



## **The PRESSCA operational early warning system for landslide forecasting: the 11-12 November 2013 rainfall event in Central Italy.**

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The Umbria Region, located in Central Italy, is one of the most landslide risk prone area in Italy, almost yearly affected by landslides events at different spatial scales. For early warning procedures aimed at the assessment of the hydrogeological risk, the rainfall thresholds represent the main tool for the Italian Civil Protection System. As shown in previous studies, soil moisture plays a key-role in landslides triggering. In fact, acting on the pore water pressure, soil moisture influences the rainfall amount needed for activating a landslide.

In this work, an operational physically-based early warning system, named PRESSCA, that takes into account soil moisture for the definition of rainfall thresholds is presented. Specifically, the soil moisture conditions are evaluated in PRESSCA by using a distributed soil water balance model that is recently coupled with near real-time satellite soil moisture product obtained from ASCAT (Advanced SCATterometer) and from in-situ monitoring data. The integration of three different sources of soil moisture information allows to estimate the most accurate possible soil moisture condition. Then, both observed and forecasted rainfall data are compared with the soil moisture-based thresholds in order to obtain risk indicators over a grid of  $\sim 5$  km. These indicators are then used for the daily hydrogeological risk evaluation and management by the Civil Protection regional service, through the sharing/delivering of near real-time landslide risk scenarios (also through an open source web platform: [www.cfumbria.it](http://www.cfumbria.it)).

On the 11th-12th November, 2013, Umbria Region was hit by an exceptional rainfall event with up to 430mm/72hours that resulted in significant economic damages, but fortunately no casualties among the population. In this study, the results during the rainfall event of PRESSCA system are described, by underlining the model capability to reproduce, two days in advance, landslide risk scenarios in good spatial and temporal agreement with the occurred actual conditions. High-resolution risk scenarios (100mx100m), obtained by coupling PRESSCA forecasts with susceptibility and vulnerability layers, are also produced. The results show good relationship between the PRESSCA forecast and the reported landslides to the Civil Protection Service during the rainfall event, confirming the system robustness. The good forecasts of PRESSCA system have surely contributed to start well in advance the Civil Protection operations (alerting local authorities and population).