Long term monitoring in coastal Greenland sheds light on CO_2 uptake potential

Henry C. Henson[1,2] *, Mikael Sejr[1,2], Josefa Verdugo[2], Lise Lotte Sørensen[2,4], Mie HS Winding[3], Johnna M. Holding[1,2]

[1]Department of Ecoscience, Aarhus University, Denmark, [2]Arctic Research Centre, Aarhus University, Denmark, [3]Greenland Climate Research Centre, Greenland Institute of Natural Resources, Nuuk, Greenland, [4]Department of Environmental Science, Aarhus University, Denmark

Background

The Greenland coastal ocean sequesters large quantities of CO_2 from the atmosphere (-9.5 ± 9.0 Tg C year^{-1}; Henson et al., in review).

Sequestration rates are still quite uncertain due to a heterogeneous coastline, low sampling density, and prohibitively harsh conditions for year-round sampling.

Better spatial and temporal monitoring will allow us to more accurately predict future carbon uptake.

Biology and freshwater runoff dictate pCO_2 levels in Greenland coastal waters

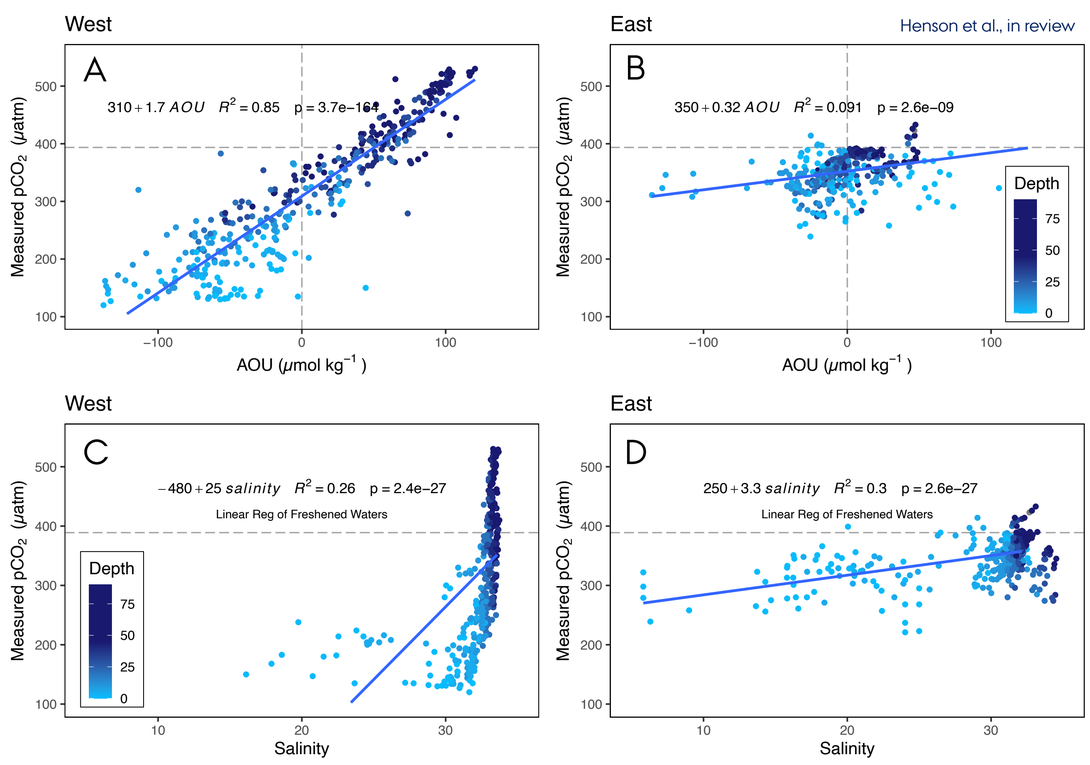

Figure 1. Relationships between apparent oxygen utilization (AOU) and pCO_2 (a, b) and salinity and pCO_2 (c, d) for East and West coasts. Linear regression fits use all data in a & b while c & d fit regression for all data below salinity of coastal seawater endmembers (Henson et al. 2023). Atmospheric pCO_2 concentrations and the equilibrium between net auto- and heterotrophy are depicted with horizontal and vertical gray dashed lines respectively.

