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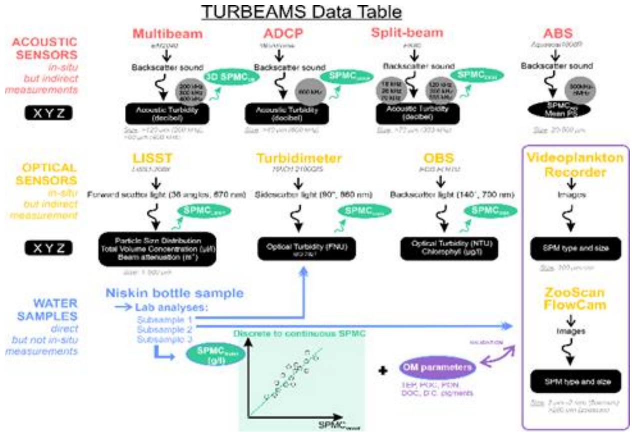
Specific call for research proposals 2021

TURBEAMS

Towards 3D turbidity by correlating multibeam sonar and in-situ sensor data



DURATION
15/12/2021 - 15/03/2026

BUDGET
€ 980 607

PROJECT DESCRIPTION

Turbidity (or the cloudiness of water) is related to the concentration and type of suspended particles in the water column. These particles may be either of planktonic (both zoo- and phytoplankton) or sedimentological origin (resuspension of surface-bound sediments). Combined they form a cloud of suspended particulate matter (SPM) which affects light penetration in coastal waters. In order to ensure good water quality, turbidity and SPM have been monitored in the Belgian Part of the North Sea for decades, either in 1D (moorings, ship-based samples, tripodes on the seafloor, …) or in 2D (Acoustic Doppler Current Profiler, ADCP, transects). However, studies have indicated the very dynamic nature of SPM variability and the complex shape turbidity clouds can have. This justifies the need for 3D measurements of turbidity and SPM.

A possible solution lies in multibeam sonars which, next to seafloor bathymetry data, are also able to deliver a 3D dataset of backscatter values in the water column. However, these 3D datasets are still scarcely used in quantitative turbidity and SPM assessments of the water column. One of the causes is that available software lacks proficient processing capabilities and it is not flexible enough to apply new innovative water column processing techniques. Another problem lies in the relationship between the acoustic return signal and the variable character of SPM, which is still insufficiently resolved. The development of an innovative methodology and software that could tackle these problems and convert acoustic water column data to quantitative 3D turbidity and SPM information would be extremely relevant for both science and industry. Scientists would be able to derive SPM concentrations within the water column over large areas or investigate plumes generated by storm events. Industry would benefit from the advanced 3D investigation capabilities of the technique, which for example would allow monitoring environmental impact of sediment plumes from bottom-disturbing activities (e.g., sand dredging or bottom-trawling fishing activities).

The ultimate goal and most anticipated result of the TURBEAMS project will be the development of a methodology which leads to **3D turbidity and SPM imaging based on multibeam water column data**, improving future monitoring tools. In order to reach this goal we outline 4 research objectives. The **first objective** of the project is to determine **SPM characteristics** (type, size and concentration). The **second objective** is to **quantify the relation between multibeam water column data and SPM-related parameters** (SPM type, concentration, grain size, optical turbidity) derived from in-situ optical and acoustic sensors. For this, we will use statistical and machine learning methods (e.g. Bayesian Evidential Learning) to analyze the large amounts of data from the many different sensors and additional environmental parameters (e.g. water currents).

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The **third objective** of the project is **to develop** a new water column multibeam **processing library** that allows for **flexible and efficient data processing and rapid visualization** using python scripts. Then we want to use this library to develop user-friendly workflows that can be applied by other scientists. Using the results from the previous objectives, the **final (and fourth) objective** of the project is to analyse the small-scale, seasonal and spatio-temporal variability and vertical distribution of SPM concentration with special attention on the near-bed SPM concentration in view of evaluating SPM concentration derived from multibeam echosounding for **monitoring human impacts**.

A fit-for-purpose survey and acquisition strategy, together with specialized and newly developed processing techniques will be implemented to fulfill the objectives. The survey and **acquisition strategy** consists of an absolute calibration of the acoustic backscatter values of the shallow-water multibeam, allowing exchange and comparison of data with other calibrated multibeam systems. Furthermore, we will implement a rigorous pinging strategy, allowing simultaneous, yet non-interfering, acquisition of multi-frequency acoustic datasets. 3D multibeam water column data will be processed using a **data processing pipeline** that builds on the newly-developed processing library. The acoustic data will be converted into turbidity and SPM information based on the relation between multibeam backscatter values and in-situ sensor data.

The multibeam water column processing workflows and empirical relationships established during the TURBEAMS project may prove crucial in acquiring 3D turbidity and SPM information in marine environments and may serve as a **catalysator in follow-up research** proposals. Examples include monitoring turbidity changes at windmill farms or downslope turbidity flows in canyons systems, located on continental slopes. The developed workflows, relationships, processing libraries and other scientific results will be published in open journals and repositories, allowing all stakeholders to use, implement and improve the deliverables from the TURBEAMS project. At the end of the project, a symposium on multibeam water colum data will be organized to disseminate the final results and bring all stakeholders together. Moreover, active participation in outreach activities for the general public (including "Dag van de Wetenschappen") will be set up, ensuring maximum outreach of the obtained results.

CONTACT INFORMATION

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