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Comparison of different sensors for river discharge estimation from space

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River discharge is an important quantity of the hydrologic cycle and it is essential for both scientific and operational applications related to water resources management and flood risk prevention. The absence of flow measurements along the natural channels and, sometimes, the inaccessibility to remote areas contribute to make the discharge estimation difficult. In recent years, the availability of remote sensing data is steadily increasing and the great potential of satellite sensors to be used for discharge estimation has been already demonstrated. In particular, recent advances in radar altimetry technology have improved the accuracy in the monitoring of water height of large rivers and lakes located in ungauged or poorly gauged inland regions. Additionally, although not specifically dedicated sensors such as Moderate Resolution Imaging Spectroradiometer (MODIS) have also the potential to provide river discharge estimates.
In this context, this study uses data provided by MODIS onboard AQUA satellite and by altimetry onboard ERS-2 and ENVISAT satellites for discharge estimation along Po River (North Italy) where in-situ observations are available from January 2002 to December 2010.
The MODIS-derive discharge is obtained exploiting the different behavior of water and land in the Near Infrared (NIR) portion of the electromagnetic spectrum (MODIS channel 2). The ratio of reflectance values between two pixels located within and outside the river increases with the presence of the water and, hence, with discharge (or velocity). In a previous study, a regional relationship between the reflectance ratio and the flow velocity is derived by using MODIS data at four river reaches along the Po River. Altimetry-derived water levels are firstly compared with in-situ observed water levels in order to verify their accuracy. Successively, discharge is estimated from velocity (MODIS) and water level (altimeter) data by using simplified hydraulic relationships that incorporate the geometric and hydraulic features of the river cross-section.
The discharge estimates derived from the two sensors are compared with in-situ measurements and the effect of the data temporal resolution on the results is also evaluated. These aspects can be of particular interest, considering the next satellite mission SWOT for which significant improvements will be obtained in terms of vertical accuracy and spatial and temporal resolution.