

A person stands on a dark beach at night, looking out at a vibrant aurora borealis in the sky. The aurora displays shades of green and blue, with a bright blue beam of light shining from the person towards the horizon. The sky is dark and filled with stars.

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Influence of aquatic metabolism on marsh carbon dynamics and associated atmospheric CO₂ fluxes

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B022 - Coastal Wetland Carbon and Nitrogen
Cycles: Recent Advances in Measurements,
Modeling, and Syntheses – 12/16/2023

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MAYEN JÉRÉMY

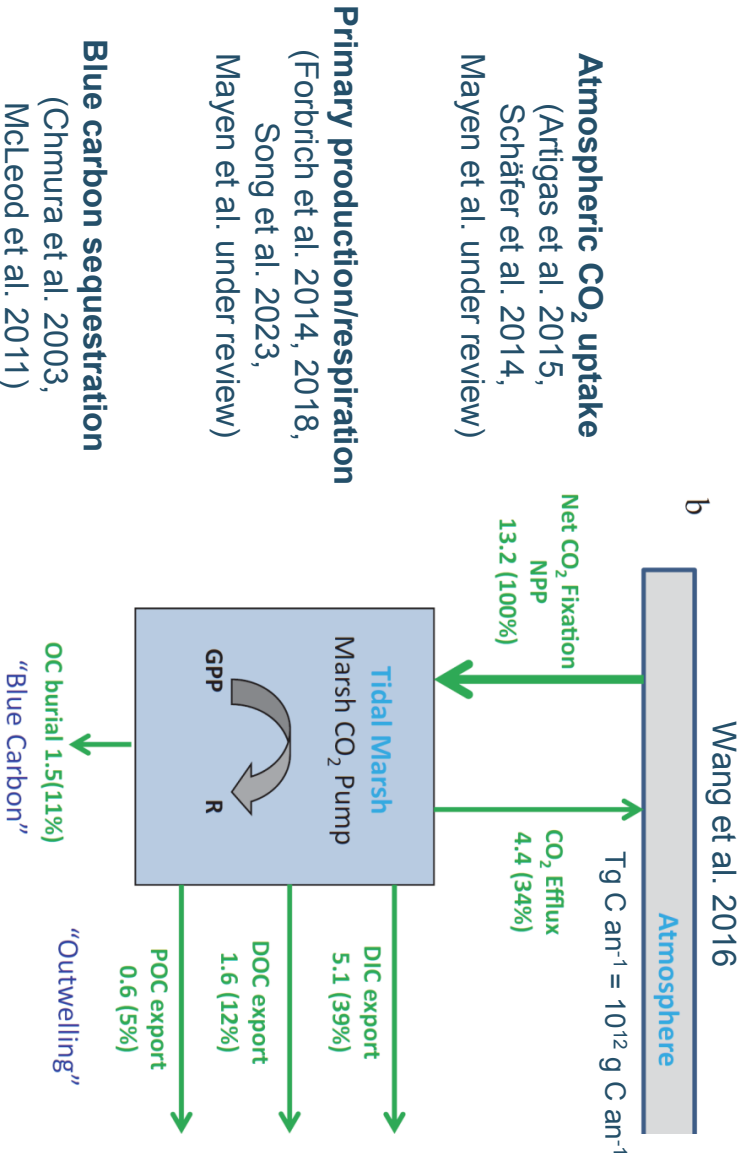
Ph.D. student in coastal biogeochemistry
at IFRIMER



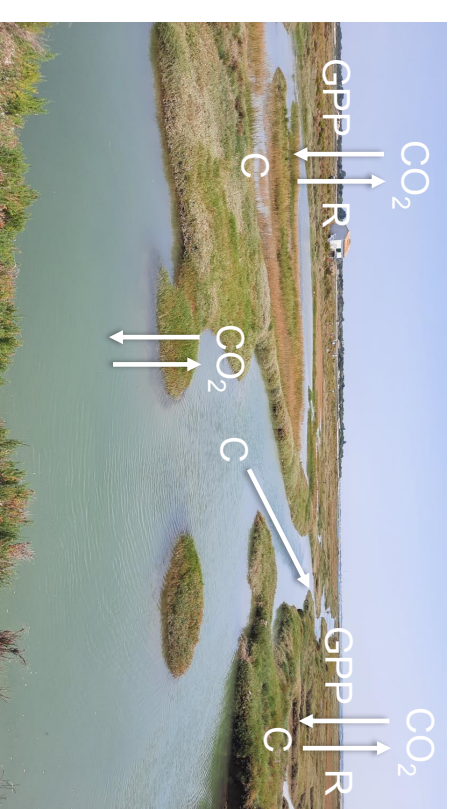
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- « Salt marshes are coastal wetlands that are flooded and drained by salt water brought in by the tides » (NOAA)

- Processes and fluxes of carbon in salt marshes:



Coastal zone



NPP : net primary production
DIC : dissolved inorganic carbon
DOC : dissolved organic carbon
POC : particulate organic carbon

Are all the ref necessary?

