A PYRN contribution

XI. INTERNATIONAL CONFERENCE ON PERMAFROST
POTSDAM, GERMANY
20-24 JUNE 2016

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

George Tanski, S. Ruttor, H. Lantuit, C. Knoblauch, B. Radosavljevic, J. Ramage, G. Mollenhauer, J. Strauss, and M. Fritz

Introduction and background

XI. INTERNATIONAL CONFERENCE ON PERMAFROST
POTSDAM, GERMANY
20-24 JUNE 2016

Permafrost coasts

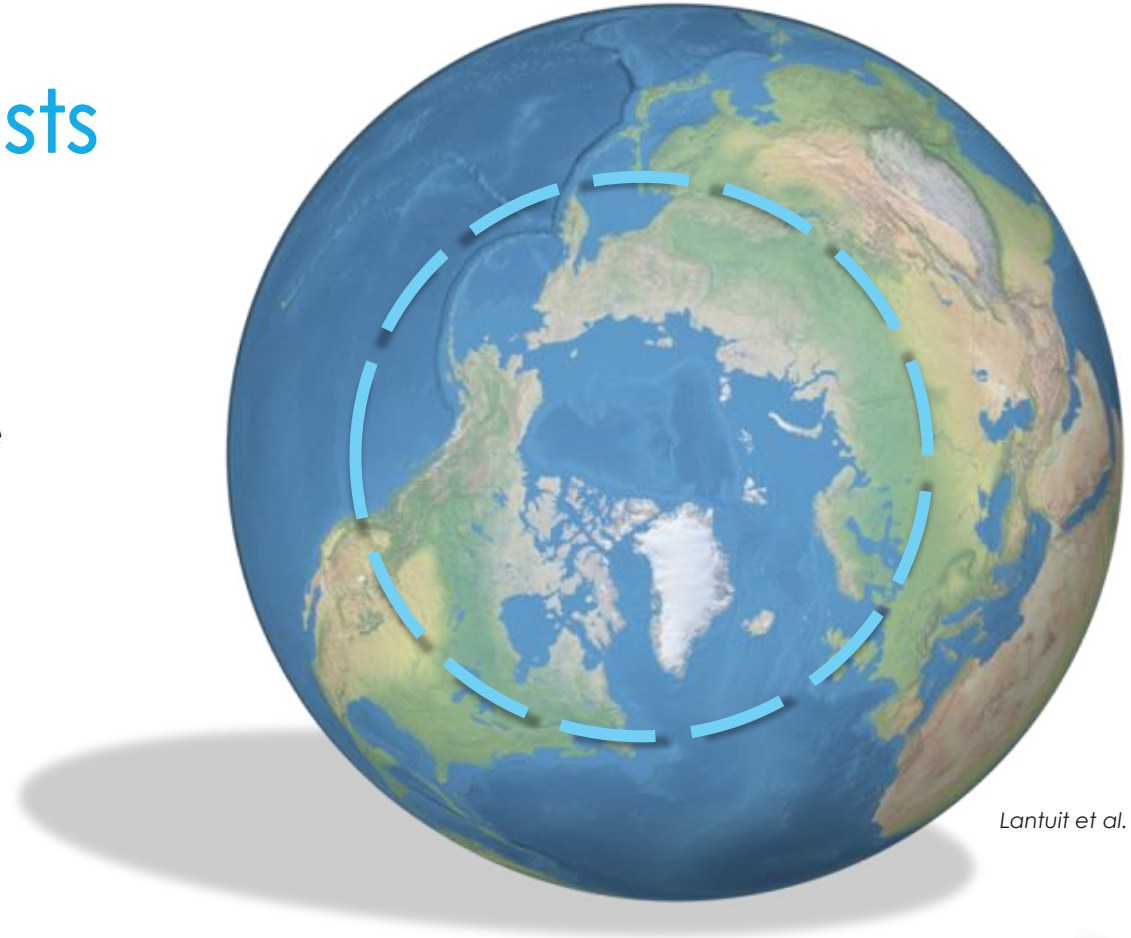
34% of global coasts

400,000km coastline

1/3 unlithified cliffs

18% ground ice

