Using Open Geospatial Data in GIS

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0.1 Why Open Geospatial Data?

In the world of data, **open** means different things. First, it's about who can access and use the data. Second, it's about how that data can be used - from the transparency of its creation and handling to the standards and protocols that make the data accessible.

Thanks to advances in computing and the internet, many organizations now embrace open data policies to share, access, and create value from data.

Having an open data policy offers several key benefits:

- Greater transparency, especially for governments. When data is open, citizens can see and understand what their government is doing.
- Increased public participation. Open data allows citizens to engage with and contribute to solutions for their communities.

- Faster and more significant advances in knowledge. Instead of spending time and money generating new data, researchers can build on existing information.
- Better reproducibility of research results. Other scientists can verify and build upon previous work.
- Improved informed decision-making, particularly for global-scale problems. When decision-makers have access to good data, they make better choices.

Open geospatial data is especially crucial for tackling global challenges like climate change, urban development, and disaster response. In these situations, quick access to accurate locationbased information can make the difference in coordinating effective responses and making smart decisions.

0.2 Sources reviewed in this tutorial

In this guide, we'll explore ways to access and use open geospatial data, focusing on Open-StreetMap and Overture Maps for Geographic Information Systems (QGIS specifically). These tools are powerful resources that anyone can use to work with location-based data.

0.2.1 OpenStreetMap OSM



OpenStreetMap (OSM) is a collaborative world map that anyone can edit and use - think of it like "Wikipedia for maps." It is created by volunteers worldwide who add and update geographic information about roads, buildings, parks, businesses, and other features. People contribute data based on their local knowledge, GPS tracks, aerial imagery, and field surveys.

Key aspects of OSM:

- **Community-driven:** The data is collected and maintained by a global community of mappers, from hobbyists to professional geographers.
- **Truly open:** Unlike commercial maps, OSM data is freely available for anyone to download, use, and modify under an open license (Open Database License).

- **Used everywhere:** The data powers thousands of applications and services from humanitarian crisis response to navigation apps, urban planning tools, and games.
- **Constantly updated:** Because anyone can contribute, OSM often has more up-to-date information than commercial maps, especially in rapidly changing areas or after natural disasters.

These are only some of the communities building OSM. Explore more communities here



The project started in 2004 in the UK and has grown into one of the largest collaborative mapping efforts in the world. Today, OSM is often considered the most comprehensive free source of geographic data available.

Although you don't need an account to explore the map, you can sign up if you want to contribute edits or be part of the communities related to the project.

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			Log in	Sign Up		010101 01010 101010			
			Free and edi and it's free f	itable. Unlike othe	er maps, OpenStre Ipdate, download a	etMap is complete and use.	ly created by people like yo	J,	
			Sign up to ge Email	et started contribu	ting.				
			Your address is	not displayed publicly,	see our privacy policy	for more information.			
			Display Nam	B					
			Your publicly dis	played username. You	can change this later i	n the preferences.			
			Password			Confirm Passwo	ord		
			By signing up	o, you agree to ou	r Terms of Use, pri	vacy policy and co	ntributor terms.		
			Sign Up						
					or sign up wi	th a third party			
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0.2.2 Overture Maps



Overture Maps is a newer collaborative effort launched in 2022 by major tech companies including Meta, Microsoft, Amazon (AWS), and TomTom. It combines information from multiple sources - including commercial datasets, open data, and machine learning - to create a high-quality, standardized global map.

Key aspects of Overture Maps:

- **Quality-focused:** It uses sophisticated data validation and conflation techniques to ensure accuracy and consistency of geographic information.
- **Business-friendly:** While free and open like OSM, it's specifically designed to meet enterprise-level mapping needs with reliable, standardized data.
- **Modern architecture:** Built from the ground up to handle today's mapping challenges, with a focus on regular updates and clear data lineage.
- **Multiple sources:** Instead of relying solely on volunteer contributions, it combines different data sources including commercial data, open data, and machine-derived features.

The project released its first major dataset in 2023 and aims to provide an alternative foundation for building mapping applications and services. While newer than OSM, it's designed to complement rather than compete with existing open mapping projects.

