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Using mm-scale seafloor roughness to improve monitoring of macrobenthos by remote sensing

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In this study, we determine seafloor roughness at mm-scales by laser line-scanning to improve the remote marine habitat monitoring of macrobenthic organisms. Towards this purpose, a new autonomous lander system has been developed. Remote sensing of the seafloor is required to obtain a comprehensive view of the marine environment. It allows for analyzing spatiotemporal dynamics, monitoring of natural seabed variations, and evaluating possible anthropogenic impacts, all being crucial in regard to marine spatial planning as well as the sustainable and economic use of the sea. One aspect of ongoing remote sensing research is the identification of marine life, including both fauna and flora. The monitoring of seafloor fauna – including benthic communities - is mainly done using optical imaging systems and sample retrieval. The identification of new remote sensing indicator variables characteristic for the physical nature of the respective habitat would allow an improved spatial monitoring. A poorly investigated indicator variable is mm-scale seafloor microtopography and -roughness, which can be measured by laser line scanning and in turn strongly affects acoustic scatter. Two field campaigns have been conducted offshore Sylt Island in 2015 and 2016 to measure the microtopography of seafloor covered by sand masons, blue mussels, and oysters and to collect multi-frequency acoustic data. The acoustic data and topography of the blue mussel and oyster fields are currently being analyzed. The mm-scale microtopography of sand mason covered seafloor were transformed into the frequency domain and the average of the magnitude at different spatial wavelengths was used as a measure of roughness. The presence of sand masons causes a measurable difference in roughness magnitude at spatial wavelengths between 0.02 m and 0.0036 m, with the magnitude depending on sand mason abundance. This effect was not detected by commonly used 1D roughness profiles but required consideration of the complete spectrum. The influenced spatial wavelengths correspond to acoustic frequencies of 75 kHz and 400 kHz that are common for acoustic monitoring purposes. The available results indicate that the development of habitat-specific indicator variables, e.g. related to the abundance of sand masons or mussels, is possible and that remote sensing may assist the monitoring of benthic habitats in the future.