LAMPO

Lombardy-based Advanced Meteorological Predictions and Observations

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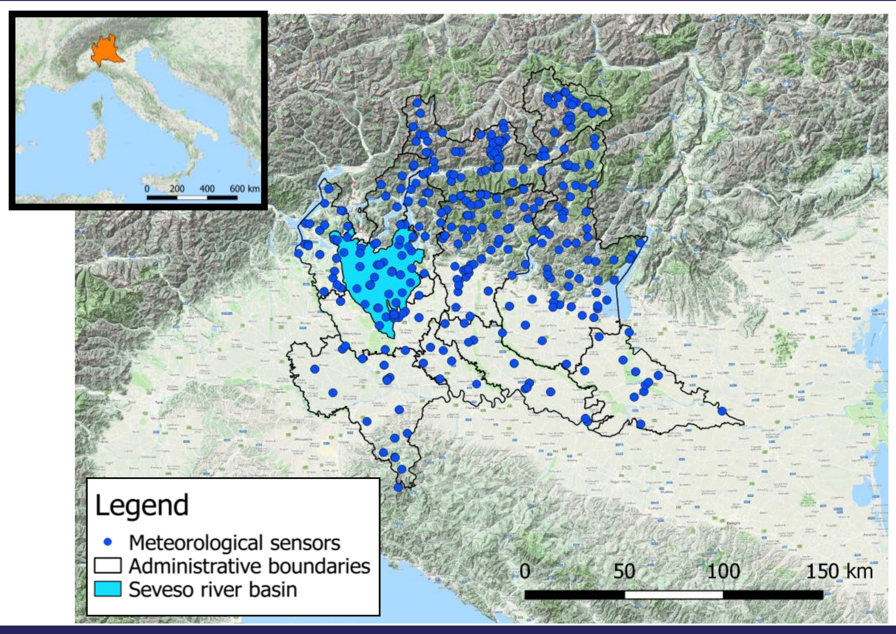
Project overview

Lombardy-based Advanced Meteorological Predictions and Observations (LAMPO) is a pilot project, funded by the Cariplo Foundation and led by the Geomatics and Earth Observation Laboratory (GEOlab) of Politecnico di Milano in cooperation with ARPA Lombardia and the Politecnico spin-off GReD (Geomatics and Research Development). The project aims at improving the nowcasting of severe storms over the Milan metropolitan area. It will exploit an experimental dense network of low cost GNSS receivers to monitor the troposphere water vapor content.

