

***Constraints and limitations of multibeam echosounders Backscatter Strength measurements for monitoring the seabed.
Surveyor and geologist point of view***

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An obligation for regular monitoring programs, to evaluate and follow the environmental status and impact of human activities on the marine environment, will be established in a near future in the European Union ("Marine Strategy Framework Directive" - Directive 2008/56/EC, Official Journal of the EU, 25.6.2008). Coastal waters, including the seabed and subsoil, are an integral part of the marine environment and will be covered by this Directive.

Due to their ability to provide simultaneously the bathymetry and the acoustic image of the seabed - reflecting the nature of the sediment - high frequency multibeam echosounder systems are certainly the most effective tools to monitor the seabed habitats in very shallow waters. The quality of a time-series data set depends on the internal variance of the measurement system. In a monitored area, variations of the bathymetry and modifications of the nature of the seabed are revealed by comparing successive digital terrain models and seabed images - "mosaics" derived from the validated soundings and the BS (backscatter strength) values. The detection of significant changes (in m or in dB) can be effective only under two conditions: a stable and reliable measurement system and a thorough knowledge of the confidence level of each measurement. The control of the parameters affecting the quality and the reproducibility of the bathymetrical measurements are well known and the IHO standards provide a clear framework for assessing the quality level of the soundings. Currently, despite the ever-increasing use of BS data from multibeam systems, there is no a formal quality level scale (as IHO standards) for the BS and consequently, no level of reliability of the dB values can be defined for the final mosaics.

In order to use the BS for monitoring changes in the nature of the seabed, external potential sources of variation must be first clarified by the surveyor – geologist. On board: antenna state, absorption coefficient, navigation orientation... In office: post processing software.

The aim of our "surveyor-geologist" contribution is to present some quantifications of these main external sources of variation of BS that we have been identified during 10 years of measurements with the Kongsberg EM1002 and later with the EM3002D and EM2040 multibeam echosounders on the very shallow sand extraction areas on the tidal sandbanks of the Belgian continental shelf. According to our data, with a good control on external parameters and a standard post processing procedure, 0.3 dB can be considered as an indicative value of the std associated with the average of the BS measurements of the same area within a short period (one tide cycle). However, high Δ dB values from one post-processing software to another restricts dramatically the quantitative acoustic characterization of the seabed and the comparison and exchange of processed BS data between geoscientists.

To allow a rigorous use of multibeam echosounder BS data, several improvements should be developed as soon as possible by the scientific community together with hardware and software companies:

- define quality standards for BS measurements and tools to evaluate on board the quality level of the BS measurement?
- define a standardisation in the post-processing software to allow exchange of processed BS data in dB level between geoscientists?