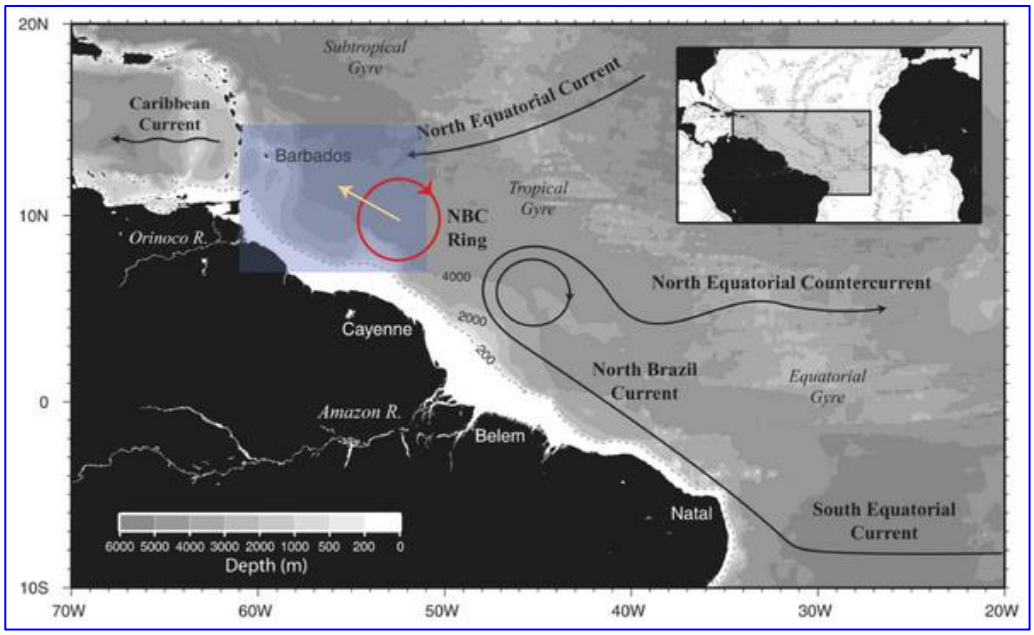
Project title	**Mesoscale Ocean-Atmosphere Turbulence and Interactions (MOATI)**
Call for expression of interest description	The Marie S. Curie Postdoctoral Fellowship (MSCA-PF) programme is a highly prestigious renowned EU-funded scheme. It offers talented scientists a unique chance to set up 2-year research and training projects with the support of a supervising team. Besides providing an attractive grant, it represents a major opportunity to boost the career of promising researchers. **The Laboratory for Physical and Spatial Oceanography (LOPS) located in Brest, France, is thus looking for an excellent postdoctoral researcher** with an international profile to write a persuasive proposal to apply for a **Marie S. Curie Postdoctoral Fellowship grant in 2023** (deadline of the EU call set **on 13 September 2023).** The topic and research team presented below have been identified in this regard.
Main Research Field	Environment and Geosciences (ENV)
Research sub-field(s)	Physical oceanography and ocean-atmosphere coupling, mathematical and physical modelling
Keywords	Turbulence at mesoscale and submesoscale, ocean-atmosphere coupling mechanisms, vortex and jet dynamics, mathematical approaches, numerical modelling
Research project description	**Context and State of the Art** The atmosphere and ocean are coupled dynamically (via the wind and current stress) and thermodynamically (via the heat fluxes at their interface). These interactions occur in turbulent boundary layers (the mixed atmospheric boundary layer and the ocean mixed layer). The meridional heat transport in the atmosphere and oceans, an essential contribution to climate variability, and the internal processes achieving this transport (atmospheric winds and vortices and oceanic jets and eddies), crucially depend on these interactions. It has been shown recently (1,2) that the mesoscale and submesoscale processes, key elements of planetary fluid turbulence, are affected (often damped) by the coupling between the atmosphere and ocean. Another important feature affecting the exchanges between the two fluids is the oceanic barrier layers in tropical oceans, which weakens the vertical exchanges of momentum in the upper ocean. However, the genesis, properties and fate of the mesoscale eddies, and their influence on Tropical Northwest Atlantic air-sea interactions, are not well known. In that respect, a major international experiment at sea and in the lower atmosphere, EUREC4A (3), was carried out in January-February 2020 (see the rectangle in the figure below).



