



European Commission

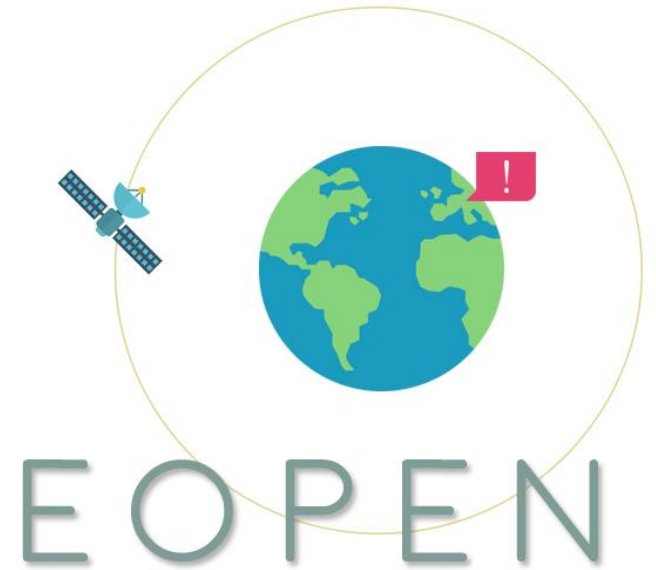
ACRS 2019 Daejeon, Korea

EOPEN PUC1 - A New Approach to Flood Risk Management

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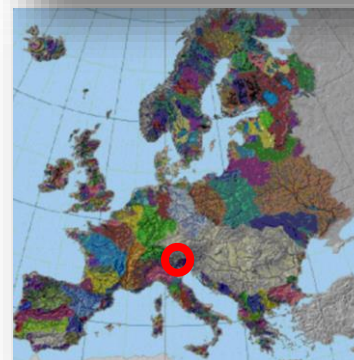
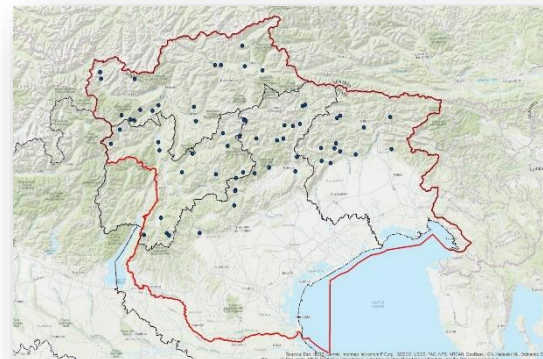
Autorità di Bacino Distrettuale delle Alpi Orientali

Distretto delle Alpi Orientali



AAWA Office

The “ Autorità di Bacino Distrettuale delle Alpi Orientali ” is the office responsible for the implementation of the flood directive (2007/60/EC) into the Eastern Alps Water Basin District that covers over 40000 sqkm of territory included in several states; most of the territory belongs to Italy but our competence extends also to a part of Slovenia (Isonzo tributary basin and Timavo river basin), Austria and Swiss.



PUC 1 - Overview

PUC 1 is focused on the management of flood risk with EO and non EO data. The demonstration site is Vicenza, a city located in the Northeast of Italy, periodically affected by floods that cause damage for billions of Euros.

AAWA that is the Authority responsible for the application of the directives 2007/60/EC and 2000/60/EC, to reduce the consequences of floods in Vicenza, has developed an Early Warning System (Flood forecasting system), active since 2012 with a bulletin to inform the Mayor of the predicted water level of the Bacchiglione river.

Ongoing work for PUC1:

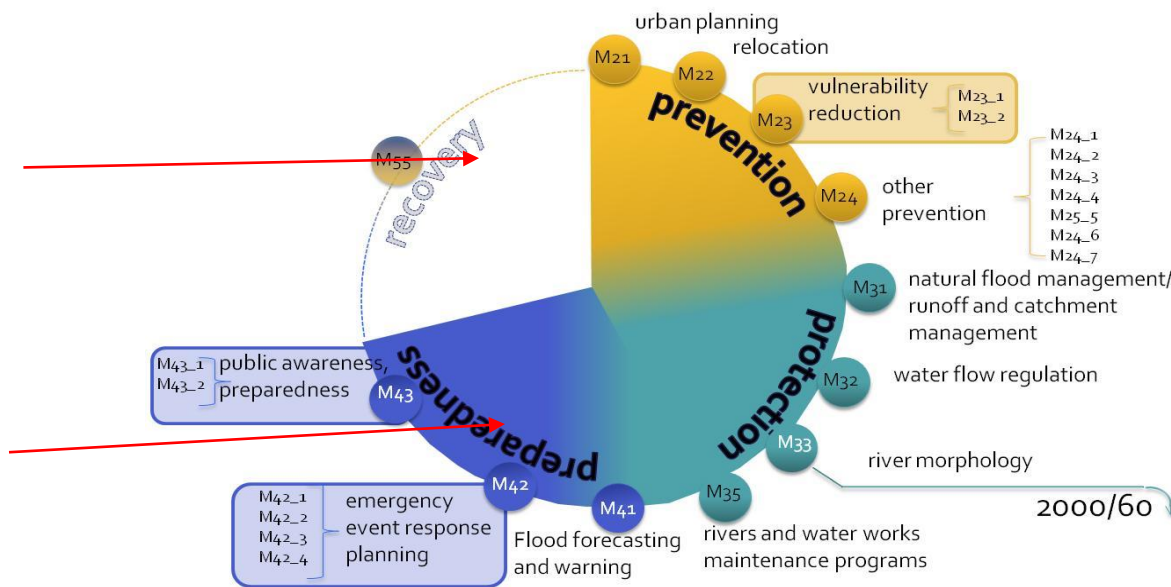
Improvement of the AMICO model (Flood forecasting system) including EO satellite data analyses to derive information supporting risk assessment and flood prevention.

