

Fine-scale zooplankton distribution in two contrasting southern Greenland fjords and its relation to environmental factors

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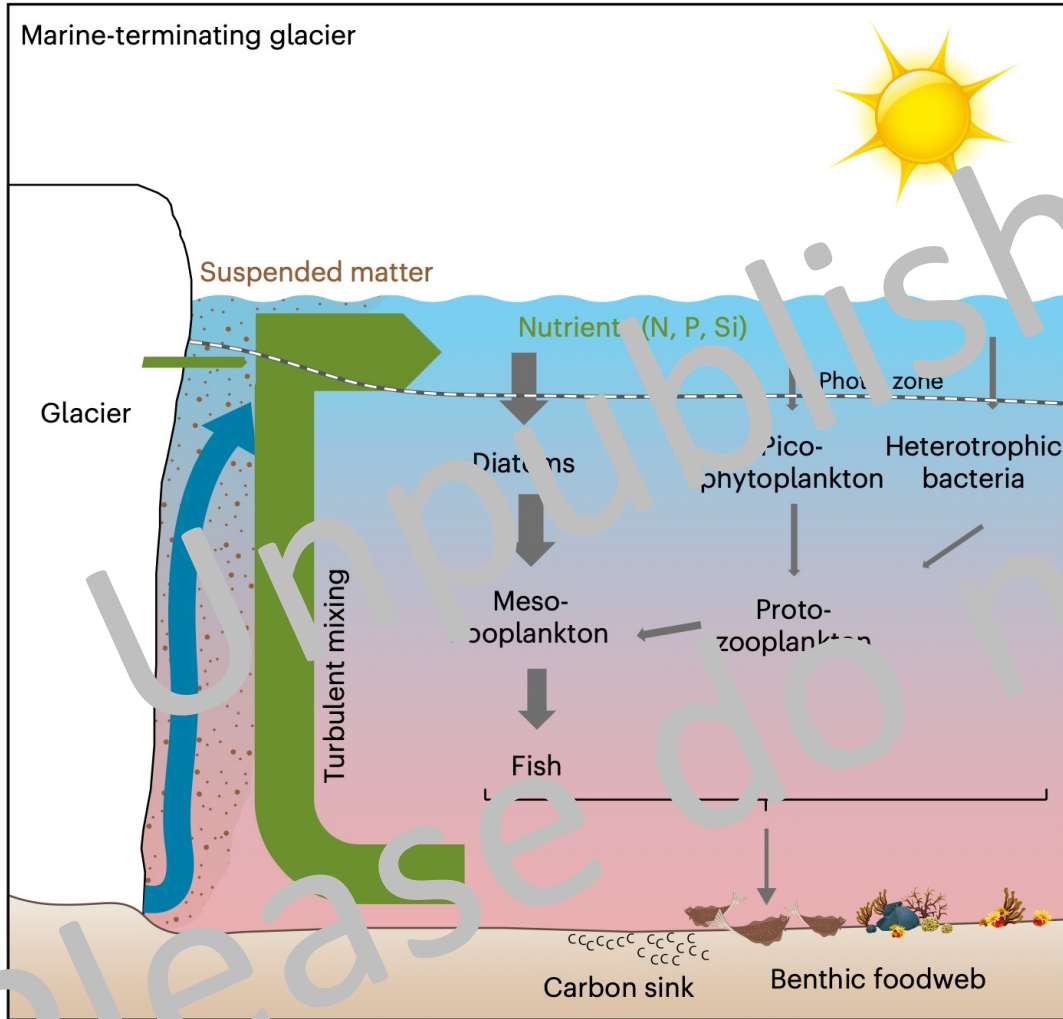
³Utrecht University, The Netherlands

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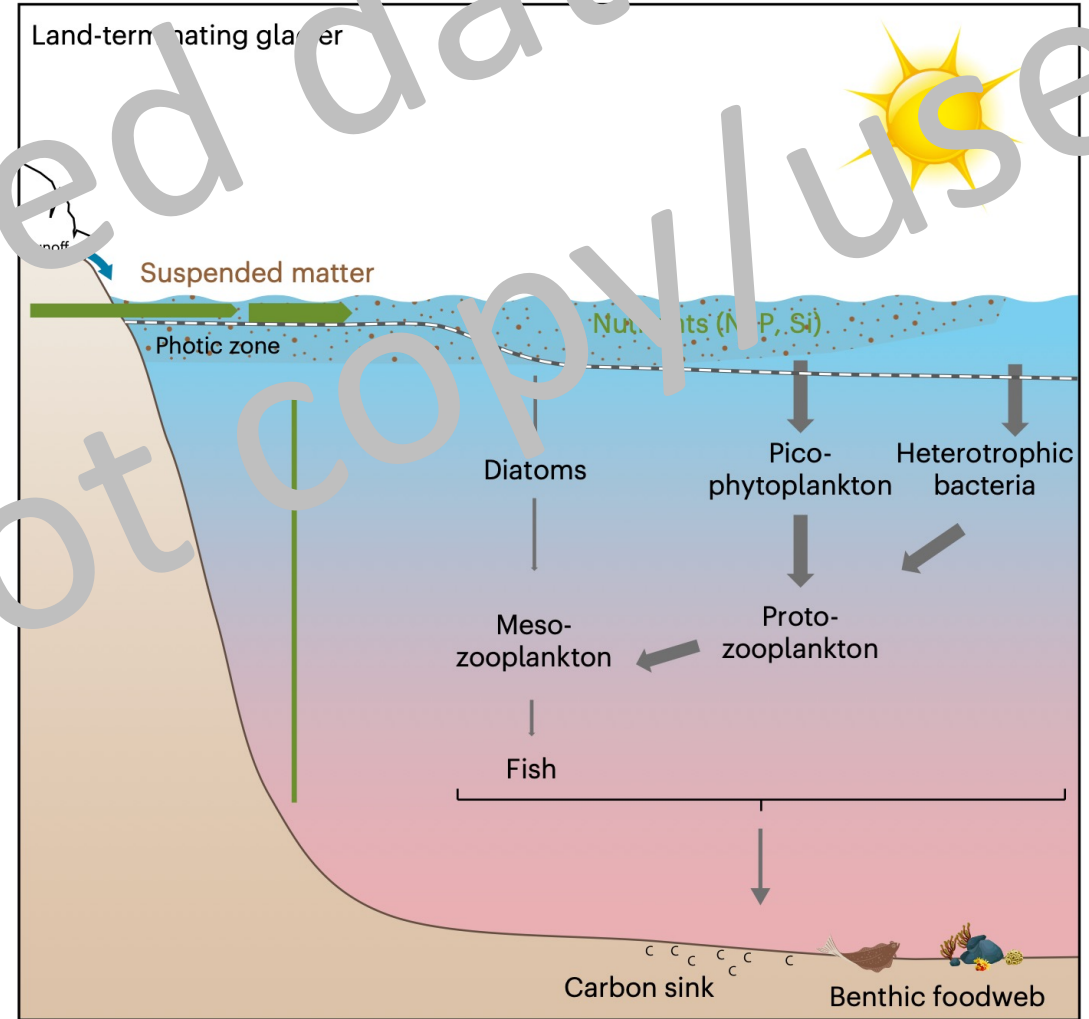
E-mail: dick.van.oevelen@nioz.nl

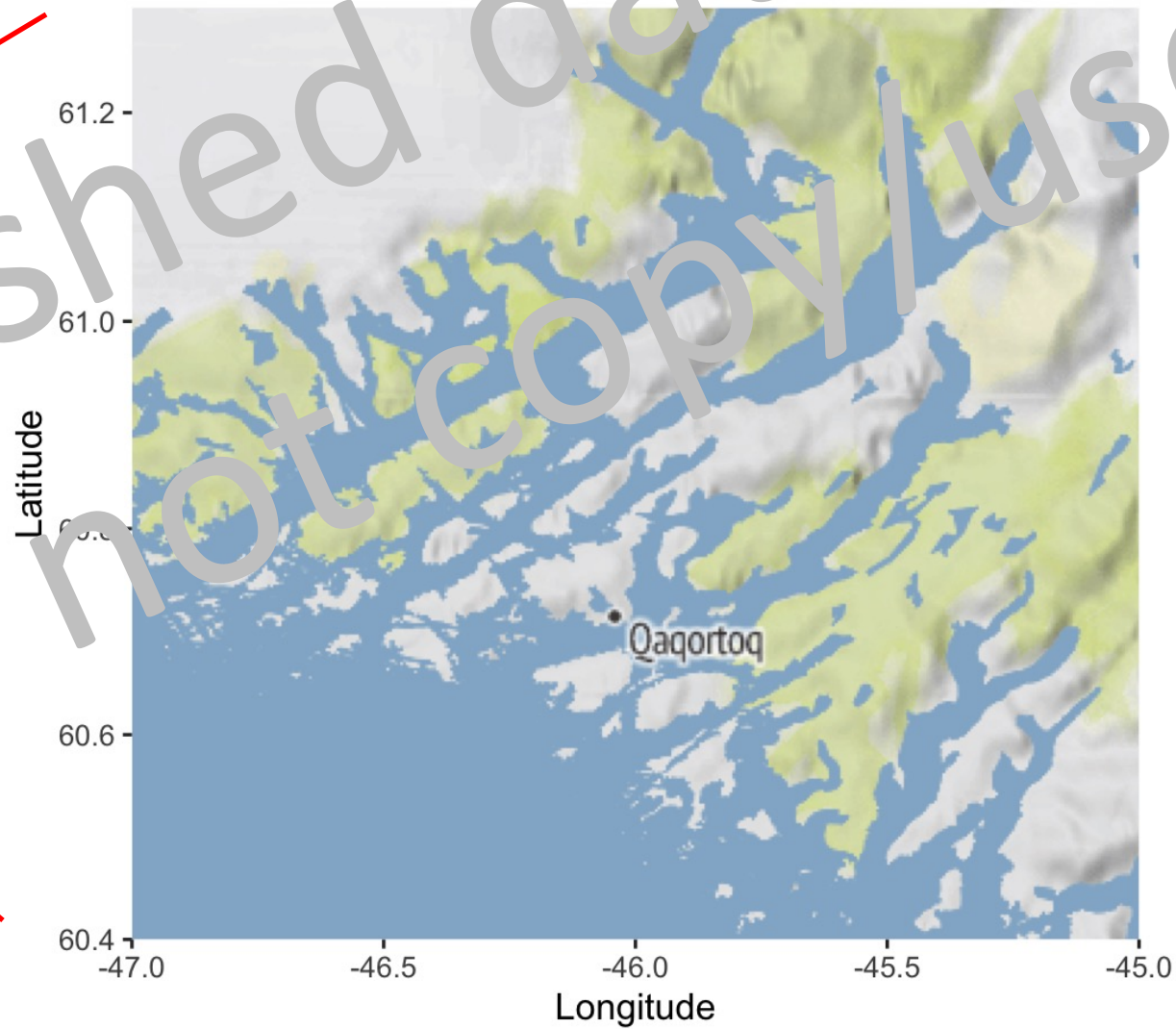
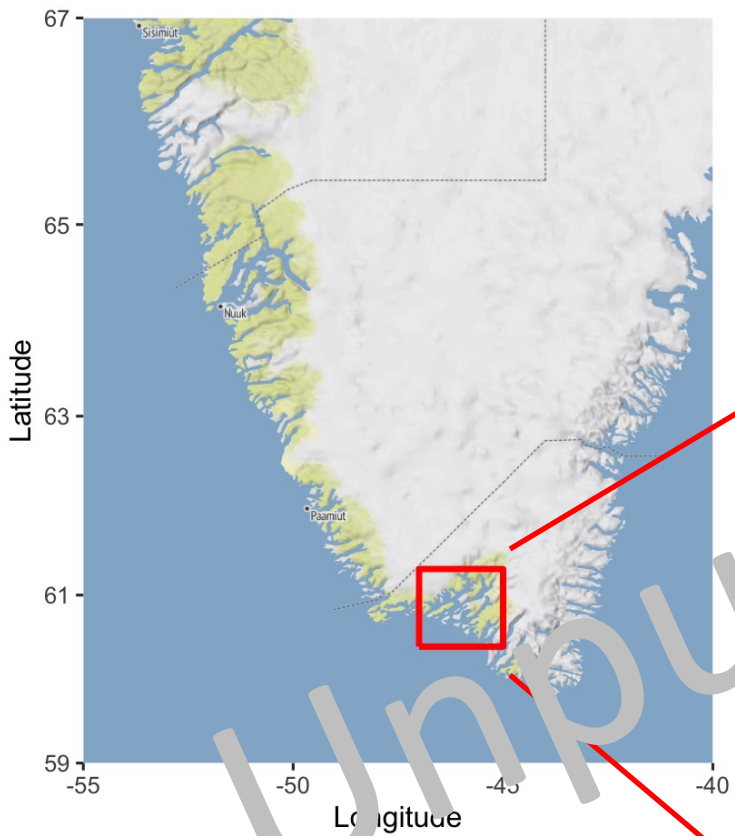


