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# Description and validation of a streamflow assimilation system for a distributed hydrometeorological model over France. Impacts on the ensemble streamflow forecasts.

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SAFRAN-ISBA-MODCOU (SIM) is a distributed hydro-meteorological model used at Météo-France to predict soil water content and river streamflows. In order to produce a more accurate initial state for the ensemble streamflow forecasts systems based on SIM, an assimilation system is developed at Météo-France. This assimilation system uses past streamflow measurements in order to assess the best initial state of soil water content of the model for ensemble streamflow prediction. The data assimilation system is developed with a modular software (PALM, from the Centre Européen de Recherche et de Formation Avancée en Calcul Scientifique, CERFACS), and is based on the Best Linear Unbiased Estimator (BLUE) method. Data from a maximum of 186 gauge stations are assimilated over France, as well as for single stations, than for embedded stations networks.

The first part of the study focuses on the selection of the best model variables for the assimilation process : root zone layer only, root zone and deep layers taken together, and finally taken apart. Two versions of the physics in SIM, including or not an exponential profile of hydraulic conductivity in the soil, are tested for each one of the three configurations. A set of classical hydrological scores are performed on a 18-month period in order to describe the performances of the experiments. This work showed a significant improvement of the Nash criteria and a decrease of the root mean square error for the configuration using the exponential profile of hydraulic conductivity in the soil and with the state variable including the root zone and deep layers taken together. The assimilation system seems more efficient for floods than for low flows.

The second part of the work is about the impact of the assimilated initial states of the model on two ensemble streamflow prediction systems (ESPS) based on SIM and the ECMWF EPS and the Météo-France PEARP EPS. The scores are assessed on the same 18-month period, and validated against streamflow observations. The scores showed, with respect to the ESPS without any assimilation, a decrease of the root mean square error, a small increase of the ensemble spread, and an improvement of the Brier and Ranked Probability Skill Scores.

This works aims at providing the best possible system for streamflow predictions, to the French flood alert services.