

Quantifying how small-scale, short-lived, advective and biologically driven processes alter the carbon uptake capacity in a shelf sea

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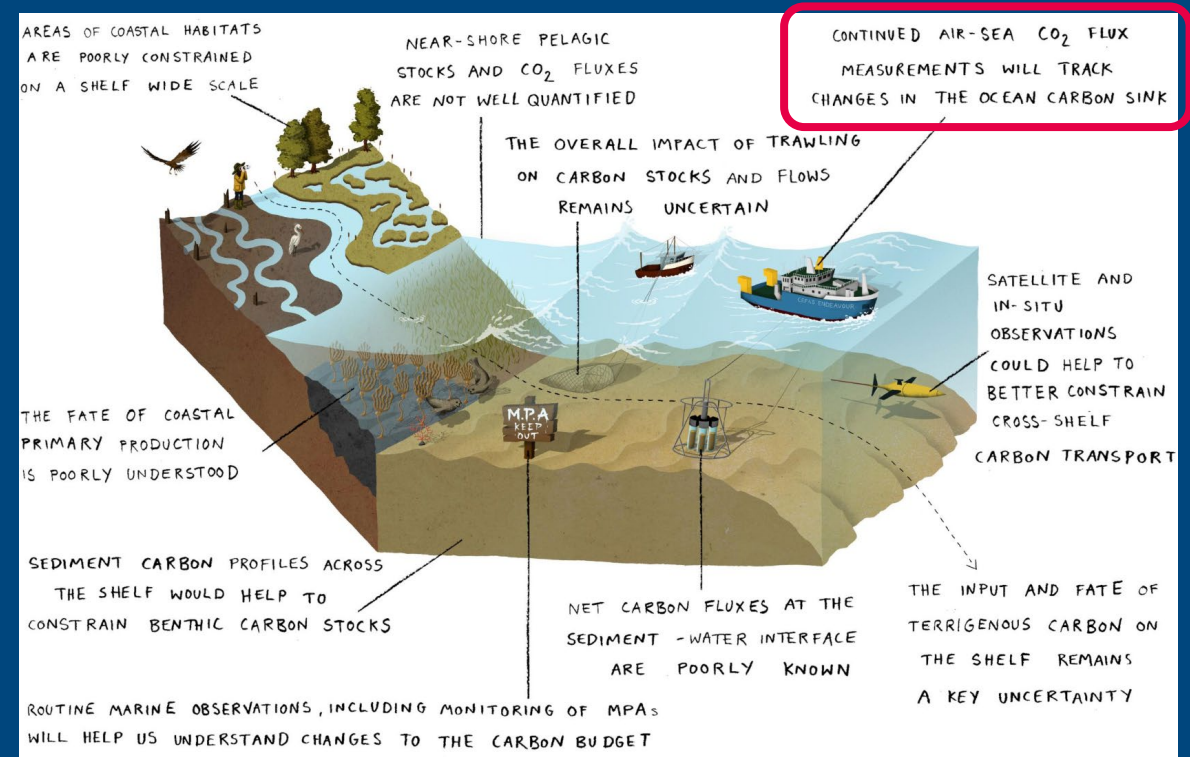
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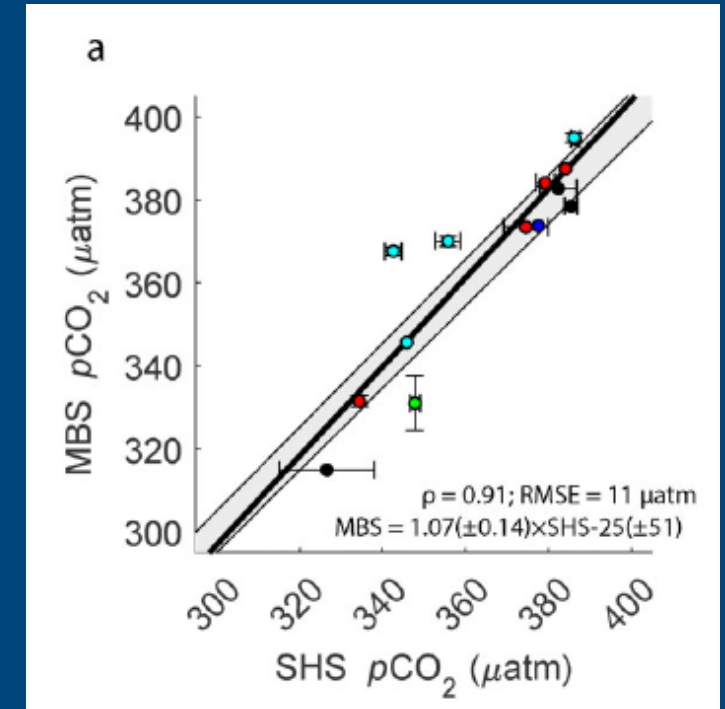
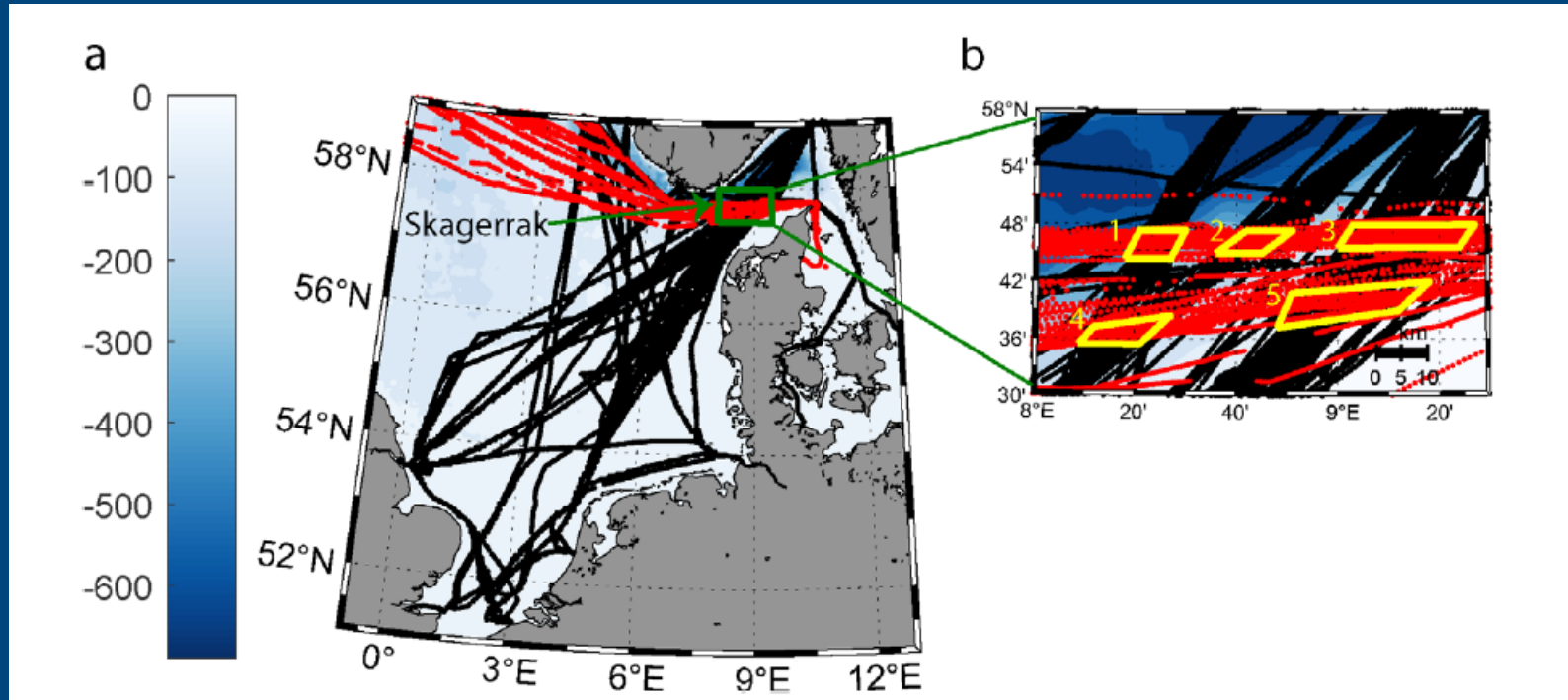
Significance of coastal carbon observations

