
The Bay of Biscay mixed layer structure and evolution

- EPIGRAM proposal, IV:

“Impact of atmospheric forcing and river plumes on the shelf dynamic”

Flavien Gouillon

With Yves Morel and Rémy Baraille

Meeting Epigram - 2011



Motivation

Mixed layer plays a **key role** in the atmosphere-ocean heat balance

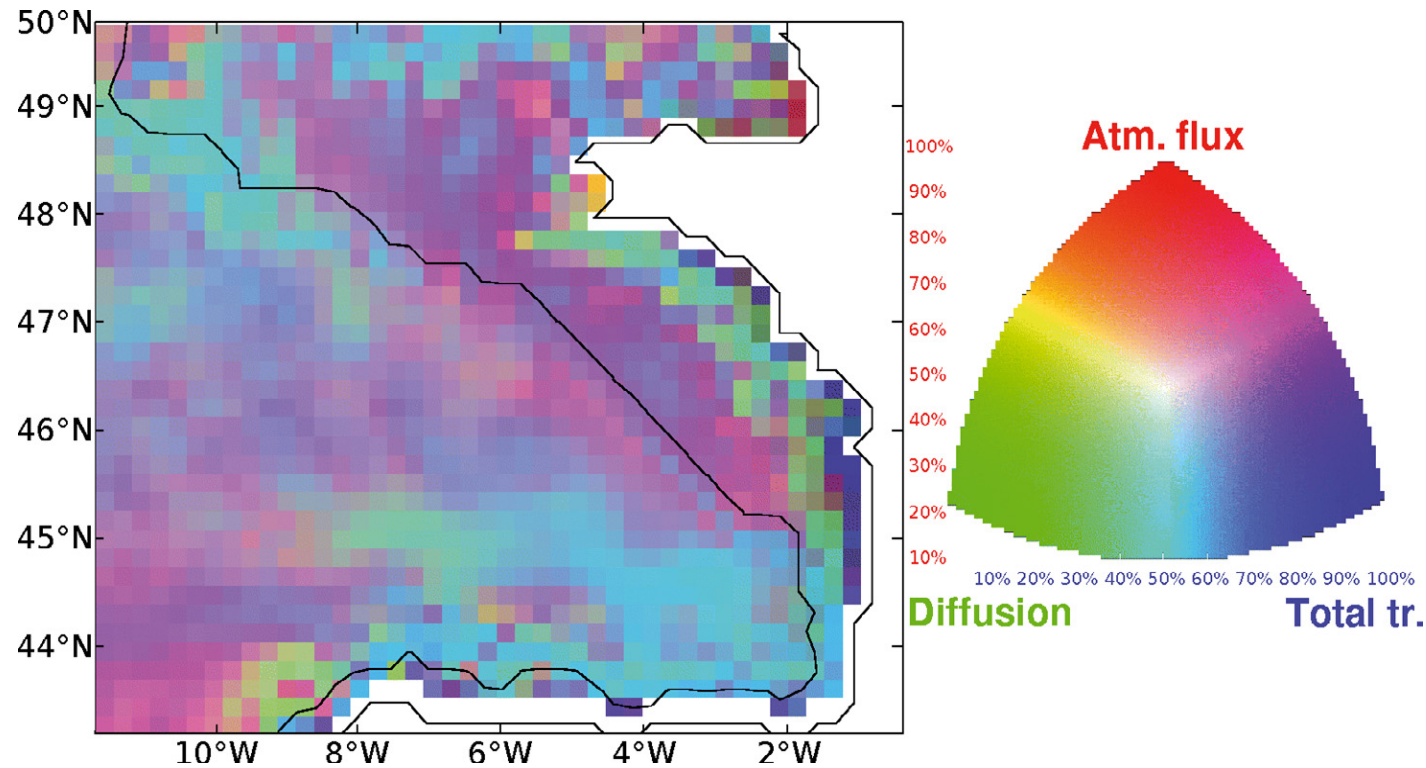
An **accurate representation** of the mixed layer depth in OGCMs is needed

What controls the dynamic of the mixed layer is known but **terms that contributes** to its evolution are not quantified in the Bay of Biscay

