# GreenFjord

## Greenlandic Fjord ecosystems in a changing climate: Socio-cultural and environmental interactions

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# GREEN FJORD

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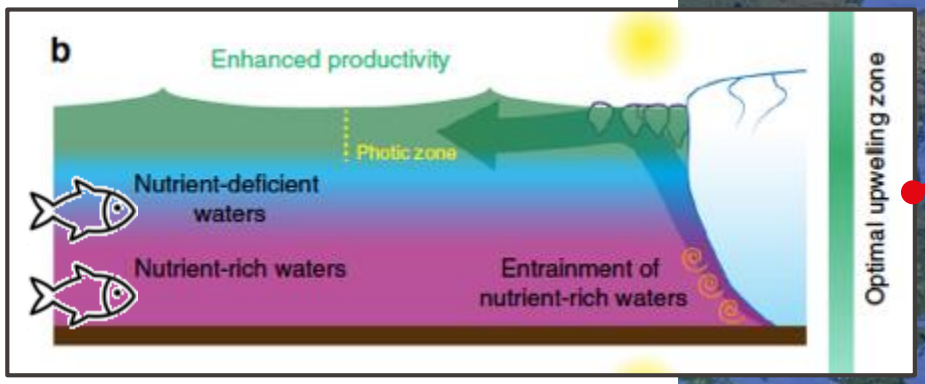
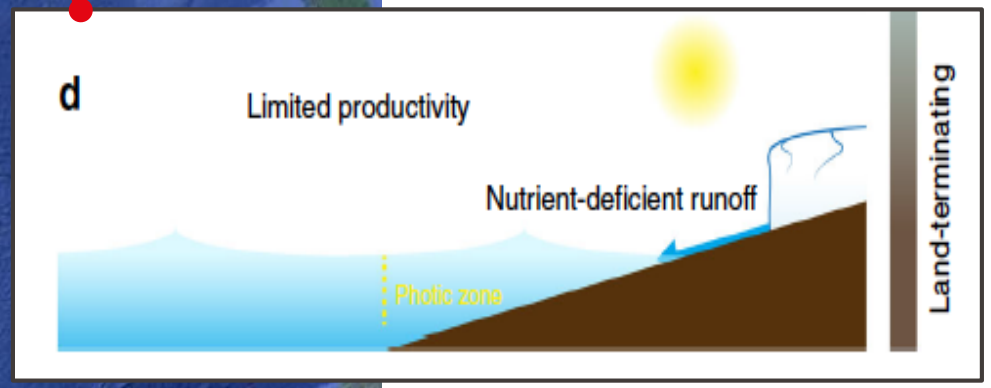
# What are the consequences of retreating ice?

