

## Master 2 or Engineer internship

### Upper ocean stratification in the North Atlantic in a changing climate

5 to 6 months internship, spring-summer 2021

Scientific contact : Anne Marie Treguier

Collaborations : Clément de Boyer Montégut

Laboratoire d'Océanographie Physique et Spatiale (LOPS), IUEM, Brest

The upper ocean is characterized by a surface well-mixed layer, overlying a transition region which is seasonally stratified, and a permanently stratified layer below. Since the pre-industrial era, the ocean has absorbed more than 90% of the excess heat generated by human activities, mainly in the upper 700m, which increases the upper ocean stratification. Understanding the physical mechanisms of changes in this stratification is very important to predict the future ocean heat uptake and the impacts of mixed layer changes on the ocean ecosystems. Stratification varies due to air-sea fluxes, ocean circulation, but also mesoscale and submesoscale eddies, which are known to play a key role in the spatial heterogeneity of the upper layers, although this role is not well quantified yet and these processes are very crudely represented in climate models.

This internship is proposed as part of the MEDLEY international project (MixED Layer heterogeneity). The objective is to better characterize the seasonal and interannual variability of the stratification at the base of the mixed layer in the North Atlantic and Nordic seas, using observations of the present climate. We will use the vertical profiles of the ARGO network to obtain a climatology of the transition layer. In complement, the OSMOSIS experiment dataset can be used to provide a high resolution, eddy-resolving picture of the seasonal cycle in a limited region of the North Atlantic.

In a second part of the internship, if time permits, it will be possible to assess the biases of climate models using the observed statistics of the transition layer.

The work will be organized in the following steps:

- Document the seasonal to interannual variability of the stratification in the upper ocean, focussing on the transition layer, in datasets built from in-situ observations such as ARGO or OSMOSIS.
- Quantify and understand the separate roles of temperature and salinity in driving changes in stratification of the transition layer, in the different regions of the North Atlantic and Nordic seas.
- Study the seasonal to interannual variability in relation with the atmospheric variability (using atmospheric reanalysis products) and observations of ocean mesoscale eddies (altimetry).
- Use the observed statistics to quantify the biases in the latest generation of coupled climate models.

Expertise required :

master 2 student in physical oceanography, meteorology, or fluid dynamics. Knowledge of numerical modelling and analysis tools such as Matlab or Python.

Workplace :

LOPS, IUEM, rue Dumont D'Urville, 29280 Plouzane

Contact :

Anne Marie Treguier ([anne-marie.treguier@univ-brest.fr](mailto:anne-marie.treguier@univ-brest.fr))