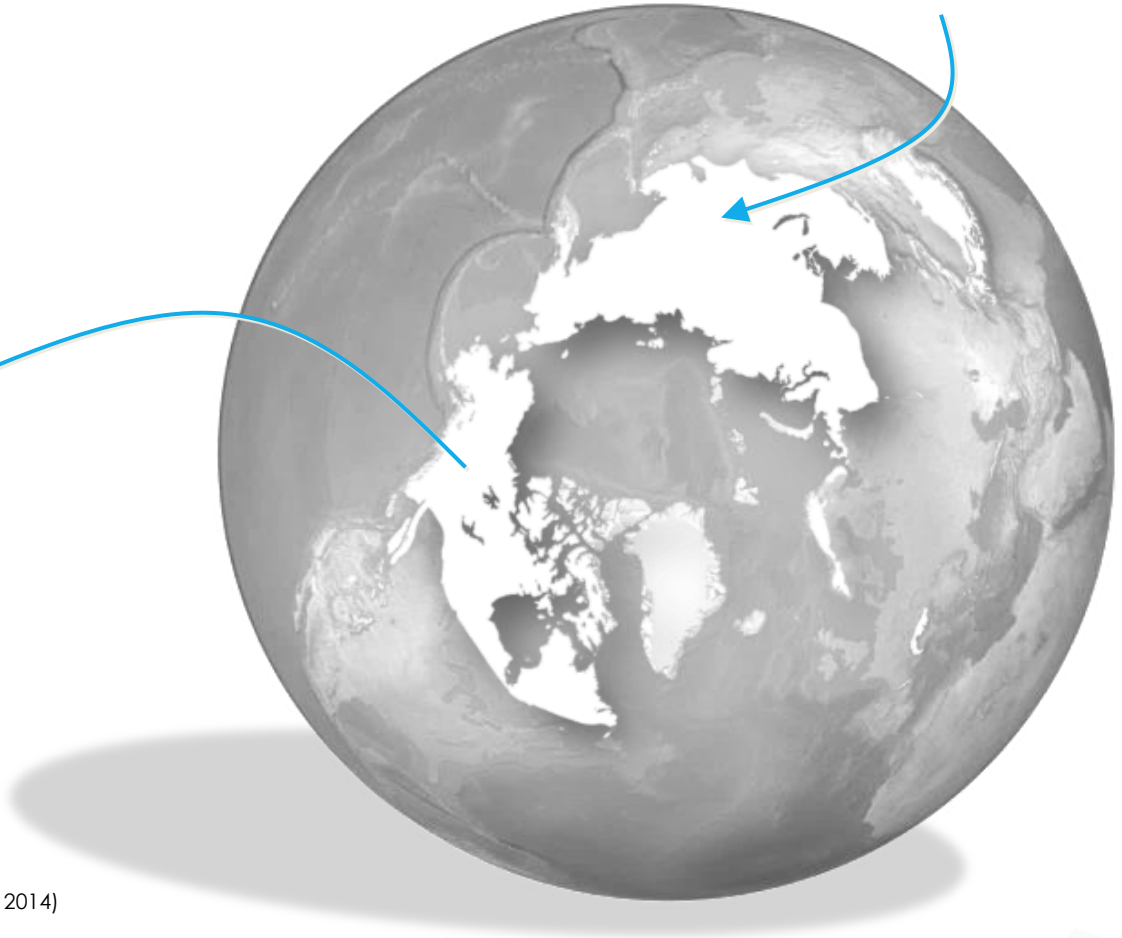
0.6m yr^{-1} erosion



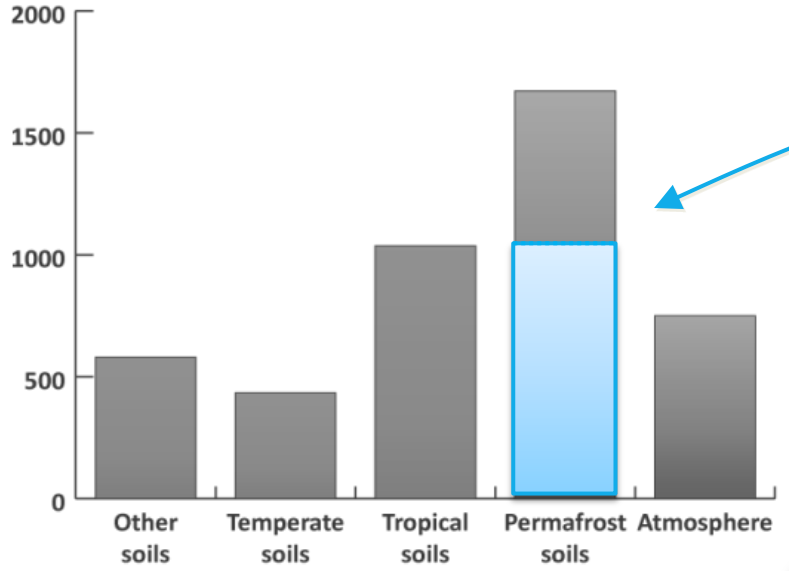
Lantuit et al. 2012

Introduction

Permafrost Carbon



(Gt $C_{org.}$) Global carbon storage in soils *



Tarnocai et al. 2009

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

Study area

XI. INTERNATIONAL CONFERENCE ON PERMAFROST
POTSDAM, GERMANY
20-24 JUNE 2016

Yukon coast

Cont. permafrost: ~600m depth

Ground ice content: 37%

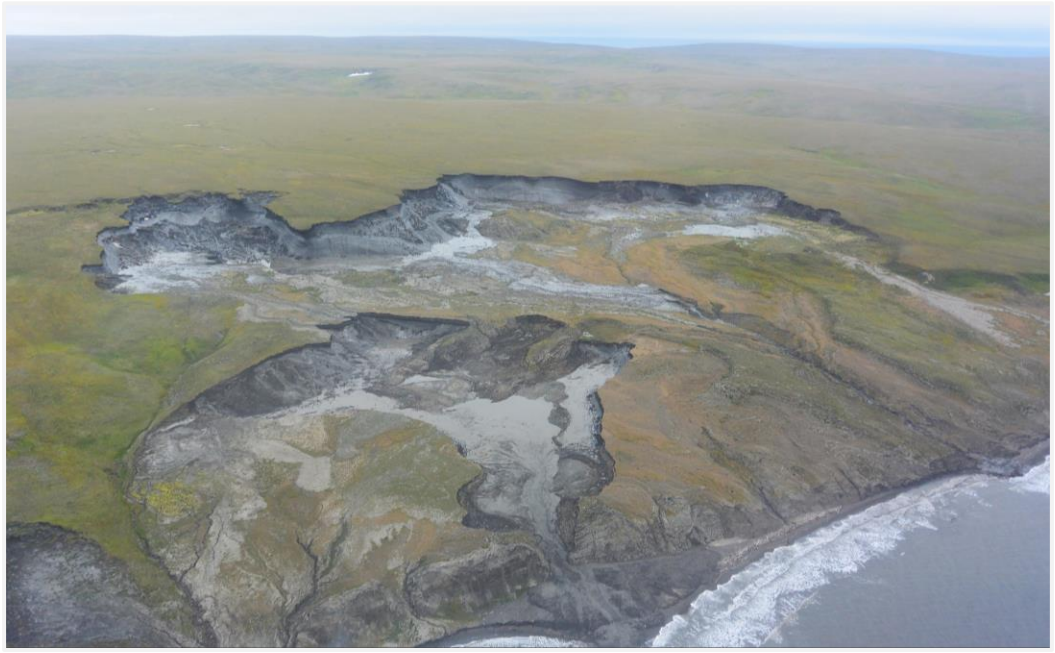
Coastal erosion rate: 0.7m yr^{-1}

Study area

