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Spatial data repository for aquaculture animal health

Working draft 1.0 – November 2024

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Preface

The Spatial Data Repository for Aquaculture Animal Health, developed as part of the AquaeStrength project, is a resource for planning GIS projects that support aquatic animal health. This document provides a catalogue of Basic Hydrographic Elements sourced from GIS data catalogues, that represent foundational geographic features for contextualizing and characterizing the aquatic spatial environment in GIS applications. These elements provide crucial background information—such as geographic names, shapes, and positional accuracy—that ensures consistent and reliable spatial data for aquaculture animal health initiatives.

A well-organized and accessible catalogue of Basic Hydrographic Elements is essential to streamlining the planning and development phases of GIS projects. By providing consistent and accurate geographic context, this catalogue supports efficient, reliable, and precise mapping and spatial analyses, ultimately enabling more efficient management and response efforts in aquaculture health. This document thus serves as a foundational tool for practitioners and researchers in aquatic animal health, supporting data-informed decisions for sustainable and resilient aquaculture systems.

GIS data catalogues and Spatial Data Infrastructures (SDI)

A GIS data catalogue, often part of a broader Spatial Data Infrastructure (SDI), is an organized repository of spatial data designed to facilitate the sharing, discovery, and integration of geospatial information across diverse users and applications. These infrastructures are essential in enabling organizations to efficiently access and use spatial data for research, planning, and decision-making.

A GIS data catalogue includes a wide range of datasets, such as geographic boundaries, environmental variables, demographic information, and thematic data relevant to various fields, including animal health. GIS data catalogues play a crucial role in enabling data interoperability and accessibility, fostering collaboration among organizations. By providing a centralized source for spatial data, SDIs help ensure consistency in geographic references, projections, and metadata, reducing redundancy and improving data quality across projects.

GIS data catalogues provide various services to facilitate data access and integration, commonly including:

- Application Programming Interfaces (APIs): APIs enable users to access and integrate data programmatically, supporting real-time updates and automated data retrieval within custom applications. This functionality is essential for projects requiring dynamic, up-to-date information. For example, an API for daily sea surface temperature (SST) data can be integrated into a GIS project using the requests library to make HTTP requests and the netCDF4 library to handle NetCDF files, which can be linked and managed as if locally stored on the computer's file system.
- Download services: Many GIS data catalogues offer data downloads in standard geospatial formats (e.g., Shapefiles, GeoTIFF), allowing users to incorporate this information into offline GIS tools or analytical workflows. Download options typically include complete datasets or customizable subsets, allowing users to access only the data relevant to their needs.
- Visualization tools: GIS data catalogues provide web-based visualization tools that allow users to preview datasets through interactive maps, helping users assess the data's relevance and suitability before downloading or linking it into their systems via APIs data connection.
- Metadata: Metadata is crucial for understanding data sources, quality, projection, and limitations.

By providing easily accessible data, GIS data catalogues streamline the planning phases of GIS projects, allowing GIS technicians to focus on analysis and application rather than data collection, which leads to faster and more reliable insights into animal health issues. In sum, GIS data catalogues and SDIs are essential

infrastructures that support efficient, reliable, and collaborative GIS projects, advancing animal health and disease management.

The following sections present a series of GIS data catalogues useful for animal health projects in aquatic environments. This guide provides a step-by-step procedure on how to access the catalogues, use visualization tools and metadata to identify relevant datasets, access the data based on available services, and, finally, an example of how to integrate these data into a GIS project.

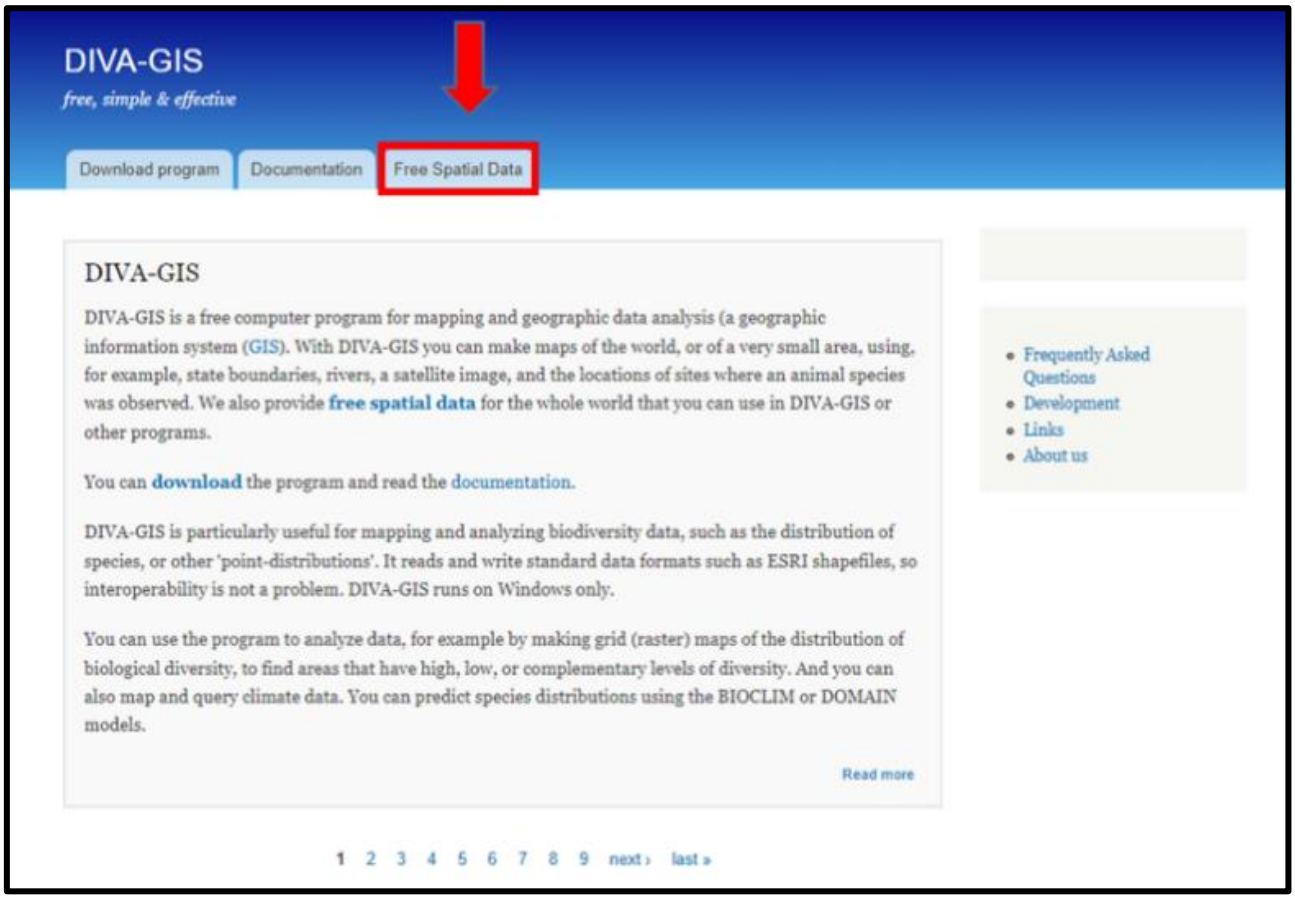
Diva-GIS

DIVA-GIS is a powerful software tool designed for mapping and geographical data analysis. It enables users to create maps incorporating various elements such as state boundaries, waterways, and satellite imagery. Additionally, DIVA-GIS offers the capability to access and download a wide range of data in common formats, including ESRI shapefiles, from across the globe. This data can be utilized within DIVA-GIS itself or in conjunction with other GIS applications such as QGIS and ArcGIS, all at no cost.

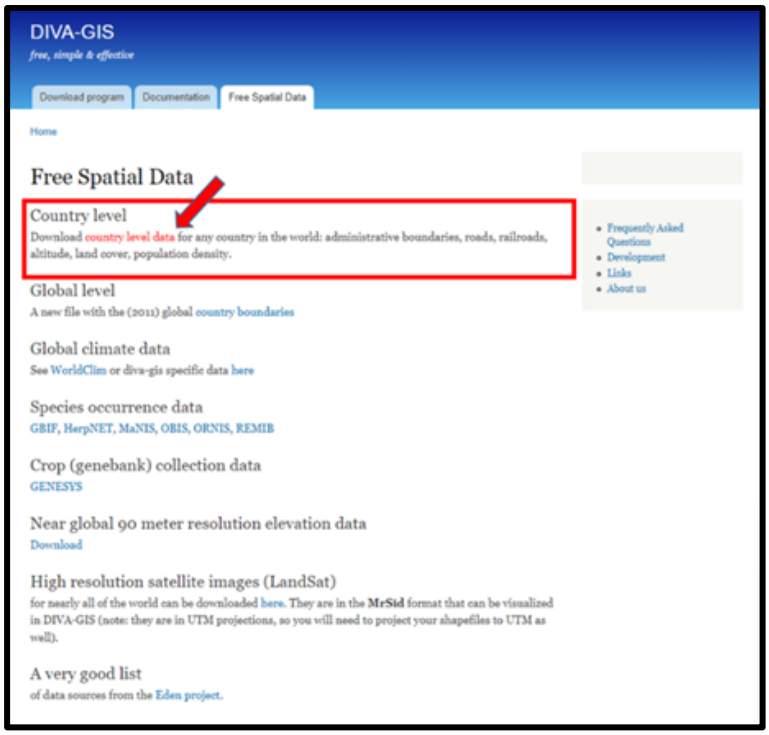
Downloading DIVA-GIS data

To download "Inland Water" data, including rivers, canals, and lakes in vector format (both line and polygon), follow these steps:

