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Ensemble Kalman filter-based discharge observation sensitivity within a spatially distributed hydrological model

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Data assimilation is a useful tool in applied hydrology to obtain more reliable and skillful forecasts by merging the model estimates with observations. Currently, most hydrological forecasts employ lumped hydrological models (with deterministic or manual state updating), but there is a clear tendency to move towards spatially distributed models with hydrological ensemble forecasting because of the increased availability and better quality of spatially measured data. Nevertheless, there has not been so much attention paid in the literature to discharge data assimilation into spatially distributed model states and evaluating the sensitivity of individual discharge gauges. In this study demonstrate how recent developments in other disciplines (e.g. meteorology and oceanography) can be applied to hydrological models used for flood forecasting. We aim to optimize the number of discharge gauges and their locations within the catchment domain using the Ensemble Kalman filter-based observation sensitivity technique. The contribution of individual discharge gauges is evaluated using a cost function difference between the model run with and without data assimilation. Twin experiments (synthetic and real world) for stratiform and convective rainfall events are carried out within the Upper Ourthe (1600 km^2), a quickly responding catchment in the Belgian Ardennes. The first results show that assimilation of discharge into the model states at interior points does improve hydrological simulations for both rainfall types. Additionally, observation bias at observation stations can also be easily identified.