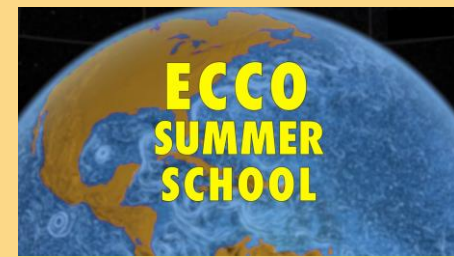


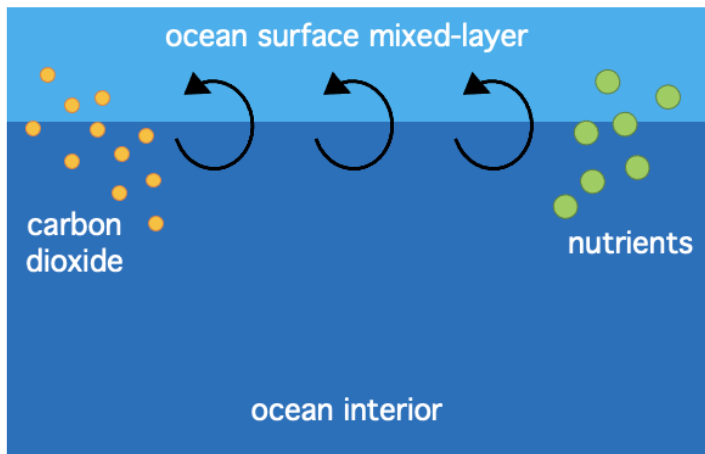
**Frontal
Transport
of Tracers
in the
Southern
Ocean**

Anna Lo Piccolo

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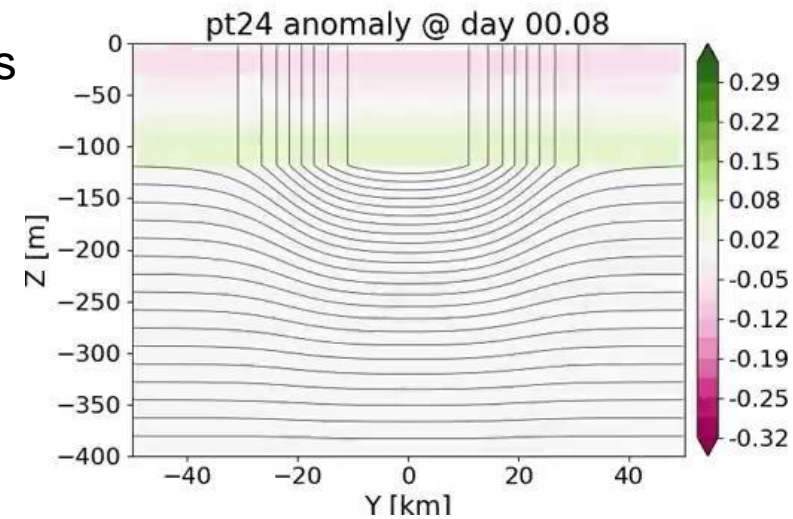


***Exploration of the
complexity of mixing
processes in the ocean
biogeochemistry in B-SOSE***



Submesoscale processes
enhance the vertical
exchange of tracers

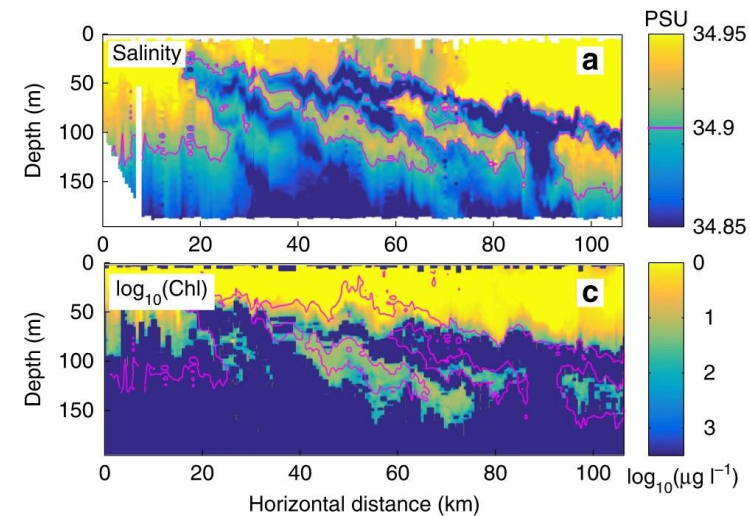
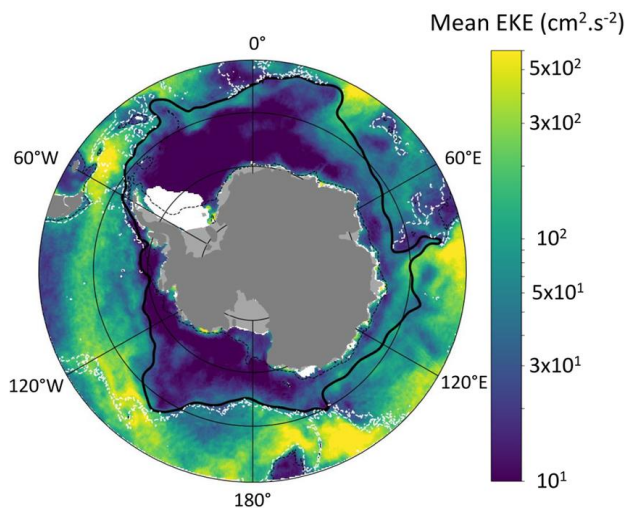
But they are not
resolved in GCMs