0.3 Exploring the data

0.3.1 In OpenStreetMap

01 Go to https://www.openstreetmap.org/ on your web browser



The screen will show a big area with a map on the center. To explore the map you can use the **Search** bar located on the top left corner. Simply type the name of a place or a street address and click enter/return or the search icon. You can also use the Navigation controls (zoom in +/zoom out -/show my location) located on the top right corner of the map.

02 Type the name of a place in the search bar.

When you type the name of a place in the Search bar, OSM will show you a list of options found in Nominatim.

i Note

Nominatim is an open-source geocoding software used to find addresses and places in OSM.

Here we typed Philadelphia and we get six main results: the city of Philadelphia, Pennsylvania, the county with the same name, a town named Philadelphia in Mississippi and three other villages named like that in other states. Notice the map has zoomed in to the city of Philadelphia, PA. The results you get are based on the current view of your map. If you want to see more results you can click on the button More results.



03 Click on the result you want to explore.

When you click on a result, the left panel will show the selected element info and tags. On the map, you would see the element highlighted in orange.



In this example we see an area highlighted in orange that corresponds to the city of Philadelphia

along with a node in the center of this area. On the left side panel we see a list with all the tags assigned to this element. For example: border_type:city, boundary:administrative, and loc_name:Philly.

• How data is organized in OSM?
All data in OSM is represented by an element . An element can be either a node , a way or a relation . Each element is described using tags which are the combination of a key and a value with tags amenity=cafe. Learn more about elements and tags here.

0.3.1.1 Querying the data

Now lets query the data we see on the map to discover the type of element and what tags are being used to describe it.

04 Type the name of a place in the search bar.

We are going to explore a more local area by typing charles library, philadelphia in the search bar. This will zoom in the map further.



05 Click on the 'Query features' tool.



On the right side of the screen, click on the Query features tool

You will notice the mouse cursor icon will change to a question mark.

06 Click on any element you see on the map to query.

Now, if you click on any area of the map, the left side panel will show two lists: 'Nearby features' and 'Enclosing features'. The Nearby features list will have all elements close to the point you clicked on the map. In this example, we got seven results.



07 Explore the results.

If you click on any of the results, the left side panel will show the element details and tags. In this example, we clicked on 'Saxbys', which is a coffee shop by Charles Library.

As you can see, this element has five tags that describe it including its name, opening hours, and wheelchair accessibility. An element can have unlimited number of tags, however, some of them might be auto-exclusive. See more details on OSM tagging system here.



0.3.2 In Overture Maps

01 Go to https://explore.overturemaps.org/ on your web browser

Overture Maps Explorer (Bettin x +	୍
← → C 😂 explore.overturemaps.org/#15/38.90678/-77.03849	🖈 🔤 è 🖆 🕛 🗄
💩 Overture Maps Explorer 🛛 Docs	O 🔅 O Download Visible
Theme selector Download	Construction button Loggin directed States Loggin directed button
	evigation tools
	A Development of the second se
	Mount Vernon Square
	etMap contributors, Overture Maps Foundation

 $02 \ Find \ your \ location \ on \ the \ map$

Unlike OSM, the Overture Maps explorer does not have a search bar. The best way to find

a location is either clicking on the 'Find my location' button or using the navigation controls (zoom in and zoom out).

Allow access to your location

The first time you use the 'Find my location' tool, you will be asked to allow the browser access. If you are ok with this, simply click on 'Allow this time'.

03 Click on any of the features you see on the map

When you click on any feature on the map, a popup window will display the feature(s) you clicked on, the bounding features (those that contain the clicked feature, like the city, the county it is on). This popup window will display the names of the features along with icons that represent the feature 'type'. In this example we can see there is a 'Charles Library' place

On the left side of the screen, an 'Inspector Panel' will show the properties of the selected feature, including: the type, sources, names and others depending on the feature type.

0.3.3 In QGIS

There are some ways to explore OpenStreetMap data in QGIS without downloading the data. The easiest way to do this is using OSM raster tiles. Follow the steps below to see OSM data in QGIS.

