A Geospatial Approach to Landslide Risk Management

Fabio Villa
IMAGEO srl
Italy

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ABOUT ACTIVITIES & SERVICES CASE HISTORIES MEDIA & PUBLICATIONS CONTACTS

GEOLOGY E GEOMATICS

Since 2007 we integrate traditional geology and geomatics.
Our field of work is mainly focused on:

- Hydrogeological risk assessment
- Landslide risk analysis
- Geomechanics

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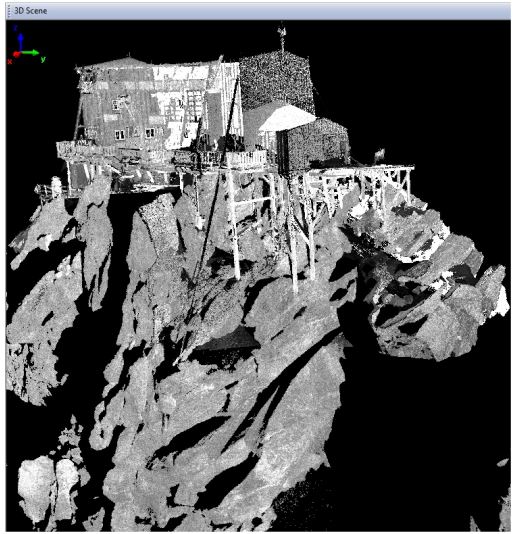
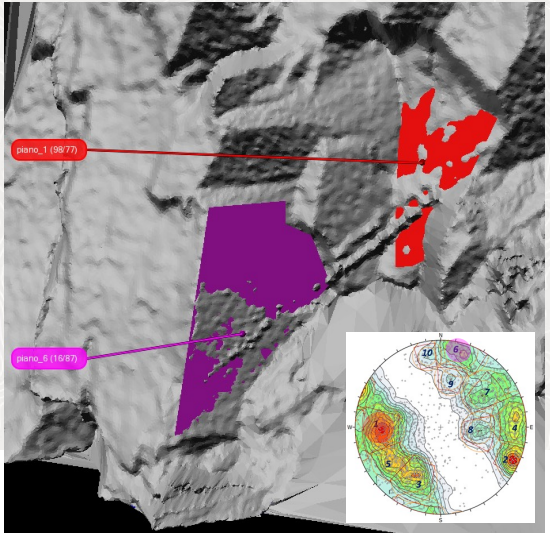
CAPANNA MARGHERITA HUT (4556MASL)

Geomechanical and glaciological analysis aimed to assess Hut stability.

TLS, photogrammetry and GPR surveys.





Limited Rock Cliff Work thanks to high detailed pointcloud.

