

# A seasonal climatology of the upper ocean pycnocline

*G. Sérazin<sup>1</sup>, A. M. Tréguier<sup>1</sup>, C. de Boyer Montégut<sup>1</sup>*

<sup>1</sup> *Ifremer, Univ. Brest, CNRS, IRD, Laboratoire d'Océanographie Physique et Spatiale (LOPS),  
IUEM, 29280, Plouzané, France*

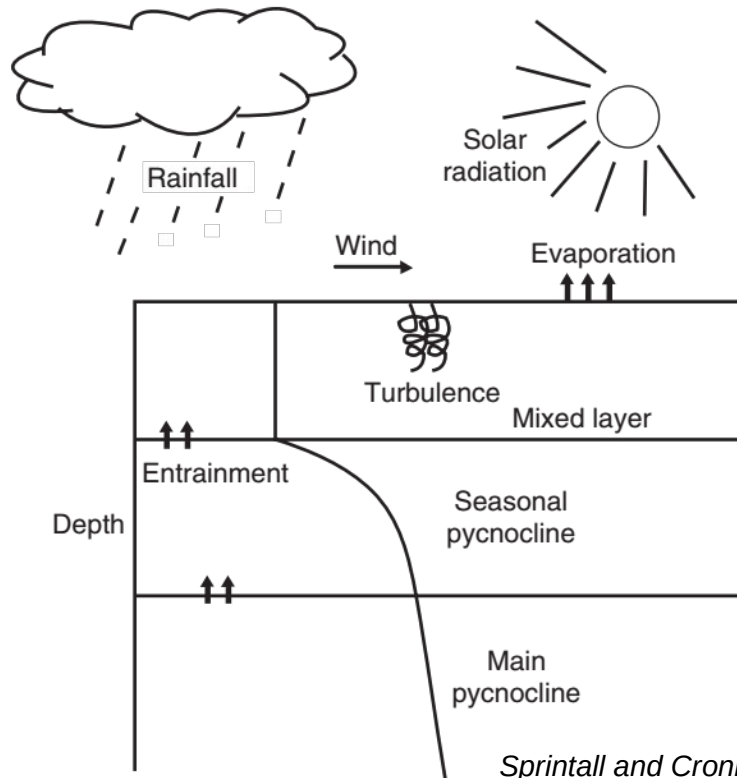
*EGU General Assembly 2022*



*Corresponding author: [guillaume.serazin@univ-brest.fr](mailto:guillaume.serazin@univ-brest.fr)*

# Introduction: the upper ocean vertical structure

## The textbook picture:



*Sprintall and Cronin, 2009*

- **Mixed layer:**
  - Intense vertical mixing
  - Vertically homogeneous (i.e., weak stratification)
  - Influenced by surface forcing (momentum and buoyancy)
- **Transition layer or seasonal pycnocline:**
  - Strong stratification
  - Strong shear
  - Moderate mixing
- **Permanent pycnocline:**
  - Moderate stratification
  - Weak mixing

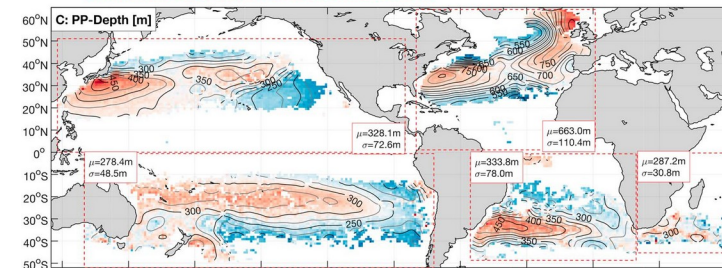
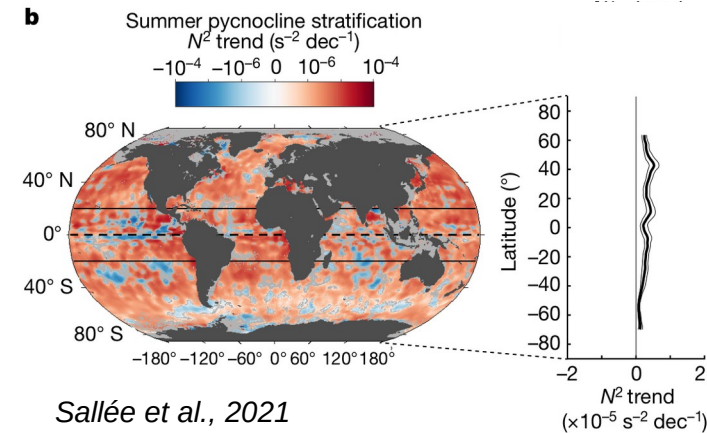
Few measurements of turbulent dissipation and vertical shear but near-global coverage of stratification from hydrographic profiles