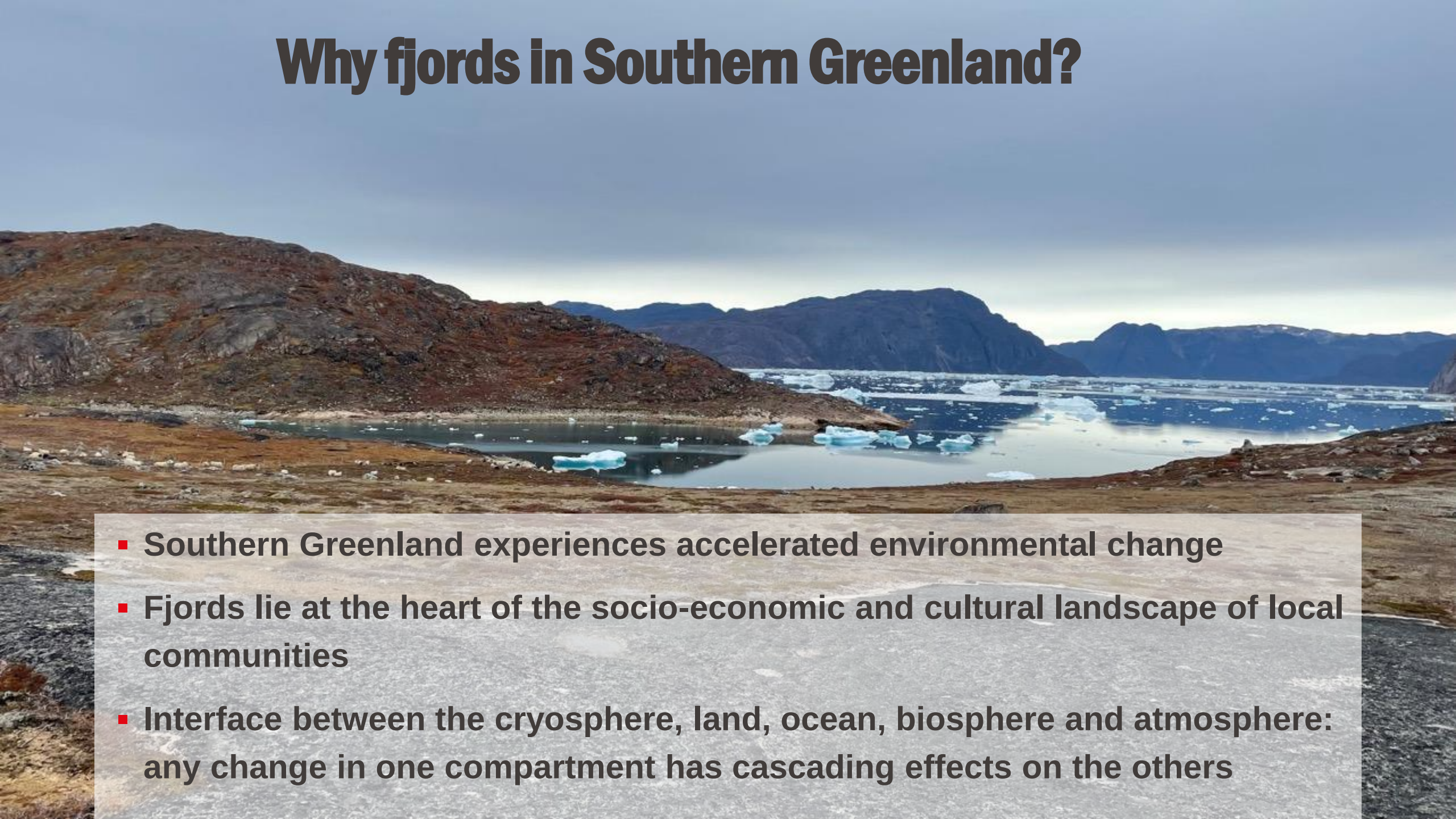
- Marine productivity
- Carbon cycle
- Local climate / weather
- Livelihoods




after Hopwood et al., 2018

# Why fjords in Southern Greenland?



- Southern Greenland experiences accelerated environmental change
- Fjords lie at the heart of the socio-economic and cultural landscape of local communities
- Interface between the cryosphere, land, ocean, biosphere and atmosphere: any change in one compartment has cascading effects on the others