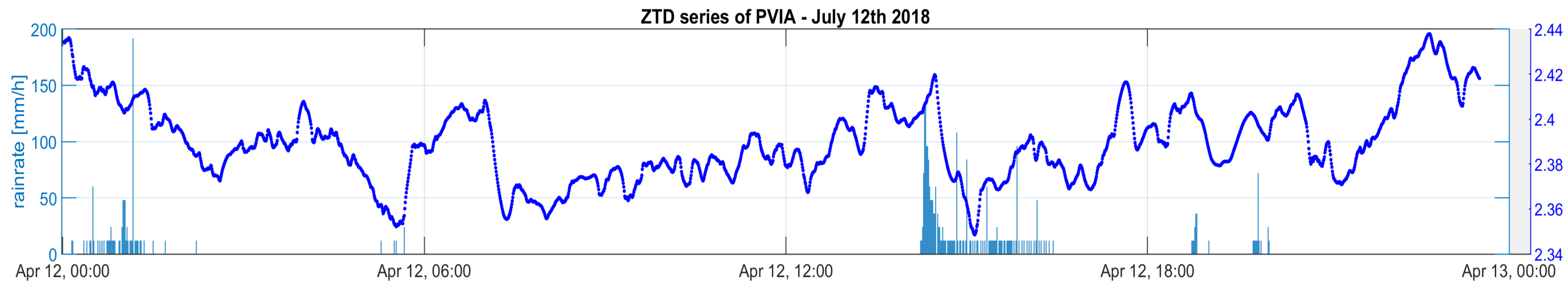
Area under study

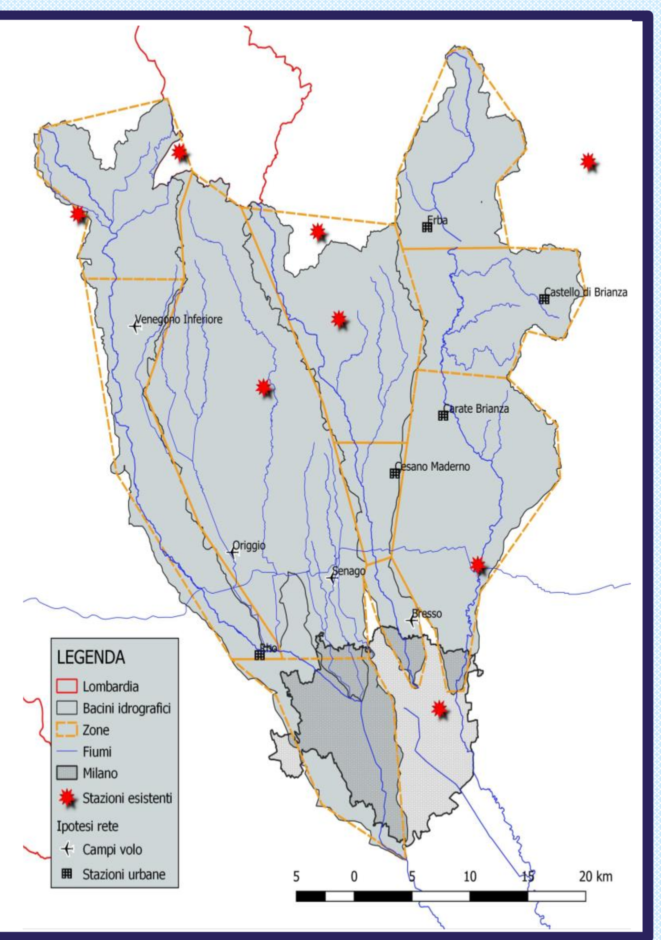
The LAMPO test area includes four river catchments (Lambro, Seveso, Groane and Olona rivers), all characterized by a short concentration time. Among the four rivers, the flash floods of Seveso, often caused by very localized and short thunderstorms, are the most dangerous for the Milan metropolitan area, also due to their frequency. In 2014, considering only the Milan municipality, Seveso floods produced damages for several million euros.



GNSS ZTD from low-cost sensors

A network of low-cost GNSS monitoring units (produced by Softeco srl) has been deployed over the LAMPO test site. The aim is to densify the existent GNSS permanent regional network. This set of 9 receivers has started to collect data from March, 15th 2019. The data will be processed by using the new version of the open software goGPS (Herrera et al. 2016) by GReD, implementing a PPP positioning strategy and a batch least squares solution. The ionospheric component of the atmospheric delay will be locally estimated by exploiting the available dual frequency geodetic stations and the SEID Approach (Deng et al. 2009). This will produce time series (30 seconds rate) of Zenith Total Delays (ZTD) for each of the considered stations.