The HYCOM simulated ocean mixed layer is too deep at the end of the summer

Global context

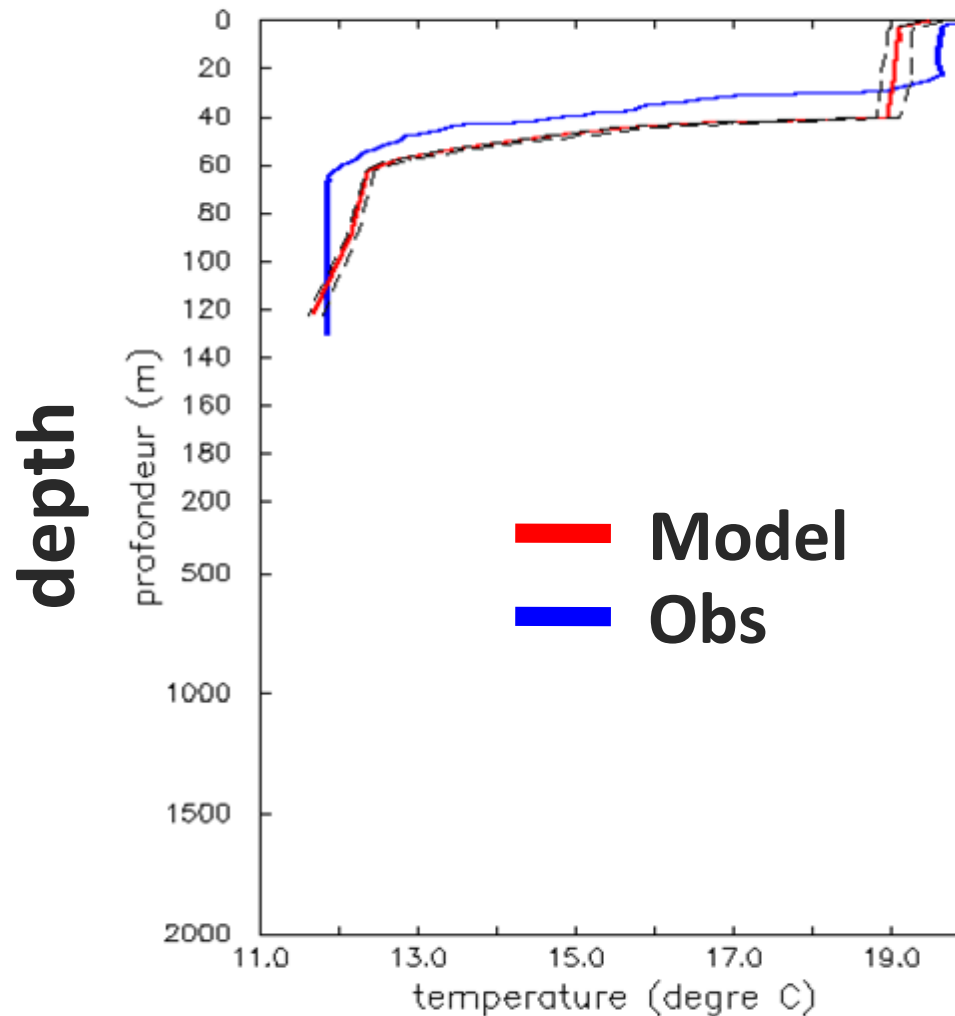
- MLD evolution is determined through the equation of heat and salt conservation: advection, vertical entrainment, thermal flux, diffusion, evaporation and precipitation
- *Lazure and Dumas (cross-shelf study), autumnal circulation*



Relative contributions of the 3 major terms to the interannual balance of the 0-200m layer from ~50 years ORCA simulation (*Michel et al., 2009*)

Inaccurate representation of the mixed layer depth in HYCOM-SHOM at the end of Summer

