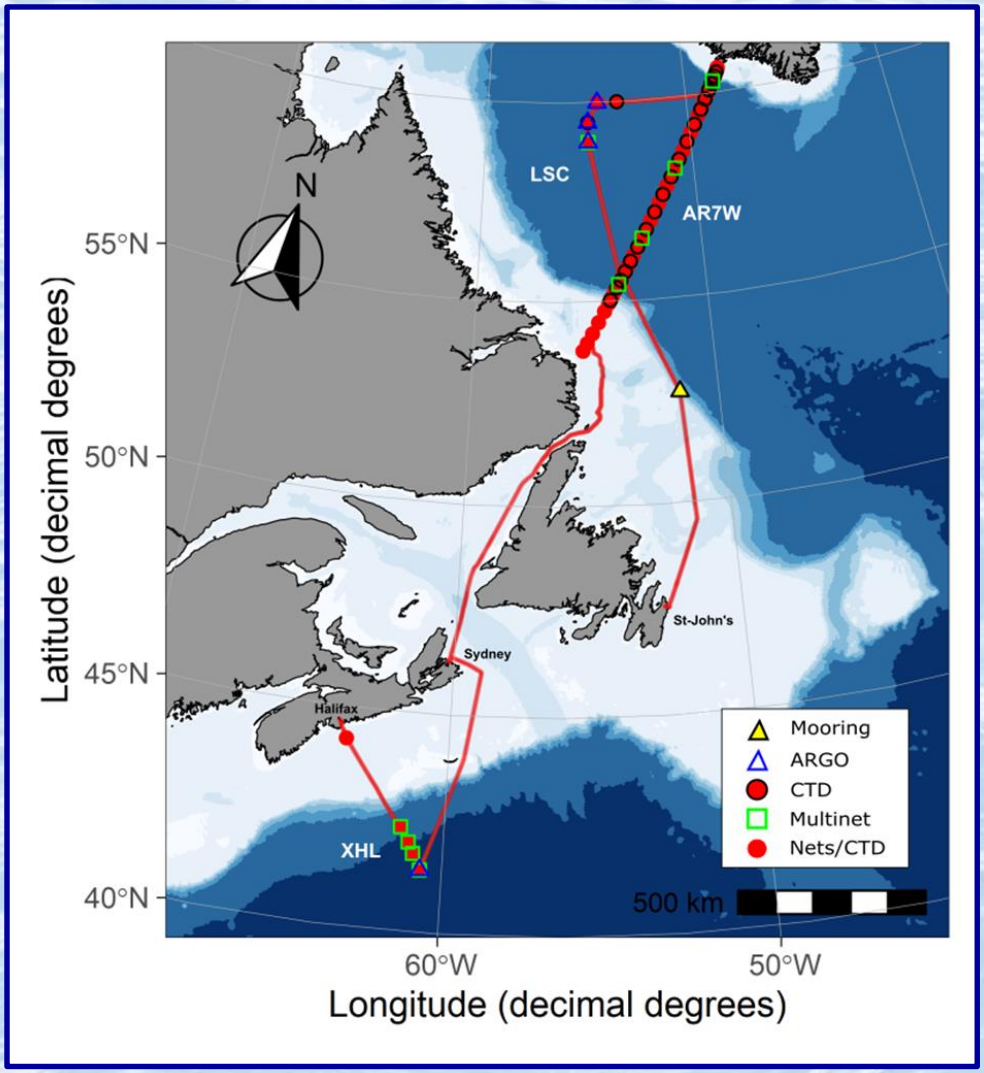
NAFO Northwest Atlantic Fisheries Organization

Biogeochemical conditions in the Labrador Sea (AZOMP) in 2023

Fisheries and Oceans Canada | Pêches et Océans Canada

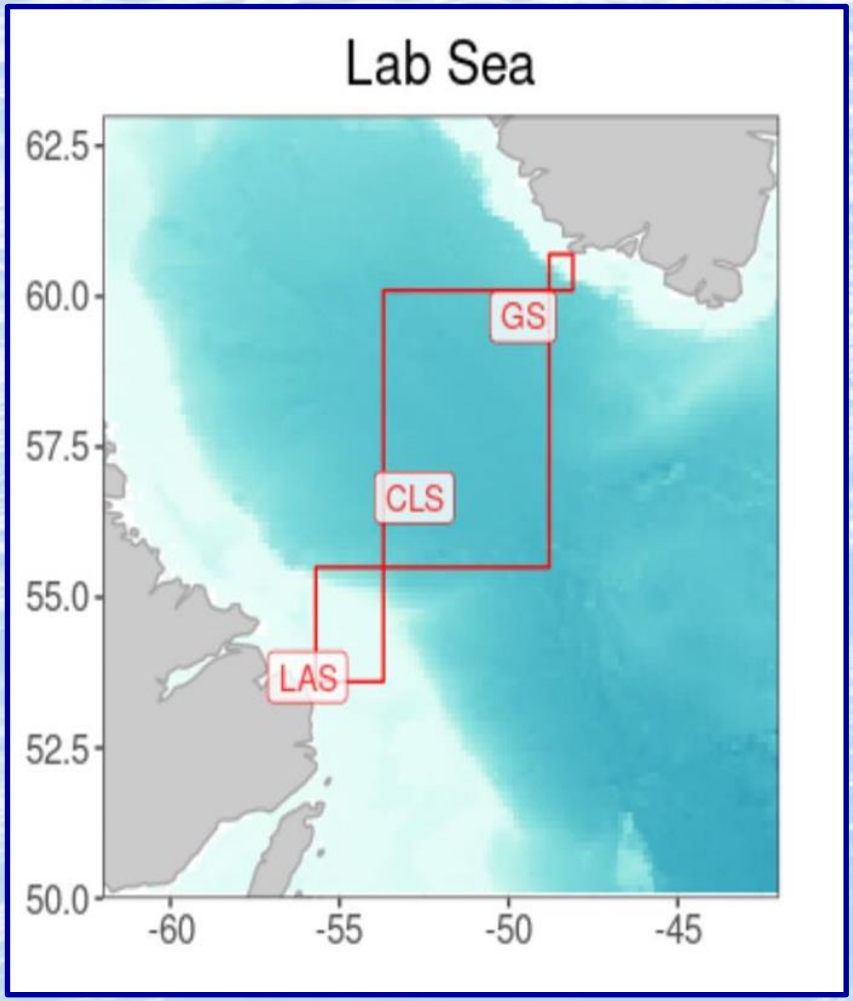
Atlantic Zone Monitoring Program (AZMP)
NAFC Oceanography Section

