# 6-month M2 internship opportunity at LOPS

## Characterizing the scales of Sea Surface Salinity using a novel filtering approach

**Laboratoire d'Océanographie Physique et Spatiale (LOPS)**

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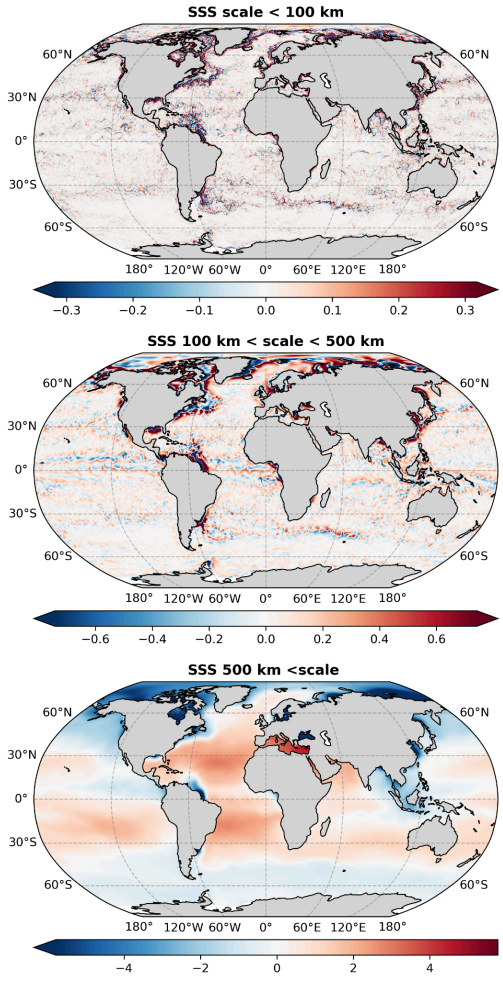


Salinity is an Essential Climate Variable, important for global ocean circulation, climate variability, and serving as a key indicator of the hydrological cycle. Despite this, it remains significantly less studied than temperature, with satellite observation only becoming available since 2010. Since then, missions like Aquarius, SMAP, and SMOS have provided near-global measurements of Sea Surface Salinity (SSS) at a maximum resolution of approximately 40 km, leading to significant improvements across various areas of ocean sciences[1].

It is recognized that mesoscale eddies play an important role in the global meridional transport of salt, water exchange between coastal and open oceans, and the mixing of larger-scale salinity features[2,3]. However, these scales are currently not well observed. Addressing this data gap, a prospective future satellite mission called SMOS-HR is currently under development, aiming to provide SSS observations at scales smaller than 40 km.

***Figure 1: Spatial scales of Sea Surface Salinity.*** *A Spatial filter is applied to a snapshot of GLORYS12 SSS in January 2010. The filter scales are given in the subplot titles.*

In this context, the objective of this internship is to advance the understanding of mesoscale salinity variability and to further demonstrate the potential scientific utility of high-resolution satellite SSS observations. To quantify and analyze the spatial variability of SSS—from unobserved mesoscales to the larger gyre scale—we will apply a novel filtering method and compute the corresponding power spectrum. We will use SSS fields derived from the eddy-permitting GLORYS12 ocean reanalysis (developed by Mercator) and compare the results with available satellite SSS observations. Preliminary results using a single day of GLORYS12 SSS are illustrated in Figure 1, which shows the result of the filter at various spatial scales, and Figure 2, which displays the resulting power spectrum. The salinity spectrum exhibits a classical power-law scaling over the mesoscale range (~10 km to ~500 km), with a transition to more complex variations at larger scales (>1000 km).

The internship will consist of one first main step and possibly a second one, depending on progression:

1) Characterize the spectra of the spatial variations of salinity globally and in several key regions. Characterize the spatial variations at multiple timescales: sub-annual, seasonal, interannual, time mean.
2) Study the physical mechanisms associated with each spatial scale of salinity variations by combining the above filtering approach with a salinity variance equation as recently done in ref [4] . Of particular interest will be the respective roles of freshwater forcing and horizontal advection.

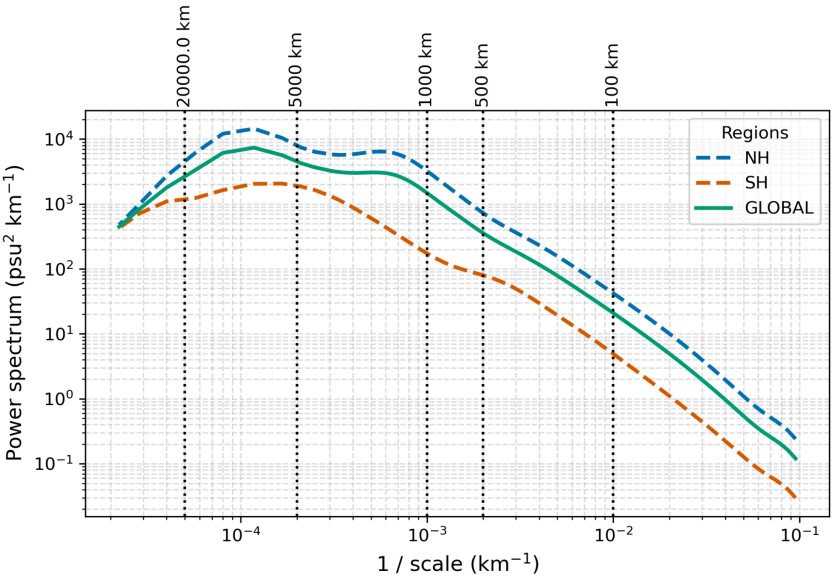


**Figure 2:** ***Spatially averaged SSS power spectrum as a function of wavenumber using a snapshot of GLORYS12.*** *The spatial average is computed over the global ocean (green), Northern Hemisphere (NH, dashed-blue) and Southern hemisphere (SH, dashed-orange).*

**Références:**


1. Reul, N. *et al.* Sea surface salinity estimates from spaceborne L-band radiometers: An overview of the first decade of observation (2010–2019). *Remote Sens. Environ.* **242**, 111769 (2020).
2. Treguier, A. M. *et al.* Meridional transport of salt in the global ocean from an eddy-resolving model. *Ocean Sci.* **10**, 243–255 (2014).
3. Swingedouw, D. *et al.* AMOC Recent and Future Trends: A Crucial Role for Oceanic Resolution and Greenland Melting? *Front. Clim.* **4**, (2022).
4. Hochet, A., Tajouri, S., Kolodziejczyk, N. & Llovel, W. Mechanisms of Tropical Sea Surface Salinity Variations at Seasonal Timescales. *J. Geophys. Res. Oceans* **130**, e2024JC021455 (2025).