-> **Focus on the upper ocean pycnocline (UOP)**  
= **first stratification maximum**

# Scientific questions

## UOP: Upper ocean pycnocline

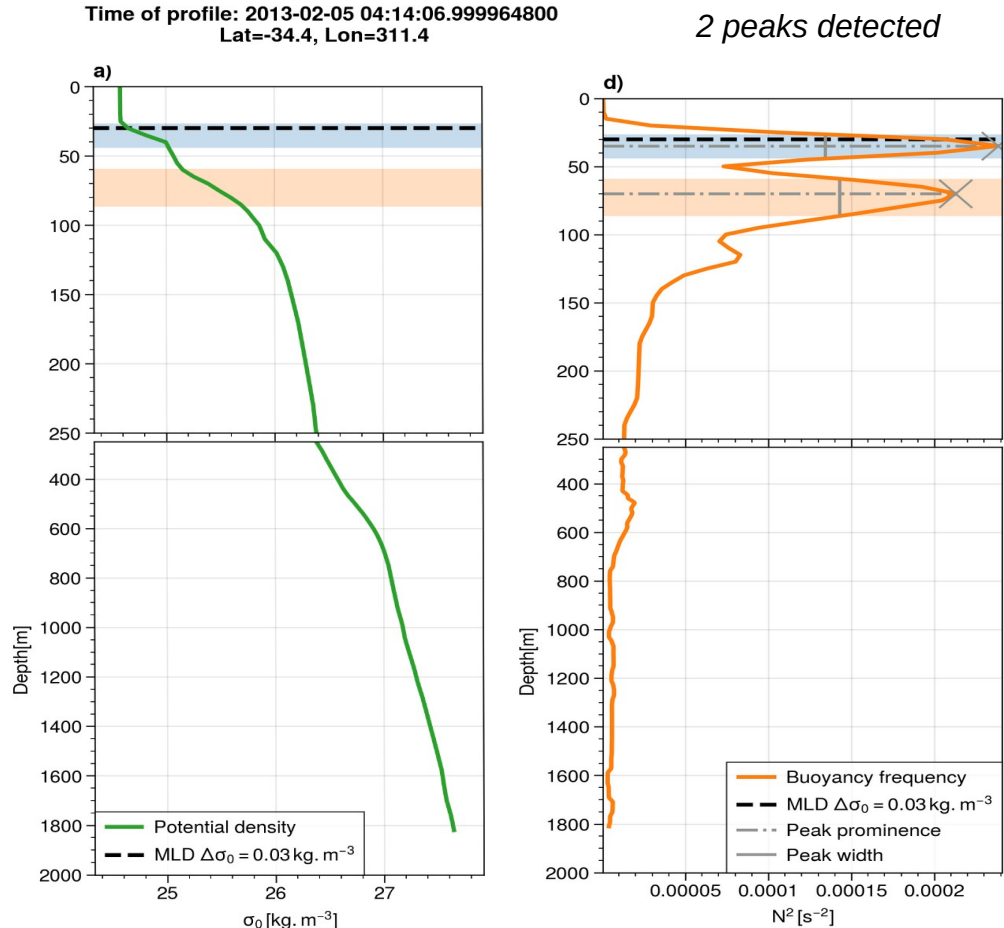
- How does the UOP thickness vary over the world ocean ?
  - the UOP thickness was considered to be constant and equal to 15 m in *Sallée et al. 2021*
  - Seasonal cruises in four regions: 8-24 m (*Jonhston and Rudnick, 2009*)
- How seasonally and regionally variable are the amplitude (stratification) and depth of the UOP ?
  - complementing the permanent pycnocline mapping (*Feucher et al., 2019*)
- How variable are UOP characteristics between season, especially during restratification periods ?