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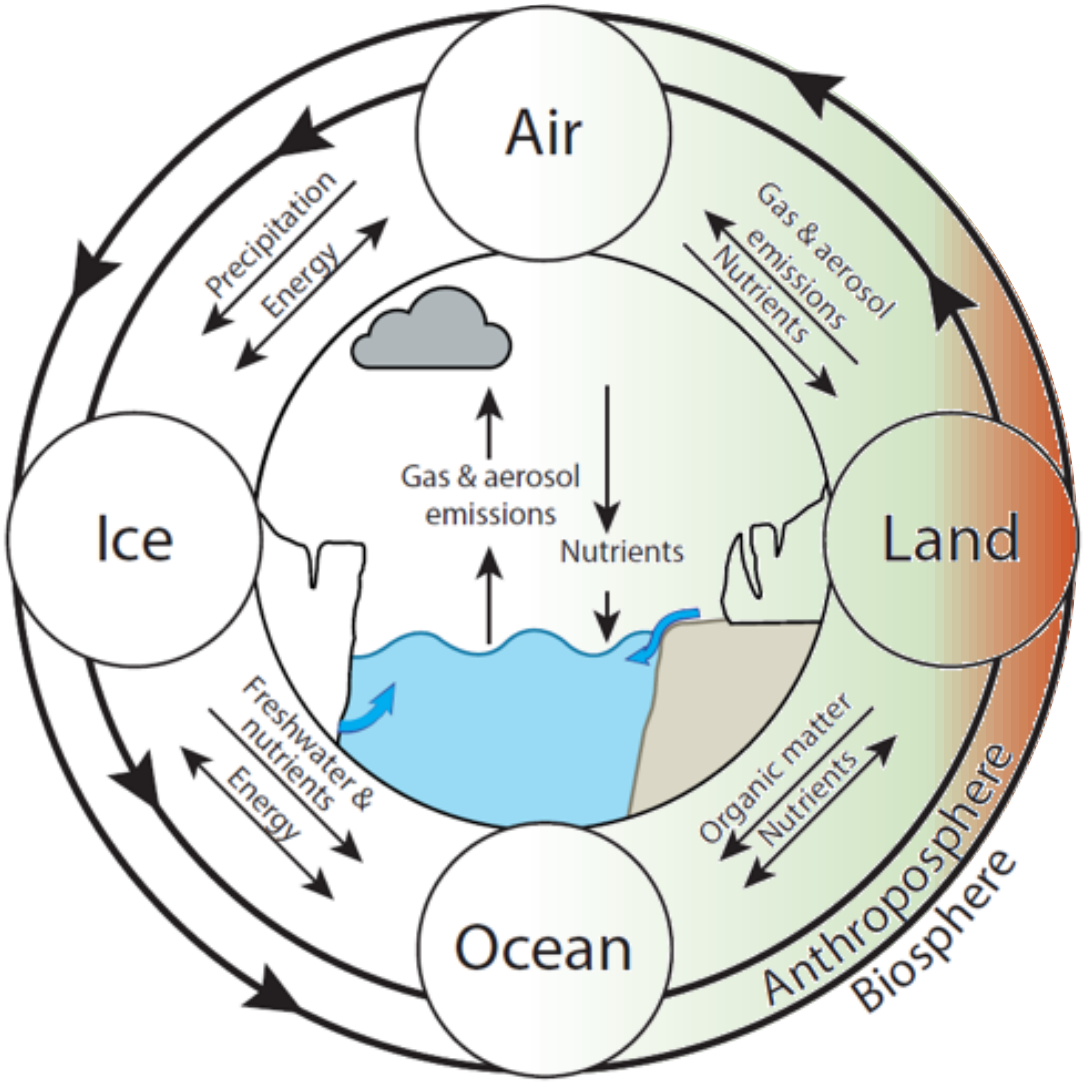
# What are the consequences of retreating ice?




**Q 1 – Fjord dynamics and biodiversity**
How does the flux of **freshwater**, **icebergs** and **sediments** to the fjord system impact the fjords' physical **circulation** and **nutrient supply** and pathways?

**Q 2 – Atmosphere and climate**
What is the **biogeochemical** fingerprint and contribution of different fjord system compartments on the **atmospheric** composition and **cloud** formation?

**Q 3 – Carbon and nutrient cycle**
To which degree does the supply of freshly weathered, reactive **minerals** associated with glacial erosion contribute to stabilize **organic matter** and enhance **carbon sequestration** in marine sediments?