XI. INTERNATIONAL CONFERENCE ON PERMAFROST
POTSDAM, GERMANY
20-24 JUNE 2016

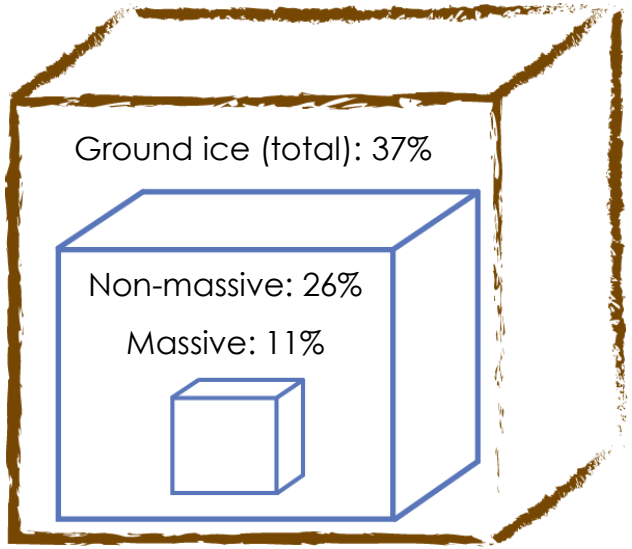
Low cliffs

Thermokarst affected

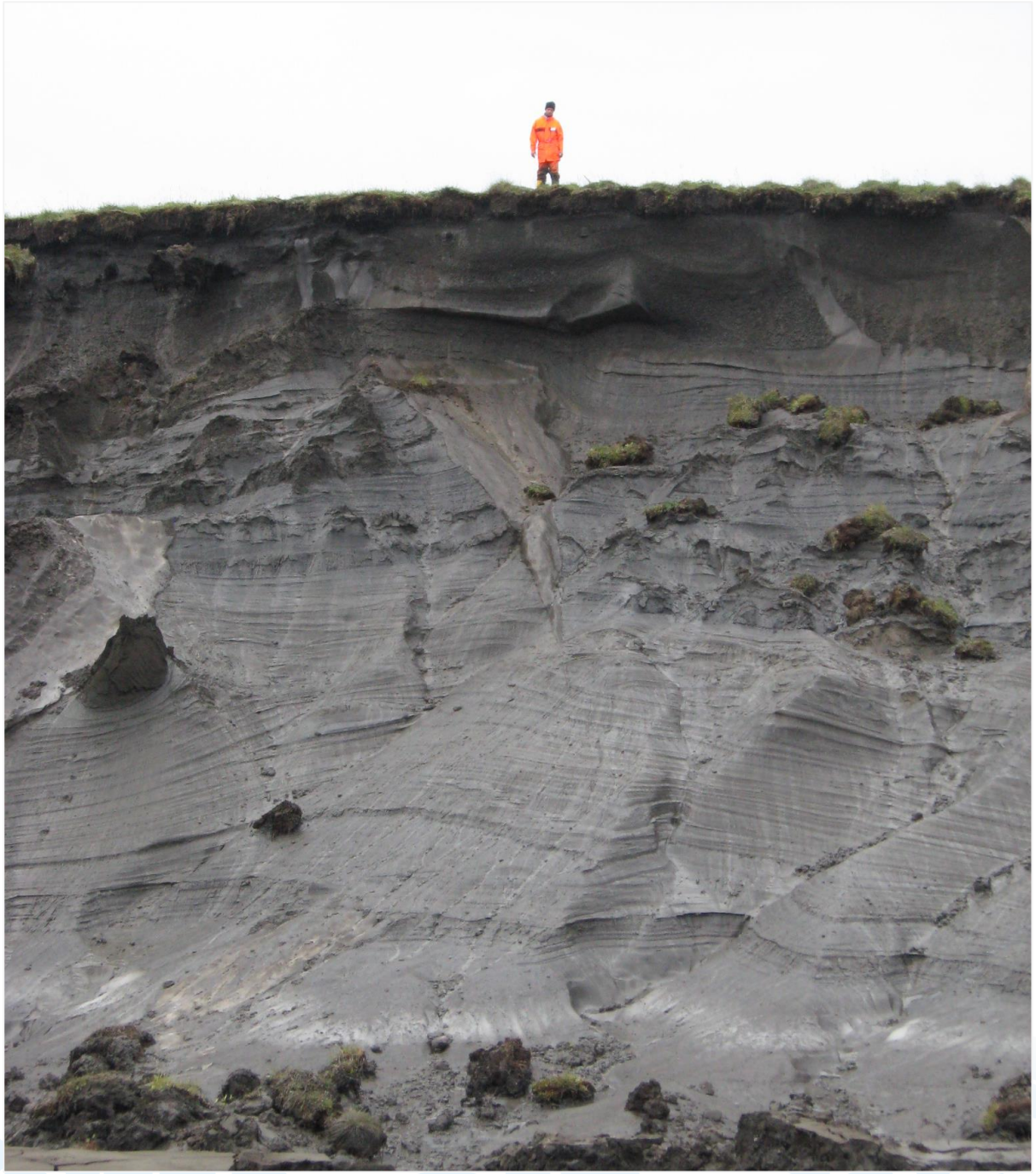


High cliffs

Study area

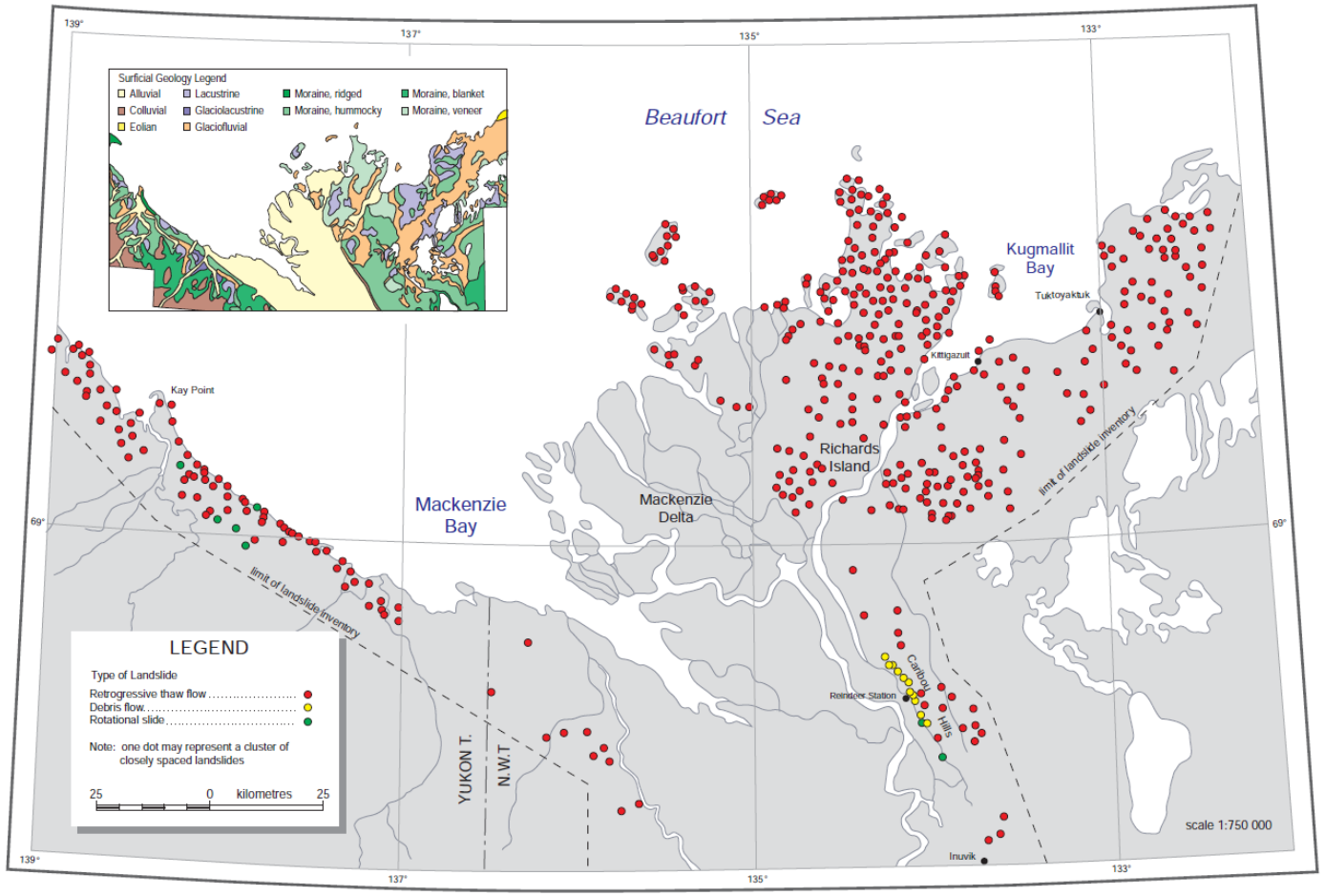


After *Couture and Pollard* 2015



Study area

Distribution of slumps

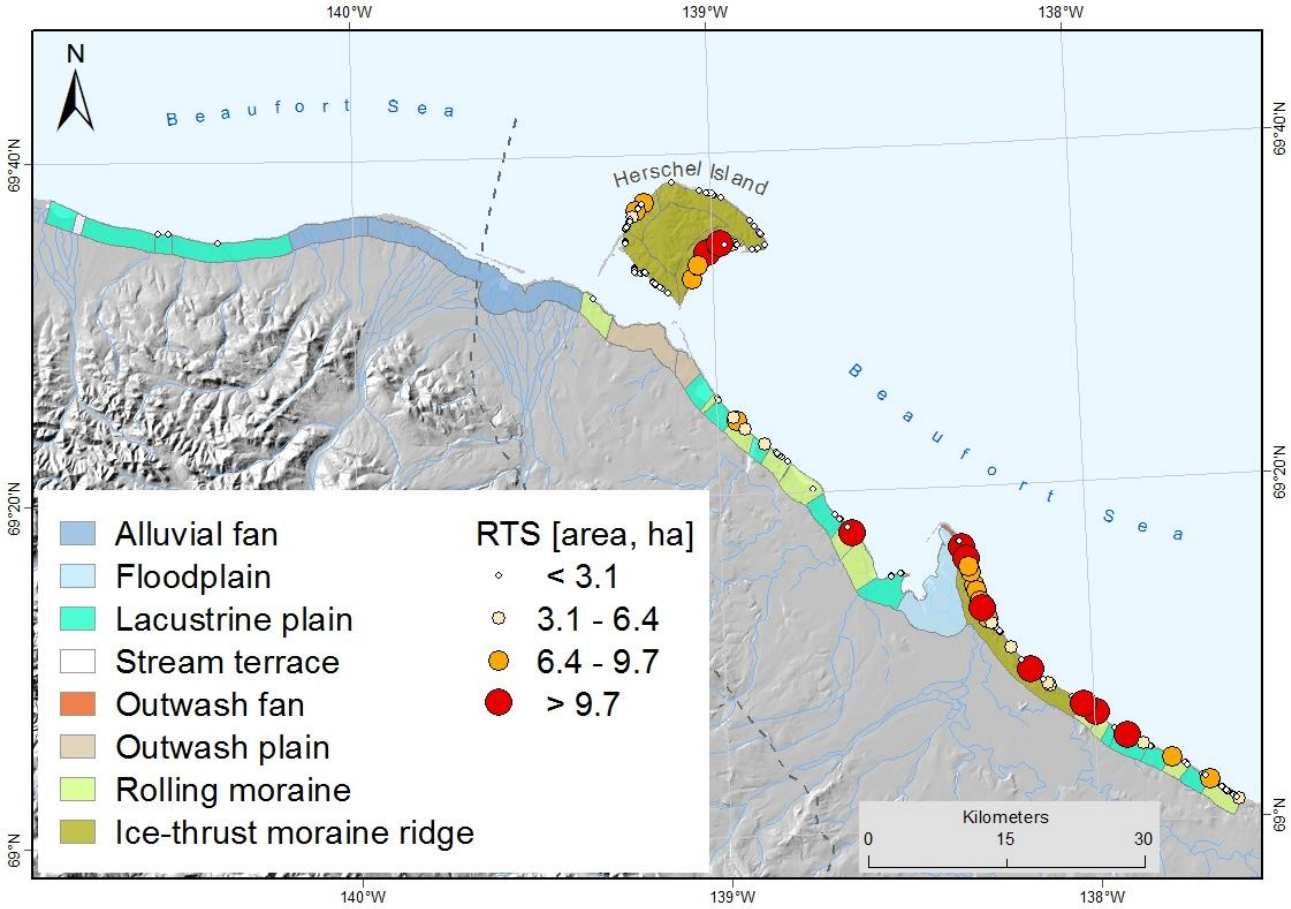


Pelletier and Medioli (eds.) 2014

Study area

XI. INTERNATIONAL CONFERENCE ON PERMAFROST
POTSDAM, GERMANY
20-24 JUNE 2016

Increase in slumping!