Mooring, 10 September, Bay of Biscay



Objectives

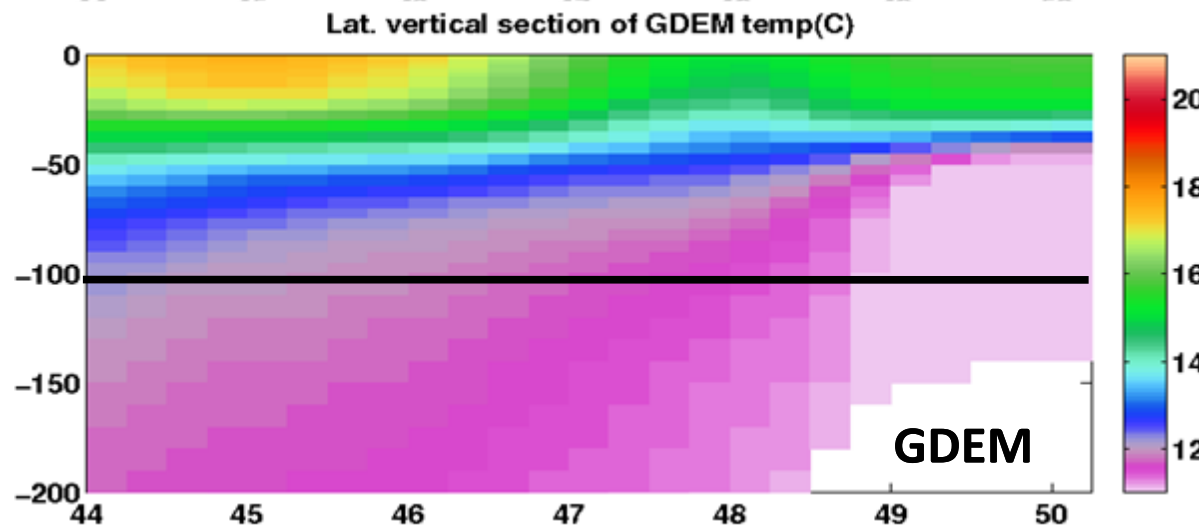
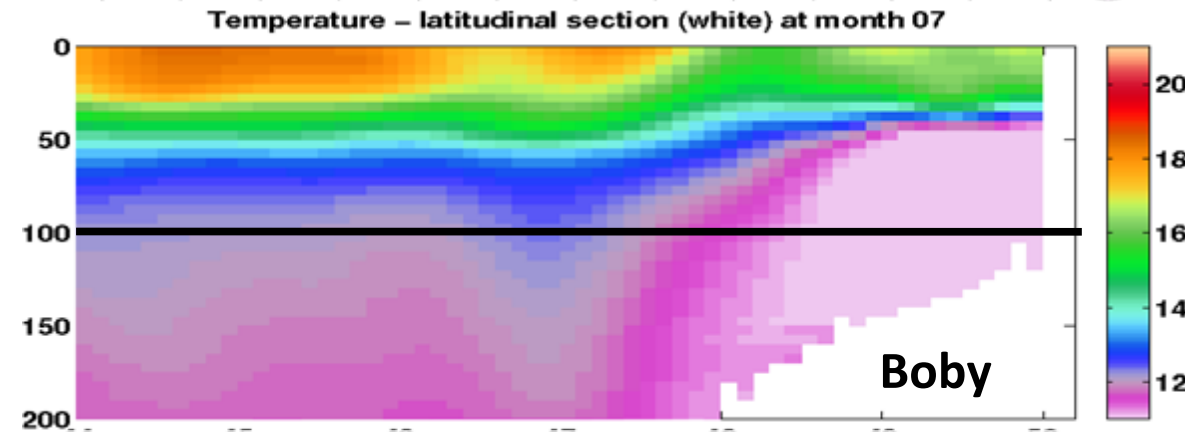
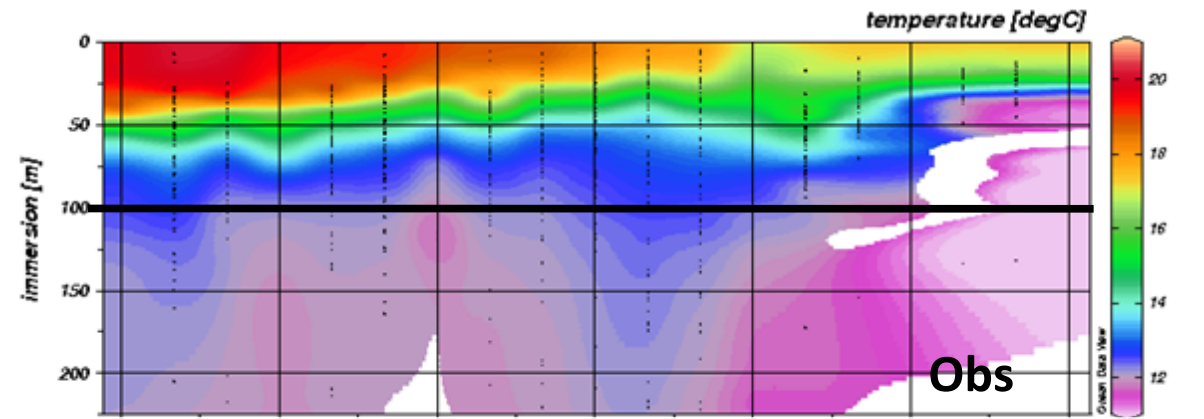
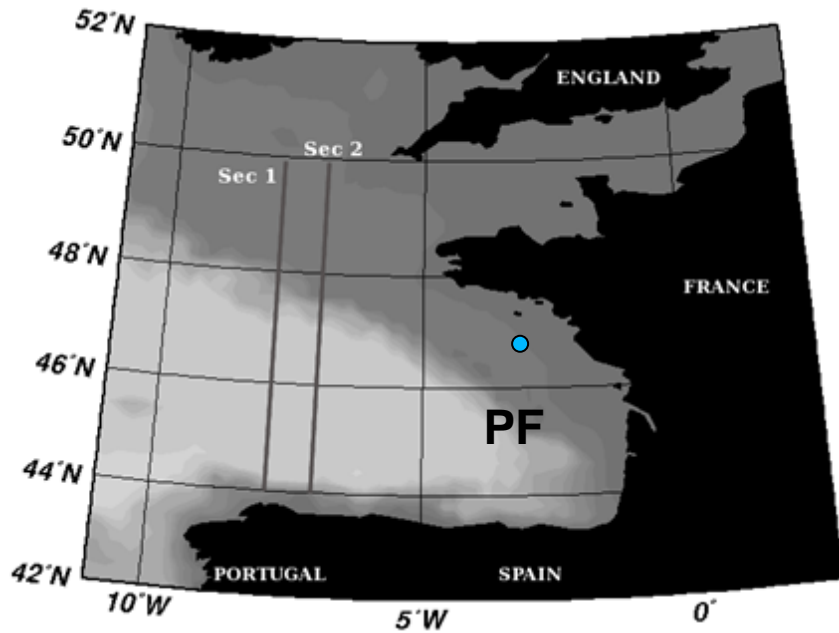
- **Better understand** the dynamic and evolution of the mixed layer in the Bay of Biscay
- **Quantify** the impact of the different terms that act on the mixed layer dynamic and its depth evolution:
 - . Mixing (shear instability, internal wave, BBL)
 - . Atmospheric flux
 - . Local and regional circulation, permanent *vs.* transient
- **Model Validation**

Approach/Methods

- 1) Observations** (MOUTON, PROTEVS, etc.)
- 2) Climatology** (GDEM, BOBY, model forcing)
- 3) Modelisation**

