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A DEEP LEARNING FRAMEWORK TO EFFICIENTLY ESTIMATE PRECIPITATION AT THE CONVECTION PERMITTING SCALE

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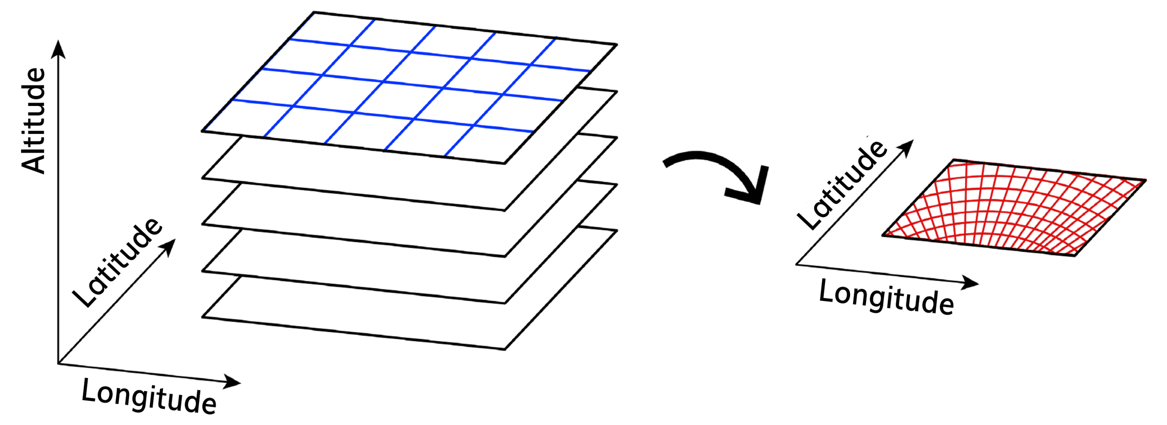
1. MOTIVATION AND OBJECTIVE

High-resolution precipitation estimates are crucial to correctly quantify the related hazard, but challenging to obtain. Classical methods based on simulations of dynamical models are computationally too expensive when it comes to high resolution.

The study aims at deriving a data-driven approach to efficiently estimate precipitation distribution at the convection permitting scale. High-resolution precipitation estimates are derived starting from low-resolution atmospheric parameters values. The proposed framework is based on deep learning architectures, following a supervised training approach.

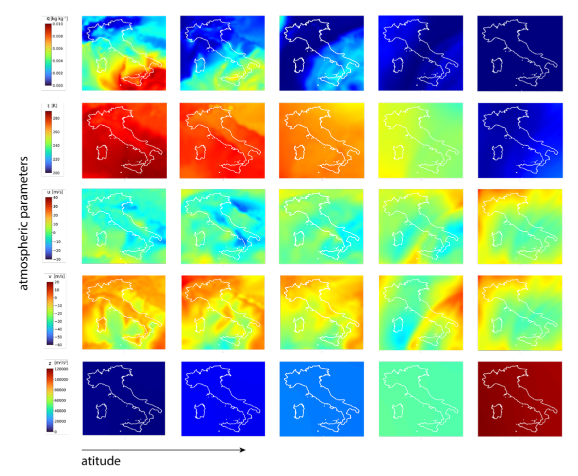


2. DATA

Input datasets

Target dataset

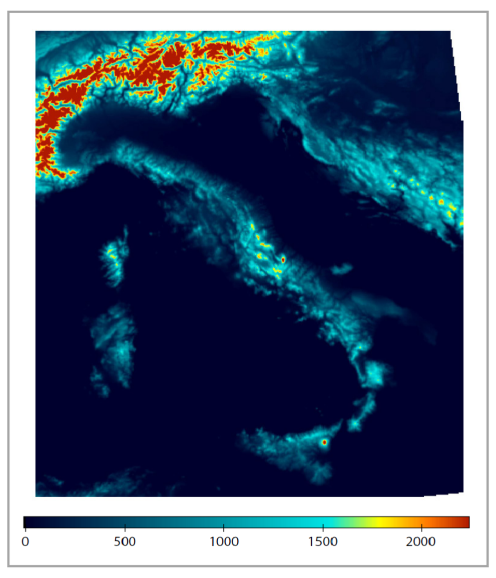
ERA5 REANALYSIS (~25 km)