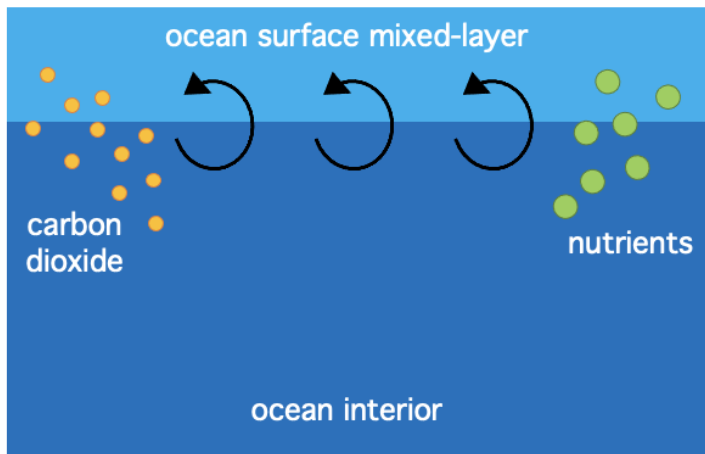


The Southern Ocean is
full of fronts, strong
submesoscale activity,
important for the ocean
carbon uptake

**Ocean mixing is important
for the transport of tracers**

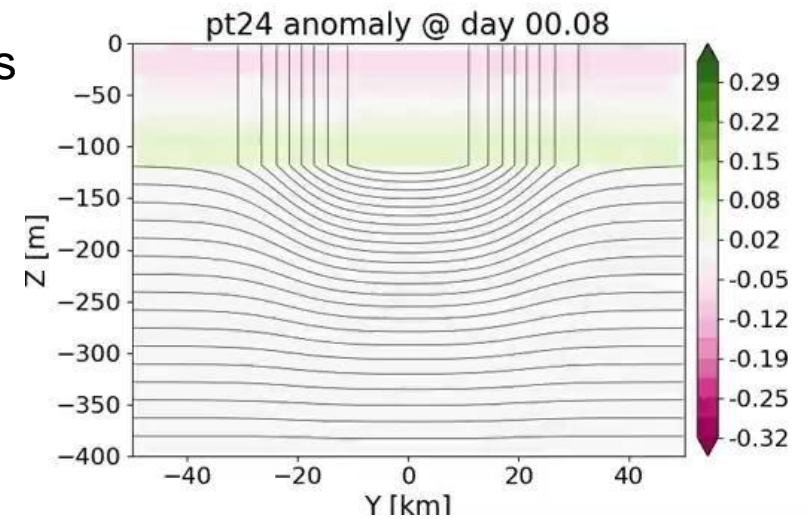
Evidence of subduction





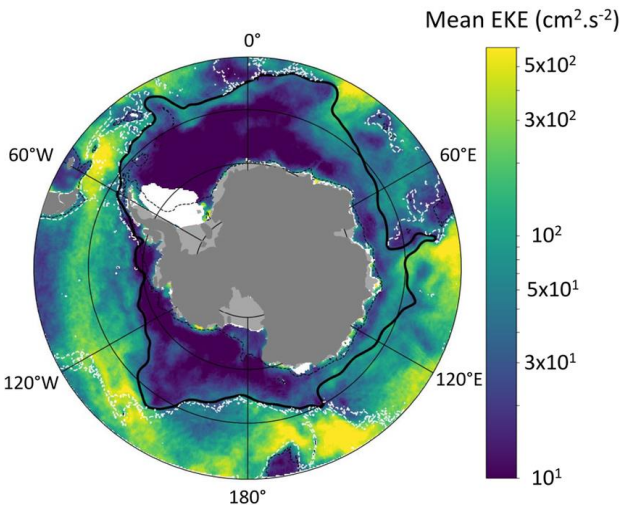
Submesoscale processes enhance the vertical exchange of tracers

But they are not resolved in GCMs



Ocean mixing is important for the transport of tracers

The Southern Ocean is full of fronts, strong submesoscale activity, important for the ocean carbon uptake



[Auger et al 2023]

