Assessing SWOT discharge algorithms performance across a range of river types

Scheduled for launch in 2020, the Surface Water and Ocean Topography (SWOT) satellite mission will measure river height, width, and slope, globally, as well as characterizing storage change in lakes, and ocean surface dynamics. Four discharge algorithms have been formulated to solve the inverse problem of river discharge from SWOT observations. Three of these approaches are based on Manning's equation, while the fourth utilizes at-many-stations hydraulic geometry relating width and discharge. In all cases, SWOT will provide some but not all of the information required to estimate discharge. The focus of the inverse approaches is estimation of the unknown parameters. The algorithms use a range of a priori information.

This paper will generate synthetic measurements of height, width, and slope for a number of rivers, including reaches of the Sacramento, Ohio, Mississippi, Platte, Amazon, Garonne, Po, Severn, St. Lawrence, and Tanana. These rivers have a wide range of flows, geometries, hydraulic regimes, floodplain interactions, and planforms. One-year synthetic datasets will be generated in each case. We will add white noise to the simulated quantities and generate scenarios with different repeat time. The focus will be on retrievability of the hydraulic parameters across a range of space-time sampling, rather than on ability to retrieve under the specific SWOT orbit.

We will focus on several specific research questions affecting algorithm performance, including river characteristics, temporal sampling, and algorithm accuracy. The overall goal is to be able to predict which algorithms will work better for different kinds of rivers, and potentially to combine the outputs of the various algorithms to obtain more robust estimates. Preliminary results on the Sacramento River indicate that all algorithms perform well for this single-channel river, with diffusive hydraulics, with relative RMSE values ranging from 9% to 26% for the various algorithms. Preliminary sensitivity tests indicate that Manning-based approaches are more sensitive to slope error on the Sacramento River than on the Garonne River, but more sensitive to width error for the Garonne River. Fully understanding these tradeoffs is critical for reliable deployment of these algorithms for global discharge estimation from SWOT observations.

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