Marine-terminating glacier

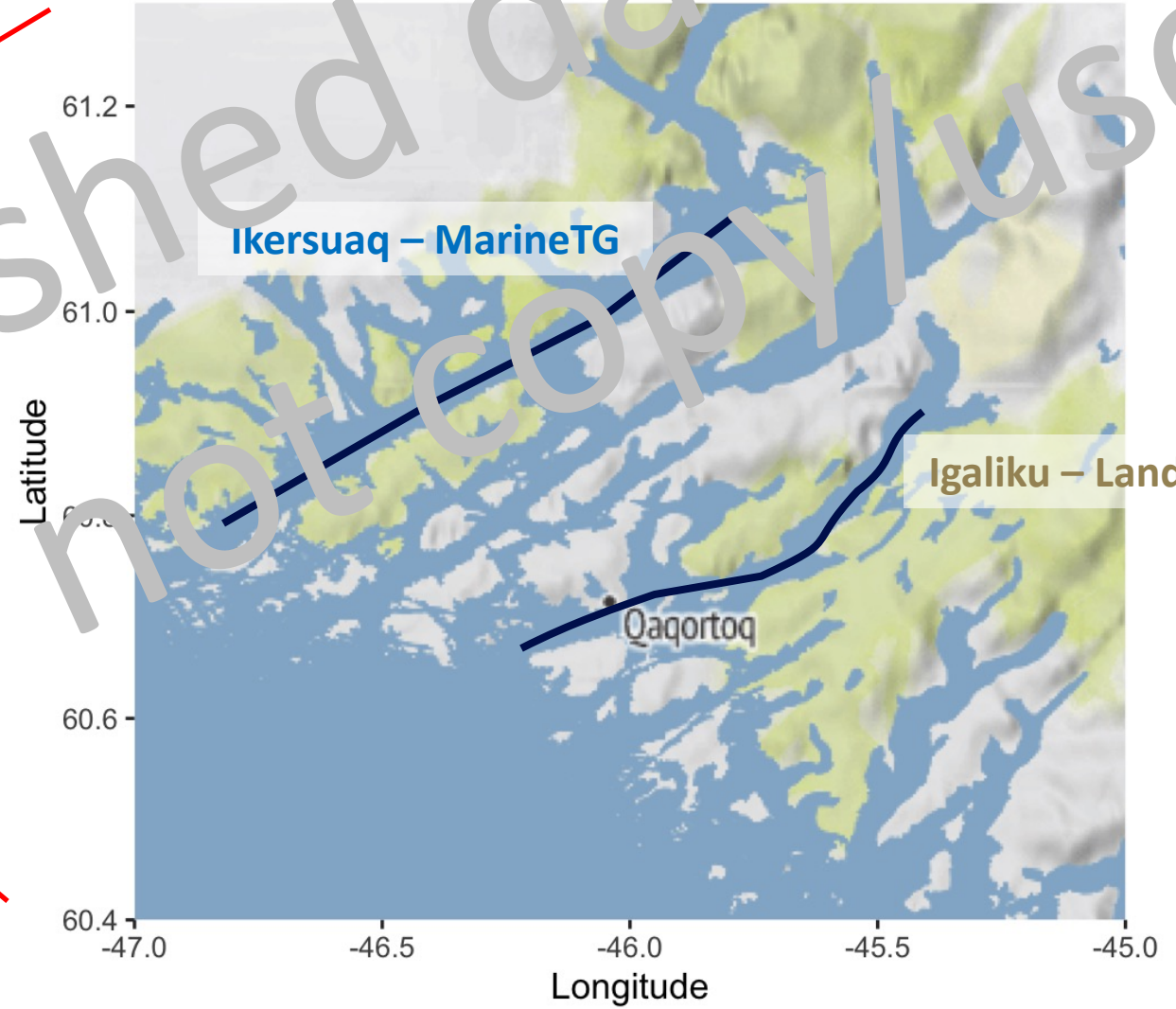
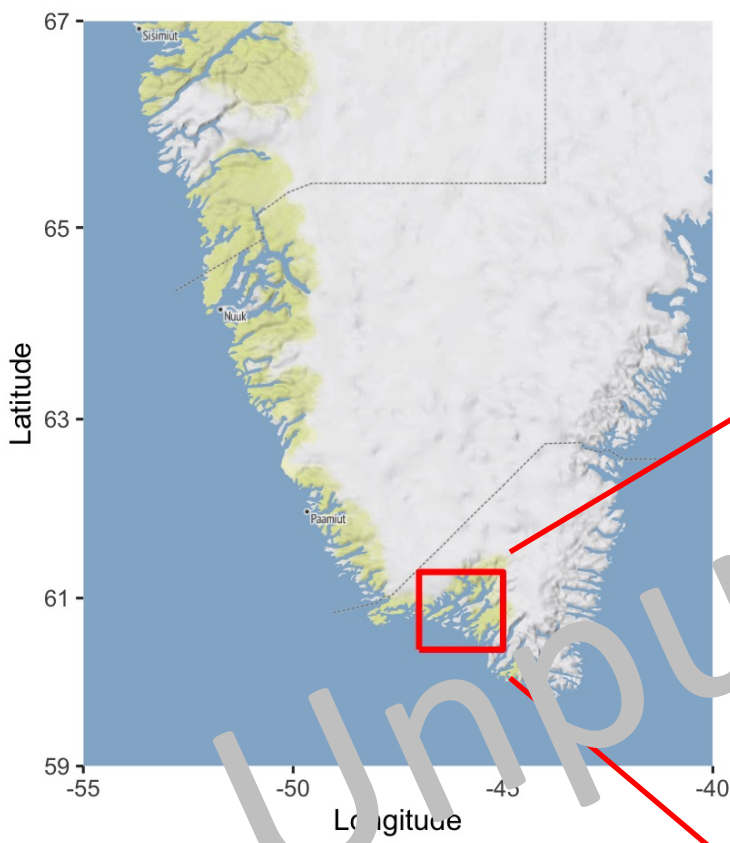