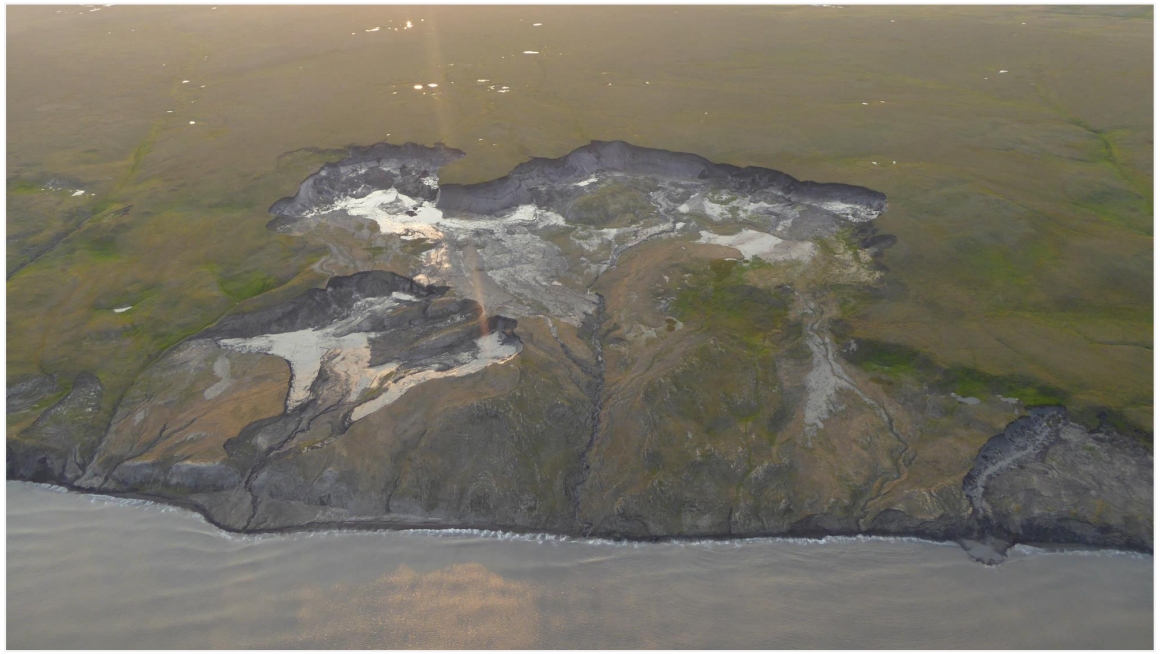
Ramage et al., in prep.

Objectives

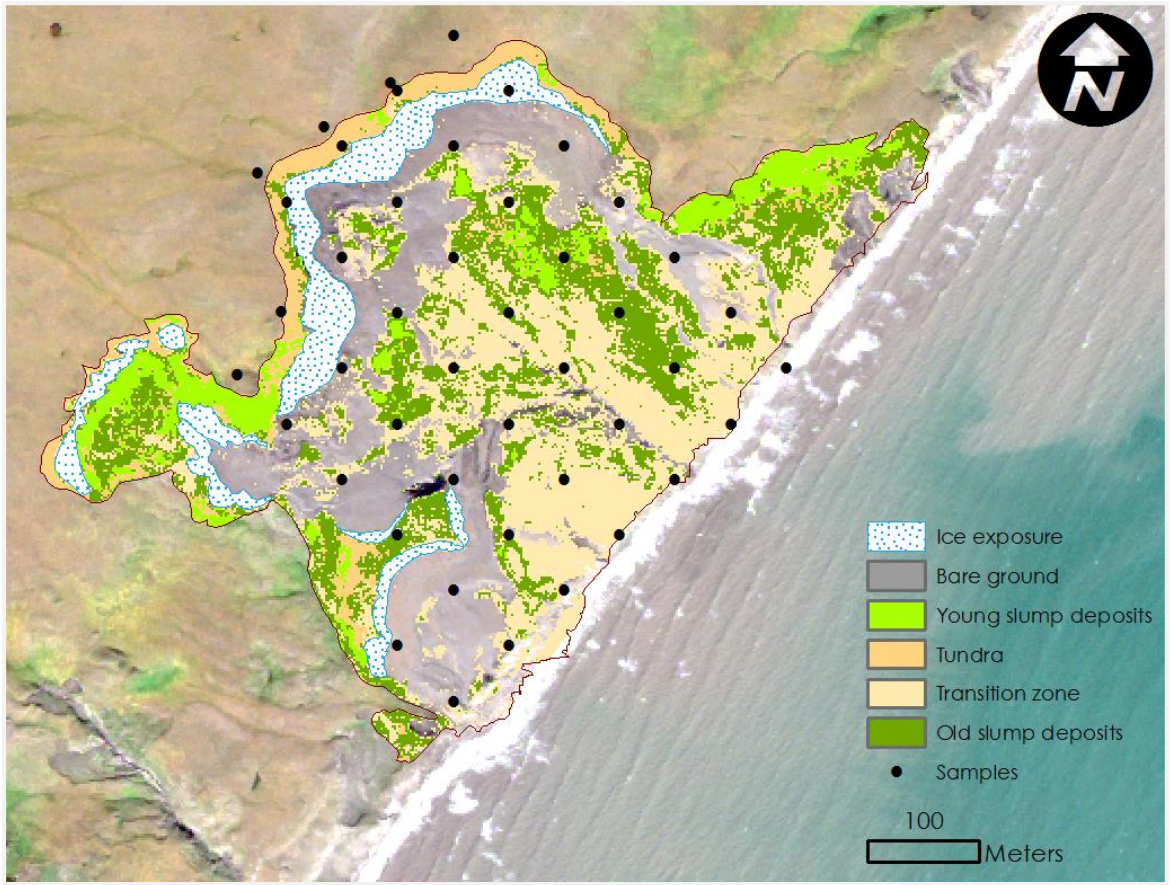
- OC differences between undisturbed and disturbed areas
- Degradation of organic matter before entering the ocean
- Fate of slump material in the ocean

