Validation of KPP in a coastal area

By Cécile Renaudie (Météo France/SHOM)

and Rémy Baraille (SHOM), Yves Morel (SHOM), Gwenaëlle Hello (Météo France), Hervé Giordani (Météo France)

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- I. Data from MOUTON2007;
- II. Atmospheric forcings;
- III. Sensitivity tests of KPP using HYCOM;
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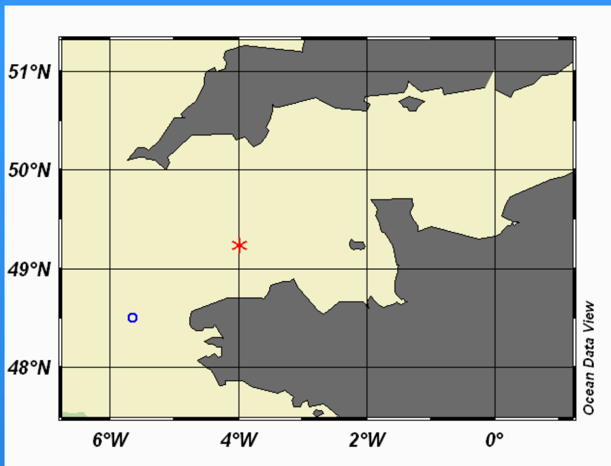
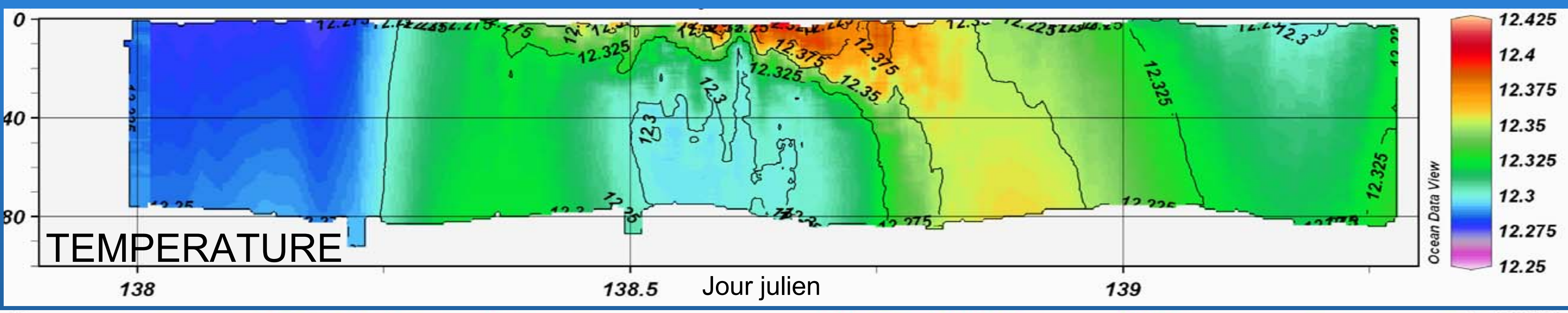
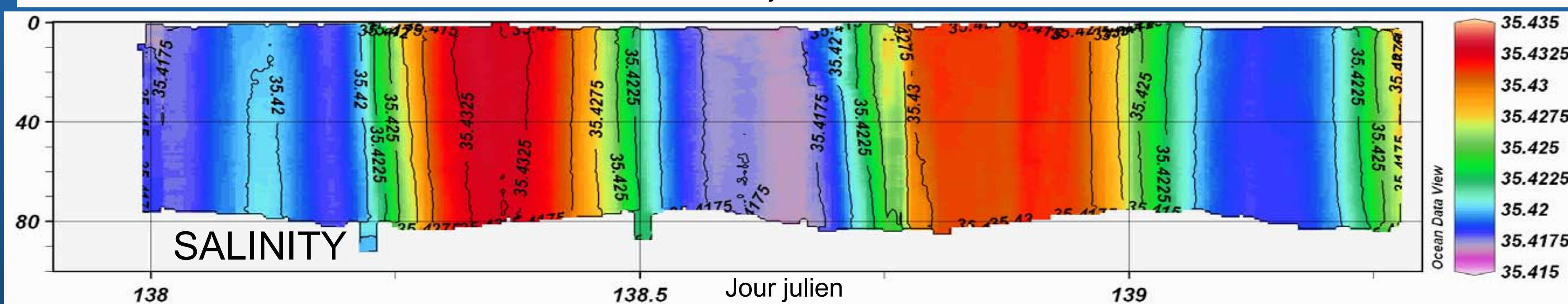
I.1. MOUTON 2007



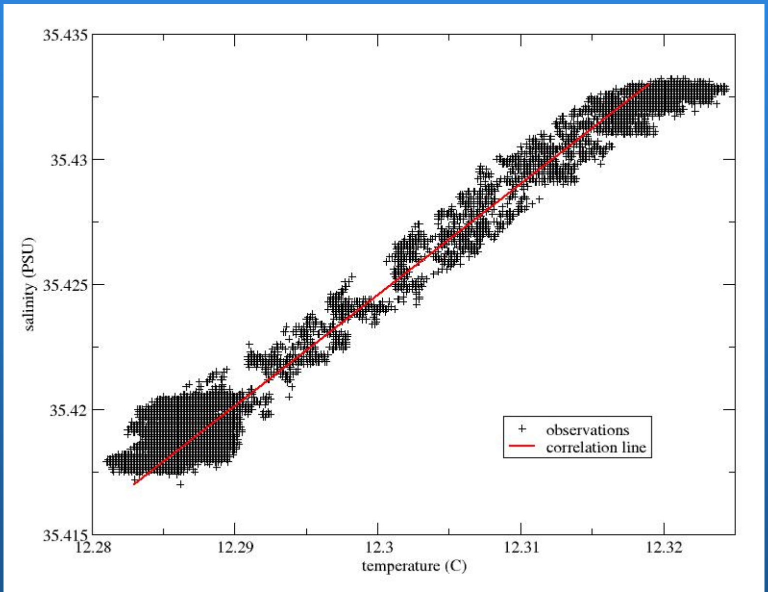
- MOUTON : project involving the French Navy and other research centers;
- Date : May 18th 2007;
- Location : Bay of Iroise;
- Mooring : (49.2N,4W) *
- Comparison with observations from a buoy located in (48.5N,5.75W) o