Feucher et al., 2019

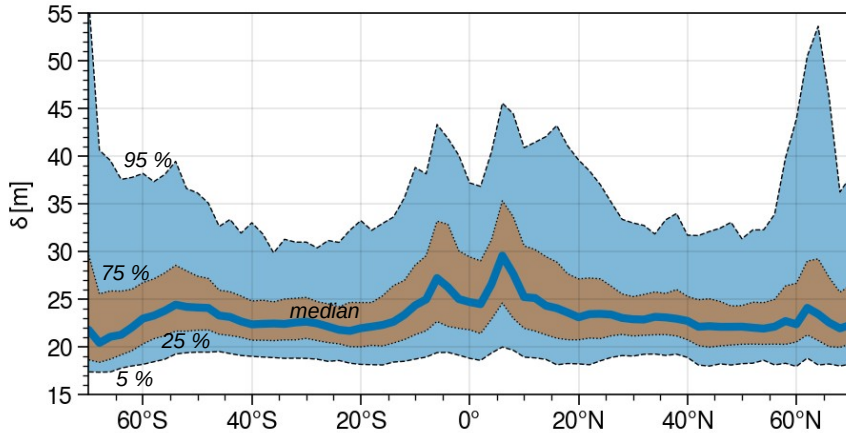
# Method: peak detection on N2 profiles

- **Dataset:** ISAS20 (ARGO profiles), delayed mode only
- **Interpolation:** 5 m vertical resolution
- **Smoothing:** 5-point running mean
- **Peak detection:** `scipy.signal.find_peak`
  - Minimum prominence: half of the vertical standard deviation
  - Distance between peaks: 5 points (25 m)
  - The UOP is defined as the first peak from the surface
- **Monthly binning in 2°x2° bins**

