River water level and flow estimation using combination of space based altimeters and hydrodynamic models

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The water level and flow in major river of India are monitored by various state and central government agencies such as central water commission (CWC), and this data is used for various water management studies such as the water availability and flood forecasting. The traditional method of measuring river water level and flow is quite expensive and requires regular maintenance of field staff gauges and flow measuring instruments. Still, the existing network of such sites may not be sufficient to provide the required level of data for various water resources management studies. Satellite based altimeters have shown great potential in last 20 years to estimate and monitor water level in wide rivers all over the world. The present study have used the SGDR data from Saral-Altika, a joint Indo-French mission with Ka band altimeter, during 2013-2017 to estimate and monitor water level in major wide rivers of India such as Brahmaputra, Ganges and Mahanadi. The Mahanadi River was monitored using Altika data for track numbers 137, 228, 696 and 782, covering part of Mahanadi River from Khairmal to Naraj gauging sites during 2013-2016 time period. The Altika data gave four virtual stations along this river and near-by CWC gauging stations water level data was used to calibrate the satellite based water levels. The Altika track number such as 595, 782, 967, 152 from Patna to Bhagalpur were used for estimating the water level in Ganga River. Similarly, the Altika track number such as 266, 537, 810, 079, 352, 623, 165 and 896 were used in case of Brahmaputra river from Lakhimpur to Guwahati gaging sites, for finding the water level. In all cases, Ice-1 re-tracker was used find the range elevation along with standard tropospheric, ionosphere, tidal and datum corrections. The ground based and simulated rating curves, flow data from water resources system of India (WRIS), and 1-dimensional hydro-dynamic river flow models such as HEC-RAS were used to find river flow at the virtual gauging sites in these rivers. The accuracy assessment of water level and river flow was done using near-by gauging sites of CWC, after making required slope and datum corrections to each virtual site. At present, the derived water level for wide rivers is estimated at 17 to 35 day interval, which may not be sufficient for operational flood forecasting, but in near future, space mission such as, surface and ocean water topography (SWOT) can reduce the spatio-temporal resolution of such products.