

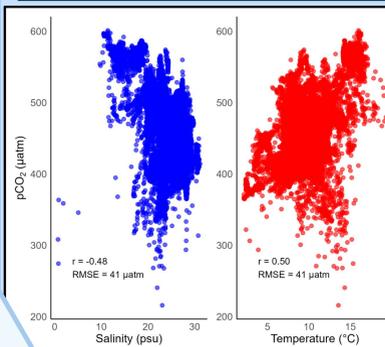
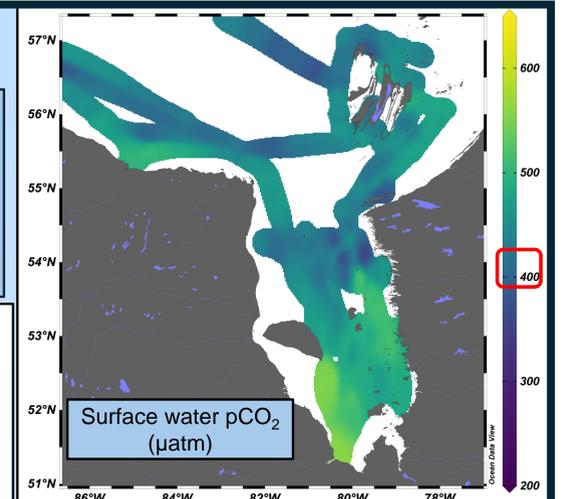
Sea to Air CO₂ Flux in the Southern Hudson Bay – James Bay Region

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Results

Average sea surface pCO₂ (µatm) measured over 3 years. Dark areas represent CO₂ depletion relative to the atmosphere. The red box indicates approximate atmospheric pCO₂ over the sampling period.



The relationship between surface water pCO₂ and the environmental variables salinity (psu) and temperature (°C). R values for Pearson's product-moment.

Poster Summary

Atmospheric CO₂ is rising globally.

In response to this, CO₂ uptake by the ocean is increasing.

The Arctic Ocean's low salinity and temperature allow for increased CO₂ absorption.

We measured the surface pCO₂ of Southern Hudson Bay and James Bay, an unstudied region.

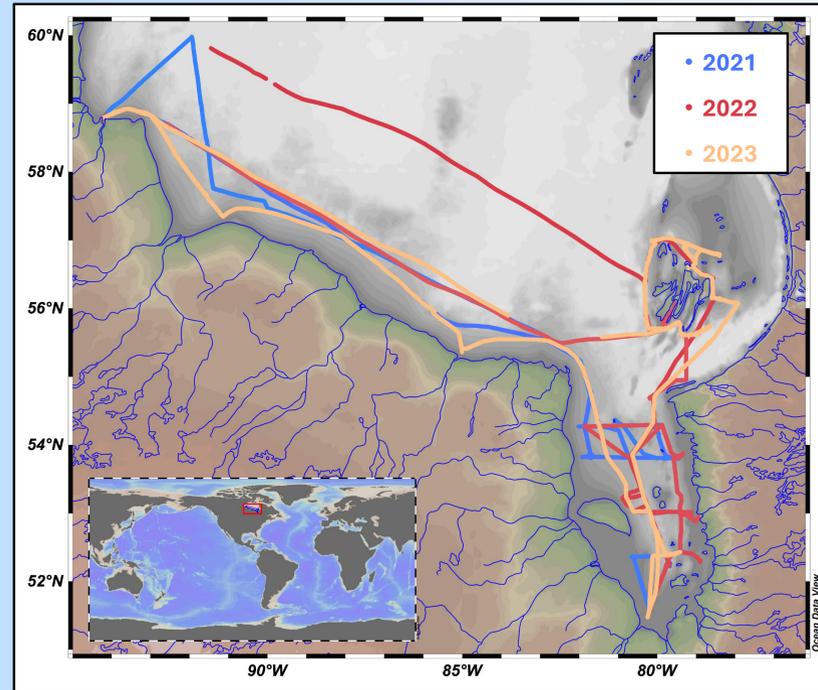
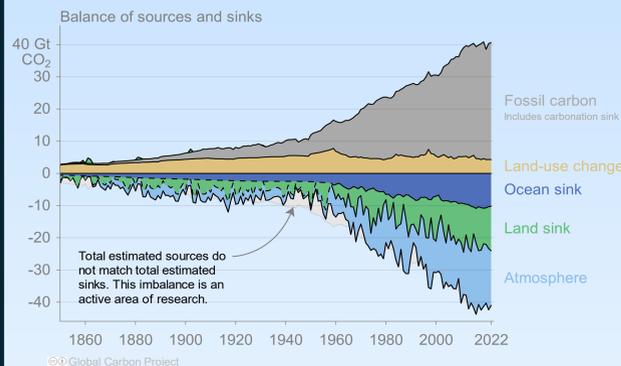
It is estimated that the region acts as a weak CO₂ source to the atmosphere.

Further work is needed to determine drivers.

Seawater and Atmospheric CO₂

Since the pre-industrial era, atmospheric CO₂ levels have risen dramatically. Consequently, the concentration of CO₂ within the ocean has also risen

Why?



