



## Shallow landslides along the pyroclastic-mantled slopes of mount Partenio (Campania, Italy): the events of 16.12.1999 and 21.12.2019

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As other mountainous areas of Campania (Italy), mount Partenio consists of carbonate rocks covered with layered air-fall deposits originated by eruptions of the two volcanic complexes of the area (Somma Vesuvius and Phlegrean Fields). The deposits are alternated layers of ashes (loamy sands) and pumices (sands with gravel), both materials characterized by negligible effective cohesion. The thickness of the deposit ranges between few centimeters along the steepest slopes (up to 50°) to some meters at the foot of the slopes, with gentle inclination. The equilibrium of the covers along the steepest slopes is guaranteed by the contribution of suction to soil shear strength. After intense and prolonged rain, this contribution is reduced by infiltrating water being stored within the cover, sometimes leading to shallow landslide triggering.

The two most recent landslide events in the area occurred on 16.12.1999 and 21.12.2019. In the first case, several landslides were triggered along slopes with inclination larger than 40°, in an area of about 10 km<sup>2</sup>, some of which evolved in the form of fast debris flows which caused damages to buildings and some victims in the town of Cervinara. In the second case, two major landslides were reported, one of which, along a slope with inclination between 42° and 45°, very close to two of the landslides of 1999, damaged roads and buildings in the town of San Martino Valle Caudina.

After the event of 1999, a hydro-meteorological monitoring station was installed near the scarp of the major landslide. Thanks to the monitoring data and laboratory investigation on the hydraulic properties of the involved soils, a mathematical model of the response of the slope to precipitation was developed (Greco et al., 2013). The model couples unsaturated flows in the pyroclastic cover with the groundwater system developing in the underlying fractured limestone bedrock, and it allows satisfactorily reproducing the seasonal trends of the terms of the hydrological balance of the slope (Greco et al., 2018).

In this study, the two events of 1999 and 2019 are compared, in terms of pre-event and event rainfall characteristics, as well as by simulating the response of the slopes by means of the mathematical model during the entire year until the day of the landslides. The obtained results show the importance of the interplay between predisposing conditions, related to the rainfall history during the months before the event, and the characteristics of the triggering event. The model simulations indicate that, while in 1999 failure conditions are predicted along slopes with inclination larger than 40°, regardless cover thickness, in 2019 landslide triggering is predicted only

on slopes mantled by a cover thinner than 1.5 meters with inclination larger than 42°.

#### References

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