An Overview of SWOT related hydrologic research in Canada, with a focus on the St. Lawrence and Peace Athabasca Delta projects

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ABSTRACT

The Surface Water and Ocean Topography (SWOT) mission, planned for 2021, will provide unique opportunities to map elevation and slope of water bodies. Canada is blessed with millions of rivers and lakes; however, it is impossible to monitor all of these. Federal, provincial, territorial governments along with water resources practitioners in engineering consulting, mining, northern development, oil and gas, and general engineering practise will be able to take advantage of the unique dataset to be provided by this satellite mission. The objective of this presentation is to outline ongoing SWOT related hydrologic research in Canada, with a focus on two sites identified in Canada for the calibration/validation phase of the mission: The St. Lawrence River, and the Peace-Athabasca Delta.

The PAD is a 3900 km² fresh water wetland complex located at the western end of Lake Athabasca in northeastern Alberta, Canada. The Peace-Athabasca Delta was recognized as a Wetland of International Significance by the RAMSAR Convention in 1982. About 80% of the delta is also located within the Wood Buffalo National Park, which became an UNESCO World Heritage Site in 1983.

The St. Lawrence River is the downstream water body of the Great Lakes and Ottawa River systems and it is subject to large variability at all scales. While decadal time scale variability is caused by climate dynamics, management of its upstream sources can significantly impact water levels at the seasonal time scale, in particular in the Montreal archipelago. Between Montreal and Trois-Rivières, more precisely downstream of Sorel, the river widens significantly. The area, known as Lac St-Pierre, is a UNESCO biosphere reserve. This ecosystem is host to a vast number of migratory birds, and sustains an important recreational and commercial fishing industry.

Specific objectives of the project for the PAD and St-Lawrence River sites are as follows:

1- Using images from the AirSWOT mission, validate images by comparing the extent of the large lakes and wetlands with high resolution satellite radar imagery of the PAD;
2- Explore the capabilities of AirSWOT and/or SWOT simulator imagery to calibrate and validate hydrodynamic models of the PAD and St. Lawrence River sites;
3- Using the SWOT simulator, evaluate the capabilities of simulated SWOT data to improve the water balance of the PAD.

To achieve these objectives, a 2D hydrodynamic model (H2D2) has been implemented on the St-Lawrence River, on the Athabasca River and on Lake Mamawi in the PAD. Water levels simulated by H2D2 were used as input to the SWOT simulator. An AirSWOT mission is also planned for July-August 2017 over the PAD. Water levels derived from AirSWOT images will be compared to in situ water level as well as water levels simulated by H2D2. In addition, fifteen Radarsat-2 images acquired over the PAD in 2012 and 2016 were used to evaluate the extent of lakes in the PAD, which will be combined with aerial LiDAR DEM of the area and simulated SWOT imagery to assess water budget of those water bodies.