Laboratoire d'Océanographie Physique et Spatiale
UMR6523 – CNRS-IFREMER-IRD-UBO
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Postdoc offer – Laboratory of Physical and Spatial Oceanography (LOPS) – Ifremer

Project title and acronym

AMOC Connectivity across the North Atlantic Subpolar-Subtropical Transition Zone

A component of the Horizon Europe **EPOC** project

Host institute and supervisors

Ifremer, National Centre for the Exploitation of the Oceans, Brest, France. (https://www.ifremer.fr/fr)
Laboratory of Physical and Spatial Oceanography (LOPS), Ocean and Climate group" (https://www.umr-lops.fr/en)

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Project presentation

Summary

A key vector for climate signal propagation is the North Atlantic Deep Water (NADW), an ocean water mass that connects with the atmosphere at high northern latitudes before sinking and spreading southward within the lower limb of the Meridional Overturning Circulation (AMOC). The rate and extent of NADW spreading and the modification of its properties *en route* are partly determined by a complex dynamical system within the subpolar-subtropical "Transition Zone" of the North Atlantic and its two topographic choke points: Flemish Cap and the Grand Banks of Newfoundland. Existing observations, however, only enable a partial description of typical circulation and mixing patterns and cannot support a comprehensive mechanistic understanding of NADW dynamics in this key region. The goal of the postdoctoral position is to help providing the missing process-oriented assessment of NADW dynamics across the subpolar-subtropical "Transition zone" using dedicated observations and novel numerical tools. An emphasis will be put on mooring data analysis to unravel the subpolar-to-subtropical propagation of buoyancy and bottom pressure anomalies, and hence on the meridional coherence of the AMOC. This postdoctoral position is funded by the Horizon Europe EPOC project.

Background

The distribution of heat, freshwater, biogeochemical parameters (e.g. carbon), and pollutants (e.g. plastic) in the ocean is at the heart of current environmental concerns[1]. The observation and modelling of ocean currents, which largely control their distributions from the basin scale to the dissipation scale, is essential to describe the anthropogenic climate transition and reduce uncertainties on its long-term projection and impacts. An essential vector for the propagation of climate-relevant quantities within the global ocean interior is the North Atlantic Deep Water (NADW), a dense water mass that regularly connects with the atmosphere at high northern latitudes before sinking and spreading southward as far as the Indian and Pacific Oceans[2]. The NADW, which occupies the deep limb of the so-called Atlantic Meridional Overturning Circulation (AMOC – Fig. 1) plays a key role on heat uptake[3], on the spreading of Arctic-origin freshwater anomalies[4], and on the penetration of anthropogenic carbon into the abyss[5]. Such a role has placed the NADW and hence the AMOC at the heart of the oceanographic community interests[6], with an ultimate goal of foreseeing their responses to future climate changes at high latitudes, such as, for instance, the expected weakening of deep convection throughout increased meltwater discharge from the Greenland ice sheet[7].

The southward export of NADW was for a long time simplified as a confined laminar flow, heading continuously southward from high latitudes along the western Atlantic margins: the so-called Deep Western Boundary current (DWBC)[8] (Fig. 1). This paradigm has now been revised, as improved observational and modelling capabilities revealed the NADW circulation as a three-dimensional system with complex patterns of vertical and meridional connectivity underpinned by strong multi-scale interactions (large-scale, mesoscale, submesoscale). Such complexity is partly determined by local ocean dynamics around a Transition Zone (TZ) that separates subpolar and subtropical basins: Flemish Cap and the Grand Banks of Newfoundland (Figure 1). This wide underwater plateau represents an important topographic obstacle for the southward propagation of NADW, and encompasses several processes that can significantly affect its intrinsic properties. Those include topography-controlled inertial separation of the boundary current towards eddy-driven recirculating gyres[9] and dispersive pathways[10], near-shore recirculation associated with the meandering North Atlantic Current (NAC)[11], intense eddy-driven vertical motions[12], or isopycnal stirring and diapycnal mixing near the steep continental slopes[13,14]. A thorough observation-driven description of those physical processes constitutes therefore a prerequisite for predicting how fast and how far forthcoming high-latitude climate changes could imprint the deep ocean globally.

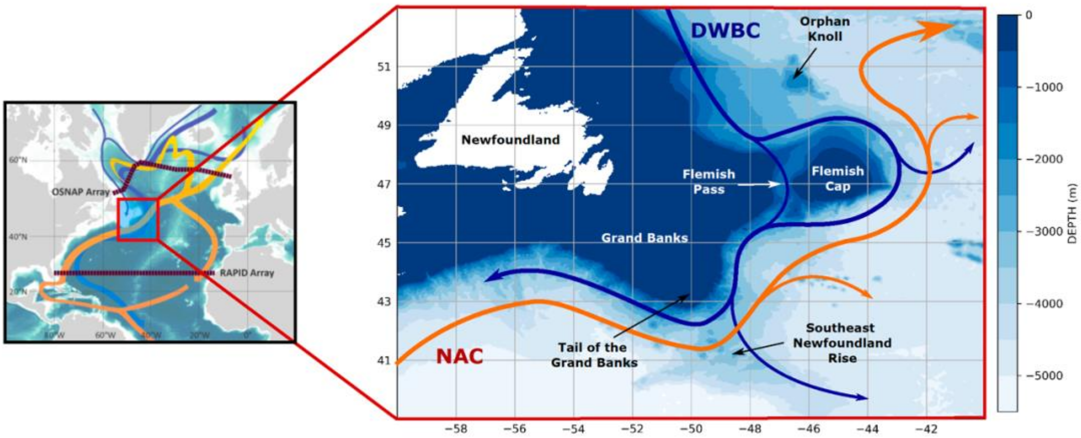

Figure 1: The large-scale circulation in the Transition Zone of the North Atlantic. The North Atlantic Current (i.e. the upper limb of the AMOC) and the Deep Western Boundary Current (DWBC) are shown in red and blue, respectively.

