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Classification of stone reefs in coastal environments using topo-bathymetric LiDAR data

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Studying stone reefs is important to be able to protect the reefs and preserve their ecosystems. Valuable knowledge of stone reef locations and conditions can be obtained by mapping present stone reefs. This knowledge is also useful for restoration of existing, and creation of new stone reefs. Mapping reefs in the same area over years makes it possible to detect potential changes in the stone reefs.
However, coastal areas have been challenging to map in high resolution with full spatial coverage due to the shallow water conditions. Acoustic measurements with vessel prone MultiBeam EchoSounder (MBES) only cover narrow swaths in shallow waters, which makes full coverage mapping in such areas both time and budget consuming. Furthermore, the research vessels often have too large drafts to sail in very shallow water close to the waterline.
An alternative is using airborne LiDAR technology. Recently, topo-bathymetric LiDAR (green wavelength of 532nm) has made it possible to derive high-resolution digital elevation models (DEM) of the bathymetry in coastal zones. Using the software package Hydrovish (AHM) for the LiDAR data processing enables a nearly automatic approach. In this study, the aim is to develop an automated and thereby reproducible method to map stone reefs from topo-bathymetric LiDAR data with a minimum of subjective decisions. The classification is done using Machine Learning algorithms, i.e. Random Forests. We exemplarily present results derived from topo-bathymetric data of the Rødsand lagoon in Denmark acquired in 2015 to demonstrate the potential of this approach.

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