Politecnico di Torino

Dipartimento di Ingegneria dell'Ambiente, del Territorio e delle Infrastrutture

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Hydrology Group of the Politecnico di Torino

http://www.idrologia.polito.it/web2/

THESIS PROPOSALS – MASTER DEGREE

Prof. Pierluigi Claps

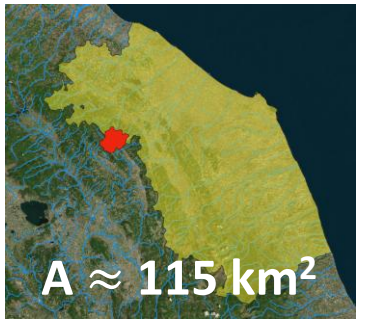
Comparative analysis of runoff coefficients of extreme events in Italy

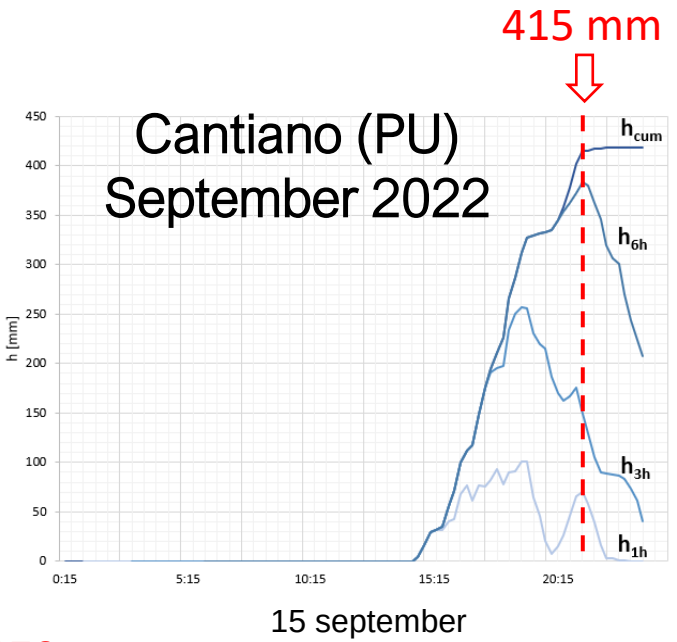
The Italian territory is often affected by the occurrence of **extreme flood events** that are very localised in time and space. When reconstructing the characteristics of the events, one wonders how characterize the soil infiltration, often summarised in the value of the **runoff coefficient**.

In this thesis, pairs of events distant in time and space, but characterised by **runoff coefficient values close to 1**, are investigated. These situations have been already observed in the literature (see Dhakal et al., 2013; https://ascelibrary.org/doi/10.1061/%28ASCE%29IR.1943-4774.0000571), but they are still poorly studied.
Relationships will be built with the geo-morphological characteristics of the basins and with soil moisture features prior to the event.

Requirements:

- Good knowledge of a programming language (R/matlab)
- Basic knowldge of GIS tools
- Simple database management skills





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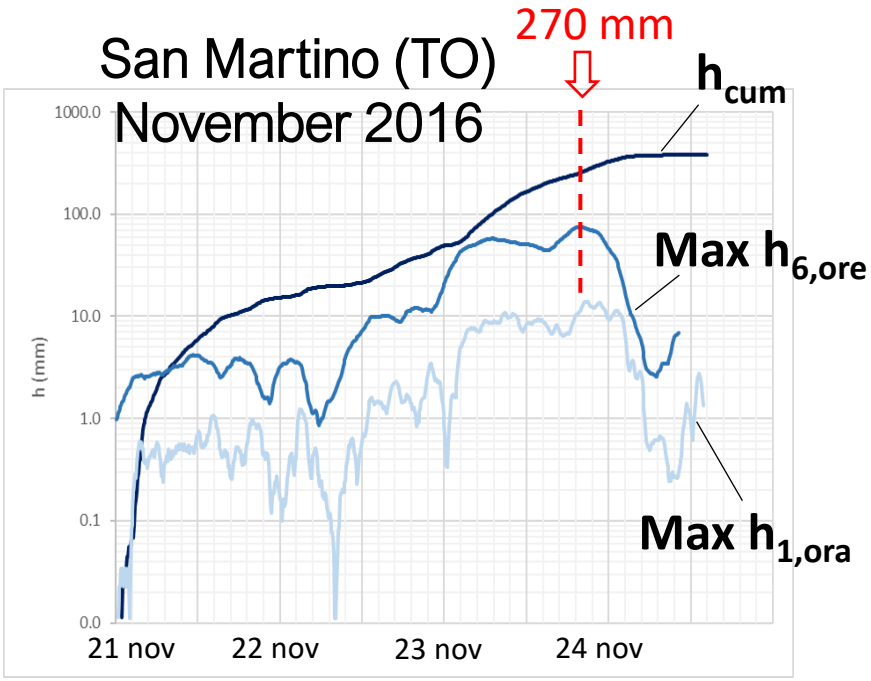