The Flood Risk Management Plan (Directive 2007/60/EC)

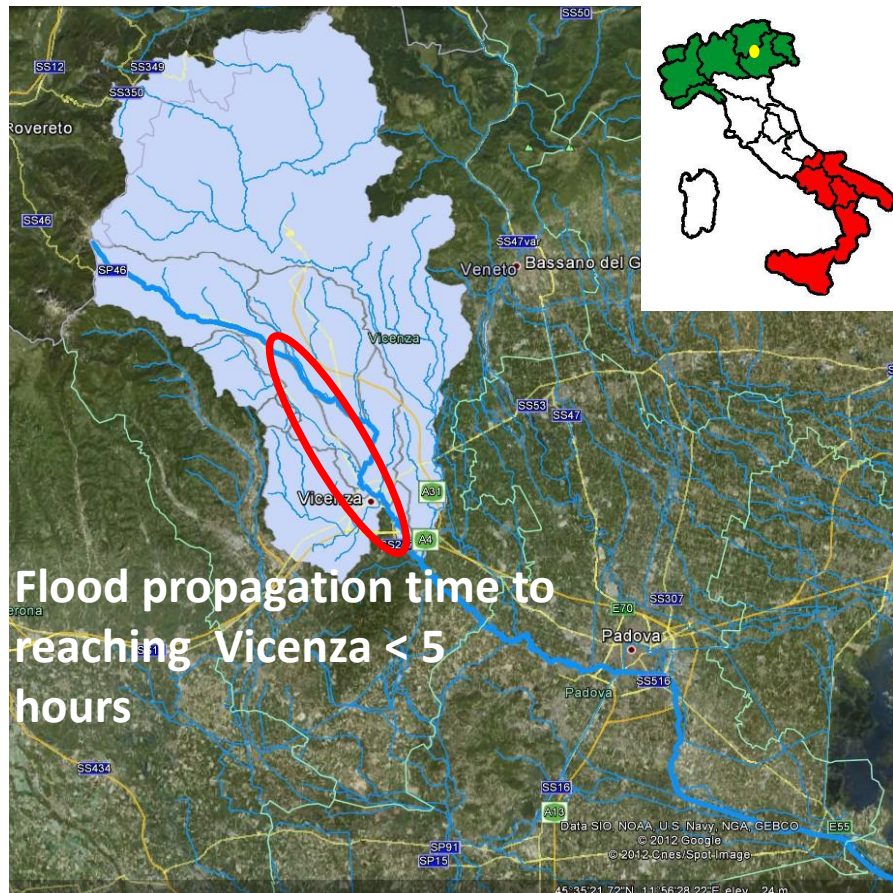
The Flood Risk Management Plan includes different measures to manage the risk of floods including both structural and non structural measures

Scheme of the Flood Risk Management Plan measures

EOPEN platform will help the implementation of the measures of AAWA Flood Risk Management Plan aligned to the European directive 2007/60/EC



Site of the pilot: Local Risk District of Vicenza (Italy)



VICENZA city:

- UNESCO World Heritage



- a **model** of **economic** activity



- at high Flood risk!!!



The 2010 Flood event in Veneto Region



2010 flood damages costs in Veneto Region (source: Veneto Region)

municipalities	349
provinces	7
overall damage to businesses	€100.200.000,00
Overall damage to private citizens	€144.600.000,00
Overall damage to private citizens, business and public works	€2.034.800.000,00



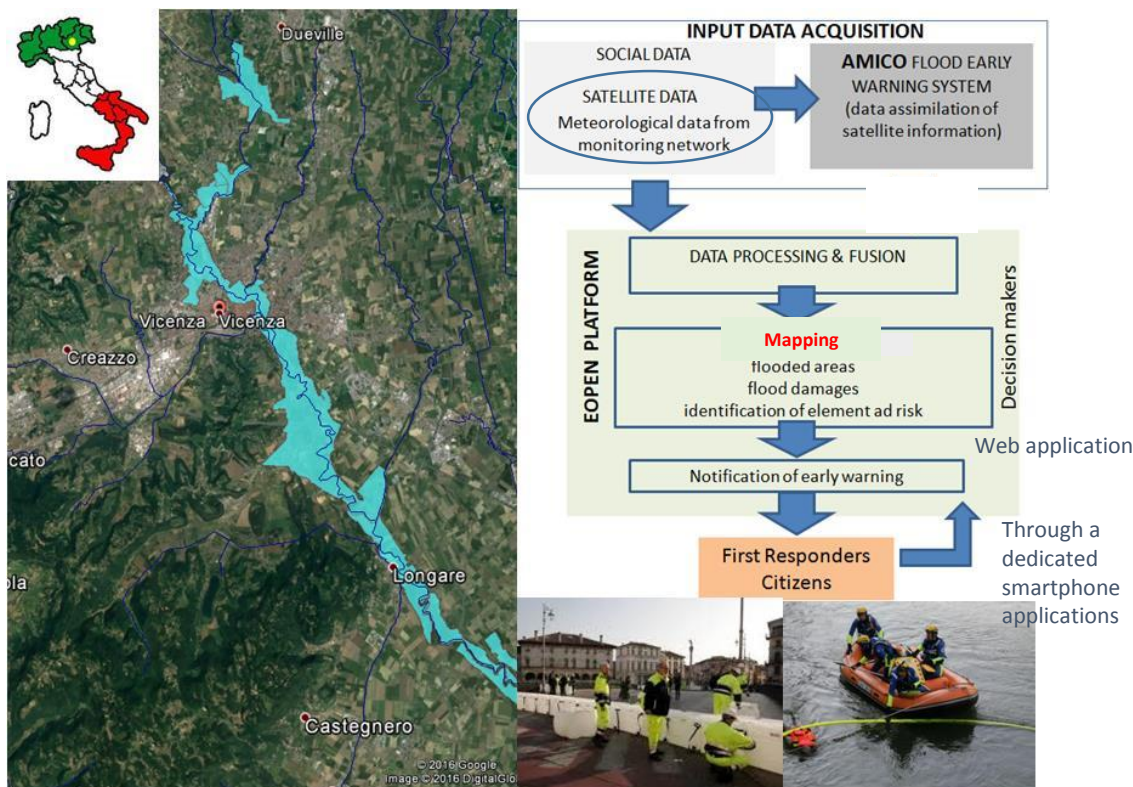
Municipality of VICENZA (mostly affected by the flood)



