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Comparative analysis of conceptual models with error correction, artificial neural networks and committee models

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In operational flow forecasting conceptual or process-based hydrological models are typically used, and more and more in combination with precipitation forecasts complemented by corrected data assimilation or data-driven error corrector models. Alternatively, predictive data-driven models, alone or in ensembles, have been employed in different researches, claiming that they ensure high accuracy of flow forecasting; for this, an artificial neural network (ANN) seems to be the most developed in studies. In this paper a comparative analysis of different error correctors and ANN models is made to contribute on the selection of operational. For this we explore the performance of various model combinations forecasting single and multiple time steps. The HBV hydrological model with and without error correction, data-driven models (ANNs) and hybrid committee models integrating conceptual models and ANNs. The capabilities of a model at a single time step (simulation) as well as multiple forecast horizons are represented in comparative graphs. Limitations of the meteorological forecasts are not contemplated in the hydrological forecast scenarios, so precipitation hindcast information was used as input in all models. Single time step forecast simulation of the HBV has 30 percent higher error than a one day forecast ANN model. However, for forecast horizons higher than 3 days a high variability of models' accuracy is found, and the clear dominant performance of the HBV hydrological model with an ANN error corrector is observed. In the forecasts for up to two days the committee and error-corrected models were the best, followed by ANN, and the conceptual model without error correction. The conceptual HBV model alone shows to perform best on long term sequential or iterative forecasts.