Install QGIS

If you don't have QGIS installed, go to https://qgis.org/download/ and follow the instructions to download the latest version for you operating system.

01 Open QGIS

02 Add a raster tile connection

In the Browser panel, right-click on XYZ Tiles, then click on New connection.

03 Set the new XYZ connection

In the new window, type OSM as the name for your connection. Then copy and paste this line $https://tile.openstreetmap.org/{z}/{x}/{y}.png$ in the URL space under 'Connection Details'.

Then click OK.

• • •	XYZ Connection
Name OSM	1
Connection Details	
URL	https://tile.openstreetmap.org/{z}/{x}/y}.png
Authentication	
Configurations	Basic
Choose or create a	an authentication configuration
No Authentication	• // = 🕀
Configurations sto	re encrypted credentials in the QGIS authentication database.
✓ Min.Zoom Level	0
✓ Max.Zoom Level	20 🖾 🗘
Referer	
Tile Resolution	Unknown (not scaled)
Interpretation	Default 3
Help	Cancel

04 Add the XYZ tiles to the map

Find the OSM XYZ raster tiles you created on previous step on the Browser panel and drag it to the Layers panel or directly to the map area.

05 Zoom in to the desired area on the map

Using the zoom in tools located in the top of the screen on QGIS you can locate the area you want to see. The map will show more details based on the level of zoom you are in. Ypu can use this raster tiles as a basemap in your projects.

0.4 Downloading the data

There are multiple ways to download data from OSM and Overture Maps. In this tutorial we focus on how to download data directly to QGIS.

$0.4.1\ {\rm From\ OSM}$ to QGIS

 $01 \ Install \ QuickOSM \ plugin$

Open QGIS.

On the top menu bar click on 'Plugins' and then on 'Manage and Install Plugins'.

On the new window, in the search bar type quickosm, then click on 'Install plugin'. Once installed, close the plugins manager window. Learn more about QuickOSM plugin

02 Build a query to download data

'QuickOSM' plugin uses *overpass API*, which is is a read-only interface that allows users to query and extract specific data from the OpenStreetMap (OSM) database using a custom query language.

To build a custom query:

- Click on the 'QuickOSM' button on the toolbar
- On the new window:
- 1. Add amenity on the key space and parking on the value space.
- 2. Add Philadelphia, PA on the 'in' space.
- 3. Click on 'Run query'.

		QuickOSM		
	Map preset	Help with key/value	Reset	•
7	Quick query	Preset Not mandatory.Ex: bakery	-	
/	Query	Key Value 1 amenity	Add Delete	
	OSM File	1		
X	Parameters			
1	About	2		
		D In Philadelphia, PA		
		All OSM objects with the key 'amenity'='parking' in Philadelphia,PA are going to be downloaded.		
		Save query in a new preset	y	
		▼ Query history 3		
		All OSM objects in the canvas or layer extent are going to be downloaded.		
		roof:shape_dome_roof:shape_flat Ail USM objects with Keys 'roof:shape'='dome' or 'roof:shape'='tiat' or 'roof:shape'='gabled' or 'roof:shape'='dambrel' or 'roof:shape'='balf_binned' or 'roof:shape'='hinned' or 'roof:shape'='mansard' or		
		All OSM objects in the canvas or laver extent are going to be downloaded		
		► Advanced		
				-
		0%		

This will generate a query to retrieve all elements tagged as 'amenity'='parking' in the city of Philadelphia.

After the download is done, close the 'QuickOSM' window and go back to the map.

i Note

Learn more on how overpass queries work in this tutorial.

The data downloaded is stored as a temporary file in your system.

⁰³ Save and style the layers

If you want to use it further from this session in QGIS you first need to save the files in your system.

To do so:

- 1. Right click on the name of the layer you want to save.
- 2. Click on the option 'Make permanent' or 'Export' and then 'Save feature as...'.
- 3. In the new window, select the format for your file, a name and, a location.
- 4. Then click 'OK'.

