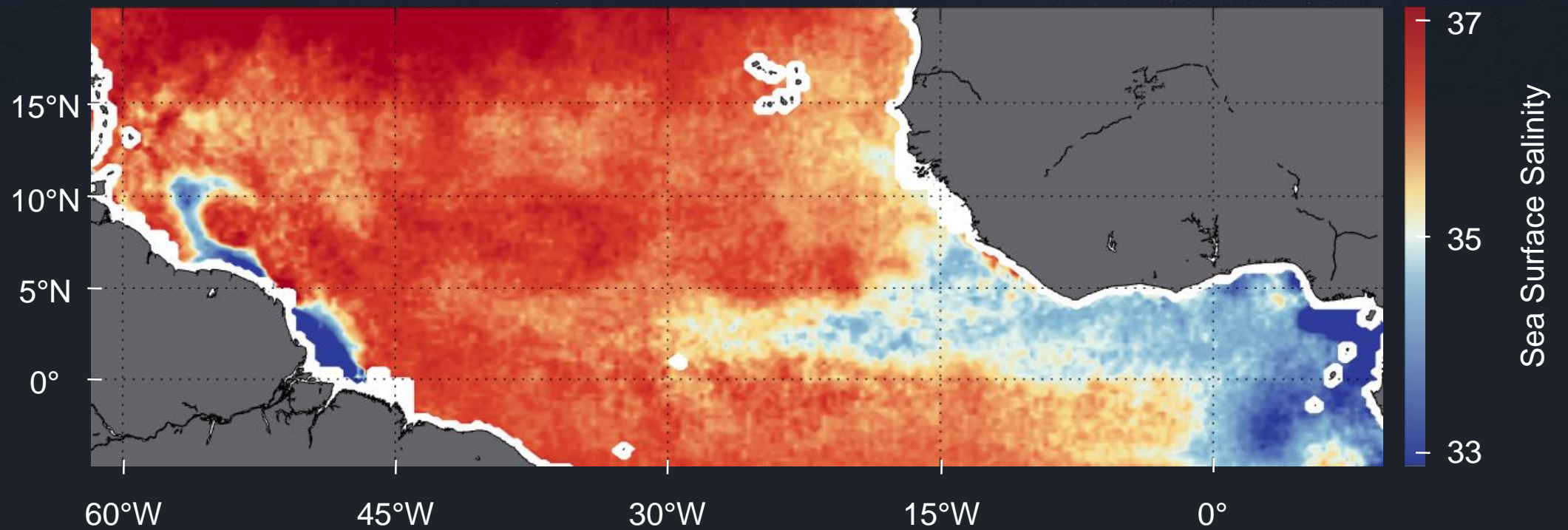


Wintertime process study of the North Brazil Current rings reveals the region as a larger sink for CO₂ than expected

L. Olivier, **J. Boutin**, G. Reverdin, N. Lefèvre, P. Landschützer, S. Speich, J. Karstensen, M. Labaste, C. Noisel, M. Ritschel, T. Steinhoff & R. Wanninkhof

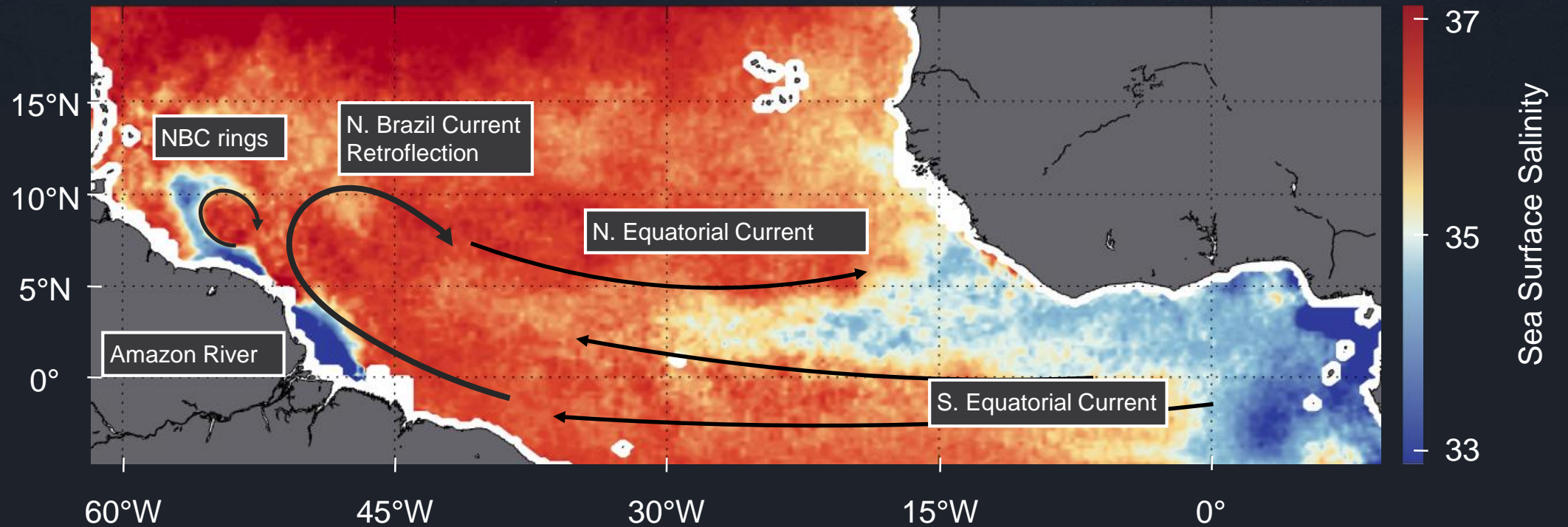
Biogeosciences, doi : <https://doi.org/10.5194/bg-2021-269>, in press, 2022