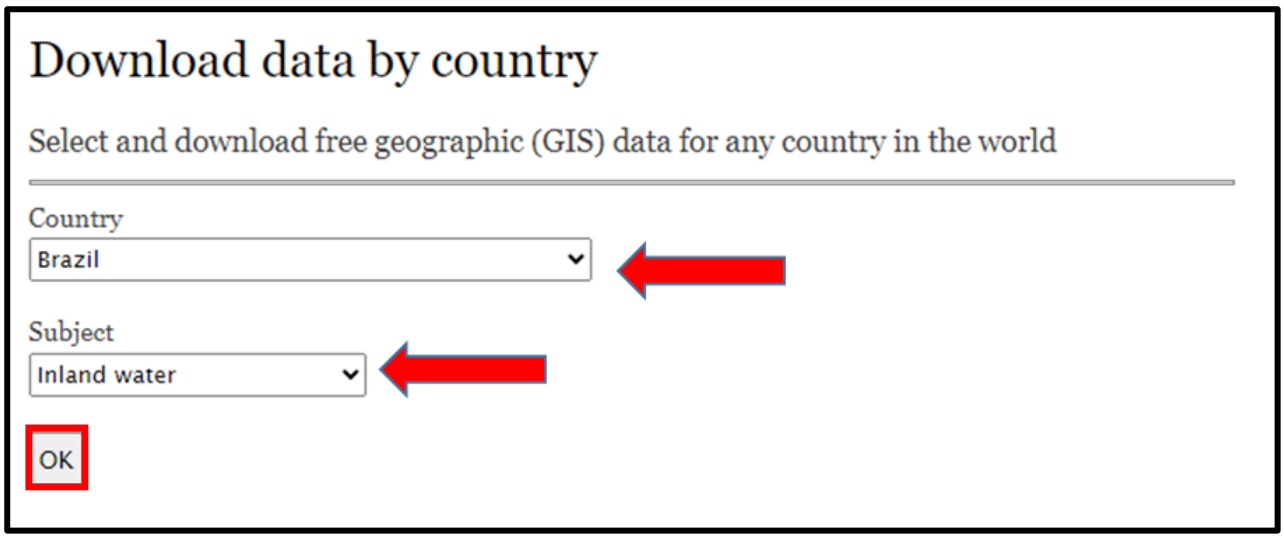
- Navigate to the DIVA-GIS website at https://www.diva-gis.org/.
- Select the "Free Spatial Data" option.



Upon reaching the page, you will be presented with multiple options for accessing free spatial data. Locate the "Country Level" section and select "Download country level data."



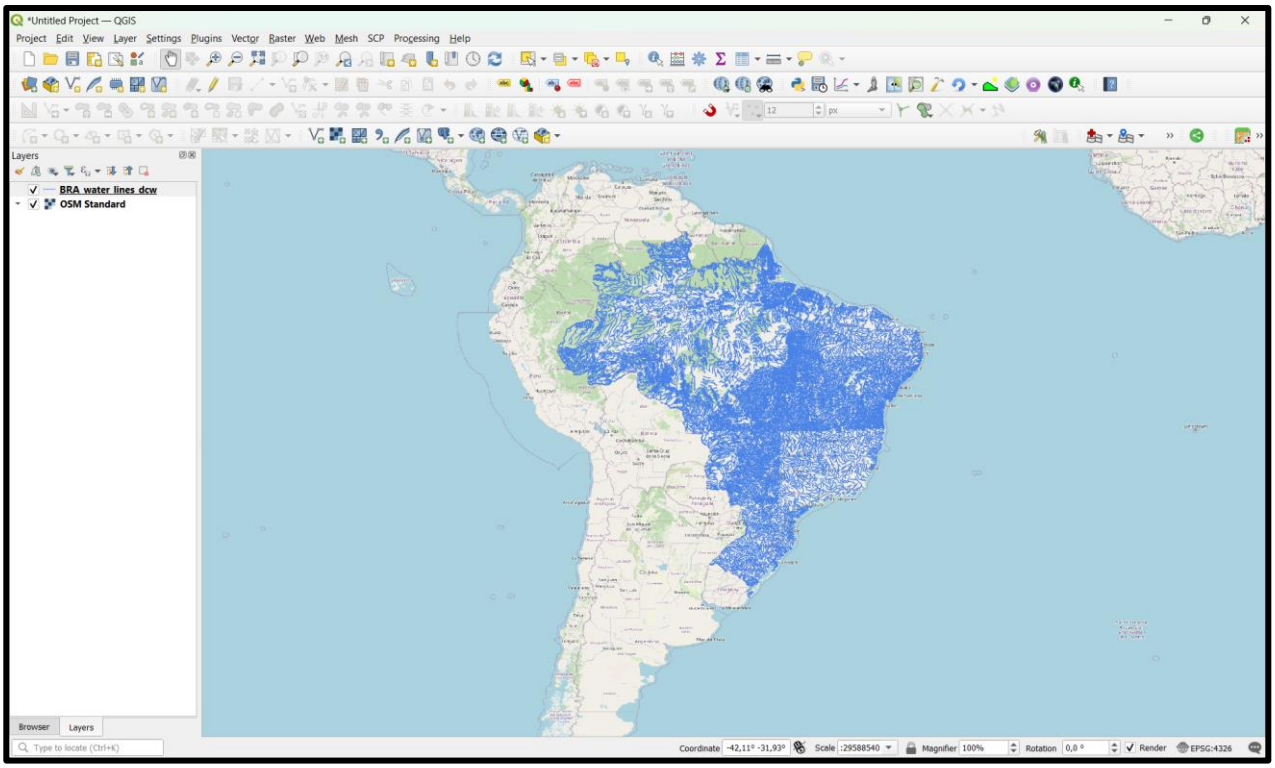
Next, select both the country and the type of data you wish to download. From the list, select "Inland Water" as your subject of interest and then click “OK” to confirm your choice.



Finally, click on the “Download” button to initiate the download process.

You should have a zip folder containing the downloaded data.

Unzip the folder, and you will be able to import the data into your GIS project, as shown in the image below.



Example of an inland water layer loaded in a QGIS project.

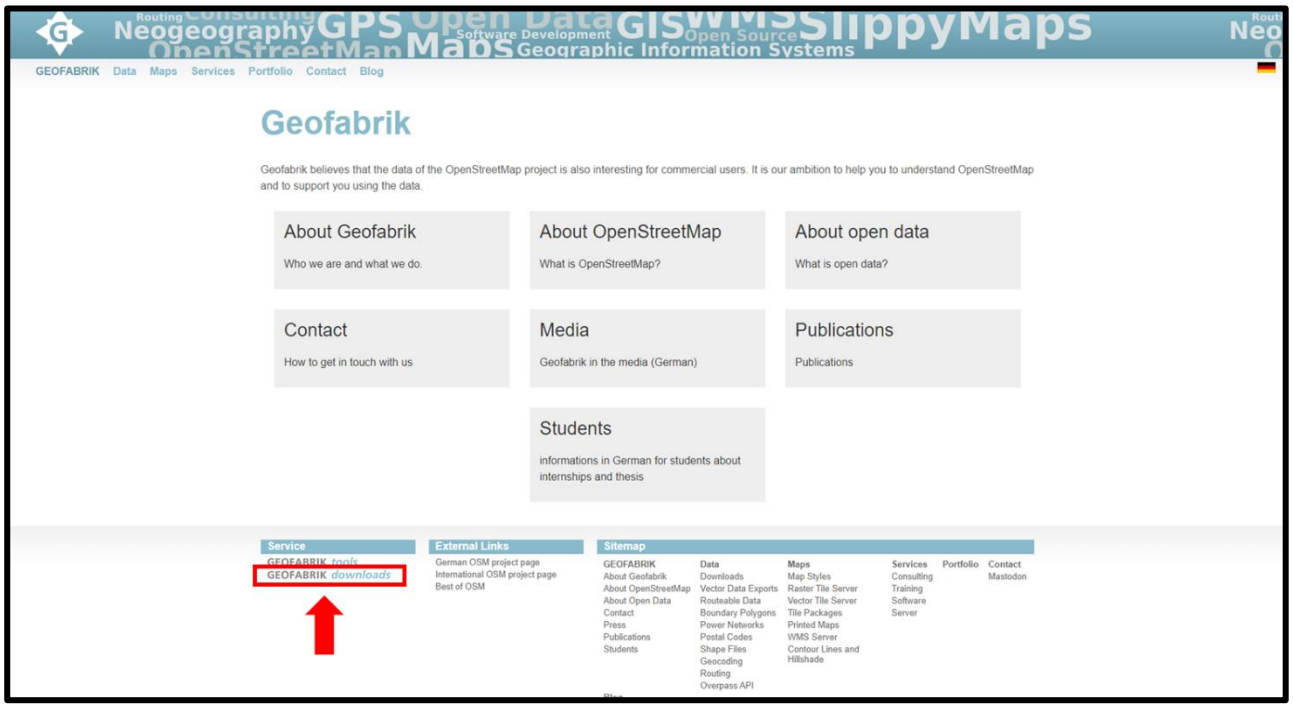
GEOFABRIK

GEOFABRIK was created to provide an easier way to download geographic data from OpenStreetMap. Unlike paid platforms with more restrictions, GEOFABRIK offers a free alternative. The data is organized by continent and country rather than by categories like DIVA-GIS. When you download data, it includes all categories such as land use, buildings, railways, and roads. To access aquatic data such as lakes, rivers, and streams, you need to download the full dataset for a country and then select "water" and "waterways". GEOFABRIK also has a network of freelancers with excellent OpenStreetMap experience.