HUMIDITY, TEMPERATURE, WIND, GEOPOTENTIAL

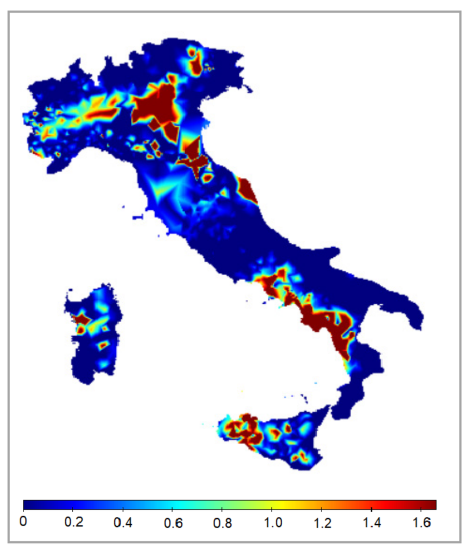
4D: lon, lat, altitude, time (hourly)

TOPOGRAPHIC ELEVATION (3 km)



2D: lon, lat

GRIPHO OBSERVATIONS (3 km)



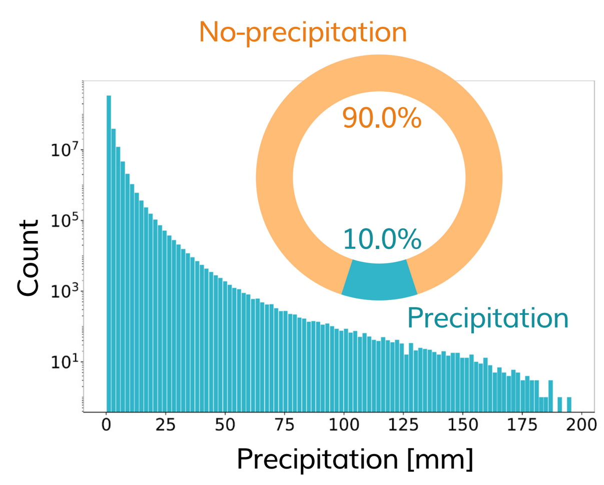
PRECIPITATION

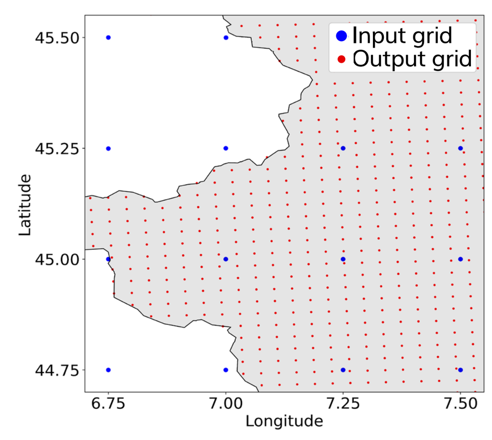
3D: lon, lat, time (hourly)

3. MAIN CHALLENGES

Severe precipitation is difficult to predict and working with real data (GRIPHO) is challenging.

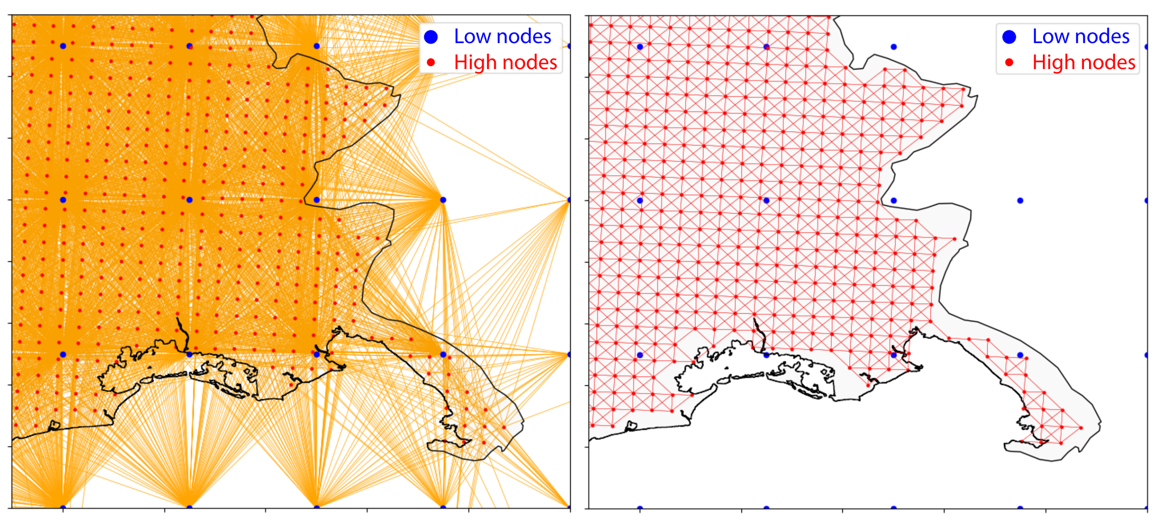
- Different grids for input and target
- Target imbalanced (~90% < 0.1 mm) and skewed





