Politecnico di Torino
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Hydrogeological aspects for ground instability analysis

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Reconstructing quantitative forecast scenarios of ground instability

RESEARCH TOPIC

The research aims to detect the impacts of **climatic variables** and thus groundwater fluctuations on **slow-moving landslides**, an issue that is widely debated due to the fragility of the Italian territory, in terms of hydrogeological instability. In particular, mountain context represents an important field of study about mechanisms that could induce ground instability, since monitoring of mountain springs allow to understand the dynamics of **aquifer reserves**.

APPROACHES AND METHODS

The reconstruction of ground instability scenarios requires:

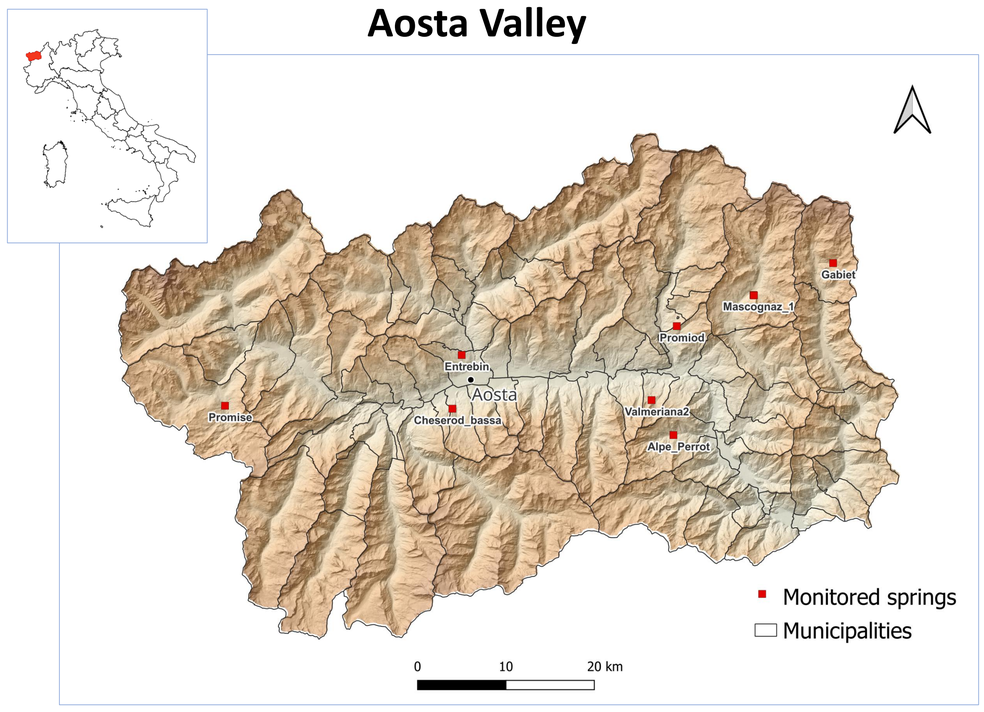
- the merging between **geological** and **hydrogeological** analysis of the site;
- examining how **groundwater storage** mechanisms are changing in response to climate-driven;
- development of analysis and techniques for investigating the **interaction** between hydrogeological factors and ground deformation processes.

Available data and instruments:

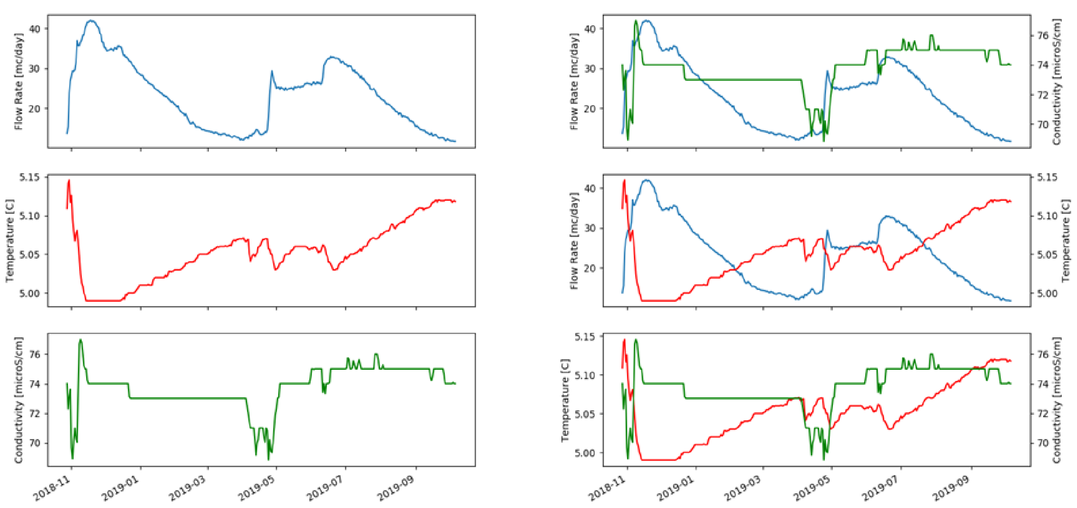
- **3D modeling** for assessing hydrostratigraphy and groundwater flow-systems;
- **Automated tools** (i.e. SOURCE) for hydrogeological characterization of the springs' aquifers;
- Software for **slope stability** modeling;
- Management of collected data on **GIS**;
- **Satellite data** to support landslide displacement monitoring.

