

The digital elevation model: the basis of support for integrated modelling activities on the St. Lawrence River

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INTRODUCTION

For almost a decade, Environment Canada's Meteorological Service has been developing expertise in the integrated modelling of the living physical aspects of the St. Lawrence River. The integrated modelling of the physical aspects is carried out by combining the results of the bi-dimensional hydrodynamic model with simulations of waves, wind, water quality and sedimentation, which are calculated on the part of the river between Cornwall and Trois-Rivières. All these simulations are supported by a high-definition Digital Terrain Model (DTM) precisely representing the region.

DIGITAL ELEVATION MODEL

The main component for this digital terrain model is the elevation or topography model. It is a digital representation of the landform of the bottom of the river and its floodplain. The digital elevation model is the result of a combination of a large number of topographic measurements carried out at different periods and coming from different sources. They are divided into two groups: Bathymetric and topometric data. Topometry is measured on firm ground using a type of LIDAR (Light Detection and Ranging) called ALSM (Airborne Laser Swath Mapping). The bathymetric data come from several sources, such as the field sheets from the Canadian Hydrographic Service, Hydro-Québec surveys and the Canadian Coast Guard, as well as reports from Environment Canada's Meteorological Service.

MEASUREMENT TECHNOLOGY

Several technologies are available to collect data describing the topography of the coastal, estuarine and river zones. Each technology includes specific characteristics in terms of precision, density at the points collected and operating environment. In aquatic environments, bathymetry measurements are traditionally taken using echosounding. The digital elevation model of the river used by the Meteorological Service of Canada has more than 1.3 million sounding sites.

In the case of floodplains, LIDAR (specifically ALSM or Airborne Laser Swath Mapping) was used for its high acquisition speed and accuracy. LIDAR is installed in an aircraft and uses laser technology to collect millions of spots elevations on the ground surface under the aircraft's position. This is relatively recent technology, which is used in a growing number of fields of study, in particular for river modelling and environmental research. Environment Canada's model has nearly 216 spot elevations for LIDAR data, i.e., approximately one point every 2 m of floodplain.

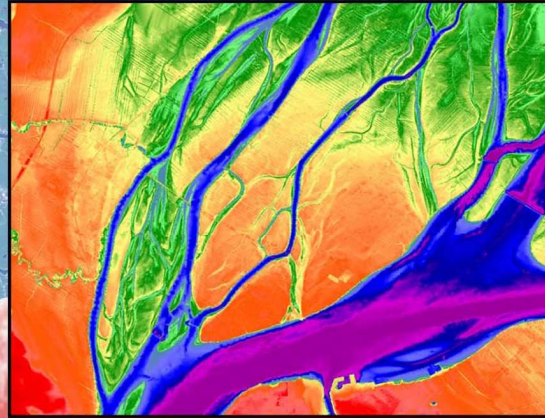
POST-PROCESSING

One of the greatest challenges in developing the elevation model involves in converting this collated data into a homogenous whole. Using different methods, data were converted into a map projection and a common reference surface.

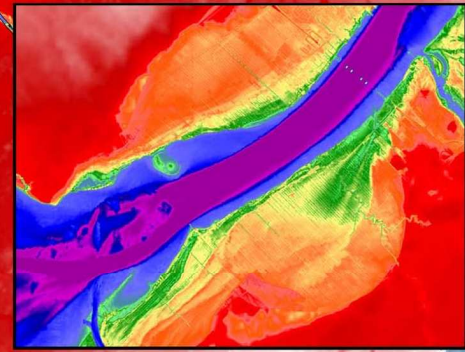
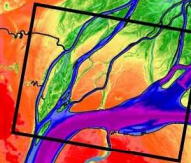
VALIDATION AND MAINTENANCE

The data were initially checked in terms of the consistency of the linkages between data sets. The data were also compared with measurements taken manually on the terrain of each sector. Validation was thus carried out using data sets measured completely independently.

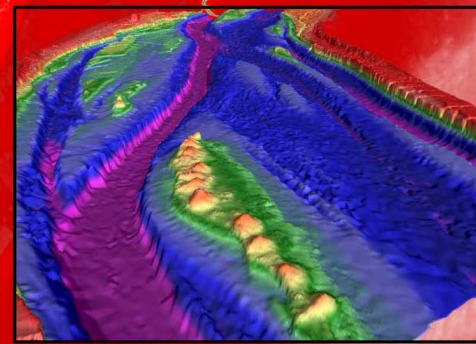
Developing and maintaining a reliable DEM (digital elevation model) is tedious work. Since the reality of the land is constantly changing, updates must be made regularly while giving priority to zones where changes are more prominent.



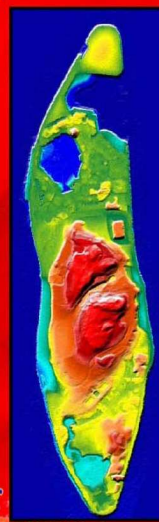
Enlargement of the Sorel Islands



Enlargement of the outlet of Lake St. Pierre up to the Lavolette Bridge in Trois-Rivières



Enlargement of the Sorel Islands



3D enlargement of Saint-Hélène Island



Aerial photography of Saint-Hélène Island