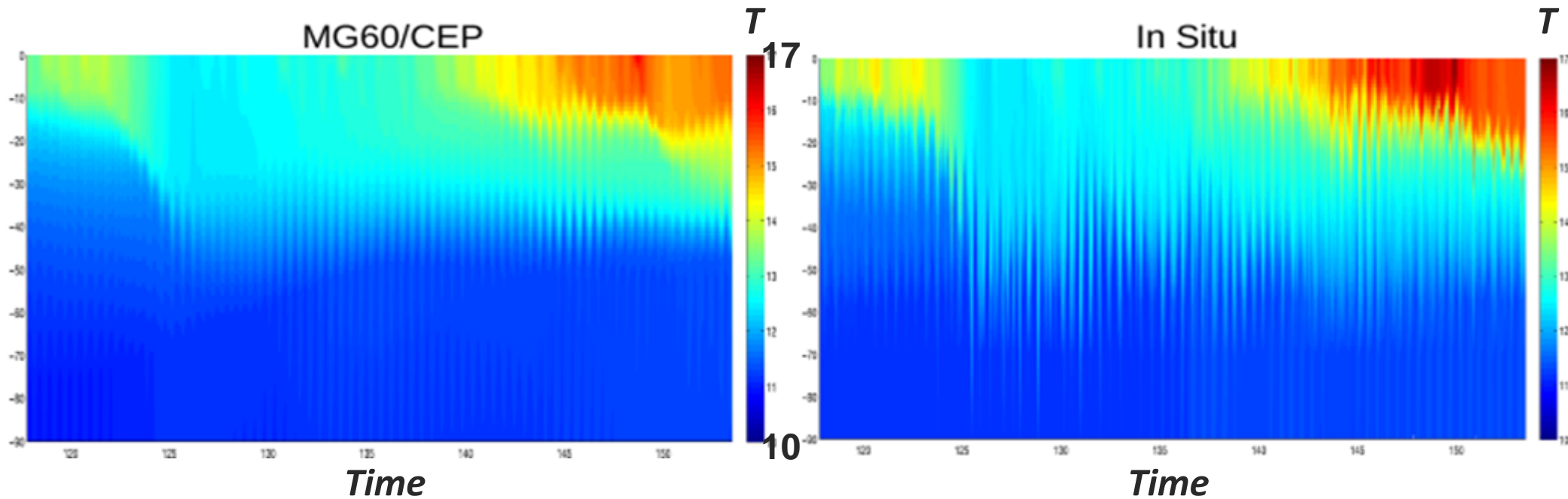
**Specific focus from May to October
(restratification, seasonal thermocline)**

1) Observation AXBT: Temp ($^{\circ}\text{C}$), July 2005

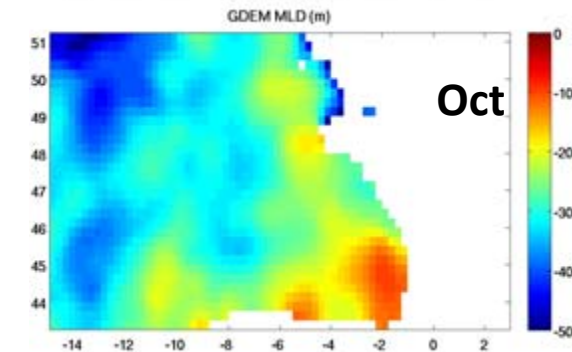
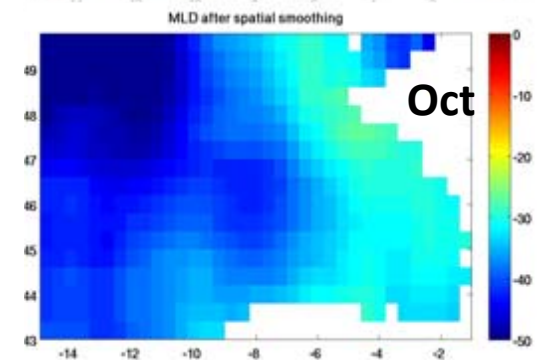
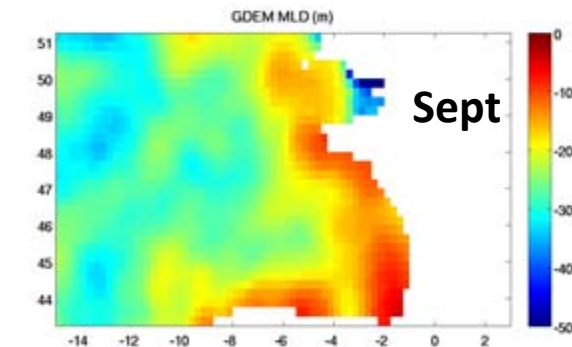
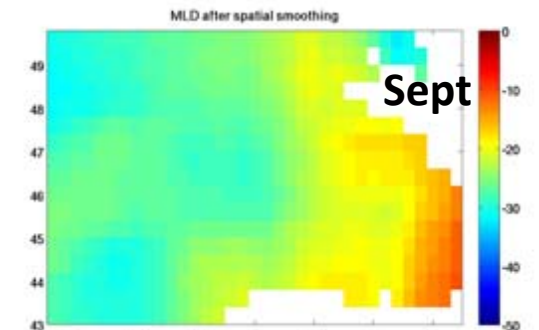
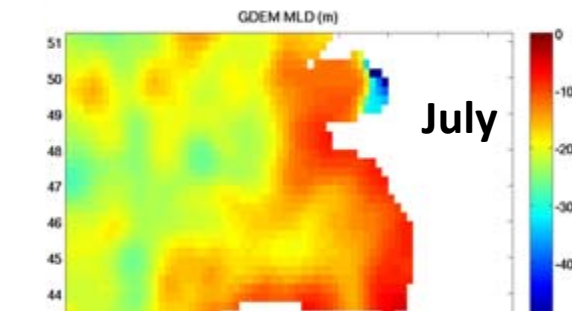
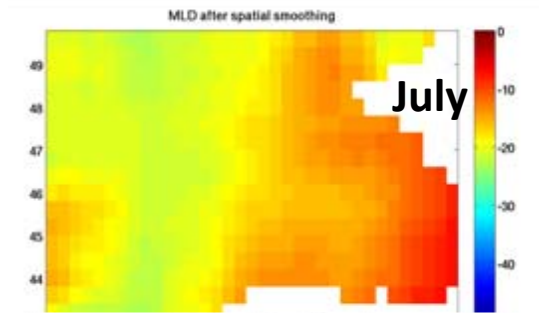
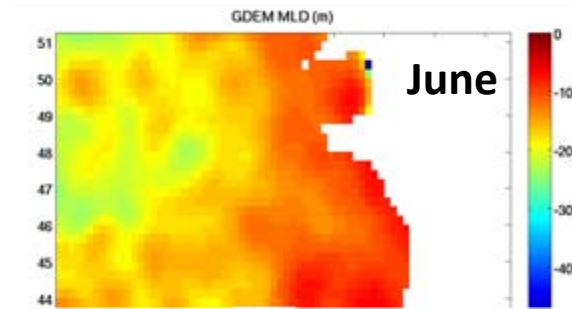
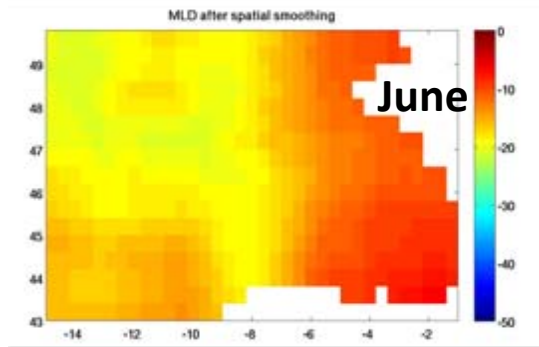