	Save Scratch Layer
Format	ESRI Shapefile
File name	/Users/felipevaldez/Desktop/parking_lots.shp 🚳 📖
Layer name	
Encoding	IITE-8
Layer O	ptions
▼ Custom	Options
Data sour	ce
Layer	
	Help Cancel OK
o Go	o further
There You co or doo accours mall For ex- use 'C	e are other options to download data usin 'QuickOSM' plugin. an try <i>preset</i> downloads, play around with different combinations of key and value , wnload all data for a specific area. To download all data for a specific area, take into ant that the amount of data can exceed your system capacity. Start downloading er areas to test. xample, zoom in to a neighborhood or block, then in the 'QuickOSM' plugin window Canvas Extent' then execute the query. In Around Canvas Extent Layer Extent Not Spatial

0.4.2 From Overture Maps

To download data from Overture Maps directly to QGIS we are going to use two plugins:

QduckDB and GeoParquet Downloader.

Follow the steps forward to download data directly to QGIS.

01 Install DuckDB plugin

Open QGIS.

On the top menu bar click on 'Plugins' and then on 'Manage and Install Plugins'.

🗯 QGIS	Project	Edit	View	Layer	Settin	igs 🤇	Plugins	Vector	Raster	Mesh	Processin	g					Wind	ow	Help	
• • •							🏠 Mana	ge and Inst	all Plugins.				*Untit	led Pi	roject —	QGIS				
	3 🗋 🕄	a	-		•	9 -	🜏 Pytho	n Console		∿: ₩ P	2	3 🗖) 🔁		888 (Σ	
1.1		•	1% -	26	× P	Ē	Zoom Lev	vel		>										
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On the new window, in the search bar type qduckdb, then click on 'Install plugin'. Once installed, close the plugins manager window.

Go back to the Plugins amanger and check that the 'QduckDB' plugin is activated (with a check mark).

		Plugins All (1831)	
all 💫	Q qdu		∞
Installed	QDuckDB	QDuckDB	
Not installed		This plugin adds a new data provider that can read DuckDB databases and display their tables as a layer in OGIS.	
	_	······································	

If not, check the box.

If you get an error message, follow the instructions in the following warining box.

/Applications/QGIS.app/Contents/MacOS/bin/python3.9 -m pip install "duckdb==1.2.0" 3. In terminal, locate and open the plugin file by typing: open ~/Library/'Application Support'/QGIS/QGIS3/profiles/default/python/plugins/qduckdb/gu: 4. Open the file dlg_add_duckdb_layer.py text editor on а app. • • • < > gui ₩ × Ĥ 📿 ··· • Q Favorites Name A Date Modified Size Kind Desktop __init__.py Today at 9:26 AM Zero bytes Python Source Documents Today at 9:51AM > pvcache Folder dlg_add_duckdb_layer.py Today at 9:51AM 7 KB Python Source Downloads dlg_add_duckdb_layer.ui Today at 9:26 AM 5 KB Design...cumer 🔒 felipevaldez dlg_open_parquet.py Today at 9:26 AM 4 KB Python Source 🖻 dlg_open_parquet.ui Today at 9:26 AM 4 KB Design...cument dlg_settings.py Today at 9:26 AM 5 KB Python Source 🛆 iCloud Drive dlg_settings.ui Today at 9:26 AM 12 KB Design...cument F? Shared Open this file in a text editor OneDrive Tags Red Orange Yellow 💭 Macintosh HD > 🧰 User> 🛅 felip > 🛅 Libr:> 🚞 App > 🚞 QGIS> 🚞 QGIS> 🊞 prof > 🚞 defa > 🧰 pyth > 🚞 plug > 🚞 qduckdb > 🚞 gui 5. Add the followin to line 3: import typing 6. Replace the text on line 89 with: def db_path(self) -> typing.Union[Path, None]: 7. Save the file. 8. Reopen QGIS. 9. Activate QduckDB plugin. Here you can find instructions for other OS.

02 Install GeoParquet Downloader plugin

On the top menu bar click on 'Plugins' and then on 'Manage and Install Plugins'.

On the new window, in the search bar type geoparquet downloader, then click on 'Install plugin'. Once installed, close the plugins manager window.

