



Ifremer



Postdoctoral Research position in Physical Oceanography at LOPS – Ifremer

Title: Physical mechanisms involved in deep CO₂ storage variability in the North-Atlantic

Description

We seek a physical oceanographer to join the Laboratoire d’Océanographie Physique et Spatiale, Ifremer in Brest (France) to investigate the key physical drivers of carbon uptake and storage in the subpolar gyre of the North Atlantic and to provide climate indicators on the capacity of the subpolar gyre at storing carbon. The research will be mainly based on the analysis of *in situ* data from the Argo program (standard, deep and BGC), complemented by the OVIDE cruises data and any additional hydrographic data available in the area.

Location: Laboratoire d’Océanographie Physique et Spatiale, Ifremer – Brest, France.

Contract: 18 months

Starting date: November 2021

Deadline for application: September 1st, 2021

Who can apply:

A PhD in physical oceanography, meteorology, climate science, or geophysical fluid dynamics is required, with experience in the field of physics, the use of large databases and methodologies linked to ocean transport estimates, and ideally with a biogeochemical background and/or experience in ocean numerical modelling. Excellent oral and written communication skills in English are required.

Motivation and details on the project

The ocean is a major sink for atmospheric CO₂, with the North Atlantic in particular being the basin where the largest amount of anthropogenic carbon (i.e. excess of CO₂ emitted by human activities since the industrial era started, C_{ant}) is being accumulated. There, physical processes such as air-sea gas exchanges, convection and circulation are involved in the uptake, storage and export of C_{ant} and their variability. Intense deep convection (Pérez et al., 2018) or positive anomaly in the amplitude of the Atlantic Meridional Overturning Cell (Zunino et al., 2016) are associated with increased rate of ocean storage of C_{ant}. It is expected that in a changing climate those mechanisms will be modified, affecting the capacity of the ocean at storing C_{ant}. For instance, increased surface stratification due to warmer surface water and larger freshwater content might inhibit deep convection. Identification of key drivers for changes in carbon uptake in the North-Atlantic Ocean is thus of paramount importance as the storage of C_{ant} in the ocean is crucial for effective and efficient climate mitigation, with economic benefit. Such question is at the heart of the H2020 Eurosea project who is in charge of evaluating the economic value (i.e. the marginal damage resulting from an additional ton of CO₂ emitted or marginal damage avoided by reducing emissions by one ton) of the ocean carbon sink in deep convection regions (task 7.1 within WP7 of EUROSEA).

The first objective of this post-doc is to investigate the physical mechanisms involved in the uptake, storage and export of C_{ant} in the subpolar gyre of the North-Atlantic Ocean and their interannual to decadal variability. The mechanisms are related to air-sea forcing, preconditioning, water mass formation (eg deep convection), transformation (entrainment of intermediate waters with overflow waters) and export, in particular through interior routes or boundary currents. The analysis will be mainly based on Argo, BGC-Argo and Deep-Argo data, using in particular dissolved oxygen concentration data that are useful to monitor air-sea gas transfers in deep-convection sites (Piron et al, 2016, 2017) or water mass pathways (Racapé et al., 2019).

A second objective is to evaluate how Argo data could be used to provide potential indicators of C_{ant} storage. This will be based on determining how the variability of the various mechanisms addressed as part of this postdoctoral work can explain the results obtained by IIM Vigo as part of the BOCATS2 project in collaboration with the LOPS OVIDE team on the monitoring of C_{ant} inventory in the Irminger Sea. Since 2002, the OVIDE project has contributed to the observation of the circulation and water mass properties along a section from Greenland to Portugal, feeding the GO-SHIP international database, and contributing to CLIVAR, IOCCP and CARBOCHANGE international programmes. Data from this program are used to monitor the amplitude of the AMOC (Mercier et al., 2015) and the formation, fate and variability of the water masses (Garcia-Ibanez et al., 2018). Joint analyses performed between IIM Vigo and LOPS OVIDE team allowed the estimation of the interannual variation of the C_{ant} inventory in the Irminger Sea (Pérez et al. 2008, 2018). Such inventory will be continued as part of the BOCATS/OVIDE project until 2023.

