Short-term geomorphic dynamics of the Yukon and Herschel Island coasts based on LIDAR DEMs from 2012 and 2013

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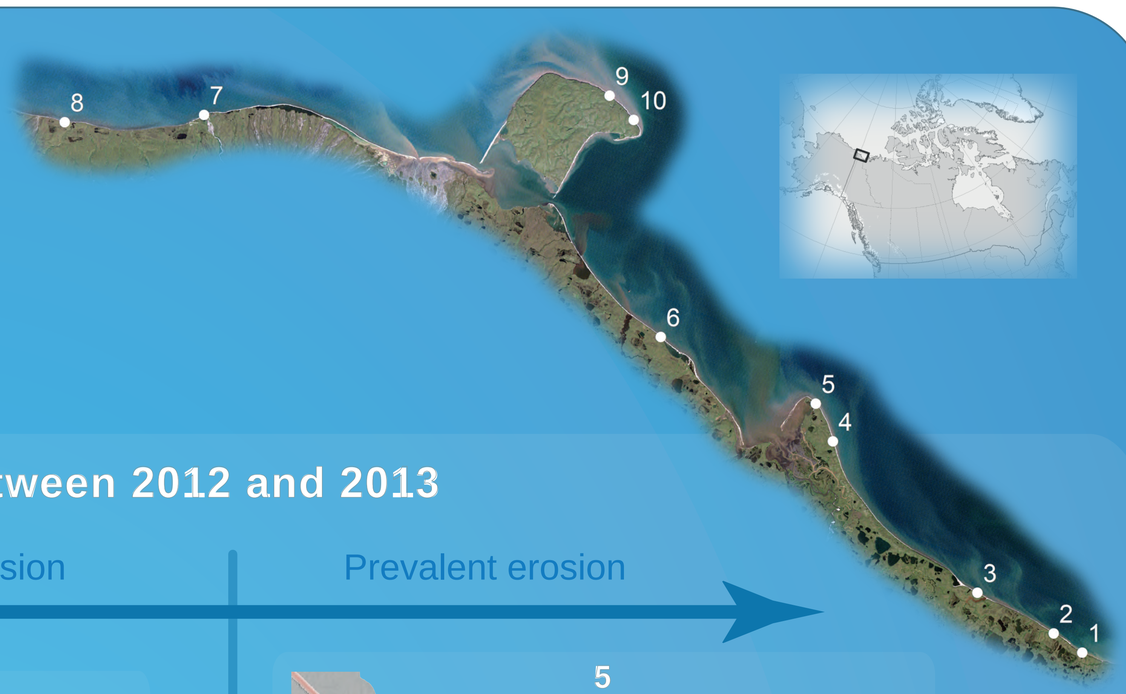
Background

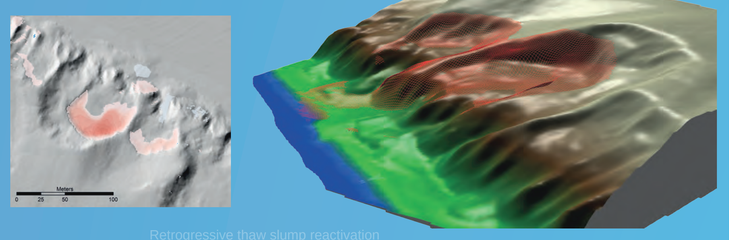
The Yukon Coast and Herschel Island in the western Canadian Arctic are rich in ground ice and consist of unconsolidated sediments. Consequently, coastal erosion is accompanied by thermoerosion and slumping processes, which are intensive during the ice-free season. Current rates of coastal erosion are up to one meter per year and rapid retrogressive thaw slump progression of up to 9 m per year are reported. Considerable amounts of organic carbon and other nutrients are being released into the near-shore zone by sediment discharge from erosion and slumping. Estimating erosion rates is also crucial for land management in the light of natural habitat loss.



