European Commission

EOPEN T7.3: User Training

PUC 1: EOPEN User Training Material Outlook

EOPEN

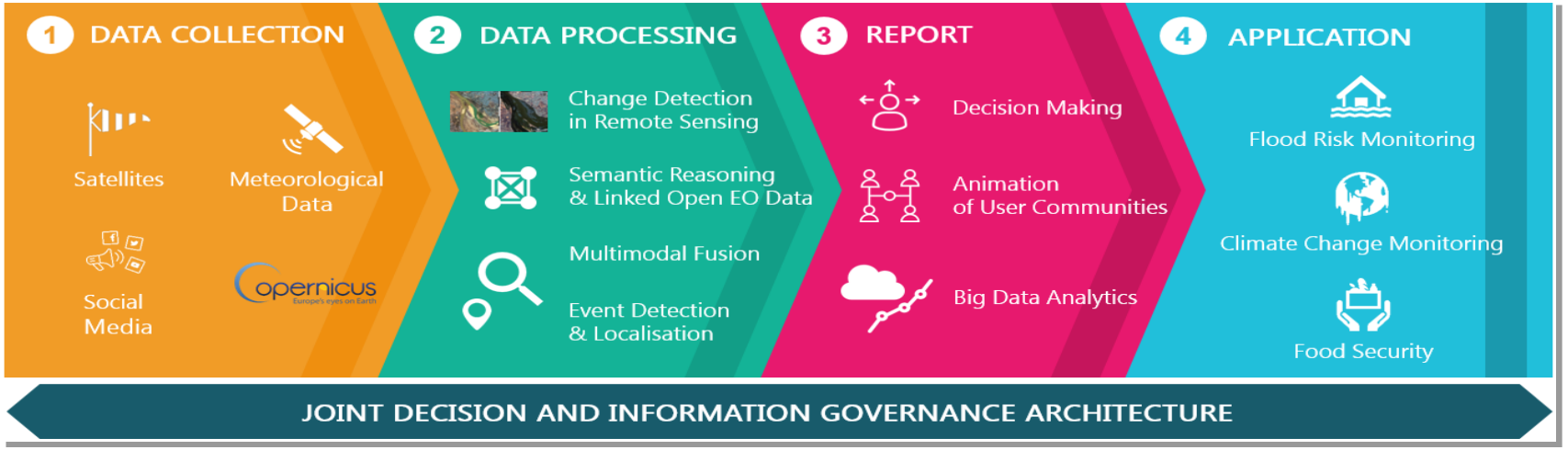
AAWA

Table of Contents

1. Background

1.1 Background of EOPEN

- EOPEN provides a platform targeting non-expert Earth Observation (EO) data users (non-traditional user communities), experts and the SME community
- The platform makes Copernicus data and services easy to use for Big Data applications by providing EO data analytics tools, decision making, and infrastructure
- And also it can support the Big Data processing life-cycle allowing the chaining of value-adding activities across multiple platforms



1. Background

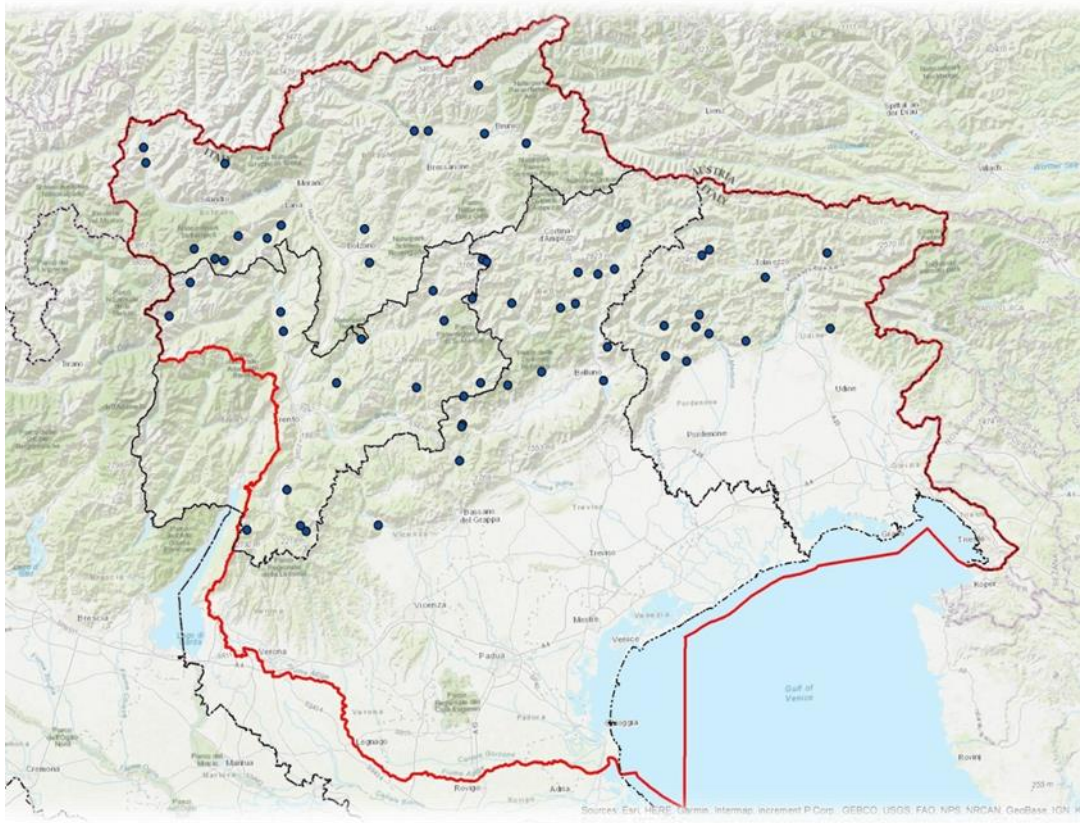
1.2 Objective

- Give the opportunity to use the results of EOPEN for end-users and interested third-parties.
- A detailed encounter for the efficient use of platform.
- Promote additional engagement activities, training activities, pursue a significant widen use of the EOPEN platform, and contributes to the uptake of EO data from the community.
- Support EOPEN's various capacity building activities, and bring effects that will outlast the project timeframe, contributing to the sustainability of EOPEN approach and system.

1. Background

1.3 The Eastern Alps river basin district

- The competence of the Authority (AAWA) covers the Autonomous Provinces of Trento and Bolzano, the Regions of Veneto, Friuli Venezia Giulia, and parts of basins falling within the borders of Switzerland, Austria and Slovenia.
- Overall, the District covers an area of over 37,000 km2.



1. Background

1.4 Floods in Italy

- The average annual precipitation is highly variable with increasing trend in the South-North direction at least up to the first orographic obstacle constituted by the pre-Alpine belt.
- The average annual values vary from just under 700 mm found in the southernmost part of the Veneto Region (province of Rovigo) to over 3,000 mm found in the Musi area of Lusevera and Uccea located near the border with Slovenia.

1. Background

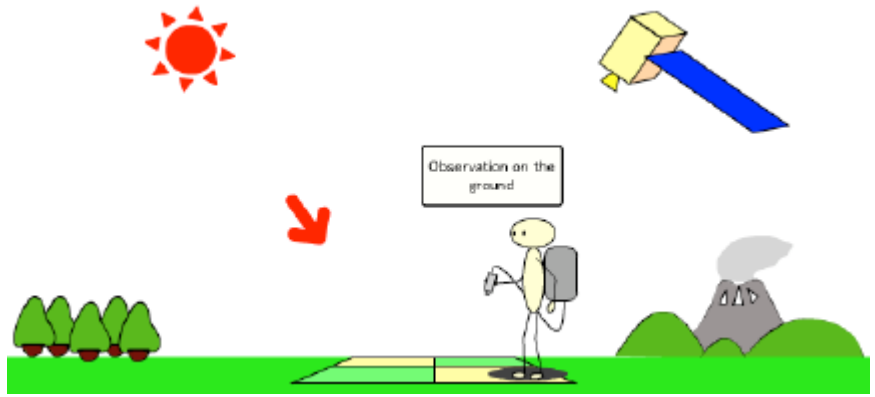
1.4 Floods in Italy

- Six major rivers flows inside the district: the Isonzo, the Tagliamento, the Livenza, the Piave, the Brenta-Bacchiglione and the Adige, all streams with high slopes and fluvial-torrent character, with average flows annual substantially between 80 and 100 m3 / sec and full flow between 2,500 and 5,000 m3 / sec

1. Background

1.5 The importance of ground truth

- In Remote Sensing, Ground truth is the data collected on site so that the input data (image) can be related to the actual features. This process compares the pixel on a satellite image to measurements at a given time, in order to verify the contents of the pixel on the image. In addition to ground truth, additional (complementary) information can be derived by tweets which are collected locally.



1. Background

1.6 The Copernicus Program and Satellite

- Copernicus is the European Union's Earth Observation Programme, looking at our planet and its environment for the ultimate benefit of all European citizens. It offers information services based on satellite Earth Observation and in situ (non-space) data.
- The Programme is coordinated and managed by the European Commission. It is implemented in partnership with the Member States, the European Space Agency (ESA), the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT), the European Centre for Medium-Range Weather Forecasts (ECMWF), EU Agencies and Mercator Océan.

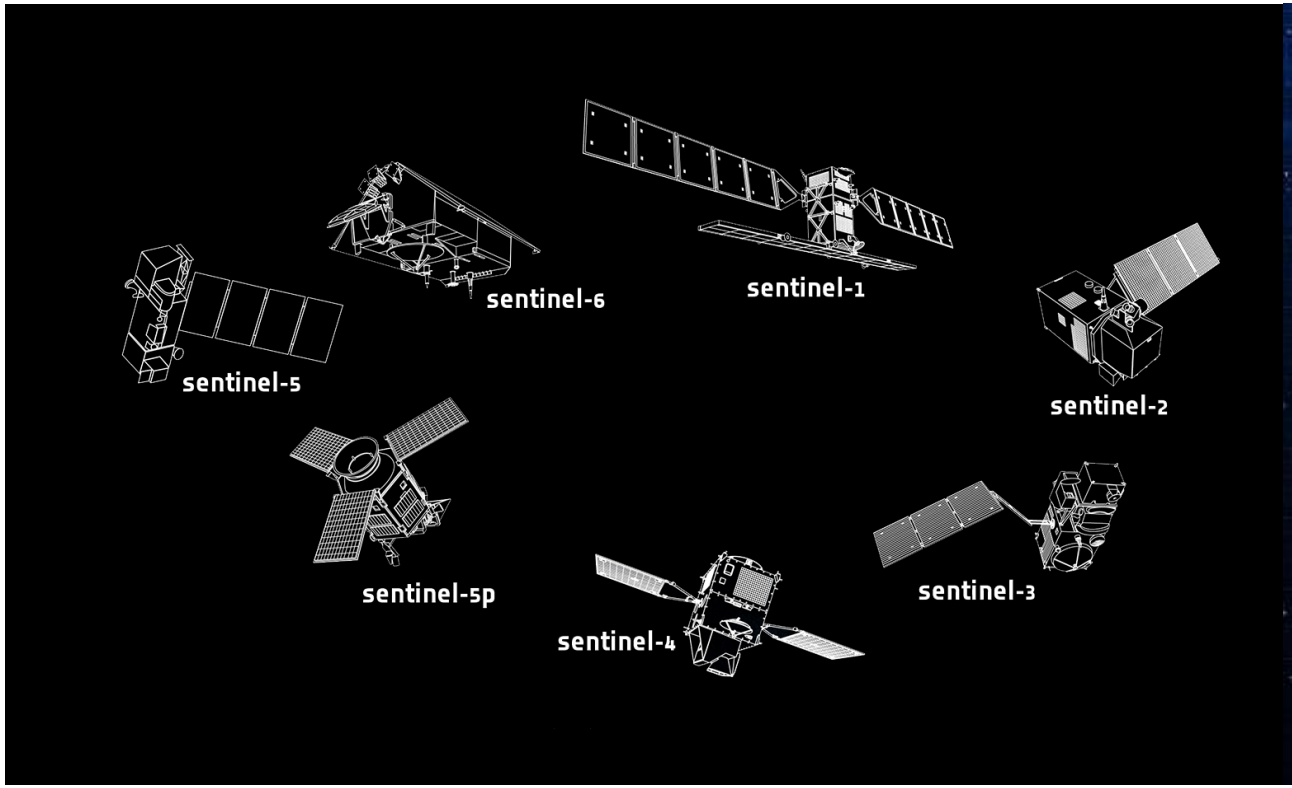
1. Background

1.6 The Copernicus Program and Satellite

- Vast amounts of global data from satellites and from ground-based, airborne and seaborne measurement systems are being used to provide information to help service providers, public authorities and other international organizations to improve the quality of life for the citizens of Europe. The information services provided are freely and openly accessible to its users.

1. Background

1.6 The Copernicus Program and Satellite



2. The EOPEN Platform for flood reduction

2.1 New methodology to derive flooded areas

- The EOPEN platform provides the opportunity to develop the concept of flooded area delineation. With EOPEN users can merge the information provided by classic hydraulic models with satellite imagine and data from social media inside a unique platform without the needs of a specific ICT infrastructure.

PRECURSORS:

Hydraulic models and simulations

Satellite imagine and maps

CONFIRMATION & Additional Information:

Ground truth and Tweets.

2. The EOPEN Platform for flood reduction

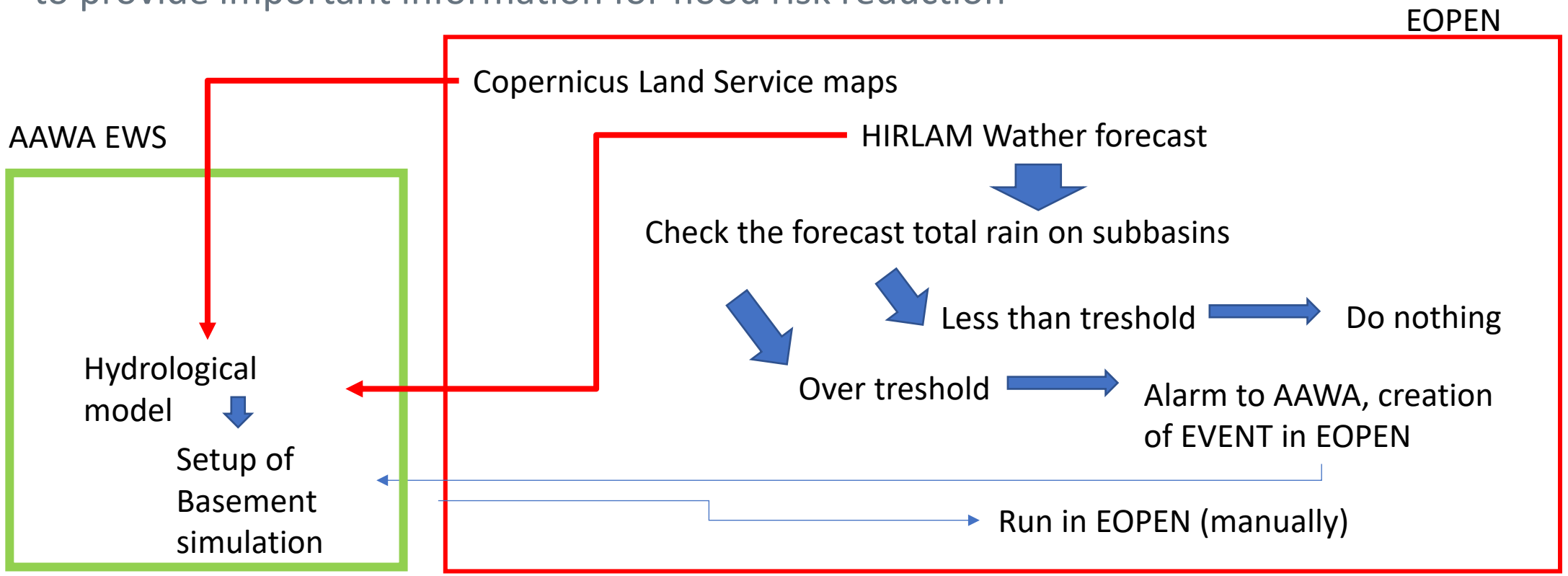
2.2 The hydrological and Hydraulic model to predict floods

- The (flood prediction) Flood Maps; those maps come as result of the hydraulic model; the model geometry is generated offline by technicians; boundary conditions come from the last hydrological run of AAWA model. The user will be able to upload the geometry and boundary files into EOPEN, run the algorithm and to download results. Once accepted by AAWA technician the user will upload Flood maps for any user.

2. The EOPEN Platform for flood reduction

2.2 The hydrological and Hydraulic model to predict floods

- The schema below show the interaction between several datasets and several infrastructure to provide important information for flood risk reduction



2. The EOPEN Platform for flood reduction

2.3 New methodology to derive flooded areas

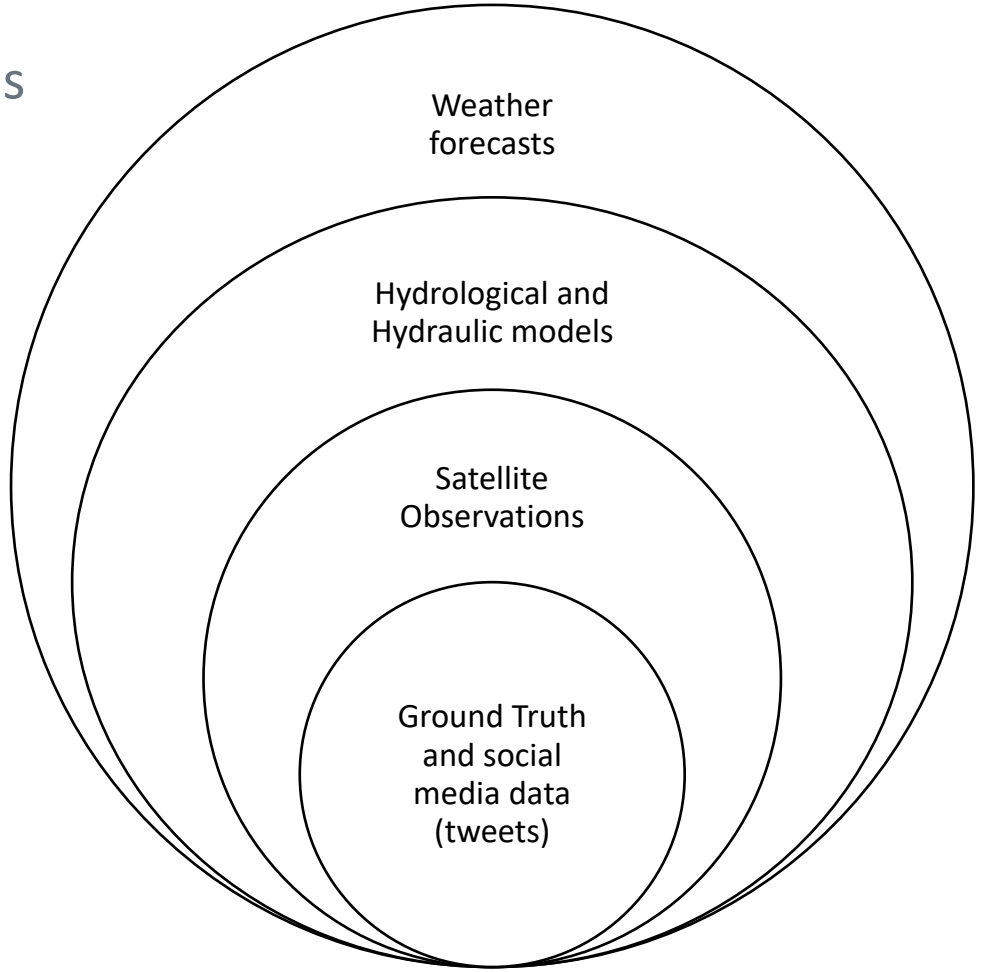
- Advantages of EOPEN

From:
Weather forecasts
Hydraulic models
Surveys

Costs

Time

To:



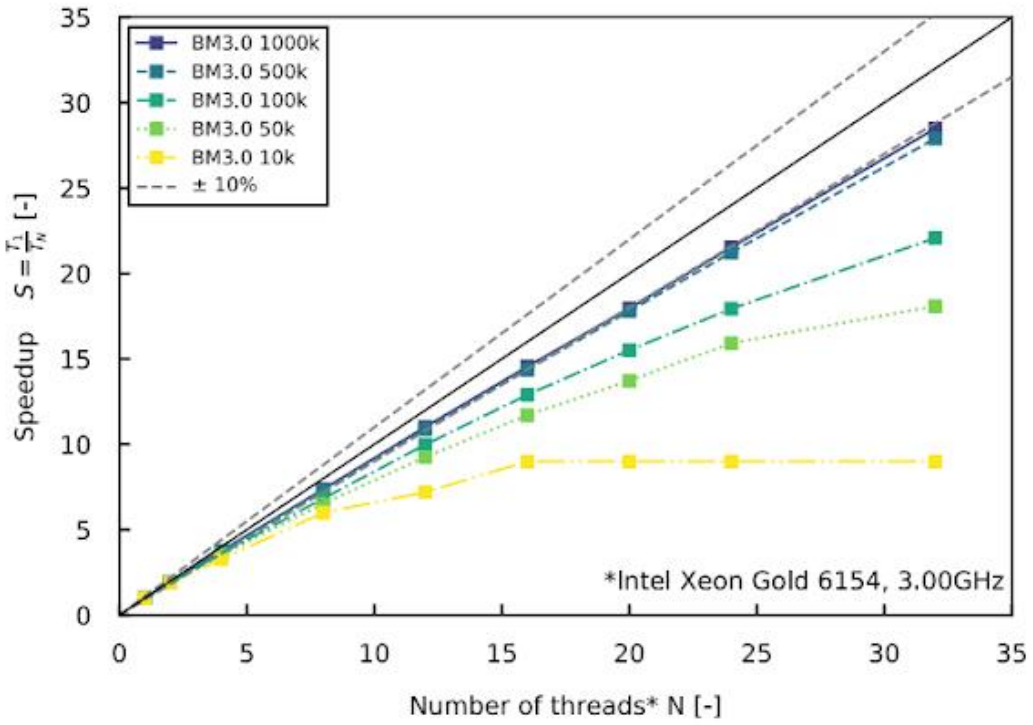
Time

Costs

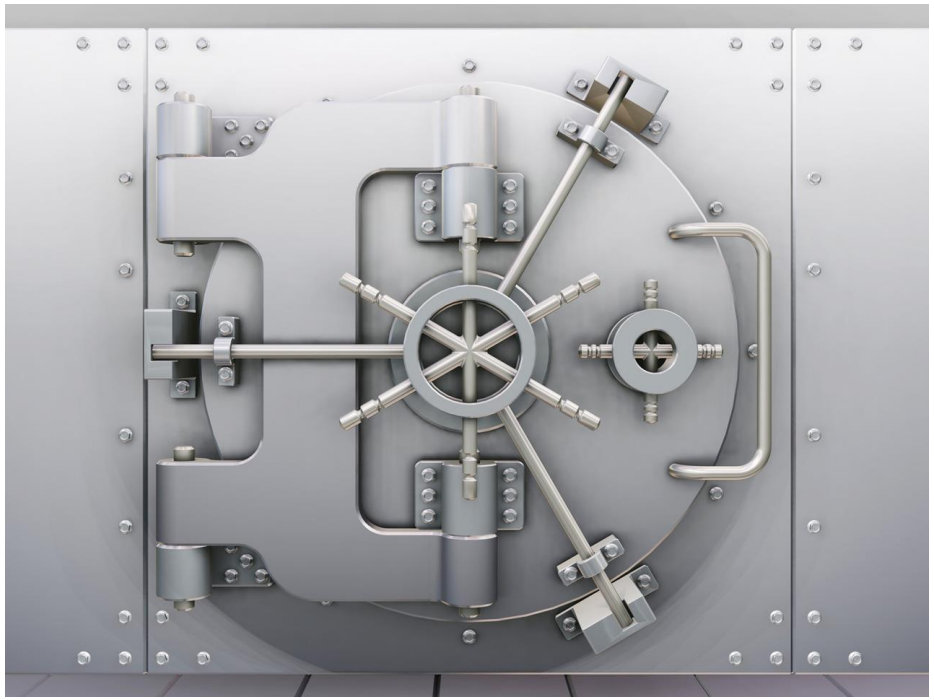
2. The EOPEN Platform for flood reduction

2.4 EOPEN capabilities for flood management

Speedup



Secure Storage



2. The EOPEN Platform for flood reduction

2.4 EOPEN capabilities for flood management

- One important advantage of EOPEN is that once a user generate a product can also decide to publish the content on the platform for other users which allows to save time and money.