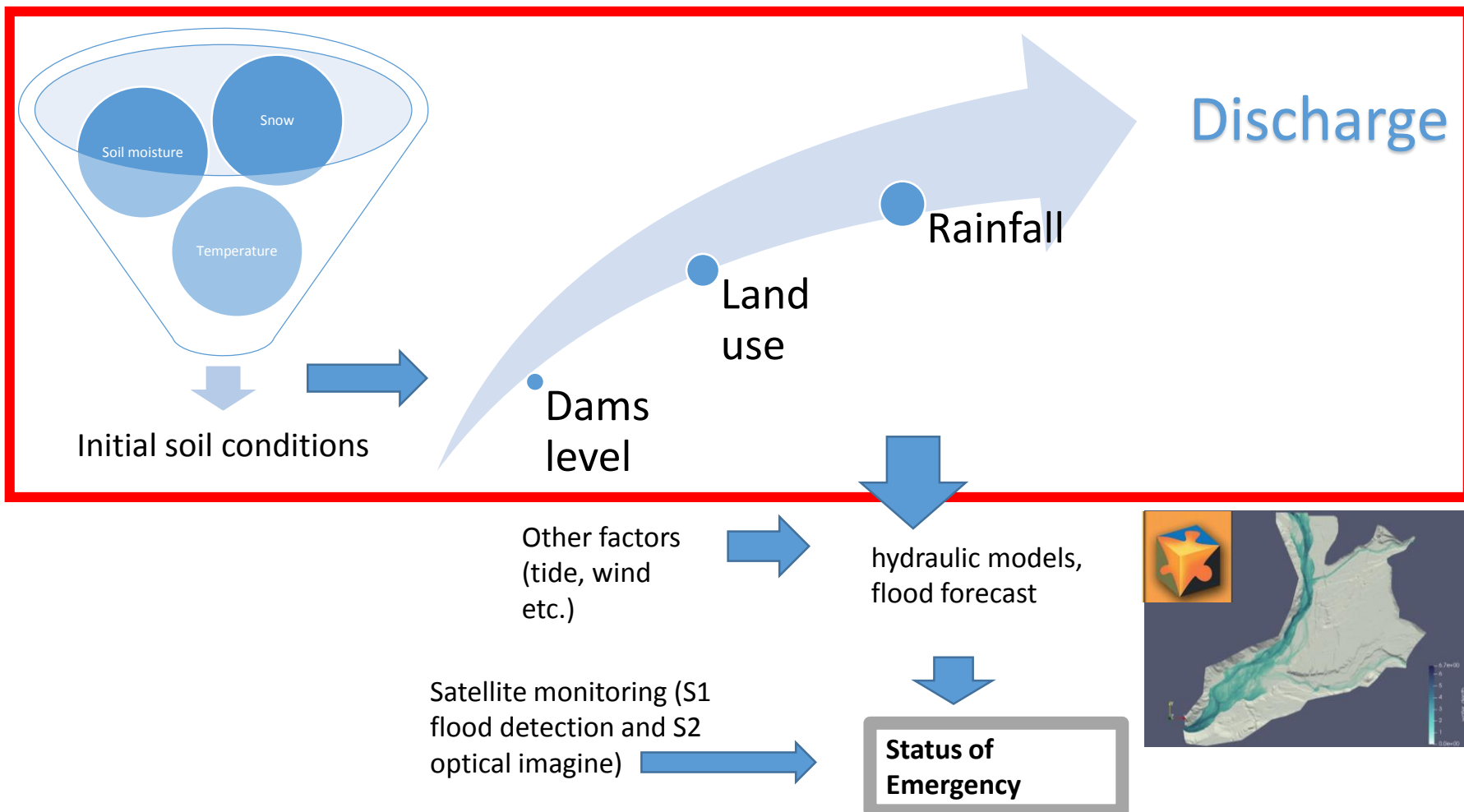
people died	2
displaced	900
damaged municipalities	30
closed main roads	20
landslides	17
floods	12
levee breaks	4
flooded surfaces	50 km ²

PUC 1 Flood Risk Pilot approach

EOPEN will reduce emergency response time by developing innovative Flood Decision Support



Integration of AAWA Early Warning System (EWS) in EOPEN



SNOW Cover



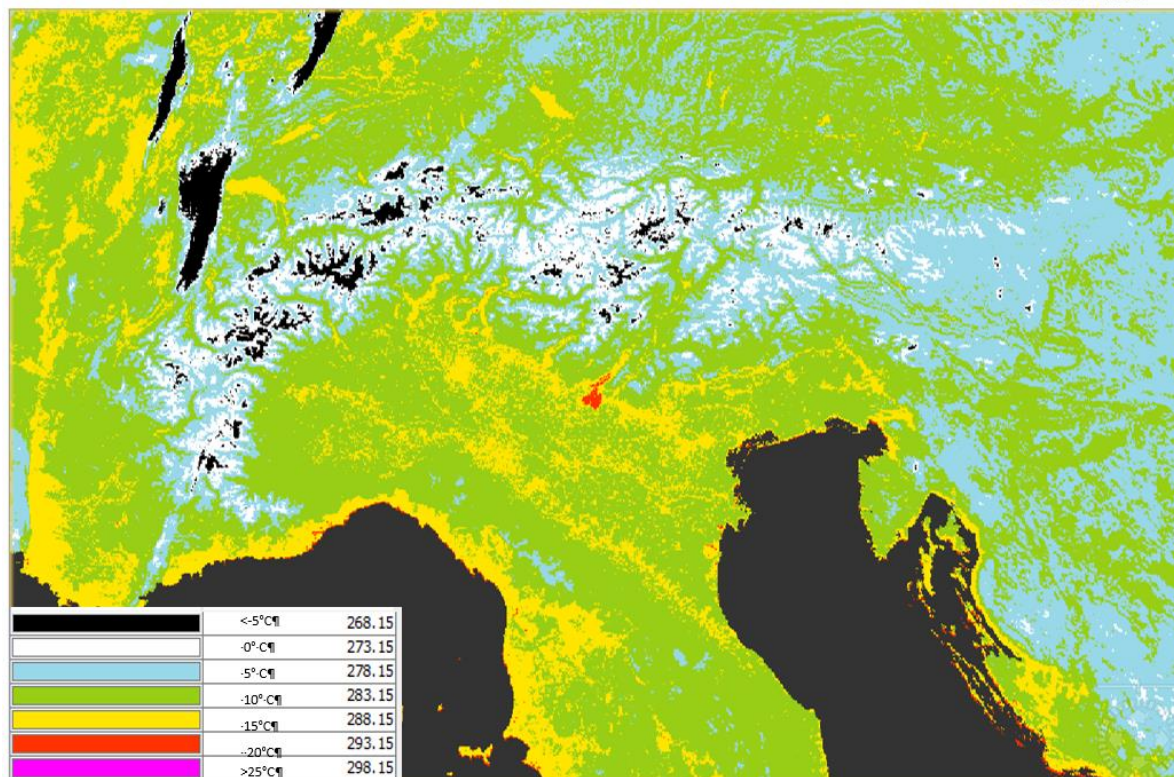
Snow cover

Copernicus Sentinel 3
OLCI L1 13-10-2018

EOPEN TEST: The VAIA storm, Italy (October 2018)

- ▷ The last intense event in our territory: the “VAIA” storm, was important to test the usage of new types of data. In particular we considered different products: either weather forecasts, or the EUMETSAT and COPERNICUS products to evaluate the effects of this event on the ground and the actual movement of the storm vs the flood forecast of our Early Warning System.
- ▷ VAIA storm rain gauges measured over **700 mm in 5 days** and winds were over **120 km/h**, causing a lot of damages on the mountain basins of several important rivers (Piave, Brenta, Bacchiglione, Tagliamento and Livenza)
- ▷ The analysis of this event shows unequivocally the importance of satellite data to support the hydrological reconstruction of the storm and also, in general, to support the entire system complementing data from the ground sensor network to improve (AMICO) flood forecasts.

