



chist-era



CHIST-ERA Projects Seminar 2022

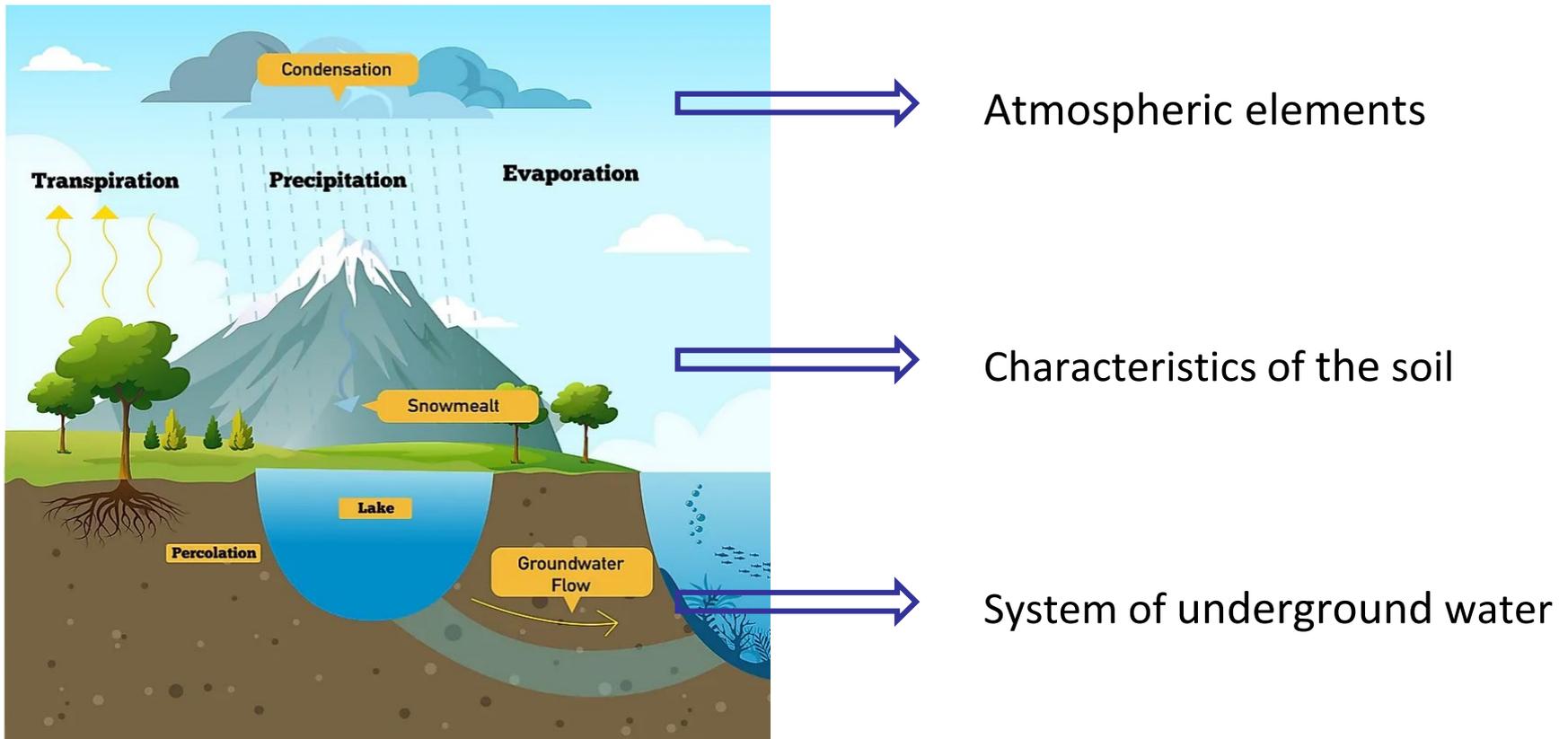
ANDROMEDA

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Programme co-funded by the
EUROPEAN UNION

ANDROMEDA: Advanced and novel hydrology models based on enhanced data collection, analysis, and prediction



Objective: combine **hydrology science** with **ICT technologies** to **study and predict hydrological processes**