Land terminating glacier





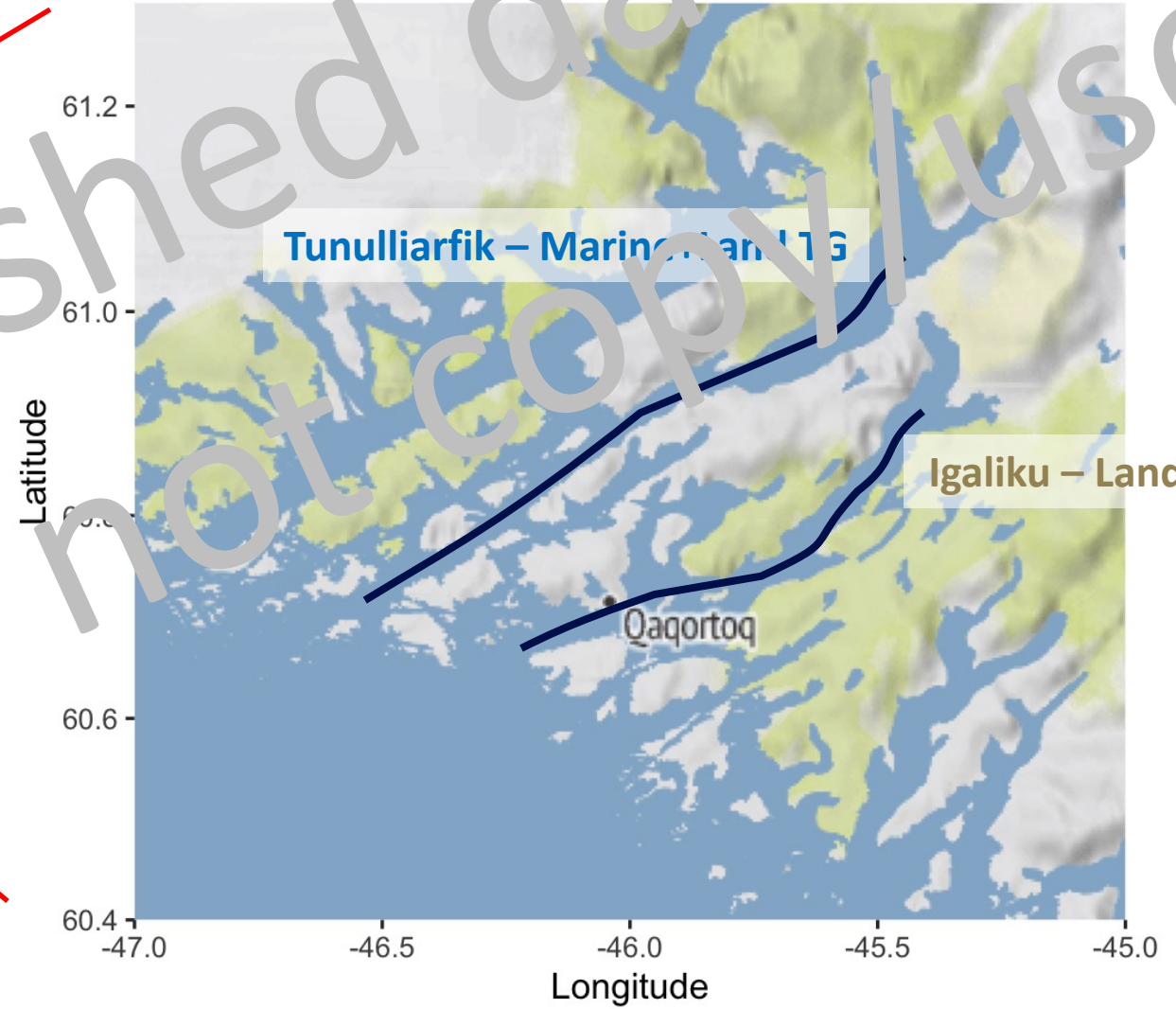
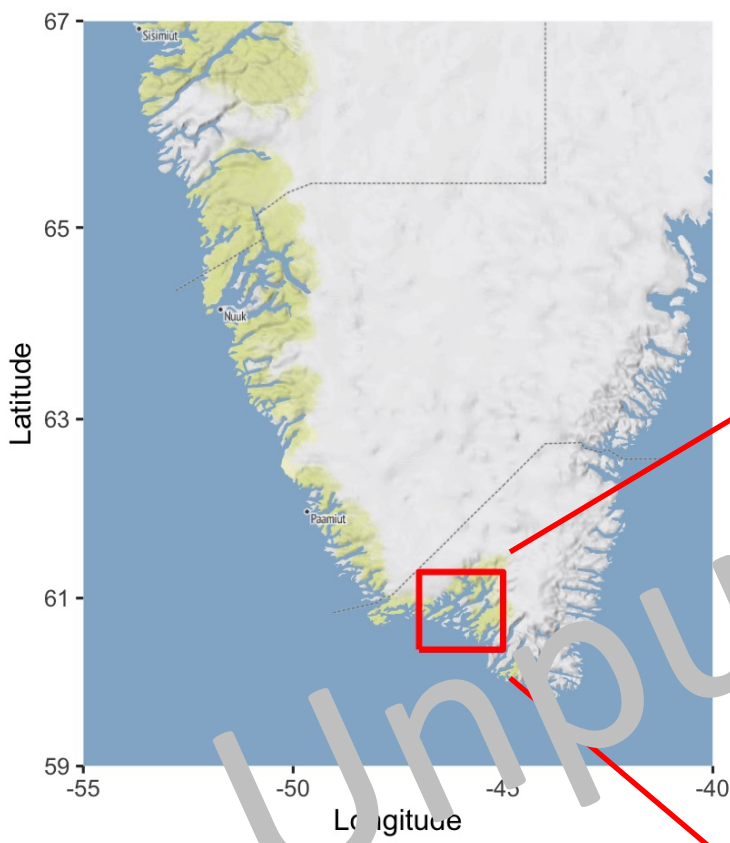
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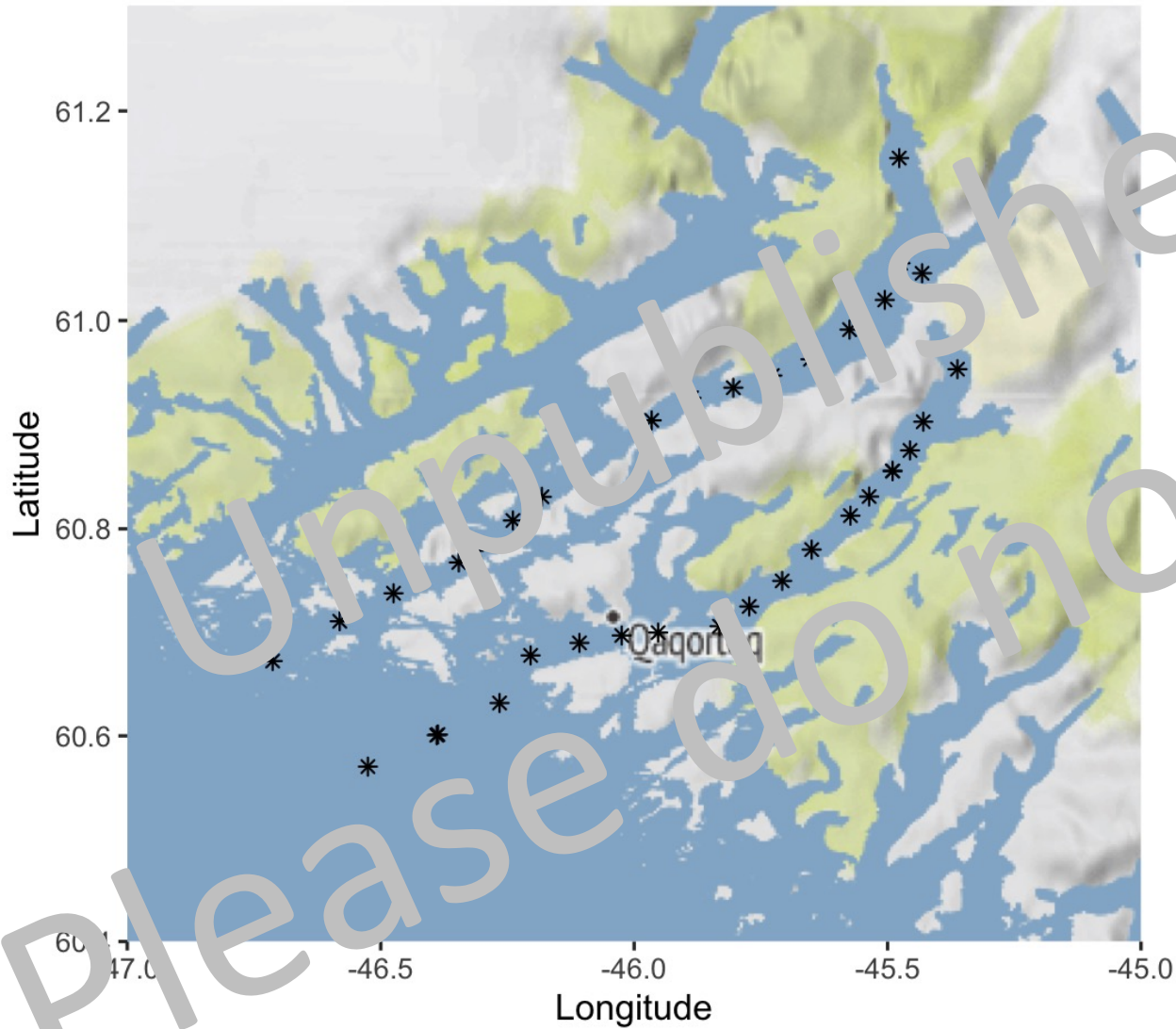


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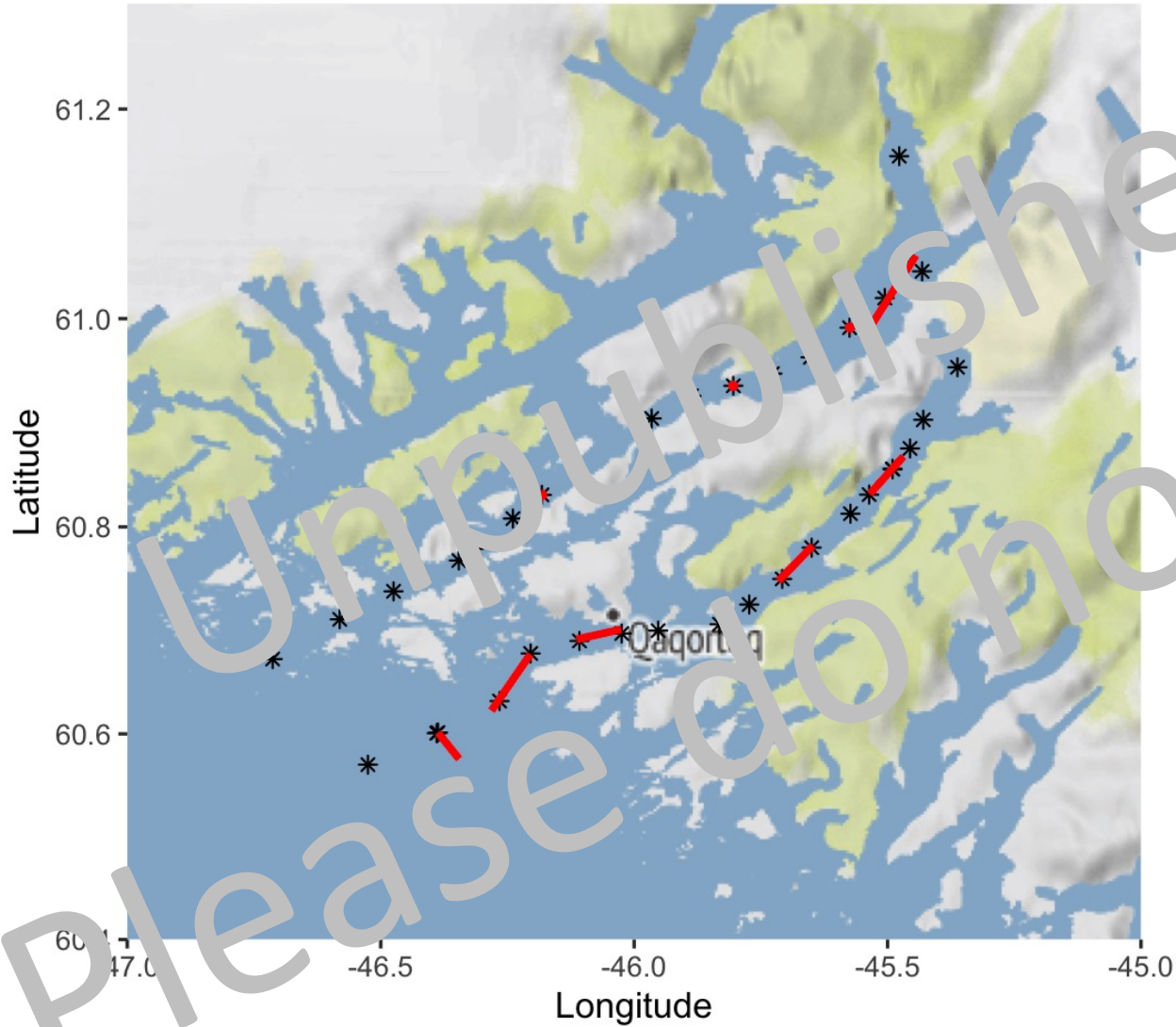
CTD stations



