Long term SAR interferometry monitoring for assessing changing levels of slope instability hazards

J. Wasowski (1), A. Ferretti (2)

(1) CNR-IRPI, via Amendola 122 I, 70126 Bari, Italy (j.wasowski@ba.irpi.cnr.it), (2) Tele-Rilevamento Europa - T.R.E. s.r.l., Milano, Italy (alessandro.ferretti@treuropa.com)

The population growth, with increasing impact of man on the environment and urbanisation of areas susceptible to slope failures, coupled with the ongoing change in climate patterns will require a shift in the approaches to landslide hazard reduction. Indeed, there is evidence that landslide activity and related socio-economic loss are increasing in both rich and less developed countries throughout the world. Because of this and because the urbanisation of hillside and mountain slopes prone to failure will likely continue in the future, the protection of new and pre-existing developed areas via traditional engineering stabilisation works and in situ monitoring is not considered economically feasible. Furthermore, in most cases the ground control systems are installed post-factum and for short term monitoring, and hence their role in preventing disasters is limited. Considering the global dimension of the slope instability problem, a sustainable road to landslide hazard reduction seems to be via exploitation of EO systems, with focus on early detection, long term monitoring and early warning. Thanks to the wide-area coverage, regular schedule and improving resolution of space-borne sensors, the EO can foster the auspicious shift from a culture of repair to a culture of awarness and prevention. Under this scenario the space-borne synthetic aperture radar differential interferometry (DInSAR) is attractive because of its capability to provide both wide-area and spatially dense information on surface displacements. Since the presence of movements represents a direct evidence of potential failure hazard, DInSAR can be used to provide a preliminary distinction of conditions of relative stability or instability. Furthermore, thanks to a regular revist schedule of the radar satellites and the millimetric precision of measurement of the advanced multi-temporal DInSAR methods e.g. Permanent/Persistent Scatterers Interferometry (PSI), a long-term monitoring of small displacements is feasible. We provide some practical examples to illustrate how following the initial, regional scale assessment of ground deformations, the advanced DInSAR methods can be applied to focus on those areas where there is a potential hazard and where more detailed in-situ investigations may utlimately be required. The information on the temporal evolution of deformations, and in particular on movement rates can be of great value for the assessments of severity of potential failure (e.g. higher velocity implying higher severity). Although the identification of threshold conditions of relative stability or instability is a difficult task, the long term, regular monitoring from space offers a unique possibility for detecting precursory deformations and significant changes in their velocity associated,

respectively, with the initiation of instability and acceleration of movements leading to a full-scale failure. This is a key factor in early warning and hazard mitigation efforts. Finally, we stress the importance of future SAR dedicated missions to overcome some current limitations of DInSAR and extend its applicability and utility in slope instability investigations. Currently the applicability is limited to a small percentage of slope movements (only very slow and large phenomena), and higher resolution (meters) sensors and shorter revisiting times (at least weekly) would be needed to monitor landslide activity and relative hazard.