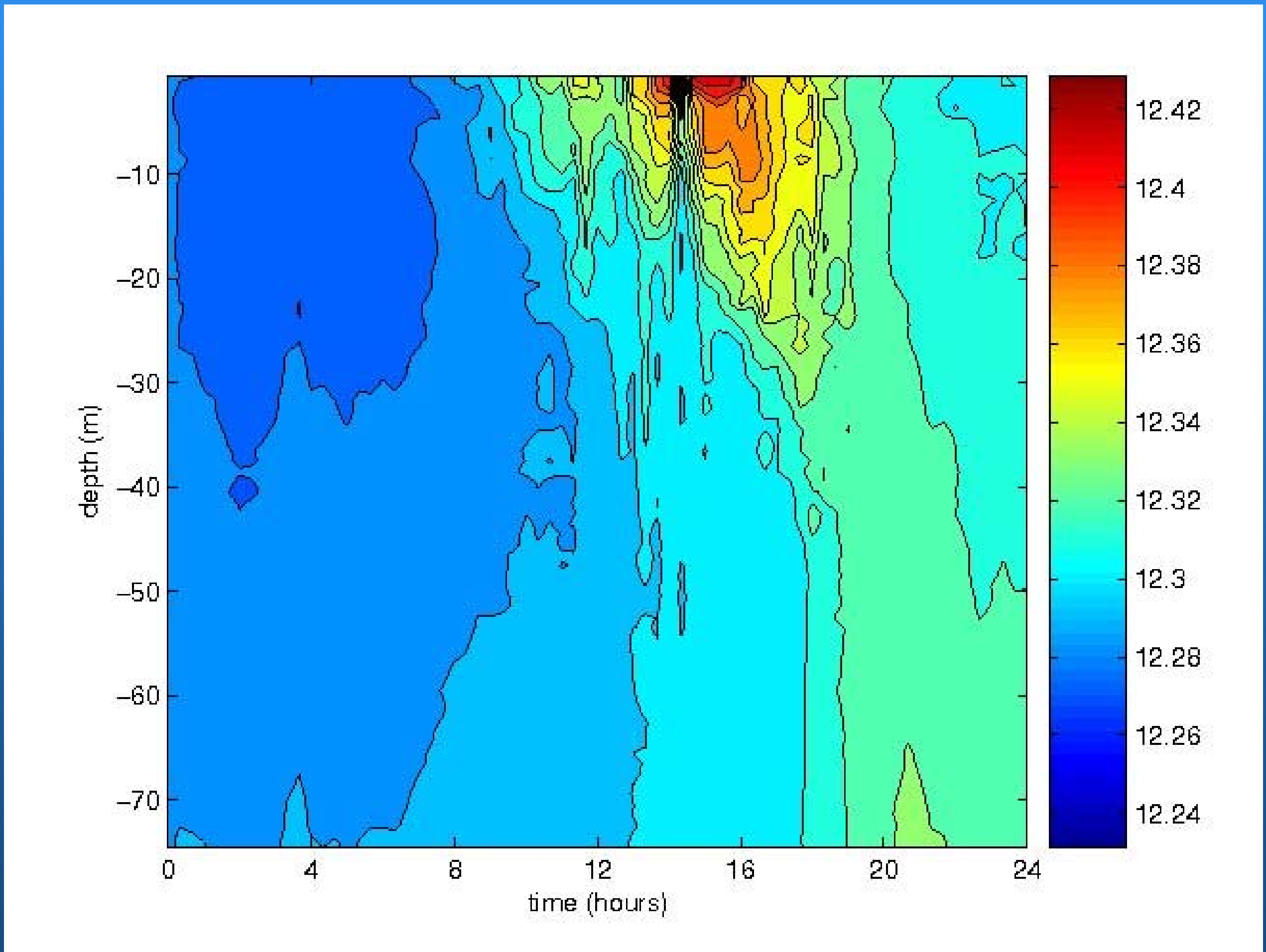




I.2. Filtering the effects of tide

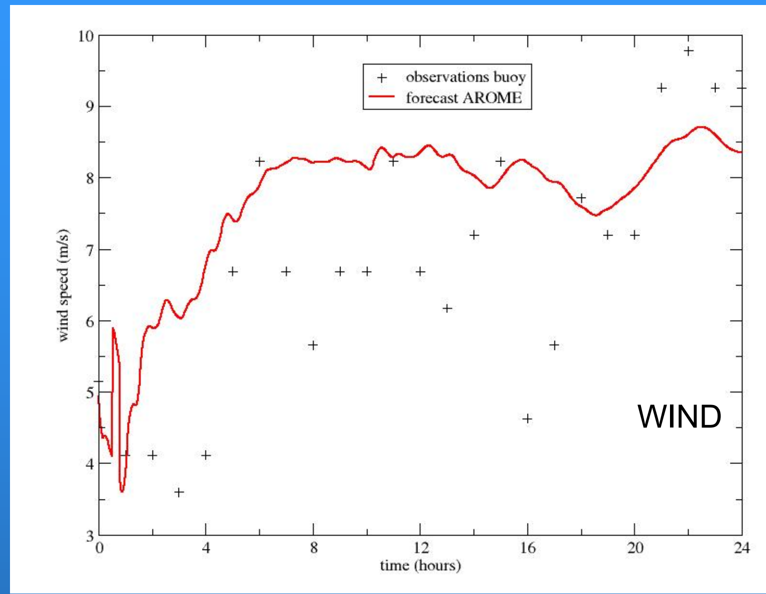
- $\Delta T_{tot} = \Delta T_{tide} + \Delta T_{rad}$
- Correlation temperature/salinity : $T_{tide} = aS + b$
- a = 2,25 and b=-67,4