**Q 4 – Cultural perception**
How do **inhabitants** relate to the fjord landscape and its **transformation**?

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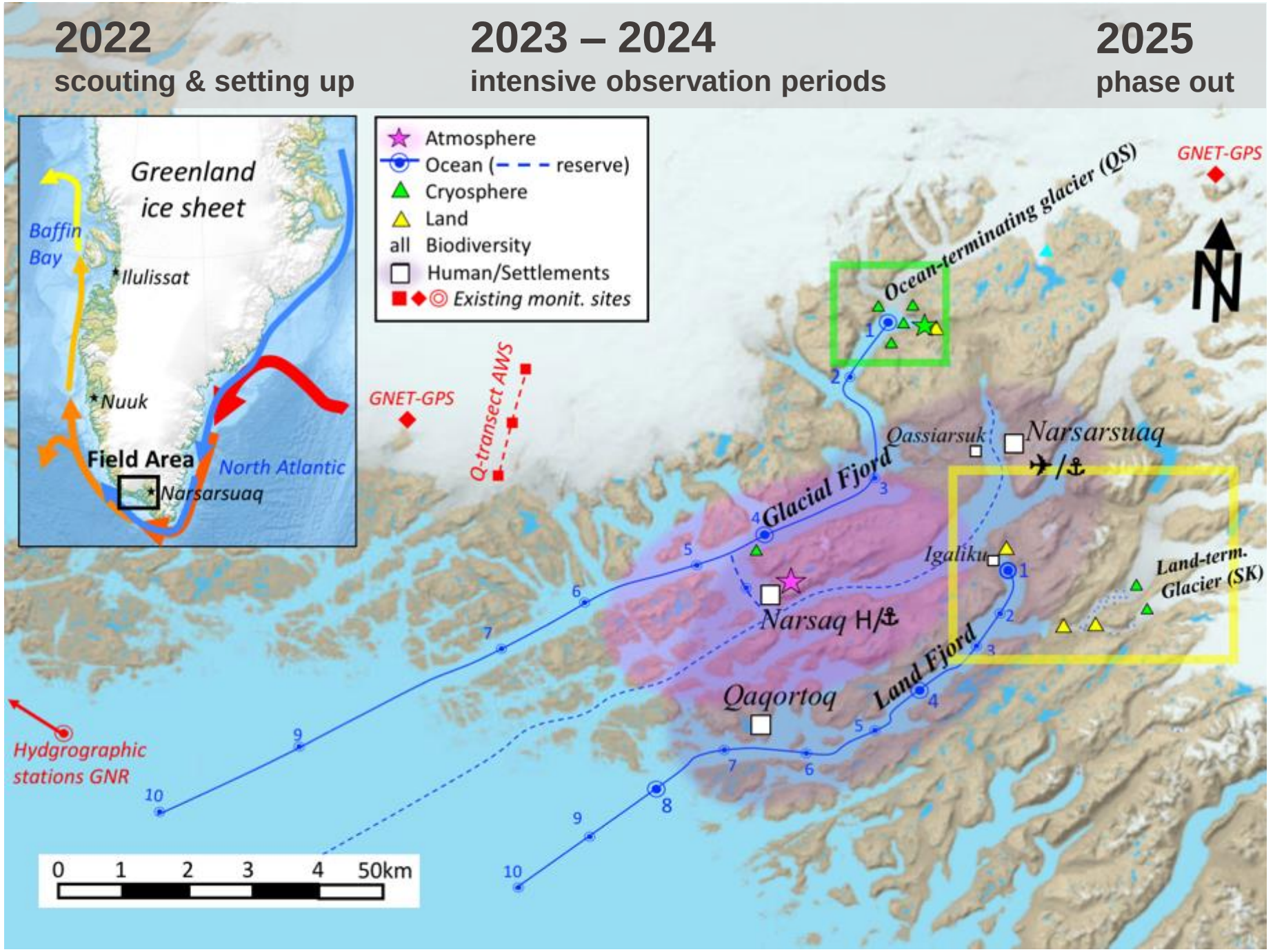
# Implementation

## Locations

- 1 super-site (Narsaq)
- 2 fjord systems
- 3 communities
- many sampling sites

## Methods

- Photo-voice engagement
- Sampling + laboratory analysis for ''carbon'', nutrients, eDNA, cloud particles
  (soils, sediments, water, aerosols, snow/ice)
- Real-time measurements
  (cameras, sensors/loggers, state-of-the-art instruments)
- Satellite images & Models
  (numerical weather models, biodiversity/food web, glacier dynamics, fjord dynamics, data-driven models)