Erosion and denudation between 2012 and 2013

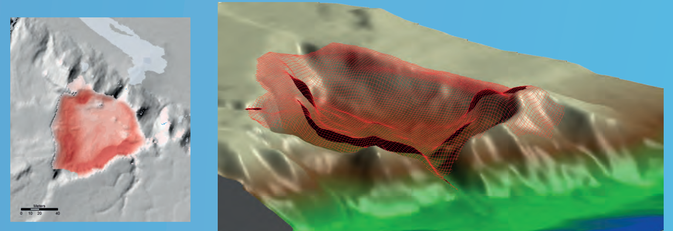
Prevalent denudation | Denudation and erosion | Prevalent erosion

1



Retrogressive thaw slump reactivation

2



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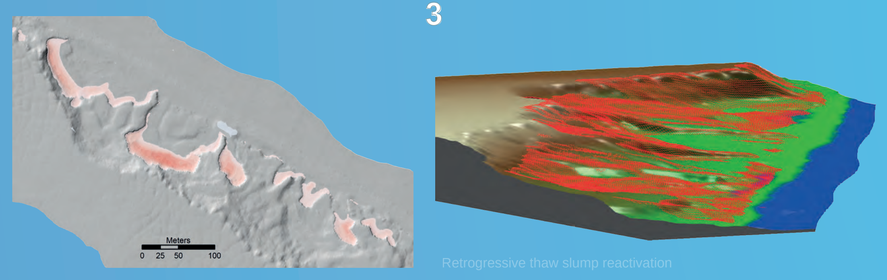
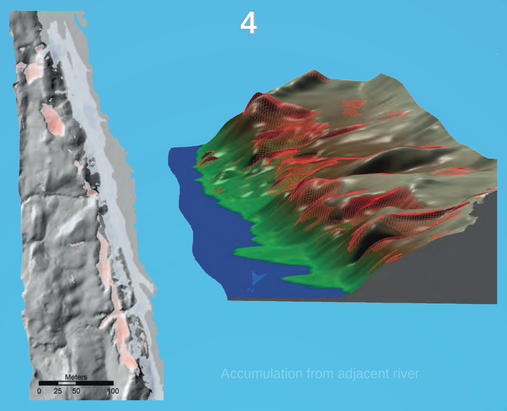


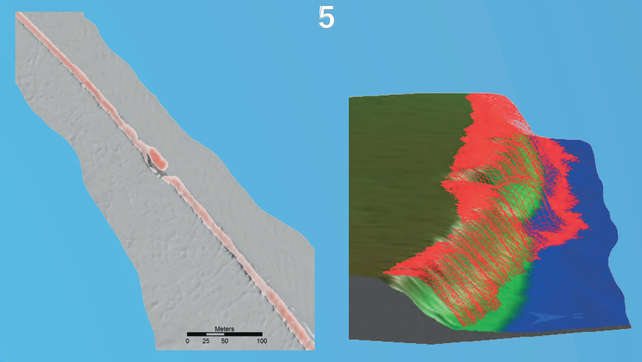
Retrogressive thaw slump reactivation

4



Accumulation from adjacent river

5



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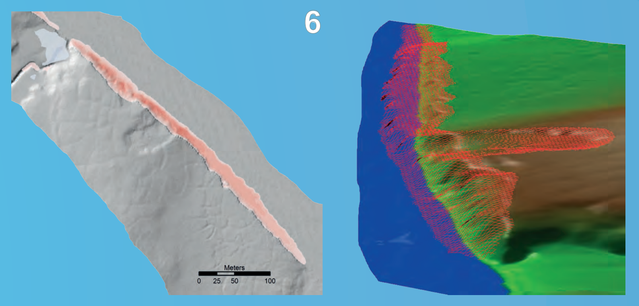

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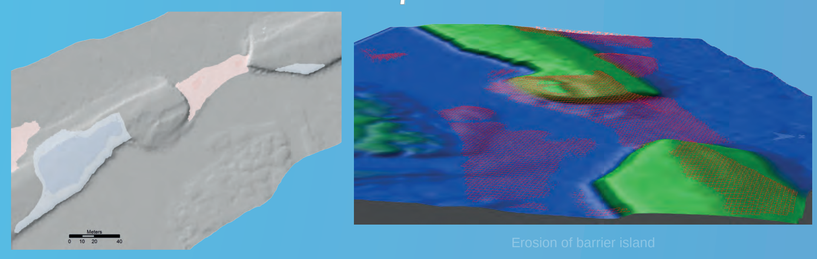
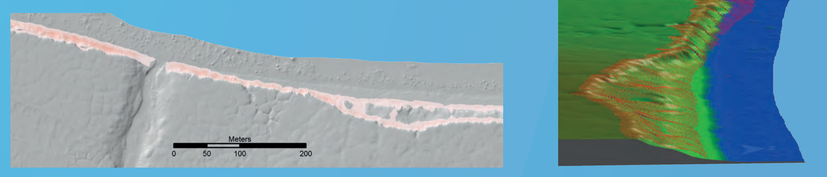