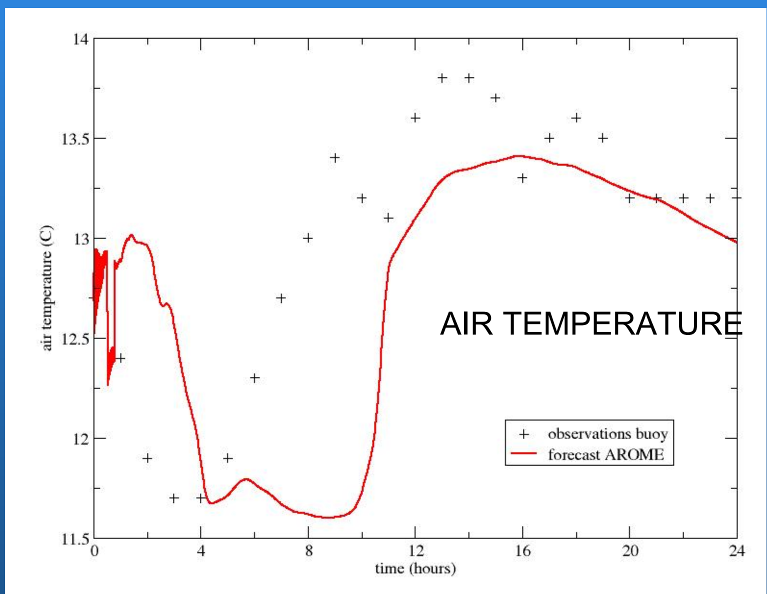


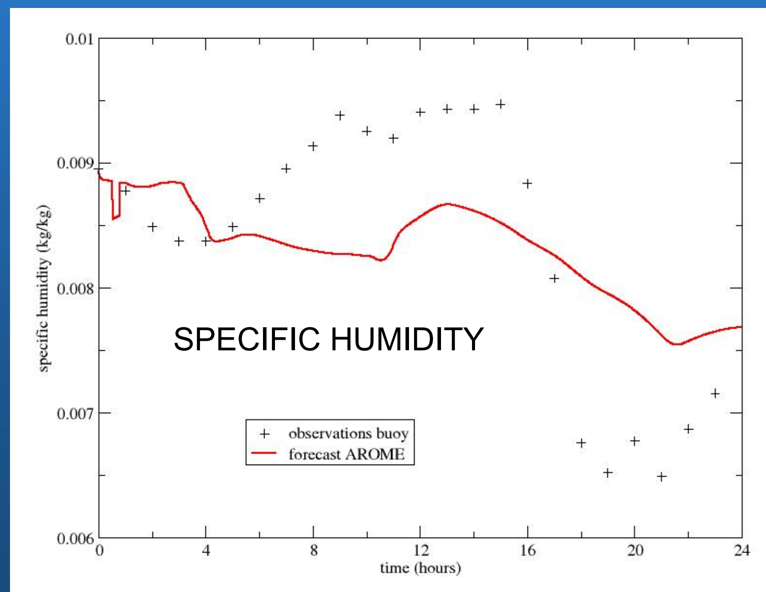


II.1. Validation of the atmospheric model AROME (at the location of the buoy)

AROME : Application of Research to Operations at MesoscalE : operational mesoscale weather forecast model developed by Météo France