Frontal Transport of Tracers in the Southern Ocean

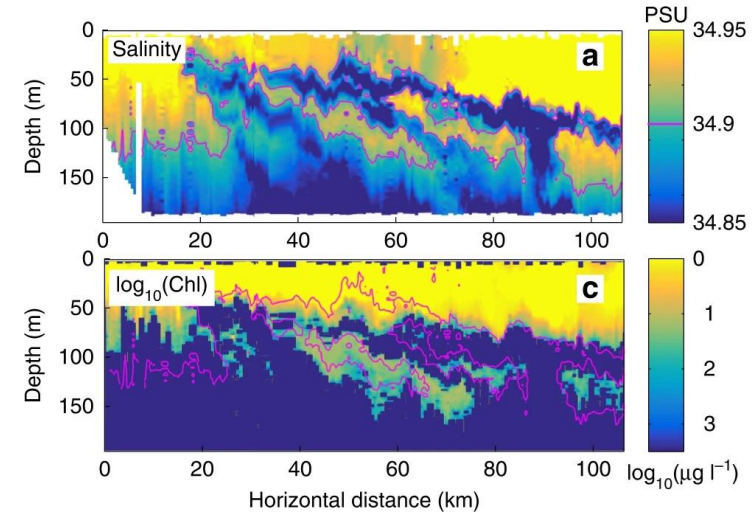
Anna Lo Piccolo

Exploration of the complexity of mixing processes in the ocean biogeochemistry in B-SOSE

ECCO SUMMER SCHOOL

Exploration of the complexity of mixing processes in the ocean biogeochemistry in B-SOSE

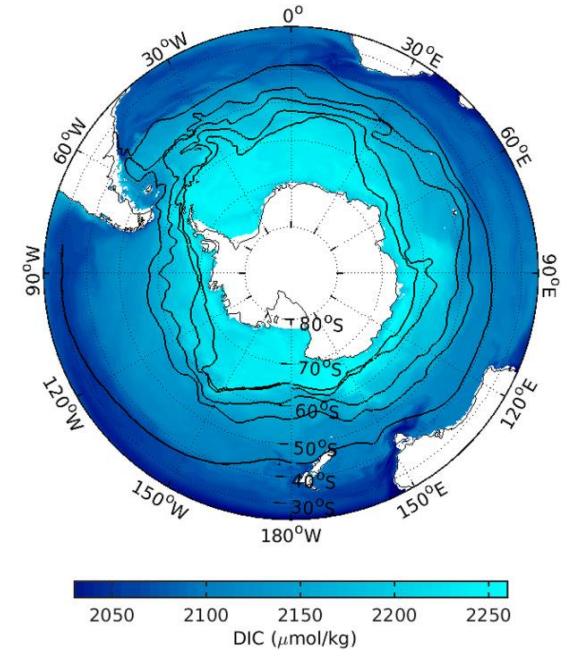
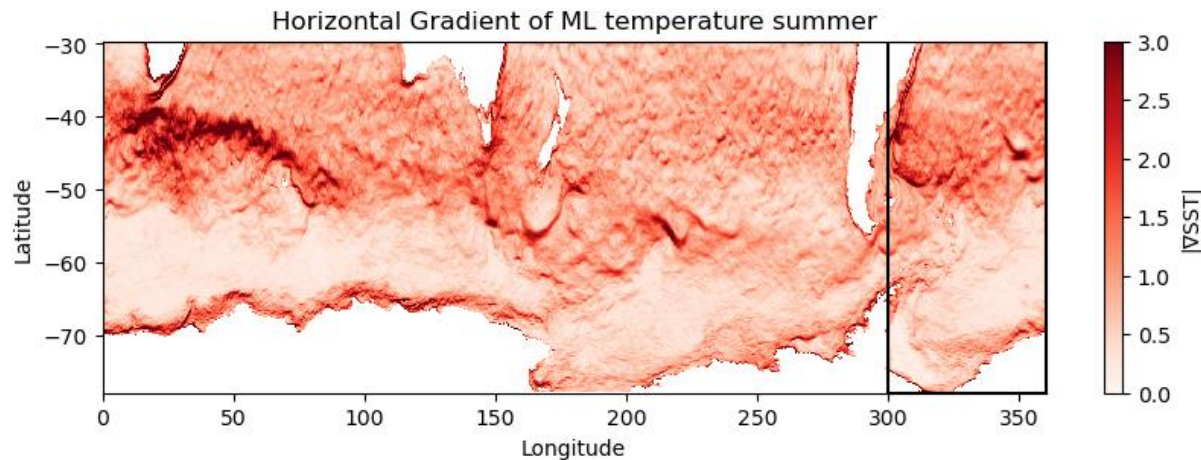
Evidence of subduction



[Lévy et al 2018]

B-SOSE as a Tool to Investigate the Role of Mixing

- Downloading as many datasets as possible from the 156 iteration at 1/6 degree
- Messing up with the grid
- Computing the magnitude of fronts in temperature and salinity in the Southern Ocean



Dissolved inorganic carbon concentration at 100 m depth in B-SOSE.
Figure from Verdy and Mazloff 2017.