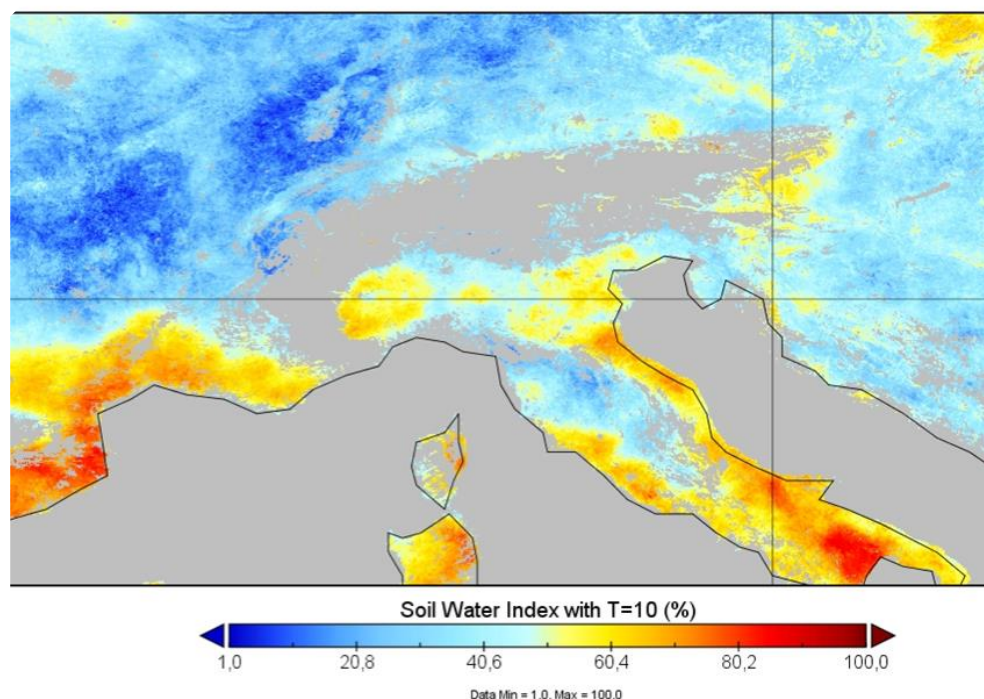
Temperature



SENTINEL 3 LST 12 October 2018 h 19.00

Soil Moisture

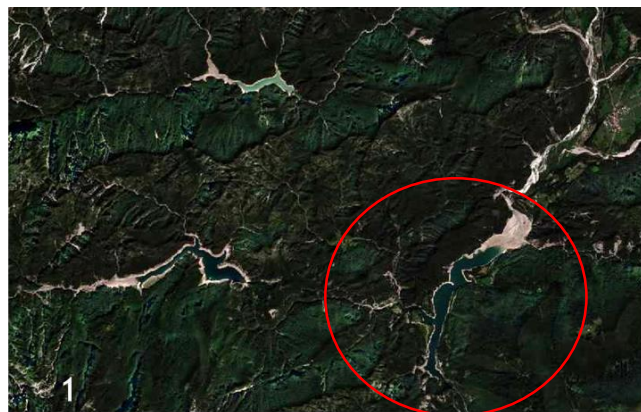
Soil Water Index with T=10



EUMETSAT 24 October 2018, T=10 (%)

The Soil Water Index quantifies the moisture condition at various depths in the soil. It is mainly driven by the precipitation via the process of infiltration. Soil moisture is a very heterogeneous variable and varies on small scales with soil properties and drainage patterns. Satellite measurements integrate over relative large-scale areas, with the presence of vegetation adding complexity to the interpretation.

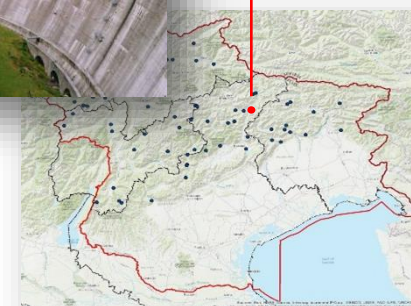
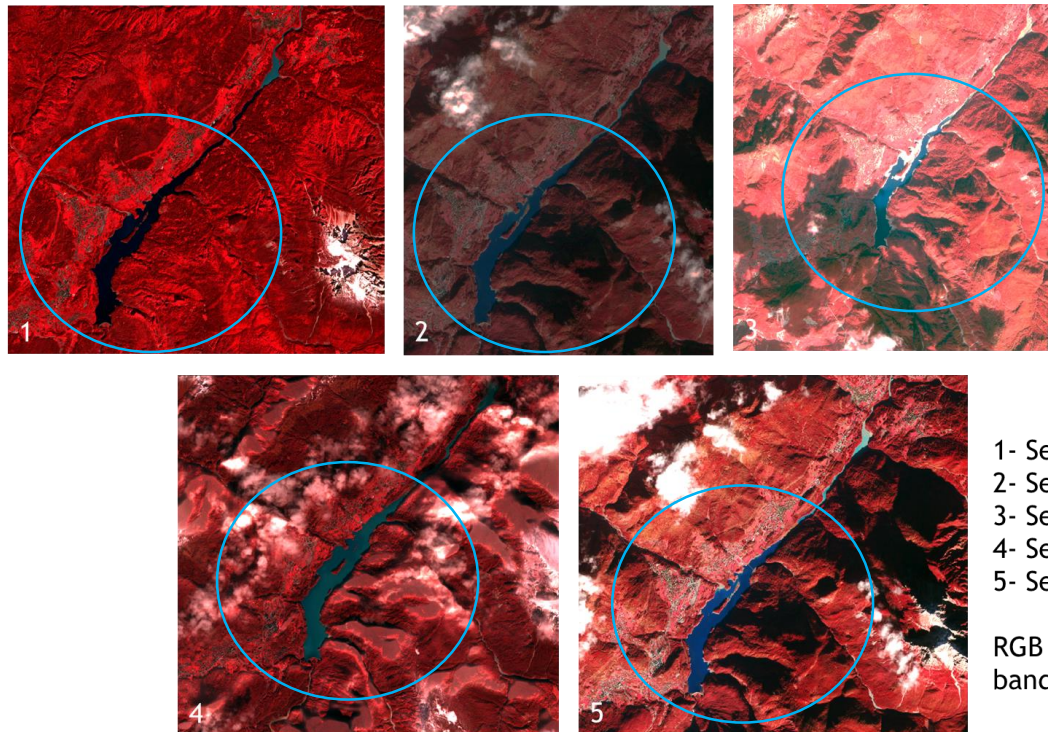
Dam status, Ponte Racli



- 1- Sentinel 2 27-8-18 RGB
- 2- Sentinel 2 11-10-18 RGB
- 3- Sentinel 2 21-10-18 RGB
- 4- Sentinel 2 31-10-18 RGB

