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Extending data assimilation beneficial effects to ungauged water levels in the case of a hydrodynamic model

C. Menghini and E. Todini
University of Bologna, 40127 Italy (clarissa.menghini2@unibo.it)

The main objective in this research is to study the possible improvements of simulated water levels at cross sections, other than the gauging station ones, using an ensemble Kalman filter (EnKF) along the River Po. Most of previous studies, mainly focussed at improving the starting forecasting value at the gauged cross sections, did not consider the effect of the correction due to data assimilation on all the other cross sections along the river, where measurements are not available. This research investigates, specifically how data assimilation at a measurement section influences simulations on the neighbouring cross sections. The procedure combines a hydrodynamic model with a sequential data assimilation method (EnKF) in vector form: the state vector contains all the water levels, while the measurement vector contains the levels in the sections where the gauges are present. The model uncertainty in specified as Normally distributed noise perturbing the hydraulic conductivity (a parameter of the model). The measurement noise represented as an error with a standard deviation of 5 cm on the water levels, to account both for the actual gauge error and the error due to the water surface oscillations. The approach was tested on the river Po in Italy, where a hydrodynamic model (the Parabolic And Backwater model) is used as the basis of a flood forecasting system. The performances of the approach were tested by eliminating single measurement sections from the measurement vector and checking the obtained improvement. In all cases, the application of the ensemble Kalman filter improves the results of the hydrodynamic model as compared to simulations without data assimilation.