Downloading GEOFABRIK data

Navigate to the GEOFABRIK website: https://www.geofabrik.de/en/geofabrik/.

Click on “GEOFABRIK downloads”.



You will be directed to a page where you can extract OpenStreetMap Data. Click on the region name to view the overview page for that region, or select one of the file extension links for quick access.

Sub Region	Quick Links		
	.osm.pbf	.shp.zip	.osm.bz2
Africa	[.osm.pbf] (6.5 GB)	✖	[.osm.bz2]
Antarctica	[.osm.pbf] (31.4 MB)	[.shp.zip]	[.osm.bz2]
Asia	[.osm.pbf] (13.0 GB)	✖	[.osm.bz2]
Australia and Oceania	[.osm.pbf] (1.2 GB)	✖	[.osm.bz2]
Central America	[.osm.pbf] (670 MB)	✖	[.osm.bz2]
Europe	[.osm.pbf] (28.8 GB)	✖	[.osm.bz2]
North America	[.osm.pbf] (14.5 GB)	✖	[.osm.bz2]
South America	[.osm.pbf] (3.3 GB)	✖	[.osm.bz2]

To view the overview page for a specific region, choose a continent and then click on the region name in the "Sub Regions" section. Alternatively, you can quickly access the data by selecting one of the file extensions (.osm.pbf, .shp.zip, .osm.bz2).

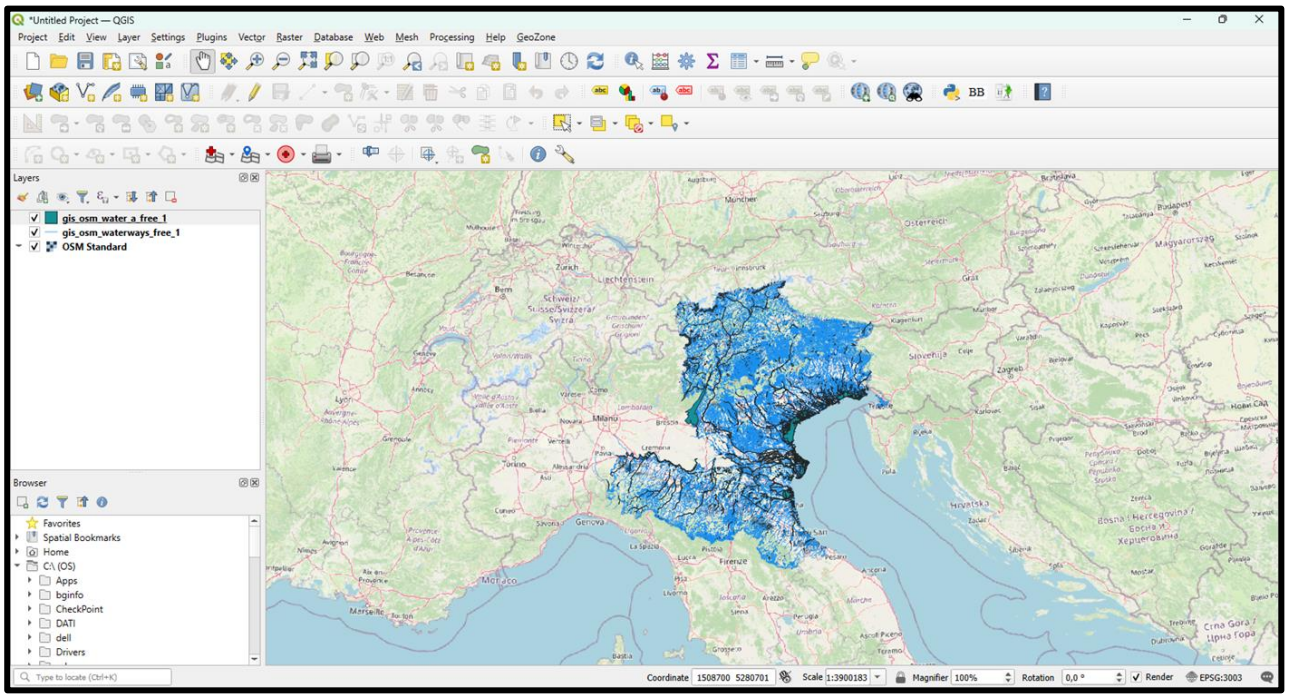
In this example, we selected Europe and then Italy in the sub-region section, and downloaded data for the northeast of Italy.

Hungary	[.osm.pbf]	(252 MB)	[.shp.zip]	[.osm.bz2]
Iceland	[.osm.pbf]	(57 MB)	[.shp.zip]	[.osm.bz2]
Ireland and Northern Ireland	[.osm.pbf]	(308 MB)	[.shp.zip]	[.osm.bz2]
Isle of Man	[.osm.pbf]	(4.9 MB)	[.shp.zip]	[.osm.bz2]
Italy	[.osm.pbf]	(1.8 GB)	✖	[.osm.bz2]

Sub Region	Quick Links			
	.osm.pbf		.shp.zip	.osm.bz2
Centro	[.osm.pbf]	(318 MB)	[.shp.zip]	[.osm.bz2]
Isole	[.osm.pbf]	(182 MB)	[.shp.zip]	[.osm.bz2]
Nord-Est	[.osm.pbf]	(541 MB)	[.shp.zip]	[.osm.bz2]
Nord-Ovest	[.osm.pbf]	(503 MB)	[.shp.zip]	[.osm.bz2]
Sud	[.osm.pbf]	(329 MB)	[.shp.zip]	[.osm.bz2]

After downloading the data, you will have a zip folder.

Unzip this folder and you will be able to import the data into your GIS project. Remember to select the specific data you want from the available options, for example, such as in QGIS, as illustrated in the image below.



Example of open street map data of northern east part of Italy in a QGIS project.

Marine Regions

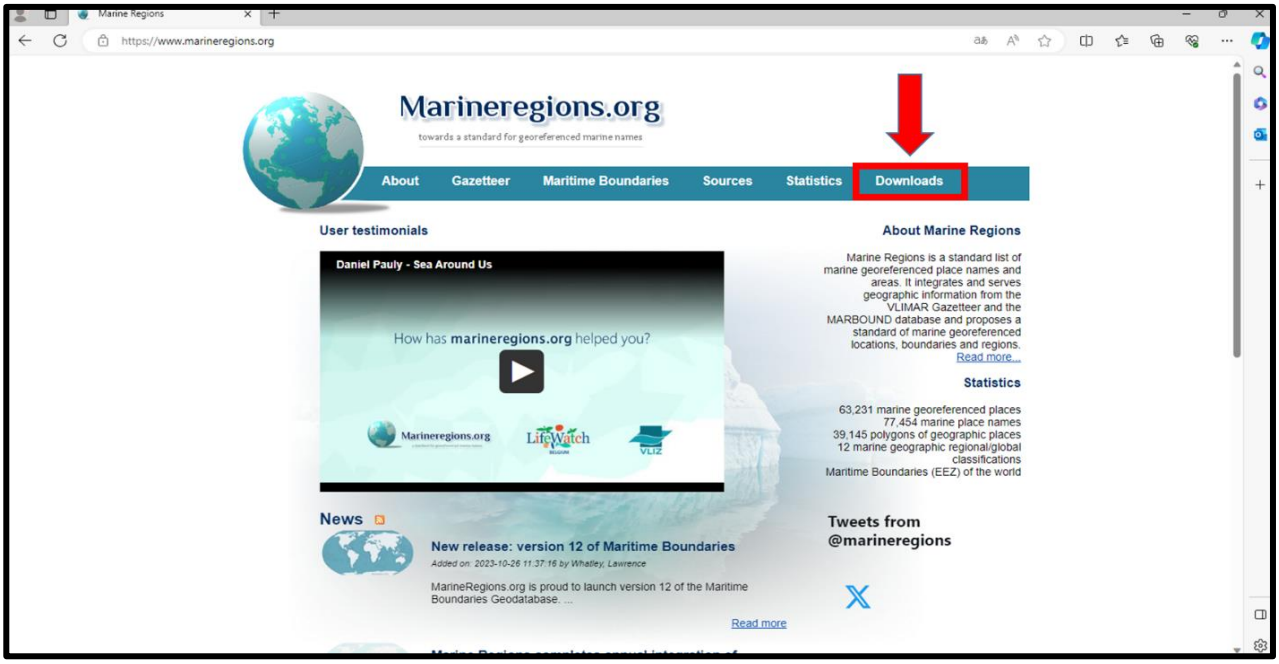
Marine Regions is a combination of two databases: the VLIMAR Gazetteer and the Flanders Marine Institute Maritime Boundaries Geodatabase. The VLIMAR Gazetteer contains a list of geographic names mainly related to marine features such as seas, sandbanks, seamounts, ridges, bays, and standard sampling stations used in marine research.