A transition region highly dynamic



February 7th, 2017, CCI+SSS

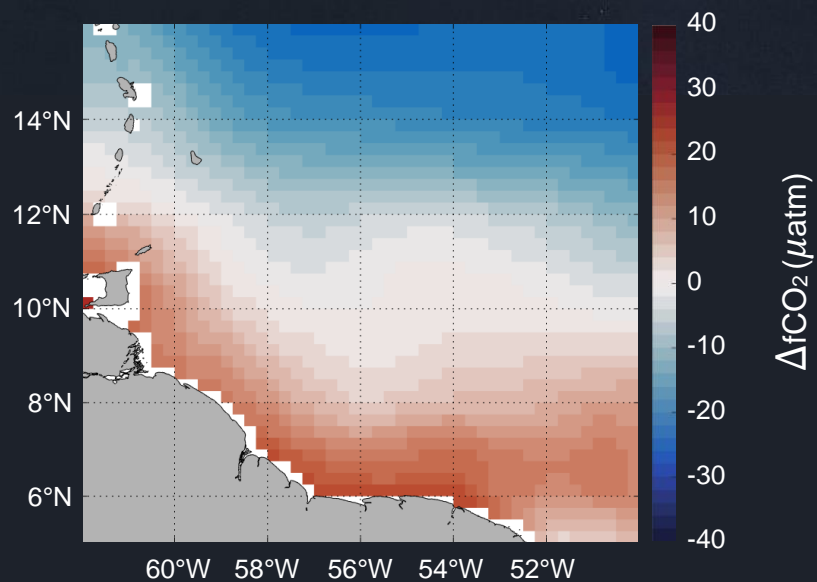
A transition region highly dynamic



February 7th, 2017, CCI+SSS

A transition region highly dynamic

February $\Delta f\text{CO}_2$ climatology



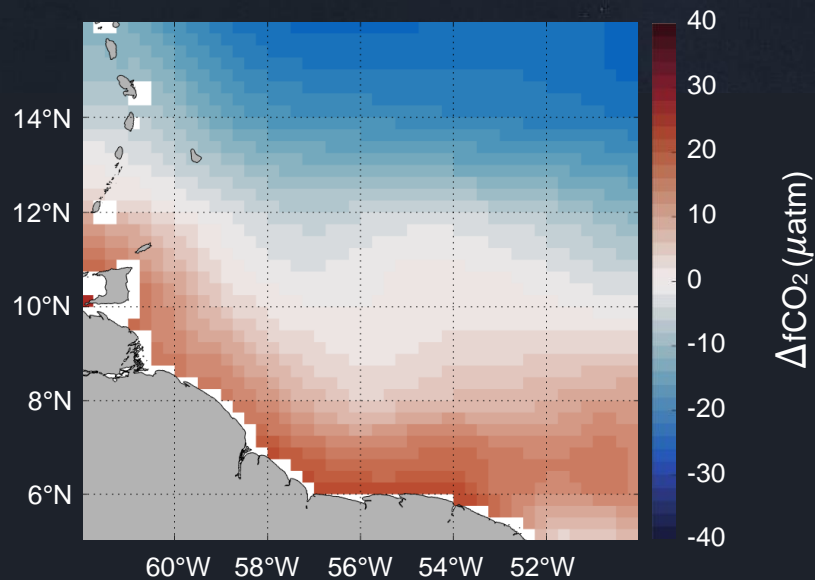
CO₂ sink generated by winter cooling

CO₂ source close to the equator waters rich in CO₂

Landschützer et al., 2020

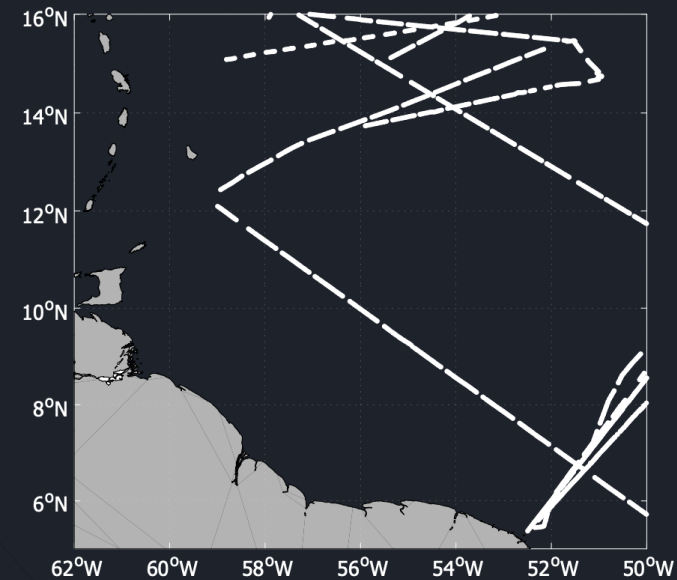
A transition region highly dynamic

February $\Delta f\text{CO}_2$ climatology



Landschützer et al., 2020

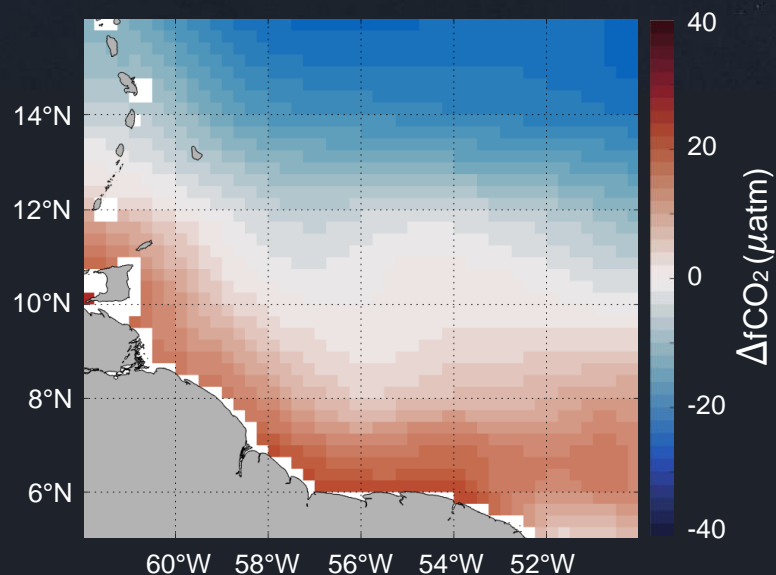
Available data in winter on the SOCAT database