- ❖ Deploying a **network of environmental sensors**, collecting measurements from multiple type of sensors (rainfall, wind, air pressure and temperature, ...) with a frequent sampling time

- ❖ Apply ML and AI algorithms to
 - ✓ Study temporal evolution of rainfall events
 - ✓ Identify the variables that have the largest impact on their dynamics
 - ✓ Predict storm evolution
 - ✓ Predict extreme/critical events





Major Achievements and Outputs

- ❖ Investigation of the State of the Art
 - ✓ Analysis of environmental data for hydrology models
 - ✓ Optimal sensor positioning
- ❖ Preliminary study of the dataset
 - ✓ Multi-Variable Time Series Analysis for Rainfall Modelling and Prediction

Other expected outputs:

- ❖ To be able to realize a comprehensive spatio-temporal hydrological model able to predict water fluxes dynamics
- ❖ To develop techniques to visualize the output of the hydrological models in a graphical format, making it possible to “observe” the processes in the different subsystems and the water fluxes and storage

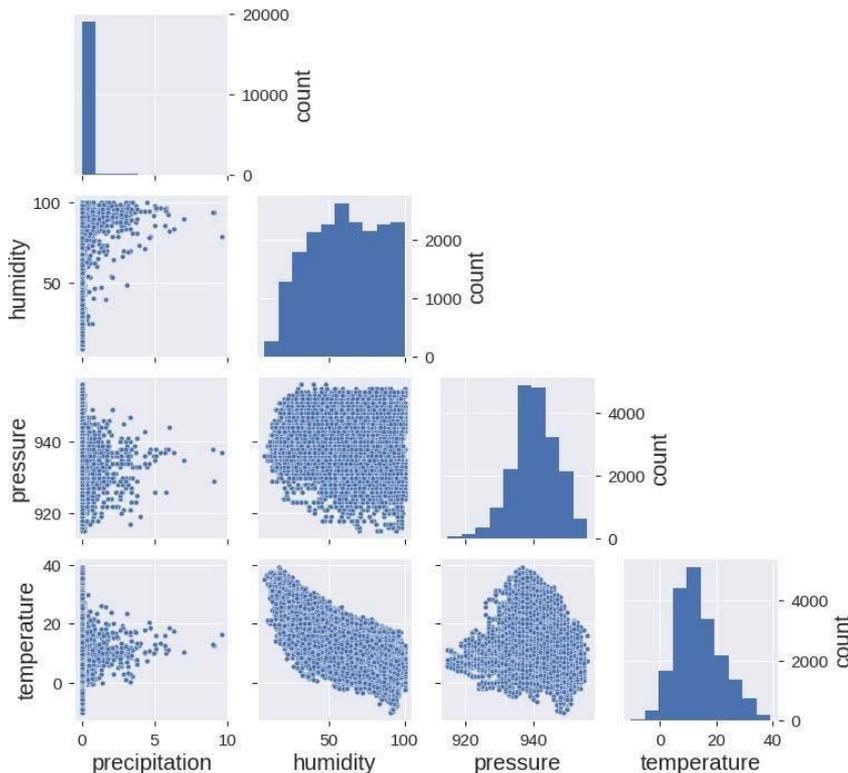


Figure. Scatter diagram of multivariate correlation.

- ❖ The rainfall process has been extensively analysed, bringing out the relationships with the other meteorological parameters, especially pressure and humidity
- ❖ Accurate short-term predictions are very challenging
- ❖ Registered spatial correlation between nearby sensors is pronounced



Results

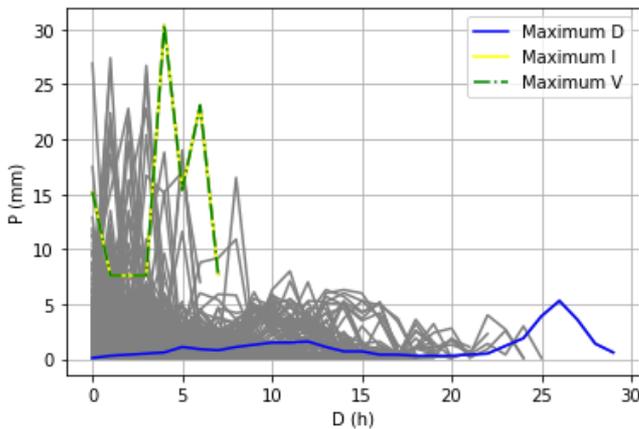


Figure. Extracted hyetographs across the weather station networks

- ❖ Observed relevant differences in storm duration, intensity and volume and even in the number of recorded storm by months

