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Laboratoire de Météorologie Dynamique  
Institut Pierre et Simon Laplace  
UMR 8539 ENS/PSL-CNRS-École Polytechnique-SU



## Post-Doctoral Fellowship In Physical Oceanography

### Assessing the Salinity/Freshwater redistribution in the South Atlantic ocean

**Supervisor:** Prof. Sabrina Speich ([sabrina.speich@lmd.ens.fr](mailto:sabrina.speich@lmd.ens.fr), <https://www.lmd.ens.fr/speich/>)

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#### Co-supervisor:

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#### Subject area

Physical oceanography, air-sea interactions, water cycle, ocean salinity, global warming, climate change

#### Subject description

The European Horizon2030 project Ocean-Cryosphere Exchanges in ANtarcctica: Impacts on Climate and the Earth system (OCEAN:ICE, <https://ocean-ice.eu>), has been funded to assess the impacts of key Antarctic Ice Sheet, ocean processes and air-sea interactions on Planet Earth, via their influence on sea level rise, deep water formation, ocean circulation, the freshwater cycle and climate.

The ocean is a global reservoir and redistribution agent for several important constituents of the Earth’s climate system, among them heat, fresh water and carbon dioxide. Whereas these constituents are actively exchanged with the atmosphere, salt is a component that is approximately conserved in the ocean. The distribution of salinity in the ocean can be used to diagnose rates of surface freshwater fluxes, freshwater transport and local ocean mixing—important components of climate dynamics.

The global water cycle, which is integral to the climate system, is expected to amplify with global warming, leading to more extreme wet and dry regions. Ocean salinity, a well-measured parameter, serves as an indicator of changes in surface freshwater flux, suggesting a 2-4% global water cycle amplification over the past 50-60 years. Net evaporation over the Atlantic Ocean drives moisture export to the Pacific, making the Atlantic more saline. This is balanced by a southward freshwater transport (FWT) within the Atlantic. The Atlantic has seen increased salinity contrasts, especially in tropical/subtropical regions, likely due to anthropogenic climate change.

Changes in the Atlantic water cycle and FWT are crucial for the global meridional overturning circulation (MOC) and climate. Warming is expected to increase southward FWT due to more freshwater input from Arctic melting, which affects the Atlantic portion of the MOC (AMOC). Strong correlations exist between southward FWT and AMOC strength, with increases in FWT attributed to an intensified oceanic water cycle. FWT consists of contributions from the AMOC ( $M_{ov}$ ) and gyre systems ( $M_{az}$ ), with changes in these components influencing the Atlantic's freshwater budget and global MOC.

Projections show an amplified water cycle and reduced AMOC strength, affecting FWT. The balance between  $M_{ov}$  and  $M_{az}$  changes will control FWT divergence, impacting the freshwater budget and global MOC.  $M_{ov}$  is also an indicator of AMOC stability, with positive  $M_{ov}$  suggesting a stable AMOC and negative  $M_{ov}$  indicating potential for collapse. Current estimates suggest a bi-stable AMOC regime, indicating susceptibility to destabilization.

This post-doc is aiming to investigate changes in the freshwater budget of the South Atlantic Ocean as observed over the last 55 years (1970–2025). We focus on how FWT changes across the South Atlantic sector with respect to the changing water cycle and AMOC from the available and new observations, the Wijffels et al. 2024 (under revision in Journal of Physical Oceanography) hydrographic Atlas and ocean reanalyses. We will distinguish between AMOC-driven ( $M_{ov}$ ) and mainly salinity-driven azonal ( $M_{az}$ ) transport contributions to changing FWT. Implications of the changing water cycle and freshwater transports to the future stability of the overturning are also discussed.