The objectives of the present proposal are thus:

1) to characterize the turbulent properties of the upper ocean in that region, based on the data collected during EUREC4A and on the results of a very high resolution ocean model
2) in that respect, to detail and explicit the mechanisms by which the ocean-atmosphere coupling alters these properties (in comparison with a simple forcing of the ocean by the
atmosphere)
3) to determine the structure and variability of the oceanic eddies at all depths in a wider region encompassing the EUREC4A domain, west of the Mid Atlantic Ridge, in particular the submesoscale coherent vortices (SCV's).

Methodology

The relevant approaches are the analysis of the oceanic and lower atmospheric data of EUREC4A above, in and below the North Brazil Current rings detected and sampled during EUREC4A. The aim is to determine the structure and evolution of these rings. These latter will be compared with the structure and evolution of rings in a 1km resolution model of the Atlantic Ocean (GIGATL). These model results will be used to detect, characterize SCVs's and explain their formation and decay mechanisms. Process studies based on idealized SW or PE model configurations will assess the influence of ocean-atmosphere coupling on these mechanisms and on the SCV's structures near the surface.

Work

The post-doctoral fellow will work in a team of scientists specialists of ocean data, ocean models and ocean processes. He/she will be more specifically responsible of analysing the GIGATL model results and of the idealized, physical process studies.

	References (1) L Renault, MJ Molemaker, JC Mcwilliams, AF Shchepetkin, F Lemarié, et al. 2016 : *Modulation of Wind Work by Oceanic Current Interaction with the Atmosphere*. Journal of Physical Oceanography 46 (6), 1685-1704 (2) L Renault, JC McWilliams, J Gula, 2018 Dampening of submesoscale currents by air-sea stress coupling in the Californian upwelling system Scientific reports 8 (1), 1-8 (3) B.Stevens et al (more than 50 authors), 2021: EUREC4A. Earth Syst. Sci. Data 13(8), 4067-4119
Supervisor(s)	The Postdoctoral Fellow will be supervised by by Pr Xavier Carton and Pr Jonathan Gula (IUF) **Pr Xavier Carton** has 35 years of experience in ocean physics, mesoscale processes and process study models. He has published more than 150 articles; he participated in the EUREC4A experiment in 2020. See https://www.researchgate.net/profile/Carton-Xavier - T.A. Capuano, S. Speich, X. Carton, B. Blanke, 2018: Mesoscale and submesoscale processes in the Southeast Atlantic and their impact on the regional thermohaline structure. J. Geophys. Res., 123, 3, 1937-1961. - C. De Marez, M. Morvan, T. Meunier, P. L'Hegaret, X. Carton, 2020: Study of the stability of a large realistic cyclonic eddy. Ocean Modelling, 146, 101540. - T. Meunier, J. Sheinbaum, E. Pallas Sanz, J. Ochoa, X. Carton and C. De Marez, 2020: Heat content and decay of warm-core rings: the example of the Gulf of Mexico. Geophys. Res. Lett., 47, 3, 2019GL085600 **Pr Jonathan Gula** is a physical oceanographer focusing on ocean turbulence and the dynamical processes that control interactions between different spatial and temporal scales of oceanic flows. He uses high-resolution modeling, theory, observations, and data-driven methods to characterize these processes and parameterize their large-scale impacts. He has (co)-authored 60 publications in international journals since 2009. See https://www.jgula.fr or https://www.researchgate.net/profile/Jonathan-Gula - Tedesco, P., J. Gula, P. Penven & C. Menesguen, 2022 : Mesoscale Eddy Kinetic Energy budgets and transfers between vertical modes in the Agulhas Current, J. Phys. Oceanogr, 52(4), 677-704. - De Marez, C., M. Le Corre & J. Gula, 2021 : The influence of merger and convection on an anticyclonic eddy trapped in a bowl, Ocean Model., https ://doi.org/10.1016/j.ocemod.2021.101874