- Distinguishing dynamics in the mixed layer from the whole ocean depth dynamics focusing on the Atlantic sector
- Getting familiar with the seasonality and interannual variability of the biogeochemistry
- Trying to put everything together in a way that makes sense

Ocean Biogeochemistry in the Atlantic Sector

Less carbon in summer:

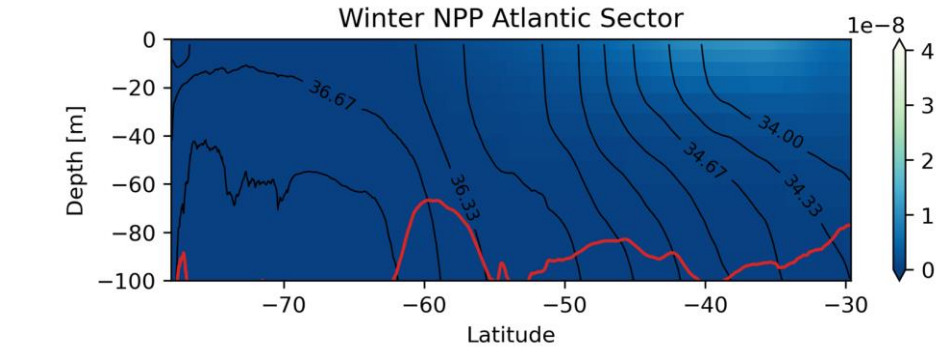
