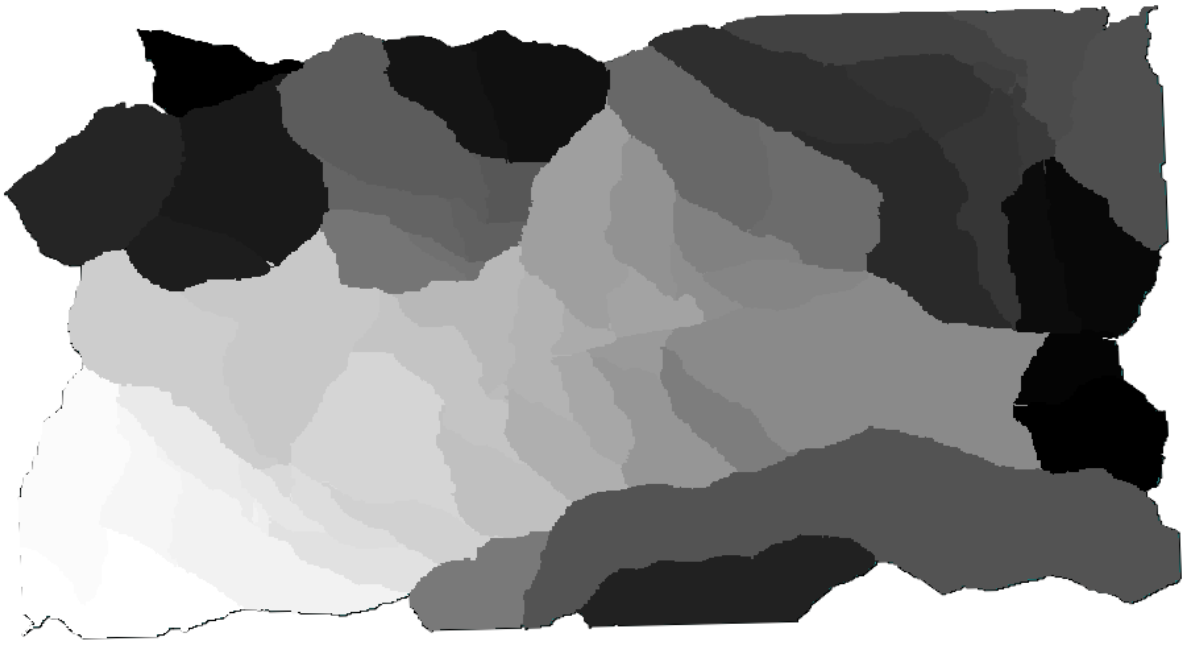
Fill the parameters dialog as shown next, and press *OK*.



Notă

In this case, better use an `Integer (1 byte)` instead of a `Floating point (4 byte)`, since the `NAME` is an integer with maximum value=64. This will result in a smaller file size and faster computations.

Veți primi un strat raster care acoperă exact zona acoperită de stratul vectorial inițial.



In some cases, the last option, *Use min covering extent from input layers*, might not be available. This will happen in those algorithm that do not have input layers, but just parameters of other types. In that case, you will have to enter the value manually or use any of the other options.

Notice that, when a selection exist, the extent of the layer is that of the whole set of features, and the selection is not used to compute the extent, even though the rasterization is executed on the selected items only. In that case, you might want to actually create a new layer from the selection, and then use it as input.

17.13 Ieșiri HTML

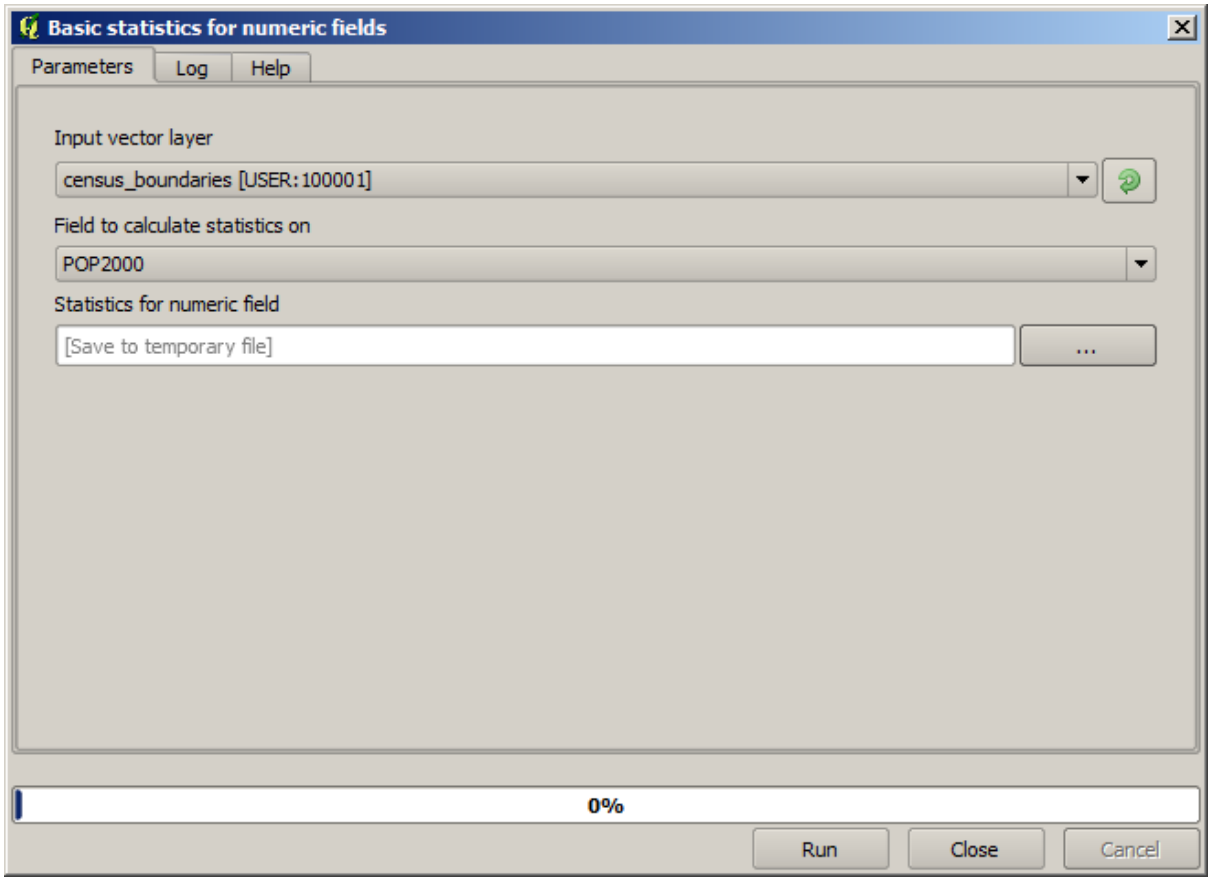
Notă

În această lecție învățăm cum administrează QGIS ieșirile în format HTML, care sunt utilizate pentru a produce text si grafică.

All the outputs we have produced so far were layers (whether raster or vector). However, some algorithms generate outputs in the form of text and graphics. All this outputs are wrapped in HTML files and displayed in the so–called *Results viewer*, which is another element of the processing framework.

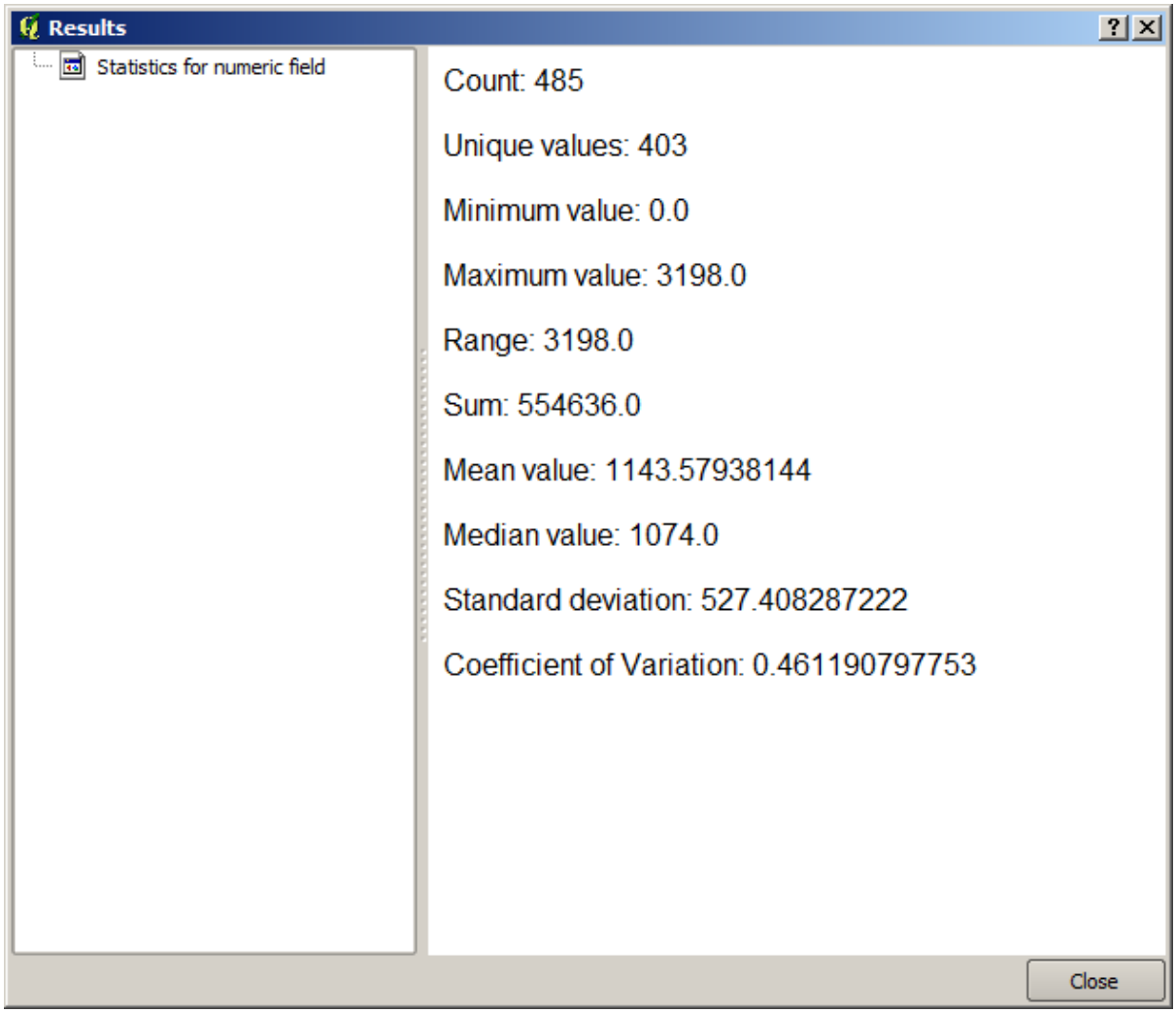
Să vedem unul dintre acești algoritmi pentru a înțelege cum funcționează.

Open the project with the data to be used in this lesson and then open the *Basic statistics for fields* algorithm.



Algoritmul este destul de simplu, trebuind să selectați doar stratul de utilizat și unul din câmpurile sale (unul numeric). Ieșirea este de tip HTML, dar caseta corespunzătoare funcționează similar cu cea pentru o ieșire de tip vectorial sau raster. Puteți introduce o cale de fișier sau să o lăsați necompletată, pentru ca salvarea să aibă loc într-un fișier temporar. Totuși, în acest caz sunt acceptate doar extensiile `html` și `htm`, nefiind nici o modalitate de a modifica formatul de ieșire.

Run the algorithm selecting the only layer in the project as input, and the `POP2000` field, and a new dialog like the one shown next will appear once the algorithm is executed and the parameters dialog is closed.



This is the *Results viewer*. It keeps all the HTML result generated during the current session, easily accessible, so you can check them quickly whenever you need it. As it happens with layers, if you have saved the output to a temporary file, it will be deleted once you close QGIS. If you have saved to a non-temporary path, the file will remain, but it will not appear in the *Results viewer* the next time you open QGIS.

Some algorithms generate text that cannot be divided into other more detailed outputs. That is the case if, for instance, the algorithm captures the text output from an external process. In other cases, the output is presented as text, but internally is divided into several smaller outputs, usually in the form of numeric values. The algorithm that we have just executed is one of them. Each one of those values is handled as a single output, and stored in a variable. This has no importance at all now, but once we move to the model designer, you will see that it will allow us to use those values as numeric inputs for other algorithms.

17.14 Un prim exemplu de analiză

Notă

În această lecție, vom efectua o analiză reală, folosind doar bara de instrumente, astfel încât să vă familiarizați cu elementele cadrului de prelucrare.

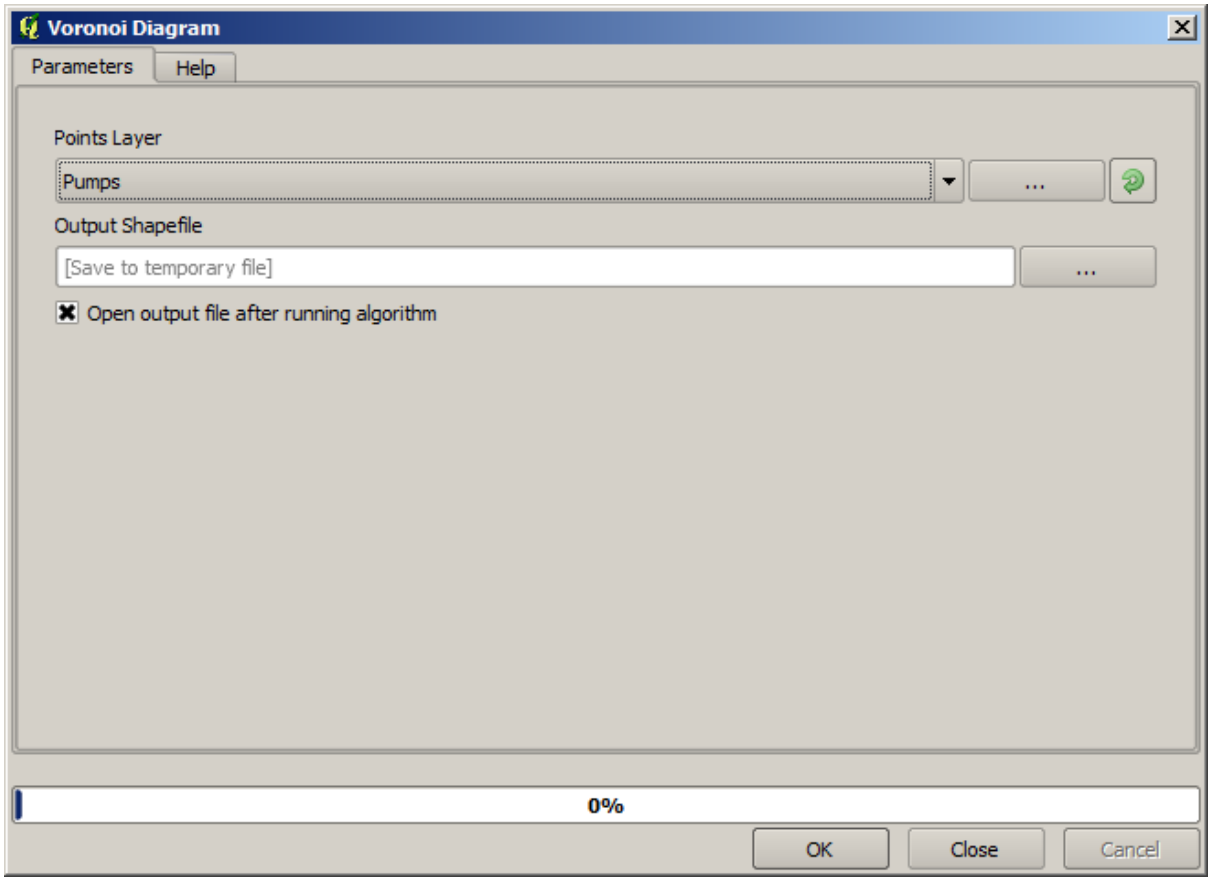
O dată ce totul este configurat, iar algoritmii externi sunt gata de utilizare, dispunem de un instrument foarte puternic pentru efectuarea analizelor spațiale. Este timpul să elaborăm un exercițiu mai amplu, folosind date din lumea reală.

We will be using the well-known dataset that John Snow used in 1854, in his groundbreaking work (https://en.wikipedia.org/wiki/John_Snow_%28physician%29), and we will get some interesting results. The analysis of this dataset is pretty obvious and there is no need for sophisticated GIS techniques to end up with good results and conclusions, but it is a good way of showing how these spatial problems can be analyzed and solved by using different processing tools.

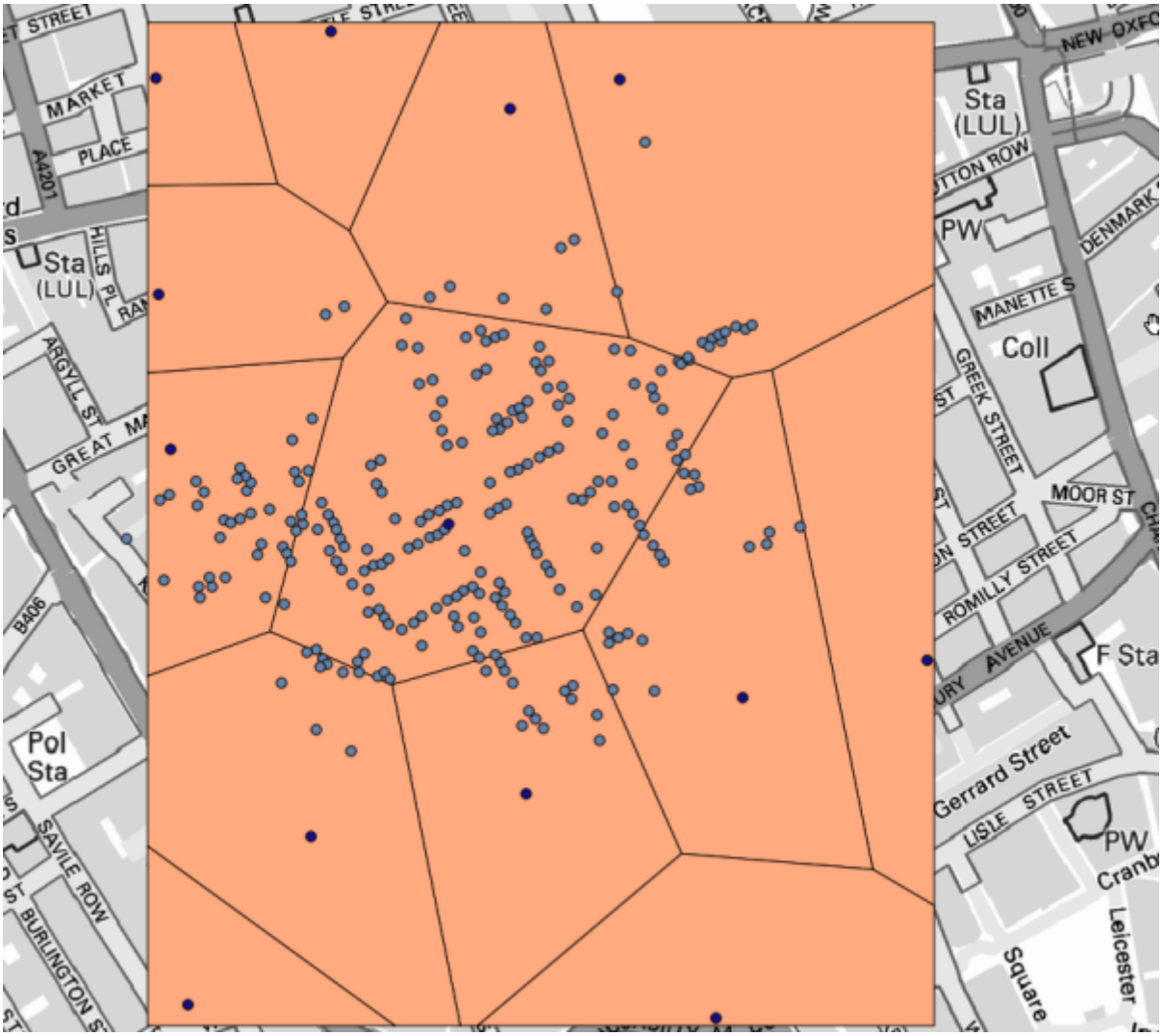
Setul de date conține fișierul shape cu decesele cauzate de holeră și locațiile pompelor, precum și o hartă OSM randată în format TIFF. Deschideți proiectul QGIS corespunzător acestei lecții.



The first thing to do is to calculate the Voronoi diagram (a.k.a. Thiessen polygons) of the pumps layer, to get the influence zone of each pump. The *Voronoi polygons* algorithm can be used for that.

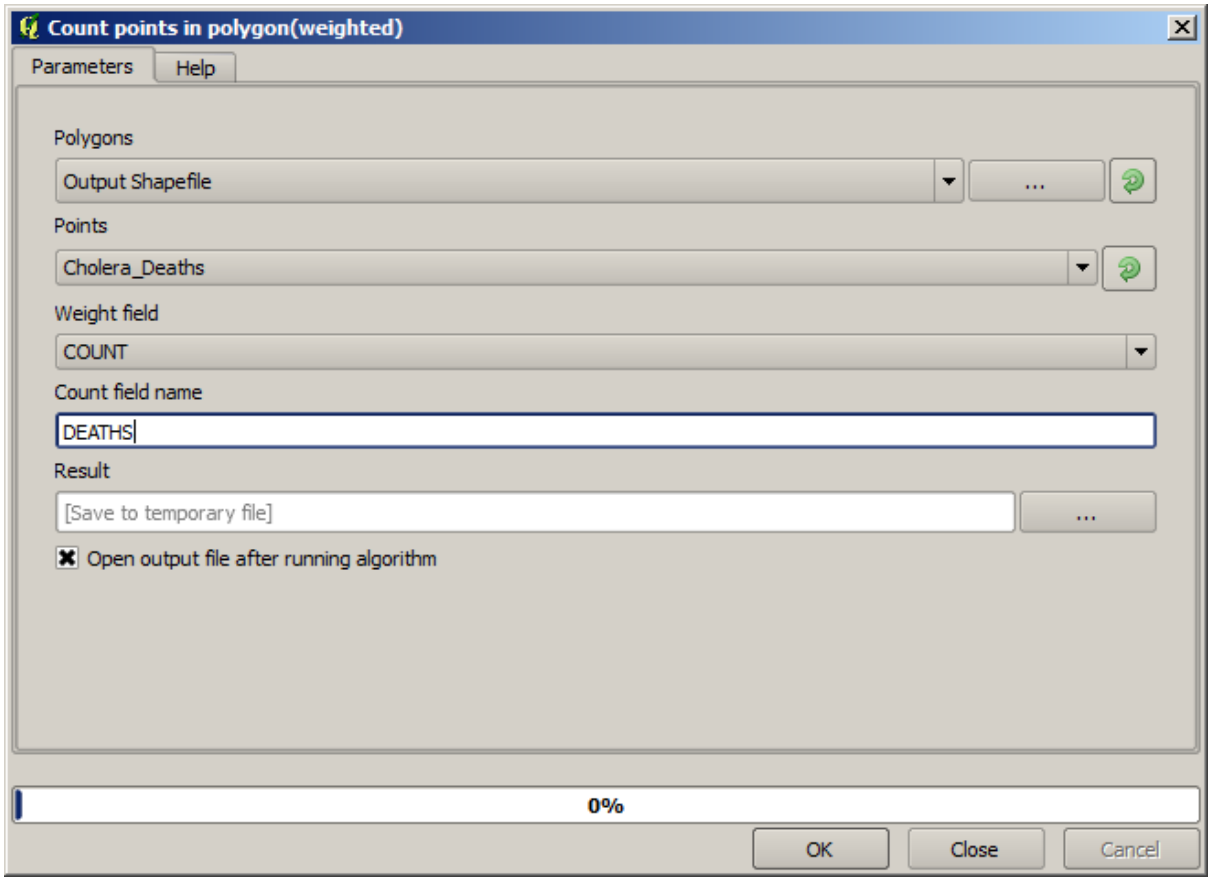


Destul de ușor, dar ne va oferi deja informații interesante.

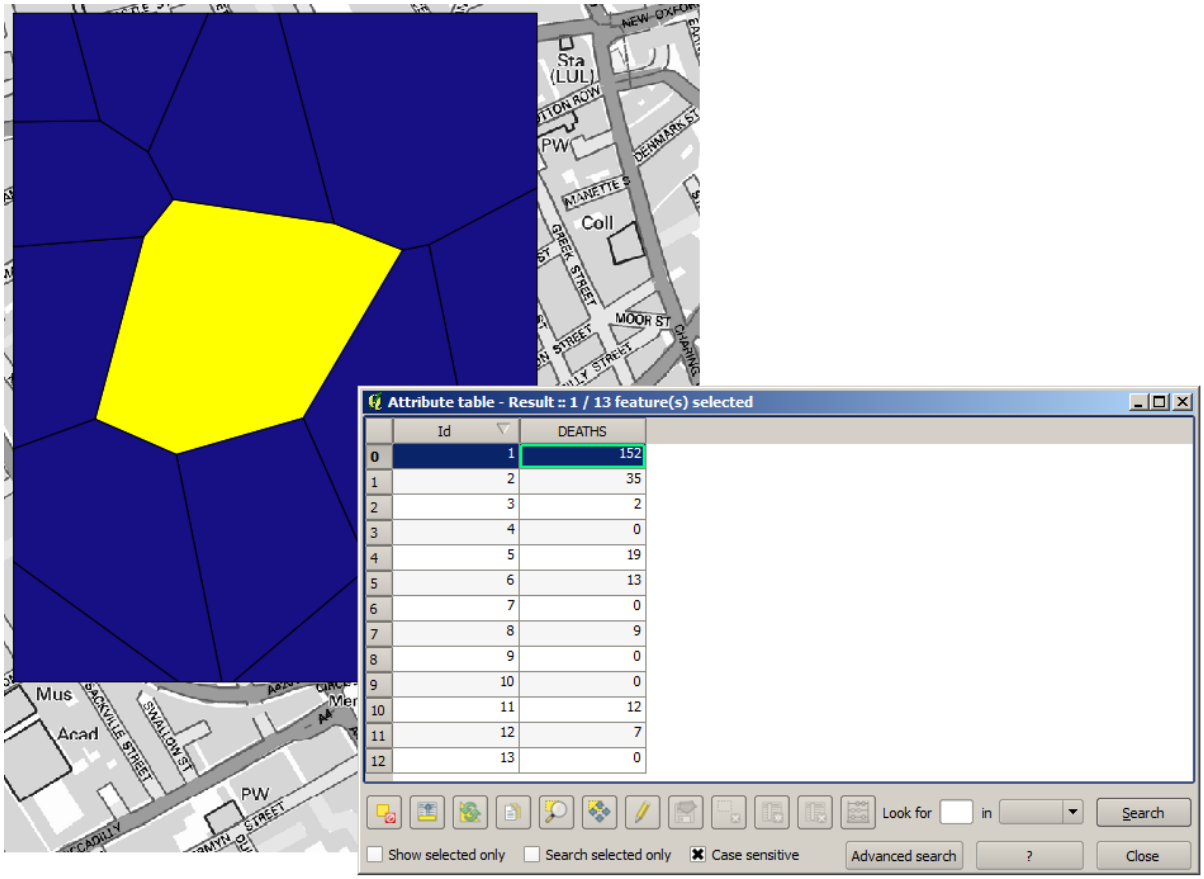


În mod evident, cele mai multe cazuri se încadrează într-unul dintre poligoane

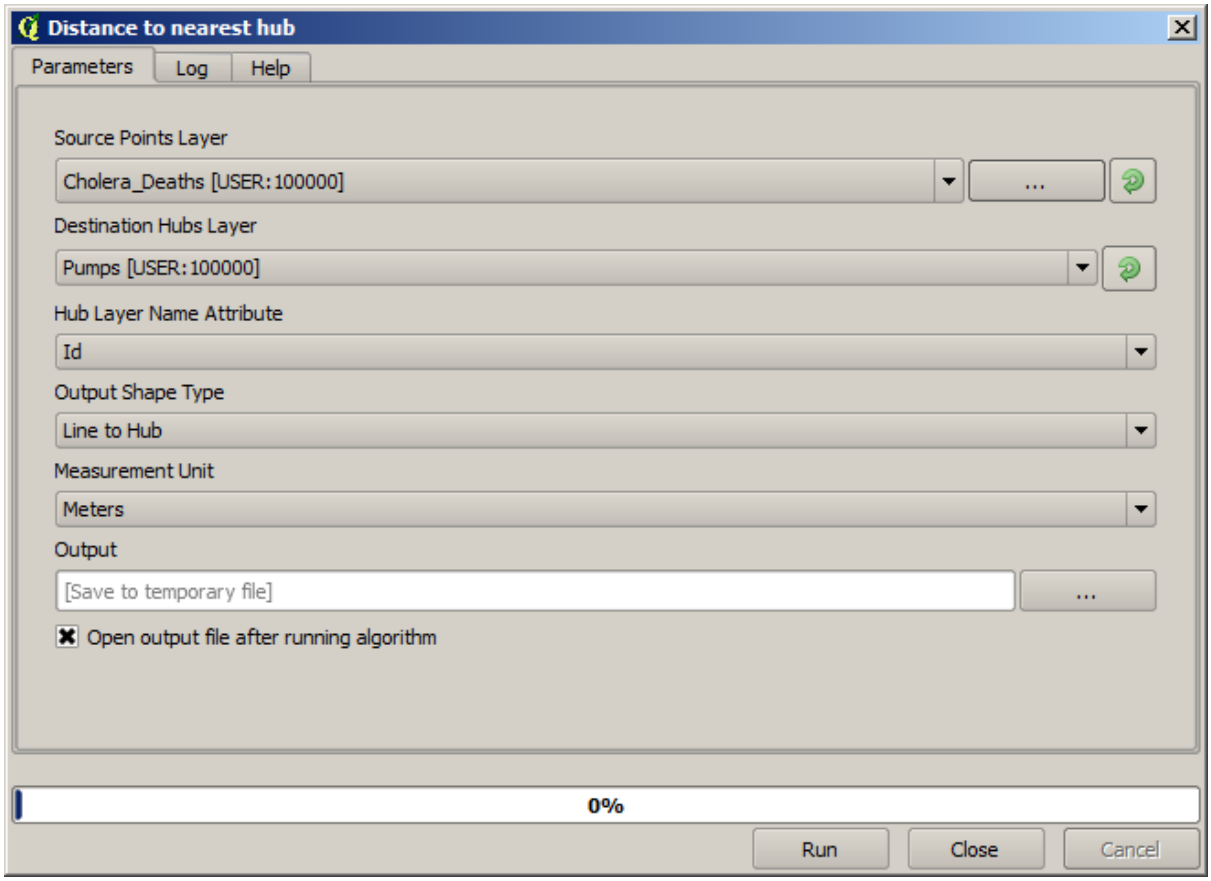
To get a more quantitative result, we can count the number of deaths in each polygon. Since each point represents a building where deaths occured, and the number of deaths is stored in an attribute, we cannot just count the points. We need a weighted count, so we will use the *Count points in polygon* tool.



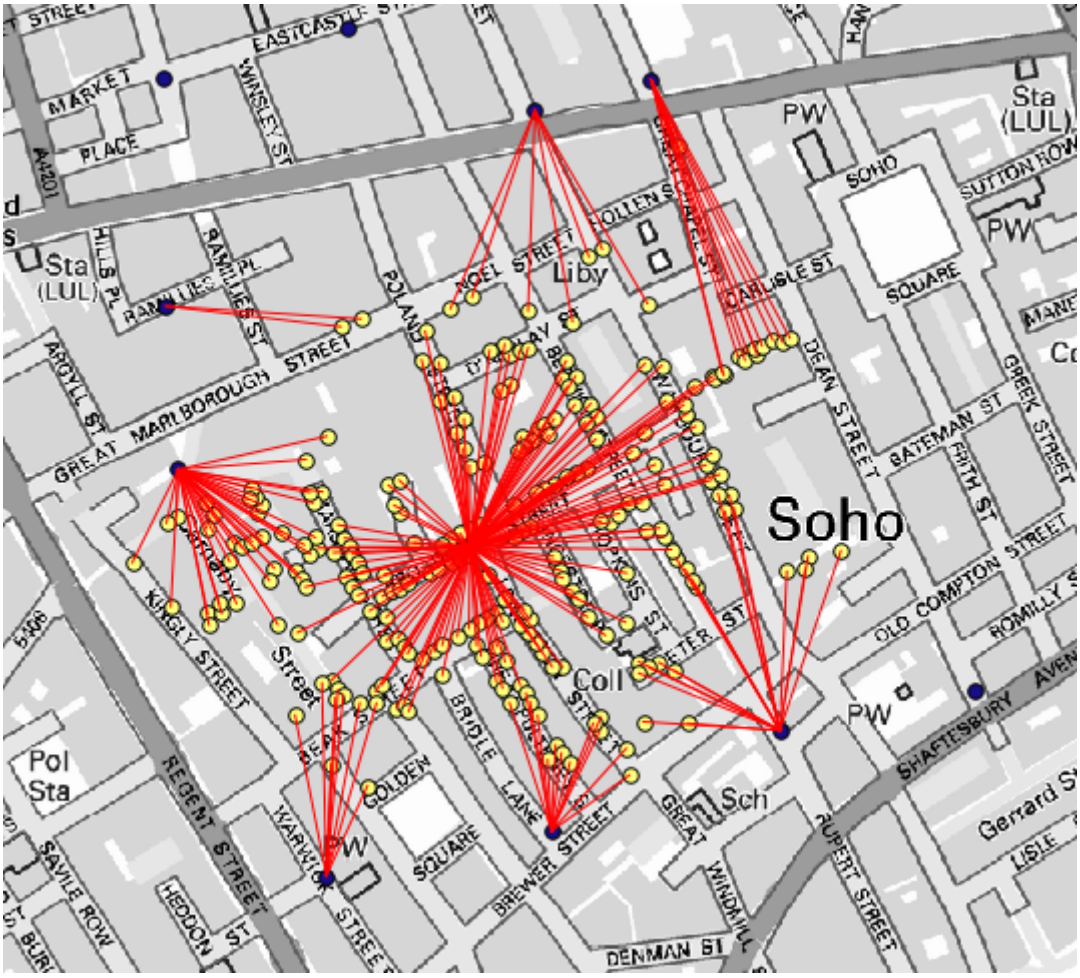
The new field will be called `DEATHS`, and we use the `COUNT` field as weighting field. The resulting table clearly reflects that the number of deaths in the polygon corresponding to the first pump is much larger than the other ones.



Another good way of visualizing the dependence of each point in the `Cholera_deaths` layer with a point in the `Pumps` layer is to draw a line to the closest one. This can be done with the *Distance to nearest hub* tool, and using the configuration shown next.

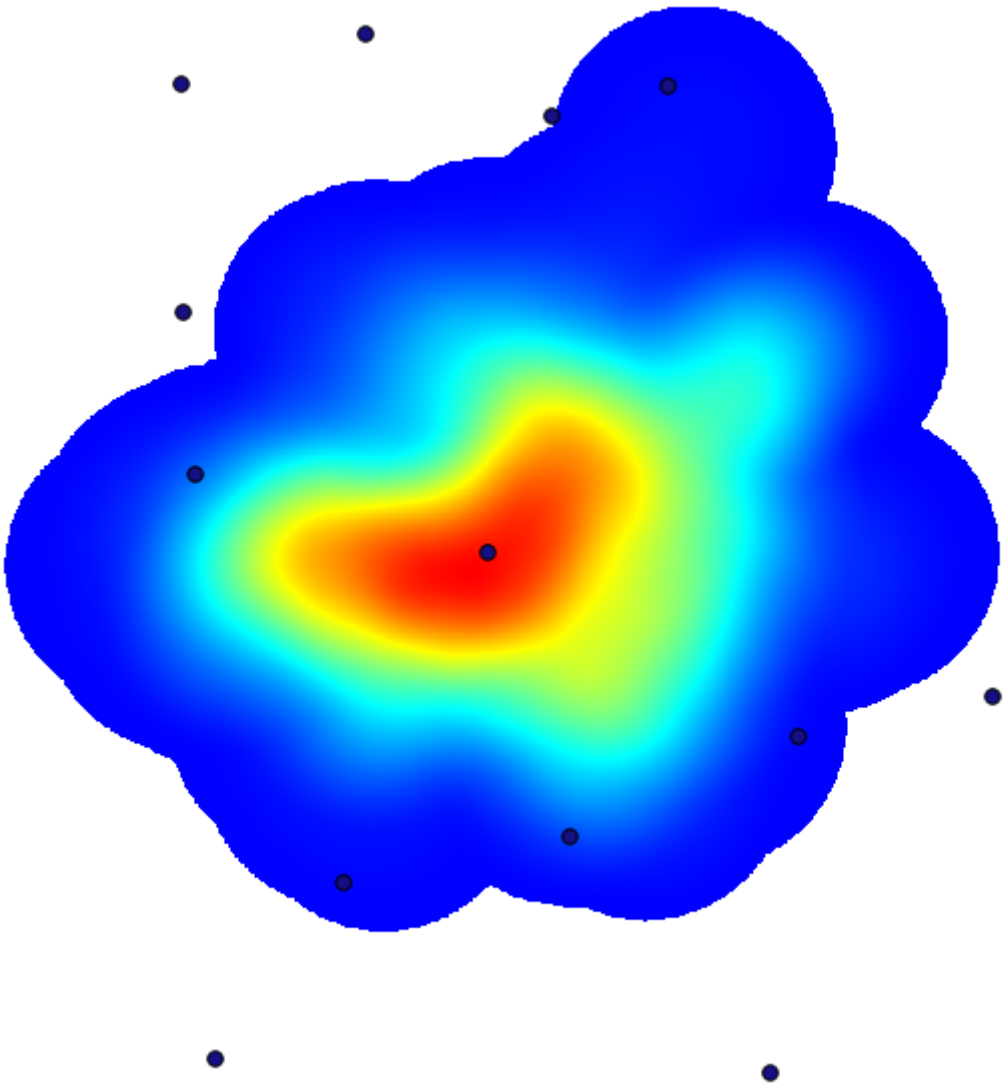


Rezultatul arată în felul următor:

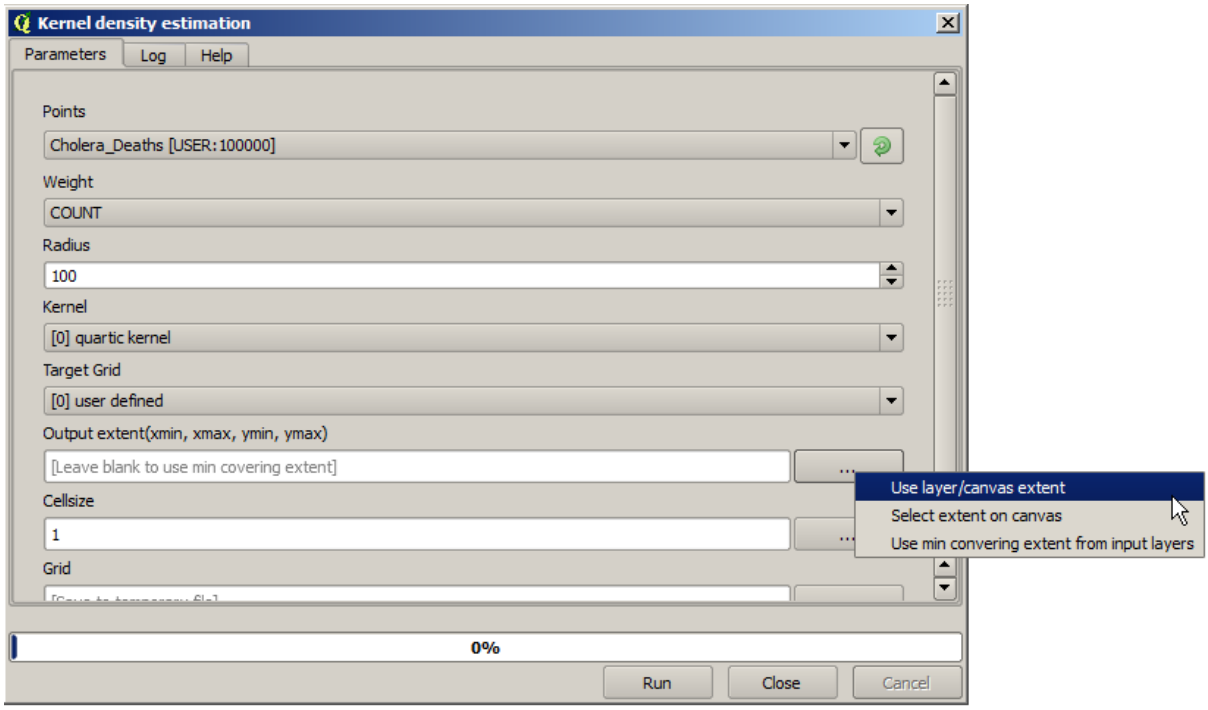


Although the number of lines is larger in the case of the central pump, do not forget that this does not represent the number of deaths, but the number of locations where cholera cases were found. It is a representative parameter, but it is not considering that some locations might have more cases than other.

A density layer will also give us a very clear view of what is happening. We can create it with the *Heatmap (Kernel density estimation)* algorithm. Using the `Cholera_deaths` layer, its `COUNT` field as weight field, with a radius of 100, the extent and cell size of the streets raster layer, we get something like this.



Remember that, to get the output extent, you do not have to type it. Click on the button on the right-hand side and select *Use layer/canvas extent*.



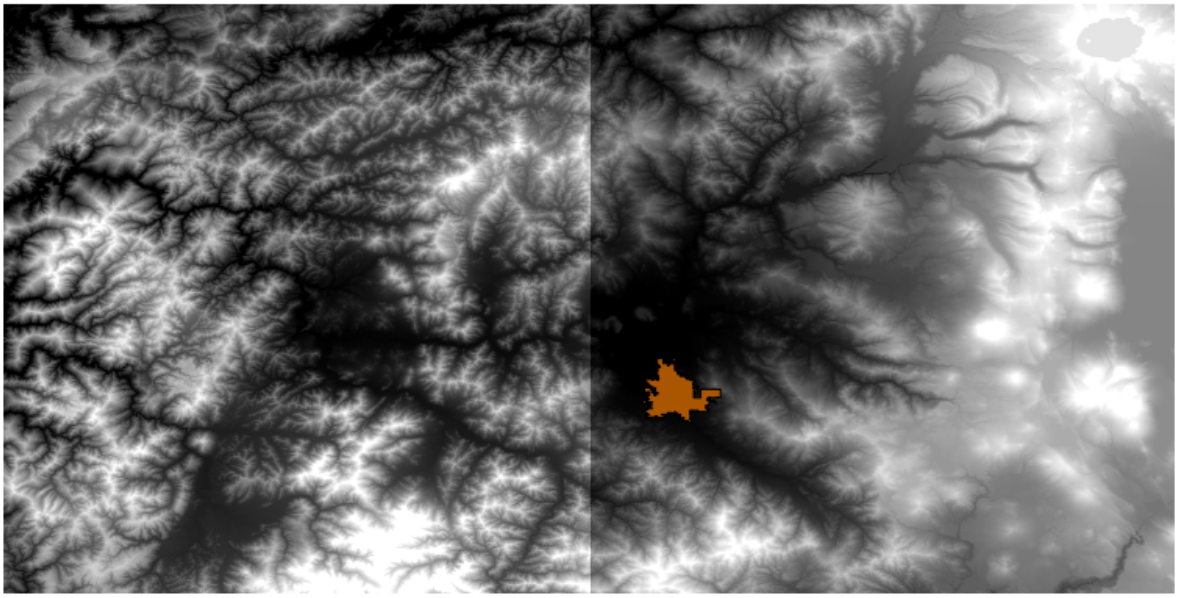
Selectați stratul străzilor raster iar întinderea sa va fi adăugată automat în câmpul de text. Trebuie să faceți același lucru cu dimensiunea celulei, selectând-o, de asemenea, din acel strat.

Prin combinarea cu stratul de pompe, vom vedea că există o pompă în mod clar în punctul fierbinte, în care se constată densitatea maximă a cazurilor de deces.

17.15 Decuparea și îmbinarea straturilor raster

> **Notă**
>
> În această lecție vom vedea un alt exemplu de pregătire a datelor spațiale, pentru a continua utilizarea geoalgoritmilor în scenarii din lumea reală.

În această lecție, vom calcula un strat de pantă pentru suprafața care înconjoară o zonă dată a orașului, dintr-un strat vectorial cu un singur poligon. DEM-ul de bază este împărțit în două straturi raster care, împreună, acoperă o suprafață mult mai mare decât cea din jurul orașului în care ne dorim să lucrăm. Dacă deschideți proiectul corespunzător acestei lecții, veți vedea ceva de genul următor.



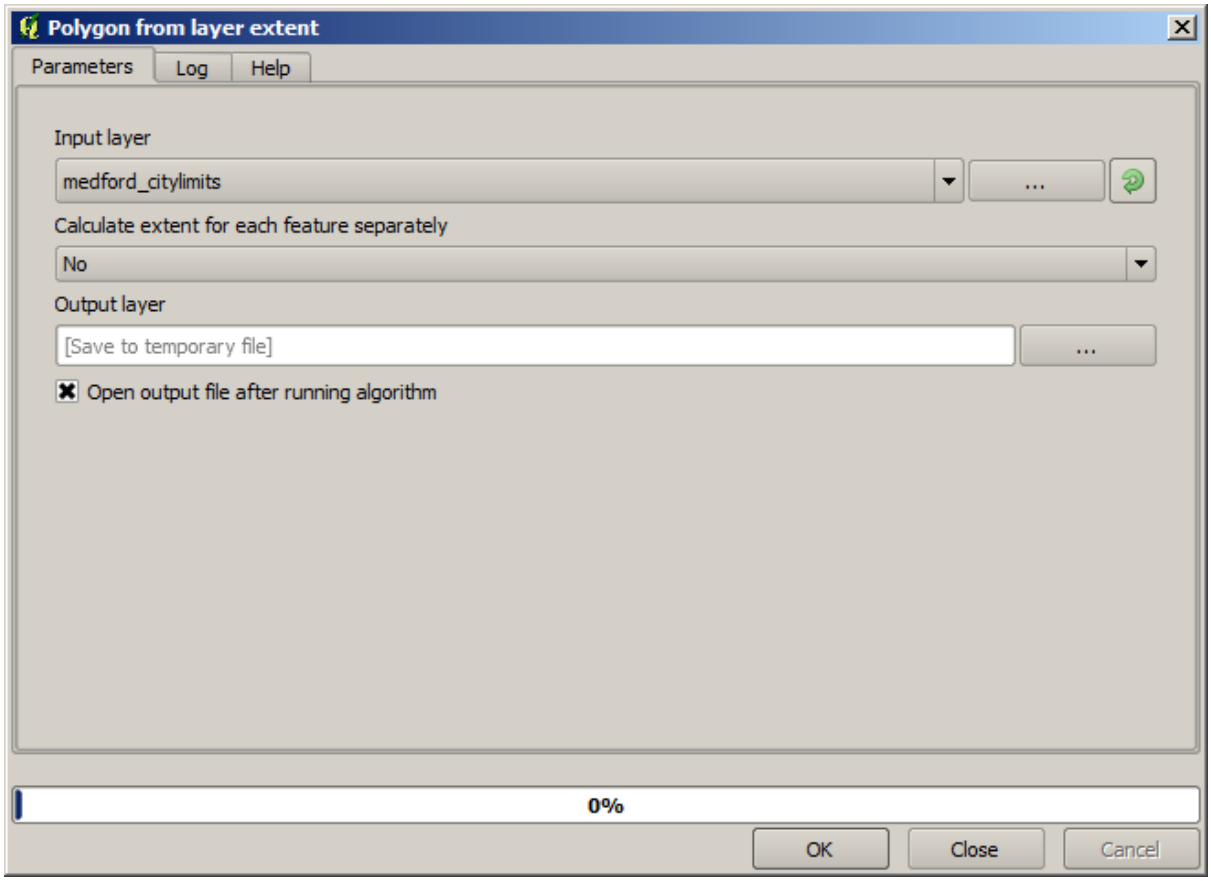
Aceste straturi au două probleme:

- Acestea acoperă o zonă care este prea mare pentru ceea ce dorim (suntem interesați de o regiune mai mică din jurul centrului orașului)
- Ele se află în două fișiere diferite (limitele orașului se încadrează doar într-un singur strat raster, dar, așa cum s-a mai zis, dorim o anumită suprafață adițională în jurul acestuia).

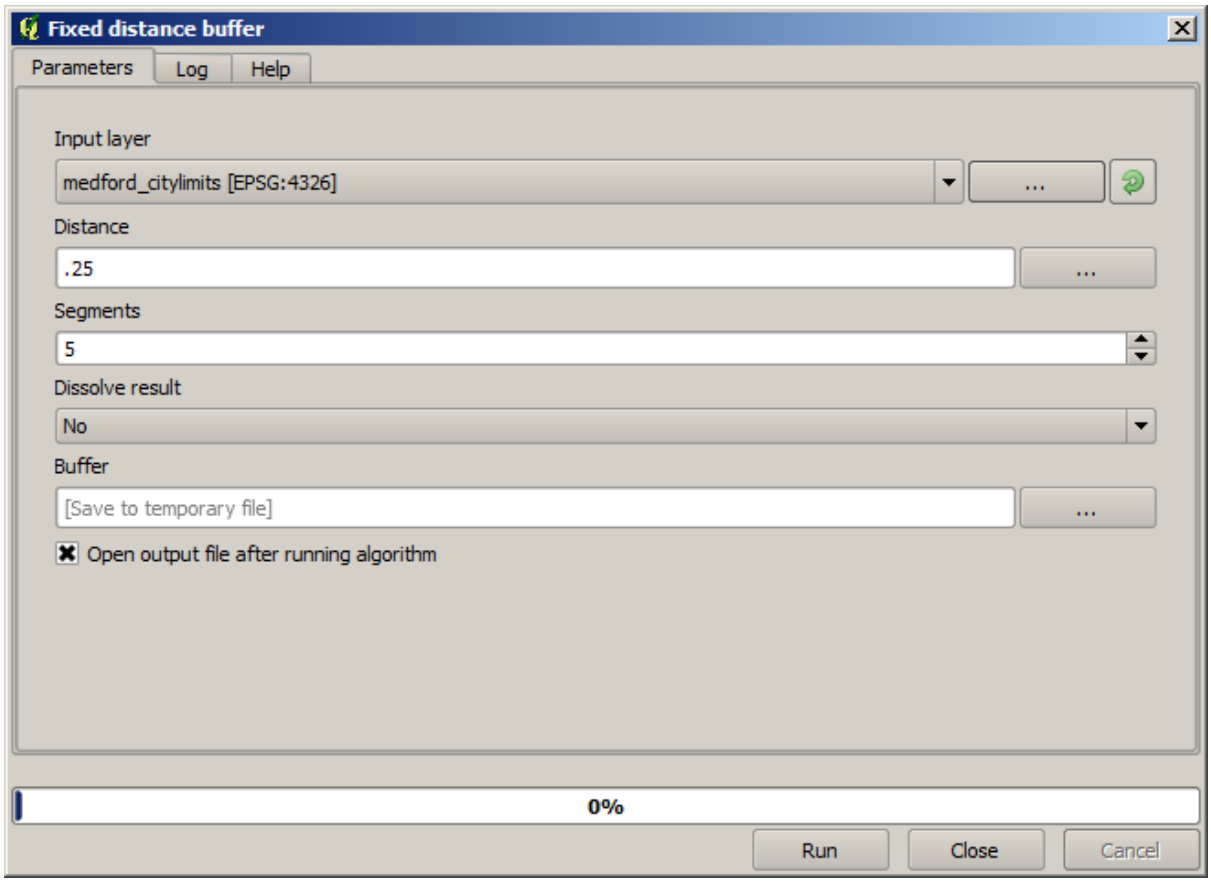
Ambele sunt ușor rezolvabile cu geoalgoritmii corespunzători.

În primul rând, vom crea un dreptunghi care definește zona dorită. Pentru aceasta, vom crea un strat care conține caseta de încadrare a stratului, împreună cu limitele suprafeței orașului, apoi vom crea un tampon, astfel încât să existe un strat raster care îl acoperă un pic mai mult decât este necesar.

To calculate the bounding box , we can use the *Extract layer extent* algorithm

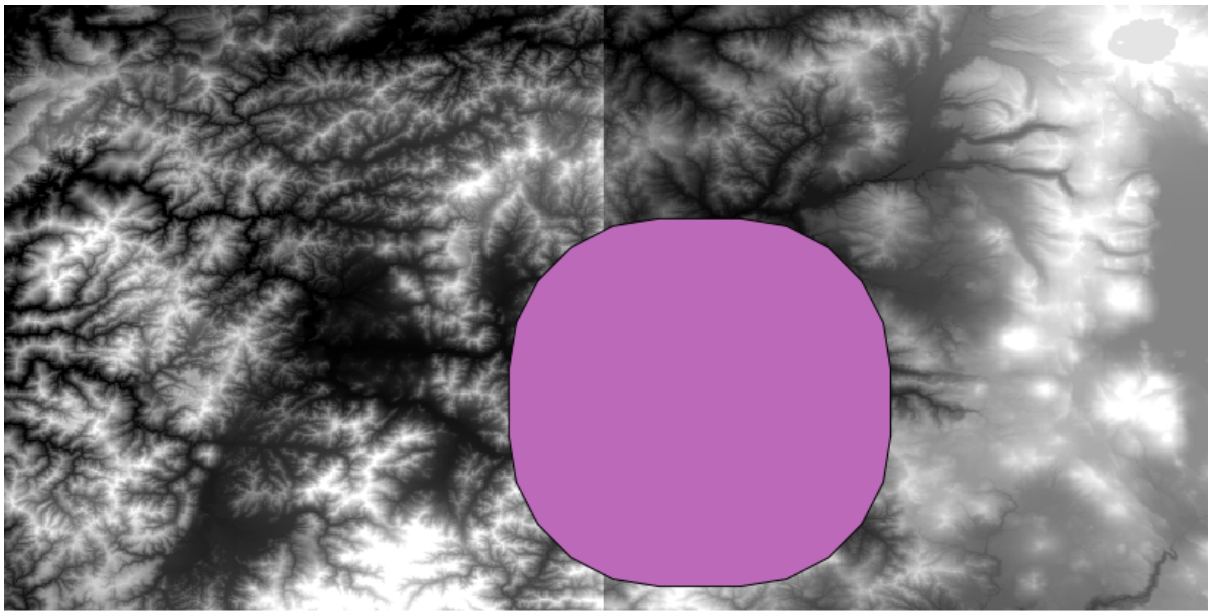


To buffer it, we use the *Buffer* algorithm, with the following parameter values.

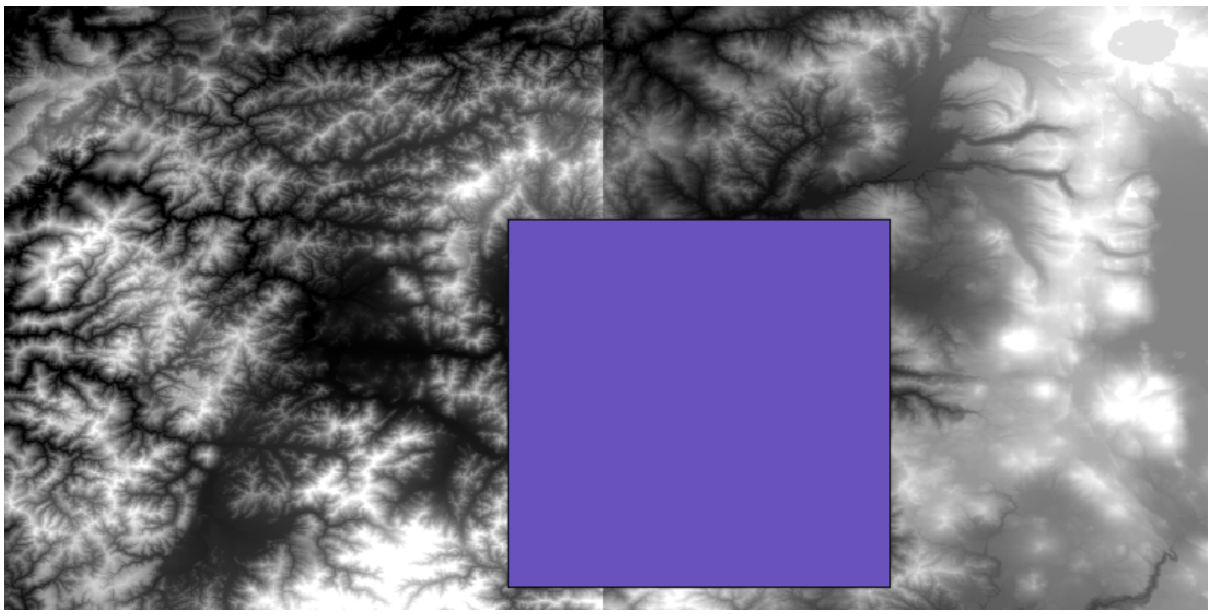


> **Atenționare**
>
> Sintaxa s-a schimbat în versiunile recente; setați atât Distanța cât și vertexul Arcului la .25

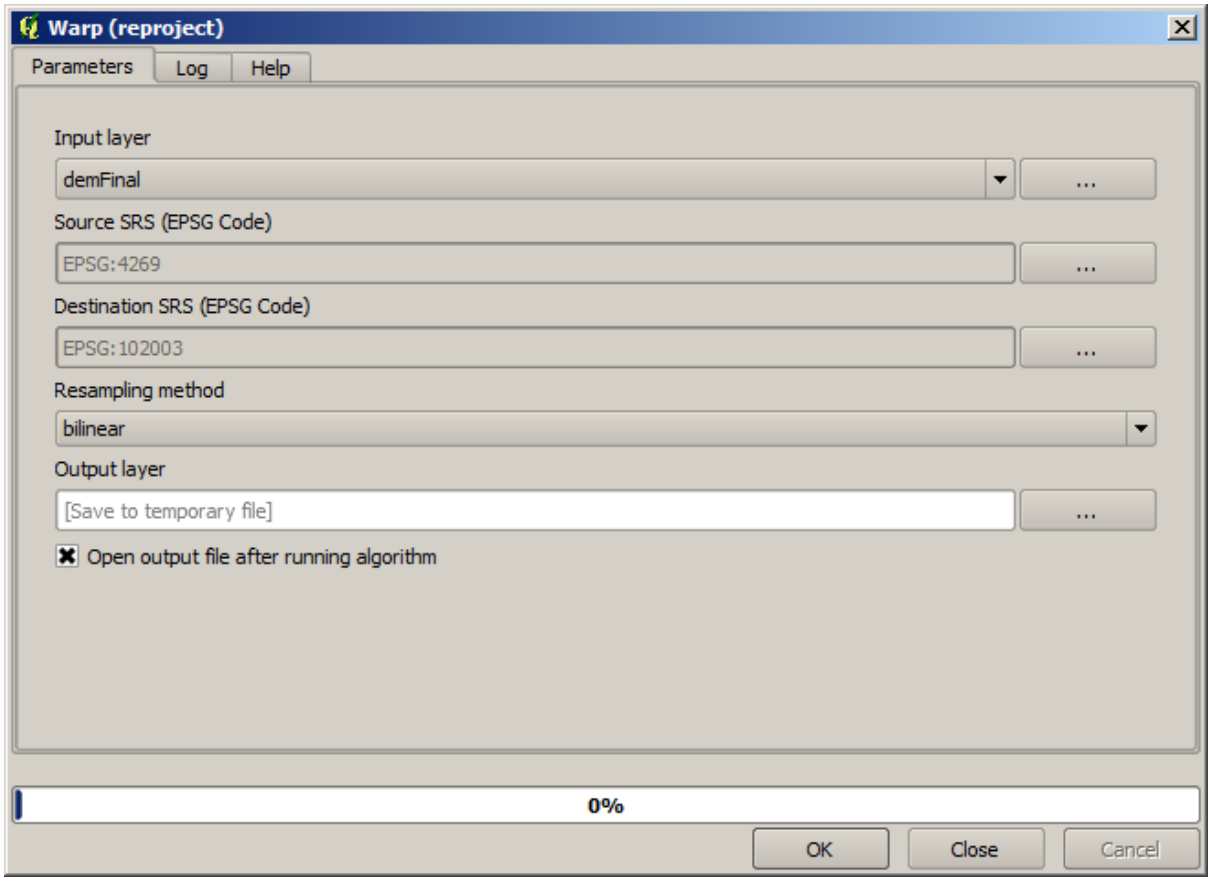
Aici se află caseta de încadrare obținută, utilizând parametrii de mai sus



It is a rounded box, but we can easily get the equivalent box with square angles, by running the *Extract layer extent* algorithm on it. We could have buffered the city limits first, and then calculate the extent rectangle, saving one step.



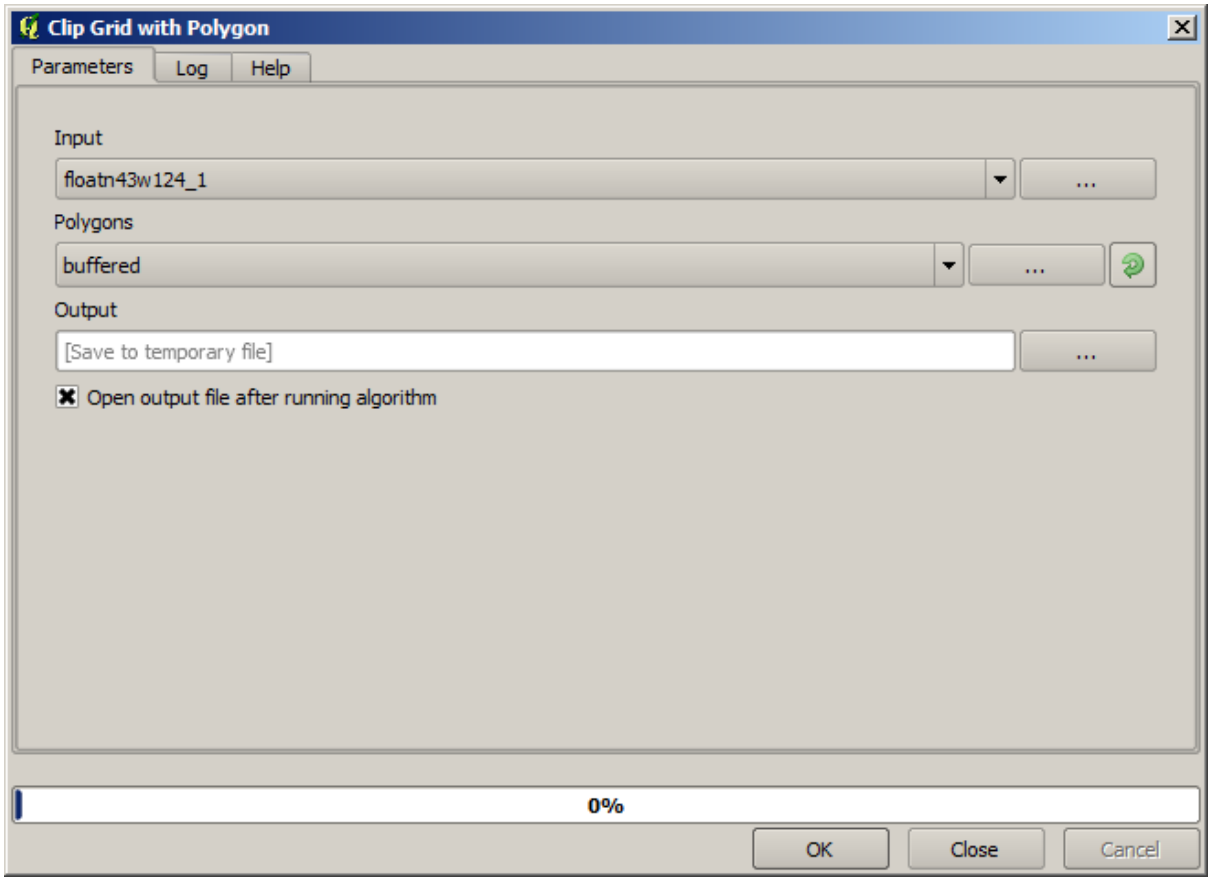
You will notice that the rasters has a different projection from the vector. We should therefore reproject them before proceeding further, using the *Warp (reproject)* tool.



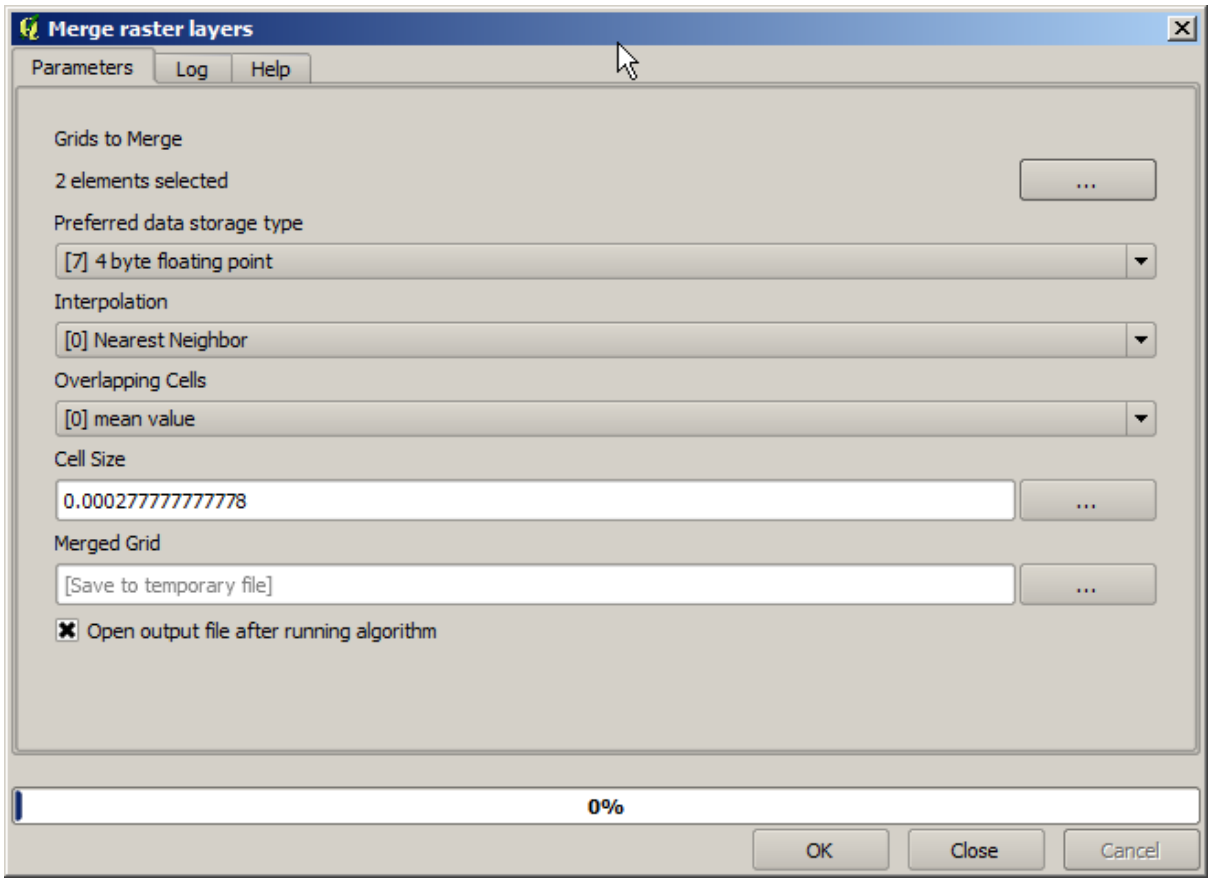
Notă

Versiunile recente au o interfață mai complexă. Asigurați-vă că cel puțin o metodă de compresie este selectată.

