Geophysical Research Abstracts
Vol. 20, EGU2018-452-2, 2018
EGU General Assembly 2018

A multispectral earth observation approach for retrieving bathymetric data: models and in situ data evaluation

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In maritime areas where safety of navigation is an essential issue, such as ports, harbours and waterways, hydrographic surveys are regularly performed by traditional echo sounder systems. However, in coastal areas with low maritime traffic, safety of navigation is usually of minor concern and consequently hydrographic surveys tends to be performed less frequently. Nevertheless, in these areas, bathymetric data is still needed for other activities such as coastal monitoring and oceanographic operational forecast models. For these applications Satellite-Derived Bathymetry (SDB) tends to be accepted as a valid tool for obtaining bathymetric models for shallow waters. These models can be extracted using several empirical algorithms combining remote sensing imagery with in situ data. In this study, we intend to evaluate the robustness of bathymetric models obtained for shallow waters in coastal zones, typically with depths equal or less than 10 m. These models were retrieved from high-resolution multispectral satellite imagery applying a methodology based on the algorithm presented by Stumpf et al. (2003). In order to accomplish this purpose, different in situ datasets were used: acquired at different time periods, earlier or distant dates from the imagery time acquisition, and/or obtained from different sources, such as traditional hydrographic surveys with echo sounders, Light Detection and Ranging (LiDAR) systems and nautical charts with ancillary bathymetric data. For each in situ datasets, two different calibration approaches were used, one based on a linear regression, as proposed by Stumpf et al. (2003), and another applying a quadratic regression. For this study Sentinel-2A and Landsat-8 imagery covering different locations along the Portuguese coast were used. Based on all different in situ datasets and calibration approaches, several bathymetric models were obtained, which were then compared with each other as well as with hydrographic data acquired with echo sounders. The results show that the proposed SDB methodology delivers bathymetric models with a good level of reliability regardless of the acquisition time or source of the in situ datasets. Furthermore, the SDB models derived from the quadratic regression approach appear to be a promising solution for modeling bathymetry for shallow waters. The present study was developed within the EU H2020 Coastal Waters Research Framework (Co-ReSyF) project and its conclusions will be applied in the validation process of the SDB application available in the Co-ResyF online platform.

References:
Stumpf, R.P., Holdereid, M., Sinclair, M. (2003). Determination of water depth with high-resolution satellite imagery over variable bottom types. Limnology and Oceanography, Vol. 48, No.1, Parte 2, Pgs. 547-556.