The importance of identifying watercourses with small catchments and assessing their hydraulic risk: case studies and effects of climate change

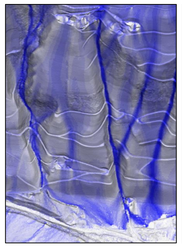
Pinamonti Valentina, Lanari Marco, Kofler Andreas, De Piccoli Federico, Casagranda Elisabetta, Molon Marco, Bertagnolli Rudi
in.ge.na. Engineering Associated Office, Schlachthofstrasse 57, Bolzano, Italy, www.ingena.info / valentina.pinamonti@ingena.info

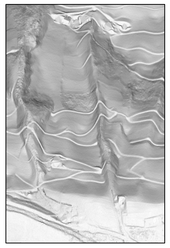
INTRO:

- Climate change is increasing the frequency of debris flow activation in very small catchments (area < 0.5 Km^2)
- Population living downstream these catchments is put at a high risk:
  - Debris flows often triggered by intense precipitation
  - No perception of the risk by the population
- Only an expert analysis can identify these potential watercourses:
  - Riverbeds often non-existent or dry almost all the year
  - Very few information on maps and about past hydrogeological events

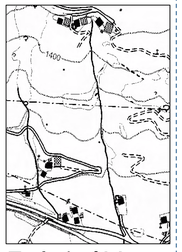
METHODS

GIS Analysis
Analysis of various maps: ortophoto, DTM, flow direction, Technical Map, etc …

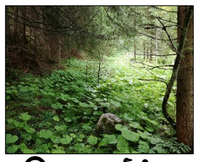

Flow directions


DTM

Ortophoto


Technical Map

Field Analysis
Validation of identified watercourses; information from «silent witnesses» and population



Field survey

Historical events

Identification of potential watercourses → Hydro - Geological Analysis → Hydraulic Analysis → Hydraulic Hazard Assessment

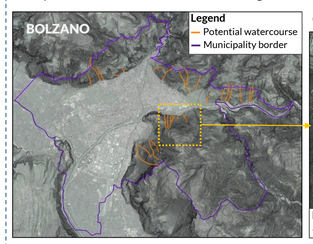
CONCLUSION

Quantifying the influence of climate change and forecasting the triggering of debris flows is still quite difficult.
If applied in a systematic way in urbanized mountain areas (as we experienced in Alto Adige Region with the elaboration of Hydro-Geological Hazard Plans) this methodology can reduce the amount of damages caused by debris flows, as protection measures can be planned and implemented in areas at risk, often before the occurrence of hydro-geological events.

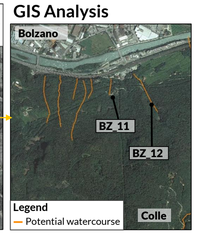
In a changing climate, identifying watercourses with small catchments and assessing their potential hazard supports risk reduction

Case study 1 - Bolzano (BZ), Italy

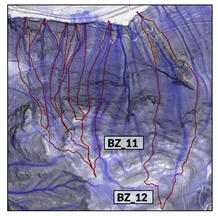
2013 – 2016: Hydro-Geological Hazard Plan for the municipality of Bolzano
Identified 28 potential hazardous watercourses to add to the Municipality Hazard Plan. They were not included in the regional dataset and in the initial set of watercourses to study.



GIS Analysis



Ortophoto



Flow directions map and DTM

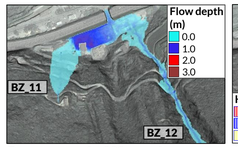
Field Analysis

Very small basins

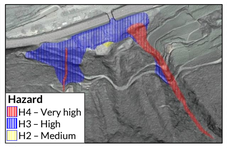
Not very clear signs of riverbeds and of the hydro-geological phenomena

No recorded historical events

Hydraulic hazard assessment (examples of watercourses BZ_11 and BZ_12)



Flow depths of a 300-year flood event



Hazard map for hydraulic phenomena

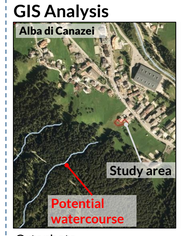
July 2017 – Debris flow and flood events on 8 of the added potential watercourses

Debris flows and floodings caused by watercourses BZ_11 and BZ_12 in the area of the Colle's cable car.

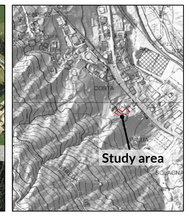
Case study 2 - Alba di Canazei (TN), Italy

September 2018 - Preliminary hydro-geological hazard assessment for a specific area

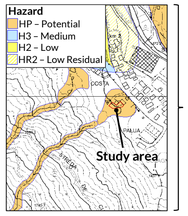
GIS Analysis



Ortophoto



DTM



Hazard Map

Identified potential hazardous watercourse from maps

Area classified as 'Area with Potential Hazard of torrential phenomena'

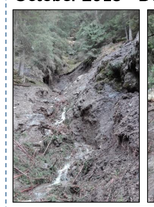
Field Analysis

No signs of riverbed and water

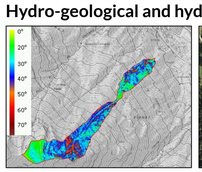
Morphological shapes of past debris flow deposits

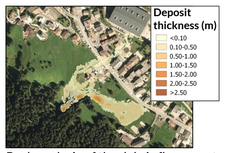
No risk perception by the population

October 2018 – Debris flow event



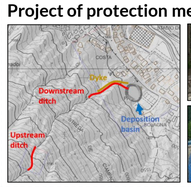
Hydro-geological and hydraulic analysis


Slope map



Back analysis of the debris flow event

Project of protection measures



Defence works against debris flows and avalanches:
- Ditches (upstream and downstream)
- Dyke on left bank
- Deposition basin (volume 11000 m^3)