Introducing hydrological information in rainfall intensity-duration thresholds

Roberto Greco (1) and Thom Bogaard (2)

(1) DICDEA, Dipartimento di Ingegneria Civile, Design, Edilizia e Ambiente, Seconda Universita di Napoli, Aversa (CE), Italy (roberto.greco@unina2.it), (2) Delft University of Technology, Water Resources Section, Faculty of Civil Engineering and Geosciences, Delft, the Netherlands

Regional landslide hazard assessment is mainly based on empirically derived precipitation-intensity-duration (PID) thresholds. Generally, two features of rainfall events are plotted to discriminate between observed occurrence and absence of occurrence of mass movements. Hereafter, a separation line is drawn in logarithmic space. Although successfully applied in many case studies, such PID thresholds suffer from many false positives as well as limited physical process insight. One of the main limitations is indeed that they do not include any information about the hydrological processes occurring along the slopes, so that the triggering is only related to rainfall characteristics. In order to introduce such an hydrological information in the definition of rainfall thresholds for shallow landslide triggering assessment, in this study the introduction of non-dimensional rainfall characteristics is proposed. In particular, rain storm depth, intensity and duration are divided by a characteristic infiltration depth, a characteristic infiltration rate and a characteristic duration, respectively. These latter variables depend on the hydraulic properties and on the moisture state of the soil cover at the beginning of the precipitation. The proposed variables are applied to the case of a slope covered with shallow pyroclastic deposits in Cervinara (southern Italy), for which experimental data of hourly rainfall and soil suction were available. Rainfall thresholds defined with the proposed non-dimensional variables perform significantly better than those defined with dimensional variables, either in the intensity-duration plane or in the depth-duration plane.