Combining Envisat and CryoSat-2 altimetry to inform hydrodynamic models - DTU Orbit (17/08/2019)

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Remote sensing provides valuable data for parameterization and updating of hydrological models, for example water level measurements of inland water bodies from satellite radar altimeters. Many studies have used satellite altimetry data from repeat-orbit missions such as Envisat, ERS or Jason, or synthetic wide-swath altimetry data as expected from the SWOT mission. This study is one of the first hydrologic applications of altimetry data from a drifting orbit satellite mission, namely CryoSat-2. CryoSat-2 is equipped with the SIRAL instrument, a new type of radar altimeter similar to SRAL on Sentinel-3. CryoSat-2 SARIn level 2 data is used to improve a 1D hydrodynamic model of the Brahmaputra river basin in South Asia set up in the DHI MIKE 11 software. CryoSat-2 water levels were extracted over river masks derived from Landsat imagery. After discharge calibration, simulated water levels were fitted to the CryoSat-2 data: In a first step, the average simulated water levels along the river were calibrated to the CryoSat-2 data by adapting the hydrodynamic cross section datums. Subsequently the simulated water level amplitudes were fitted to those obtained from Envisat virtual station time series by adapting the cross section shapes.

The water level was only calibrated for the Brahmaputra in the Assam valley due to a lack of Envisat data further upstream. Despite the steep and rugged terrain in the upstream part of the Brahmaputra, the CryoSat-2 data was found usable after a Landsat river mask was applied. After calibration a hydrodynamic model with accurate spatio-temporal representation of water levels is obtained.

This is a prerequisite for real-time model updating by assimilation of CryoSat-2 altimetry or multi-mission data in general. For this task, a data assimilation framework has been developed and linked with the MIKE 11 model, enabling the integration of any kind of water level measurements. It is a flexible framework that can assimilate water level data which are arbitrarily distributed in time and space. Different types of error models and data assimilation methods can easily be used and tested. Furthermore, it is not only possible to update the water level of the hydrodynamic model, but also the states of the rainfall-runoff models providing the forcing of the hydrodynamic model. The setup has been used to assimilate CryoSat-2 observations over the Assam valley for the years 2010 to 2013, testing different data assimilation methods and model error representations. Performance improvement in terms of discharge forecast due to the assimilation of satellite altimetry data was then evaluated.

**General information**

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