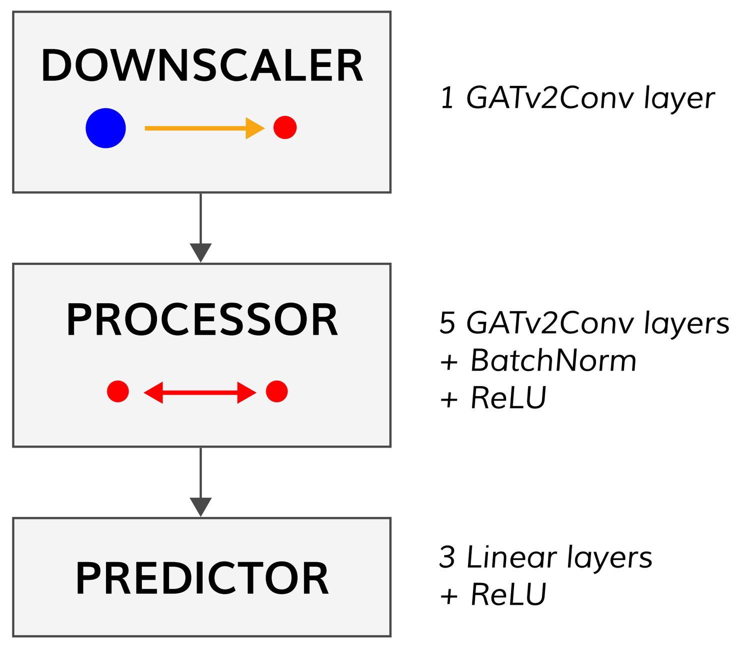
4. GRAPH CONCEPTUALIZATION

- Low nodes (~25 km)
- High nodes (3 km)
- Low-to-High edges
- High-within-High edges