1 transect south of Barbados
crossing the region

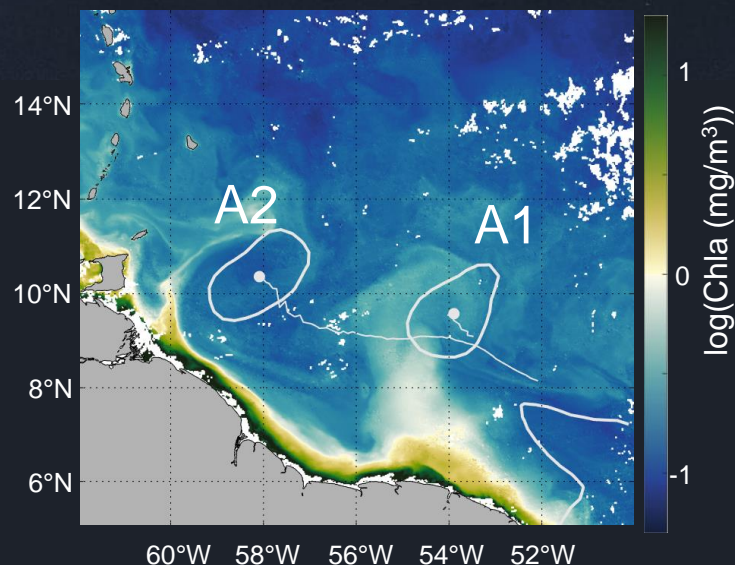
A transition region highly dynamic

February $\Delta f\text{CO}_2$ climatology



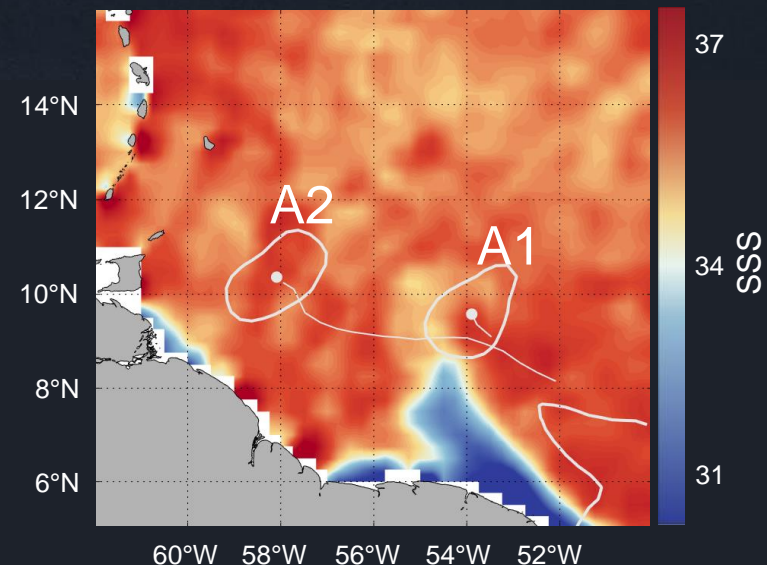
Landschützer et al., 2020

Satellite Chla on Feb 6th 2020



CLS 0.02 km

Satellite SSS on Feb 6th 2020



SMOS CATDS + SMAP RSS ~50km



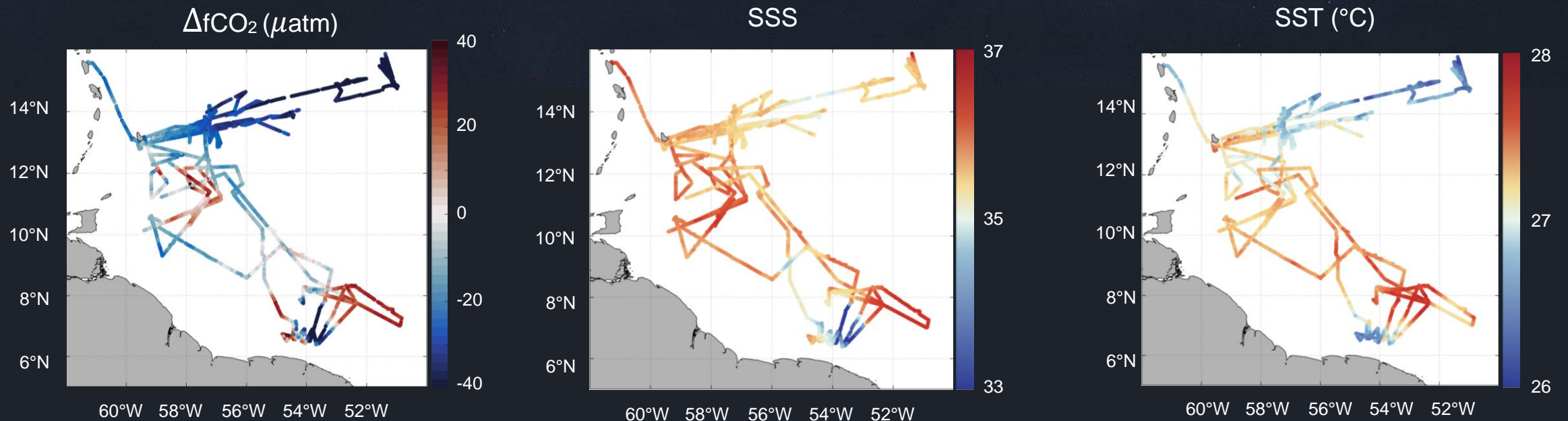
Problematics

How do mesoscale and sub-mesoscale dynamics influence the regional air-sea CO₂ fluxes ?

Impact of the amazon plume in a low outflow period ?

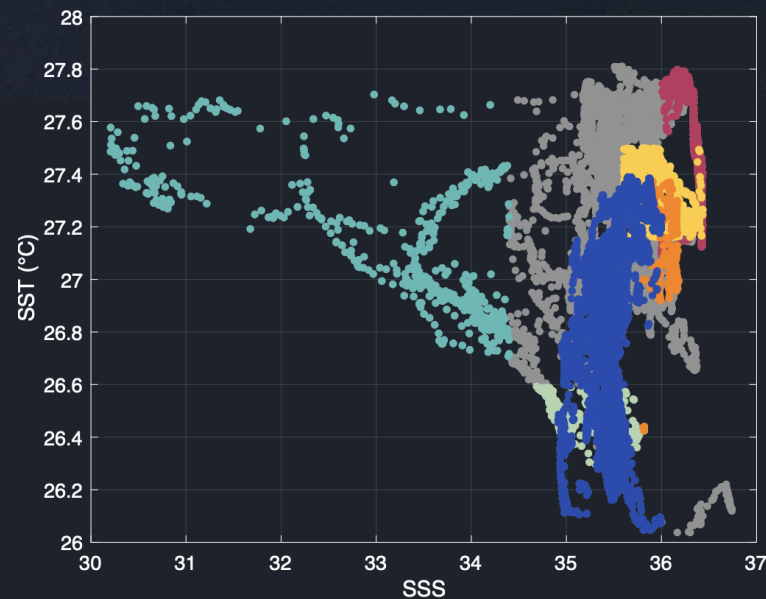
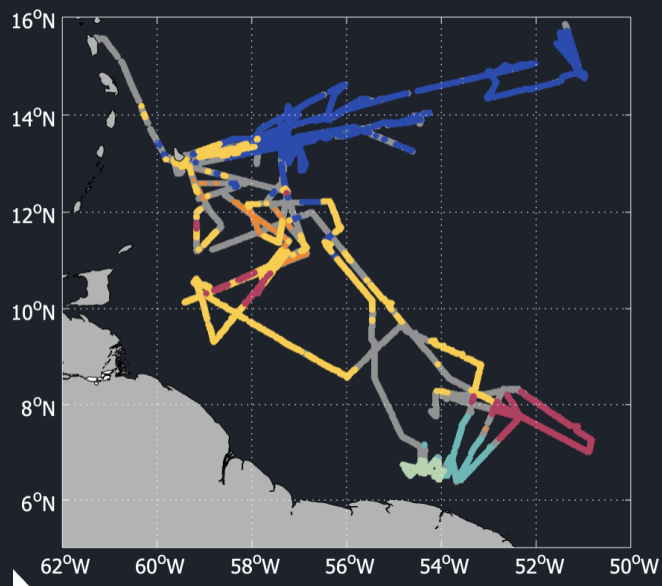
What is the impact of NBC eddies on the CO₂ fluxes ?