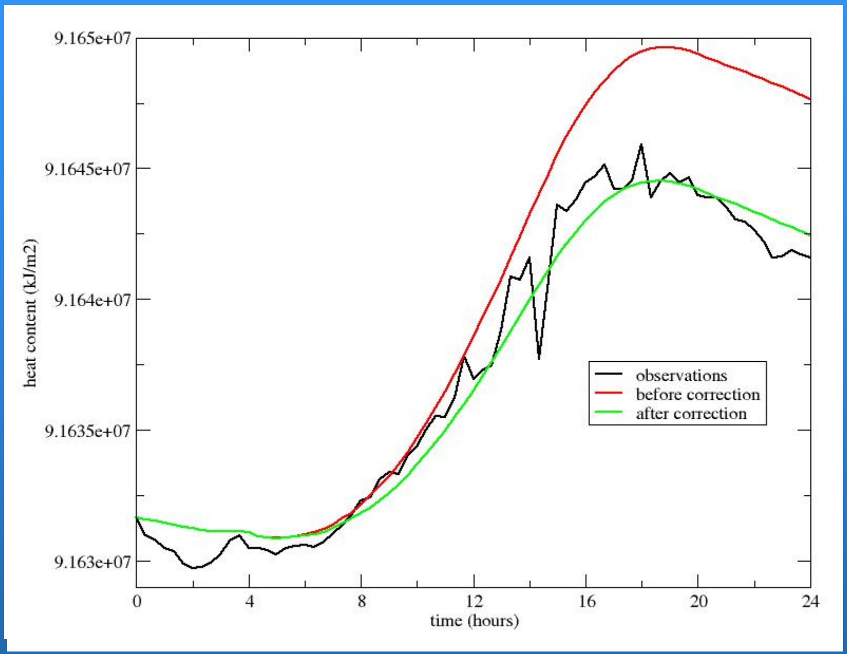


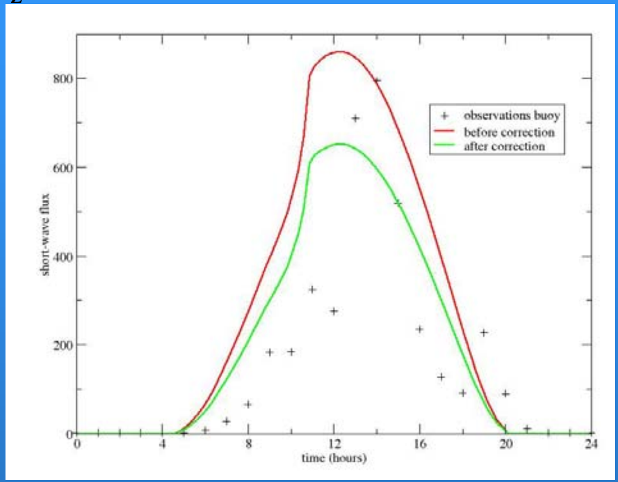


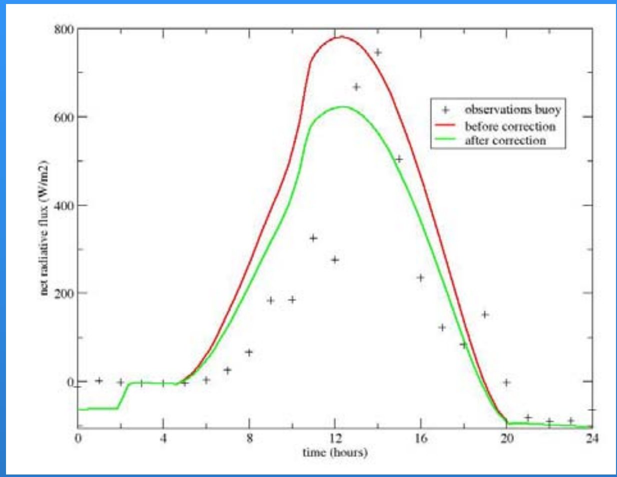
June 2009
LOM 2009, Miami, Florida
Cécile Renaudie

II.2. Correction of radiative fluxes

Determination of $Q(t) = \rho \int_z T(t,z)dz$ after simulation HYCOM







	Short-wave flux	Net radiative flux
Observations	3893.48	3271.048
Before correction	6682.902	5292.885
After correction	5062.299	4065.285

→ Too much heat

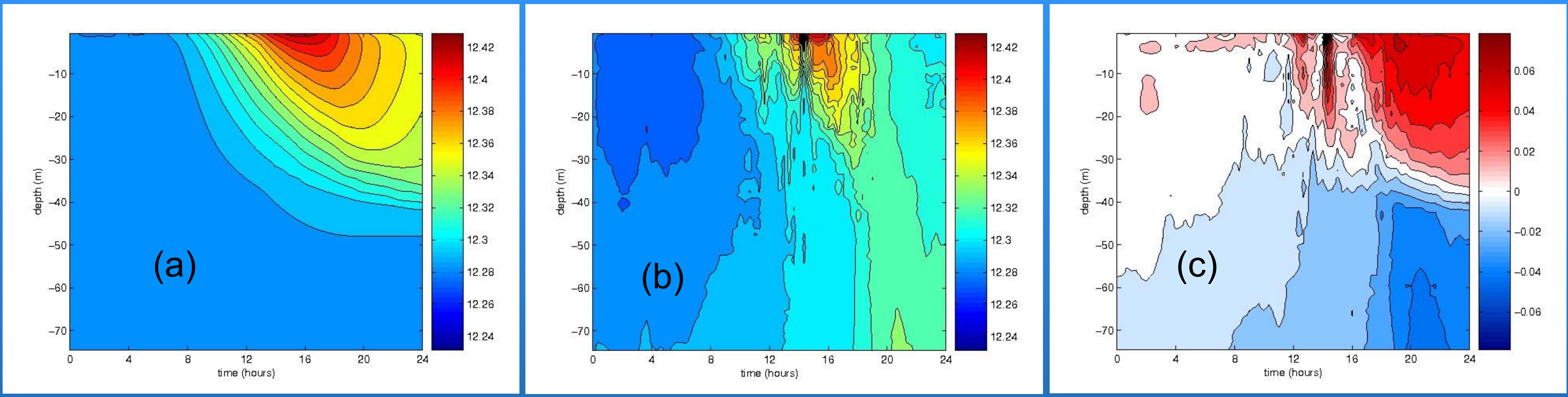
→ Short-wave flux changed : SW=SW*0.76.

III. Sensitivity tests with HYCOM

- Initialization : with observations;
- Forcings : from the atmospheric model, at the location of the mooring;
- Comparison with observations filtered from the effects of tide;
- Vertical mixing scheme : KPP (K-Profile Parameterization, Large 1994);
- Sensitivity tests to different parameters of the KPP and to the calculation of turbulent fluxes.

III.1. Influence of the velocity profile

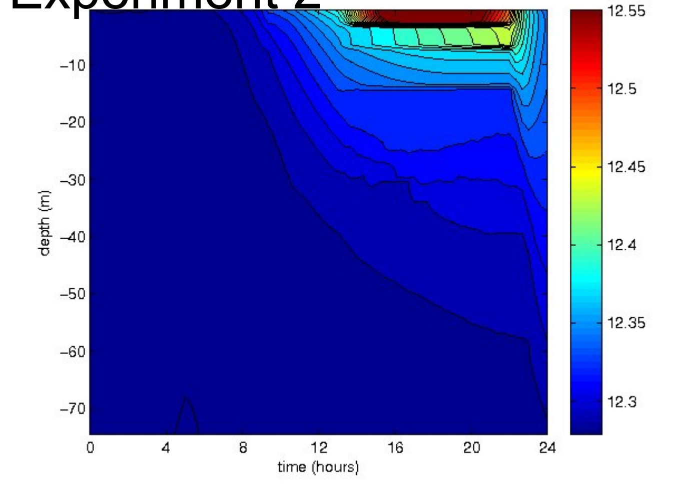
- Experiment 1 : HYCOM after correcting radiative fluxes (a), compared to observations filtered of tide (b) and difference of temperature between both (c).