1) Observation: Mooring

Comparison between real time simulations and in situ data at PF
C. Lathuiliere



2) Mensual MLD Climatology Boby / GDEM



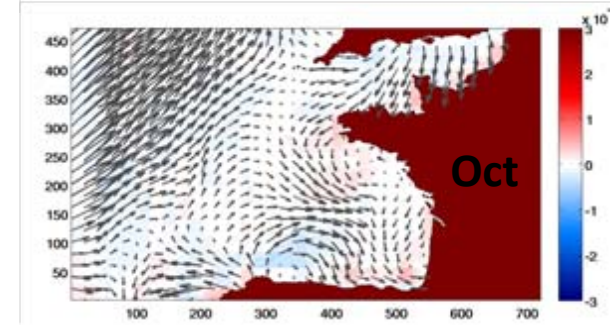
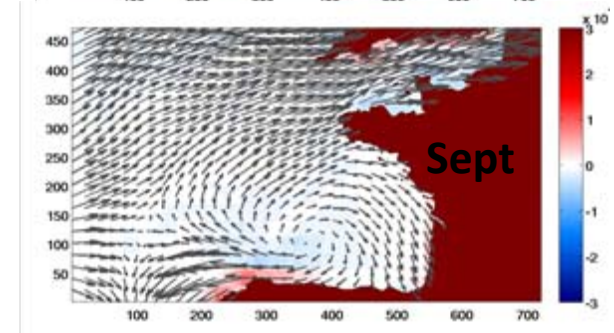
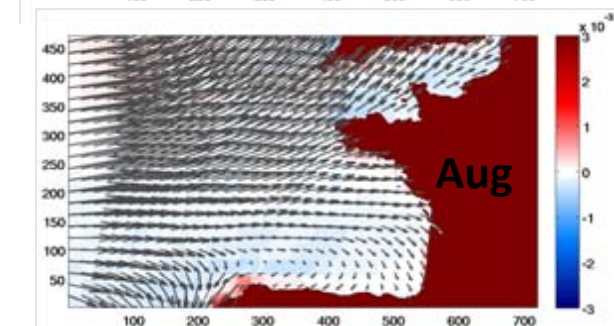
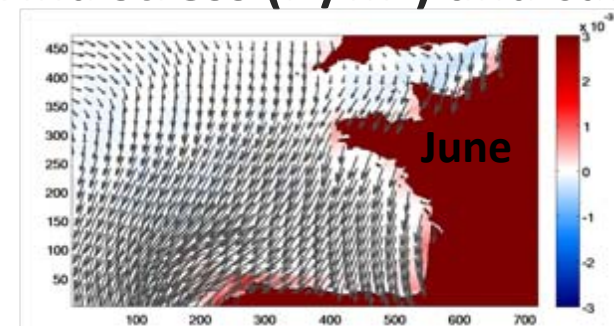
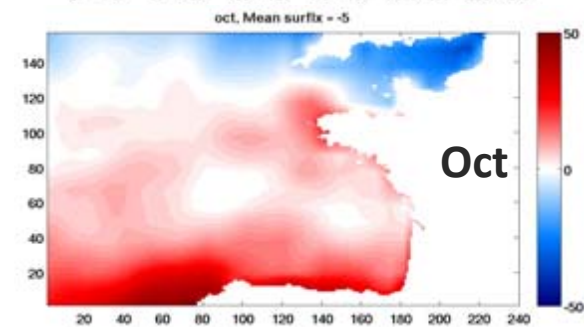
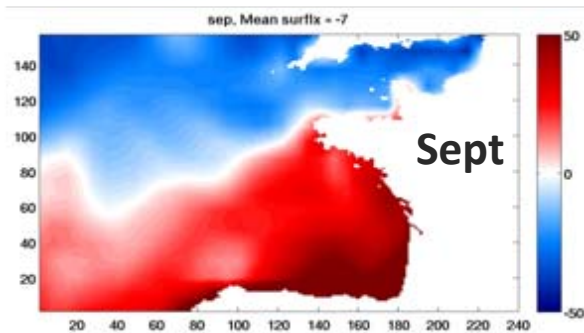
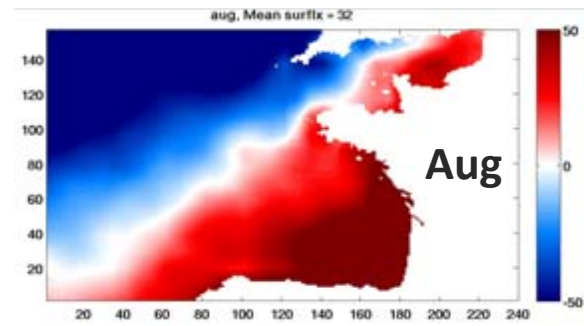
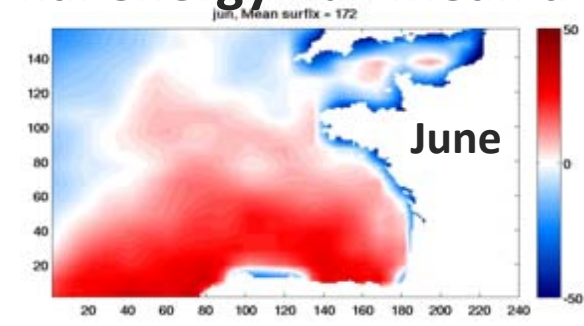
Use of T criteria of
Boyer de Montegut

