Understanding SWOT Measurements in Coastal Wetlands

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Mangrove and tidal marshes are found on most of Earth's coastlines and estuaries. These ecosystems are regulated by a complex hydrodynamics processes including tides and influx of fresh water from the adjacent watershed. These ecosystems provide numerous services: they function as an extraordinary carbon sequestration system, serve as habitat and nursery for fish, crustaceans and amphibians. To coastal populations, they also provide lumber and act as an effective protection against tsunamis, storm surges and hurricanes. However, these ecosystems are threatened by sea level rise. However, the greatest threats result from human activity, which often changes the hydrology.

The Surface Water and Ocean Topography (SWOT) mission will enable estimation of water level and velocity along the coast and within large rivers. However, SWOT's capabilities and limitations in coastal wetlands remains to be assessed. Coastal wetlands are complex systems characterized by a mosaic of various vegetation types covering the water surface and are interspersed with numerous rivers and channels of different sizes.

Our overall goal is to assess the potential and limitations of SWOT to measure and monitor hydrodynamic processes in coastal wetlands, and to define the SWOT science products specific to coastal wetlands.

The specific objectives of this proposal are:

1. Assess the accuracy of SWOT's water level measurement in coastal wetland environments
2. Assess the ability of SWOT measurements to capture rapidly changing hydrology and phenology conditions in coastal wetlands.
3. Define SWOT's science products in coastal wetlands

This proposal will make extensive use of AirSWOT, in-situ and ancillary datasets collected during the May 2015 campaign in the Mississippi delta.

Our team:
Marc Simard, Benoit Laignel and Ernesto Rodriguez actively participated in the field campaign measuring vegetation type, coverage and biomass, and conducting several ADCP transects of channel bathymetry and flow velocity. These data will serve to simulate SWOT measurements and also to calibrate a hydrodynamic model. The model will be used to simulate water levels under various hydrological conditions and provide inputs to JPL/CNES-SWOT Simulator. In order to simulate SWOT's response to vegetation cover, we will use the AirSWOT and in situ datasets collected in the delta. Once understood, the vegetation response will be integrated as a module into the SWOT simulator.

To mitigate issues related to mixed pixels, we propose to use a spatial segmentation approach based on ancillary data to delineate homogeneous segments/objects of the landscape. Averaging SWOT pixels within those segments will increase the number of averaged pixels, thereby improving water elevation accuracy without significant degradation of the landscape features (e.g. small channel, vegetation zonation).

With a calibrated hydrology model and a SWOT simulator capable of handling coastal wetland environments, we will be able to generate scenarios in various hydrologic conditions and vegetation phenological stages over the Mississippi delta. These simulations will be used in the assessment of SWOT capabilities and limitations, both spatially and temporally.

Finally, we will compile and generate a global coastal wetlands map with structural parameters necessary to enhance the SWOT mission and generate science products specific to coastal wetlands. The definition of these products will be supported through a survey of the science community needs afforded through the existing domestic and international science networks of Simard and Laignel.
Our strong collaboration with French scientists proposing to the French TOSCA call for SWOT SDT participation is fully enacted with the proposed project. The French team includes 14 different teams led by Co-I Benoît Laignel from the Université de Rouen.