Data - The EUREC⁴A-OA cruise



January - February 2020 - 3 ships equipped with CO₂ system - RVs Atalante-
Merian- Ron Brown

Water masses identification

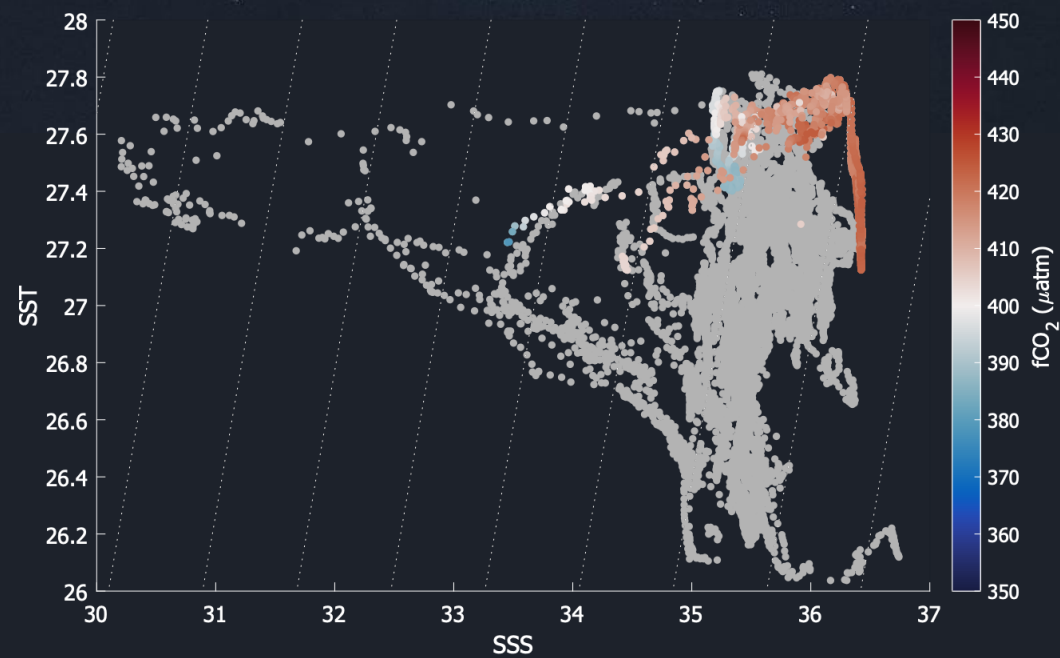
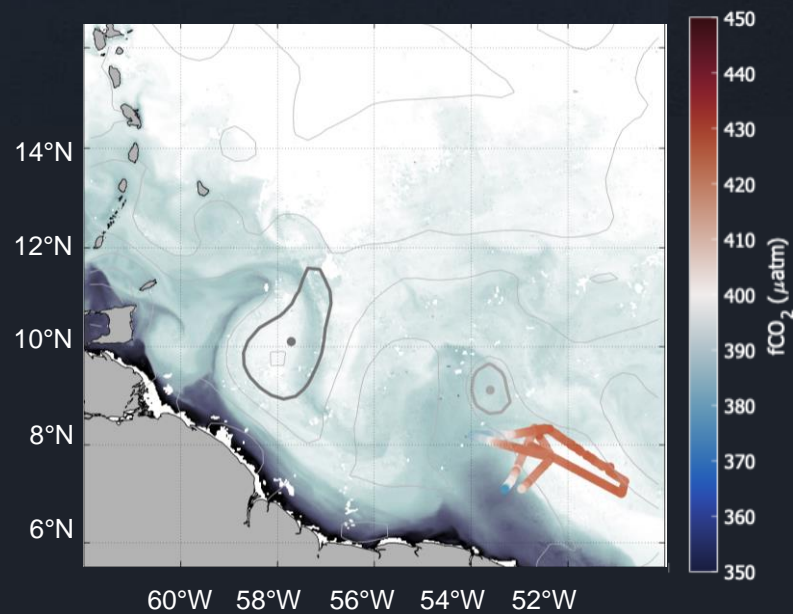


