Classification of stones in coastal marine environments using random forest machine learning on topo-bathymetric LiDAR data

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Stones on the seabed in coastal marine environments form an important hard substrate for macroalgae, and hence for coastal marine reefs. Such reef areas constitute important ecosystem services, e.g. storage of organic carbon in macroalgae or “blue carbon” as well as important habitats to fish for living, hiding and feeding. Information and knowledge about stone locations and geometry in coastal marine environments are often obtained as part of seabed habitat mapping. Usually, seabed habitat mapping is based on geophysical surveys using multibeam echo sounding along with side-scan sonar imaging in combination with biological ground-truthing. However, coastal areas are challenging to map with full spatial coverage due to the shallow water conditions. Furthermore, the research vessels often have too large drafts to sail in very shallow water close to the coastline. An alternative is to use airborne LiDAR technology. Topo-bathymetric LiDAR (green wavelength of 532 nm) has made it possible to derive high-resolution data of the bathymetry in coastal zones (e.g. Andersen et al., 2017). This technology can cover the transition zone between land and water, and the time consumption for data acquisition is small compared to vessel borne methods. However, the processing of the data still requires manual decision steps, which makes it rather time consuming, and to some extent subjective.

The aim of this study was to investigate the possibility of developing an automated method to classify stones from topo-bathymetric LiDAR data in coastal marine environments with shallow water (<6 m). The Rødsand lagoon in Denmark, where topo-bathymetric LiDAR data were acquired in 2015, was used as test. The classification was done using the random forest machine learning algorithm. The study resulted in the development of a nearly automated method to classify stones from topo-bathymetric LiDAR data. The classification accuracy was between 80 and 90% for the test site. The obtained knowledge about stone locations can provide important information about the ecosystem services and improved management of the coastal marine environment.

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References