	- Schubert, R., J. Gula, R.J. Greatbatch, B. Baschek & A. Biastoch, 2020 : The Submesoscale Kinetic Energy Cascade : Mesoscale Absorption of Submesoscale Mixed-Layer Eddies and Frontal Downscale Fluxes, J. Phys. Oceanogr., 50, 2573–2589.
Department/ Research	The postdoctoral fellow will work **at IUEM (European University Institute for Marine Studies) in the Laboratoire d'Océanographie Physique et Spatiale (LOPS).** IUEM hosts more than 7 labs devoted to marine sciences and gathers 1000 scientists and students. Among these labs, LOPS is devoted to ocean physics and remote sensing. It has 30 years of experience and is world-wide renowned. It includes a complete team for work at sea, a supercomputer (at IFREMER) and can access central supercomputers in Paris. LOPS has 4 scientific teams working on ocean general circulation and climate, coastal oceanography, ocean surface processes and remote sensing, ocean scale interactions. The postdoc will work in the latter team in collaboration with the three other teams. LOPS is involved in many national and European projects bearing on data collection and analysis in the Atlantic Ocean, on very high resolution ocean modelling and on oceanic process studies. Pr Gula and Carton are members of several of these projects. **https://www.umr-lops.fr/en**
Location	**Technopôle de Plouzané (France)** : this site hosts many scientific institutes and technological start-up companies devoted to marine and computer sciences. It is located at the tip of Brittany, the westernmost peninsula of France on the Atlantic Ocean. More than 2000 scientists, engineers and students work in Brest and Plouzane on marine sciences and technology.
Suggestion for interdisciplinary / intersectoral secondments and placements	No secondment in a secondary institution is envisaged in the context of this project ; interdisciplinary work can be a small complement to this project, either with applied mathematics (formal solutions of oceanic problems) or with ocean biogeochemistry (as an application of ocean physics)
Skills Requirements	- Experience with oceanic process studies, in particular at mesoscale and submesoscale, is expected from applicants (as confirmed by a list of publications or theses) - Skills with numerical ocean modelling (in Fortran) and analysis (in Python or matlab) are necessary - Required Languages: English (fluent), French (optional) - the applicant is expected to have experience of work in team, of scientific communication; possibly he/she will mentor younger students. - Publications: at least 1 per year since the PhD in 1st author

<table>
<tr><td>Eligibility criteria for applicants</td><td>Academic qualification: By 13 September 2023, applicants must be in possession of a doctoral degree, defined as a successfully defended doctoral thesis, even if the doctoral degree has yet to be awarded.

Research experience: Applicants must have a maximum of 8 years full-time equivalent experience in research, measured from the date applicants were in possession of a doctoral degree. Years of experience outside research and career breaks (e.g. due to parental leave), will not be taken into account.

Nationality & Mobility rules: Applicants can be of any nationality but must not have resided in France more than 12 months between 13/09/2020 and 13/09/2023</td></tr>
<tr><td>Application process</td><td>We encourage all motivated and eligible postdoctoral researchers to send their expressions of interest through the EU Survey application form (link here), before 1st of May 2023. Your application shall include:

• a CV specifying: (i) the exact dates for each position and its location (country) and (ii) a list of publications;

• a cover letter including a research outline (up to 2 pages) identifying the research synergies with the project supervisor(s) and proposed research topics described above.

Estimated timetable

<table>
<tr><td>Deadline for sending an expression of interest</td><td>1st of May 2023</td></tr>
<tr><td>Selection of the most promising application(s)</td><td>May – June 2023</td></tr>
<tr><td>Writing the MSCA-PF proposal with the support of the above-mentioned supervisor(s)</td><td>June – September 2023</td></tr>
<tr><td>MSCA-PF 2023 call deadline</td><td>13 September 2023</td></tr>
<tr><td>Publication of the MSCA-PF evaluation results</td><td>February 2024</td></tr>
<tr><td>Start of the MSCA-PF project (if funded)</td><td>1st of May 2024 (at the earliest)</td></tr>
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