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Enhancing water quality modelling & forecasting in the Han River basin (Korea) using data assimilation

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Data assimilation in operational systems is a promising method to enhance the lead-time and reduce the uncertainty of water quality forecasts and provides a good base for the setup of monitoring schemes in large catchments (locations and frequency of sampling).
In the River Han (Korea) three weirs have been constructed to prevent flooding and improve the water quality in the main stream. With real-time automated data imports and two water quality models, HSPF and EFDC, embedded in the FEWS-NIER forecasting platform, information about the current water quality status and daily water quality forecasts seven days ahead is provided to -water management agencies in the basin.
To improve both the quality and the lead time of the water quality forecasts the EFDC hydrodynamics and water quality model has been implemented in OpenDA, an open interface standard for data assimilation (DA) in numerical models. The setup of this real-time water quality data assimilation system to enhance the algal dynamics modelling and the forecasts in the Han River basin (20,960 km^2 in size) was performed by a number of steps using Ensemble Kalman Filtering (EnKF). Using a twin experiment the correct working of the algorithm was tested. Noise was applied to several water quality variables in the main tributaries with a sequential simulation algorithm, to obtain correct noise settings that result in a realistic spread between the individual ensemble members. As the next step, the inclusion of observations in the main stream for data assimilation was tested using the EnKF algorithm to define their effect on the model results. Noise was applied to global solar radiation to improve water temperature forecasts, as well as to phosphate, nitrate and chlorophyll-α concentrations in the large tributaries to improve the prediction of algal level upstream of the weirs. Different combinations of noise and observation settings (standard deviation and time correlation) to find the best model update of algae concentrations have been tested. The first results indicate that an improvement occurs every time when weekly observations are available. The tests show that the data assimilation has a clear effect on the water quality in the whole river downstream of the assimilation location leading to adjustments that persist for at least five days.

Keywords: data assimilation, water quality predictions, real-time monitoring, operational forecasting system.