An event based real-time conditioned predictor of hourly hyetograph characteristics

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Setting up stochastic models capable to perform real-time conditioned rainfall predictions at high temporal resolution is crucial in developing hydro-geological early warning systems. Indeed, several rainfall-induced dangerous phenomena taking place at catchment or slope scale, such as flash floods and debris flows, may be triggered by relatively short rainfall events. The small spatial resolution at which the predictions are needed does not allow to make use neither of rainfall forecasts based on global circulation models, nor of data coming from radar sensors. Thus, the most reliable source of information is still represented by rain gauges installed at the site to be monitored.

Modelling of point rainfall series has been addressed in hydrological literature with two major approaches: cluster-based models and event-based models.

In this paper, using rainfall data observed in real time during a storm, a stochastic predictor of its future evolution is presented. The core of the predictor consists in an event based stochastic model. An event based approach is adopted, since it permits to identify a storm on the basis of the observed series of rainfall data and to calculate univocally its probability, thus allowing to perform the desired predictions in a relatively straightforward way. With this approach, predictions can be conditioned only to the part of real time observed rainfall data on which future evolution of the storm depends, in the stochastic sense.

Conversely, cluster-based stochastic models, widely used for the generation of synthetic rainfall series, are not trivially suitable for real-time conditioned predictions, since they do not allow to evaluate unambiguously the probability of an observed hyetograph, because it can be generated by more than one combination of rain cells.

The proposed model has been calibrated with hourly rainfall series of the rain gauges of the meteorological alert network of the Civil Protection Agency of Campania, Southern Italy. The statistical hypotheses on which the model is based have been checked by classical statistical tests, such as Blum-Kiefer-Rosenblatt test for independence. Furthermore, the information about the observed internal structure of the storm, at hourly scale, has been coupled with the external structure model, allowing to perform conditioned predictions of hydrologic response indexes, depending on the future evolution of hyetograph shape.