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Radar altimetry assimilation in catchment-scale hydrological models

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Satellite-borne radar altimeters provide time series of river and lake levels with global coverage and moderate temporal resolution. Current missions can detect rivers down to a minimum width of about 100m, depending on local conditions around the virtual station. Water level time series from space-borne radar altimeters are an important source of information in ungauged or poorly gauged basins. However, many water resources management applications require information on river discharge. Water levels can be converted into river discharge by means of a rating curve, if sufficient and accurate information on channel geometry, slope and roughness is available.
Alternatively, altimetric river levels can be assimilated into catchment-scale hydrological models. The updated models can subsequently be used to produce improved discharge estimates. In this study, a Muskingum routing model for a river network is updated using multiple radar altimetry time series. The routing model is forced with runoff produced by lumped-parameter rainfall-runoff models in each subcatchment. Runoff is uncertain because of errors in the precipitation forcing, structural errors in the rainfall-runoff model as well as uncertain rainfall-runoff model parameters. Altimetric measurements are translated into river reach storage based on river geometry. The Muskingum routing model is forced with a runoff ensemble and storages in the river reaches are updated using a Kalman filter approach.
The approach is applied to the Zambezi and Brahmaputra river basins. Assimilation of radar altimetry significantly improves the capability of the models to simulate river discharge.