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Forecasting of rainfall induced superficial slope instabilities - a regional empirically-based model

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Heavy rainfalls can trigger superficial slope instabilities such as soil slips and debris flows, when critical rainfall conditions are surpassed. The landscape can be considered in equilibrium with the regular meteorological conditions, drastic modifications of the landscape, such as natural hazard phenomena, can thus be linked to extraordinary circumstances. The critical conditions for triggering superficial slope instabilities have been studied in many regions of the world, and also in the Swiss central and Southern Alps [e. g. 1, 2]. These analyses are usually illustrated with diagrams of rainfall duration-intensity, introduced by [3].

We present a regional model that can be used to assess the risk of triggering superficial slope instabilities during an ongoing event of heavy rainfall. It is applied to the area of Ticino (Southern Switzerland), but can be used everywhere, if the necessary base data is available. The model does not consider any physical aspect of the territory, where it is applied. It is merely based on the analysis of the pluviometric conditions of historically documented events of superficial slope instabilities.

The model is based on the known regional triggering levels in the area. A network of online pluviographs and the rainfall forecast are used to relate an ongoing event to the known triggering levels and thus to judge the hazardness of the situation. The time horizon and the reliability of the stability forecast are limited to the quality of the available rainfall forecast.

The model uses the following input elements: (1) About 40 online pluviometric stations in the Ticino area deliver continuously the amounts of fallen rainfall. (2) The rainfall forecast delivers the foreseen rainfall quantities on a 7 by 7 km grid, twice a day for the next 72 hours. (3) The mean annual precipitations in the area are used

to normalize the rainfall at the different pluviometric stations to a common base [4]. (4) Known triggering levels identify different levels of hazardness [1], in terms of an event magnitude (slope instabilities/km2).

The different data sources are regridded onto a 1 by 1 km mesh, where the actual assessment is done to obtain regional maps. A color coding (green-yellow-blue-red) is used to identify the different levels of hazardness on the maps with regards to the triggering of superficial slope instabilities. The model is implemented in Fortran and produces maps as GIF-images or animated sequences, using the free software package ImageMagick.

The model was used to produce regional maps of critical rainfall for different events (6, 12, 24 hours duration), and was successfully applied to a few real events of heavy rainfall in Ticino. It is now systematically used when heavy rainfall is announced, to give an idea of the overall situation and to forecast its development.

References

[1] Ceriani M. et al. (1994): Rainfall thresholds triggering debris flows in the Alpine area of Lombardia Region, Central Alps-Italy. Man and Mountain, Ponte di Legno (BS), Aug. 1994.

[2] Zimmermann M. et al. (1997): Murganggefahr und Klimaänderung - ein GIS-basierter Ansatz. vdf Hochschulverlag ETH Zürich. Switzerland.

[3] Cannon, S.H. (1988): Regional rainfall-threshold condition for abundant debris-flow activity. In: Ellen, S.D., and Wieczorek, G.F., eds., Landslides, floods, and marine effects of the storm of January 3-5, 1982, in the San Francisco Bay region, California. USGS Prof. Paper 1434, 27-33.

[4] Istituto Italiano di Idrobiologia (1981): Carta delle potenzialità pluviometriche di 12 mesi. Periodo di osservazione 1921-1970.