Identification using SSS, SST and
colocalised satellite Chla

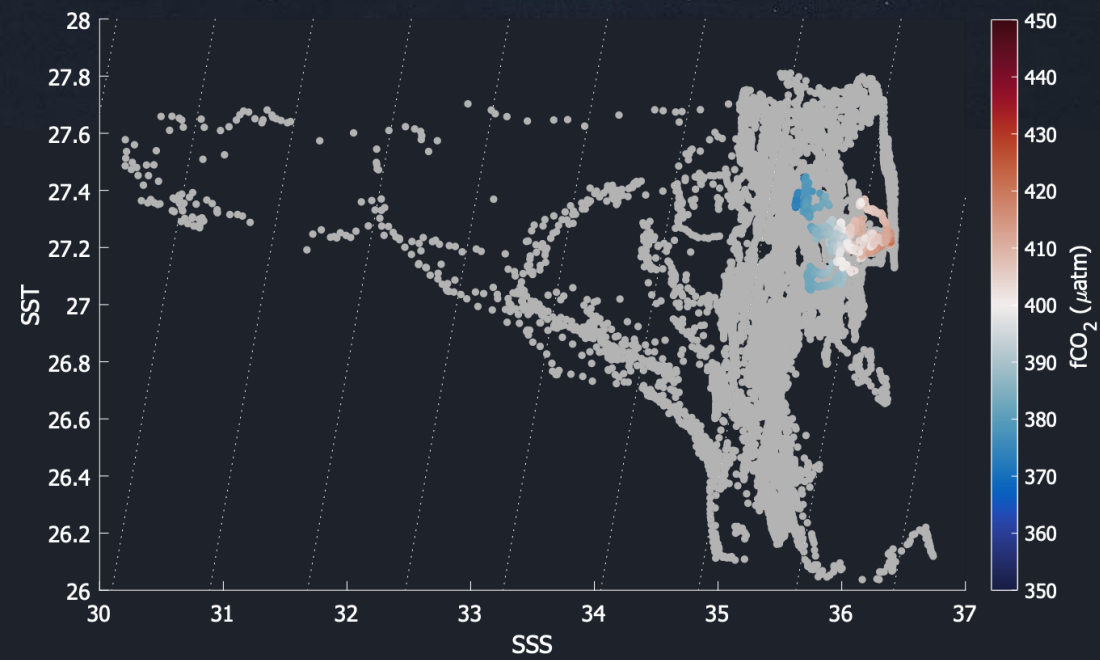
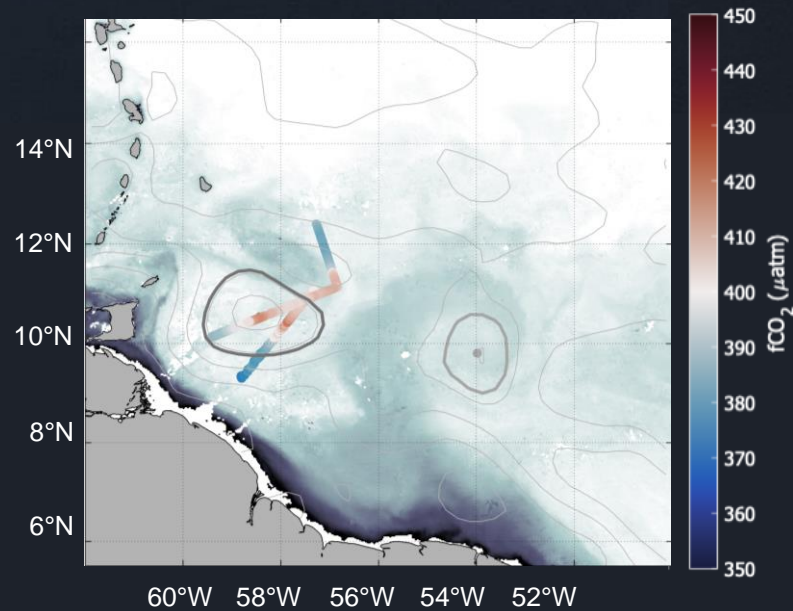
Boundaries varying in space and
time