Carbon export
 (Wang and Cai 2004, Santos et al. 2019, Song et al. 2023, Gong et al. 2023, Mayen et al. in prep.)

Primary production/respiration
 (Forbrich et al. 2014, 2018, Song et al. 2023, Mayen et al. under review)

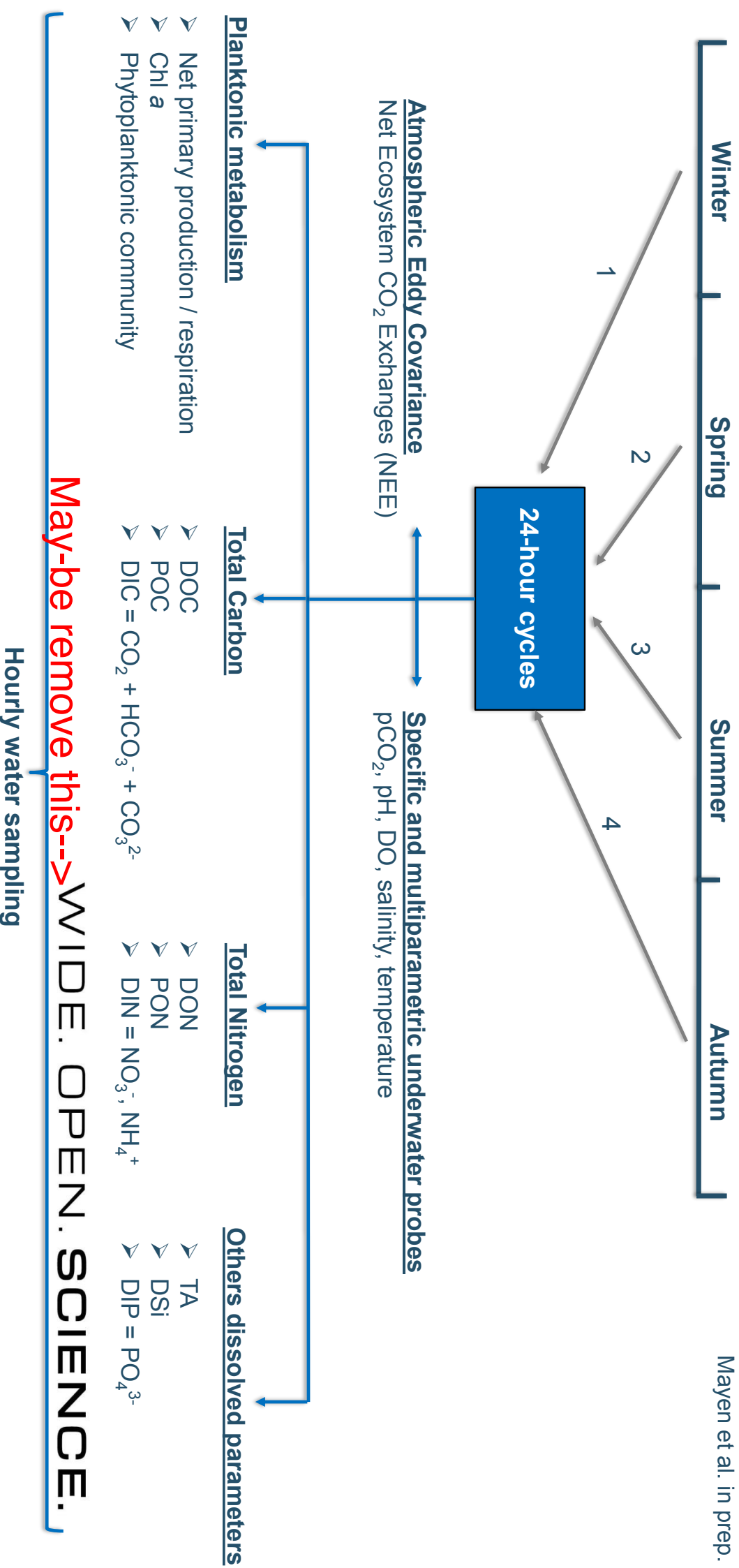
Blue carbon sequestration
 (Chmura et al. 2003, McLeod et al. 2011)

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What is the contribution of metabolic processes in the water column to carbon dynamics in a tidal salt marsh?