NAFO Subareas : AZOMP – Atlantic Zone Offshore Monitoring Area



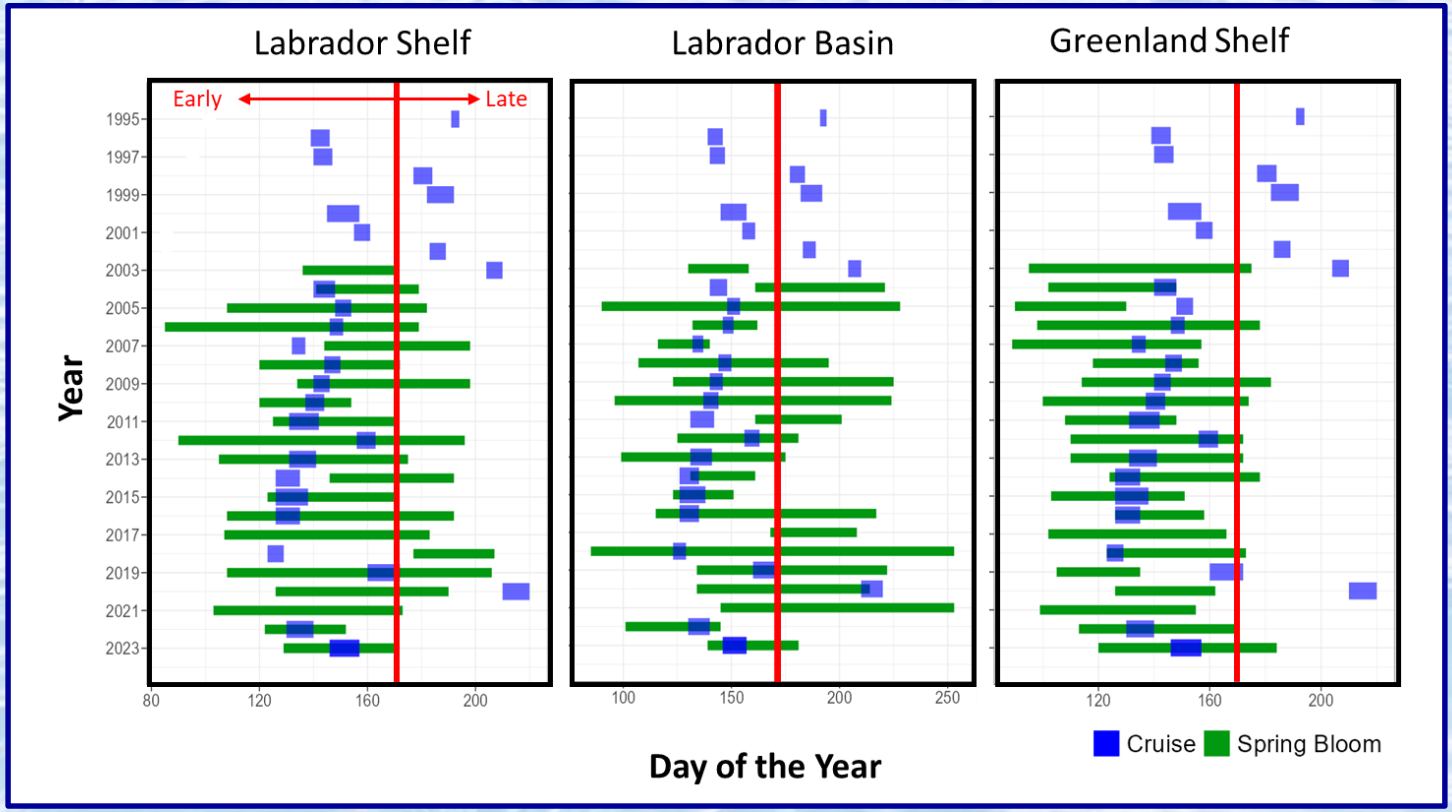
- Cruise length: 2727nm
- Stations:
  - AR7W (29 core + 25 CTD)
  - LSC (7 CTD & Net + 6 CTD)
  - XHL (15 core + 3 CTD)
- 1 mooring sites
- 232 single operations
- Cover **NAFO subareas 1, 2, 3 & 4**

Satellite-derived seasonalized bloom metrics



- **3 regions** as historically defined
- Averages determined following Clay & Devred (2023) and PhytoFit Tech report (*in prep.*)
- Cover **NAFO subareas 1 & 2**

