Developing an innovative method to map turbidity in the North Sea

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Mapping turbid areas in the North Sea is vital, as the turbidity or 'cloudiness' of water is one of the key parameters that can (negatively) impact water quality and marine life. Remote sensing of ocean color has been used successfully for decades to derive turbidity, but is restricted to the surface layer of the water column. Multibeam sonars, on the other hand, hold great potential to deliver a 3D image (one of the MSFD recommendations). Traditionally, multibeam sonars measure bathymetry, but recent advances in storage capacity and processing power now also allow recording of backscatter values in the water column at sufficiently high resolution (Colbo et al., 2014). This novel technology of using backscatter to visualize the water column has been embraced by a myriad of applications, e.g. detection of fish populations, gas seepage or ship wrecks. Only a handful of studies have used water column data so far to detect suspended sediment in the water column (e.g. Simmons et al., 2017). Furthermore, the majority of these studies have been conducted in a controlled environment or experimental set-up.

In the TIMBERS project, the strengths of both optical remote sensing (VITO) and multibeam echo-sounding technologies (VLIZ) will be combined in order to create 3D-turbidity maps. VLIZ will focus - for the first time - on the development of a practical methodology to map turbidity over a 3D volume in an 'uncontrolled' natural environment, i.e. the Belgian Part of the North Sea. For this purpose, we will collect multibeam data with the Kongsberg EM 2040 from the RV 'Simon Stevin' and a portable system (Norbit Multibeam sonar) installed on the RIB 'Zeekat'. The feasibility of using multibeam data to extract sediment concentrations in the water column will be investigated by acquiring in-situ turbidity measurements with various sensors (LISST200X and OBS D&A 3+) and Niskin bottle samples at the same time. Comparison of the acoustic backscatter values with the in-situ measurements of turbidity will yield an empirical relationship, allowing fast future turbidity measurements.

In October 2019, we joined a 'Lifewatch' campaign, intended for monitoring biodiversity in the North Sea. At each measuring station, we concurrently collected multibeam water column and in-situ turbidity data. After the campaign, the acquired multibeam water column data was evaluated. Two major artefacts appeared. First, a distinct line artefact was observed in the data, caused by a slightly different frequency in the two transducer heads. Secondly, the water column data clearly demonstrated that the movements of the ship influenced the data quality: a slow-moving vessel yielded the best data. Looking at some of the sensor data in detail indicated that the general trend of the turbidity profiles is very similar to the grain-size trend. Also, the mean grain size of the particles in suspension (36-132 µm) varies slightly through the water column; higher concentrations of the sand fraction occur at intermediate levels. The preliminary results highlighted that some challenges need to be tackled in the future, but also provided useful insights to further finetune the acquisition and processing pipeline of this 'cutting edge' research.

Once a robust method is established that confidently converts backscatter to reliable turbidity values, the applicability of this innovative method can be expanded to different acquisition systems and other regions. As multibeam echo-sounding is one of the most popular marine measurement tools available in the world, our approach holds great potential for a multitude of applications. In Belgium, the perspective of efficiently monitoring turbidity in the water column in 3D is very valuable for both the research community and industry (e.g. the Blue Cluster).

References

- Colbo, K., Ross, T., Brown, C., Weber, T., 2014. A review of oceanographic applications of water column data from multibeam echosounders. *Estuarine, Coastal and Shelf Science* 145, 41–56.
- Simmons, S.M., Parsons, D.R., Best, J.L., Oberg, K.A., Czuba, J.A., Keevil, G.M., 2017. An evaluation of the use of a multibeam echo-sounder for observations of suspended sediment. *Applied Acoustics* 126, 81-90.

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