- Continental shelf seas are essential for carbon uptake from the atmosphere.
- They are highly variable environments, where high-frequency observations are needed to reduce carbon fluxes uncertainty.



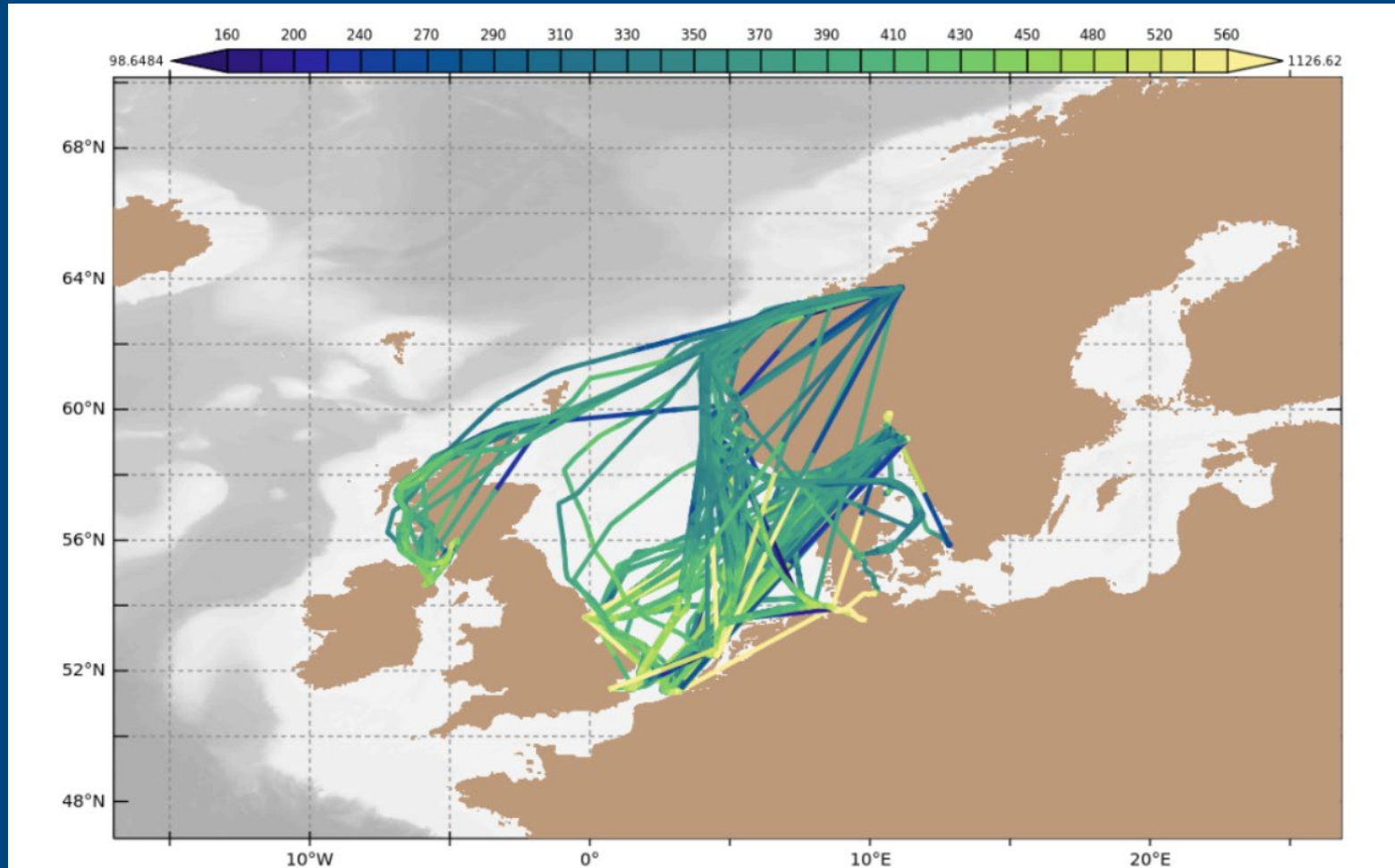
(Legge et al., 2020)