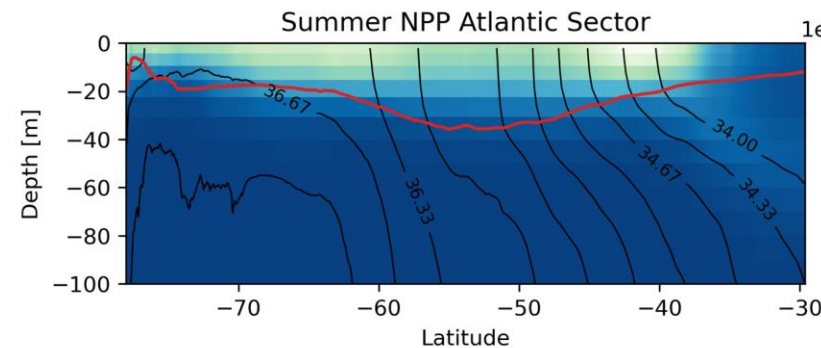
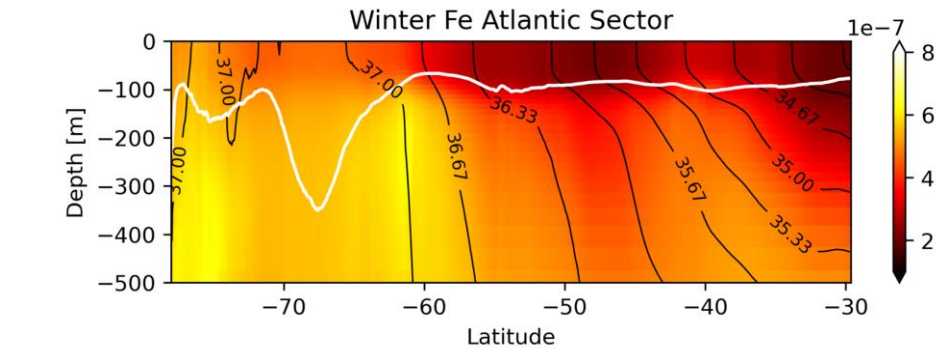
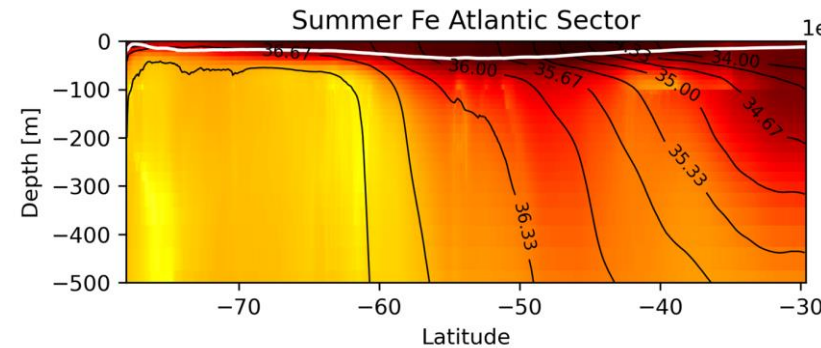
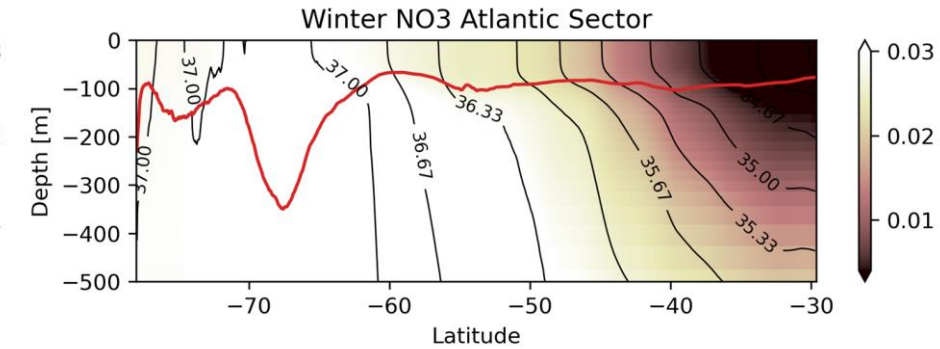
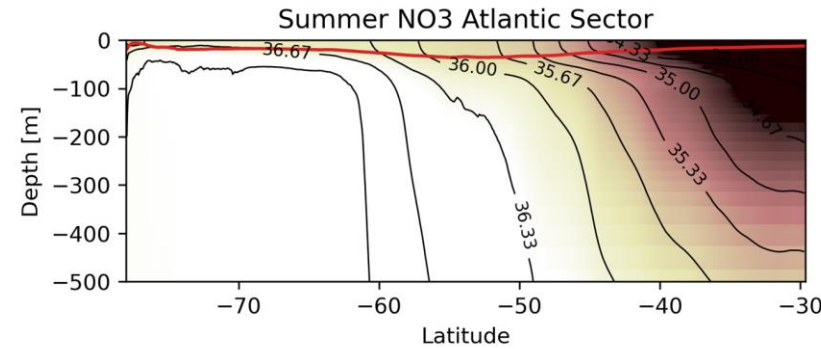
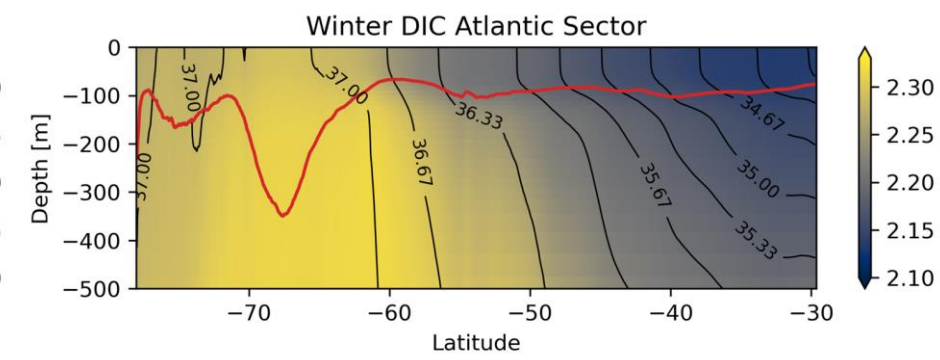
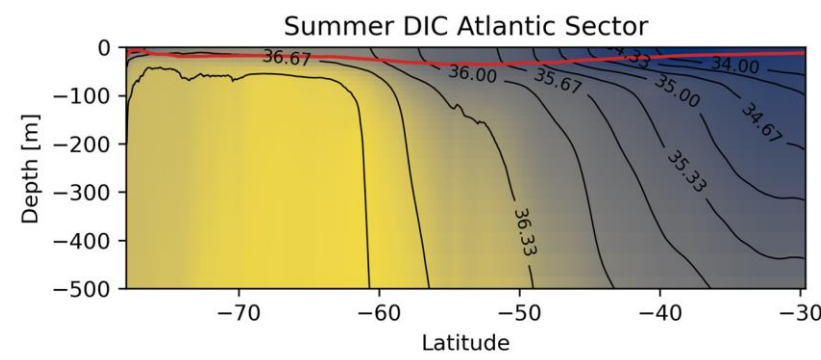
- biology takes up carbon and sinks it down at depths

