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Sensitivity of SWOT discharge algorithm to measurement errors: Testing on the Sacramento River

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Scheduled for launch in 2019, the Surface Water and Ocean Topography (SWOT) satellite mission will utilize a Ka-band radar interferometer to measure river heights, widths, and slopes, globally, as well as characterize storage change in lakes and ocean surface dynamics with a spatial resolution ranging from 10 - 70 m, with temporal revisits on the order of a week.

A discharge algorithm has been formulated to solve the inverse problem of characterizing river bathymetry and the roughness coefficient from SWOT observations. The algorithm uses a Bayesian Markov Chain estimation approach, treats rivers as sets of interconnected reaches (typically 5 km – 10 km in length), and produces best estimates of river bathymetry, roughness coefficient, and discharge, given SWOT observables.
AirSWOT (the airborne version of SWOT) consists of a radar interferometer similar to SWOT, but mounted aboard an aircraft. AirSWOT spatial resolution will range from 1 - 35 m. In early 2013, AirSWOT will perform several flights over the Sacramento River, capturing river height, width, and slope at several different flow conditions. The Sacramento River presents an excellent target given that the river includes some stretches heavily affected by management (diversions, bypasses, etc.). AirSWOT measurements will be used to validate SWOT observation performance, but are also a unique opportunity for testing and demonstrating the capabilities and limitations of the discharge algorithm.

This study uses HEC-RAS simulations of the Sacramento River to first, characterize expected discharge algorithm accuracy on the Sacramento River, and second to explore the required AirSWOT measurements needed to perform a successful inverse with the discharge algorithm. We focus on the sensitivity of the algorithm accuracy to the uncertainty in AirSWOT measurements of height, width, and slope.