Comparability of our $p\text{CO}_2$ measurements



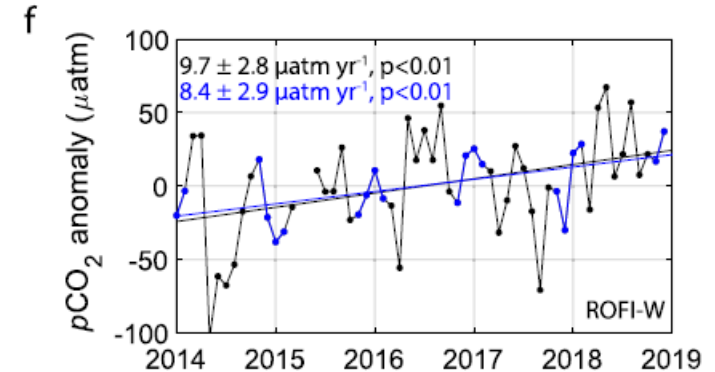
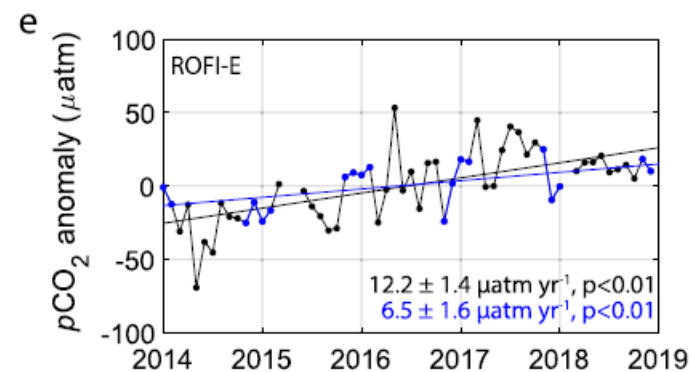
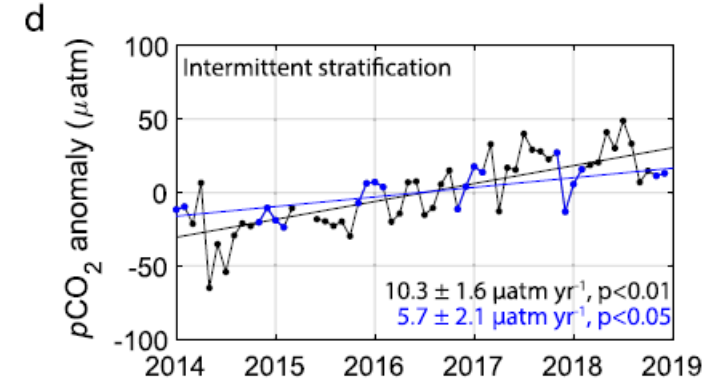
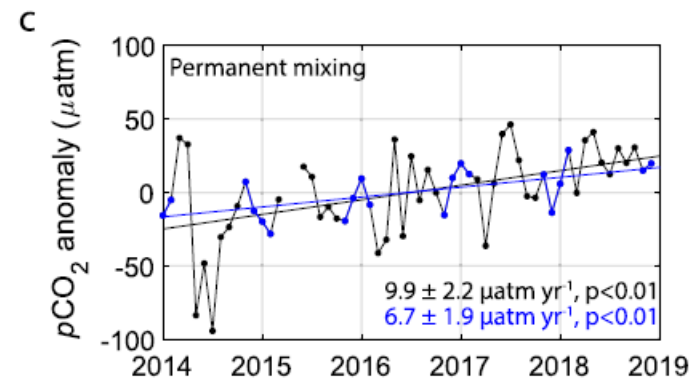
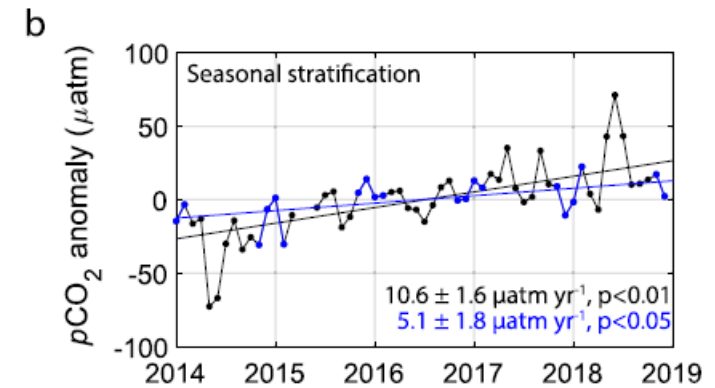
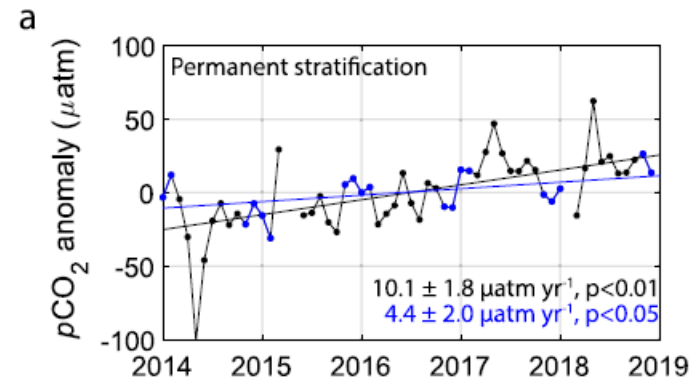
- Successful across-ship intercomparison with a showerhead equilibrator system.

Data now available in public repositories



North Sea carbon trends

- Ubiquitous seawater increase at a higher rate than the atmospheric increase.
- The northern part became a weaker sink, while the southern part became a stronger source.