Initially focused on the Belgian Continental Shelf, the Scheldt Estuary, and the Southern Bight of the North Sea, it has since expanded to include more regional and global information. The Maritime Boundaries database, on the other hand, delineates the Exclusive Economic Zones (EEZs) of the world. By combining these two databases, the marineregions.org website was created.

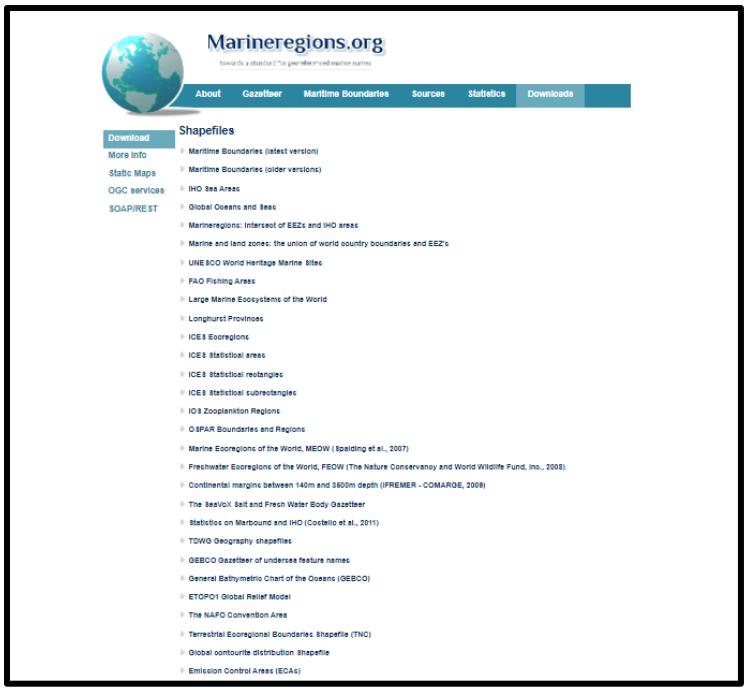
The Marine Regions platform is managed by the Flanders Marine Institute, which initially received funding from the EU Network of Excellence MarBEF and other European projects such as Lifewatch, supporting its maintenance and ongoing management.

Downloading Marine Regions data

Navigate to the Marine Regions website: https://www.marineregions.org/ and click on “Download”.



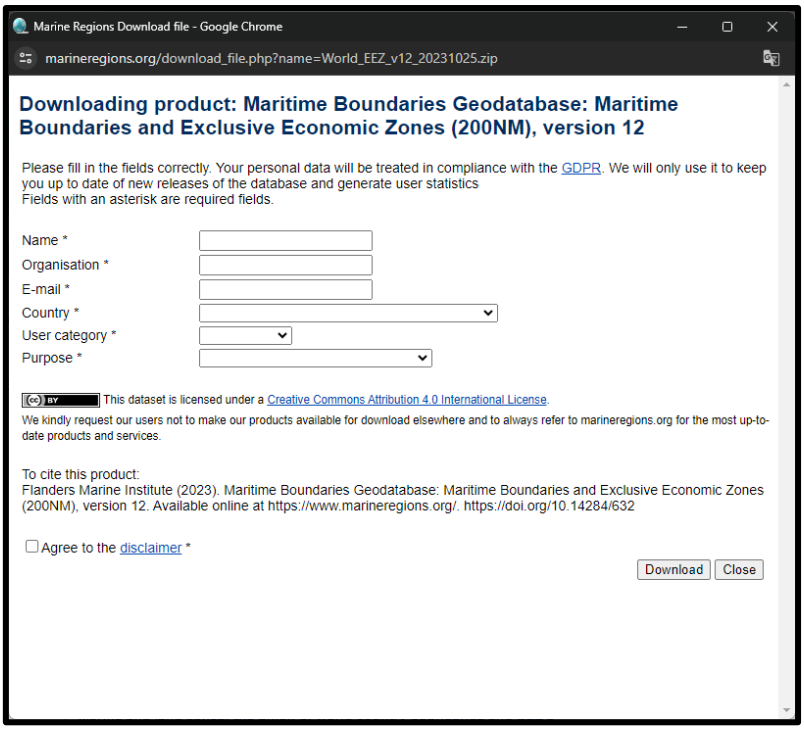
Marine Regions offers a variety of geographical data, including **Exclusive Economic Zones** (EEZs), **Maritime Boundaries**, and **International Hydrographic Organization** (IHO) Sea Areas, as shown in the image below.



Decide which type of data you need.

Choose the format in which you need the data. Common formats include shapefiles (for GIS software), KML/KMZ (for Google Earth), or GeoJSON. Once you have found the dataset you need, there should be an option to download it.

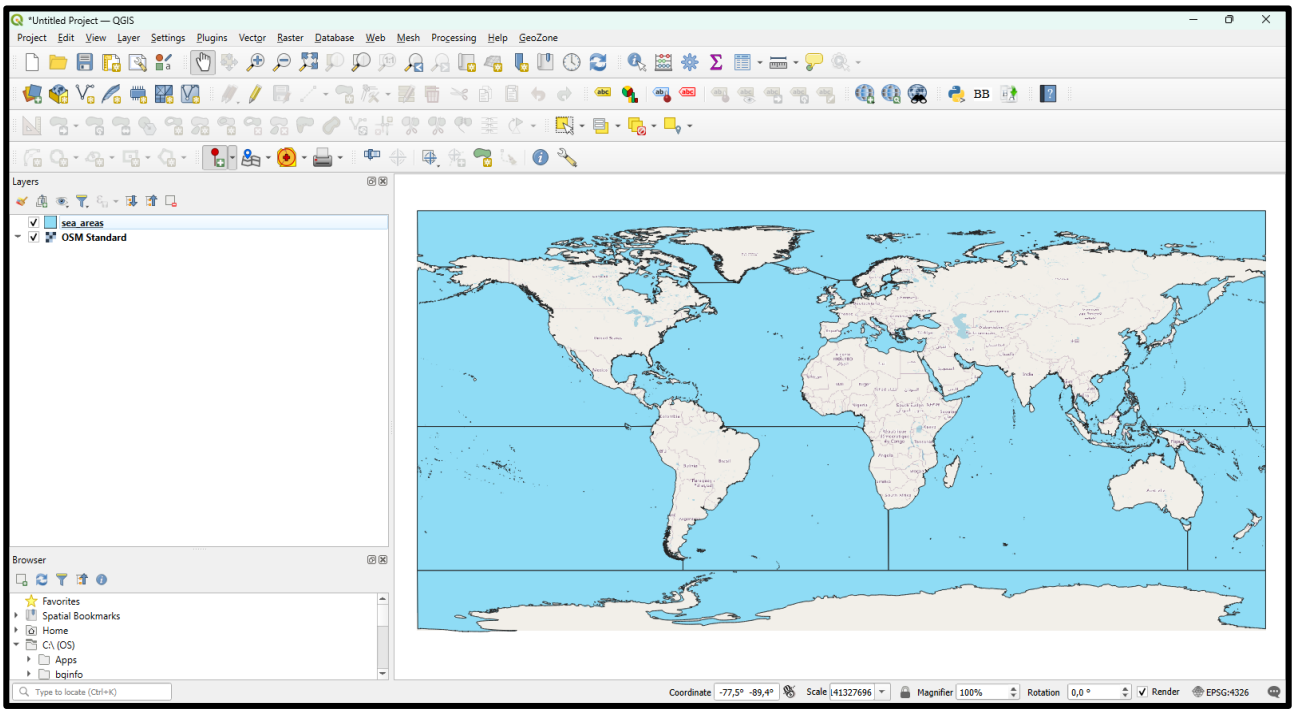
Before starting the download process, fill out the required fields with your personal information, as shown in the figure below:



Click on the “Download” button to initiate the download. This will be direct download link.

To view or manipulate the downloaded data, you will need GIS software such as QGIS or ArcGIS. Certain data formats, such as KML, can also be opened with Google Earth.

Your downloaded data should appear in QGIS as illustrated in the image below:



Example of Marine Regions data in a QGIS project.