With this layer that contains the bounding box of the raster layer that we want to obtain, we can crop both of the raster layers, using the *Clip raster by mask layer* algorithm.



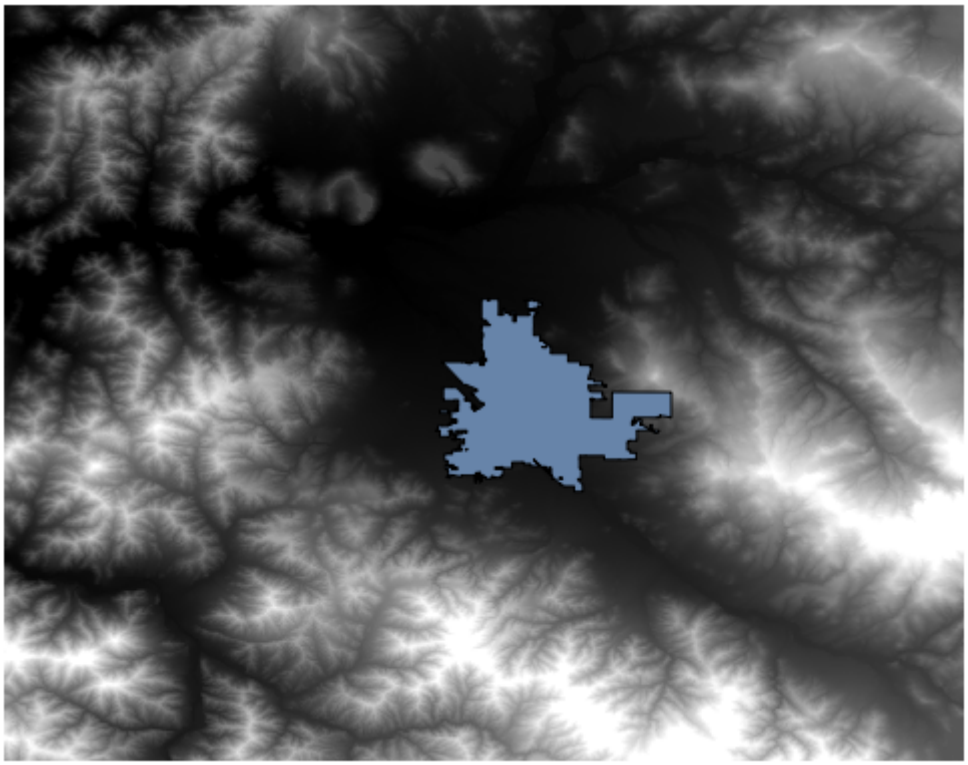
Once the layers have been cropped, they can be merged using the SAGA *Mosaic raster layers* algorithm.



Notă

Puteți economisi timp prin efectuarea mai întâi a îmbinării, și abia mai apoi a decupării, evitându-se astfel apelarea de două ori a algoritmului de decupare. Totuși, în cazul în care mai multe straturi cu o dimensiune apreciabilă trebuie îmbinate, vă veți alege cu un strat voluminos, care poate fi dificil de prelucrat ulterior. În acest caz, s-ar putea avea să apelați algoritmul de tăiere de mai multe ori, operație consumatoare de timp, însă nu vă îngrijorați pentru că veți vedea că există unele instrumente adiționale, dedicate automatizării acestui proces. Pentru exemplul următor nu este cazul să vă faceți griji, deoarece folosim numai două straturi.

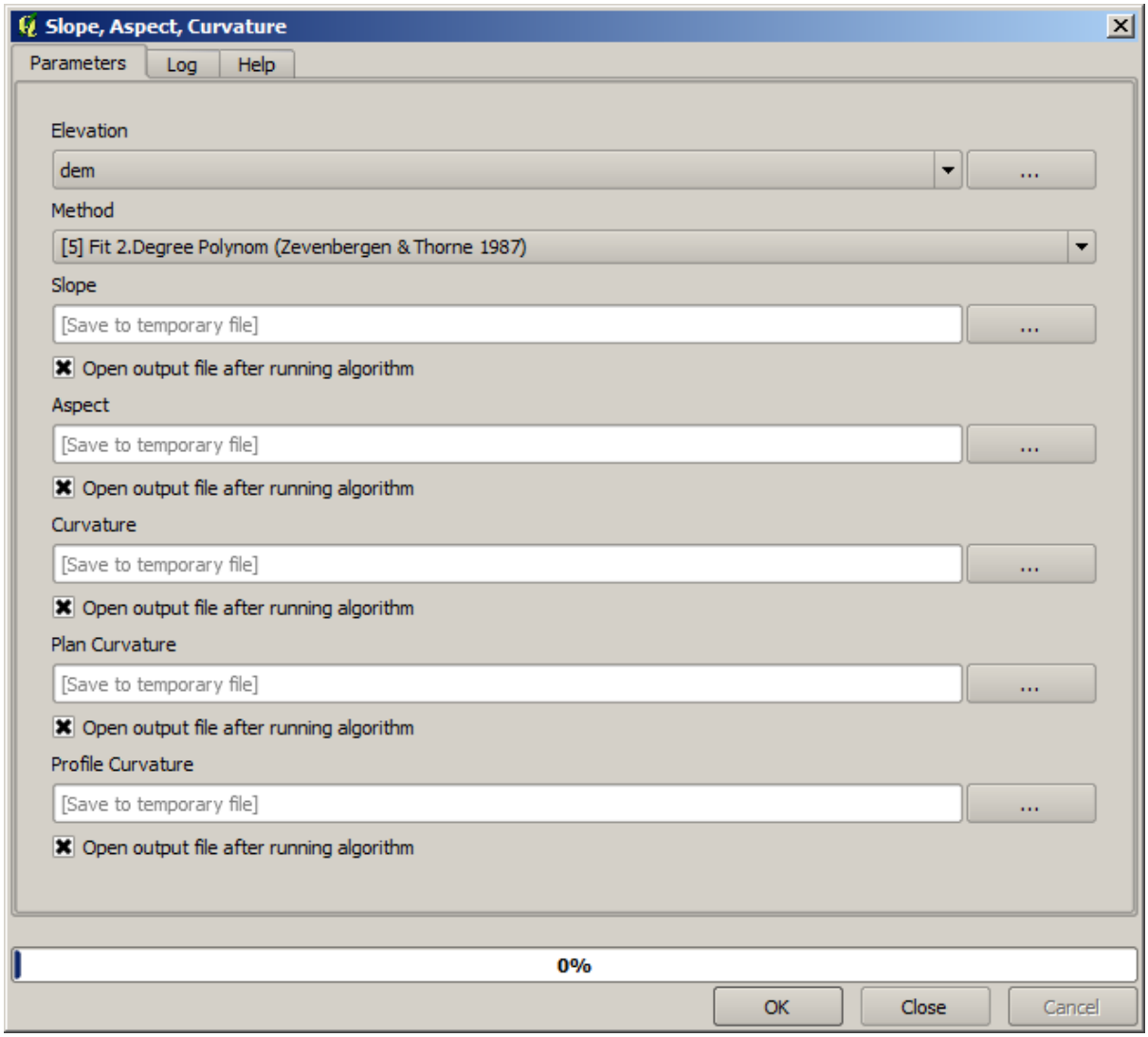
Cu asta, vom obține DEM-ul final pe care ni-l dorim.



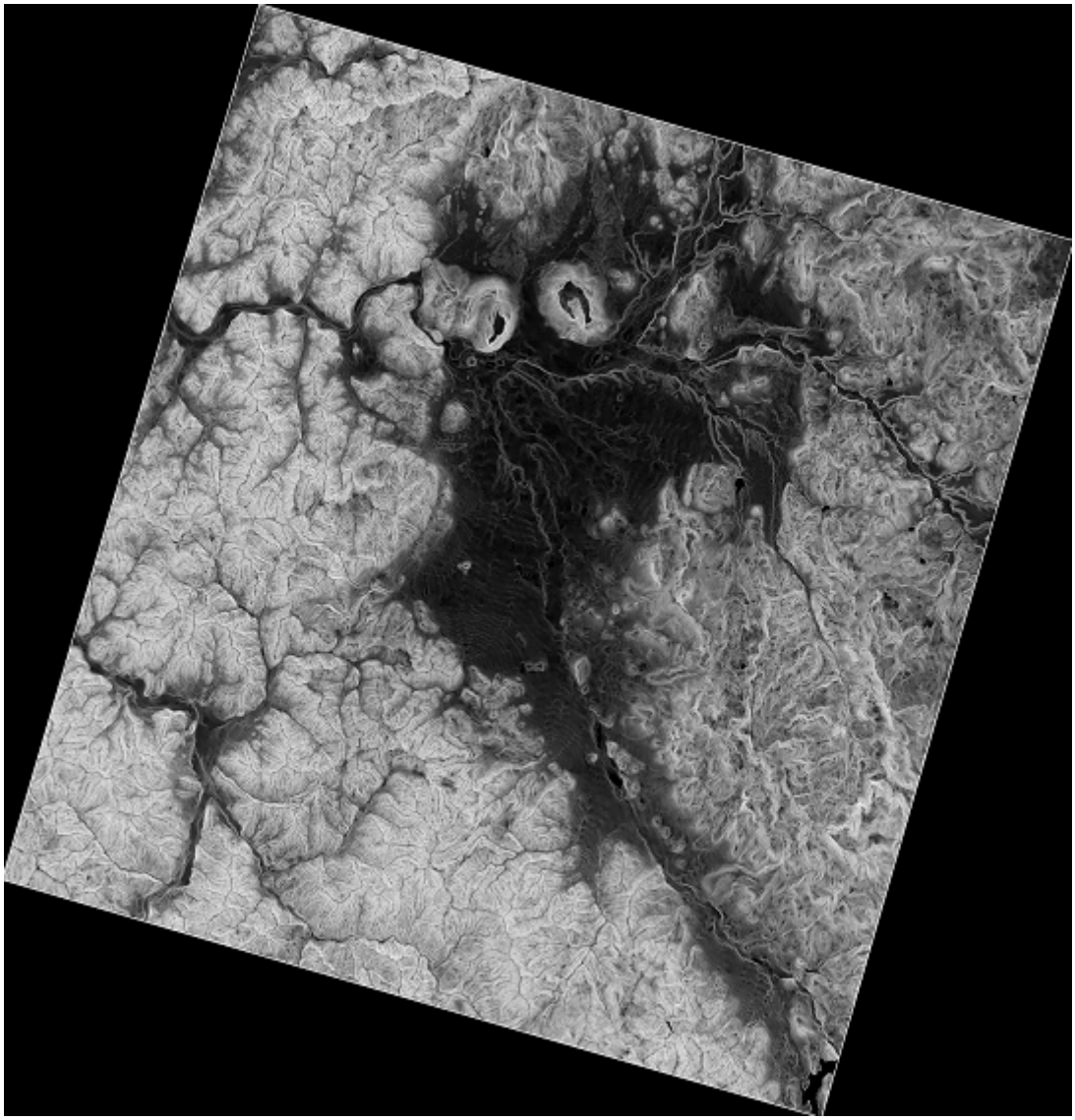
Acum este timpul să calculăm stratul pantei.

A slope layer can be computed with the *Slope* algorithm, but the DEM obtained in the last step is not suitable as input, since elevation values are in meters but cellsize is not expressed in meters (the layer uses a CRS with geographic coordinates). A reprojection is needed. To reproject a raster layer, the *Warp (reproject)* algorithm can be used again. We reproject into a CRS with meters as units (e.g. 3857), so we can then correctly calculate the slope, with either SAGA or GDAL.

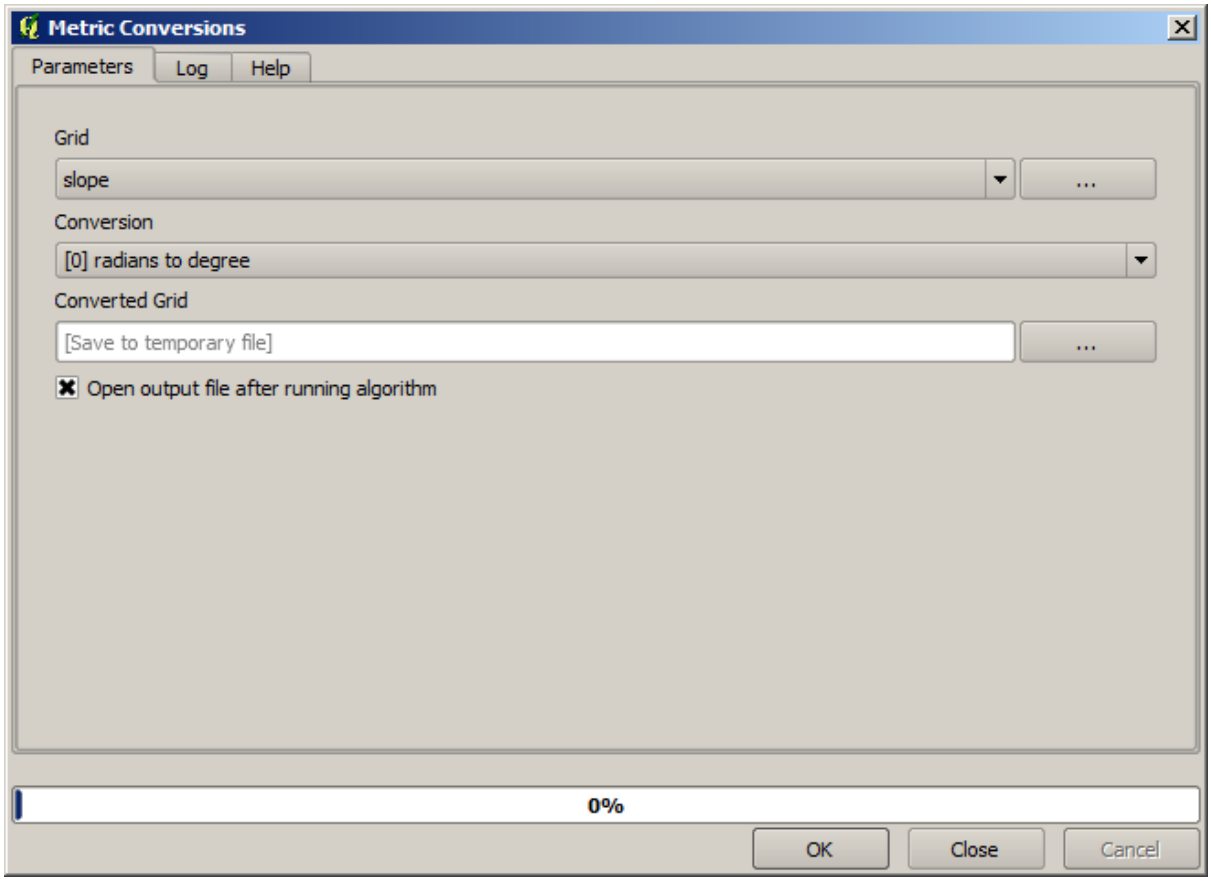
Panta poate fi de acum calculată, cu ajutorul noului DEM.



Iar aici este stratul pantei rezultate.



The slope produced by the *Slope* algorithm can be expressed in degrees or radians; degrees are a more practical and common unit. In case you calculated it in radians, the *Metric conversions* algorithm will help us to do the conversion (but in case you didn't know that algorithm existed, you could use the raster calculator that we have already used).



Reprojecting the converted slope layer back with the *Reproject raster layer*, we get the final layer we wanted.

Datorită proceselor de reproiectare, stratul final ar putea conține datele din afara casetei de încadrare, pe care am calculat-o într-unul dintre primii pași. Acest lucru poate fi rezolvat prin reluarea decupării, așa cum am procedat la obținerea DEM-ului de bază.

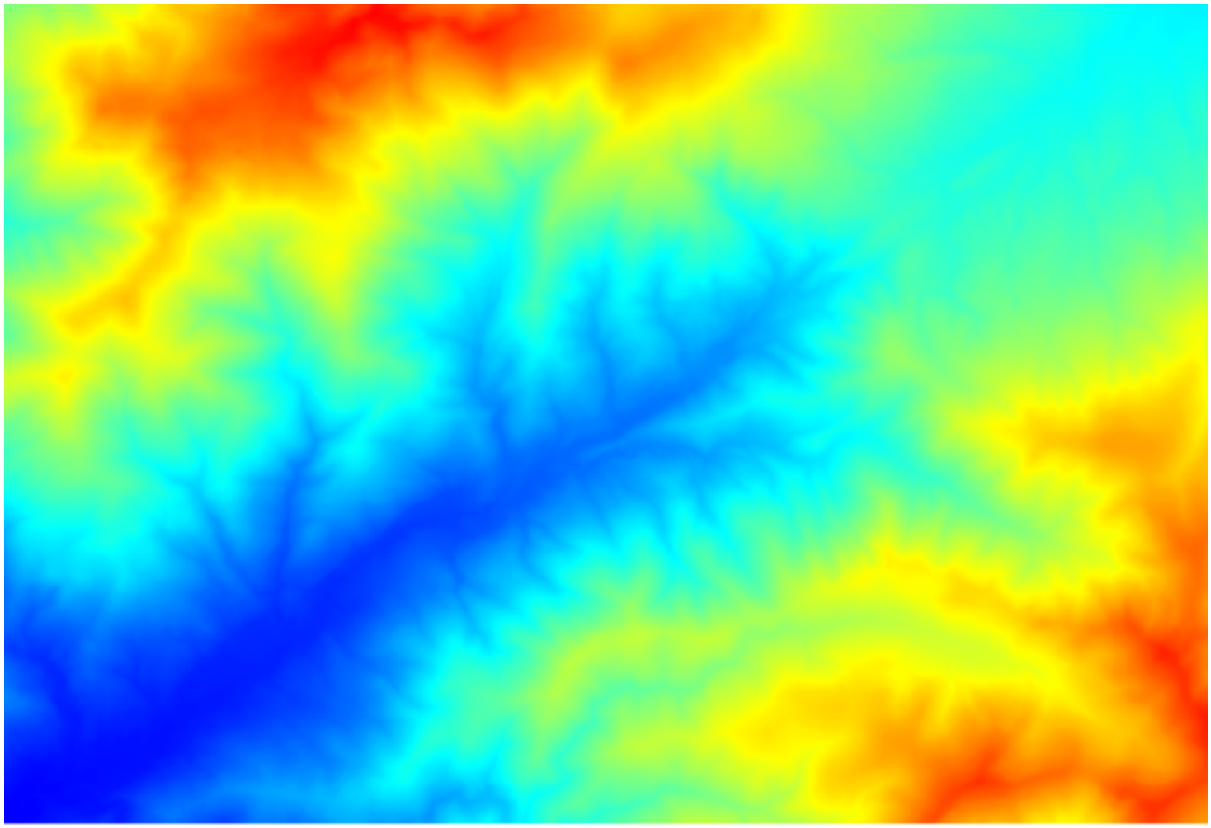
17.16 Analize hidrologice

Notă

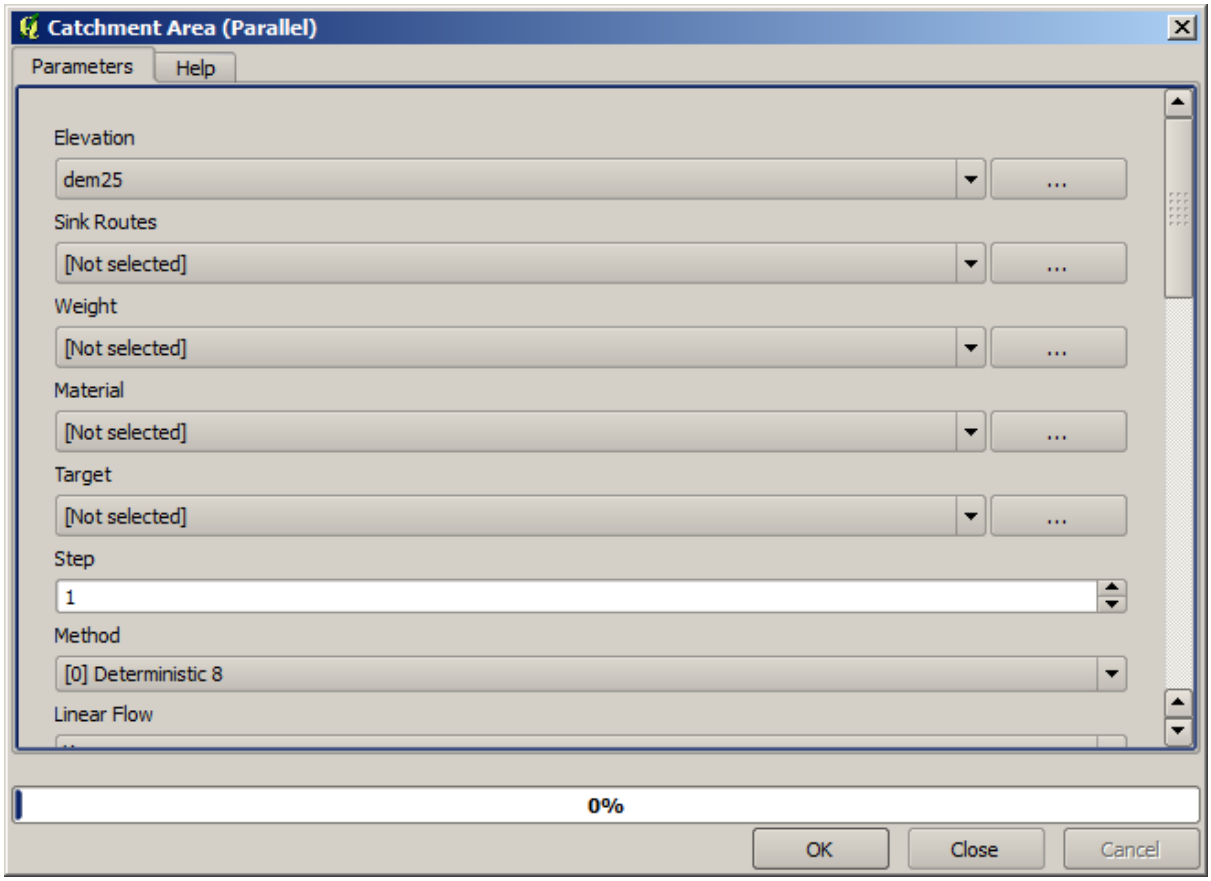
În această lecție, vom efectua unele analize hidrologice. Această analiză va fi utilizată în unele din următoarele lecții, deoarece constituie un exemplu foarte bun de analiză a fluxului de lucru, pe care o vom folosi pentru a demonstra unele caracteristici avansate.

Objectives: Starting with a DEM, we are going to extract a channel network, delineate watersheds and calculate some statistics.

1. Primul lucru este de a încărca proiectul cu datele lecției, care conține doar un DEM.

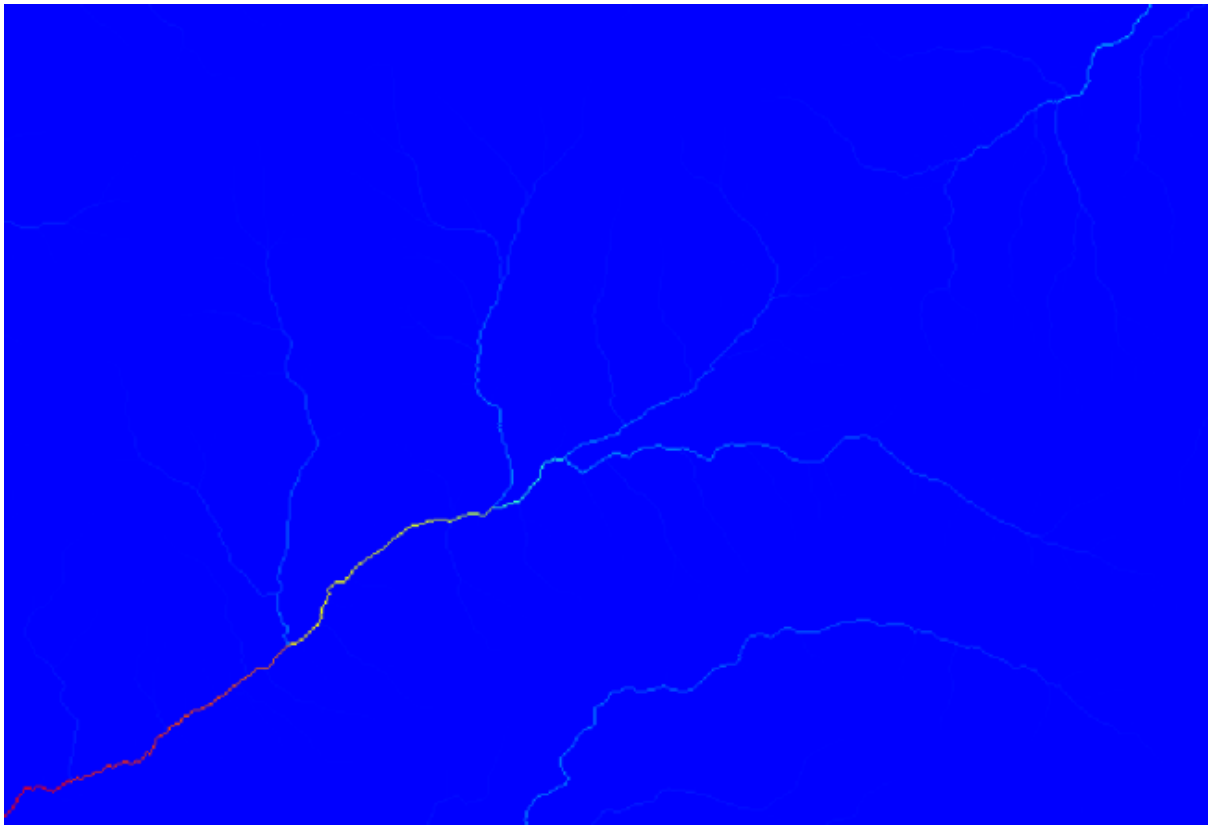


2. The first module to execute is *Catchment area* (in some SAGA versions it is called *Flow accumulation (Top Down)*). You can use any of the others named *Catchment area*. They have different algorithms underneath, but the results are basically the same.
3. Select the DEM in the *Elevation* field, and leave the default values for the rest of the parameters.

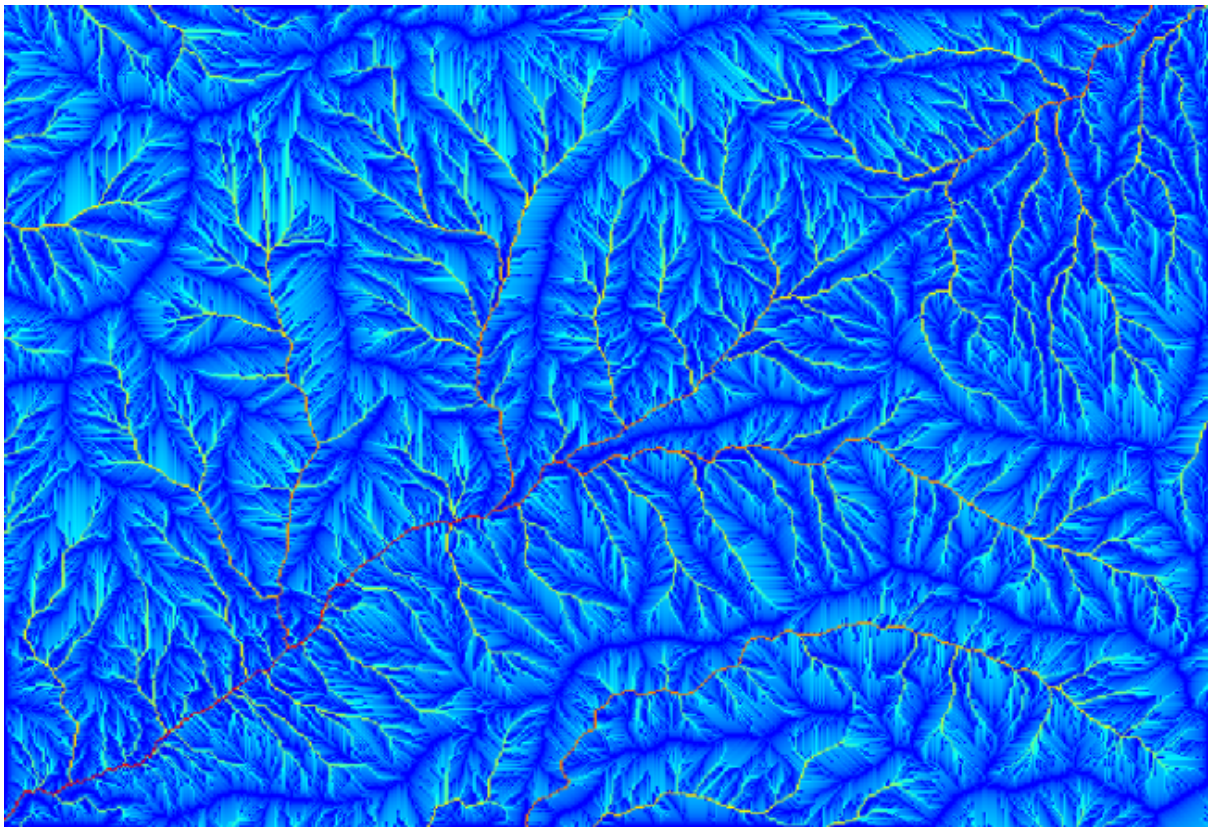


Some algorithms calculate many layers, but the *Catchment Area* layer is the only one we will be using. You can get rid of the other ones if you want.

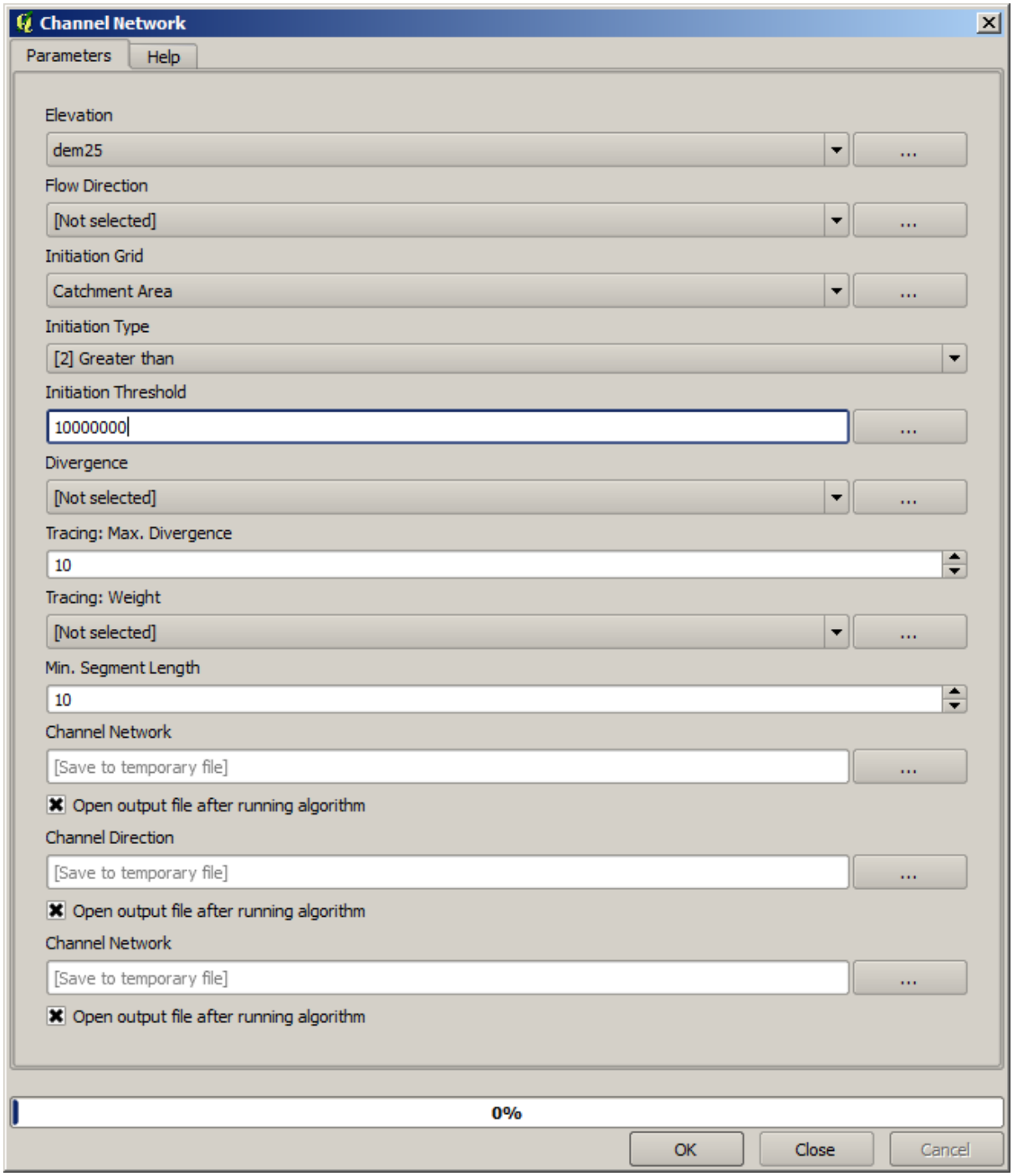
Randarea stratului nu este foarte informativă.



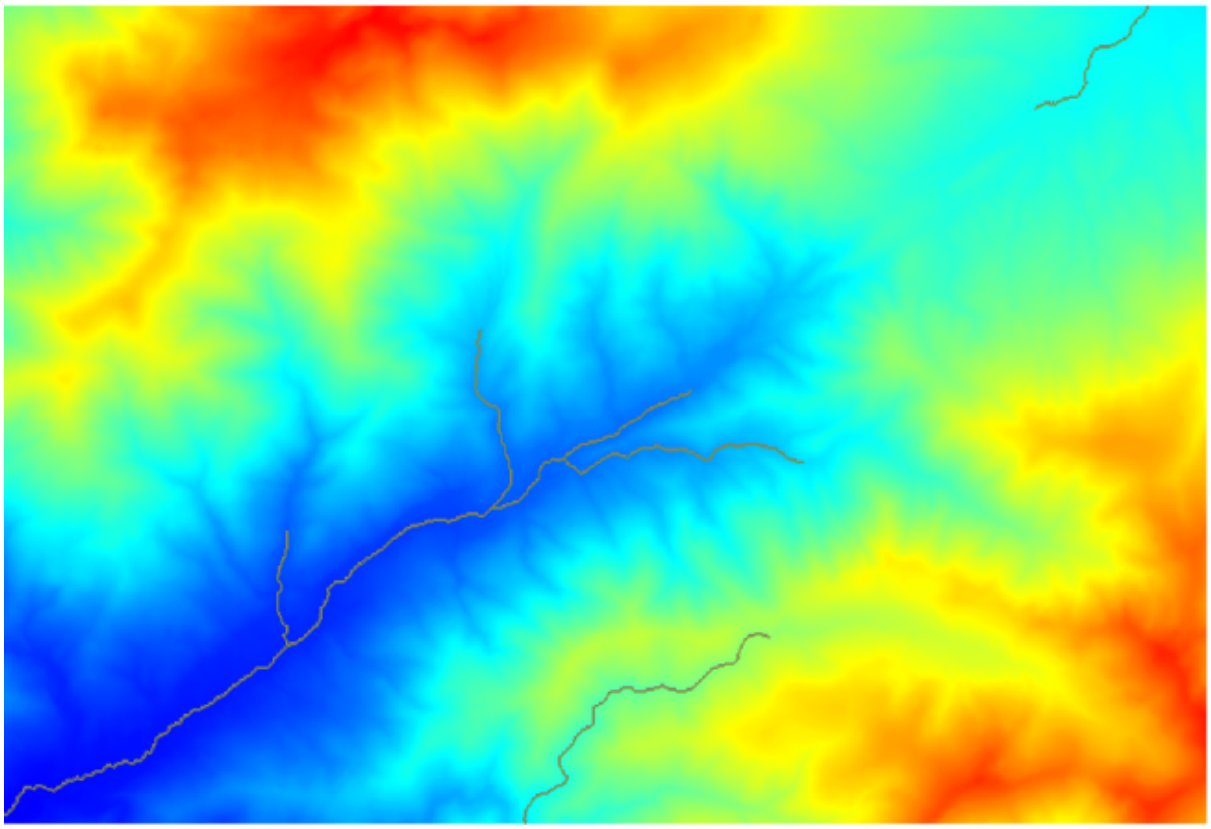
To know why, you can have a look at the histogram and you will see that values are not evenly distributed (there are a few cells with very high value, those corresponding to the channel network). Use the *Raster calculator* algorithm to calculate the logarithm of the catchment value area and you will get a layer with much more information



4. The catchment area (also known as flow accumulation) can be used to set a threshold for channel initiation. This can be done using the *Channel network* algorithm.
   - *Initiation grid*: use the catchment area layer and not the logarithm one.
   - *Initiation threshold*: `10.000.000`
   - *Initiation type*: *Greater than*

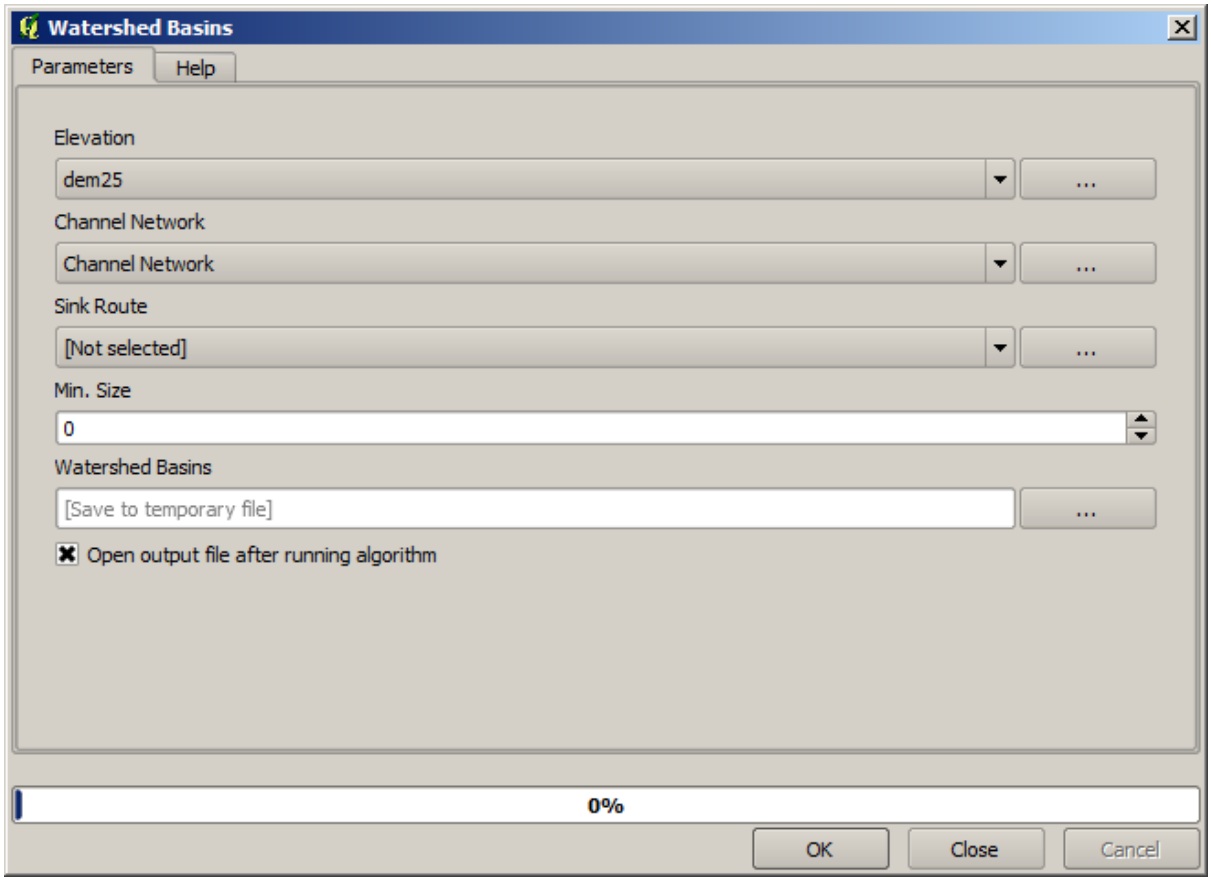


If you increase the *Initiation threshold* value, you will get a more sparse channel network. If you decrease it, you will get a denser one. With the proposed value, this is what you get.

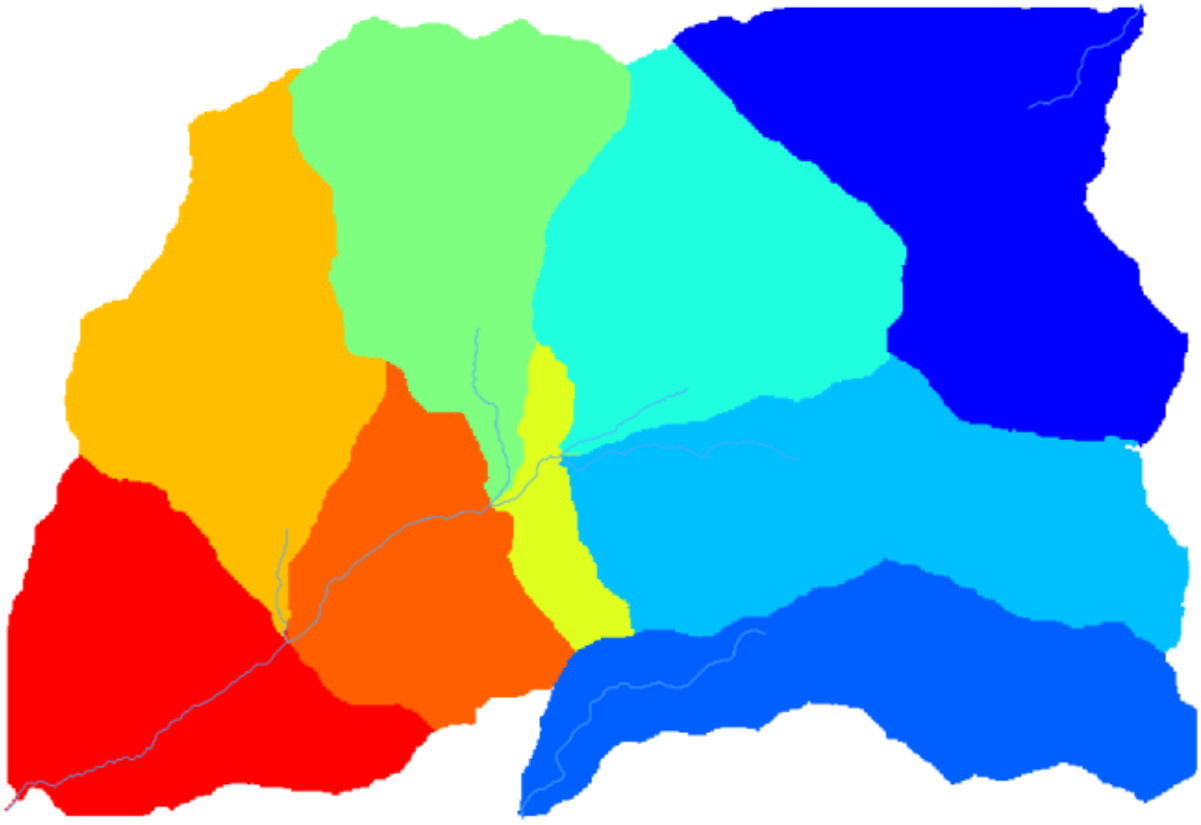


The image above shows just the resulting vector layer and the DEM, but there should be also a raster layer with the same channel network. That raster will be, in fact, the layer we will be using.

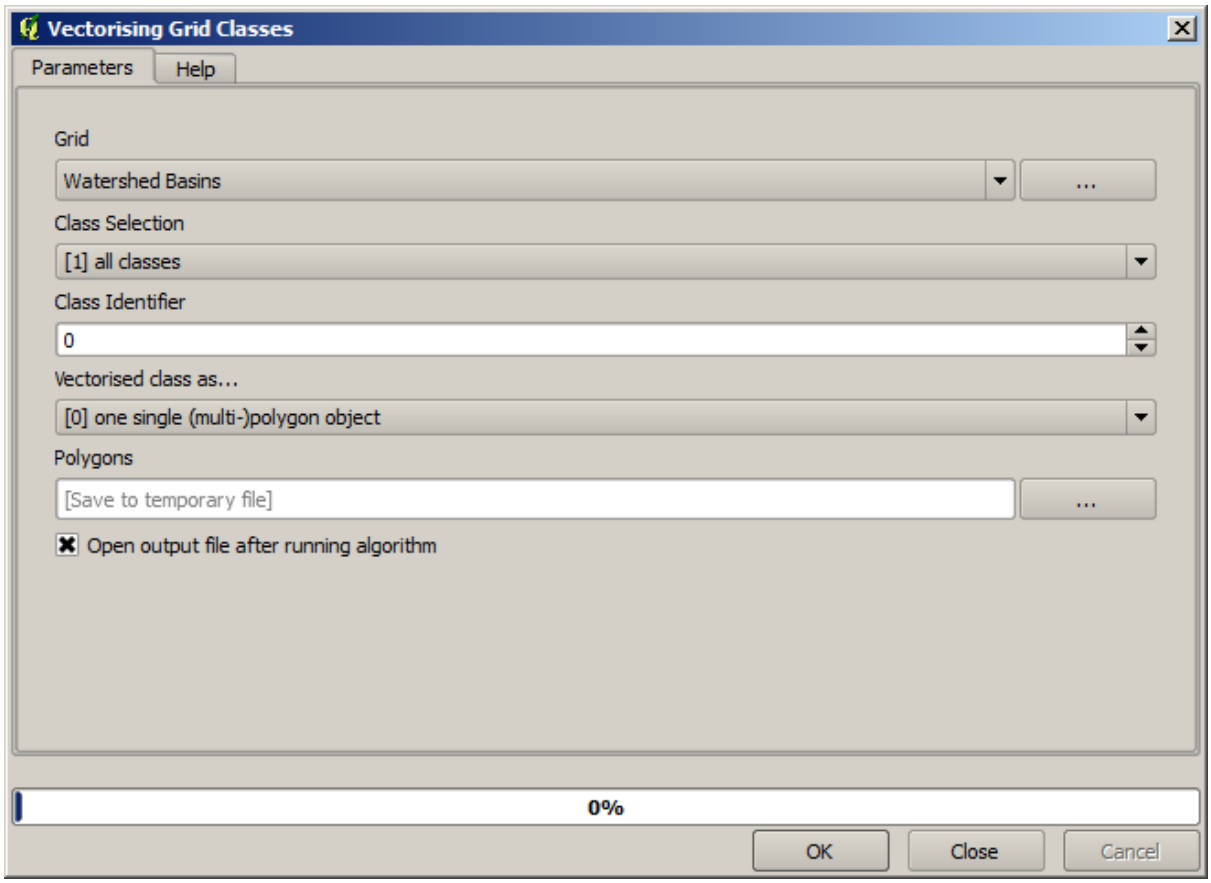
5. Now, we will use the *Watersheds basins* algorithm to delineate the subbasins corresponding to that channel network, using as outlet points all the junctions in it. Here is how you have to set the corresponding parameters dialog.

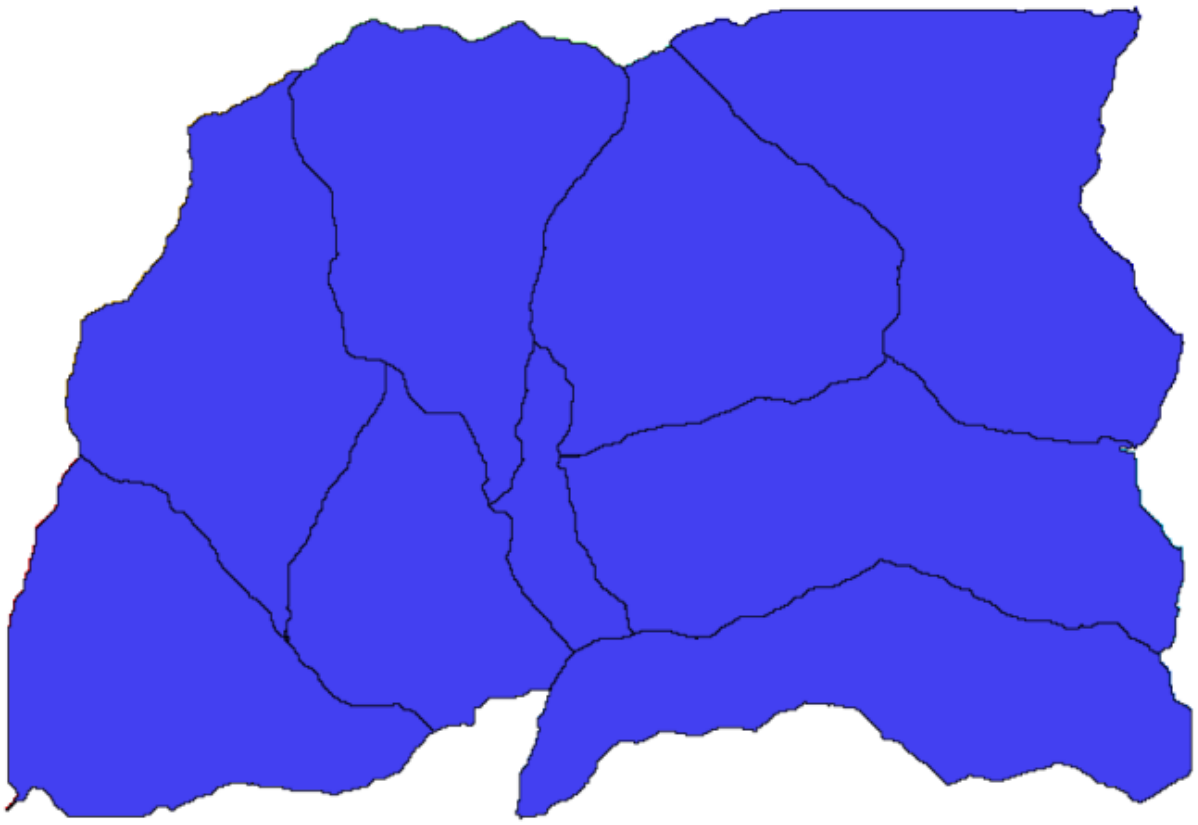


Acesta veți obține.



6. This is a raster result. You can vectorise it using the *Vectorising grid classes* algorithm.

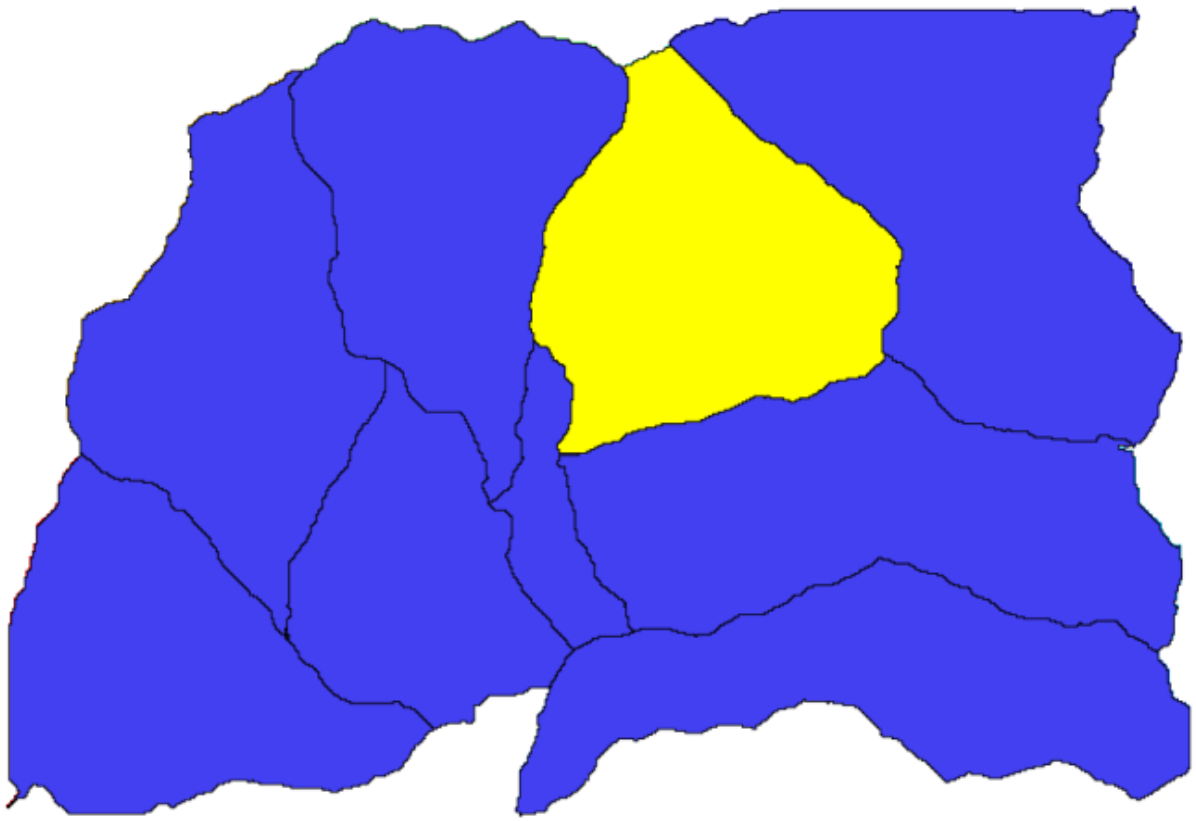




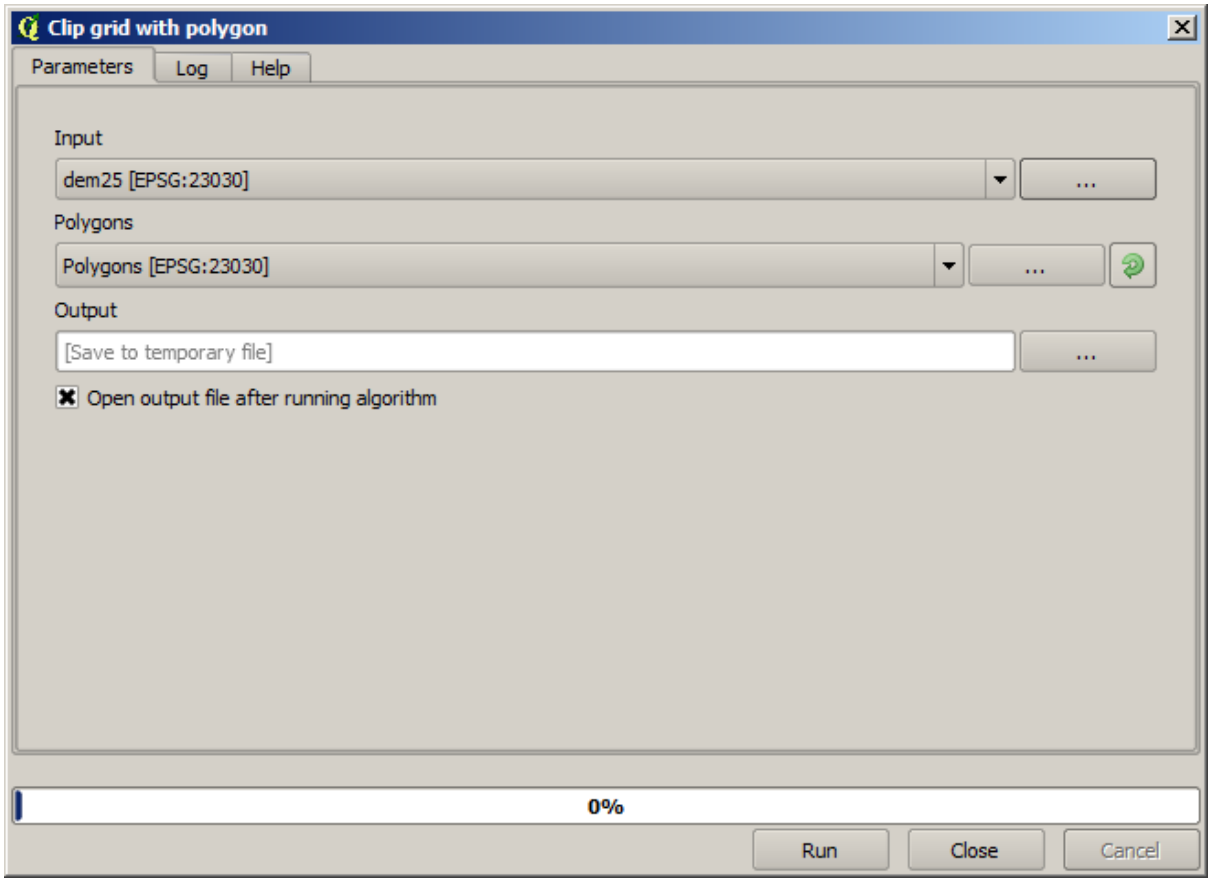
Acum, să încercăm să calculăm statistici referitoare la valorile elevației dintr-unul din sub-bazine. Ideea este de a avea un strat cu altitudinile din cadrul acelui sub-bazin pe care, ulterior, să-l transmitem modulului care calculează aceste statistici.

1. First, let's clip the original DEM with the polygon representing a subbasin. We will use the *Clip raster with polygon* algorithm. If we select a single subbasin polygon and then call the clipping algorithm, we can clip the DEM to the area covered by that polygon, since the algorithm is aware of the selection.

    1. Select a polygon

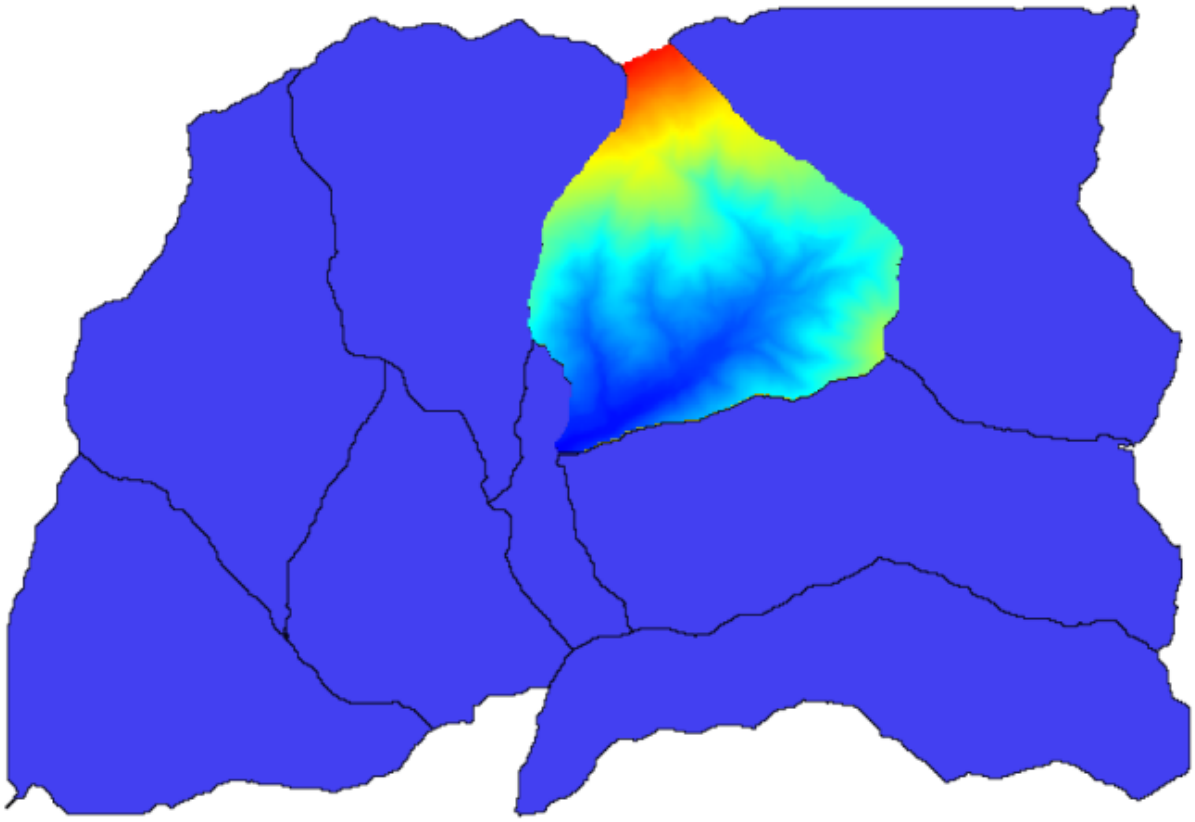


2. Call the clipping algorithm with the following parameters:

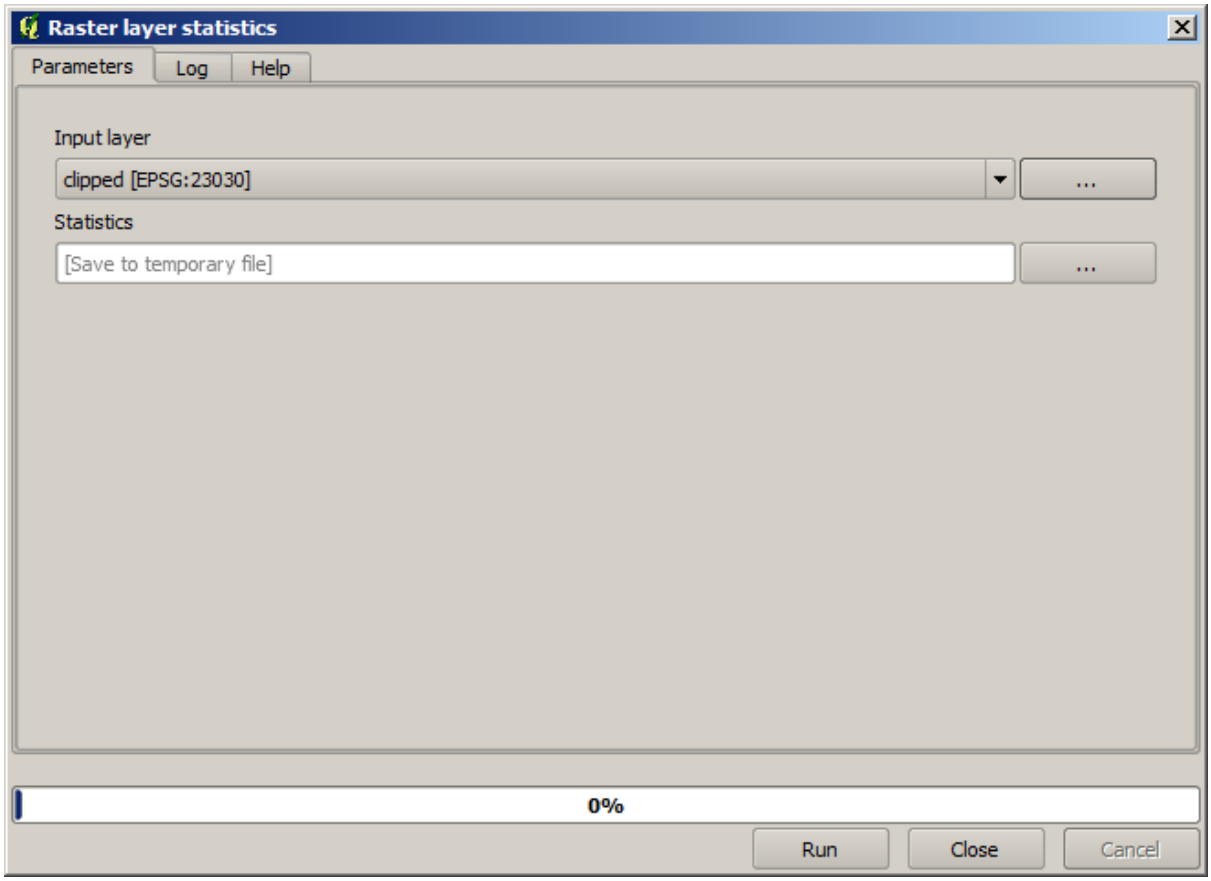


The element selected in the input field is, of course, the DEM we want to clip.