West/East pattern

Warm pool \rightarrow minimum
MLD

2) Mensual Forcing Climatology (CEP)

Thermal energy flux mean anomaly (W/m^2) Wind stress (N/m^2) and curl (N/m^3)



3) Modelisation: 3D Model without advection

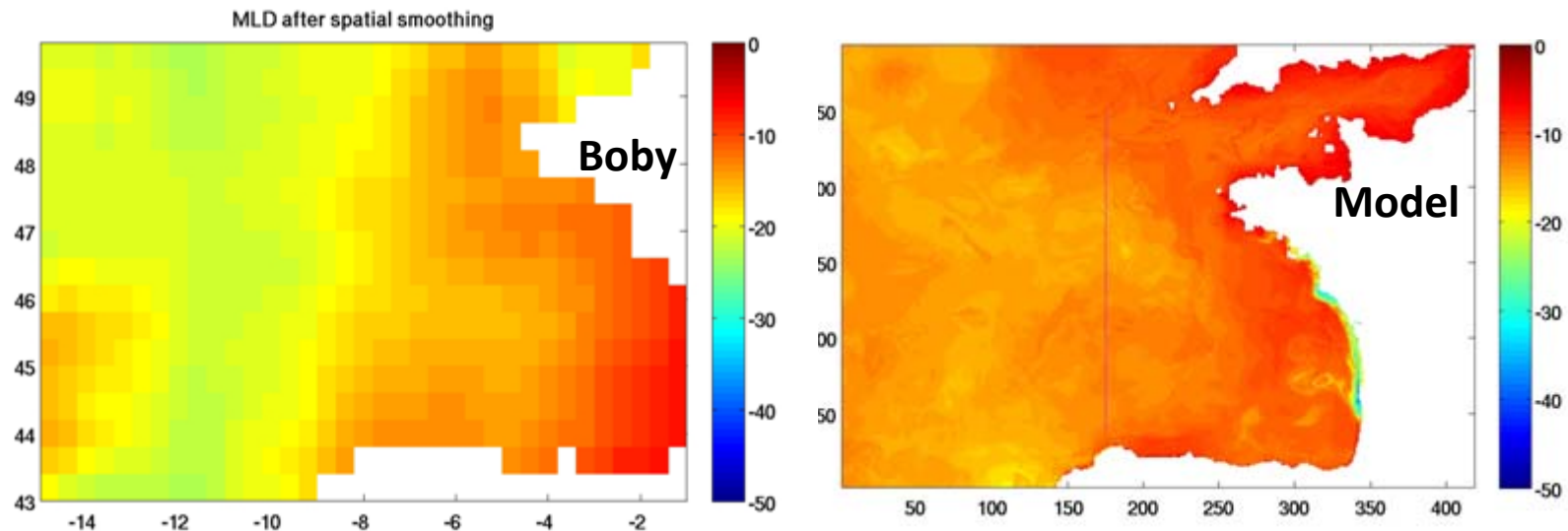
Manche Gascogne, 5.5km, 32 layers

KPP vertical mixing scheme

