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X-slip: a physically-based model for the triggering of shallow rainfall-induced landslides, implemented in a GIS platform for alert systems

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A kind of landslide involving small scars of superficial soil, which is also called "soil slip", is usually triggered by short duration and intense rainfalls and mostly occurs on slopes composed of an impermeable bedrock and a shallow very permeable layer. Soil slips caused a lot of property damages and casualties in Italy and all over the world during the last few years.
Since 1997, at the Department of Civil Engineering of University of Parma, has been carried out a research to develop a physically-based model to foresee the triggering of soil slips on spatial scale. The model has been validated, at local scale, on the basis of some case-histories. The model is deliberately simplified, in order to evaluate the safety factor of a slope in function of the geotechnical characteristic of soil, of geometrical features of the slope and of rainfall depth, which can be observed and forecasted.
The model has been implemented in a platform for a real-time territory control, allowing the evaluation of regional soil slip susceptibility in the area of Emilia Romagna Region (Northern Italy). In the paper the model has been used to back analyse the occurrence of the phenomenon in some recent case-histories occurred in the Emilia Romagna Appennines, on 10-11th April 2005 and on 19-20th May 2008.
A procedure of back analysis, based on observed rainfall depths, shows the capability of the model in matching, on a wide area, the occurrence of the phenomenon in the case-histories analysed. The input data for the model, which have been introduced through a GIS framework, include slope geometric features, the geotechnical characteristics of involved soils, both in saturated and unsaturated conditions, the drainage capability of the slope, the way of rainfall infiltration, the time varying rainfalls.
The paper shows as the model could be capable of reaching the final aim of mapping susceptible zones and setting up an alert system for people against the analysed phenomena, if coupled with a model of foreseen rainfalls.

Keywords: soil slip, GIS, triggering model, safety factor, rainfall.