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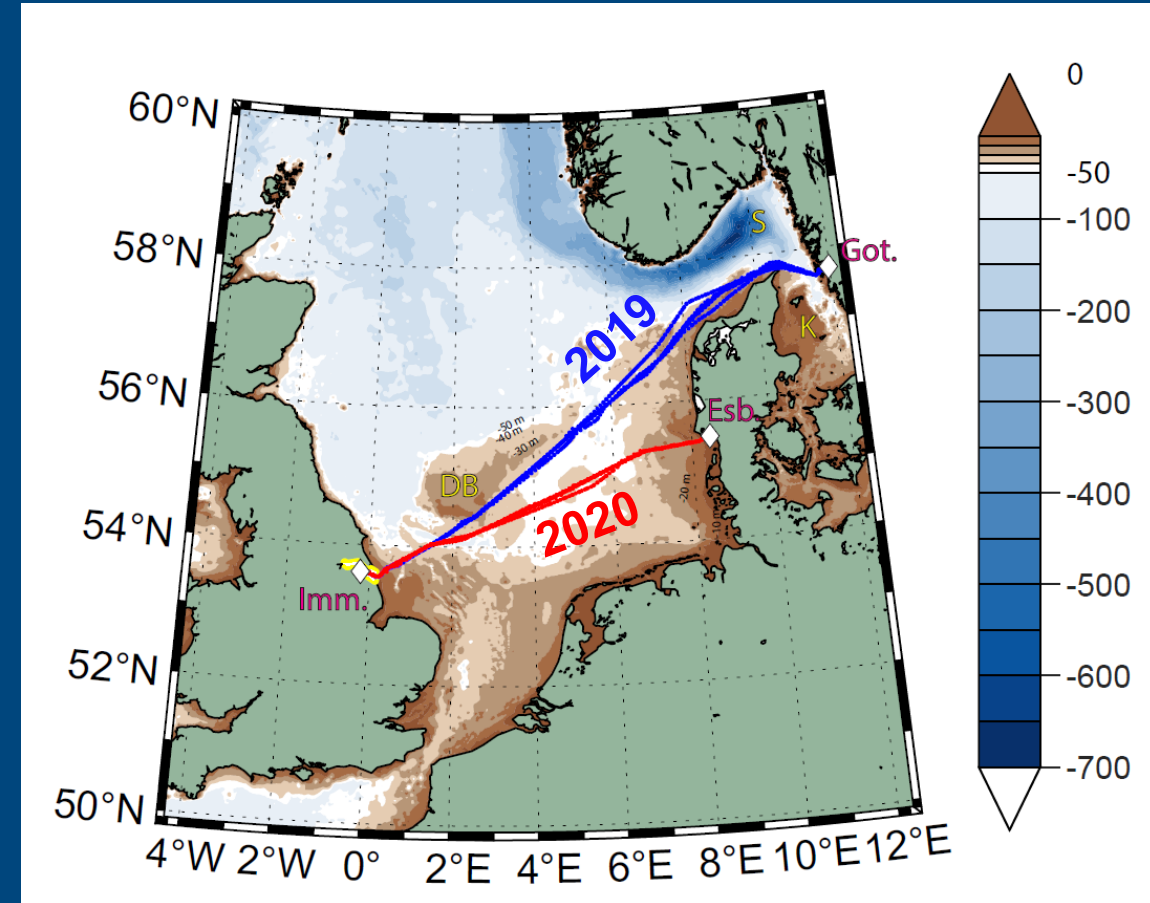
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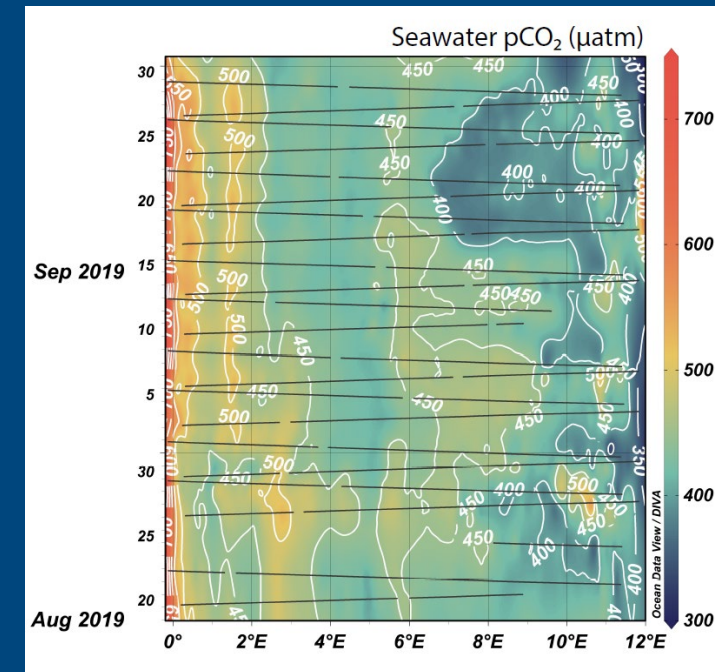
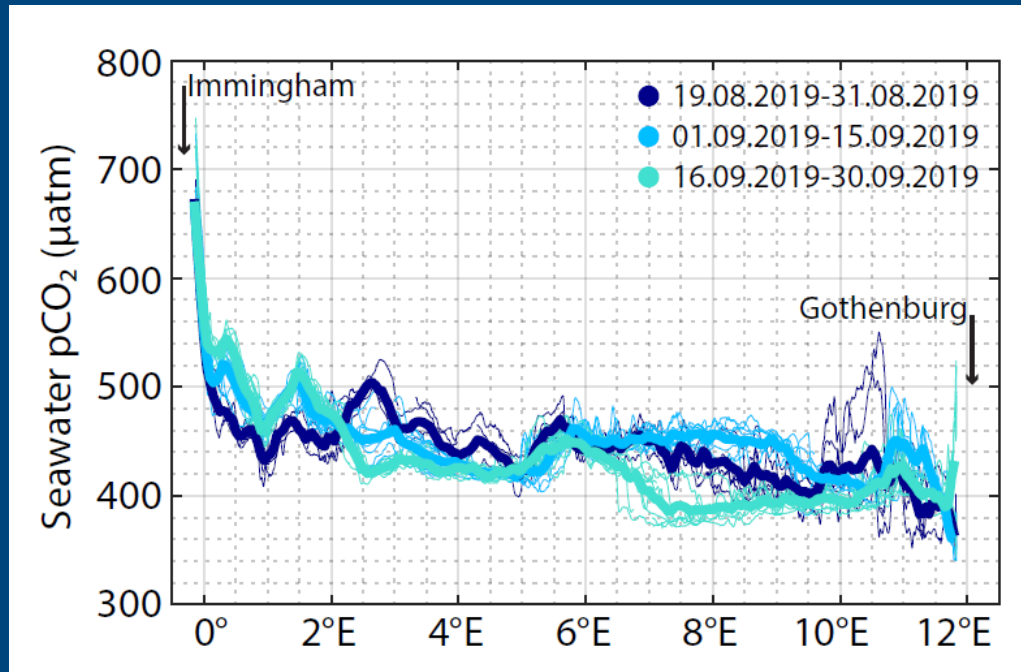
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Study area and measurements

- Surface seawater $p\text{CO}_2$ measured autonomously on two routes in the North Sea in two consecutive autumns.
- Ancillary FerryBox measurements, Lagrangian particle transport simulation, BGC model outputs.

