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Estimating the impact of satellite observations on large-scale river flood forecasting

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Floods are one of the costliest natural disasters, posing severe risks to human population. Hydraulic models are able to predict flood characteristics, such as water surface elevations and inundated area, and are being used for forecasting operationally although there are many uncertainties. In this work, the potential value of satellite observations to initialize these hydraulic models (and their forecasts correspondingly) is explored. The Ensemble Sensitivity method is adapted to evaluate the impact of potential satellite observations on the forecasting of flood characteristics. The estimation of the impact is based on the Local Ensemble Transform Kalman Filter, allowing for the forecast error reductions to be computed without additional model runs. The study area was located in the Ohio River basin, and the model used was the LISFLOOD-FP hydrodynamic model. The experimental design consisted of two configurations of the LISFLOOD-FP model. The first (baseline) simulation represents a calibrated 'best effort' model based on a sub-grid channel structure using observations for parameters and boundary conditions, whereas the second (background) simulation consists of estimated parameters and SRTM-based boundary conditions. Results showed that the forecast skill was improved for water heights up to lead times of 11 days, while even partial observations of the river contained information for the entire river's water surface profile and allowed forecasting 5 to 7 days ahead. On the other hand, discharge forecasts were not improved as much when assimilating water height observations although forecast errors were reduced. Finally, the potential for identifying errors in the model structure and parameterizations via the ensemble sensitivity method is discussed.