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Monitoring large-scale landslides and their induced hazard with COSMO-SkyMed Intermittent SBAS (ISBAS): a case study in north-western Sicily, Italy.

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Landslides detection and mapping are fundamental requirements for every hazard and risk evaluation. Due to their inevitable shortcomings, geomorphological field surveys and airphoto interpretation do not document all the gravitational events. Indeed some unstable slopes are inaccessible to field surveyors, while some landslides are too slow to be detected with the naked eye or interpretation of aerial photographs. In this work, we integrate geomorphological surveys with ground motion data derived by employing COSMO-SkyMed satellite imagery and the Intermittent Small BAseline Subset (ISBAS; Sowter *et al*., 2013), a new Advanced Differential Interferometry Synthetic Aperture Radar (ADInSAR) technique which has been developed recently at the Nottingham University in the UK. The main advantage of ISBAS with respect to other InSAR and SBAS techniques, is the possibility to detect good radar reflectors even in non-urbanized terrain, where ground targets usually look intermittently coherent, meaning they have high coherence only in some interferograms but not in others. ISBAS has proven capable of increasing results over natural, woodland and agricultural terrains and, as a result, it makes it possible to improve the detection of landslide boundaries and the assessment of the state of activity where other InSAR approaches fail. We used COSMO-SkyMed StripMap data covering the period between November 2008 and October 2011, with 3m ground range resolution, 40° look angle and minimum revisiting time of 8 days. The data consist of 38 ascending images (track 133, frame 380) with ground track angle at scene centre of 169.5° from the north-south direction. These have been obtained thanks to an agreement between the Italian Ministry for the Environment, Land and Sea and the University of Naples "Federico II".

We tested ISBAS in north-western Sicily (southern Italy), over a 1,530 km^2 area where 1,473 landslides have been identified based on optical imagery and field surveys by the local Hydro-geomorphological Setting Plan published in 2006. The geological and tectonic setting of the area, related to the Apenninic-Maghrebian Chain orogeny, makes most of the instability phenomena of complex or flow type with an extremely slow to very slow velocity, namely very suitable for an interferometric analysis.

We show the results for Piana degli Albanesi, a thrust faults-bounded basin located in the northern Mt. Kumeta massif, filled in with Lower Miocene marls and pelitic deposits. Here landslide risk affects housing and public infrastructure (e.g. the SP34, the SP38 and SP102 highways), and the unstable slopes extend up to a gravity masonry dam, such as to require continuous rebuilding of infrastructures in the portions with the higher displacement rates. The ISBAS results for ascending geometry entail an unprecedented 685,518 points in a 90 km^2 extended processing area, and their Line Of Sight velocities range between -6.4 mm/yr (away from the sensor) and +6.6mm/yr (towards the sensor). ISBAS results detect a total of 89 mapped landslides, of which 23 are previously not recorded. The analysis of ISBAS COSMO-SKyMed time-series allows us to compare the deformation trends to rainfall events, and to evaluate the correlation between heavy or prolonged rainfall and accelerations in the ground motion histories of the identified landslides.

Sowter A., Bateson L., Strange P., Ambrose K., Syafiudin M.F., 2013. *DInSAR estimation of land motion using intermittent coherence with application to the South Derbyshire and Leicestershire coalfields*. Remote Sensing Letters, v.**4** : 979-987.