Updating of a landslide inventory map through InSAR techniques: outcomes from ESA - Terrafirma project.

V. Pancioli, N. Casagli

Department of Earth Sciences, University of Firenze

valeria.pancioli@unifi.it

Terrafirma is an initiative funded by ESA (European Space Agency) in the framework of GMES (Global Monitoring for Environment and Security). The project aims at providing pan-European services based on the latest technology to measure terrain motion from satellite InSAR data relating to subsidence, landslides, crustal deformation and volcanic deformation.

There are two different types of Terrafirma landslide product: Landslide Inventory and Landslide Monitoring.

This work concerns a landslide inventory product related to the Calabrian basin; a LSI product consists of the updating of a pre - existing inventory map, produced with conventional geomorphologic tools, through the integration of Permanent Scatterers ground displacements information. The most involved users of this kind of product are represented by National Civil Protection Agencies and public authorities in charge of landslide risk management at national or local level.

This analysis concerns the Reggio Calabria districts and the southern portions of Vibo Valentia and Catanzaro districts. The area, with an extension of 4200 km2, is located in the south Italy along the Calabrian Apennines, this part of Apennines is one of the most landslide prone area of the Italian territory.

The proposed methodology is based on the integration of remote sensing optical and radar data with an existing landslide inventory. Radar datasets used are SAR images acquired by ERS1 and ERS2 satellite (spanning the temporal interval from 1992 to 2002) acquired both in ascending and descending geometry and SAR images from

ENVISAT satellite (spanning the temporal interval from 2002 to 2006) acquired both in ascending and descending geometry.

For this purpose thematic layers, including landslide inventory, aerial photos, digital elevation model and topographic maps, were managed within a GIS environment.

The analysis has been carried out in the following steps: acquisition and homogenization of landslide inventory maps (PAI, IFFI) acquisition of thematic layers, homogenization of PS datasets, multi-temporal PS and optical data interpretation.

In order to define the real landslide state of activity a matrix of activity was employed, it is based on the medium velocity computed for every landslides from ERS PS and ENVISAT PS data.

The available radar datasets for the investigated area are related to a 15 years interval resulting a PS density of 66,1 PS/km^2 for ERS data, and 22,4 PS/km^2 for ENVISAT data.

With respect to several PS analyses carried out over similar environments, ERS PS density is higher, whereas ENVISAT PS density is quite low.

PS allowed the following additional information with respect to the original landslide inventory:

1. updating of landslide inventory

2. modification of landslide boundaries

3. reclassification of landslide state of activity

4. detection of new landslides

5. evaluation of landslide average velocity displacement in the last 15 years

Results highlight that a high number of PS (20385) gives displacements landslides information and that a high percentage, that amount of 38.8%, of landslides have within PS information. Moreover the analysis has allowed to identify 340 new landslides, 276 of which are in an active state. Focusing on the urban area, where around 12800 PS give displacements landslide information and 38.4% of landslides have within PS information, a positive feedback has been given to the capabilities of PSI in providing quantitative measurements over urban areas, where usually the highest level of risk are concentrated due to the high value of element at risks; LSI can be used for

differed-time analyses over large areas in order to identify areas affected by critic stability conditions where more in depth geological investigations can be planned along with local authorities.

The results confirm the capabilities of multi-interferometric InSAR data, integrated and coupled with conventional techniques, to support landslides investigation at regional scale.

We consider that the proposed method could be a repeatable and controlled procedure suitable for different geologic and geomorphologic environments.