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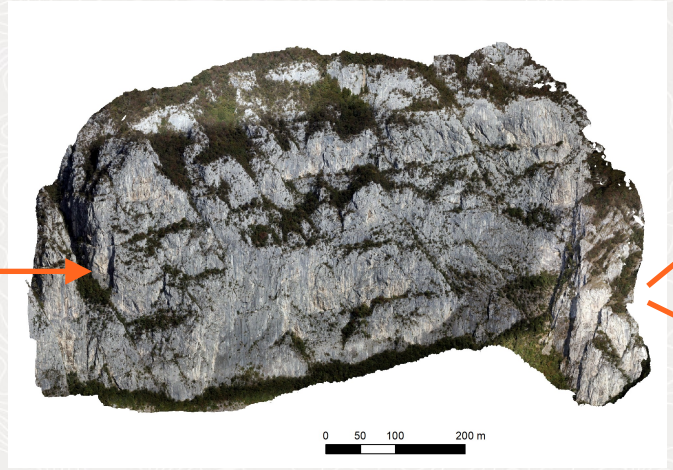
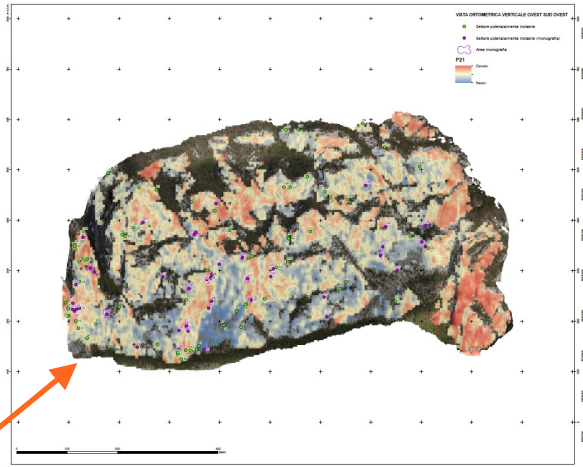
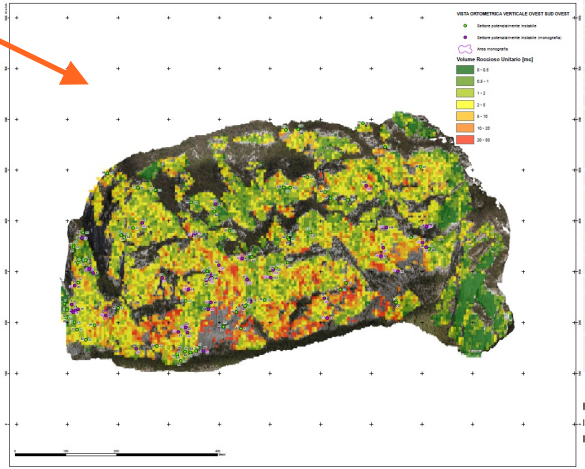
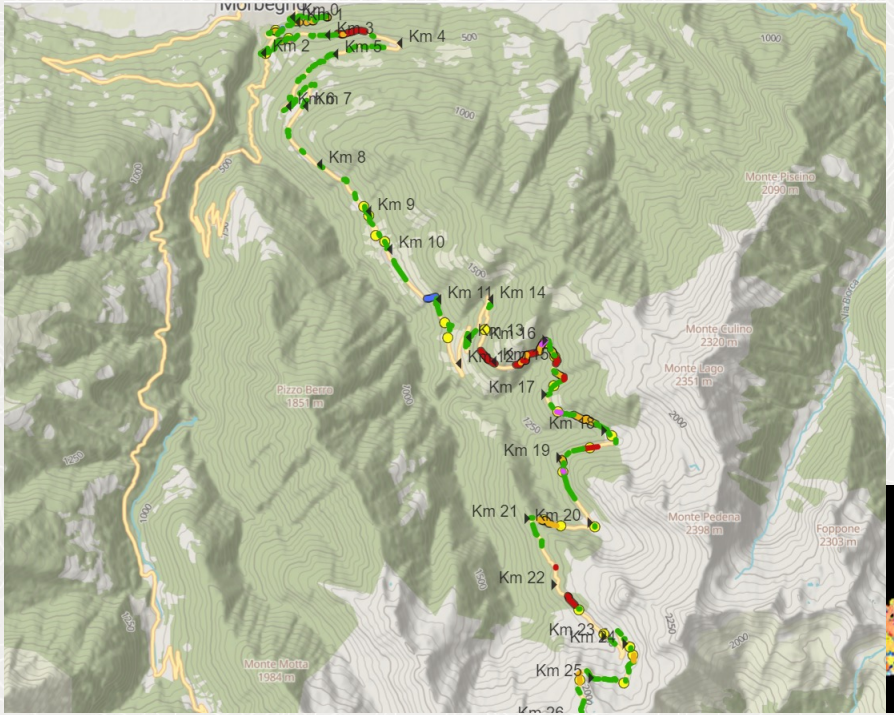
GEOMECHANICAL DETAILED STUDY ON A ROCK WALL - COMO LAKE