Methods

XI. INTERNATIONAL CONFERENCE ON PERMAFROST
POTSDAM, GERMANY
20-24 JUNE 2016



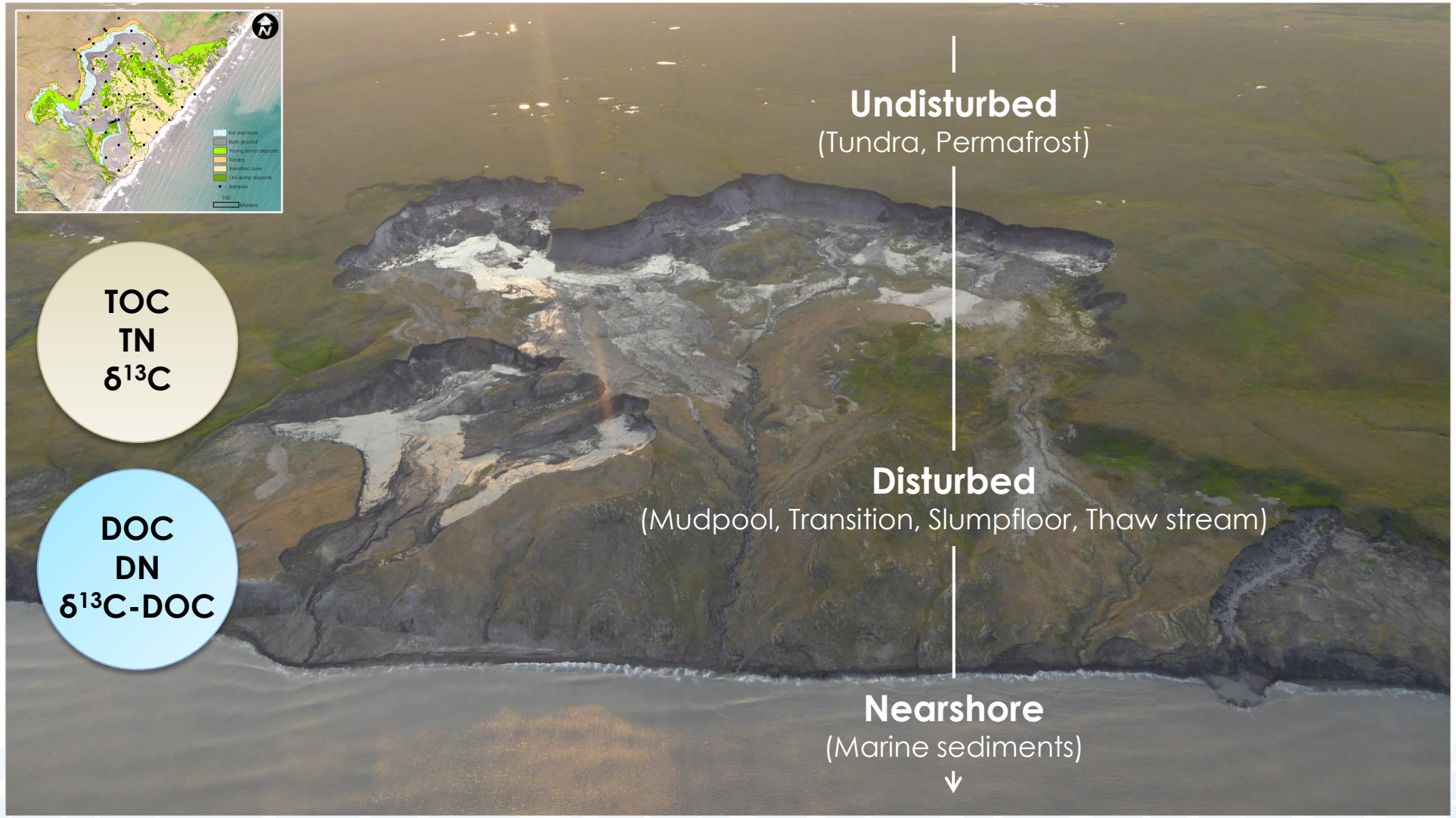
Retrogressive thaw slump „Slump D“



Vegetation classification of „Slump D“ based on NDVI and sampling scheme

Methods

XI. INTERNATIONAL CONFERENCE ON PERMAFROST
POTSDAM, GERMANY
20-24 JUNE 2016

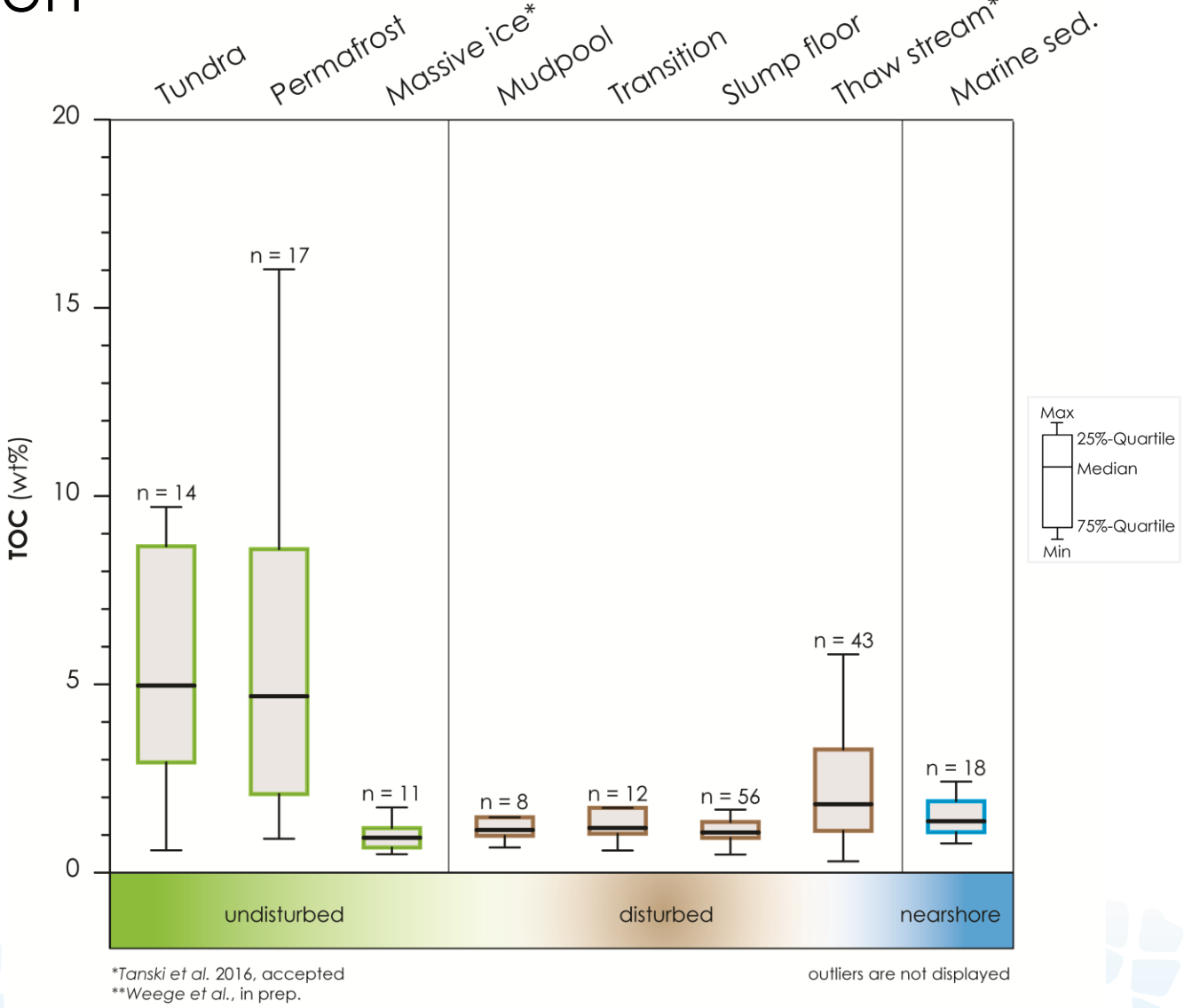


Results and Discussion

XI. INTERNATIONAL CONFERENCE ON PERMAFROST
POTSDAM, GERMANY
20-24 JUNE 2016

TOC
$\delta^{13}C$
TN

Strong decrease of organic carbon content after thaw



*Tanski et al. 2016, accepted
**Weege et al., in prep.