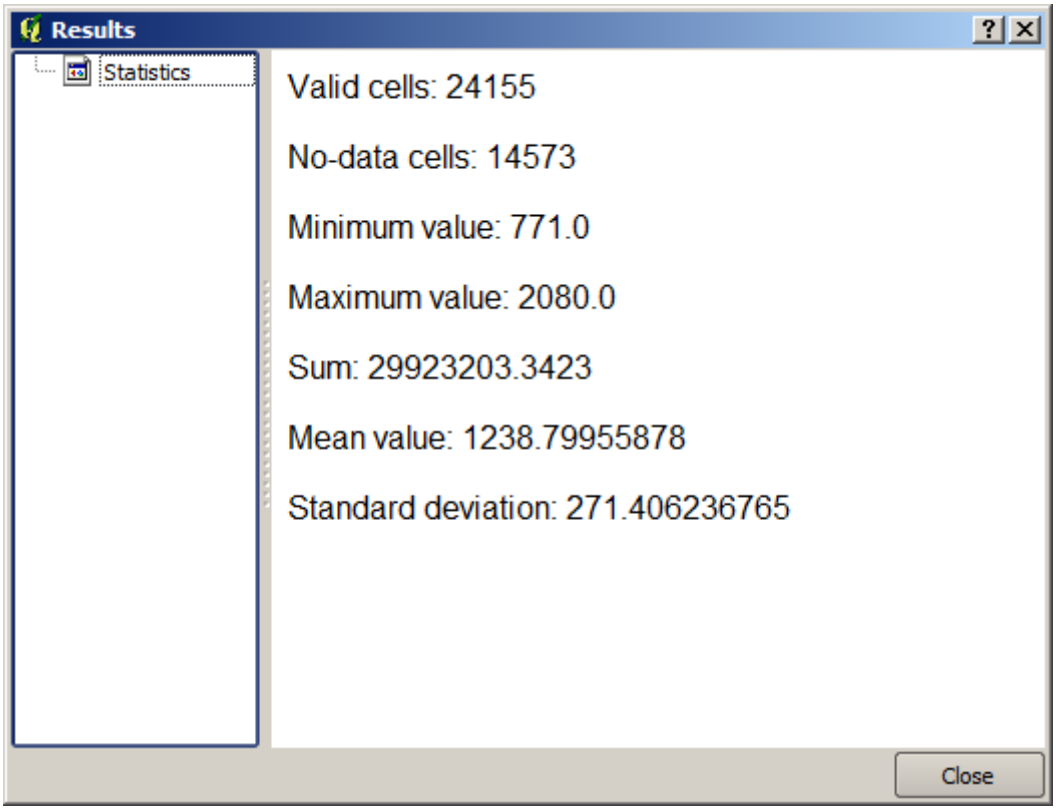
Veți obține ceva de genul acesta.



2. This layer is ready to be used in the *Raster layer statistics* algorithm.



Statisticile rezultate sunt următoarele.



Vom folosi și în alte lecții atât procedura de calcule a bazinului, cât și calcularea statisticilor, pentru a afla cum ne pot

ajuta alte elemente la automatizarea amândurora, cât și pentru a lucra mai eficient.

17.17 Starting with the model designer

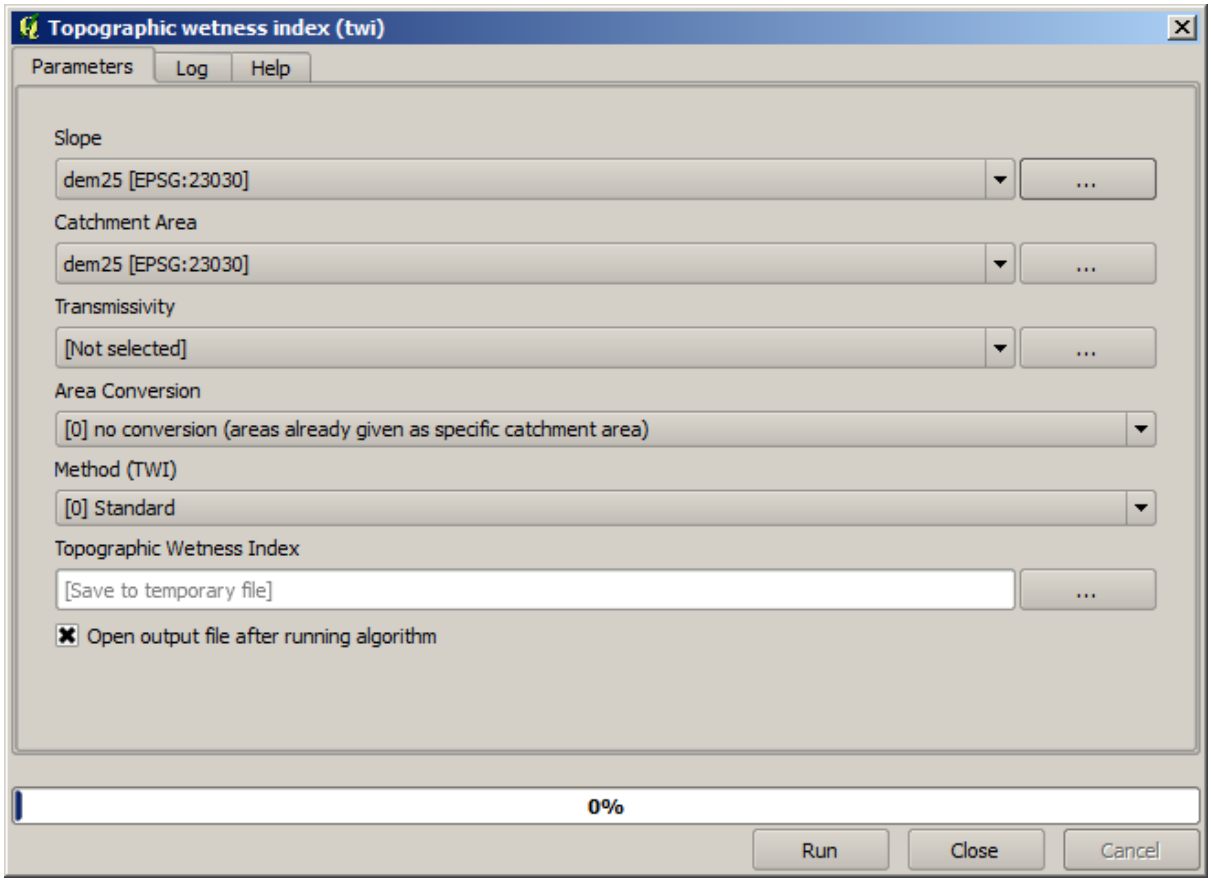
Notă

In this lesson we will use the model designer, a powerful component that we can use to define a workflow and run a chain of algorithms.

O sesiune normală cu uneltele de procesare include mai mult decât rularea unui singur algoritm. De obicei, multe dintre ele sunt rulate pentru a obține o ieșire, unele dintre aceste rezultate fiind folosite ca intrare pentru alți algoritmi.

Using the model designer, that workflow can be put into a model, which will run all the necessary algorithms in a single run, thus simplifying the whole process and automating it.

To start this lesson, we are going to calculate a parameter named Topographic Wetness Index. The algorithm that computes it is called *Topographic wetness index (twi)*.



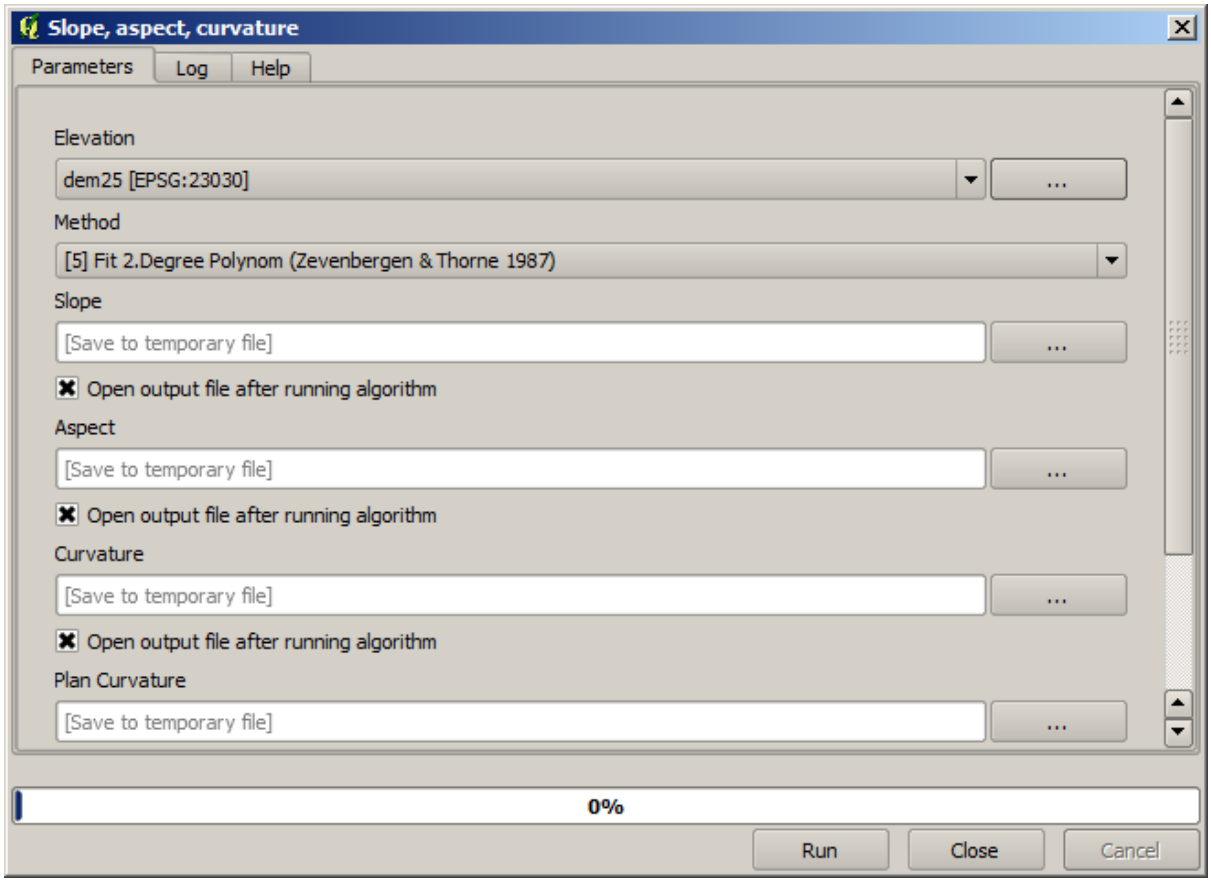
As you can see, there are two mandatory inputs: *Slope* and *Catchment Area*. There is also an optional input, but we will not be using it, so we can ignore it.

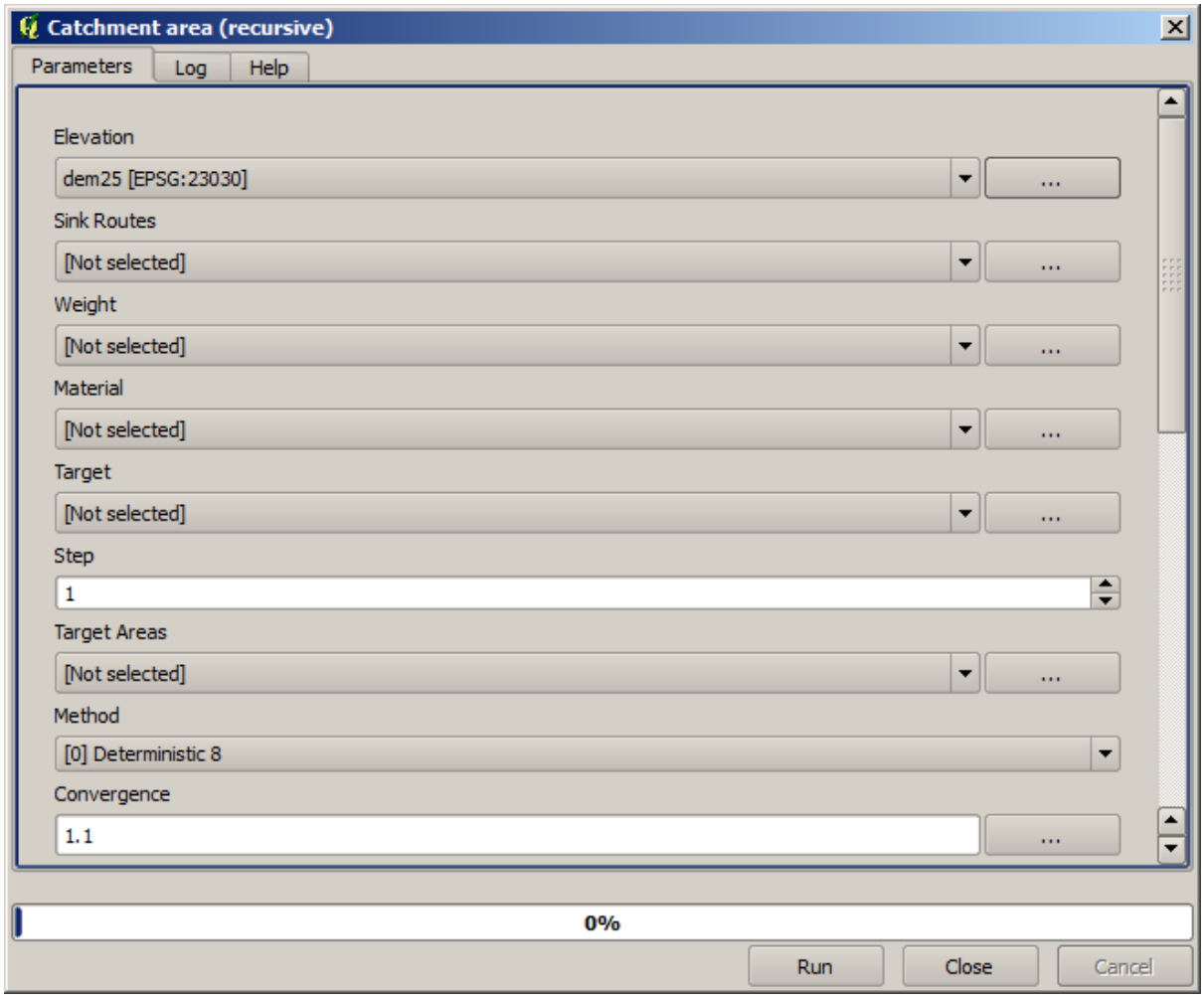
The data for this lesson contains just a DEM, so we do not have any of the required inputs. However, we know how to calculate both of them from that DEM, since we have already seen the algorithms to compute slope and catchment area. So we can first compute those layers and then use them for the TWI algorithm.

Aici sunt dialogurile pentru parametrii care ar trebui să fie utilizați în calculul a 2 straturi intermediare.

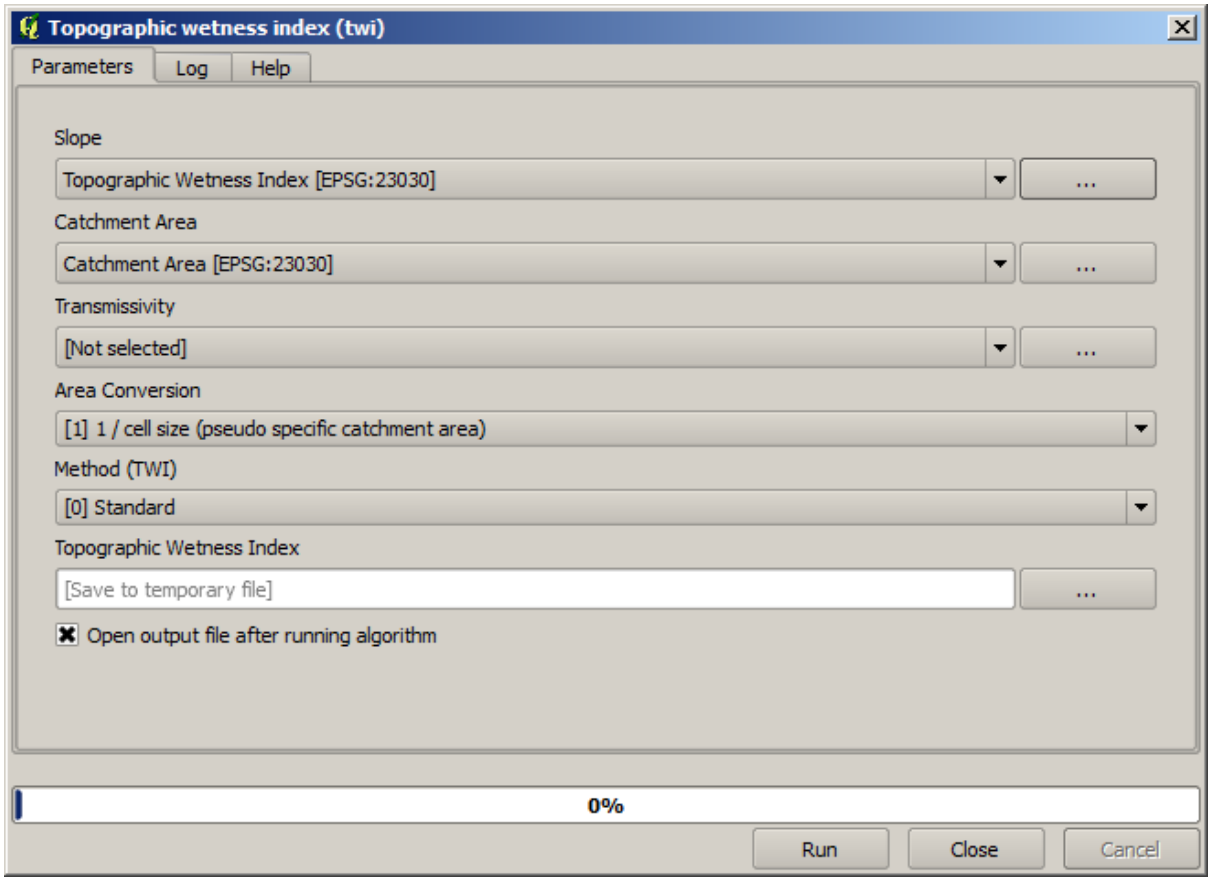
Notă

Panta trebuie să fie calculată în radiani, nu în grade.

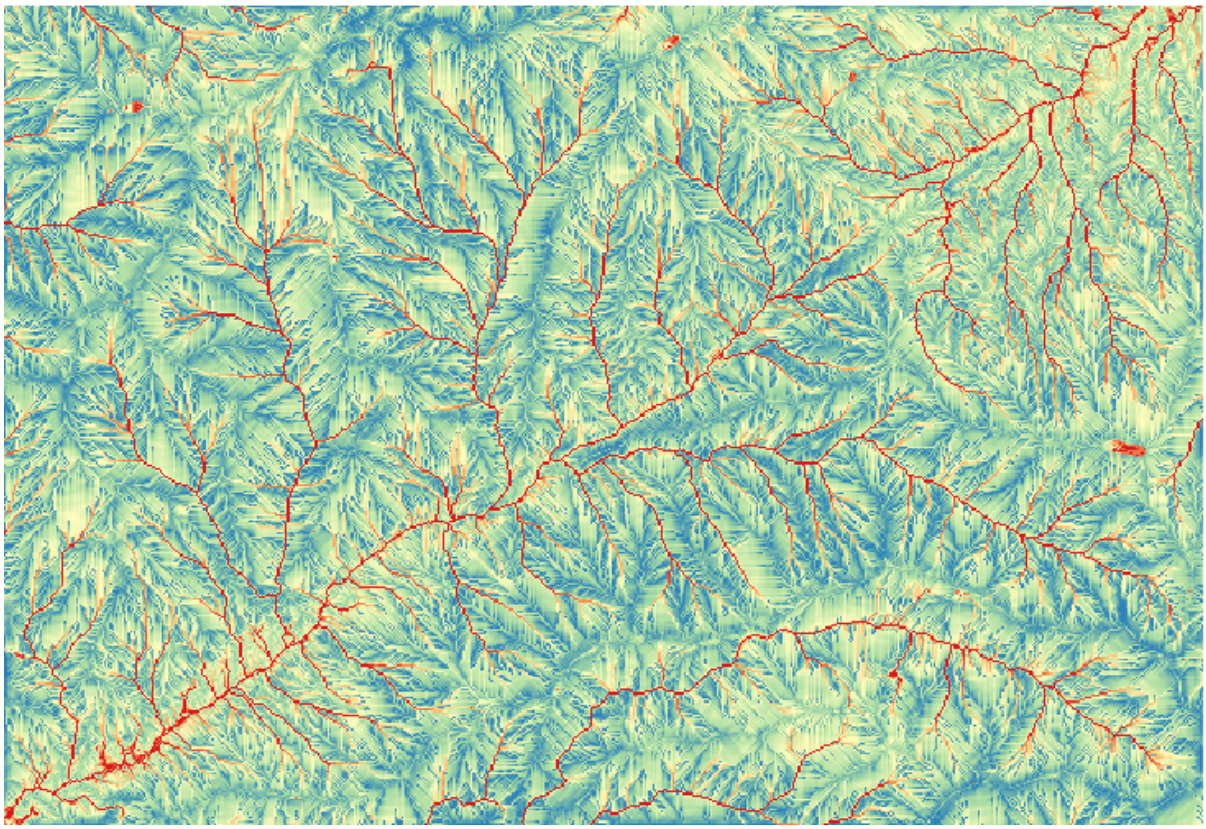




Acesta este modul în care va trebui să setați parametrii dialogului pentru algoritmul TWI.

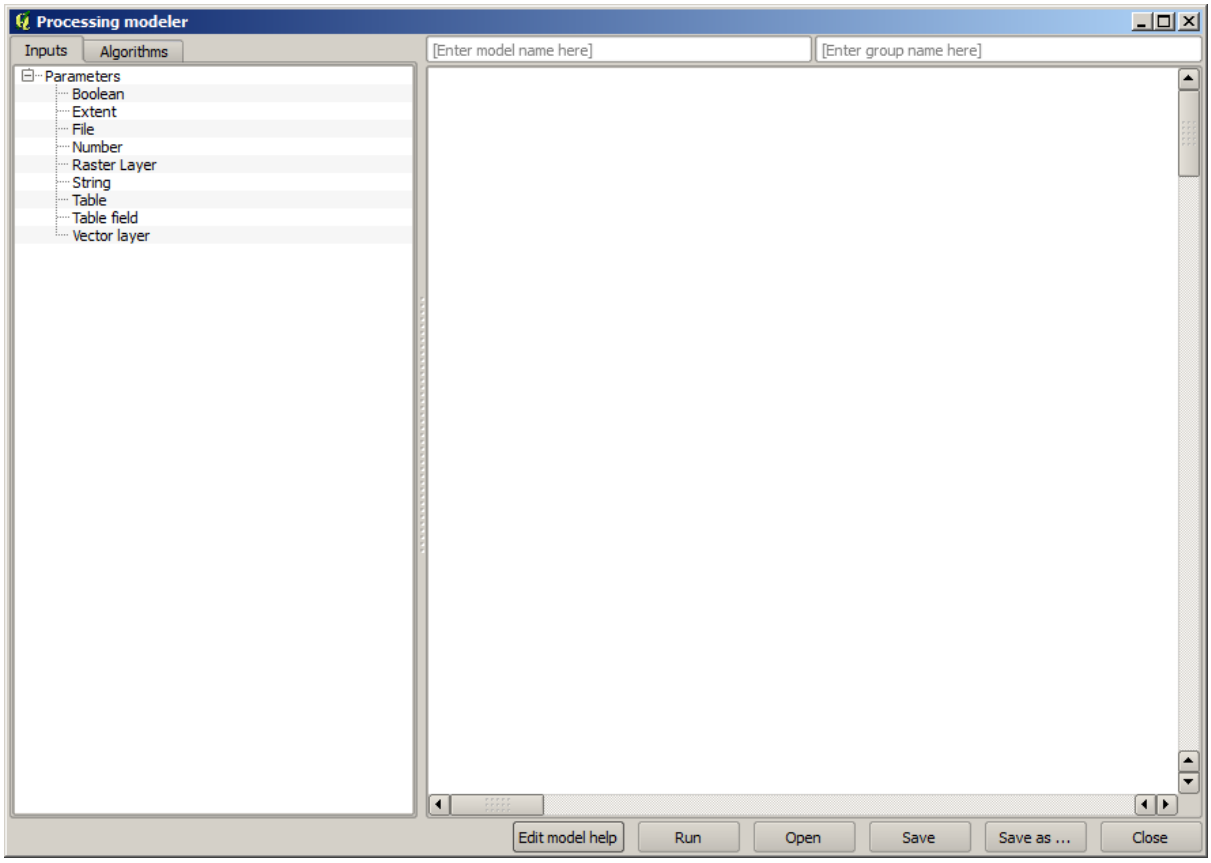


This is the result that you will obtain (the default singleband pseudocolor inverted palette has been used for rendering). You can use the `twi.qml` style provided.



What we will try to do now is to create an algorithm that calculates the TWI from a DEM in just one single step. That will save us work in case we later have to compute a TWI layer from another DEM, since we will need just one single step to do it instead of the three above. All the processes that we need are found in the toolbox, so what we have to do is to define the workflow to wrap them. This is where the model designer comes in.

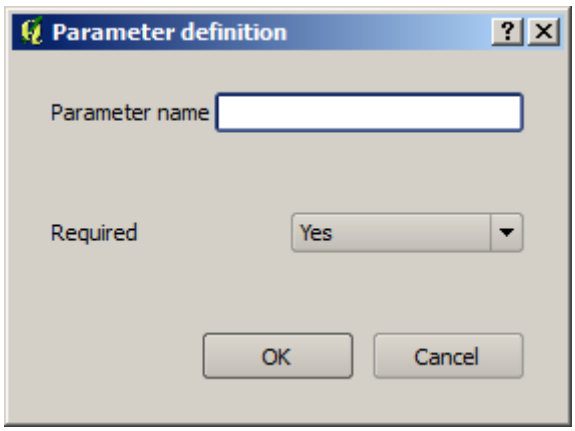
1. Deschideți modelatorul, prin selectarea intrării sale din meniul de prelucrare.



   Two things are needed to create a model: setting the inputs that it will need, and defining the algorithm that it contains. Both of them are done by adding elements from the two tabs in the left-hand side of the modeler window: *Inputs* and *Algorithms*.

2. Let's start with the inputs. In this case we do not have much to add. We just need a raster layer with the DEM, and that will be our only input data.

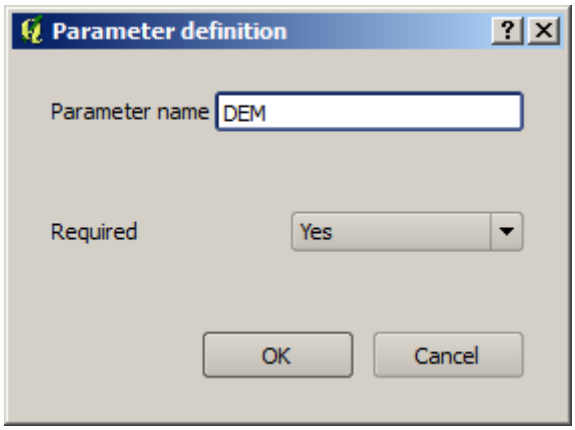
3. Double click on the *Raster layer* input and you will see the following dialog.



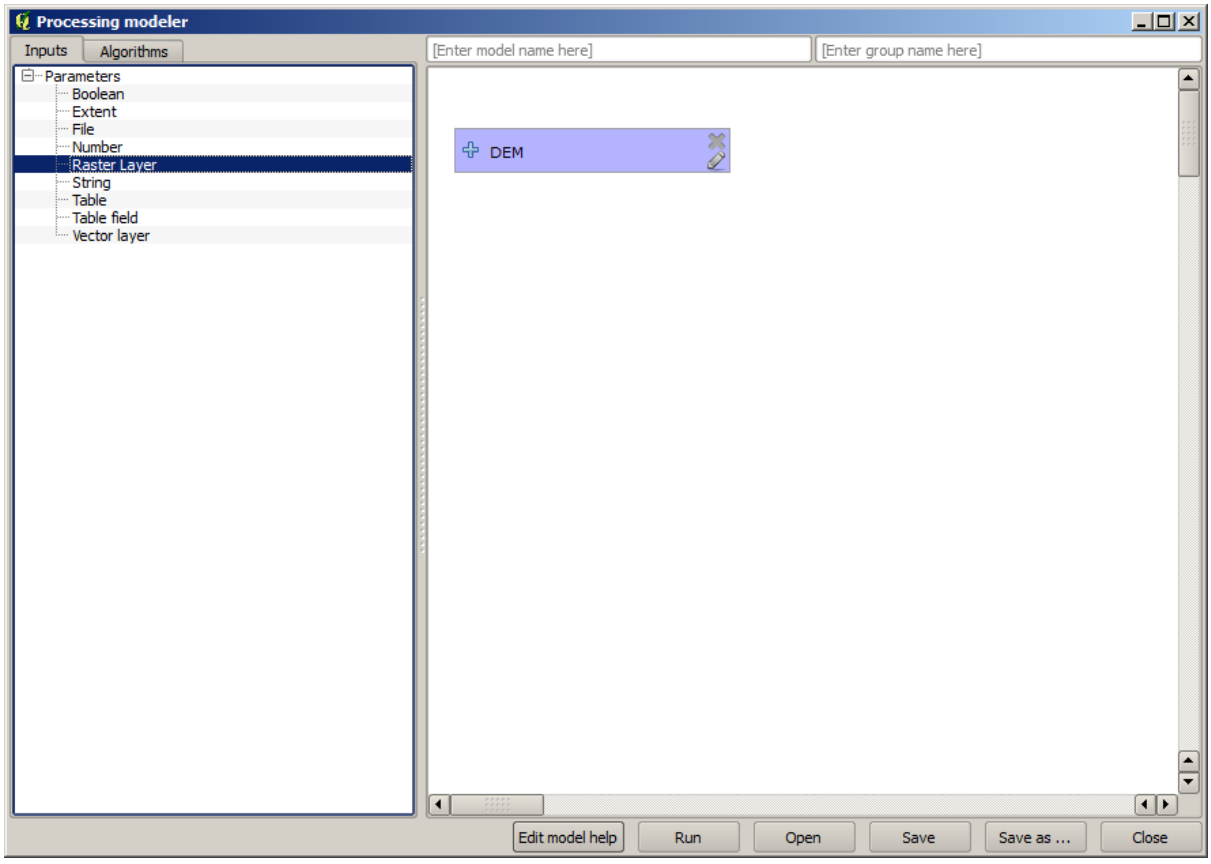
4. Here we will have to define the input we want:

1. Since we expect this raster layer to be a DEM, we will call it `DEM`. That's the name that the user of the model will see when running it.
2. Since we need that layer to work, we will define it as a mandatory layer.

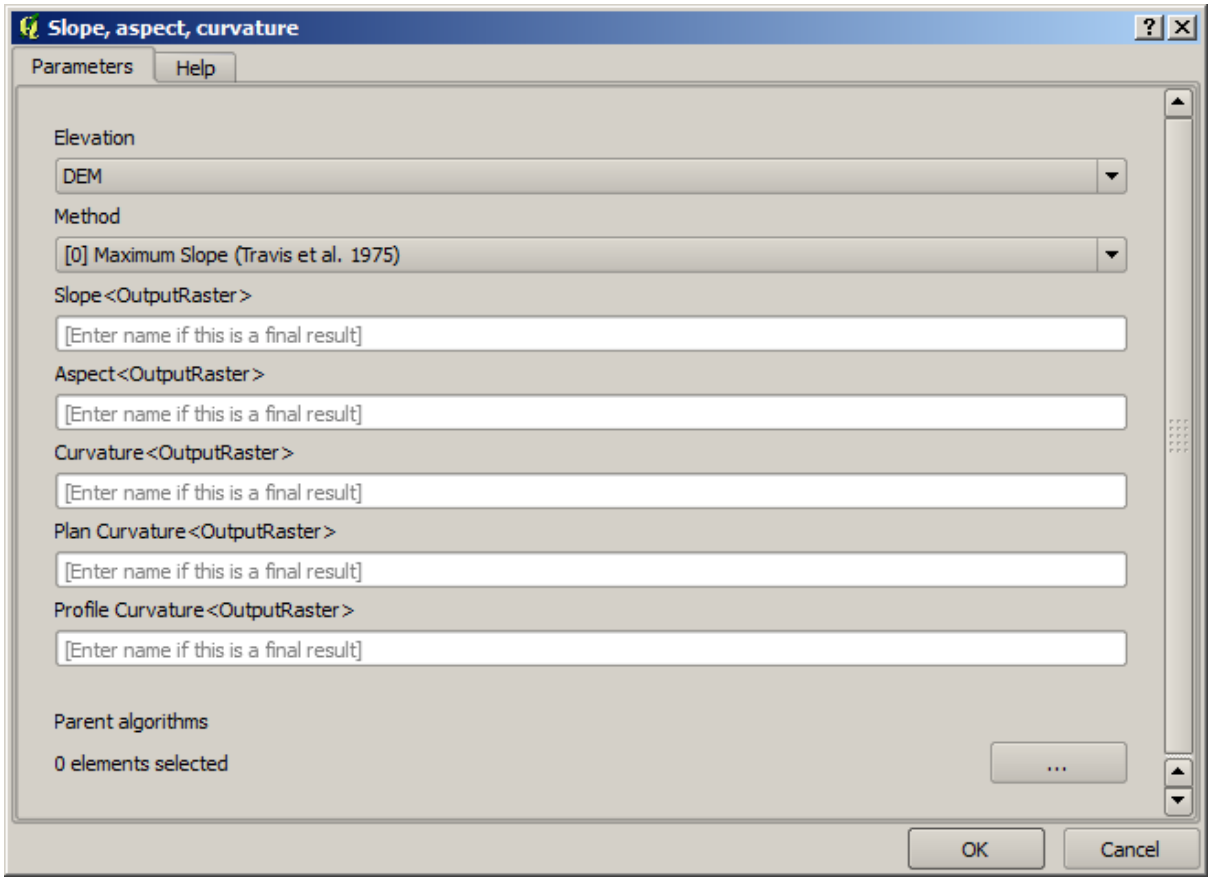
Iată cum ar trebui să fie configurat dialogul.



5. Click on *OK* and the input will appear in the modeler canvas.



6. Now let's move to the *Algorithms* tab.
7. The first algorithm we have to run is the *Slope, aspect, curvature* algorithm. Locate it in the algorithm list, double-click on it and you will see the dialog shown below.

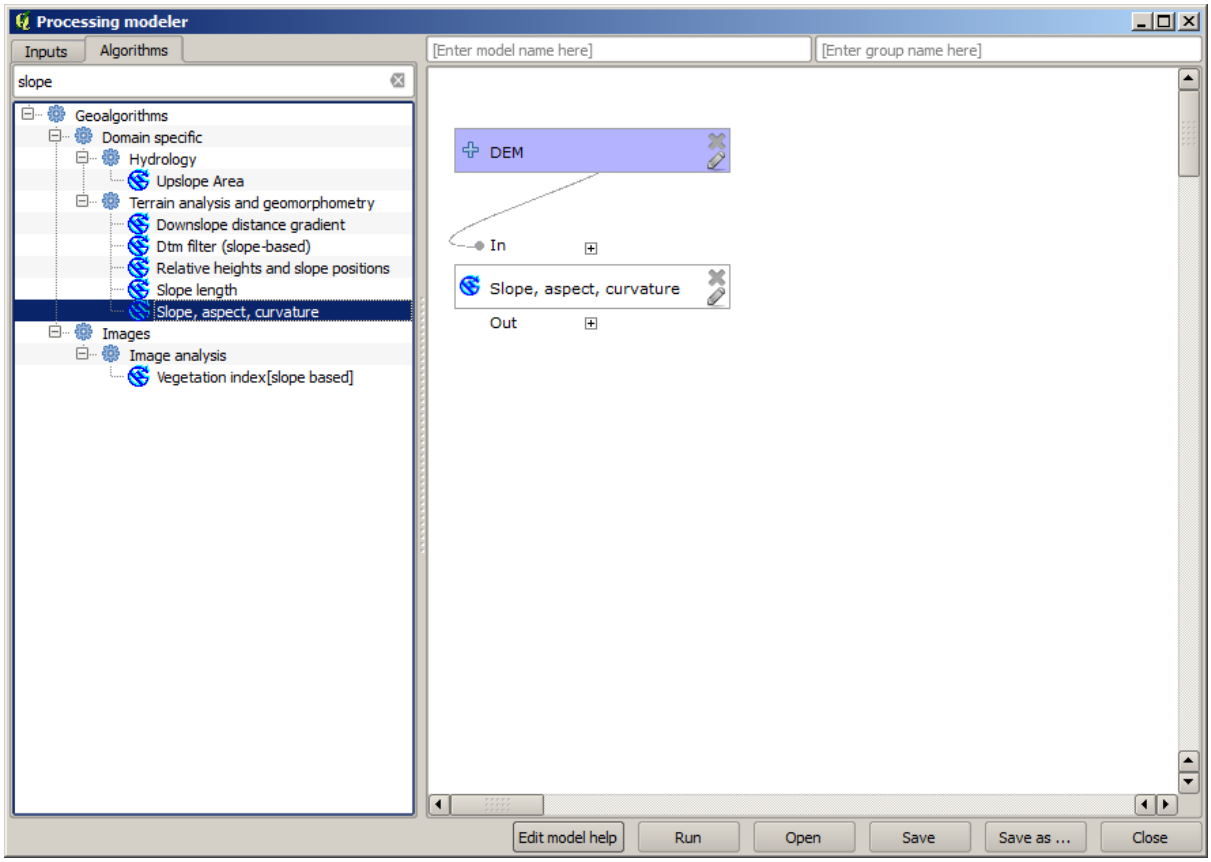


This dialog is very similar to the one that you can find when running the algorithm from the toolbox, but the element that you can use as parameter values are not taken from the current QGIS project, but from the model itself. That means that, in this case, we will not have all the raster layers of our project available for the *Elevation* field, but just the ones defined in our model. Since we have added just one single raster input named `DEM`, that will be the only raster layer that we will see in the list corresponding to the *Elevation* parameter.

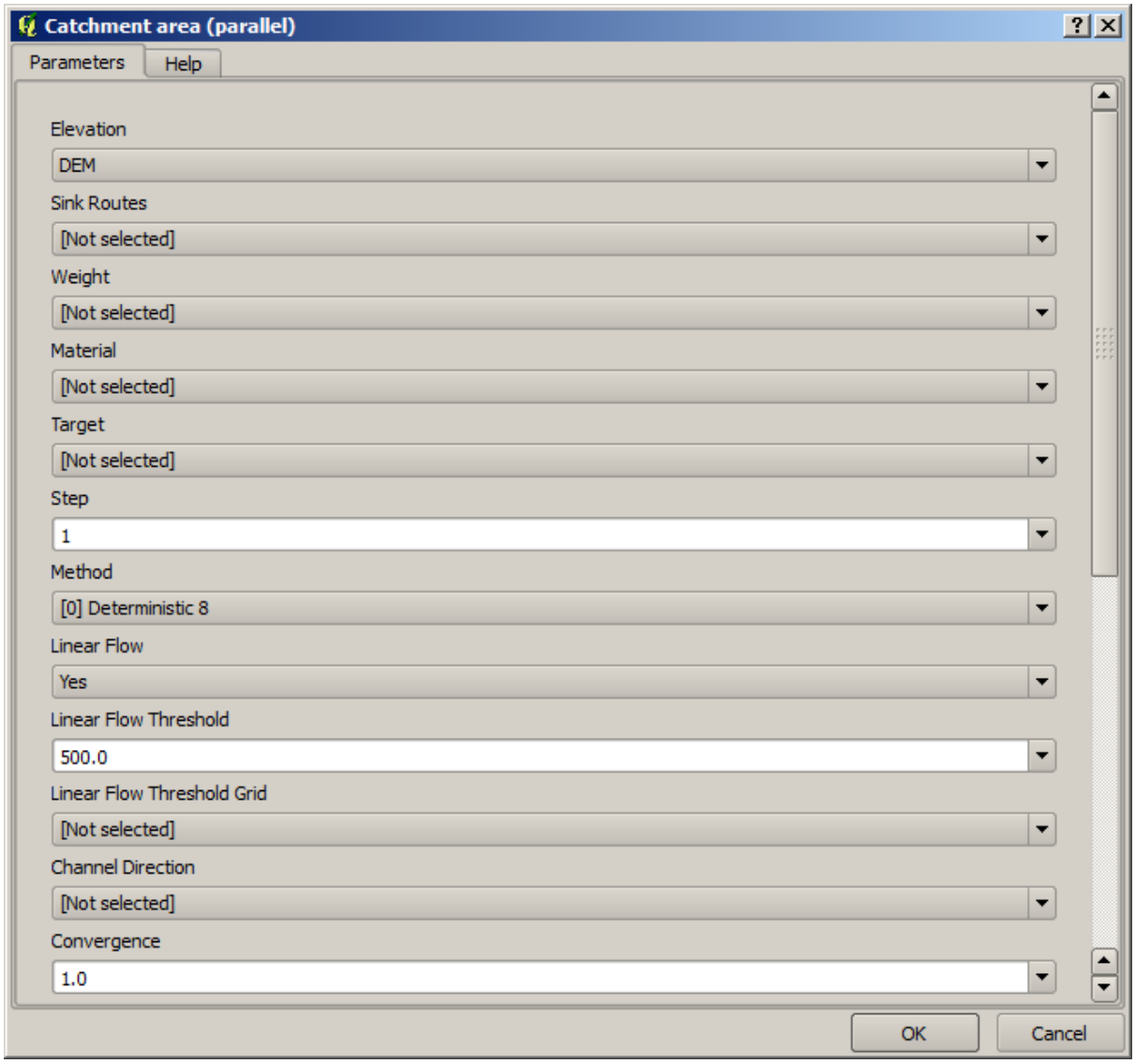
Output generated by an algorithm are handled a bit differently when the algorithm is used as a part of a model. Instead of selecting the filepath where you want to save each output, you just have to specify if that output is an intermediate layer (and you do not want it to be preserved after the model has been executed), or it is a final one. In this case, all layers produced by this algorithm are intermediate. We will only use one of them (the slope layer), but we do not want to keep it, since we just need it to calculate the TWI layer, which is the final result that we want to obtain.

When layers are not a final result, you should just leave the corresponding field. Otherwise, you have to enter a name that will be used to identify the layer in the parameters dialog that will be shown when you run the model later.

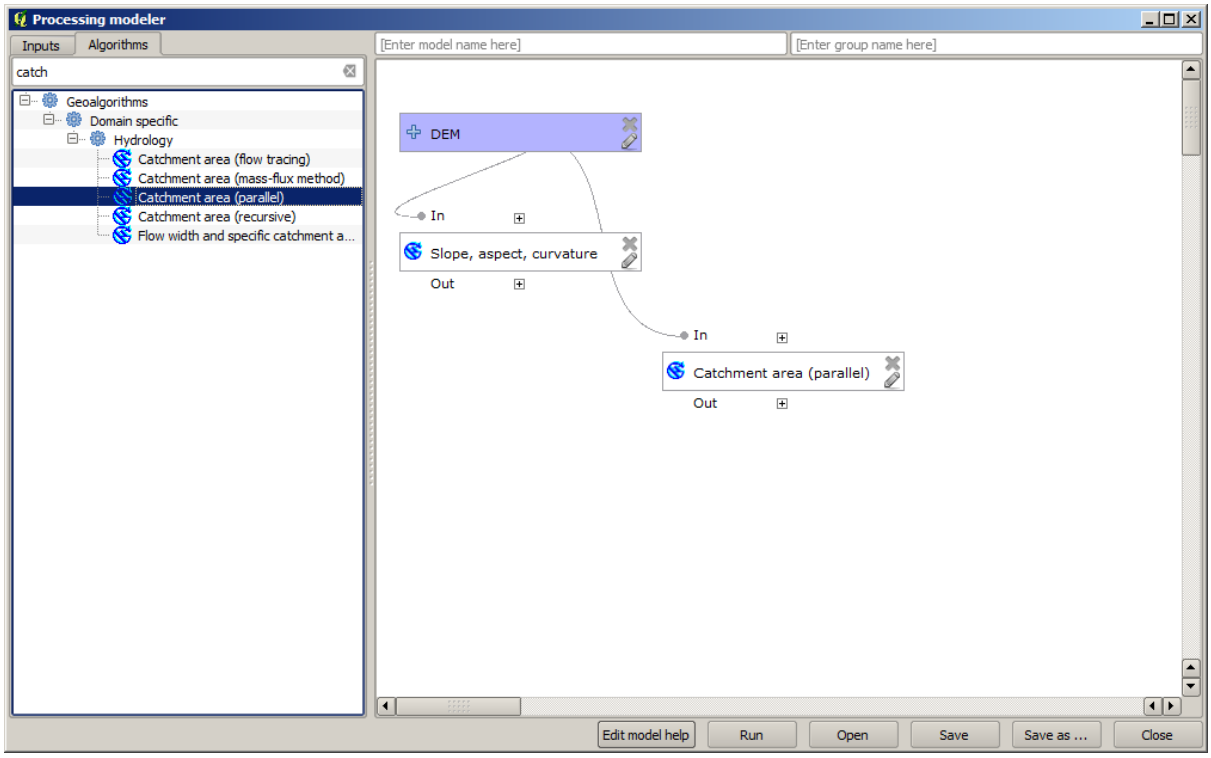
8. There is not much to select in this first dialog, since we do not have but just one layer in our model (The DEM input that we created). Actually, the default configuration of the dialog is the correct one in this case, so you just have to press *OK*. This is what you will now have in the modeler canvas.



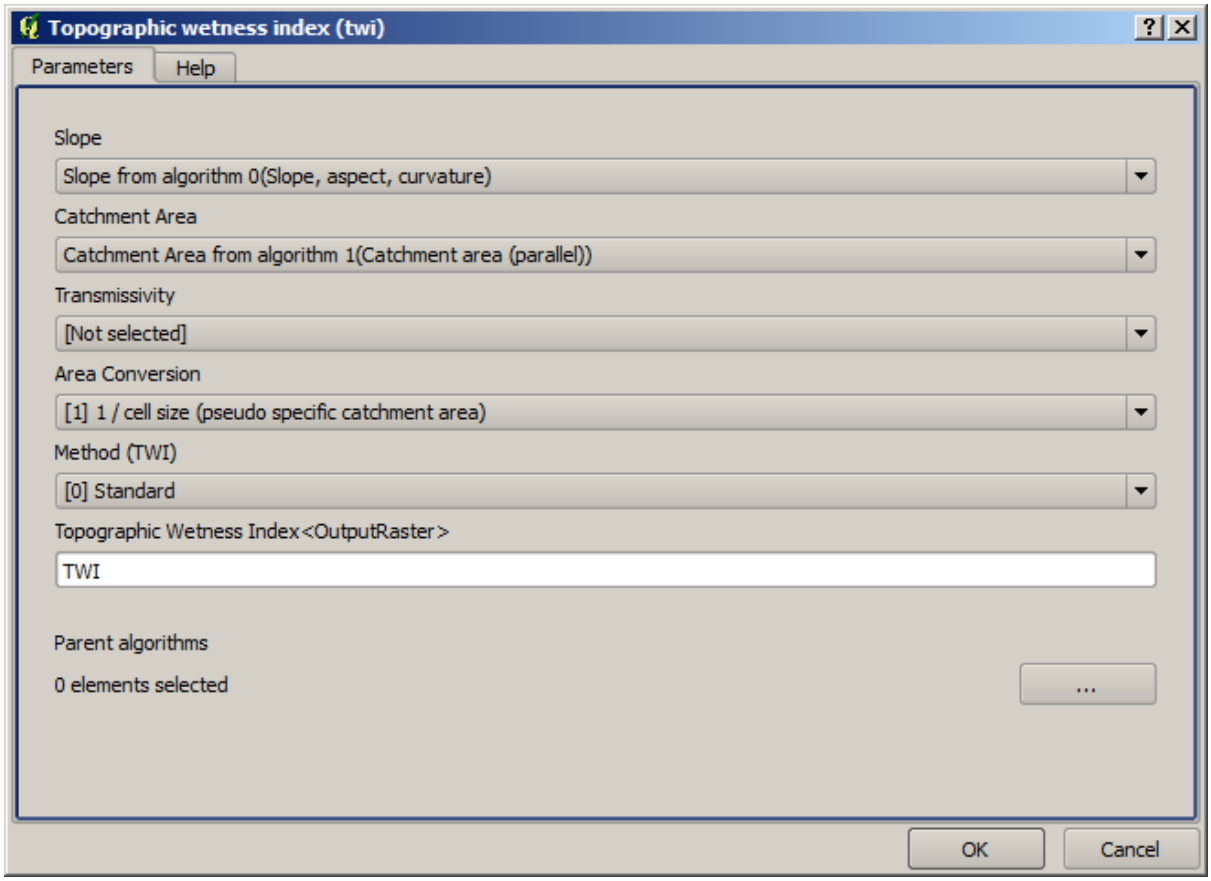
9. The second algorithm we have to add to our model is the catchment area algorithm. We will use the algorithm named *Catchment area (Paralell)*. We will use the DEM layer again as input, and none of the ouputs it produces are final, so here is how you have to fill the corresponding dialog.



Acum, modelul dvs. ar trebui să arate în felul următor:



10. The last step is to add the *Topographic wetness index* algorithm, with the following configuration.

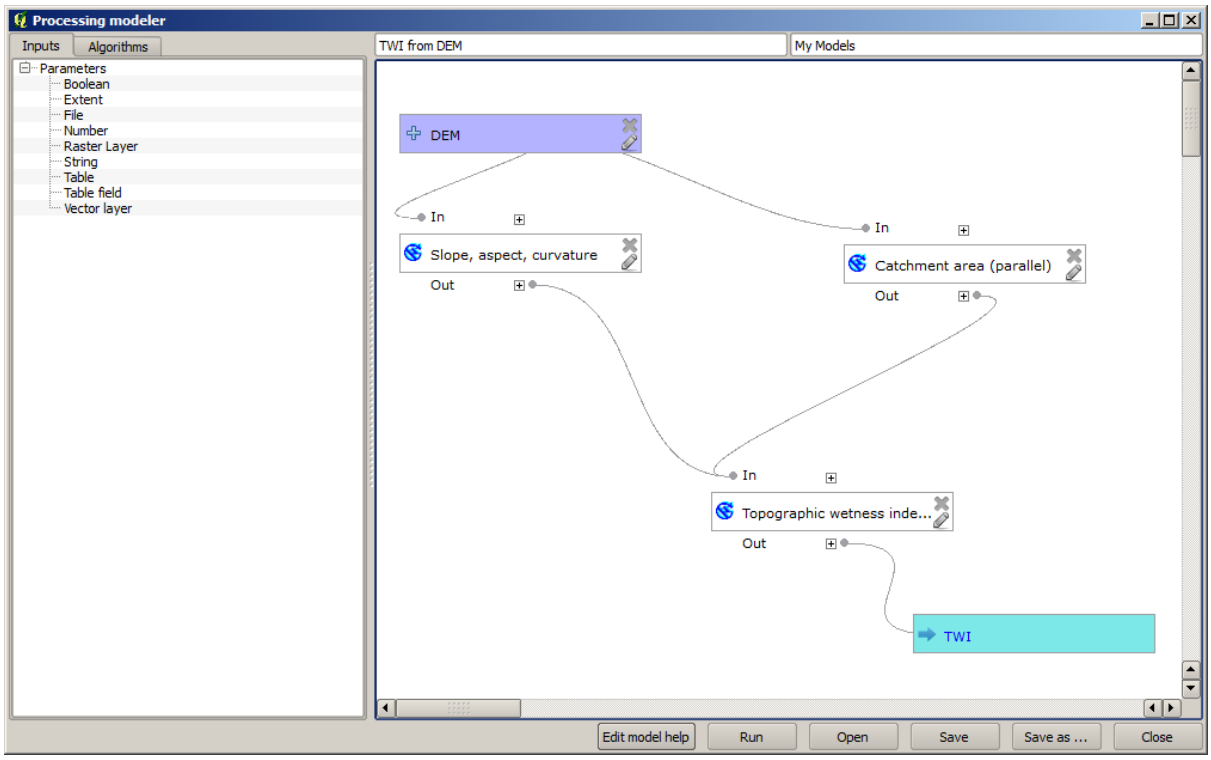


In this case, we will not be using the DEM as input, but instead, we will use the slope and catchment area layers that are calculated by the algorithms that we previously added. As you add new algorithms, the outputs they

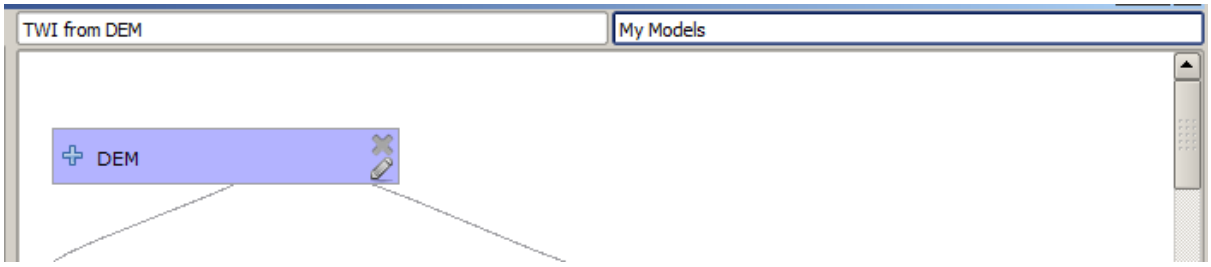
produce become available for other algorithms, and using them you link the algorithms, creating the workflow.

11. In this case, the output `TWI` layer is a final layer, so we have to indicate so. In the corresponding textbox, enter the name that you want to be shown for this output.

    Acum, modelul dvs. este finalizat, și ar trebui să arate în felul următor:

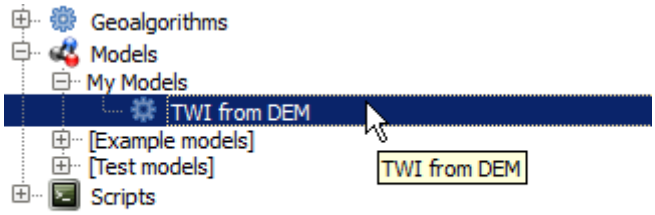


12. Enter a name and a group name in the upper part of the model window.

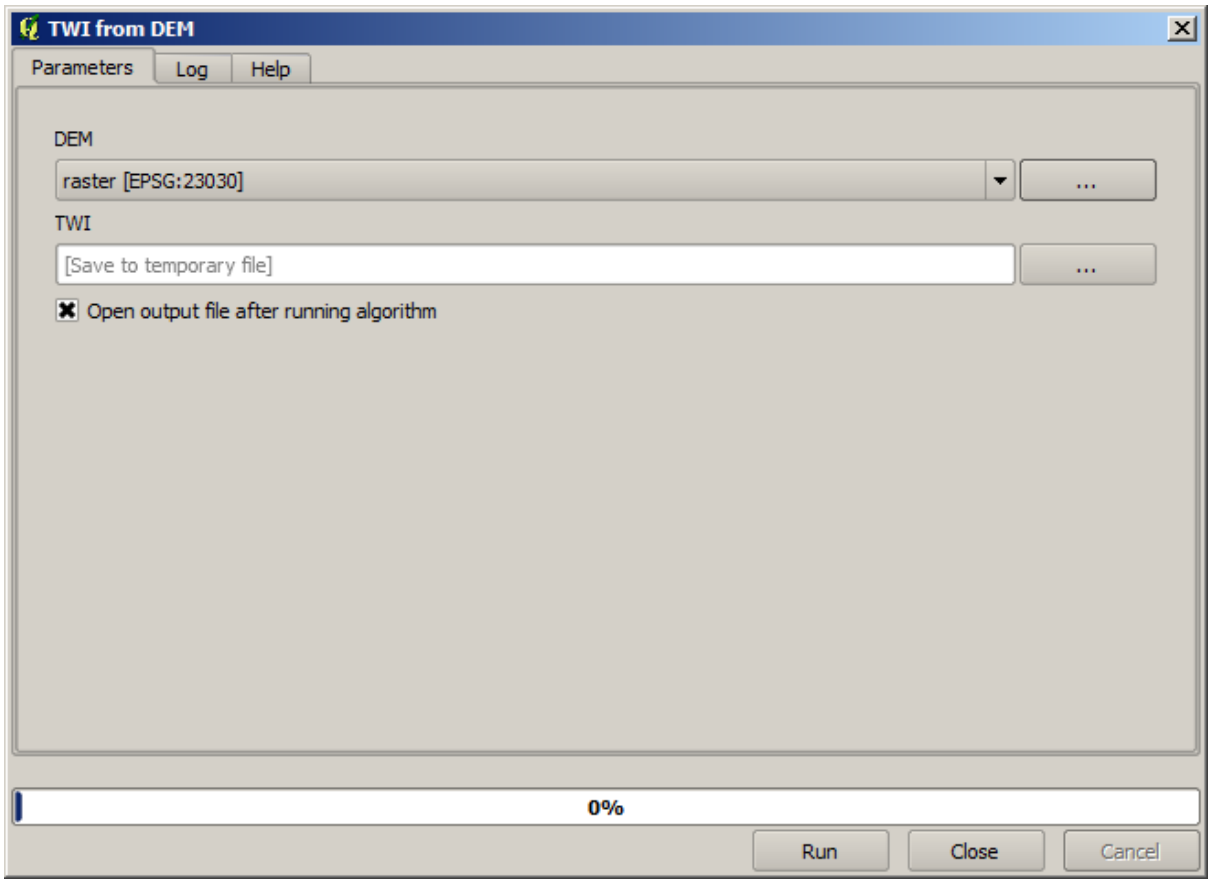


13. Save it clicking on the *Save* button. You can save it anywhere you want and open it later, but if you save it in the models folder (which is the folder that you will see when the save file dialog appears), your model will also be available in the toolbox as well. So stay on that folder and save the model with the filename that you prefer.

14. Now close the modeler dialog and go to the toolbox. In the *Models* entry you will find your model.



15. You can run it just like any normal algorithm, double-clicking on it.



După cum puteți vedea, dialogul parametrilor, conține intrarea pe care ați adăugat-o modelului, împreună cu ieșirile pe care le stabiliți ca fiind finale, atunci când adăugați algoritmii corespunzători.

16. Rulați-l folosind DEM-ul ca intrare, apoi veți obține stratul TWI, într-un singur singur pas.

17.18 Modele mai complexe

Notă

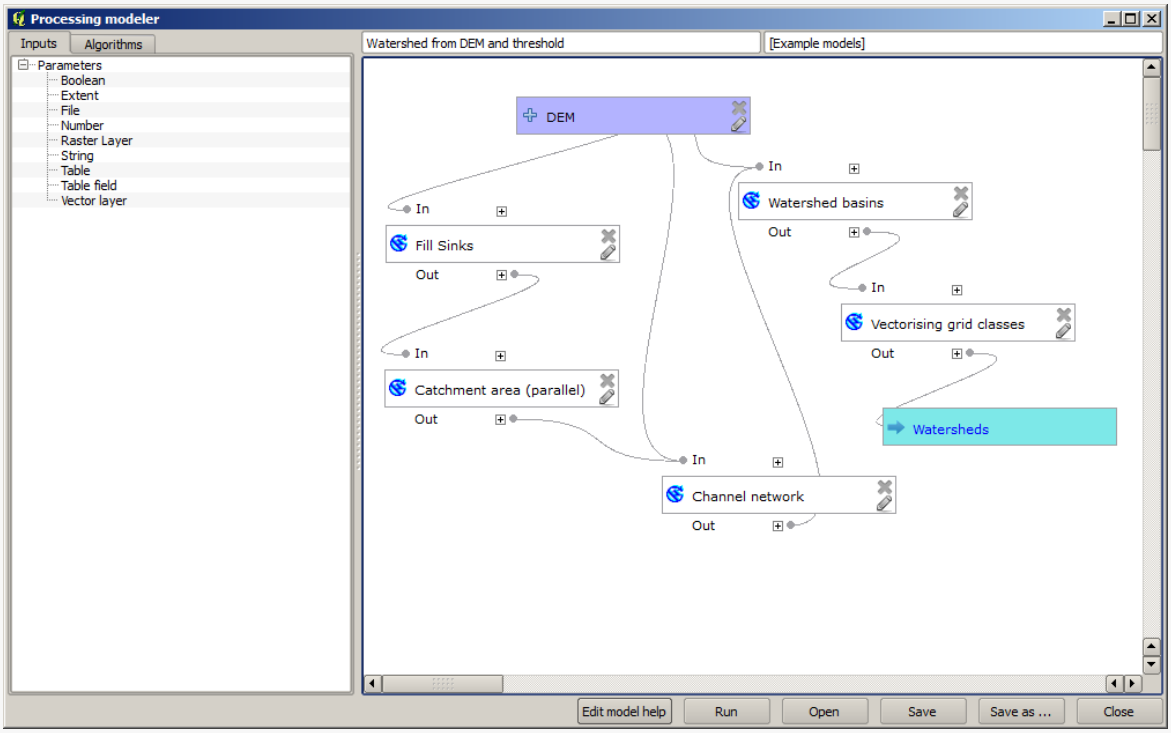
In this lesson we will work with a more complex model in the model designer.

The first model that we created in the previous chapter was a very simple one, with just one input and three algorithms. More complex models can be created, with different types of inputs and containing more steps. For this chapter we will work with a model that creates a vector layer with watersheds, based on a DEM and a threshold value. That will be very useful for calculating several vector layers corresponding to different thresholds, without having to repeat each single step each time.

This lesson does not contain instructions about how to create your model. You already know the necessary steps (we saw them in a *previous lesson*) and you have already seen the basic ideas about the modeler, so you should try it yourself. Spend a few minutes trying to create your model, and don't worry about making mistakes. Remember: first add the inputs and then add the algorithms that use them to create the workflow.

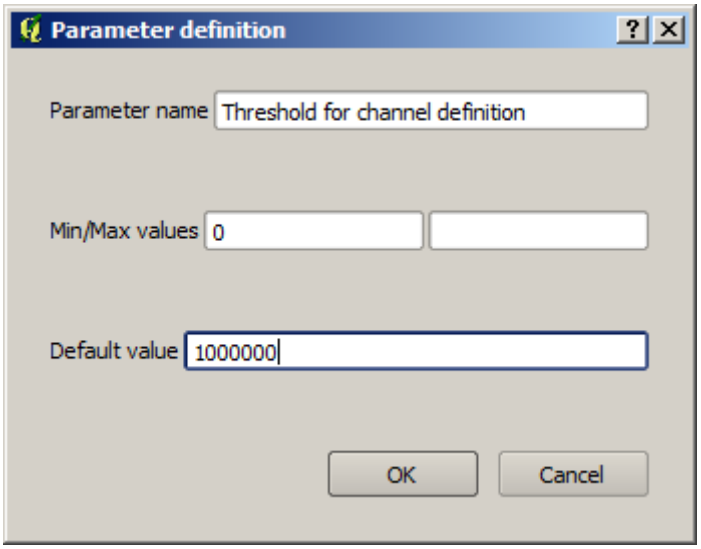
Notă

In case you could not create the full model yourself and you need some extra help, the data folder corresponding to this lesson contains an «almost» finished version of it. Open the modeler and then open the model file that you will find in the data folder. You should see something like this.

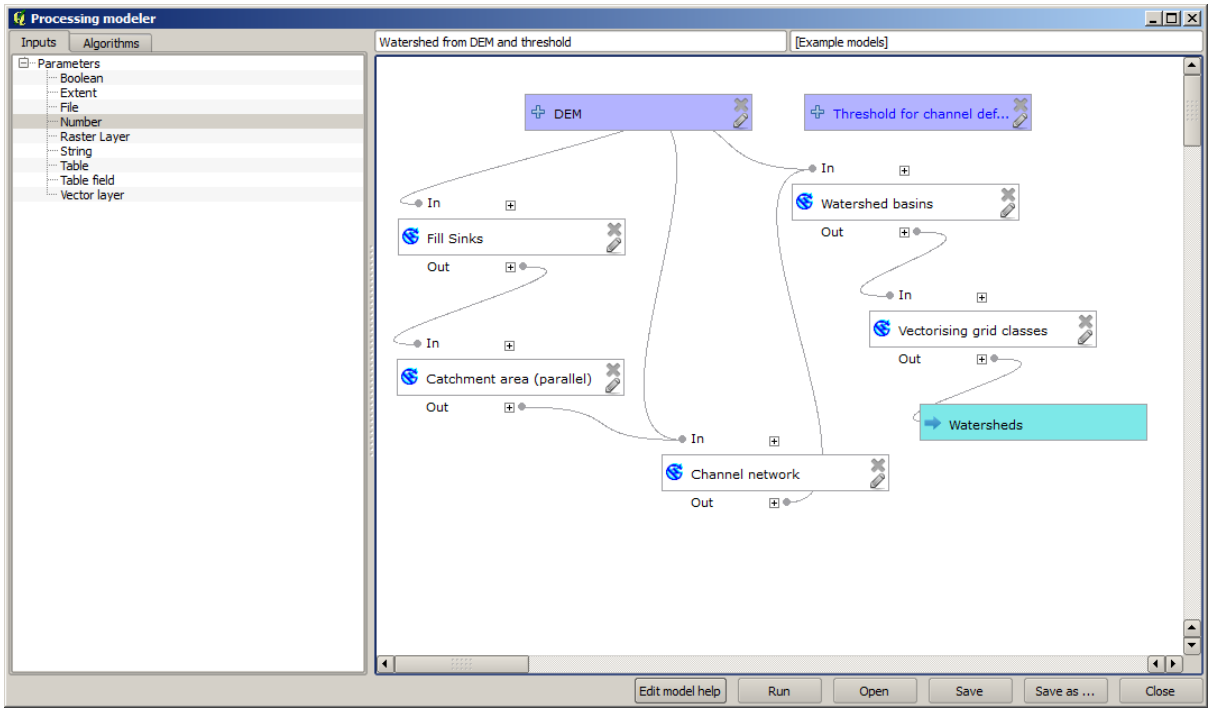


This model contains all the steps needed to complete the calculation, but it just has one input: the DEM. That means that the threshold for channel definition uses a fixed value, which makes the model not as useful as it could be. That is not a problem, since we can edit the model, and that is exactly what we will do.

