Evaluation of the sand extraction impact on the seabed and the water column at short time and space scale in an intensively dredged area of the Belgian part of the North Sea by using multibeam echosounder bathymetric, backscatter strength and water column data

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For several decades the Belgian Continental Shelf (BCS) has been exploited for its natural resources like gravel and sand. As this exploitation in the legal extraction zones intensified over the years, according with the environmental regulation both on national and European levels, evaluating the extraction impact there is an increased importance to monitor these changes in higher resolution and research the possible influences on on the seabed bathymetry and morphology of the seabedas well as on the sediment nature itself is a legal obligation..

Monitoring of sand extraction on the BCS is done by the Continental Shelf Service (CSS) of the Belgian government. For this purpose multiple campaigns a year on board of either RV Belgica or RV Simon Stevin acquire data at the current sand extraction hot spots.By providing simultaneously at high spatial resolution derived bathymetric and backscatter strength (BS) models of the seabed with water column content imagery from raw acoustic data, modern multibeam echosounder (MBES) is certainly the most efficient technology that can be used to provide a full quantitative picture of the impact of extraction on the marine environment.

Since more than 15 years, the Continental Shelf Service from the FPS Economy has collected MBES bathymetric and BS time series on several monitoring areas inside the extraction sectors. This unique dataset demonstrates the direct and non-cumulative impact of the extraction on the bathymetry of the sandbanks and the unsustainable character of the sand resource. However, several questions remain regarding the precise way the extraction impacts directly the seabed morphology and sedimentology. Moreover, dredging by suction (the only technique allowed in Belgium) generates fine sediment plumes which could by transport followed by sedimentation, notably modifying the habitats within a certain radius around the extraction sites. If the sediment plumes generated during the dredging operation have been the subject of numerous publications, few projects have been attempted to visualize these plumes and quantify in real time the volume of fine sediment implies by using MBES water column amplitude data.

These questions are addressed in a master thesis for which specific series of acoustic measurements using the Kongsberg EM2040 MBES installed on the RV Simon Stevin were carried out following operating dredging vessels on the Thorntonbank. In September 2016, three surveys were conducted following three dredging vessels under excellent sea conditions. The resulting high quality dataset allows to evaluate the real time impact of the extraction on the seabed and the water column. By combining this dataset with bathymetric and BS data derived from surveys done with the same acoustic equipment in March, April, November and December 2016, it is possible to clarify with a high spatial resolution the extraction impact on the seabed and on the sediment pattern at different time scale and as well as to evaluate the fading and evolution of the dredging furrows on the seabed after extraction.

Another goal of this research is to evaluate the feasibility to use the MBES water column amplitude data to visualize, characterize and quantify the sediment plumes generated by the dredging operation. 4D visualization of the MBES water column data from the dataset recorded following operating dredging vessels reveals the distinction between the lower plume caused by the dragging of the suction head over the seabed and the upper plume due to the dumping of the water that has been sucked up during the dredging operation.

As this study is still ongoing, different “key correlations” will be analyzed in the near future. It is crucial to assess to what extent the average amplitude level measured in the water column is correlated with the time varying distance and angle between the acoustic system installed on the research vessel and

the dredging head of the dredging vessel. These data will also be used to evaluate the extent to which the density of suspended sediment in the water column as reflected by the water column amplitude can significantly influence the seabed BS as measured by the MBES at the bottom detection window.

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