LINEAR INFRASTRUCTURES – INSTABILITIES ASSESSMENT ON ALPINE ROADS



Mobile mapping + georeferenced videos and images + automated extractions of geological/geomorphological parameters allow to extrapolate the information derived from traditional geological survey and to produce a distributed map of priority intervention areas on approx 50 km of alpine road

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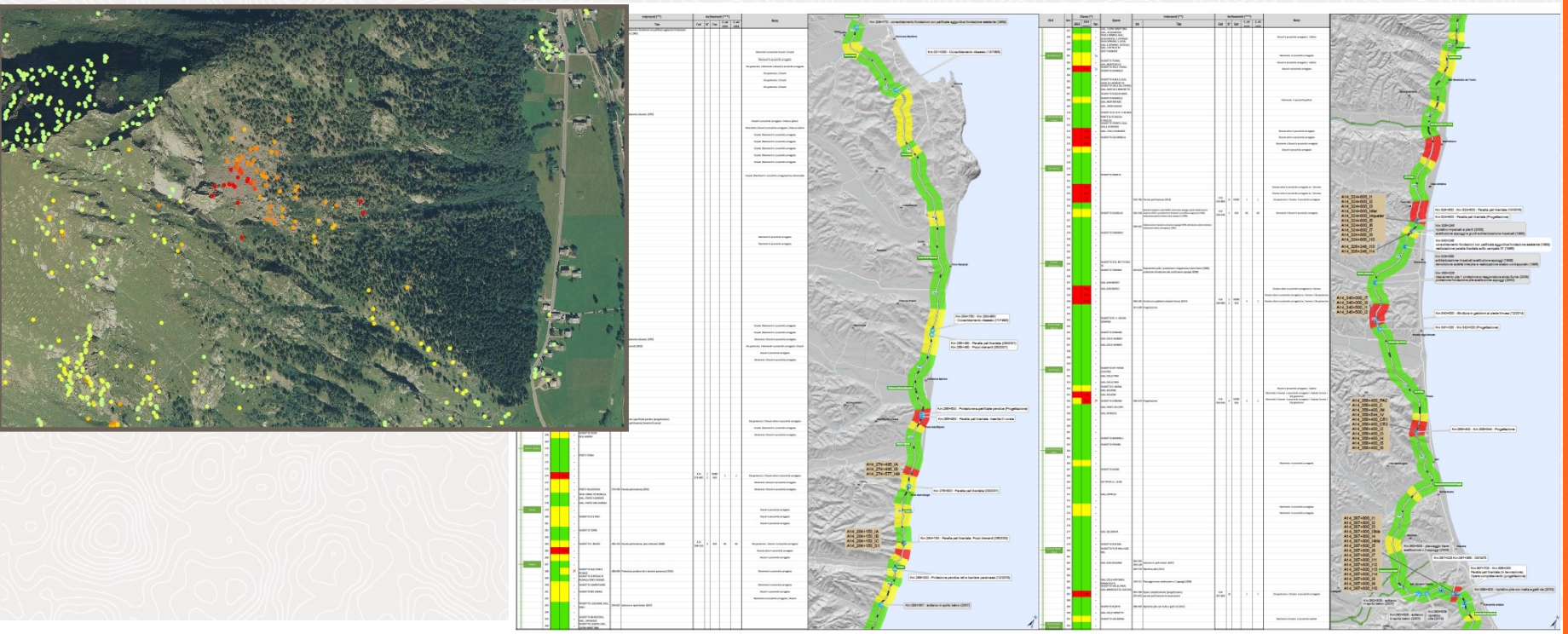
HIGHWAY HAZARD MAPPING

Baseline + dynamic classification: based on Sentinel2 satellite interferometric data (update time 15 days) and inclinometric sensor data. Simplification of complexity to provide easily understandable data.