Sampling strategy: Bloom occurrence

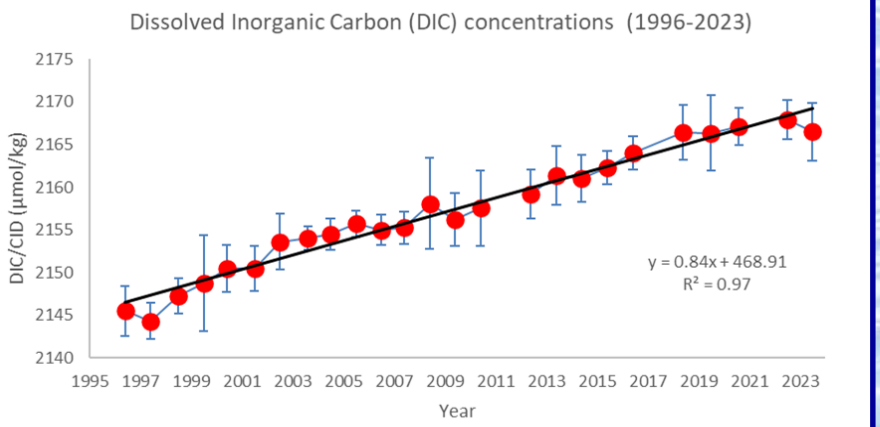


- Missions within the **normal time frame** since 2018, 2022 & **2023**.
- 1 in **late** June (2019)
- 1 in **late** summer (2020)
- **No mission** in 2017 and 2021

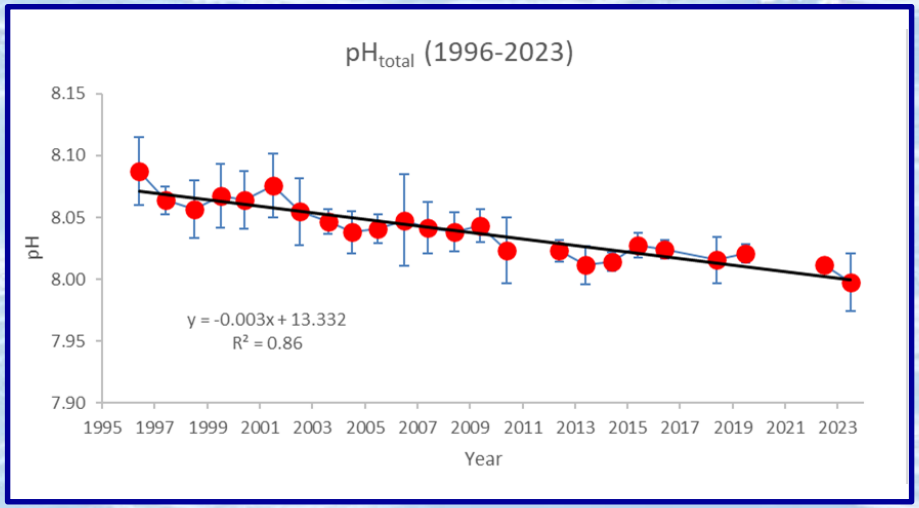
- Spring bloom estimates using MODIS – 2003 onwards
- The late sampling not include in the climatology
- **3 regions sampled** within the **spring bloom period**

Chemical oceanography:

Time series of mean total dissolved inorganic carbon and pH total in newly ventilated Labrador Sea water