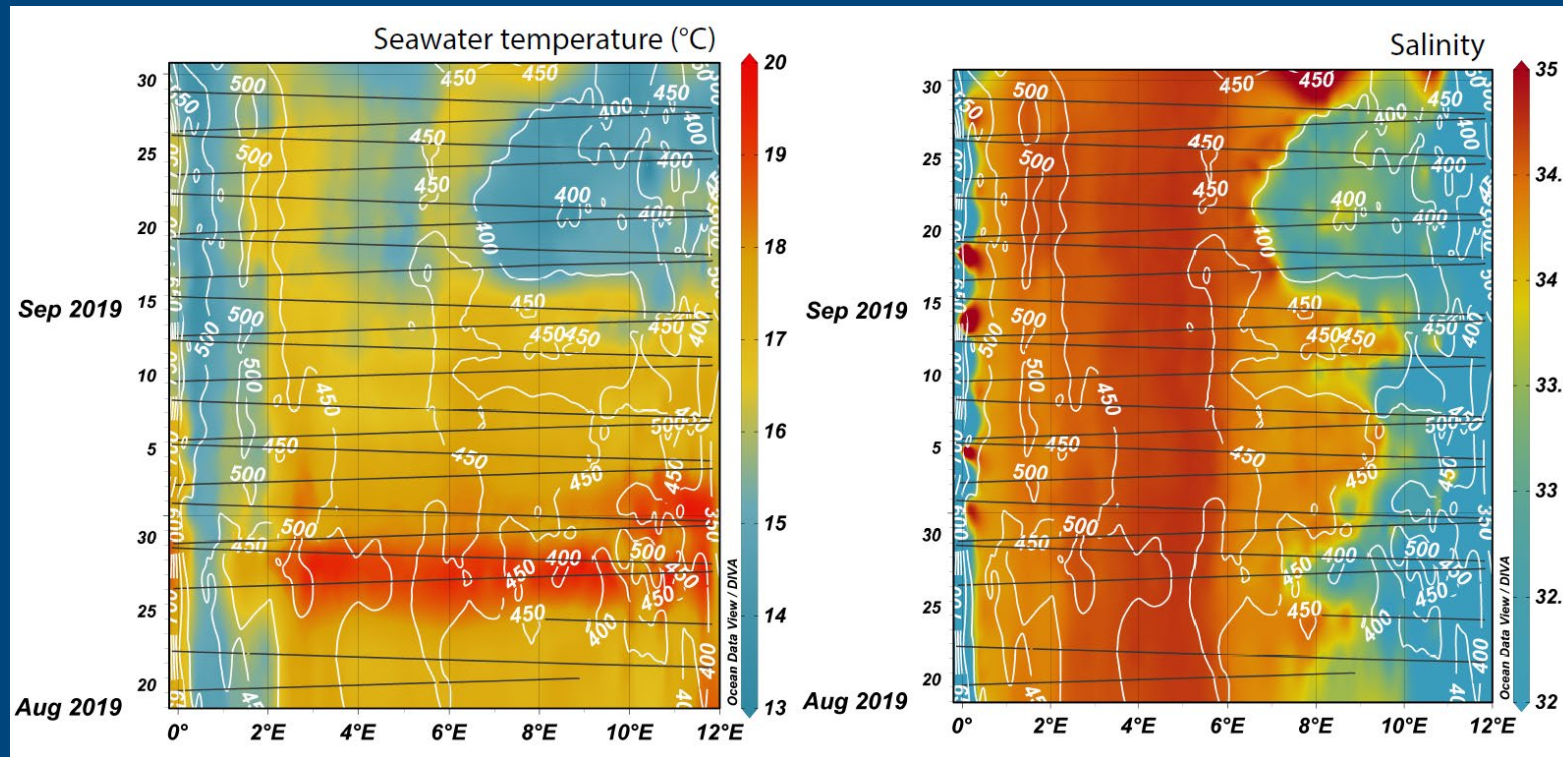


Variability in seawater $p\text{CO}_2$ (2019)



- The high frequency observations allow the identification of short-lived, strong decreases in seawater $p\text{CO}_2$.

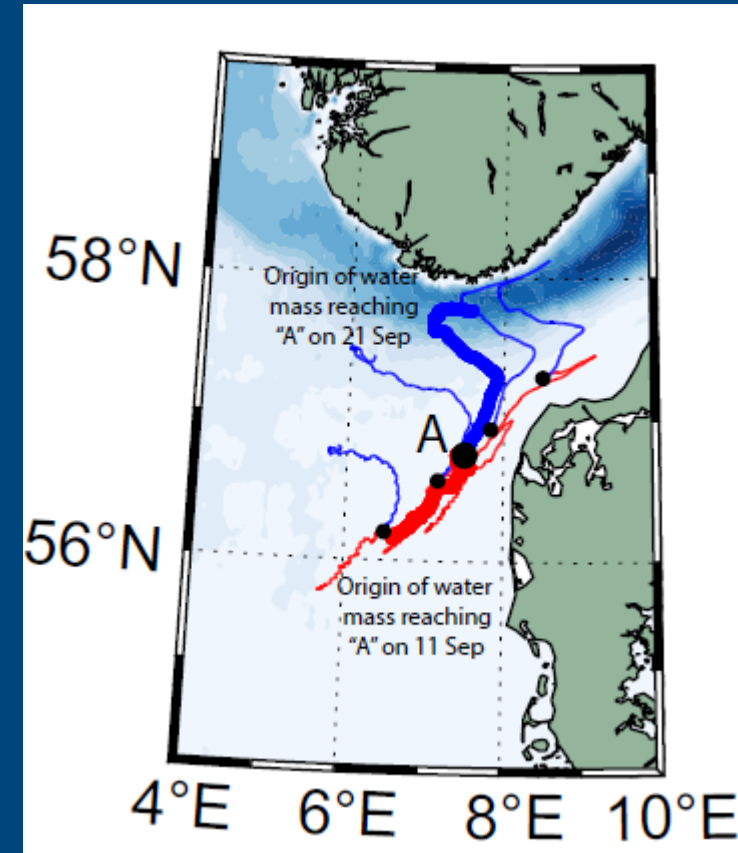
Complementary observations (2019)



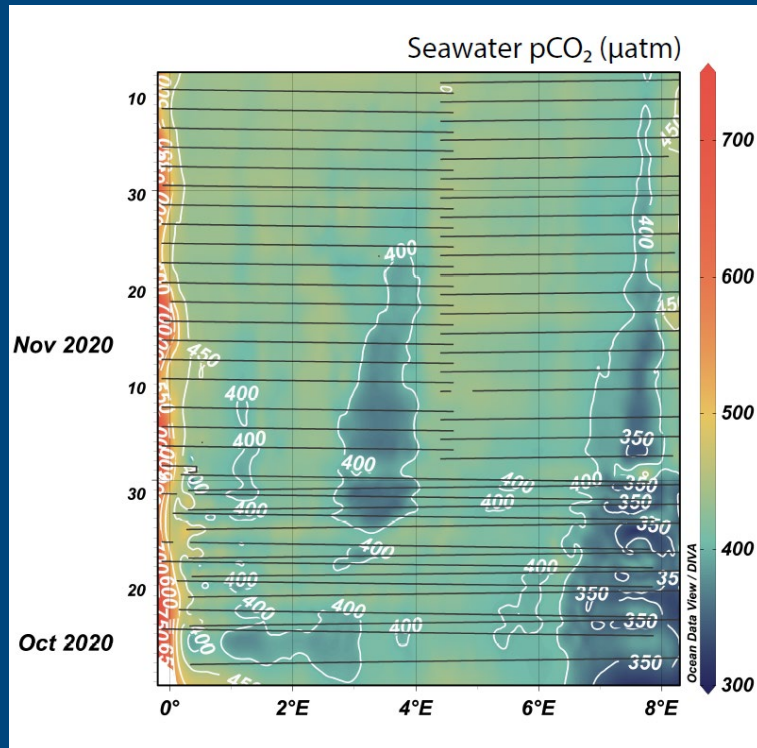
- The low seawater $p\text{CO}_2$ matches low temperature and salinity observations.

Advective event explanation (2019)

- The second half of September featured a water flow direction reversal compared to usual conditions.