More carbon in winter:

- less biology
- well mixed vertically in the ML

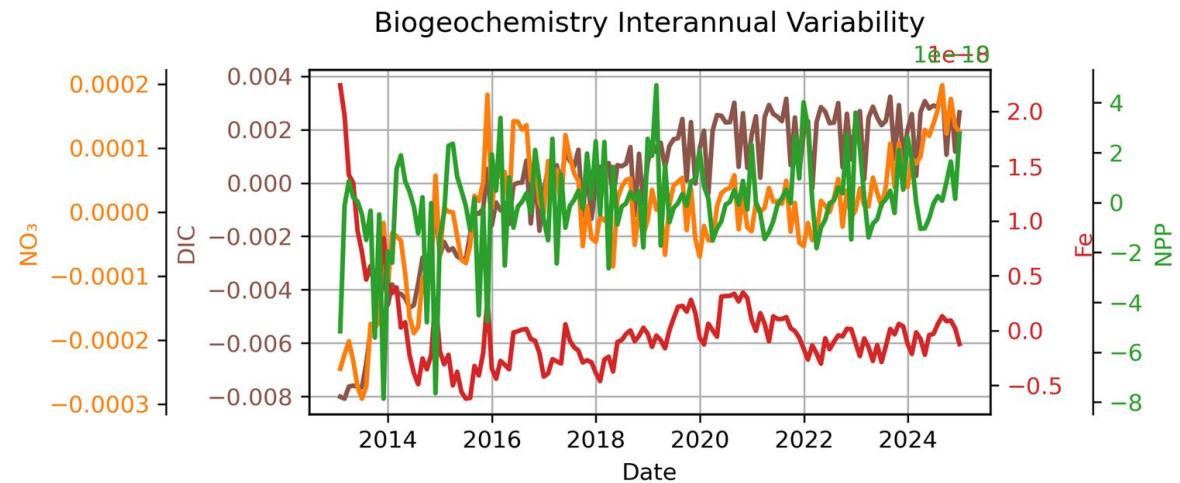
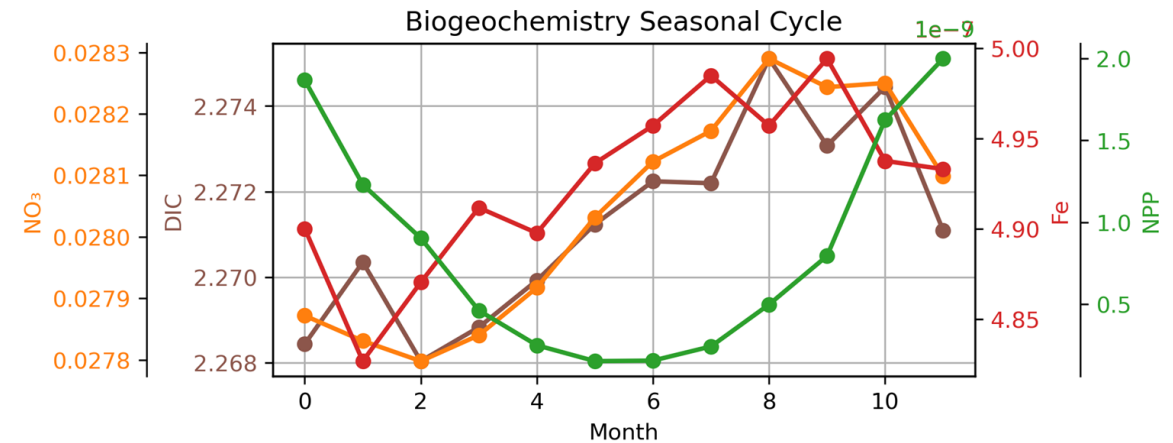
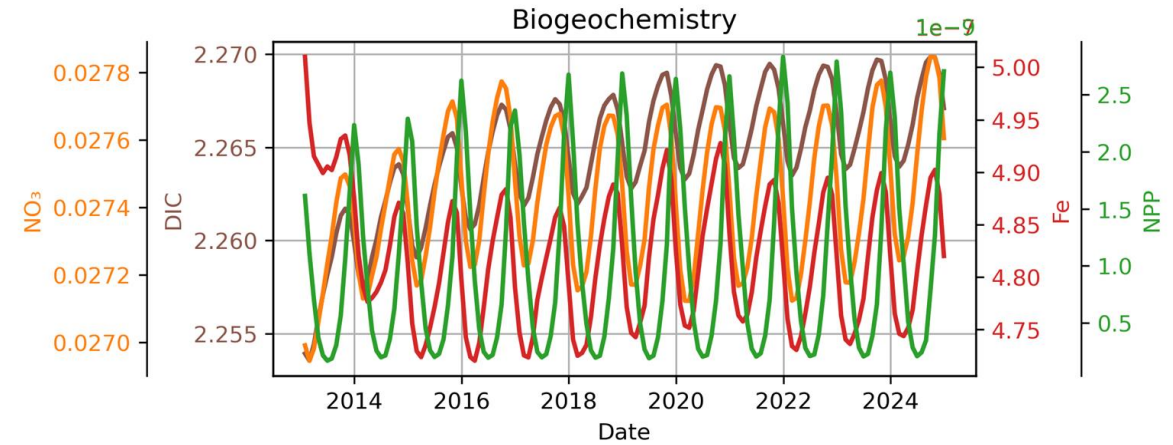