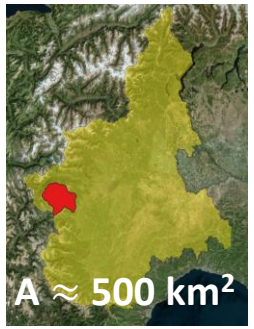

You will work with: Giulia Evangelista
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Processing big data to support hydrogeological risk mitigation

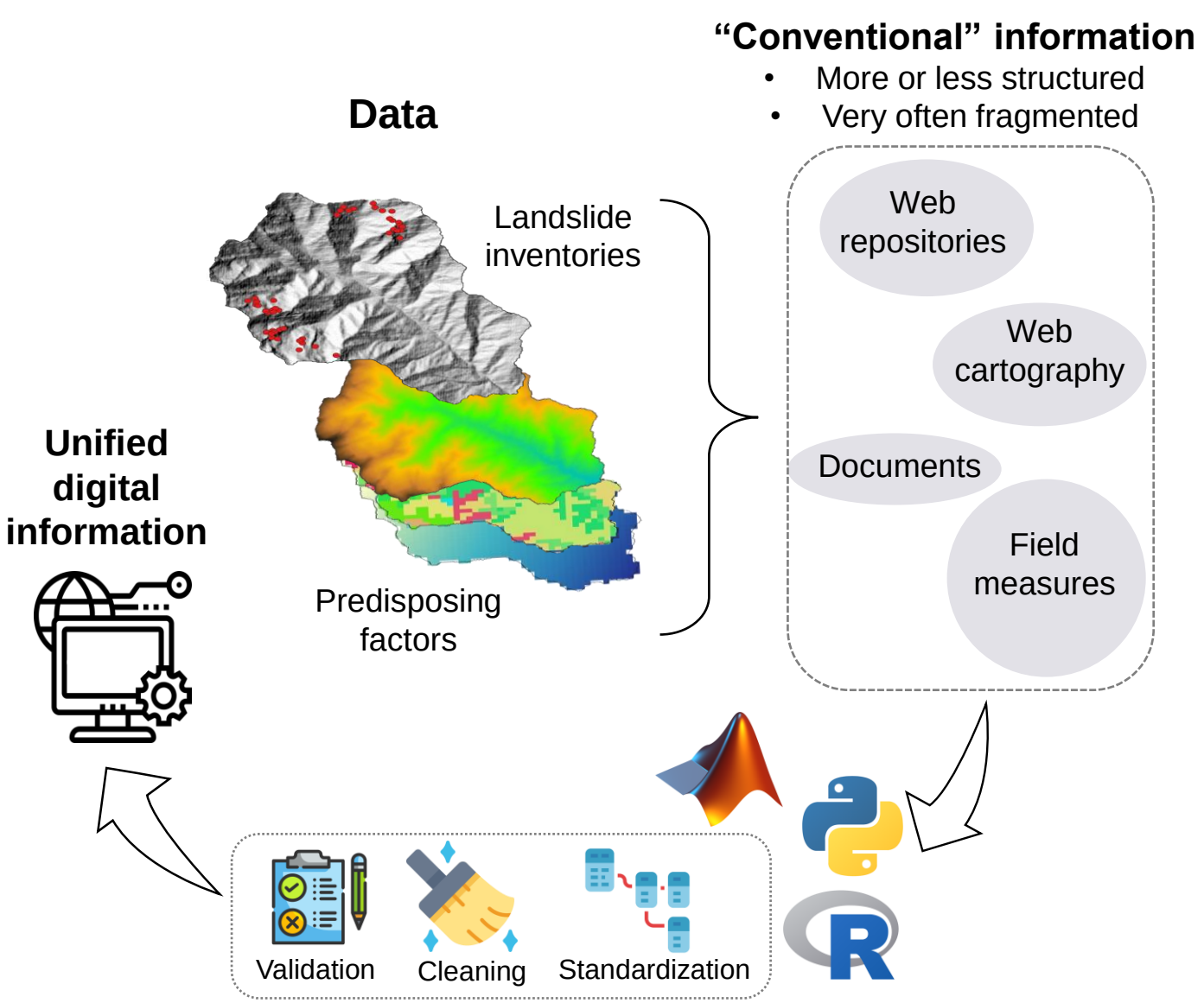
The field of application of this thesis is the prediction of landslides and mudflows, or debris flows, triggered by rainfall, a major problem in Italy.
This phenomenon is widespread in many regions of the country and poses a significant threat to the integrity of infrastructure, both roads and railways, and the safety of local communities, especially in mountainous areas.