CTD stations

- CTD casts to seafloor
- Turbidity, fluorescence sensors
- PAR sensor
- Fast Repetitive Rate Fluorometry (FRRF) measurements for depth-integrated photosynthesis

Stations

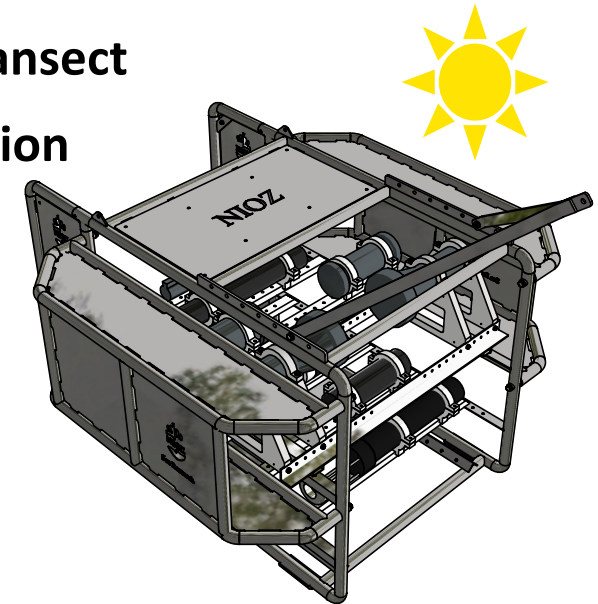


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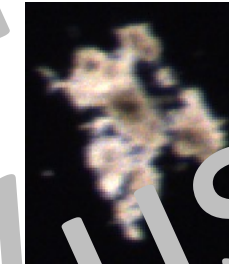
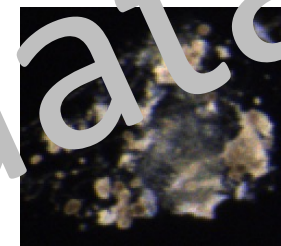
Tow-yo transect

Yo-yo station





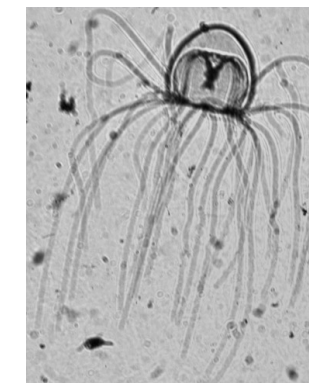
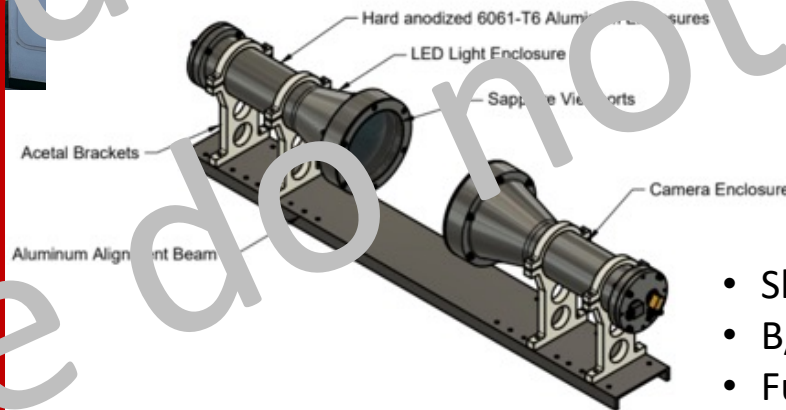
Continuous Particle Imaging and Classification System (CPICS)



- Clarkfield
- Color images
- In-house detection of Region of Interest (ROI)
- Target particle size: 100 – 1,000 μm
- 8 fps, 10 L h⁻¹



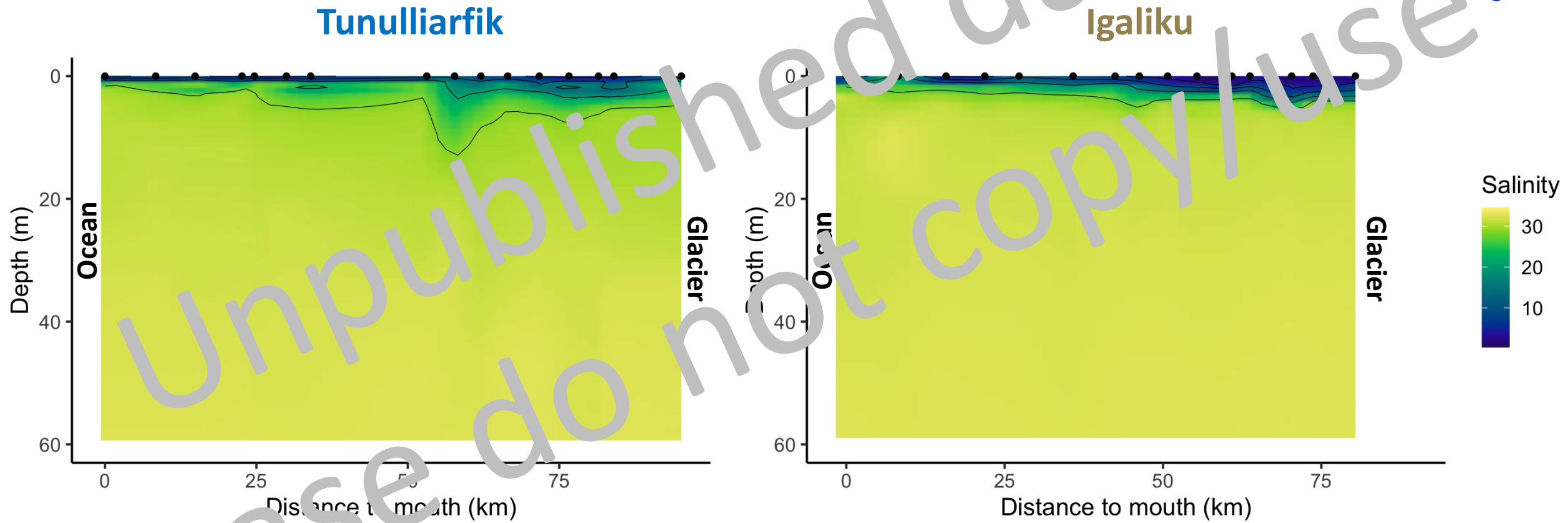
In-Situ Phytoplankton Imaging System (ISIPS)



- Shadowgraph, area-scan technology
- B/W images
- Full frames, ROIs extracted on return
- Target particle size: 500 μm – 20 mm
- 4-5 fps 20,000 L h⁻¹

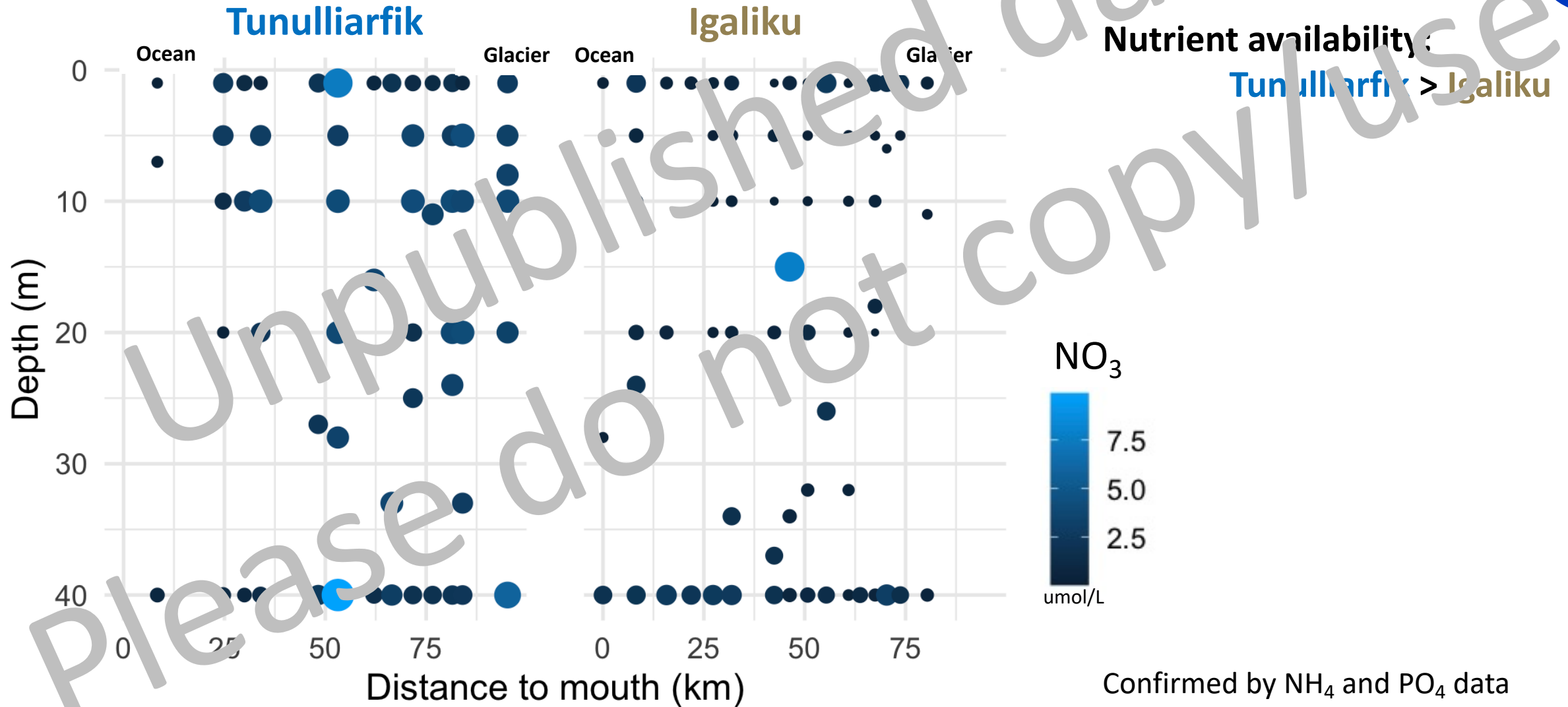
RBRmaestro – CTD, chl-a, turbidity, oxygen