Results of this study would allow us to evaluate the timescales of inertia in the ocean freshwater cycle in the South Atlantic, its impacts on ocean stratification, and consequently, the climate response time to changes in anthropogenic emissions. Particularly, this post-doc proposition is aiming to:

- Analyze critical areas of regional salinity/freshwater accumulation and transport, and determine their drivers of change (e.g., stratification) under global warming.
- Identify the most critical areas and processes (e.g., climate variability such as ENSO, role of marine heat waves) in the redistribution of salt/freshwater across the South Atlantic water column/water masses, and how this has changed over the past decades.
- Deepen our understanding in characterizing the changes in salinity across different water layers and identify changes in ocean salinity/freshwater content at isopycnal layers to distinguish between upper layers, the subtropics thermocline waters, the subpolar mode and intermediate waters and the polar regions deep and abyssal waters.
- Enhance our understanding on changes (e.g., reduction) in the ocean water cycle component linked to ongoing global warming (e.g., changes in stratification due to changes in salinity).

### Postdoctoral profile

We are seeking a highly motivated candidate with a PhD's degree in physical oceanography, atmospheric sciences, or a related field. Applicants from physical or mathematical disciplines with an interest in climate science are also welcome.

### Employment

- Employment form: Fixed-term employment, 2 years.
- Extent: 100%
- Placement: : Laboratoire de Météorologie Dynamique - IPSL  
Ecole normale supérieure - PSL  
45 rue d'Ulm  
75231 Paris Cedex 05, France
- First day of employment: Upon agreement (approximately 1 January 2025)

## The working environment

The *École normale supérieure* (ENS: <https://www.ens.psl.eu/en>) is home to 800 researchers and lecturers, 300 post-doctoral researchers and 600 doctoral students. It hosts 32 research units in the humanities and sciences, covering a very broad scientific field at the highest international level. As part of the Université Paris Sciences et Lettres, the Ecole normale supérieure promotes fundamental research that expands the frontiers of knowledge while facilitating and encouraging its exploitation. Its research is structured in a dynamic way to anticipate and support the latest developments in the most advanced fields of science and to promote multidisciplinary initiatives. Strong research and attractive study programmes attract researchers and students from around the world. With new knowledge and new perspectives, the Ecole normale supérieure contributes to a better future.

The *Laboratoire de Météorologie Dynamique* (LMD: <https://www.lmd.ipsl.fr/en/home-2/>) studies climate, planetary atmospheres and the ocean by combining theoretical approaches, instrumental developments for observation and numerical modelling. It is at the forefront of research on the dynamic, physical and biogeochemical processes enabling the study of the evolution and forecasting of ocean, meteorological and climatic phenomena. The LMD is clearly positioned both on fundamental research on the processes, dynamics and biogeochemistry of the ocean, atmosphere and climate, and on finalized research, particularly on questions relating to the anticipation of global warming and its consequences.

The LMD has an interdisciplinary width that includes marine biology, marine chemistry, oceanography, and experts on the dynamics and physics of the atmosphere. Our scientists and students often have prominent roles in international project, from Antarctica, Arctic, and the great world seas, atmosphere and climate.

## Contact information

If you have any questions about the position, please contact Prof Sabrina Speich [sabrina.speich@lmd.ens.fr](mailto:sabrina.speich@lmd.ens.fr)

## Application

Submit your application by email to [sabrina.speich@lmd.ens.fr](mailto:sabrina.speich@lmd.ens.fr)

The application should be sent in French or English and contain:

- A one page cover letter outlining your ambitions for the outlined position and relevance to the position description must be included.
- ID
- CV
- Copy of diplomas

**Applications must be received by: 2024-12-15**

## Information for International Applicants

Choosing a career in a foreign country is a big step. Thus, to give you a general idea of what we and Paris have to offer in terms of benefits and life in general for you and your family/spouse/partner please visit:

<https://www.ens.psl.eu/en/campus-life-paris>

The ENS works actively to achieve a working environment with equal conditions, and values the qualities that diversity brings to its operations.

Salaries are set individually at the ENS.

In connection to this recruitment, we have already decided which recruitment channels we should use. We therefore decline further contact with vendors, recruitment and staffing companies.