		Plugins All (1831)		
🏠 All	Q geoparquet			
Installed	🛓 GeoParquet Downloader (O)	GeoParquet I	Downloader (Overtur	e, 🥡
Not installed		Source & Cus	stom Cloud)	Ŷ
🔁 Upgradeable		This plugin connects t	o cloud-based GeoParquet data and	d downloads
1. Install from ZIP		configured sources fo	r Overture Maps, Source Cooperativ	ve, and you can
i Settings		enter the location of a best with the bbox str will work. You can say DuckDB, FlatGeobuf, o QGIS supports GeoPa but GeoParquet gener Most Windows install install via conda. For this wiki page. The plu installed automaticall with DuckDB installin	iny online GeoParquet file or partiti "uct from GeoParquet 1.1, but any (ye the output data as GeoParquet, (pr GeoJSON. The plugin does not re rquet, as you can download data as "ally works better (faster and bette ations come with it, and for Mac and information on installing Geoparqu ugin depends on DuckDB, which sho y when you install the plugin. If yoo g please file an issue on the GitHub	on. It works SeoParquet file SeoPackage, quire that your GeoPackage, r nested data). d Linux you can et support see ould be u have issues issue tracker.
		Plugin for downloading GeoPa	rquet data from cloud sources.	
		☆☆☆☆☆ 3 rating vote(s), 3616 downloads	
		Tags	cloud, geopackage, duckdb, parquet, overture, geoparquet	source cooperative,
		More info	homepage bug tracker code repository	
		Author	Chris Holmes	
		Available version (stable)	0.6.0 updated at 2/16/2025 12:57PM EST	
		Upgrade All		Install Plugin
	Help			Close

You should see the following icons on your tool bar \bigcirc \diamondsuit

If not, right click on any empty space on the tool bar and activate the 'Plugins toolbar'.

rooibars
Advanced Digitizing Toolbar
Annotations Toolbar
✓ Attributes Toolbar
✓ Data Source Manager Toolbar
Database Toolbar
✓ Digitizing Toolbar
GPS Toolbar
Help Toolbar
Label Toolbar
✓ Manage Layers Toolbar
✓ Map Navigation Toolbar
Mesh Digitizing Toolbar
✓ Plugins Toolbar
✓ Project Toolbar
✓ QuickOSM
Raster Toolbar
✓ Selection Toolbar
Shape Digitizing Toolbar
Snapping Toolbar
Vector Toolbar
✓ Web Toolbar

03 Select the data source and type to download

i Note

GeoParquet is a geospatial extension of 'Apache Parquet' format that efficiently stores geographic data in a columnar structure. It provides optimized compression, native support for geometries (points, lines, polygons), and includes spatial metadata like coordinate reference systems.

- Click on the 'Download GeoParquet Data' button on the toolbar \checkmark
- In the new window, select the source 'Overture Maps' and the types you want to down-

	e GeoParquet Data Source
	Overture Maps Source Cooperative Hugging Face Custom URL
	Buildings Places Transportation Addresses Divisions
	Base
load	OK Cancel

• Set a directory and name where you want to save the file.

🛕 Warning!

The 'GeoParquet Downloader' will download data for the current map extent. Be sure to limite the view to a local area to avoid saturating the download process.

Once the download is complete you should see a message like this:

04 Open the downloaded data

- Click on the 'Open Parquet with DuckDB' button on the toolbar \square
- Point to the file you downloaded in the previous step and set EPSG:4326 as the CRS.
- Click 'Open'

en (Geo)Parquet	files with DuckD	B			
′ou can open one c he plugin doesn't i	r more parquet fil ıse QGIS's native	es and choose parquet provid	whether or not er; a DuckDB m	to group the rest emory base will	ults.To do this, be created to
ead the parquet fil	e(s),then the plug	in's QDuckDB	provider will be	used to create tl	he layer in QGIS
Users/felipevaldez	/Desktop/overtur	e_places_2025	0226_101609.	parquet	☑
Default CRS: EPSG	:4326 - WGS 84				•

The resulting map shows all places around Temple University downloaded from Overture Maps

Attribution

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