Seeking best streamflow assimilation scheme in a semi-distributed hydrological model for flood forecasting

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Seeking best streamflow assimilation scheme in a semi-distributed hydrological model for flood forecasting

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Semi-distributed hydrological models have the potential to improve the efficiency of flood forecasting chains. Such models take into account the spatial distribution of both meteorological forcings and soil moisture states to predict streamflow along the river network and allow the assimilation of streamflow observations on multiple internal flow gauges. How to update the model states on ungauged upstream sub-catchments remains however a challenge. Indeed, the actual relative contribution of each upstream sub-catchment to the observed streamflow at the outlet cannot be observed but simply estimated by the hydrological model from the simulated upstream streamflow and routing-lag. In this work, we test the following hypotheses:

- the simultaneous assimilation of streamflow observations at internal gauges should improve streamflow predictions at the main downstream outlet
- accounting for time lags between flow gauges is needed to efficiently update model states in cases where no streamflow observations are available at internal gauges

The analysis is performed with a semi-distributed version of the hourly GR5H model (de Lavenne et al., 2019; Peredo-Ramirez et al., 2021) on a large dataset of French gauged catchments, each one having at least one internal gauged station. Several experiments were set up in gauged and pseudo-ungauged contexts to test both hypotheses. Two updating schemes were used: a particle filter (Piazzi et al., 2021) and a direct insertion method used in the operational flood forecasting model GRP (Furusho et al., 2016).

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