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Snowmelt influence in shallow landslides

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Mass wasting is a major landform shaping process in mountainous and steep terrains, and Italy is among the most affected countries in Europe. Lombardia region has 130.450 landslides mapped, covering an area of 3.300 km^2 (i.e. 7.2% of the regional area). The 41% of landslides in Lombardia are rapid mass movements involving shallow soils, occurring mainly in the Alps and Fore-Alps. Many shallow landslides (SLs) result from infrequent meteorological events, inducing unstable conditions, or accelerate movements on otherwise stable slopes. In mountainous areas such as the Alps of Lombardia region, snowmelt concurs with rainfall intensity, and duration in setting the hydrologic conditions favorable to the occurrence of SLs. However, snowmelt contribution to SLs triggering is little investigated hitherto. In regions experiencing seasonal snowmelt in spring and summer, melting water thereby could decrease the intensity and duration of rainfall needed for SL initiation, or even lead to LSs in dry weather conditions.

Under the umbrella of the project MHYCONOS, a project founded by Fondazione CARIPLO, we developed a robust, and parameter wise parsimonious model, that mimics the triggering mechanism of shallow landslides by accounting for the combined effect of precipitation duration and intensity in, and snowmelt at thaw. The model is applied to the case study of Tartano basin, paradigmatic of SLs in the Alps of Lombardia, where in July 1987 a SL event produced 30 fatalities.

Our results show that about 37% of the Tartano Basin slopes display unstable condition, and more than 50% therein is influenced by soil moisture variation. Using a traditional (i.e. rainfall based) approach, occurrence of shallow landslides is predicted only during rainy periods, mainly October and November. In contrast, when including snow melt, the model mimics failures potentially also during April and May, when melting rate is the highest, and may increase triggering potential of rainfall. Currently, our efforts are aimed to conduct interviews and construct temporally based datasets, where occurrences of snow melt driven failures can be evidenced.

Risk perception by population may change, and public authority may be prepared to implement emergency plans in order to prevent injuries, causalities and damages to infrastructures also during spring time, when shallow landslides may occur in response to fast snow melt, even during clear sky days, in lack of precipitation.