Sharing contents between users

2. The EOPEN Platform for flood reduction

2.5 Satellite images and water presence maps

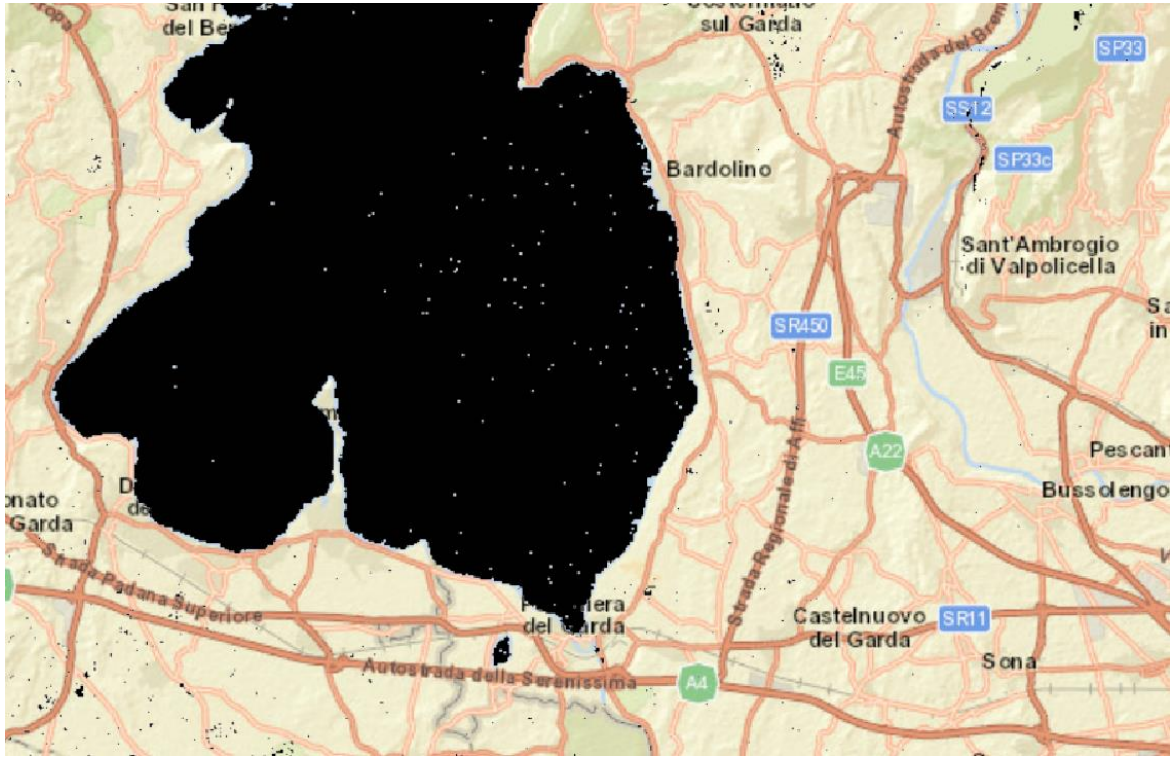
▷ Products available and tools for flood risk reduction

- The Water Presence Maps (WPM): maps of the areas covered by water (flooded and non flooded areas)

2. The EOPEN Platform for flood reduction

2.5 Satellite images and water presence maps

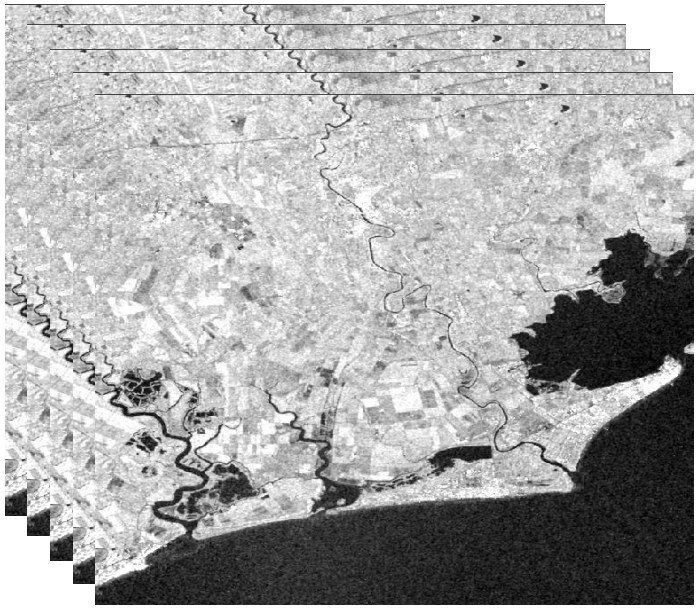
- ▷ Products available and tools for flood risk reduction
- The Water Presence Maps (WPM): those maps are the output of the water detection algorithm; this algorithm daily searches into the catalogue if there are new S1 or S2 images available and from it derives the maps that indicates the presence of water. The outputs are corrected applying masks to delete waterbodies and other permanent pools from the maps.



2. The EOPEN Platform for flood reduction

2.5 Satellite imagine flood map – outlier detection

X: Current image



TS: Timeseries of 30 previous images

Outlier (flood) detection on a target image X compared against a timeseries of 30 previous images that represent the “normal-state” of the area

$$\frac{X - TS_{mean}}{TS_{std}} > alpha$$

2. The EOPEN Platform for flood reduction

2.5 Satellite images and flood maps

(a) (b)

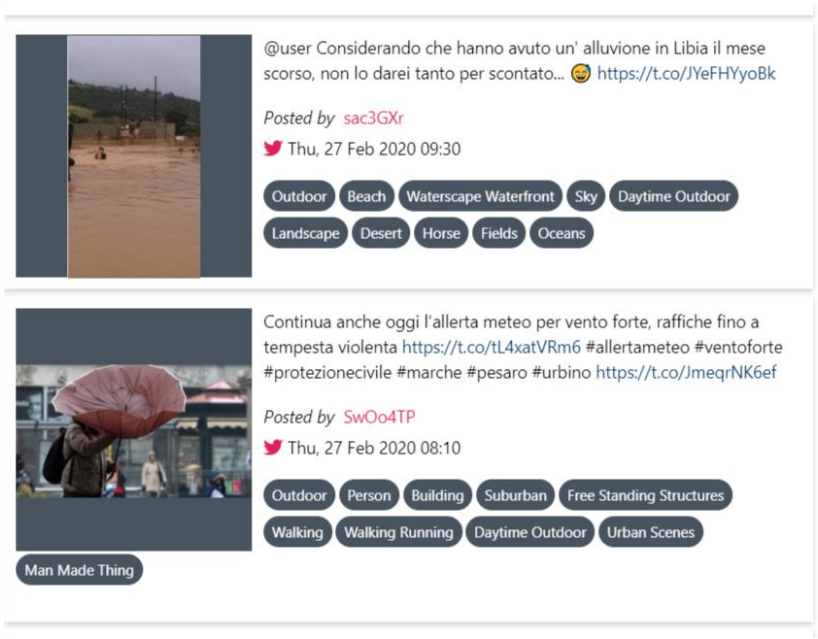
▷ Comparison between non flooded and flooded dates:

Flood map of Lemene river region on 15/11/2019, at a dry state (a) and on 17/11/2019, during a flood event (b). Flooded areas appear in red colour.

2. The EOPEN Platform for flood reduction

2.6 Social media data

- Social media data are a feedback from the territory. EOPEN platform can every day scan the web to derive data from social media, in this case tweets, to provide more information about the situation.



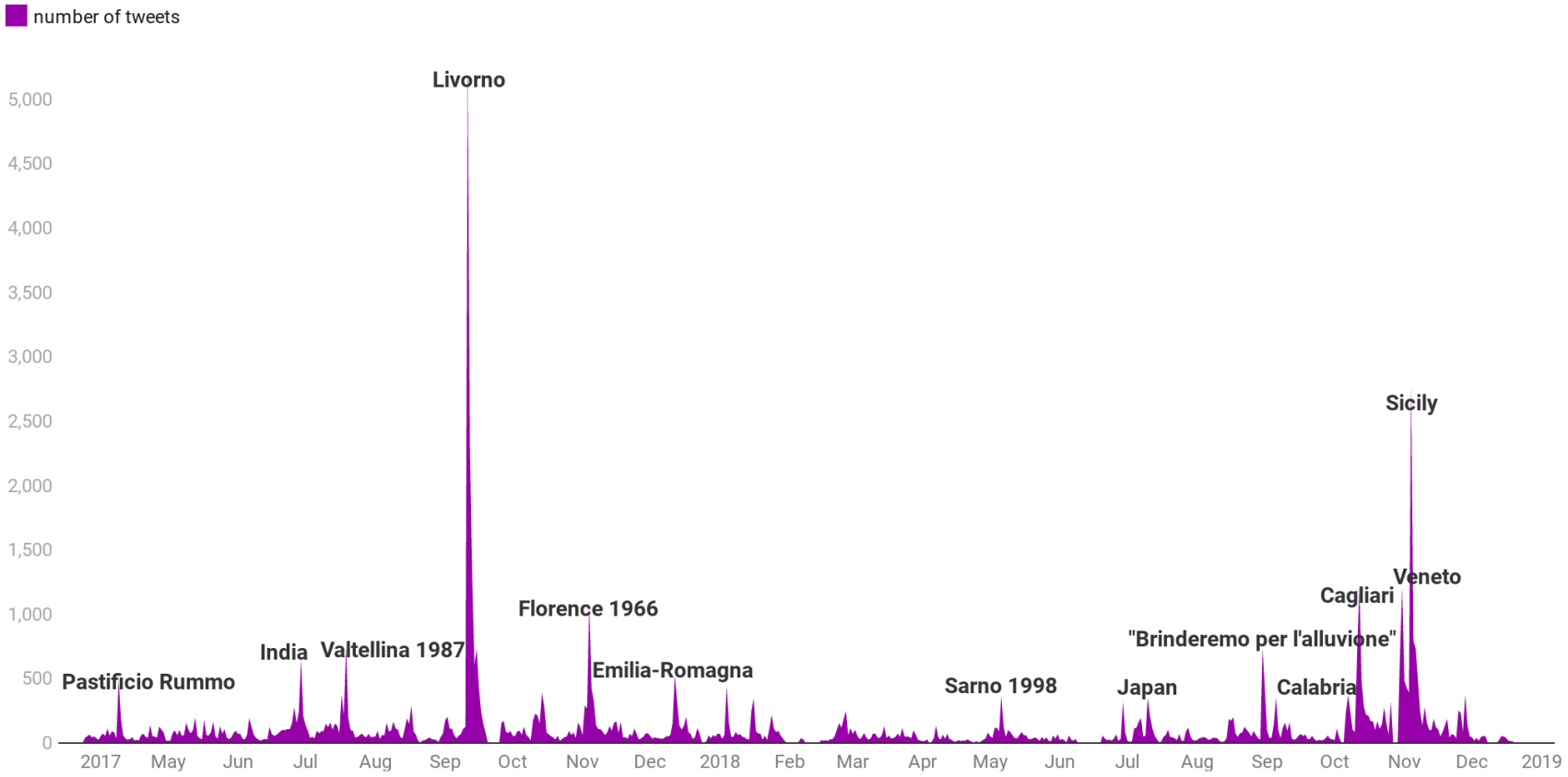
2. The EOPEN Platform for flood reduction

2.7 Events on social media data

- Event detection is based on the fluctuation of collected tweets per day
- Outliers (peaks) can be associated to real-world events (flood incidents)
- Retrieving the most frequent words and the most detected locations can provide more insights on the event
- A detected event can trigger the acquisition of satellite images of the area and the production of water masks

2. The EOPEN Platform for flood reduction

2.7 Events on social media data



Example of automatically detected flood events in Italy in years 2017 & 2018

3. Practical training

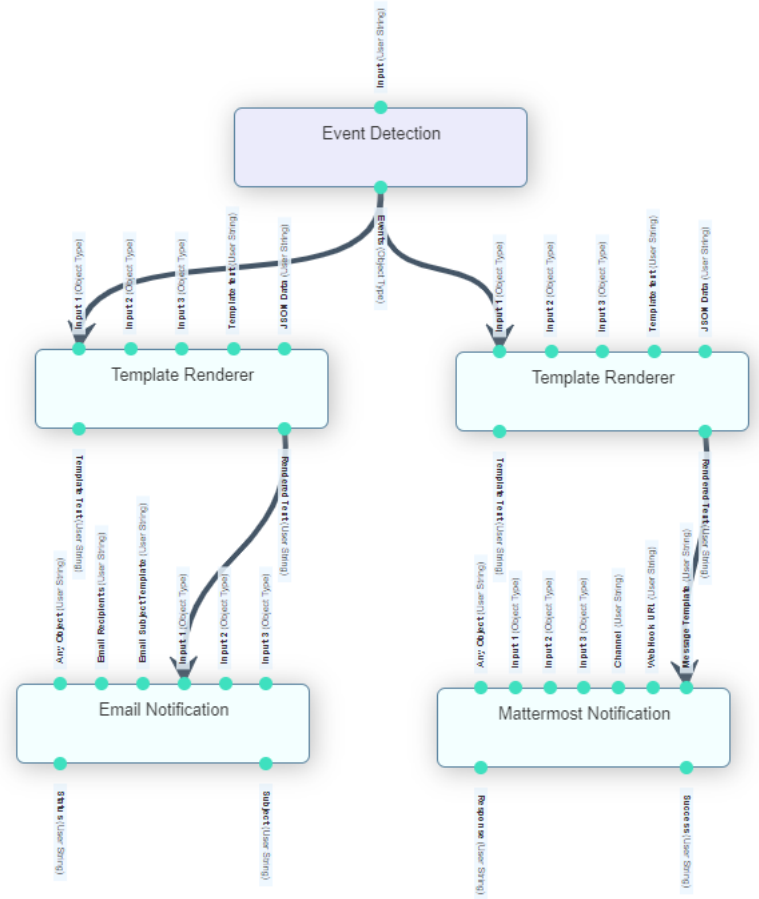
THE EOPEN PLATFORM

Link: https://eopen.spaceapplications.com

3. Practical Training

3.1 WORKFLOWS

- The platform most important feature is the ASB.
- The ASB is a framework enabling platform and application agnostic solution for implementing complex processing chains over globally distributed processing and data resources.
- ASB provides a “low coding” solution to develop a data processing facility based on orchestrated workflows.



3. Practical Training

3.3 EOPEN Event detection module

- Inside the platform exist many different workflows defined by users or created by the EOPEN team. One of these workflows already implemented inside EOPEN is the Event detection module; this module sends a notification every time a rain threshold is exceeded.

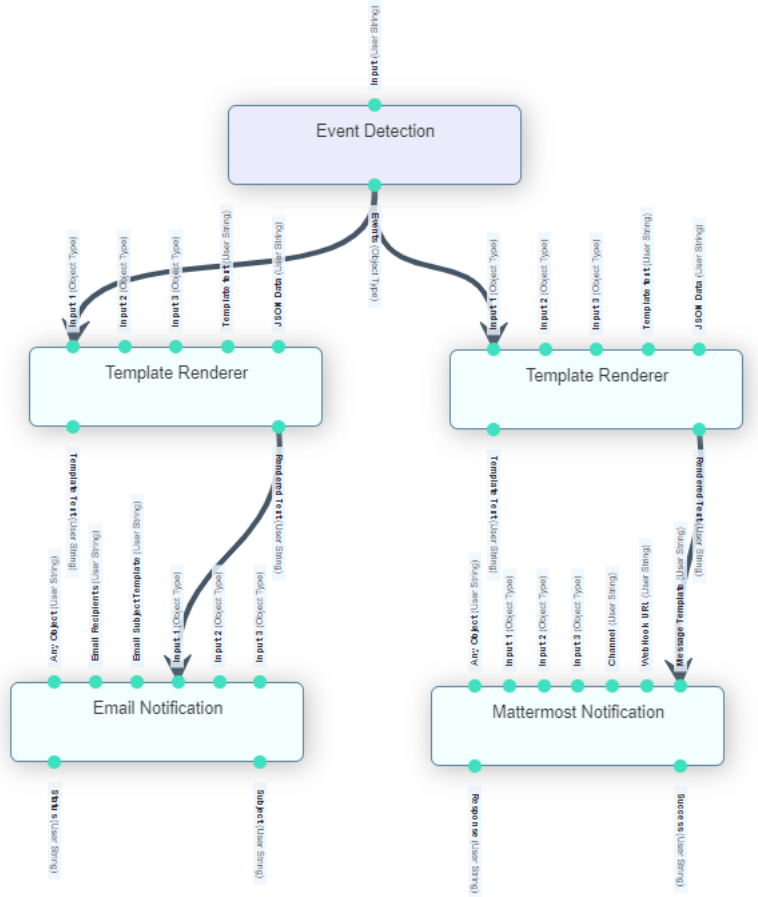
EOPEN, last Hirlam forecast on the platform → EOPEN will check Precipitation tresholds → EOPEN will rise an alarm (email and notifications)

3. Practical Training

3.3 EOPEN Event detection module

▷ The event detection workflow

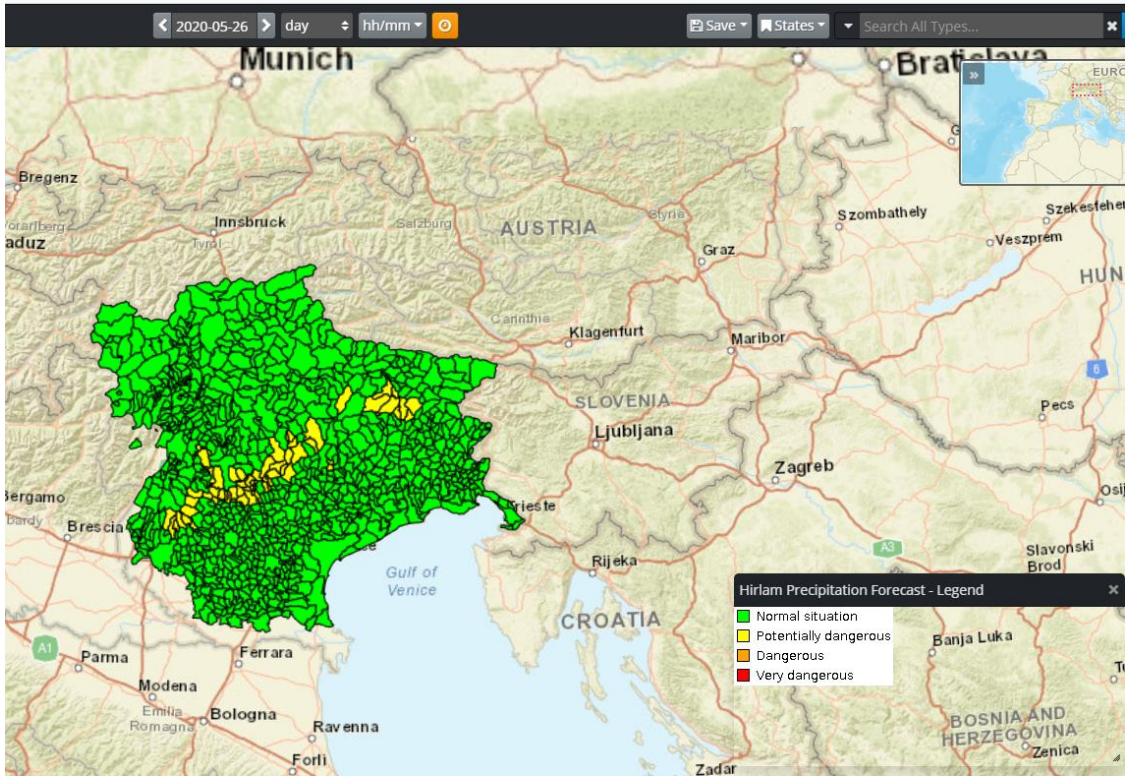
- The event detection module specifically checks the Hirlam forecast every time HIRLAM consortium publishes a new one. For each timestep the workflow checks threshold values of a variable (p.es. hourly rain) and sends a notification to the user, in case it is exceeded.
- Each box presents input and output of the process.



3. Practical Training

3.3 EOPEN Event detection module

- ▷ The event detection workflow
- The result of the event detection module is a map of the whole Eastern Alps River Basin District territory divided into municipalities where users can see the forecast at various time steps (24h, 36h, 48h).
- To provide a user-friendly view there is also a colored scale for each exceeded threshold value.