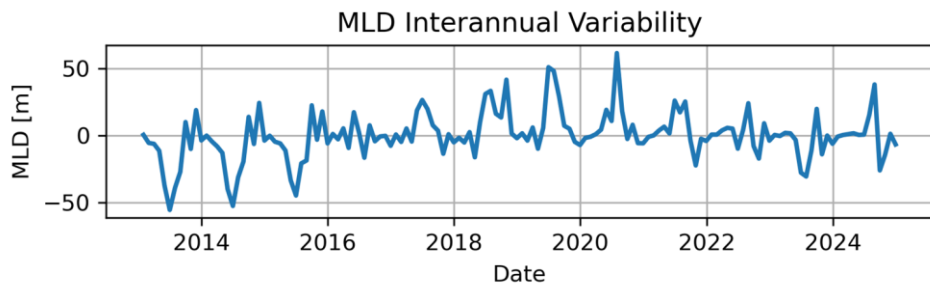
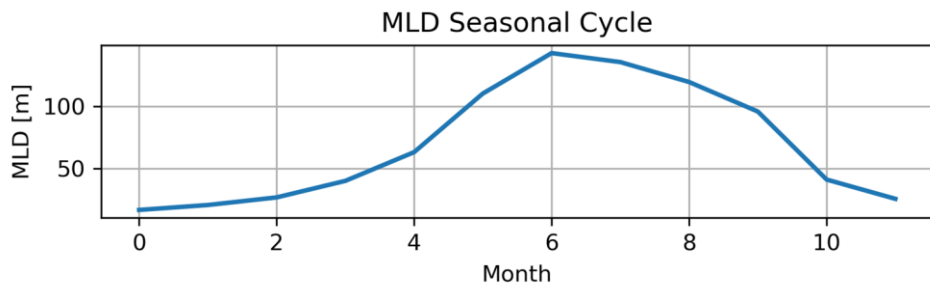
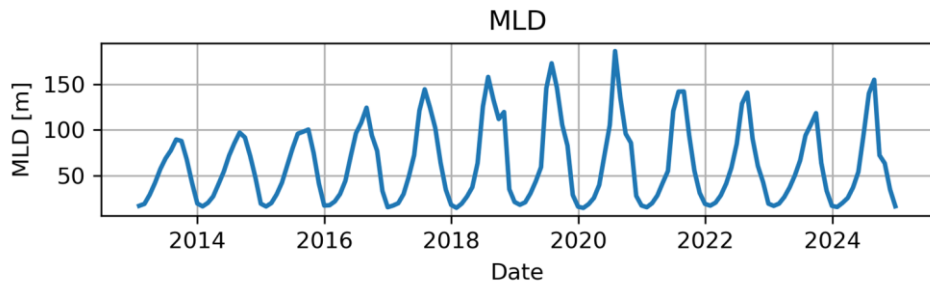
Nitrate and iron are upwelled in winter due to outcropping isopycnals

