



## **Coastal and tidal landform detection from high resolution topobathymetric LiDAR data**

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Coastal and tidal environments are valuable ecosystems, which, however, are under pressure in many areas around the world due to globalisation and/or climate change. Detailed mapping of these environments is required in order to manage the coastal zone in a sustainable way. However, historically these transition zones between land and water are difficult or even impossible to map and investigate in high spatial resolution due to the challenging environmental conditions. The new generation of airborne topobathymetric light detection and ranging (LiDAR) potentially enables full-coverage and high-resolution mapping of these land-water transition zones.

We have carried out topobathymetric LiDAR surveys in the Knudedyb tidal inlet system, a coastal environment in the Danish Wadden Sea which is part of the Wadden Sea National Park and UNESCO World Heritage. Detailed digital elevation models (DEMs) with a grid cell size of 0.5 m x 0.5 m were generated from the LiDAR point cloud with a mean point density in the order of 20 points/m<sup>2</sup>.

The DEM was analysed morphometrically using a modification of the tool Benthic Terrain Modeler (BTM) developed by Wright et al. (2005). Initially, stage (the elevation in relation to tidal range) was used to divide the area of investigation into the different tidal zones, i.e. subtidal, intertidal and supratidal. Subsequently, morphometric units were identified and characterised by a combination of statistical neighbourhood analysis with varying window sizes (using the Bathymetric Positioning Index (BPI) from the BTM, moving average and standard deviation), slope parameters and area/perimeter ratios. Finally, these morphometric units were classified into six different types of landforms based on their stage and morphometric characteristics, i.e. either subtidal channel, intertidal flat, intertidal creek, linear bar, swash bar or beach dune.

We hereby demonstrate the potential of using airborne topobathymetric LiDAR for seamless mapping of land-water transition zones in challenging coastal environments with high water column turbidity and continuously varying water levels due to tides. Furthermore, we demonstrate the potential of morphometric analysis on high-resolution topobathymetric LiDAR data for automatic identification, characterisation and classification of different landforms present in coastal land-water transition zones.

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### **References**

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