RGB= bands 4,3,2

Dam status, Pieve Cadore

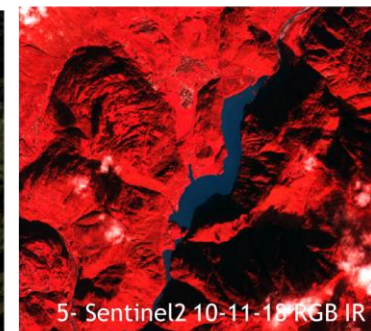
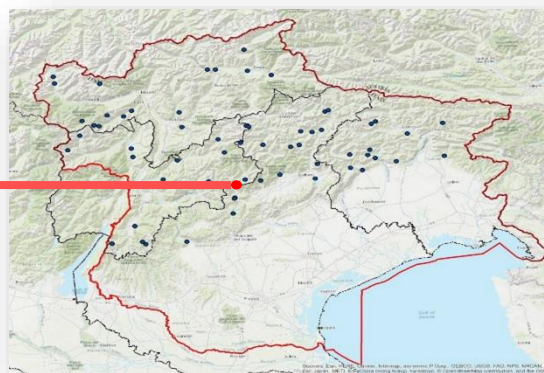
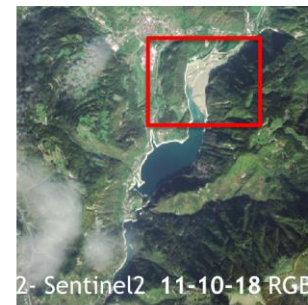


- 1- Sentinel 2 27-8-18 RGB IR
- 2- Sentinel 2 11-10-18 RGB IR
- 3- Sentinel 2 21-10-18 RGB IR
- 4- Sentinel 2 31-10-18 RGB IR
- 5- Sentinel 2 10-11-18 RGB IR