Long-term monitoring allows us to determine trends in marine biological and physical/chemical parameters

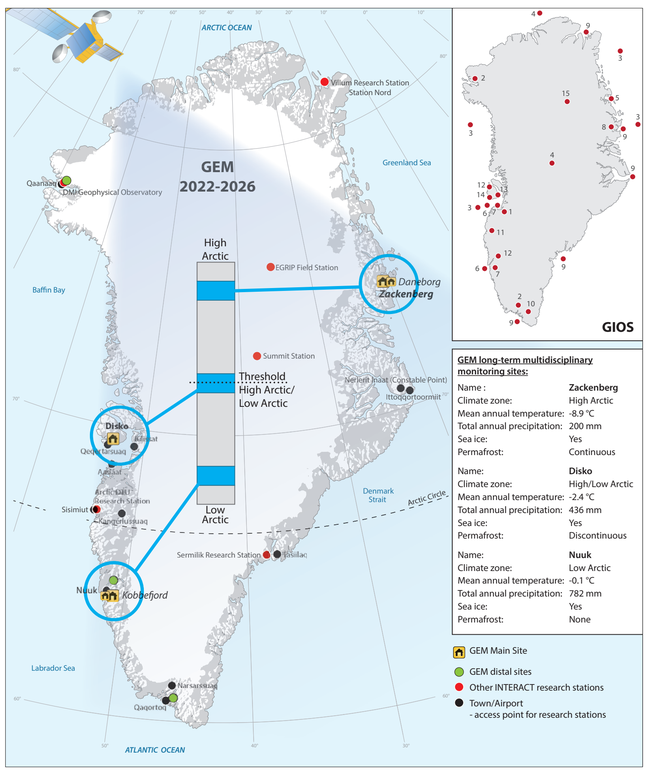

Figure 2. The GEM programme combines intensively studied ecosystems at three main sites (Disko, Nuuk and Zackenberg).

GEM
Greenland Ecosystem Monitoring

Marine Basis monitoring:

- sea ice coverage
- ocean temperature
- salinity
- pCO_2
- dissolved inorganic carbon
- total alkalinity
- nutrient dynamics
- primary production
- marine biodiversity

https://g-e-m.dk/

Young Sound conceptual model

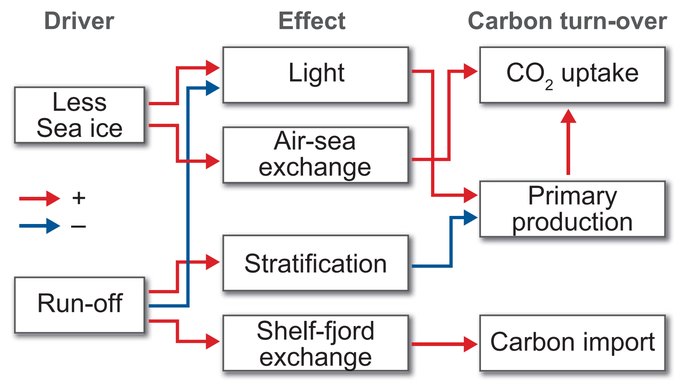

Figure 3. Conceptual diagram of the main effects of changes in runoff and sea ice cover on carbon cycling in Young Sound during summer. Published in Sejr et al., (2022) *PNAS*.