Salinity (0 – 60m)

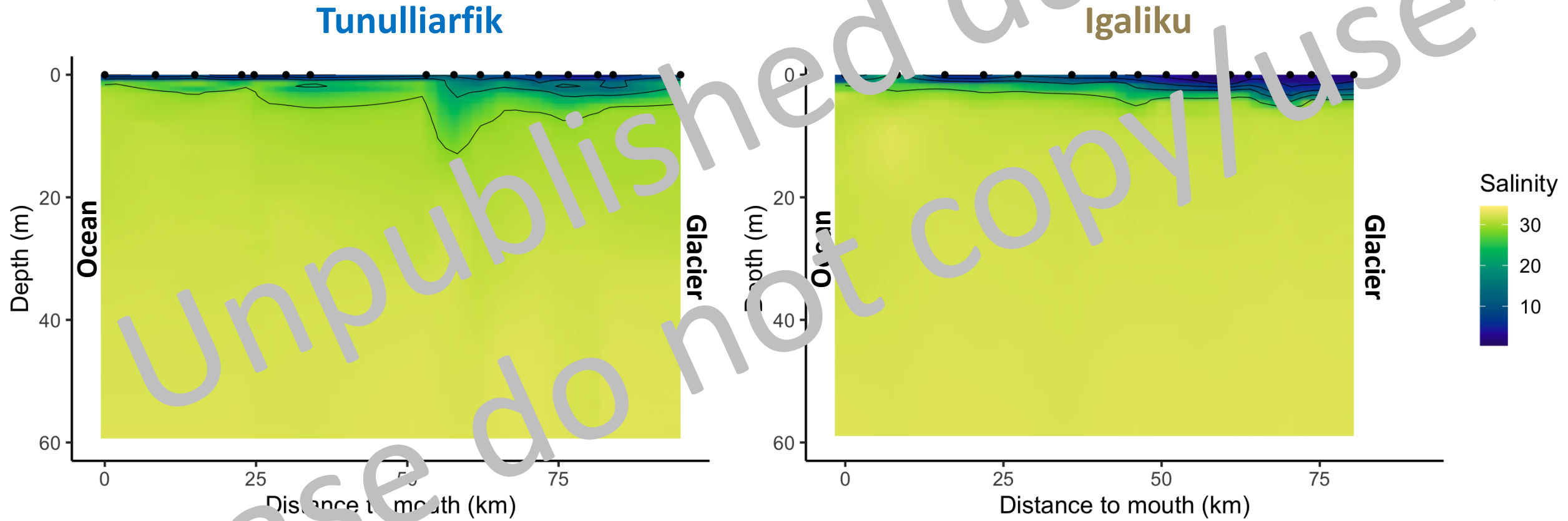


CTD data consistent with Tunulliarfik as MarineTG and Igaliku as LandTG

Nitrate concentrations (0 – 40m)

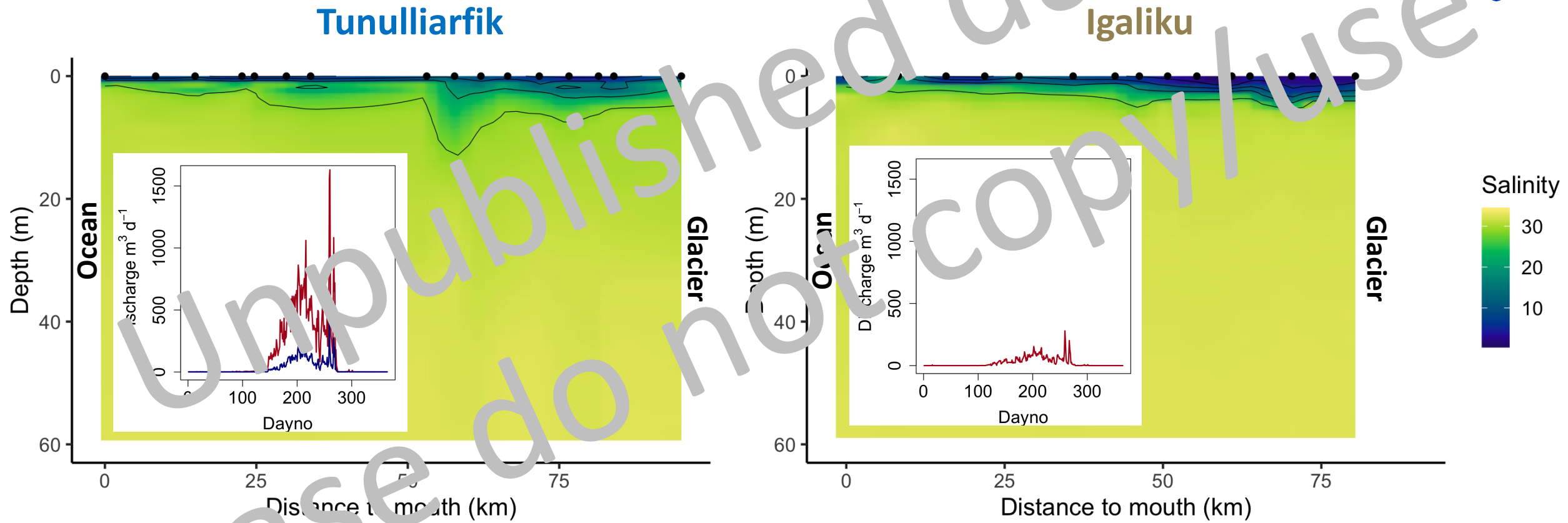


Salinity (0 – 60m)



CTD data consistent with Tunulliarfik as MarineTG and Igaliku as LandTG

Salinity (0 – 60m)



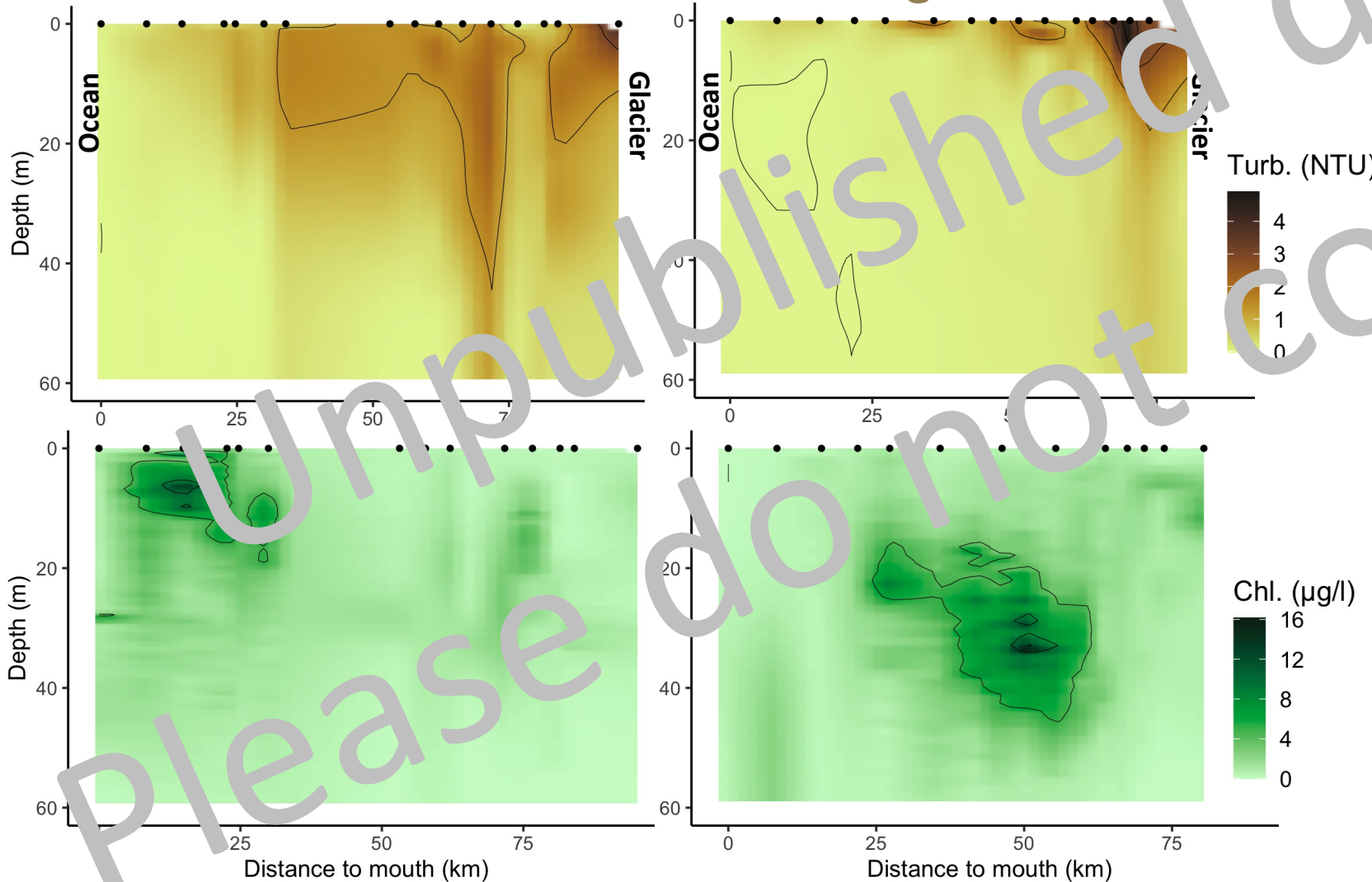
CTD data consistent with Tunulliarfik as MarineTG and Igaliku as LandTG, but most discharge in Tunulliarfik is from the LandTG

Turbidity & Chlorophyll (0 – 60m)