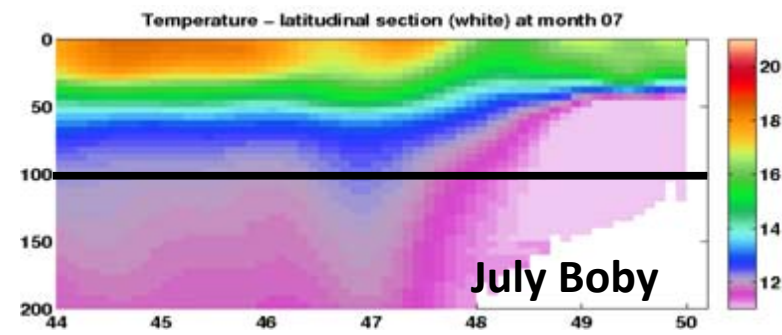
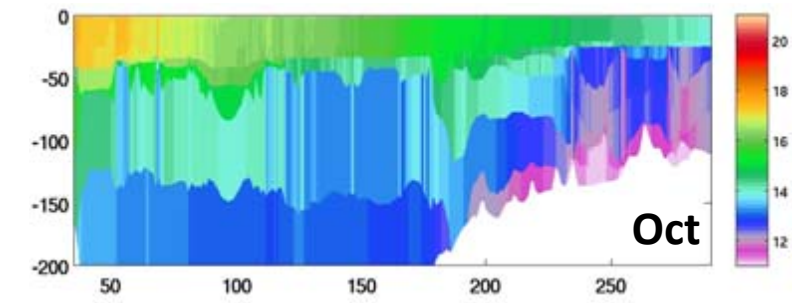
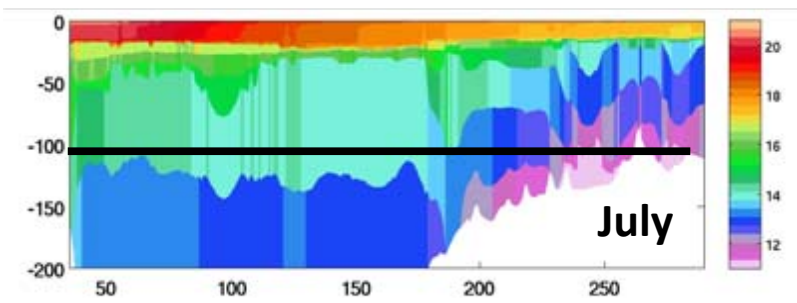
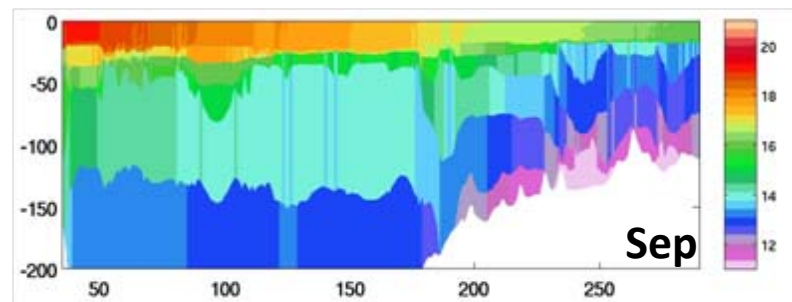
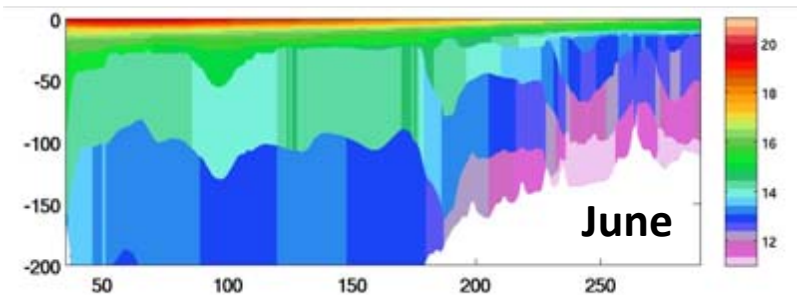
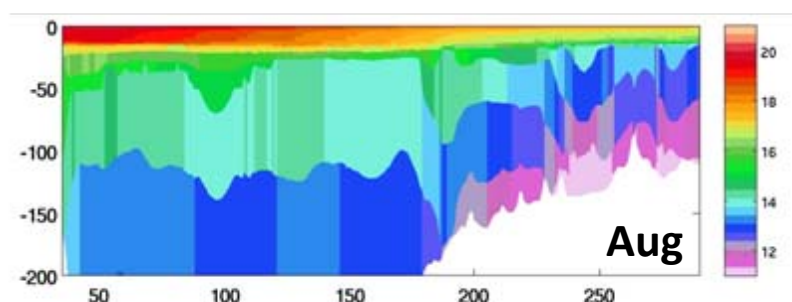
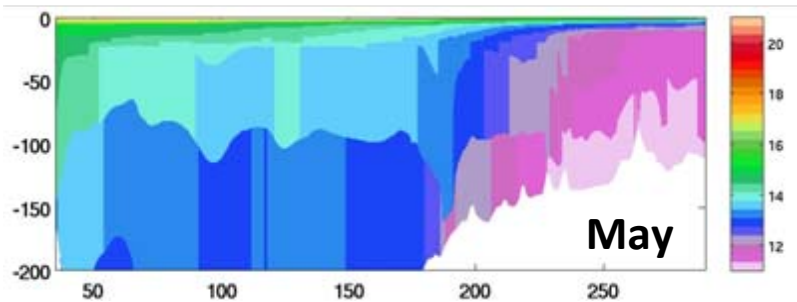
CEP forcing (analysis)

No advection (but stress in the momentum equation)

