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Rapid evolution of the paraglacial Moosfluh rock slope instability (Swiss Alps) captured by Sentinel-1

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The Great Aletsch Region (GAR, Swiss Alps) has undergone to several cycles of glacial advancement and retreat, which have deeply affected the evolution of the surrounding landscape. Currently, this region is one of the places where the effects of climate change can be strikingly observed, as the Aletsch glacier is experiencing a remarkable retreat with rates in the order of 50 meters every year. In particular, a deep-seated slope instability located in the area called “Moosfluh” has shown during the past 20 years evidences of a slow but progressive increase of surface displacement. The moving mass associated to the Moosfluh rockslide affects an area of about 2 km2 and entails a volume estimated in the order of 150-200 Mm3. In the late summer 2016, an unusual acceleration of the Moosfluh rockslide was observed. Compared to previous years, when ground deformations were in the order of few centimeters, in the period September-October 2016 maximum velocities have reached locally 1 m/day. Such a critical evolution resulted in an increased number of local rock failures and caused the generation of several deep tensile cracks, hindering the access to hiking paths visited by tourists. Moreover, surface deformations have also affected the Moosfluh cable car station, located near the crest of the unstable slope. In this critical framework, the information available on ground was not enough to disentangle the spatial extent of the most active region. To investigate that, we have processed a number of Sentinel-1 SAR images acquired over the GAR. We paired images with maximum temporal baseline spanning 12 and 24 days, in order to preserve the highest possible interferometric coherence over the target area. Secondly, by stacking surface displacements obtained from the differential interferograms, we have increased the signal-to-noise ratio to produce velocity maps of the Moosfluh landslide over the period of interest. This approach has allowed us to constrain the lateral borders of the most active area, and to define a strategy for the installation of additional in-situ monitoring targets. Thus, we have improved our capability to monitor in near-real-time the evolution of surface displacement, as well as to provide a better interpretation of the ongoing critical phase and to define evolutionary scenarios.
Space borne DInSAR for the analysis of unstable slopes is experiencing a new Era. In former times, the combination of poor temporal sampling and rapid evolution of surface displacements has hindered this technique from performing analysis on landslides during critical acceleration phases. Indeed, the time spanning between the acquisition of a robust SAR dataset and the availability of reliable results were in the order months or, in some cases, even years. Nowadays, by leveraging the unprecedented spatial and temporal coverage provided by the ESA Sentinel-1 A and B, the time spanning from data acquisition to the generation of ground displacements has been reduced to weeks or, in some cases, days. Thus, we can now obtain information current stage of the slope instability and also to catch the rapid evolution towards a potential catastrophic failure.