outliers are not displayed

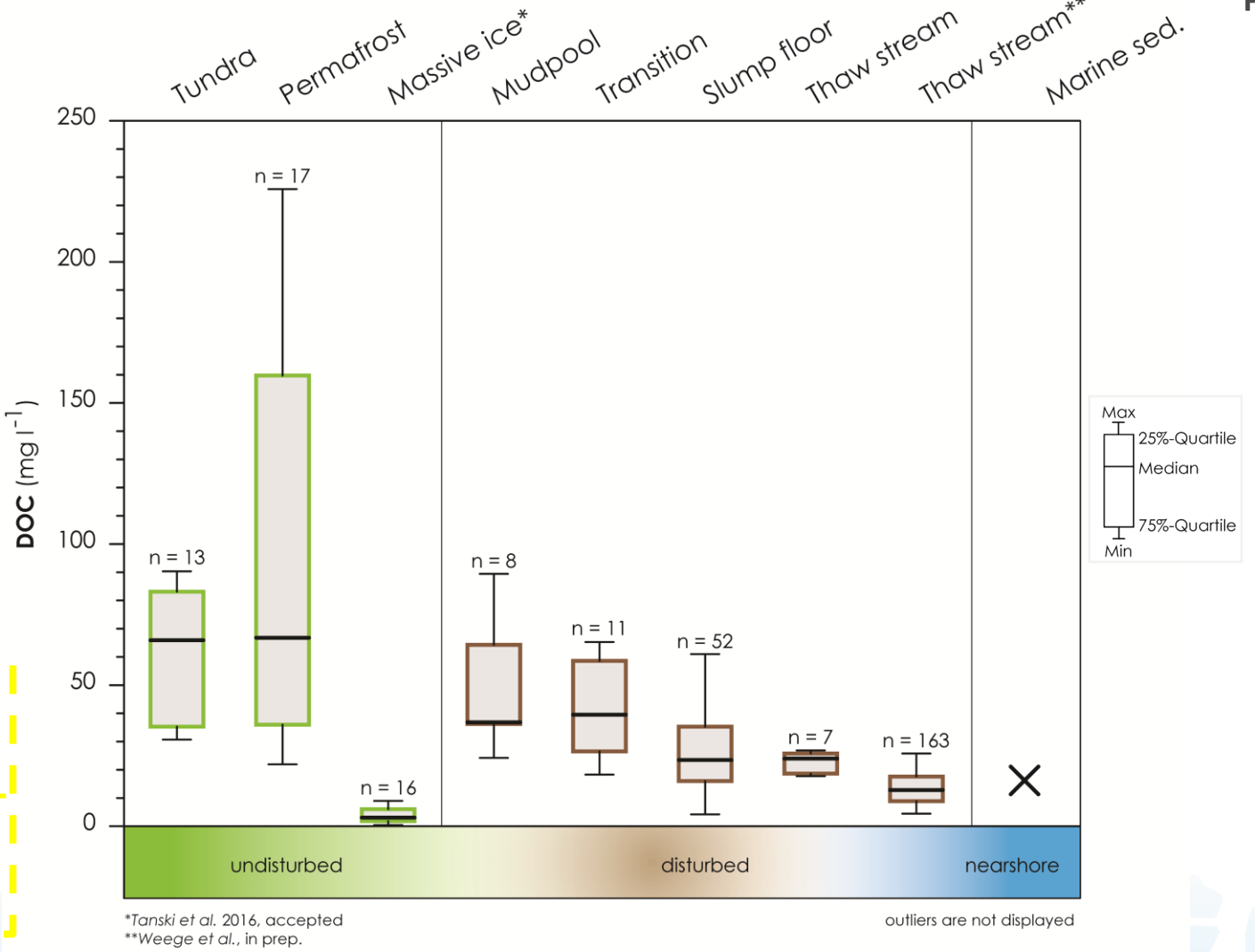
Results and Discussion

XI. INTERNATIONAL CONFERENCE ON PERMAFROST
POTSDAM, GERMANY
20-24 JUNE 2016

DOC
DN
δ^{13}C-DOC

Steady decrease of DOC conc. after thaw

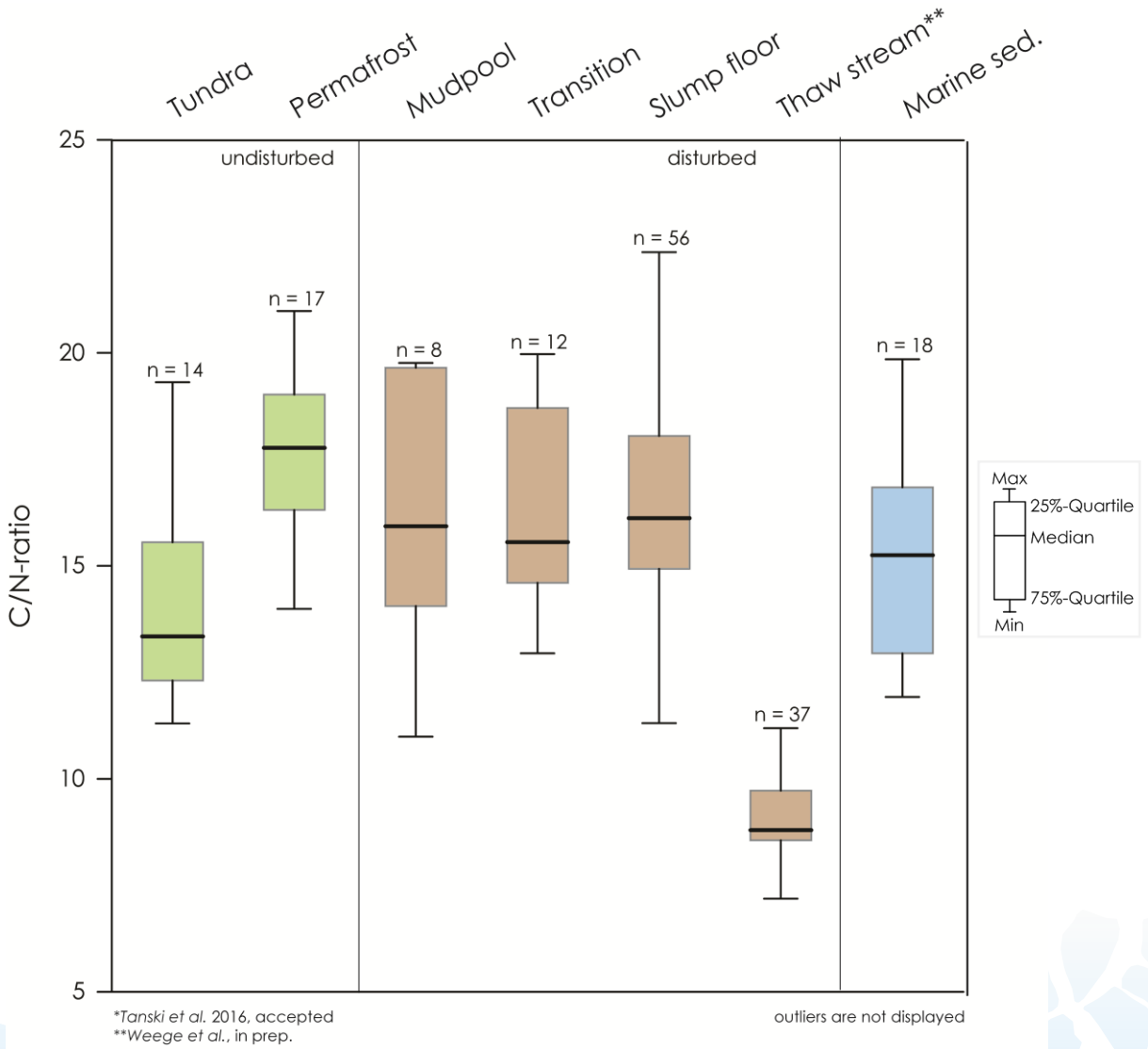
Indicates degradation and/or dilution by massive ice



Results and Discussion

C/N (TOC)

