Glacial meltwater supports the **storage of organic carbon** in the East-Greenland fjord Scoresby Sund

Glacial meltwater effects on the carbon cycle of Scoresby Sund (Greenland), the world's largest fjord system

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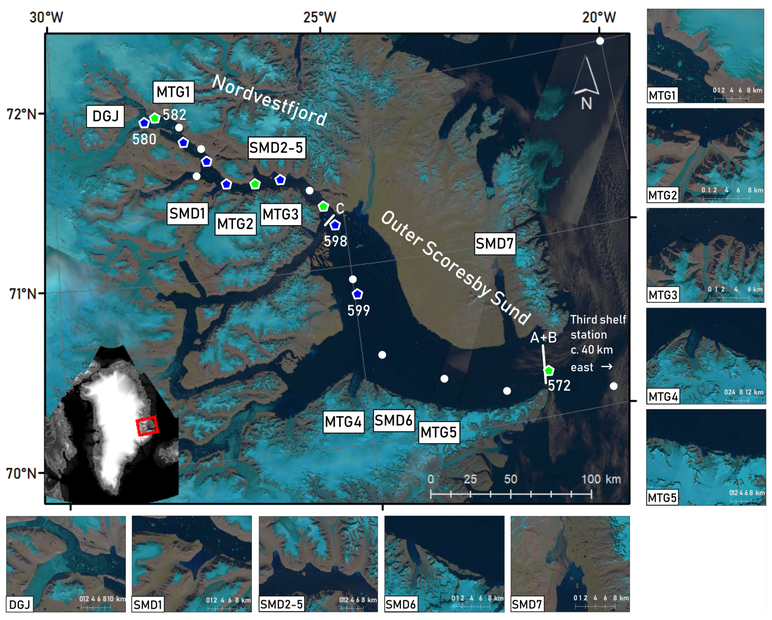
Background

- Greenland fjords receive considerable amounts of glacial meltwater discharge from the Greenland Ice Sheet due to present climate warming.
- We present the first comprehensive analysis of the summer carbon cycle in the world's largest fjord system situated in southeastern Greenland.

Methods

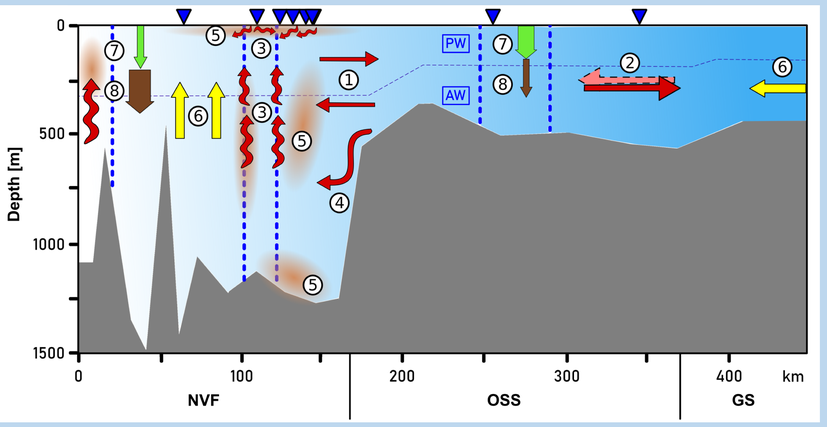
- *RV Maria S. Merian* from 10 to 19 July 2016 along a transect from the inner Nordvestfjord to the fjord mouth.
- Twenty-two stations with measurements of salinity, temperature, chlorophyll *a*, dissolved oxygen, nutrients, DIC, TA, and export flux.
- Derived NCP and POC flux.
- Circulation patterns determined based on LADCP measurements from a second cruise to the fjord in 2018.



Landsat 8 false color images (OLI/TIRS C1 Level-1, courtesy of the U.S. Geological Survey)

Abbreviations

DIC = dissolved inorganic carbon
TA = total alkalinity
NCP = net community production
POC = particulate organic carbon flux
LADCP =
PW = Polar Water
AW = Atlantic Water
NVF = Nordvestfjord
OSS = Outer Scoresby Sund
GS = Greenland Shelf
DGJ = Daugaard-Jensen glacier
MTG = marine-terminating glacier
SMD = surface meltwater discharge



① Two-dimensional circulation at the entrance to NVF with inflowing water below 400-500 m depth, and outflowing water above.
② Formation of a 3D circulation pattern consisting of outflowing water at the southern side and inflowing water at the northern side due to the width of the OSS.
③ Import of meltwater by rising meltwater plumes from submarine discharge and surface meltwater inflow.
④ Deep overflow of AW across the sill, filling the basin of NVF.
⑤ Currents, bottom topography, and meltwater discharge cause plumes of high turbidity at the depths of surface and submarine meltwater discharges as well as resuspension.
⑥ Distribution of nutrients is determined by upwelling caused by rising plumes of subglacial discharge, and by the import with AW and PW from the shelf.
⑦ NCP; arrows scaled to the according magnitude.
⑧ POC flux; arrows scaled to the according magnitude.