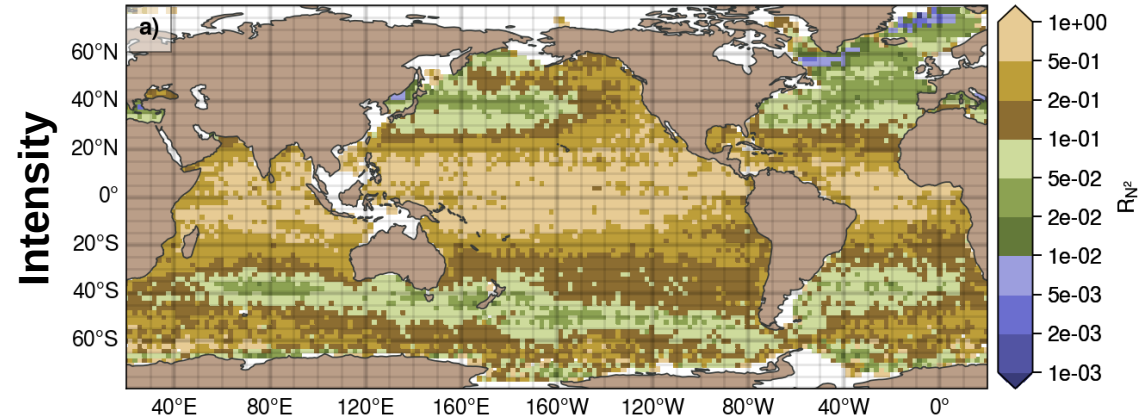


# Results: UOP seasonal climatology

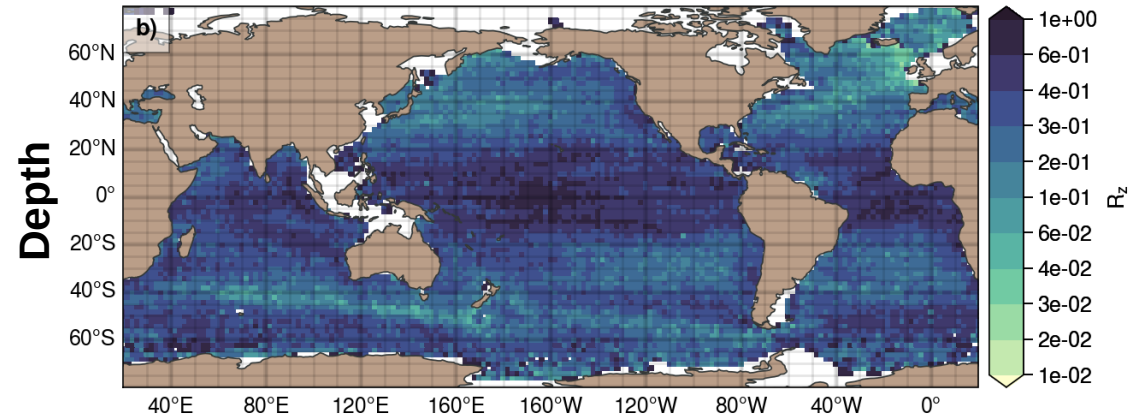
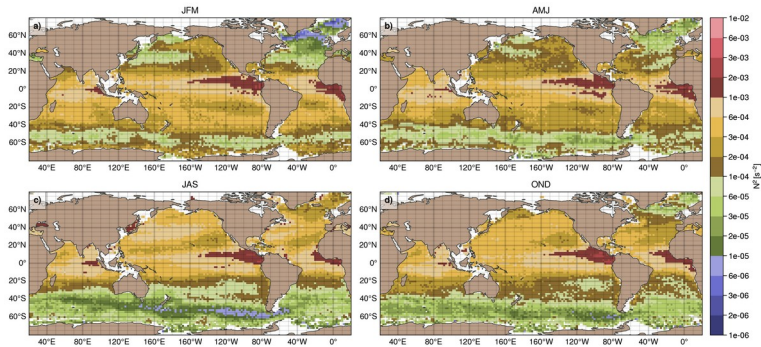
## UOP thickness on a zonal average



## Seasonal ratio min / max

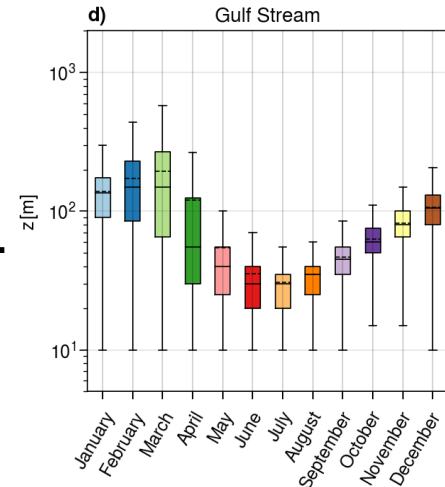
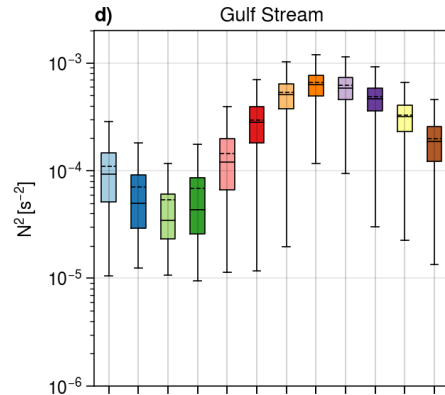