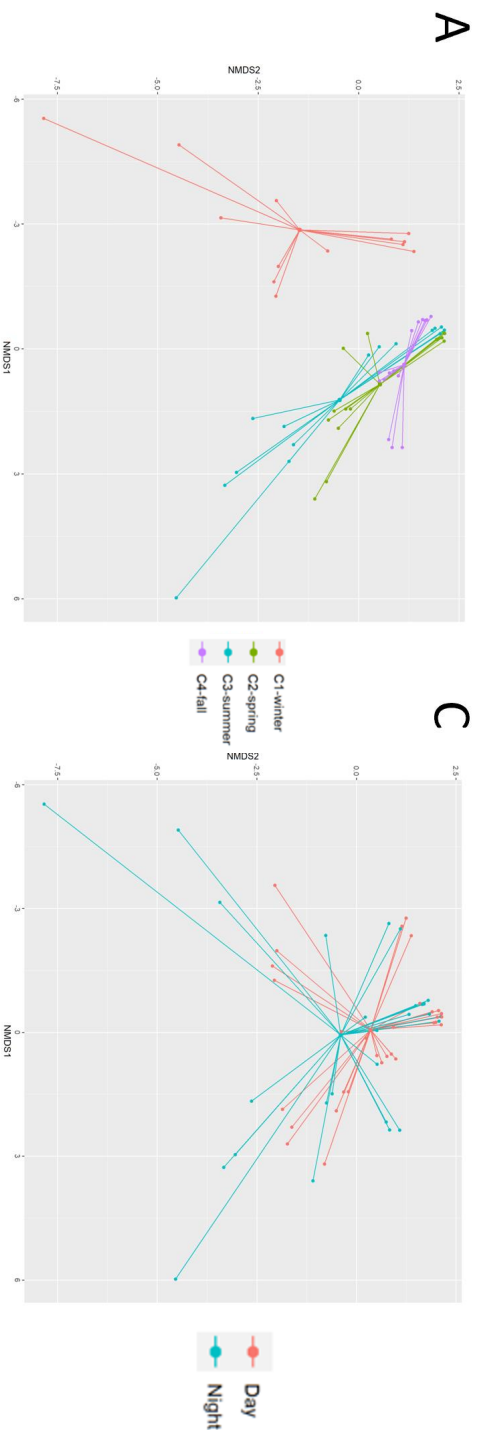


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→ nMDS (dist. eucl.) with Chla, pCO₂, DIC, TA, POC, DOC, PON, DON, DIN, DIP, DSI

Mayen et al. in prep.



