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Levels of risk and of alarm in the phenomena of slope instability

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The paper analyzes particular experimental on-site measurements that facilitate an evaluation of the levels of risk and alarm in increasingly frequent and dangerous phenomena of rapid flow. This increased frequency and hazard is related to climate change and to environmental modifications caused by human interventions. The risk parameter is normally identified in the value of the damage that may result in elements distinguished by a given vulnerability to the occurrence of an event of given hazard. Risk evaluation is thus a hierarchical assessment that is not absolute but relative, since it is linked to the nature and vulnerability of the various elements in play and also to the particular event and its level of hazard (UNESCO definitions and hypothesis of limited spatial propagation of the phenomenon).

Public authorities responsible for land management are interested in simple tools that can be easily applied in both technical and administrative terms in order to: 1) identify areas at real and/or potential risk; 2) determine technical standards for the assessment and design of structural and non-structural interventions for risk mitigation; 3) set up alarm systems to integrate into civil protection plans.

A number of predictive methods aiming to support such an action have been proposed in recent years, the most innovative and propitious of which appear to be those which combine soil stability models with water infiltration and transport models.

It can also be noted that displacement processes are triggered when rainfall causes the slope's surface layer to become heavier and seepage determines neutral pressures that cancel out the cohesion and friction forces.

It therefore appears to be initially useful to determine a matrix for the assessment of a warning threshold A (further subdivided into four fields, from moderate to very high) linked to a weather event severity parameter I, a function of the rainfall intensity, and a soil state and property parameter F, a function of the h/z ratio (z is the height of the soil layer; h is the groundwater level, with reference to z). These parameters should be calibrated to every single Reference Territorial Unities (RTU characterising the geometry and the hydrological properties of the soil), which calls for specific investigations.

Use of this matrix is complementary to the installation, in the single RTU, of monitoring instruments (rain gauges and piezometers) which are needed (in addition to the characterization of the soil's geometry and hydrological properties) in order to calibrate the parameters I and F and to define warning thresholds in the civil protection plan.he soil), which calls for specific investigations.

The utility of and necessity for monitoring instruments on slopes in limit conditions are highlighted by the results obtained in a piezoemetric and pluviometric measurements campaign lasting five years and conducted on a sliding slope stabilized by means of drainage operations.

Keywords—rapid flow, alarm matrixes, alarm threshold, slope monitoring.
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