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Comparison of probabilistic methodologies for flood rainfall thresholds evaluation

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In medium and small size basins, floods are often characterised by a very rapid response to storms, leaving only a short lead time for triggering civil protection measures. For a given duration it is possible to identify rainfall values that generates a critical discharge in a given river cross section. If the rainfall threshold values are exceeded it can produce a critical situation in river sites exposed to alluvial risk. Comparing directly the observed or forecasted precipitation with critical reference values, allows to issue a flood warning without running online real-time forecasting systems.
The critical rainfall threshold values are evaluated by probabilistic methodologies, considering the joint cumulative distribution of cumulated rainfall and the corresponding peak discharge, for different soil saturation conditions (represented by AMC classes) and time durations. To estimate the joint distributions three approaches are examined: firstly, the data are transformed to normality by a Cox-Box Transformation, and the corresponding joint distribution is a bivariate normal. With the second method the marginal distributions are transformed via the Normal Quantile Transform, and the corresponding joint distribution is a meta-Gaussian. Finally, the Copula is applied to obtain joint distributions without assumptions about data or marginal. The joint distributions are then used to evaluate a risk function based on the informative entropy concept.
The rainfall threshold values are estimated for the Mignone River basin, located in Central Italy. The study concludes with a system performance analysis, in terms of correctly issued warnings, false alarms and missed alarms for each proposed approach.