Long term monitoring in coastal Greenland sheds light on CO_2 air-sea gas exchange

Henry Henson[1,2], Josefa Verdugo[1], Mikael Sejr[1,2], Lise Lotte Sørensen[2,3], and Johnna Holding[1,2]

[1]Department of Ecoscience, Aarhus University, 8000 Aarhus, Denmark.

[2]Arctic Research Centre, Aarhus University, 8000 Aarhus, Denmark.

[3]Department of Environmental Science, Aarhus University, 4000 Roskilde, Denmark.

Main contact: Henry Henson, hch@ecos.au.dk

The global oceans mitigate climate change by sequestering approximately 25% of annually emitted anthropogenic carbon dioxide (CO_2). High latitude shelf waters, such as Greenlandic fjords, represent important sinks for CO_2 due to their distinct environmental conditions. However, global surface warming is accelerating the retreat of the Greenland ice sheet and subsequent increase in meltwater discharge into fjord waters. This freshening of fjord ecosystems induces biogeochemical changes that impact the carbonate system and alter fjord circulation dynamics, potentially influencing future productivity and rates of CO_2 uptake. The pronounced freshwater gradients that are formed between the Greenland ice sheet and the mouth of the fjord provide useful insight into carbon cycling in a future, fresher Arctic. The Greenland Ecosystem Monitoring (GEM) Program, spanning two decades of data collection, serves as an environmental barometer, gauging climate impacts and ecosystem shifts in the Arctic. Through the assessment of marine physical, chemical, and biological parameters within subarctic and high Arctic fjords, valuable comparisons with potential future climates can be made. Annual summer measurements of key parameters such as sea ice coverage, ocean temperature, salinity, pCO_2, dissolved inorganic carbon (DIC), total alkalinity (TA), nutrient dynamics, primary production, and marine biodiversity provide a holistic understanding of carbon cycling. Notably, our dataset of pCO_2, now rounding 1.5 decades, now shed light on the evolution of fjord waters as a carbon sink and help to explain processes of freshening and modified air-sea exchange in a future Arctic.