Coastline change detection utilizing ground-based laser scanning

Tim Webster, Kevin McGuigan, Nathan Crowell, and May Kongwongthair
Applied Geomatics Research Group, Centre of Geographic Sciences, NSCC, Middleton, Nova Scotia Canada
<timothy.webster@nscc.ca>

The study area is Cape John, Nova Scotia, where the coastline consists of sedimentary bedrock headlands separating an embayment which transitions in relief and material type from steep bedrock cliffs to a glacial till bank and finally into a dune and salt marsh environment. The focus of this study was to examine the change of the glacial till bank, which is comprised of red fine grained unconsolidated sediments and clay with few clasts, after the 2010 winter storm season. The local relief of the bank is 5–7 m and consists of a grass pasture landward of the coast. The area has been studied utilizing traditional airphoto change detection methods and rates calculated. However, because the airphotos are acquired on a decadal scale, it is difficult to quantify the effects of a single storm event or storm season. Airborne lidar has been acquired over the site yearly since 2006; however, rates of erosion and steepness of the terrain have been at the precision limit of change detection for the surveys. A ground-based lidar unit, Optech ILRIS, was used to survey the glacial till bank in June, July, October, and December, 2010, and in January, 2011, to monitor change. In addition to the lidar and GPS surveys, a weather station and water level sensor were deployed to capture the environmental conditions. A strong winter storm, a classic Nor'easter, affected Maritime Canada on December 21, and to a lesser extent again on December 28, 2010. The storm surge caused extensive coastal flooding and erosion for many coastal communities with shorelines exposed to the north and east. The tide gauge indicates a maximum water level of 2.2 m and the debris wrack line elevation is 2.4 m. The ILRIS scans were geocoded and derived surface models were compared. The points and surface models were used to assess the gradual erosion from June to December and the catastrophic erosion on December 21 and 28. The erosions vertical limit of the bank is between 4–5 m based on the longitudinal and transverse profiles. Along a 150 m section of the bank, 771 m3 of material was removed between December 16 and January 4. The pattern of erosion is typical of coastal areas with an increase in the bank slope and a lowering of the beach elevation adjacent to the bank and raising the beach farther seaward. The steep bank slope remained stable while the ground was frozen but slumped in the spring as a result of thawing and increased saturation levels in the soil.

Copyright © Atlantic Geology 2012

Atlantic Geology, 2012, Volume 48, Number 1
Copyright © 2015 Atlantic Geology