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HYDROGEOLOGICAL HAZARD ASSESSMENT AND EARLY WARNING SYSTEM ON ITALIAN RAILWAYS

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HYDROGEOLOGICAL HAZARD ASSESSMENT AND EARLY WARNING SYSTEM ON ITALIAN RAILWAYS

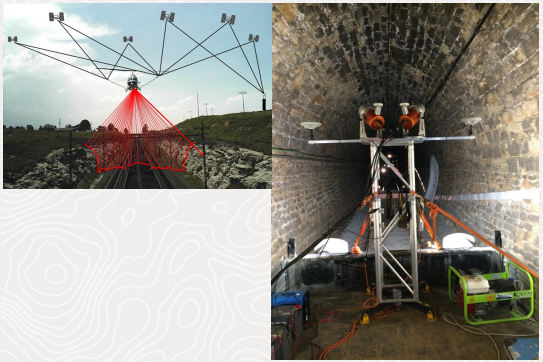
MAIN CRITICAL ISSUES

- Long infrastructures (100 to 1000 km) crossing different environment -> high variety, different hazard situations
- High interruption cost
- High monitoring costs due to infrastructure extention
- Limited time for data survey (nightime only) and limited physical access to slopes
- Intervention paralysis. Often protection measures are taken after events
- Zero Risk Illusion

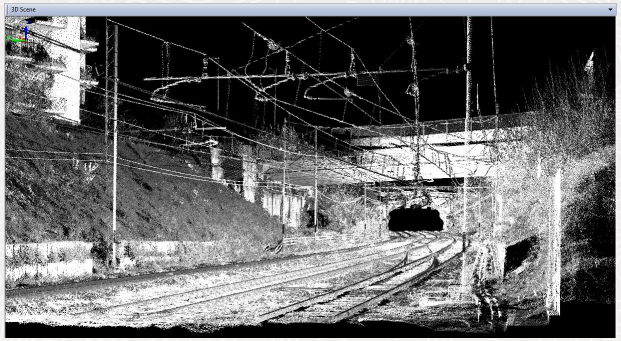
PROPOSED SOLUTIONS

- Geospatial based survey approach (mobile mapping, lidar) integrated with ground surveys
- Standardized analysis procedures. Complex data → simple output classification
- Priority intervention areas definition
- Integration between spatialized static analysis (hazard map) and spatialized dynamic data (meteorological data, online/IoT sensors) → Spatialized Early Warning System, useful to manage In-Line-Intervention, to organize monitoring and maintainance intervention and to collect spatially and temporally distributed hydrogeological data, needed to feed the thresholds calibration.