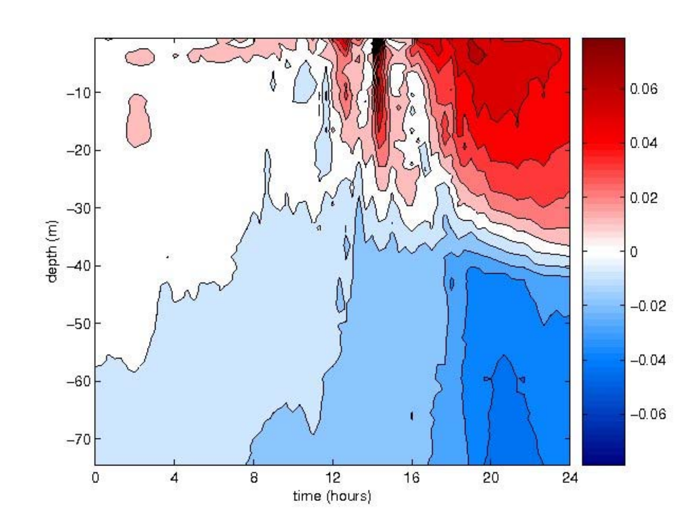


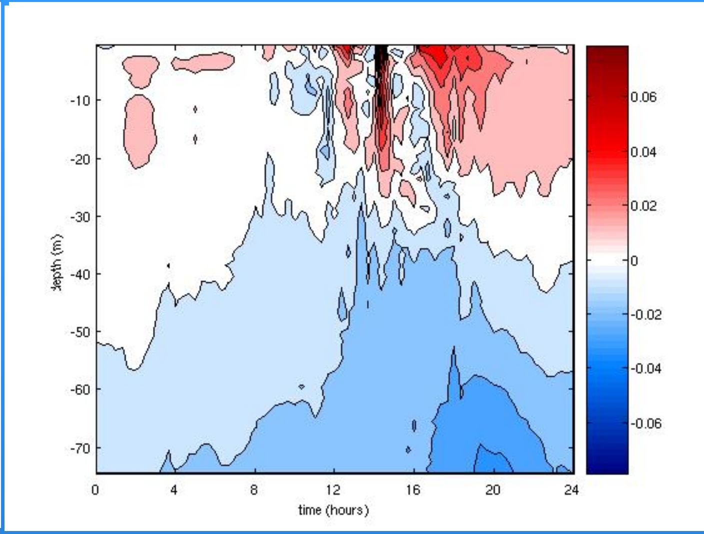
- Temperature too high at the surface and too low at the bottom $\longrightarrow$ mixing problem;
- Mixing is triggered when $Ri_g = \dfrac{N^2}{(\partial_z \overline{U})^2 + (\partial_z \overline{V})^2} < Ri_0 = 0.7 \longrightarrow$ problem with velocities;
- Experiment 2 : The velocity of the model is forced with the one observed.

III.1. Influence of the velocity profile

Experiment 2







Difference with observations

- Experiment 2 : lack of velocity gradient at the surface;

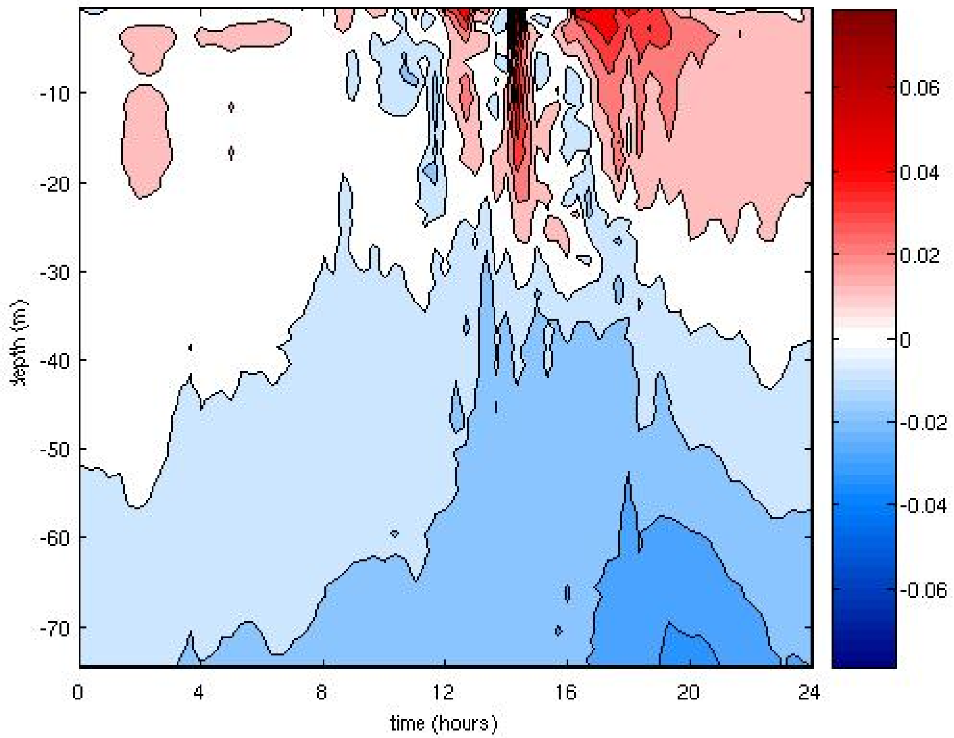
- This is because ADCP measurements are problematic near the surface : the treatment replaces the value in the first cell at 5 meters deep by the value in the second cell at 10 meters deep $\longrightarrow$ no vertical shear in the first 10 meters;

- Experiment 3 : Experiment 1 + Experiment 2;