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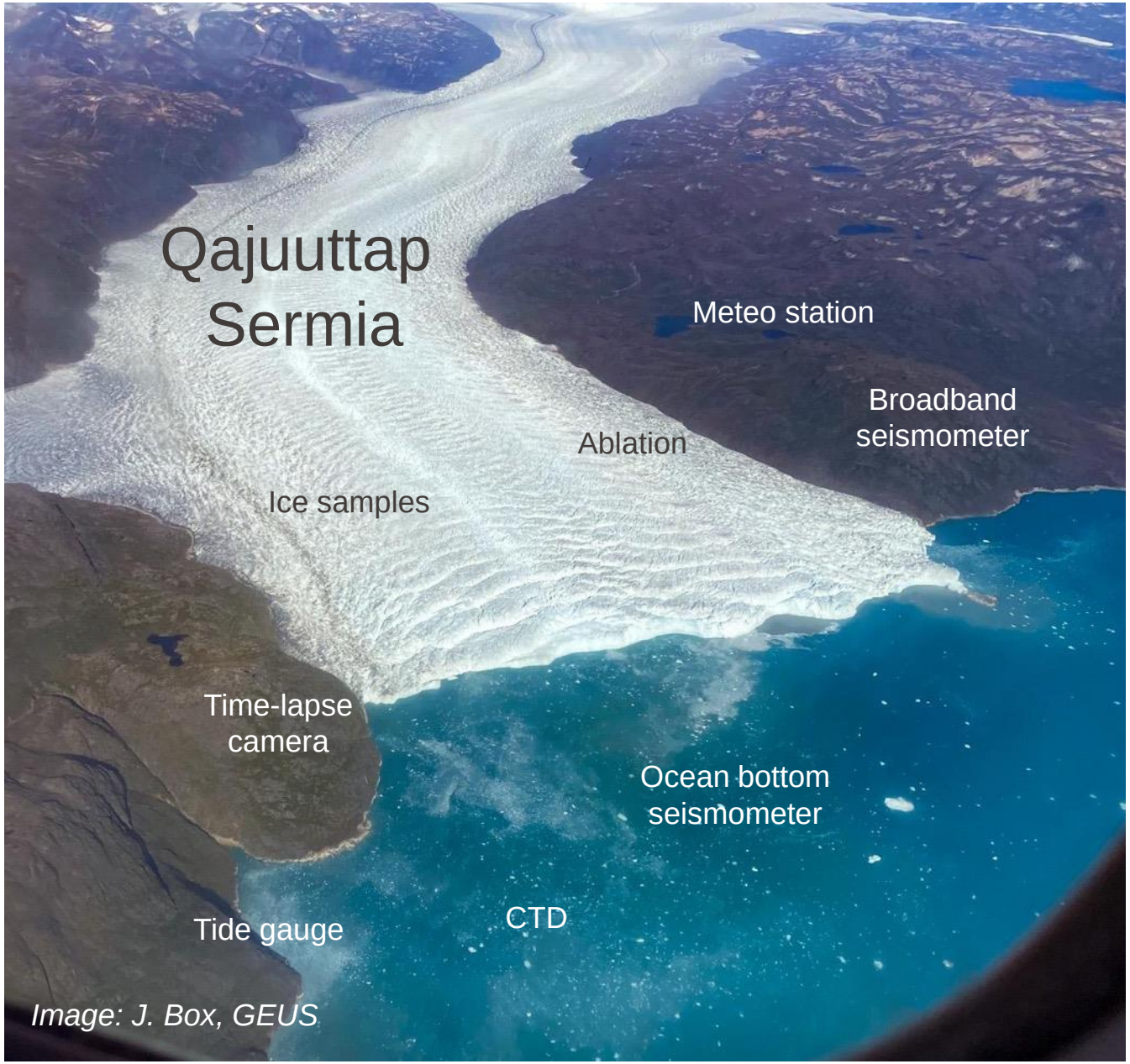
# Cryosphere & Ocean Clusters

## Investigate the ice-ocean boundary

- **Understand processes:** calving, meltwater upwelling, fjord circulation,…
- **Quantify fluxes:** icebergs, meltwater, sediment/nutrients,…
- Setup/develop **field monitoring**

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# Cryosphere & Ocean Clusters

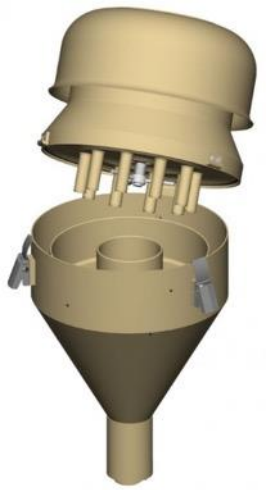


Impression from field work at Qajuuttap Sermia, South Greenland (Photo: A. Vieli)

**First expedition July 13 to August 1, 2022:**

- **Installation of time-lapse cameras, seismometers and tide** gauges for monitoring calving, ice flow and ice cover in fjord
- **Oceanic measurements** (CTDs, bathymetry, …)
- **Scouting** for future main field work in 2023 and 2024