- Average linear **increase** of 0.84 µmol DIC kg^{-1} y^{-1} since 1996

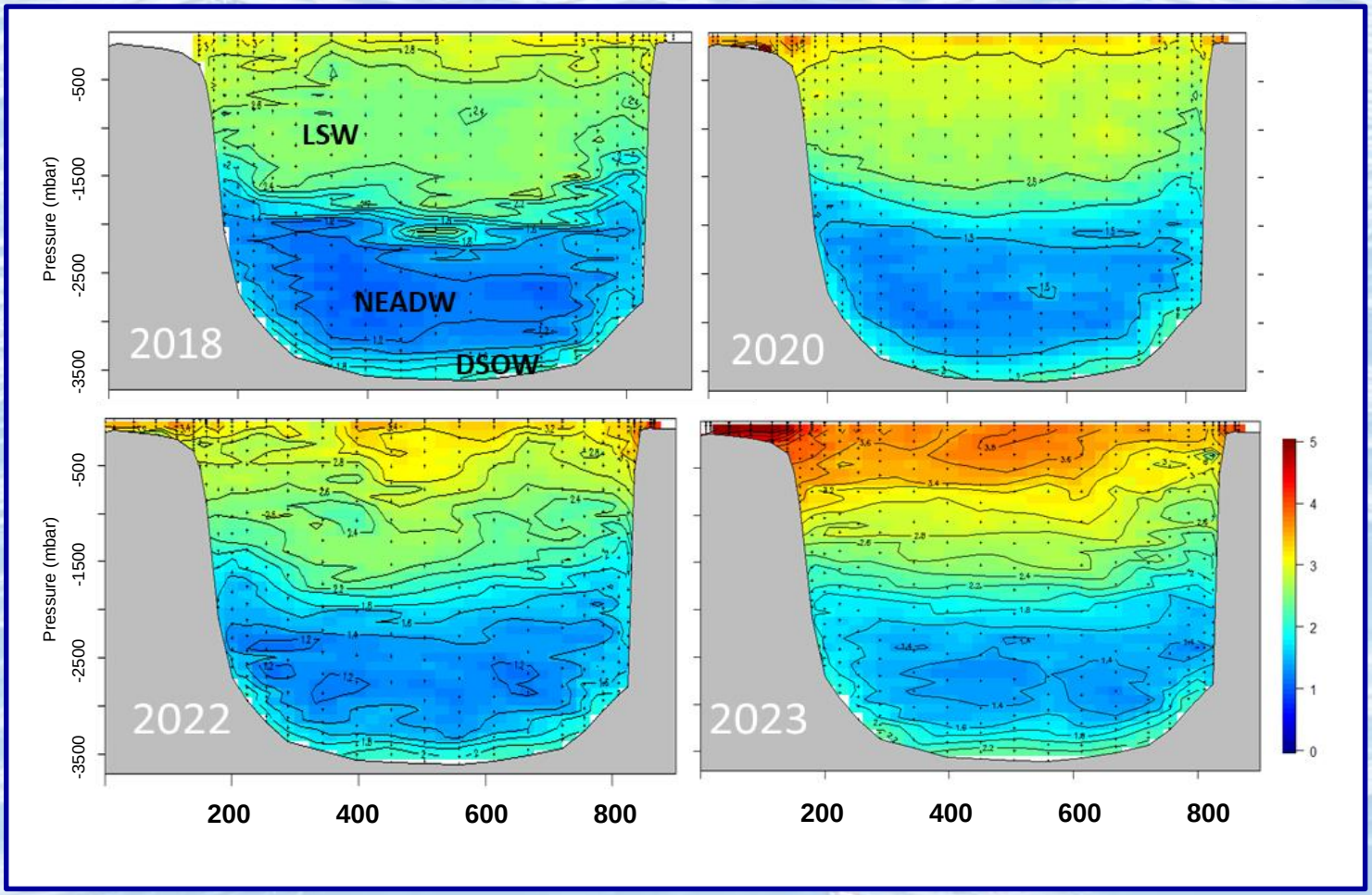


- Corresponding **decline** in pH_{total} of 0.003 y^{-1} (global average is 0.002 y^{-1})

- Error bars represent one standard deviation.
- **Both parameters** align with the rising atmospheric **carbon dioxide levels** attributed to **human activities**

Chemical oceanography:

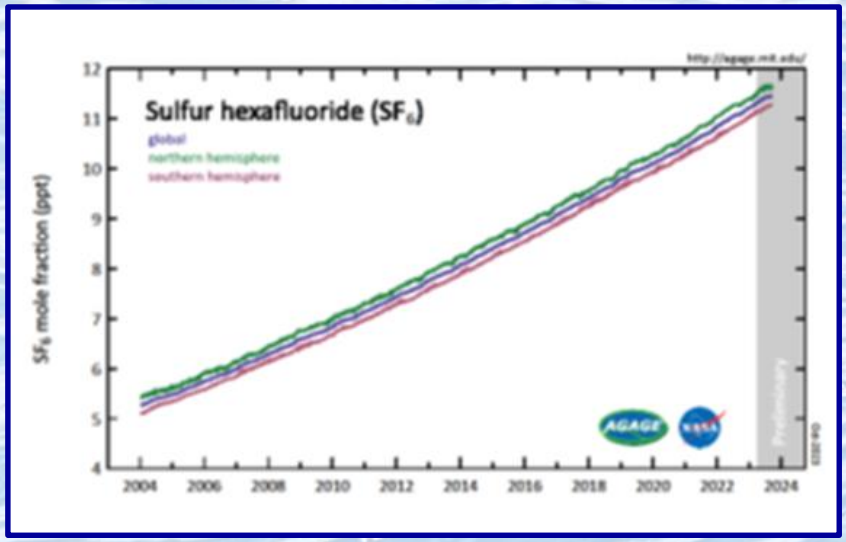
Transient tracers in the Labrador Sea - SF_6 (fmol kg^{-1})



- The **2023** data from the **newly-ventilated Labrador Sea Water** indicate a steady **increase** in **SF_6** concentrations (3.64±0.14 fmol kg^{-1}), and a slight **decrease** in **CFC-12** concentrations (2.84±0.23 pmol kg^{-1}), mirroring atmospheric trends.

Chemical oceanography:

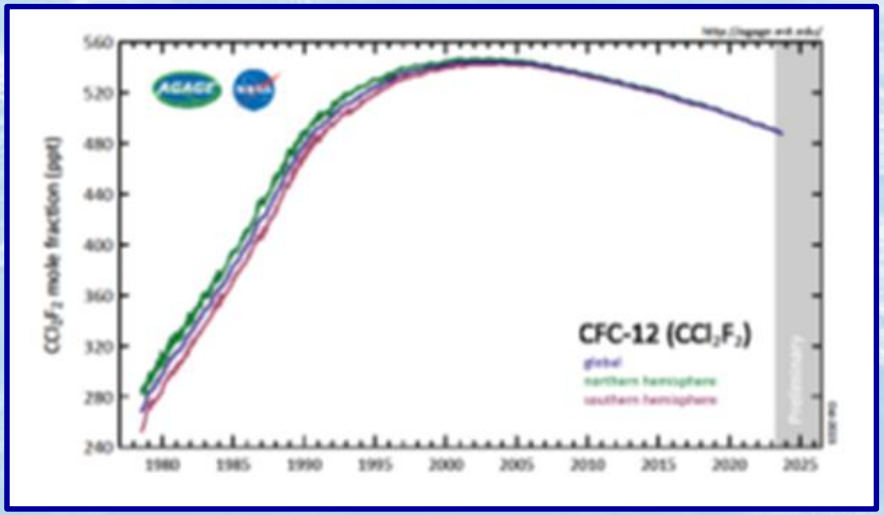
Transient tracers in the Labrador Sea - SF_6 (fmol kg^{-1})



- Transient Tracer observations and distribution analyses, indicate that the **inventory of anthropogenic CO_2 increased** at an average rate of 1.8 mol m^{-2} y^{-1} over the past 30 years, roughly **3X the global average** accumulation rate.

- Variability in **anthropogenic CO_2** accumulation rate is linked to temporal changes in the relative layer thickness of annually ventilated **Labrador Sea Water** and underlying **Northeast Atlantic Deep Water** and **Denmark Strait Overflow Water**.