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

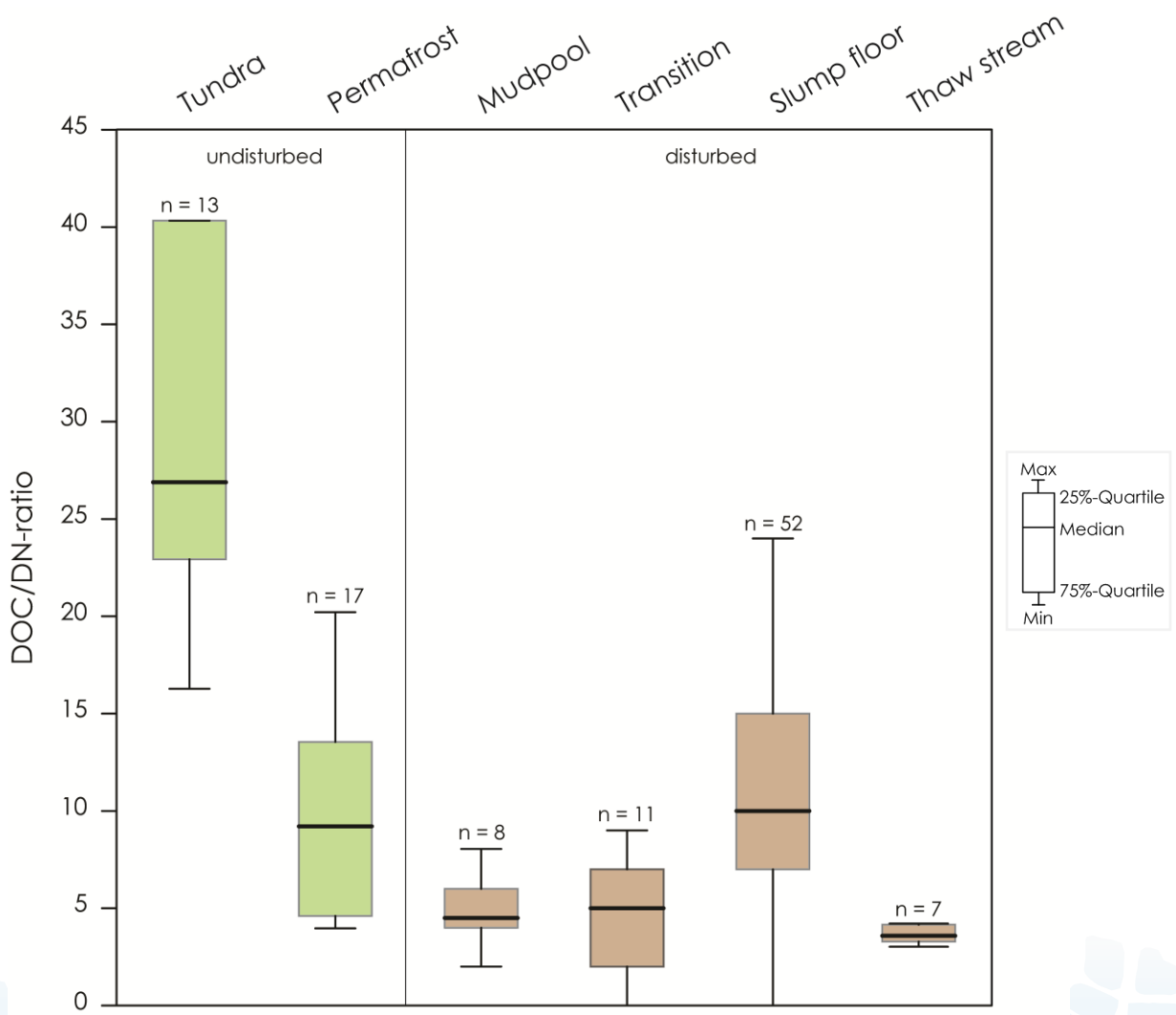


Results and Discussion

XI. INTERNATIONAL CONFERENCE ON PERMAFROST
POTSDAM, GERMANY
20-24 JUNE 2016

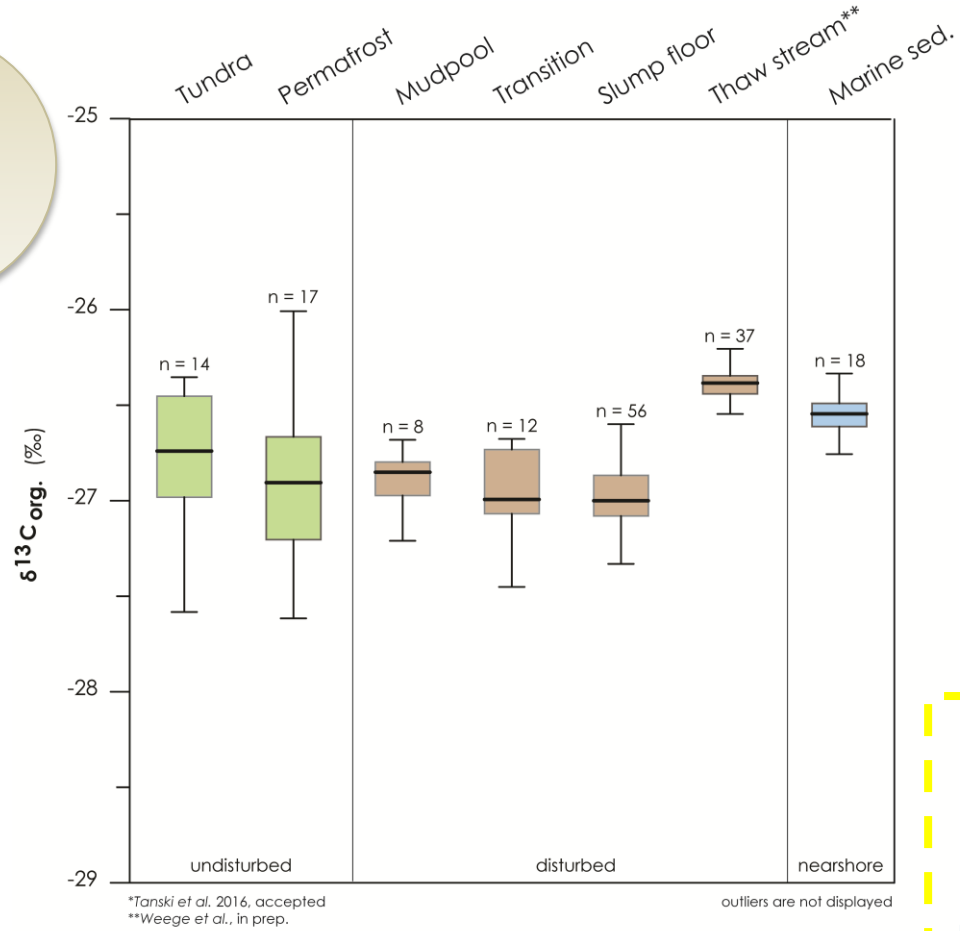
C/N (DOC)