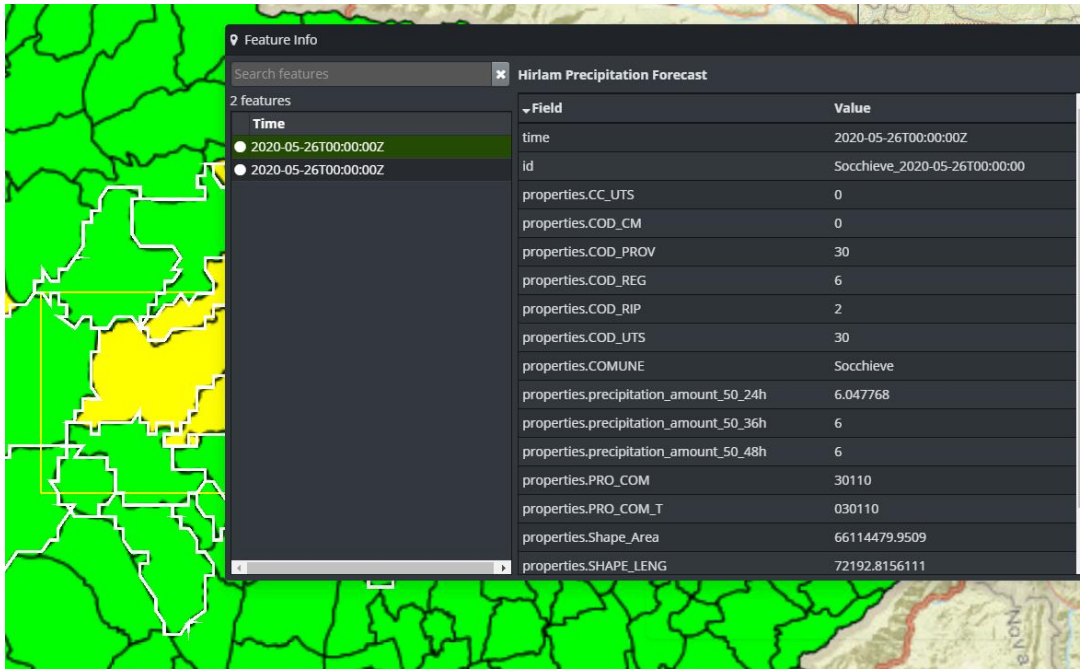
3. Practical Training

3.3 EOPEN Event detection module

▷ The event detection module

- Users can query the layer to know specific information about the forecast; EOPEN platform provides also an archive of those layers so users can also see past forecasts.
- Thresholds are listed below:

PV= precipitation value (mm)	Duration			
Colours	1h	24h	36h	48h
green	0<PV<15	0<PV<50	0<PV<70	0<PV<100
yellow	16<PV<25	51<PV<70	71<PV<100	101<PV<200
orange	26<PV<39	71<PV<100	101<PV<200	201<PV<250
Red	Red: PV>40	PV>100	PV>200	PV>250



3. Practical Training

3.2 EOPEN workflow to derive a WPM

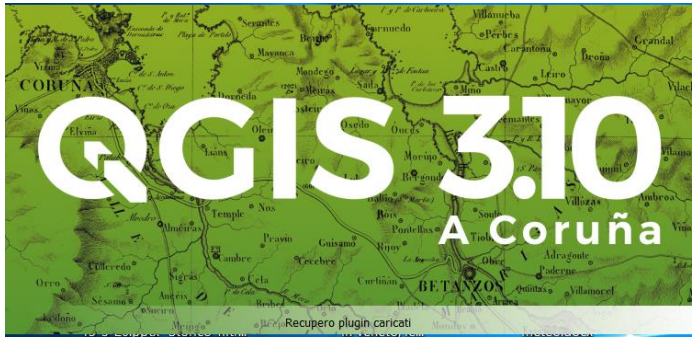
- Water presence maps come from a predefined algorithm developed by CERTH based on Sentinel S1 and S2 observation with several corrections (permanent water bodies, elevation etc.). Following this method only the flooded areas are extracted.
- To run the algorithm users need only to select the workflow (users can also modify the workflow) and run it inside the platform.
- The algorithm works also automatically, and users will be able to visualize results directly in EOPEN.

3. Practical Training

3.3 Obtain a Flood Map

- To obtain a (flood prediction) flood map and, preliminarily, to prepare the hydraulic model each user needs some software and plugins (freeware) listed below:

Softwares:



BASEMENT

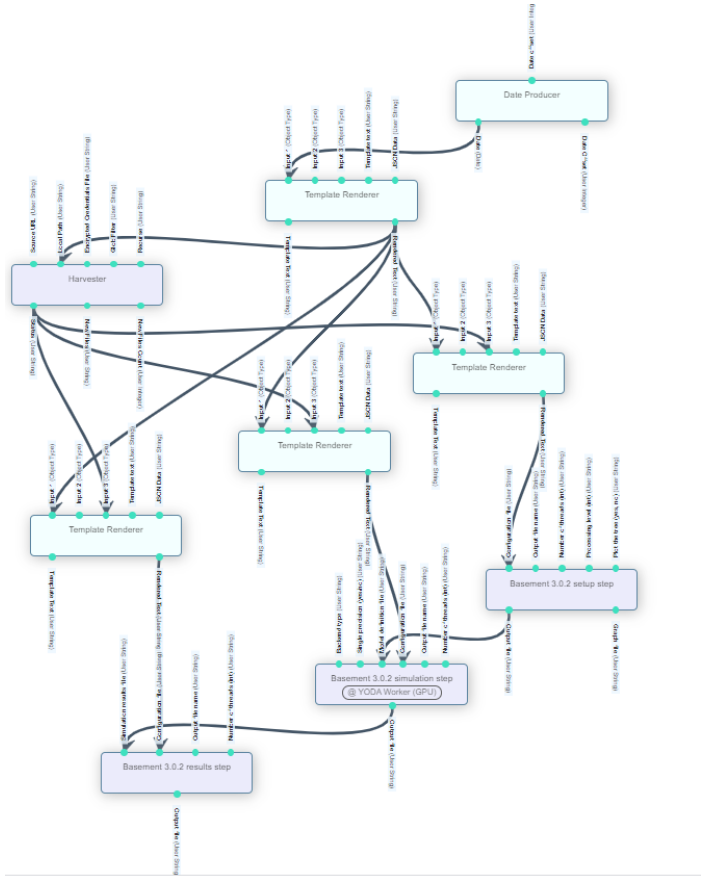
Plugins:

Crayfish

3. Practical Training

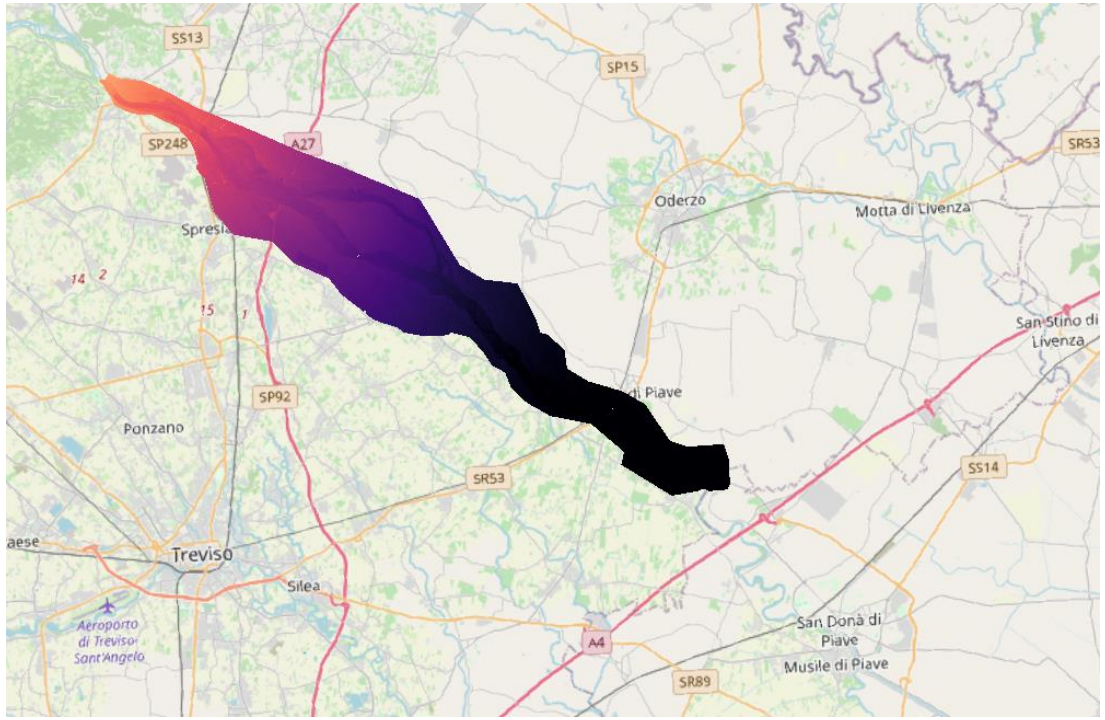
3.3 Obtain a Flood Map

- To setup the simulation the user should:
  - Compile basement input file offline
  - Copy on AAWA FTP the simulation files
  - Run the Basement workflow
- Once the simulation ends:
  - Download results files
  - Run the process for publish geotiff



3. Practical Training

3.3 Obtain a Flood Map



Practical example:

The Flood Maps (simulations of predicted flood) are produced offline after the run of AAWA hydrological model and after the Basement run on EOPEN, a domain with:

Edges: 2593042

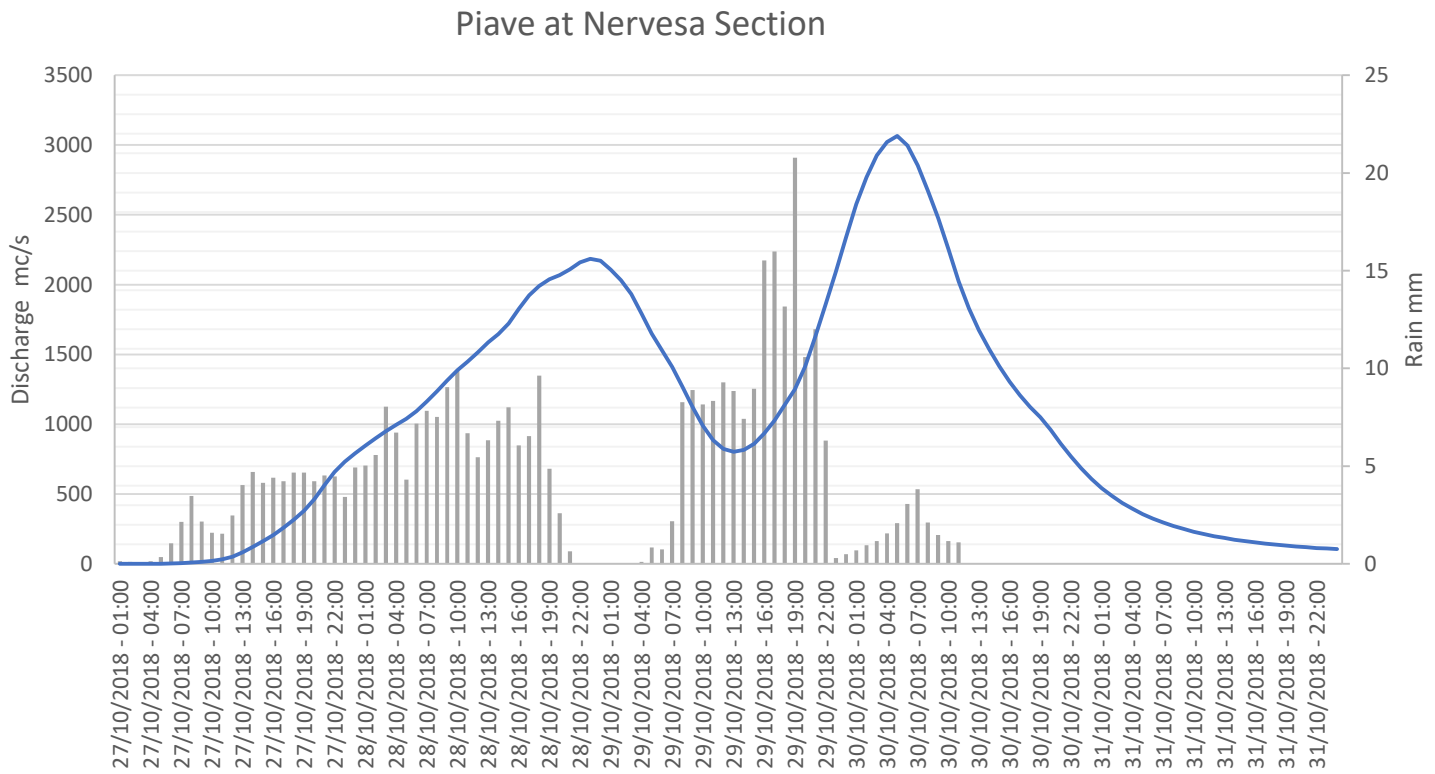
Vertex: 1299807

83h of simulation (duration of the flood event),

normally it takes 2-3 days on a single PC, in EOPEN it runs in 2 hours.

3. Practical Training

3.3 Obtain a Flood Map



Practical example:

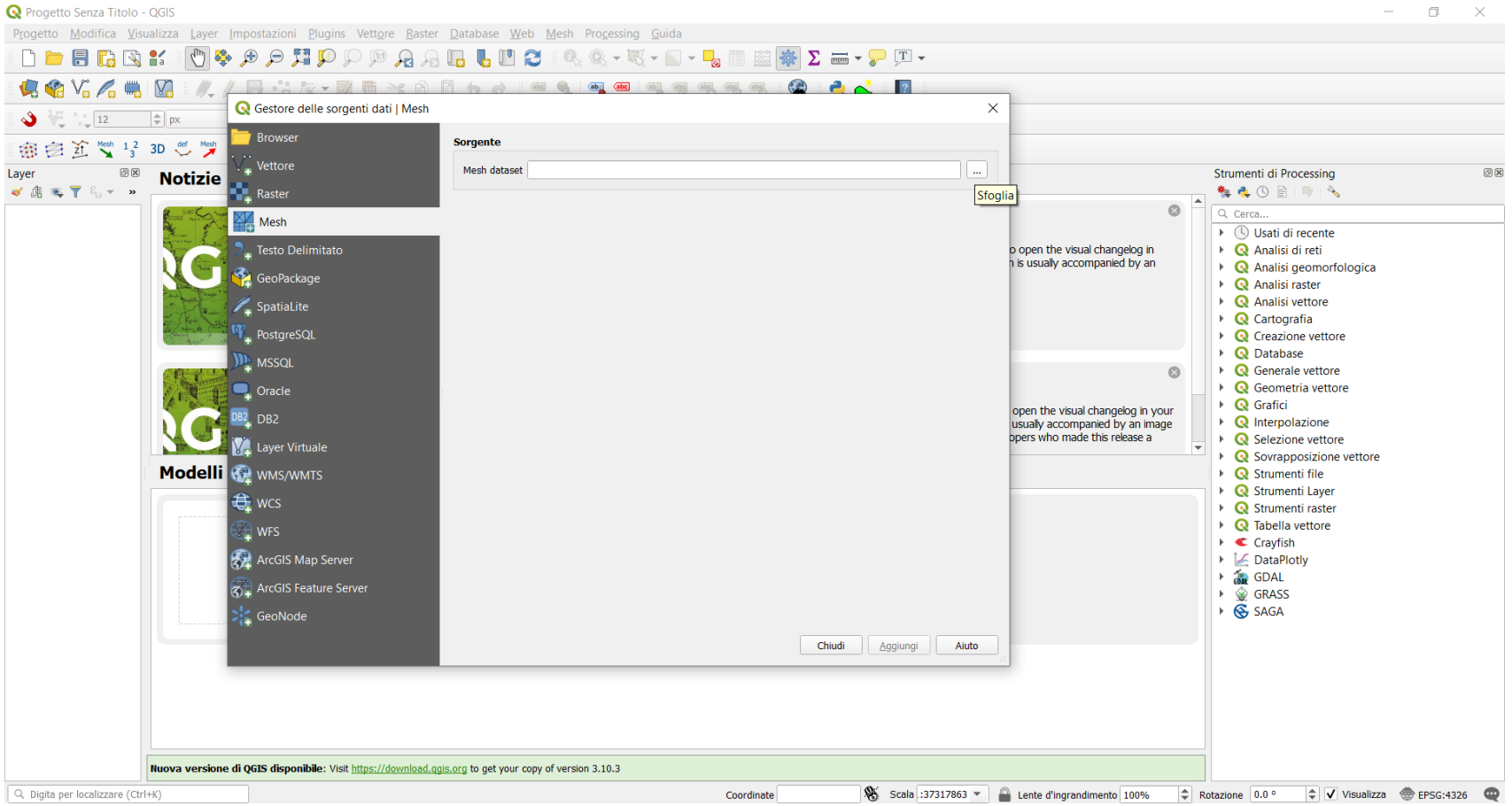
Inputs:

- Geometry file
- Discharge
- Configuration file

3. Practical Training

3.3 Obtain a Flood Map

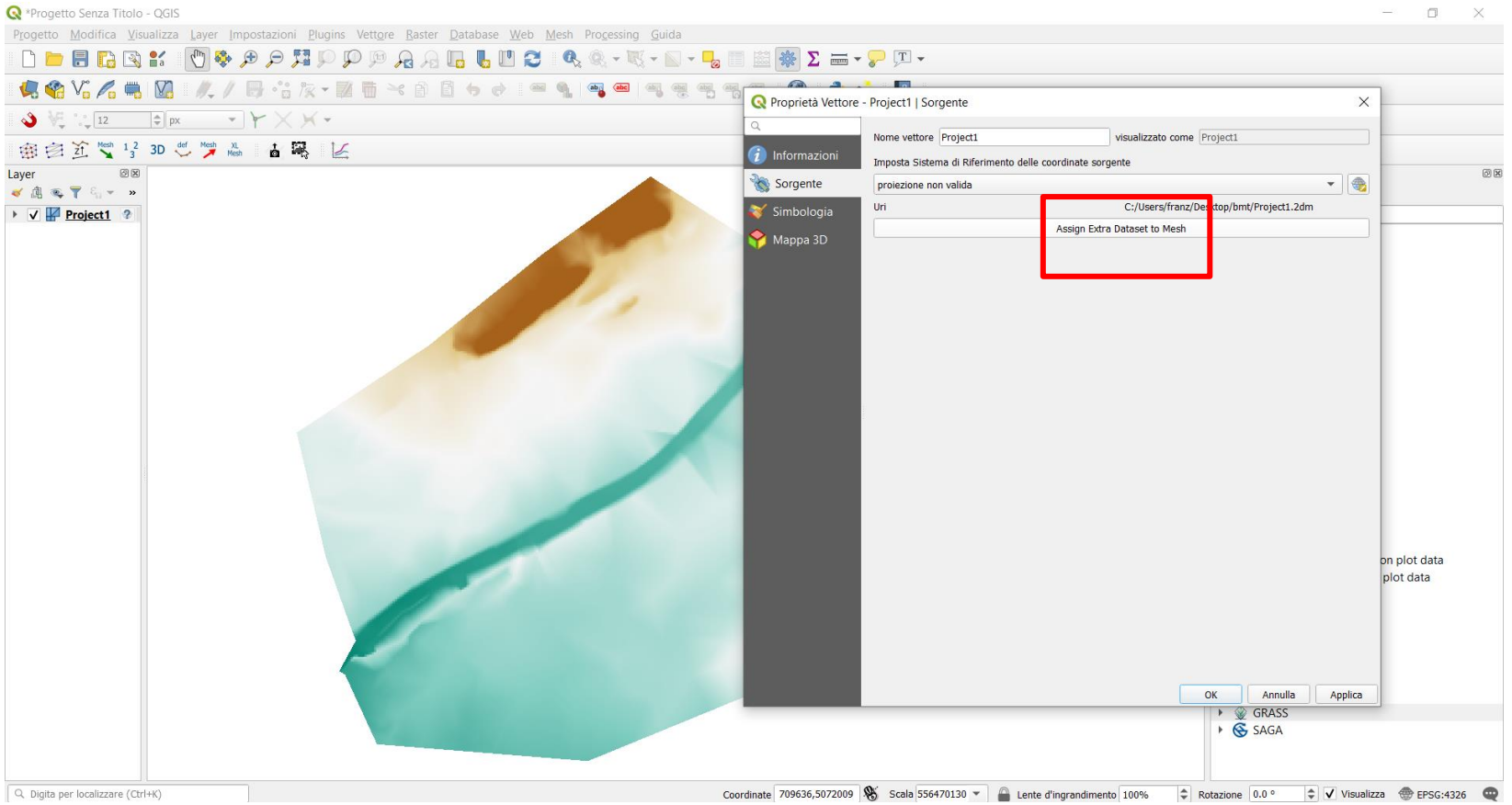
- Open the geometry from the 2dm file which represents the initial geometry



3. Practical Training

3.3 Obtain a Flood Map

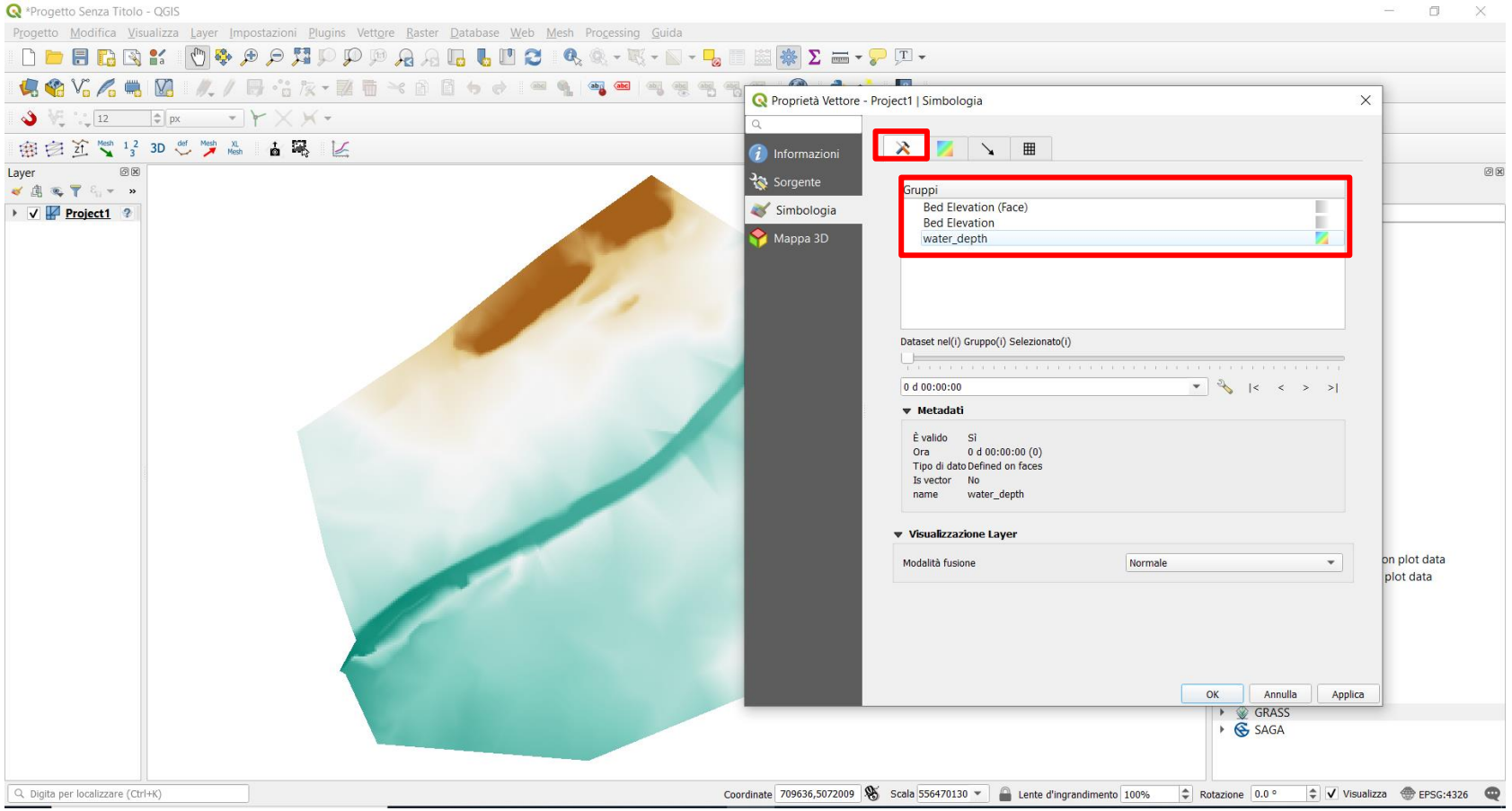
- Add results datasets (xdmf) obtained from EOPEN platform