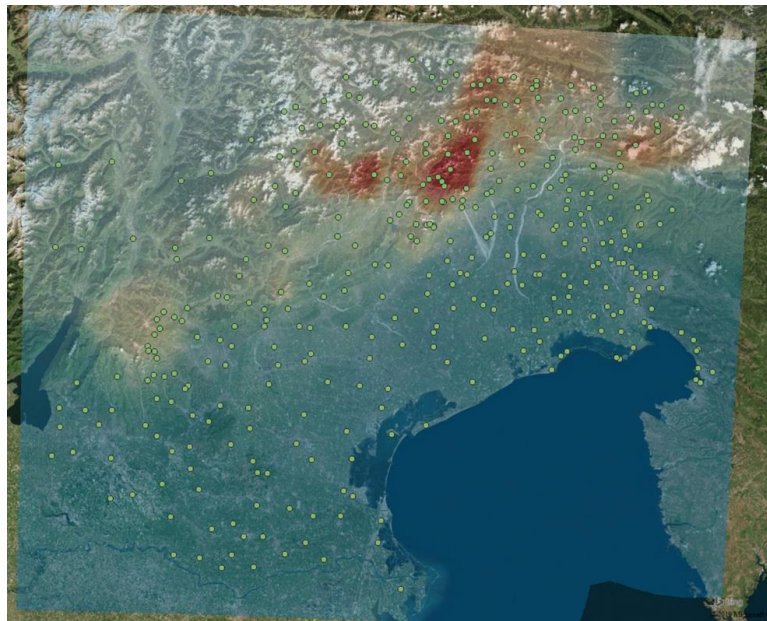
RGB IR: False colour RGB IR band

False colour RGB IR= bands: 8,3,2

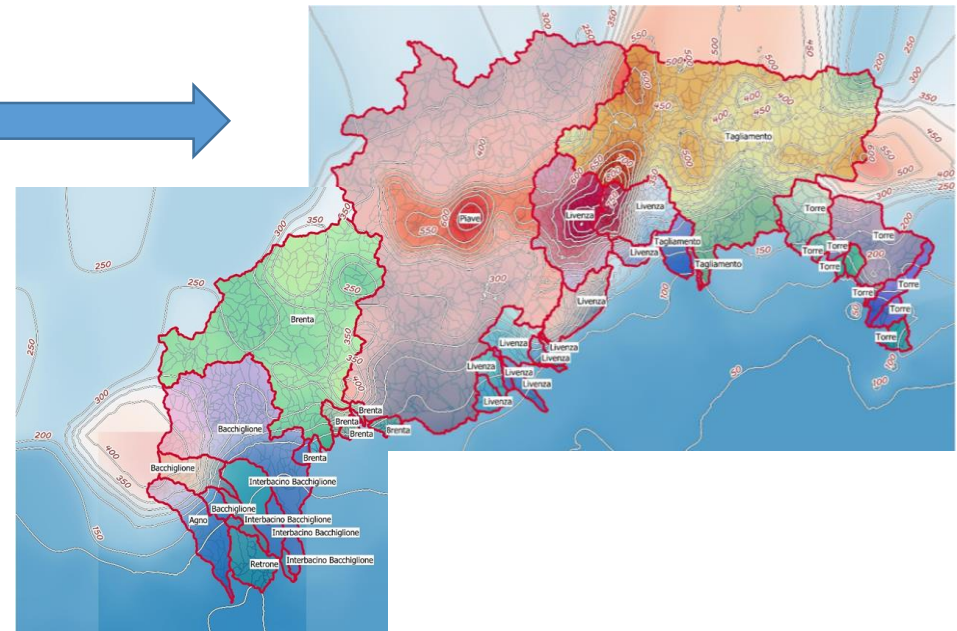
Corlo Dam



Rainfall, ground sensors pattern, ws satellite data



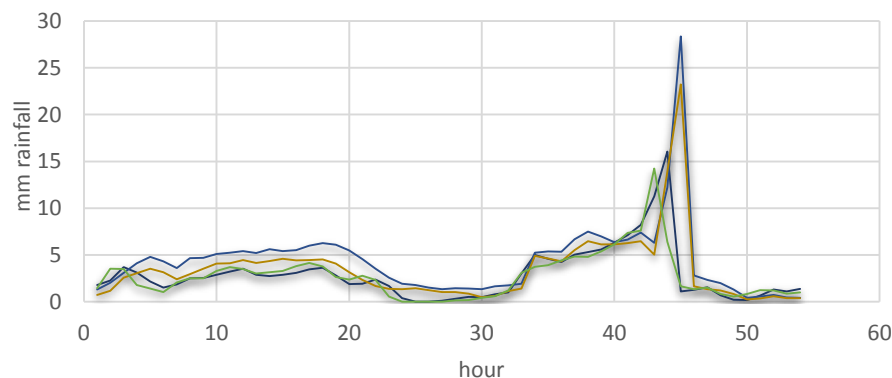
Ground stations



Interpolated rainfall, IDW

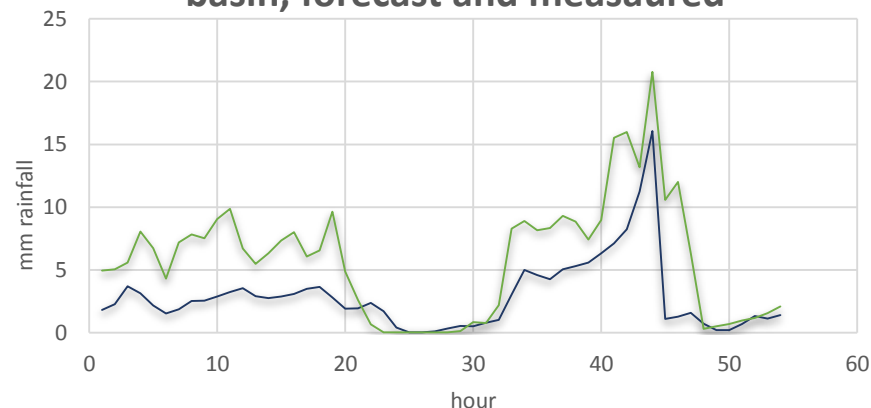
Hirlam forecast vs measured

Hirlam_28_h00_ mean hourly precipitation for each basins



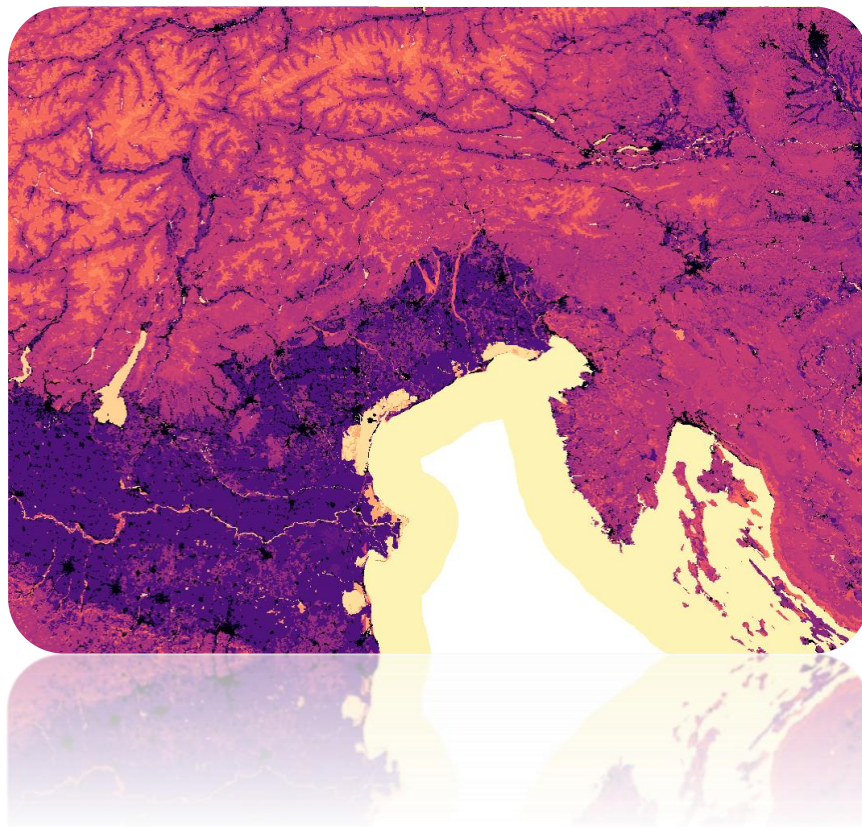
— Piave a Nervesa della Battaglia
— Cellina a Montereale
— Tesina a Longare
— Meduna a Meduno
— Brenta a Bassano

Hourly precipitations for Piave river basin, forecast and measured



— Piave a Nervesa della Battaglia HIRLAM 28 h00
— Piogge Piave misurate Nervesa

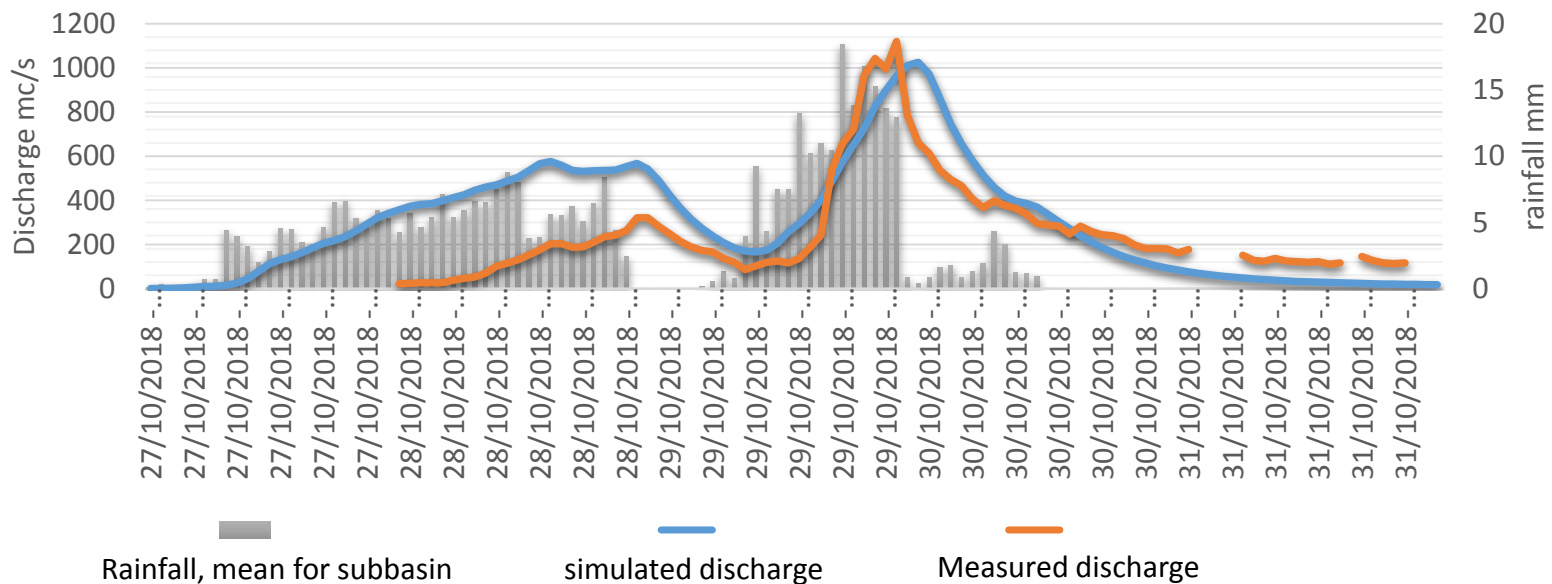
Other variables; Land use, Corine Ic 2018