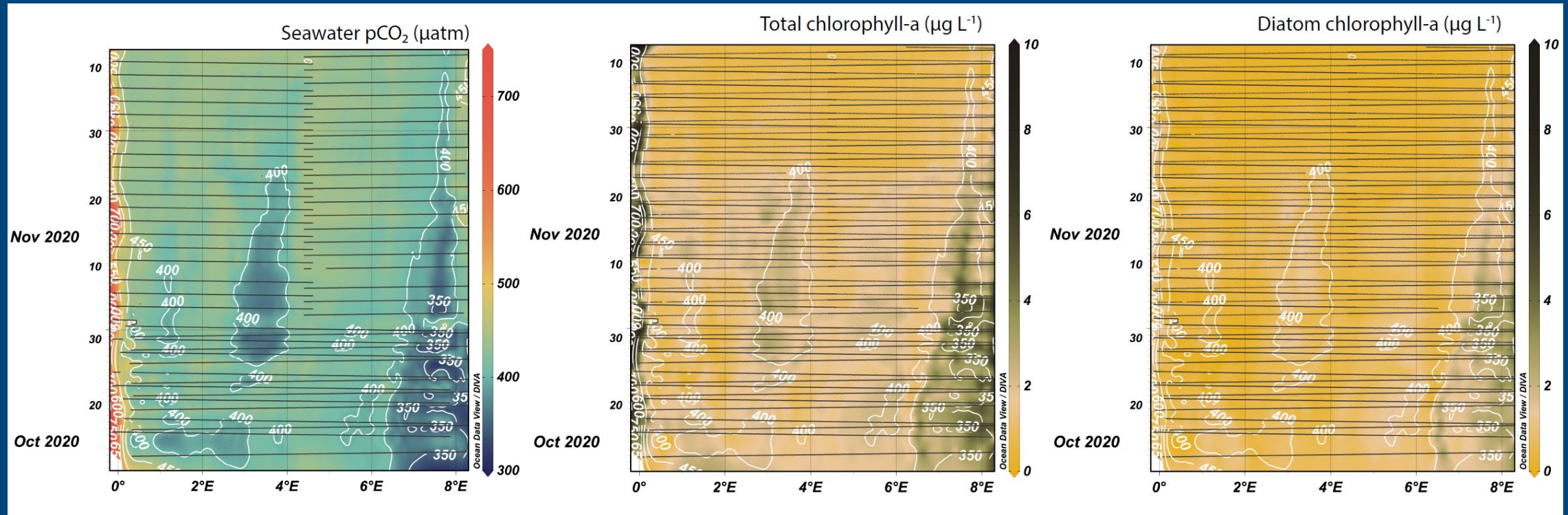


Variability in seawater $p\text{CO}_2$ (2020)



- The autumn 2020 observations featured two low $p\text{CO}_2$ events.

Biological event explanation (2020)



- The autumn 2020 observations featured two low $p\text{CO}_2$ events.
- These matched increases in diatom-dominated chlorophyll.

Effect on carbon fluxes

Geophysical Research Letters




RESEARCH LETTER

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Key Points:

- The surface seawater partial pressure of carbon dioxide ($p\text{CO}_2$) trend between 2014 and 2018 in the South

Reduced Ocean Carbon Sink in the South and Central North Sea (2014–2018) Revealed From FerryBox Observations

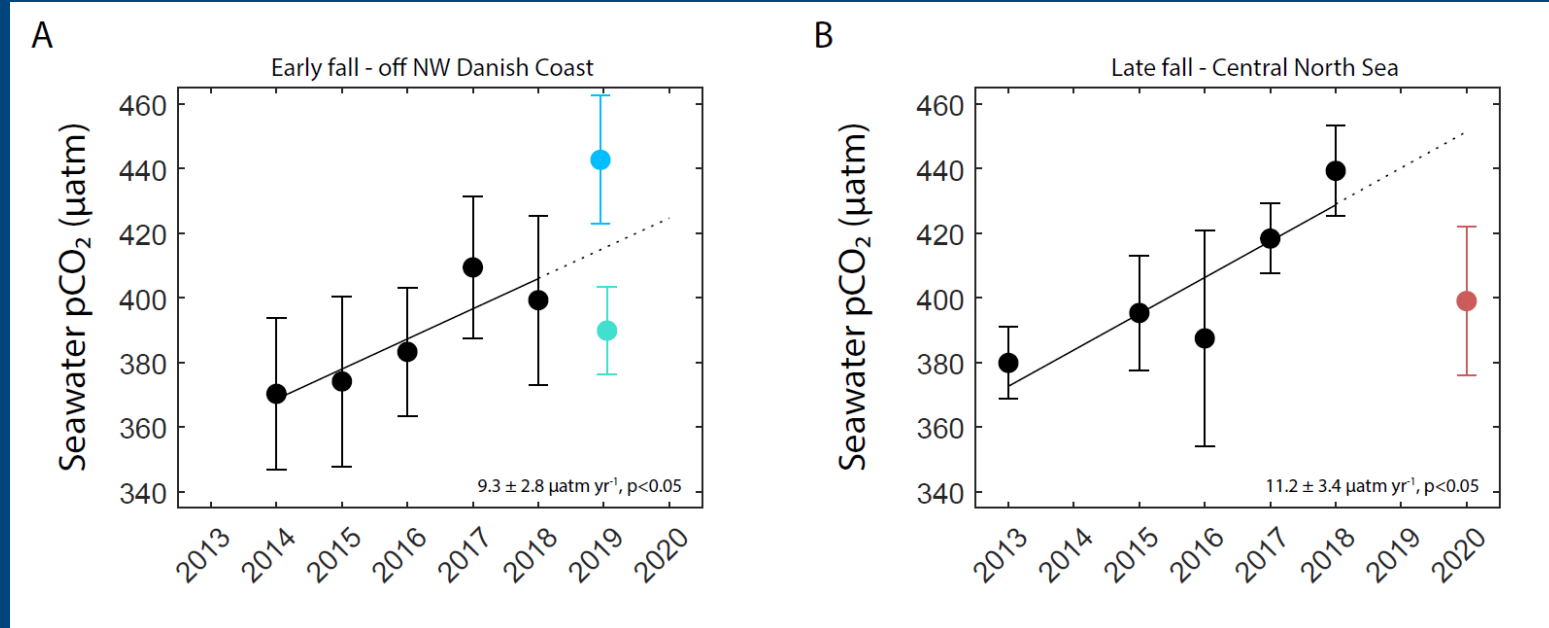
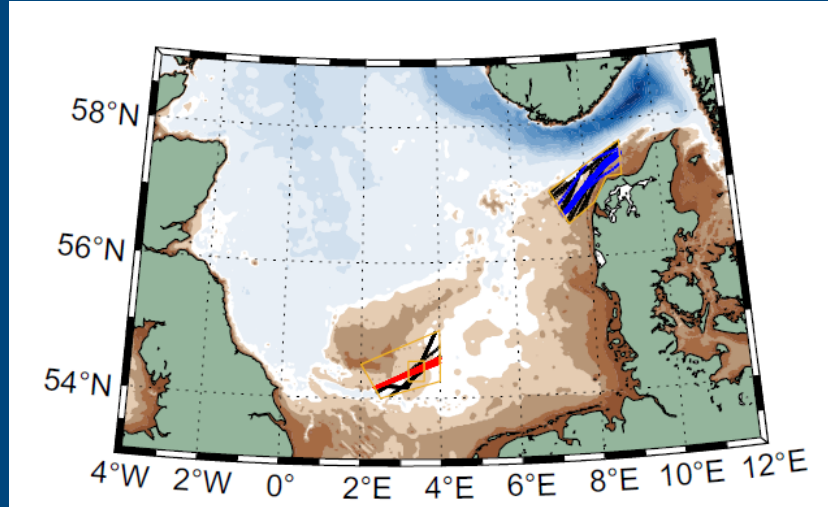
V. A. Macovei¹ , W. Petersen¹, H. Brix¹ , and Y. G. Voynova¹ 



- Over a longer term, the seawater $p\text{CO}_2$ in the North Sea is rapidly increasing.




