Geophysical Research Abstracts
Vol. 21, EGU2019-10084, 2019
EGU General Assembly 2019

Prediction of slope failure at regional scale with Sentinel-1 satellites: possibilities and limitations

Federico Raspini, Emanuele Intrieri, Silvia Bianchini, Matteo Del Soldato, Roberto Montalti, Lorenzo Solari, and Nicola Casagli

University of Firenze, Earth Sciences Department - Firenze, Italy

In many landslide studies, the possibility to predict future behaviour is still a major concern. The most popular methods to achieve this prediction rely on the analysis of monitoring data of displacement for the detection of accelerating areas, as they can directly related to precursory movements that typically precede collapse. Methods deducing reliable failure predictions have been largely applied at local scale, where in situ monitoring systems can be installed. So far, the lack of systematic information on ground displacement acquired at regional scale was a serious limit hampering the application of failure prediction methods at wide scale. Such limitations can be partially solved through the exploitation of spaceborne platforms. Despite this, the low data sampling frequency of most of the satellite systems hampered the possibility to retrieve the necessary details of tertiary creep characterized by accelerating deformation.

The launch of Sentinel-1 mission opened a new opportunity for InSAR monitoring applications thanks to the increased acquisition frequency, the regularity of acquisitions and the policy on data access. The potential of the Sentinel-1 for the detection of pre-failure accelerating creep has been recently proved through some retrospective InSAR analysis. For instance, the post-event application of the Fukuzono method to the Sentinel-1 deformation time series of the catastrophic Maoxian landslide (China), occurred on 24 June 2017, pointed out that an accurate estimation of the time of collapse was already possible at the begin of June.

Despite the operational readiness of the Sentinel-1 constellation, most of the applications so far have been aimed at assessing the use of this data source to spot unstable areas or to capture pre-failure signs after major collapse, rather than providing new streamlines of information for monitoring solutions. We provide an example of the potential of multi-temporal InSAR analyses applied to Sentinel-1 data for continuous monitoring of ground deformation induced by hydrogeological processes. We exploit Sentinel-1 images to implement an operational service based on advanced interferometric products suitable for risk mitigation at the regional scale. This service relies on the systematic processing of Sentinel-1 images to create continuously updated ground deformation data. In fact, as soon as a new acquisition is available, the new image is used to update all displacement time series of all measurement points identified in the area of interest. Time series are then automatically analysed through a post-processing procedure, highlighting any anomalous trends and/or acceleration affecting the area of interest and providing possible alerts.

We present and discuss this monitoring system through the case study of the Tuscany and Valle d'Aosta Region (Italy), specifically selected due to their peculiar geological settings, highly prone to slope instability phenomena. These results show that satellite radar data, systematically acquired over large areas with short revisiting time, could be used not only for mapping unstable areas, but also for actual landslide warning, at least for some typologies of sliding phenomena. This means that the transition from historical analysis of ground deformation to a continuous monitoring with prediction capabilities at regional scale using satellite radar data is now possible.