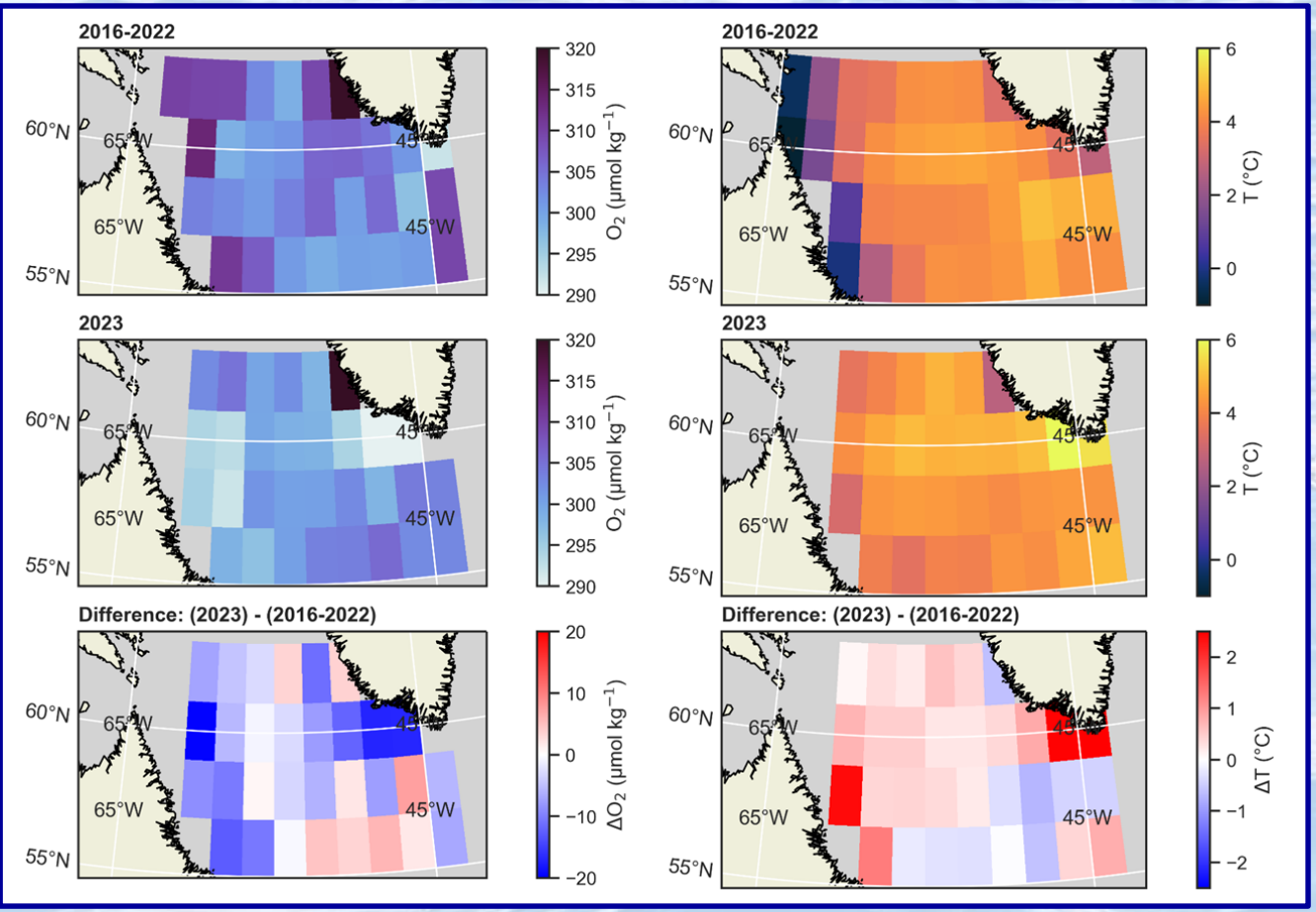
- Non-steady anthropogenic CO_2 accumulation emphasizes **the importance of sampling frequency**, especially in regions of variable deep mixing and **high carbon inventories**, such as the **Labrador Sea**.



Advanced Global Atmospheric Gases Experiment (AGAGE)
https://agage.mit.edu/data/agage-data

Chemical Oceanography: ARGO floats

Annual mean Oxygen and Temperature (< 200m)