See seasonal climatology in supplementary slides

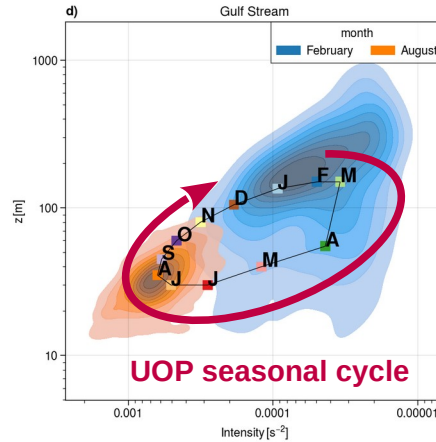


# Results: UOP seasonal statistics

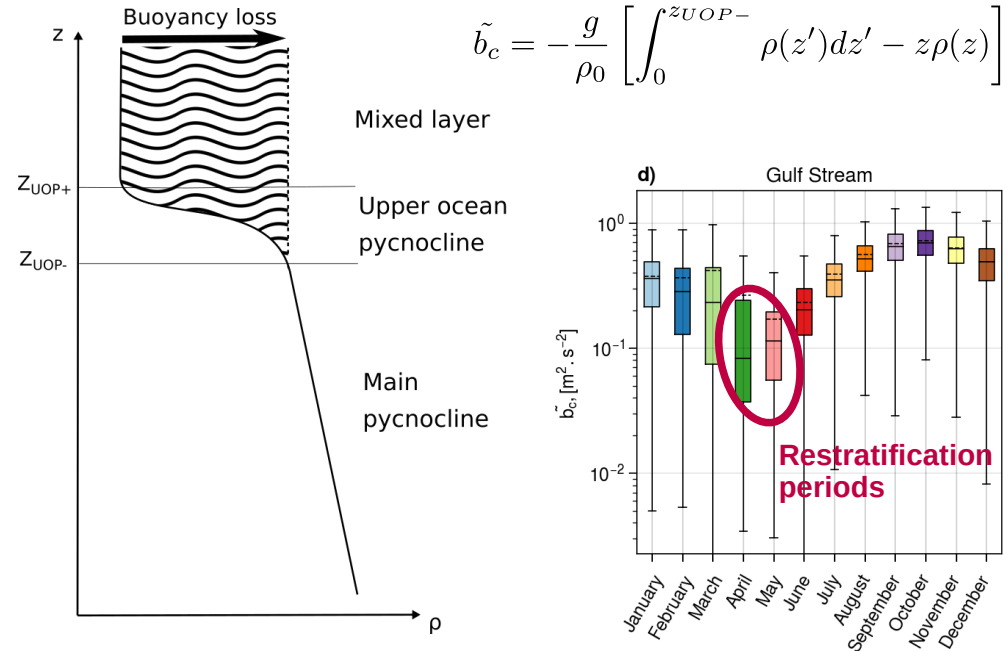
## Seasonal distributions



## Joint distribution Intensity vs depth



Intensity  $\times$  Depth  $\Rightarrow$  buoyancy anomaly required to destratify the UOP



Low  $\tilde{b}_c \rightarrow$  weakly-stratified UOP that can be easily eroded by buoyancy loss

# Main messages

- The UOP thickness is relatively constant over the world ocean around **23 m**.
- The seasonal amplitude is large at mid and high latitudes:
  - Gulf Stream, Kuroshio extension, ACC  $O(10)$ ,
  - Nordic Seas, and Labrador seas  $O(100)$
- The columnar buoyancy anomaly associated with the UOP is a good proxy for restratification, it is minimum and very variable during restratification events
- We are preparing a complete dataset that will be available to the community  
+ 1 paper coming soon