Thesis Title

LiDAR-based Quantification of Indiana Lake Michigan Shoreline Changes

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Abstract

Recent high-water levels in Lake Michigan caused extensive shoreline changes along the Indiana coastline. To evaluate recent shoreline changes of the Indiana coastline along Lake Michigan, topographic LiDAR surveys available for the years 2008, 2012, 2013, 2018, 2020, and 2022 were analyzed. This study included LiDAR data of over 400 cross-shore transects, generated at 100 m spacing. Beach profiles were generated to detect the shoreline position and quantify beach width and nearshore volume change. The analysis revealed accretion of both shoreline and beach width from 2008 to 2013 during a low water level period. The beach was rebuilt with a median increased value of 4 m. On the contrary, the shoreline eroded during increasing and high-water periods. Both shoreline and beach width receded with median values of 41 m and 32 m respectively during the period of water level increase from 2013 to 2020. Consequently, the beach profiles lost a median sand volume of 21.6 m3/m. Overall, the Indiana shoreline moved with a median of 18 m landward from 2008 to 2022. However, there was a large amount of spatial variability in the shoreline changes. The shoreline movement varied spatially between 63 m recession to 29 m accretion. Similarly, beach profiles showed a loss of median sand volume of 10 m3/m. The volume change ranged from 918 m3/m loss to 296 m3/m accumulation varying spatially along the shoreline. The largest sand loss was experienced at the downdrift of Michigan city harbor near Mt. Baldy. In addition to the spatial variation, the recession also varied slightly with shoreline type. The natural and hardened beaches were mostly recessional. The recession along the hardened shoreline was influenced by the timing of construction and its proximity to inland areas. Buffered beaches, characterized by a swath of vegetation or dunes, experienced the least erosion.