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Rainfall-runoff modelling for quick-flood forecasting. Application on the upper Loire river catchment

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Though numerical rainfall-runoff models have been developed since the 1950's, they are seldom used in an operational forecasting context. There is a lack of flood forecasting tools for the majority of fast-reacting catchments, particularly in France. The present work attempts to evaluate the usefulness of these models for forecasting issues.

Performances of various types of rainfall-runoff models are compared for 11 catchments of the upper Loire river basin (France), with areas ranging from 20 to 3200 km^2. These fast-reacting catchments are under the influence of both oceanic and convective Mediterranean precipitation regimes, and have practical management issues - reservoir management, urban flood protection - justifying the improvement of flood forecasting tools. Lumped hydrological models, conceptual as well as "black box" ones (e.g. linear regression models and artificial neural networks) were applied using an hourly time step. Linear models are considered as the most basic tools and therefore as the reference to beat. In order to evaluate flood forecasting performances, a validation data set is used and specific criteria reflecting the objectives are chosen.

Results show that the performance of conceptual rainfall-runoff models is low and depends strongly on the forecasting horizon. An optimal range of forecasting horizons is subsequently defined: the lower bound is limited by the model simulation errors and the upper one by the uncertainties on future rainfalls. Another result is that an accurate model forecast in relation to time has a decisive impact on the forecasting efficiency; this influence is not so clear when models are evaluated in simulation mode. Perspectives and directions for further investigations are proposed.