In line with the student profile, the activity is focused on the computational aspect of managing and integrating heterogeneous data such as, for example, meteorological variables and other parameters that are critical in the analysis of landslide triggering processes, including the production of dedicated databases and the use of machine learning algorithms.

Procedures will be implemented for the automated acquisition, standardization, and integrated analysis of data from various sources, as well as systems for managing terrain data, with the ultimate goal of improving the predictive ability of landslide phenomena as a function of impending or predicted precipitation.

Requirements:

- Basic knowledge in database management and querying.
- Knowledge of API procedures, useful for setting up new databases from web repositories.
- Familiarity with fundamental data structures and programming principles.



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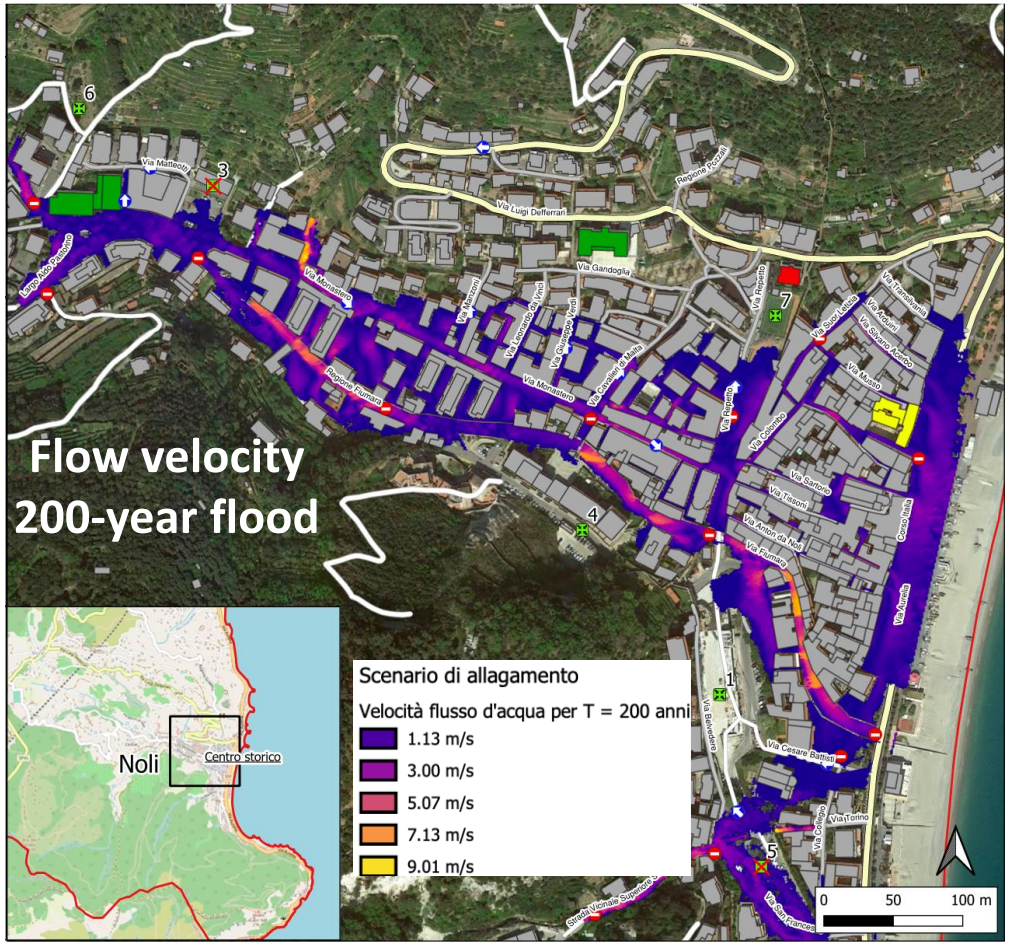
Hydrodynamic modeling for flood travel time estimation during major events