More exchange in winter associated with stronger mixing



Ocean Biogeochemistry in the Atlantic Sector

Quite complicated
But it must be
somehow connected
to the dynamics

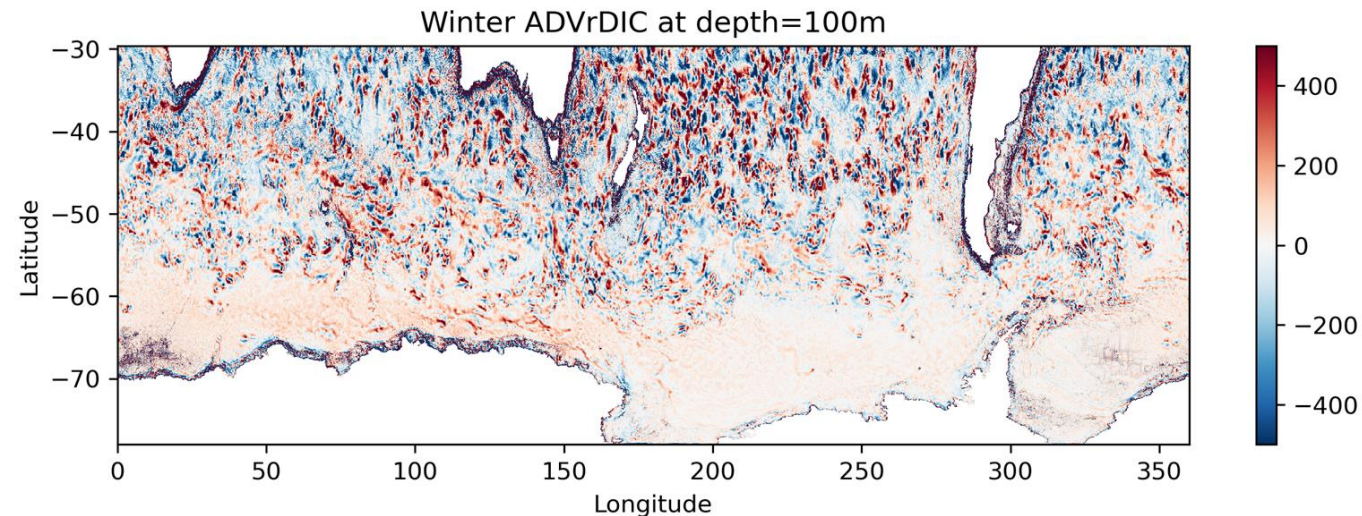
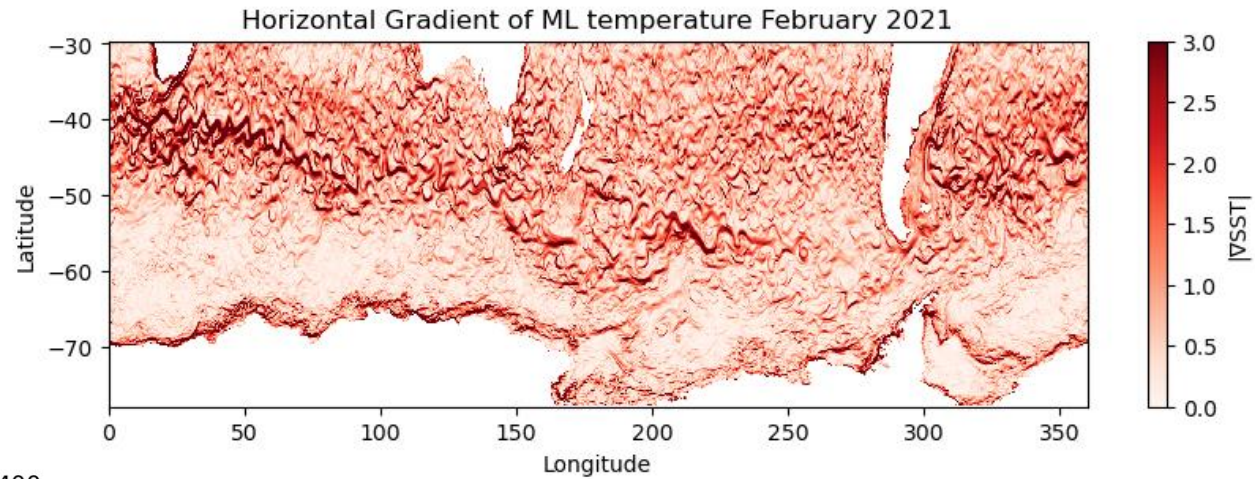
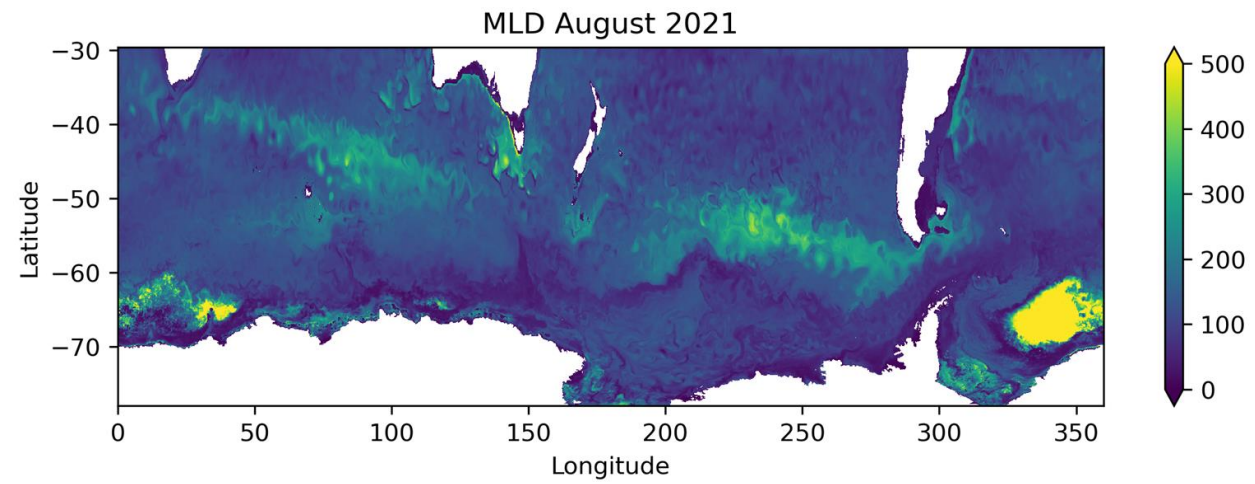


Vertical Transport of Tracers

- Big pool of deep MLD in the Weddell Sea associated with ventilation of the deep ocean
- This is not exactly where the fronts are located

But:

- vertical advection of DIC is locally stronger in the frontal region



This is where the sub-grid scale turbulence and the submesoscale may potentially play an important role in advecting biogeochemical tracers

Project Reflections

Challenges:

- Dealing with B-SOSE for the first time
- Dealing with biogeochemistry for the first time
- Difficult to formulate a clear research question

What did I learn:

- So many things: ECCO, state estimate models, B-SOSE, a little of biogeochemistry
- Ocean models are complex: full of feedback
- Believe in the things I care

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New skills I acquired:

- Got more familiar with Jupyter notebooks
- Understood how not to mess up with the source MITgcm code (Thanks to Jean-Michel!)
- Git and GitHub

If I have more time I would:

- Evaluate other basins in the Southern Ocean
- Look at vertical profiles of tracer fluxes
- Study the biogeochemistry
- Run B-SOSE with a parameterization for submesoscale