3. Practical Training

3.3 Obtain a Flood Map

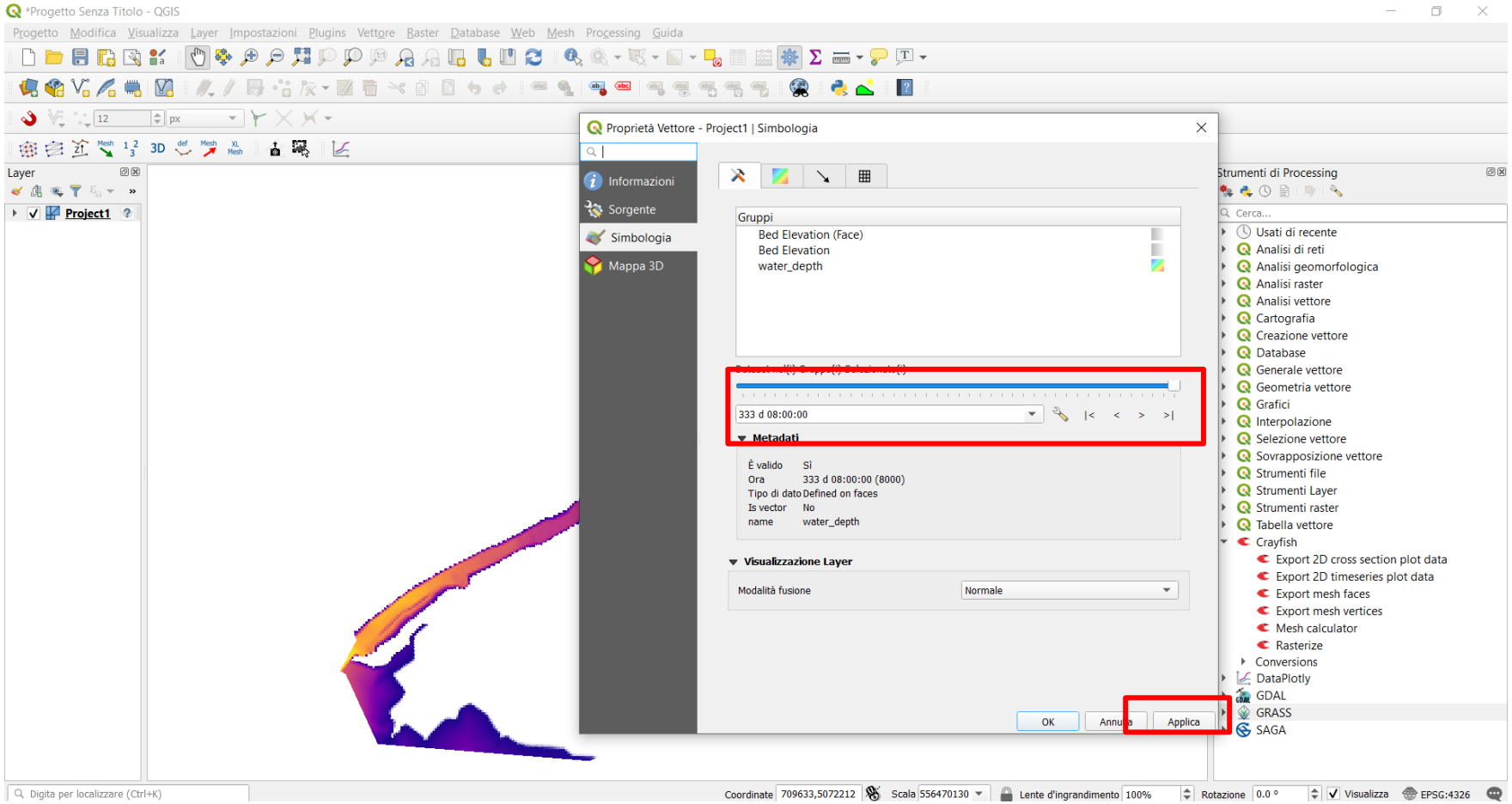
- Select the corresponding variables (es. Water depth or velocity)



3. Practical Training

Obtain a Flood Map

- Select the time step of the simulation



3. Practical Training

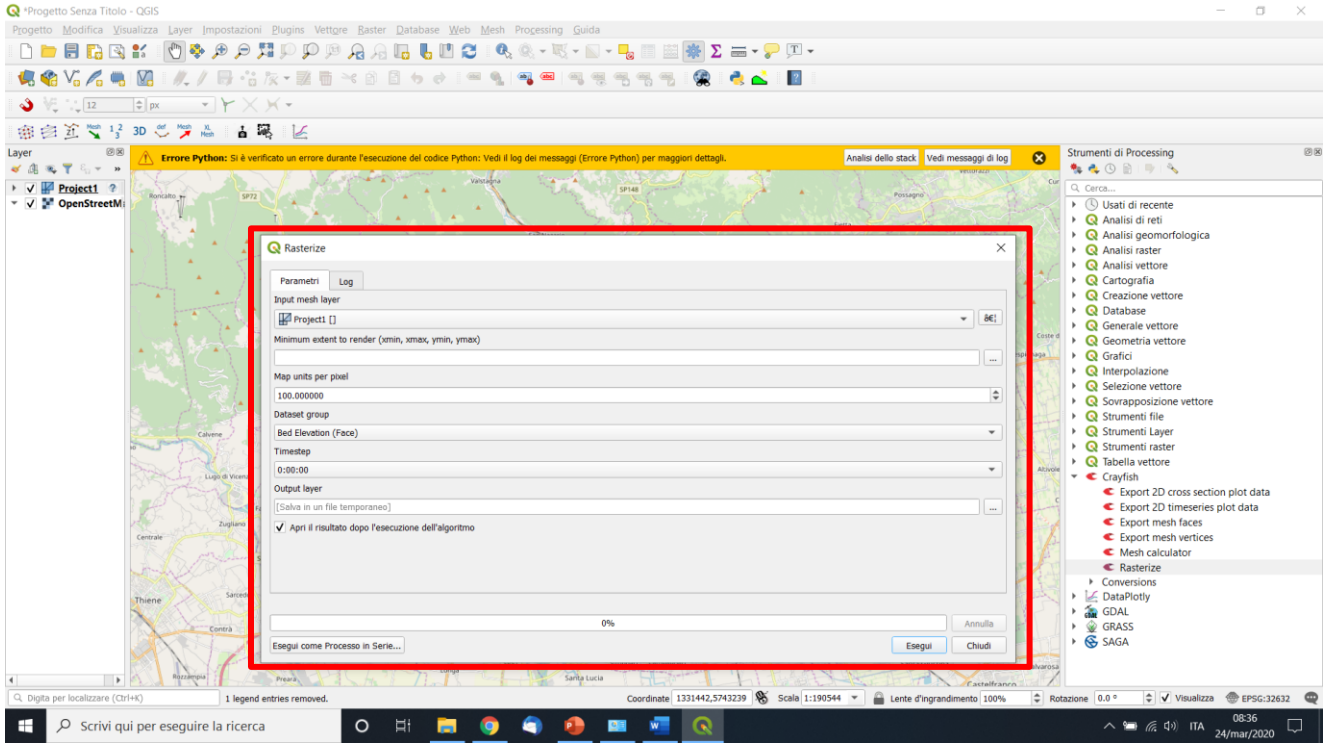
3.3 Obtain a Flood Map

- Export geotiff with crayfish plugin:

- NAME CONVENTION:

AA_EWS_FF_DDMMYYstart_DDMMYYend

- And upload, if necessary, on EOPEN



3. Practical Training

3.3 Obtain a Flood Map

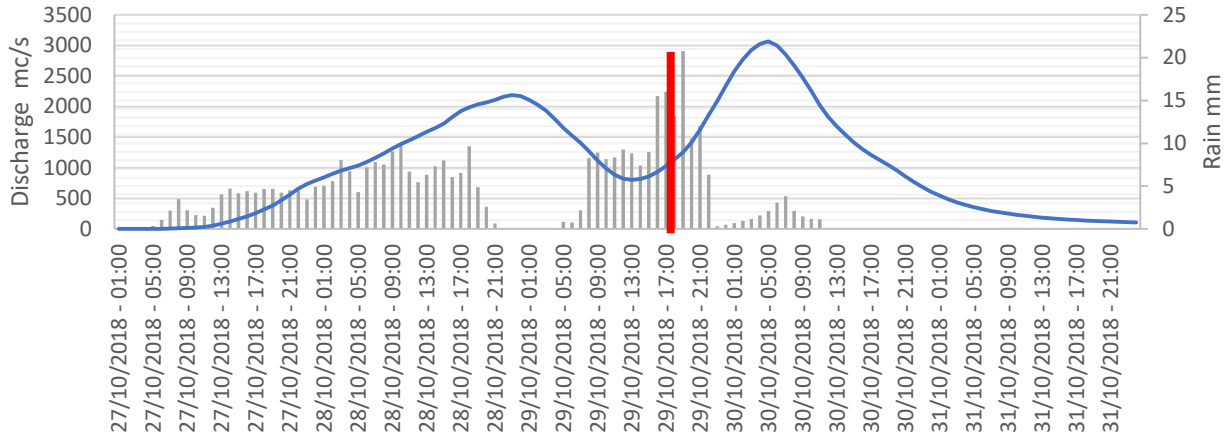
▷ Other Examples of flood maps; results of simulations obtained with Basement in a different basin (Brenta)

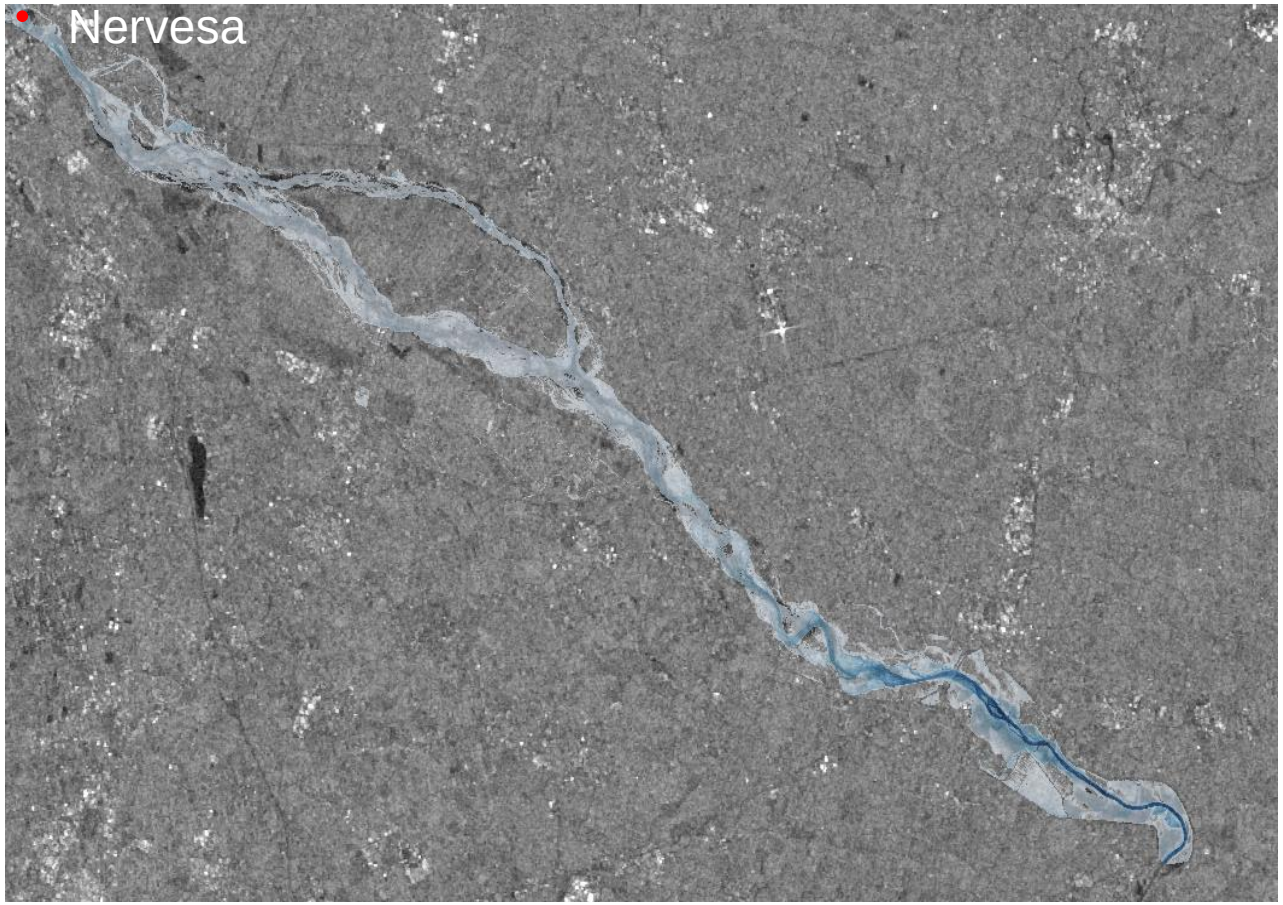
3. Practical Training

3.3 Obtain a Flood Map

Comparison fo the Piave river flow path obtained with the hydrological discharge from AAWA model and hydraulic model (Basement simulation) on EOPEN and from satellite maps derived from S1

Piave at Nervesa Section, AAWA hydrological model (inputs)

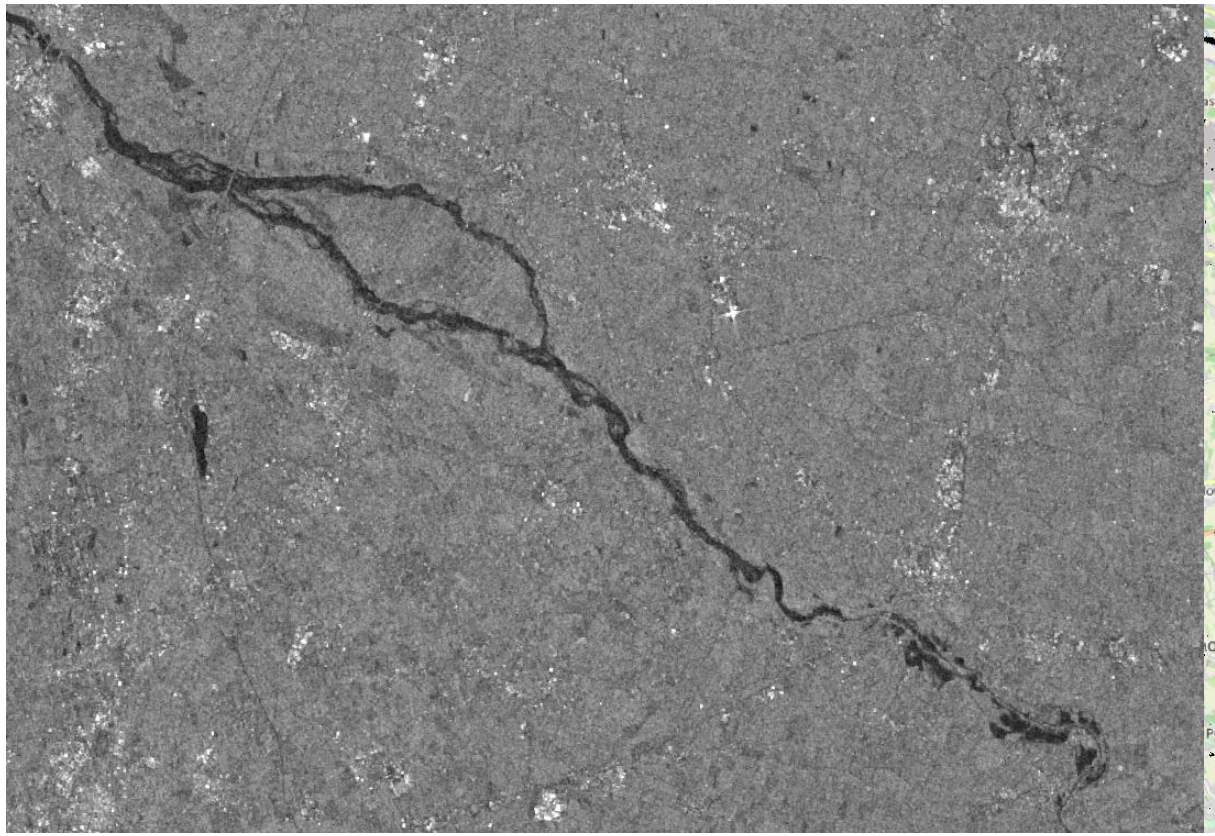




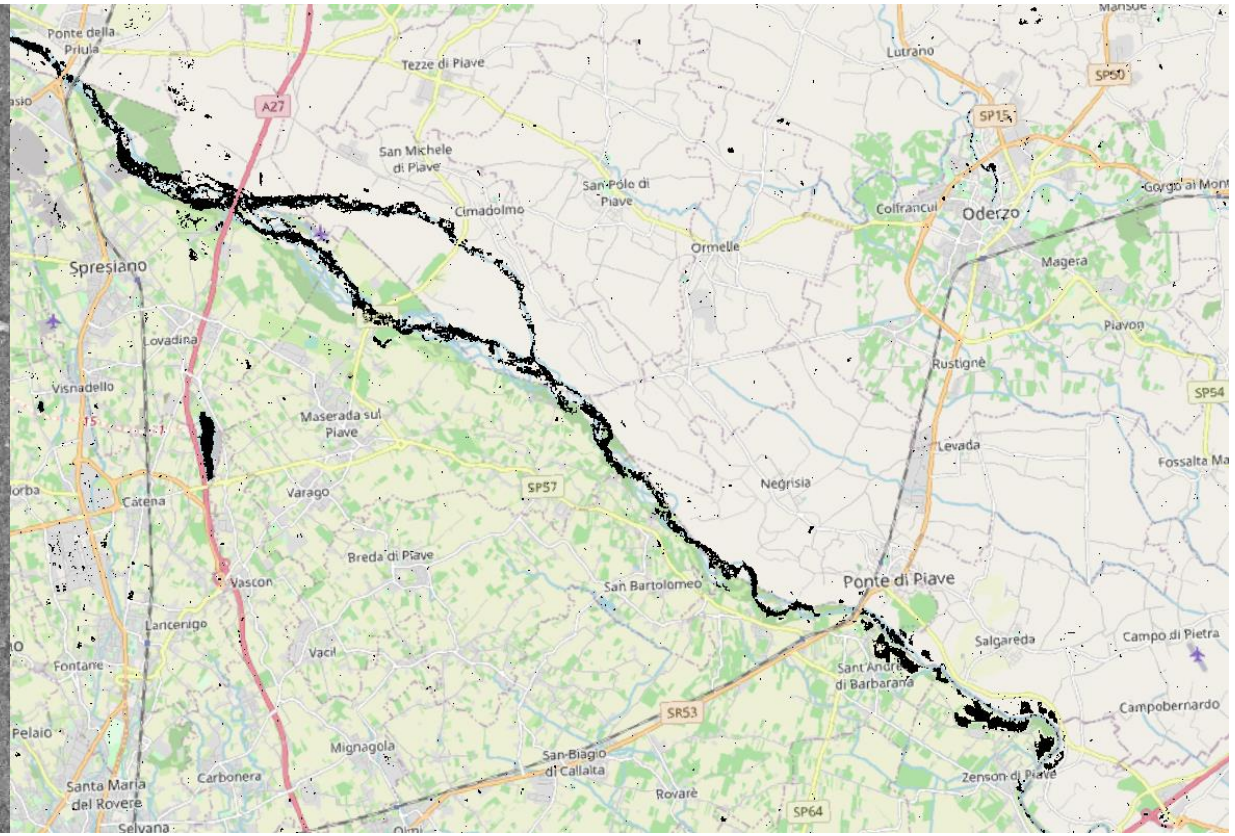
3. Practical Training

3.3 Obtain Flood Maps

Flood Maps from satellite imagines; Sentinel 1B_ 29-10-2018 16:57



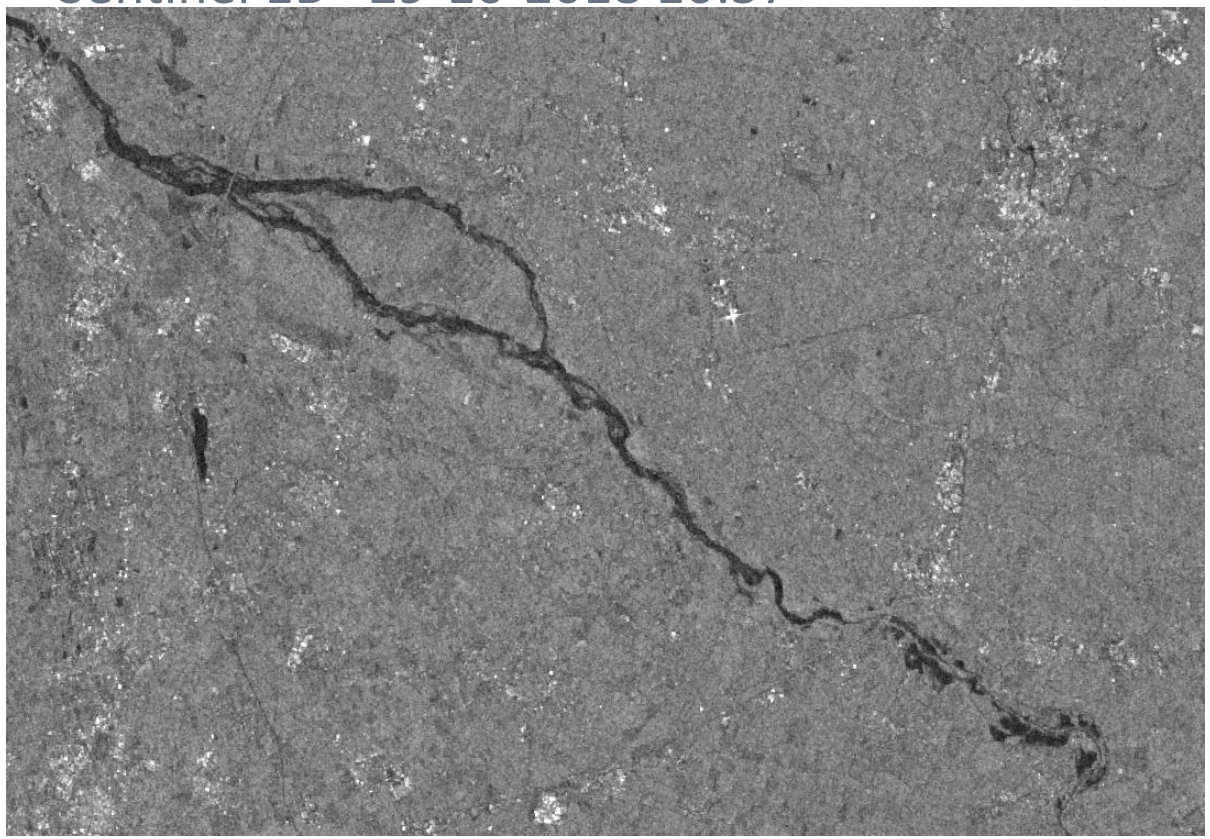
Satellite imagine elaborations, Sentine 1B_ 29-10-2018 16:57_ WPM