Effect on carbon fluxes




- Over a longer term, the seawater $p\text{CO}_2$ in the North Sea is rapidly increasing.
- The two events identified here temporarily offset the increase, preventing from release/uptaking 2.8 Gg C and 21.8 Gg C respectively.

Thank you for your attention!

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ORIGINAL RESEARCH
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Mesoscale Advective and Biological Processes Alter Carbon Uptake Capacity in a Shelf Sea

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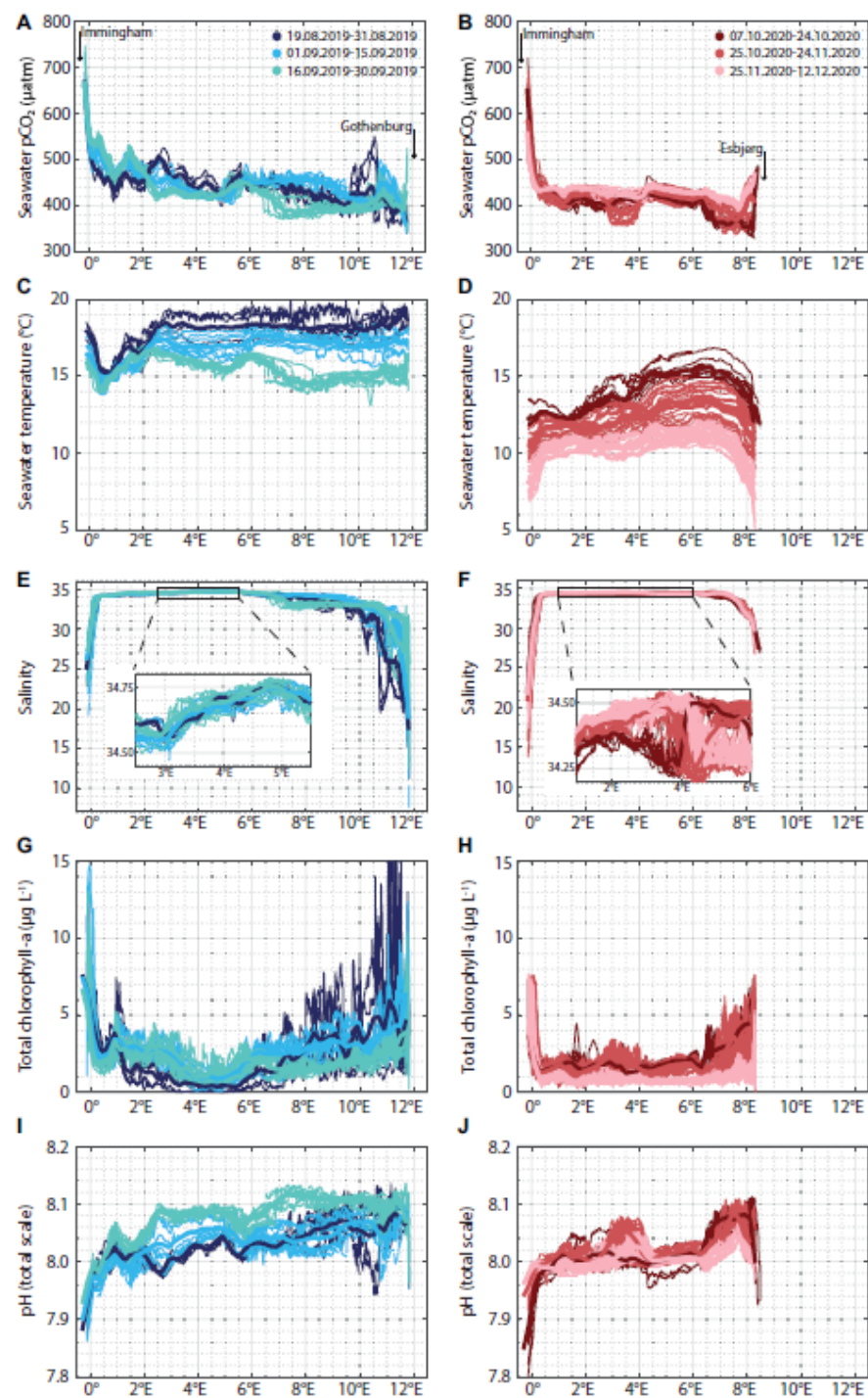
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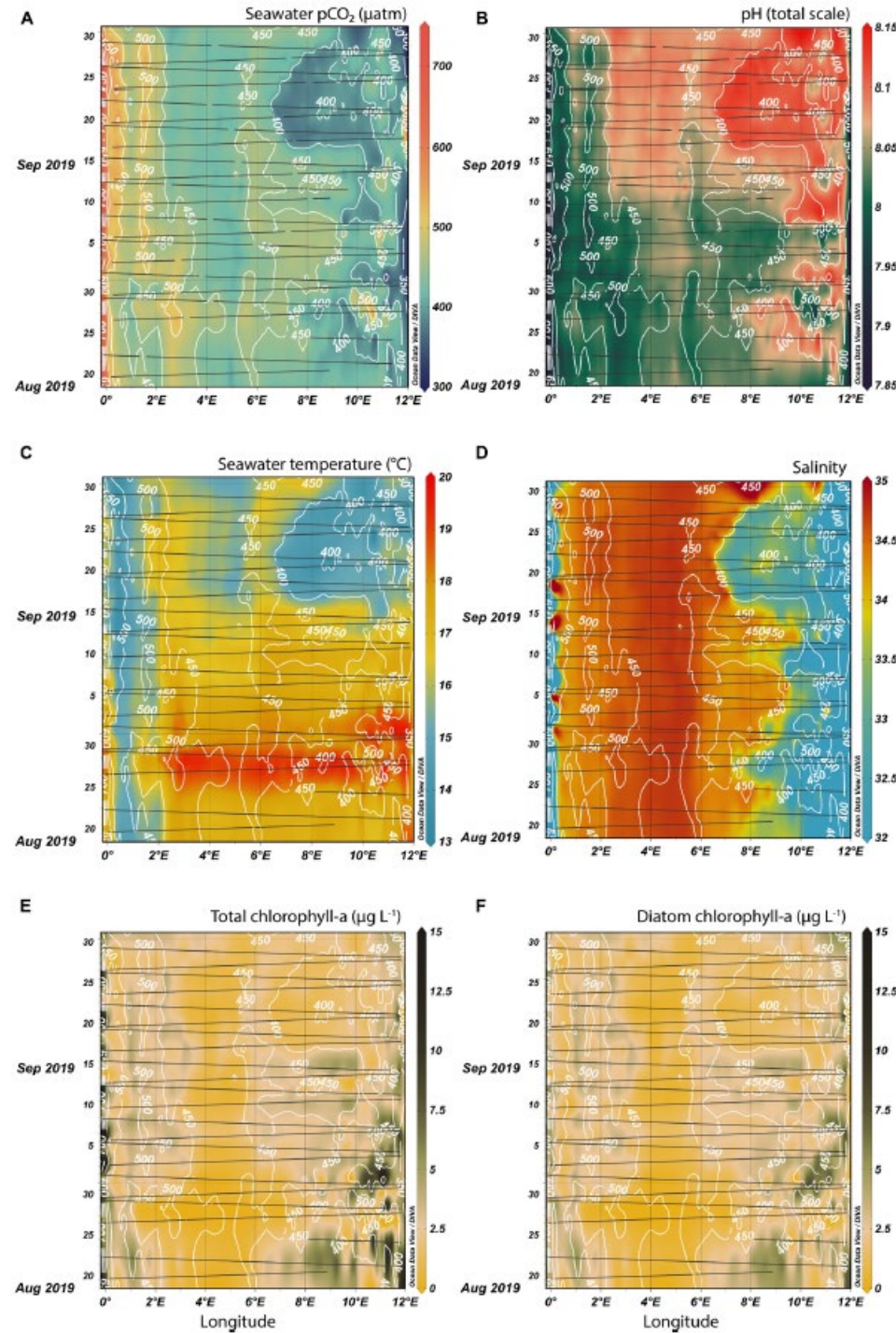
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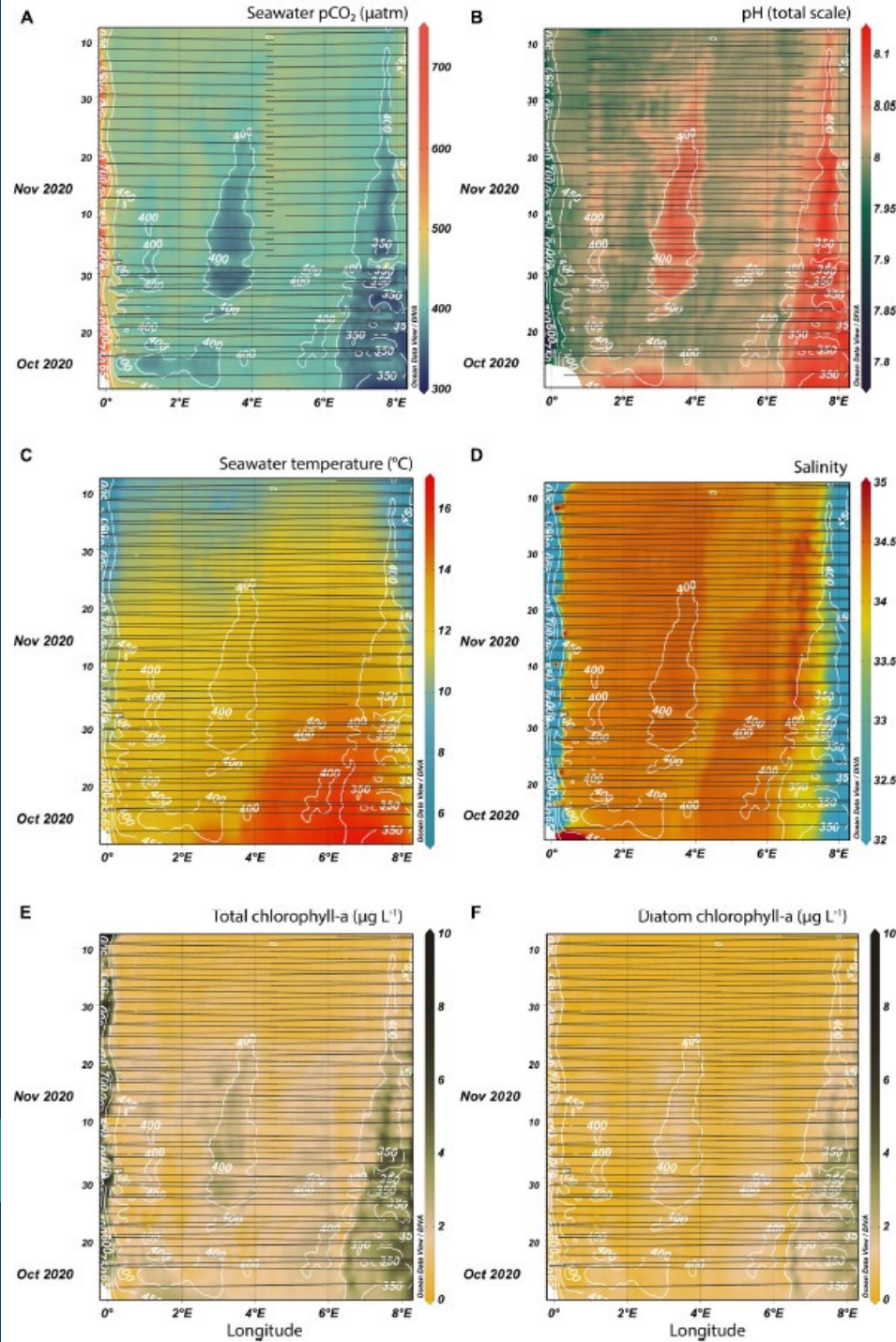
Bonus slide



