Comparing Airborne LiDAR and Multibeam Echo Sounding on Different Beach Types – a Case Study for the Belgian Coast

Junling JIN[1*], Lars DE SLOOVER[1], Thomas VANDORPE[2] Alain DE WULF[1]

[1] Department of Geography, Ghent University
[2] VLIZ – Flanders Marine Institute, Oostende, Belgium
[*] Corresponding author: junling.jin@ugent.be

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Abstract: With sea level rise, climate change and increasing coastal populations, it has become essential to have a good understanding of coastal morphodynamics. Modelling beach dynamics is commonly done through digital surface modelling, requiring accurate and high resolution spatial data. Many topographic measurement methods are available to do so, but not all are eligible for modelling the beach. Since the early 2000s, the entire Belgian shoreline has been mapped on a bi-annual basis using non-acoustic airborne LiDAR. With vertical accuracy of decimeter-order and a spatial resolution of 10 cm, including the capability of shallow-water seabed modelling, airborne LiDAR has proven to be an effective technique for coastal data acquisition. While LiDAR beach surveys take place at low-tide, high-tide conditions offer the possibility of performing acoustic multibeam in the same intertidal zone, yielding vertical accuracies of ca. 20 cm at a point density of > 100 points/m². Even if the aforementioned altimetric accuracies are generally agreed upon, the effect of local beach topography needs to be studied further. In this case study, two different beach types were considered. One is a 400 m wide artificial beach in Ostend (Belgium), characterized by a groin field, seawall and an average slope of 2%. Another is a 600 m wide natural beach in Oostduinkerke (Belgium) with intertidal bars and runnels, sloping at 1%. Both beaches are situated in a macro tidal regime. This study aimed to examine differences in altimetry on different beach types between simultaneous LiDAR and multibeam surveys. The data showed there is a mean vertical difference between both techniques of (7.7 ± 5.1) cm on the artificial beach and a mean difference of (8.9 ± 2.1) cm on the natural beach. A possible reason for the larger difference between the two techniques on the natural beach is the existence of inundated runnels which prevent the airborne LiDAR to measure the real beach surface. It is noteworthy that there are higher waves in the surf zone of the artificial beach due to the comparatively steep terrain. In the zone around the submerged groins, waves break earlier. This could influence the multibeam vessel's calibration Euler angles, increasing the standard deviation of difference between the two techniques. In conclusion, the vertical difference of two techniques used in this study is very close for surveying artificial and natural beaches. Airborne LiDAR is a more suited technique to accurately measure the terrain on the artificial beach with steeper waves.