Process Study of a Retrogressive Thaw Slump on Herschel Island, Yukon Coast

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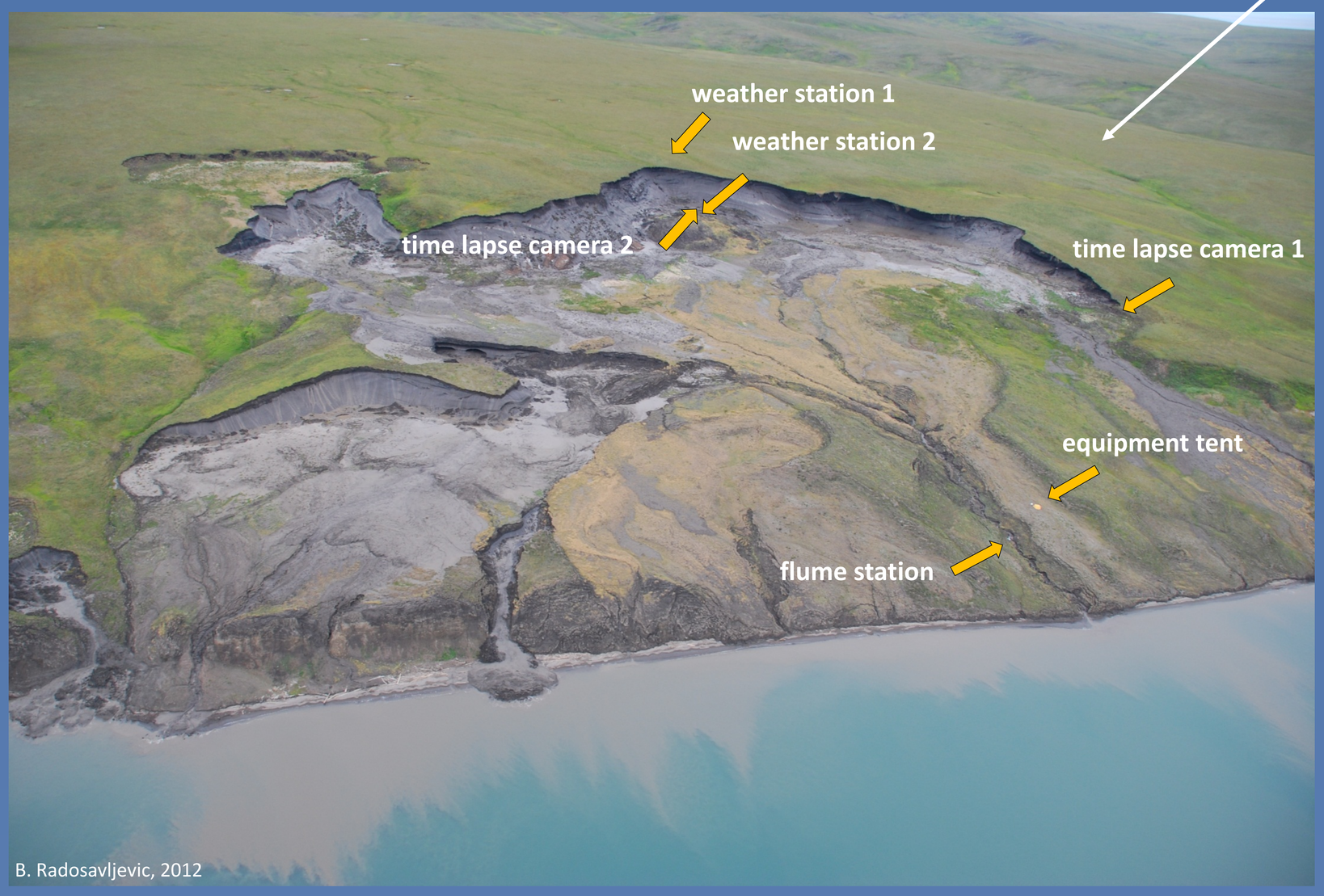
Background:

The Canadian Yukon Coast is an ice-rich permafrost region and is highly vulnerable to environmental change. Rising sea level, increasing summer temperatures, and changing sea ice conditions are projected to lead to accelerated permafrost degradation and coastal erosion. Retrogressive thaw slumps (RTS) are common thermokarst features along arctic coasts and are mostly initiated by wave erosion and thawing of exposed ice-rich permafrost headwalls. Among other components, thawing permafrost releases large quantities of organic carbon into the nearshore zone, where it is recycled and sequestered. Organic carbon is released as particulate organic carbon (POC) and dissolved organic carbon (DOC). While recent studies have greatly improved our knowledge on the stocks and fluxes of POC in permafrost, the dissolved fraction is mostly still disregarded. However, DOC is chemically labile and directly available to the marine ecosystem. Changes in this complex and sensitive system, e.g. due to climate change, that increase coastal erosion may cause changes in the carbon cycle from the local to regional scale. It is therefore important to improve our knowledge regarding the amount of total organic carbon stored and potentially released from thawing permafrost.