Tunulliarfik

Igaliku



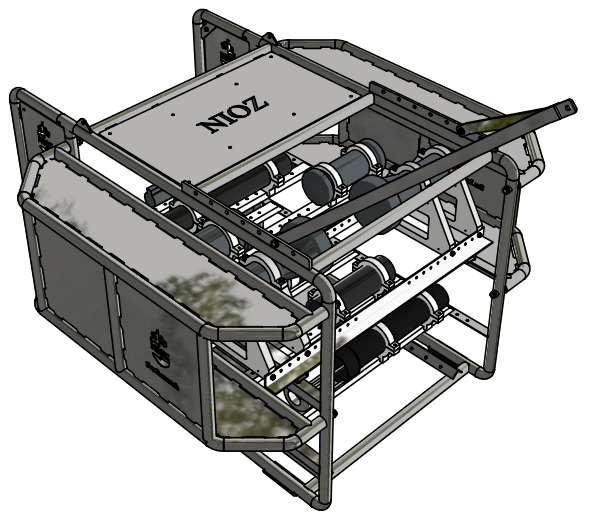
Turbidity:

Tunulliarfik > Igaliku

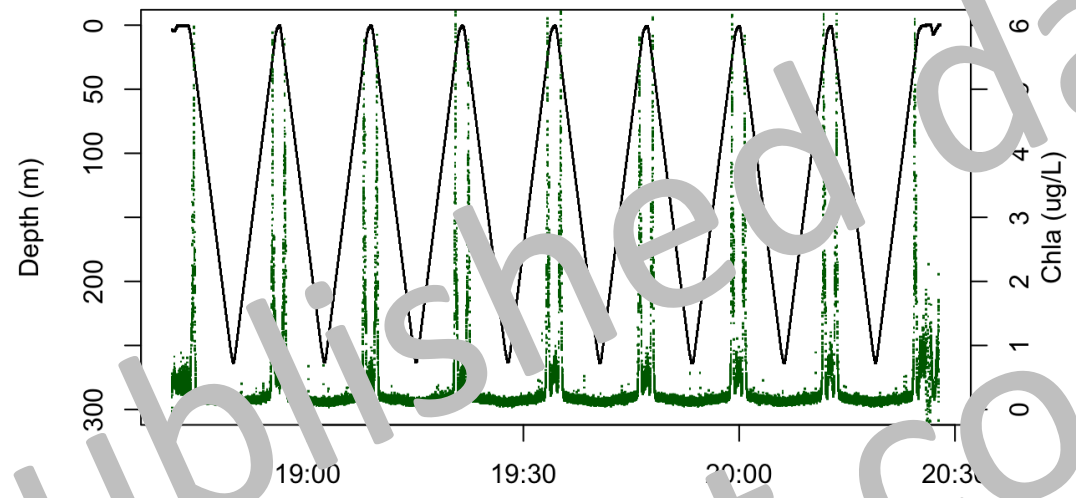
Productivity:

Igaliku > Tunulliarfik

Confirmed by depth-integrated primary productivity (based on PAR and FRRF)

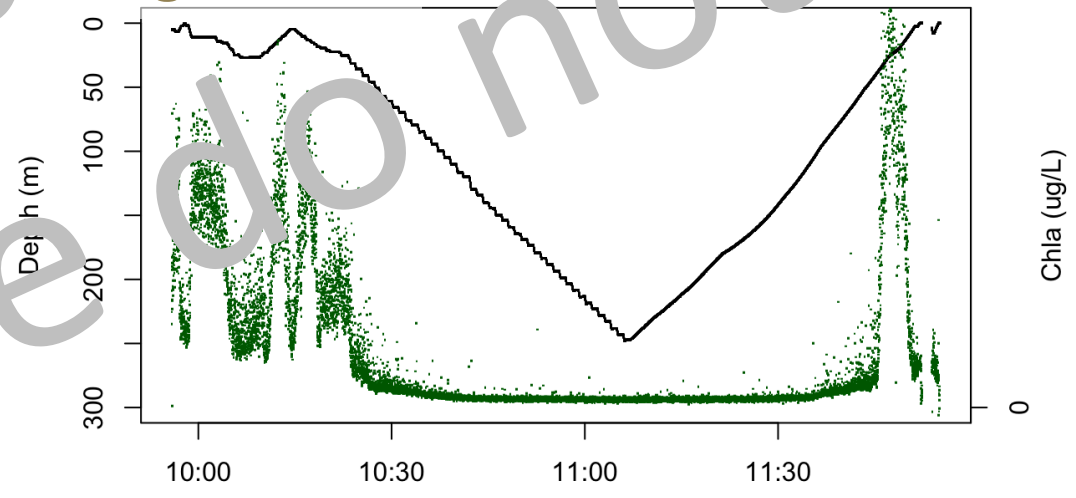


Tunulliarfik

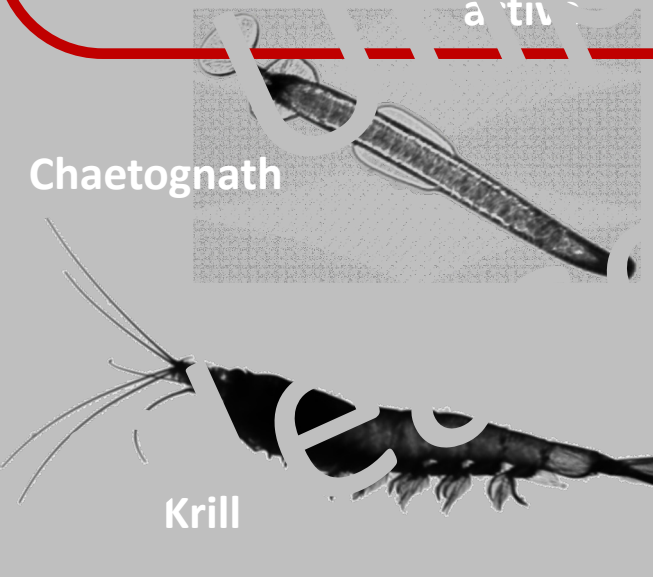
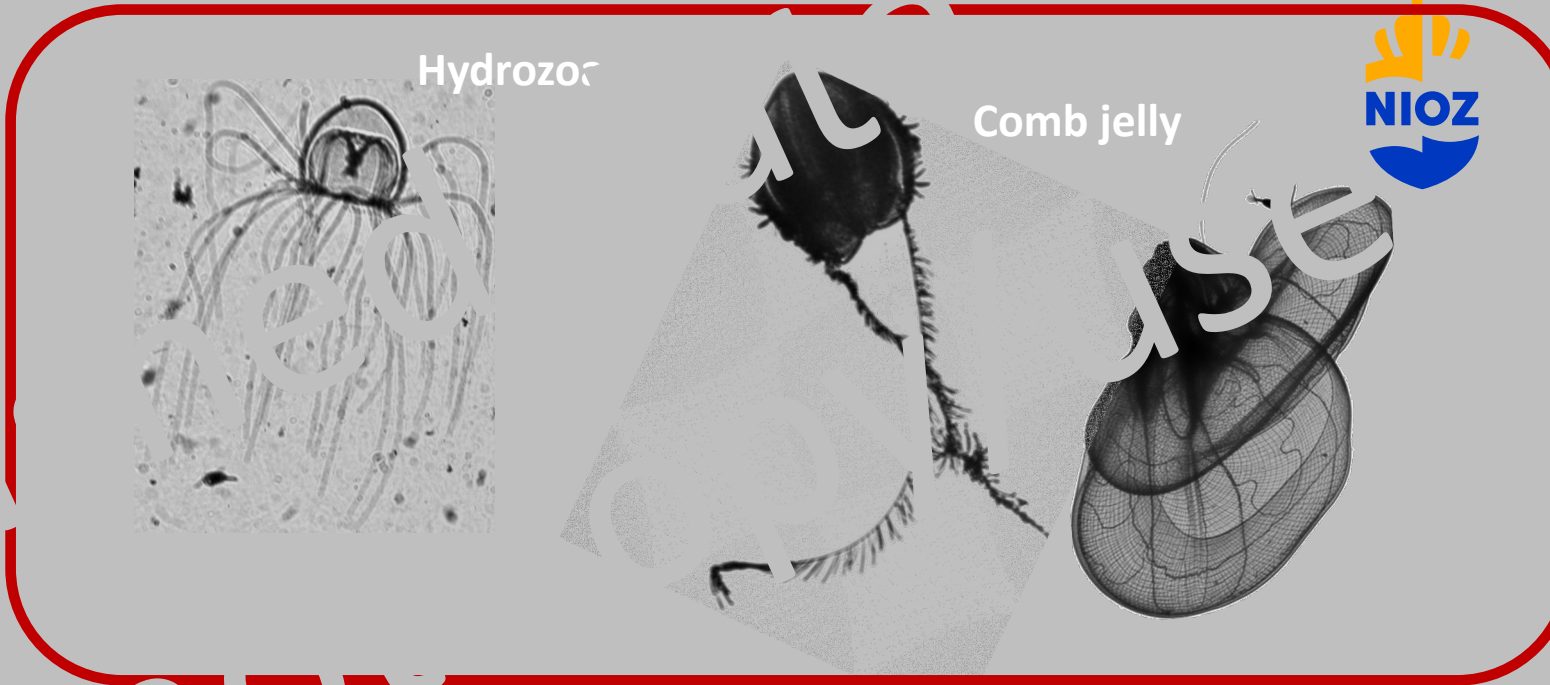
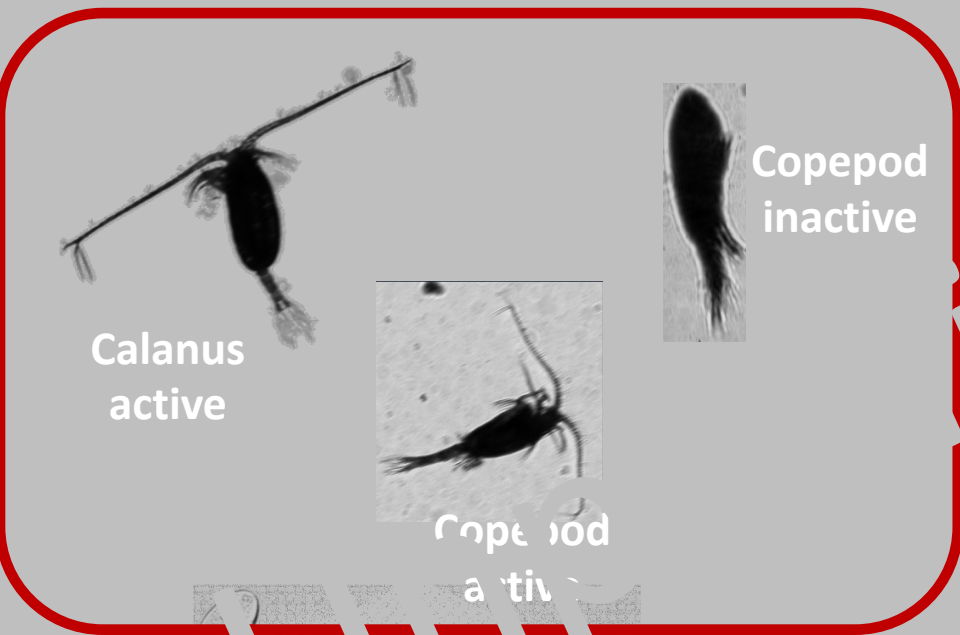


