Mass wasting and coastal erosion on Yukon Coast and Herschel Island

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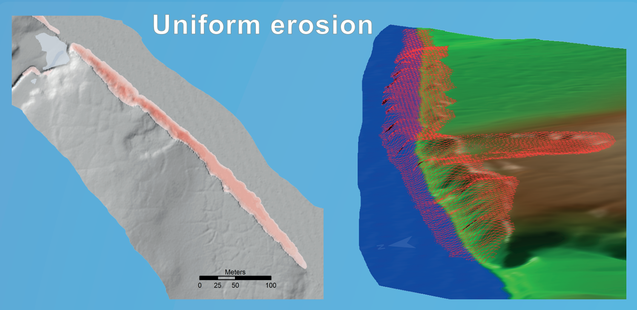
Background

The Yukon Coast and Herschel Island in the western Canadian Arctic consist of ice-rich unconsolidated sediments. Consequently, coastal erosion and accompanying mass-wasting processes are very intensive during ice-free season. Coastal erosion rates of several metres per year and numerous retrogressive thaw slumps are observed. Considerable amounts of sediment, organic carbon and other nutrients are being released into the near-shore zone by coastal erosion and slumping. Our aim is to study relationships between mass wasting and coastal erosion and how mass wasting effects different measures of coastal erosion.

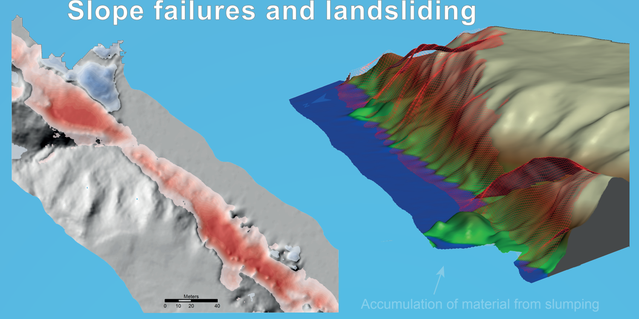
Coastal morphology changes between 2012 and 2013

Uniform erosion



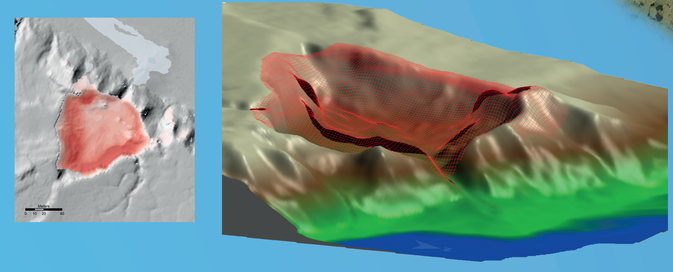
Uniform coastal erosion up to 20 m and little mass wasting in coasts lower than 10 m.

Slope failures and landsliding

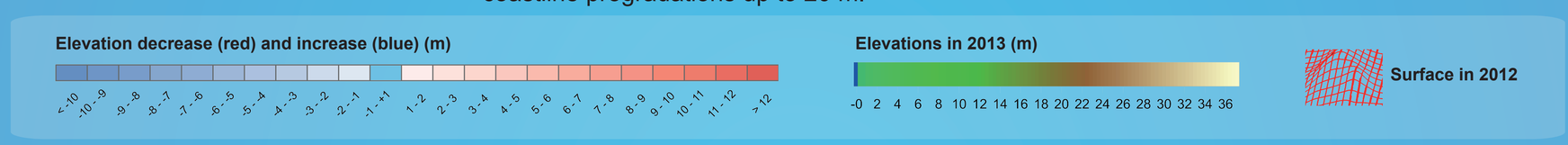


Mass wasting is very active on high coasts. Common are slope failures, slumping and active-layer detachments. Accumulation of material caused short- term coastline progradations up to 20 m.

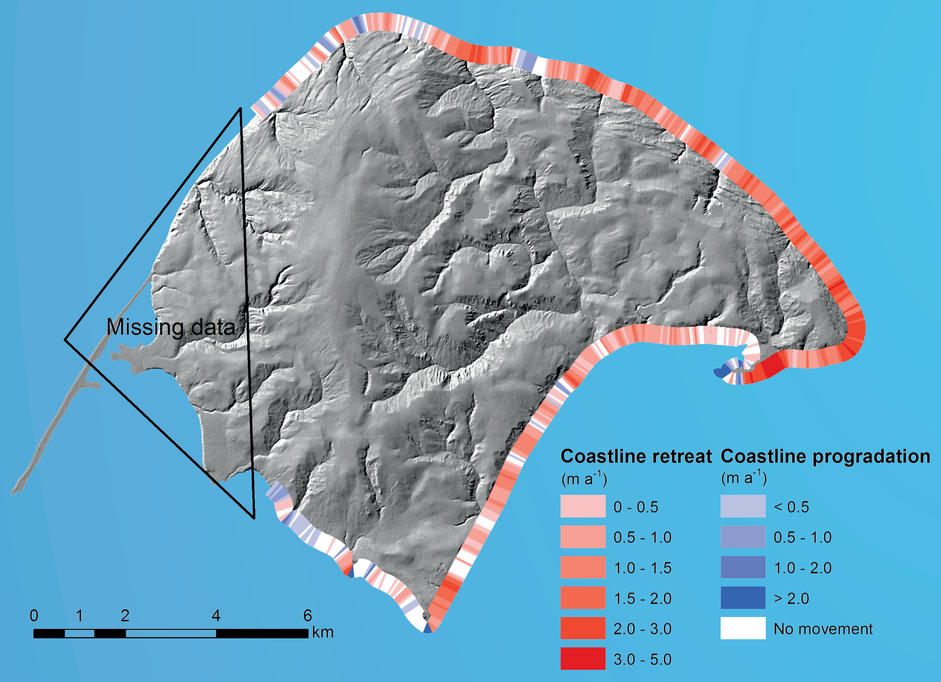
Retrogressive thaw slumps



Active retrogressive thaw slumps released considerable amounts of sediments and caused coastline progradations up to 40 m.