# Atmosphere cluster



**Vertical measurements up to 800 m:**
- Boundary layer thermodynamics
- Aerosol properties
  - Size
  - Number
  - Chemistry
  - CCN estimation
  - INP
  - Morphology, mixing state
  - eDNA
- Trace gases

**Ground-based measurements:**
- Filter measurements:
  - Chemical composition
  - Nutrients
  - eDNA
  - Morphology, mixing state
- Aerosol properties
  - Size
  - Number
  - CCN estimation
  - INP
- Trace gases
- Weather station data



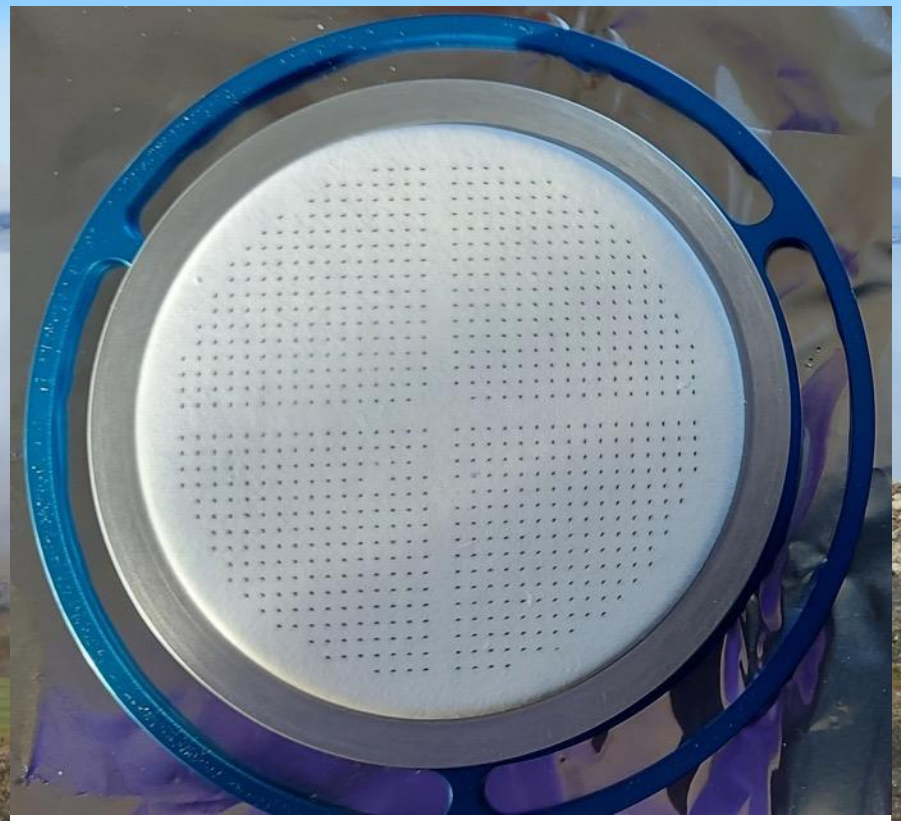
**Measurements will allow us to:**
- **Link vertical profiles to thermodynamics**
- **Do source apportionment**

# Atmosphere cluster

## Conclusions from reconnaissance visit (August 19 to September 1, 2022):

**Narsaq is a great place to study aerosol-cloud interactions.**
**It is mostly clean, but local vehicles emit a lot of black carbon.**

Research station



Black carbon particles smaller than 0.44 micron (typical exhaust particles)

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# Land cluster


- Study the **delivery of nutrients and carbon** to the fjord ecosystem **by rivers and streams**
- Compare **glacial and non-glacial streams** to investigate the role of freshly weathered **minerals** in organic matter export and fate upon delivery to the marine environment
- Gain further understanding on how organic matter and sediment fluxes will **respond to changing environmental conditions**