FIRST APPLICATIONS

Aosta Valley

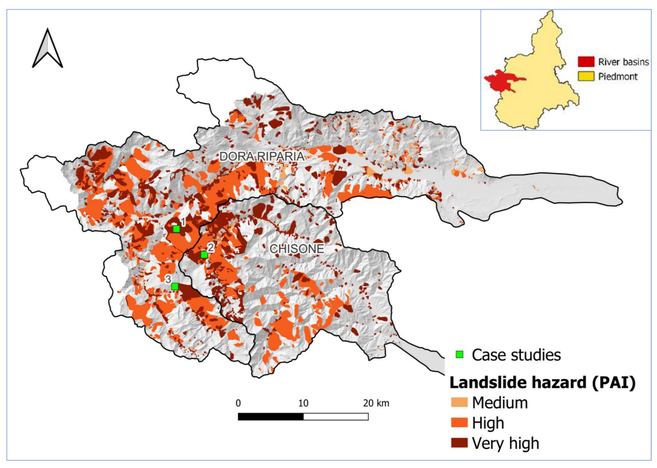


Measurement campaign in July 2023

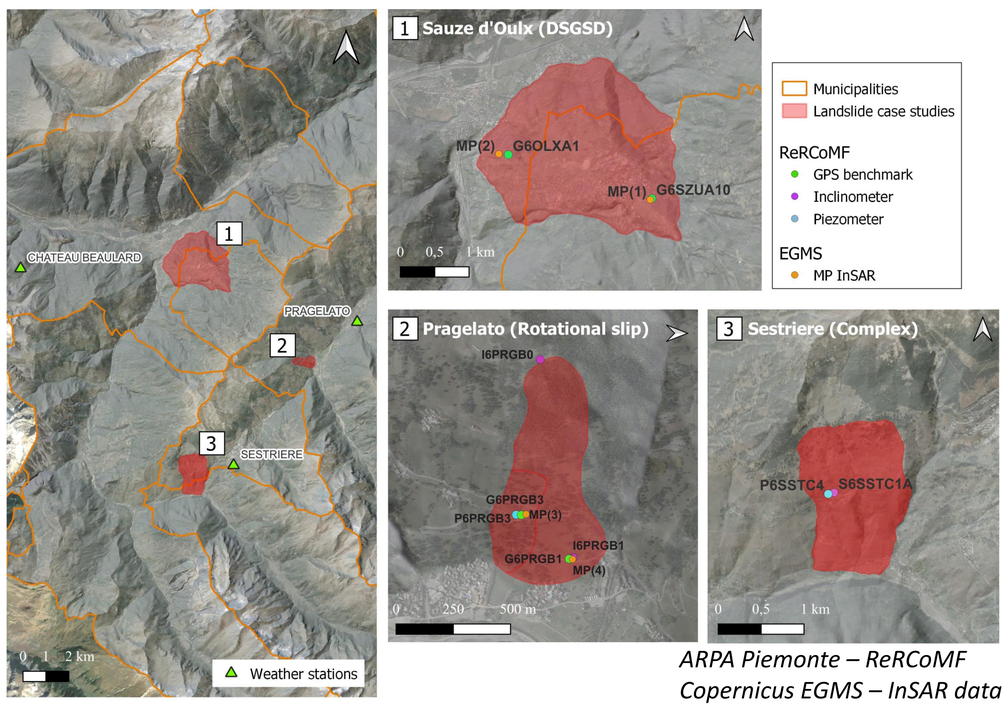


Discharge (Q), **temperature** (T) and **electrical conductivity** (EC) parameters measured and recorded continuously with probes (example of Alpe Perrot spring, SOURCE code output).

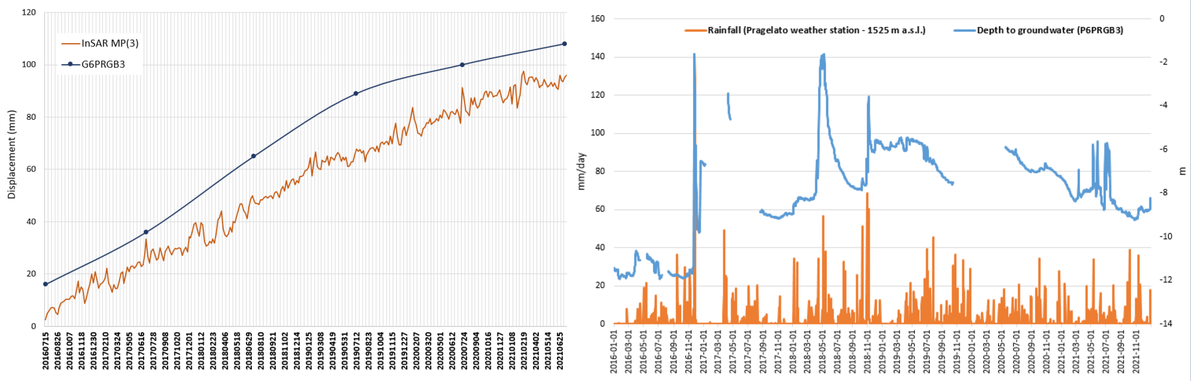
Piedmont



- Western alpine areas are affected by a high landslide susceptibility
- Analysis of intense meteorological events pattern over the reference period 1991-2020
- Detecting displacements of slow-moving landslides in response to climate-driven processes



ARPA Piemonte – ReRCoMF
Copernicus EGMS – InSAR data



Time series of Pragelato landslide displacements from GPS and InSAR (EGMS) measurements (left) and groundwater changing in response to rainfall events (right).

FUTURE DEVELOPMENTS

Identification of areas affected or predisposed to ground instability can be achieved by implementing a **quantitative analysis of susceptibility** through hydrogeological, geomorphological, and geotechnical parameters. Monitoring techniques (in-situ and remote) and spatial modeling allow to detect and observe precursor indicators.

REFERENCES

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Lo Russo S., Suozzi E., Gizzi M., Taddia G. (2021) SOURCE: a semi-automatic tool for spring-monitoring data analysis and aquifer characterisation. *Environmental Earth Sciences* 80,710 https://doi.org/10.1007/s12665-021-10027-8