1. First, let's add a numerical input. That will ask the user for a numerical input that we can use when such a value is needed in any of the algorithms included in our model.
2. Click on the *Number* entry in the *Inputs* tree, and you will see the corresponding dialog.
3. Fill it with the following values.
   - *Numele parametrului*: `Pragul pentru definirea canalului`
   - *Default value*: `1,000,000`

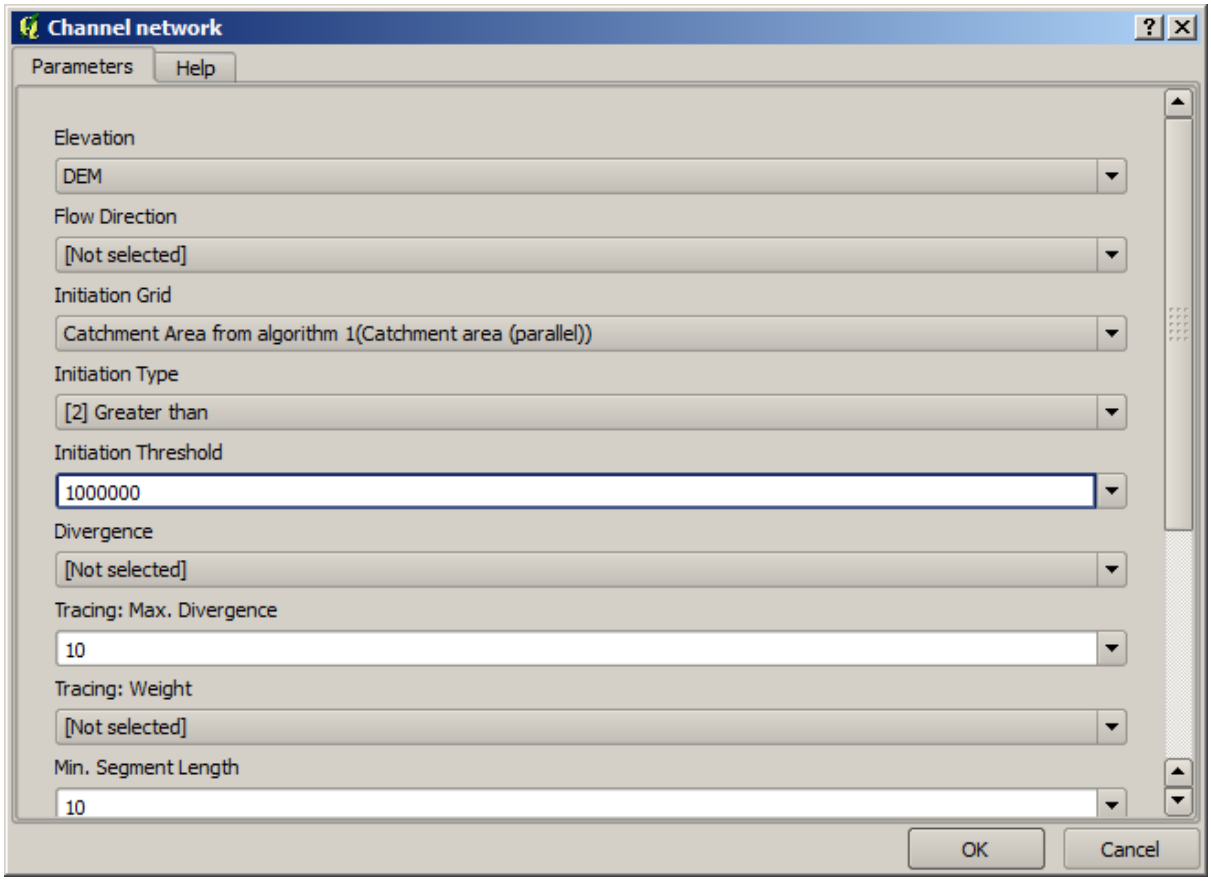


Acum, modelul dvs. ar trebui să arate în felul următor:



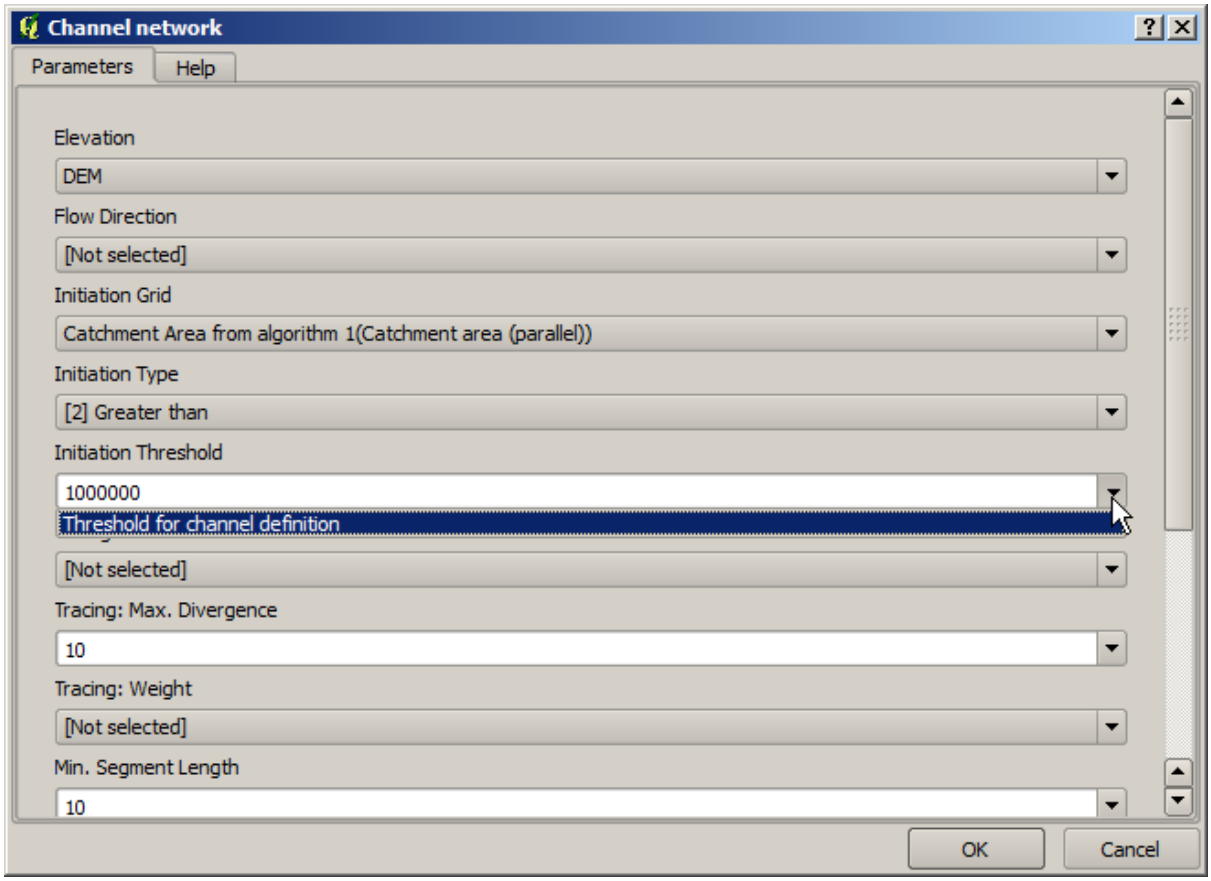
The input that we have just added is not used, so the model hasn't actually changed. We have to link that input to the algorithm that uses it, in this case the *Channel network* one. To edit an algorithm that already exists in the modeler, just click on the pen icon on the corresponding box in the canvas.

4. Click on the *Channel network* algorithm and you will see something like this.



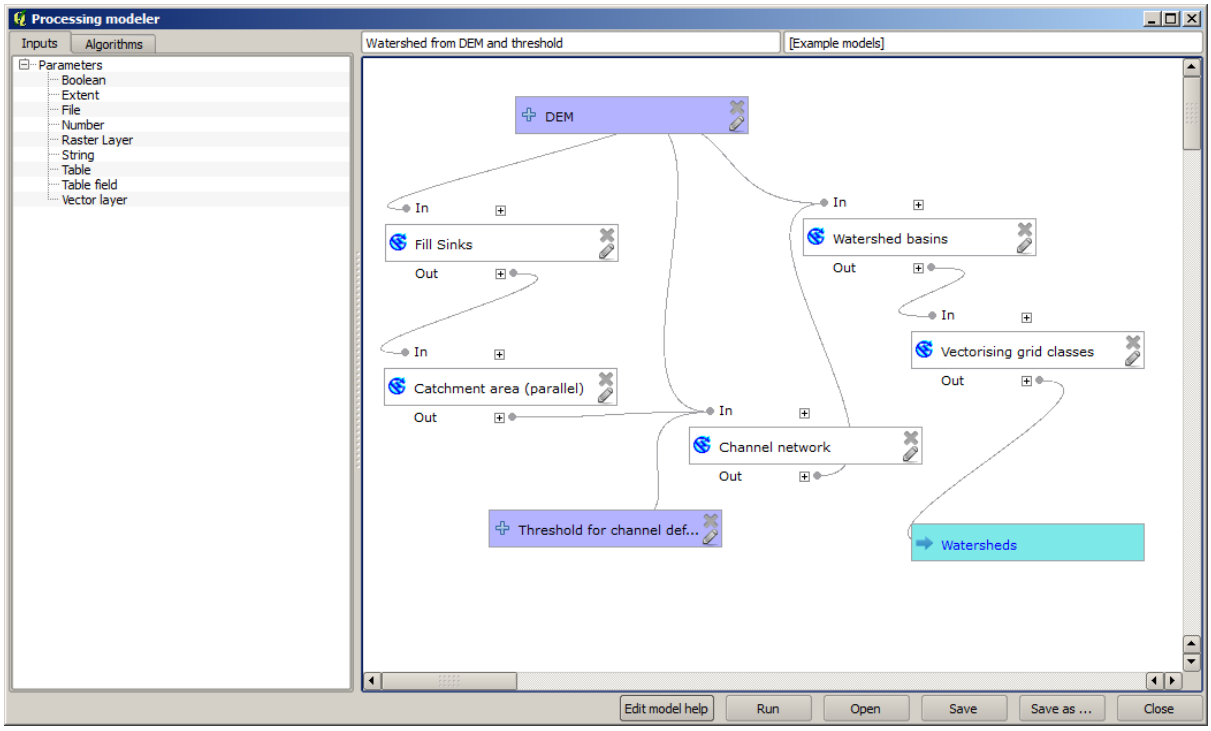
The dialog is filled with the current values used by the algorithm. You can see that the *Initiation threshold* parameter has a fixed value of 1,000,000 (this is also the default value of the algorithm, but any other value could be put in there). However, you might notice that the parameter is not entered in a common text box, but in a drop-down menu.

5. Unfold the threshold parameter menu and you will see something like this.



The input that we added is there and we can select it. Whenever an algorithm in a model requires a numerical value, you can hardcode it and directly type it, or you can use any of the available inputs and values (remember that some algorithms generate single numerical values. We will see more about this soon). In the case of a string parameter, you will also see string inputs and you will be able to select one of them or type the desired fixed value.

6. Select the `Threshold for channel definition` input in the *Initiation threshold* parameter.
7. Click on *OK* to apply the changes to your model. Now the design of the model should look like this.



8. The model is now complete. Run it using the DEM that we have used in previous lessons, and with different threshold values.

   Below you have a sample of the result obtained for different values. You can compare with the result for the default value, which is the one we obtained in the *hydrological analysis lesson*.

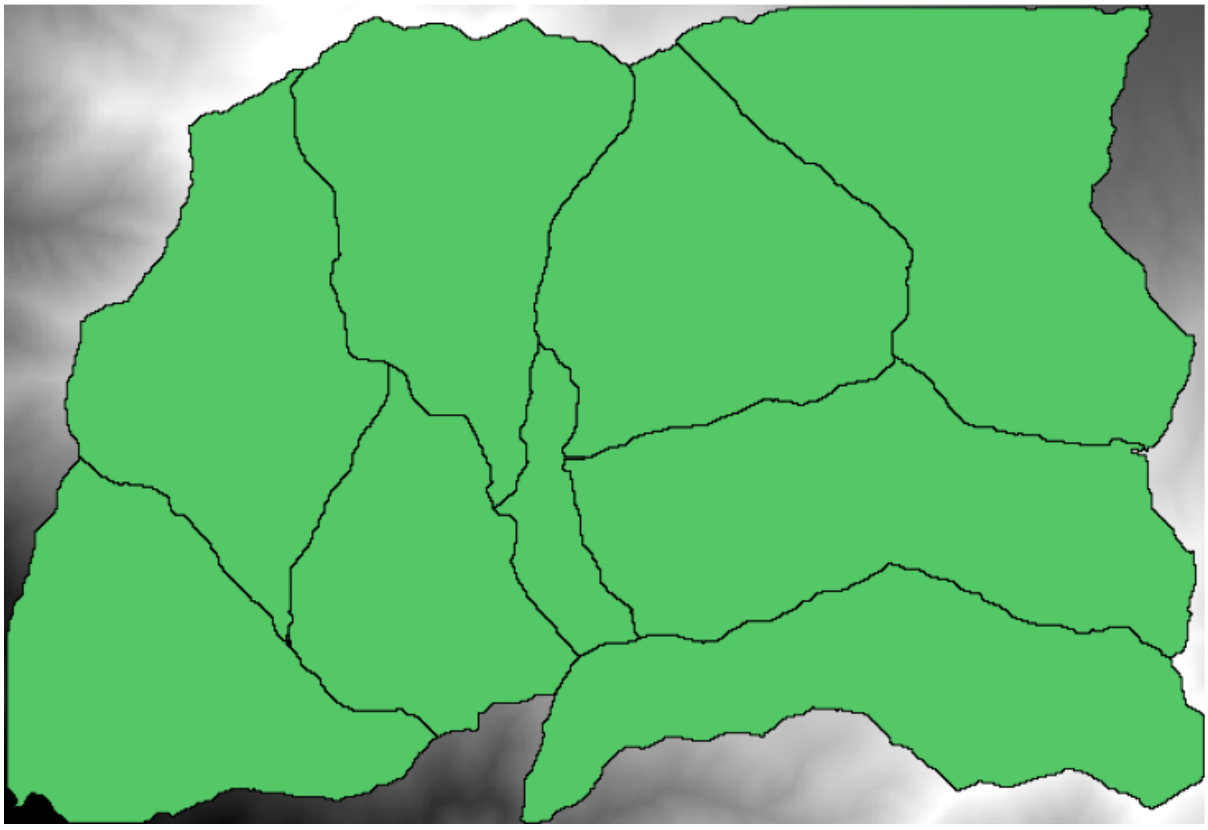


Fig. 17.1: Prag = 100,000

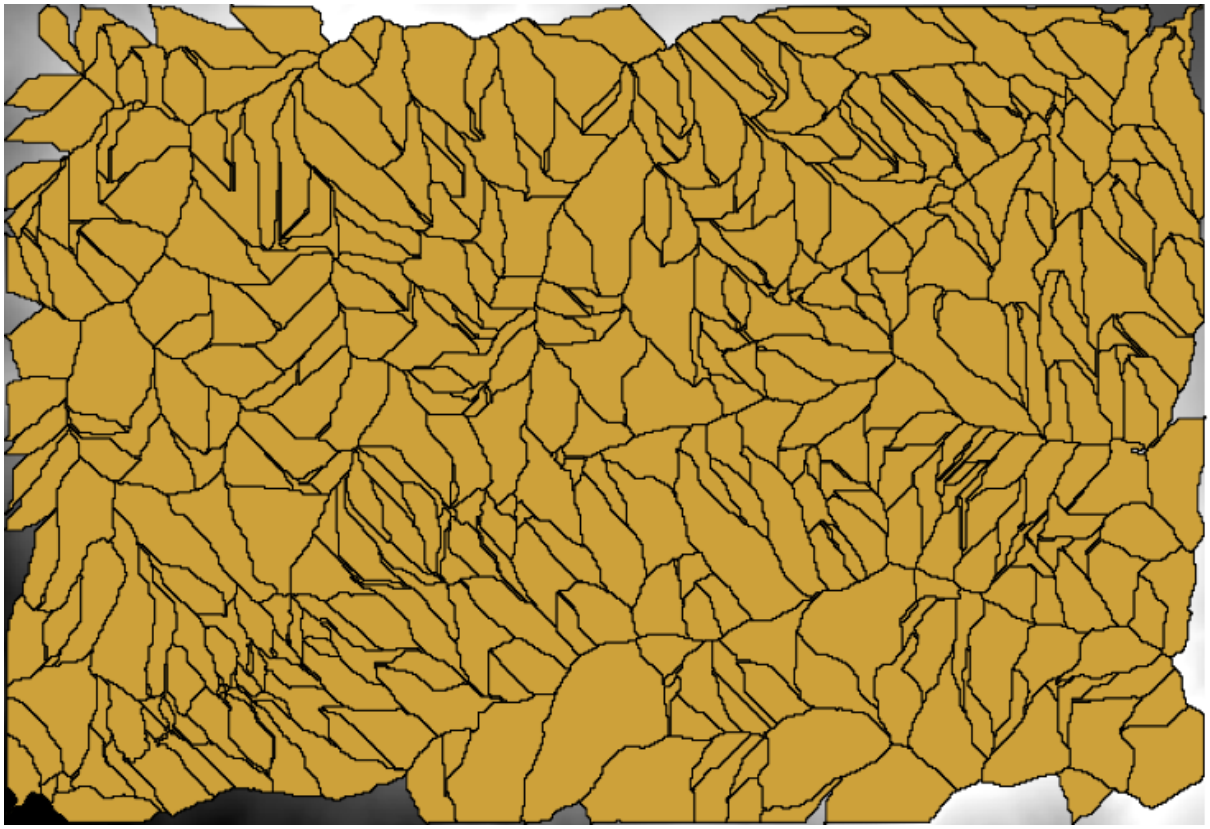


Fig. 17.2: Prag = 1,0000,000

17.19 Calculele numerice din modelator

Atenționare

Atenție, deoarece acest capitol nu este bine testat, vă rugăm să raportați orice problemă; imaginile lipsesc

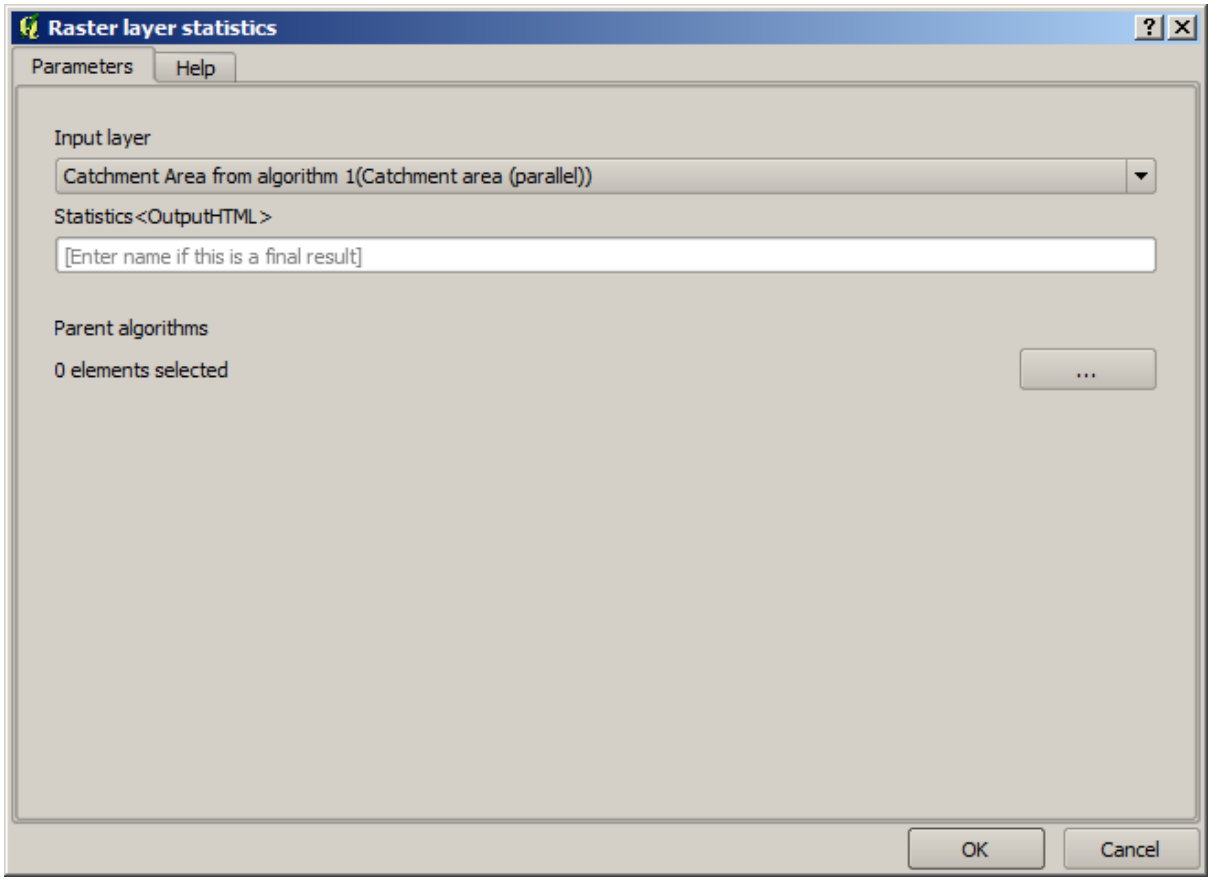
Notă

În această lecție vom vedea cum se generează ieșirile numerice din modelator

Pentru această lecție, vom modifica modelul hidrologic pe care l-am creat în ultimul capitol (deschideți-l în modelator înainte de a începe), astfel încât să putem automatiza calcularea unei valori valide de prag, nefiind nevoie să cerem utilizatorului să o introducă. Deoarece această valoare se referă la variabila din pragul stratului raster, o vom extrage din acest strat, pe baza unor analize statistice simple.

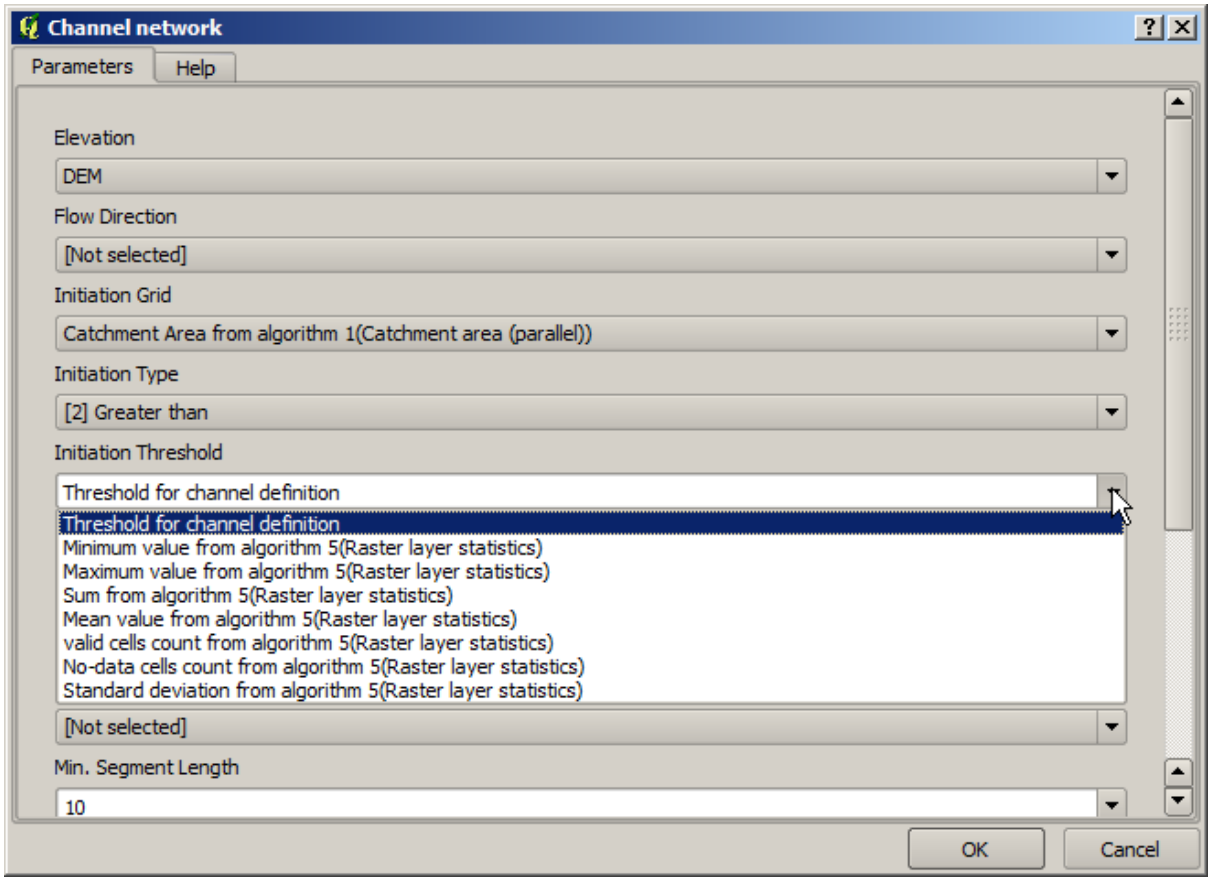
Începand cu modelul menționat mai înainte, haideți să facem următoarele modificări:

First, calculate statistics of the flow accumulation layer using the *Raster layer statistics* algorithm.



Acest lucru va genera un set de valori statistice, care vor fi de acum disponibile pentru toate câmpurile numerice ai altor algoritmi.

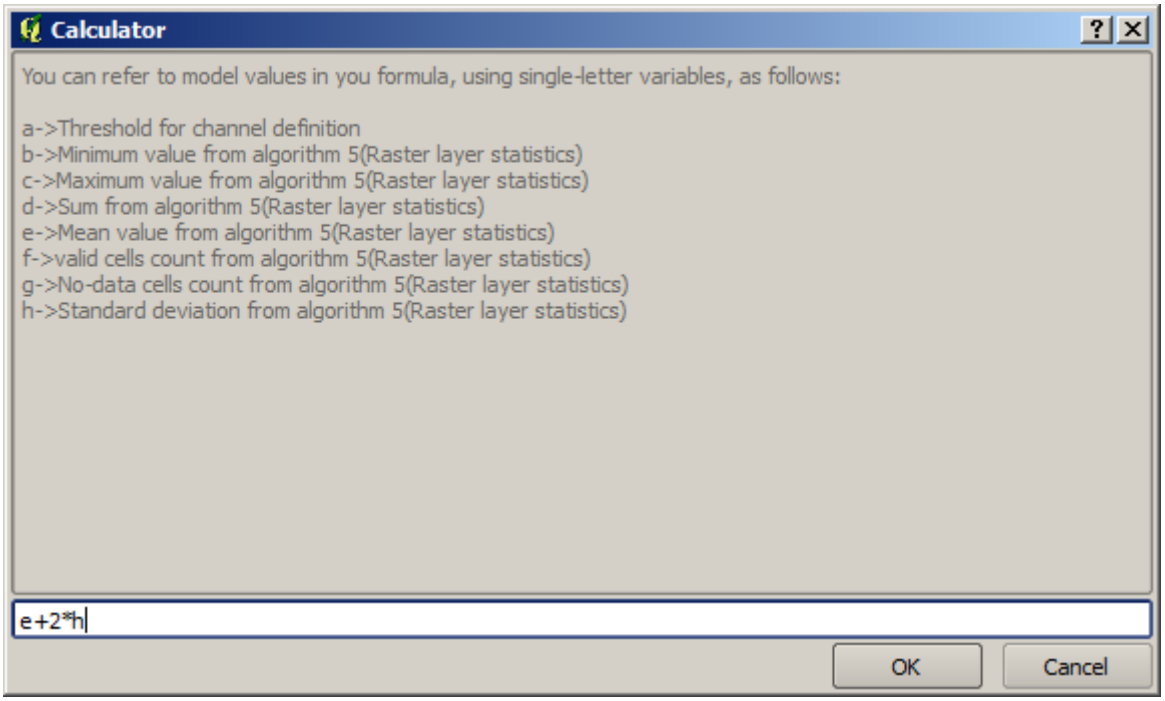
If you edit the *Channel network* algorithm, as we did in the last lesson, you will see now that you have other options apart from the numeric input that you added.



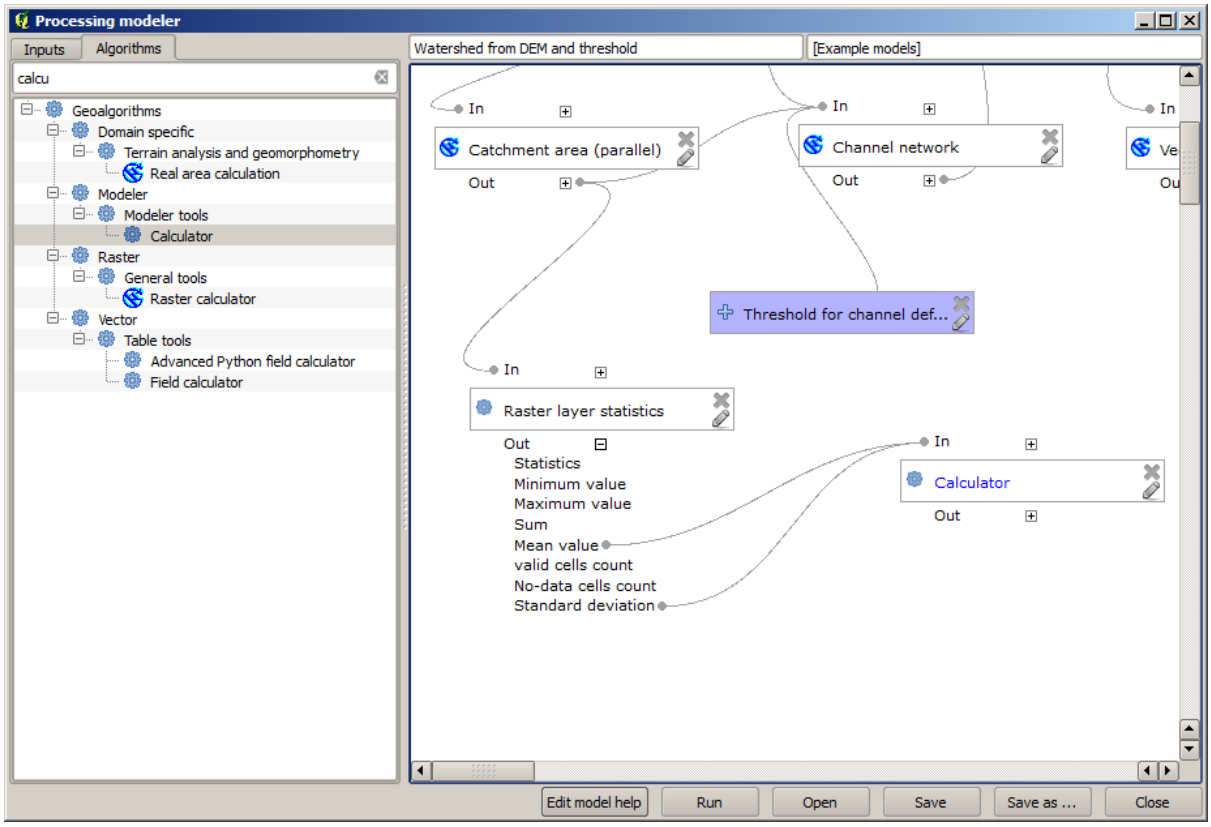
Cu toate acestea, nici una dintre aceste valori nu este adecvată pentru a fi utilizată ca și prag valid, atât timp cât acestea vor produce rețele de canale nu prea realistice. Putem obține, în schimb, un nou parametru pe baza lor, pentru a obține un rezultat mai bun. De exemplu, putem folosi media, la care se va adăuga de 2 ori deviația standard.

Pentru a adăuga această operațiune aritmetică, putem folosi calculatorul, pe care îl veți găsi în grupul *Geoalgorithms/modeler/modeler-tools*. Acest grup conține algoritmi care nu sunt foarte utili în afara modelatorului, dar care oferă funcționalități utile la crearea unui model.

Dialogul parametrilor pentru algoritmul calculatorului arată astfel:



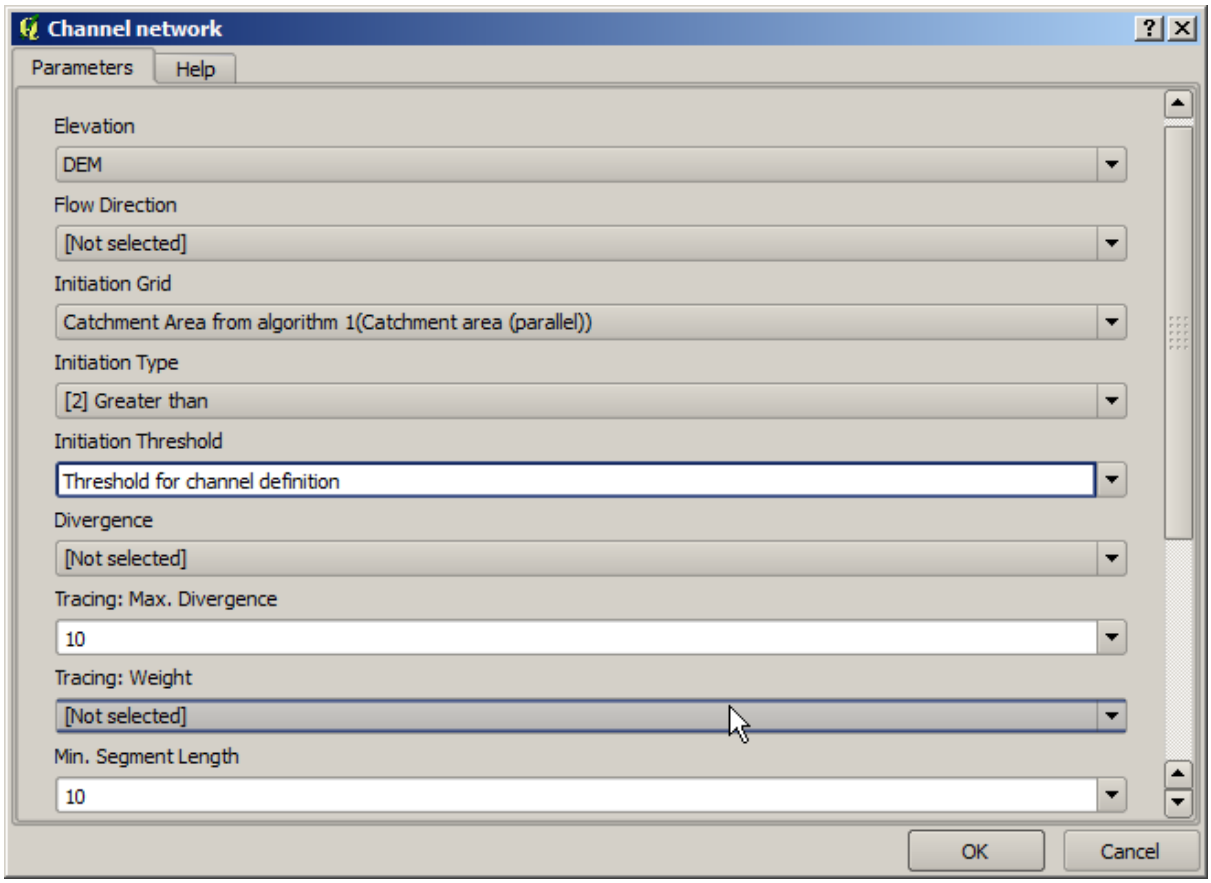
As you can see, the dialog is different to the other ones we have seen, but you have in there the same variables that were available in the `Threshold` field in the *Channel network* algorithm. Enter the above formula and click on *OK* to add the algorithm.



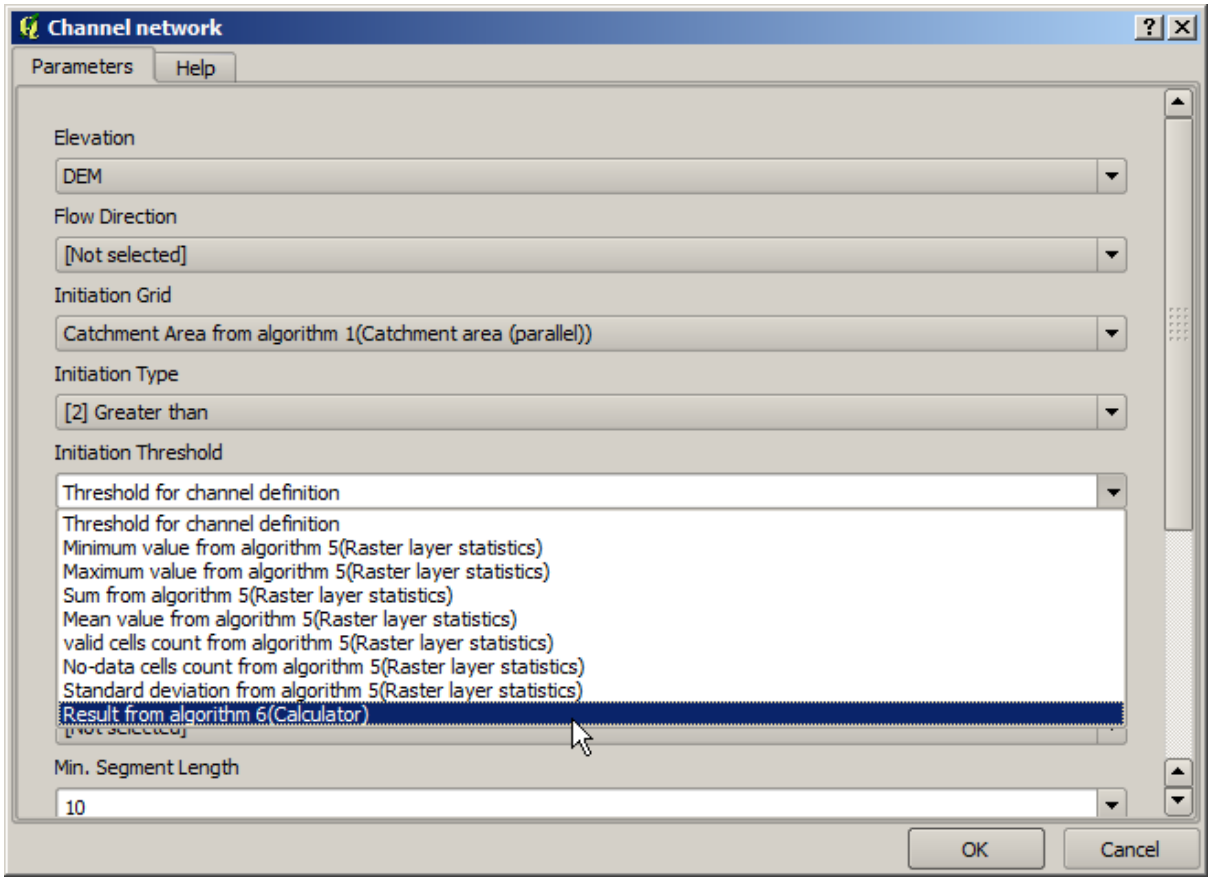
Dacă extindeți intrarea rezultatului, așa cum se arată mai sus, veți vedea că modelul este conectat la două dintre valori, și anume media și abaterea standard, care sunt cele pe care le-am folosit în formulă.

Adding this new algorithm will add a new numeric value. If you go again to the *Channel network* algorithm, you can

now select that value in the `Threshold` parameter.



Click on *OK* and your model should look like this.



We are not using the numeric input that we added to the model, so it can be removed. Right-click on it and select *Remove*

Atenționare

todo: De adăugat imaginea

De acum, noul nostru model este terminat.

17.20 Un model în cadrul unui model

Atenționare

Atenție, deoarece acest capitol nu este bine testat, vă rugăm să raportați orice problemă; imaginile lipsesc

Notă

În această lecție vom vedea cum să folosim un model într-un alt model, mai mare.

Am creat deja câteva modele, iar în această lecție vom vedea cum le putem combina într-unul singur, mai mare. Un model se comportă la fel ca oricare alt algoritm, ceea ce înseamnă că puteți adăuga un model pe care îl aveți deja, ca parte a altuia, pe care urmează să-l creați.

În acest caz, vom extinde modelul nostru hidrologic, prin adăugarea valorii medii TWI în fiecare dintre bazinele pe care le generează ca rezultat. Pentru aceasta, avem nevoie de calculul LST și a unor statistici. Din moment ce am creat deja un model pentru a calcula LST dintr-un DEM, este o idee bună să refolosiți acel model, în locul adăugării algoritmilor pe care îi conține în mod individual.

Să începem cu modelul folosit ca punct de plecare pentru ultima lecție.

Atenționare

todo: De adăugat imaginea

În primul rând, vom adăuga modelul LST. Pentru ca acesta să fie la îndemână, ar fi trebuit să fie salvat în dosarul modelelor, în caz contrar el nefiind afișat în caseta de instrumente sau în lista de algoritmi din modelator. Asigurați-vă că este disponibil.

Adăugați-l la modelul actual și folosiți DEM-ul de intrare ca și ieșire. Ieșirea este una temporară, din moment ce vrem să obținem doar stratul TWI, pentru a-l folosi la calculul statisticilor. Singura ieșire a acestui model va fi, în continuare, stratul vectorial al bazinelor hidrografice.

Iată dialogul parametrilor corespunzători:

Atenționare

todo: De adăugat imaginea

Acum avem un strat TWI, pe care îl putem folosi împreună cu stratul vectorial al bazinelor hidrologice, pentru a genera unul nou, care conține valorile TWI corespunzătoare fiecărui bazin hidrografic.

This calculation is done using the *Grid statistics in polygons* algorithm. Use the layers mentioned above as input, to create the final result.

Atenționare

todo: De adăugat imaginea

The output of the *Vectorize grid classes* algorithm was originally our final output, but now we just want it as an intermediate result. To change that, we have to edit the algorithm. Just double–click on it to see its parameters dialog, and delete the name of the output. That will make it a temporary output, as it is by default.

Atenționare

todo: De adăugat imaginea

Iată cum ar trebui să arate modelul final:

Atenționare

todo: De adăugat imaginea

După cum vedeți, utilizarea unui model într-un alt model nu reprezintă nimic special, putând fi adăugat la fel ca oricare alt algoritm, atât timp cât modelul este salvat în dosarul de modele și este disponibil în caseta de instrumente.

17.21 Utilizarea pentru crearea unui model doar a instrumentelor modelatorului

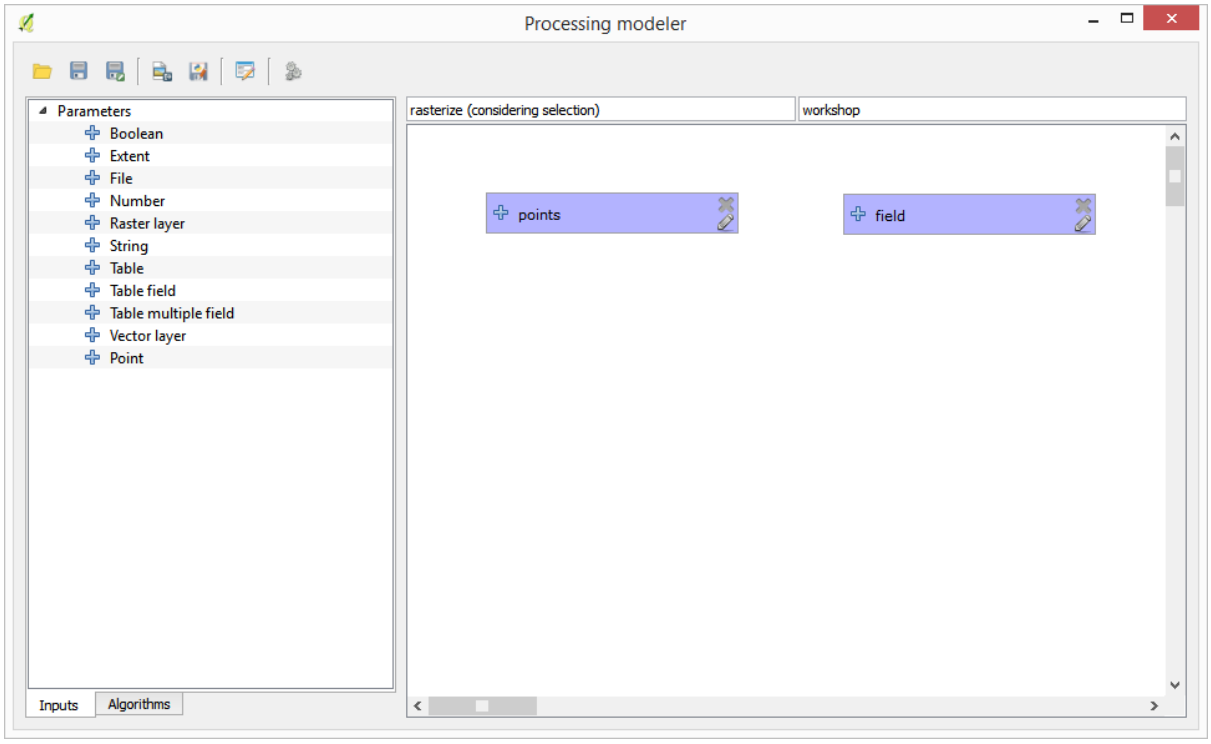
Notă

Această lecție vă arată cum să utilizați niște algoritmi disponibili doar în modelator, pentru a oferi funcționalități adiționale modelelor.

Scopul acestei lecții este de a folosi modelatorul la crearea unui algoritm de interpolare, care să țină cont de selecția curentă, nu doar să folosească numai entitățile selectate, dar și să utilizeze extinderea acelei selecții pentru a crea stratul raster interpolat.

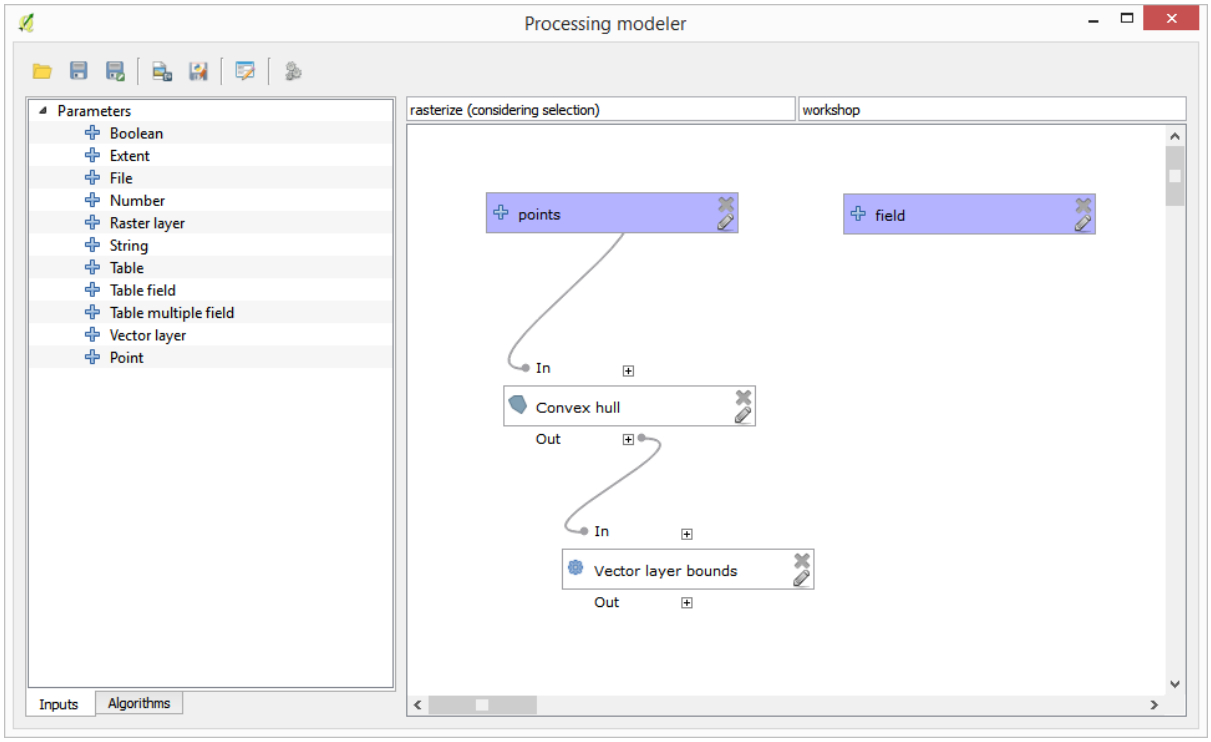
The interpolation process involves two steps, as it has been already explained in previous lessons: rasterizing the points layer and fill the no-data values that appear in the rasterized layer. In case the points layer has a selection, only selected points will be used, but if the output extent is set to be automatically adjusted, the full extent of the layer will be used. That is, the extent of the layer is always considered to be the full extent of all features, not the one computed from just the selected ones. We will try to fix that by using some additional tools into our model.

Open the modeler and start the model by adding the required inputs. In this case we need a vector layer (restricted to points) and an attribute from it, with the values that we will use for rasterizing.

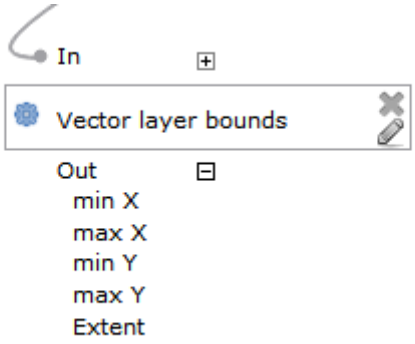


The next step is to compute the extent of the selected features. That's where we can use the model-only tool called *Vector layer bounds*. First, we will have to create a layer that has the extent of those selected features. Then, we can use this tool on that layer.

An easy way of creating a layer with the extent of the selected features is to compute a convex hull of the input points layer. It will use only the selected point, so the convex hull will have the same bounding box as the selection. Then we can add the *Vector layer bounds* algorithm, and use the convex hull layer as input. It should look this in the modeler canvas:

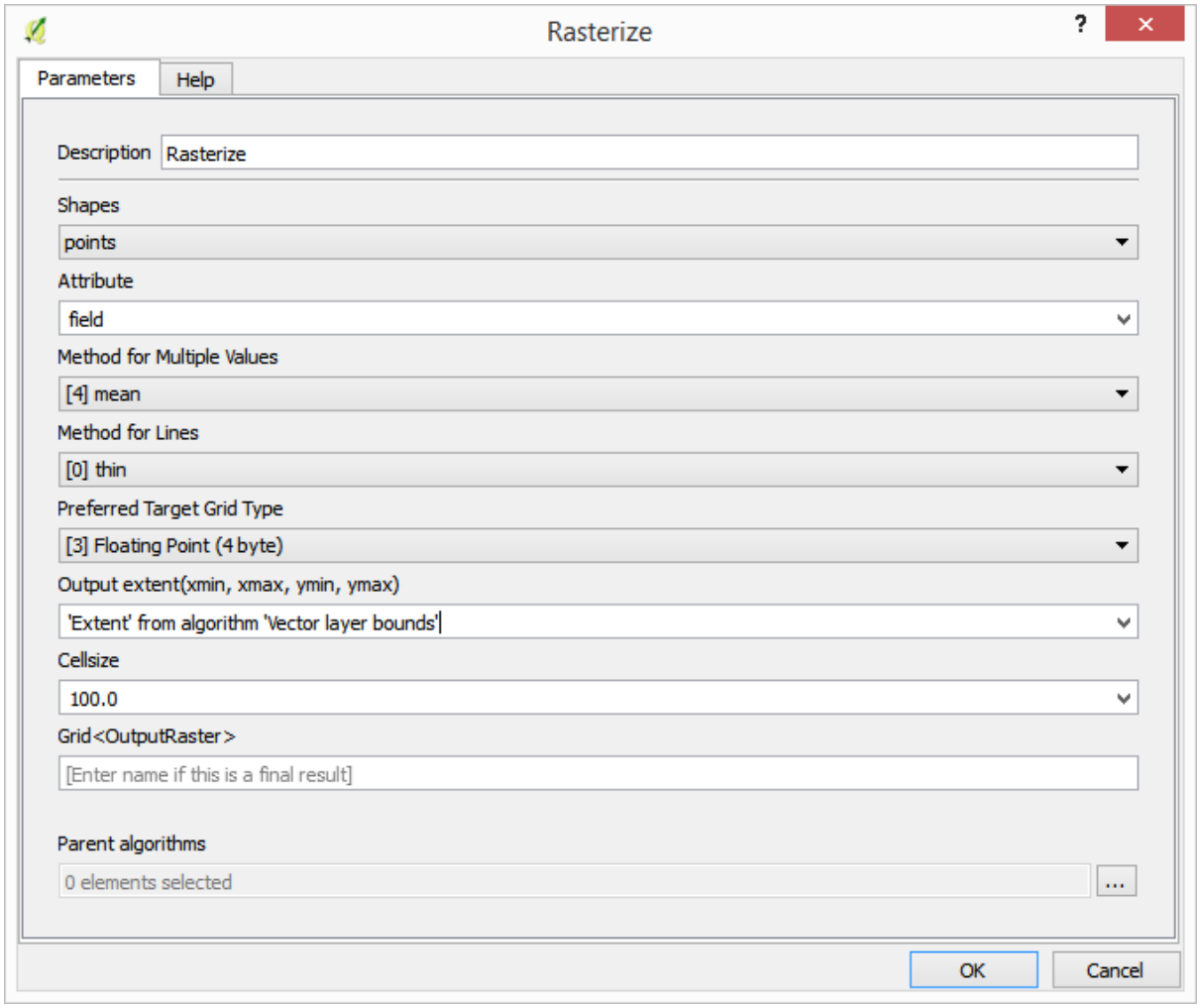


The result from the *Vector layer bounds* is a set of four numeric values and a extent object. We will use both the numeric outputs and the extent for this exercise.

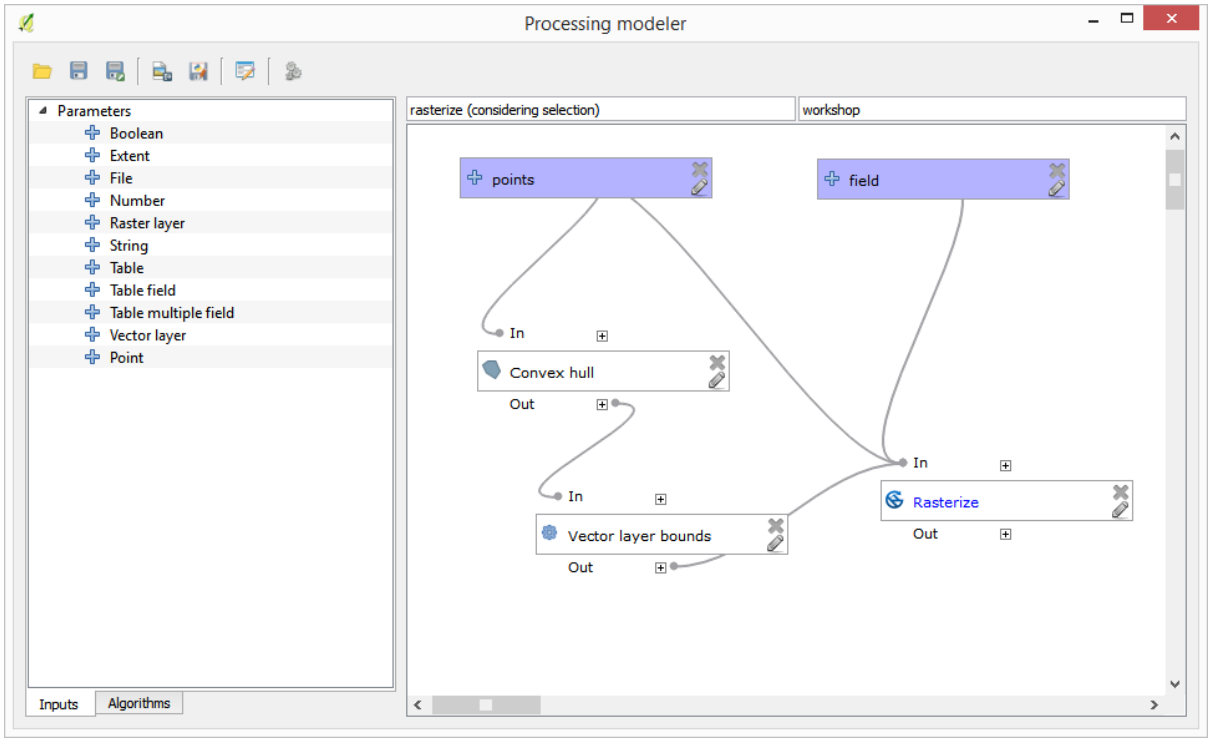


We can now add the algorithm that rasterizes the vector layer, using the extent from the *Vector layer bounds* algorithm as input.

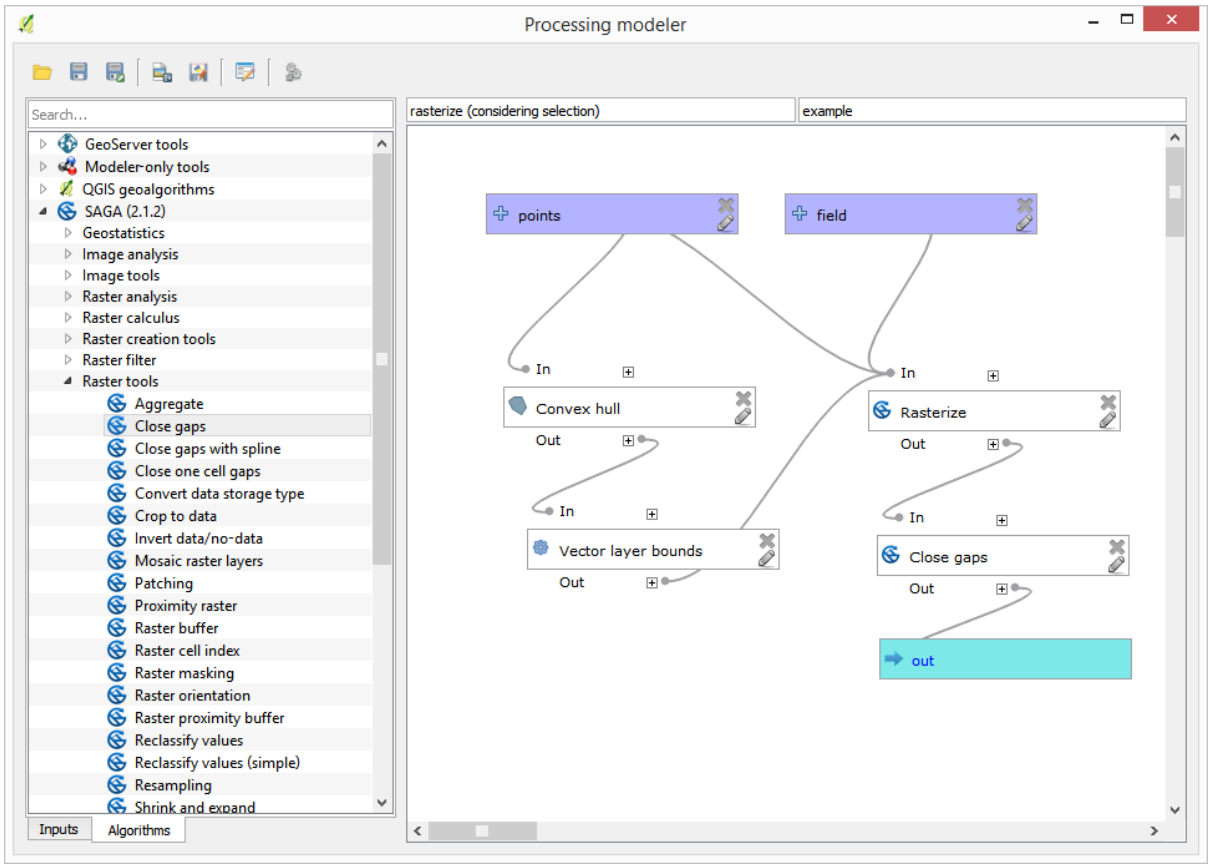
Completați parametrii după cum se arată în continuare:



Canevasul ar trebui să arate astfel:



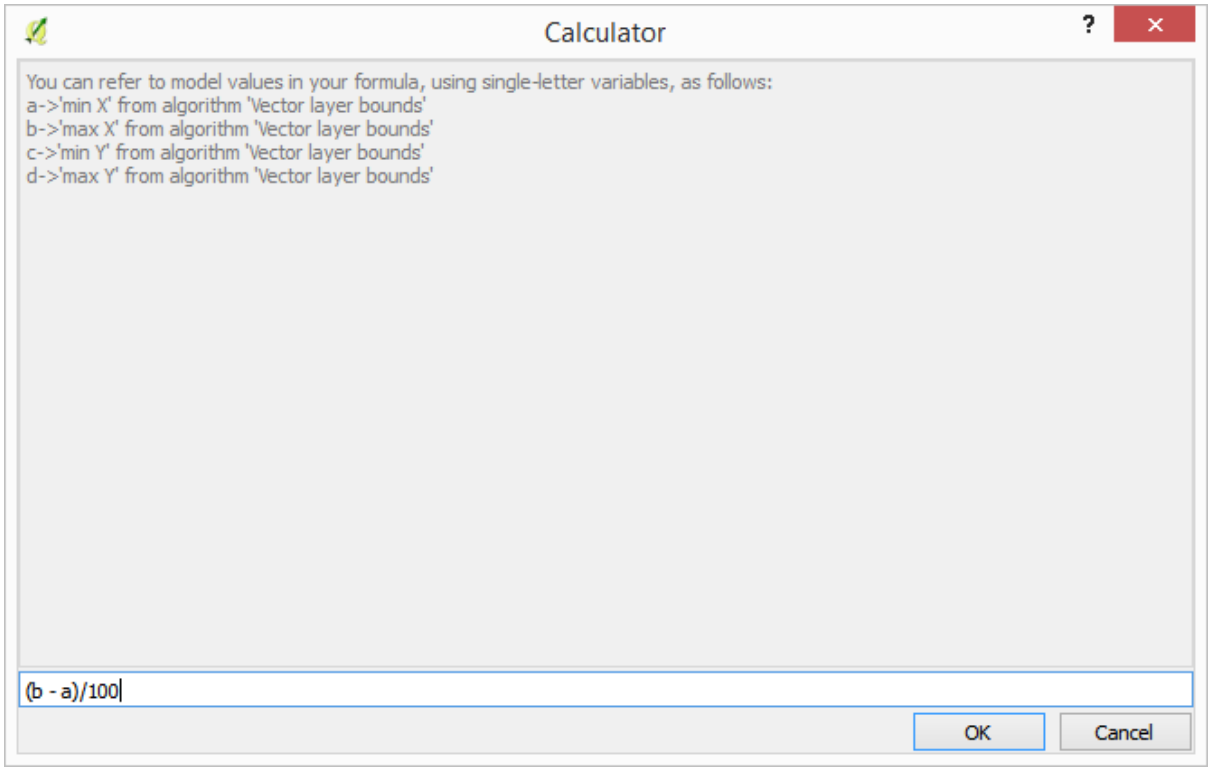
Finally, fill the no-data values of the raster layer using the *Close gaps* algorithm.



The algorithm is now ready to be saved and added to the toolbox. You can run it and it will generate a raster layer from interpolating the selected points in the input layer, and the layer will have the same extent as the selection.

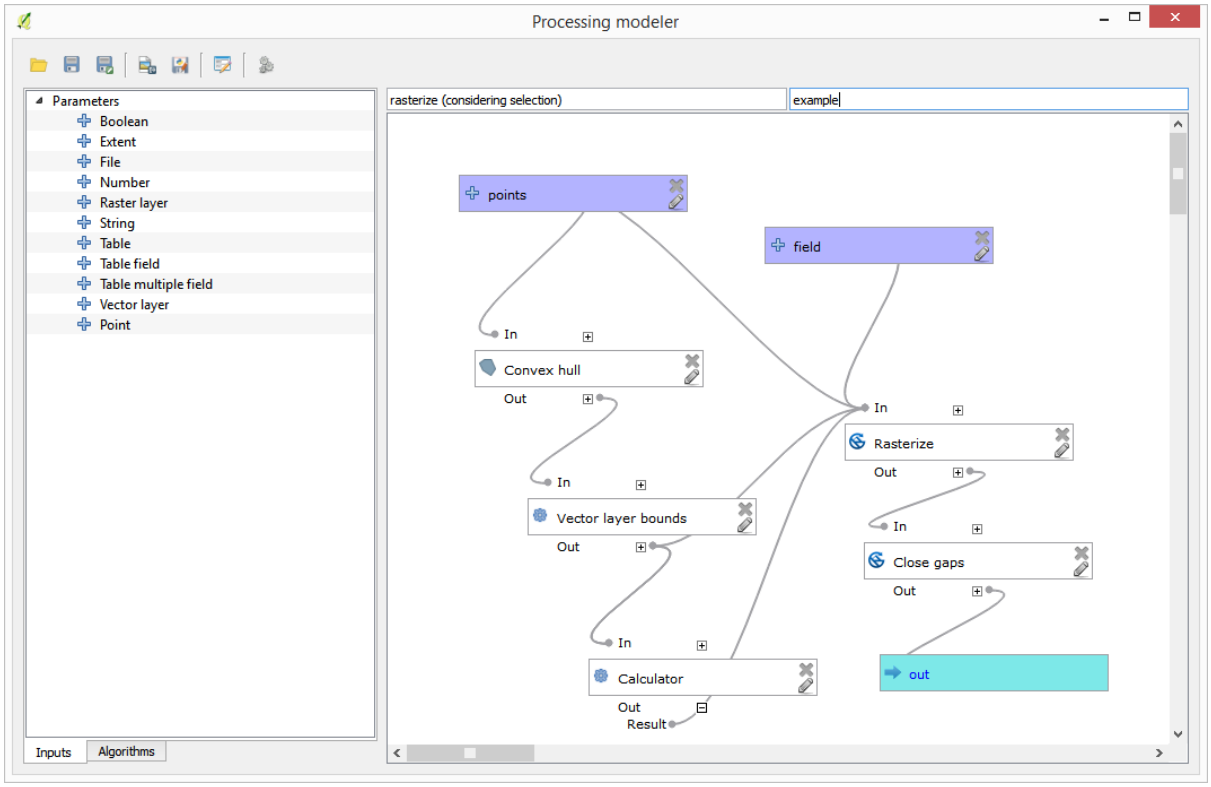
Here's an improvement to the algorithm. We have used a harcoded value for the cellsize when rasterizing. This value is fine for our test input layer, but might not be for other cases. We could add a new parameter, so the user enters the desired value, but a much better approach would be to have that value automatically computed.

We can use the modeler-only calculator, and compute that value from the extent coordinates. For instance, to create a layer with a fixed width of 100 pixels, we can use the following formula in the calculator.



Now we have to edit the rasterize algorithm, so it uses the output of the calculator instead of the hardcoded value.