Objectives and Methodology

The aim of this postdoctoral position is to tackle the aforementioned task using a dedicated mooring-based dataset, along with state-of-the-art high-resolution regional modelling. A particular emphasis will be put on the subpolar-subtropical propagation and modification of buoyancy and bottom pressure anomalies within the DWBC system of the TZ. The observational dataset, built in the framework of the EPOC and CROSSROAD projects, is shown in Figure 2. The recruited postdoc will primarily be responsible for the analysis of a 2-year time series from 9 tall moorings equipped with temperature-conductivity-pressure sensors and current meters (red circles) and 4 Pressure Inverted Echo sounder (green triangles), as well as a 1-year time series of microstructure measurement (blue square). This observation-driven analysis will be preceded by the analysis of a ~10-yearlong submesoscale-resolving simulation of the TZ that will provide a longer and larger scale context (GIGATZ). An ultimate goal of the 36-month position will be to evaluate the divergence of the DWBC properties within the TZ, identify key underlying processes, and assess its impact on the meridional coherence of the AMOC between subpolar and subtropical latitudes.

Key objectives

O1. Describe the mean large-scale and local buoyancy budget.

Tools: GIGATZ simulation and EPOC mooring data

O2. Describe the propagation of subpolar buoyancy and bottom pressure gradient anomalies.

Tools: EPOC mooring data and GIGATZ simulation

O3. Evaluate the subpolar – subtropical AMOC connectivity

Tools: GIGATZ simulation and mooring data (EPOC, OSNAP, RAPID)

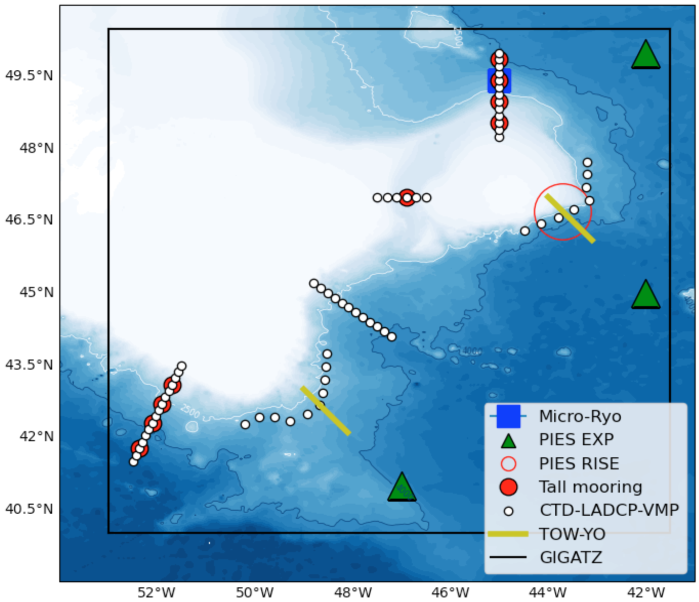

Figure 2 : CROSSROAD and EPOC fieldworks.
The data to be analysed as part of the Postdoc include notably 2-year time series from 9 tall moorings (red dots) and 4 Pressure-Inverted Echo Sounders (green triangles). Other instrumental components include a microstructure mooring (blue square) and CTD-LADCP-VMP casts (white dots). A subkilometric simulation of the TZ (GIGATZ, black square) will also be available.

Applicant

The selected candidate will join the "Ocean and Climate" team of the Laboratory for "Ocean Physics and Satellite remote sensing" at Ifremer and interact with several senior researchers. He/she will closely collaborate with two early-career researchers working on complementary aspects of the TZ dynamics with alternative tools and approaches (high-resolution modelling and hydrography data). Moreover, the EPOC Horizon Europe project (https://epoc.blogs.uni-hamburg.de/) will ensure fruitful collaborations with several European partners (University of Bremen and Hamburg in particular), as well as the opportunity to participate to fieldwork activities.

The selected candidate will hold a PhD in physical oceanography, dynamic meteorology, or related discipline for less than 3 years (legal requirement). He/she will have good knowledge of computer programming for environmental data analysis (Matlab, Python, ...) and good skills in English language (written and spoken).

How to apply

Contract start date: from **09/09/2024**

Application deadline: **31/05/2024**

Applicants should send their complete application package by email to damien.desbruyeres@ifremer.fr and eleanor.frajka@uni-hamburg.de. This includes: a complete CV with publication list, a short motivation statement, and the contacts of two references. Selected candidate may be contacted for a short interview.

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