Copernicus
Land Service,
Corine LC 2018, 100m
resolution

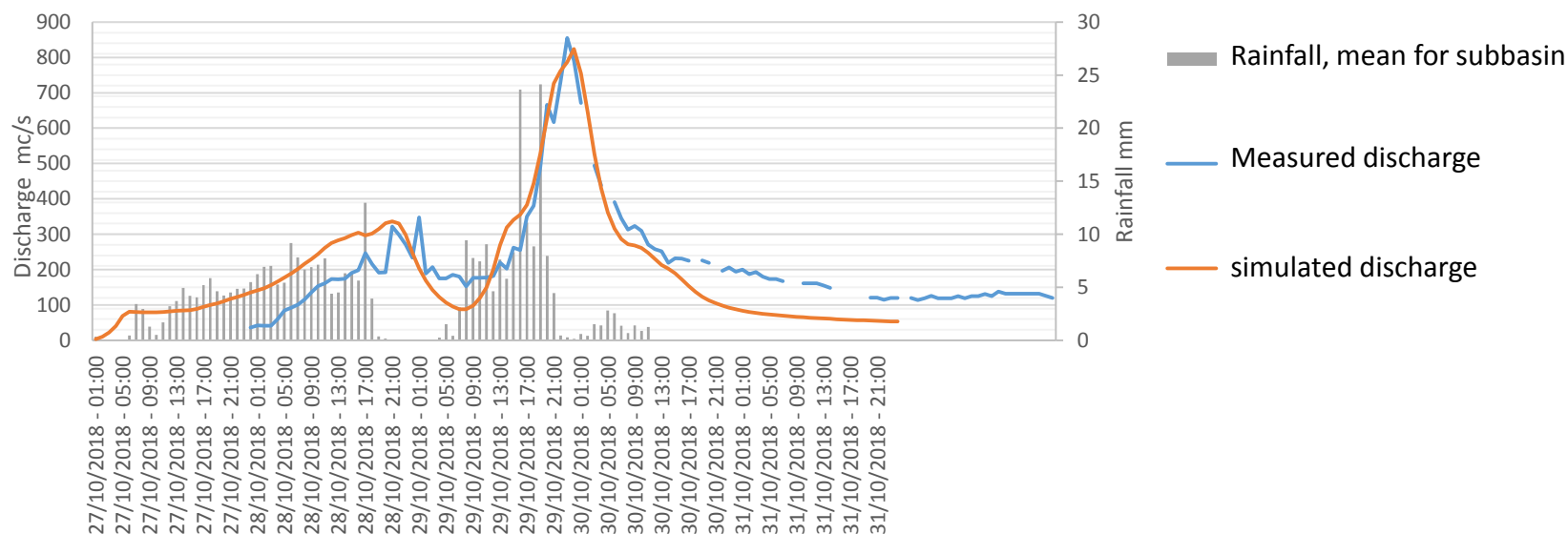
AMICO Results: closure section of most affected basins