Maybe put all the figures at the top to avoid blank space

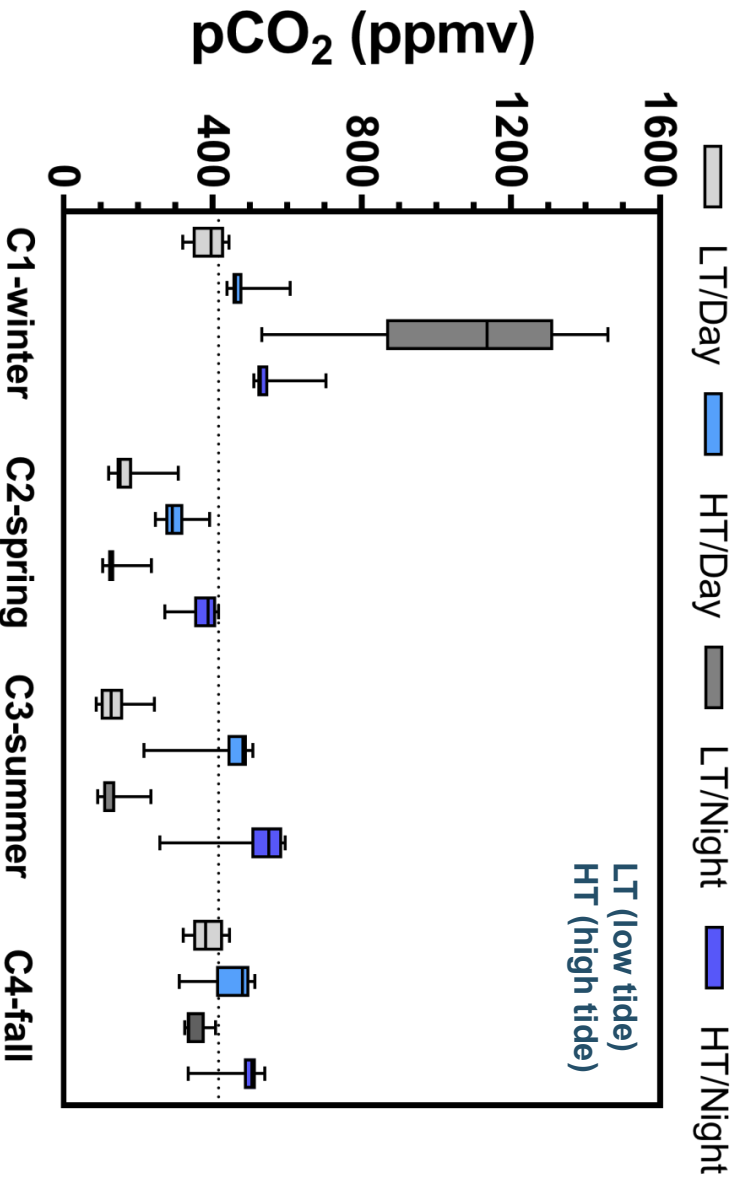
- Strong control of seasonal factor (between 24-h cycles) and tidal factor (high tide vs low tide) **is not only winter that is different?**
- Low control of diurnal factor (daytime vs night-time)

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pcO₂(water) < pcO₂(air) : undersaturated in CO₂ with respect to the atmosphere (CO₂ sink)

Mayen et al. in prep.

pcO₂(water) > pcO₂(air) : oversaturated in CO₂ with respect to the atmosphere (CO₂ source)



- **Marsh waters (high tides) influenced by shelf :** slightly oversaturated in CO₂ (except in spring)
- **Channel waters (low tides) influenced by salt marshes:** strongly oversaturated in CO₂ in winter (LT/Night) and strongly undersaturated in CO₂ in spring and summer (LT/Day and LT/Night)

what about fall?

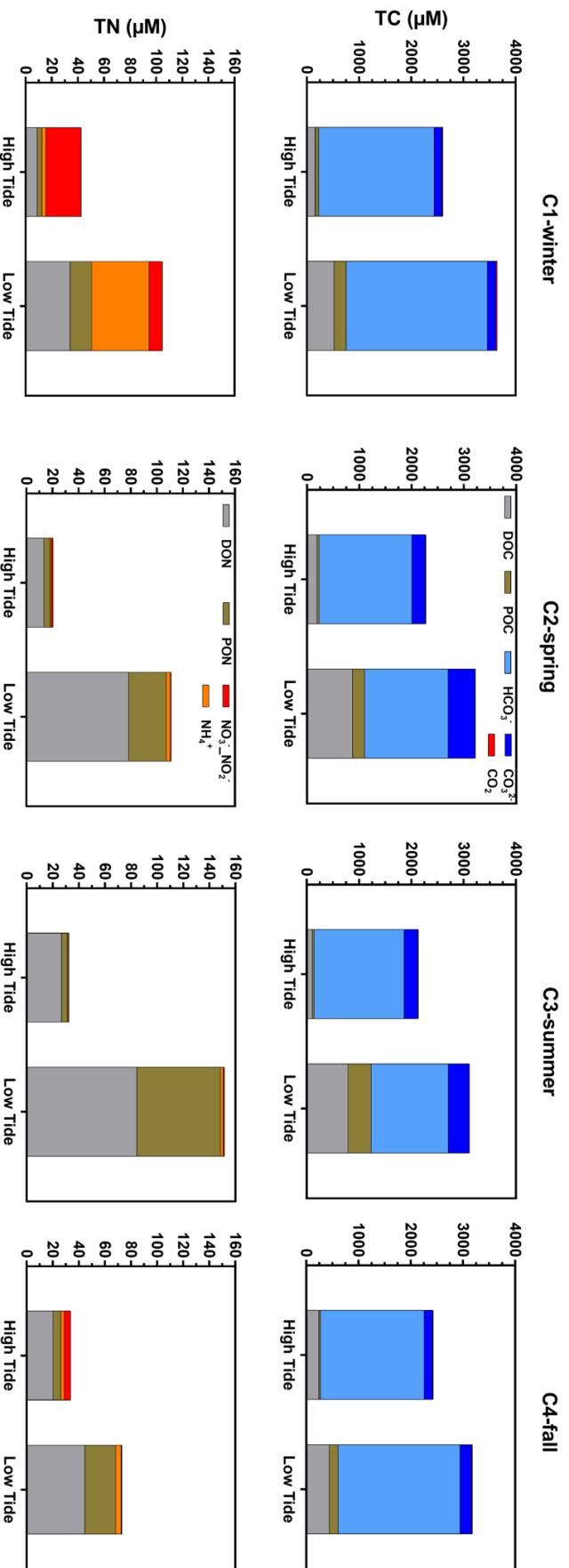
shelf sea?