Erosion of barrier island

8



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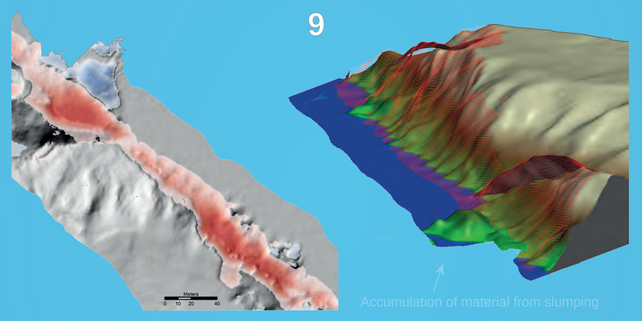
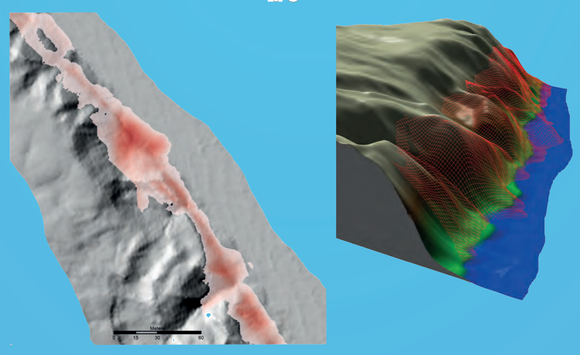
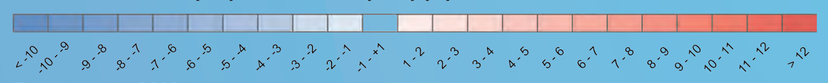


Accumulation of material from slumping

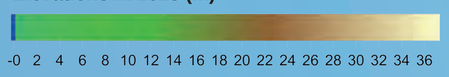
10

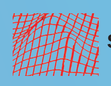


Elevation decrease (red) and increase (blue) (m)



Elevations in 2013 (m)





Surface in 2012

Methodology

The DEMs of the Yukon Coast and Herschel Island were obtained from airborne LIDAR surveys during the AIRMETH campaigns in 2012 and 2013 with the AWI research aircraft Polar 5. LIDAR point data were interpolated with inverse distance weighting to obtain bare ground DEMs with horizontal resolution of 1 meter. The elevations from the 2012 DEM were then subtracted from elevations in 2013 to obtain elevation decrease for each pixel (positive values for erosion and negative for accumulation). Here, we display only elevation changes greater than 1 m.

Study site	Area (m^2)	Max. elevation decrease (m)	Area undergoing decrease (m^2)	Volume decrease (m^3)	Max. elevation increase (m)	Area undergoing increase (m^2)	Volume increase (m^3)	Total volume decrease (m^3)
1	45,363	11.1	7,816	15,512	1.8	462	580	14,932
2	44,069	18.7	11,354	60,631	2.8	2.669	3,446	57,185
3	191,666	8.7	14,739	33,530	1.9	334	414	33,116
4	110,107	7.0	7,205	14,369	4.4	17.074	23,938	-9,569
5	182,779	9.6	8,281	26,552	2.0	101	111	26,441
6	188,046	9.4	10,178	37,929	2.9	1.436	2,034	35,894
7	50,352	2.4	3,113	3,413	2.7	3.527	6,746	-3,332
8	175,020	5.8	15,668	27,944	2.0	194	230	27,713
9	57,530	16.7	9,650	50,283	9.3	1.695	5,443	44,840
10	49,876	13.8	7,250	27,147	3.3	516	845	26,301

Table shows basic morphologic and elevation change characteristics of 10 chosen study sites. Calculations include elevation decreases higher as 0.5 m and increases higher than 1 m

First observations

- There were variety of **denudational, erosional and transporting** processes operating and resulting in different forms of coastal retreat.
- **Elevation decrease prevailed**, but some areas (four and seven) were showing total elevation increase.
- Events in vicinity of study site could influence erosion and accumulation.

Outlook

- Relate elevation changes to weather and other environmental variables.
- Classification of the coasts and slumps according to terrain characteristics.
- Extrapolate the sediment discharge rates to parts of the coast with similar morphology.
- Estimate short-term natural hazard potential

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