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REGIONAL SCALE LANDSLIDE ACTIVITY INTENSIFICATION INFERRED FROM SATELLITE SAR INTERFEROMETRY AFTER TRIGGERING EVENTS AND PREPARATION OF FOLLOWING LANDSLIDE SCENARIO

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Purpose: Post-seismic ground effects can induce prolonged erosion and perturbations, especially by the interaction between rainfall or climate features and the proneness of the slopes to fail. In particular, the increase in soil moisture level due to rainfalls prepare the subsequent triggering of landslides by seismic events and/or further weather storms. In this study we analyze the landslide reactivations after the August 16th, 2018, Mw 5.1 Montecilfone (Molise, Italy) earthquake and a slope instability scenario triggered by severe weather events, such as the Buran event of February 2018 in Central Italy. We infer causal relationships of landslide preparatory and triggering events (which in principle could be represented by both earthquakes and heavy rains) at basin-scale, highlighting the effect of preparatory factors in promoting the re-activations of slope instability phenomena.

Methods: Multitemporal analyses of satellite Synthetic Aperture Radar interferometry (InSAR) over the years across the triggering events have been carried out, using C-band Sentinel-1 data. The Differential SAR Interferometry (DInSAR) technique, that concerns the analysis of single interferograms, allowed to detect impulsive phenomena such as landslide reactivations and nonlinear movements such as the acceleration of a landslide. Therefore, the "unperturbed" conditions before the triggering event, have been compared with the post-event conditions and with the available landslide inventories, in order to perform a quantitative analysis on the landslide activity variations at a basin scale. The Advanced interferometric techniques allowed the analysis of time series of displacement at large scale and therefore the detection of any trend change in the deformation pattern of the landslides. This analysis at basin scale can reveal the spatial distribution of landslides reactivations following a triggering event.

Results: A sharp increase in the number of landslides characterizes the year following the earthquake of Montecilfone under equal rainfall conditions: in particular, considering the number of landslide reactivations, a positive percentage variation equal to +118% was determined for the post-seismic year with respect to the 1st pre-seismic (2017–2018) year. The intensification of landslide activity after a low-magnitude earthquake, involved the first year after the earthquake, and the most significant increase in landslide number, occurred in the 3 months immediately following the earthquake. This suggests that the seismic event contributed to reducing the resistance of the soils and acted as a preparatory factor for the rainfall-induced reactivations. Moreover, the detection of the acceleration trends of deformation over time reflects the destabilizing action of a triggering event such as exceptional weather events.

Conclusions: InSAR analyses provide large-scale data that allow regional landslide reactivation scenarios reconstructions, involving a different kind of multi-temporal approaches, exploiting A-DInSAR or DInSAR techniques. This study concerned landslide instability scenarios that have been affected by triggering events (both seismic events and weather storms) which have acted as a crucial destabilizing factor on the slopes, for a prolonged time period and Therefore, it allowed to infer causal relationships between preparatory factors and triggering events.