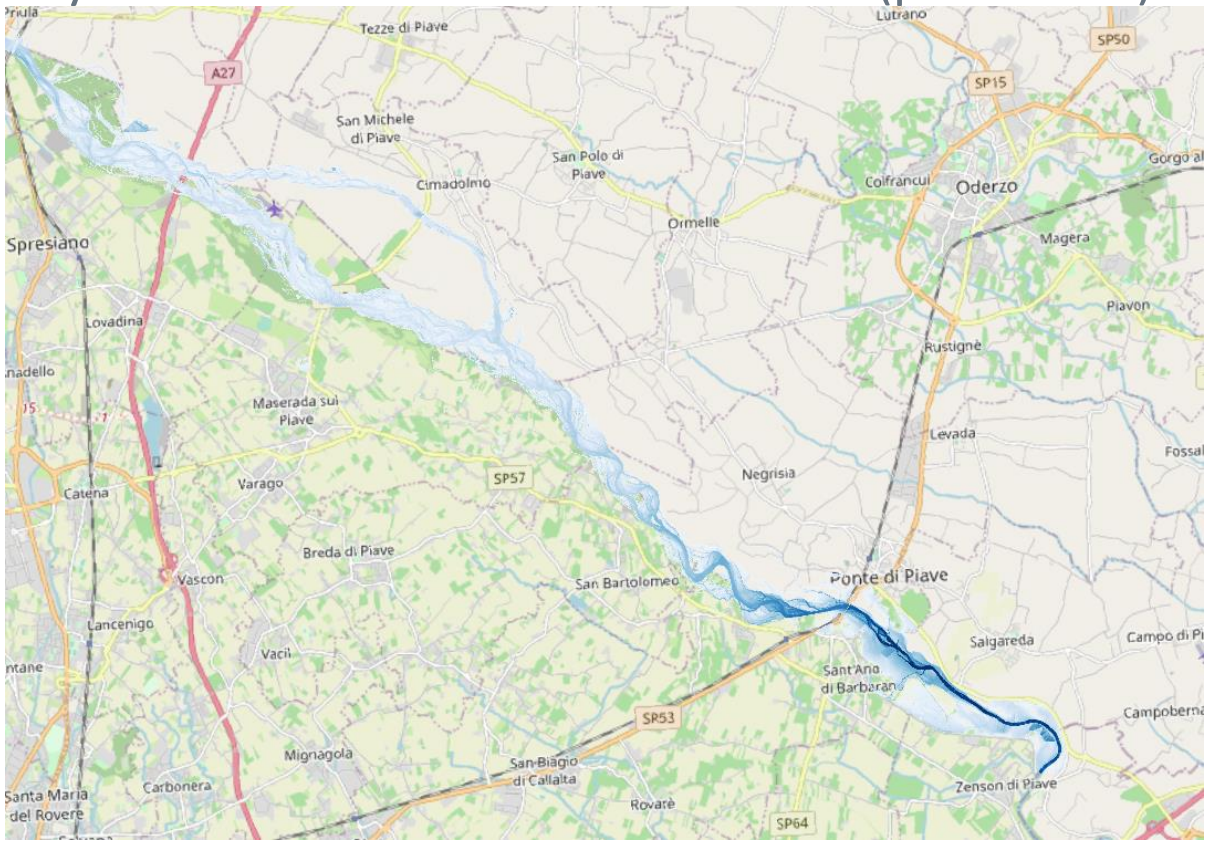
3. Practical Training

3.3 Obtain a Flood Map

The Flood Maps; the VAIA Storm results
Sentinel 1B 29-10-2018 16:57



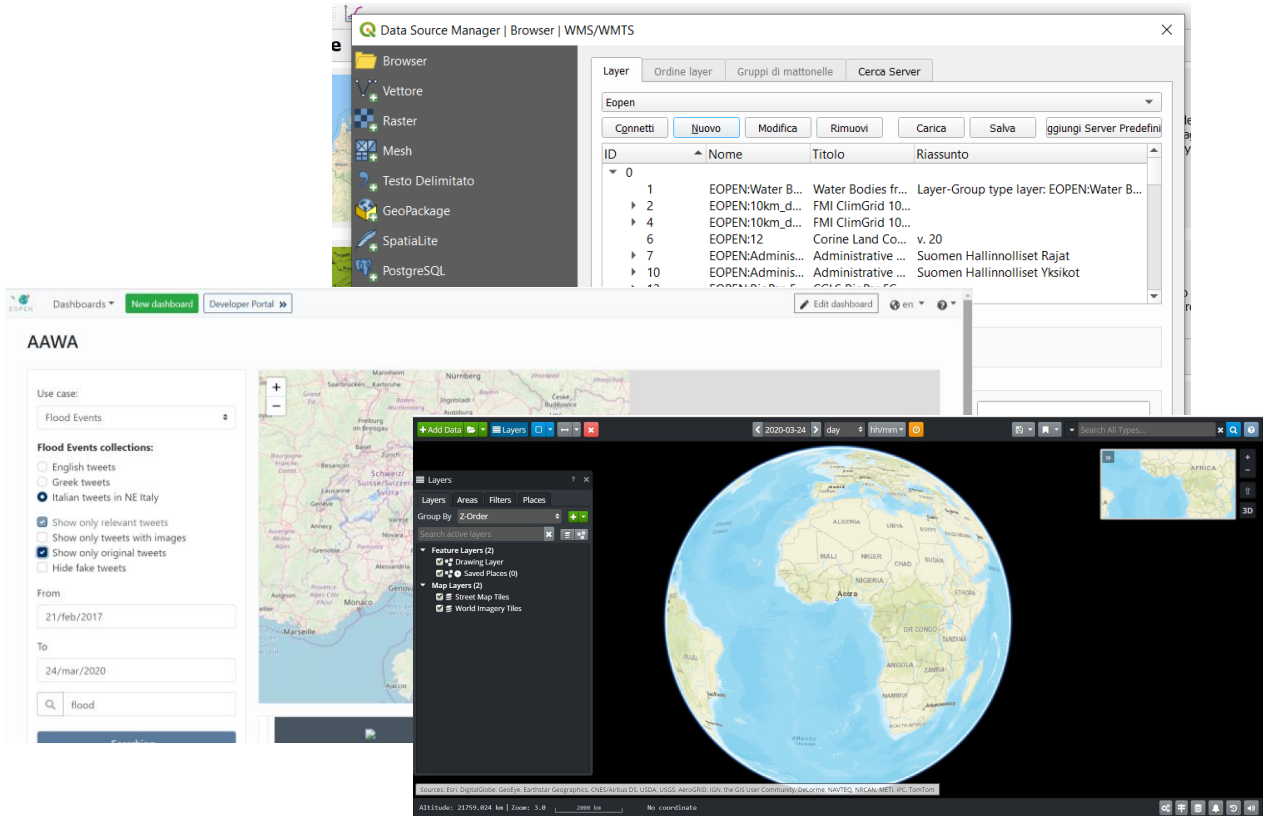
The Flood Maps; the VAIA Storm: results of the Hydraulic model 29-10-2018 17:00 (prediction)



4. Visualization

EOPEN provides users different interfaces and tools to visualize results; the main tools are:

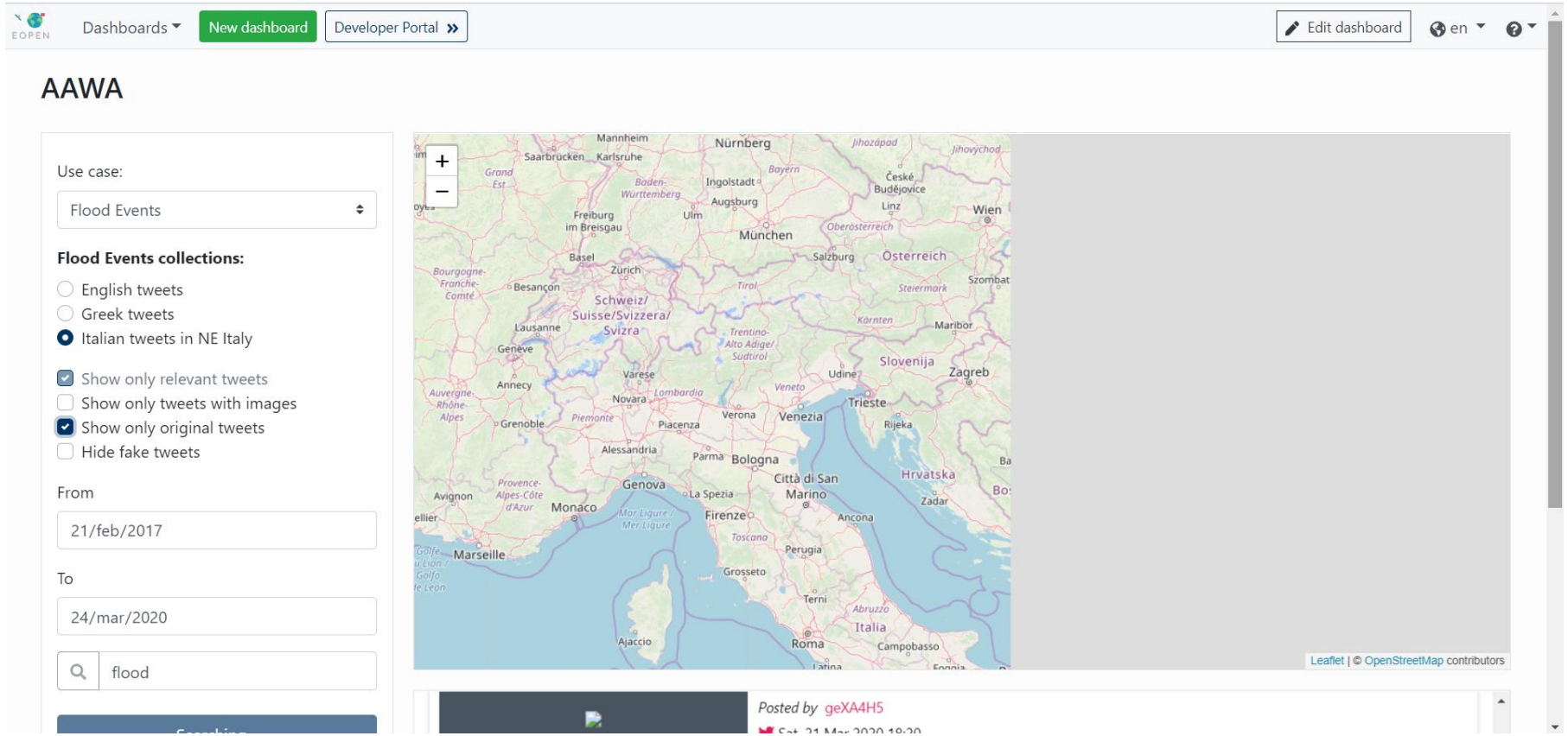
- ▷ Dashboards
- ▷ Opensphere (GIS viewer)
- ▷ The EOPEN Geoserver (WMS service)
- With these tools everyone can integrate the platform in his working procedures and offices.