Each deployment:
±2 hours
±30 k images
±60 m³
±1 Tb data

Igaliku



Main zooplankton classes



- Segmentation (22 million Regions of Interest)
- Training (Hovenkamp subm. L&O methods):
 - 6.5k manually labelled images
 - 25 classes
 - Evenly distributed over ROIs size spectrum
 - EfficientNet with hyperparameter training
- Results: >80% precision and recall

Zooplankton: 2nd and 3rd trophic level

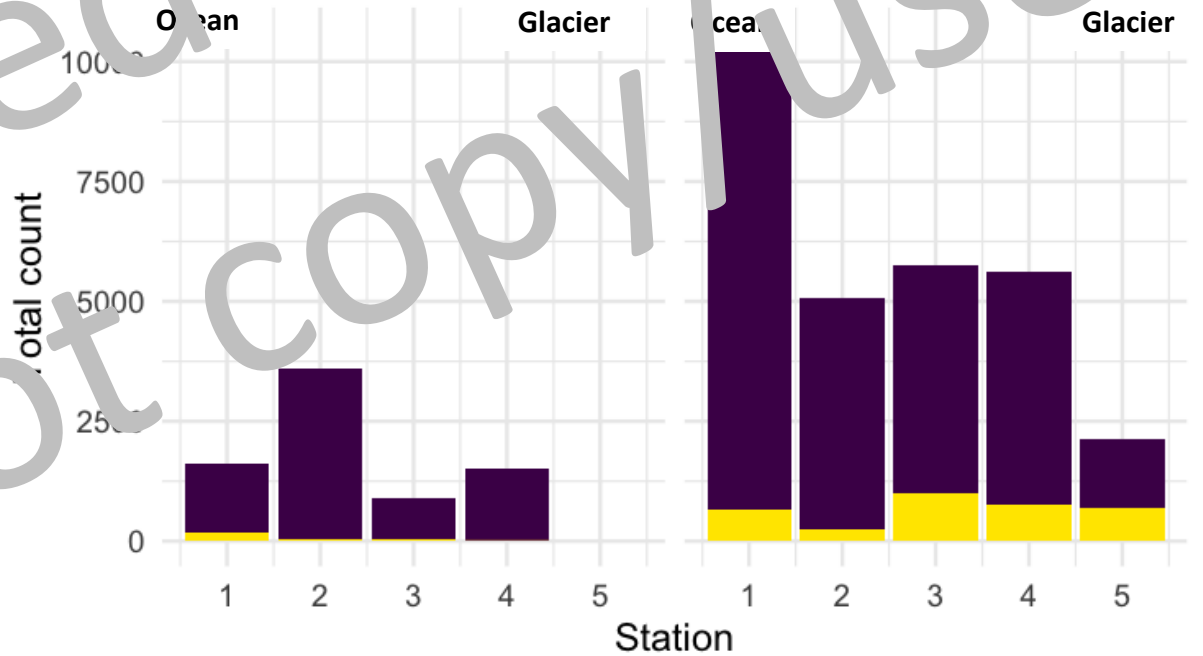
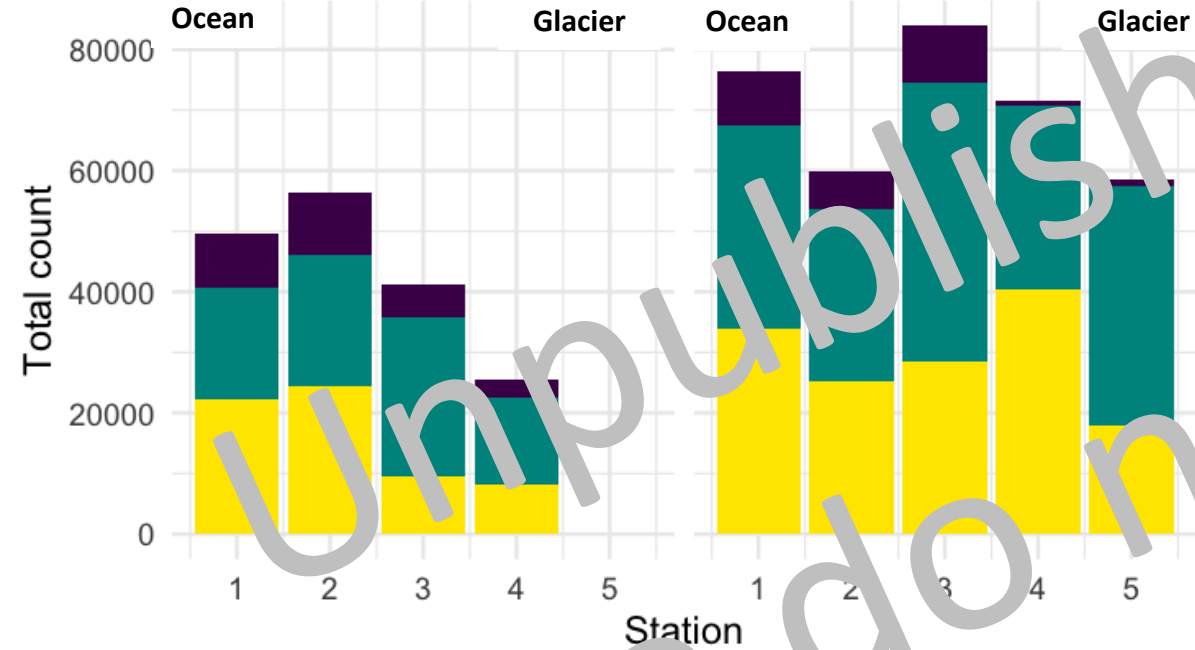


Tunulliarfik

Igaliku

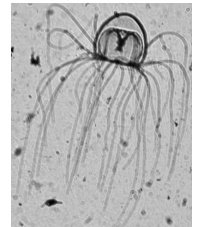
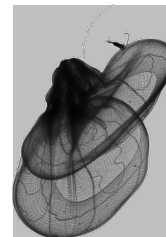
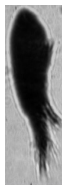
Tunulliarfik

Igaliku



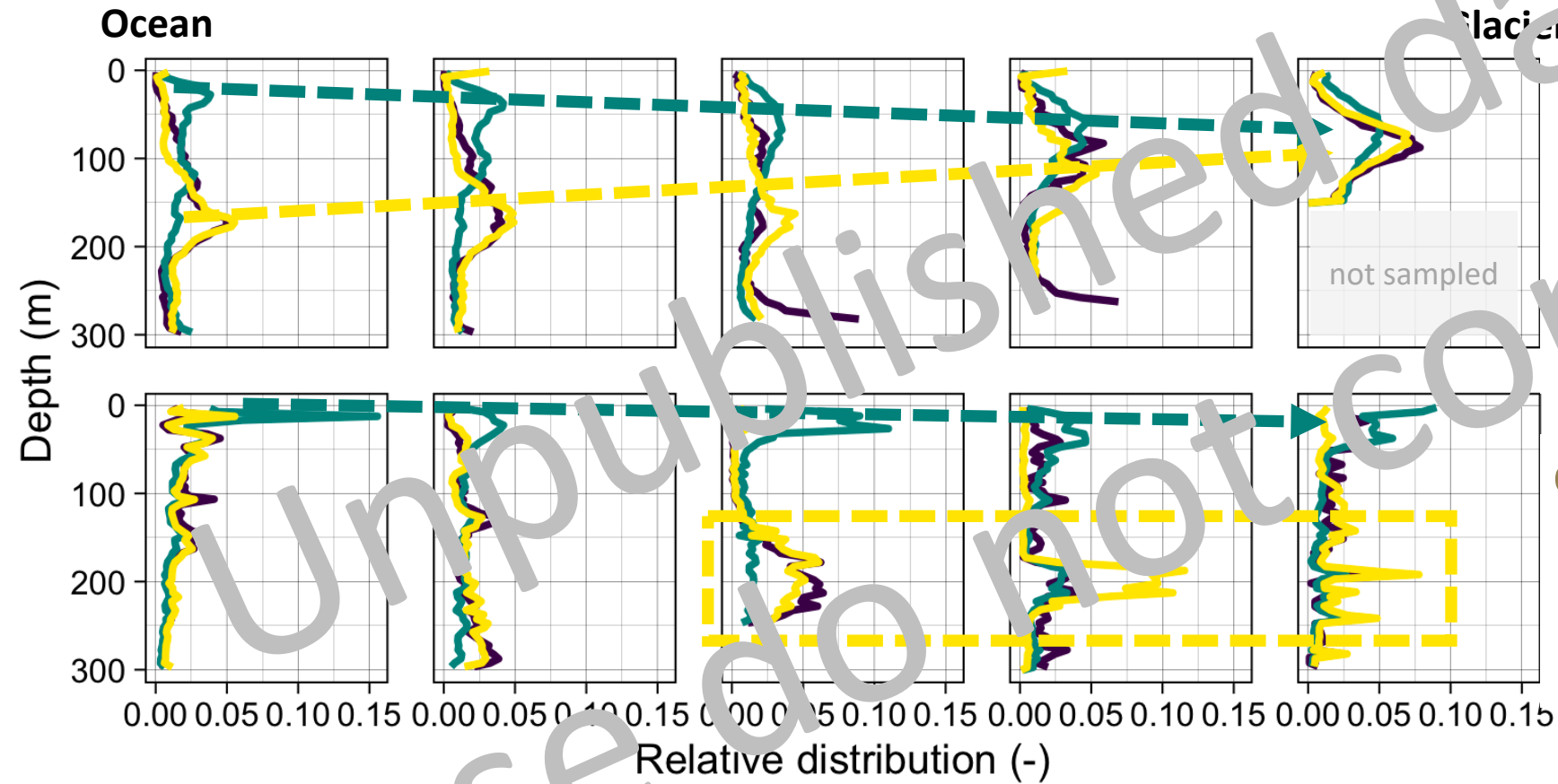
■ Calanus
 ■ Copepods active
 ■ Copepods inactive

■ Ctenophore
 ■ Hydrozoa



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Zooplankton: Distribution over depth