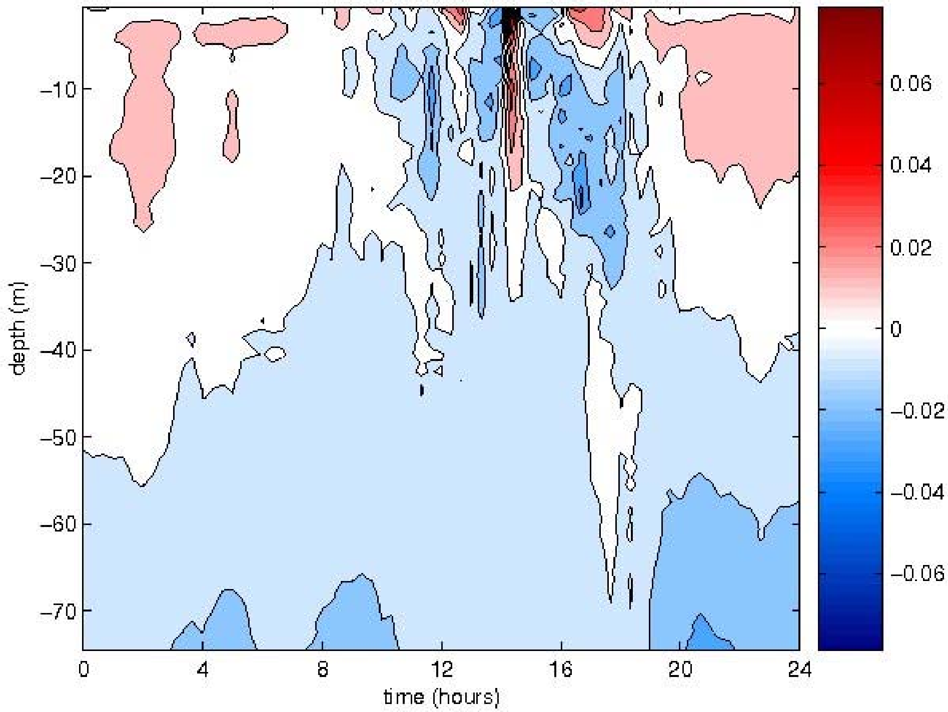
- Experiment 3 allows mixing, the heat penetrates all the way to the bottom and difference between experiment and observations lower.