4. Visualization

4.1 Dashboards

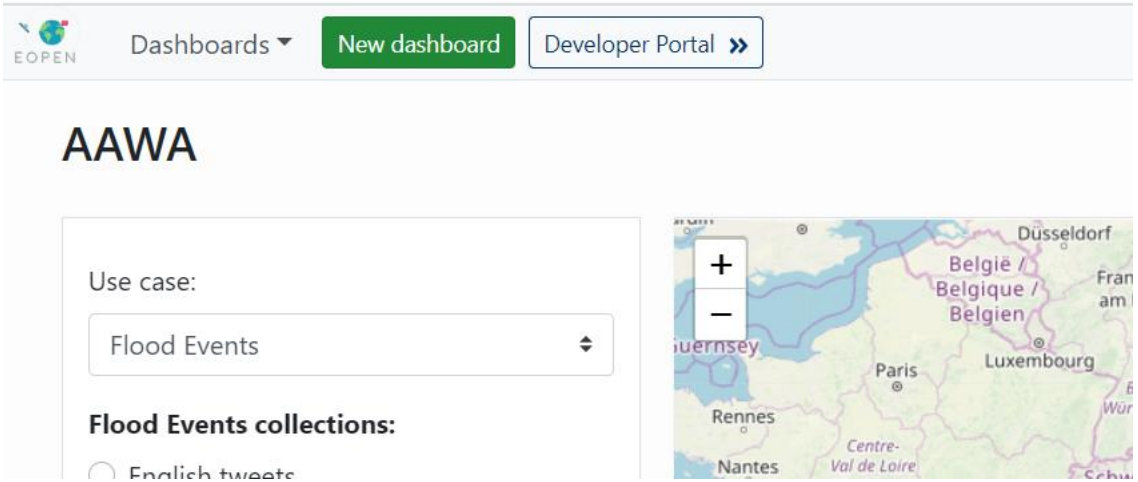
▷ Dashboards



4. Visualization

4.1 Dashboards

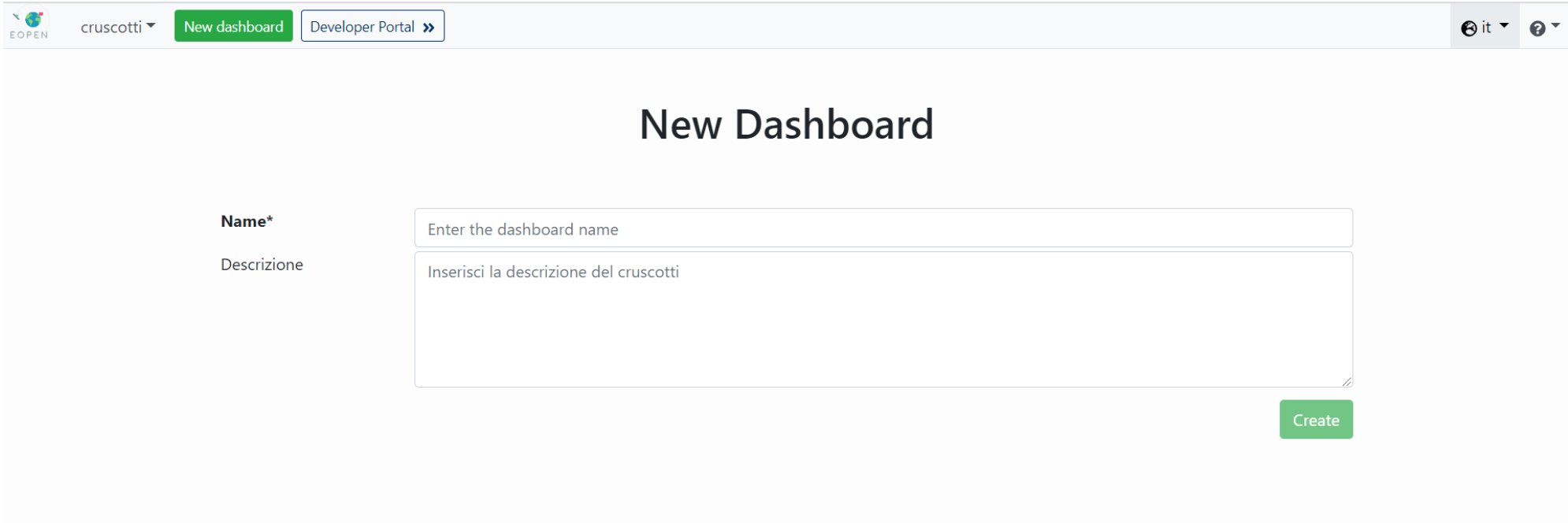
▷ Create a Dashboard



4. Visualization

4.1 Dashboards

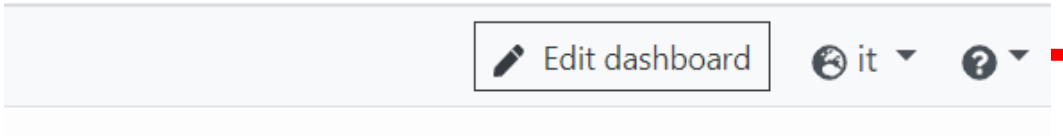
▷ Create a Dashboard

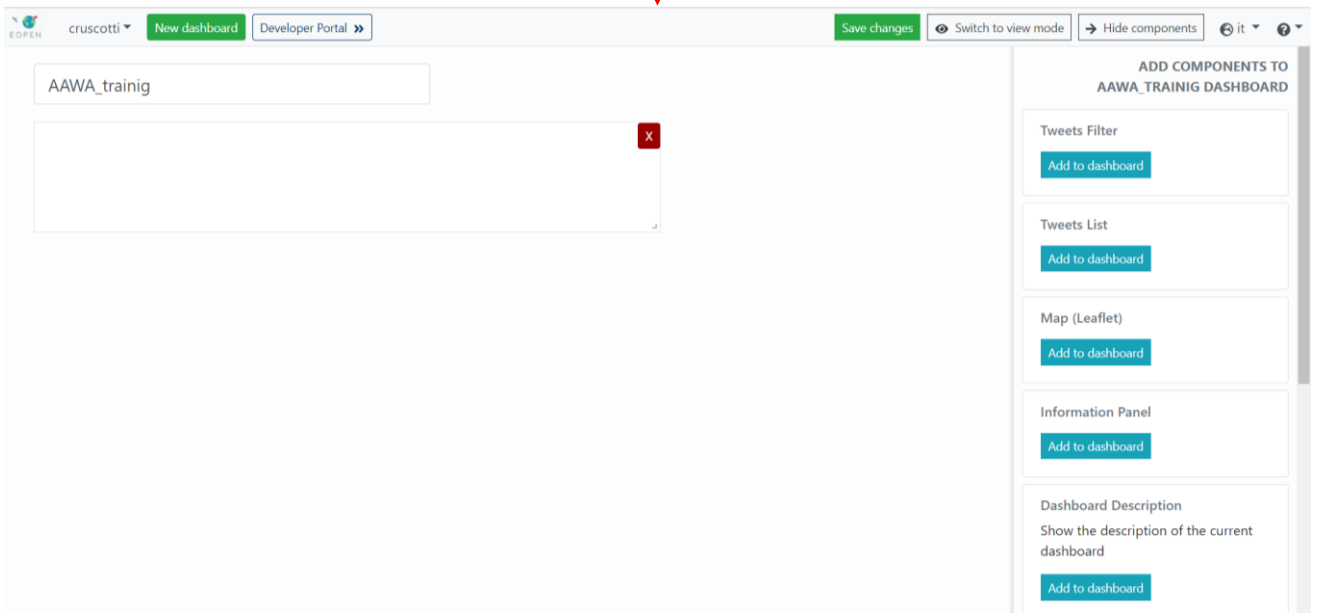


4. Visualization

4.1 Dashboards

▷ Create a Dashboard



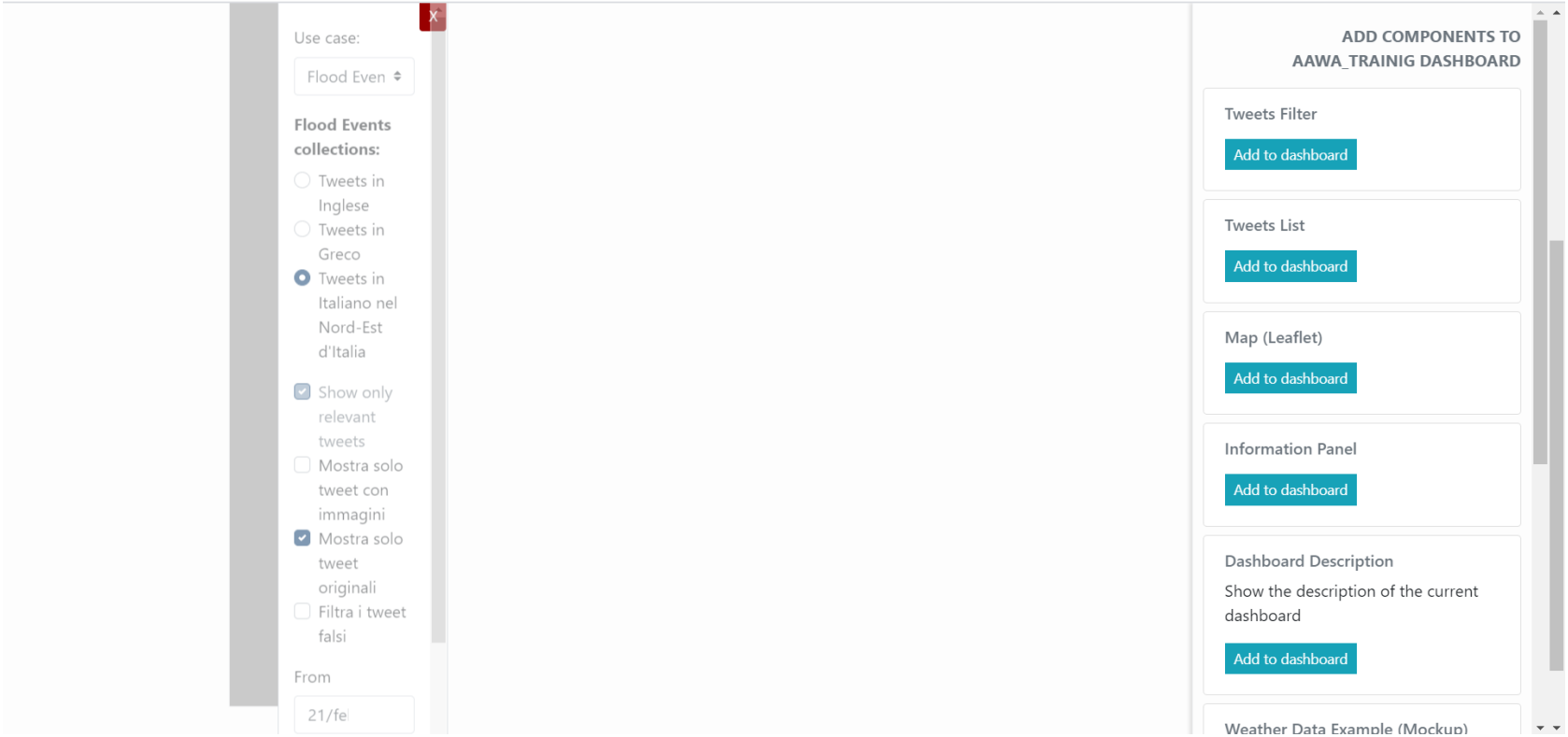


4. Visualization

4.1 Dashboards

▷ Create a Dashboard

Add and move elements

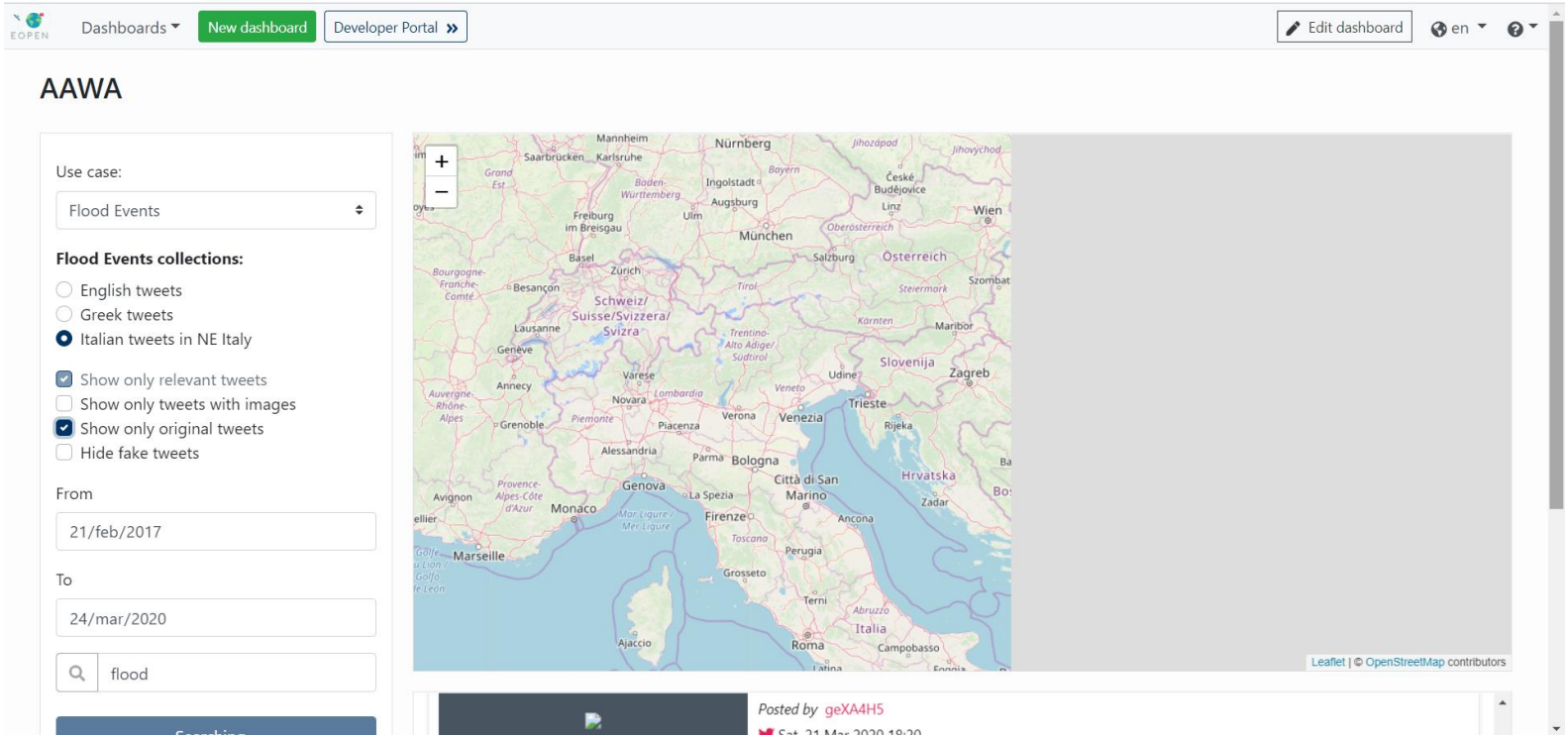


4. Visualization

4.2 Tweet visualization

▷ How to visualize tweets

Filters



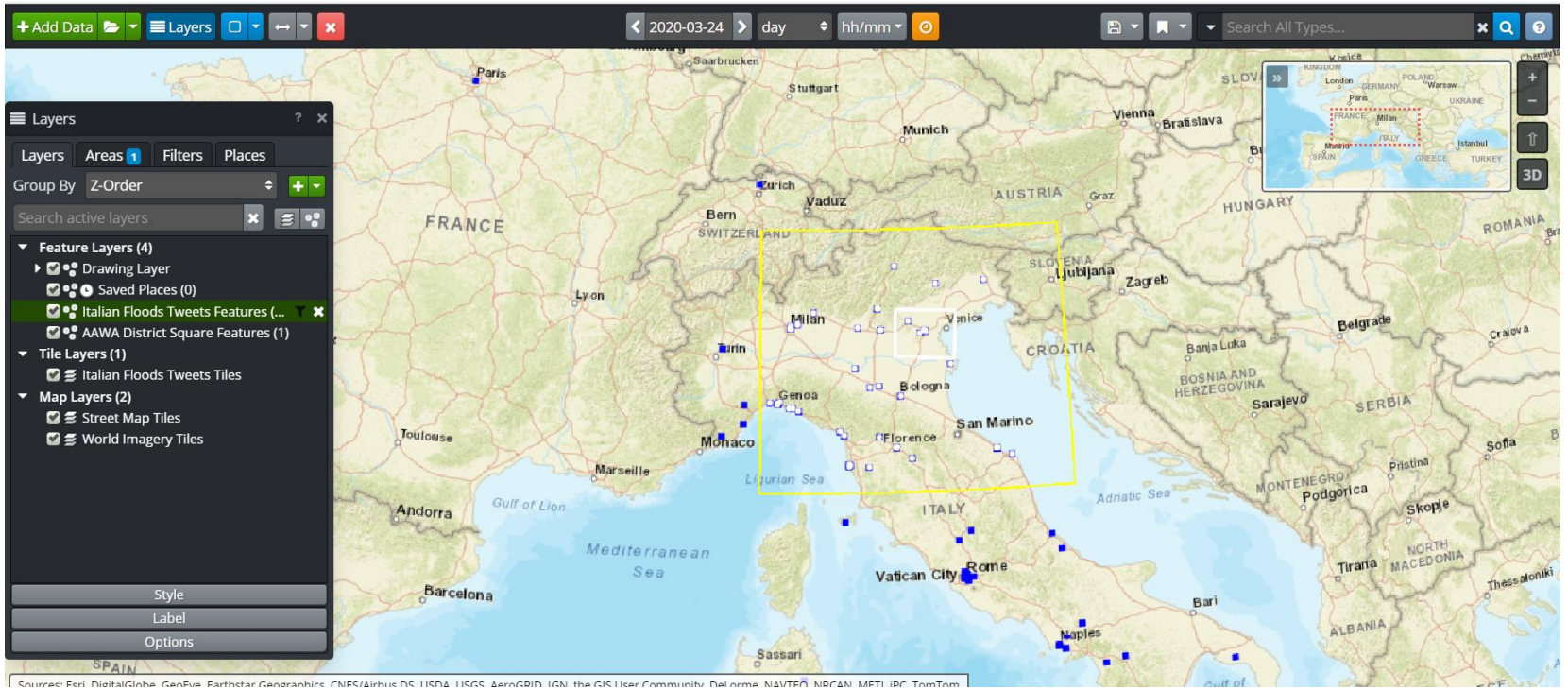
4. Visualization

4.2 Tweet visualization

▷ How to visualize tweets in the geoserver

1- select tweet layer
2- draw a box or an AOI
3- right click, query, load

Selected features become white

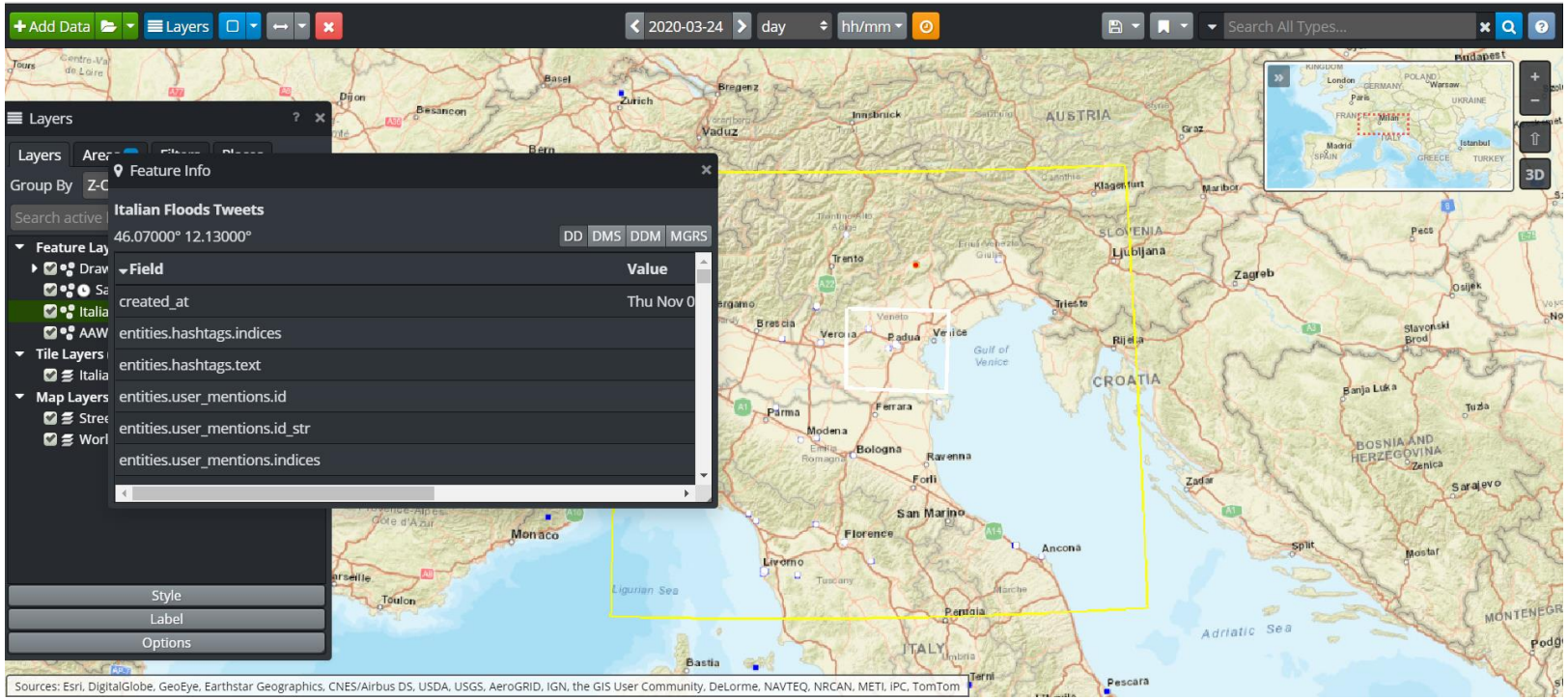


4. Visualization

4.2 Tweet visualization

- How to visualize tweets in the geoserver

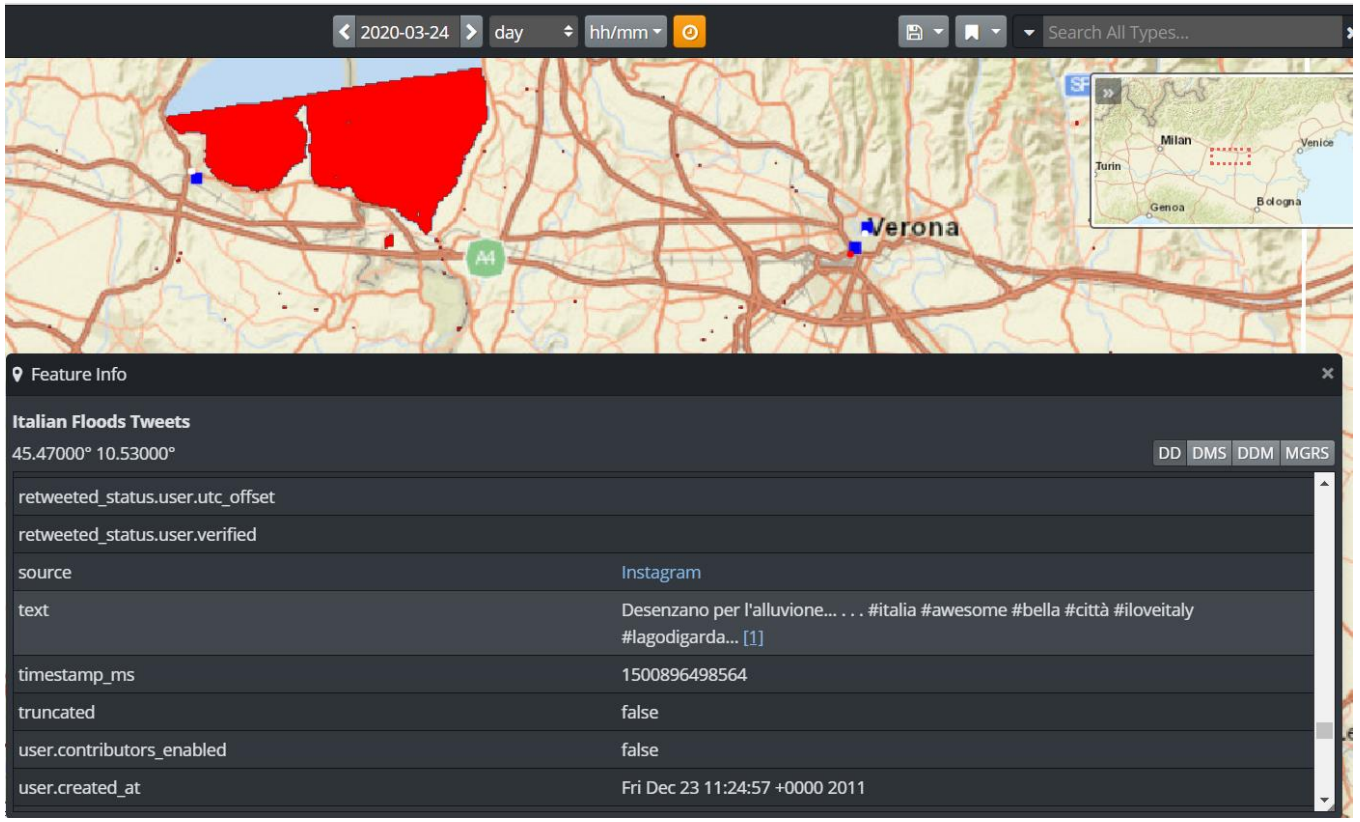
Select the feature layer (eg. Italian tweets)
Double click a point and the map shows the selected tweet