The final algorithm should look like this:



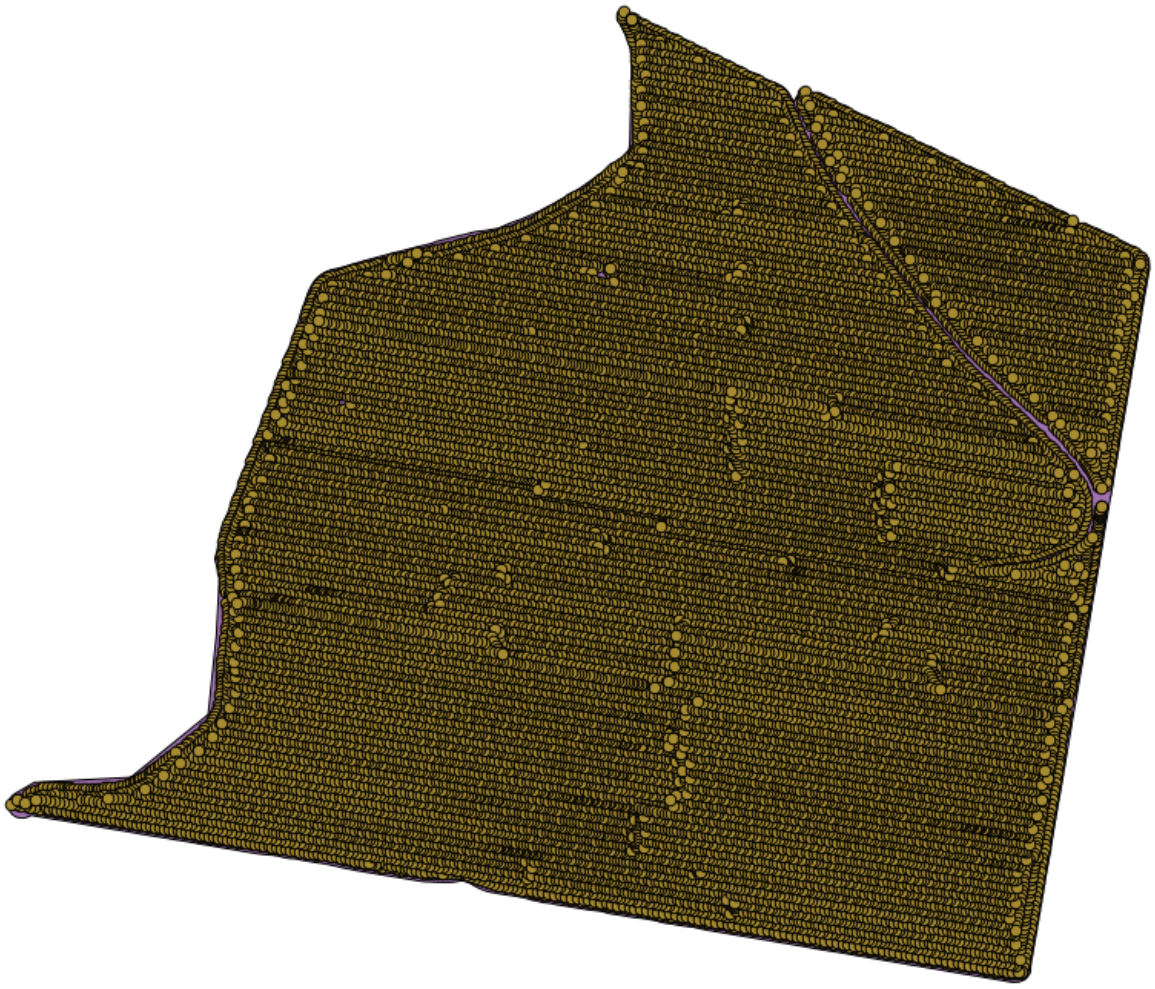
17.22 Interpolarea

Notă

Acest capitol prezintă cum se pot interpola datele punctuale, și vi se arată un alt exemplu real de efectuare de analize spațiale

În această lecție, vom interpola datele punctelor pentru a obține un strat raster. Înainte de a face aceasta, va trebui să realizăm o anumită pregătire a datelor, iar după interpolare vom efectua o procesare suplimentară, pentru a modifica stratul rezultat, obținând în acest fel o rutină de analiză completă.

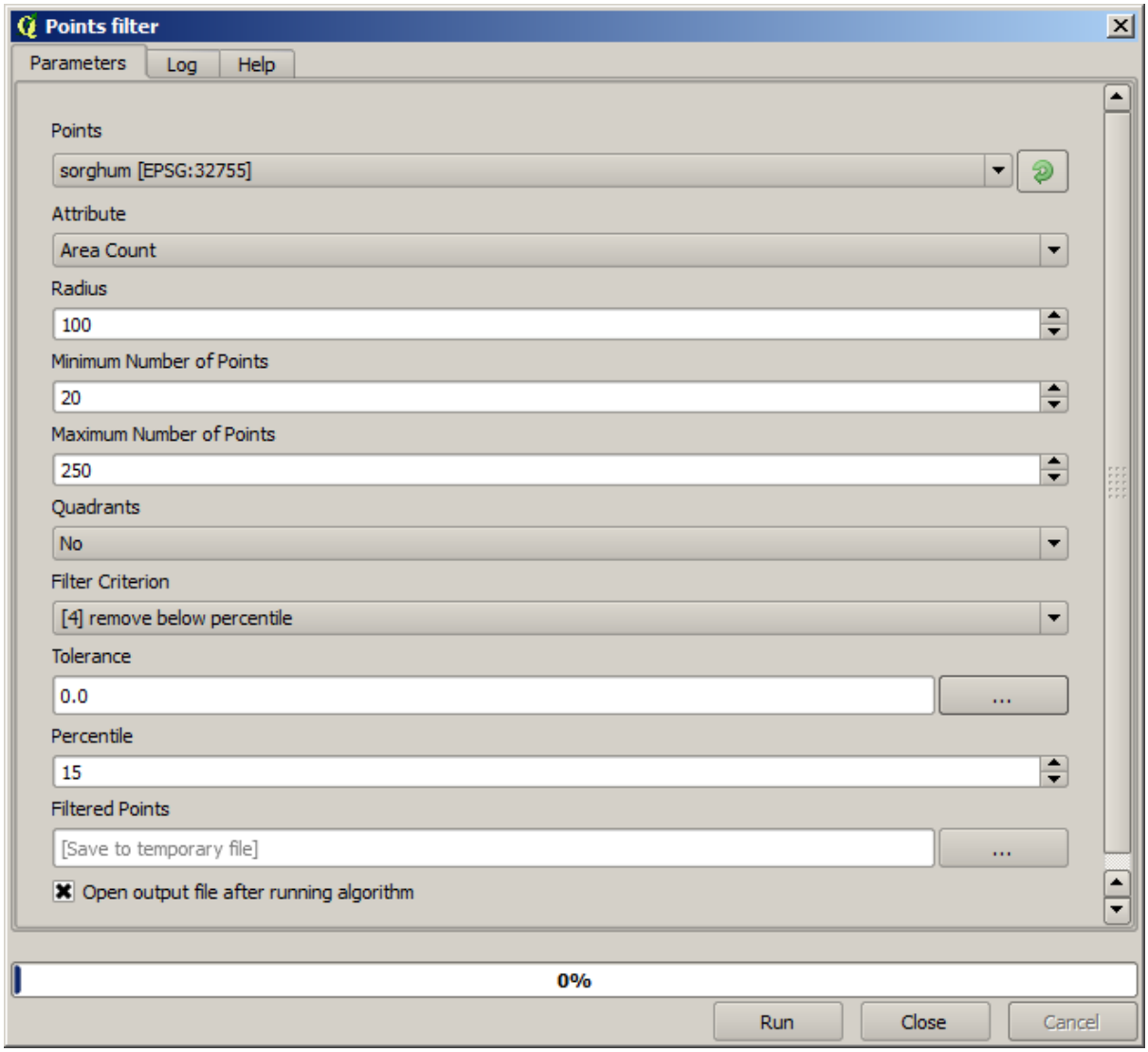
Deschideți datele exemplu pentru această lecție, care ar trebui să arate astfel.



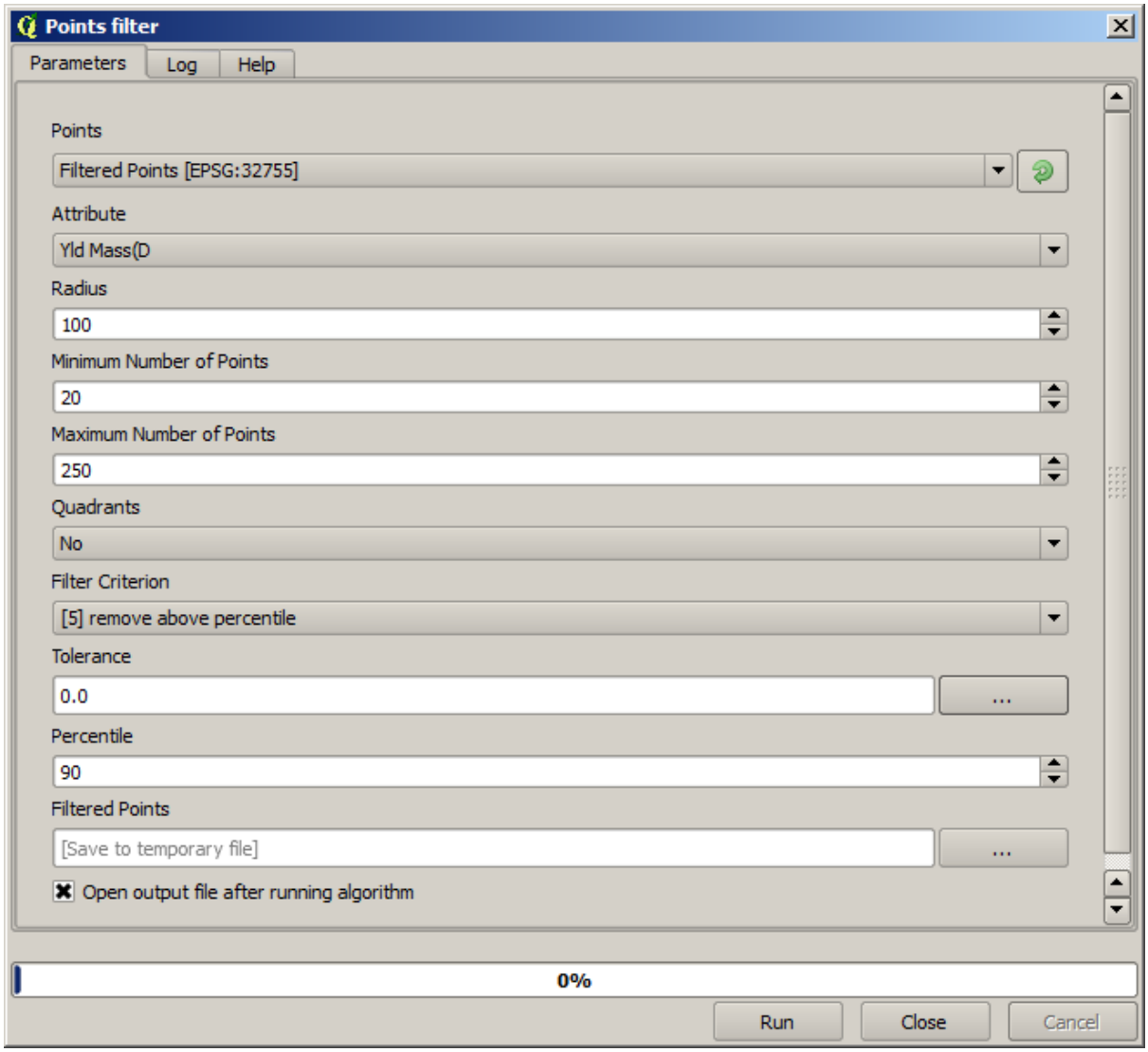
The data correspond to crop yield data, as produced by a modern harvester, and we will use it to get a raster layer of crop yield. We do not plan to do any further analysis with that layer, but just to use it as a background layer for easily identifying the most productive areas and also those where productivity can be improved.

The first thing to do is to clean–up the layer, since it contains redundant points. These are caused by the movement of the harvester, in places where it has to do a turn or it changes its speed for some reason. The *Points filter* algorithm will be useful for this. We will use it twice, to remove points that can be considered outliers both in the upper and lower part of the distribution.

Pentru prima execuție, folosiți următoarele valori ale parametrilor.



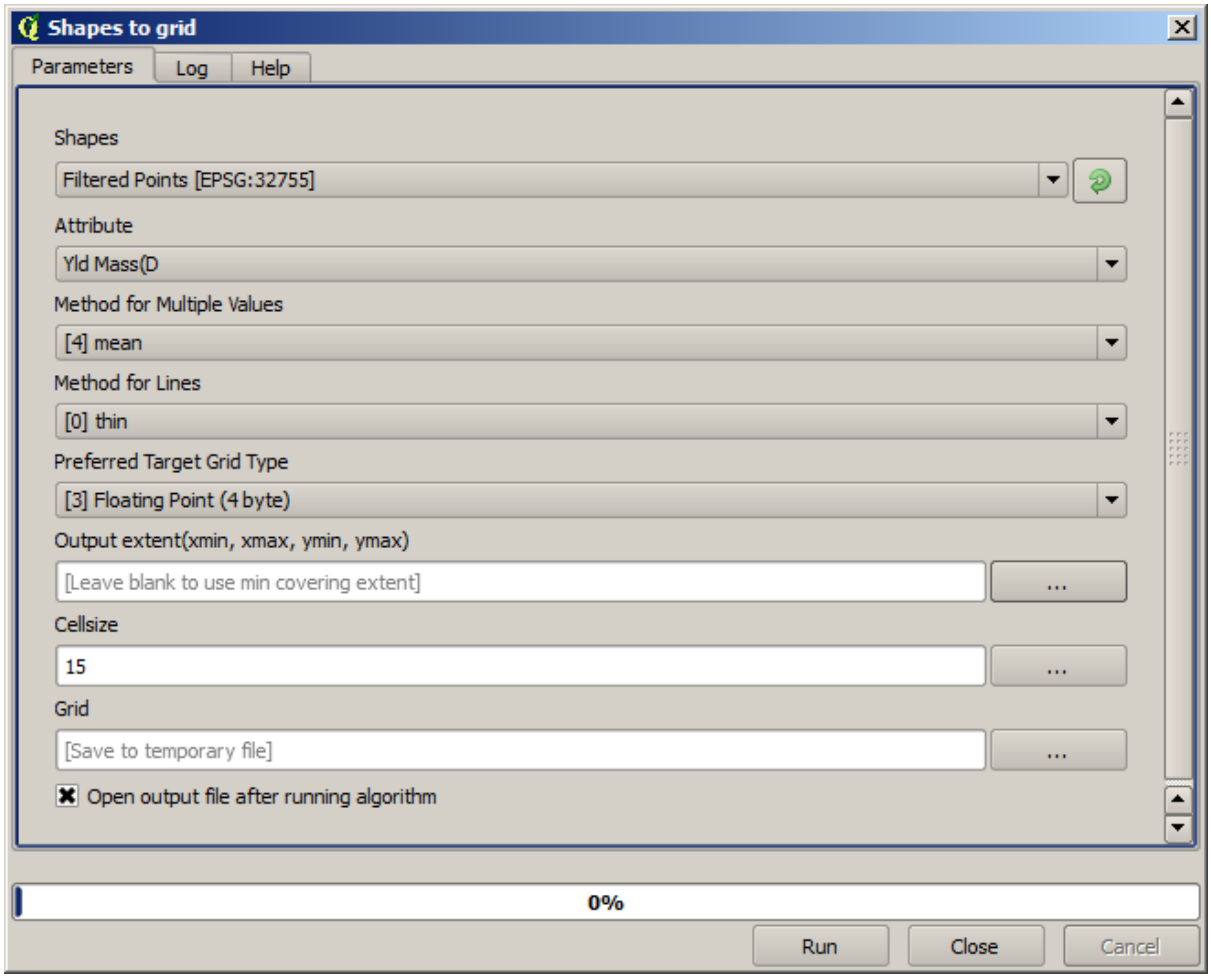
Pentru următoarea execuție, folosiți configurația prezentată mai jos.



Observați că nu utilizăm stratul original ca intrare, ci rezultatul execuției anterioare în loc.

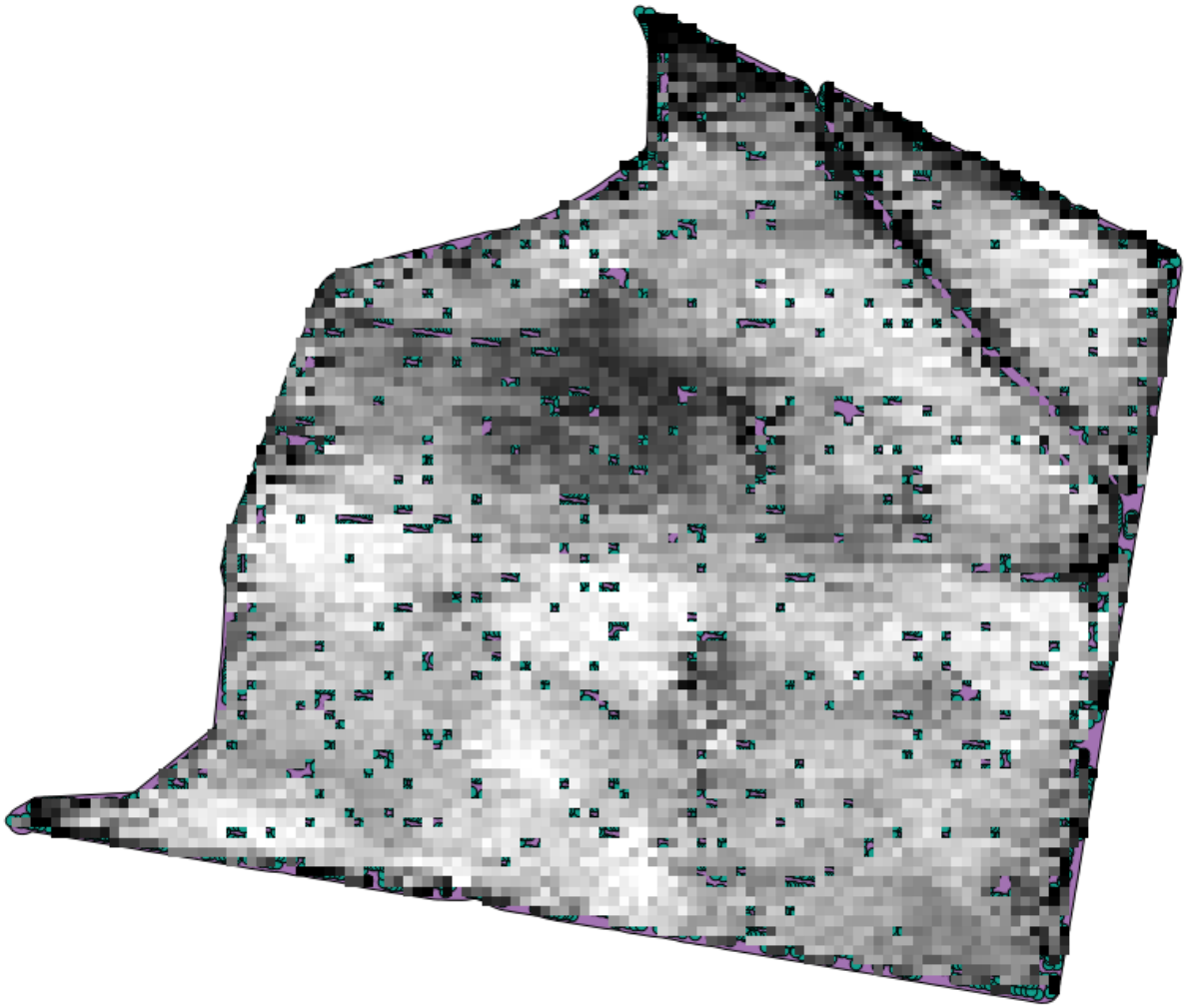
Stratul de filtrare final, cu un set redus de puncte, ar trebui să arate similar cu cel original, dar conține un număr mai mic de puncte. Puteți verifica acest lucru, prin compararea tabelelor de atribute.

Now let's rasterize the layer using the *Rasterize* algorithm.

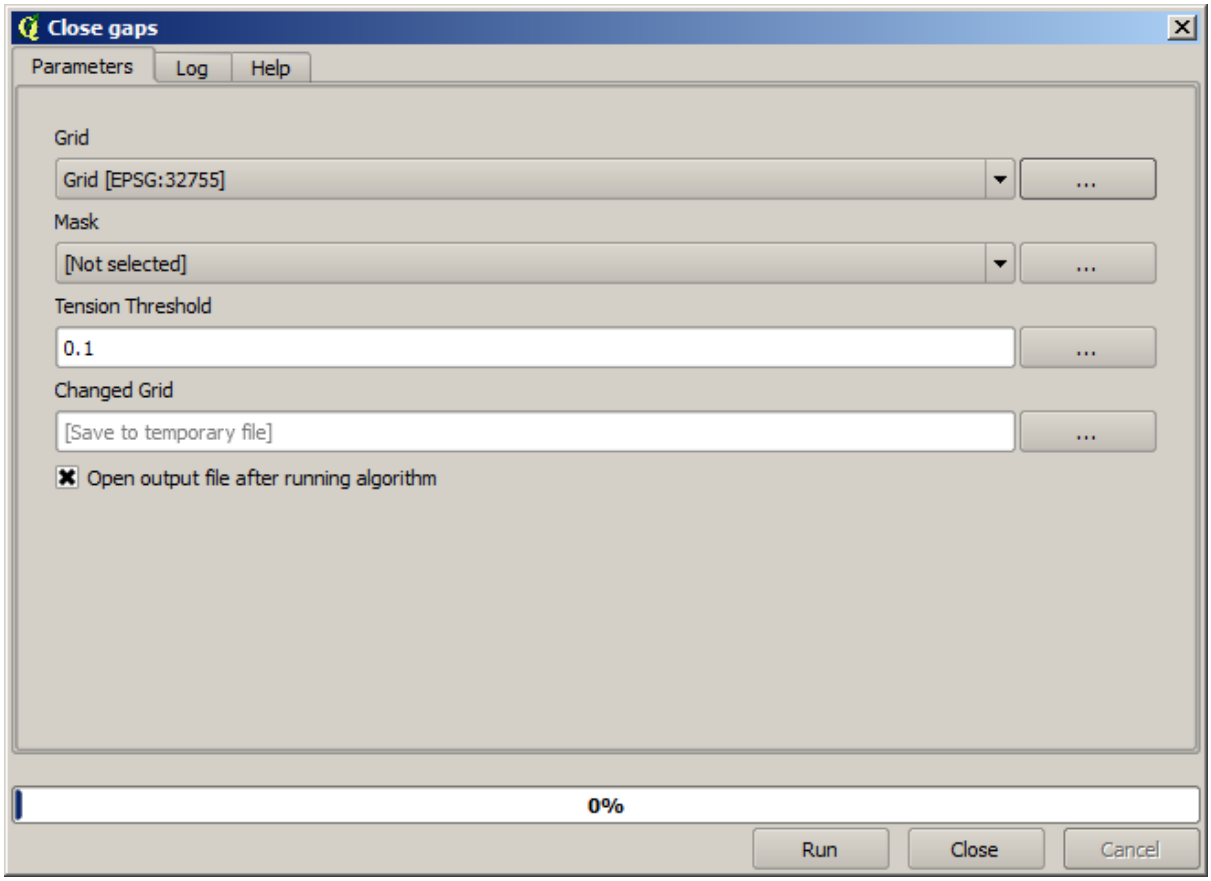


The `Filtered points` layer refers to the resulting one of the second filter. It has the same name as the one produced by the first filter, since the name is assigned by the algorithm, but you should not use the first one. Since we will not be using it for anything else, you can safely remove it from your project to avoid confusion, and leave just the last filtered layer.

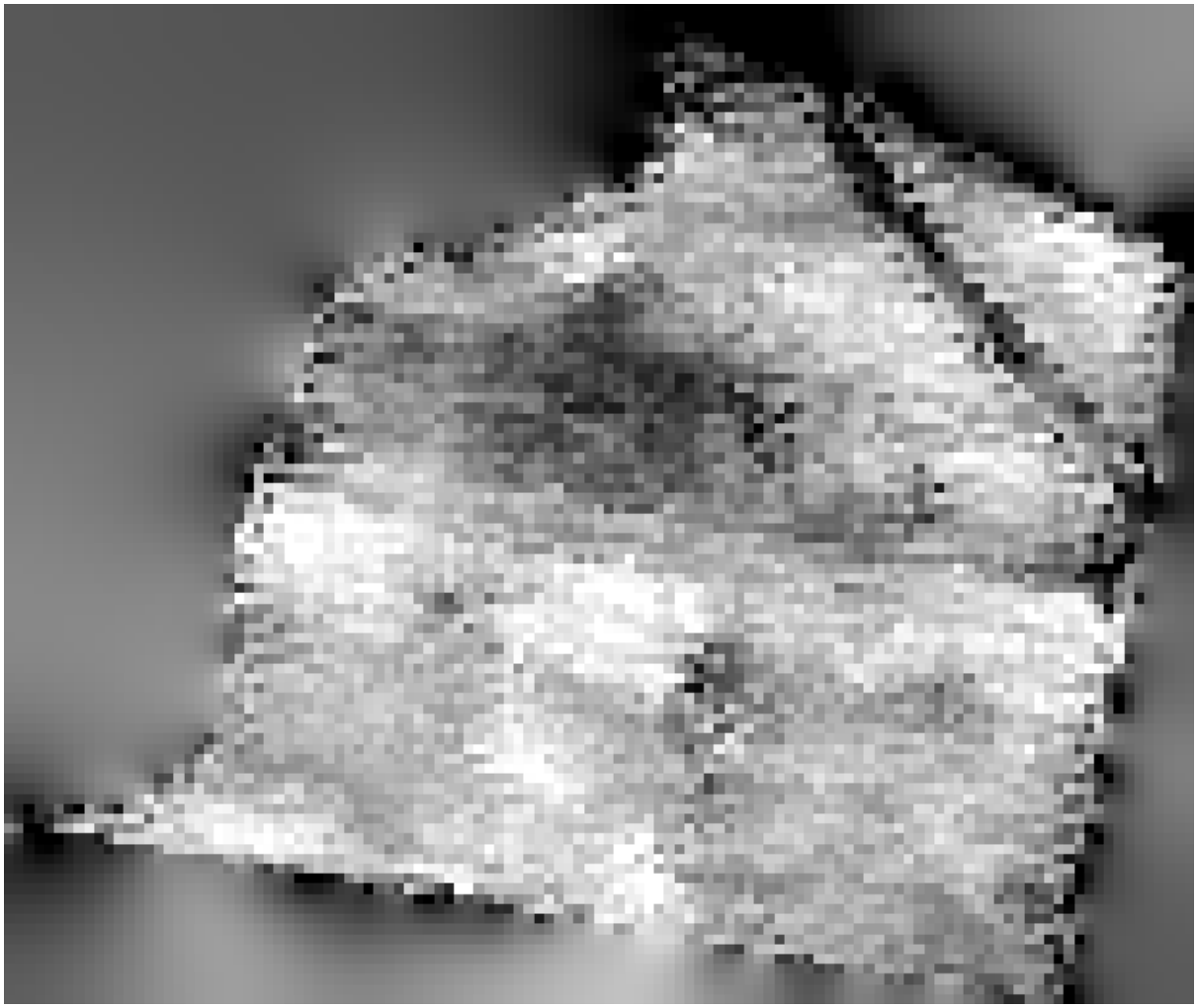
Rezultatul raster arată în felul următor.



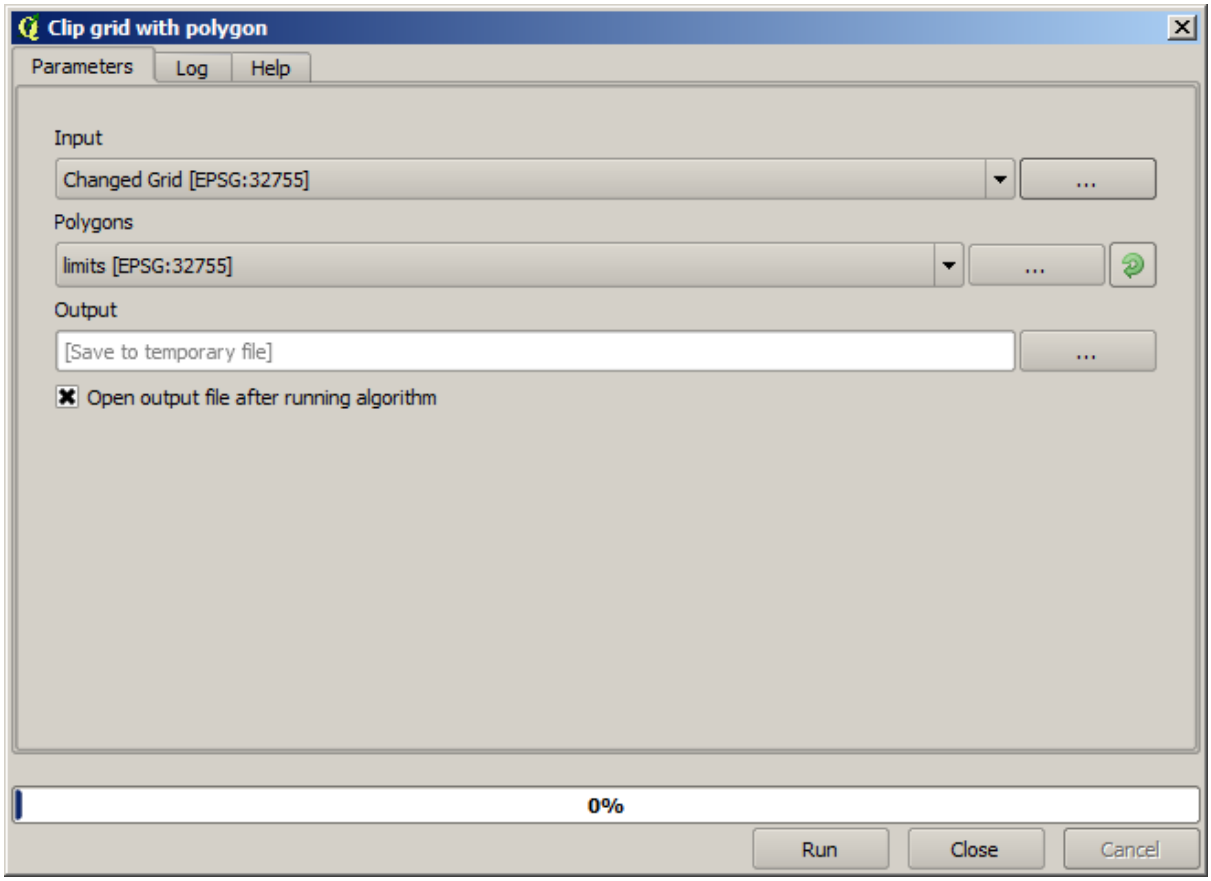
It is already a raster layer, but it is missing data in some of its cells. It only contain valid values in those cells that contained a point from the vector layer that we have just rasterized, and a no–data value in all the other ones. To fill the missing values, we can use the *Close gaps* algorithm.



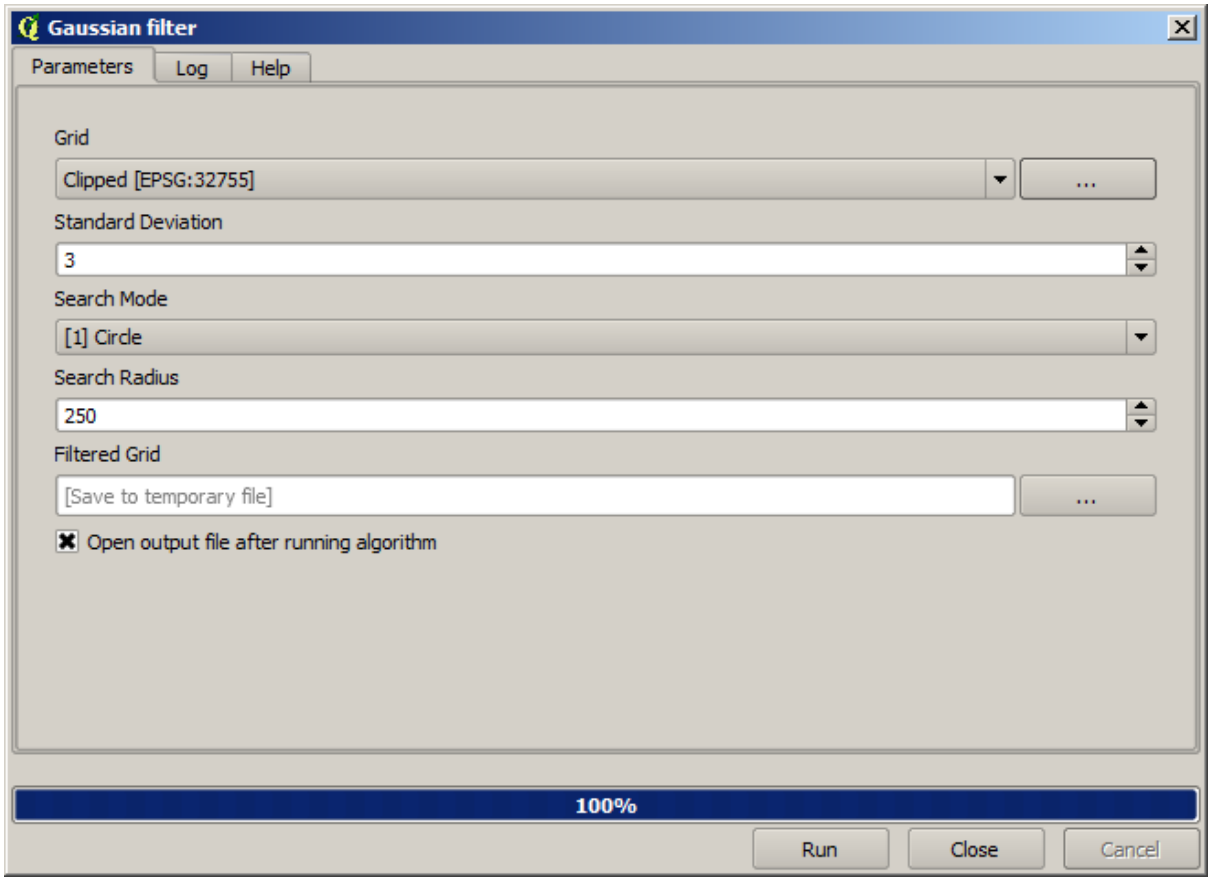
Stratul din care lipsesc valorile fără–date arată în felul următor.



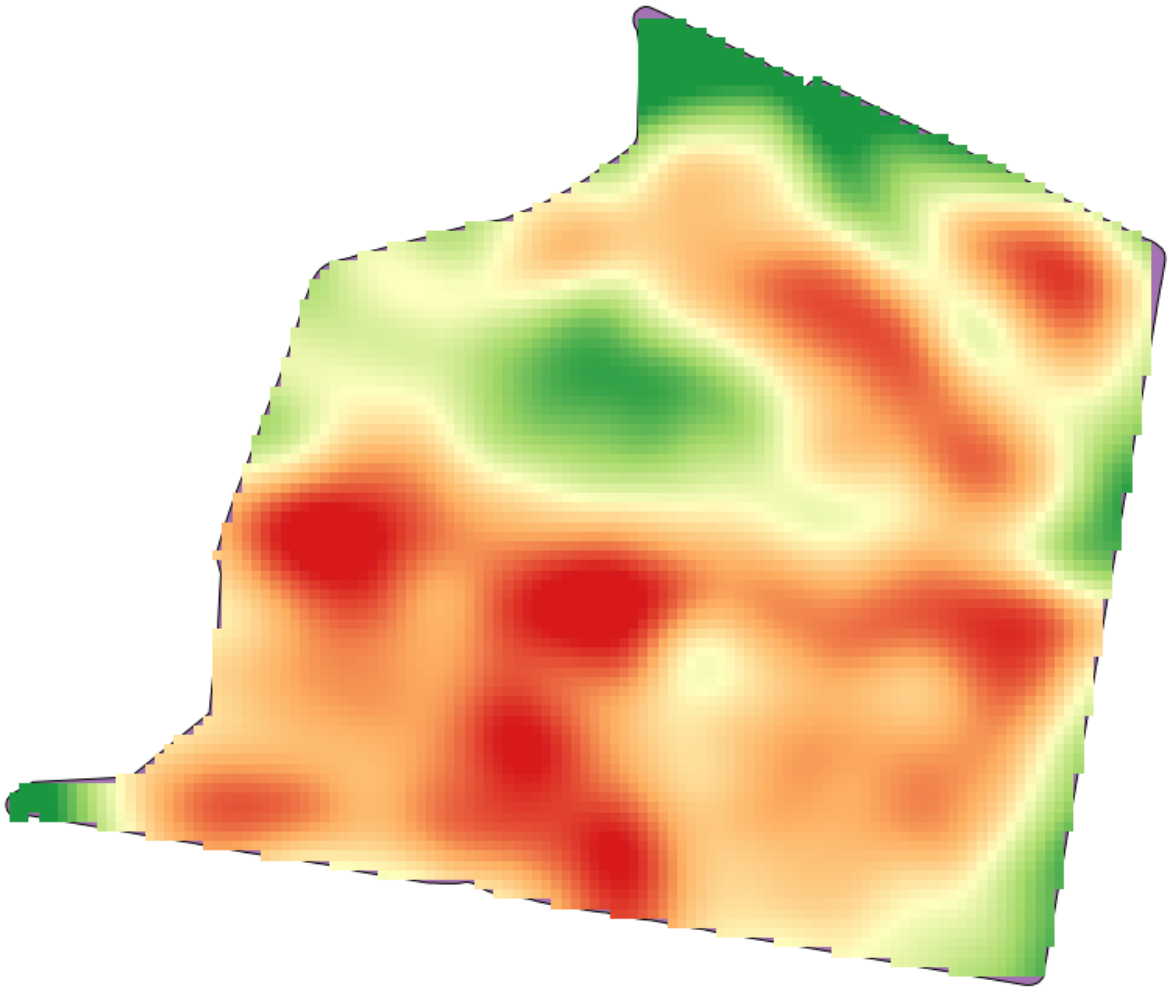
To restrict the area covered by the data to just the region where crop yield was measured, we can clip the raster layer with the provided limits layer.



And for a smoother result (less accurate but better for rendering in the background as a support layer), we can apply a *Gaussian filter* to the layer.



Cu parametrii de mai sus, veți primi următorul rezultat



17.23 Mai multe despre interpolare

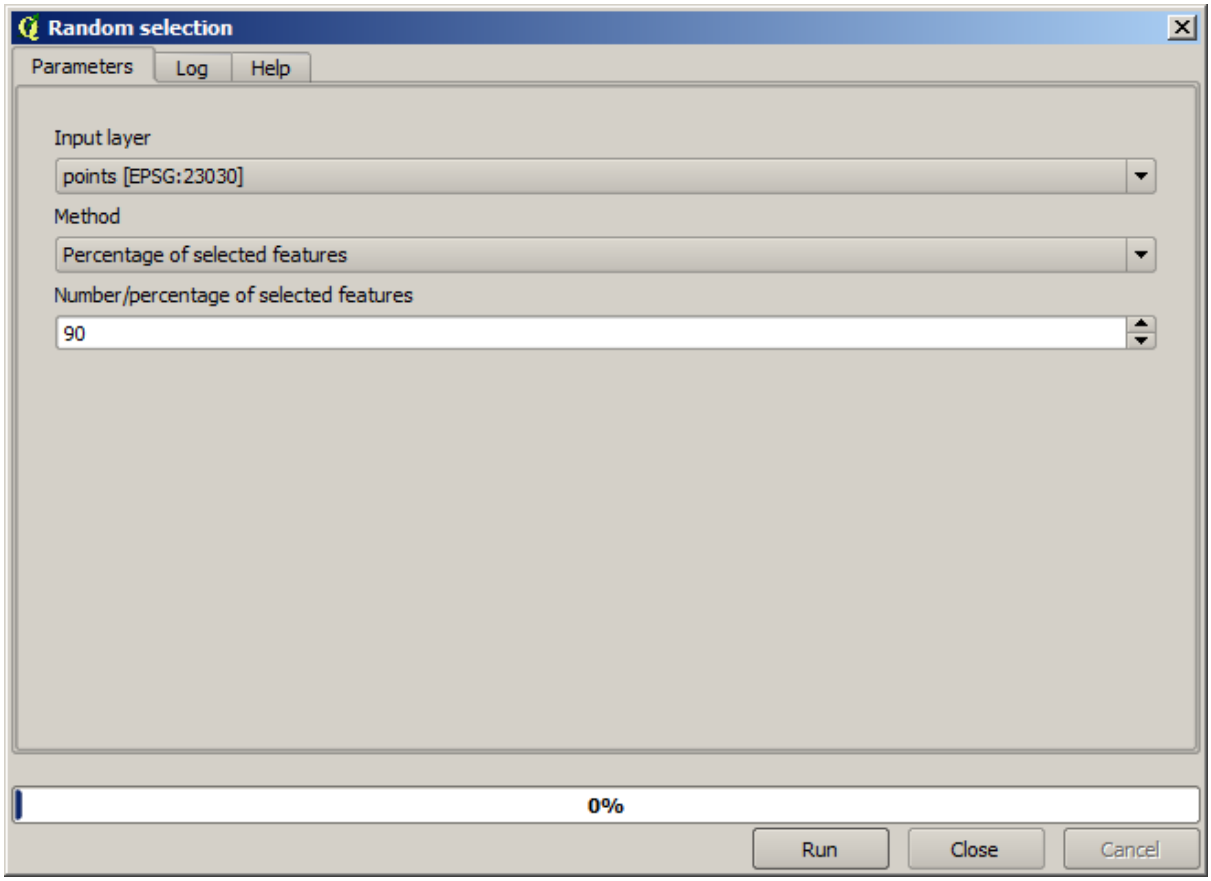
Notă

Acest capitol prezintă alte cazuri practice de folosire a algoritmilor de interpolare.

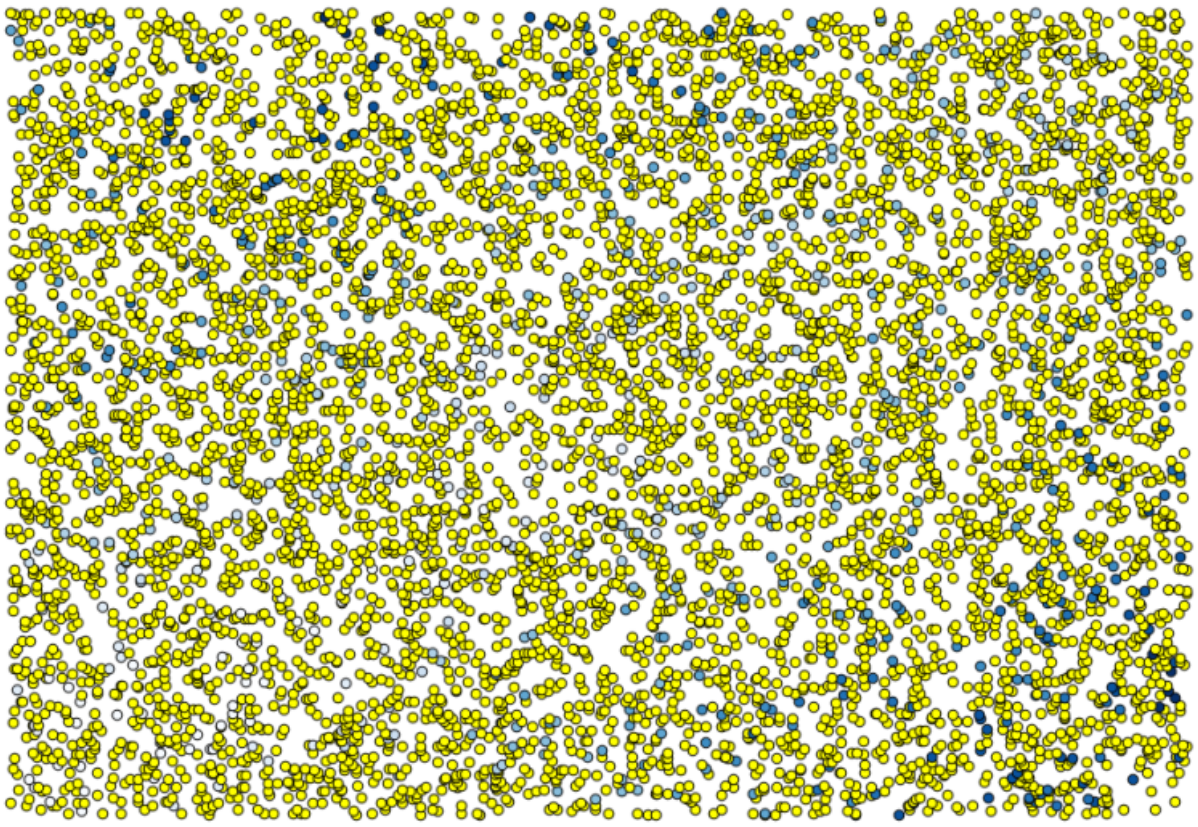
Interpolarea este o tehnică obișnuită, acesta putând fi folosită pentru a demonstra mai multe tehnici care pot fi aplicate cu ajutorul cadrului de lucru Processing din QGIS. Această lecție utilizează unii algoritmi de interpolare care au fost deja prezentați, dar care utilizează o abordare diferită.

Datele pentru această lecție conțin, de asemenea, un strat de puncte, în acest caz, cu date de elevație. În general, îl vom interpola în același mod ca și în lecția anterioară, însă, de data aceasta, vom salva o parte din datele originale, pe care o vom utiliza în evaluarea calității procesului de interpolare.

First, we have to rasterize the points layer and fill the resulting no–data cells, but using just a fraction of the points in the layer. We will save 10% of the points for a later check, so we need to have 90% of the points ready for the interpolation. To do so, we could use the *Split shapes layer randomly* algorithm, which we have already used in a previous lesson, but there is a better way to do that, without having to create any new intermediate layer. Instead of that, we can just select the points we want to use for the interpolation (the 90% fraction), and then run the algorithm. As we have already seen, the rasterizing algorithm will use only those selected points and ignore the rest. The selection can be done using the *Random selection* algorithm. Run it with the following parameters.

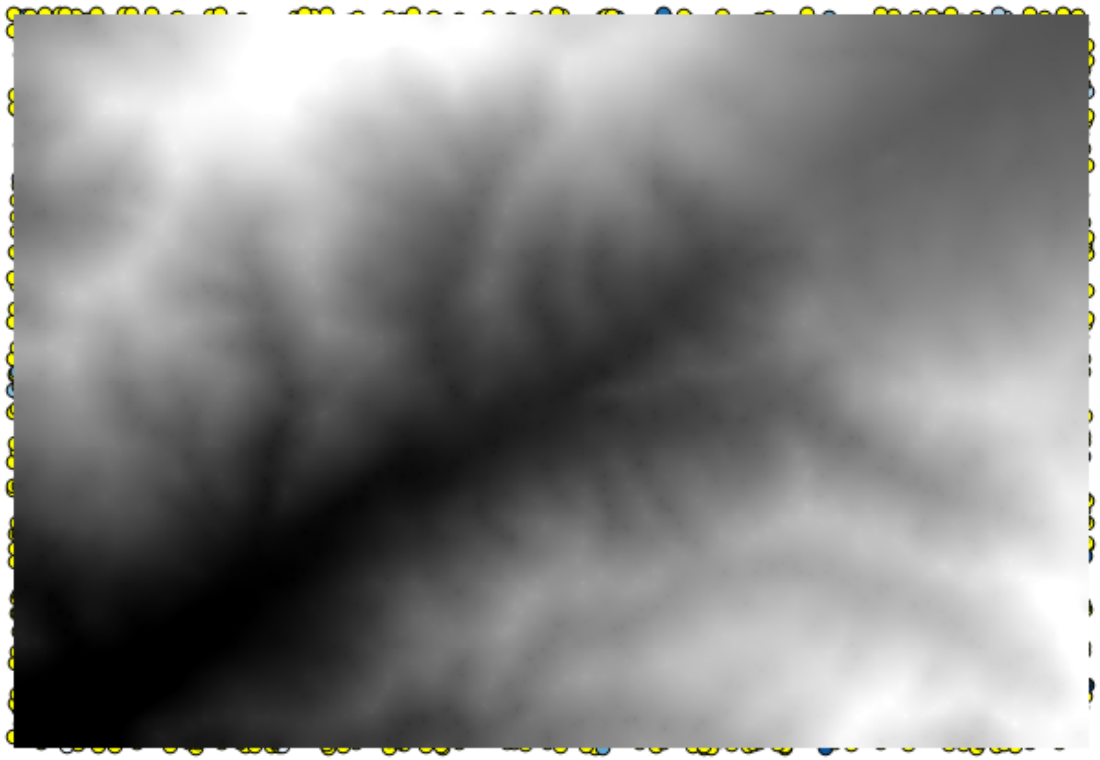


Se vor selecta 90% dintre punctele din stratul de rasterizat



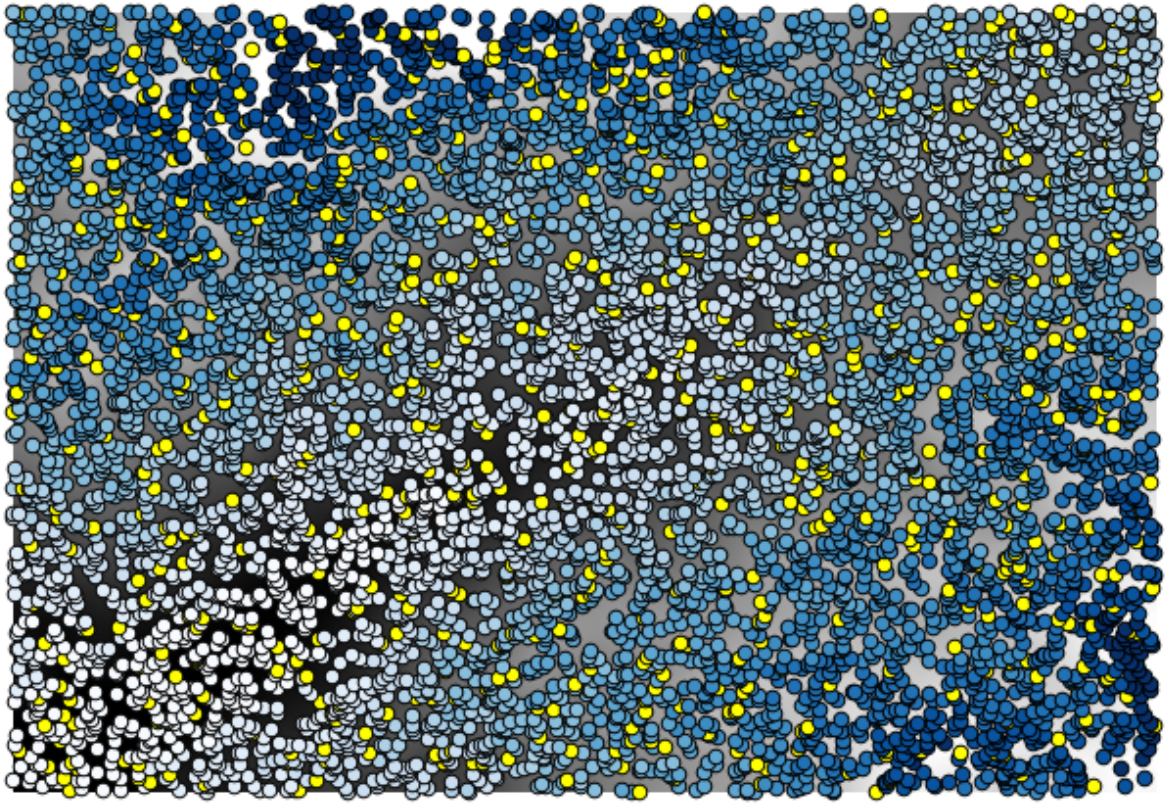
Selecția este aleatoare, astfel încât selecția dvs. ar putea diferi de selecția arătată în imaginea de mai sus.

Now run the *Rasterize* algorithm to get the first raster layer, and then run the *Close gaps* algorithm to fill the no-data cells [Cell resolution: 100 m].

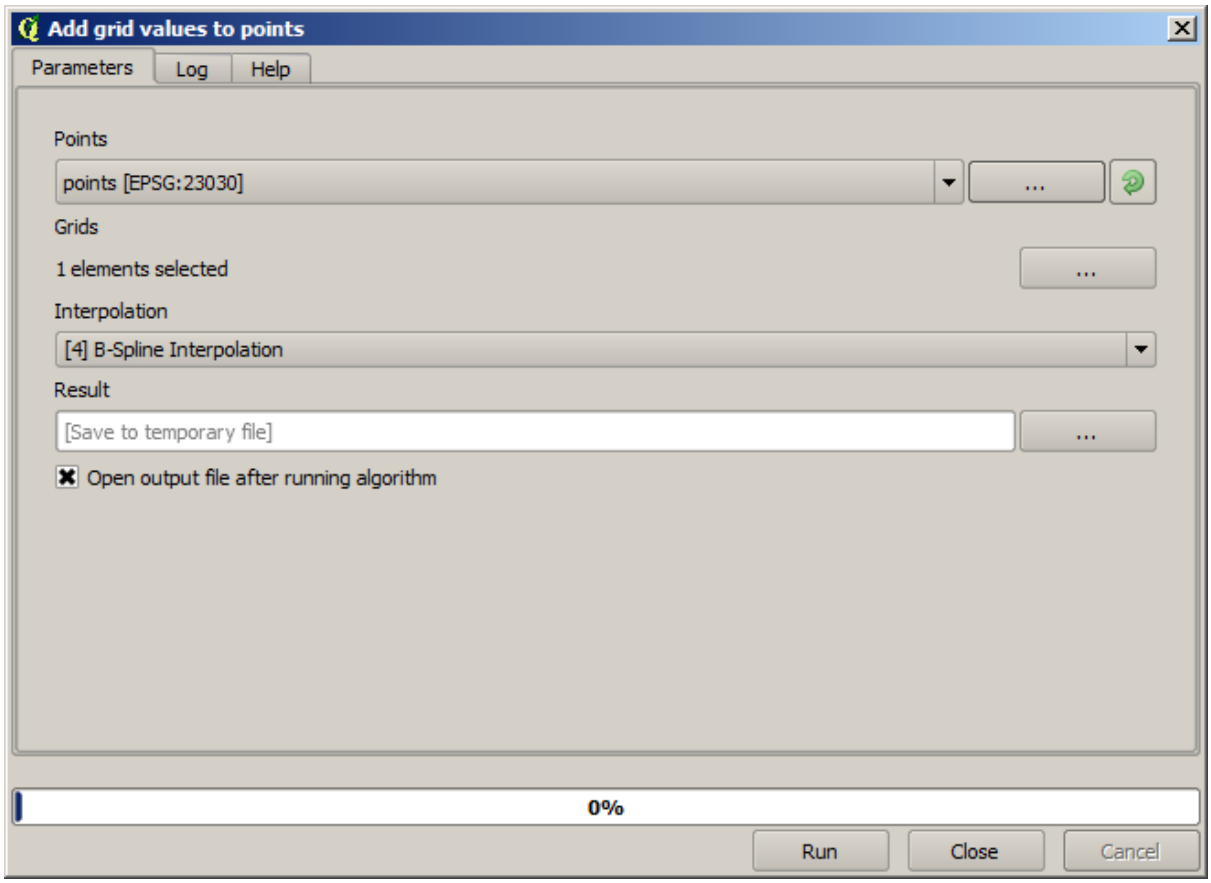


To check the quality of the interpolation, we can now use the points that are not selected. At this point, we know the real elevation (the value in the points layer) and the interpolated elevation (the value in the interpolated raster layer). We can compare the two by computing the differences between those values.

Din moment ce vom folosi punctele care nu sunt selectate, în primul rând, haideți să inversăm selecția.

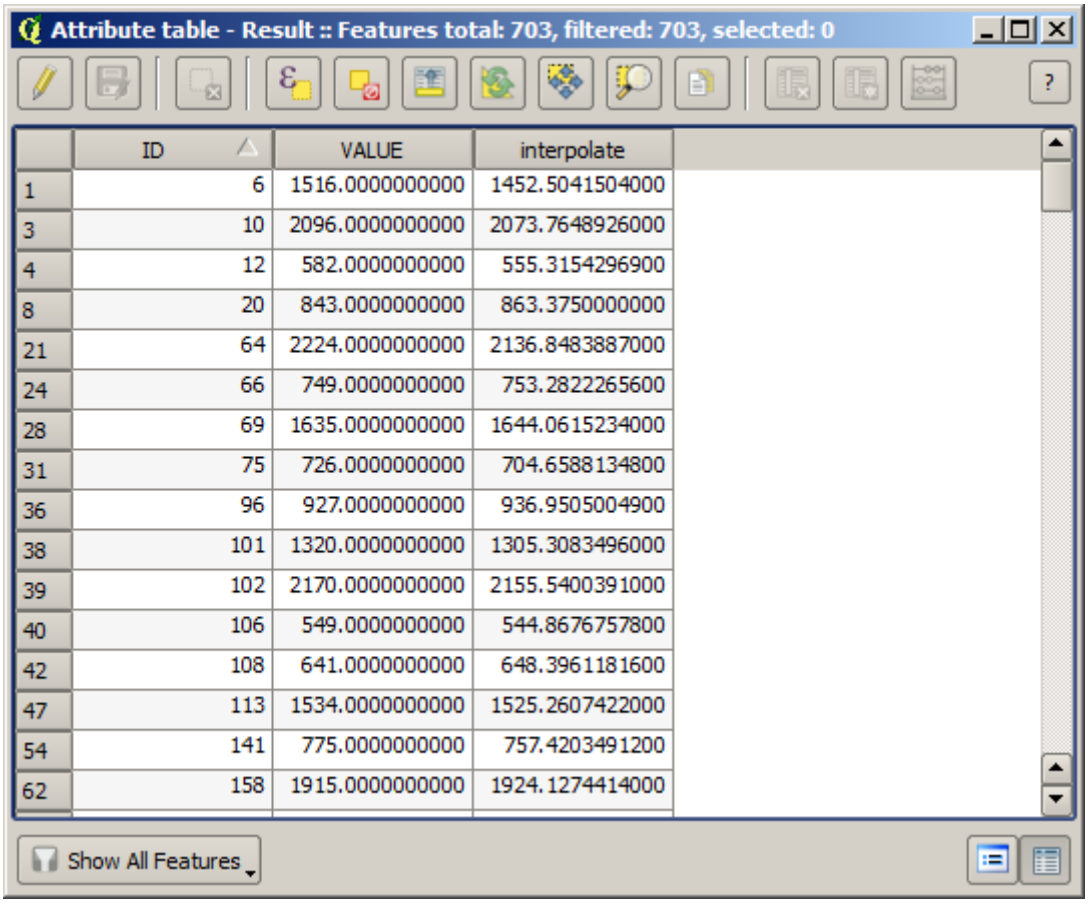


The points contain the original values, but not the interpolated ones. To add them in a new field, we can use the *Add raster values to points* algorithm



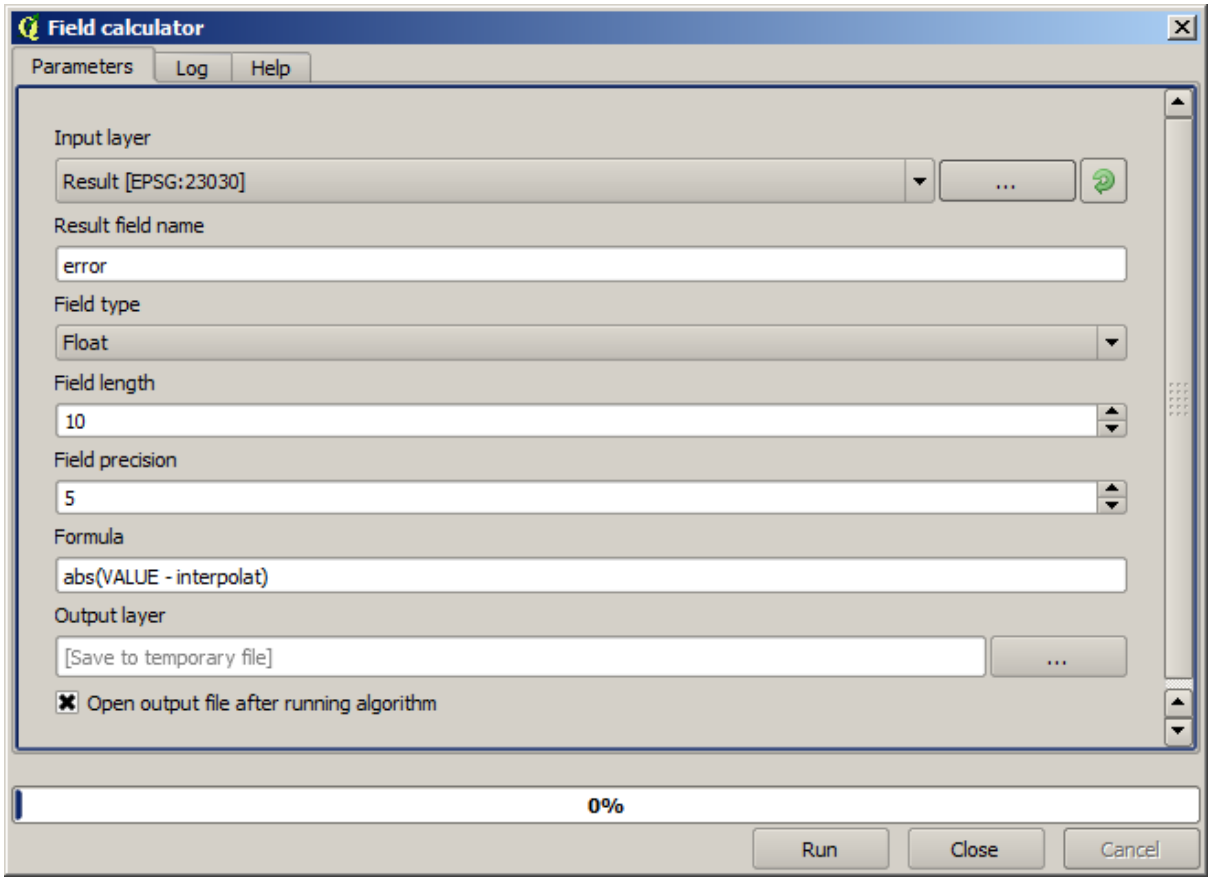
The raster layer to select (the algorithm supports multiple raster, but we just need one) is the resulting one from the interpolation. We have renamed it to `interpolate` and that layer name is the one that will be used for the name of the field to add.

Acum avem un strat vectorial care conține ambele valori, cu punctele care nu au fost utilizate pentru interpolare.



	ID	VALUE	interpolate
1	6	1516.0000000000	1452.5041504000
3	10	2096.0000000000	2073.7648926000
4	12	582.0000000000	555.3154296900
8	20	843.0000000000	863.3750000000
21	64	2224.0000000000	2136.8483887000
24	66	749.0000000000	753.2822265600
28	69	1635.0000000000	1644.0615234000
31	75	726.0000000000	704.6588134800
36	96	927.0000000000	936.9505004900
38	101	1320.0000000000	1305.3083496000
39	102	2170.0000000000	2155.5400391000
40	106	549.0000000000	544.8676757800
42	108	641.0000000000	648.3961181600
47	113	1534.0000000000	1525.2607422000
54	141	775.0000000000	757.4203491200
62	158	1915.0000000000	1924.1274414000

Now, we will use the fields calculator for this task. Open the *Field calculator* algorithm and run it with the following parameters.



If your field with the values from the raster layer has a different name, you should modify the above formula accordingly. Running this algorithm, you will get a new layer with just the points that we haven't used for the interpolation, each of them containing the difference between the two elevation values.

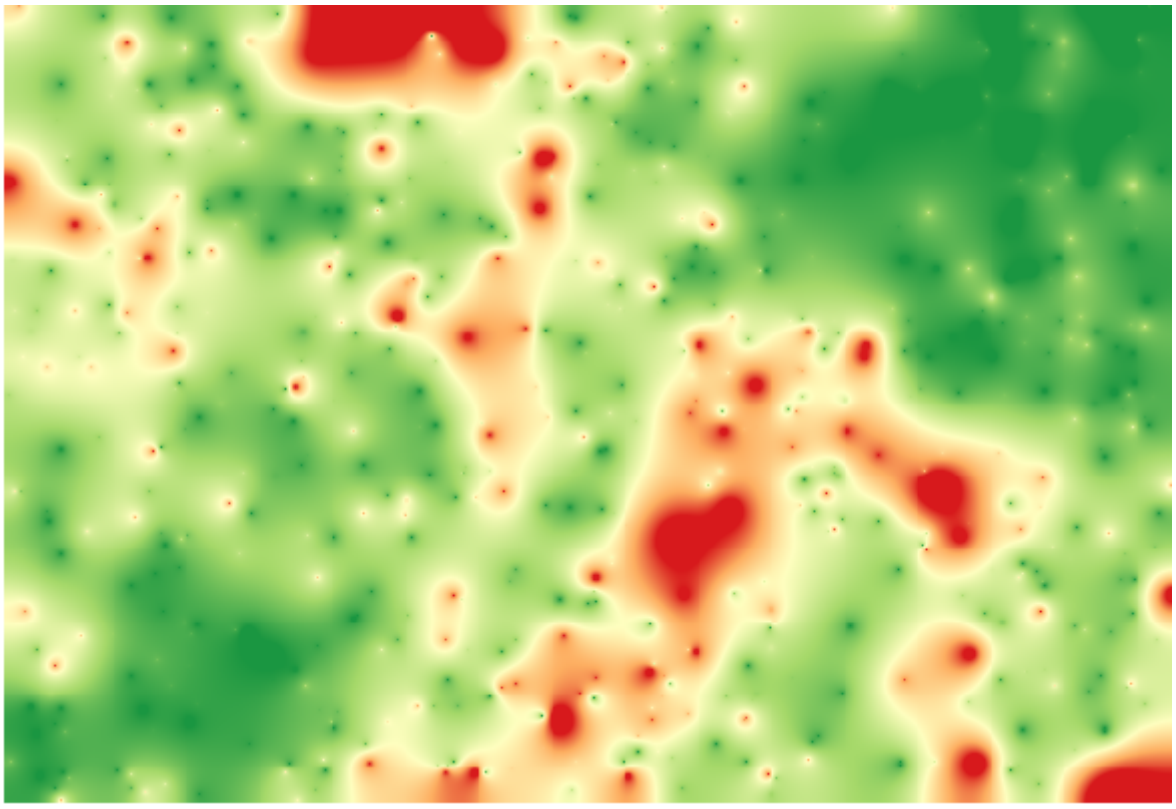
Reprezentând stratul în conformitate cu acea valoare, vom avea o primă idee despre locația celor mai mari discrepanțe.

