MODELING VALIDATION AT UNEXPECTED DEBRIS FLOW EVENT

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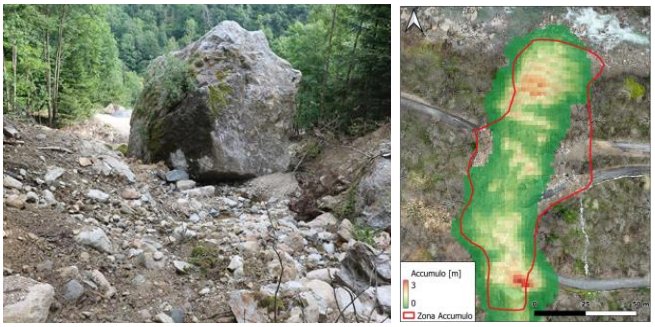
OBJECTIVES

In April 2025 a debris flow occurred at a site about 60 km North of Turin, involving the burden of a mountain side not marked in risk maps. Regular slope topography, extended coverage by trees and vegetation and absence of previous events claimed for investigation and modeling in order to update the risk assessment maps. A local road has been interrupted, a consistent amount of the debris has dumped into a river bed at the slope toe and a huge boulder rolled along the gully. Rough topography for initial conditions was available, while a UAV (by drone) survey has been carried out for the majority of the extension of the erosion path. Several simulations were carried out using the DAN3D code [1], with rheological parameters calibrated to match the observed debris volume, flow path and shape of the accumulation zone. The removed volume from the slope has been back calculated by using the digital map obtained from the survey; this value was used as a reference to validate the simulations, and each specific parametric factor of ground has estimated after geomorphological evidence. Back-analysis allowed to define and update the local map for geological risk and implement warnings systems as well.

STUDY SITE DESCRIPTION

- The studied site is located between 1550 and 1000 m a.s.l., in a narrow V-shaped valley, in metamorphic context with morainic and detritic burden (0.5 m to 35 m thick), dipping about 31° (55° to 5°).
- Flow has been triggered by huge rainfalls [2] (300 – 400 mm in two days) and travelled about 1000 m; total volume about 5200 m^3.
- Run-out and accumulation zone have covered the final part of the slope and a river bed, and damaged a local road,.
- A 120 m^3 block travelled over tens of meters.

Figure 1. Left: erosion zone, distributed grain size of cover debris and huge boulder, about 120 m^3. Right: model of run-out on aerial view taken after the event.



MAIN RESULTS AND CONCLUSIONS

- Erosion zones, debris type and grain size, local thickness, geometry of accumulation and diversion of the flow have been mapped to properly set input parameters of code (Voellmy fluid). Voellmy model involve water content, turbulence, friction; erosion coefficient remains independent.
- Comparison of three main settings scenarios, considering different surface conditions and erosion coefficients, validated against observed volume and run-out pattern.
- Mapping of landslide risk should be reconsidered today, due to heavy and unusual rainfall events in mountain zones. Flow trigger threshold values for instant and cumulative rainfalls have been estimated.

REFERENCES

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[2] C. Oggeri (1996) Geotechnical description of landslides during the 1993-1994 floods in Northern Italy. Proc. 7th Int.Conf. on Landslides, Senneset ed., Balkema, 835-840.