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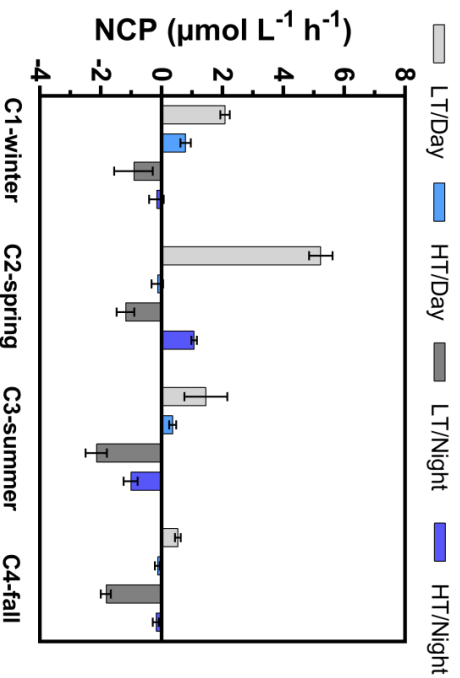
Total Carbon (TC) = POC + DOC + DIC ($\text{HCO}_3^- + \text{CO}_3^{2-} + \text{CO}_2$)

Total Nitrogen (TN) = PON + DON + DIN ($\text{NO}_3^- + \text{NO}_2^- + \text{NH}_4^+$)