The recruited postdoc will take advantage of the Argo dataset (standard, deep and BGC), but also hydrographic data (eg OVIDE) available in the area. The position comprises a strong data analysis component. The period of interest mainly concerns the Argo/Ovide period (2000-present) but could be extended backward in-time depending on data availability.

Context

The work will be carried out as part of EUROSEA (European Contribution to the Future of the Seas and Oceans Flagship Initiative) WP7: Climate Demonstration Project (Task 7.1. Carbon and heat uptake in the Subpolar NW Atlantic). It will be done in collaboration with IIM-CSIC (Vigo, Spain) leader of the BOCATS2 (Biennial Observation of Carbon, Acidification, Transport and Sedimentation in the North Atlantic) and RECCAP2 (REgional Carbon Cycle Assessment and Processes-2) projects.

How to apply

Application (detailed CV including a list of publications, cover letter, name/email of at least 2 references). Informal enquiries can be sent to Virginie Thierry (Virginie.Thierry@ifremer.fr) or Lidia Carracedo (Lidia.Carracedo@ifremer.fr)

References

- García-Ibáñez, Maribel I., Fiz F. Pérez, Pascale Lherminier, Patricia Zunino, Herlé Mercier and Paul Tréguer, 2018: Water mass distributions and transports for the 2014 GEOVIDE cruise in the North Atlantic. *Biogeosciences*, 15(7), 2075-2090, <https://doi.org/10.5194/bg-15-2075-2018>
- Mercier, H., P. Lherminier, A. Sarafanov, F. Gaillard, N. Danaïult, D. Desbryères, A. Falina, B. Ferron, T. Huck, V. Thierry, 2015: Variability of the meridional overturning circulation at the Greenland-Portugal Ovide section from 1993 to 2010. *Progress in Oceanography*, 132, 250-261, doi:10.1016/j.pocean.2013.11.001.
- Pérez, F. F., M. Vazquez-Rodriguez, E. Louarn, X. A. Padin, H. Mercier, A. Rios, **2008**: Temporal trends of the anthropogenic CO_2 storage in the Irminger Sea. *Biogeosciences*, 5, 1669-1679, doi:10.5194/bg-5-1669-2008 or <http://archimer.ifremer.fr/doc/2008/publication-5925.pdf>.
- Perez, Fiz F., Marcos Fontela, Maribel I. García-Ibáñez, Herlé Mercier, Anton Velo, Pascale Lherminier, Patricia Zunino, Mercedes de la Paz, Fernando Alonso-Pérez, Elisa F. Guallart, Xose A. Padin, **2018**: Meridional overturning circulation conveys fast acidification to the deep Atlantic Ocean. *Nature*, 554, 515-518, <https://doi.org/10.1038/nature25493>
- Piron, A., V. Thierry, H. Mercier, and G. Caniaux (2017), Gyre-scale deep convection in the subpolar North Atlantic Ocean during winter 2014–2015, *Geophys. Res. Lett.*, 44, 1439–1447, doi:10.1002/2016GL071895.
- Piron A., V. **Thierry**, H. Mercier and G. Caniaux, 2016: Observation of basin-scale deep convection in the Irminger Sea with Argo floats in the 2011-2012 winter, *Deep-Sea Research Part I*, 109, 76-90, doi: 10.1016/j.dsr.2015.12.012
- Racape V., Thierry Virginie, Mercier Herle, Cabanes Cecile (2019). **ISOW spreading and mixing as revealed by Deep-Argo floats launched in the Charlie Gibbs Fracture Zone**. *Journal Of Geophysical Research-oceans*, 124(10), 6787-6808. Publisher's official version : <https://doi.org/10.1029/2019JC015040>, Open Access version : <https://archimer.ifremer.fr/doc/00513/62428/>
- Zunino Rodriguez Patricia, Mercier Herle, Thierry Virginie (2020). **Why did deep convection persist over four consecutive winters (2015-2018) southeast of Cape Farewell?** *Ocean Science*, 16(1), 99-113. Publisher's official version : <https://doi.org/10.5194/os-16-99-2020>, Open Access version : <https://archimer.ifremer.fr/doc/00606/71776/>