Geophysical Research Abstracts
Vol. 13, EGU2011-11511, 2011
EGU General Assembly 2011

An integrated approach for an operative early warning system of landslides forecasting based on rainfall thresholds and soil moisture assessment

Francesco Ponziani (1), Nicola Berni (1), Claudia Pandolfo (1), Marco Stelluti (1), Luca Brocca (2), and Tommaso Moramarco (2)

(1) Umbria Region, Italy (centrofunzionale@regione.umbria.it), (2) Research Institute for Geo-Hydrological Protection, National Research Council, Perugia, Italy

The Umbria Region is one of the worst areas in Italy, yearly hit by landslides and flood events at different spatial and temporal scales. For early warning procedures aimed at the assessment of the hydrogeological risk, the rainfall thresholds represent the main component of the Italian Civil Protection System. An accurate and reliable methodology for the landslide risk assessment and management is one of the main targets of the Umbria regional Civil Protection Centre (where the "Decentralized Functional Centre" – CFD is the operative early warning office), to fill the gap between the poor performance of landslides prediction tools and the good ones obtained for flood predictions. It is well known that soil moisture conditions at the onset of a storm event play a critical role in triggering floods and slopes failure. By acting on the pore water pressure, the soil moisture modulates the strength-stress ratio in soils and so it is a significant precondition for triggering landslides off; maybe as important as thresholds based on accumulated rainfall values. This insight was already pointed out in a precedent study (Ponziani et al., 2010) showing the correlation between the triggering of several large landslide events occurred in the Umbria region and the initial soil moisture of the involved sites. On this basis, to improve the performances of the alert system for the landslide risk, Umbria Region CFD, in cooperation with the Research Institute for Geo-Hydrological Protection (IRPI-CNR), developed and tested a continuous physically based soil water balance model, addressed to the estimation of soil moisture conditions over the whole regional territory prior to storm events. The main purpose is to get a new Early Warning System for landslide risk prevention of the CFD by coupling the computed soil moisture pre-conditions with the already operative rainfall thresholds.
Nowadays, the system is still under development with three main tasks:
- Application to 110 high risk landslide sites located across the whole regional territory;
- Application to a case study rockslide (Torgiovannetto Rockslide), for which a real time extensimeter network is also available and it can be used to test the reliability of the system itself;
- Application to the whole regional territory over a dense computation grid aimed at the development of a real time landslide risk scenario.

The three tasks are implemented in real time by using both observed rainfall data from the dense regional hydrometeorological network and 72 hour rainfall forecast by local scale meteorological model. The performance of the system for landslides forecasting was tested considering both historical landslide events and the period August 2010-December 2010 for which the system is operational. First results highlight the simplicity and robustness of the implemented methodology and, at the same time, the main critical points that have to be addressed in the near-future. In particular, a linear relation between the rainfall thresholds and the initial soil moisture conditions was found with correlation coefficients up to 0.60 showing the key role of initial soil moisture conditions on landslide triggering. Therefore, the correlation established between the maxima cumulative rainfall values and the soil moisture prior to the triggering of landslides allows to dynamically adjust the rainfall thresholds which is of paramount interest for warning activities.

References

Ponziani. F., Berni, N., Pandolfo, C., Stelluti, M., Brocca, L. (2010). An integrated approach for the real-time monitoring of a high risk landslide by a regional civil protection office. Proc Int. Conf. EGU Leonardo Topical Conference Series on the hydrological cycle 2010, 10-12 November 2010, Luxembourg, Luxembourg