Southern Hudson Bay and James Bay

We conducted 3 years of cruises to collect inorganic carbon system data in a previously unstudied region

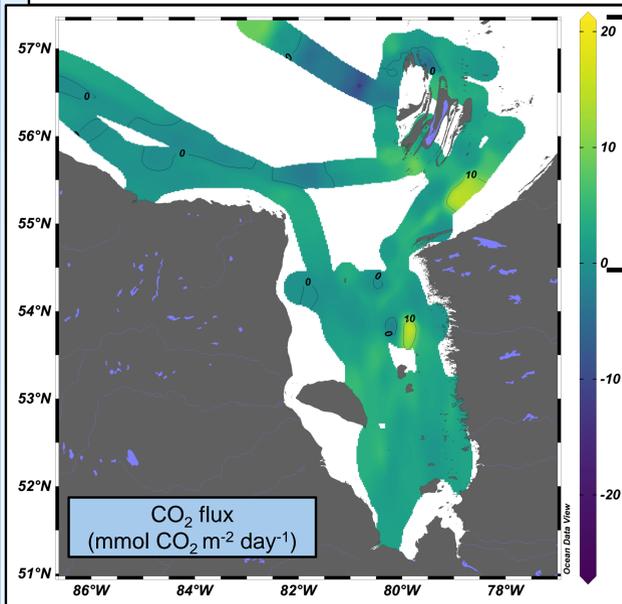
- Region is undergoing rapid alteration due to climate change
- August of 2021 -2023
- Visited the Belcher Islands in 2022 and 2023
- Collected pCO₂, temperature, and salinity data continuously

The Arctic ocean plays an important role in regulating the carbon cycle by absorbing CO₂:

- **Source:** contributes CO₂ to the atmosphere
- **Sink:** removes CO₂ from the atmosphere

Goal: By performing small scale regional carbonate system calculations, we may begin to close this gap. As coastal environments are dynamic ecosystems, these are among the hardest areas to estimate.

Year	Means			Flux Metrics			
	Atmospheric CO ₂ (µatm)	Surface Water pCO ₂ (µatm)	Water Temp (°C)	Mean	S.D.	Min	Max
2021	414	456	9.8	2.7	3.8	-6	21
2022	416	453	9.3	1.5	3.3	-27	15
2023	417	477	10.1	3.7	3.7	-7	20
All	416	462	9.7	2.5	3.7	-27	21



Flux is measured in mmol CO₂ m⁻² day⁻¹

Net CO₂ Source to atmosphere

Sea surface – atmosphere CO₂ flux measured in mmol m⁻² day⁻¹. Dark areas represent areas of atmospheric CO₂ absorption while light areas correspond to CO₂ release. Fluxes presented are a gridded average from all three years of sampling.

Seawater pCO₂ Flux

Flux is a quantification of CO₂ exchange between the ocean and the atmosphere.

Flux may be estimated using the equation:

Net CO₂ exchanged between seawater and atmosphere

CO₂ transfer velocity

CO₂ solubility

Dependent on temperature, salinity, and wind speed

$$F_{sw-atm} = k K_0 (pCO_{2(sw)} - pCO_{2(atm)})$$

- Positive flux ($F > 0$) indicates emission (CO₂ ocean to atmosphere)
- Negative flux ($F < 0$) indicates absorption (CO₂ atmosphere to ocean)

Difference between the concentration of CO₂ in the atmosphere and concentration of CO₂ in the ocean

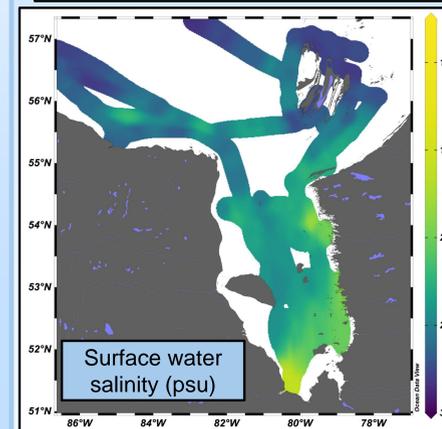
These variables control the speed and magnitude of CO₂ flux

This controls the direction of CO₂ flux

The temperature and salinity of the Arctic Ocean contribute to increasing marine CO₂

The Southern Hudson Bay - James Bay region is a CO₂ source to the atmosphere. How does this compare to similar regions?

Mean gridded sea surface salinity (psu) measured by the ships underway system. Light colours represent low salinity, and dark colours represent high salinity.



Next Steps

Reference	Shelf Sea	Season	Mean Flux	Mean Depth
Else et al. (2008)	Hudson Bay	Fall	-0.7	150
Murata and Takizawa (2003)	Beaufort Sea	Summer	-10.0	124
Ahmed et al. (2021)	Hudson Bay and Strait	Spring - early Summer	-5.1	150
This Study	SHB-JB	Summer	2.5	50

When compared with other shelf seas, it is clear southern Hudson Bay and James Bay are exhibiting different behaviour. What's causing the behaviour to differ from these other regions?

- The answer may lie within the river systems of the area
- The salinity measurements from the cruises mimic the distribution of pCO₂.
 - Pearson's product-moment indicates moderate relationship with salinity; however, relationship is more complex.
 - River signal data (CDOM, d18O, etc.) may help to decipher major controls within the region



References, about me, the inorganic carbon system, and more!