III.2. Influence of the bottom boundary layer BBL

Without BBL

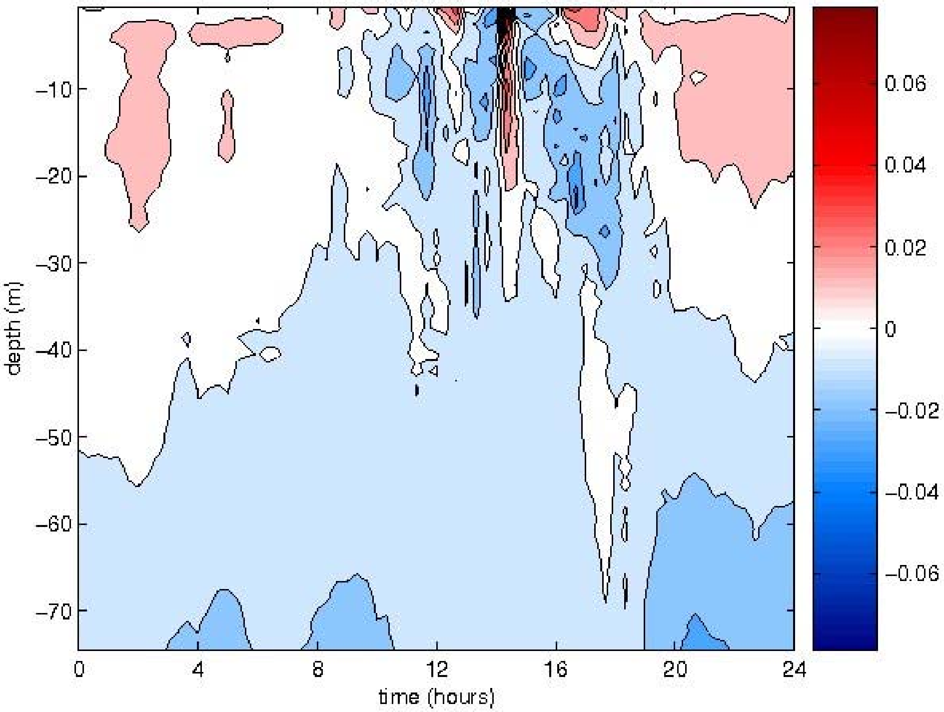


With BBL

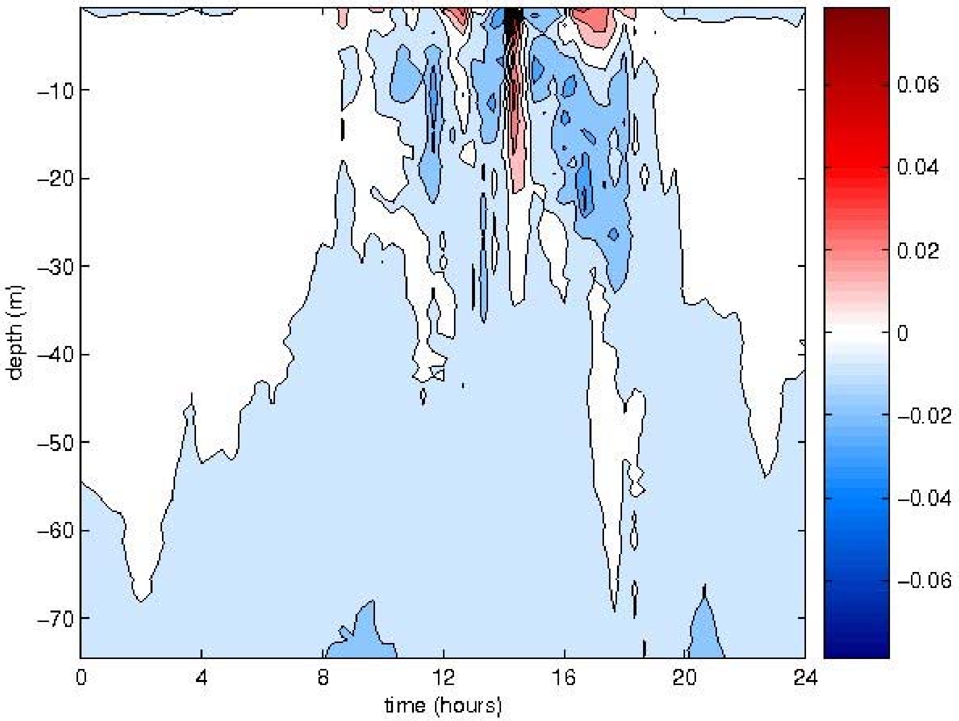


III.3. Influence of the nonlocal terms

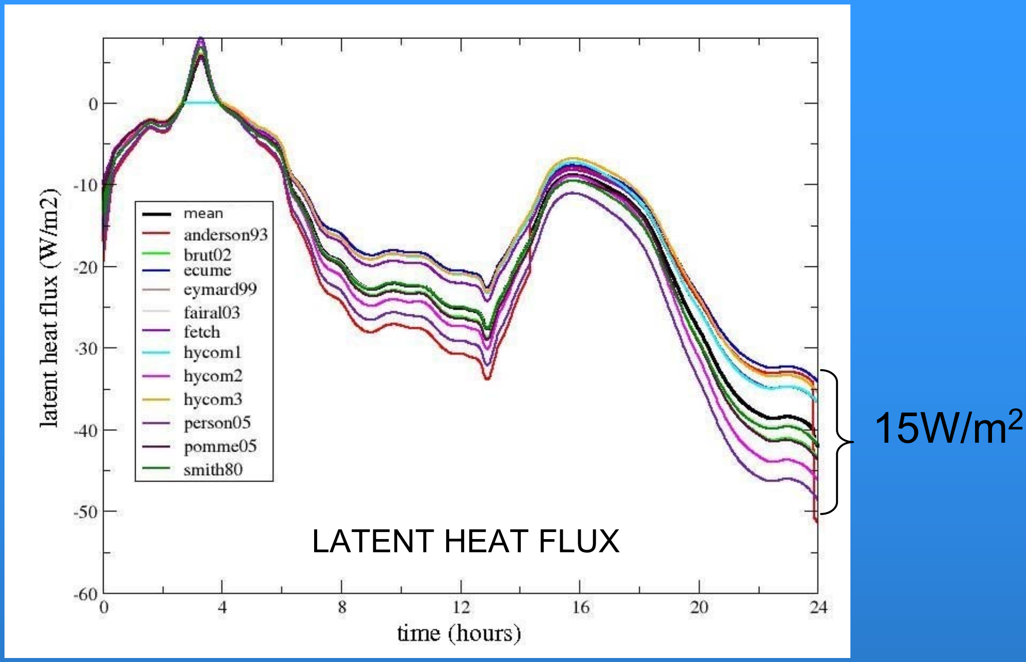
With nonlocal terms

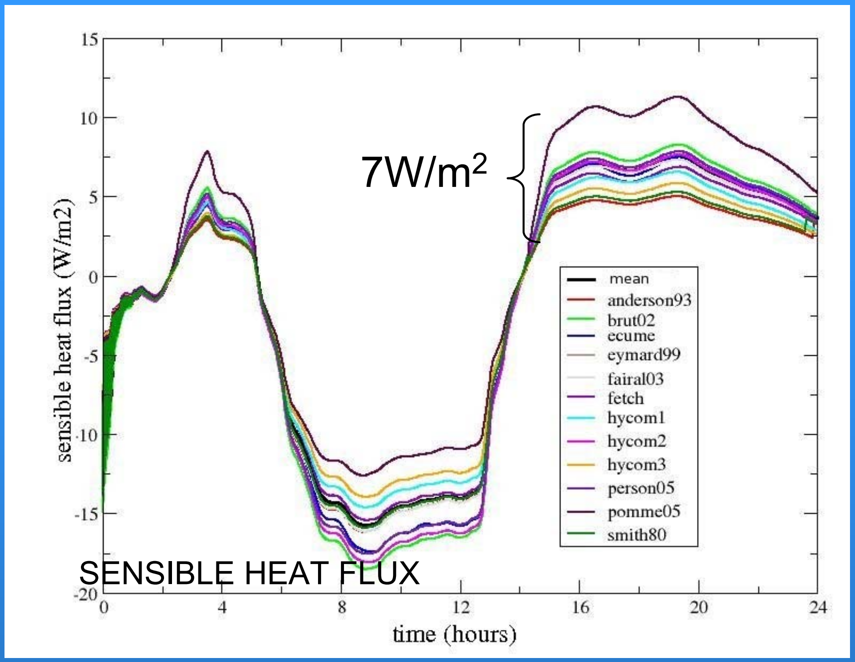


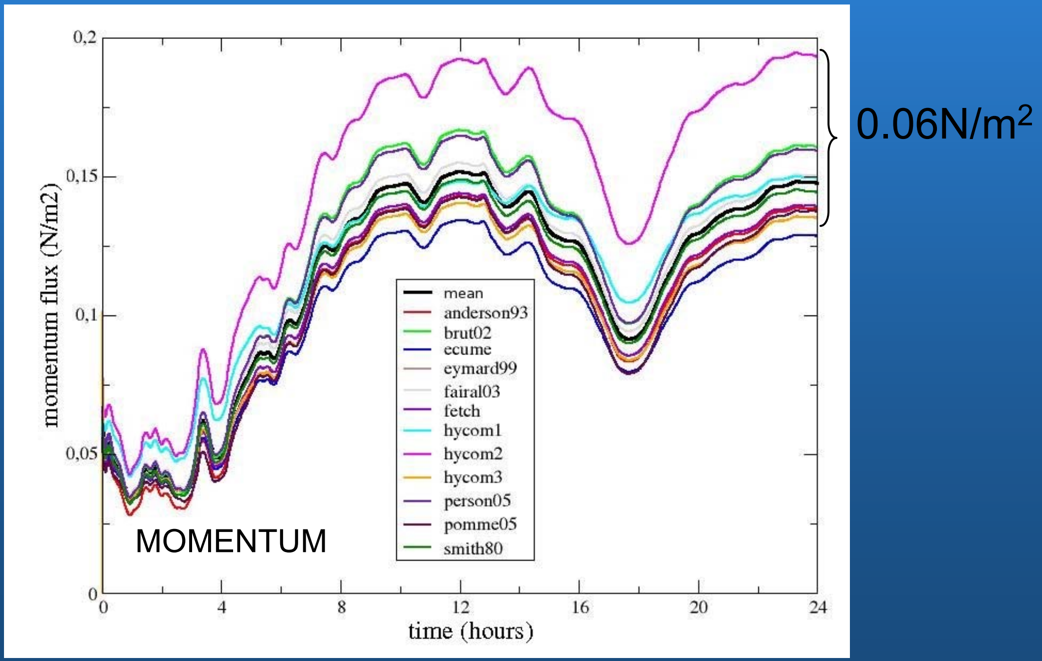
Without nonlocal terms



III.4. Influence of turbulent fluxes calculation







Closest to the mean value :
- latent and sensible : fairal03
- momentum : smith80

