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A past discharges assimilation system for ensemble streamflow forecasts over France

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The coupled physically-based hydro-meteorological model SAFRAN-ISBA-MODCOU (SIM) is developed at Météo-France for many years. This fully distributed catchment model is used in a pre-operational mode since 2005 for producing mid-range ensemble streamflow forecasts based on the 51-member 10-day ECMWF EPS. A past discharges assimilation system has been implemented in order to improve the initial states of these ensemble streamflow forecasts. The daily observed discharges of a selection of 186 gauging stations distributed over France were used over a 19-month period. The analysis operator is the Best Linear Unbiased Operator (BLUE), and 3 configurations of the assimilation system were tested, each one adjusting the soil moisture in a different way. An optional improvement of the physics of the model (the exponential profile of the hydraulic conductivity in the soil) was tested. The performance of the system was assessed for a selection of 148 assimilated stations, as well as for a selection of 49 totally independent stations for each configuration. A global improvement of the simulated streamflows was found, and the modifications imposed by the BLUE remained low. Finally, the impact of the assimilation system on the ensemble streamflow forecasts, and the impact of the improved physics were assessed separately in comparison with the operational streamflow forecasts. The results show a significant improvement of the forecasts, and the best configuration demonstrate the benefit of the method along the 10-day range, even for very high flows and for stations where assimilation was not directly performed.