Tunulliafik

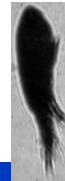
Igaliku

Shoaling of 'Copepod inactive' and deepening of 'Copepods active'

Distribution of 'Copepods active' confined to the surface 50m

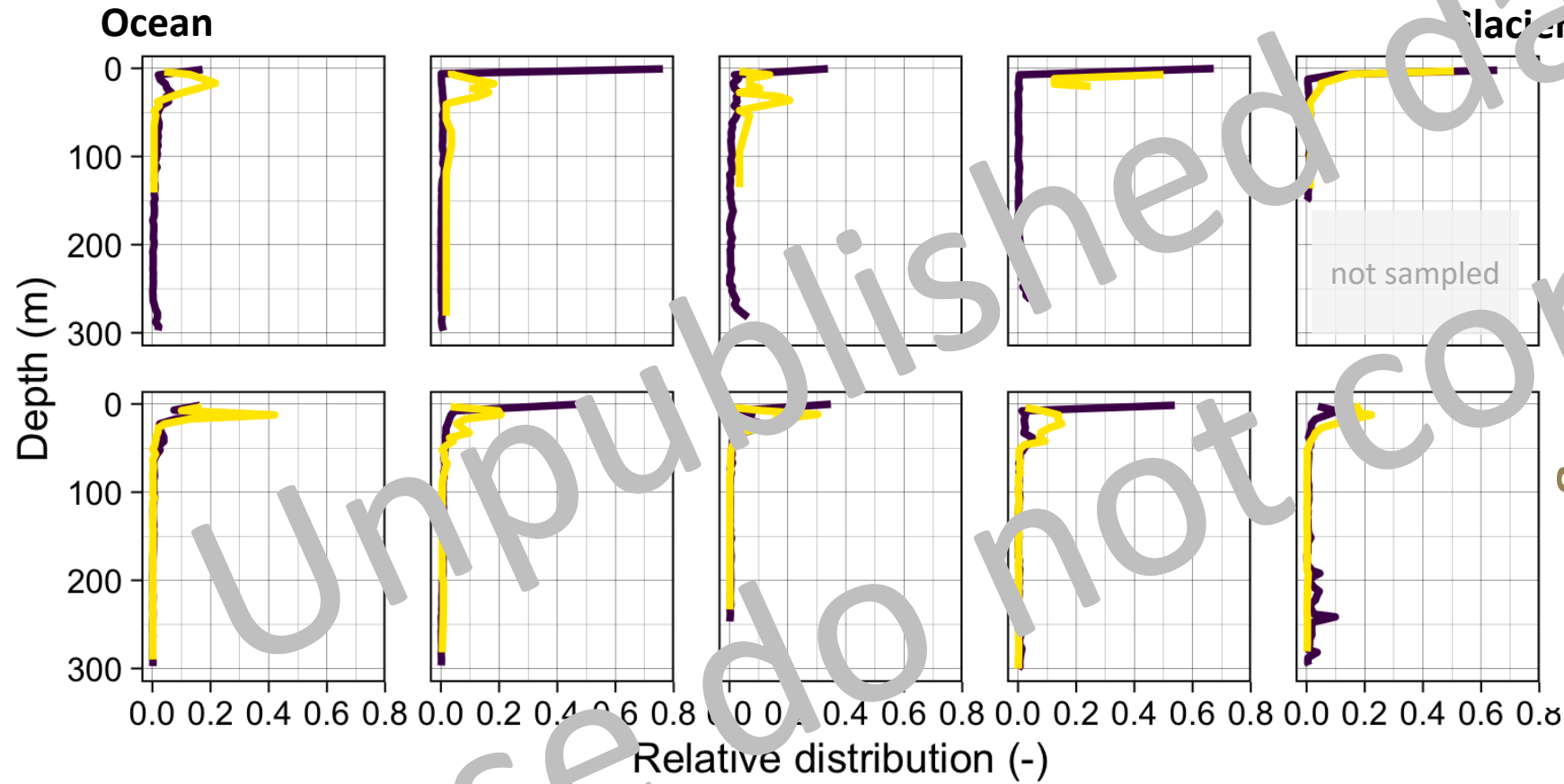
Formation of distinct deep layer of inactive copepods

Calanus Copepods active Copepods inactive

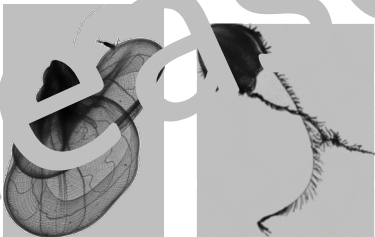


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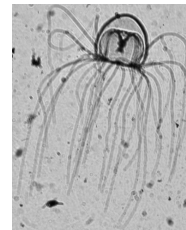
Zooplankton: Distribution over depth



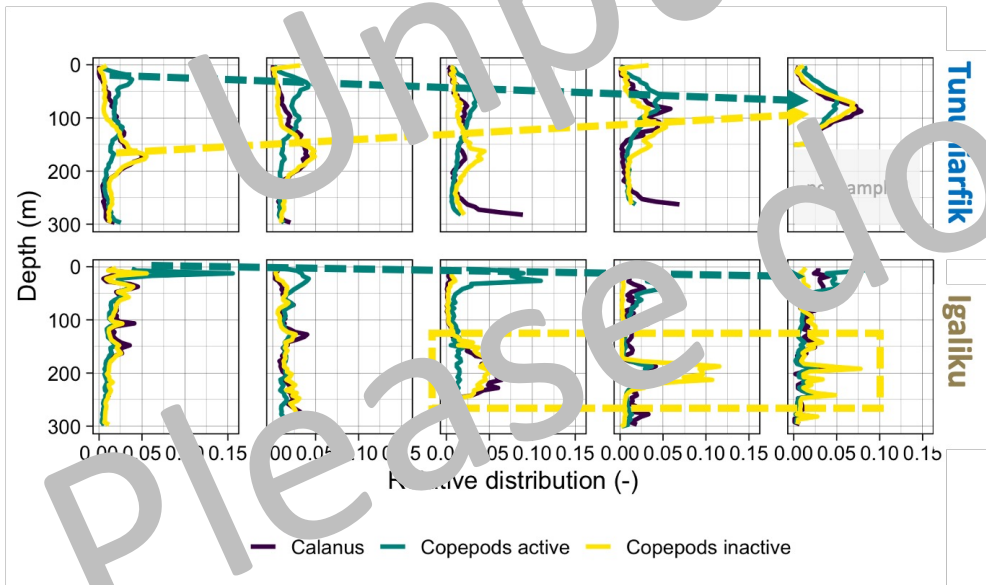
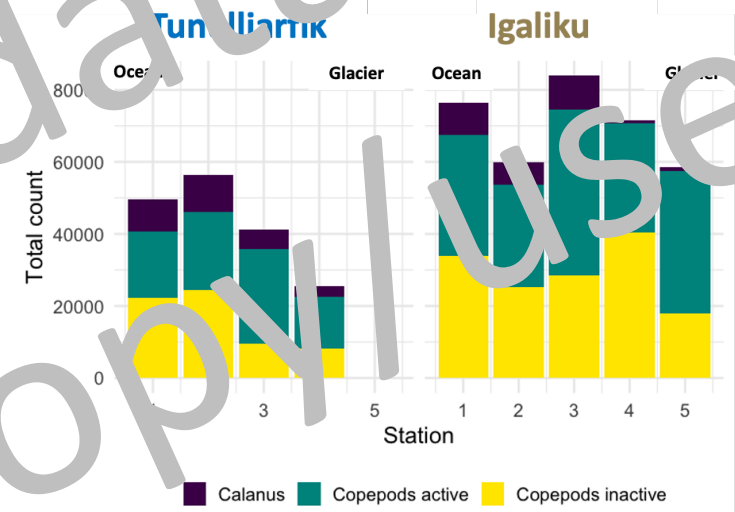
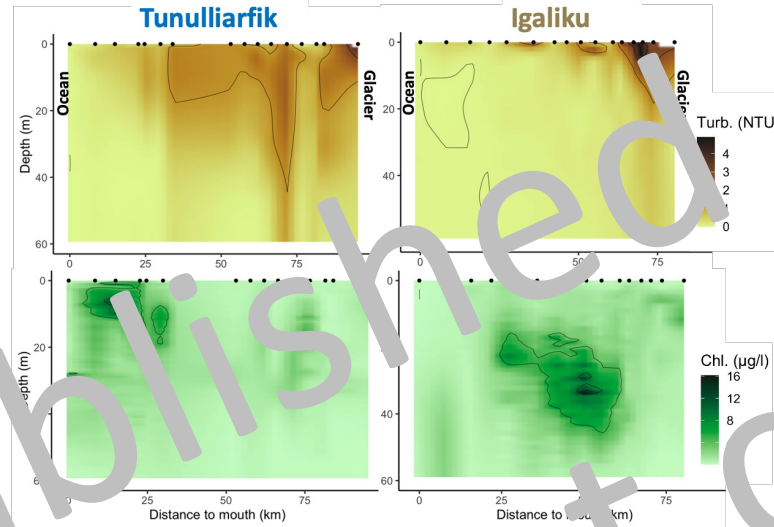
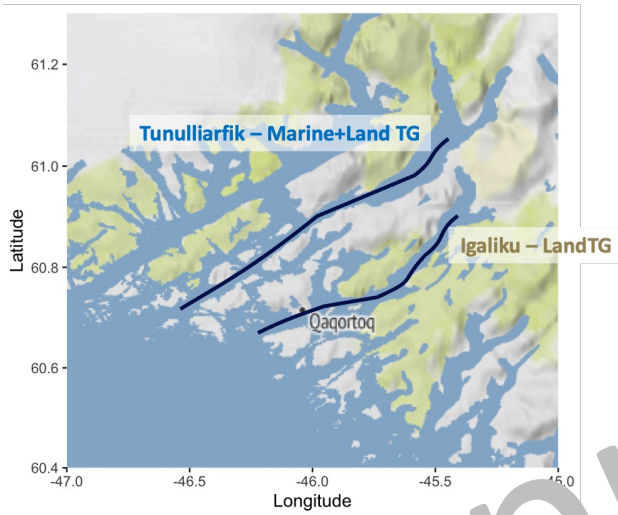
Gelatinous predators are confined to the surface 50m and do not follow their prey



— Ctenophore — Hydrozoa



Summary and conclusions



Turbidity from land-terminating glacial discharge appeared to be the driving factor behind the differences in the pelagic food web and created bottom-up controlled food webs

Team on board of RV Belgica

13/07 – 03/08/2023