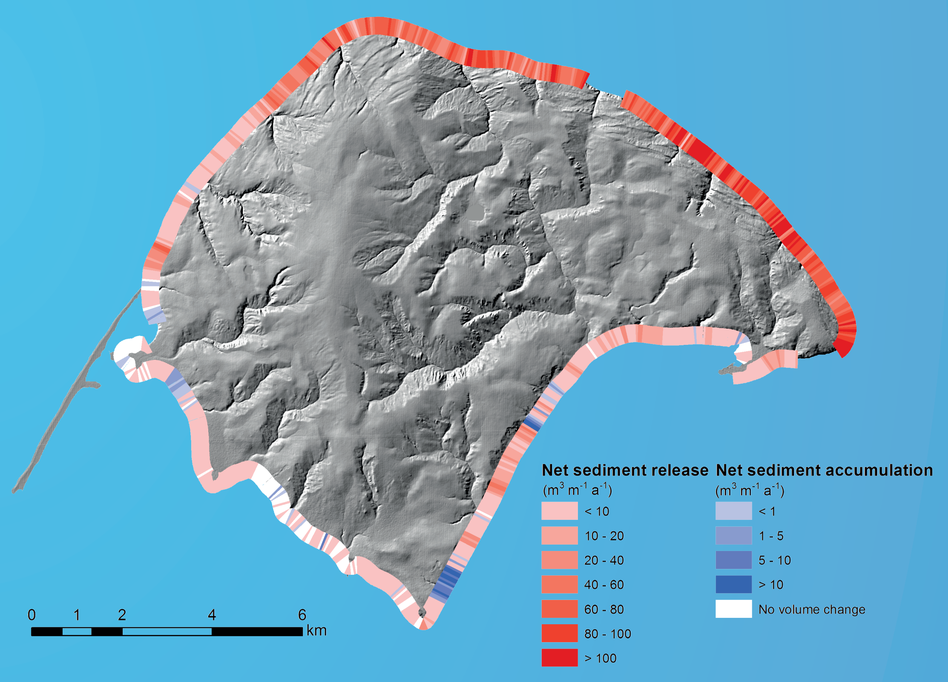


Coastline movements 2000 - 2011



Coastline movements observed from satellite imagery show high site-to-site variability and alternation between retreat and progradation.

Volume change 2004 – 2012/13



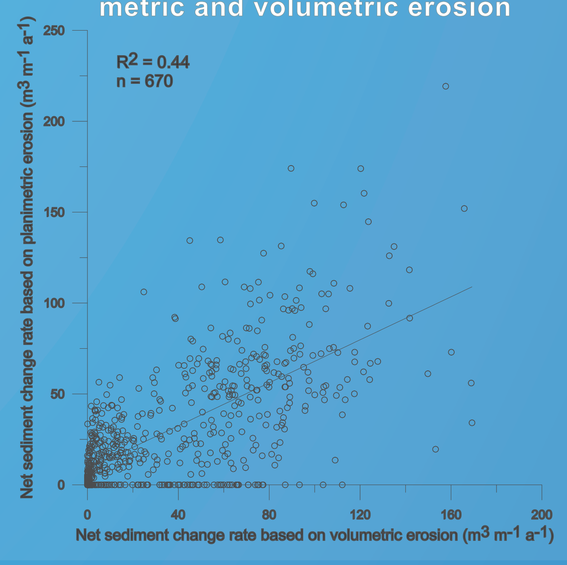
Volume changes derived from DEMs show less variability and more uniform patterns of coastal erosion. High volume decrease along north coast corresponds better with prevailing storm wind direction.

Methodology

The digital elevation models (DEMs) with 1 m horizontal resolution of the Yukon Coast and Herschel Island were obtained from airborne LIDAR surveys during the AIRMETH campaigns in 2012 and 2013. The elevations from both DEMs were subtracted to identify land surface changes and relate them to coastal erosion and different mass-wasting processes.
Coastline movements on Herschel Island were identified by digitalisation of coastline from Ikonos satellite image from 2000 and GeoEye image from 2011.
Volumetric changes were calculated from elevation change between photogrammetrically derived DEM from 2004 and the existing LIDAR DEMs from 2012 and 2013.
Sediment release was calculated separately from elevation changes and coastline changes multiplied by cliff height.

- **Mass-wasting processes can cause significant short-term fluctuations of coastline position.**
- **This results in high variability of coastline position, despite the prevailing volume decrease.**
- **Sediment release calculated from coastline movements and cliff heights can therefore be inaccurate along coasts where mass wasting occurs.**

Sediment release estimations from planimetric and volumetric erosion



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