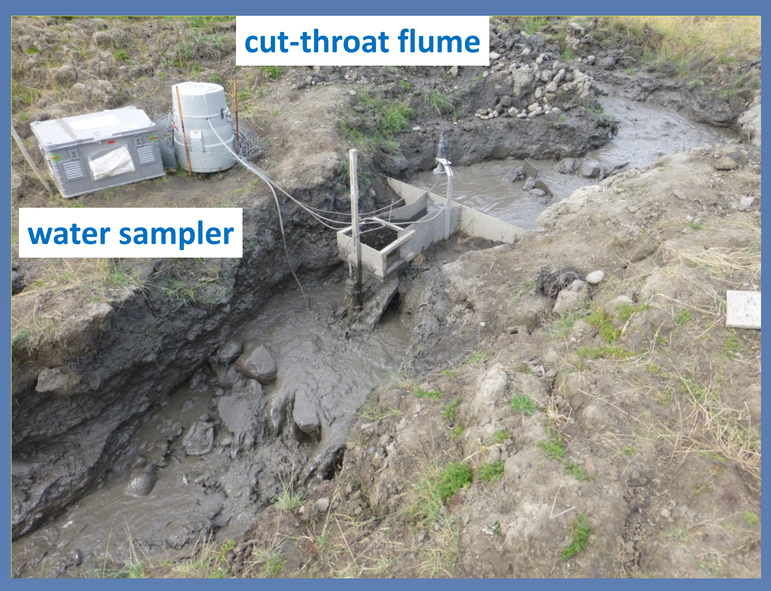
B. Radosavljevic, 2012

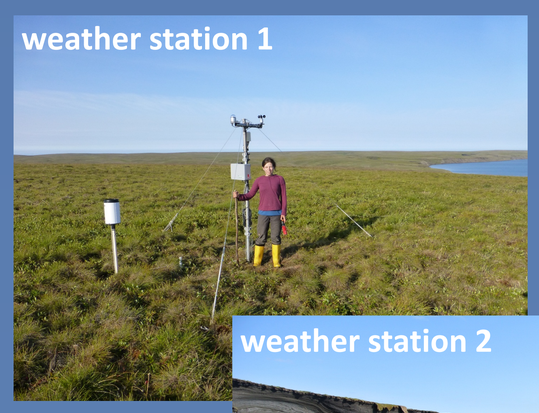
Field Study:

Here we present the first steps of a process study of one of the largest RTS in the Arctic, on Herschel Island off the Yukon Coast, performed over the summers 2011 and 2012. The studied RTS is over 435 m wide, has an exposed headwall of up to 30 m, and undergoes erosion at a rate exceeding 10 m/yr. Our study utilised an outflow channel equipped with a radar sensor to measure the discharge resulting from thawing permafrost in a known catchment before the material enters the nearshore zone, and hence to determine the eroded volume and the amount of organic carbon released. Washload samples taken at the outflow with an automatic water sampler provide continuous sampling over the thaw season, with measurements taken up to several times a day. Analysis of meltwater and suspended matter provides quantitative information about the material flux of minerogenic matter, POC and especially DOC. We also obtained a detailed understanding of the grain size composition and hydrochemical characteristics (pH, conductivity, major anion and cation composition) of the sediments and fluids that are released.

Outcome 2012:

- climate forcing (solar radiation, air and ground temperature, precipitation, wind speed)
- headwall retreat
- water discharge
- photo series
- water samples





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First Results of the Water Samples:

- pH (7.3-8.1)
- elect. conductivity (3.68-5.36 mS/cm)
- bicarbonates
- DOC (12-25 mg/l)
- sediment content (3-34%)
- anions and cations
- grain size
- TOC, CNS
- $\delta^{13}C$

Outlook:

In summer 2013 we will continue our process study. Additional we will extend the diversity of sampling locations along the Yukon Coast. Another step will be the start with DOC analysis from permafrost and nitrogen and phosphorus analysis.

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