NBC retroflection

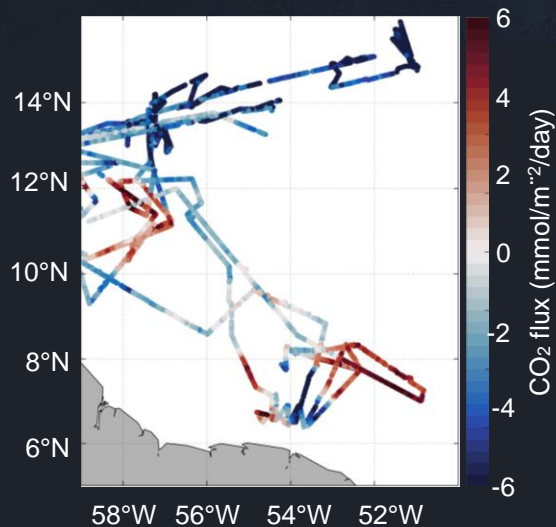


NBC ring A2

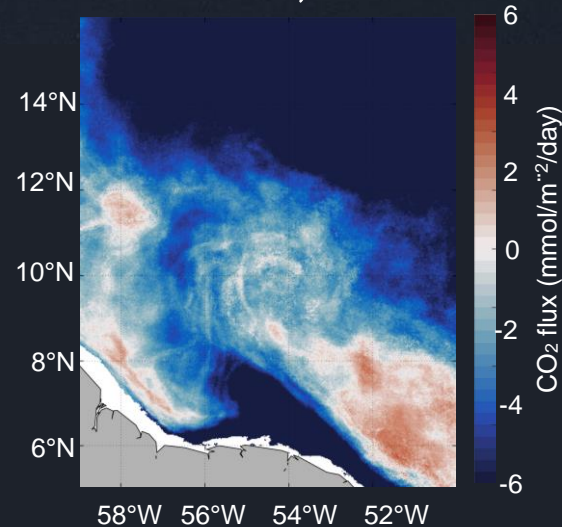


Air-sea CO₂ flux

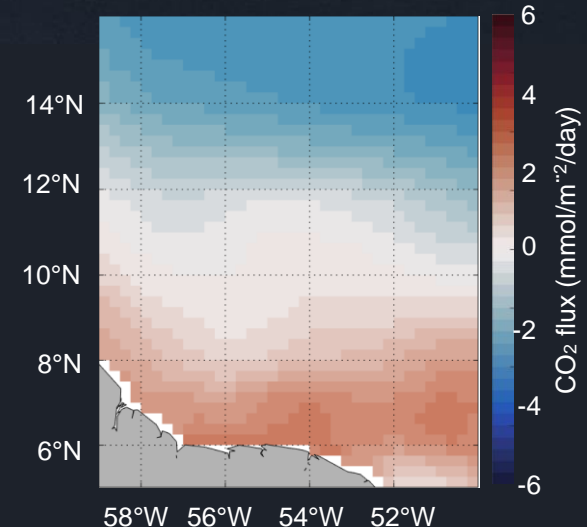
EUREC⁴A data



Reconstructed from
Satellite SSS, SST & Chla

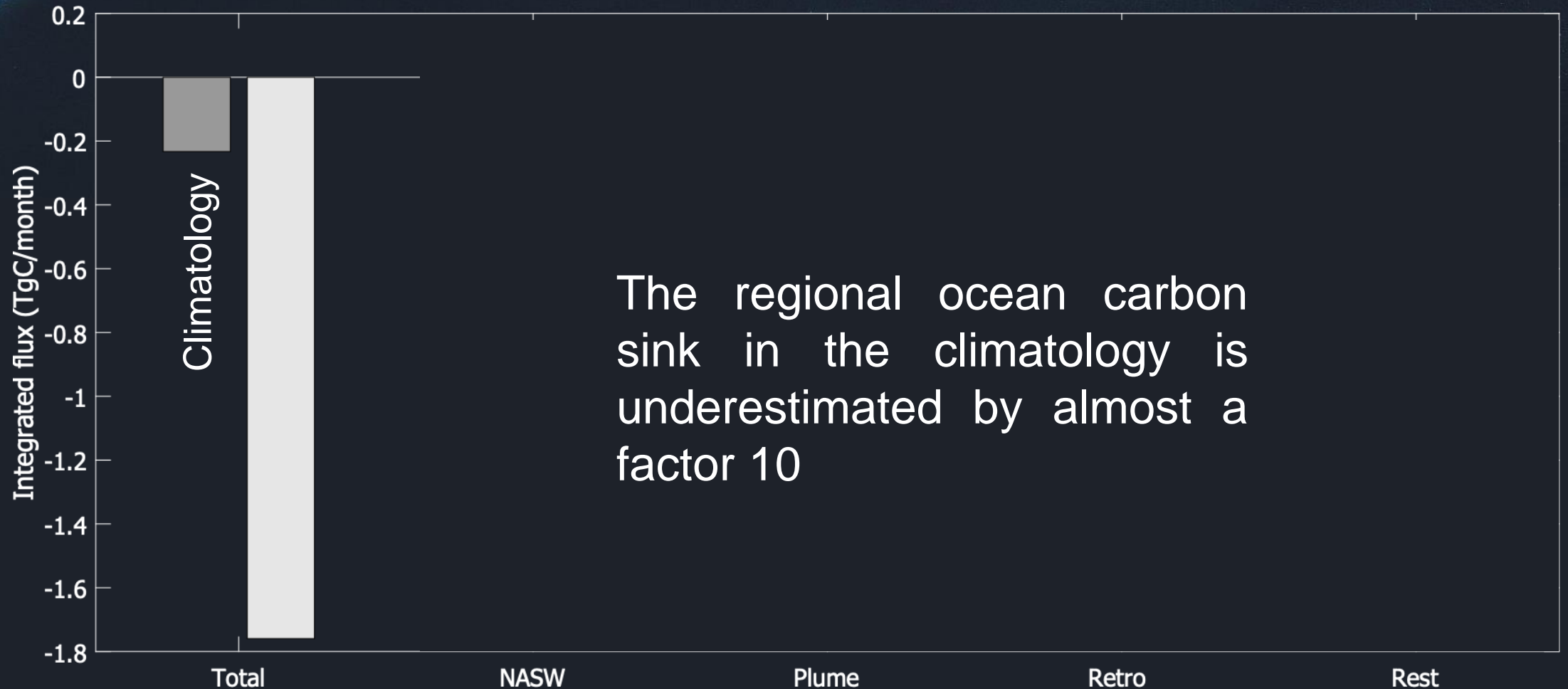


Landschützer et al., 2020



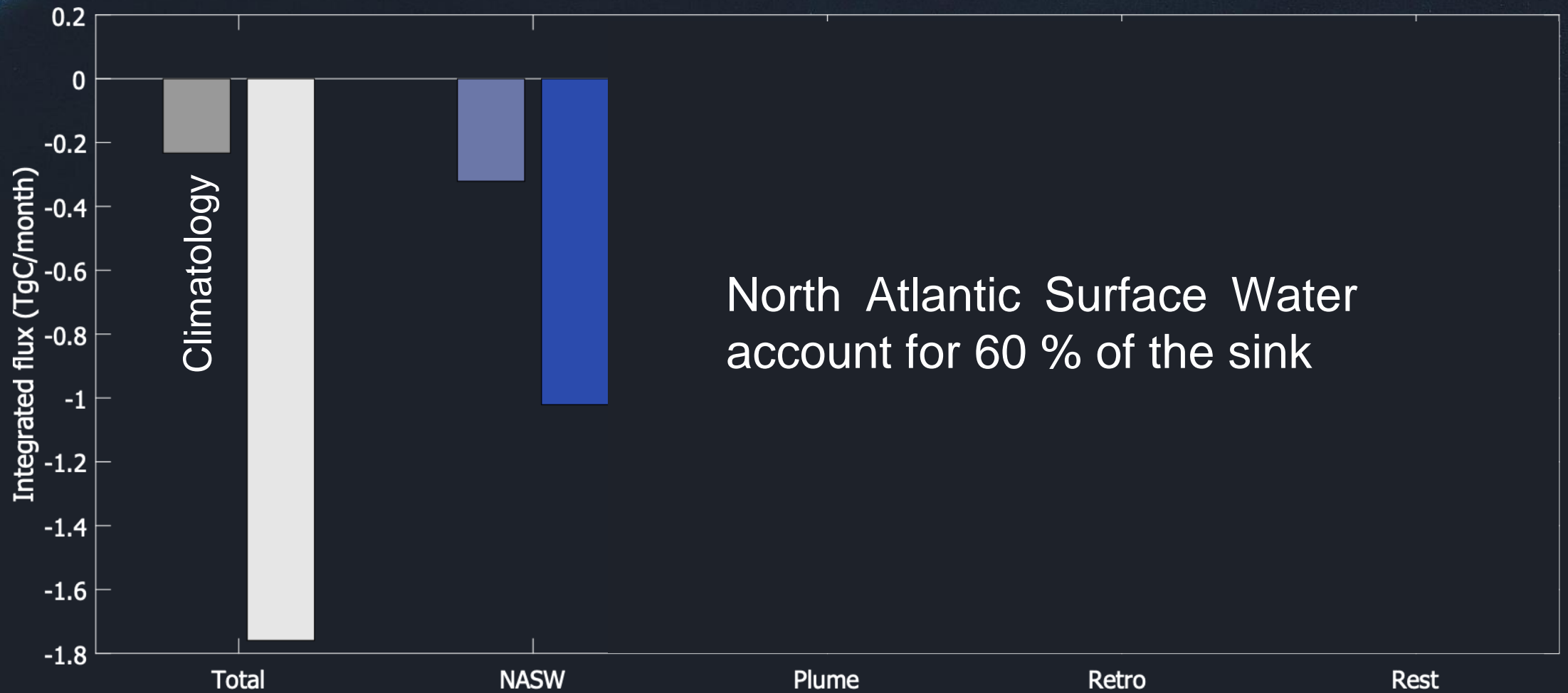
*Error on mean flux linked to uncertainty on ship measurements absolute calibration <0.1 mmol/m²/day
Error (noise) on individual pCO₂ estimate linked to interpolation and reconstruction ~4 to 9 μatm*