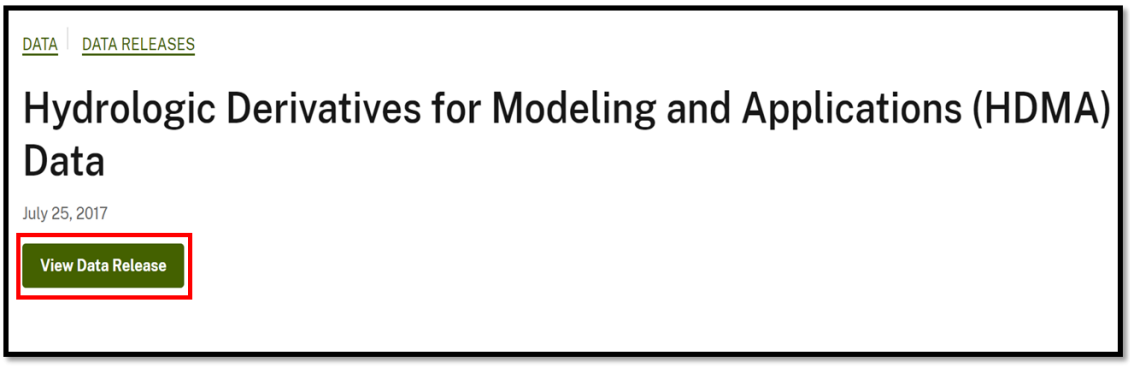
HDMA database

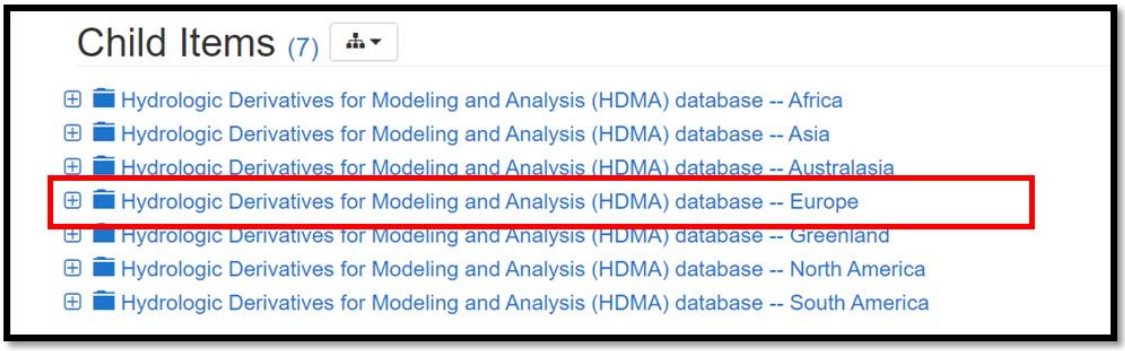
The Hydrologic Derivatives for Modeling and Analysis (HDMA) database offers comprehensive and consistent global coverage of topographical data in both raster and vector formats. It includes five raster

layers: Digital Elevation Model (DEM) data, flow direction, flow accumulation, slope, and Compound Topographic Index (CTI). Additionally, it provides three vector layers: streams, catchment boundaries, and processing units. The data covers the entire globe (-180 to 180 longitude, -90 to 90 latitude) and is based on a hybrid DEM derived from three datasets: HydroSHEDS, Global Multi-resolution Terrain Elevation Data 2010, and the Shuttle Radar Topography Mission (SRTM). The raster data has a resolution of 3-arc-seconds south of 60 degrees North (matching the resolution of the SRTM) and 7.5-arc-seconds north of 60 degrees North, except for Greenland, where it is 30-arc-seconds. Streams and catchments are labeled with Pfafstetter codes, providing important topological information.

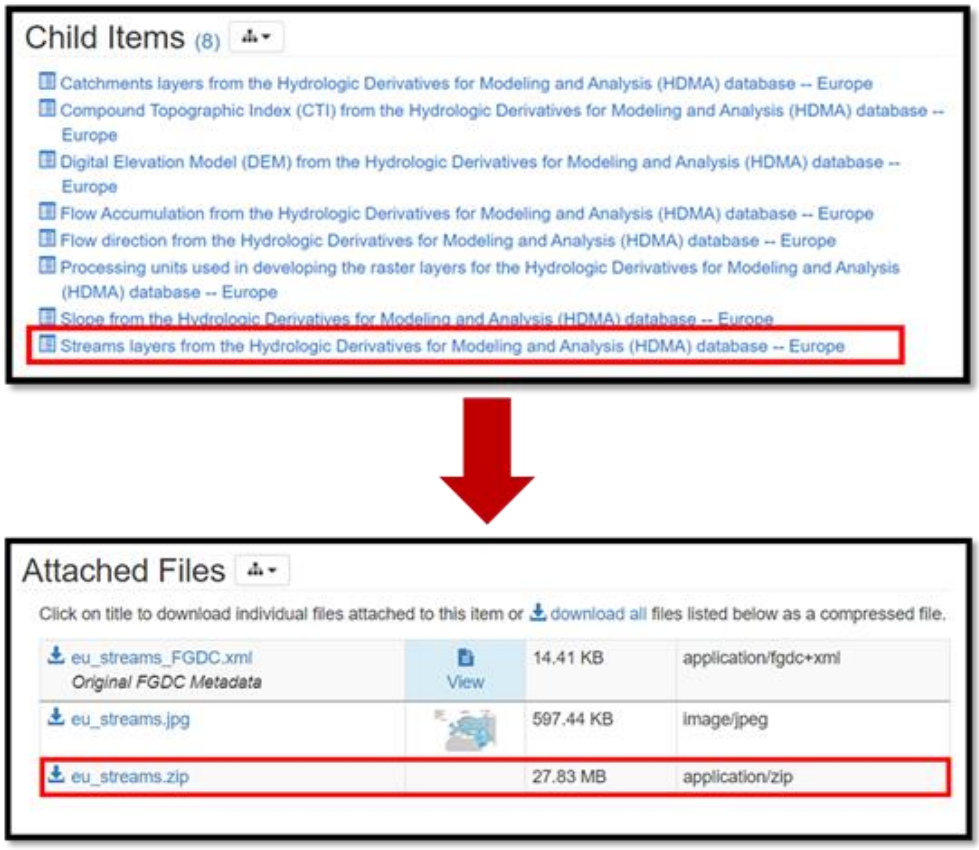
Downloading HDMA database data

To download data from the HDMA database click on "View Data Release" on their web page.
Select your area of interest.

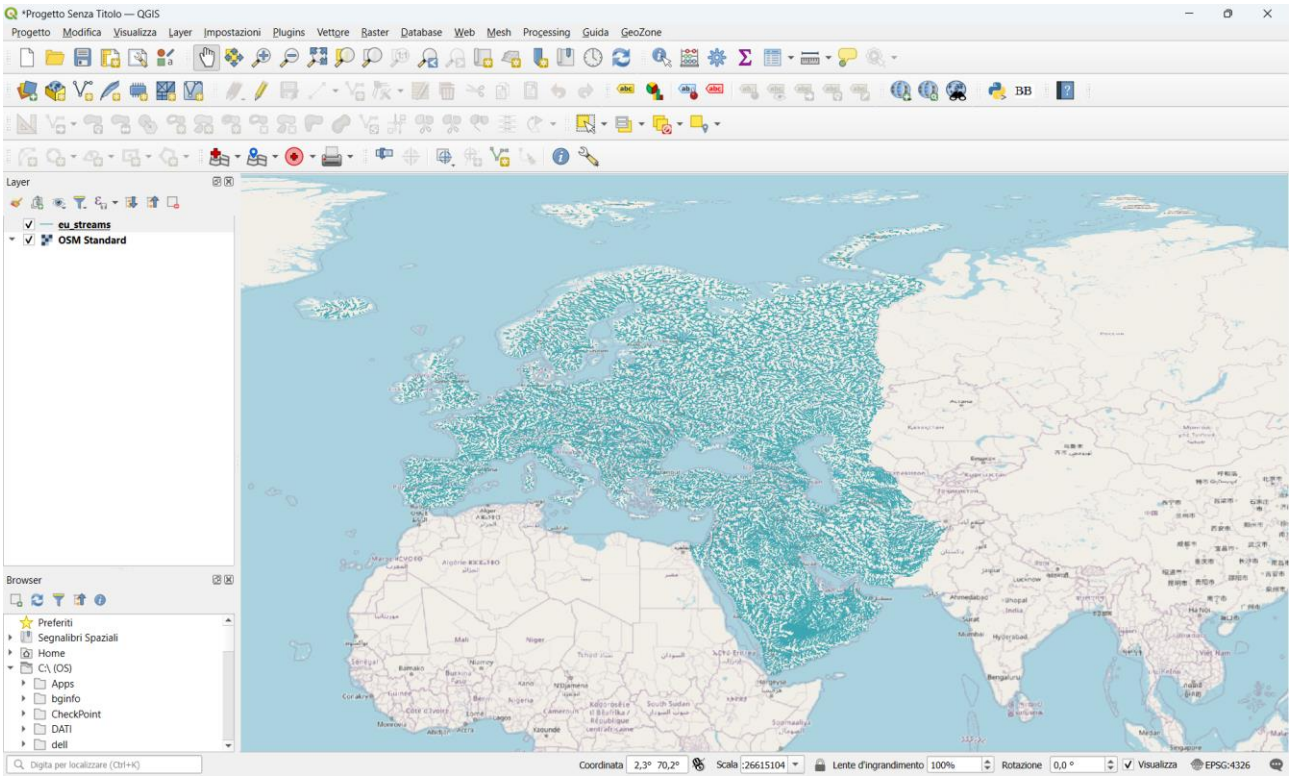




The "eu_stream.zip" file was selected from the "Streams layers from the Hydrologic Derivatives for Modeling and Analysis (HDMA) database – Europe.



Once downloaded, unzip the file, and you will be able to import the data into your GIS project (e.g. QGIS, ArcGIS). The downloaded data will appear in your QGIS project, as shown in the image below:



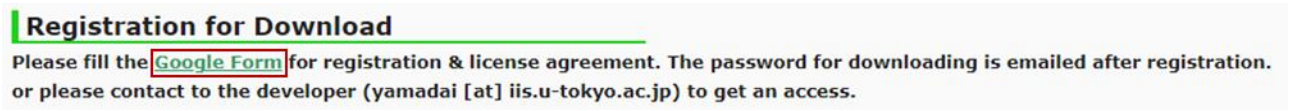
Example of HDMA data in a QGIS project.

