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Estimating River Discharge Using Data Assimilation and SRTM-based Bathymetry: The Case of Po River (Italy)

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Nowadays, remote sensing approaches to measure hydraulic parameters (such as water surface elevation, river and lakes width) are strongly consolidated. Nevertheless, river discharge estimation directly from satellite is still a current challenge. Data Assimilation (DA) methods are becoming increasingly popular in hydraulic-hydrological applications. They combine available information from observations (remotely sensed or in-situ) and mathematical models simulations to provide an optimal estimation of unknown variables (i.e. river discharge) and parameters (i.e. roughness coefficient, bed elevation). Focusing on hydraulic modeling, DA methods are based on optimization algorithms that require prior knowledge of the model inputs, such as roughness and fluvial bathymetry. However, even if remotely sensed Digital Elevation Models (DEMs) are exploited to overcome the lack of topographic data in remote or poorly surveyed areas, they are not able to provide submerged river portion information. The aim of this study is to evaluate the improvement in river discharge estimation using spaceborne digital elevation model integrated with river bathymetry information. The study refers to a 132 km-stretch of the Po River (Italy) whose geometry information derives from a freely available satellite DEM SRTM (Shuttle Radar Topography Mission) with a resolution of 30 meters. River discharge is estimated using SIC4DVAR algorithm that combines the 1.5 full Saint-Venant hydraulic model SIC^2 and a variant of the 4D-Var method, while prior bathymetry information is retrieved from two different approaches: i) Channel Bankfull Approach (CB) that estimates river bottom from an empirical relationship identified by a set of hydromorphological variables available for a limited number of river sections; ii) Slope Break Approach (SB), which is based on the relationship between water surface width and elevation retrieved exclusively from spaceborne data. Simulation results further prove that fundamental role of the bathymetry in river discharge estimation and highlight the potential of the proposed methodologies to integrate remotely-sensed DEMs with bathymetric data.