Enhancing resilience to flooding in the face of climate change has become a significant challenge for decision-makers, urban planners, and engineers worldwide.

Accurate travel time estimation is crucial for a range of applications, including the estimation of design floods, the evaluation of flood retention measures, and flood forecasting. However, accurately determining flood travel times remains a complex challenge due to significant uncertainties.
Hydrodynamic models, which can simulate the two-dimensional movement of water within catchments, represent a powerful tool for predicting flood hydrographs and improving these estimates.

This thesis focuses on the application of a 2D hydrodynamic model to estimate travel times during recent major flood events in small catchments in Italy.



Requirements:

- Experience with or readiness to learn hydraulic modeling software.

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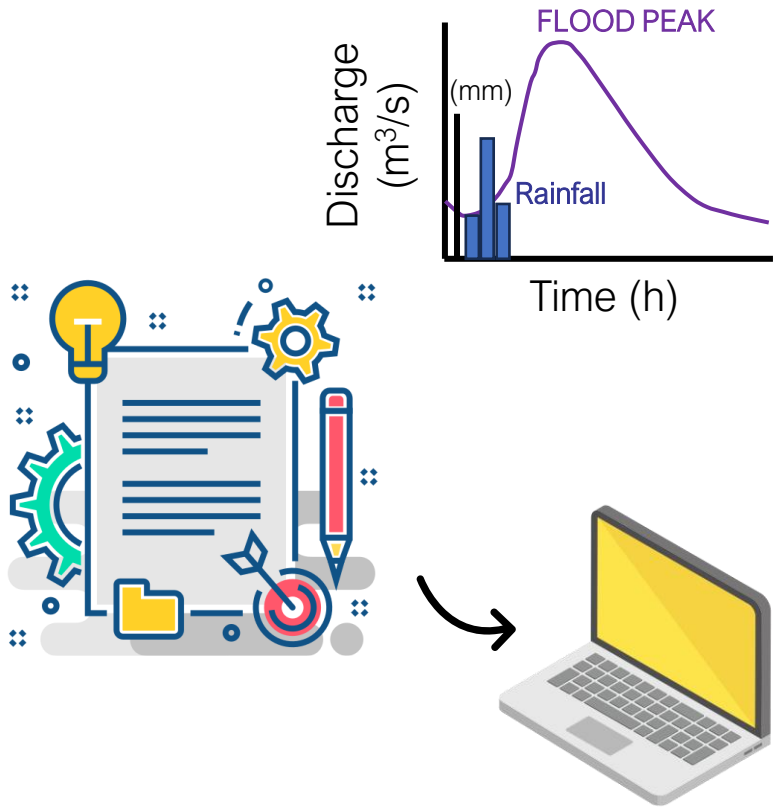
Time of concentration formulas used in engineering projects in Italy: comparing conservative vs. non-conservative approaches

The time of concentration (ToC) is a critical parameter in modern hydrological models, widely used by both professional and scientific communities. As a foundational component of hydrological calculations, it plays a significant role in determining peak discharge estimates.

In engineering practice, the ToC is typically calculated using empirical formulas applied at the basin scale. To ensure safety in infrastructure design, conservative estimates of ToC are recommended. However, non-conservative estimates, i.e. that overestimate ToC, are sometimes used in practice, particularly in small basins. This overestimation can lead to underestimating flood peaks.

This thesis investigates the prevalence of non-conservative ToC estimates in professional reports, engineering projects, and best practice guidelines in Italy.



Requirements:

- Collection of a representative sample of hydrological reports, engineering project documents, and case studies through a web-based search using targeted keywords.
- Basic knowledge of a programming language (R/matlab)

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