Merit Hydro

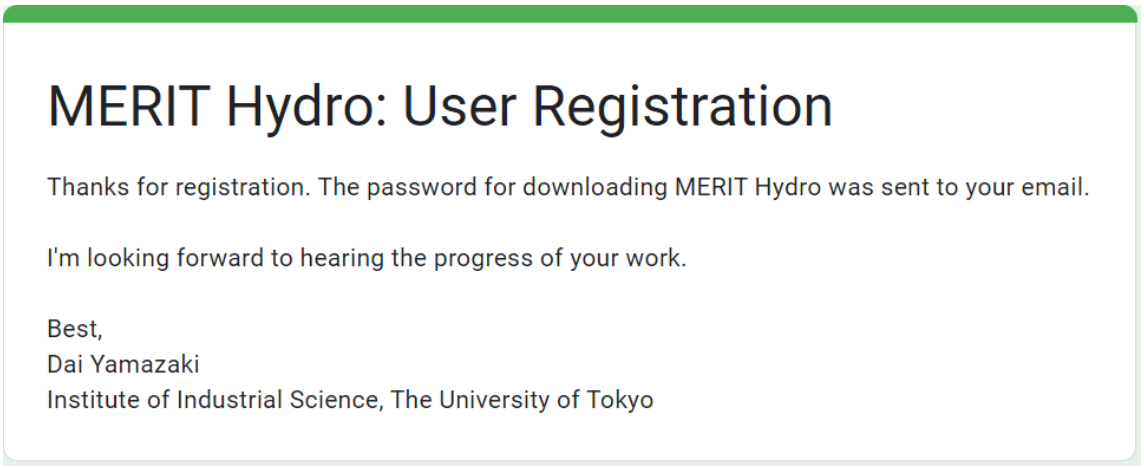
Merit Hydro is a global hydrography dataset developed using the MERIT DEM and various inland water maps. It includes data on flow direction, flow accumulation, hydrologically adjusted elevations, and river channel width. The dataset is available for download following registration and acceptance of the license agreement via a Google Form.

Downloading Merit Hydro data

To access and download materials from the MERIT Hydro: Global Hydrography Datasets, you need to register on the website first.



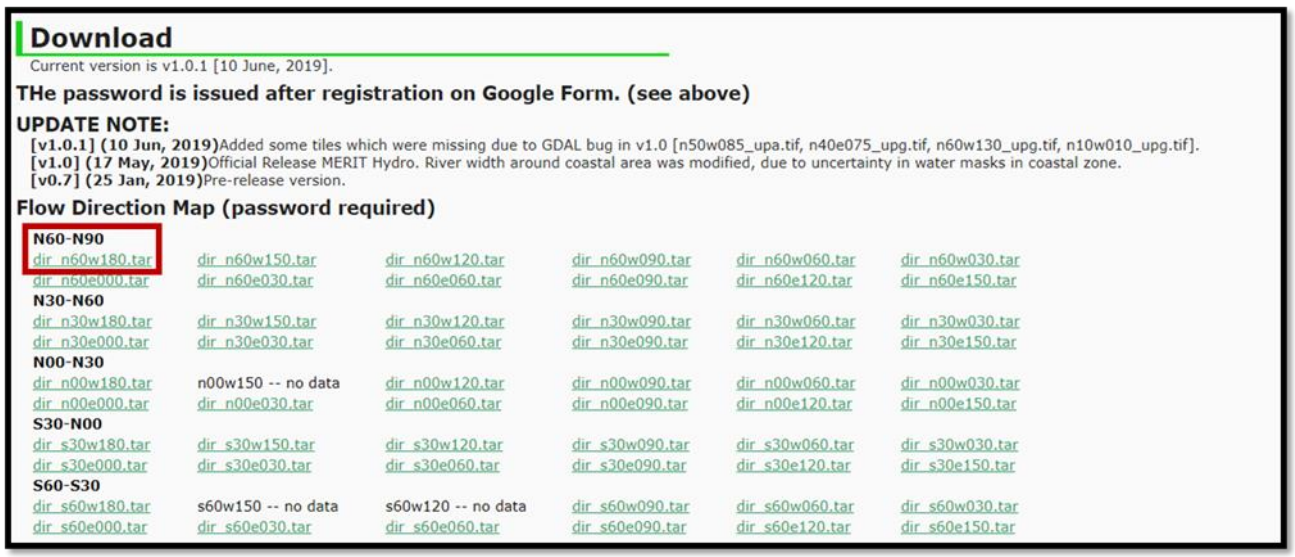
Complete the registration form, and a key will be sent to your email address.



Use this key to access and download the data you need.

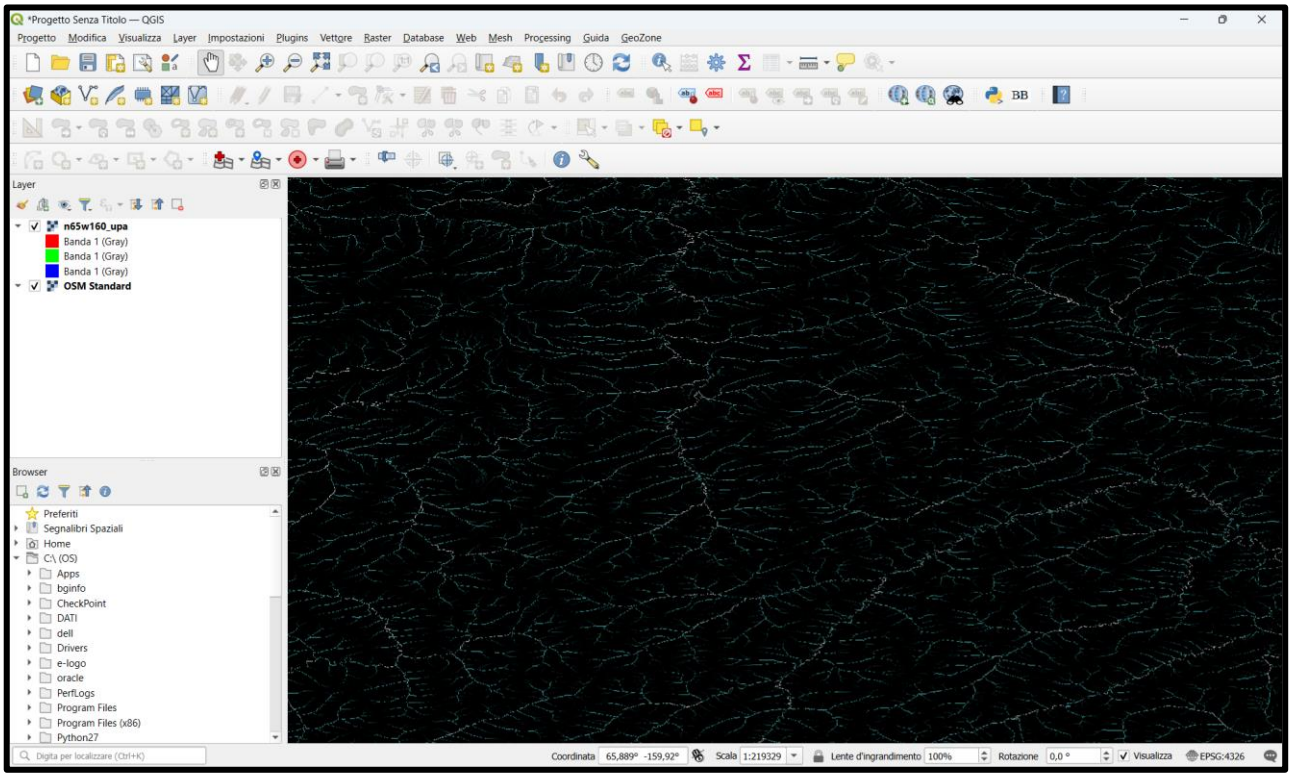
At the bottom of this page, navigate to the "Download" section.

The page offers various types of data for download, including "flow direction," "adjusted elevation," "upstream drainage area," "number of upstream drainage pixels," "river width," and "height above nearest drainage."



Select the data of your interest and choose the desired range. You will find the file named “file.tar” available for download.

Once the download is complete, you can import the data into your GIS project. For example, using the “Upstream Drainage Area Range N60-N90” dataset.



Example of Merit hydro data in a QGIS project.