Integrated air-sea CO₂ flux

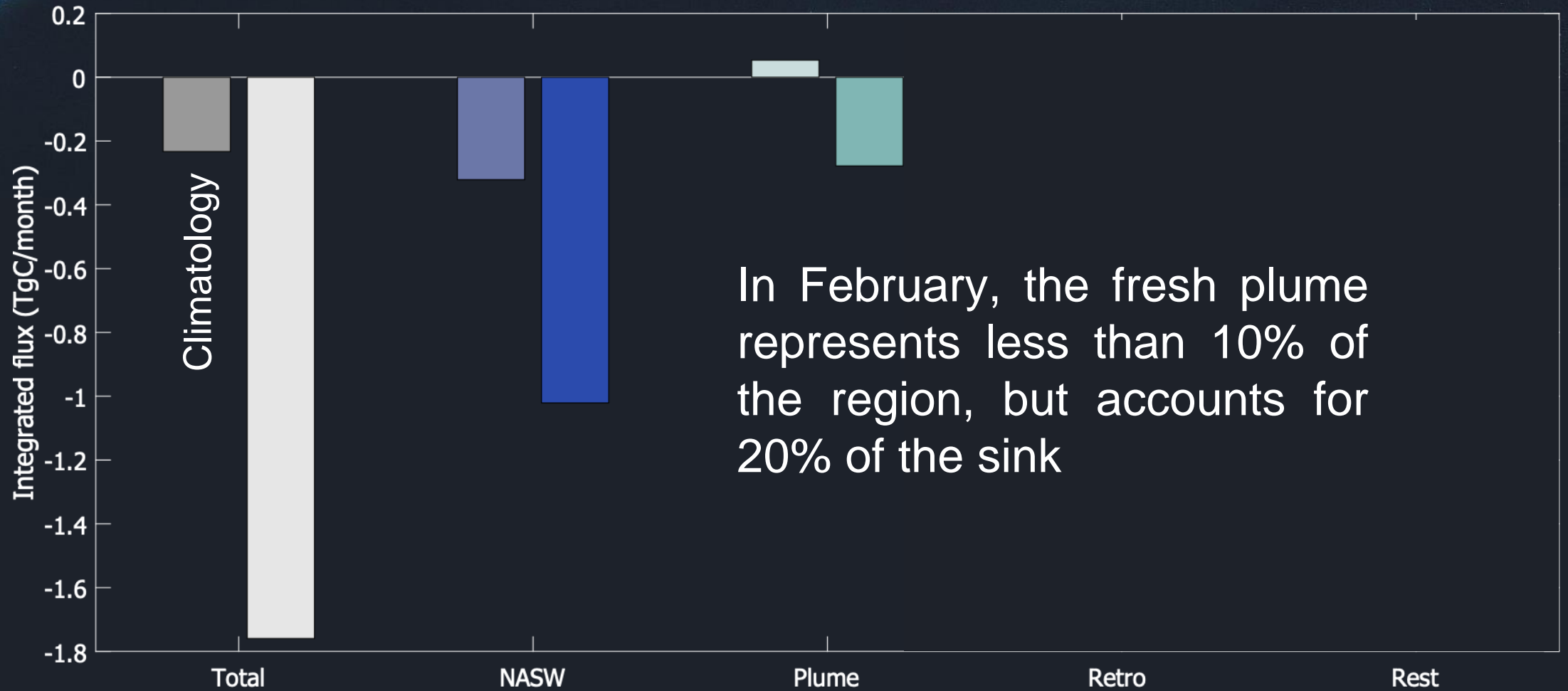


The regional ocean carbon sink in the climatology is underestimated by almost a factor 10