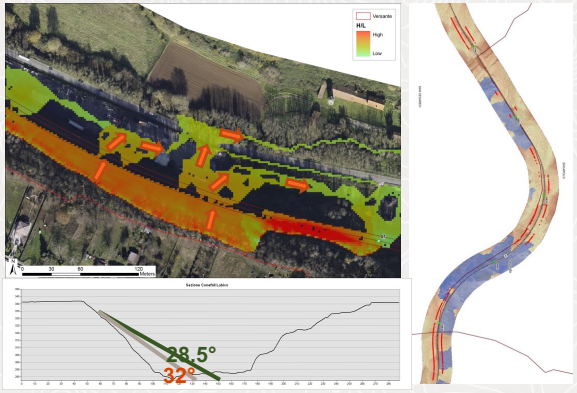
FROM DATA COLLECTION TO HAZARD MAP



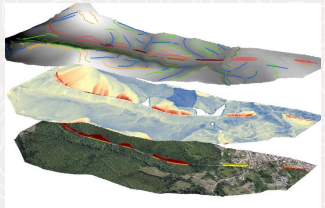
High res. Pointcloud

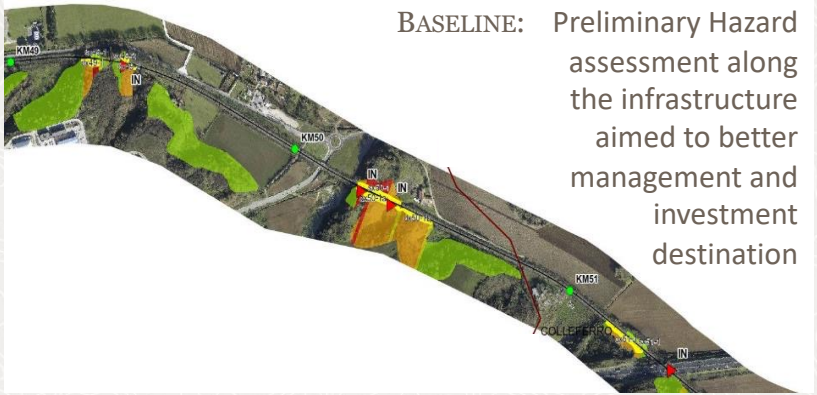


Geospatial Analysis: Runout models, Connectivity, rockfalls analysis, etc..