4. Visualization

4.2 Tweet visualization

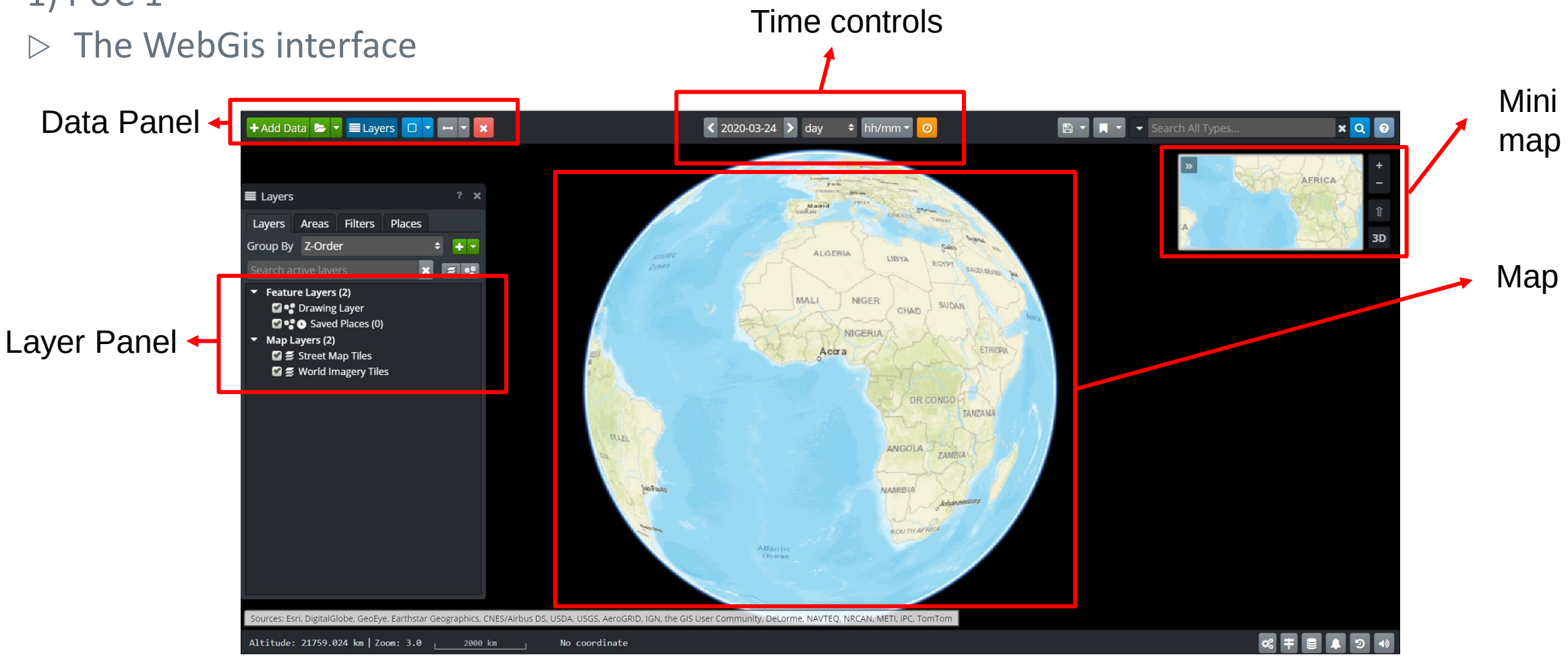
▷ Flood information inside EOPEN



4. Visualization

1) PUC 1

- The WebGis interface



4. Visualization

1) PUC 1

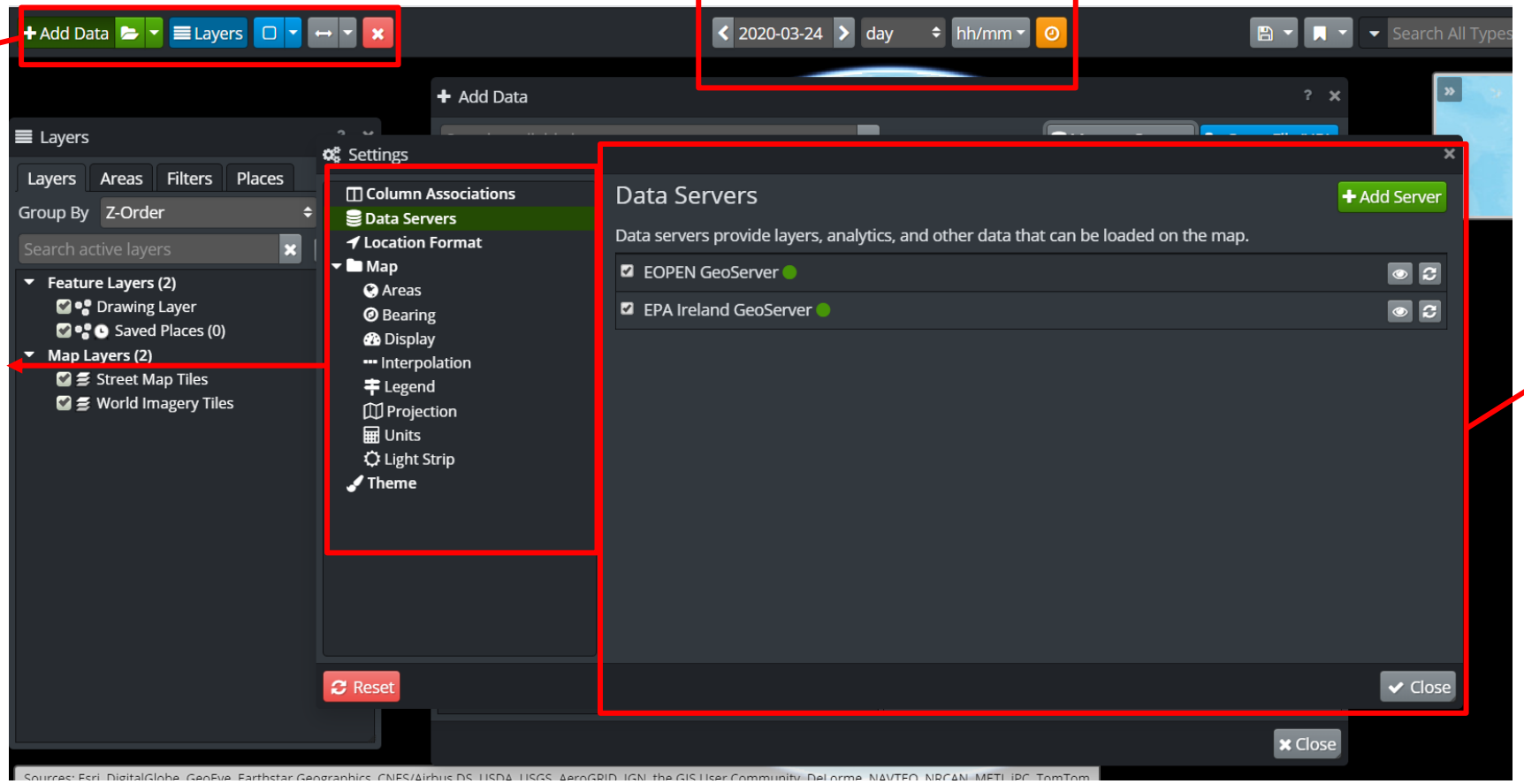
▷ The WebGis interface

Time controls

Data Panel

View options

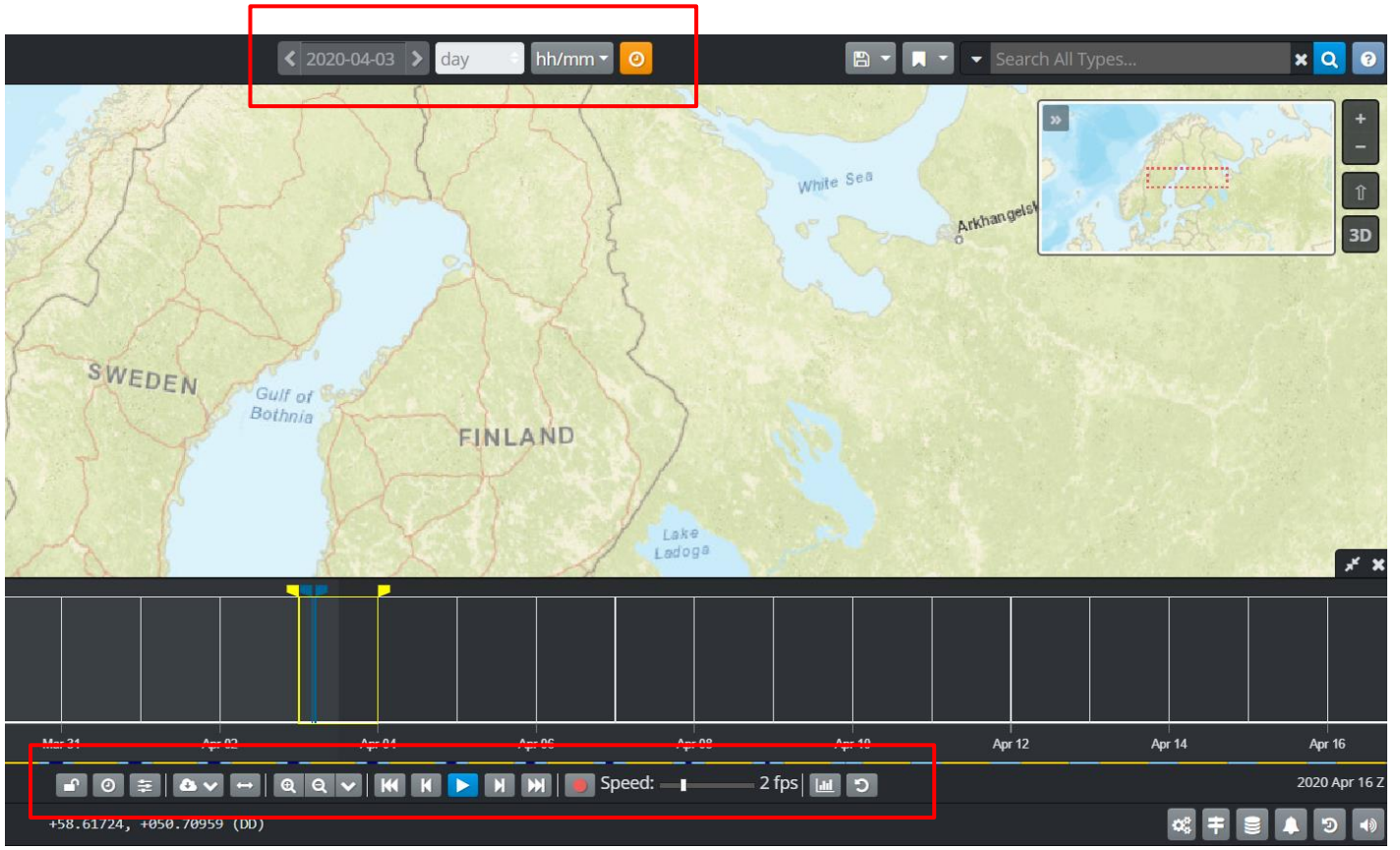
Services and geoservers



4. Visualization

1) PUC 1

- The WebGis interface, time controls

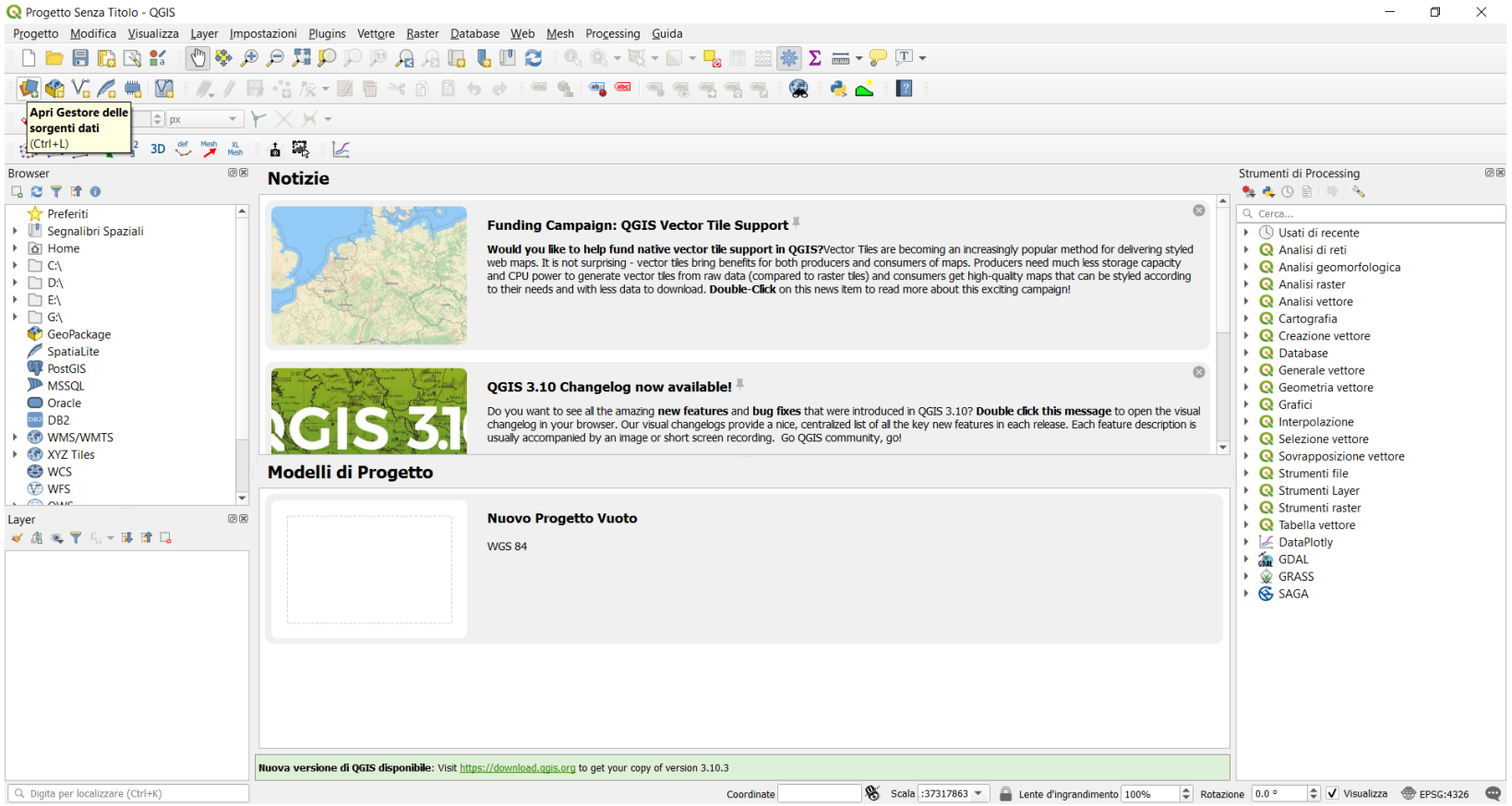


4. Visualization

1) PUC 1

▷ EOPEN as a Geoserver

1- Open Qgis

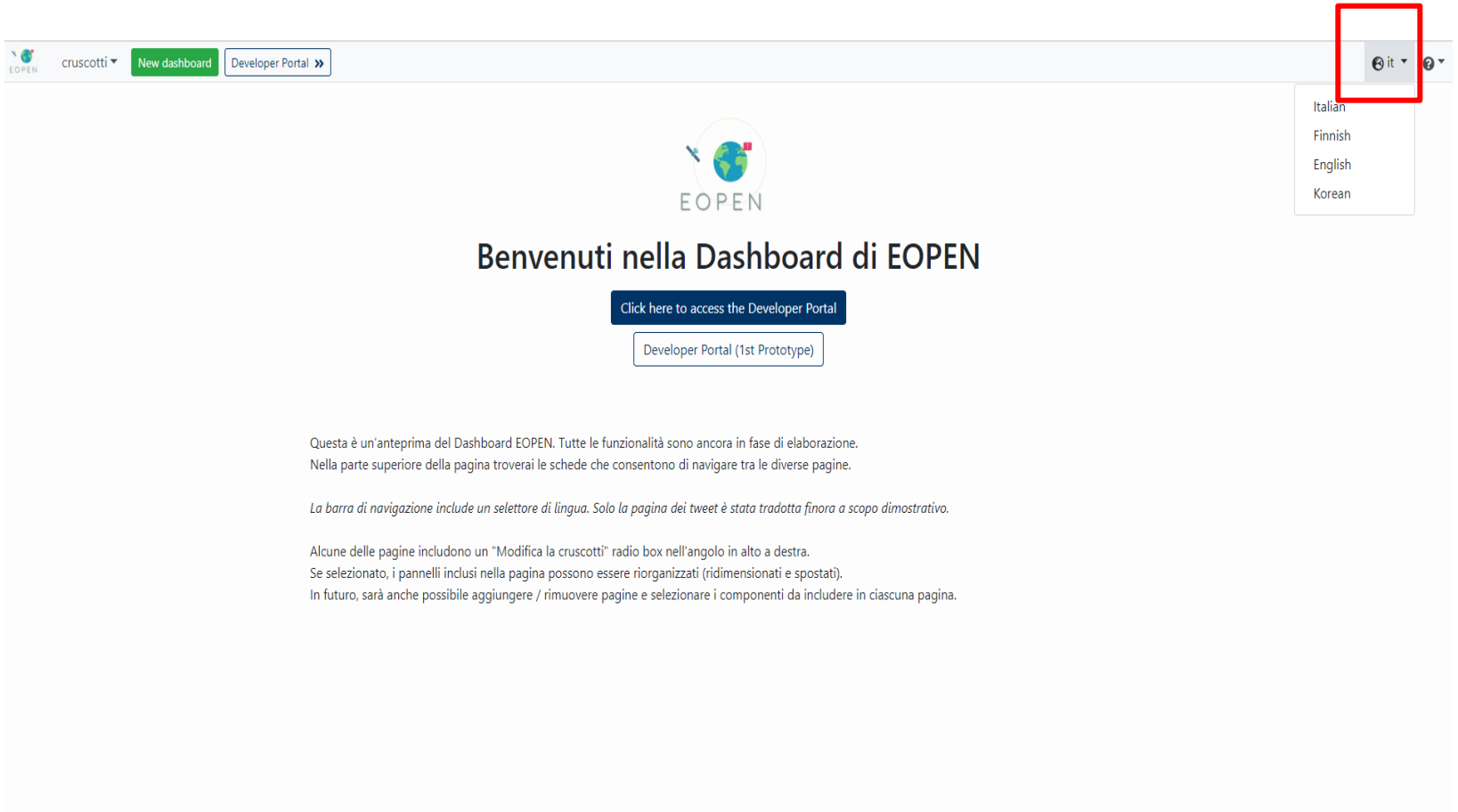


4. Visualization

1) PUC 1

- How to visualize a WPM

1- change language

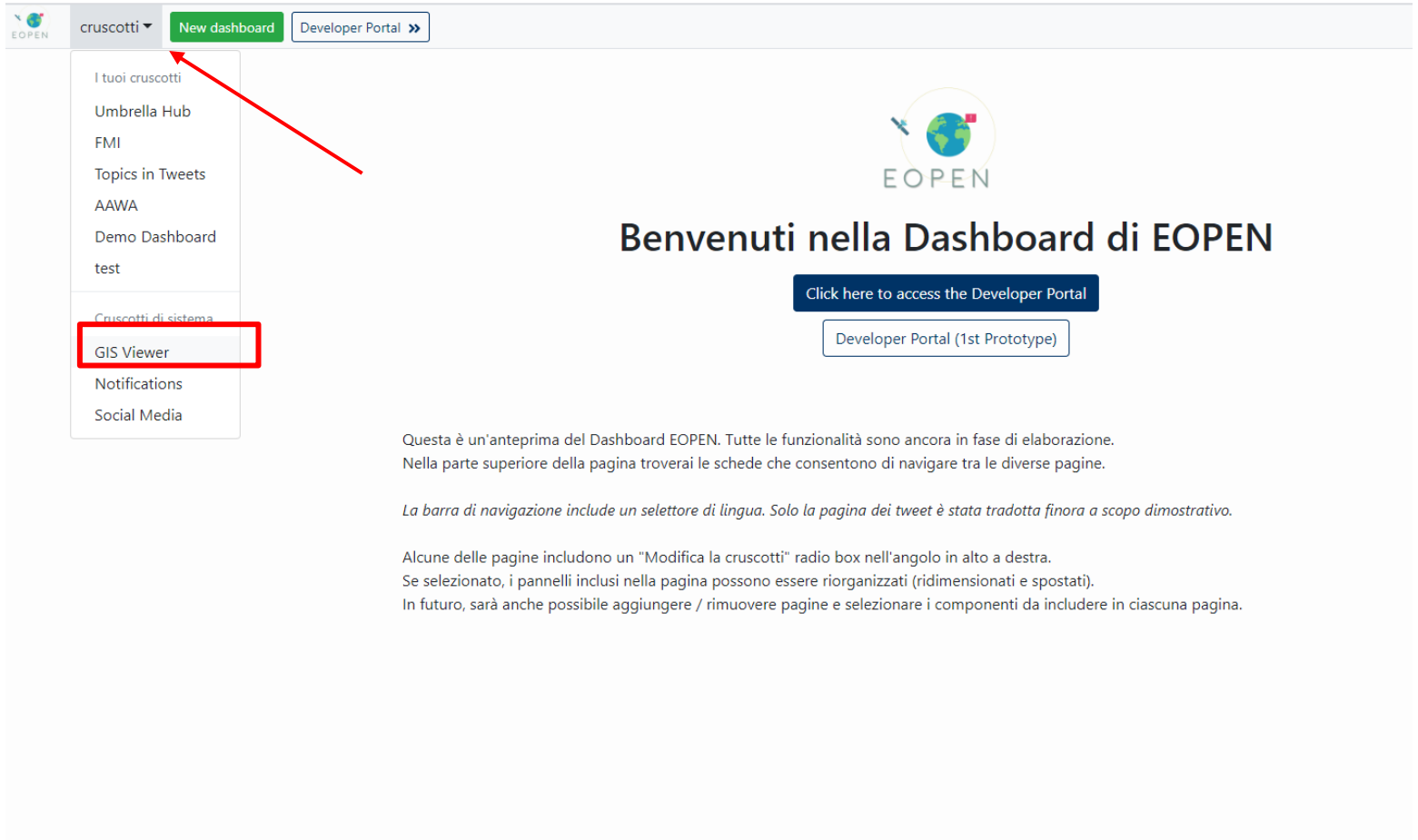


4. Visualization

1) PUC 1

▷ How to visualize a WPM

2- select GIS Viewer



4. Visualization

1) PUC 1

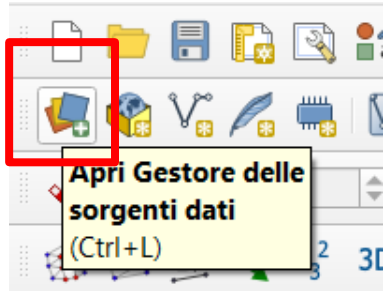
- How to visualize a WPM

3- access to EOPEN geoserver

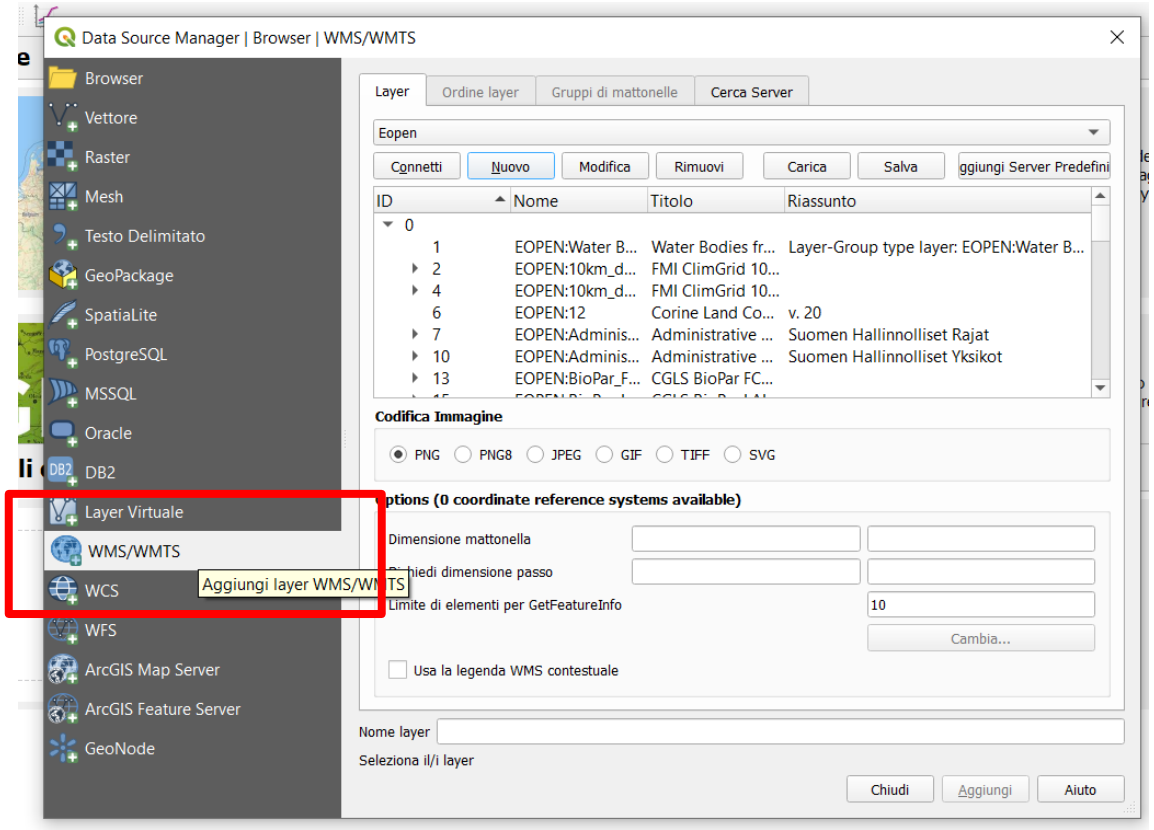
4. Visualization

1) PUC 1

▷ EOPEN as a Geoserver



2- Select add WMS layer



