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Definition of 3D rainfall thresholds for operative LEWS

Ascanio Rosi¹, Antonio Monni², Angela Gallucci², and Nicola Casagli¹

¹University of Florence, School of Sciences, Dep. of Earth Sciences, Firenze, Italy (ascanio.rosi@unifi.it)

²Emilia-Romagna Agency for Territorial Safety and Civil Protection, 40122, Bologna, Italy

Rainfall induced landslide is one of the most common hazards worldwide and it is responsible every year of huge losses, both economic and social.

Because of the high impact of this kind of natural hazard, the forecasting of the meteorological condition associated with the initiation of landslide has become paramount in the recent years and several papers addressing this issue have been published.

When working over large areas, the definition of rainfall thresholds is the most used approach, since it requires few data that can be easily retrieved: landslide triggering date and location and rainfall recording associated to landslide events.

The intensity-duration threshold is the most used approach and it showed over the time its potential to be implemented in an operative landslide early warning system (LEWS), but literature papers showed that this approach is affected by a main drawback, i.e., the high number of false positives (events that are not capable of triggering landslides are classified as landslide triggering events).

To overcome this problem several authors tried to combine these thresholds with other parameters and recently one of the most promising approach is the use of the antecedent soil moisture condition, but this parameter is not very easily available for large areas and it is difficult to retrieve it in real time, so as it can be used in a LEWS.

In our work we used antecedent rainfall to simulate the progressive saturation of the soil and then the soil moisture condition associated with the initiation of landslides.

In a given area the total rainfall recorded by each rain gauge over a defined period of time prior the landslide is considered and used to define a parameter named MeAR (Mean Antecedent Rainfall), which represent the mean rainfall of the area over a given time interval, as recorded by all the active rain gauges.

The MeAR parameter has been coupled with classical I-D thresholds to define 3D thresholds, where the conditions associated with the initiation of a landslide are defined by a portion of a 3D space, instead of a portion of a 2D plane. This approach has been tested in Emilia-Romagna region (Italy) and it resulted the possibility of reducing false positives from 30% up to 80% on different areas.