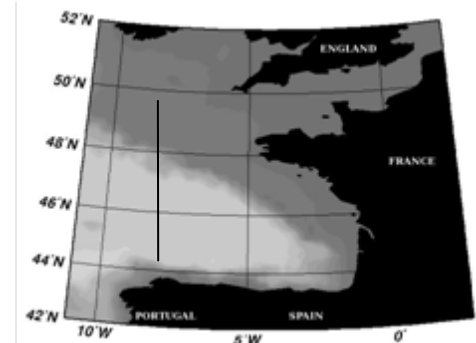
1 year simulation, output every 6 hours



3) 3D Model without advection

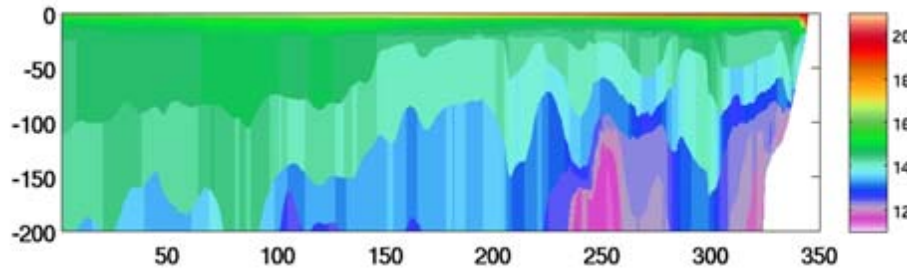


AXBT, 2005

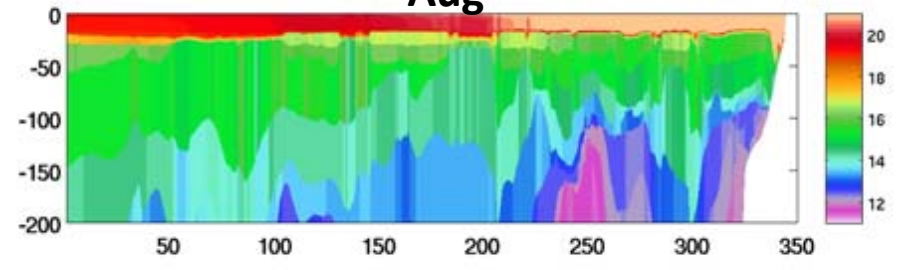


3) Modelisation (warm pool)

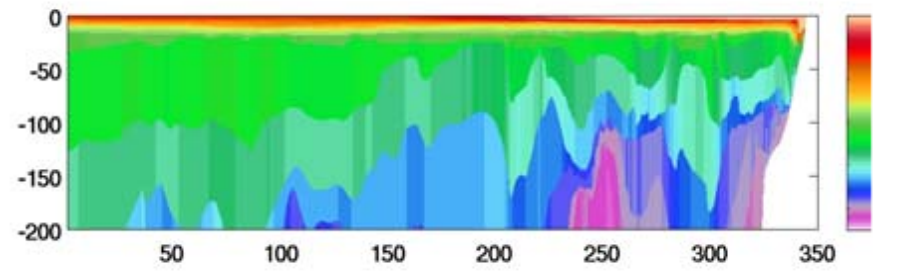
May



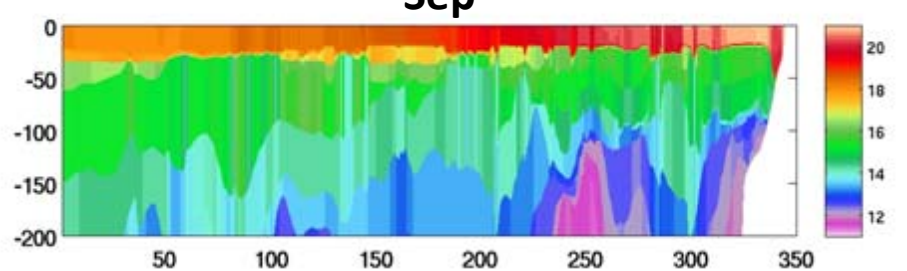
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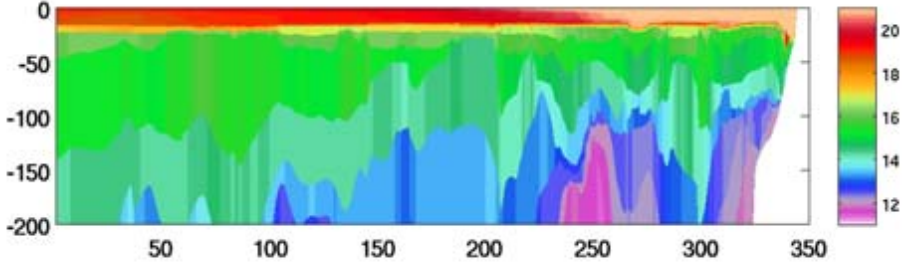
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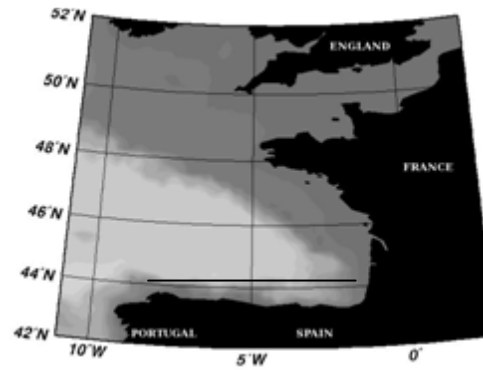
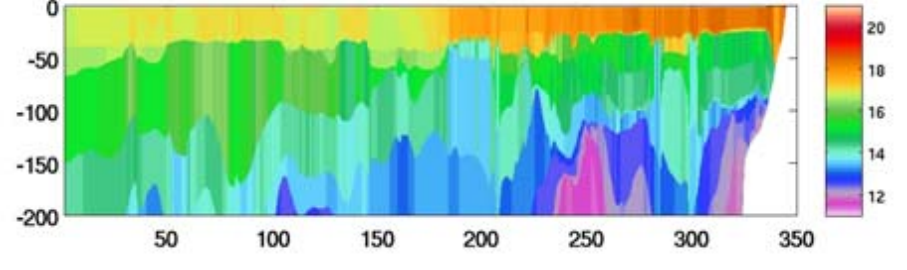
Sep



July



Oct



Bathysonde, 2005-leg2

Conclusion and perspective

- Understand first the 'big' pattern in the temperature (MLD) gradient through climatology
- These big pattern seems to be present in the 3D model without advection
- More analysis:
 - quantification of contributing terms in the mixing through academic simulations
 - Comparison full 3d with and without advection
 - Comparison to observation, SST, *Lorbacher* criteria
- In the forcing, is there a bias in steric effect looking at the integrated thermic content?
- Numerical point of view: run 3D model with more layers and other vertical scheme
- Pure 1D academic simulation have been done to study impact of turbulent closure scheme and model vertical resolution choice