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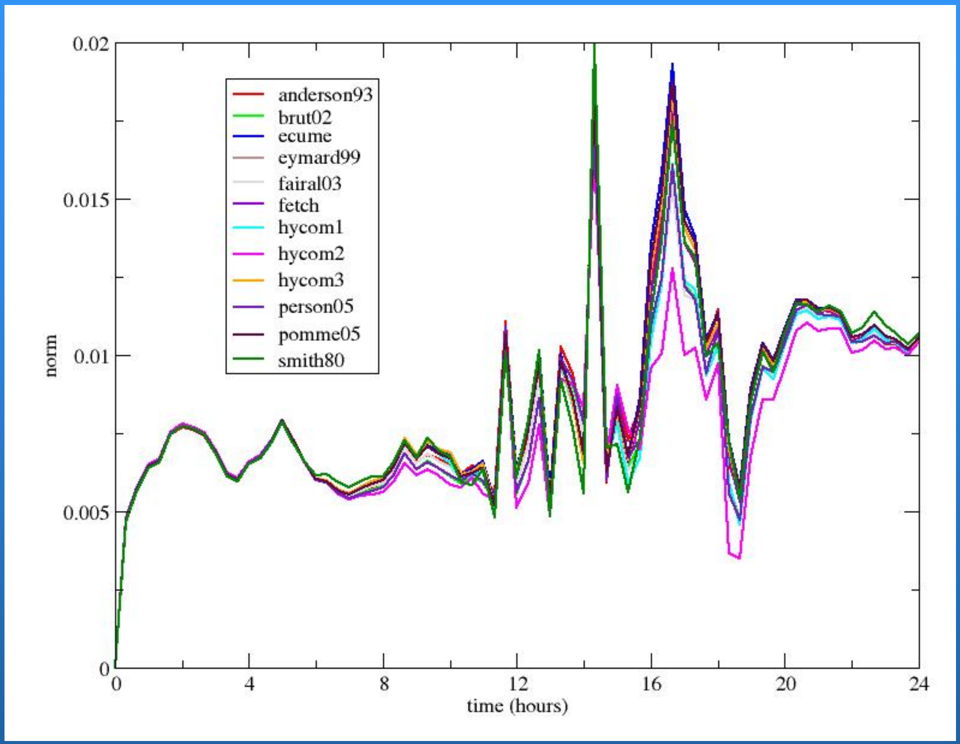
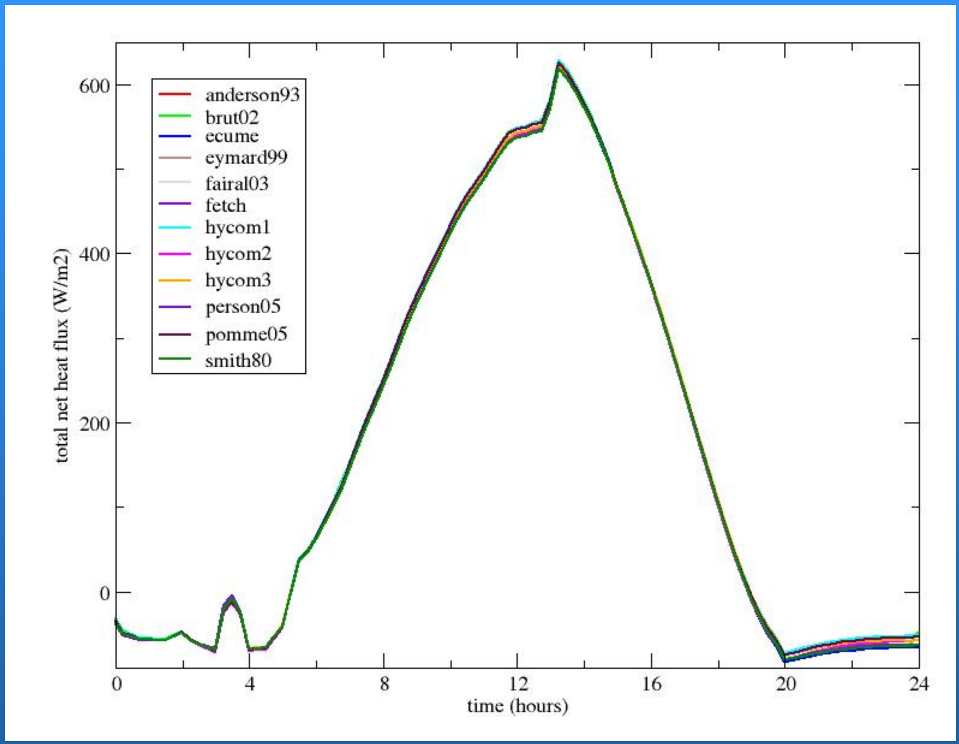
III.4. Influence of turbulent fluxes calculation

RMSE (root mean square error) : $RMSE = \sqrt{\frac{1}{H} h_i (T_{obs}(i) - T_{\exp}(i))^2}$





RMSE for twelve methods

FT=RN-LE-H

V. Conclusions

- The main processes here are mixed layer dynamics and shear instability;
- After correcting radiative fluxes and taking into account observed velocities, HYCOM results are close to the observations;
- The best solution is obtained when the bottom boundary layer is activated and the nonlocal fluxes are not activated;
- The fact that we did not have any observations in the atmosphere was a problem $\longrightarrow$ new campaign at sea in 2008 with radio soundings and measures of surface parameters;
- Prospect : study the impact of waves, perform the same job on the moorings gathered in 2008.

Thank you

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