Piave river discharge at Pieve Cadore river section

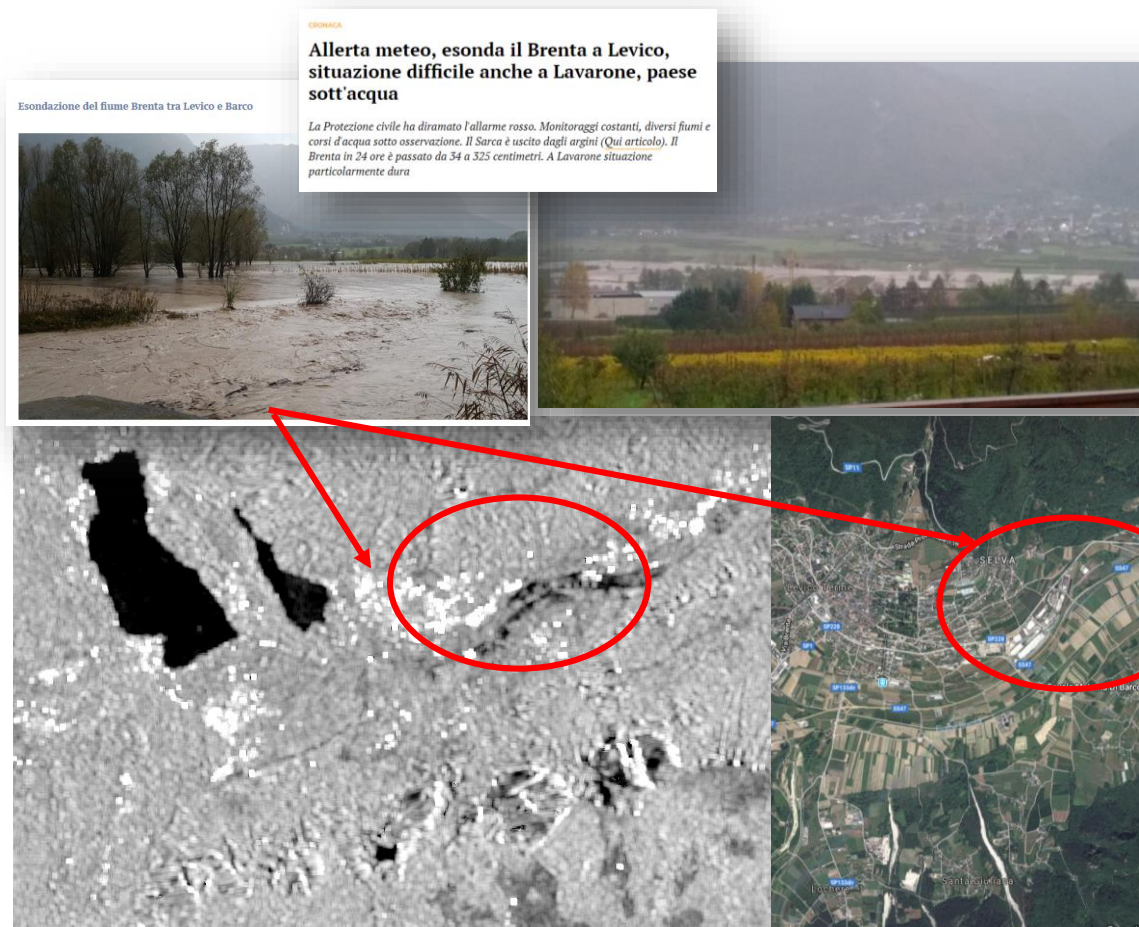


AMICO Results: closure section of most affected basins

Cismon river discharge at Corlo Dam river section

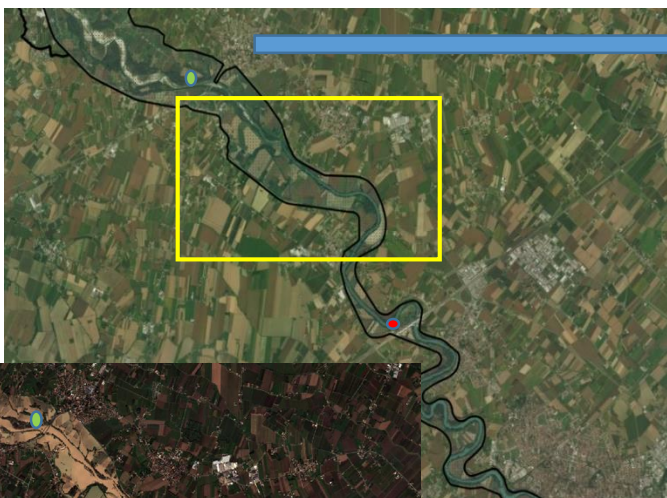


Flood detection



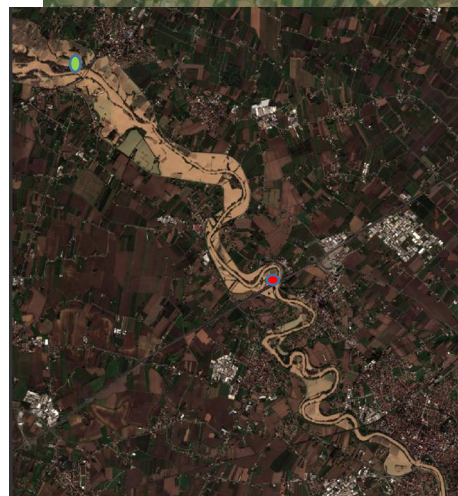
Flood in Levico, Brenta river flooded a rural area between Levico and Braco as appearing on a Sentinel 1 image (acq. 28-10-2018 17:07)

Floods?

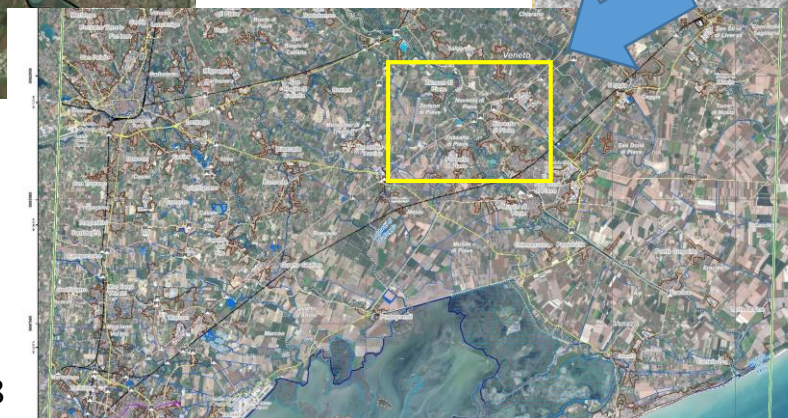
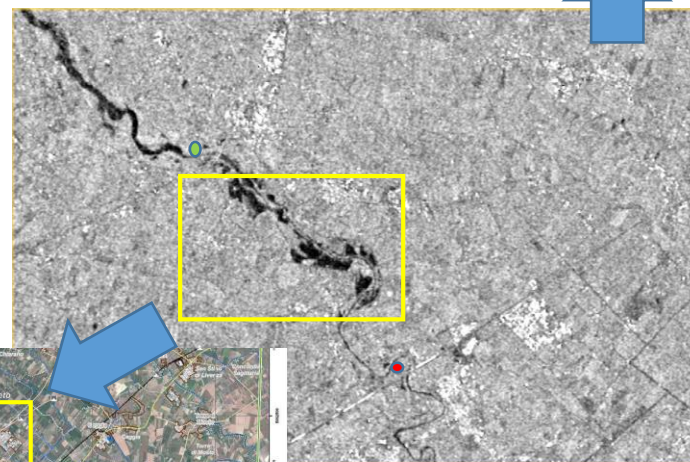


Piave river fluvial area (area where the river develops morphological processes)

Piave 29-10-2018 - Sentinel 1 radar elaboration by "Autorità di Bacino Distrettuale delle Alpi Orientali" (AAWA)

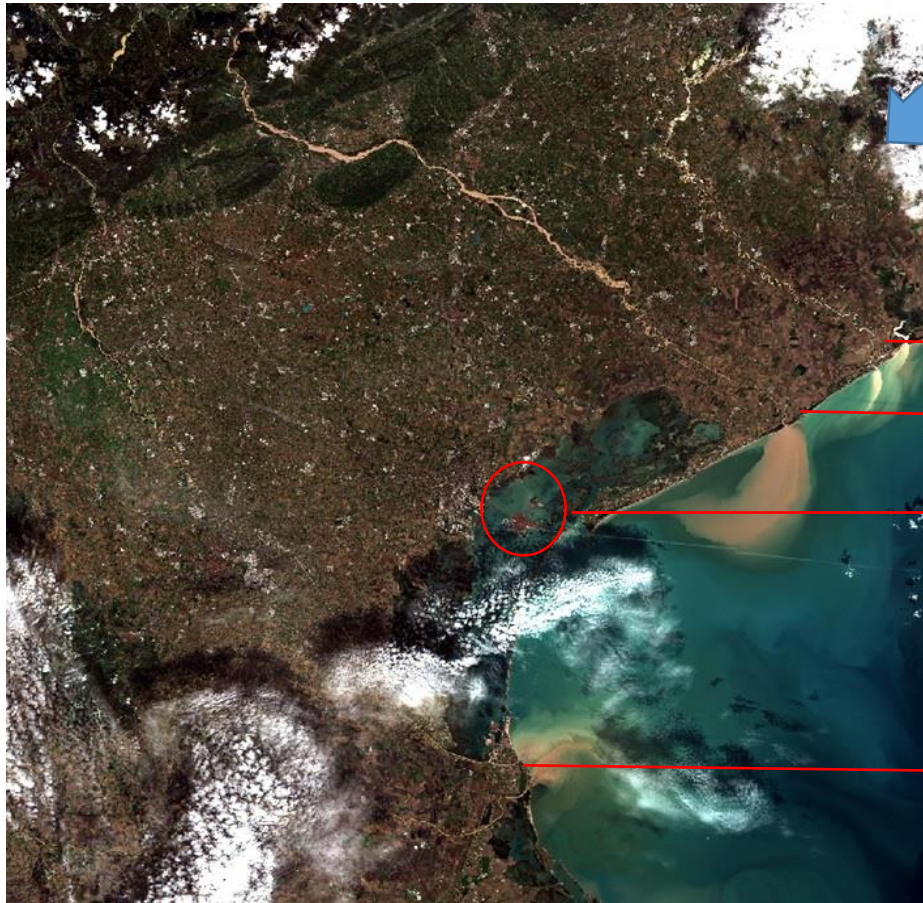


Sentinel 2, end of October 2018



False positives from Copernicus Emergency Management Service (EMS)

River sediments discharge after VAIA storm



Livenza

Piave

Venice

Adige and Brenta-
Bacchiglione

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