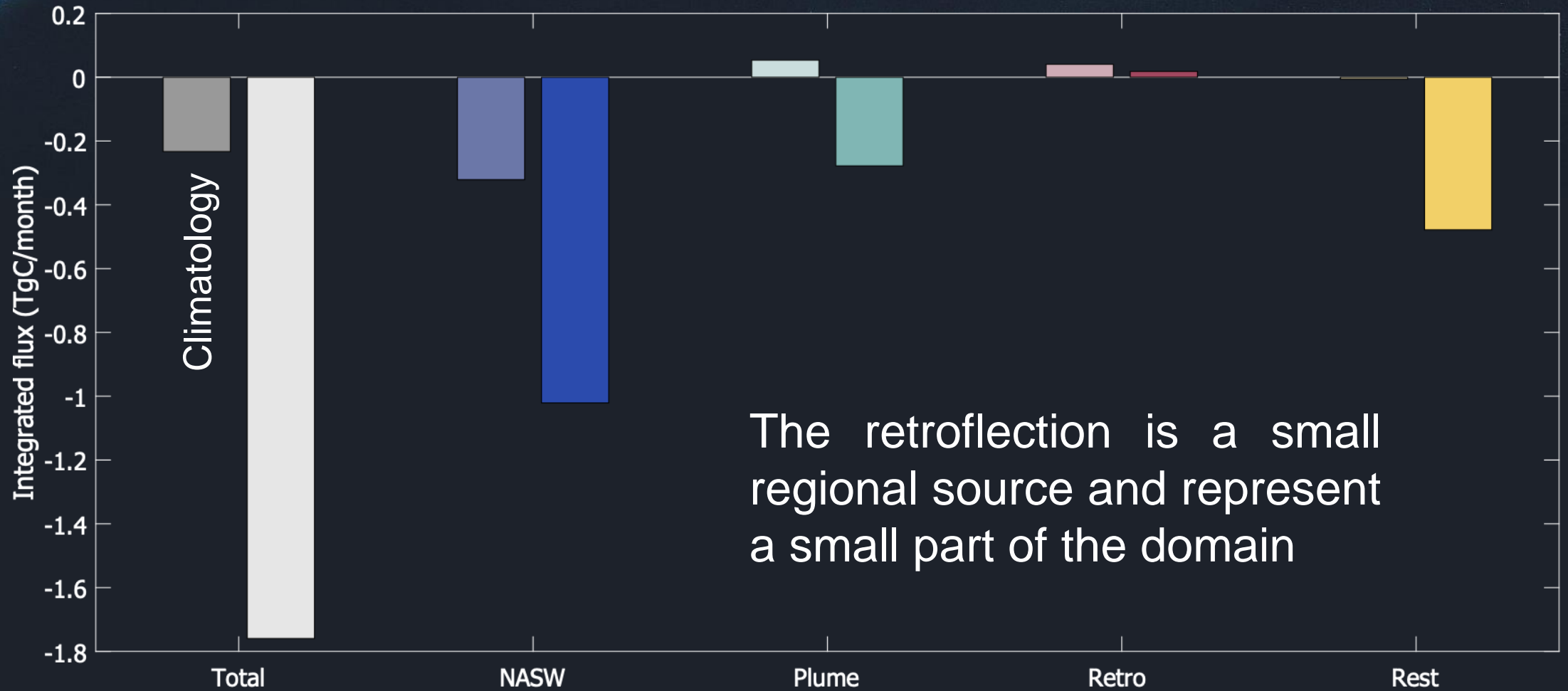
Integrated air-sea CO₂ flux



Integrated air-sea CO₂ flux

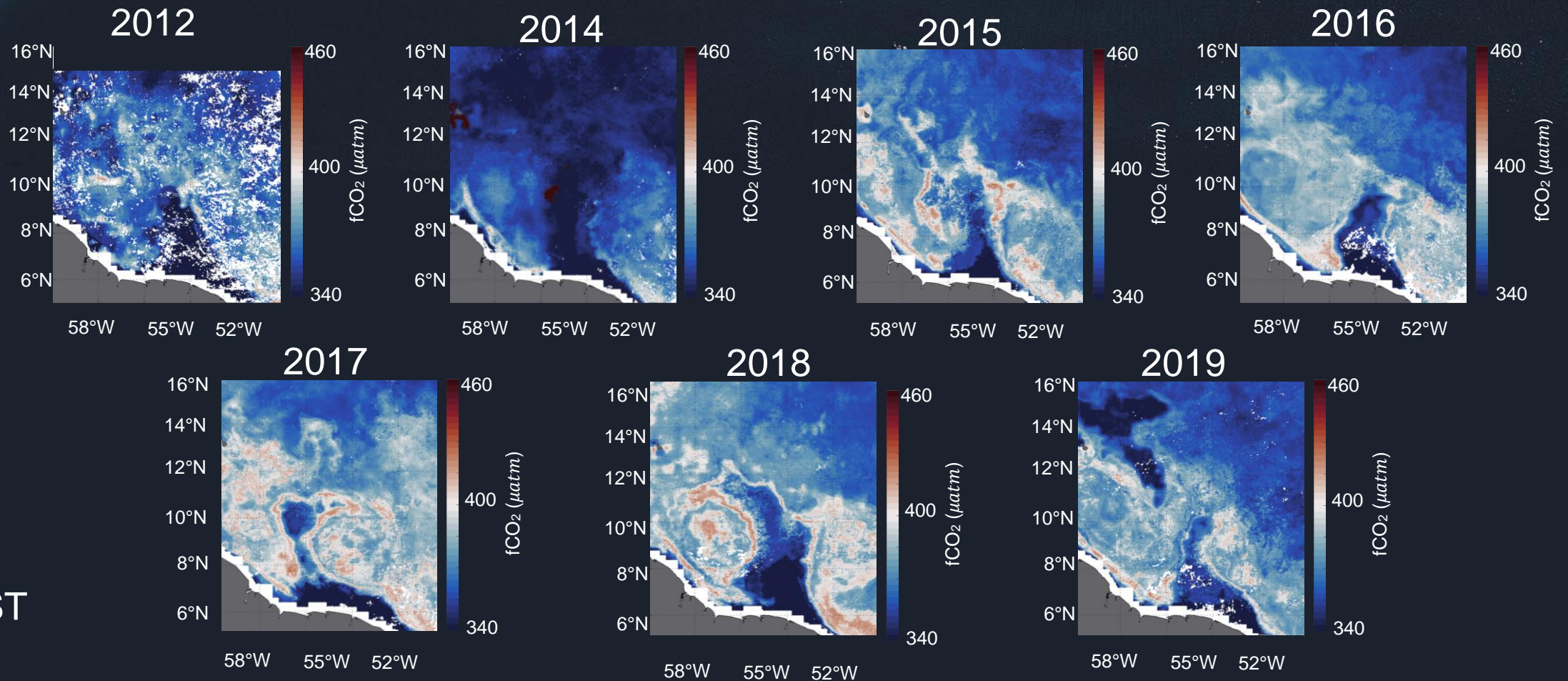


Integrated air-sea CO₂ flux



Interannual variability

Freshplume events observed 7 years out of 10 from 2010 to 2019



CCI SSS
OSTIA SST
CLS Chla

An aerial photograph of a large body of water, likely a bay or estuary, showing intricate patterns of water flow and sediment. A semi-transparent dark grey rectangular box is overlaid on the center of the image, containing white text. The text is centered and reads "Conclusions" at the top, followed by two paragraphs of text. A thin white horizontal line is positioned below the title.

Conclusions

The NBC retroflection is a source of carbon to the Atmosphere

The signal of the NBC rings is dampened over time, but conserve high $f\text{CO}_2$ near the centre

An aerial photograph of the ocean with white-capped waves breaking against a dark coastline. The water is a deep blue, and the waves are white and frothy. The coastline is visible on the right side, showing a mix of dark and light patches.

Conclusions

The main effect of NBC rings is through the filaments they stir, even in period of low Amazon outflow on the shelf

The Fresh plume, often not taken into account, accounts for 20 % of the total sink

An aerial photograph of a coastline, showing the ocean on the left and a landmass on the right. A semi-transparent dark grey rectangular box is overlaid on the landmass, containing white text. The text is centered and reads "Conclusions" at the top, followed by a horizontal line, and then two paragraphs of text below.

Conclusions

The NASW represents 60 % of the total sink

This strong sink compared to the climatology can be due to interannual variability or a lack of data in global datasets

An aerial photograph of a coastline, showing the ocean on the left and a landmass on the right. The landmass has a complex, irregular shape with many small inlets and peninsulas. A semi-transparent dark grey rectangular box is overlaid on the right side of the image, containing the text. The text is white and centered within the box. A thin white horizontal line is positioned above the text.

Conclusions

The regional ocean carbon sink is underestimated by a factor 10 in the climatology, due to a lack of data and of small scale representation

An aerial photograph of the ocean's surface, showing intricate patterns of white foam and blue water. A semi-transparent, dark grey rectangular box is centered over the image, containing white text. The text is arranged in three sections: a title at the top, a horizontal line, a paragraph of text, another horizontal line, and a second paragraph of text at the bottom.

Perspectives

Study of the summer season from recently acquired Tara Microbiome data in August-September 2021

Better characterization of the role of the NBC rings and of the Amazon plume in a strong outflow period

An aerial photograph of a coastline, showing the dark blue ocean on the left and the lighter, textured land on the right. A semi-transparent rectangular box is overlaid on the land area, containing the text "Thank you" and a DOI link.

Thank you

Biogeosciences doi : <https://doi.org/10.5194/bg-2021-269>, in press, 2022