Attribute table - Output layer :: Features total: 703, filtered: 703, selected: 0

	ID	VALUE	interpolat	error
0	4107	1243.0000000000	1199.6501465000	43.34985
1	6	1516.0000000000	1452.5041504000	63.49585
2	4112	1594.0000000000	1590.4835205000	3.51648
3	10	2096.0000000000	2073.7648926000	22.23511
4	12	582.0000000000	555.3154296900	26.68457
5	4121	1101.0000000000	1103.0323486000	2.03235
6	6176	1258.0000000000	1260.9846191000	2.98462
7	4125	1241.0000000000	1225.0878906000	15.91211
8	20	843.0000000000	863.3750000000	20.37500
9	6179	1195.0000000000	1198.4991455000	3.49915
10	2075	1786.0000000000	1799.5468750000	13.54688
11	4133	1196.0000000000	1156.2314453000	39.76855
12	6188	1720.0000000000	1724.4638672000	4.46387
13	6189	1497.0000000000	1498.2706299000	1.27063
14	6191	1349.0000000000	1347.5555420000	1.44446
15	2086	1277.0000000000	1296.1885986000	19.18860

Show All Features

Interpolând acel strat veți obține un strat raster cu eroarea estimată în toate punctele din zona interpolată.



You can also get the same information (difference between original point values and interpolated ones) directly with *GRASS ► v.sample*.

Your results might differ from these ones, since there is a random component introduced when running the random selection, at the beginning of this lesson.

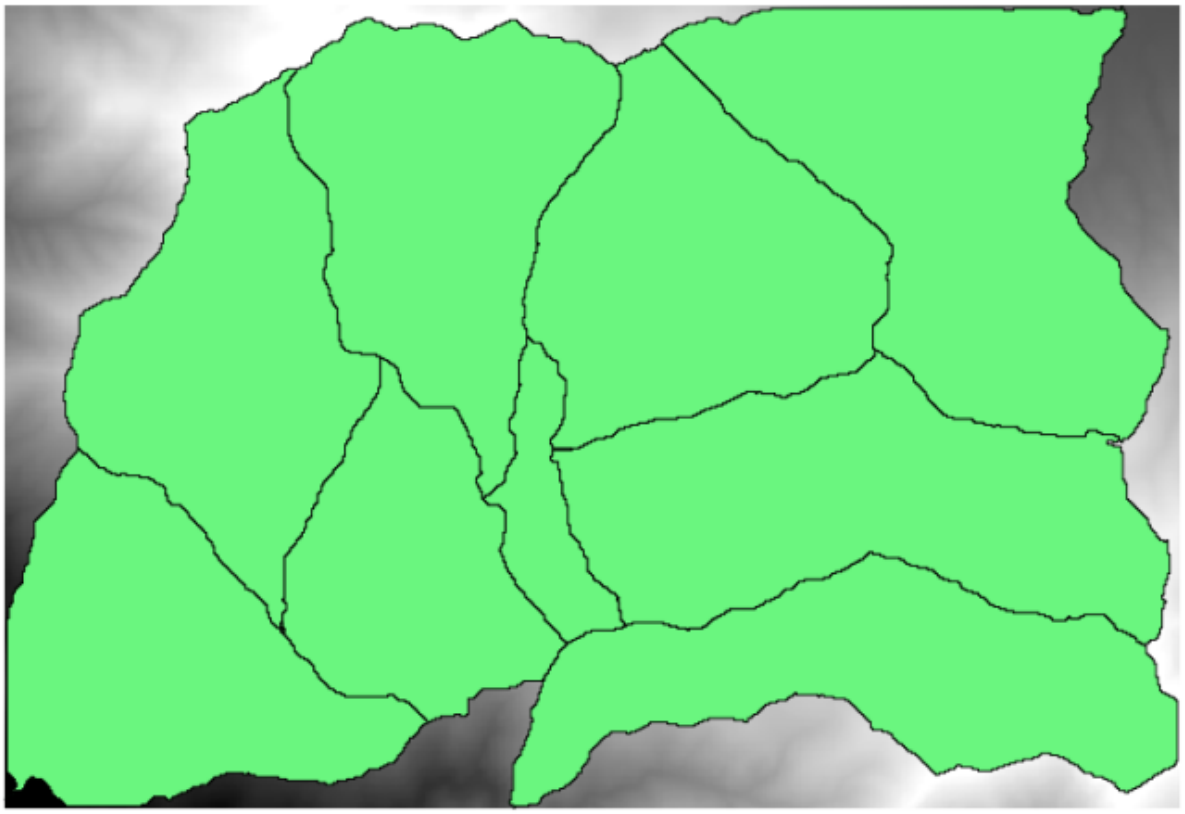
17.24 Execuția iterativă a algoritmilor

Notă

Această lecție prezintă un mod diferit de a executa algoritmii care folosesc straturi vectoriale, prin rularea lor în mod repetat, iterând entitățile dintr-un strat vectorial de intrare

We already know the model designer, which is one way of automating processing tasks. However, in some situations, the modeler might not be what we need to automate a given task. Let's see one of those situations and how to easily solve it using a different functionality: the iterative execution of algorithms.

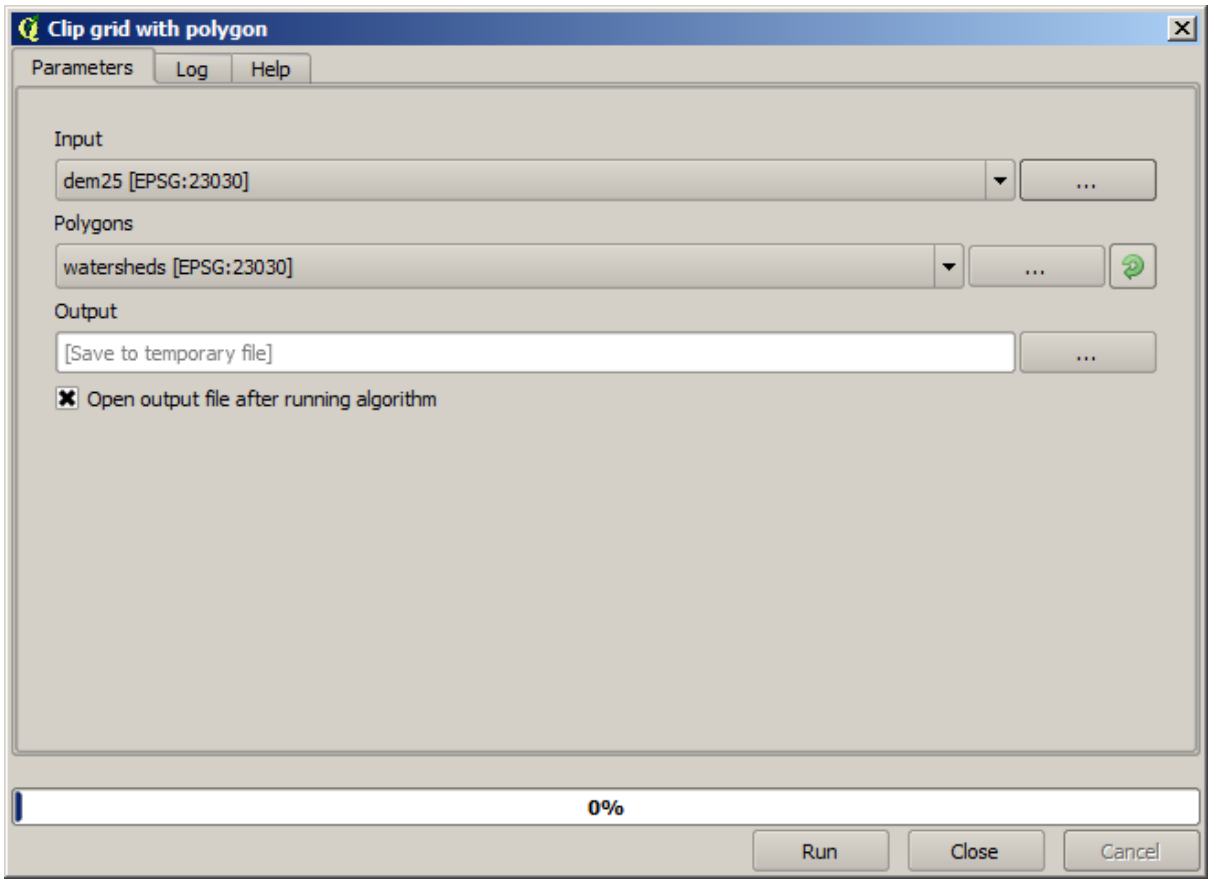
Deschideți datele corespunzătoare acestui capitol. Acesta ar trebui să arate astfel.



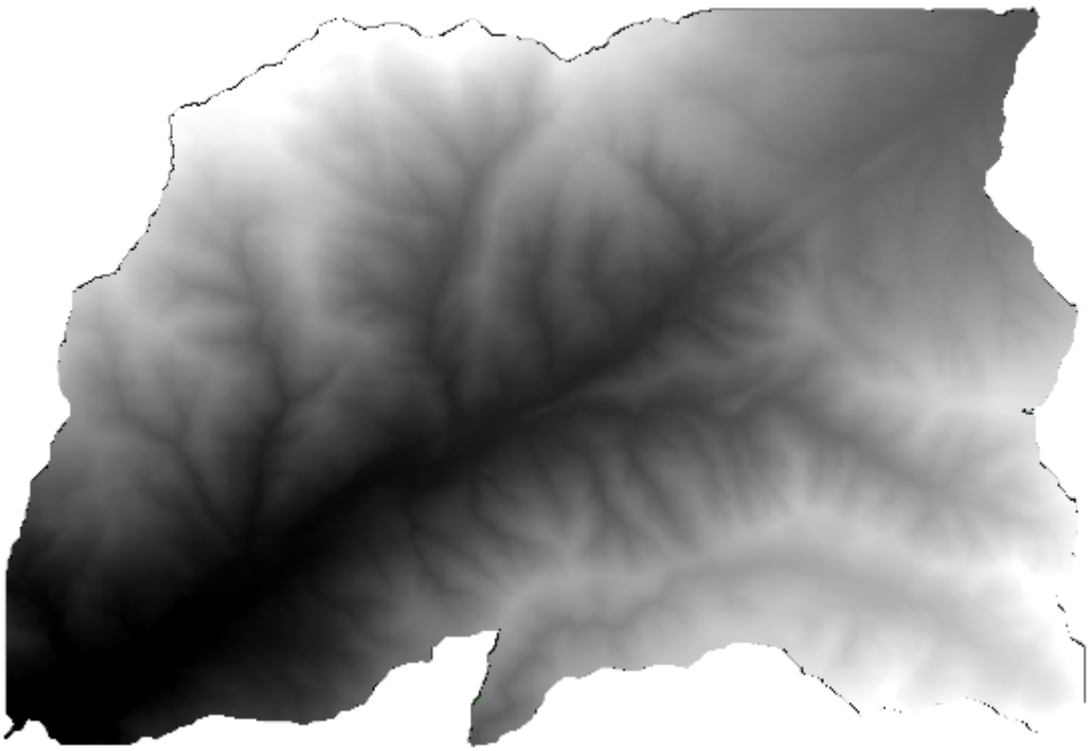
Veți recunoaște DEM-ul nostru bine-cunoscut din capitolele anterioare, și un set de bazine hidrografice extrase din el. Imaginați-vă că trebuie să reducem DEM-ul în mai multe straturi mici, fiecare dintre ele conținând doar datele de elevație corespunzătoare unui singur bazin hidrografic. Acest lucru va fi util dacă doriți mai târziu să calculați unii parametri ce țin de fiecare bazine hidrografice, cum ar fi cota de elevație sau curba hipsographică.

Acest lucru reprezintă o sarcină lungă durată și plictisitoare, mai ales în cazul în care numărul bazinelor hidrografice este mare. Cu toate acestea, este o sarcină care poate fi ușor automatizată, așa cum vom vedea.

The algorithm to use for clipping a raster layer with a polygon layer is called *Clip raster with polygons*, and has the following parameters dialog.

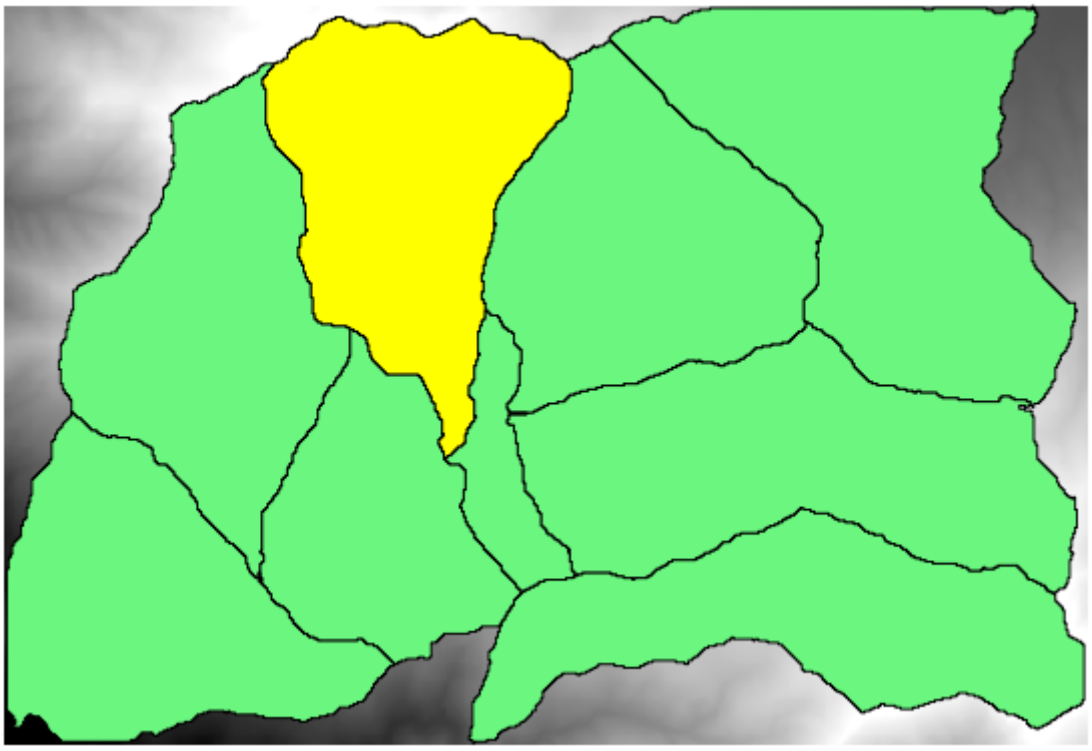


Puteți să-l executați folosind stratul bazinelor hidrografice și DEM-ul ca intrare, apoi veți obține următorul rezultat.

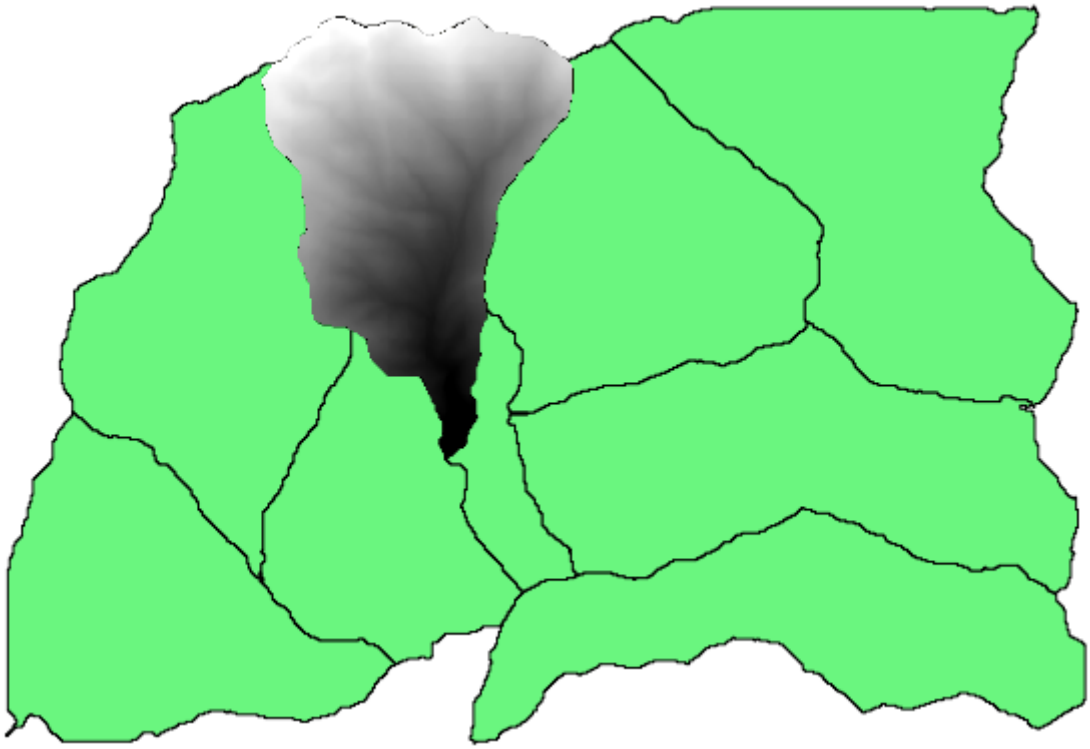


După cum puteți vedea, se utilizează aria acoperită de toate poligoanele bazinelor hidrografice.

Puteți decupa DEM-ul după un singur bazin hidrografic, prin selectarea bazinului dorit, și apoi prin rularea algoritmului așa cum am făcut-o mai înainte.

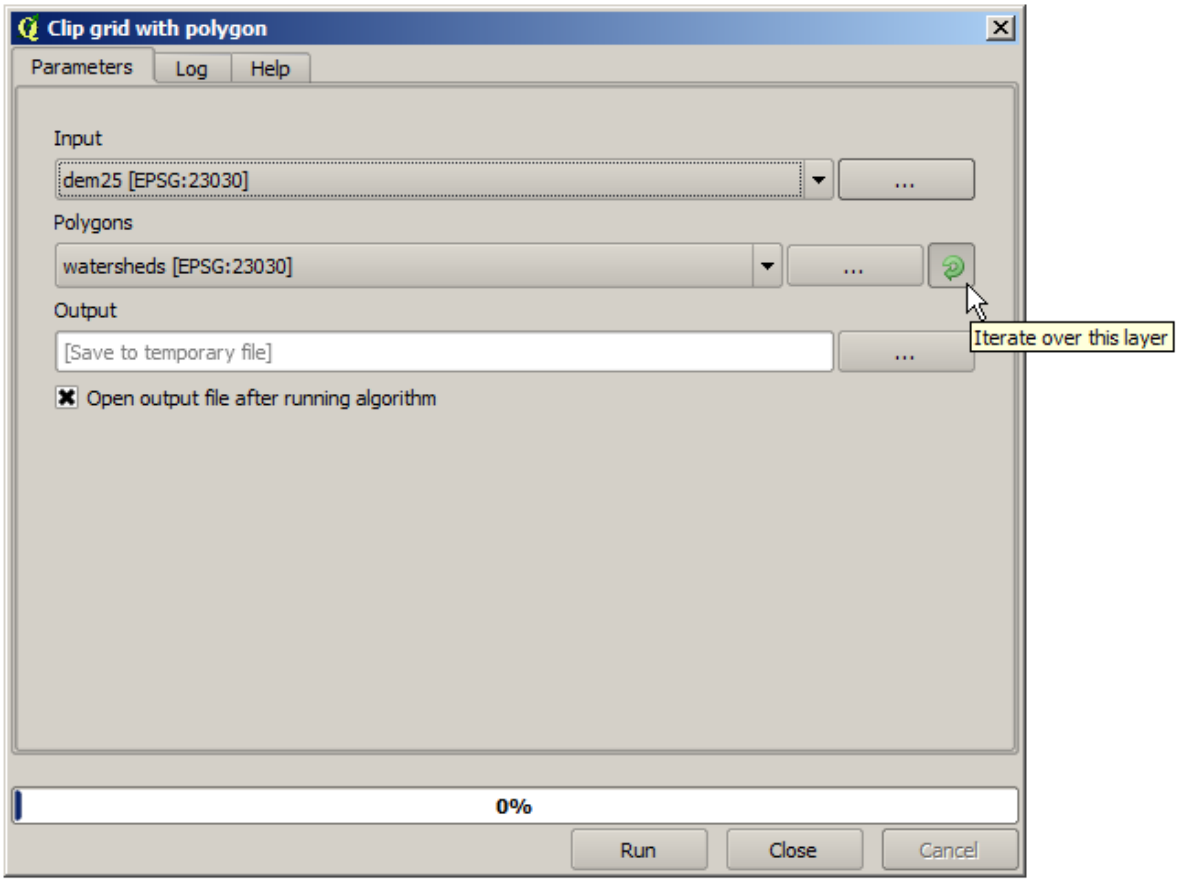


Deoarece numai entitățile selectate sunt folosite, numai poligonul selectat va fi folosit pentru a decupa stratul raster.



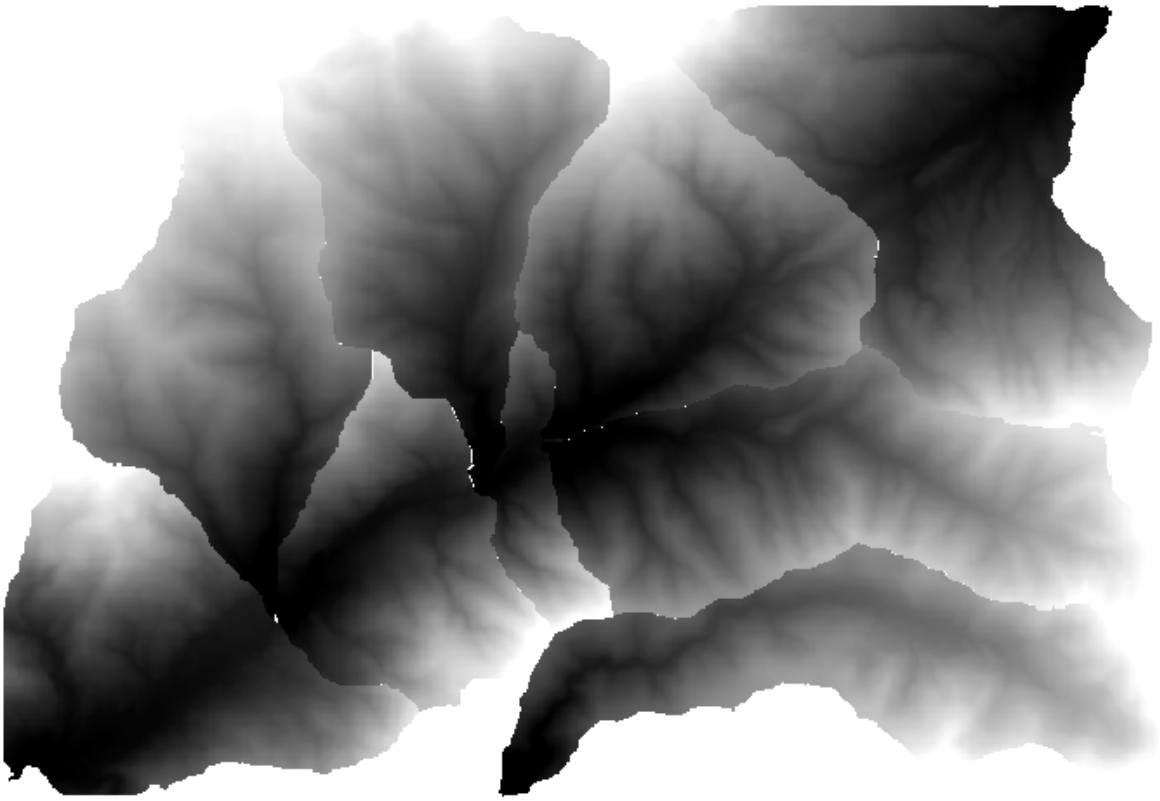
Făcând acest lucru pentru toate bazinele, se va produce rezultatul pe care îl căutăm, dar aceasta nu arată ca un mod foarte practic de lucru. În schimb, să vedem cum automatizăm rutina *selectare și decupare*.

First of all, remove the previous selection, so all polygons will be used again. Now open the *Clip raster with polygon* algorithm and select the same inputs as before, but this time click on the button that you will find in the right-hand side of the vector layer input where you have selected the watersheds layer.



Acest buton va cauza divizarea stratului de intrare selectat în mai multe straturi, pe măsură ce se descoperă entitățile, fiecare dintre ele conținând câte un singur poligon. Algoritmul va fi solicitat în mod repetat, câte o dată pentru fiecare dintre aceste straturi cu un singur poligon. Rezultatul, în loc de un singur strat raster, va consta într-un set de straturi raster, fiecare dintre ele corespunzând câte unei execuții a algoritmului.

Iată rezultatul pe care îl veți obține, dacă ați rulat algoritmul de tăiere așa cum s-a explicat.



Pentru fiecare strat, paletă de culori alb-negru, (sau orice paletă pe care o utilizați), este ajustată în mod diferit, de la minim până la valorile sale maxime. Acesta este motivul pentru care puteți vedea diferite piese, iar culorile nu par a se potrivi la granița dintre straturi. Valorile, cu toate acestea, se potrivesc.

Dacă introduceți un nume pentru fișierul de ieșire, fișierele rezultate vor fi denumite folosind ca nume de fișier și, ca sufix, un număr corespunzător pentru fiecare iterație.

17.25 Mai multe utilizări ale execuției iterative a algoritmilor

> **Notă**
>
> Această lecție vă arată cum să combinați execuția iterativă a algoritmilor cu modelatorul, pentru a extinde automatizarea.

Execuția iterativă a algoritmilor este disponibilă nu doar pentru algoritmii încorporați, ci, de asemenea, și pentru algoritmii pe care îi puteți crea, cum ar fi modelele. Vom vedea cum putem combina un model cu executarea iterativă a algoritmilor, astfel încât să putem obține cu ușurință rezultate mai complexe.

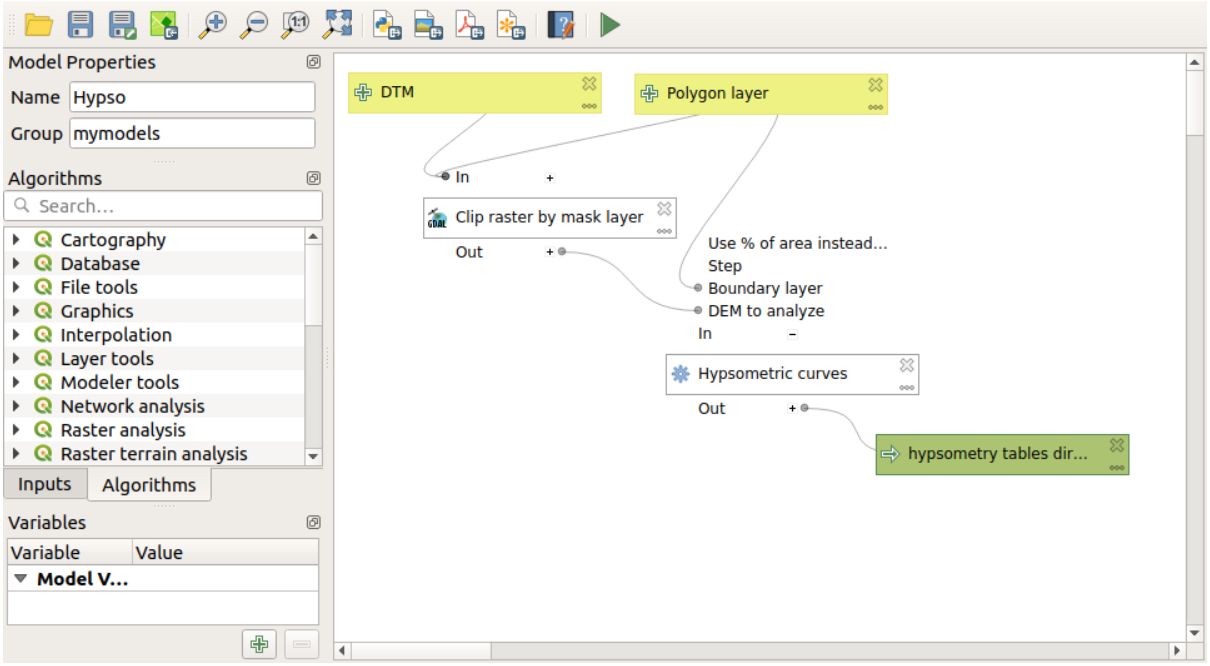
Datele pe care le vom folosi sunt aceleași pe care le-am folosit deja în ultima lecție. În acest caz, în afară de decuparea DEM-ului în funcție de poligonul fiecărui bazin hidrografic, vom adăuga câțiva pași, în care vom calcula o curbă hipsometrică pentru fiecare bazin, pentru a studia modul în care este distribuită elevația în cadrul bazinelor hidrografice.

Din moment ce avem un flux de lucru care implică mai multe etape (decupare + calcul curbă hipsometrică), ar trebui să mergem la modelator și să creăm modelul corespunzător fluxului respectiv.

You can find the model already created in the data folder for this lesson, but it would be good if you first try to create it yourself. The clipped layer is not a final result in this case, since we are just interested in the curves, so this model

will not generated any layers, but just a table with the curve data.

Modelul ar trebui să arate astfel:

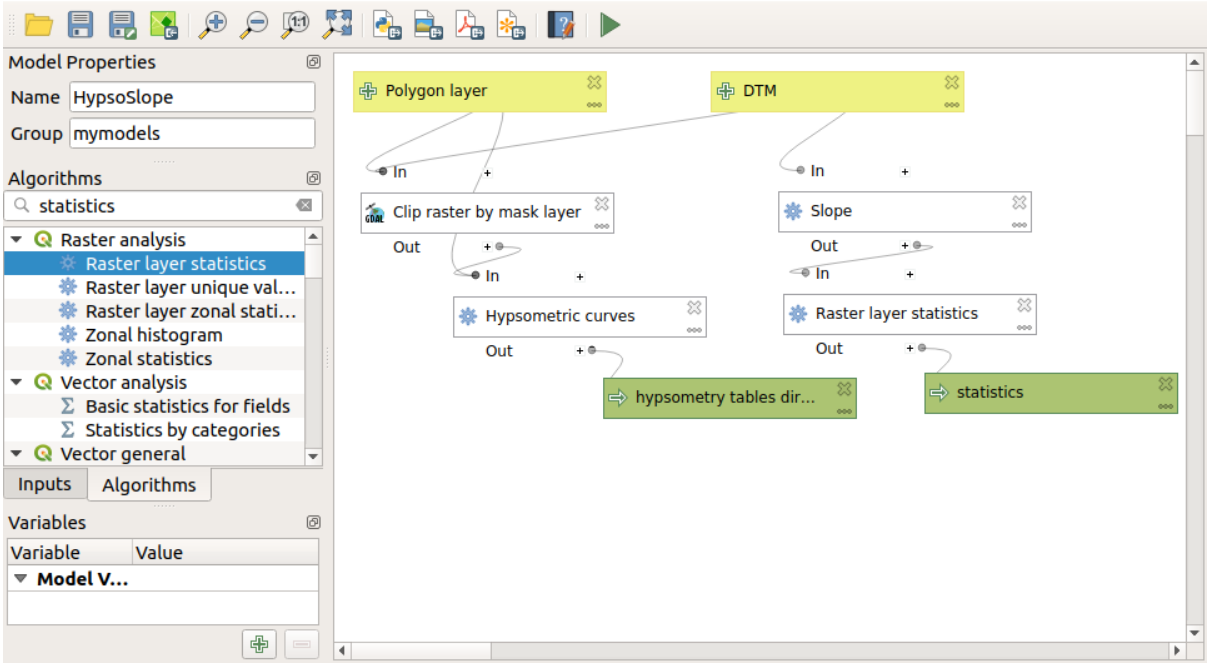


Add the model to you models folder, so it is available in the toolbox, and execute it.

Select the DEM and watersheds basins.

The algorithm will generate tables for all the basins and place them in the output directory.

We can make this example more complex by extending the model and computing some slope statistics. Add the *Slope* algorithm to the model, and then the *Raster statistics* algorithm, which should use the slope output as its only input.



Dacă rulați acum modelul, în afară de tabele, veți obține un set de pagini cu statistici. Aceste pagini vor fi disponibile în caseta de dialog a rezultatelor.

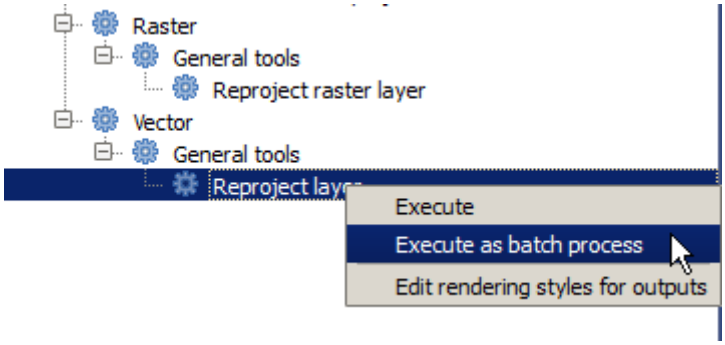
17.26 Interfața de prelucrare în serie

Notă

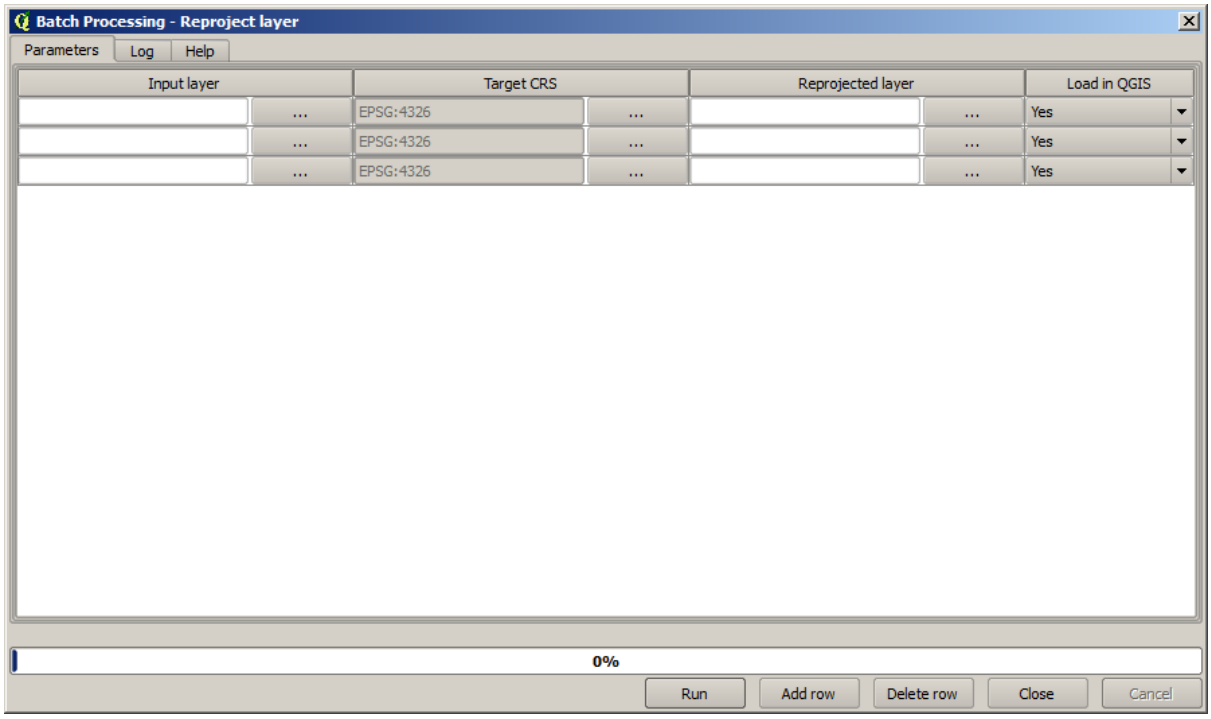
Această lecție introduce interfața de prelucrare în serie, care permite executarea unui singur algoritm, cu un set de valori de intrare diferite.

Uneori, un anumit algoritm trebuie executat în mod repetat cu diverse intrări. Acest caz se întâmplă, atunci când un set de fișiere de intrare trebuie convertit dintr-un format în altul, sau atunci când mai multe straturi aflate într-o anumită proiecție trebuie convertite în altă proiecție.

In that case, calling the algorithm repeatedly on the toolbox is not the best option. Instead, the batch processing interface should be used, which greatly simplifies performing a multiple execution of a given algorithm. To run an algorithm as a batch process, find it in the toolbox, and instead of double-clicking on it, right-click on it and select *Run as batch process*.



For this example, we will use the *Reproject layer* algorithm, so find it and do as described above. You will get to the following dialog.

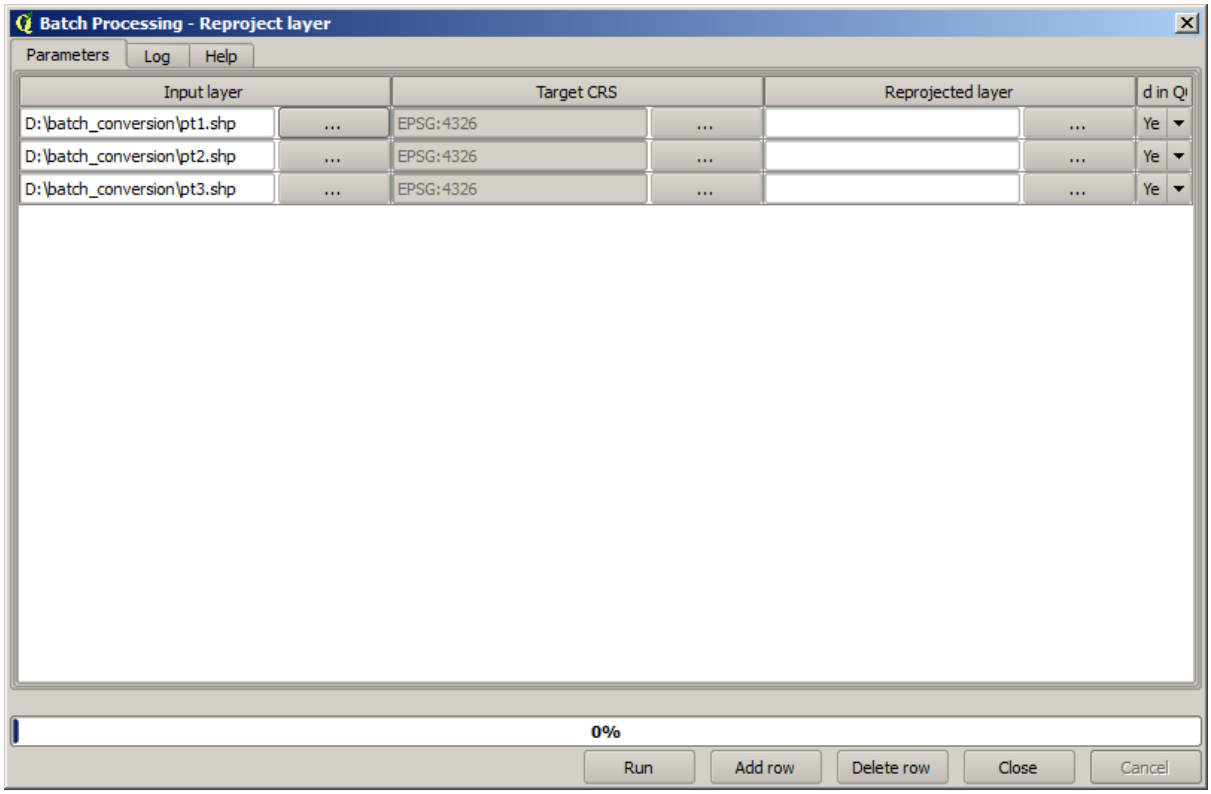


Dacă aruncați o privire la datele acestei lecții, veți vedea că acestea conțin un set de trei fișiere shape, dar nici un fișier de proiect QGIS. Aceasta se datorează faptului că, atunci când un algoritm este rulat ca un proces în serie, intrările stratului pot fi selectate fie din proiectul QGIS curent, fie din fișiere. Asta face mai ușoară procesarea unei cantități mari de straturi, cum ar fi, de exemplu, toate straturile dintr-un folder dat.

Fiecare rând din tabelul dialogului de prelucrare în serie, reprezintă o singură execuție a algoritmului. Celulele dintr-un rând corespund parametrului necesar algoritmului, ele nefiind dispuse una deasupra celeilalte, la fel ca într-un dialog normal de execuție singulară, ci orizontal în acel rând.

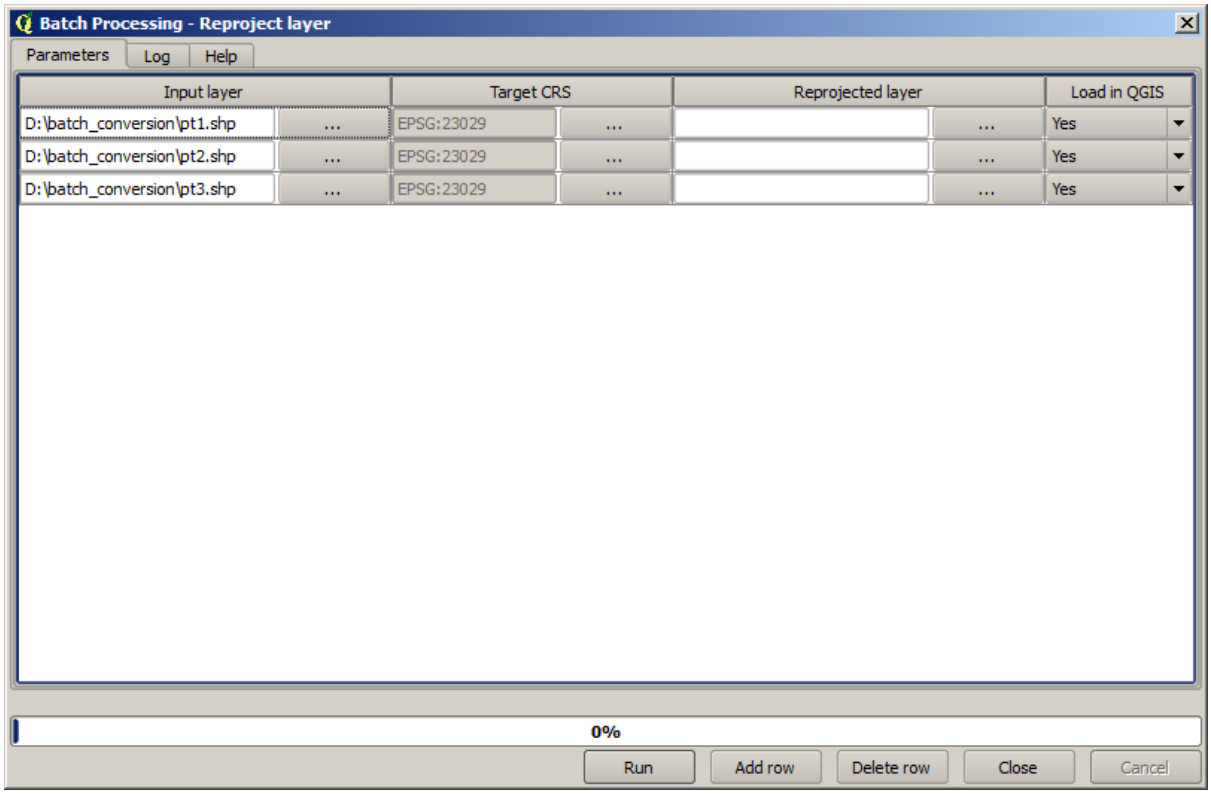
Definirea procesului care va rula în serie constă în completarea tabelului cu valorile corespunzătoare, iar dialogul în sine conține multe instrumente care ușurează această sarcină.

Let's start filling the fields one by one. The first column to fill is the *Input layer* one. Instead of entering the names of each one of the layers we want to process, you can select all of them and let the dialog put one in each row. Click on the button in the upper-left cell, and in the file selection dialog that will popup, select the three files to reproject. Since only one of them is needed for each row, the remaining ones will be used to fill the rows underneath.



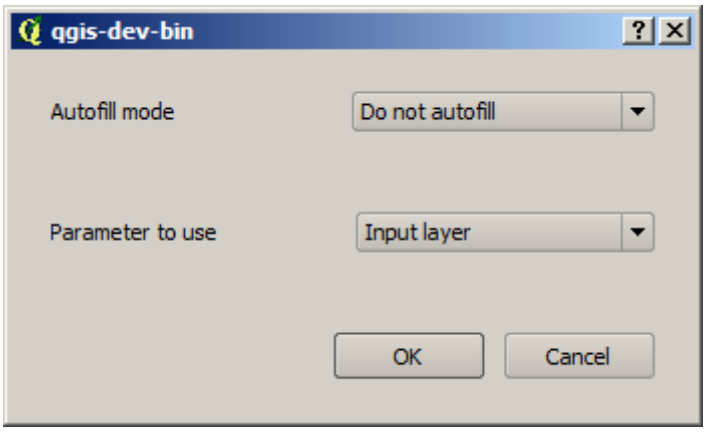
The default number of rows is 3, which is exactly the number of layers we have to convert, but if you select more layers, new rows will be added automatically. If you want to fill the entries manually, you can add more rows using the *Add row* button.

We are going to convert all those layers to the `EPSG:23029` CRS, so we have to select that CRS in the second field. We want the same on for all rows, but we do not have to do it for every single row. Instead, set that CRS for the first row (the one at the top) using the button in the corresponding cell, and then double click on the column header. That causes all the cells in the column to be filled using the value of the top cell.

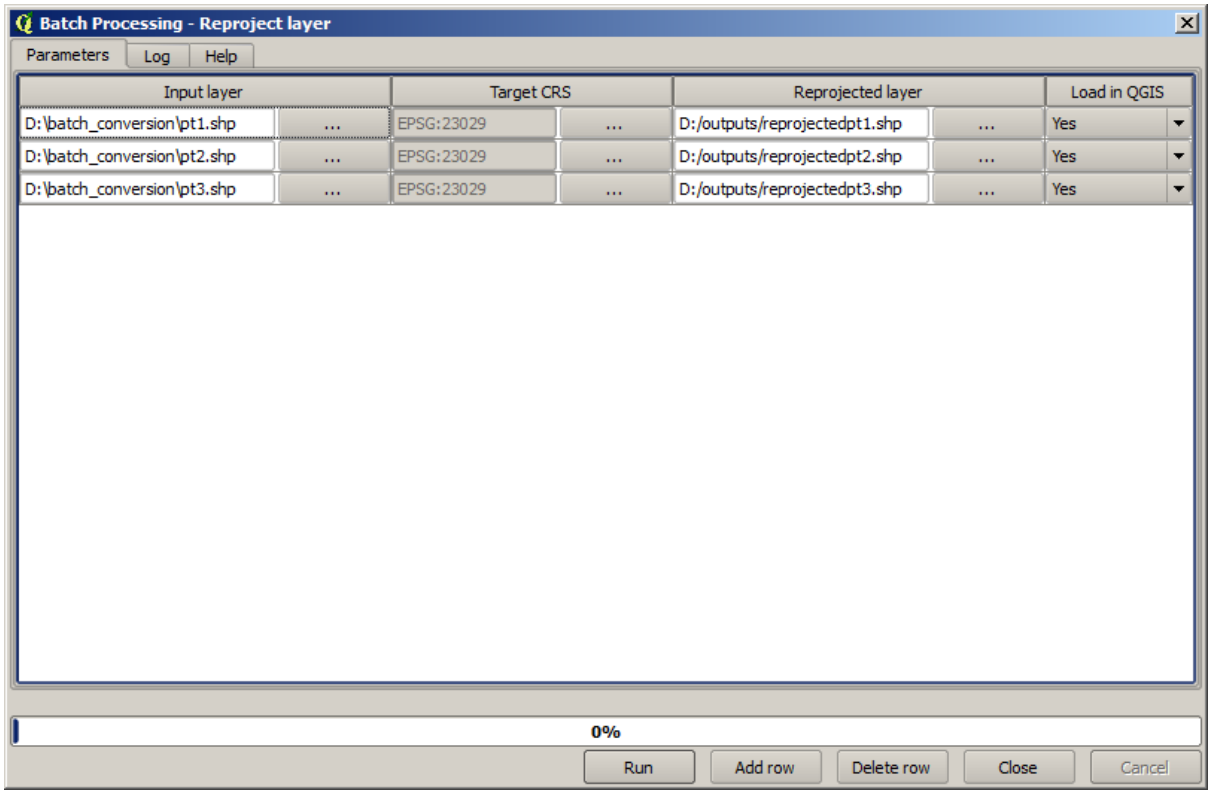


Finally, we have to select an output file for each execution, which will contain the corresponding reprojected layer. Once again, let's do it just for the first row. Click on the button in the upper cell and, in a folder where you want to put your output files, enter a filename (for instance, `reprojected.shp`).

Now, when you click *OK* on the file selection dialog, the file does not automatically gets written to the cell, but an input box like the following one is shown instead.



If you select the first option, only the current cell will be filled. If you select any of the other ones, all the rows below will be filled with a given pattern. In this case, we are going to select the *Fill with parameter value* option, and then the `Input Layer` value in the drop down menu below. That will cause the value in the `Input Layer` (that is, the layer name) to be added to the filename we have added, making each output filename different. The batch processing table should now look like this.



The last column sets whether or not to add the resulting layers to the current QGIS project. Leave the default `Yes` option, so you can see your results in this case.

Click on *OK* and the batch process will be run. If everything went fine, all your layers will have been processed, and 3 new layers would have been created.

17.27 Modelele în interfața de prelucrare a loturilor

Atenționare

Atenție, deoarece acest capitol nu este bine testat, vă rugăm să raportați orice problemă; imaginile lipsesc

Notă

Această lecție prezintă un alt exemplu de interfață de prelucrare a loturilor, dar de data aceasta cu ajutorul unui model în locul unui algoritm încorporat

Modelele sunt similare oricărui alt algoritm, ele putând fi utilizate în interfața de prelucrare a loturilor. Pentru a demonstra aceasta, iată un scurtă exemplu în care folosim modelul nostru hidrologic, bine-cunoscut deja.

Asigurați-vă că aveți modelul adăugat la setul de instrumente, apoi rulați-l ca lot. Iată cum ar trebui sa arate dialogul de prelucrare a lotului:

Atenționare

todo: De adăugat imaginea

Adăugați un total de 5 rânduri. Selectați fișierul DEM corespunzător acestei lecții ca intrare pentru ele. Apoi introduceți 5 valori de prag diferite, așa cum se arată în continuare.

Atenționare

todo: De adăugat imaginea

După cum vedeți, interfața de prelucrare a lotului poate funcționa nu doar la rularea aceluiași proces pe diferite seturi de date, dar, de asemenea, și pe același set de date cu parametrii diferiți.

Faceți clic pe *OK*, după care ar trebui să obțineți 5 noi straturi, cu bazinele corespunzătoare celor 5 valoril de prag specificate.

17.28 Script de interceptare a pre- și post-execuției

Notă

Această lecție vă arată cum se utilizează scripturile de interceptare a pre- și post-execuției, permițând astfel efectuarea unor operații adiționale înainte și după procesarea efectivă.

Scripturile Processing de interceptare a pre și post-execuției se execută înainte și după prelucrarea datelor efective. Ele pot fi folosite pentru a automatiza sarcinile care ar trebui să fie efectuate, ori de câte ori un algoritm este executat.

The syntax of the hooks is identical to the syntax of Processing scripts, see the corresponding chapter in the QGIS User Guide for more details.

În plus față de toate caracteristicile scripturilor, în codurile de interceptare puteți utiliza o variabilă globală specială dnumită `alg`, care reprezintă algoritmul care tocmai a fost (sau urmează să fie) executat.

Here is an example post-execution script. By default, Processing stores analysis results in temporary files. This script will copy outputs to a specific directory, so they won't be deleted after closing QGIS.

```
import os
import shutil
from processing.core.outputs import OutputVector, OutputRaster, OutputFile

MY_DIRECTORY = '/home/alex/outputs'

for output in alg.outputs:
    if isinstance(output, (OutputVector, OutputRaster, OutputFile)):
        dirname = os.path.split(output.value)[0]
        shutil.copytree(dirname, MY_DIRECTORY)
```

In the first two lines we import the required Python packages: `os` — for path manipulations, e.g. extracting file name, and `shutil` — for various filesystem operations like copying files. In the third line we import Processing outputs. This will be explained in more detail later in this lesson.

Then we define a `MY_DIRECTORY` constant, which is the path to the directory where we want to copy analysis results.

La sfârșitul scriptului, avem codul principal de interceptare. În cadrul unei bucle vom itera toate ieșirile algoritmilor și vom verifica dacă ele reprezintă fișiere și dacă pot fi copiate. Dacă da, determinăm directorul de nivel superior în care sunt localizate fișierele de ieșire, apoi le copiem în directorul nostru.

To activate this hook we need to open the Processing options, find the entry named *Post-execution script file* in the *General* group, and specify the filename of the hook script there. the specified hook will be executed after each Processing algorithm.

In a similar way, we can implement pre-execution hooks. For example, let's create a hook to check input vectors for geometry errors.

```
from qgis.core import QgsGeometry, QgsFeatureRequest
from processing.core.parameters import ParameterVector

for param in alg.parameters:
    if isinstance(param, ParameterVector):
        layer = processing.getObject(param.value)
        for f in layer.getFeatures(QgsFeatureRequest().setSubsetOfAttributes([])):
            errors = f.geometry().validateGeometry()
            if len(errors) > 0:
                progress.setInfo('One of the input vectors contains invalid␣
↪geometries!')
```

As in the previous example, first we import required QGIS and Processing packages.

Then we iterate over all the algorithm parameters and if a ParameterVector parameter is found, we get the corresponding vector layer object from it. We loop over all the features of the layer and check them for geometry errors. If at least one feature contains an invalid geometry, we print a warning message.

To activate this hook we need enter its filename in the *Pre-execution script file* option in the Processing configuration dialog. The hook will be executed before running any Processing algorithm.

17.29 Alte programe

Module contributed by Paolo Cavallini - Faunalia

Notă

Acest capitol vă arată cum să utilizați programe suplimentare din interiorul Procesării. Pentru a finaliza, trebuie să aveți instalate pachetele relevante, cu ajutorul instrumentelor specifice sistemului de operare.

17.29.1 GRASS

GRASS este o suită GIS gratuită, cu sursă deschisă, pentru managementul și analiza datelor geospațiale, pentru prelucrare de imagine și grafică, producție de hărți, modelare și vizualizare spațială.

Acesta este instalat în mod implicit în Windows, cu ajutorul pachetului de instalare independent OSGeo4W (32 și 64 biți), existând pachete și pentru toate distribuțiile majore de Linux.

17.29.2 R

R este un mediu software cu sursă liberă și deschisă, pentru calcul statistic și grafică.

Trebuie instalate separat, împreună cu câteva biblioteci necesare (**LIST**). Pentru a permite utilizarea lui R în QGIS, trebuie instalat și pluginul *Processing R Provider*.

Frumusețea implementării Processing este că puteți adăuga propriile scripturi, fie simple sau complexe, acestea putând fi apoi utilizate ca orice alt modul, conectate în fluxuri de lucru mai complexe, etc.

Testați unele dintre exemplele preinstalate, dacă aveți R deja instalat (amintiți-vă să activați modulele R din interfața de configurare generală a Processing).

17.29.3 Altele

LASTools reprezintă un set de comenzi mixte, libere și proprietare, pentru a procesa și analiza datele Lidar. Disponibilitatea în diferite sisteme de operare este variabilă.

Mai multe instrumente sunt disponibile, prin intermediul plugin-urilor suplimentare, cum ar fi:

- LecoS: o suită de statistici de acoperire a terenului și de ecologie a peisajului
- lwgeom: fostă parte din PostGIS, această bibliotecă aduce câteva instrumente utile pentru curățarea geometriei
- Animove: instrumente de analiză a unei serii de animale domestice.

Mai multe vor urma.

17.29.4 Comparație între backend-uri.

Distanțe și tampoane

Haideți să încărcăm `points.shp` și să scriem``buf`` în filtrul instrumentului din bara de instrumente, apoi faceți dublu clic pe el:

- *Tamponul cu distanță fixă*: Distanța 10000
- *Tamponul cu distanță variabilă*: MĂRIMEA câmpului distanță
- *v.buffer.distance*: distanța 10000
- *v.buffer.column*: MĂRIMEA bufcolumn
- *Shapes Buffer*: valoarea fixă 10000 (dissolve și not), câmpul atribut (cu scalare)

Vedeți câtă viteză diferă, și câte opțiuni sunt disponibile.

Exercițiul pentru cititor: găsiți diferențele din geometria rezultată prin metodele diferite.

Acum, tampoanele și distanțele:

- în primul rând, încărcați și rasterizați vectorul `rivers.shp` cu *GRASS* ► *v.to.rast.value*; **atenție:** mărimea celulelor trebuie să fie setată la 100 m, în caz contrar timpul de calcul va fi enorm; harta rezultată va conține 1 și NULL-uri
- la fel, cu *SAGA* ► *Shapes to Grid* ► *COUNT* (harta rezultată: de la 6 la 60)
- apoi, *proximitatea* (valoarea= 1 pentru GRASS, o listă de ID-uri de râuri pentru SAGA), *r.buffer* cu parametrii 1000,2000,3000, *r.grow.distance* (prima din cele două hărți; a doua va arăta suprafețele ce țin de fiecare râu, dacă se aplică pe un raster SAGA).

Dizolvare

Dizolvare entități pe baza unui atribut comun:

- *GRASS* ► *v.dissolve* `municipalities.shp` pe PROVINCIE
- *QGIS* ► *Dissolve* `municipalities.shp` pe PROVINCIE
- *OGR* ► *Dizolvă* `municipalities.shp` pe PROVINCIE
- *SAGA* ► *Polygon Dissolve* `municipalities.shp` pe PROVINCIE (**NB:** *Păstrare granițe interioare* trebuie să fie neselectat)

> **Notă**
>
> Ultima nu funcționează în SAGA <=2.10

Exercițiu pentru cititor: găsiți diferențele (de geometrie și de atribute) prin metode diferite.

17.30 Interpolarea și conturarea

Module contributed by Paolo Cavallini - Faunalia

> **Notă**
>
> Acest capitol prezintă folosirea diferitelor variante de calcularre a interpolărilor.

17.30.1 Interpolarea

Proiectul prezintă un gradient de precipitații, de la sud la nord. Să folosim metode diferite pentru interpolare, toate bazate pe vectorul `points.shp`, parametrul `RAIN`:

> **Atenționare**
>
> Set cell size to `500` for all analyses.

- *GRASS* ► *v.surf.rst*
- *SAGA* ► *nterpolare B-Spline Multinivel*
- *SAGA* ► *Distanța Inversă Ponderată* [Distanța inversă ridicată la o putere; Puterea: 4; Raza de căutare: Global; Intervalul de căutare: toate punctele]
- *GDAL* ► *Grilă (Distanța Inversă ridicată la o putere)* [Puterea:4]
- *GDAL* ► *Grilă (Deplasări medii)* [Raza1&2: 50000]

Apoi măsurați variația dintre metode și corelați-o cu distanța până la puncte:

- *GRASS* ► *r.series* [Deselectare NULL-uri Propagate, Operația de Agregare: stddev]
- *GRASS* ► *v.to.rast.value* asupra `points.shp`
- *GDAL* ► *Proximitatea*
- *GRASS* ► *r.covar* pentru a arăta matricea de corelație; verificați semnificația corelației, de exemplu, cu http://vassarstats.net/rsig.html.

Astfel, zonele de puncte îndepărtate vor avea o interpolare mai puțin precisă.

17.30.2 Curbe de nivel

Diverse metode pentru a desena linii de contur [întotdeauna pasul= 10] în rasterul *stddev*:

- *GRASS* ► *r.contour.step*
- *GDAL* ► *Curbe de nivel*
- *SAGA* ► *Curbele de nivel dintr-o grilă* [**NB:** în unele versiuni mai vechi de SAGA, shp-ul nu este valid, ceea ce este o eroare cunoscută]

17.31 Simplificarea și netezirea vectorilor

Modulul a fost dezvoltat de Paolo Cavallini - Faunalia

Notă

Acest capitol prezintă modalitățile de simplificare a vectorilor, precum și de netezire a colțurilor ascuțite.

Uneori avem nevoie de o versiune simplificată a unui vector, pentru a avea o dimensiune mai mică de fișier și pentru a scăpa de detaliile inutile. Multe instrumente fac acest lucru într-un mod foarte brut, omițând uneori corectitudinea topologică și adiacența poligoanelor. GRASS este instrumentul ideal pentru acest lucru: fiind un GIS topologic, adiacența și corectitudinea sunt păstrate chiar și la niveluri foarte ridicate de simplificare. În cazul nostru, avem un vector rezultat dintr-un raster, fapt indicat de modelul „zimților" de la frontiere. Aplicarea simplificării va produce linii drepte:

- *GRASS* ► *v.generalize* [Valoarea toleranței maxime: 30 m]

De asemenea, putem proceda și invers, făcând un strat mai complex, prin netezirea colțurilor ascuțite:

- *GRASS* ► *v.generalize* [methoda: chaiken]

Încercați să aplicați această a doua comandă atât vectorului inițial, cât și celui de la prima analiză, pentru a vedea diferența. Rețineți că adiacența nu este pierdută.

Această a doua opțiune se poate aplica, de exemplu, curbelor de nivel care rezultă dintr-o raster grosier, la traseele GPS cu noduri rare, etc.

17.32 Planificarea unei ferme solare

Module contributed by Paolo Cavallini - Faunalia

Notă

Acest capitol arată cum să utilizați diverse criterii, în scopul localizării zonelor potrivite pentru instalarea unei centrale fotovoltaice

Mai întâi de toate, creați o hartă a aspectului dintr-un DTM:

- *GRASS* ► *r.aspect* [Tipul datei: int; cell size:100]

În GRASS, aspectul este calculat în grade, în sens invers acelor de ceasornic, pornind de la Est. Pentru a extrage numai pantele orientate spre Sud (270 de grade +- 45), putem să-l reclasificăm:

- *GRASS* ► *r.reclass*

cu următoarele reguli:

```
225 thru 315 = 1 south
* = NULL
```

Puteți utiliza fișierul text furnizat, `reclass_south.txt`. De asemenea, rețineți că, folosind aceste fișiere text simple, putem crea reclasificări foarte complexe.

Dorim să construim o fermă mare, astfel încât vom selecta doar zonele învecinate mari (> 100 ha):

- *GRASS* ► *r.reclass.greater*

În final, le convertim într-un vector:

- *GRASS* ► *r.to.vect* [Tipul entității: arie; Colțuri netede: da]

Exercițiu pentru cititor: repetați analiza, înlocuind comenzile GRASS cu unele similare cu ale altor programe.

17.33 Utilizarea scripturilor R în cadrul procesării

Module contributed by Matteo Ghetta - funded by Scuola Superiore Sant'Anna

Processing (with the *Processing R Provider* plugin) makes it possible to write and run R scripts inside QGIS.

Atenționare

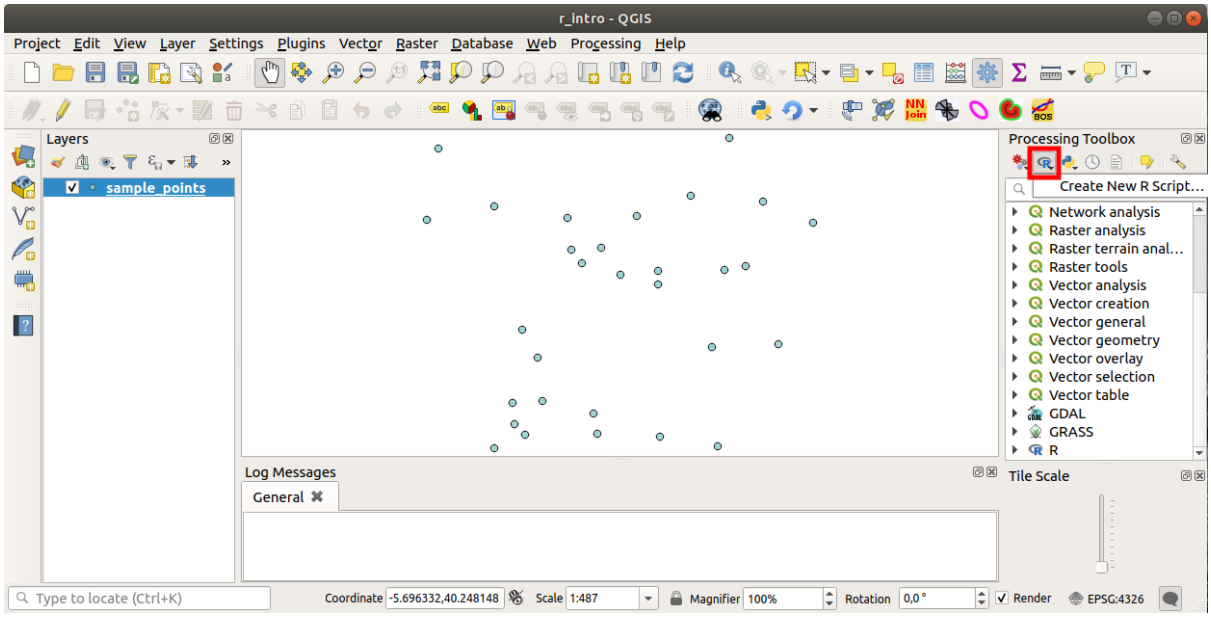
R has to be installed on your computer and the PATH has to be correctly set up. Moreover Processing just calls the external R packages, it is not able to install them. So be sure to install external packages directly in R. See the related chapter in the user manual.

Notă

If you have *package* problems, it may be related to missing *mandatory* packages required by Processing, like `sp`, `rgdal` and `raster`.

