Mathematical models for early warning systems

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Abstract In recent years, non-structural measures based on Early Warning Systems increasingly play a relevant role in hydrogeological risk mitigation. Consequently, modelling of all the phenomena related to floods and landslides induced by rainfall, should be developed, with the aim of gaining accurate simulations and forecasting the events with a lag time large enough for activating civil protection measures. Indeed, in all the cases where the phenomenon rapidly evolves, like flash floods or shallow landslides, the lag time between observed rainfall and flood or landslide occurrence can be too short and must be extended by rainfall fields forecasting. The paper describes several mathematical models, developed at CAMILab laboratory of “Dipartimento di Difesa del Suolo” (University of Calabria), which are operating into Early Warning Systems. The models represent different processes and are integrated in order to firstly provide the nowcasting of precursor (rainfall) and then the occurrence evaluation of induced phenomena (floods and landslides). As regards rainfall nowcasting, stochastic models (temporal and space-time ones) and a coupled meteorological and stochastic model are illustrated. According to space-time scale and data availability, flood forecasting for real time warnings can be performed by using different rainfall–runoff models. Finally, for triggering conditions of landslides, a hydrological model and a complete landslide are considered.

Key words early warning systems; rainfall nowcasting; flood forecasting; landslide induced by rainfall