Innovation in shallow water mapping

HYDROGRAPHY

An EU co-funded R&I project aims to develop a remote solution for global satellite-derived sea-floor mapping

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Understanding the sea floor's topography and characteristics is vital for planning and managing the blue economy's sustainable marine and coastal activities in accordance with UN Sustainable Development Goal 14: 'Conserve and sustainably use the oceans, seas, and marine resources'.

Sea floors are usually mapped via active sensors installed on vessels. Underwater acoustic techniques such as single-beam and multibeam echo sounders can provide accurate and high-resolution bathymetry down to the farthest reaches of the ocean floor. However, shipborne mapping in shallow water is significantly more time-consuming than in deepwater areas and presents a greater safety risk. Airborne lidar bathymetry (ALB) can map shallow water areas quickly, but requires optimal water clarity. The costs associated with multibeam or ALB survey campaigns depend on the scope of work, but they can be considerable.

The development of satellite technologies and sensors has enabled satellite-derived bathymetry (SDB) to become an emerging technology in support of conventional shallow-water sea-floor mapping, where water clarity permits. SDB is a passive mapping method that uses multispectral satellite imagery data: satellite platforms capture the sunlight reflecting from the sea floor and record it in multiple spectral ranges. In September 2020, the International Hydrographic Organization released the new edition of Standards for Hydrographic Surveys and categorised SDB as a depth measurement technique that can meet different survey needs.

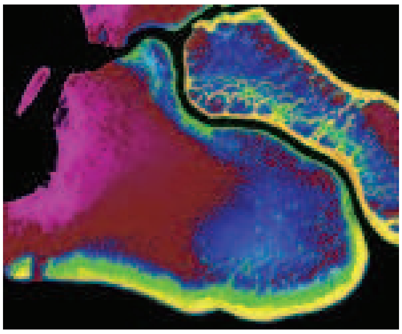
Satellite consortium

A consortium of satellite data analytics, geo-data and biology experts is partnering on '4S' (Satellite Seafloor Survey Suite), an innovative solution for mapping for shallow water based on cloud-processing satellite sea-floor data. The 4S consortium is led by EOMAP, and partners include Fugro, the Hellenic Centre for Marine Research, QPS, Länsstyrelsen Västerbotten, CNR ISMAR, the Hydrographic Institute and Smith Warner International Ltd. It has received funding from the EU's Horizon 2020 R&I programme.

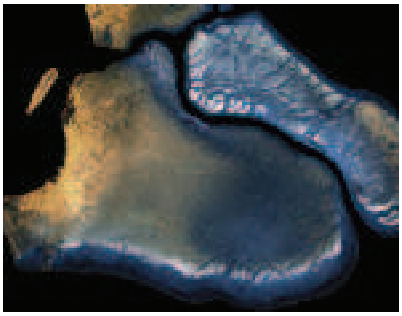
4S will use EOMAP's Modular Inversion Program (MIP), a physics-based light inversion model, to provide shallow-water bathymetry. MIP can:

- derive bathymetry without requiring in situ data;
- provide water column properties; and
- provide sea-floor properties.

The above can be achieved in environments of approximately 1 to 1.3-time Secchi disk depth at the time of satellite image recording.



Above: Satellite-derived bathymetry of Great Barrier Reef from reef crest down to approximately 25m water depth. Below: Sea-floor reflectance of Great Barrier Reef



Artificial intelligence will then be used to select satellite images, and machine learning will classify sea-floor properties based on users' uploaded data and existing on-site knowledge, while new on-site data will be used to train the 4S algorithm and sea-floor classification software.

Due to limitations in accuracy and resolution, satellite sea-floor mapping will never replace acoustic and lidar techniques. Nonetheless, it can be a powerful tool for different applications, including supporting the planning phase of high-resolution mapping projects by quickly providing reconnaissance data. It can also act as a data gap filler in shallow-water areas that are unsafe for small boat operations.

Satellite solutions can access remote locations and are therefore cost-effective and reduce human health, safety, security and environment exposure. 4S aims to provide a highly automated cloud-based web application for remotely mapping and monitoring the shallow-water sea floor from the comfort of our desks. ■

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