17.33.1 Adăugarea scripturilor

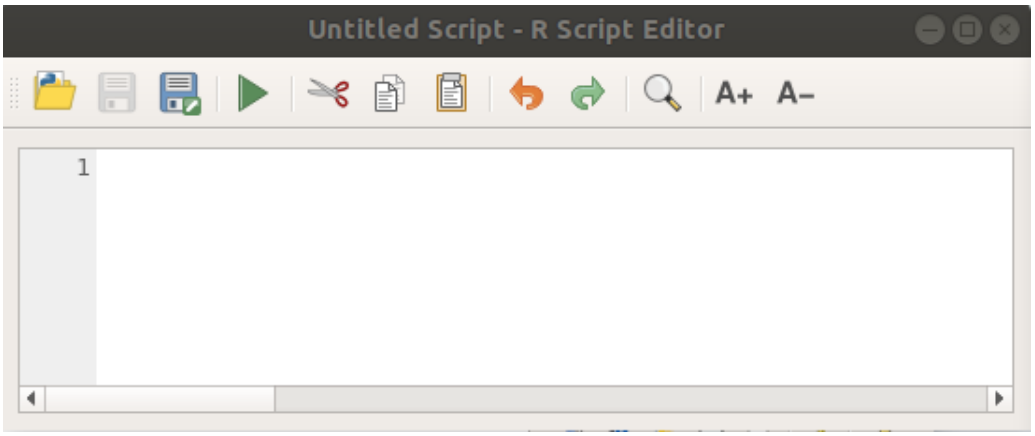
Adding a script is simple. The easiest way is to open the Processing toolbox and choose *Create new R script…* from the R menu (labelled with an R icon) at the top of the Processing Toolbox. You can also create the script in for instance a text editor and save it in your R scripts folder (`processing/rscripts`). When it has been saved there, it will be available for editing by right-clicking on the script name in the processing toolbox and then choose *Edit Script…*).



Notă

Dacă nu puteți vizualiza R în Processing, trebuie să îl activați din *Processing* ► *Opțiuni* ► *Furnizori*

It opens a *R Script Editor* in which you have to specify some parameters before you can add the script body.



17.33.2 Crearea diagramelor

În cadrul acestui tutorial vom crea o diagramă de tip **boxplot** pentru un câmp al unui strat vectorial.

Open the `r_intro.qgs` QGIS project under the `exercise_data/processing/r_intro/` folder.

Parametrii scriptului

Deschideți editorul și începeți să scrieți.

Va **trebui** să specificați câțiva parametri **înaintea** editării scriptului:

1. The name of the group (*plots* in this case) in which you want to put your script (if the group does not exist, it will be created):

   ```
   ##plots=group
   ```

   You will find your script in the **plots** R group in the Processing toolbox.

2. You have to tell Processing that you want to display a plot (in this example):

   ```
   ##showplots
   ```

   You will then find a link to the plot in the **Result Viewer** panel (can be turned on / off in *View* ► *Panels* and with *Processing* ► *Results Viewer*).

3. You also need to tell Processing about your input data. In this example we want to create a plot from a field of a vector layer:

   ```
   ##Layer=vector
   ```

   Processing now knows that the input is a vector. The name *Layer* is not important, what matters is the **vector** parameter.

4. Finally, you have to specify the input field of the vector layer (using the name you have provided above - *Layer*):

   ```
   ##X=Field Layer
   ```

   Processing now knows that you need a field of *Layer*, and that you will call it **X**.

5. It is also possible to define the name of your script using `name`:

   ```
   ##My box plot script=name
   ```

   If not defined, the file name will be used as the name of the script.

Corpul scriptului

O dată ce partea introductivă a scriptului a fost setată, puteți adăuga o funcție:

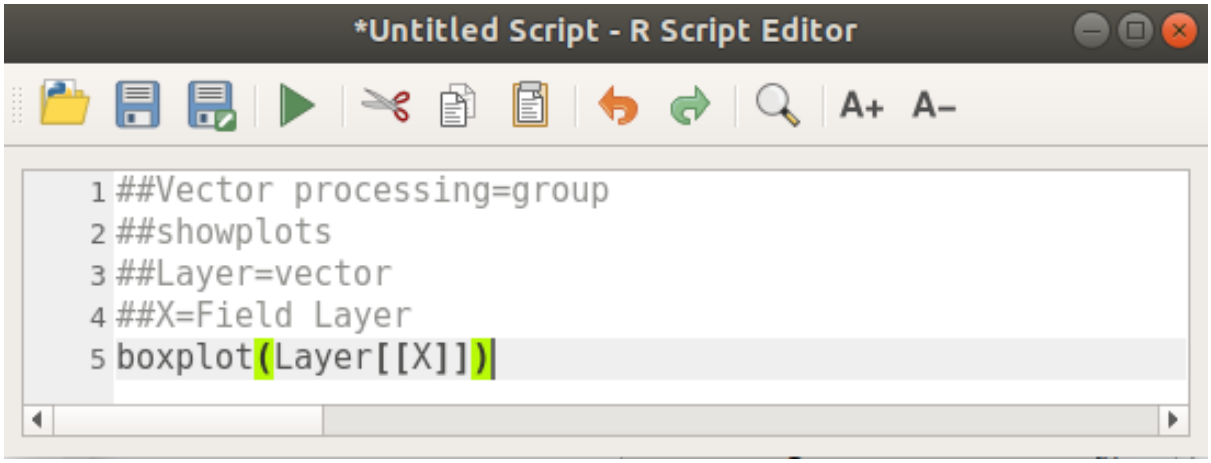
```
boxplot(Layer[[X]])
```

boxplot is the name of the R function, the parameter **Layer** is the name that you have defined for the input dataset and **X** is the name you have defined for the field of that dataset.

> **Atenționare**
>
> The parameter **X** has to be within double square brackets (`[[]]`).

Scriptul final va trebui să arate astfel:

```
##Vector processing=group
##showplots
##Layer=vector
##X=Field Layer
boxplot(Layer[[X]])
```

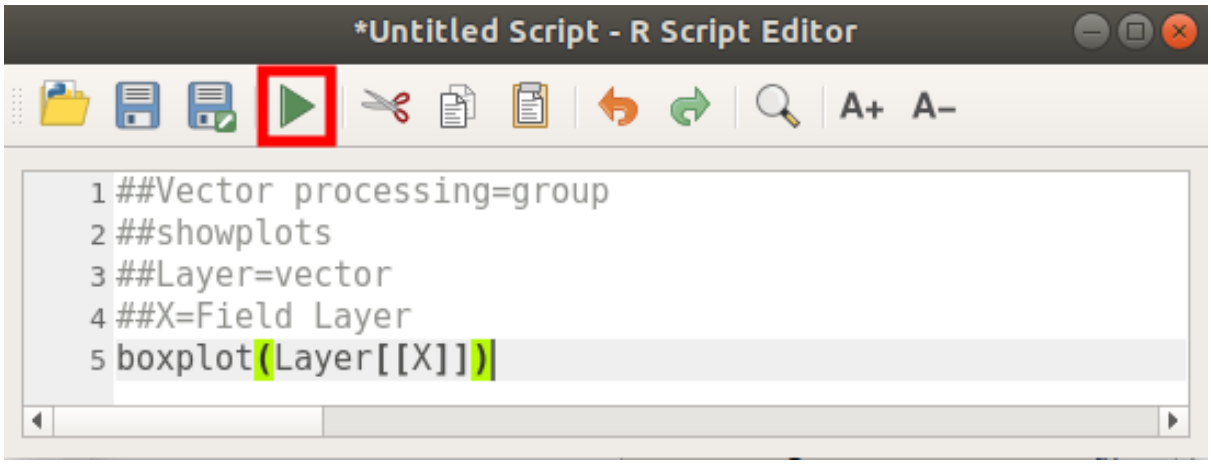


Save the script in the default path suggested by Processing (processing/rscripts). If you have not defined a `name` in the script heading, the file name you choose will become the name of the script in the Processing toolbox.

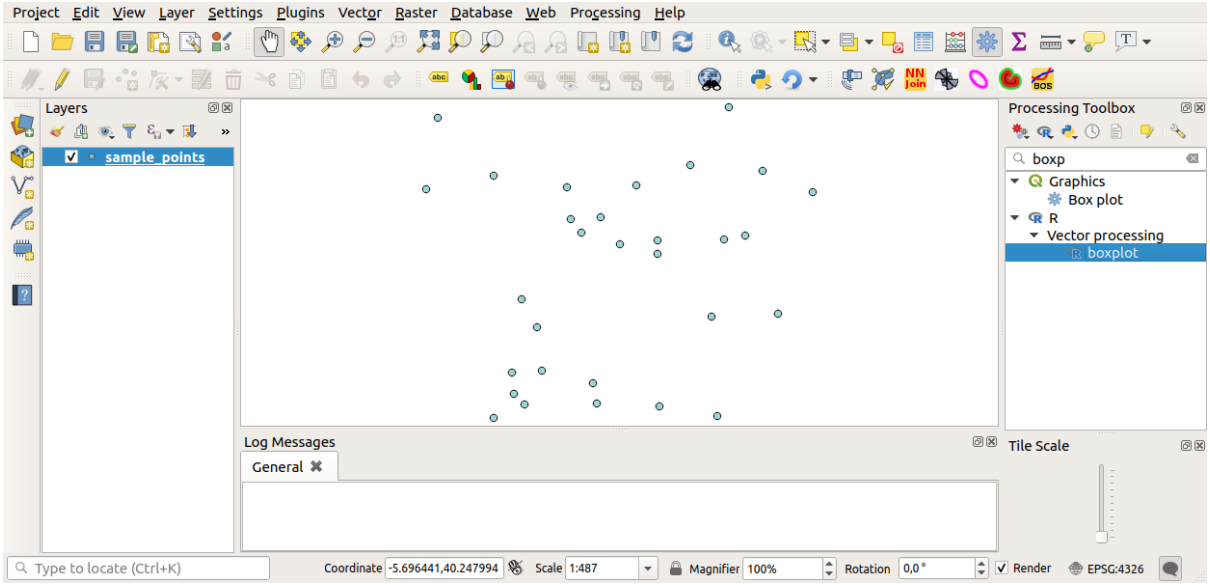
Notă

You can save the script wherever you like, but Processing will then not be able to include it in the processing toolbox automatically, so you have to upload it manually.

Acum, doar rulați-l, folosind butonul din partea de sus a ferestrei editorului:



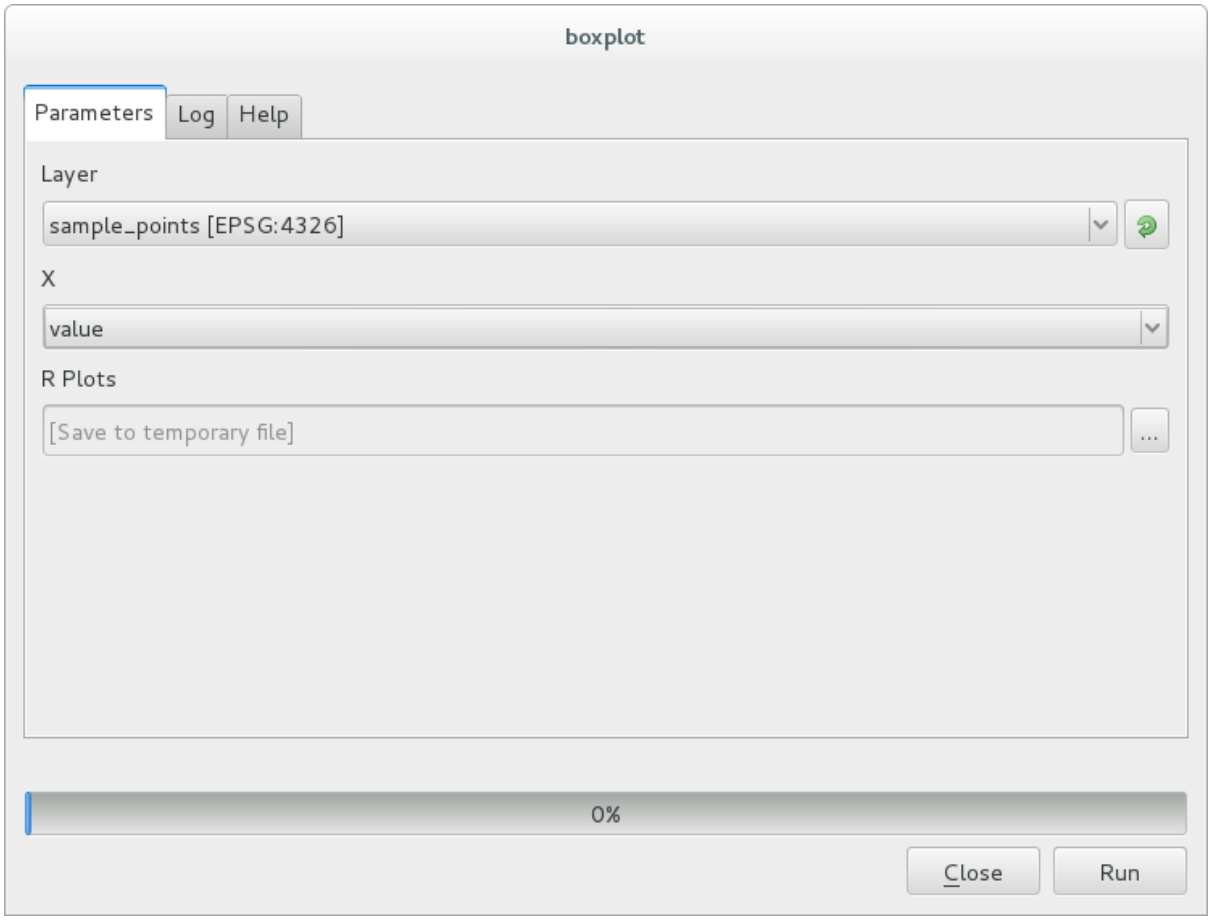
Once the editor window has been closed, use the text box of Processing to find your script:



You can now fill the parameters required in the Processing algorithm window:

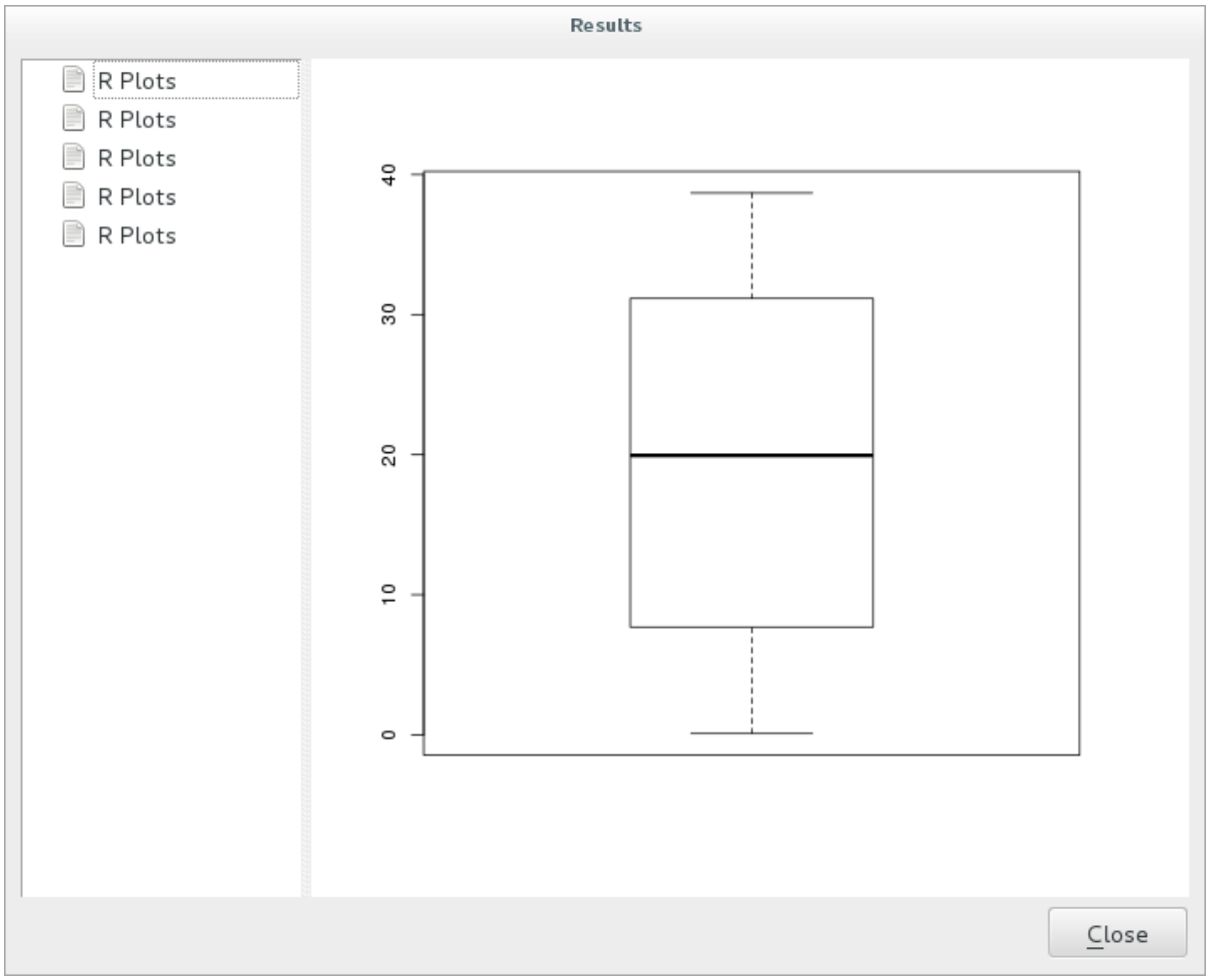
- for **Layer** choose `sample_points`
- for the **X** field choose `value`

Click on *Run*.



Fereastra rezultatelor ar trebui să fie deschisă în mod automat, dacă nu, doar faceți clic pe *Processing* ► *Result Viewer*....

Click on the link in the viewer and you will see:



Notă

You can open, copy and save the image by right clicking on the plot.

17.33.3 Crearea unui vector

You can also create a vector layer and have it automatically loaded into QGIS.

The following example has been taken from the `Random sampling grid` script that can be found in the online collection of R scripts (the scripts in this online collection can be found in https://github.com/qgis/QGIS-Processing/tree/master/rscripts).

The aim of this exercise is to create a random point vector layer using an input vector layer to restrict the extent using the `spsample` function of the `sp` package.

Parametrii scriptului

Ca și mai înainte, avem de stabilit câțiva parametri la începutul script-ului:

1. Specify the name of the group in which you want to put your script, in this case *Point pattern analysis*:

```
##Point pattern analysis=group
```

2. Define an input parameter (a vector layer) that will constrain the placement of the random points:

```
##Layer=vector
```

3. Set an input parameter for the number of points that are going to be created (`Size`, with a default value of `10`):

```
##Size=number 10
```

> **Notă**
>
> Since a default value (`10`) is defined, the user can change this number or can leave the parameter without a number.

4. Specify that there is an output vector layer (called `Output`):

```
##Output=output vector
```

Corpul scriptului

Acum puteți adăuga corpul funcției:

1. Use the `spsample` function:

```
pts=spsample(Layer, Size, type="random")
```

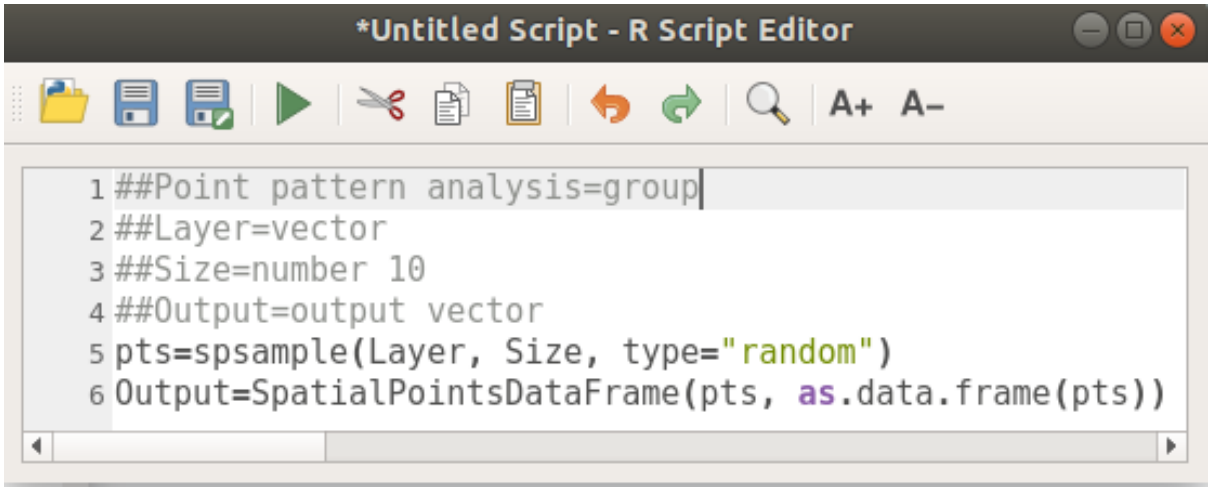
   The function uses the *Layer* to constrain the placement of the points (if it is a line layer, a points will have to be on one of the lines in the layer, if it is a polygon layer, a point will have to be within a polygon). The number of points is taken from the *Size* parameter. The sampling method is *random*.

2. Generate the output (the `Output` parameter):

```
Output=SpatialPointsDataFrame(pts, as.data.frame(pts))
```

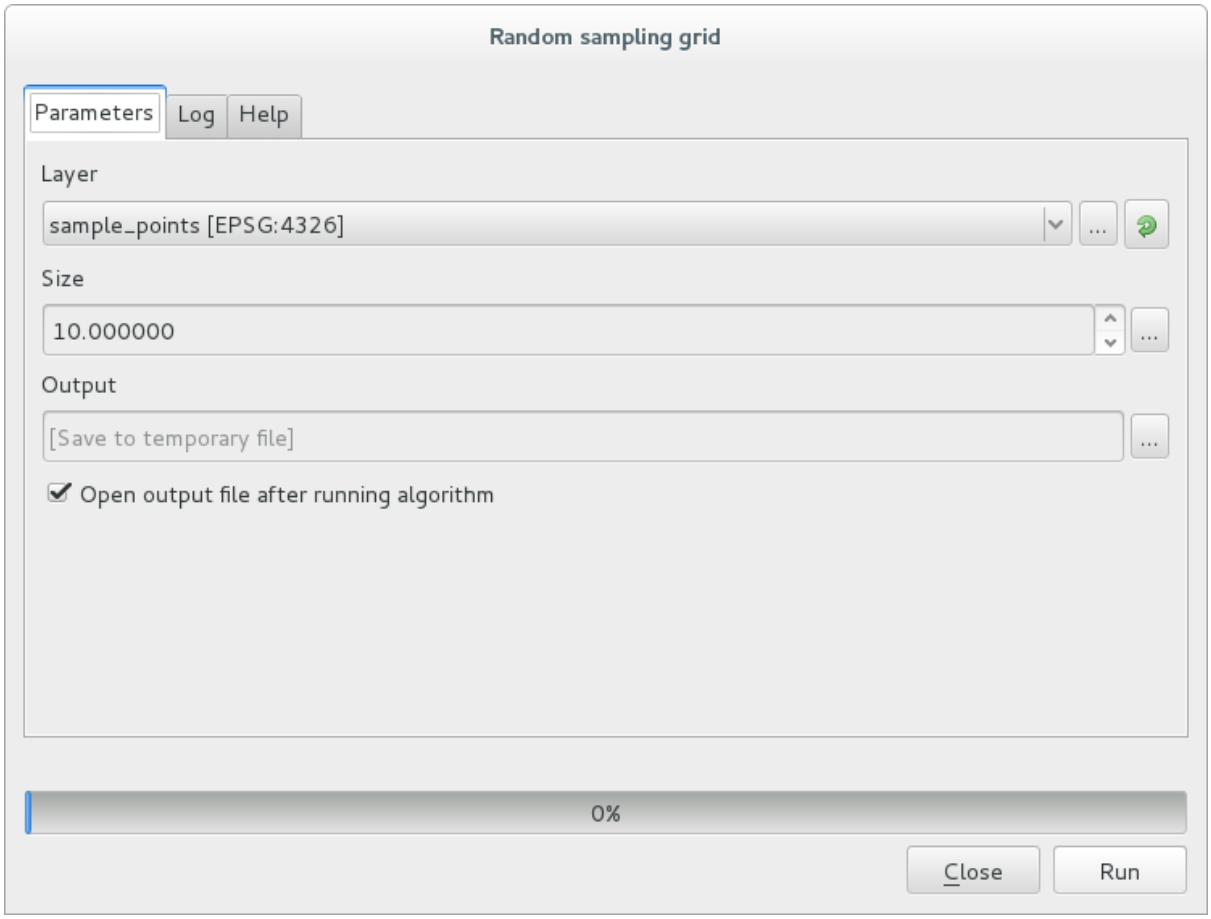
Scriptul final va trebui să arate astfel:

```
##Point pattern analysis=group
##Layer=vector
##Size=number 10
##Output=output vector
pts=spsample(Layer, Size, type="random")
Output=SpatialPointsDataFrame(pts, as.data.frame(pts))
```



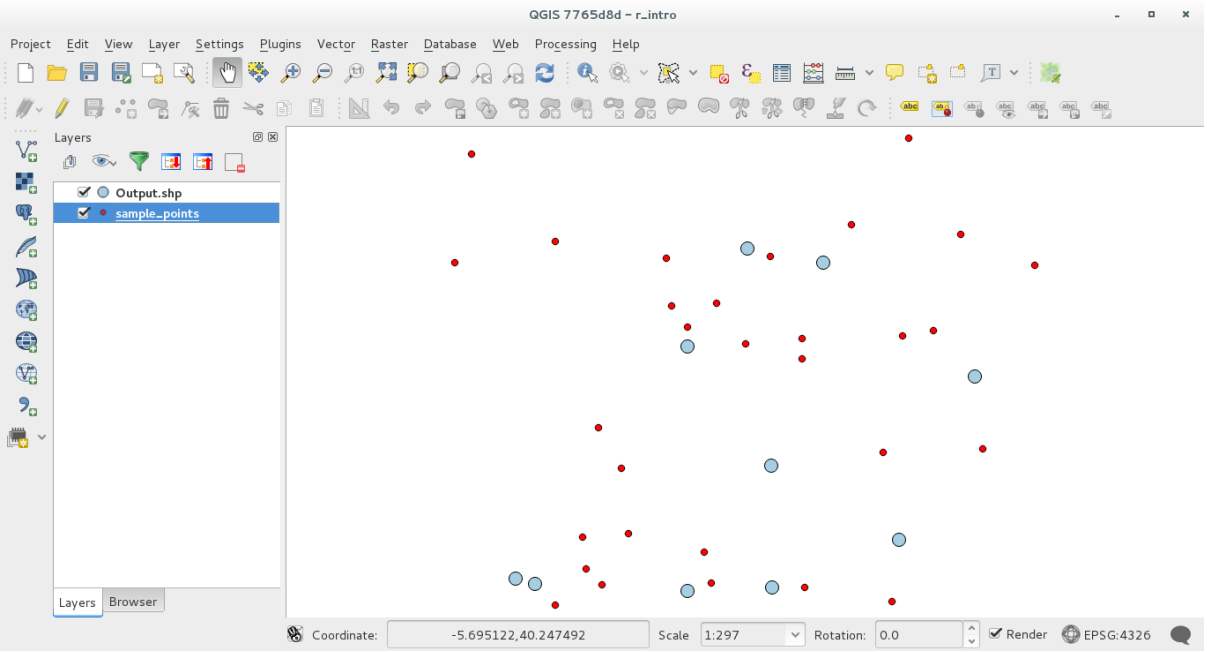
Save it and run it, clicking on the run button.

În noul tip de fereastră scrieți parametrii potriviți:



apoi faceți clic pe rulare.

The result layer will be added to the table of contents and its points will be displayed on the map canvas:



17.33.4 Text and graph output from R - syntax

Processing (with the `Processing R Provider plugin`) uses special syntax to get the results out of R:

- > înainte de comanda dvs., ca în `>lillie.test(Layer[[Field]])` denotă că rezultatul ar trebui să fie trimis la ieșirea R (Vizualizatorul de rezultate)
- `+` after a plot enables overlay plots. For example `plot(Layer[[X]], Layer[[Y]]) + abline(h=mean(Layer[[X]]))`

17.34 Prezicerea alunecărilor de teren

Modulul a fost dezvoltat de Paolo Cavallini - Faunalia

> **Notă**
>
> Acest capitol vă arată cum să creați un model simplificat pentru a prezice probabilitatea alunecărilor de teren.

În primul rând, vom calcula panta (aleasă dintre diferite variante; cititorul interesat poate calcula diferența dintre rezultate):

- *GRASS* ► *r.slope*
- *SAGA* ► *Pantă, Aspect, Curbură*
- *Panta GDAL*

Apoi vom crea un model de predicție a precipitațiilor, pe baza interpolării valorilor precipitațiilor de la stațiile meteo:

- *GRASS* ► *v.surf.rst* (rezoluția: 500 m)

Probabilitatea unei alunecări de teren va fi afectată atât de precipitații cât și de pantă (desigur, un model la scară reală va folosi mai multe straturi, și parametri mai potriviți), rezultând formula `(precipitații * pantă)/100`:

- *SAGA* ► *Calculator raster* precipitații, pantă: `(a*b)/100` (sau: *GRASS* ► *r.mapcalc*)

- apoi vom calcula care sunt municipalitățile cu un mai mare risc de precipitații: *SAGA* ► *Statistici pentru rastere cu poligoane* (parametrii de interes fiind *Maximum* și *Medie*)

CAPITOLUL 18

Module: Using Spatial Databases in QGIS

In this module you will learn about how to use Spatial Databases with QGIS to manage, display and manipulate data in the database as well as performing analysis by querying. We will primarily use PostgreSQL (which was covered in previous sections), but the same concepts are applicable to other spatial database implementations including SpatiaLite.

18.1 Lesson: Working with Databases in the QGIS Browser

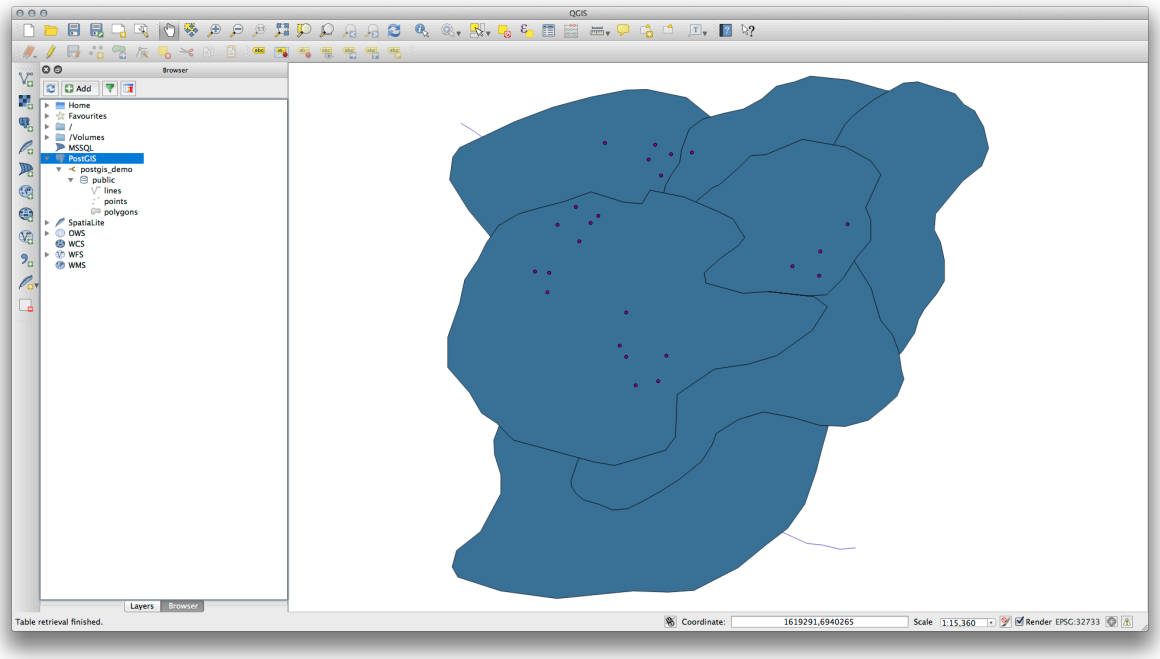
În cele 2 module anterioare am prezentat conceptele de bază, facilitățile și funcțiile de bază ale bazelor de date relaționale, precum și extensiile care permit stocarea, administrarea, interogarea și manipularea datelor spațiale. Această secțiune va aborda, în detaliu, utilizarea eficientă a bazelor de date spațiale în QGIS.

Scopul acestei lecții: Utilizarea interfeței QGIS pentru a interacționa cu bazele de date spațiale.

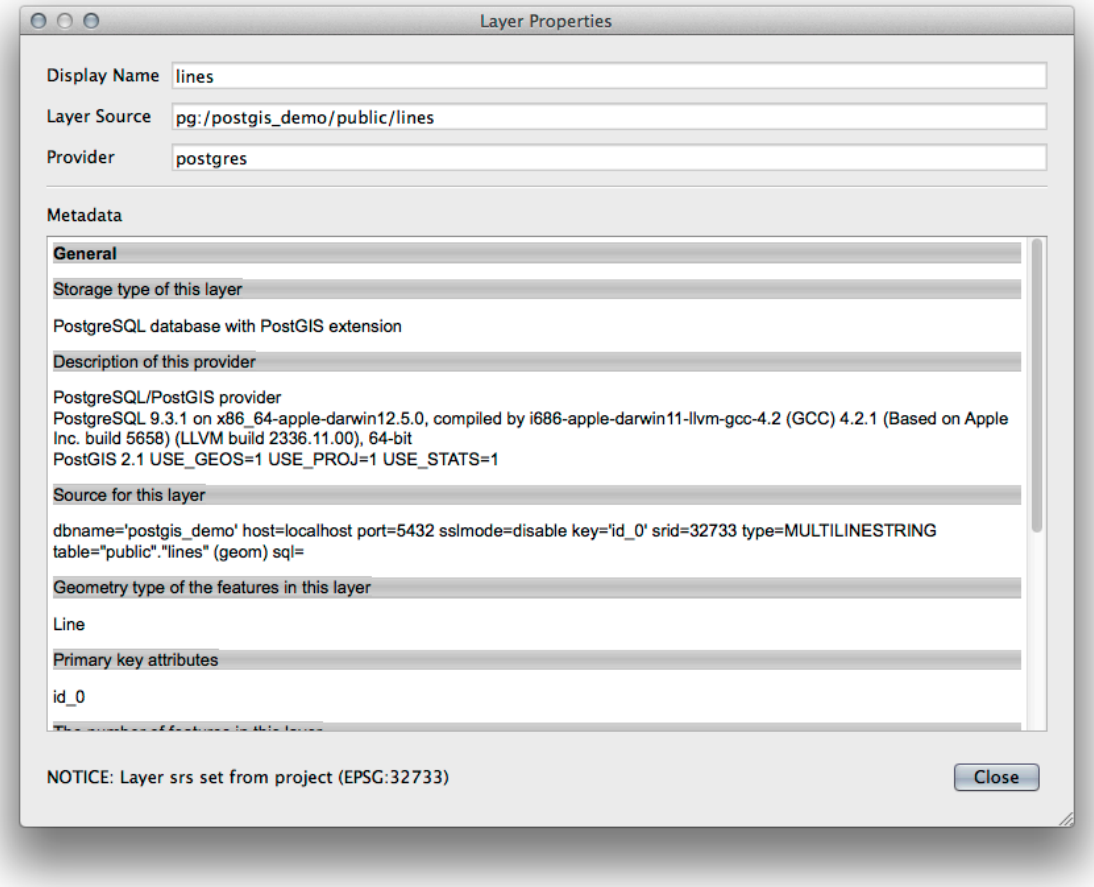
18.1.1 ??? Follow Along: Adding Database Tables to QGIS using the Browser

Am văzut, pe scurt, cum pot fi adăugate, sub formă de straturi QGIS, tabelele dintr-o bază de date; haideți acum să intrăm în mai multe detalii și să vedem diverse moduri de a face acest lucru în QGIS. Să aruncăm, mai întâi, o privire la noua interfață a Navigatorului.

- Începeți o nouă hartă în QGIS.
- Open the Browser by clicking the *Browser* tab. If you do not see this tab, you can enable it by going to *View* ► *Panels* ► *Browser*.
- Open the PostgreSQL portion of the tree and you should find your previously configured connection available (you may need to click the *Refresh* button at the top of the browser window).



- Un clic dublu pe oricare din tabelele/straturile listate aici va duce la adăugarea sa pe Canevasul Hărții.
- Făcând clic dreapta pe o tabelă/strat în această vizualizare veți observa câteva opțiuni. Alegeți *Proprietăți*, pentru a vedea proprietățile stratului.



Notă

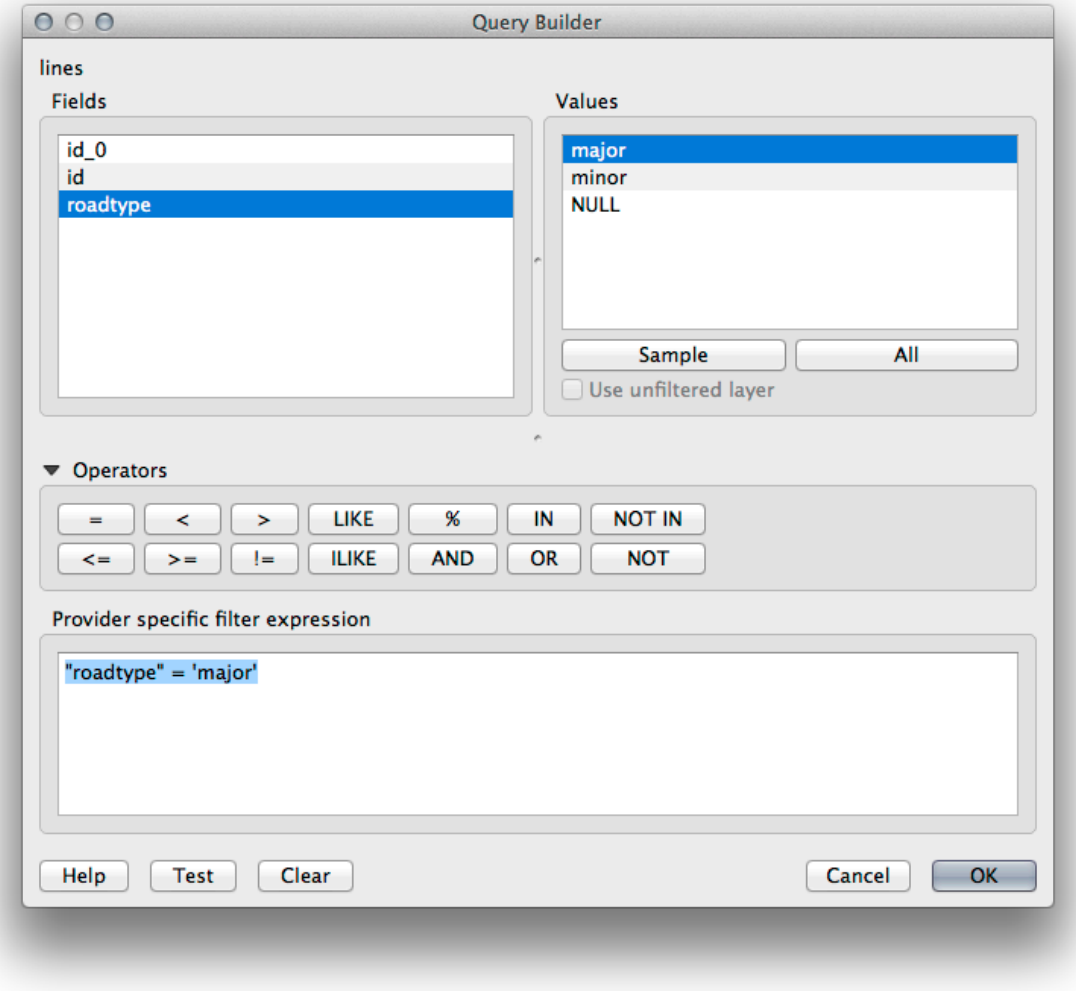
Of course you can also use this interface to connect to PostgreSQL databases hosted on a server external to your workstation. Right clicking on the PostgreSQL entry in the tree will allow you to specify connection parameters for a new connection.

18.1.2 ??? Follow Along: Adding a filtered set of records as a Layer

Acum, că am văzut cum puteți adăuga în QGIS un întreg tabel, sub formă de strat, puteți continua, adăugând un set de înregistrări filtrate dintr-un tabel, utilizând interogările învățate în secțiunile anterioare.

- Începeți o hartă nouă, fără straturi
- Click the *Add PostgreSQL Layers* button or select *Layer* ► *Add PostgreSQL Layers* from the menu.
- In the *Add PostgreSQL Table(s)* dialog that comes up, connect to the *postgis_demo* connection.
- Expand the *public schema* and you should find the three tables we were working with previously.
- Click the `lines` layer to select it, but instead of adding it, click the *Set Filter* button to bring up the *Query Builder* dialog.
- Construiți următoarea expresie, utilizând butoanele sau prin introducere directă:

```
"roadtype" = 'major'
```



- Faceți clic pe *OK* pentru a încheia editarea filtrului, apoi pe *Adăugare*, pentru a adăuga pe hartă stratul filtrat.
- Rename the `lines` layer in the tree to `roads_primary`.

Veți observa că numai Drumurile Primare au fost adăugate pe hartă, și nu întregul strat.

18.1.3 În concluzie

Ați văzut cum se poate interacționa cu bazele de date spațiale folosind QGIS Browser, și modul în care se pot adăuga straturi pe hartă în funcție de un filtru de interogare.

18.1.4 Ce urmează?

În continuare, este prezentat lucrul cu interfața Managerului DB din QGIS, pentru o serie amplă de activități de gestiune a bazelor de date.

18.2 Lesson: Using DB Manager to work with Spatial Databases in QGIS

Am văzut deja cum se pot efectua în QGIS multe operații cu bazele de date, la fel de simplu ca și cu celelalte instrumente, dar acum este timpul să ne uităm la instrumentul DB Manager, care oferă o mare parte din aceeași funcționalitate, similar cu alte instrumente dedicate managementului.

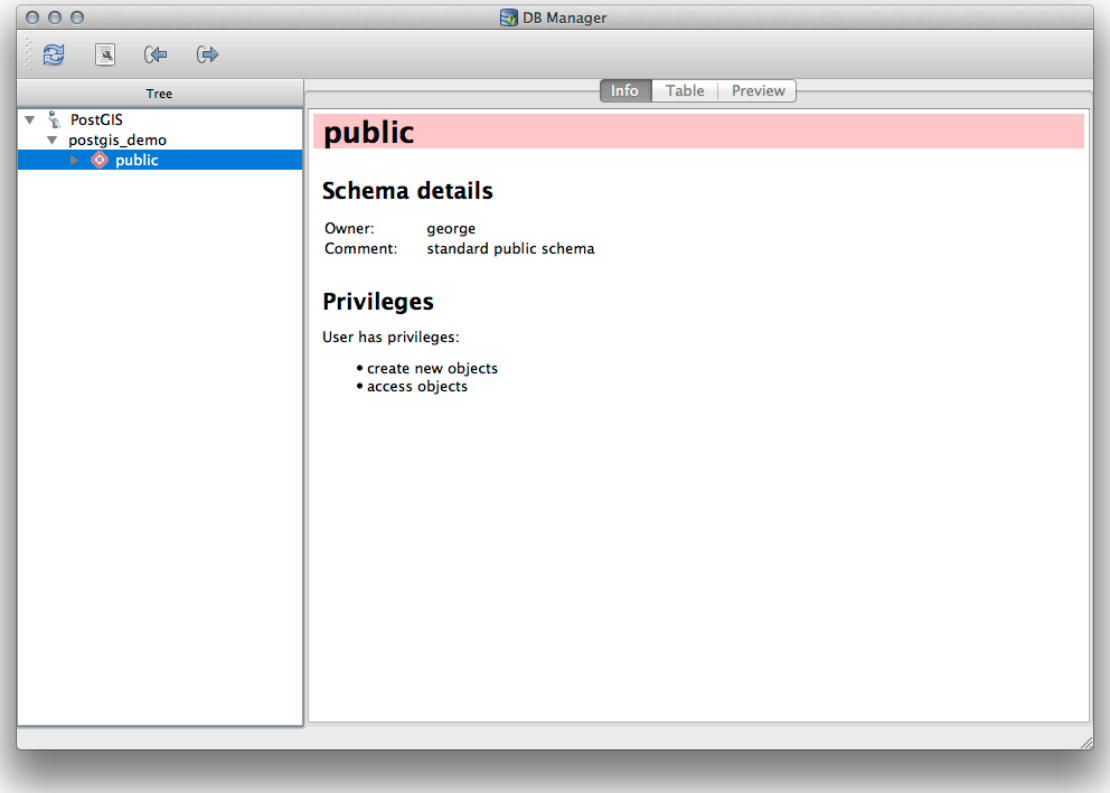
Scopul acestei lecții: De a se învăța interacțiunea cu bazele de date raster, folosind interfața DB Manager din QGIS.

18.2.1 ??? Follow Along: Managing PostgreSQL Databases with DB Manager

You should first open the DB Manager interface by selecting *Database* ► *DB Manager* ► *DB Manager* on the menu or by selecting the DB Manager icon on the toolbar.

You should already see the previous connections we have configured and be able to expand the `myPG` section and its `public` schema to see the tables we have worked with in previous sections.

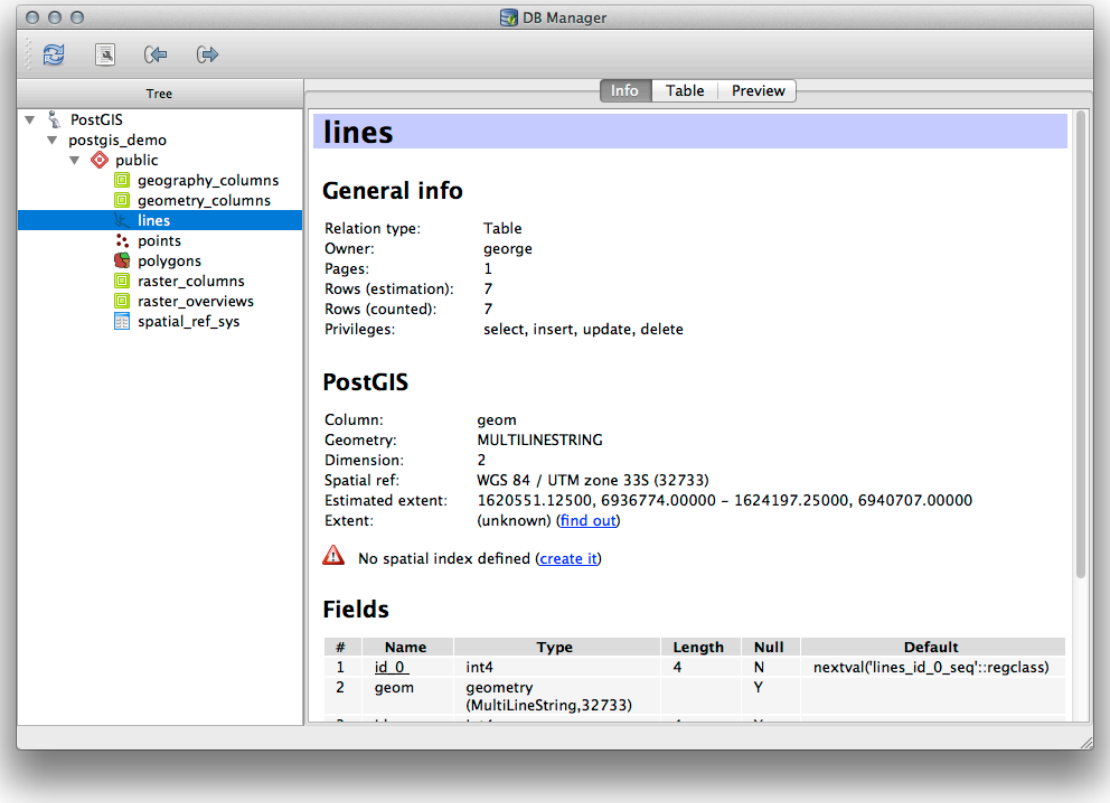
Primul lucru care se remarcă este faptul că, de acum, puteți vedea unele metadate ale Schemelor conținute în baza de date.



Schemas are a way of grouping data tables and other objects in a PostgreSQL database and a container for permissions and other constraints. Managing PostgreSQL schemas is beyond the scope of this manual, but you can find more information about them in the PostgreSQL documentation on Schemas. You can use the DB Manager to create new Schemas, but will need to use a tool like pgAdmin III or the command line interface to manage them effectively.

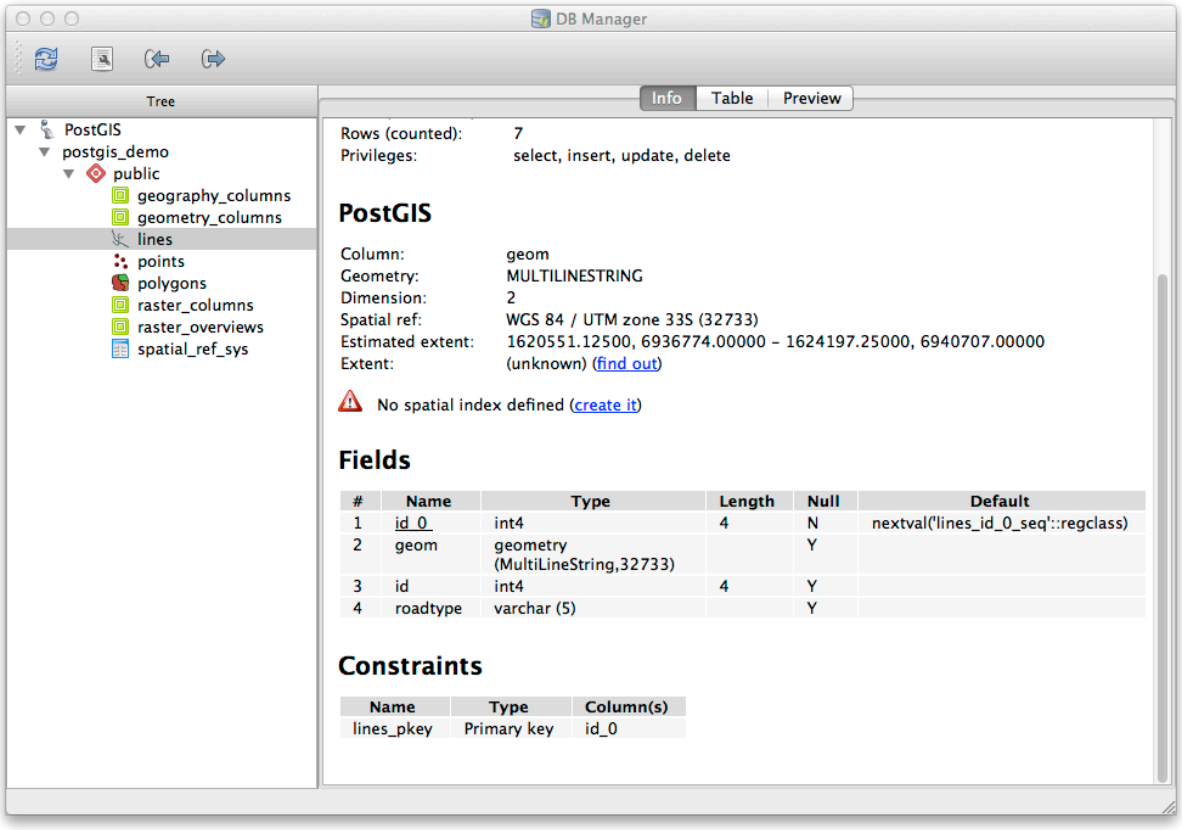
De asemenea, DB Manager se poate folosi pentru a administra tabelele din baza de date. Am analizat deja diferite moduri de creare și gestionare a tabelelor din linia de comandă, dar acum dorim să vedem cum se poate face acest lucru în DB Manager.

First, its useful to just look at a table's metadata by clicking on its name in tree and looking in the *Info* tab.

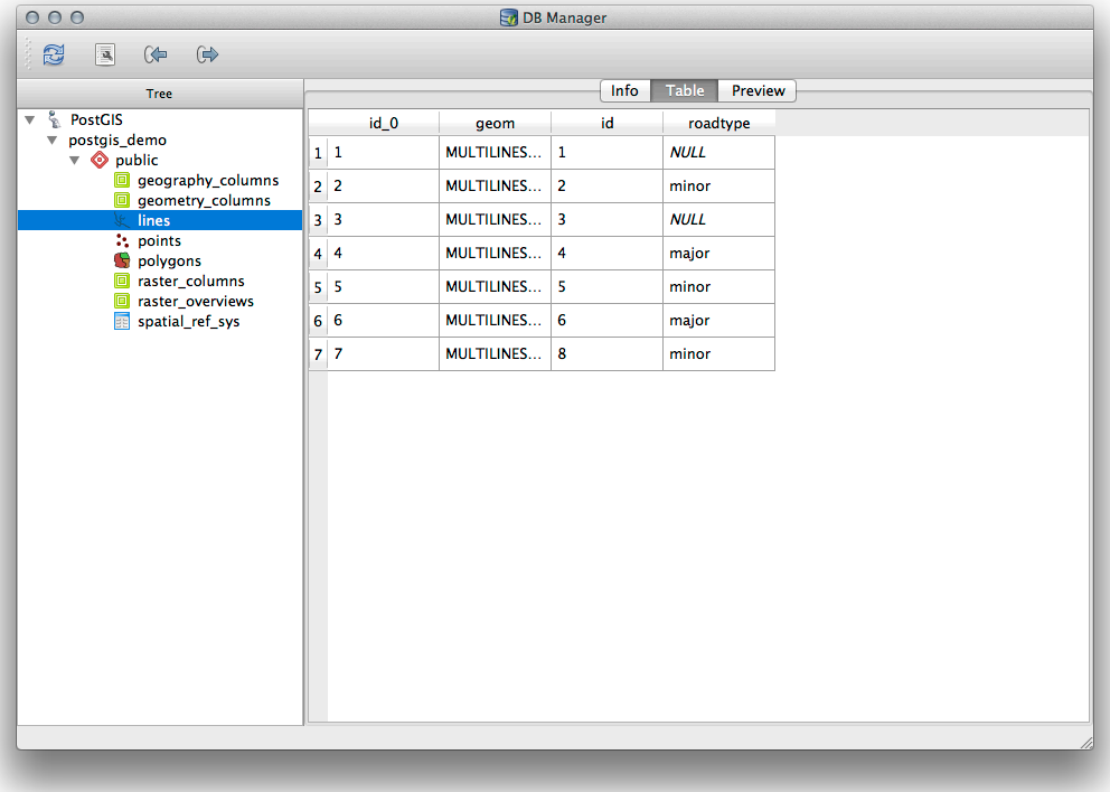


In this panel you can see the *General Info* about the table as well the information that the PostGIS extension maintains about the geometry and spatial reference system.

If you scroll down in the *Info* tab, you can see more information about the *Fields*, *Constraints* and *Indexes* for the table you are viewing.



Its also very useful to use DB Manager to simply look at the records in the database in much the same way you might do this by viewing the attribute table of a layer in the Layer Tree. You can browse the data by selecting the *Table* tab.

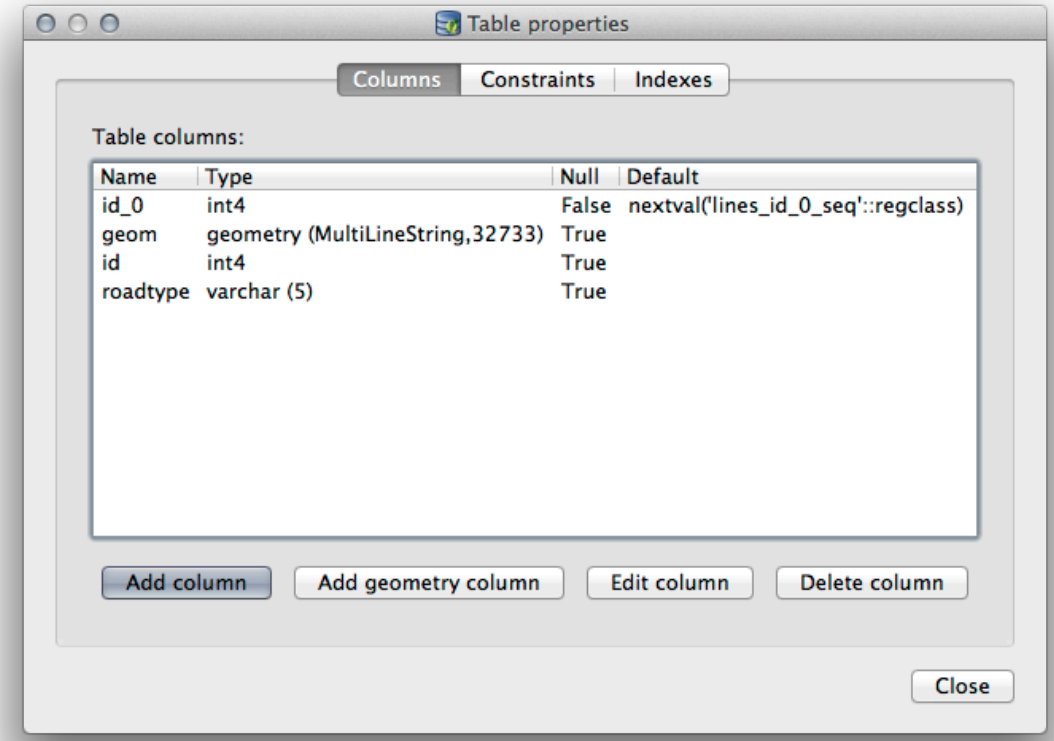


Există, de asemenea o filă *Preview*, care vă va arăta datele stratului într-o hartă de previzualizare.

Click-dreapta pe unul dintre straturi și, făcând clic pe *Add to Canvas*, acesta se va adăuga pe hartă.

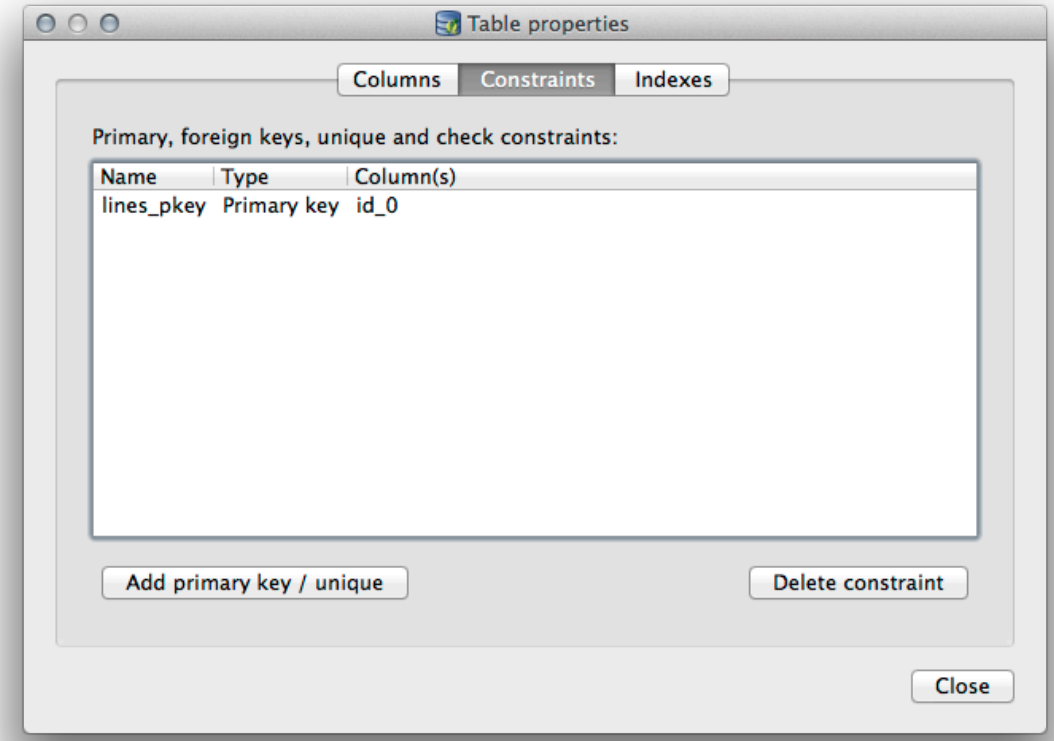
So far we have only been viewing the database its schemas and tables and their metadata, but what if we wanted to alter the table to add an additional column perhaps? DB Manager allows you to do this directly.

1. Selectați din arbore tabela pe care doriți să o editați
2. Select *Table* ► *Edit Table* from the menu, to open the *Table Properties* dialog.

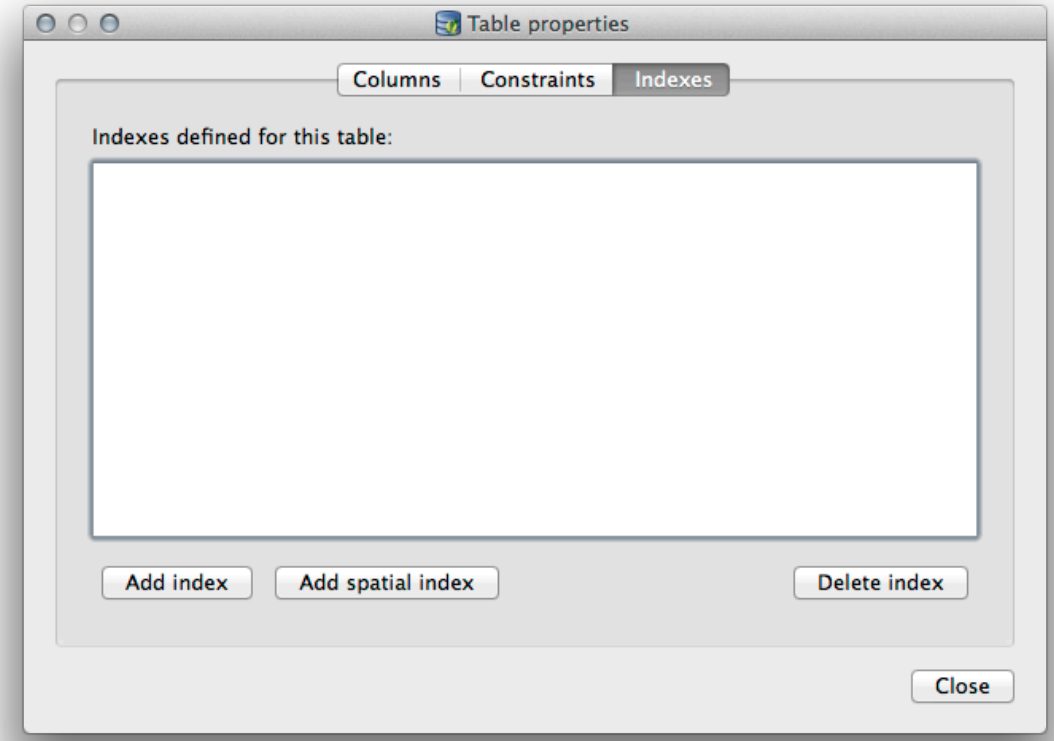


Puteți folosi acest dialog pentru a Adăuga Coloane, Coloane pentru geometrii, pentru a edita coloanele existente sau pentru a elimina complet o coloană.

Using the *Constraints* tab, you can manage which fields are used as the primary key or to drop existing constraints.



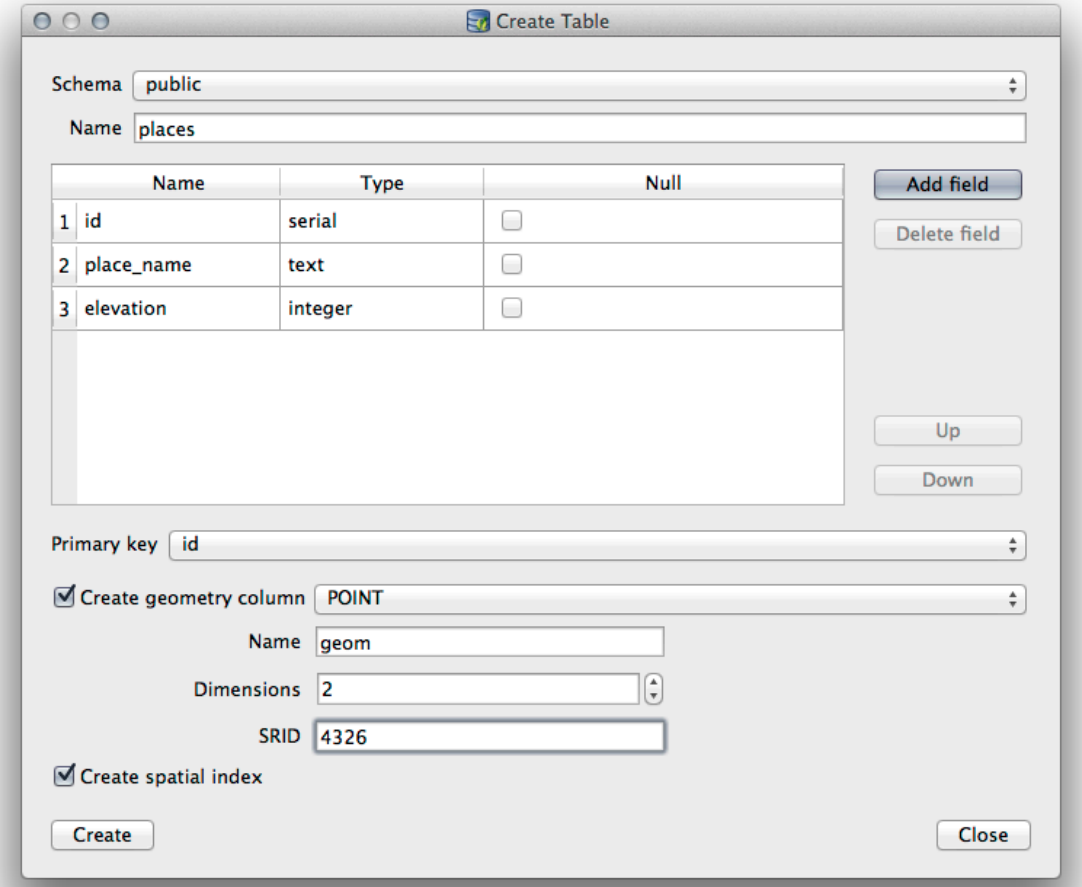
Fila *Indecșilor* poate fi folosită pentru a adăuga și șterge atât indicii spațiali, cât și cei normali.



18.2.2 Follow Along: Creating a New Table

Acum, că am trecut prin procesul de lucru cu tabelele existente în baza noastră de date, haideți să folosim DB Manager pentru a crea o nouă tabelă.

