Impact of NBC rings on the CO$_2$ air-sea flux variability in winter 2020

L. Olivier, J. Boutin, G. Reverdin, N. Lefèvre, P. Landschützer, S. Speich, J. Karstensen & R. Wanninkhof

Doi: https://doi.org/10.5194/bg-2021-269, in review, 2021

A transition region highly dynamic
Impact of NBC rings on the CO$_2$ air-sea flux variability in winter 2020

L. Olivier, J. Boutin, G. Reverdin, N. Lefèvre, P. Landschützer, S. Speich, J. Karstensen & R. Wanninkhof

Doi: https://doi.org/10.5194/bg-2021-269, in review, 2021

A transition region highly dynamic

Problematics

How do mesoscale and sub-mesoscale dynamics influence the regional CO$_2$ air-sea fluxes?

Impact of the Amazon plume in a low outflow period?

What is the impact of NBC eddies on the CO$_2$ fluxes?

Landschützer at al., 2020

CO$_2$ sink generated by winter cooling in the North

CO$_2$ source close to the equator waters rich in CO$_2$
Data

The EUREC4A-OA cruise

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

Air-sea CO₂ flux

Error linked to ship measurements < 0.1 mmol/m²/day
Error linked to interpolation and reconstruction ~ 4 to 9 μatm

Water masses identification

Identification using SSS, SST and colocalised satellite Chla

Boundaries varying in space and time

Integrated air-sea CO₂ flux

The retroflection is a small regional source and represent a small part of the domain
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 fCO$_2$ near the centre
- 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 in Jan-Feb, accounts for 20 % of the total sink.

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

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
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
Impact of NBC rings on the CO$_2$ air-sea flux variability in winter 2020

L. Olivier, J. Boutin, G. Reverdin, N. Lefèvre, P. Landschützer, S. Speich, J. Karstensen & R. Wanninkhof

Doi : https://doi.org/10.5194/bg-2021-269, in review, 2021

Perspectives

1 yr: Summer (strong outflow) period (Tara microbiome measurements)

1-5yr: Improve the knowledge of large mesoscale and filaments biogeochemical properties, of their role for air-sea CO$_2$ fluxes:

**Need for measurements**: in situ (pCO$_2$) and satellite (SSS in addition to Chl (both a tracer of ocean dynamic and an indicator of biological activity) and SST (useful to monitor solubility variability but not always a good tracer of the fronts!)

5-10yr: Need for satellite **SSS continuity** (CIMR) and **high resolution** ($\leq 45$km) (SMOS-High resolution) allowing to pursue such investigations!