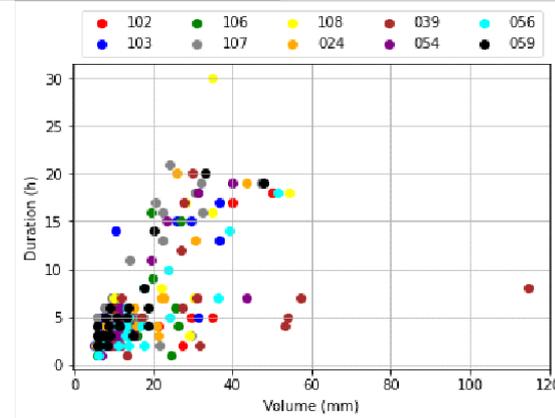
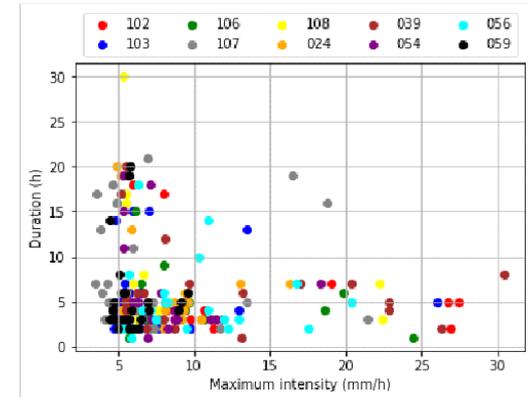
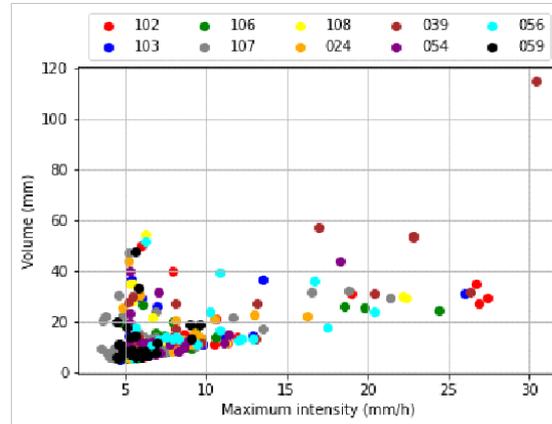
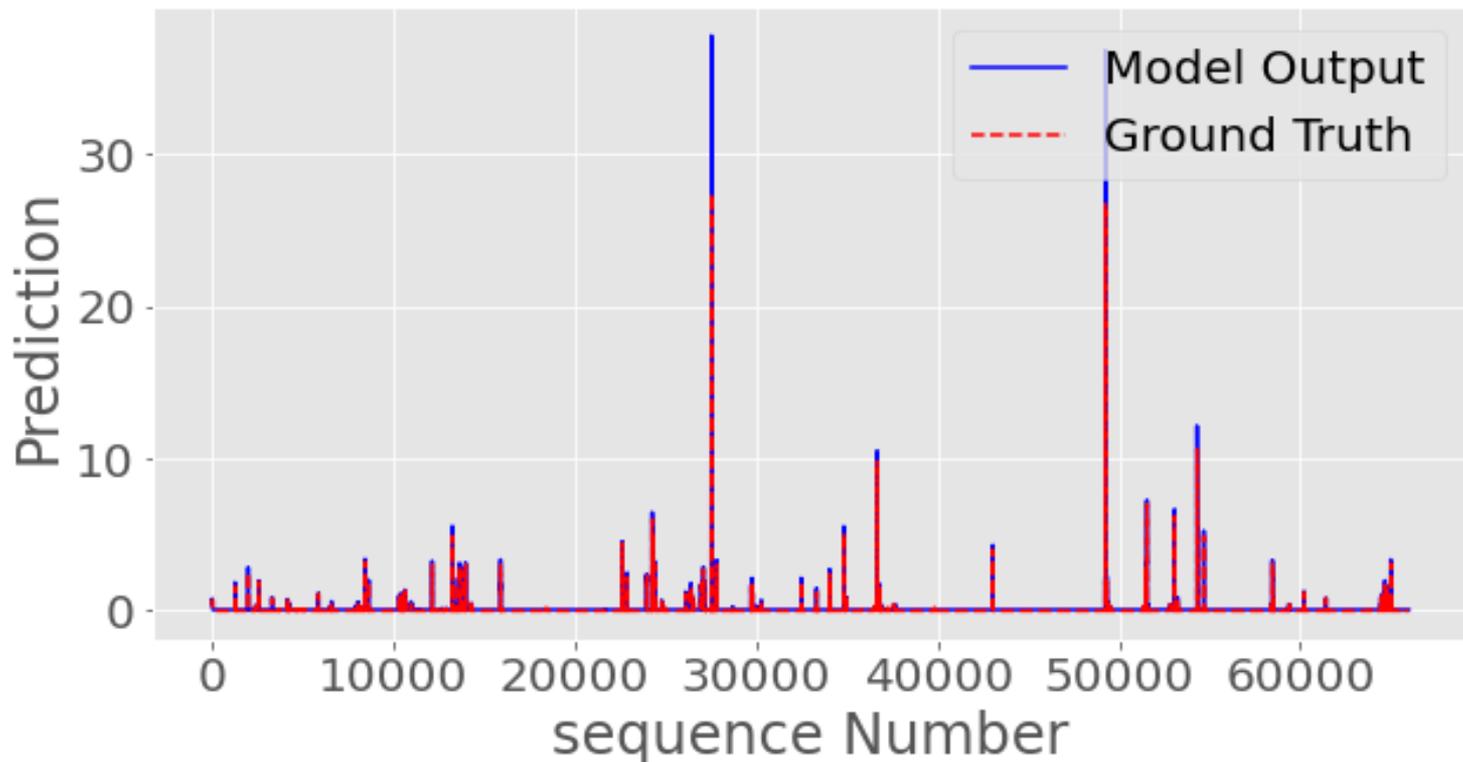


