Estimation of Satellite Derived Bathymetry capabilities for shallow water mapping in the Saint Lawrence river

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Abstract—The capabilities of Satellite Derived Bathymetry and associated bottom products obtained from different kinds of satellite data are evaluated, for their further use in mapping of shallow waters of the Saint Lawrence River in Quebec.

Keywords—satellite derived bathymetry; Saint Lawrence River; shallow water mapping; bottom reflectance; bottom reflectivity

I. INTRODUCTION

The results of a collaborative pilot project between CIDCO, Quebec, who explores methods and tools to facilitate the logistics of data acquisition in shallow water, and Hytech-imaging, France, specialized in building operational products for coastal mapping using passive optical imagery, both multispectral and hyperspectral, are presented. The main goal of the study is to evaluate the contribution of satellite imagery and aerial orthoimagery to coastal mapping in the region between Tadoussac and Baie-Comeau on the north shore of the Saint Lawrence River in Quebec.

The capabilities of high spatial resolution (Sentinel-2, Worldview, and Planet) multispectral optical satellite data and aerial orthoimagery are comparatively evaluated, with the aim to extract the bathymetry and the reflectivity of the bottom, then to derive structural and radiometric parameters for the spatial characterization of shallow waters. Those two layers of information are to be used in the further river bottom substrate and vegetation mapping process, that will also make use of other available data sources (bathymetric lidar data, airborne hyperspectral data, acoustic data, field data, etc.).

II. MATERIAL AND METHODS

A. Sources of data

The following imagere is used in the evaluation: Sentinel 2, including 13 spectral bands between 400 and 2500nm, but with only 4 bands at 10m spatial resolution in the VNIR range (400-1000nm); WorldView II, including 8 spectral bands at 2m in the VNIR range; PlanetScope images from Planet, including 4 spectral bands at 3m in the VNIR range; orthoimagery including 4 spectral bands at 0.3m in the VNIR range. Multibeam echosounder data acquired by CIDCO is used in the estimation of errors and quality assessment.

B. Estimation of bottom parameters

The data are first corrected for the atmosphere using the so-called ‘a2cor’ processing chain, developed by Hytech-imaging, which is based on the 6S radiative transfer code and a specific automatic procedure aimed at estimating the optical thickness of the atmosphere. The calculation of the water depth and bottom reflectivity is done using SWIM® (Shallow Water mapping from optical reMote sensors), a specific code for the inversion of the radiative transfer model in the water column and the generation of cartographic products in shallow waters [1]. The water depth data are filtered using a semi-automatic process that takes into account the water quality parameters provided by SWIM®, thus eliminating inconsistent data. The data are then projected on a regular grid in the UTM system. The height of the water is converted to bathymetry using a tidal model. The accuracy obtained is evaluated thanks to the IHO Hydrographic Standard S44 [2].

III. RESULTS

Following figure shows an example of bathymetry (left) and bottom reflectivity used to derive substrate types (right) obtained from Sentinel 2 on the pilot site of Manicouagan.

REFERENCES
