BLUE OCEAN FLOOR

NEW HIGH-RESOLUTION MAPS FOR SEAFLOOR HABITATS AND SHALLOW WATER TOPOGRAPHY HAVE BEEN CREATED FOR THE ABU DHABI USING SOPHISTICATED SATELLITE IMAGE PROCESSING METHODS. KNUT HARTMANN EXPLAINS HOW IT WAS DONE AND WHAT BENEFITS IT WILL HAVE IN THE FUTURE

The Environmental Agency of Abu Dhabi (EAD) has been tasked with raising environmental awareness, aiding sustainable development and promoting environmental issues. To further these aims, in 2013, it initiated a multi-year programme to create fine-scale land-use, land-cover and habitat maps for the entire country and surrounding seas, to provide baseline data layers for decision-making and management.

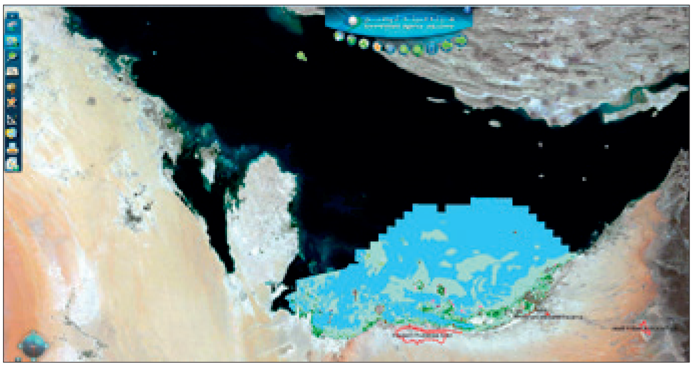
As the only applicable and cost-effective solution to perform this work in a timely manner was through using satellite imagery, EAD contracted a consortium of remote sensing companies to deliver these services. In particular, it selected my firm, the German-based satellite service provider EOMAP, to map the seafloor habitats and compile bathymetric data for the 25,000km^2 of Abu Dhabi seawaters. Until this point, a complete, high resolution and temporally significant seafloor composition dataset was not available for this area.

For our analysis, we used satellite imagery from the RapidEye constellation, which provides colour information in a 5m grid. In total, we selected 12 satellite scenes from 2011 to 2013 to derive the products. The classification schema of the seafloor habitats followed the well accepted CMECS (Coastal and Marine Ecological Classification Standard) but it was refined in cooperation with EAD and with the ecological knowledge supplied by the local company Nautica Environmental Assessment LLC.

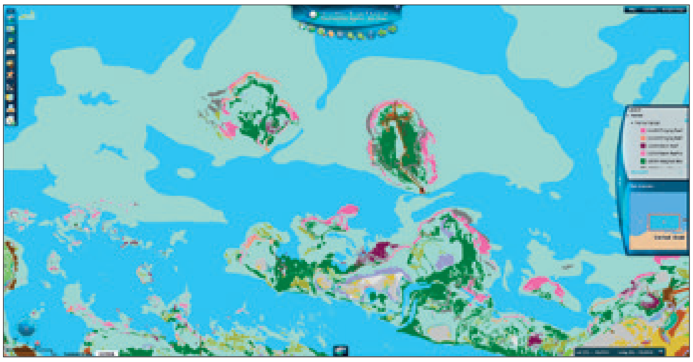
In total, we identified and mapped 11 habitat classes, including corals, seagrass and macroalgae. The classification was based on seafloor reflectance data derived from the RapidEye satellite imagery through a multi-step processing system that corrects the data for various negative environmental effects encountered in the atmosphere and water column. The final classification methods followed an object-based approach that considered the seafloor reflectance, the textural properties of the seafloor and the water depth information.

The mapping products were validated by 58 independently collected in-situ sample data, which were located throughout the programme area.

At the end of the project, we provided EAD with high-resolution classification of the seafloor habitats and bathymetry to a depth of 15m, based on current data. The benthic mapping was validated to have an overall fit of 83% when compared to in situ measurements. The geodata product followed OGC standards and is now freely accessible through the EAD online portal (http://enviroportal.ead.ae/mapviewer/)



Seafloor classification of Abu Dhabi visualised in the online portal of the Environmental Agency of Abu Dhabi (http://enviroportal.ead.ae/mapviewer/)



More detailed view of the seafloor classification of Abu Dhabi visualised in the online portal of the Environmental Agency of Abu Dhabi (http://enviroportal.ead.ae/mapviewer/)

Reflectance product of Al Quaffay Island and shallow waters. © EOMAP 2015/ DigitalGlobe 2013

Results

Baseline data of this kind provides up-to date and highly detailed information of the seafloor extent and can inform the decision-making process in the coastal region for activities such as mapping and engineering impact assessments. Dredging, for example, affects the health of nearby corals when water quality parameters exceed certain thresholds over time. With the knowledge of the position and extent of each coral patch in Abu Dhabi, the impact on dredging to these environments can be minimised.

Furthermore, the newly available information will be used to understand and track animal movements, such as the dugong (seacow). Dugongs consume 21-36kg of seagrass every day and thus require large seagrass ranges to prosper. Based on the project results, the overall extent and presence of seagrass was mapped in high detail, providing key information on the dugongs' feeding grounds. A total seagrass area of 1,027km^2 was identified. This information will also be considered in future decisions to define or reshape marine parks and protected areas.

Another hot topic with respect to seagrass mapping is the assessment of the 'blue carbon', which is the carbon assessment for benthic habitats. Seagrass is a major carbon sink and has a strong growth rate over large areas. Mapping these areas was a first step in assessing the carbon storage of this habitat and an important input into Abu Dhabi's national greenhouse gas inventory.

By using satellite image analysis to fulfil the project's scope, EAD is now the first agency in the Gulf to have full knowledge of its marine benthic habitats. Compared to in-situ sampling, which is often a mixture of dive transects and underwater video or image captures, the satellite solution is only a fraction of the cost and provides rapid results. These benefits can be seen as even more significant, when the assessment of the bathymetric data is considered as well. Compared to conventional methods to acquire bathymetric data, such as MBES or LIDAR, the speed of delivery and cost saving is approximately 10- to 20-fold.

Outlook

In the near term, we see satellite-derived seafloor and bathymetric datasets becoming fundamental spatial data sources used in decision-making for the coastal zone. But to maintain it reliably and accurately, regular maintenance and updates of the data are mandatory.

Here, again, satellite service will be an important tool. With more and more high resolution satellite data available – DigitalGlobe's World-View-3 was launched in August last year, the second South-Korean Kompsat 3 satellite in March this year – updating the benthic mapping products is realistic and cost attractive. Furthermore the upcoming European Space Agency Sentinel-2 fleet will provide high resolution satellite data every there to five days over the same area.

This data can then be used to map not only the current benthic habitat coverage but also the annual cycle and growth patterns in the coastal environment. Seagrass, for example, has the maximum extent in the winter months, while the extent decreases in the summer months. To handle the amount of big data from space, more and more focus will be on the effective data handling and merging of multitemporal satellite imagery, which requires an effective workflow and access to the satellite imagery from the archive.

WE SEE SATELLITE-DERIVED SEAFLOOR AND BATHYMETRIC DATASETS BECOMING FUNDAMENTAL SPATIAL DATA SOURCES USED IN DECISION-MAKING FOR THE COASTAL ZONE

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