Paper for consideration by NSHC

FR SDB study

Submitted by:	France
Executive Summary:	Satellite derived bathymetry new promising methods have been put to the test, a basic hydrographic analysis leads to findings which show that there is still room for further progress.
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General context

Hydrographic surveys are expensive. Due to some budget cuts there are deficiencies and erosion of general bathymetric knowledge. This situation is paradoxical as there are growing needs for up to date, precise and dense information to guide political action and to support the blue growth.

For economic reasons HOs are increasingly tempted to use bathymetry derived from satellite optical images. There are scientific and technical challenges to solve before reproducing as faithfully as possible the reality, SHOM and pioneers of SDB know that. Moreover, without any ground control truths and in a full remote mode, HOs should significantly reduce costs. There is no doubt that it requires both good algorithms and high quality images but theory is very promising. How high are the stakes?

Framework and main results

In 2015, SHOM put SDB to the test and subcontracted a study to experiment new radiative methods. It led SHOM to select French well known atolls, with clear water and few clouds most of the time. Pléiades and WorldView2 images fuelled non-empirical algorithms with high resolute pixels and then SHOM made comparison between this new SDB method, the empirical Lyzenga models and some sonar depths sharing the same location.

Visually new models look consistent with the topographic details expected. In particular, tops of coral pinnacles are best captured, compared to Lyzenga methods, it was quite a nice surprise.

Even though S-44 was not created specifically for SDB evaluation, it gives some reference values well known in the hydrographic community and it facilitates comparisons. Thus, putting in the details, SHOM continued its analysis by tracing scatterplots of the results. It is noticeable that there are dispersion and significant differences, on both sides of the regression line that separates models of any kind from sonar depths. Many results are far away from S-44 thresholds. Most often, the results are out of range, none succeeds to reach special order, order 1 or even order 2.

Charting the differences with S-44 orders, differences are obviously not always correlated to the depth. There is a spatial dispersion of uncertainties which reflects more the inhomogeneity of the images than the performances of the algorithms. The SDB agreed rule of 10% depth uncertainty is thus undermined in many cases. The uncertainty model issued by new methods has exactly the same drawbacks and is not useable directly to determine an appropriate cut-off.
Lyzenga models do not take advantage of ground control depths either, and lead to fairly similar findings. Surprisingly this study is also challenging for SHOM's production line. The good point is that the study reinforces the idea that, in some still mysterious circumstances, ancillary calibration is not necessary.

Analysis and ways ahead

It is of course impossible to draw general conclusions within this single case study. Sonar depths soundings used for the comparison derive from a vertical sonar and as a consequence comparisons are limited along single tracks. Thus, there is nothing that can be said on detection capability of small objects, for instance.
Other studies within the HO community mixing high density surveys (MBES), different typical areas and seasons will help to quantify the impact of the environmental conditions on the performances of the SDB algorithms.
At last, the quality of images is essential to insure good quality SDB products. SHOM suspects that there is much more room to enhance satellite images (shooting strategy, collaborative satellites), instead of improving radiative inversion methods, already stretched to the limits.

Action required by NSHC

The NSHC is invited to take note of that information paper.