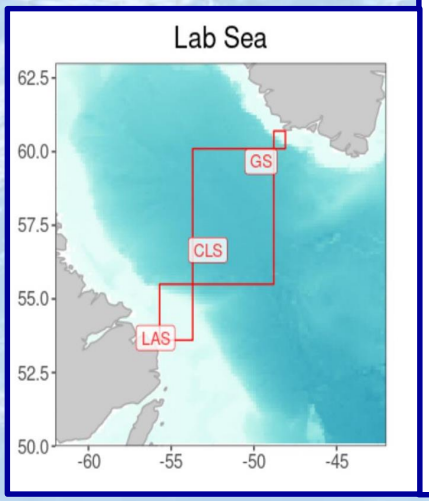


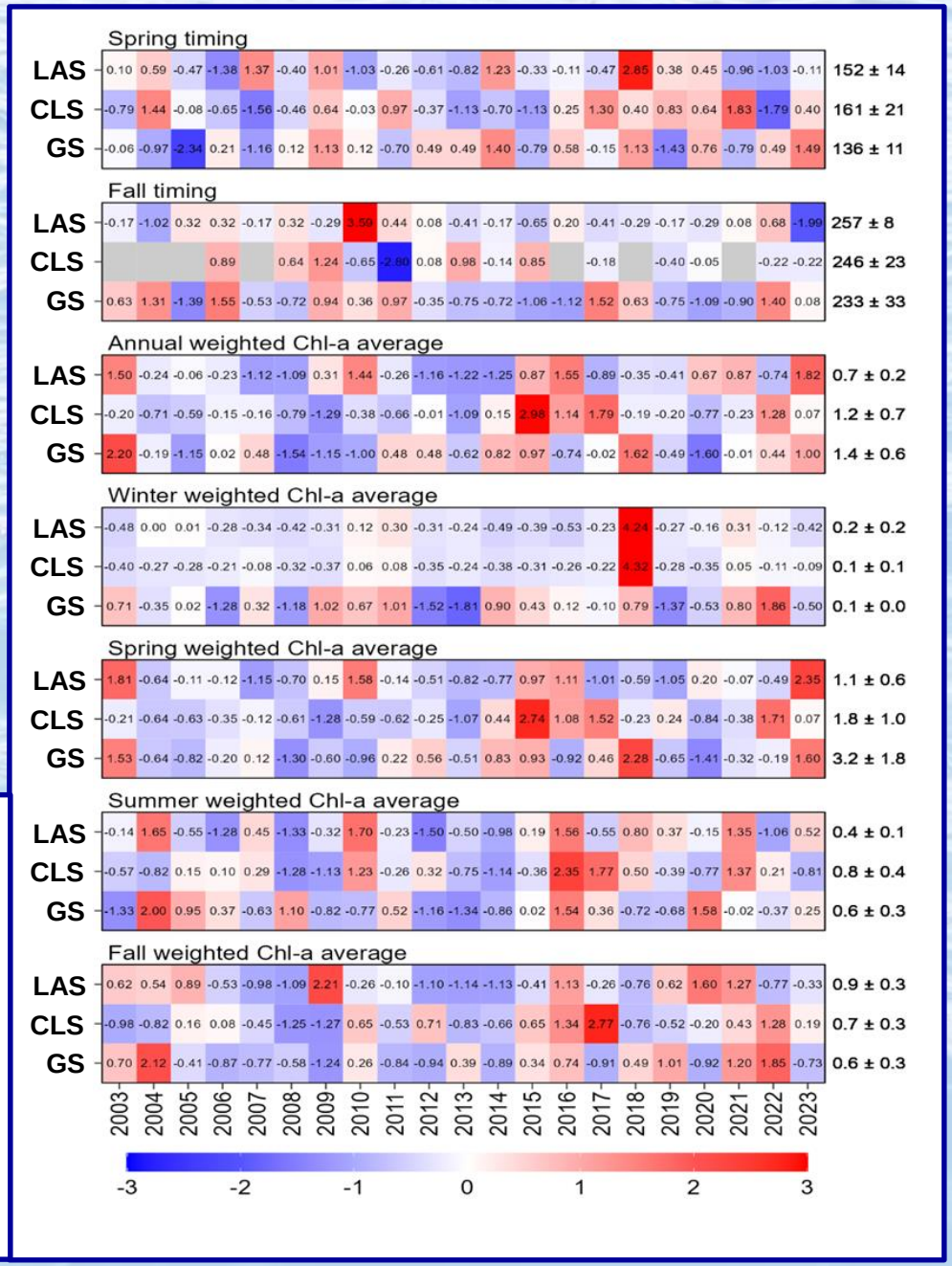
Decrease mostly in the **S-W** region of **the Labrador Shelf** and **increase** in the **N-W** and **along the region** off the **Greenland shelf**.

- Temperature generally **higher** than average.
- Oxygen concentration **lowest** around AR7W.
- Relatively **colder temperature** in the southern region allows for **higher** O_2 concentration.

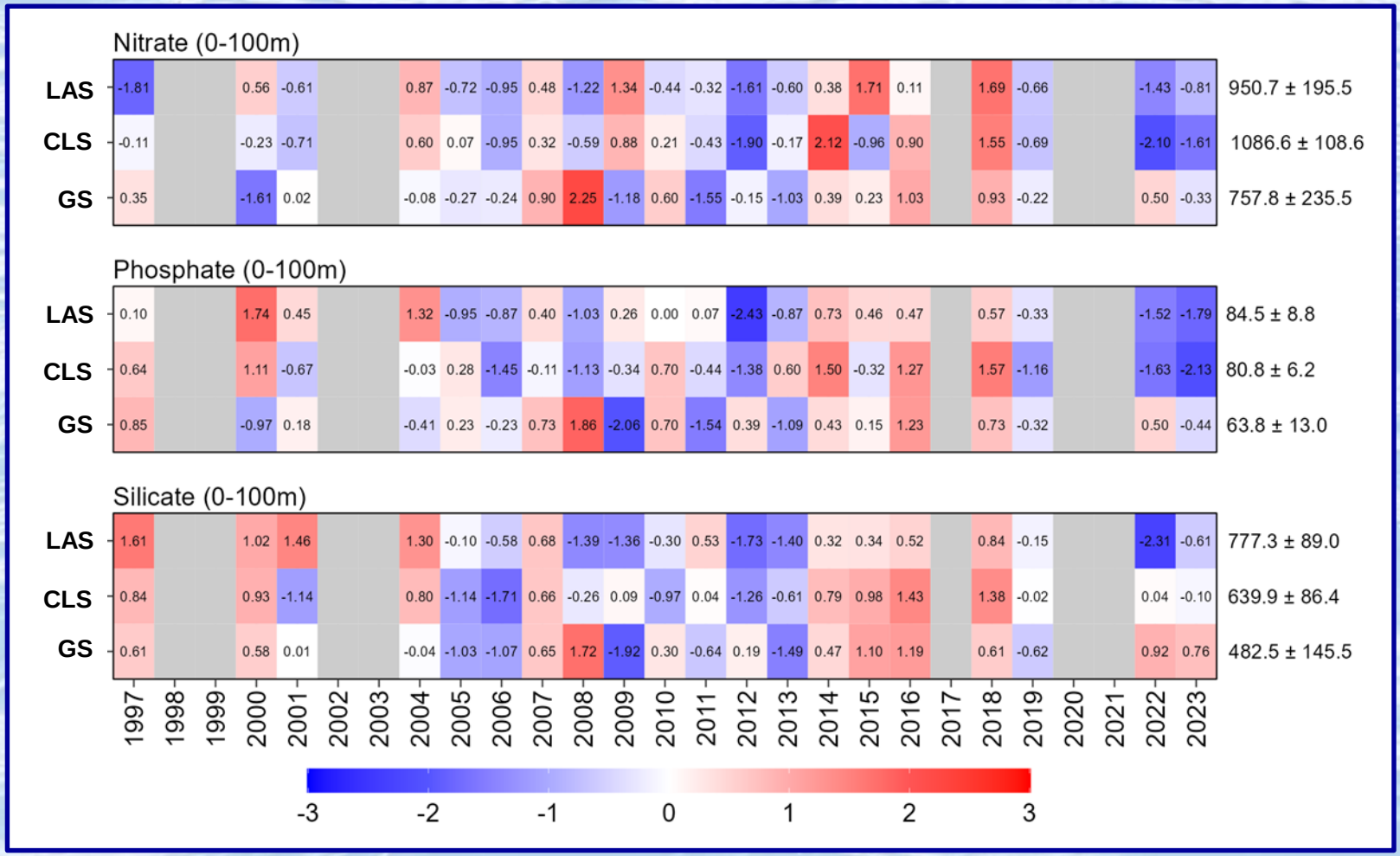
Satellite-derived seasonalized bloom metrics