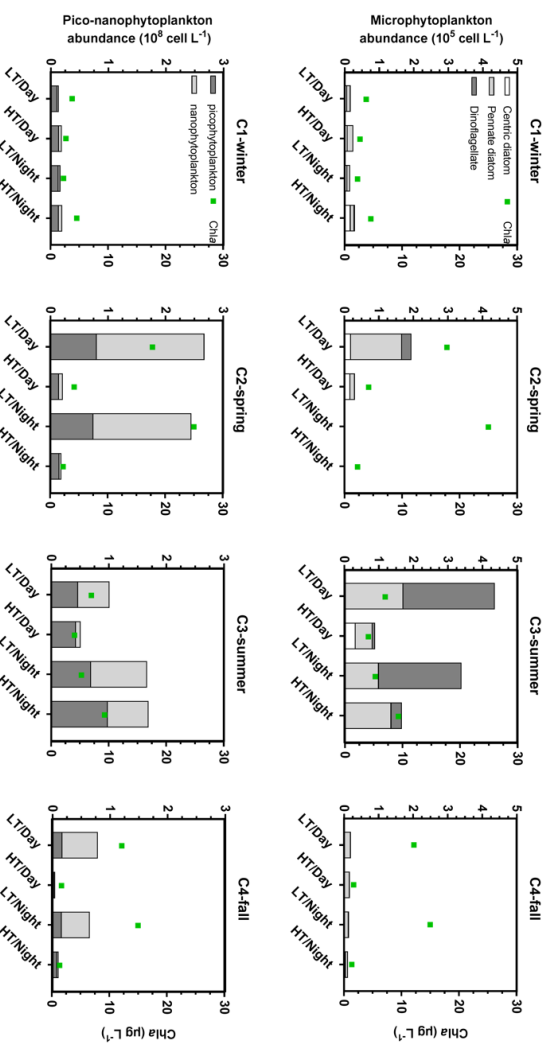
very interesting



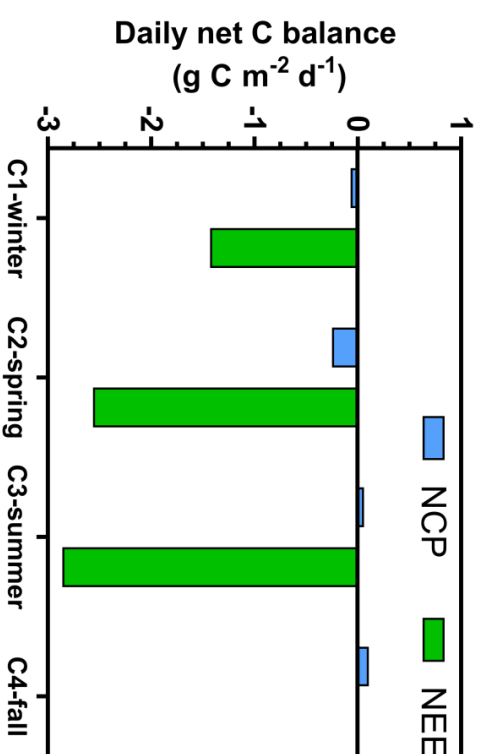
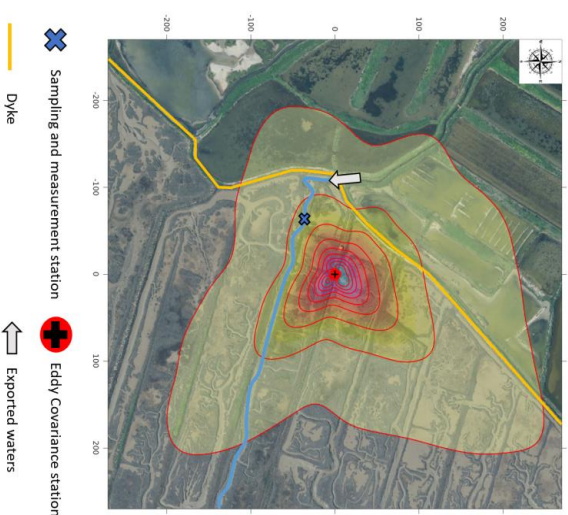
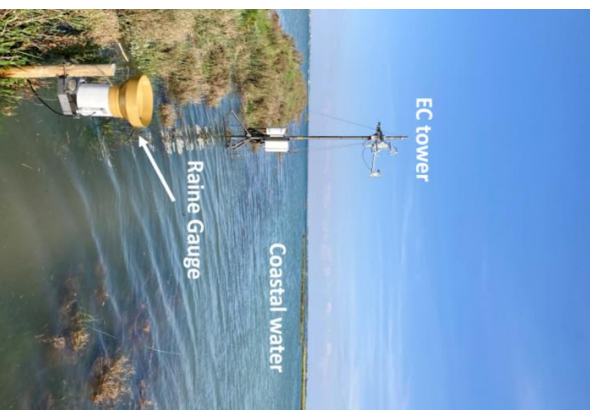
- Winter: NH_4^+ and DIC (HCO_3^-) increases from high to low tide (tidal pumping) → strong mineralization of marsh organic matter
 - Spring and summer: DOC and DON increases from high to low tides
- strong marsh primary production (phytoplankton, macroalgae and terrestrial macrophytes)
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- **Autotrophy at day** (except to C2-HT/Day and C4-HT/Day) and **heterotrophy at night** (except to C2-HT/Night)
- Higher production and respiration rates of planktonic communities in channel waters (LT) than in coastal waters (HT)
- Highest planktonic autotrophy : C2-LT/Day



- Winter: microbial mineralization of organic matter in the salt marsh → strong increases of DIC (and DIP, NH_4^+) by tidal pumping
is it from organic matter? it is quit controversial!
- Spring and summer: lateral exportation of CO_2 -depleted and DOC-concentrated waters (high primary production in the salt marsh)
- Significant contribution of planktonic metabolism to CO_2 undersaturation water exports (and microphytobenthos on mudflats)
very nice, often microphyto are overlooked in budget
- Horizontal exchanges in salt marshes has a major impact on water carbon dynamics
- Low contribution of planktonic metabolism on the atmospheric C uptake by the salt marsh (footprint)