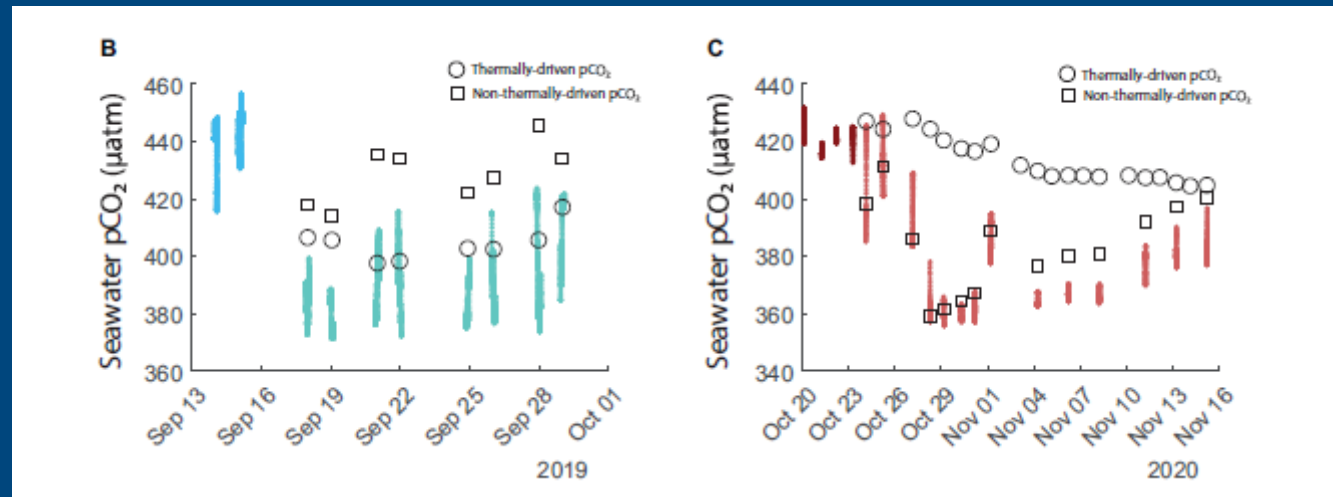
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