- Spring Blooms started **late** in **CLS** and **GS** squares
- Fall Bloom began very **early** on **Labrador Shelf**
- Annual high yields on both shelves are largely caused by the spring blooms since all other seasons/regions remains around the average.





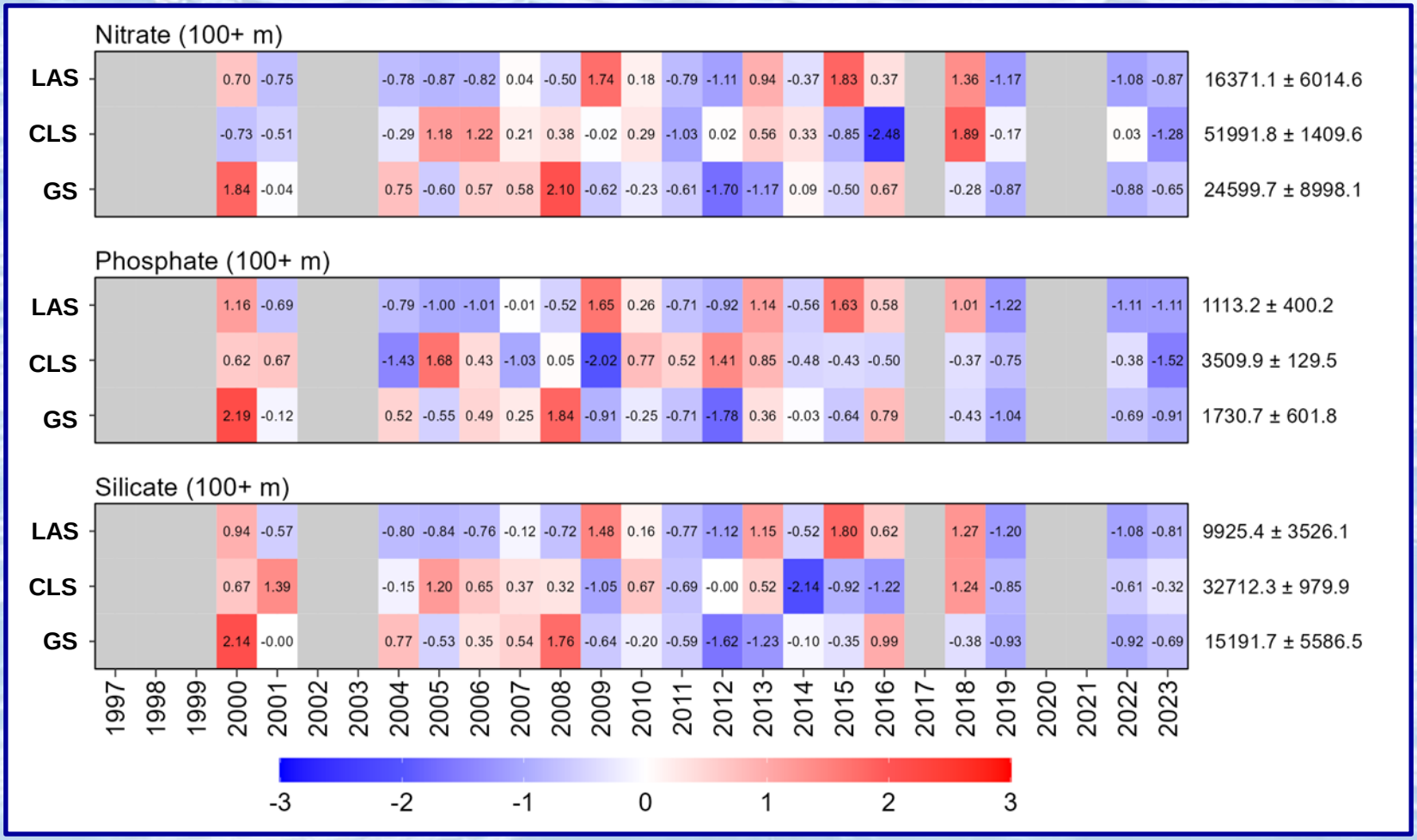
Nutrients (surface water)



Lower than average nutrient in **Labrador shelf** and **Central** region at the exception of **higher** than average ***silica*** observed on the **Greenland Shelf**

