Assimilation of near real-time radar altimetry data into a hydrodynamic model for streamflow and water level forecasting

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Satellite radar altimetry has been widely used in hydrological studies, such as monitoring of lakes and reservoirs, retrieving water level and discharge of rivers, calibration of river models, etc. Sentinel-3 SAR altimeter delivers data at three levels of latency, i.e. near real-time (less than 3 hours after data acquisition), slow time critical (within 48 hours after data acquisition), and non-time critical (typically one month after data acquisition). However, most studies use final products, i.e. non-time critical products of altimetry data for inland water monitoring or hydrological simulations. So far, to the best of our knowledge, no study has been exploiting the value of near-real time satellite altimetry data for hydrological research.

In this study, we first investigate data quality of Sentinel-3 near real-time data against non-time critical product and in-situ data over the Han River in China. Then, we assimilate these data into a 1-D hydrodynamic model, i.e. MIKE Hydro River, to exploit the near-real time altimetry dataset for hydrological forecasting. Specifically, we use the Ensemble Kalman Filter to assimilate altimetry-derived water surface elevation data into MIKE Hydro River model. The model state variable that is updated is the water level defined on the numerical grid of the 1D hydrodynamic model. Observation error estimates are generated from the standard deviations of water levels at each virtual station. Applying this operational forecasting system retrospectively over historical periods, the effect of updating water level at multiple virtual stations on forecast performance is investigated.

Through this study, we gain new knowledge about near real-time altimetry products for hydrological studies. This will be informative for both the hydrology community and satellite data providers.