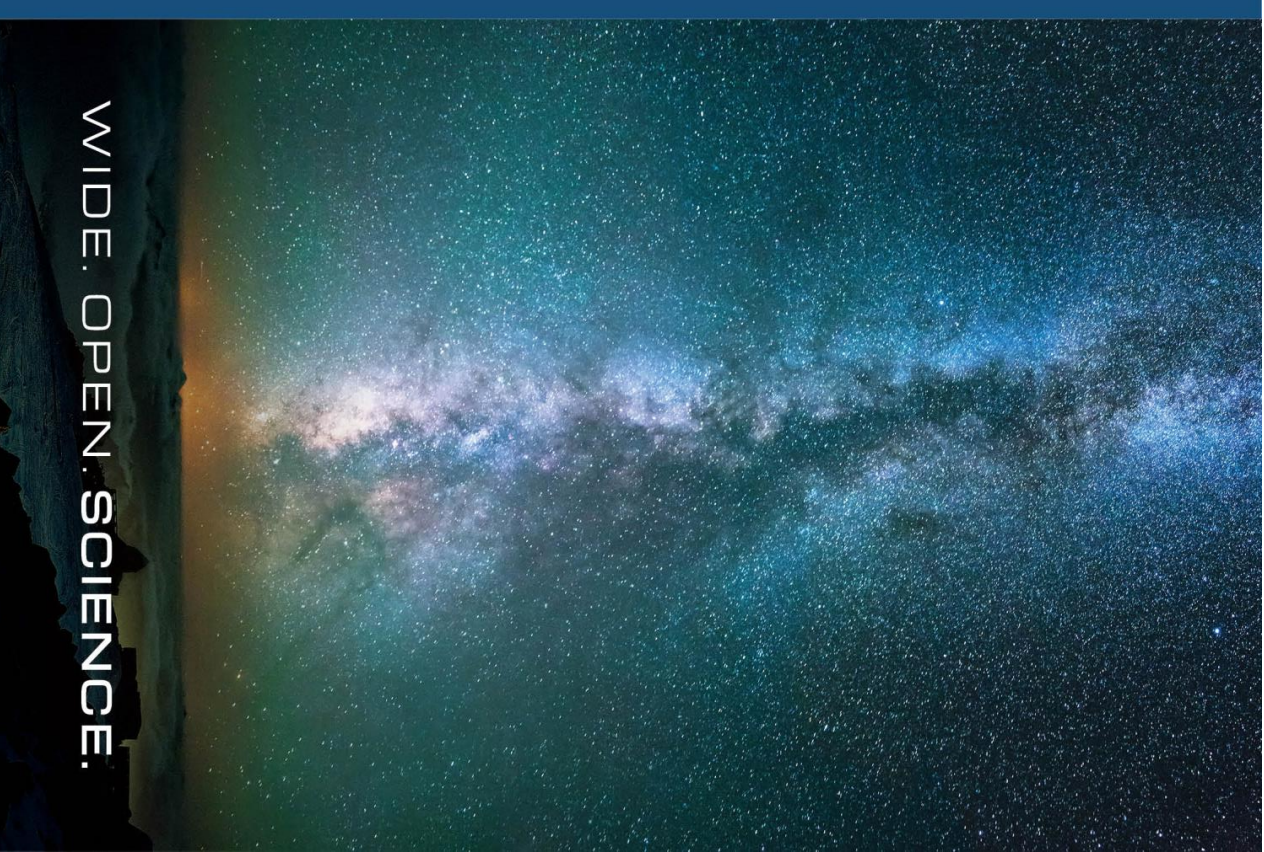
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THANK YOU