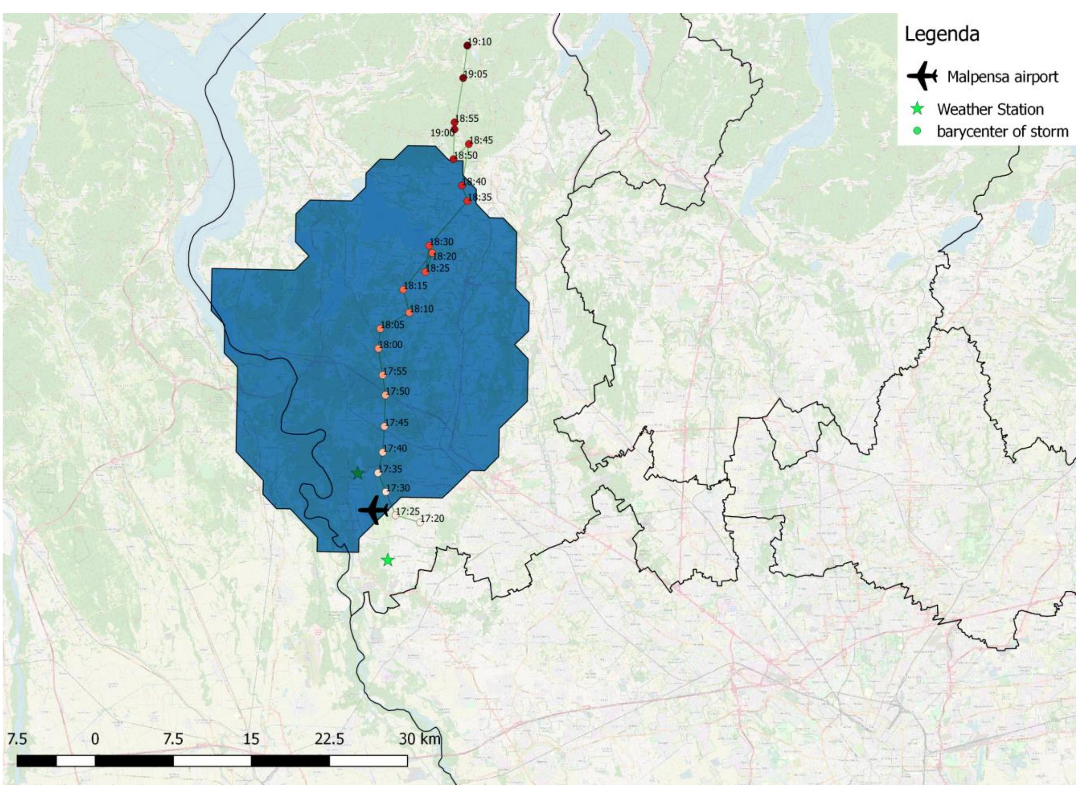
Identification of extreme events and climatology

The identification of extreme rain events has been performed in two different ways:

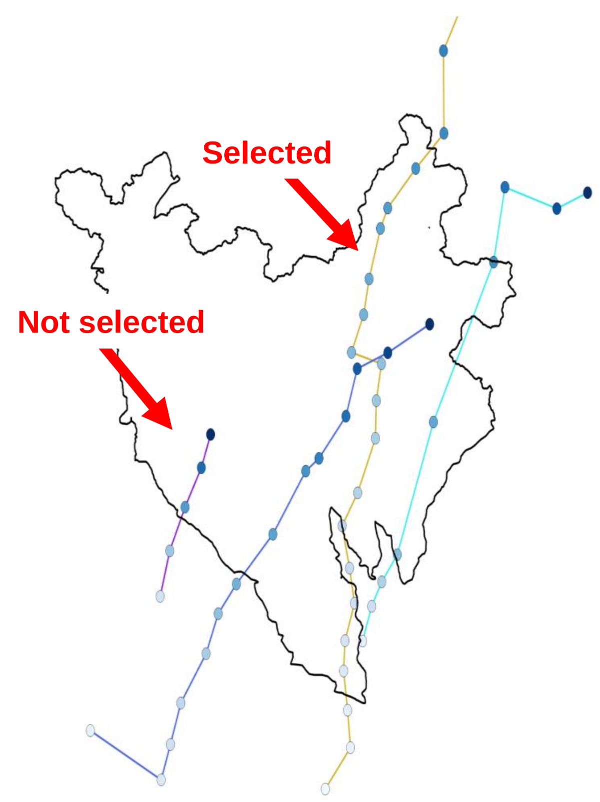
Classification criterion based on rain rate measurements of rain gauges
1. convective events generating a rain rate higher than the 95th percentile of a GEV distribution fit to the observed rain rate histogram of each rain gauge;

Classification criteria exploiting Thunderstorm Radar Tracking (TRT) algorithm
1. convective cells with at least 5 time steps (25 min) inside the LAMPO test area
2. mean of maximum reflectivity of the track > 50 dBZ

With these thresholds a total of about 450 extreme convective rain events has been identified.