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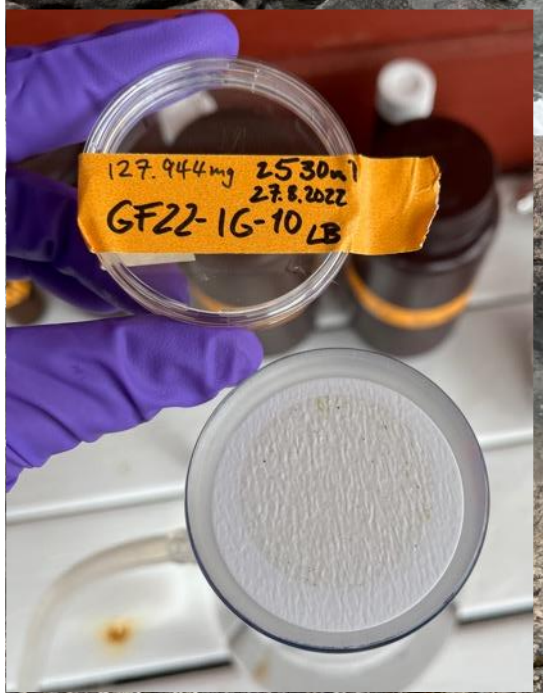
# Land cluster

## First field visit (August 19 to 30, 2022)

Glacial river downstream Jespersen Bræ

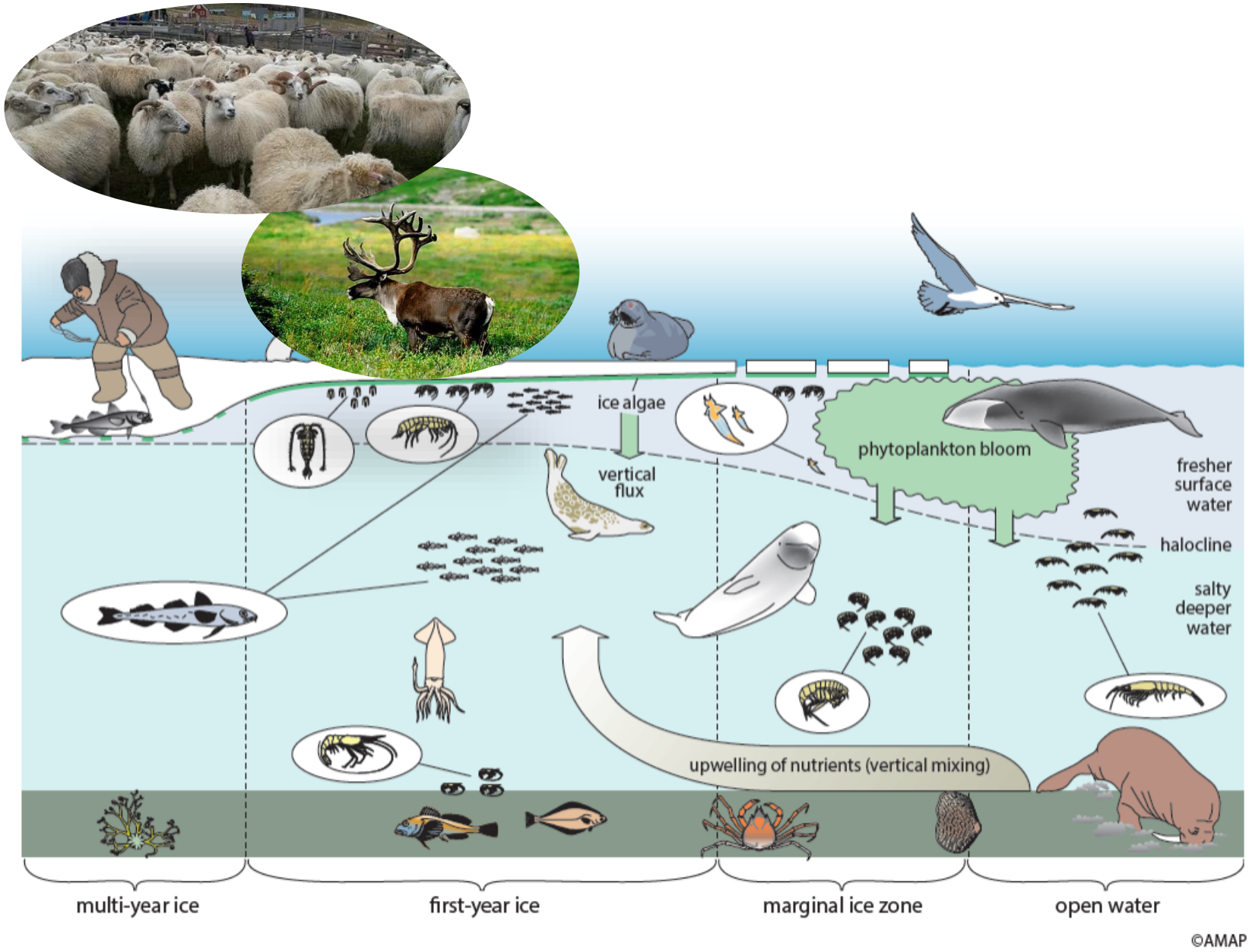

Non-glacial river near Igaliku




Sample collection:

- **Soils and sediments** for grainsize, mineral and organic matter characterization
- **River and stream water** for dissolved and particulate (in-) organic carbon, nutrients, stable water isotopes
- **Rainwater and glacial ice** for stable isotope analyses

# Biodiversity Cluster




Analyze relationships between **community dynamics** and **environmental change** to determine how **biodiversity** is affected by the rapid changes in fjord ecosystems using **environmental DNA** in

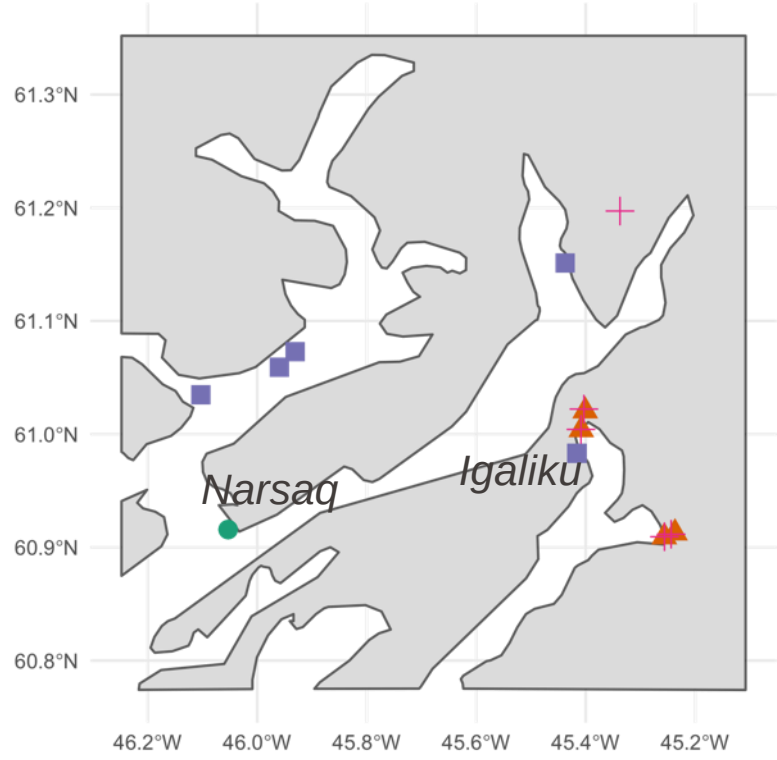
- Glacial ice
- Soils
- Marine and riverine waters
- Atmospheric aerosols

# Biodiversity Cluster

Air sampling
(8)

Water sampling
(5 marine)
(4 freshwater)

Soil sampling
(5)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# Human cluster - working with Greenlanders to understand ways of dwelling with Fjords

- **Representations and Perceptions** of the fjord environment
- **Livelihoods** related to fjord ecosystem
- **Dynamics** of these perceptions and livelihoods under **climate change**

## Art based methods

- Photo contest about Fjord landscape
- “Walking interviews”: excursions with Greenlanders
- Video workshops with schools
- Interviews

# Human cluster - working with Greenlanders to understand ways of dwelling with Fjords

**Ongoing reconnaissance trip: August 16 to September 9, 2022**

- **Presentation of the GreenFjord project, getting feedback and finding local partners**:
  - Kujalleq municipality – meeting with the mayor
  - South Greenland Innovation
  - Qaqortoq and Narsaq museum
  - Fisheries and hunting associations
  - Kujalleq Campus in Qaqortoq
  - Narsaq school
  - Food campus Inuirilli
- **1st interviews and test of “commented path” (walking interviews) with fishermen**


Qujanaq
Tak
Thank you
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