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A study on dynamic of instable slopes through 3D analysis of ground displacements

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Analyses of ground displacements can help in defining dynamic of slopes affected by instability phenomena and in the identification of triggering factors. In fact, ground displacements are strictly connected to slope dynamic and can be used to define it. To this end, remote sensing techniques (Advanced DInSAR and GPS) can be used to collect direct measurement of superficial deformations in landslide-prone areas. Results from remote sensing data can be then compared with outcomes from numerical simulation of slope dynamic, and in particular with displacement or velocity fields. This comparison can help in validating numerical model and eventually recalibrate it, to obtain a more realistic simulation of instabilities and of predisposing and triggering conditions.
The main aim of this paper is to test the information contribute of Advanced DInSAR techniques in 3D numerical simulation of slope instabilities. The test is performed in a landslide-prone area located in the piedmont sector of the Vicenza Province (North-Eastern Italian Alps). Recently, this area was affected by considerable ground displacements after an exceptional rainfall event occurred during autumn 2010. Displacements are related to the reactivation of complex landslide phenomena involving debris cover deposits and highly fractured and weathered bedrock. Time series of displacements detected using PS-InSAR and SBAS interferometry techniques are used to identify and delimitate instability phenomena, and to evaluate the state of activity. Displacements are also compared to rainfall regime to investigate triggering factors. Then, displacements measured along the Line Of Sight (LOS) between satellites and ground surface are decomposed in the vertical, horizontal and slope direction. These data are compared with outputs from 3D numerical simulation of stress-strain conditions of slopes (i.e. displacement and velocity fields). This comparison helps in validating and refining numerical simulation of slope instability.
Measured displacements considered in this work derive from processing of SAR images acquired from ERS and ENVISAT satellites in the period 1992-2010. A more in depth study will be performed with SAR data acquired by Cosmo-SkyMed satellite constellation, thanks to its higher resolution and shorter revisiting time. The aim of future study is to implement useful tools for investigating instable slope dynamic and monitoring temporal evolution of instabilities in near real time, based on interferometry processing of SAR data.