SEABED MAPPING: NO ONE-SIZE-FITS-ALL!

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Marine ecosystems are affected by a multitude of drivers and pressures, both natural and anthropogenic. Sustainable management therefore requires a diverse range of tools and approaches in which seabed mapping is an essential component. This is exemplified in the European Marine Strategy Framework Directive (MSFD, 2008/56/EC), prescribing monitoring of changes in broad habitat types (BHT) for the assessment of Good Environmental Status, and seafloor integrity (SI) in particular. The substrate part of the BHT mapping relies on estimating ratios of mud, sand, and gravel in seabed sediments, and is a common denominator for seabed mapping across Europe (i.e., Folk classification in EMODnet-Geology, Kaskela et al., 2019). Within the constraints of this context, approaches need to be found that can cope with small-scale transitions between BHTs, but still build on datasets that are widely available for consistent seabed change assessments across regions.

Meanwhile, rapid evolutions in methodology take place in seabed mapping, mostly linked to the use of acoustic remote sensing and seafloor classification. Whilst at the smaller scale, highly detailed sediment maps can be produced with good predictive power, the confidence in the required regional BHT maps is typically much lower. This is related to integration of more fragmented data collected over a wide time span, and consequently also because of the variety of technologies and gear used over time. Amplification of uncertainties in the data chain is inevitable, complicating seabed change analyses. For BHT maps to be useful for management, these shortcomings need to be bypassed, e.g., by increasing the understanding of the nature and dynamics of the different sediment types. This is especially true for the coarse sediment habitats for which changing sand dynamics may lead to irreversible loss.

A new mapping approach was developed relying on differences in small-scale relief as a proxy of sediment type. This gives the advantage that also very-high resolution bathymetry can be used being available increasingly over vast areas. With relevance to the entire BPNS, data was used from Flemish Hydrography (agentschapmdk.be/en), and were analysed against a diverse range of other datasets (e.g., sediments, geology, biology) and morphodynamic information to map sediment types. To build up knowledge on seabed nature and dynamics systematically, whilst assessing human-induced changes as well, a new monitoring network (SI-NET) was designed, crossing gradients of seabed types and human-activity hotspots over the entire BPNS.

Original maps were produced at 50k scale and were then resampled to 100k, 250k at 1M scales following guidelines set by EMODnet-Geology. The sediment type polygons were attributed with seabed features providing relevant context on seabed nature and dynamics influencing confidence. The maps (e.g., Van Lancker et al., 2023) were then integrated into the latest release of the pan-European seabed substrate maps and further translated into BHT maps (downloadable via EMODnet.eu, via the Geology and Seabed Habitats Lots respectively).

In next releases incorporation of newest evolutions in the use of multibeam backscatter and machine learning approaches will be evaluated. Future developments will also incorporate new elements enabling change assessments (geological markers, seabed patterns and bedform complexity) and will benefit from detailed morphodynamic research (NWO BANX). Cross-fertilisation is further aimed at with international networks such as EMODnet.eu (Geology and Seabed Habitats), GeoHab.org, and the Geological Service for Europe (eurogeosurveys.org).

The research contributes to the Belgian monitoring programme on the implementation of the Marine Strategy Framework Directive, and ZAGRI (private revenues related to sand extraction); as well as to EMODnet-Geology. The developments align with RBINS' Research Strategy on 'Science for a Sustainable Marine Management' and 'Geology for Society'.

References

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