Figure. Points exceeding the intensity 90th quantile



Results

Precipitation with Humidity and Pressure



R2_score: 0.75

MSE: 0.07



Upcoming challenges:

- ❖ Deployment of a large sensor network
- ❖ Weather data (few storms)
- ❖ Exploit ML techniques to extract abstract models of heterogeneous sensing data, including remote sensing.
- ❖ Develop techniques to automatically configure the hydrologic models parameters based on the information obtained from the data, in order to improve their accuracy while reducing complexity



- ❖ How can the challenges identified within the call topic be tackled?
 - ✓ Implementation of the sensor network
 - ✓ Use of simulated data to train ML algorithms
 - ✓ Include remote sensing to train ML algorithms
 - ✓ To create a pilot model

- ❖ How can the expected impact be achieved?
 - ✓ We will tackle hydrology from a comprehensive approach yielding complete solutions for the whole hydrological system
 - ✓ Fusion of different types of measurements
 - ✓ To investigate unsupervised deep learning techniques for the data analysis

- ❖ Where should the outputs be made available during and after projects?
 - ✓ Published papers
 - ✓ Official websites
 - ✓ Code- and data-sharing websites



Role of the CHIST-ERA Support

- ❖ The financial aid allows hiring young researchers that can develop the proposed lines of research, guided by experts in the area
- ❖ Present the goals and achievements to the research community
- ❖ Guide plans for data management plan

Unless prevented by specific non-disclosure requests of the data owner, data used in the research, related to the objectives of the project (open data management guidelines of the H2020 programme). More specifically, we will:

- ❖ Deposit research data in a research data repository (e.g. Zenodo, arXiv, engrXiv) that facilitates linking publications and underlying data through persistent identifiers and data citations.
- ❖ Enable third parties to access, mine, exploit, reproduce and disseminate (free of charge) this research data, by attaching Creative Commons Licenses to the data deposited.
- ❖ Provide information (via research repository) about the tools available to users that are needed to validate results (e.g. software, algorithms and analysis tools) and, when possible, provide these instruments.



Questions ?