Conclusion

Circulation and biogeochemical cycling largely depend on the kind of freshwater import from the Greenland Ice Sheet to the fjord, and the fjord width that defines the degree how meltwater can act on the hydrography of the fjord.
We identified two different regimes in Scoresby Sund:

1. Nordvestfjord

narrow, influenced by marine- and land-terminating glaciers

- Comparably **low NCP** due to a surface meltwater layer that prevented the resupply of nutrients, and silts contained in the meltwater that were shading the upper water column.
- The **POC flux was high** close to glacier fronts due to the ballasting effect of silts.

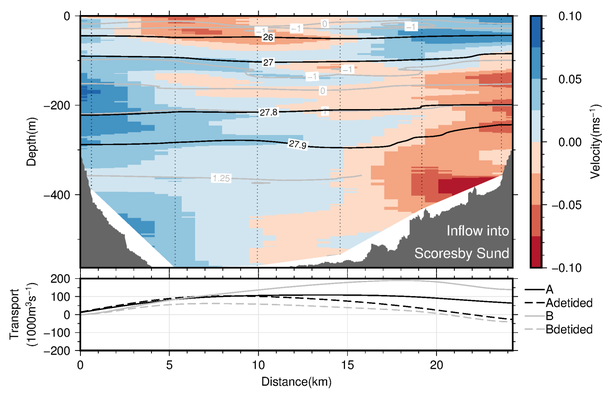
2. Outer Scoresby Sund

wide, less pronounced meltwater signs

- Nutrients were imported from the shelf, **increasing the NCP** in this part of the fjord.
- **POC was quickly remineralised** in the water column and was exported to a smaller extent to depth.

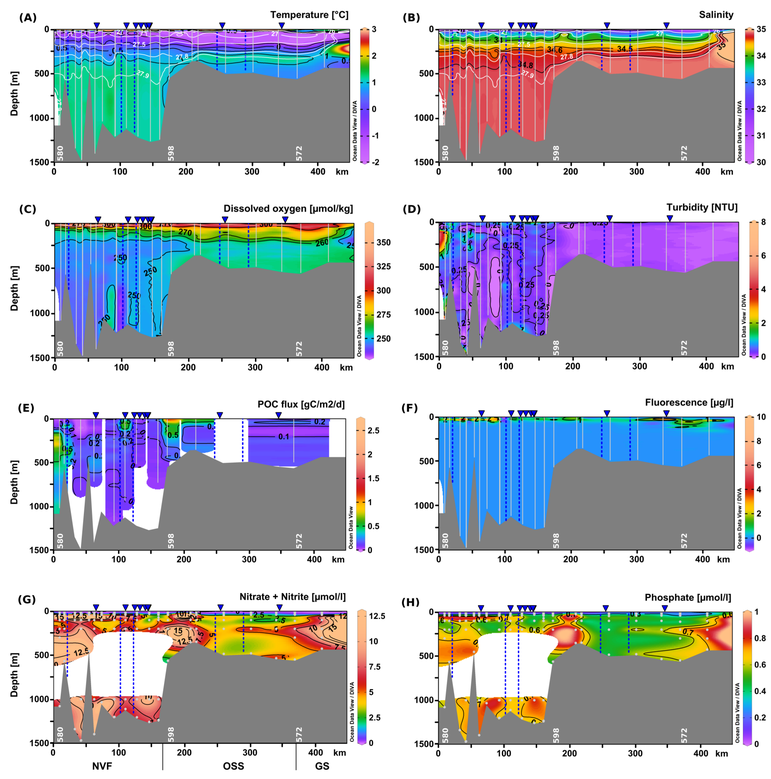
Additional figures

Please ask if you need further explanation

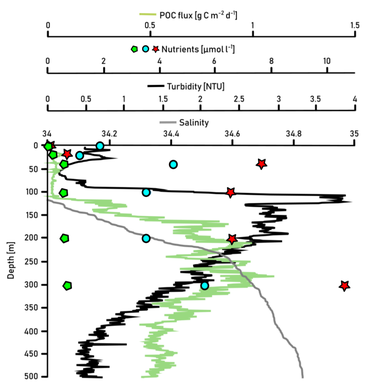


Across-section velocity profile and cumulative volume transport along the mouth of Scoresby Sund; the view is out-fjord directed. Blue shading denotes inflowing water from the shelf to the fjord, red shading denotes outflow.

	NVF	OSS
$NCP_{Phosphate}$ (mmol C m^{-2} d^{-1})	32 ± 6	58 ± 23
$NCP_{Nitrate+Nitrite}$ (mmol C m^{-2} d^{-1})	36 ± 8	82 ± 32
POC_{bottom} (g C m^{-2} d^{-1})	0.06 – 2.5	0.1 – 0.2



Vertical distribution as distance from the fjord head (left) to the shelf (right). Bright lines indicate CTD and camera profiles, and bright dots water samples. Blue dashed lines show the approximate positions of marine-terminating glaciers, and blue triangles denote surface meltwater discharge.



POC flux, nutrient concentrations, turbidity, and salinity in the upper 500 m of the water column at a station close to the front of a marine-terminating glacier.

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