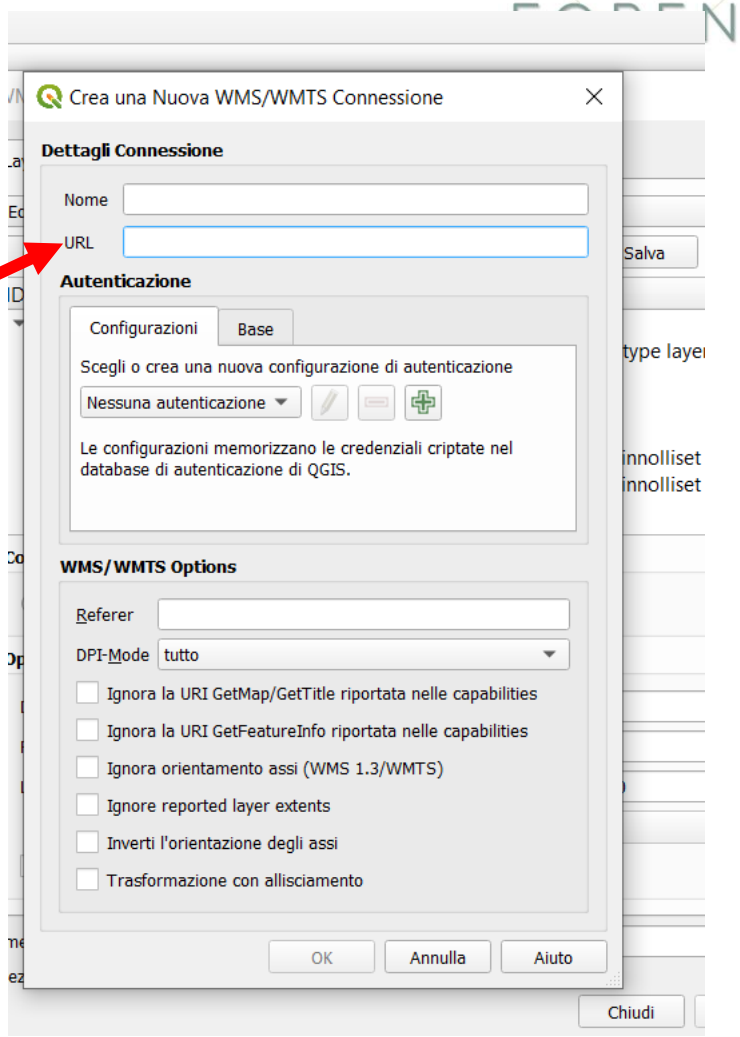
4. Visualization

1) PUC 1

▷ EOPEN as a Geoserver

3- Add

https://eopen.spaceapplications.com/geoserver/ows

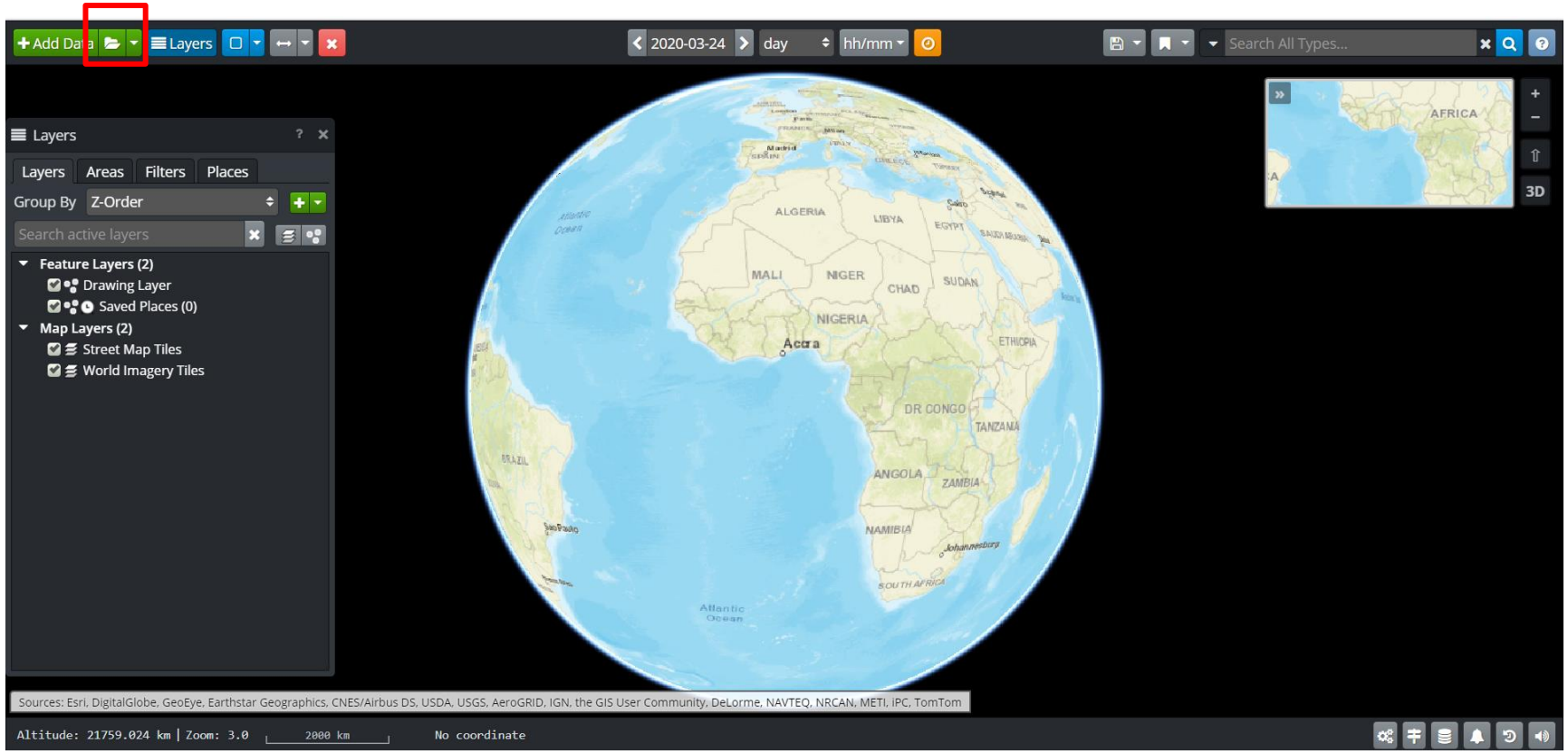


4. Visualization

1) PUC1

- How to merge different layers in a unique interface

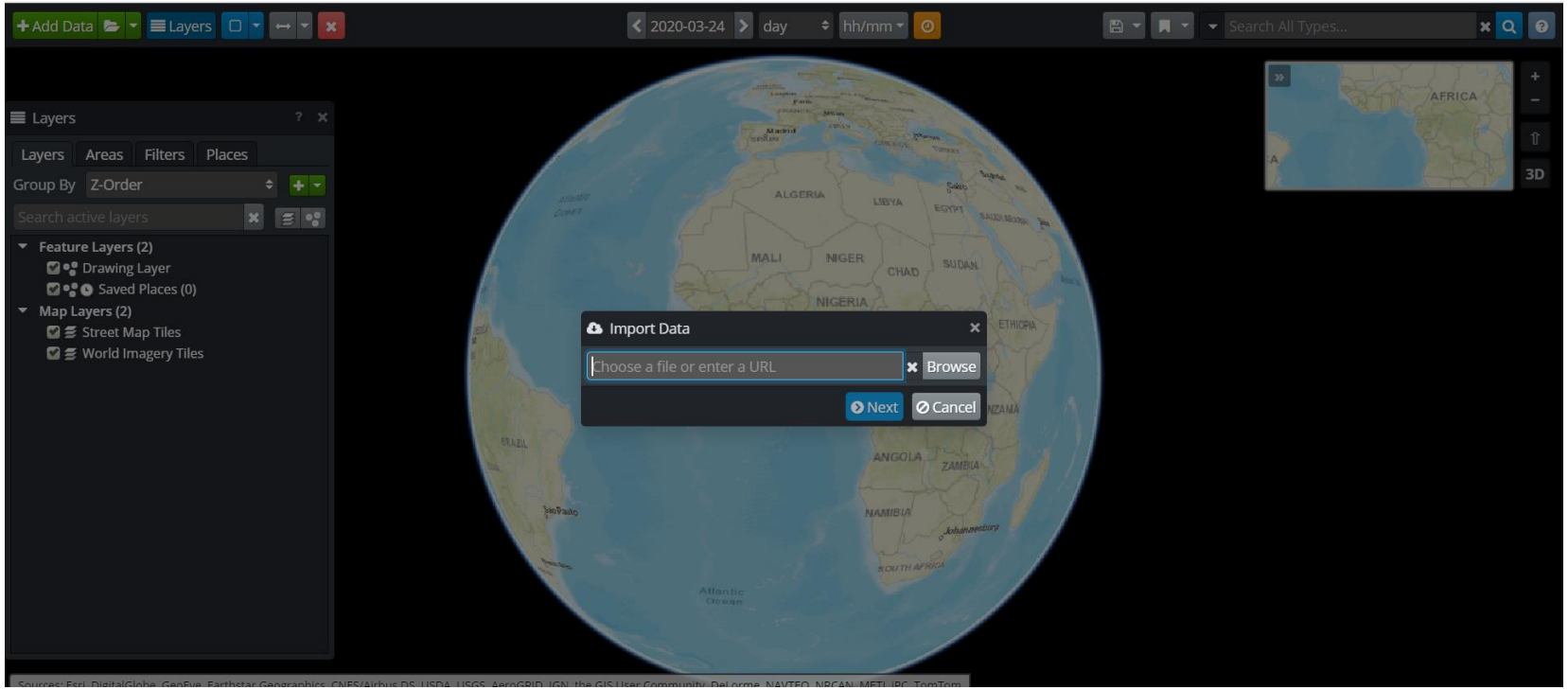
Add



4. Visualization

1) PUC1

- How to merge different layers in a unique interface

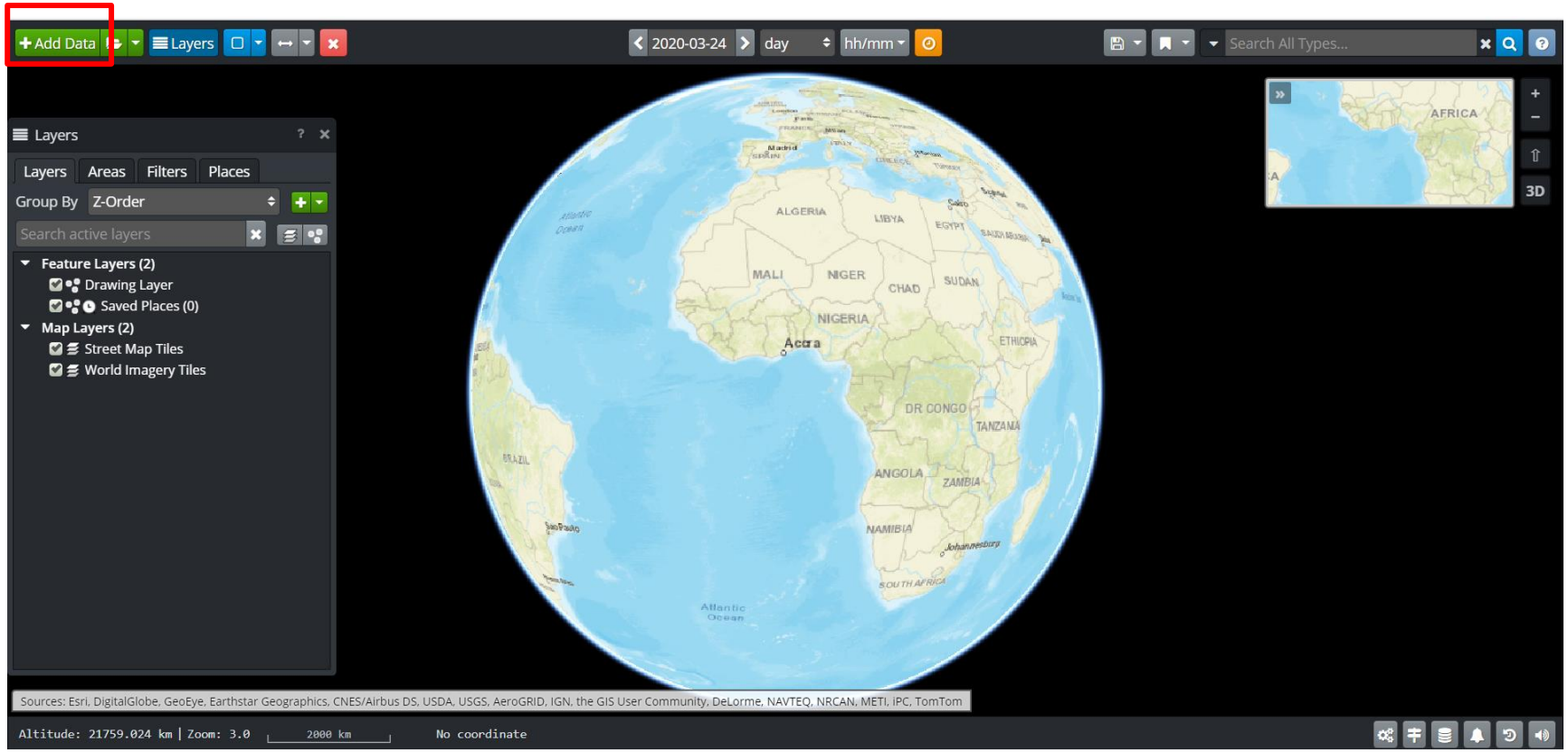


4. Visualization

1) PUC1

- How to merge different layers in a unique interface

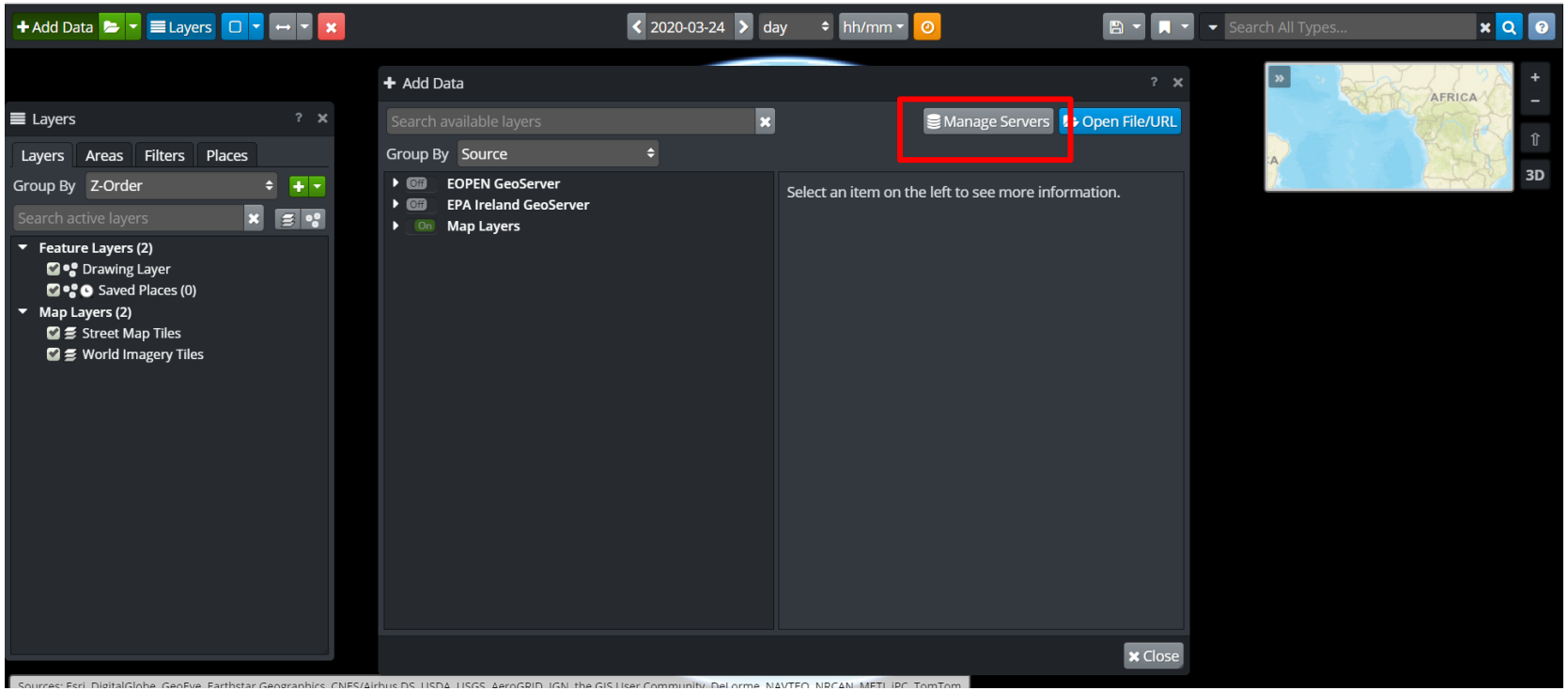
Add



4. Visualization

1) PUC1

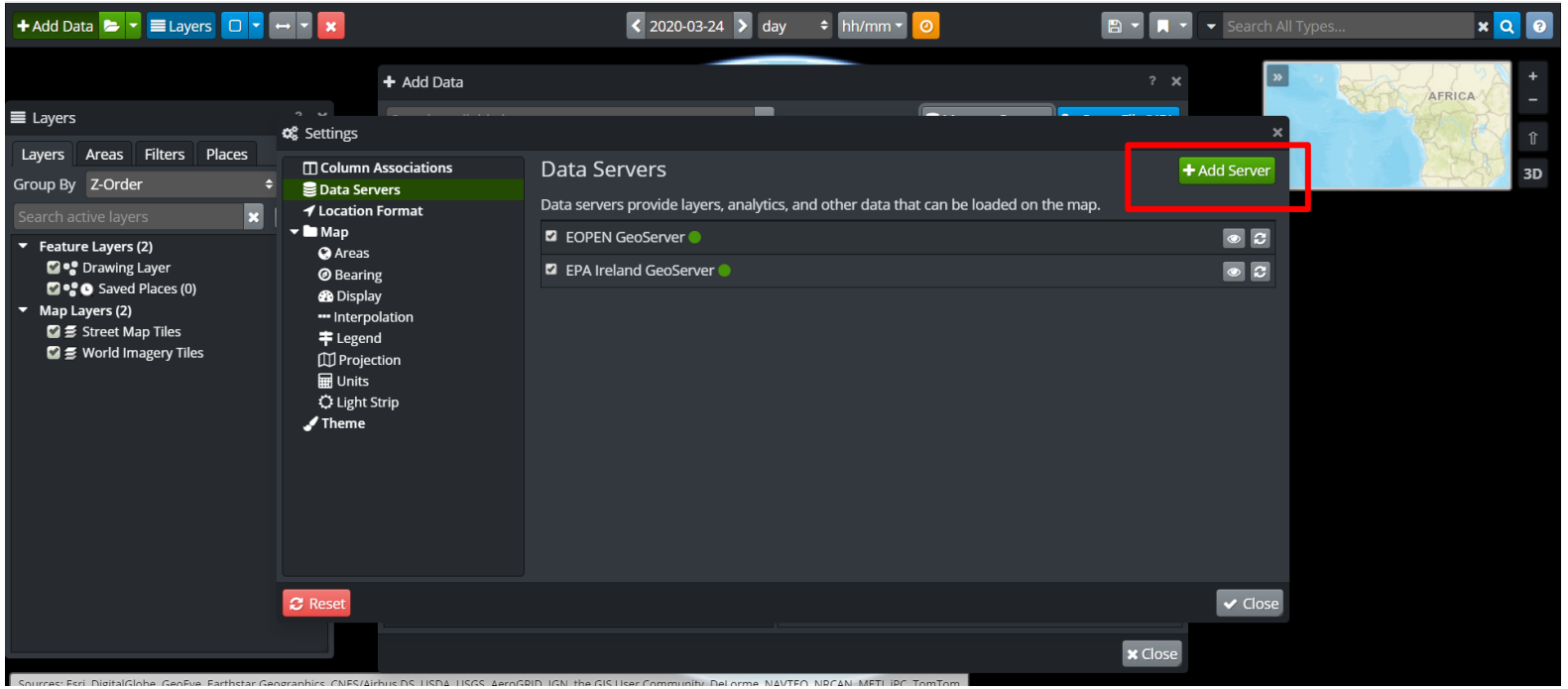
- How to merge different layers in a unique interface



4. Visualization

1) PUC1

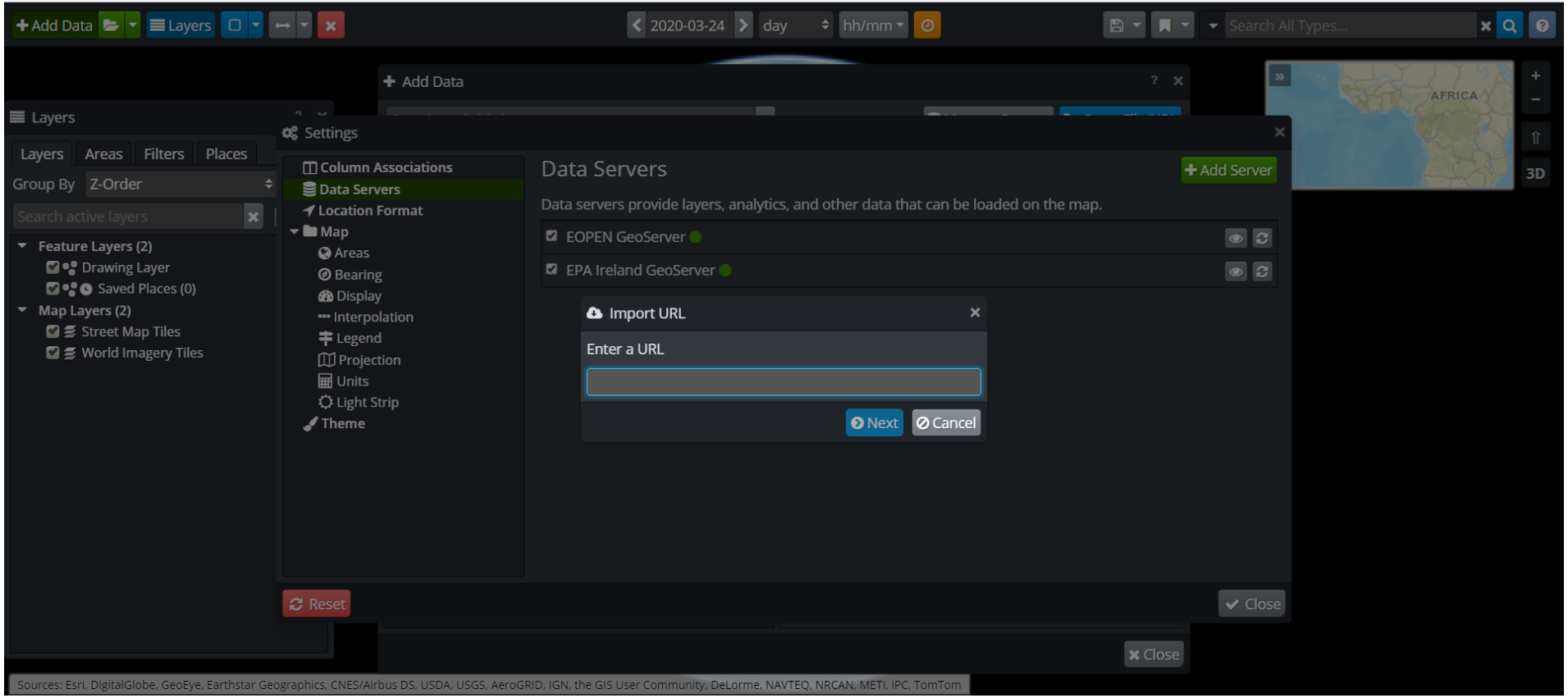
- How to merge different layers in a unique interface



4. Visualization

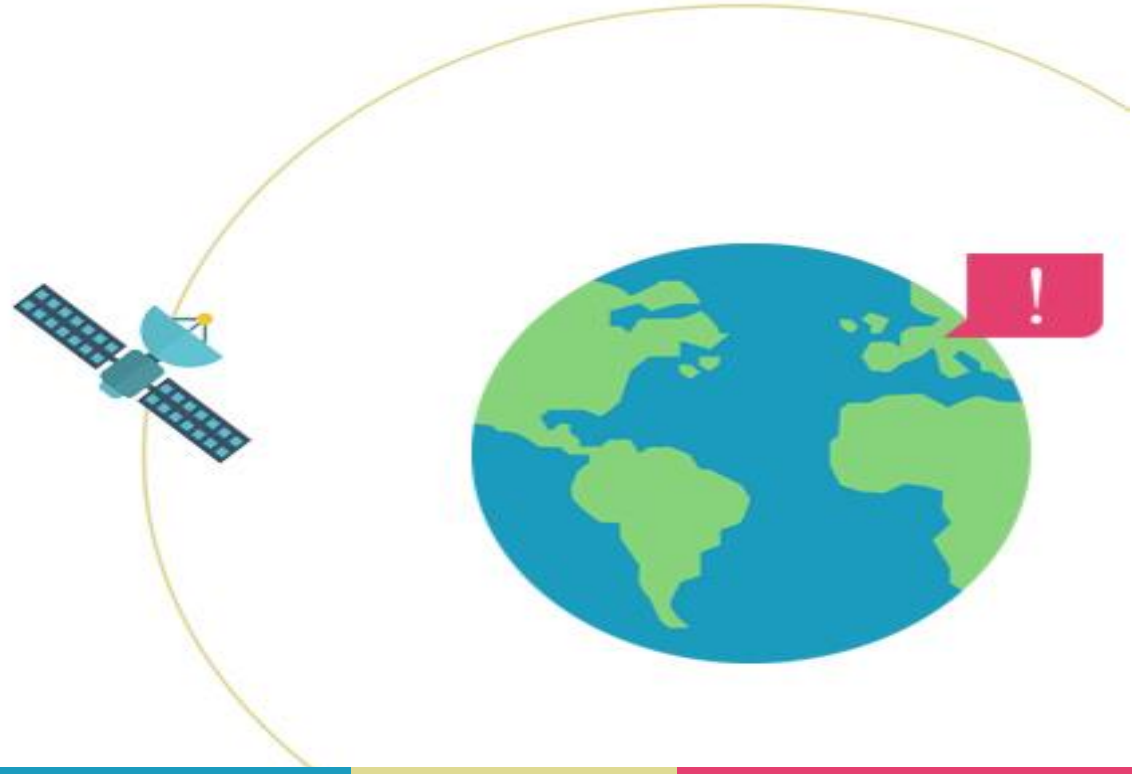
1) PUC1

- How to merge different layers in a unique interface



Thanks!

Any questions?



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