Position of a tracked convective cells in the LAMPO test area based on the TRT algorithm

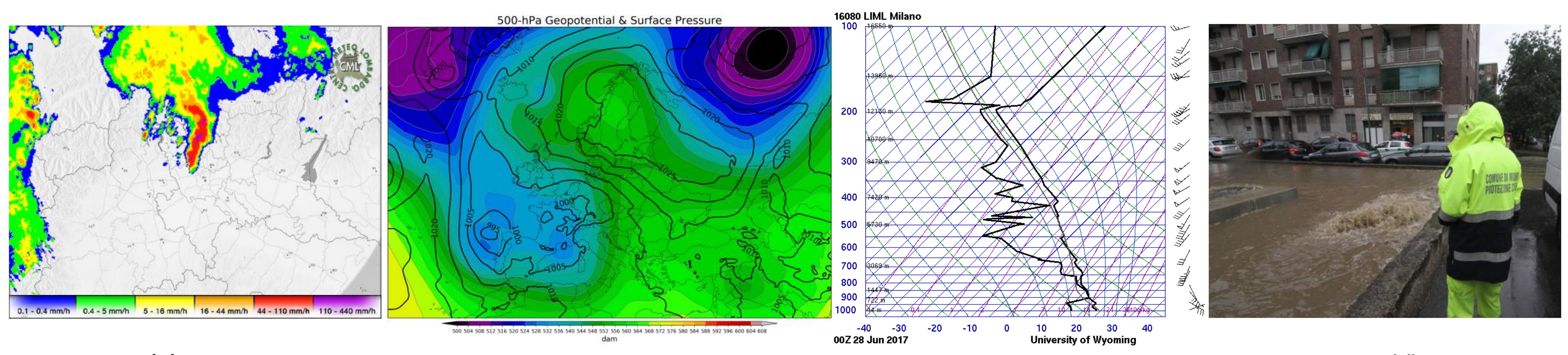


Examples of tracked convective cells: colors represent different tracks

Proper average values have been computed from the available time series of meteorological variables. The data cover a period of almost 8 years, from 2010 to 2018. Time series of GNSS ZTD from the existent SPIN network have been obtained as well.

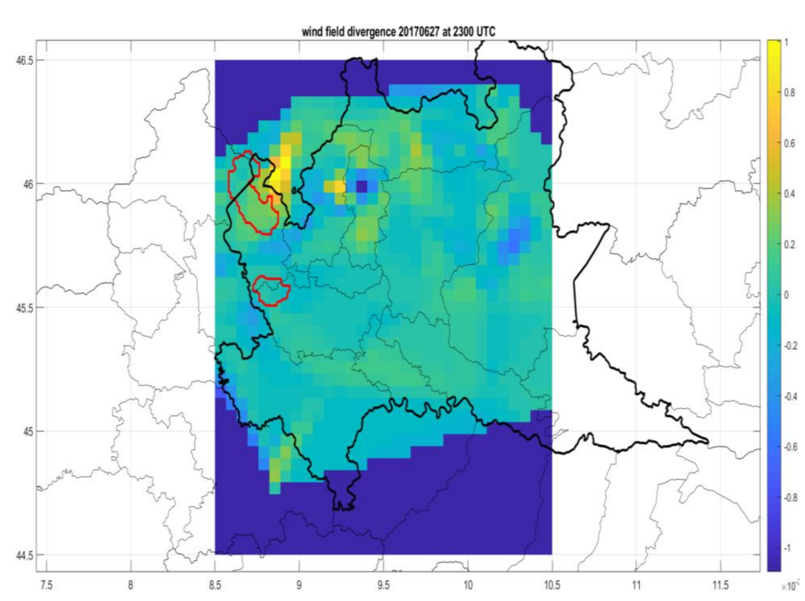
Case study

On June 28th 2017 a flash flood of Seveso river due to an intense storm caused damages and problems in Milan municipality.



Images related to the selected event: (a) Rain intensity rom radar, (b) Synoptic condition from ERA5 reanalysis, (c) Radiosonde skew-T of Milano Linate station, (d) Photo of a flooded area in Milan

A common feature of the analyzed events is the presence of wind field convergence (measured by the network of weather stations) and a clear increasing trend of the GNSS estimated Zenith Tropospheric Delay (ZTD) before the rain event (Barindelli et al. 2018).



Wind field divergence at 23:00 UTC

ZTD time series of COMO station and rainrate of the nearest rain gauge

Preprocessing of all the available meteorological and GNSS ZTD time series is going on to obtain the training dataset for a neural network based prediction algorithm.

References

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