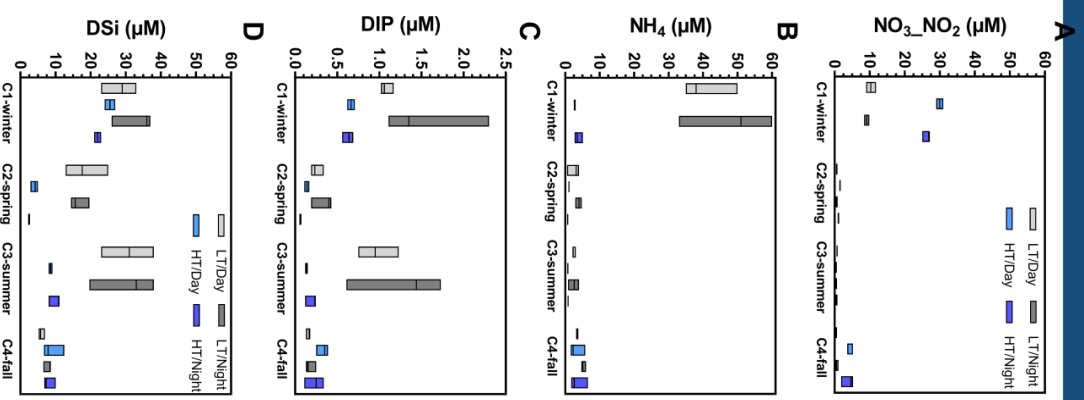


Important role of salt marshes in horizontal
and vertical exchanges of carbon

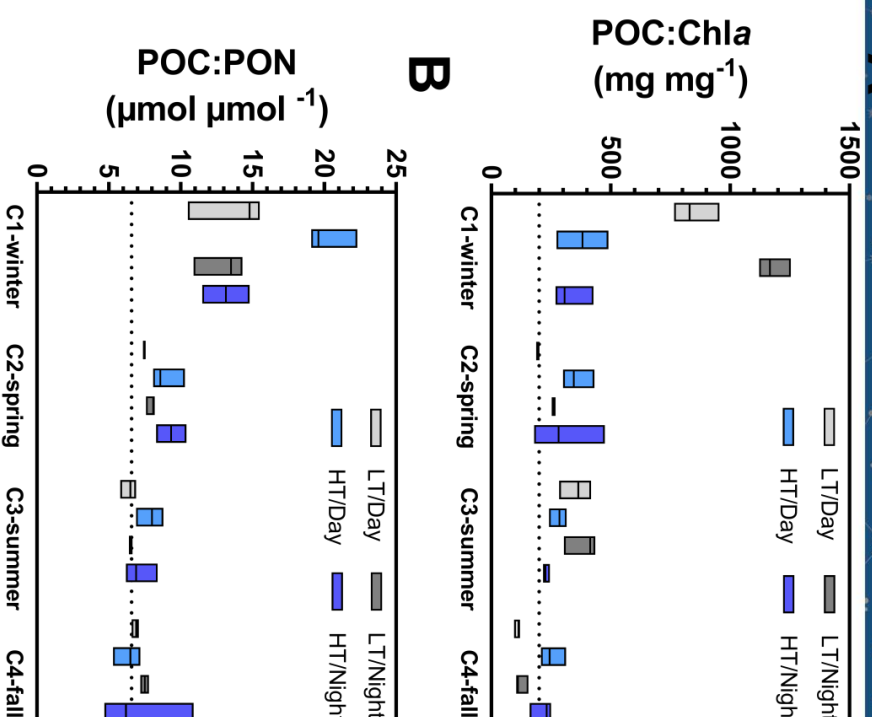
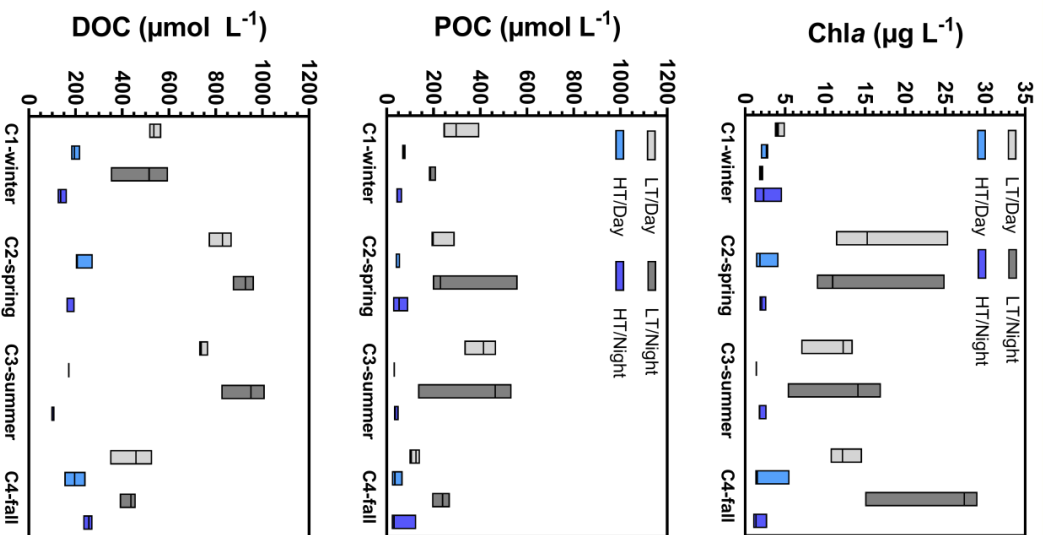
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