1. If it is not already open, open the DB Manager window, and expand the tree until you see the list of tables already in your database.
2. Selectați meniul :guilabel:`Table –> Create Table`pentru a deschide dialogul de Creare a Tabelei.
3. Use the default `Public` schema and name the table `places`.
4. Add the `id`, `place_name`, and `elevation` fields as shown below
5. Make sure the `id` field is set as the primary key.
6. Click the checkbox to *Create geometry column* and make sure it is set to a `POINT` type and leave it named `geom` and specify `4326` as the *SRID*.
7. Faceți clic pe caseta de bifare de *Creare a indexului spațial*, apoi pe *Create* pentru a crea tabela.



8. Închideți dialogul care vă informează că tabela s-a creat cu succes, apoi faceți clic pe *Close* pentru a închide Dialogul de Creare a Tabelei.

You can now inspect your table in the DB Manager and you will of course find that there is no data in it. From here you can *Toggle Editing* on the layer menu and begin to add places to your table.

18.2.3 ??? Follow Along: Basic Database Administration

The DB Manager will also let you do some basic database administration tasks. It is certainly not a substitute for a more complete database administration tool, but it does provide some functionality that you can use to maintain your database.

Database tables can often become quite large and tables which are being modified frequently can end up leaving around remnants of records that are no longer needed by PostgreSQL. The *VACUUM* command takes care of doing a kind of garbage collection to compact and optional analyze your tables for better performance.

Let us take a look at how we can perform a *VACUUM ANALYZE* command from within DB Manager.

1. Select one of your tables in the DB Manager Tree
2. Select *Table* ► *Run Vacuum Analyze* from the menu

PostgreSQL will now perform the operation. Depending on how big your table is, this may take some time to complete.

You can find more information about the VACUUM ANALYZE process in the PostgreSQL Documentation on VACUUM ANALYZE.

18.2.4 ??? Follow Along: Executing SQL Queries with DB Manager

DB Manager also provides a way for you to write queries against your database tables and to view the results. We have already seen this type of functionality in the *Browser* panel, but lets look at it again here with DB Manager.

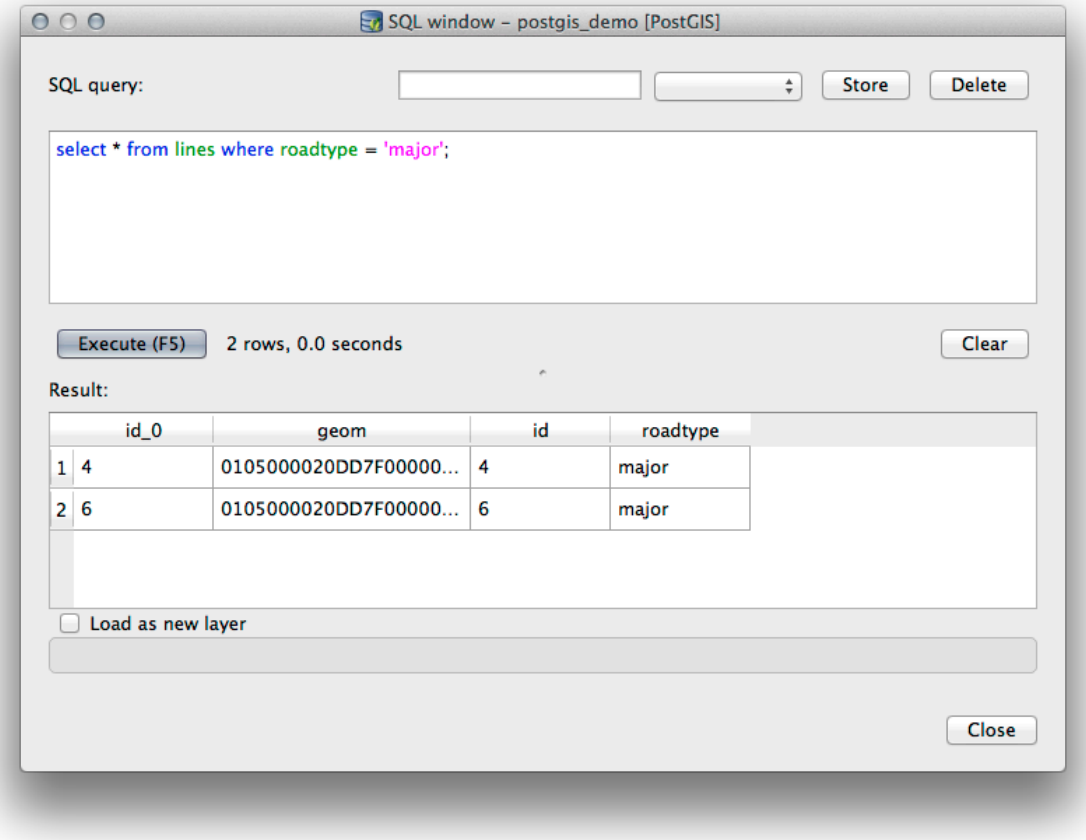
1. Select the `lines` table in the tree.
2. Selectați butonul *SQL window* din bara de instrumente DB Manager.



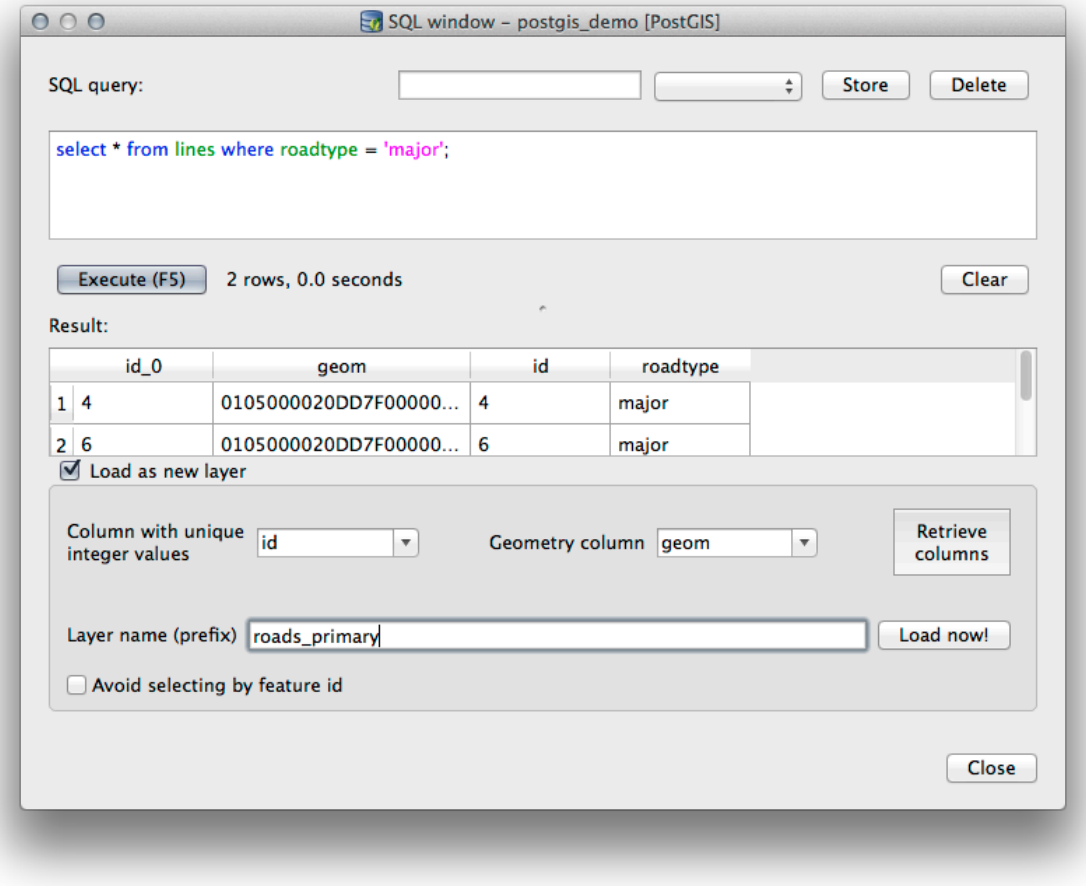
3. Compuneți următoarea *Interogare SQL* în spațiul furnizat:

```
select * from lines where roadtype = 'major';
```

4. Clic pe butonul *Execute (F5)* pentru a rula interogarea.
5. Ar trebui să vedeți acum înregistrările care corespund panoului *Rezultate*.



6. Faceți clic pe caseta de bifare *Load as new layer* pentru a adăuga rezultatele în harta dvs.
7. Select the `id` column as the *Column with unique integer values* and the `geom` column as the *Geometry column*.
8. Enter `roads_primary` as the *Layer name (prefix)*.
9. Faceți clic pe *Load now!* pentru a încărca rezultatele ca un nou strat în harta dvs.



The layers that matched your query are now displayed on your map. You can of course use this query tool to execute any arbitrary SQL command including many of the ones we looked at in previous modules and sections.

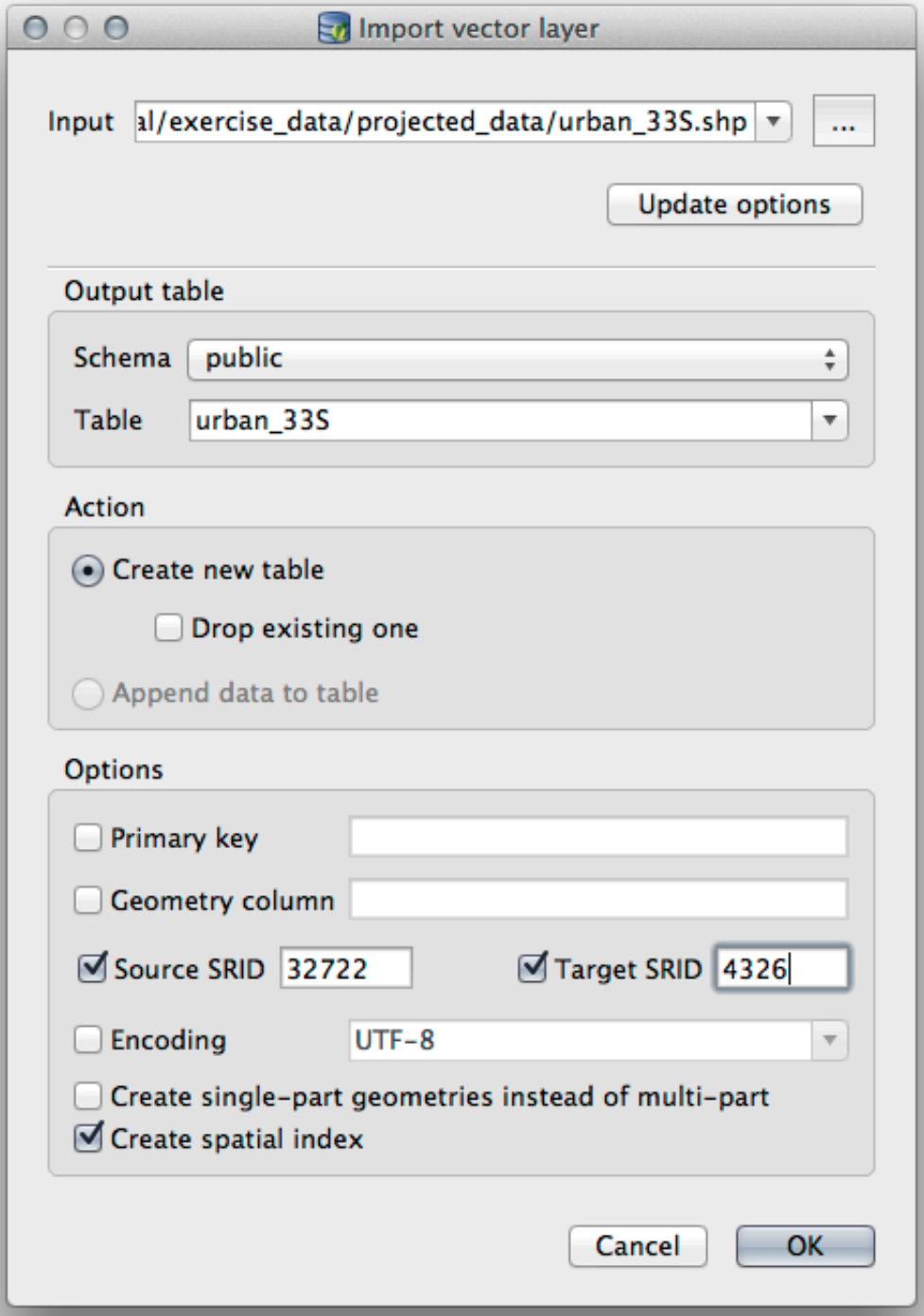
18.2.5 Importarea datelor dintr-o Bază de date cu ajutorul DB Manager

We have already looked at how to import data into a spatial database using command line tools, so now let's learn how to use DB Manager to do imports.

1. Clic pe butonul *Import layer/file* din Bara de Instrumente a dialogului DB Manager.

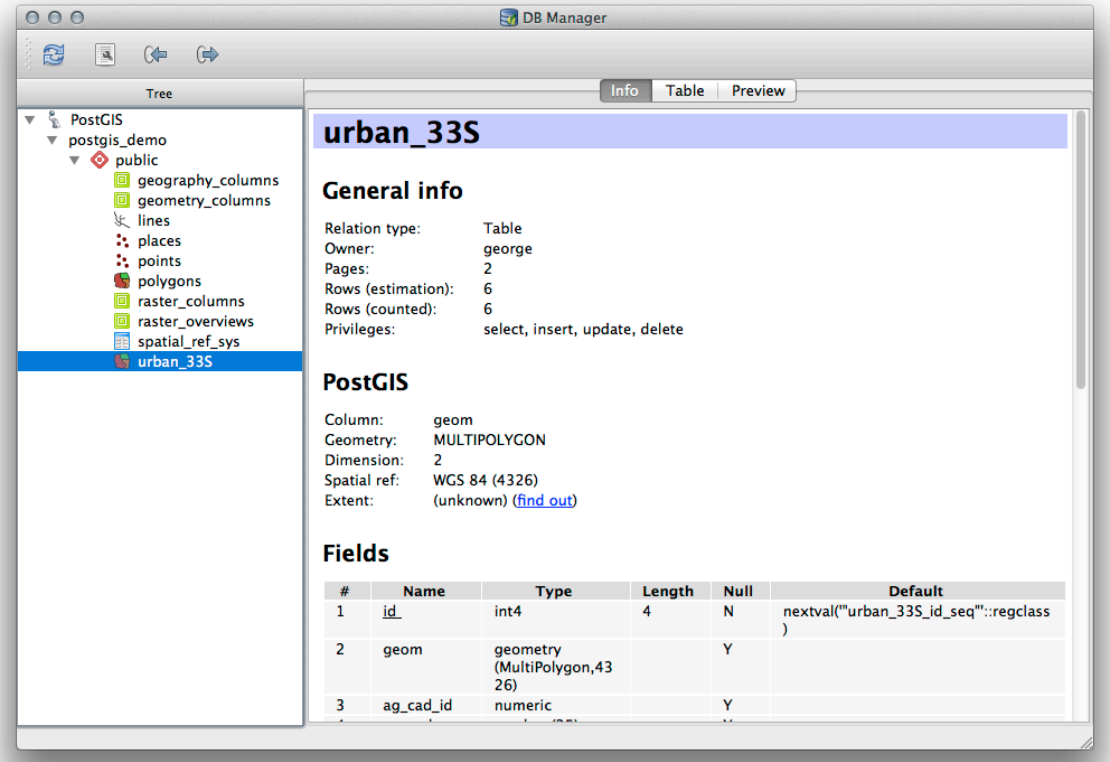


2. Select the `urban_33S.shp` file from `exercise_data/projected_data` as the input dataset
3. Clic pe butonul *Opțiunilor de actualizare* pentru a pre-completa unele din valorile formularului.
4. Asigurați-vă că este selectată opțiunea *Creare tabelă nouă*.
5. Specify the *Source SRID* as `32722` and the *Target SRID* as `4326`
6. Activați caseta de bifare pentru a *Crea îndexul Spațial*
7. Click *OK* to perform the import



8. Închideți dialogul care vă informează că importul a avut loc cu succes
9. Click the *Refresh* button on the DB Manager Toolbar

You can now inspect the table in your database by clicking on it in the Tree. Verify that the data has been reprojected by checking that the *Spatial ref:* is listed as `WGS 84 (4326)`.

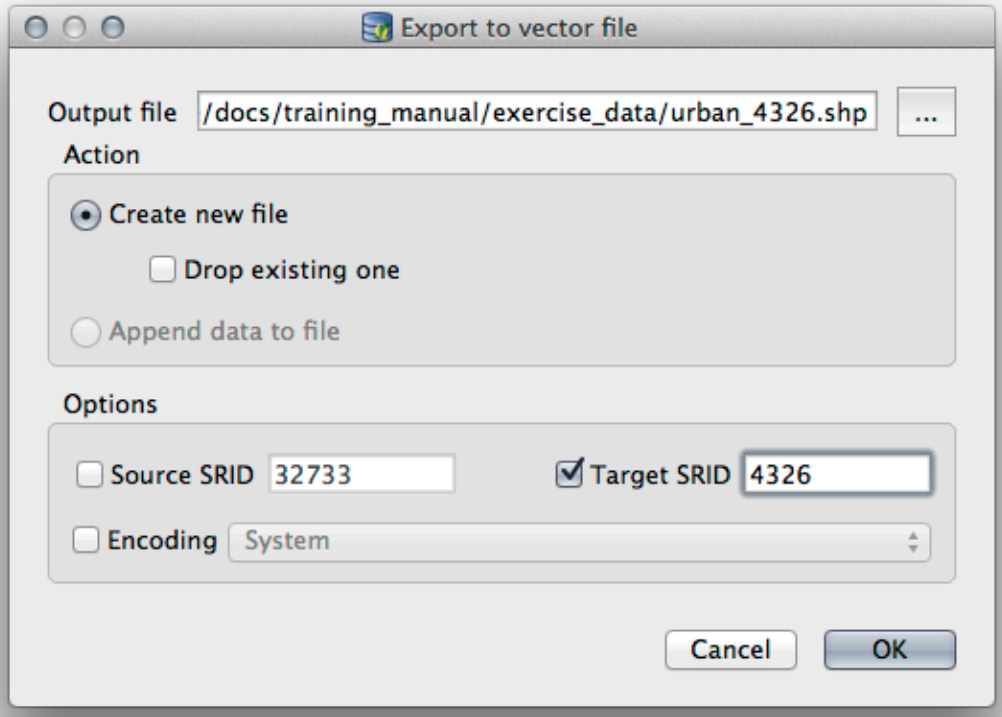


Click-dreapta pe unul dintre straturile din Arbore și apoi, făcând clic pe *Adăugare la Canevas*, tabela se va adăuga pe hartă, sub formă de strat.

18.2.6 Exportul datelor cu DB Manager dintr-o Bază de date

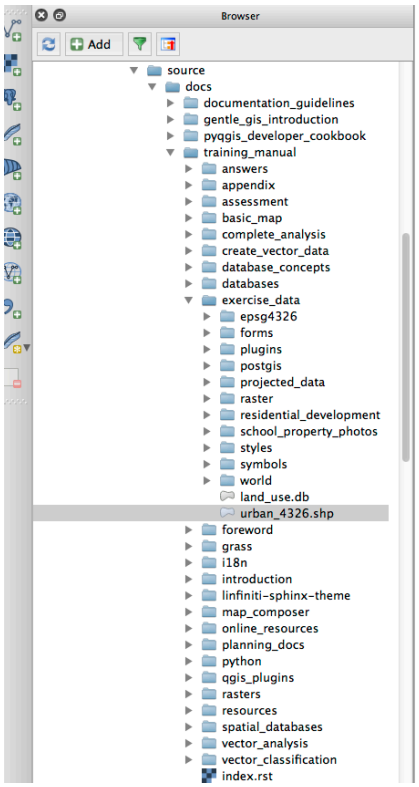
De asemenea, DB Manager se poate utiliza pentru exportul datelor din bazele de date spațiale, așa că haideți să aruncăm o privire la modul în care se face aceasta.

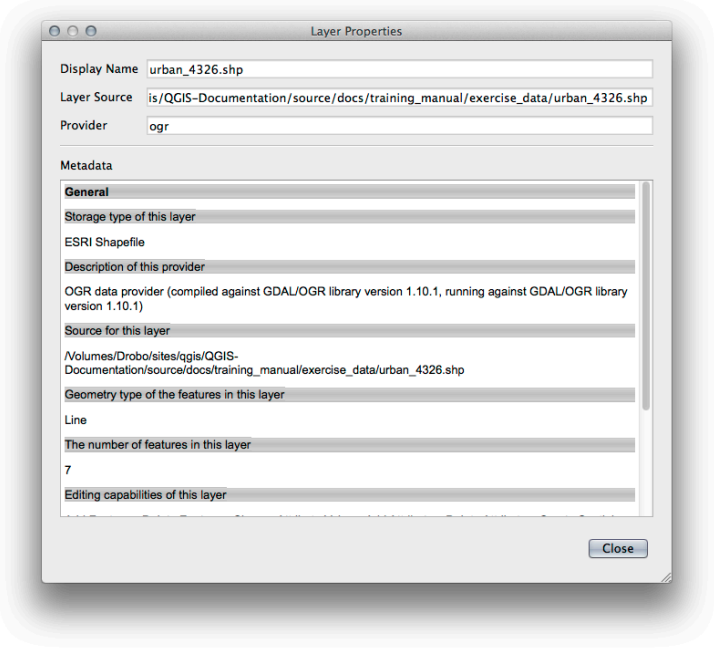
1. Select the `lines` layer in the Tree and click the *Export to File* button on the toolbar to open the *Export to vector file* dialog.
2. Click the … button to select the *Output file* and save the data to your `exercise_data` directory as `urban_4326`.
3. Set the *Target SRID* as `4326`.
4. Clic *OK* pentru a inițializa exportul.



5. Închideți dialogul care vă informează că exportul a avut loc cu succes, apoi închideți DB Manager.

Puteți inspecta de acum fișierul shape pe care l-ați creat cu panoul de Răsfoire.





18.2.7 În concluzie

You have now seen how to use the DB Manager interface in QGIS to manage your spatial databases, to execute SQL queries against your data and how to import and export data.

18.2.8 Ce urmează?

Next, we will look at how to use many of these same techniques with *SpatiaLite* databases.

18.3 Lesson: Working with SpatiaLite databases in QGIS

While PostGIS is generally used on a server to provide spatial database capabilities to multiple users at the same time, QGIS also supports the use of a file format called *SpatiaLite* that is a lightweight, portable way to store an entire spatial database in a single file. Obviously, these 2 types of spatial databases should be used for different purposes, but the same basic principles and techniques apply to both. Let's create a new SpatiaLite database and explore the functionality provided to work with these databases in QGIS.

The goal for this lesson: To learn how to interact with SpatiaLite databases using the QGIS Browser interface.

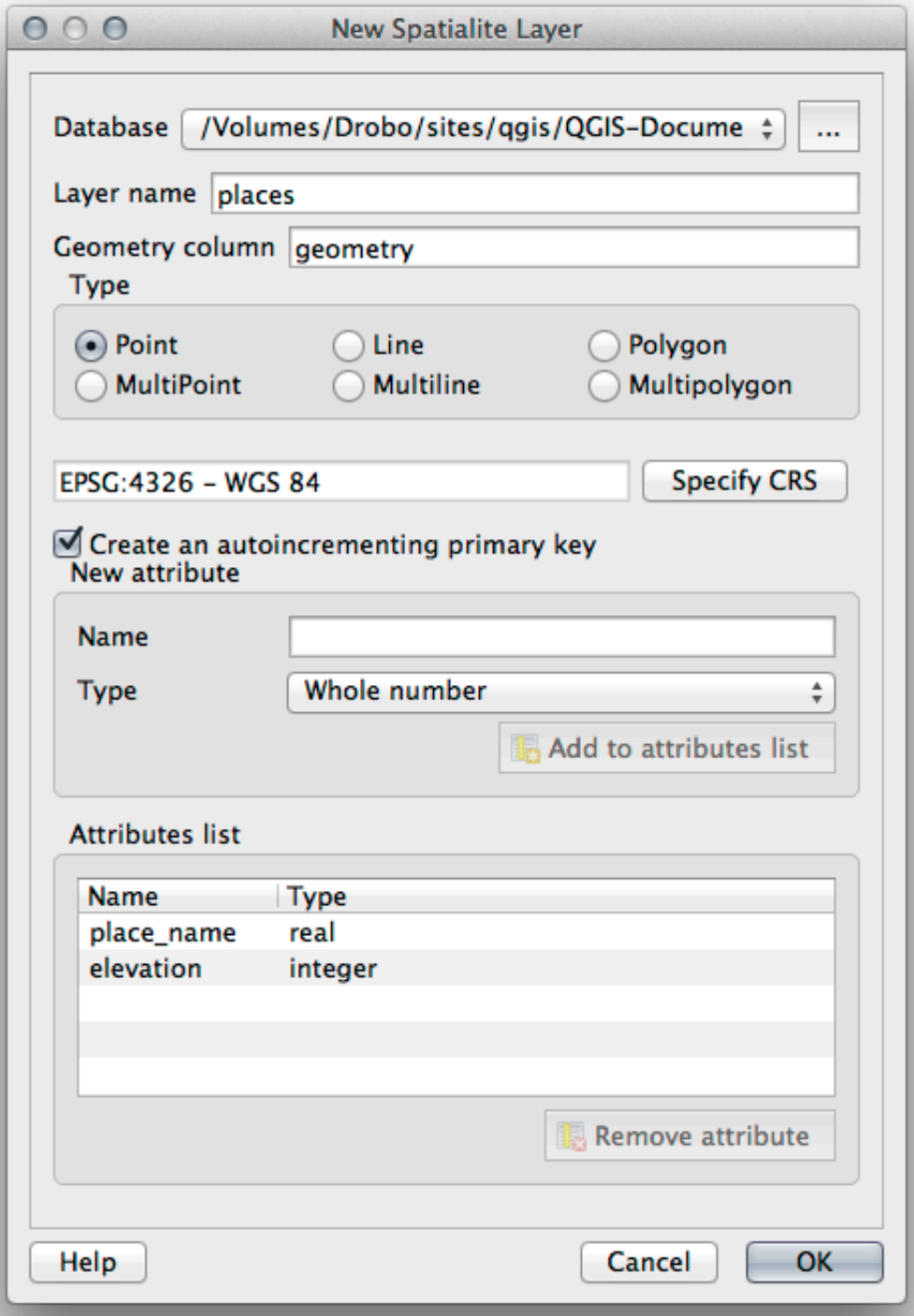
18.3.1 ??? Follow Along: Creating a SpatiaLite database with the Browser

Using the Browser panel, we can create a new SpatiaLite database and get it setup for use in QGIS.

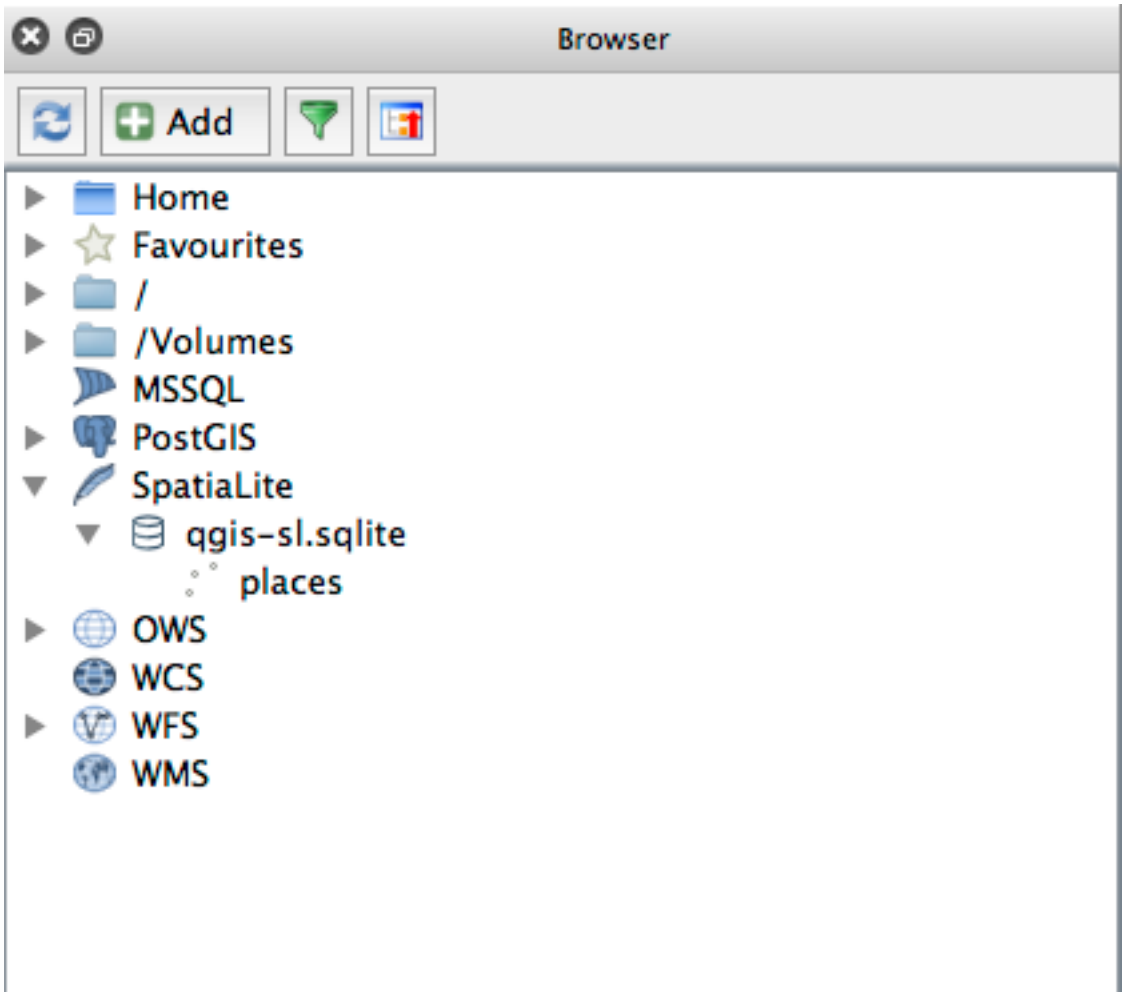
1. Right click on the *SpatiaLite* entry in the Browser tree and select *Create Database*.
2. Specify where on your filesystem you want to store the file and name it `qgis-sl.db`.
3. Again right click on the *SpatiaLite* entry in the Browser tree and now select the *New Connection* item. Find the file you created in the last step and open it.

Acum, că v-ați configurat noua bază de date, veți descoperi că intrarea din arborele Navigatorului nu are nimic sub ea, iar singurul lucru pe care îl puteți face în acest moment este de a șterge conexiunea. Acest lucru se datorează faptului că, desigur, noi nu am adăugat nici un tabel în această bază de date. Haideți să mergem mai departe și să facem asta.

1. Find the button to create a new layer and use the dropdown to create a new SpatiaLite layer, or select *Layer* ► *New* ►  *New SpatiaLite Layer*.
2. Selectați baza de date pe care am creat-o în pașii anteriori în meniul derulant.
3. Give the layer the name `places`.
4. Bifați caseta de lângă *Create an auto-incrementing primary key*.
5. Add two attributes as shown in below
6. Clic pe *OK*, pentru a crea tabela.



7. Click the refresh button at the top of the Browser and you should now see your `places` table listed.



Puteți să faceți clic dreapta pe tabelă și să-i vizualizați proprietățile, așa cum am făcut-o în exercițiul precedent.

De aici puteți începe o sesiune de editare și să adăugați date direct la noua bază de date.

We also learned about how to import data into a database using the DB Manager and you can use this same technique to import data into your new SpatiaLite DB.

18.3.2 În concluzie

You have seen how to create SpatiaLite databases, add tables to them and use these tables as layers in QGIS.

CAPITOLUL 19

Anexă: Contribuții La Acest Manual

To add materials to this course, you must follow the guidelines in this Appendix. You are not allowed to alter the conditions in this Appendix except for clarification. This is to ensure that the quality and consistency of this manual can be maintained.

19.1 Descărcare resurse.

Sursa acestui document se poate găsi la GitHub. Consultați GitHub.com pentru instrucțiunile de folosire a sistemului de versionare git.

19.2 Formatul Manualului

Acest manual este scris folosind Sphinx, un generator de documente Python, care folosește limbajul de marcare **`reStructuredText <https://docutils.sourceforge.io/rst.html >`_** . Instrucțiuni despre cum să utilizați aceste instrumente sunt disponibile pe respectivele site-uri.

19.3 Adăugarea unui Modul

To add a new module:

1. First create a new directory (directly under the top-level of the `qgis-training-manual` directory) with the name of the new module.
2. Under this new directory, create a file called `index.rst`. Leave this file blank for now.
3. Open the `index.rst` file under the top-level directory. Its first lines are:

```
.. toctree::
   :maxdepth: 2

   foreword/index
   introduction/index
```

You will note that this is a list of directory names, followed by the name `index`. This directs the top-level index file to the index files in each directory. The order in which they are listed determines the order they will have in the document.

1. Add the name of your new module (i.e., the name you gave the new directory), followed by `/index`, to this list, wherever you want your module to appear.
2. Amintiți-vă să mențineți ordinea modulelor logice, astfel încât modulele ulterioare se construiesc pe cunoștințele prezentate în modulele anterioare.
3. Open your new module's own index file (*`module_name`*`/index.rst`).
4. Along the top of the page, create the module heading:
   1. write a first line of asterisks (`*`).
   2. Follow this with a line containing the markup phrase `Module:`, followed by the name of your module.
   3. End this off with another line of same number of asterisks.

> **Notă**
>
> The underline and the overline should not be shorter than the line containing the module title.

5. Lăsați o linie deschisă după aceasta.
6. Scrieți un scurt paragraf, explicând scopul și conținutul modulului.
7. Lăsați o linie deschisă, apoi adăugați următorul text:

```
.. toctree::
   :maxdepth: 2

   lesson1
   lesson2
```

… where `lesson1`, `lesson2`, etc., are the names of your planned lessons.

Fișierul index la nivel de modul va arăta astfel:

```
*******************************************************************************
Module: Module Name
*******************************************************************************

Short paragraph describing the module.

.. toctree::
   :maxdepth: 2

   lesson1
   lesson2
```

19.4 Adăugarea unei Lecții

Pentru a adăuga o lecție pentru un modul nou sau existent:

1. Deschideți directorul modulului
2. Open the `index.rst` file (created above in the case of new modules).
3. Ensure that the name of the planned lesson is listed underneath the `toctree` directive, as shown above.
4. Creați un nou fișier în directorul modulul.
5. Name this file exactly the same as the name you provided in the module's `index.rst` file, and add the extension `.rst`.

> **Notă**
>
> For editing purposes, a `.rst` file works exactly like a normal text file (`.txt`).

1. To begin writing the lesson, write the markup phrase `Lesson`, followed by the lesson name.
2. In the next line, write a line of equal signs (=), not shorter than the lesson title.
3. Lăsați o linie deschisă după aceasta.
4. Scrieți o scurtă descriere asupra scopului lecției.
5. Includeți o introducere generală în subiect. Parcurgeți lecțiile existente în acest manual, pentru exemple.
6. Sub aceasta, începeți un nou alineat, începând cu această frază:

```
**The goal for this lesson:**
```

7. Explicați pe scurt rezultatul intenționat al completării acestei lecții.
8. În cazul în care obiectivul lecției nu se poate descrie într-una sau două propoziții, luați în considerare împărțirea subiectului în mai multe lecții.

Fiecare lecție va fi împărțită în mai multe secțiuni, care vor fi abordate în continuare.

19.5 Adăugarea unei Secțiuni

Există două tipuri de secțiuni: „procedați în mod similar” și „încercați singuri”.

- O secțiune de „urmărire” reprezintă un set detaliat de instrucțiuni, menite să învețe cititorul cum să folosească un anumit aspect din QGIS. Acest lucru se face, de obicei, oferind instrucțiuni clic cu clic, cât mai clar posibil, intercalate cu capturi de ecran.
- A „try yourself” section gives the reader a short assignment to try by themselves. It is usually associated with an entry in the answer box beneath, which will show or explain how to complete the assignment, and will show the expected outcome if possible.

Every section comes with a difficulty level. An easy section is denoted by ★☆☆, moderate by ★★☆, and advanced by ★★★.

19.5.1 Adăugați o secțiune „procedați în mod similar”

1. Pentru a începe această secțiune, scrieți fraza de marcare a nivelului de dificultate intenționat (după cum se arată mai sus).
2. Leave a space and then write `Follow Along:`.
3. Lăsați un alt spațiu și scrieți numele secțiunii (folosiți doar o literă mare, precum și majuscule pentru substantive proprii).
4. In the next line, write a line of minuses/dashes (−), not shorter than the section title.
5. Scrieți o scurtă introducere a secțiunii, explicându-i scopul. Apoi oferiți instrucțiuni detaliate (clic-după-clic) privind procedura care trebuie demonstrată.
6. În fiecare secțiune, includeți link-uri interne, link-uri externe și capturi de ecran după cum este necesar.
7. Încercați să terminați fiecare secțiune cu un scurt paragraf, care să se încheie și să conducă în mod natural la secțiunea următoare, dacă este posibil.

19.5.2 Adăugați o secțiune „încercați singuri”

1. Pentru a începe această secțiune, scrieți fraza de marcare a nivelului de dificultate intenționat (după cum se arată mai sus).
2. Leave a space and then write `Try Yourself:`.
3. In the next line, write a line of minuses/dashes (−), not shorter than the section title.
4. Explicați exercițiul pe care doriți ca cititorul să-l finalizeze. Consultați secțiunile anterioare, lecțiile sau modulele, dacă este necesar.
5. Includeți capturi de ecran pentru a clarifica cerințele, în cazul în care o descriere textuală simplă nu este de ajuns.

In most cases, you will want to provide an answer regarding how to complete the assignment given in this section. To do so, you will need to create and feed an answer block beneath the instructions.

1. First, create the custom collapsible widget that contains the answer:

```
.. admonition:: Answer
   :class: dropdown
```

2. Keeping an indentation with regard to the above block, write the instructions on how to complete the assignment, using links and images where needed.

19.6 Adăugarea unei Concluzii

To end a lesson:

1. Write the phrase `In Conclusion`, followed by a new line of minuses/dashes (−).
2. Write a conclusion for the lesson, explaining which concepts have been covered in the lesson.

19.7 Adăugarea unei Secțiuni de Lecturi suplimentare

Această secțiune este opțională.

- Write the phrase `Further Reading`, followed by a new line of minuses/dashes (`-`).
- Includeți trimiteri către site-urile externe corespunzătoare.

19.8 Adăugarea Secțiunii „Ce Urmează”

1. Scrieți expresia `Ce urmează?`, urmată de o nouă linie de minusuri/liniuțe (`-`).
2. Explicați modul în care a pregătit această lecție studenții pentru lecția sau modulul următor.
3. Nu uitați să schimbați secțiunea „ce urmează” din lecția anterioară, dacă este necesar, astfel încât să se refere la noua dvs. lecție. Acest lucru va fi necesar dacă ați introdus o nouă lecție printre lecțiile existente sau după o lecție existentă.

19.9 Utilizarea Marcajelor

Pentru a adera la standardele acestui document, va trebui să adăugați marcajul standard textului dvs.

19.9.1 Noi concepte

If you are explaining a new concept, you will need to write the new concept's name in italics by enclosing it in asterisks (`*`).

```
This sample text shows how to introduce a *new concept*.
```

19.9.2 Atenție specială

- To emphasize a crucial term which is not a new concept, write the term in bold by enclosing it in double asterisks (`**`).
- Folosiți-le cu moderație! Dacă utilizați prea multe, cititorul ar putea avea impresia că strigați sau ca aveți un aer de superioritate.

```
This sample text shows how to use **emphasis** in a sentence. Include the
punctuation mark if it is followed by a **comma,** or at the **end of the
sentence.**
```

19.9.3 Images

- When adding an image, save it to an `img` folder next to the lesson file.
- Includeți-l în document, în felul următor:

```
.. figure:: img/image_file.extension
   :align: center
```

- Nu uitați să lăsați o linie, deasupra și dedesubtul marcajului imaginii.

19.9.4 Legături interne

- Pentru a crea o ancoră pentru un link, scrieți următoarea linie deasupra locului către care doriți să indice linkul:

```
.. _link-name:
```

- Nu uitați să lăsați o linie, deasupra și dedesubtul acestei linii.
- To create a link, refer to it as below:

```
:ref:`Descriptive link text <link-name>`
```

19.9.5 Legături externe

- Pentru a crea o legătură externă, scrieți-o astfel:

```
`Descriptive link text <link-url>`_
```

19.9.6 Utilizați text monospațiat

- When you are writing text that the user needs to enter, a path name, or the name of a database element such as a table or column name, you must write it in `monospaced text`. For example:

```
Enter the following path in the text box: ``path/to/file``.
```

19.9.7 Etichetarea elementelor GUI

- Dacă vă referiți la un element GUI, cum ar fi un buton, trebuie să scrieți numele acestuia în *formatul etichetei GUI*. De exemplu:

```
To access this tool, click on the :guilabel:`Tool Name` button.
```

- Acest lucru se aplică, de asemenea, dacă menționați numele unui instrument fără a cere utilizatorului să efectueze clic pe un buton.

19.9.8 Selecția meniului

- Dacă ghidați un utilizator prin meniuri, trebuie să utilizați *menu* ► *selection* ► *format*. De exemplu:

```
To use the :guilabel:`Tool Name` tool, go to :menuselection:`Plugins -->
Tool Type --> Tool Name`.
```

19.9.9 Adăugarea notelor

- You might need to add a note in the text, which explains extra details that can't easily be made part of the flow of the lesson. This is the markup:

```
[Normal paragraph.]

.. note:: Note text.
  New line within note.

  New paragraph within note.

[Unindented text resumes normal paragraph.]
```

19.9.10 Adăugarea o notă de sponsorizare/drepturi de autor

Dacă scrieți un nou modul, o lecție sau o secțiune în numele unui sponsor, trebuie să includă un scurt mesaj, la alegerea sponsorului. Acesta trebuie să informeze cititorul despre numele sponsorului și trebuie să apară sub titlul modulului, lecției sau secțiunii sponsorizate. Totuși, mesajul nu poate consta într-o reclamă pentru compania sponsorului.

If you have volunteered to write a module, lesson or section in your own capacity, and not on behalf of a sponsor, you may include an authorship note below the heading of the module, lesson or section that you authored. This must take the form `This [module/lesson/section] contributed by [author name].` Do not add further text, contact details, etc. Such details are to be added in the „Contributors" section of the Foreword, along with the name(s) of the part(s) you added. If you only made enhancements, corrections and/or additions, list yourself as an editor.

19.10 Mulțumiri!

Vă mulțumim pentru contribuția la acest proiect! Procedând astfel, faceți QGIS mai accesibil pentru utilizatori și adăugați valoare întregului proiect QGIS.

CAPITOLUL 20

Pregătirea Datelor pentru Exerciții

Important

Acest proces este destinat profesorilor sau utilizatorilor de QGIS experimentați care doresc să creeze seturi cu eșantioane de date localizate pentru cursurile lor. Seturile de date implicite sunt furnizate cu Manualul de instruire, dar este posibilă utilizarea acestor instrucțiuni dacă doriți să înlocuiți seturile de date implicite.

The *sample data provided* with the Training Manual refers to the town of Swellendam and its surroundings. Swellendam is located about 2 hours» east of Cape Town in the Western Cape of South Africa. The dataset contains feature names in both English and Afrikaans.

Oricine poate utiliza, fără dificultate, acest set de date, dar este posibil să preferați să utilizați date din propria țară sau din orașul natal. În cazul în care alegeți să faceți acest lucru, datele dvs. localizate vor fi utilizate în toate lecțiile, de la Modulul 3 până la modulul 7.2. Modulele ulterioare folosesc surse de date mai complexe, care pot fi valabile, sau nu, pentru regiunea dumneavoastră.

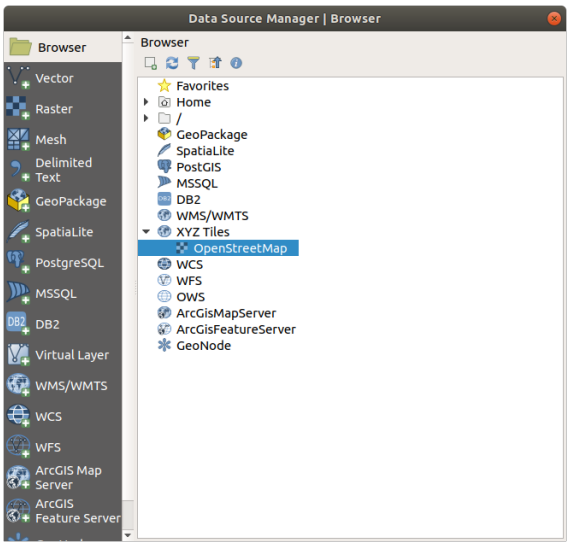
Notă

Aceste instrucțiuni presupun că aveți o bună cunoaștere a QGIS, nefiind destinate utilizării ca material didactic.

20.1 Create OSM based vector files

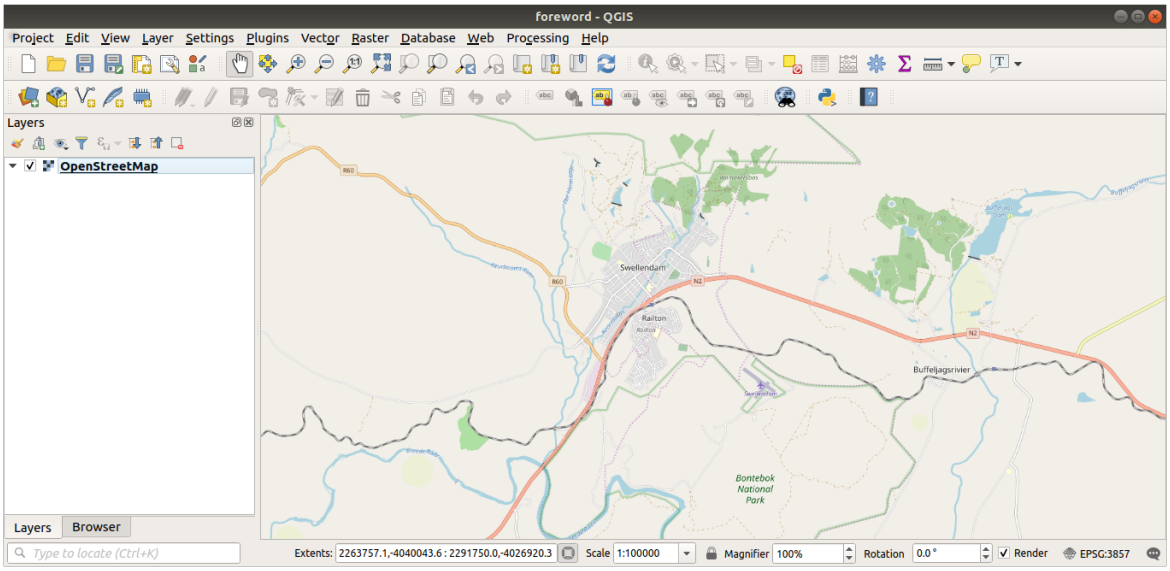
If you wish to replace the default data set with localised data for your course, this can easily be done with tools built into QGIS. The region you choose to use should have a good mix of urban and rural areas, containing roads of differing significance, area boundaries (such as nature reserves or farms) and surface water, such as streams and rivers.

1. Deschideți un nou proiect QGIS
2. Select *Layer* ► *Data Source Manager* to open the *Data Source Manager* dialog
3. In the *Browser* tab, expand the *XYZ Tiles* drop-down menu and double-click the *OpenStreetMap* item.



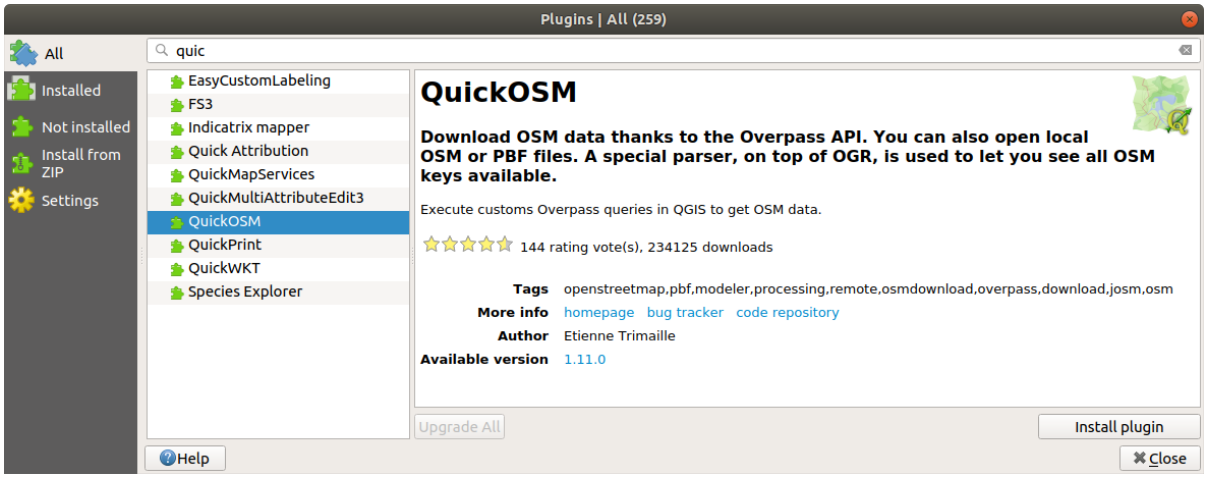
A map of the world is now visible on the map canvas.

4. Close the *Data Source Manager* dialog
5. Move to the area you'd like to use as study area

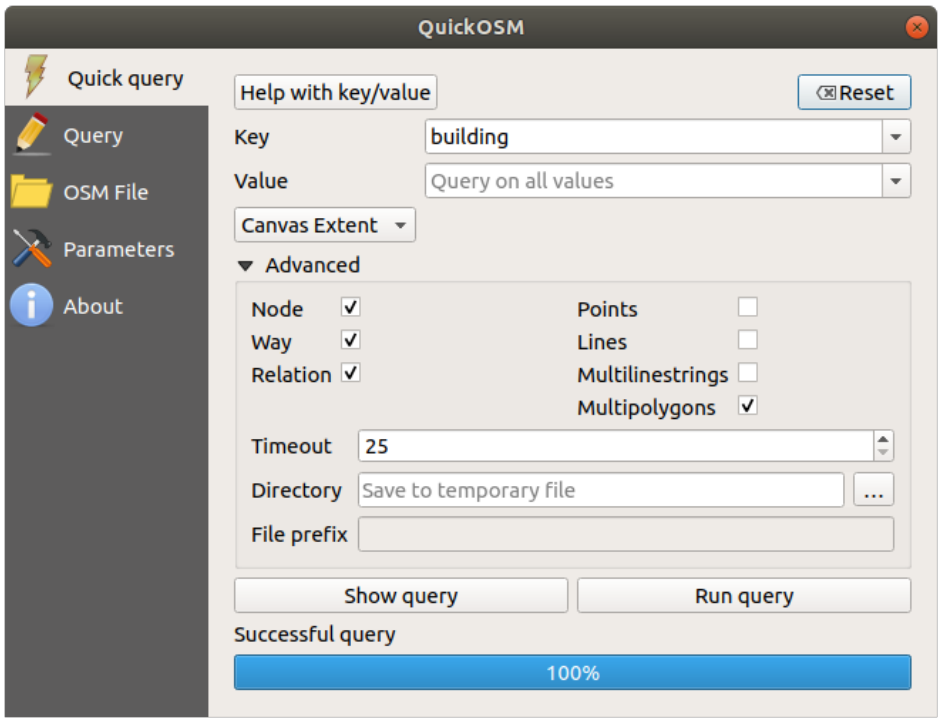


Now that we have the area we'll extract the data from, let's enable the extraction tools.

1. Go to *Plugins* ► *Manage/Install Plugins…*
2. In the *All* tab, type `QuickOSM` in the search box
3. Select the QuickOSM plugin, press *Install Plugin* and then *Close* the dialog.



4. Execute the new plugin from *Vector* ► *QuickOSM* ► *QuickOSM…* menu
5. In the *Quick query* tab, select `building` in the *Key* drop-down menu
6. Leave the *Value* field empty, meaning that you are querying all buildings.
7. Select *Canvas Extent* in the next drop-down menu
8. Expand the *Advanced* group below and uncheck all geometry types on the right except *Multipolygons*.
9. Press *Run query*

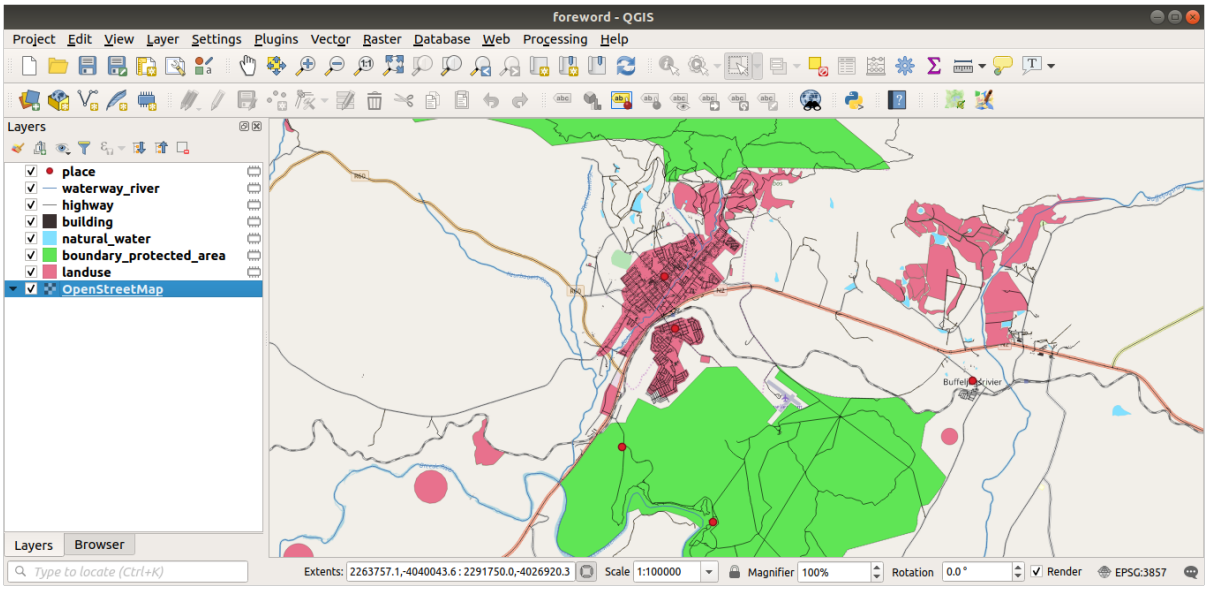


A new `building` layer is added to the *Layers* panel, showing buildings in the selected extent.

10. Proceed as above to extract other data:
    1. `Key = landuse` and `Multipolygons` geometry type.
    2. `Key = boundary`, `Value = protected_area` and `Multipolygons` geometry type.
    3. `Key = natural`, `Value = water` and `Multipolygons` geometry type.
    4. `Key = highway` and check `Lines` and `Multilines` geometry types.

5. `Key = waterway`, `Value = river` and check `Lines` and `Multilines` geometry types.
6. `Key = place` and `Points` geometry type.

This process adds the layers as temporary files (indicated by the icon next to their name).



You can sample the data your region contains in order to see what kind of results your region will yield.

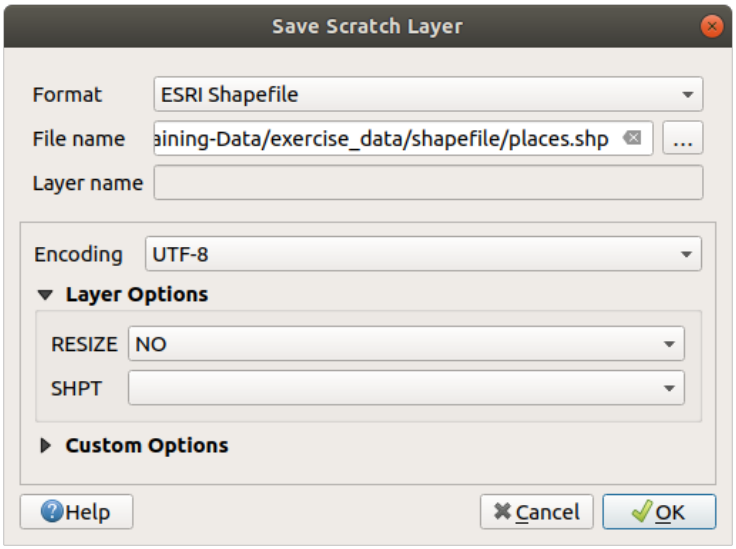
We now need to save the resulting data to use during your course. We'll be using ESRI Shapefile, GeoPackage and SpatiaLite formats depending on the data.

To convert the `place` temporary layer to another format:

1. Click the icon next to the `place` layer to open the *Save Scratch Layer* dialog.

> **Notă**
>
> If you need to change any of the temporary layer's properties (CRS, extent, fields…), use the *Export* ► *Save Features as…* contextual menu instead, and ensure the *Add saved file to map* option is checked. This adds a new layer.

2. Select the *ESRI Shapefile* format
3. Use the … button to browse to the `exercise_data/shapefile/` folder and save the file as `places.shp`.



4. Apăsați pe *OK*

   In the *Layers* panel, the temporary `place` layer is replaced with the saved `places` shapefile layer and the temporary icon next to it removed.

5. Double-click the layer to open its *Layer Properties* ► *Source* tab and update the *Layer name* property to match the file name.

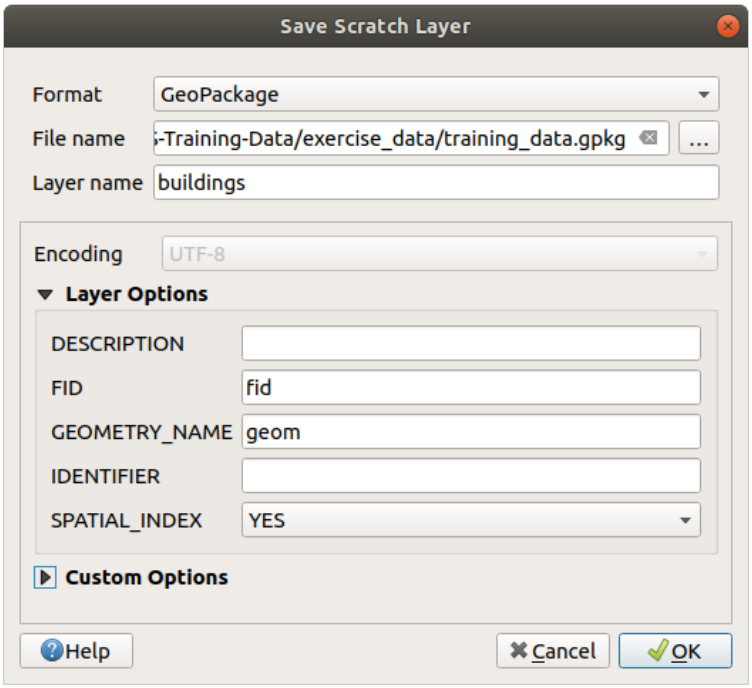
6. Repeat the process for other layers, renaming them as follows:

   - `natural_water` into `water`
   - `waterway_river` into `rivers`
   - `boundary_protected_area` into `protected_areas`

   Each resulting data set should be saved in the `exercise_data/shapefile/` directory.

The next step is to create a GeoPackage file from the `building` layer to use during the course:

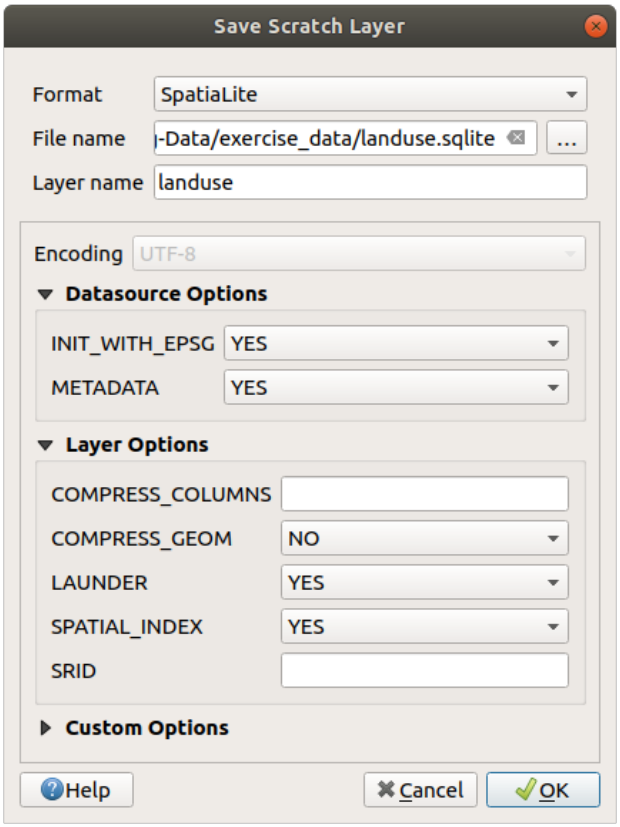
1. Click the icon next to the `building` layer
2. Select the *GeoPackage* format
3. Save the file as `training_data.gpkg` under the `exercise_data/` folder
4. By default, the *Layer name* is filled as the file name. Replace it with `buildings`.



5. Apăsați pe *OK*
6. Rename the layer in its properties dialog
7. Repeat the process with the `highway` layer, saving it as `roads` in the same GeoPackage database.

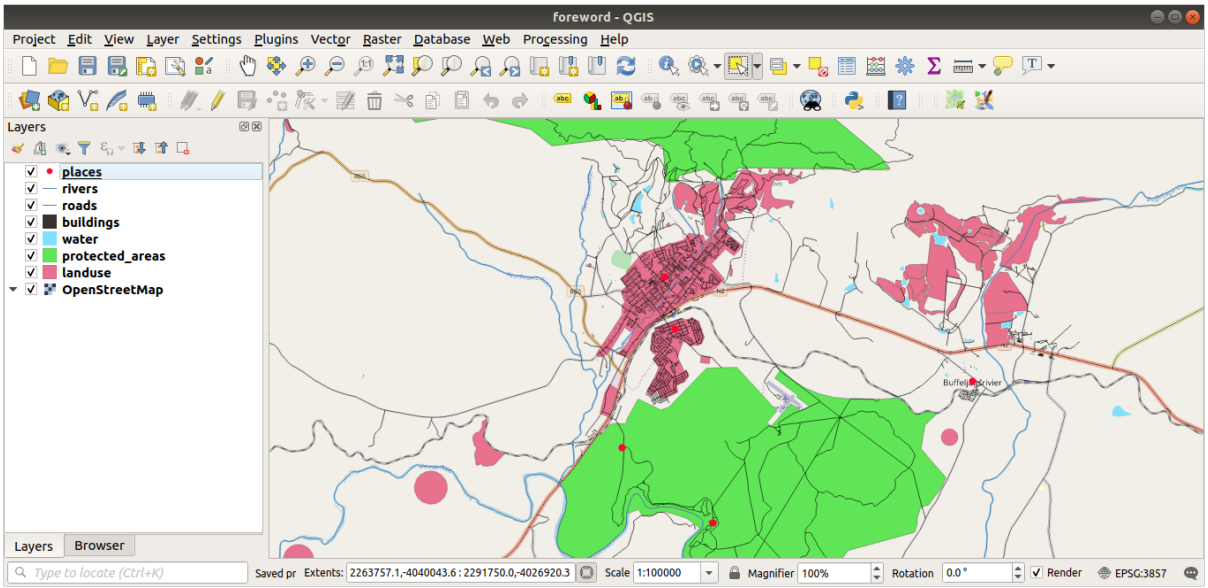
The last step is to save the remaining temporary file as a SpatiaLite file.

1. Click the icon next to the `landuse` layer
2. Select the *SpatiaLite* format
3. Save the file as `landuse.sqlite` under the `exercise_data/` folder. By default, the *Layer name* is filled as the file name. Do not change it.



4. Apăsați pe *OK*

You should now have a map which looks something like this (the symbology will certainly be very different, because QGIS randomly assigns colors when layers are added to the map):



The important thing is that you have 7 vector layers matching those shown above and that all those layers have some data.

20.2 Create SRTM DEM tiff files

For modules *Module: Creating Vector Data* and *Modulul: Rastere*, you'll also need raster images (SRTM DEM) which cover the region you have selected for your course.

The CGIAR-CGI provides some SRTM DEM you can download from https://srtm.csi.cgiar.org/srtmdata/.

You'll need images which cover the entire region you have chosen to use. To find the extent coordinates, in QGIS  zoom to the extent of the largest layer and pick the values in the  *Extents* box of the status bar. Keep the `GeoTiff` format. Once the form is filled, click on the *Click here to Begin Search* >> button and download the file(s).

Once you have downloaded the required file(s), they should be saved in the `exercise_data` directory, under `raster/SRTM` subfolders.

20.3 Create imagery tiff files

In Module *Module: Creating Vector Data*, *Follow Along: Data Sources* lesson shows close-up images of three school sports fields which students are asked to digitize. You'll therefore need to reproduce these images using your new SRTM DEM tiff file(s). There is no obligation to use school sports fields: any three school land-use types can be used (e.g. different school buildings, playgrounds or car parks).

For reference, the image in the example data is:



20.4 Replace tokens

Having created your localized dataset, the final step is to replace the tokens in the `substitutions.txt` file so that the appropriate names will appear in your localized version of the Training Manual.

The tokens you need to replace are as follows:

- `majorUrbanName`: this defaults to „Swellendam". Replace with the name of the major town in your region.
- `schoolAreaType1`: this defaults to „athletics field". Replace with the name of the largest school area type in your region.
- `largeLandUseArea`: this defaults to „Bontebok National Park". Replace with the name of a large landuse polygon in your region.
- `srtmFileName`: this defaults to `srtm_41_19.tif`. Replace this with the filename of your SRTM DEM file.
- `localCRS`: this defaults to `WGS 84 / UTM 34S`. You should replace this with the correct CRS for your region.