Paper for consideration by NSHC
[Hydrographic bench of Satellite-Derived Bathymetry]

Submitted by:	France
Executive summary:	France has launched a study to assess the quality of new approaches of SDB. This paper describes the context and the current status of this study.
Related Documents:	Proposal 6 for the EIHC5 – CCL IHB n°8, 21 February 2014
Related Projects:	-

Background
SHOM has been using satellite imagery for several years to improve hydrography in remote regions, where scarce or insufficient survey data exists and is difficult to collect with ships. It is a cost effective way to bring new information to charts compiled from very old or sparse bathymetric data.

Principle and limitations
Multispectral imagery analysis principle lays on the sun light reflectance from water column, the removal of air column and seabed effect, and the intensity analysis of reflected bands to derive depth data.
Main limitations are the environmental conditions (sea surface disturbance, turbidity and cloud cover) and some systematic and physical limitations (sun glint and sensor angle).
Bathymetric extraction from the radiance signal received by satellites can be broadly divided into two approaches:

- Empiric models based on the very simple exponential attenuation of light and further heavily dependent on field calibrations. It consists of calculating the various unknowns from a statistical comparison with field measurements and assuming that the conditional probability law thus defined can be extended to the entire area. The limits of these methods are well known as corrections are generally calibrated for only one given dataset and one given location. Thus, they are not necessary repeatable, nor transferable worldwide.
- Physic-based models, all derived from the Lee & al equations (1999), do not require calibration data and are far more robust in terms of transferability between different water and atmosphere optical properties. The key differences with empirically calibrated methods are that :
    - water optical properties and bottom reflectance are treated as 'constrained unknowns',
    - all the bands of multi or hyperspectral data are used simultaneously to find an optimal solution.

The way ahead
The very promising physic-based methods have the inconvenience of having been mostly tested by academics developing them on a limited selection of well surveyed sites.
For this reason SHOM decided to conduct a realistic assessment of the SDB potential in operational conditions, in order to make the new methods applicable to production, in accordance with the scientific state of the art.
A study was contracted with ACRI-ST company, in order to have an objective measure of SDB uncertainty with new physical-based methods. Trials are located on 3 French overseas zones in Pacific Ocean (atoll of Tahanea, atoll of Ouvéa and Beautemps-Beaupré), and Indian Ocean (banc de la Zélée), which surface can go up to about 50 by 50 kms.
By end of June 2014, the results of the physic-based methods will be delivered to SHOM, which will only then give ACRI-ST the existing bathymetric data and empiric model, in order to compare them with the physic-based model.
The final result will be transmitted by end of August, so the new tools can be evaluated and tested at SHOM up to end of October.
A new coding quality of surveys obtained by satellites will be proposed, very inspired by the formalism of IHO S-44. Mapping the uncertainty with reference to this encoding could thus be associated with the bathymetry model derived from satellite.

At the end, if the study gives good results, new performance standards will be proposed to indicate to the end users which confidence they can have on SDB data.

Current status
The study is progressing well but it is premature to show any results right now. Some intermediary and pending results could be presented at the EIHC 5th. France will keep IHO member States updated on the final results of the project.

Action required of NSHC

The NSHC is invited to note the paper and take action as appropriate.