Coastal dune fields as a sediment reservoir: evaluation of sand volume estimation using LiDAR, ASTER and SRTM data

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ABSTRACT: Coastal dune fields are important reservoirs of sand. The estimation of sand volume stored in coastal dune fields is an important issue to understand sediment transfer from continental to marine depositional systems. This is especially important in wave-dominated coasts of passive continental margins such as the Brazilian coast, which comprises more than two hundred active dune fields. In this work, we analyze how the variation of cell size influences the volume calculated from LiDAR-derived DTMs in two coastal Late Holocene dune fields located in southern Brazil. Cell size varied from 1 to 100m. The RMSE of the resampled DTMs about the original LiDAR (with 0.5m resolution) increases linearly with cell size, while the R-squared decreases following a second-order trend. The volume does not show a simple linear or exponential behavior, but fluctuates, with positive and negative deviations from the original DTM. This can be explained by a random factor on the position of the cell about the landforms and a relationship between cell size and landform size, where a small change in cell size can lead to an under- or over-estimation of the volume. ASTER GDEM and X-SAR SRTM (1 arcsec) DEMs were not considered viable sources of volume due large deviations from the reference data, either as consequence of strong noise presence (SRTM X-SAR) or lack of bias elevation correction to a common reference base in the GDEM processing chain. Volumes from 3-arcsec SIR-C SRTM deviated around +/- 5.5% about the reference data and are considered suitable for sand volume calculation. Considering the high cost of LiDAR data, the public available SIR-C SRTM is a valuable tool for modeling of dune fields as part of a source-to-sink system, especially in continental-scale studies covering huge areas. .
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