Permafrost carbon degradation and transport pathways at thermokarst coasts in the Arctic

Introduction and background

**Permafrost coasts**

34% of global coasts

400,000 km coastline

1/3 unlithified cliffs

18% ground ice

0.6 m yr\(^{-1}\) erosion

Lantuit et al. 2012
Introduction

**Permafrost Carbon**

Global carbon storage in soils *

*SOC content in 0–3 m of soils: 1035 ±150 Pg (Hugelius et al. 2014)

Tamocai et al. 2009
Study area

Yukon coast

Cont. permafrost: ~600m depth

Ground ice content: 37%

Coastal erosion rate: 0.7m yr⁻¹
Study area

Ground ice (total): 37%

- Non-massive: 26%
- Massive: 11%

After Couture and Pollard 2015
Study area

Increase in slumping!
Objectives

- OC differences between undisturbed and disturbed areas
- Degradation of organic matter before entering the ocean
- Fate of slump material in the ocean
Methods

Vegetation classification of "Slump D" based on NDVI and sampling scheme

Retrogressive thaw slump "Slump D"
Methods

Undisturbed
(Tundra, Permafrost)

Disturbed
(Mudpool, Transition, Slumpfloor, Thaw stream)

Nearshore
(Marine sediments)

TOC
TN
δ\(^{13}\)C

DOC
DN
δ\(^{13}\)C-DOC
Results and Discussion

Strong decrease of organic carbon content after thaw

*Yanko et al. 2016, accepted
**Wegge et al., in prep.
Results and Discussion

Steady decrease of DOC conc. after thaw

Indicates degradation and/or dilution by massive ice

DOC

$\delta^{13}$C-DOC

*Janski et al. 2016, accepted
**Weege et al. In prep.

Outliers are not displayed
Results and Discussion

C/N (TOC)

C/N does not reflect degradation, except in thaw streams
Results and Discussion

C/N (DOC)

C/N-ratio shows poss. degradation; but only for freshly thawed material
Results and Discussion

No degr. reflected by $^{13}$C$_{org.}$ conc.
Results and Discussion

Decomposition of organic material right upon thaw and/or direct transport into the ocean
Conclusion

• Strong decrease of TOC upon thaw
• Dilution of thawed material with massive ice
  • hard to detect degradation patterns
• Degradation dynamics not reflected by C/N and $^{13}\text{C}_{\text{org}}$
• Rapid degradation upon thaw possibly indicated by $\text{NH}_4^+$-N
• Transport of undegraded material directly into the ocean
Outlook and open questions

What are the degradation mechanisms?

What happens with permafrost carbon after transport into the ocean?

What are possible impacts on nearshore marine nearshore ecosystem?

How is OC incorporated into local food webs?
Thank you very much for the attention!