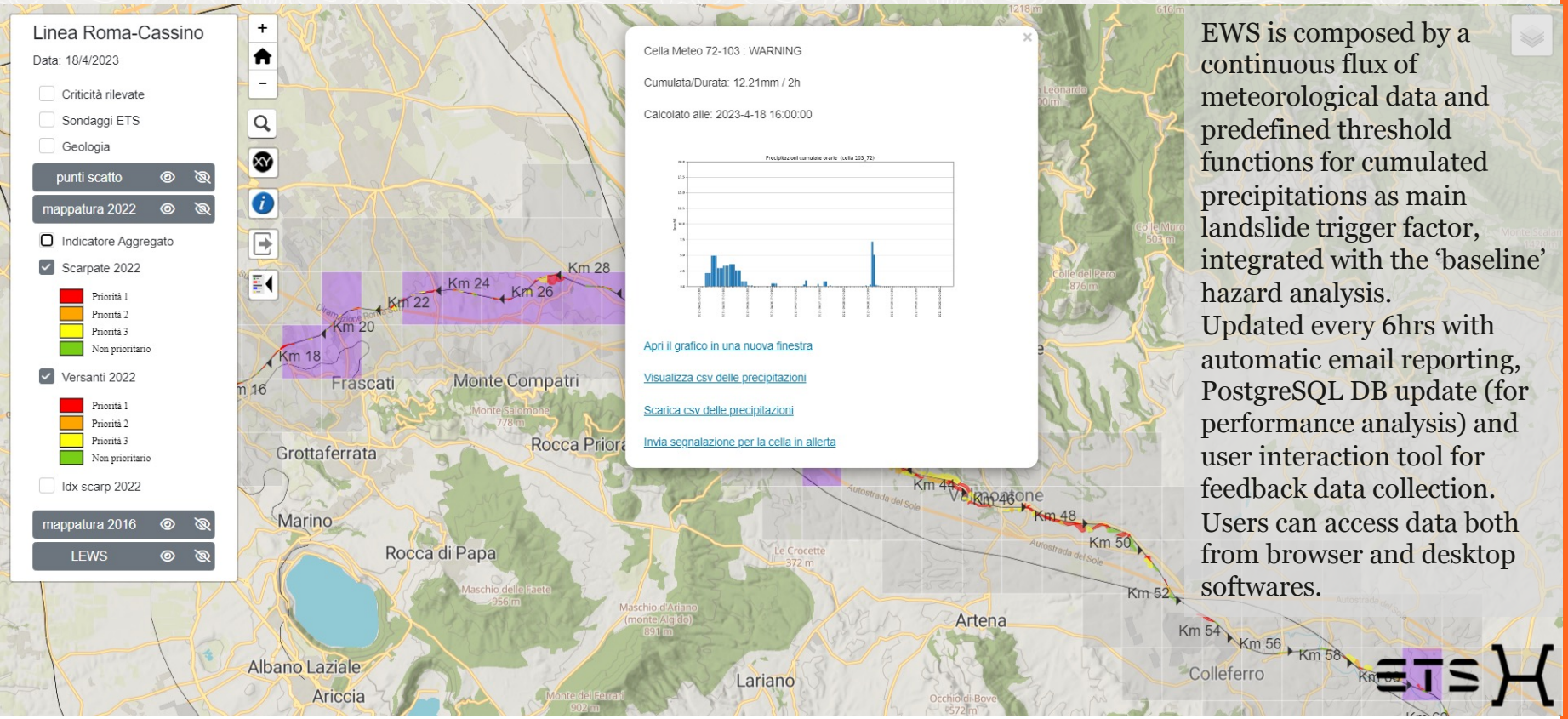
MCA approach





BASELINE: Preliminary Hazard assessment along the infrastructure aimed to better management and investment destination

EARLY WARNING SYSTEM



EWS is composed by a continuous flux of meteorological data and predefined threshold functions for cumulated precipitations as main landslide trigger factor, integrated with the 'baseline' hazard analysis.
Updated every 6hrs with automatic email reporting, PostgreSQL DB update (for performance analysis) and user interaction tool for feedback data collection.
Users can access data both from browser and desktop softwares.

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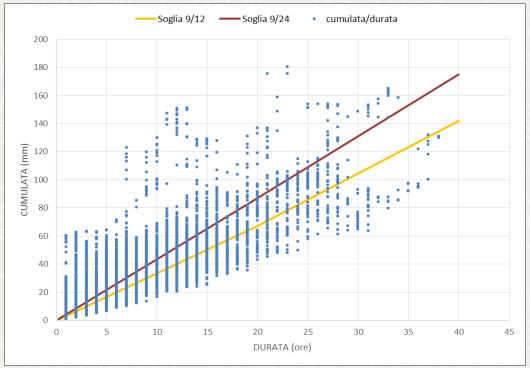
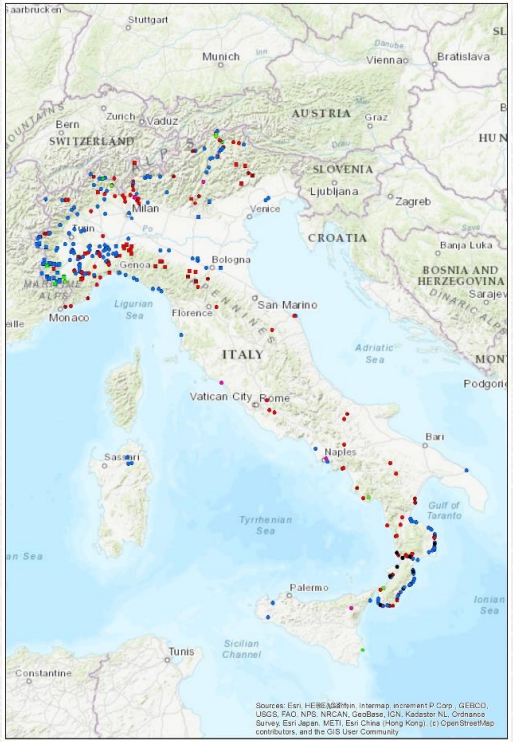
EARLY WARNING SYSTEMS OR 'THE IMPORTANCE OF ACCESSIBLE GEOSPATIAL DATABASES'

The ALERT system is based on threshold functions. To define correct threshold values it is needed a **robust database** on landslides events **temporally** and **spatially** located at the correct scale (in space and time).
The availability of geospatial databases is fundamental for a correct and fast deployment of an EWS.
To define the initial threshold function for the Roma-Napoli railway line EWS, a big geostatistic work have been made, crossing **10 years** of hourly meteorological data (precipitations), spatialized on a **1km** grid, on a 17000 km2 area (Lazio region), with about 500 landslides events.

Landslide data derive from different sources, from scientific papers, to local news.
A correct positioning in space and time of the landslide events is crucial for a correct analysis.

Every 6 months a re-calibration of the thresholds is made, by analyzing meteorological events and landslides occurrences on the railway line.





THANK YOU!

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