Aquastat

The Food and Agriculture Organization of the United Nations (FAO)'s AQUASTAT program collects and analyses data on water resources, water usage, and agricultural water management in African, Asian, Latin American, and Caribbean countries, with a focus on irrigated agriculture. Its goal is to promote sustainable use the sustainable use of water and land through the provision of accurate, standardized information facilitating agricultural and rural development. AQUASTAT offers:

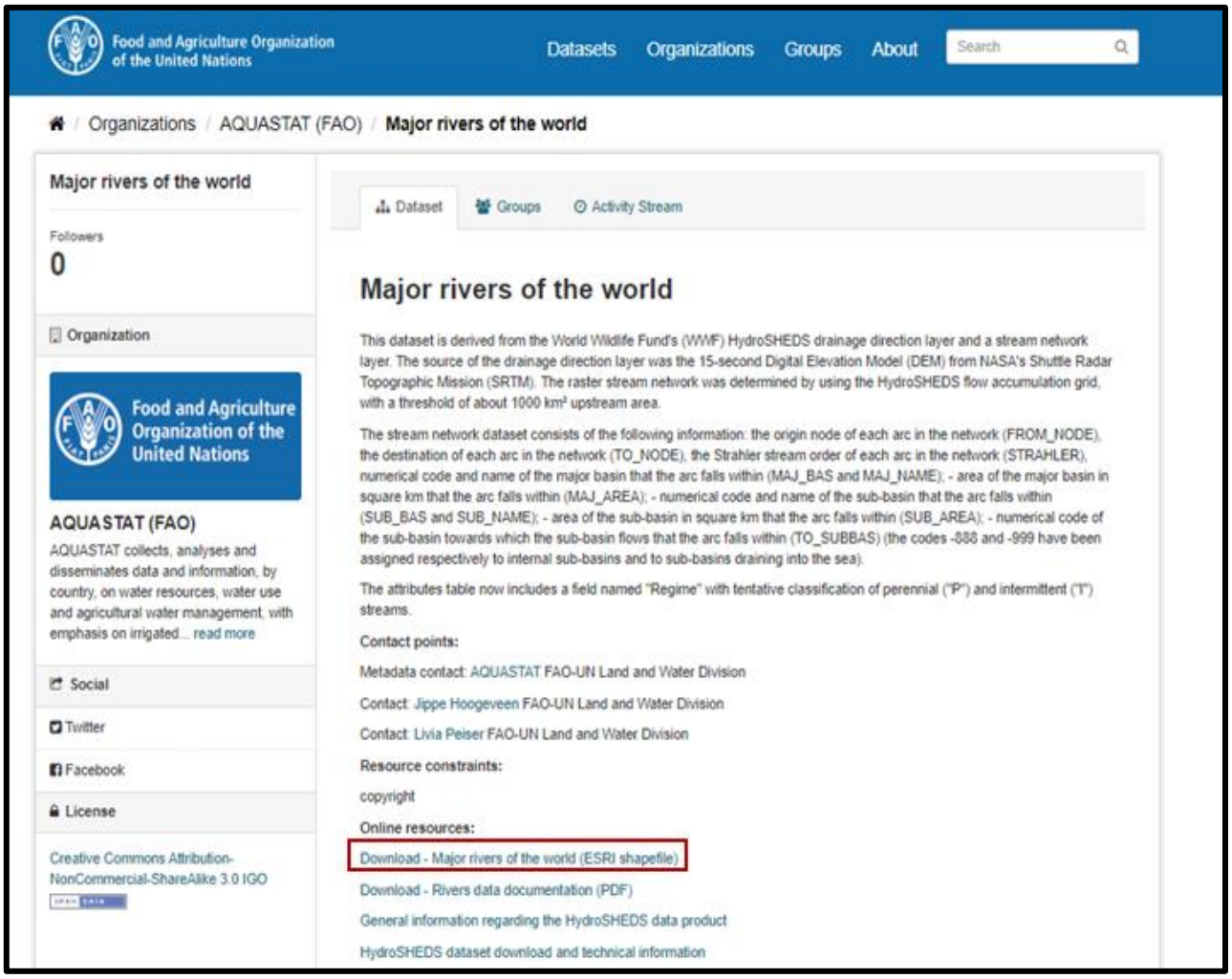
- Standardized data and information for tracking progress and supporting decision-making;
- Tools for analysis, conclusions, and content creation for articles and presentations;
- Capacity building for better understanding and monitoring of water resources, water usage, and irrigation management.

It provides various types of information including data, metadata, reports, country profiles, river basin profiles, regional analyses, maps, tables, spatial data, guidelines, and other tools related to:

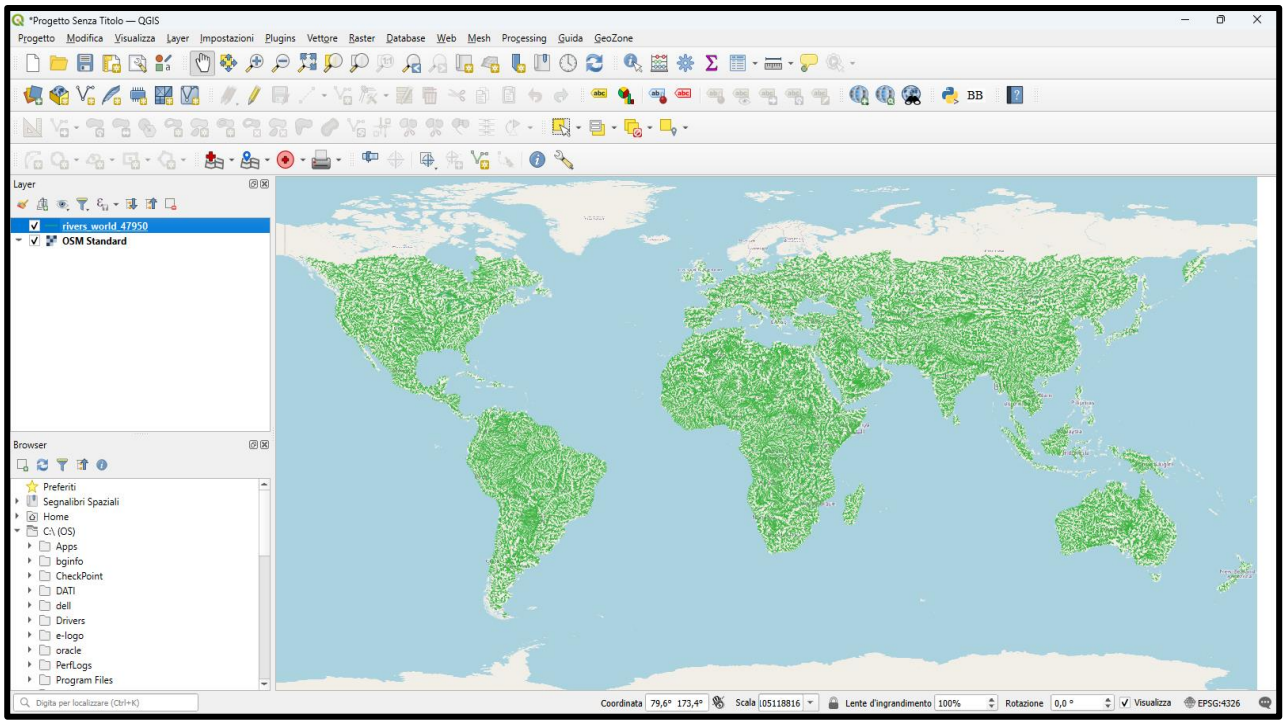
- Water resources (internal, transboundary, and total);
- Water usage (by sector, source, and wastewater);
- Irrigation (location, area, typology, technology, and crops);
- Dams (location, height, capacity, and surface area);
- Water-related institutions, policies, and legislation.

Downloading Aquastat data

To download river data, go to the AQUASTAT - FAO's Global Information System on Water and Agriculture platform and click on "Download – Major rivers of the world (ESRI shapefile)."



A direct download link will initiate. Once downloaded, you can work with the global river data in your GIS project:



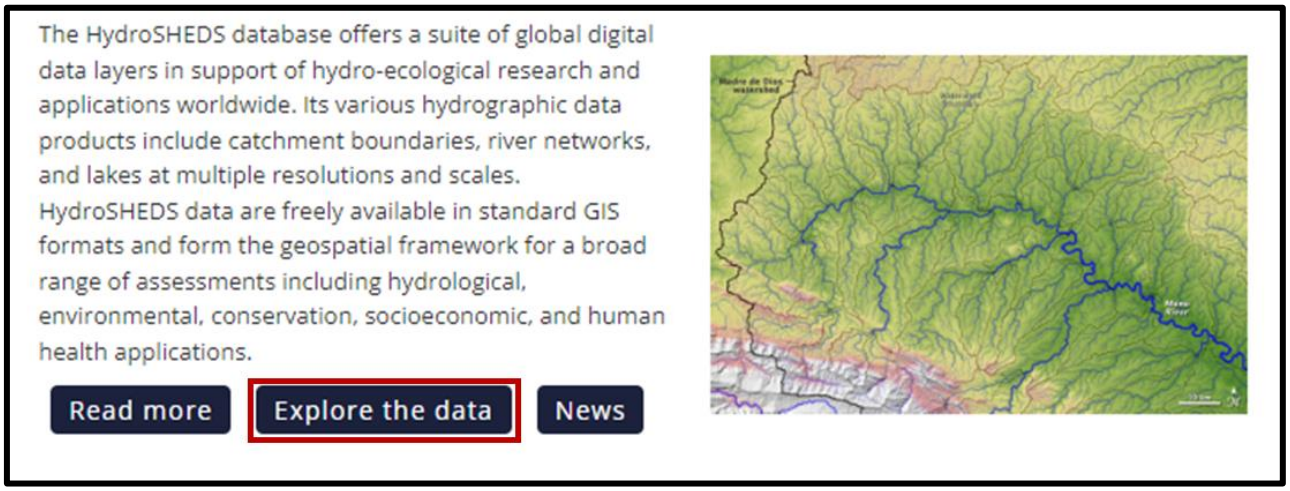
Example of Aquastat data in a QGIS project.