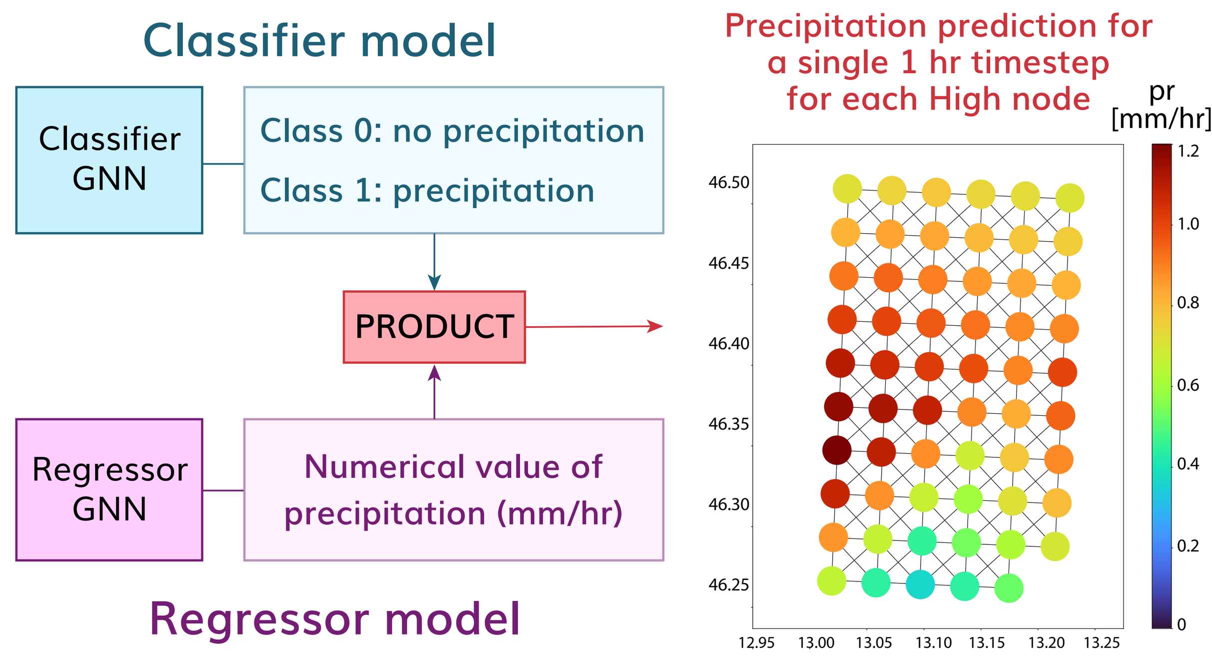


5. DEEP LEARNING MODEL

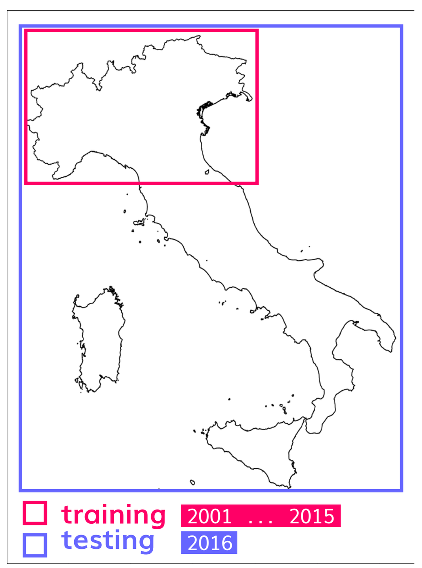
Graph Neural Network (GNN) architecture

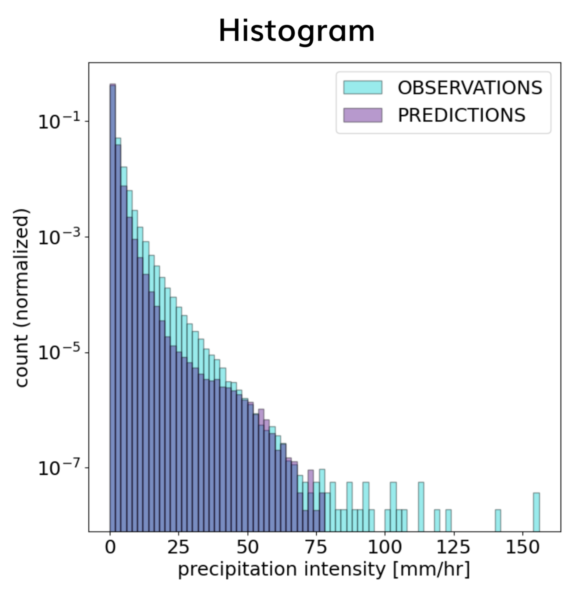


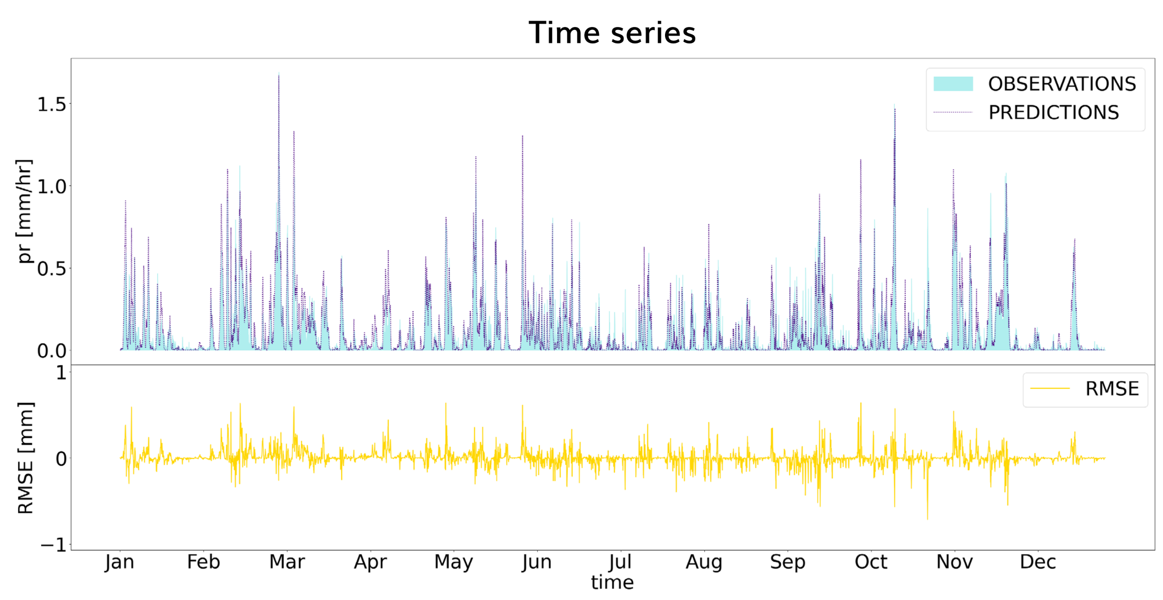
Hurdle approach to tackle imbalance

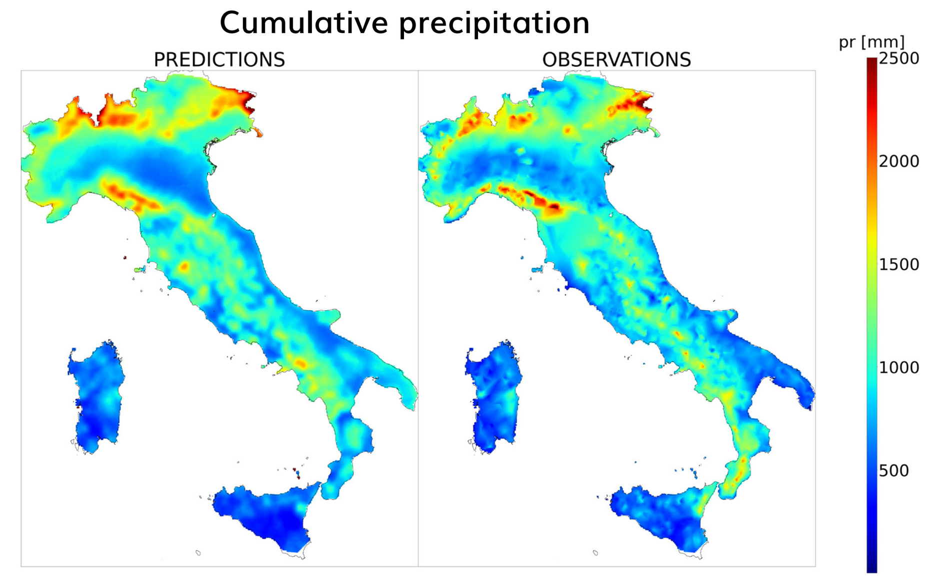


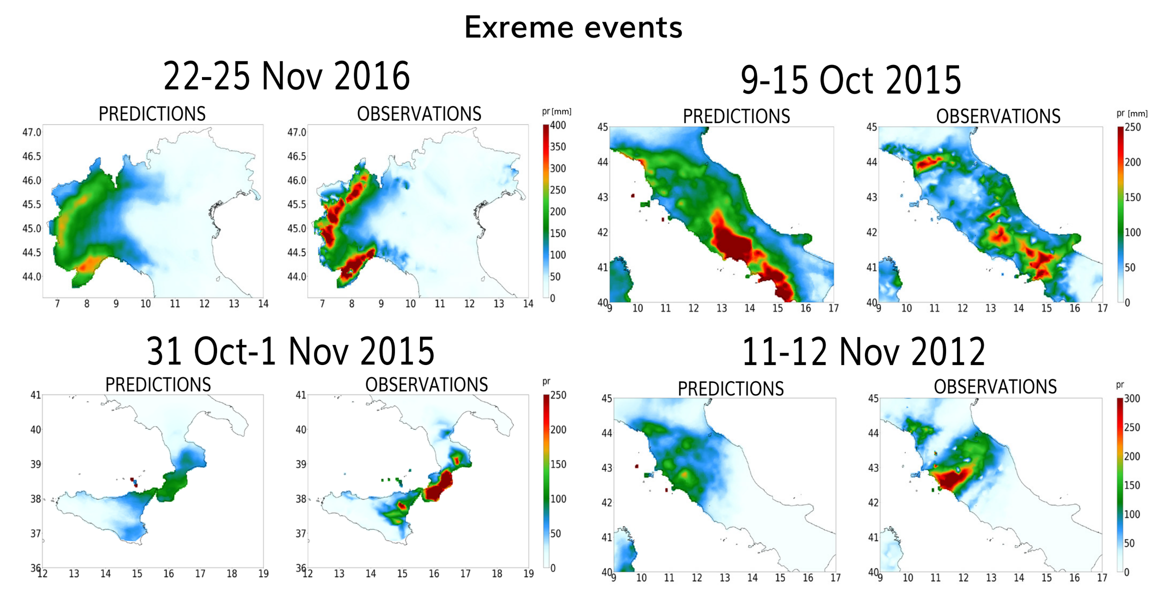
6. RESULTS











7. FUTURE STEPS

- Explore different DL architectures and training losses to improve:
  1) the spatial downscaling capabilities;
  2) the quality of the distribution estimation.
- Further investigate the transferability potential.
- Use model-generated predictors as input to the framework trained on reanalysis data to predict High Precipitation weather Events (HPEs) and compare the results with those of conventional dynamical down-scaling methods.

. MAIN REFERENCES

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