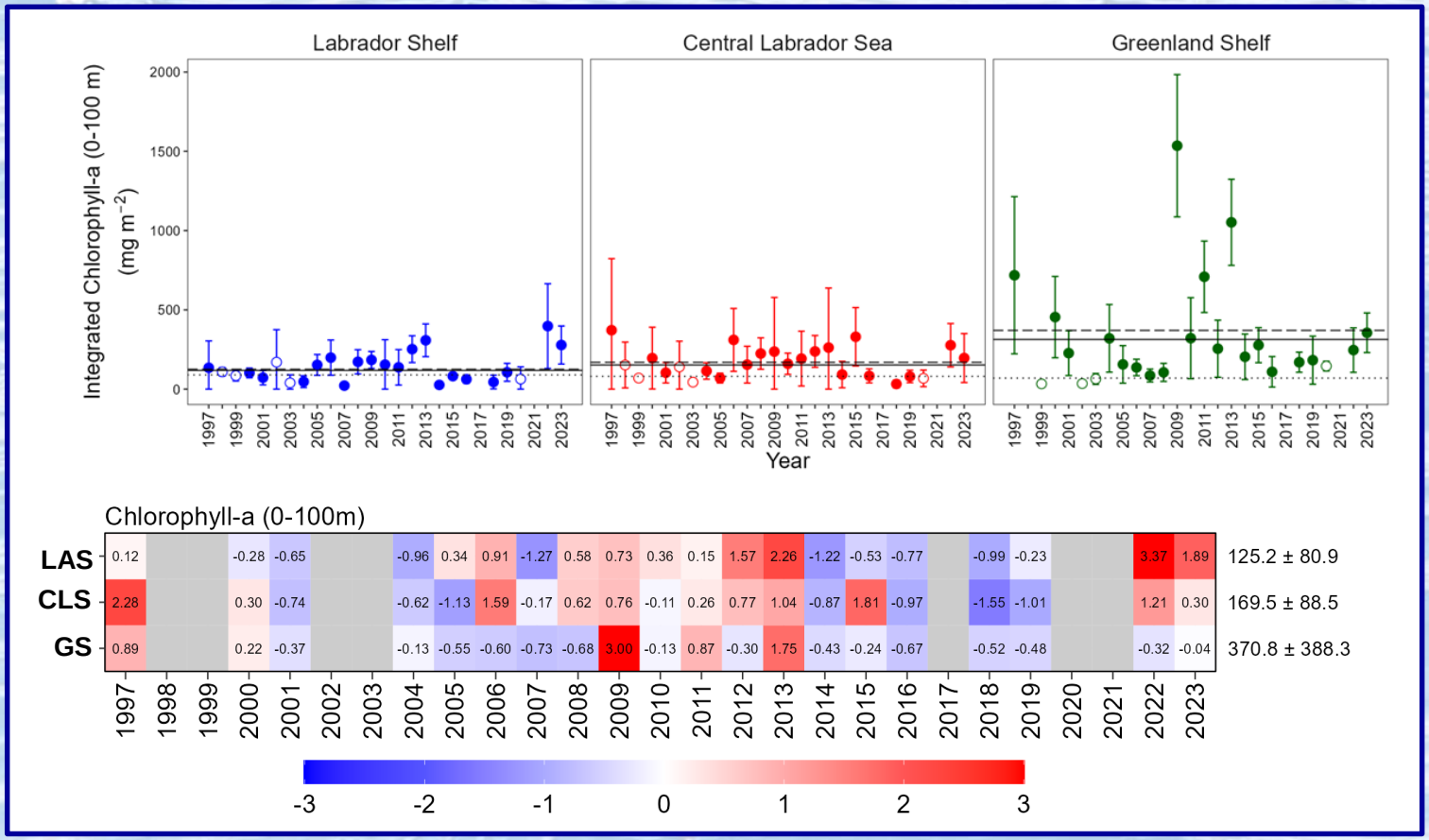
Similar trend observed in the last two years (2022 and 2023)

Nutrients (deep water)



- **Lower** than average nutrient in **all region**.
- Si**milar trend** observed in the last two years (2022 and 2023)
- First observed in 2019 but gap in sampling does not allow to confirm.

Chlorophyll-a

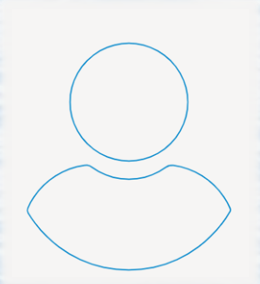


- Chlorophyll abundance were **higher** than average on the **Labrador Shelf** and **Central Labrador Sea**.
- Sampling dates relative to **the bloom formation** is important with **Labrador Shelf** sampled close to the **peak season** as opposed to generally early.
- **High** chlorophyll **on Labrador Shelf** coincides with high **satellite surface chlorophyll** in the **spring** season.

Highlights

- Inventory of **anthropogenic CO_2 increased** roughly **3X the global average** accumulation rate over **the last 30 years**.
- **Nutrients** (surface and deep) have remained **lower** than average for at least the last two years
- **Short** and **later**-than-usual, but **intense**, blooms lead to **higher**-than-usual chlorophyll-a yield on **both shelves**.
- **Chlorophyll-a** inventory **higher** than normal in **Labrador Shelf** and **Central Labrador Sea** and **normal** on **Greenland Shelf**


Marc Ringuette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Source:

M. Ringuette, **E. Devred, K. Azetsu-Scott**, E. Head, **C.E. Gabriel, S. Clay**. (2024). Optical, Chemical, and Biological Oceanographic Conditions in the Labrador Sea from summer 2019 and 2023, NAFO SCR Doc. 24/042

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Additional information:

Clay, S. E. Devred, 2023, SOPhyE Satellite Data Processing Technical Report Series: 1. Ocean Colour Satellite Intercalibration Can. Tech. Rep. Fish. Aquat. Sci. 3560: vi + 42 p.