Hydroshed

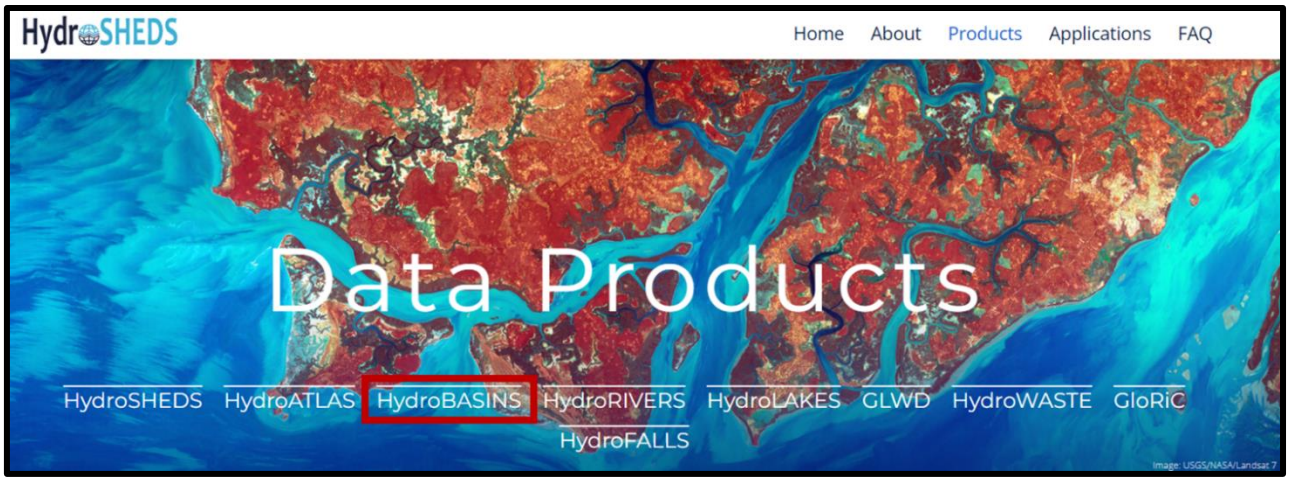
The HydroSHEDS database provides a comprehensive set of global digital data layers to support hydro-ecological research and applications worldwide. It offers various hydrographic data products, including catchment boundaries, river networks, and lakes, available at multiple resolutions and scales.

Downloading Hydrosheds data

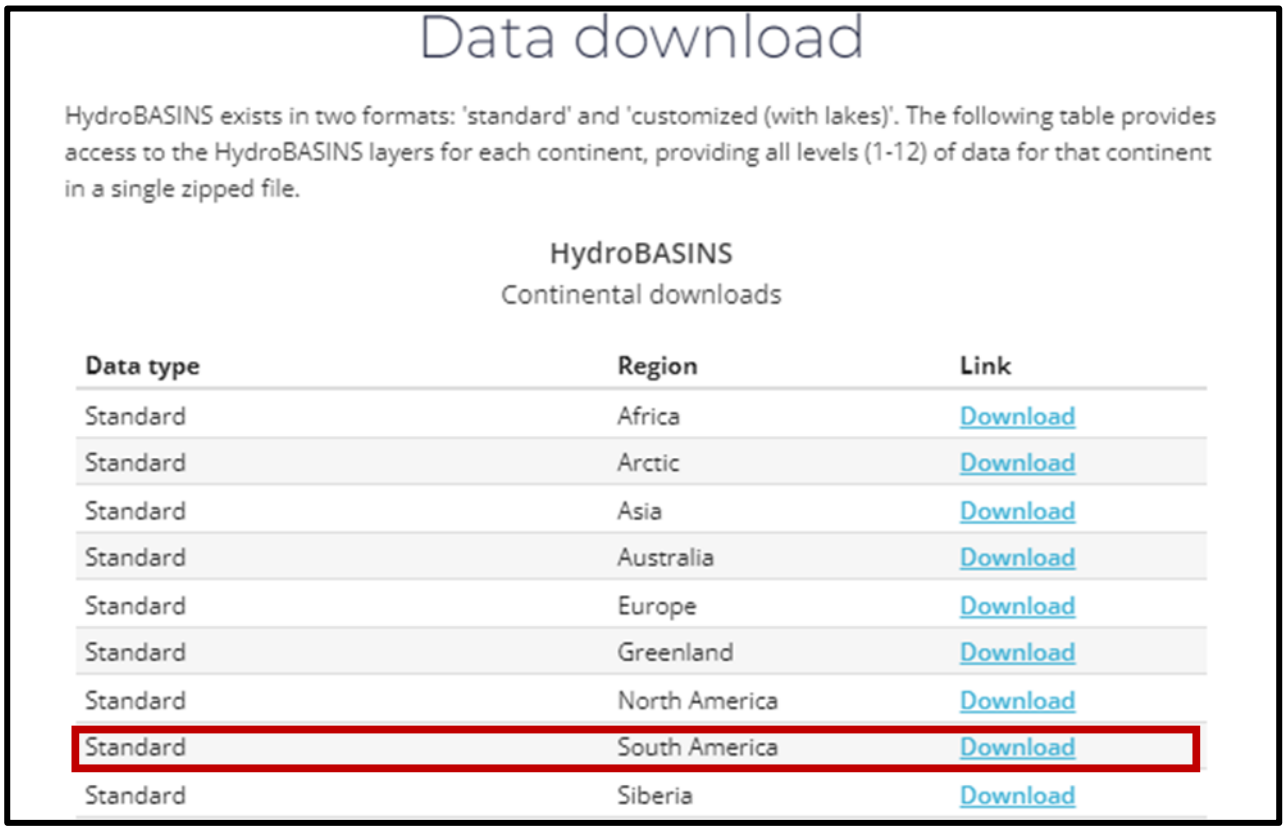
To download data from this source, navigate to the webpage: https://www.hydrosheds.org/ and click on "Explore the data."



You will see a range of options for downloading data. For this example, select the "HydroBASINS" option.



From the list of countries, choose your area of interest. In this example, select "South America".



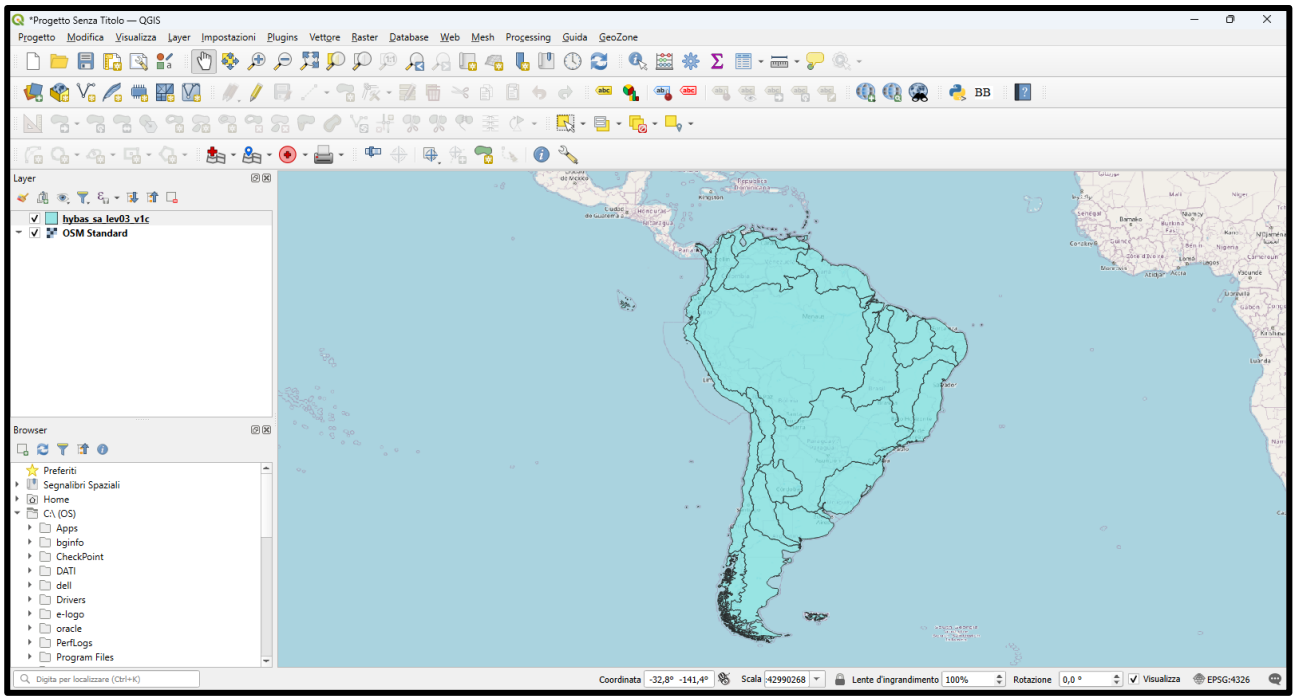
Data download

HydroBASINS exists in two formats: 'standard' and 'customized (with lakes)'. The following table provides access to the HydroBASINS layers for each continent, providing all levels (1-12) of data for that continent in a single zipped file.

HydroBASINS
Continental downloads

Data type	Region	Link
Standard	Africa	Download
Standard	Arctic	Download
Standard	Asia	Download
Standard	Australia	Download
Standard	Europe	Download
Standard	Greenland	Download
Standard	North America	Download
Standard	South America	Download
Standard	Siberia	Download

This process will allow you to download a shapefile containing basin data to your computer, which can then be used in your QGIS projects. As demonstrated in the figure below:



Example of Hydroshed data in a QGIS project.