Geophysical Research Abstracts,
Vol. 11, EGU2009-5242, 2009
EGU General Assembly 2009

Rainfall height stochastic modelling as a support tool for landslides early warning

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Occurrence of landslides is uneasy to predict, since it is affected by a number of variables, such as mechanical and hydraulic soil properties, slope morphology, vegetation coverage, rainfall spatial and temporal variability.
Although heavy landslides frequently occurred in Campania, southern Italy, during the last decade, no complete data sets are available for natural slopes where landslides occurred. As a consequence, landslide risk assessment procedures and early warning systems in Campania still rely on simple empirical models based on correlation between daily rainfall records and observed landslides, like FLAIR model [Versace et al., 2003]. Effectiveness of such systems could be improved by reliable quantitative rainfall prediction.
In mountainous areas, rainfall spatial and temporal variability are very pronounced due to orographic effects, making predictions even more complicated. Existing rain gauge networks are not dense enough to resolve the small scale spatial variability, and the same limitation of spatial resolution affects rainfall height maps provided by radar sensors as well as by meteorological physically based models. Therefore, analysis of on-site recorded rainfall height time series still represents the most effective approach for a reliable prediction of local temporal evolution of rainfall.
Hydrological time series analysis is a widely studied field in hydrology, often carried out by means of autoregressive models, such as AR and ARMA [Box and Jenkins, 1976]. Sometimes exogenous information coming from additional series of observations is also taken into account, and the models are called ARX and ARMAX (e.g. Salas [1992]). Such models gave the best results when applied to the analysis of autocorrelated hydrological time series, like river flow or level time series. Conversely, they are not able to model the behaviour of intermittent time series, like point rainfall height series usually are, especially when recorded with short sampling time intervals. More useful for this issue are the so-called DRIP (Disaggregated Rectangular Intensity Pulse) and NSRP (Neymann-Scott Rectangular Pulse) model [Heneker et al., 2001; Cowpertwait et al., 2002], usually adopted to generate synthetic point rainfall series.
In this paper, the DRIP model approach is adopted in conjunction with FLAIR model to calculate the probability of flowslides occurrence. The final aim of the study is in fact to provide a useful tool to implement an early warning system for hydrogeological risk management.
Model calibration has been carried out with hourly rainfall hieght data provided by the rain gauges of Campania Region civil protection agency meteorological warning network. So far, the model has been applied only to data series recorded at a single rain gauge. Future extension will deal with spatial correlation between time series recorded at different gauges.

ACKNOWLEDGEMENTS
The research was co-financed by the Italian Ministry of University, by means of the PRIN 2006 PRIN program, within the research project entitled 'Definition of critical rainfall thresholds for destructive landslides for civil protection purposes'.

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