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



Results and Discussion

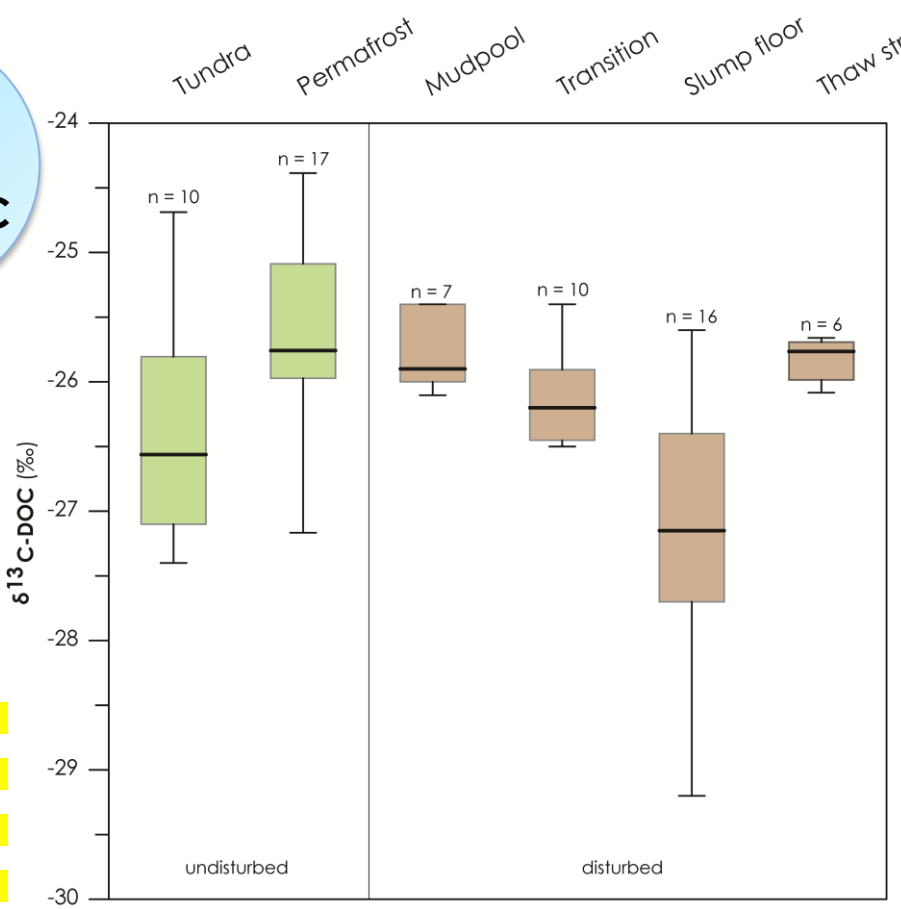
TOC
TN
$\delta^{13}C$

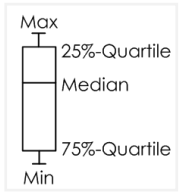


*Tanski et al. 2016, accepted
**Weege et al., in prep.

outliers are not displayed

DOC
DN
$\delta^{13}C$-DOC

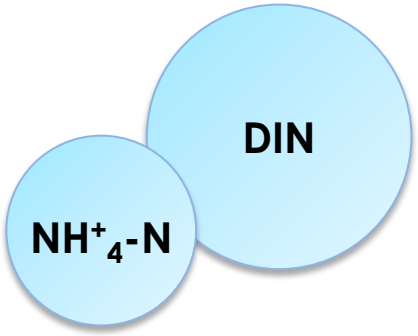




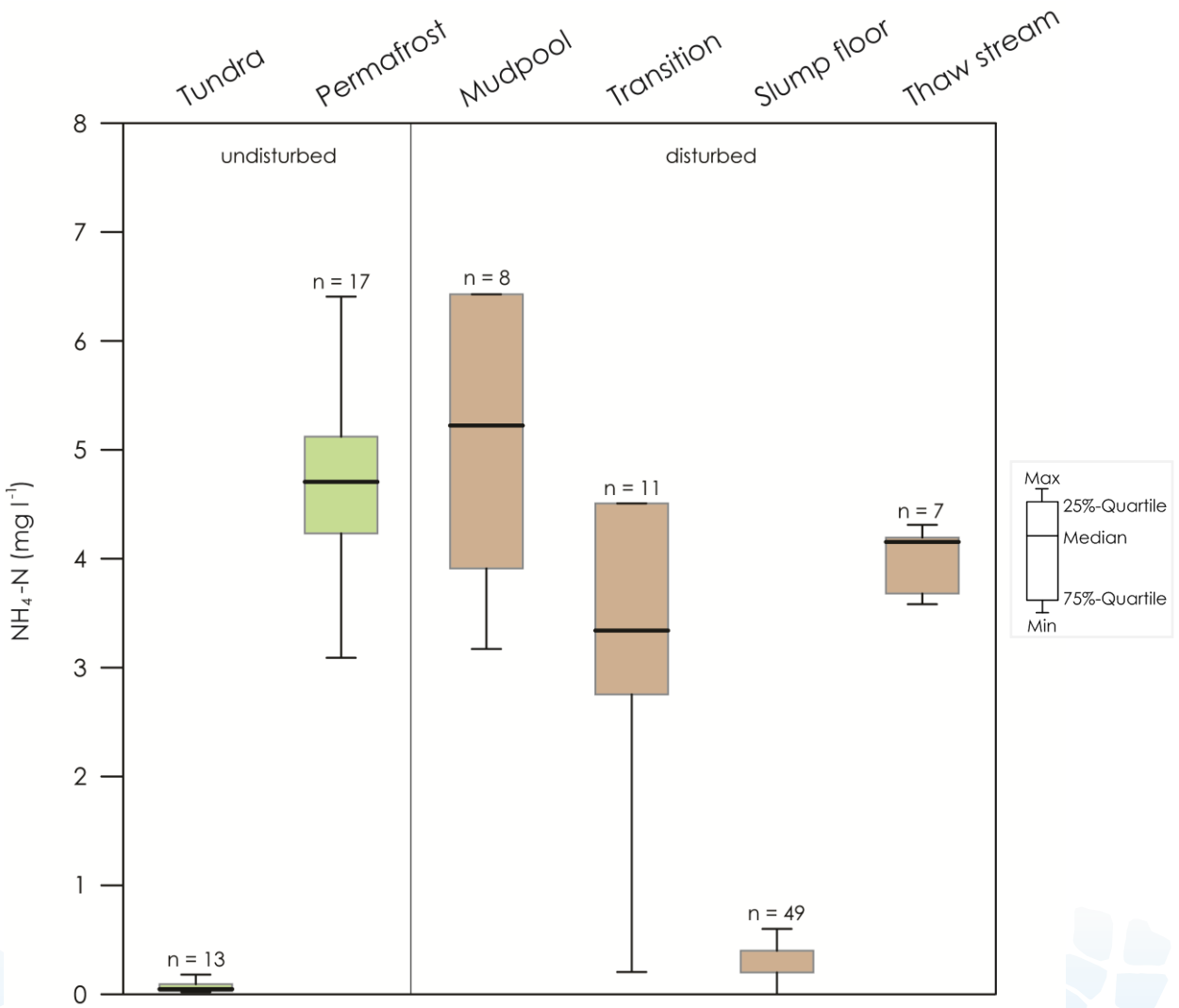
No degr. reflected by $^{13}C_{org.}$ conc.

Results and Discussion

XI. INTERNATIONAL CONFERENCE ON PERMAFROST
POTSDAM, GERMANY
20-24 JUNE 2016



Decomposition of org. material right upon thaw and/or direct transport into the ocean



Conclusion

XI. INTERNATIONAL CONFERENCE ON PERMAFROST
POTSDAM, GERMANY
20-24 JUNE 2016

- 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 $^{13}C_{org.}$
- Rapid degradation upon thaw possibly indicated by NH_4^+-N
- Transport of undegraded material directly into the ocean

Outlook and open questions

XI. INTERNATIONAL CONFERENCE ON PERMAFROST
POTSDAM, GERMANY
20-24 JUNE 2016

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**?

Acknowledgements

XI. INTERNATIONAL CONFERENCE ON PERMAFROST
POTSDAM, GERMANY
20-24 JUNE 2016

Parcs Canada

Parks Canada

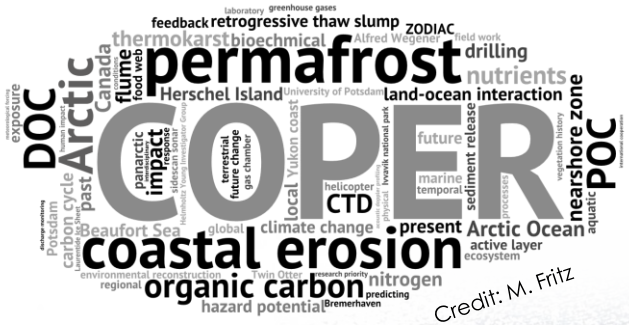
GFZ Helmholtz-Zentrum Potsdam

POLMAR Helmholtz Graduate School for Polar and Marine Research

Universität Potsdam

Thank you very much for the attention!

XI. INTERNATIONAL CONFERENCE ON PERMAFROST
POTSDAM, GERMANY
20-24 JUNE 2016



Credit: M. Fritz

www.awi.de/forschung/nachwuchsgruppen/coper

Arctic coastal erosion group