Air-sea CO_2 uptake may be slowing down despite increased glacial melt

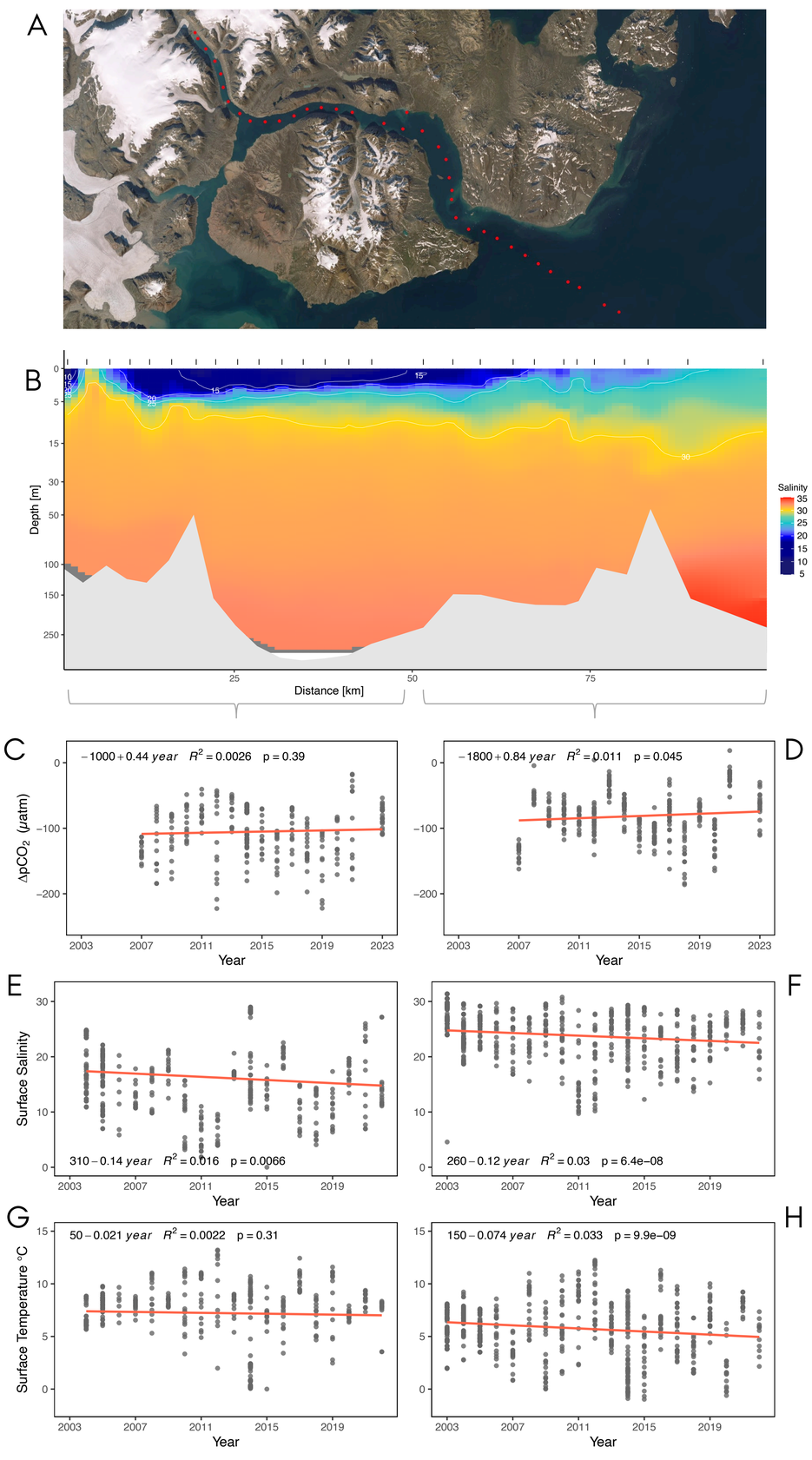

Figure 4. Map of Young Sound with transect stations (a). Contour plot of salinity along the transect line (b). Trend in surface water ΔpCO_2 (1m) since 2007 at inner and outer fjord stations (c, d). Trends in surface salinity (e, f) and temperature (g, h) since 2003 at inner and outer fjord stations respectively.

Conclusion

Long term marine monitoring allows scientists to determine whether rapid change is occurring as predicted, or if conceptual models are incomplete.

AARHUS UNIVERSITY
DEPARTMENT OF ECOSCIENCE

GREEN FEEDBACK

ARCTIC OBSERVING SUMMIT
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HENRY CHURCHILL HENSON
PHD STUDENT
hch@ecos.au.dk

Pinngortitaleriffik
Grønlands Naturinstitut Greenland Institute of Natural Resources