**Investigating the interaction between snowmelt runoff and road network in the occurrence of hillslope instabilities affecting a landslide-prone mountain basin through a multi-modeling approach**

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**Abstract**

The presence of roads is frequently linked with the occurrence of land degradation processes such as landslides and erosive dynamics, especially in steep slope mountain areas. In this regard, the use of Airborne Laser Scanning (ALS)-derived high-resolution topographic data allowed to better represent landscapes and related physical processes at the basin-scale. Furthermore, the implementation of topographically-based hydrological models also increased our possibilities to simulate water overland flows and investigate the occurrence of specific soil degradative phenomena. Snowpack melting plays a primary role in altering superficial water dynamics in mountain landscapes, but accurate investigation about the interaction between snowmelt-runoff and human infrastructures such as roads and trails in the occurrence of hillslope failures is still obscure. This research aims therefore to assess the relationship between snowmelt-runoff, road presence and terrain instabilities affecting a landslide-prone steep slope mountain meadow (northern Italy). The detection of snowmelt overflows alteration due to the presence of the road, as well as its relation with the activation of a shallow landslide were performed through an innovative multi-modeling approach. In this regard, the role of the road in altering snowmelt-runoff was investigated both considering its presence and assuming its absence by a novel Digital Elevation Model (DEM) editing procedure. Different hydrological and slope stability models were interactively implemented, starting from pre-event ALS-derived DEM in order to compute predictive simulations at the basin scale. Results attested the key role played by the road in altering snowmelt runoff pathways, as well as their combined contribution in the foreseen activation of the observed shallow landslide. Starting from on-field observations conducted after the landslide triggering (2020), the Area Under the Receiver Operating Characteristic curve (AUC-ROC) and the Cohen’s kappa-index were elaborated to assess the accuracy of instabilities predictions. AUC-ROC and Cohen’s k respectively resulted around 0.9 and 0.6. This work could be a useful tool for planning specific mitigation interventions able to reduce the occurrence of similar risk scenarios, also providing suggestions for developing and promoting efficient sustainable actions for mountain landscapes.