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Glider Observations and modelling of an abrupt mixing process in the upper ocean

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SOCIB Balearic Islands Coastal Observing and Forecasting System

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Outline

- Introduction: IMEDEA glider activities at Western Med
- Objectives
- Data set:
  - Dec09 glider mission
  - Buoys network
  - Model outputs
- Results
- Summary

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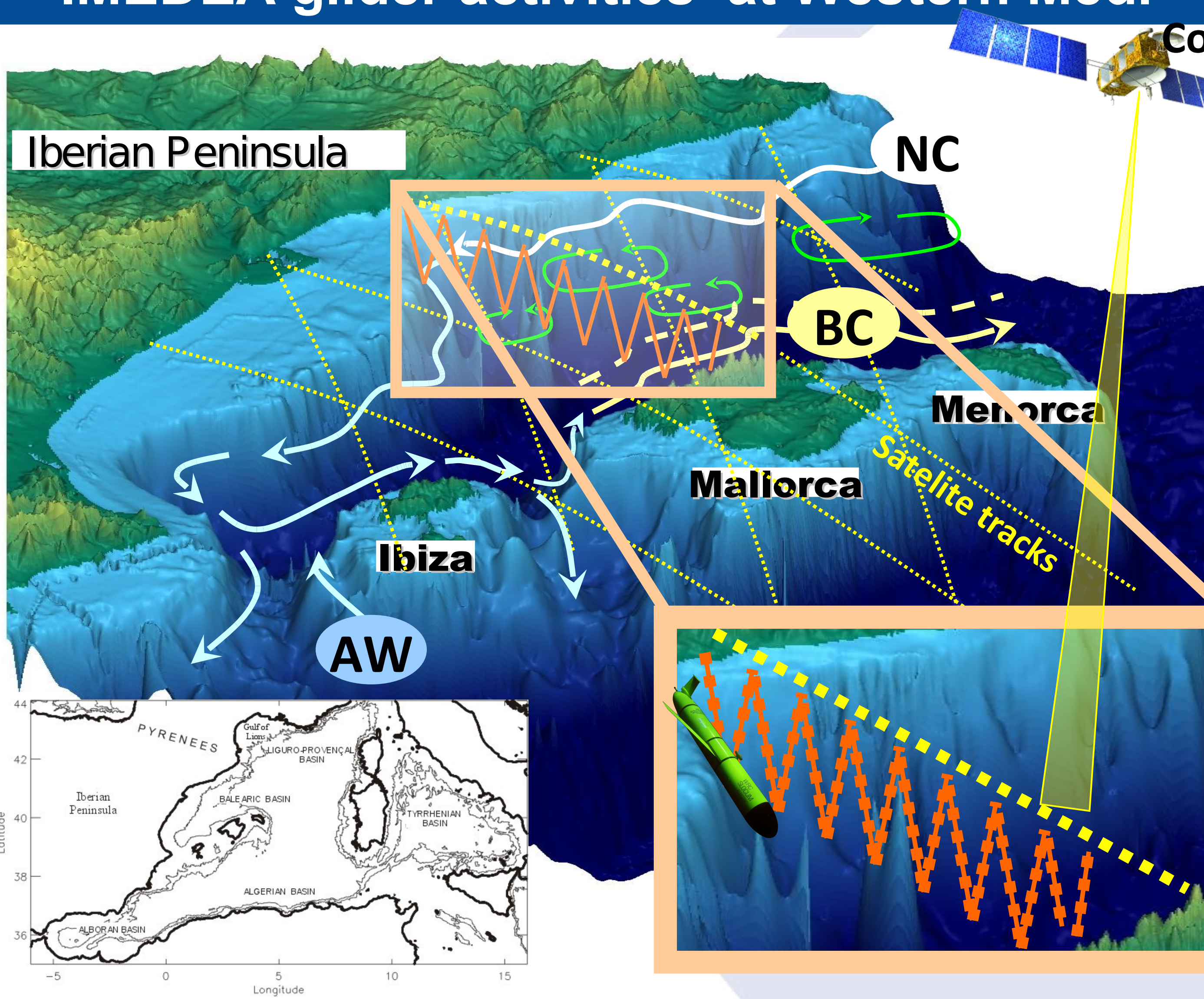
IMEDEA glider activities at Western Med.



Complex dynamics

- At North: **NC**
- At south **BC**, its associated **front** and **AW inflow**
- In-between, mesoscale (eddies, meandering….) due to heterogenous water masses mixing

Path planning / adpative sampling
Alvarez et al., 2004, IEEE
Garau et al., 2006, IEEE
Alvarez et al., 2007, J. Mar. Sys.

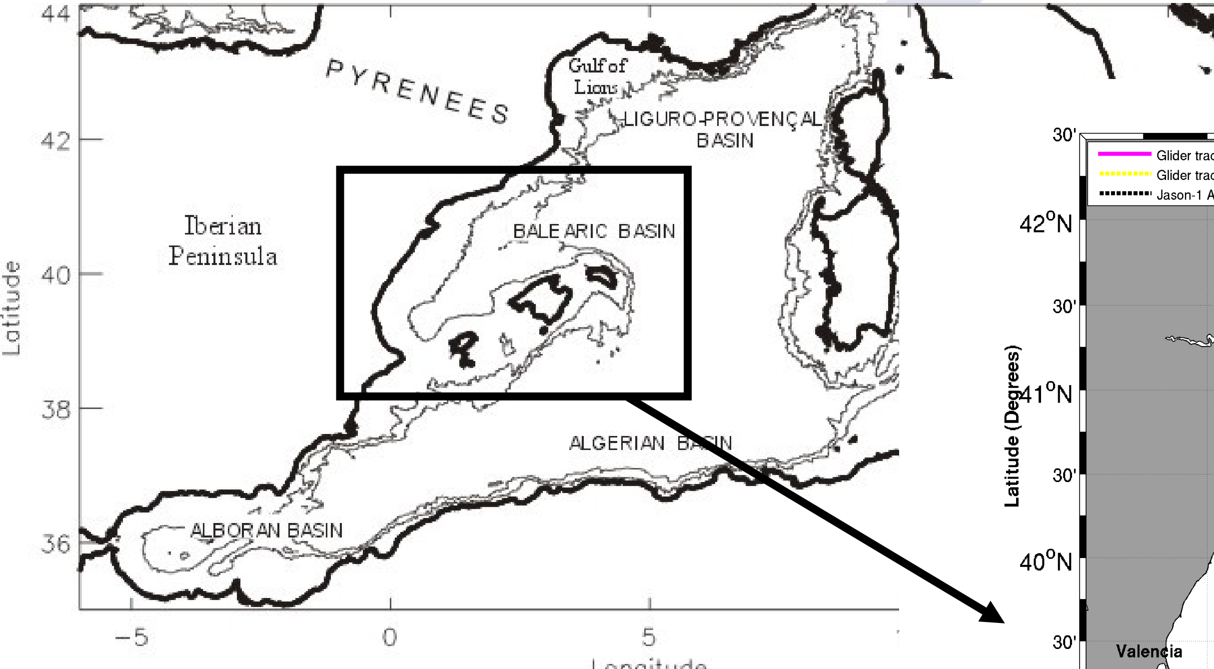
Glider and altimetry
Ruiz et al., 2009a , J.Mar.Sys.
Ruiz et al., 2009b, Geophy. Res. Lett.
Bouffard et al., 2010, J.Geophys.Res.

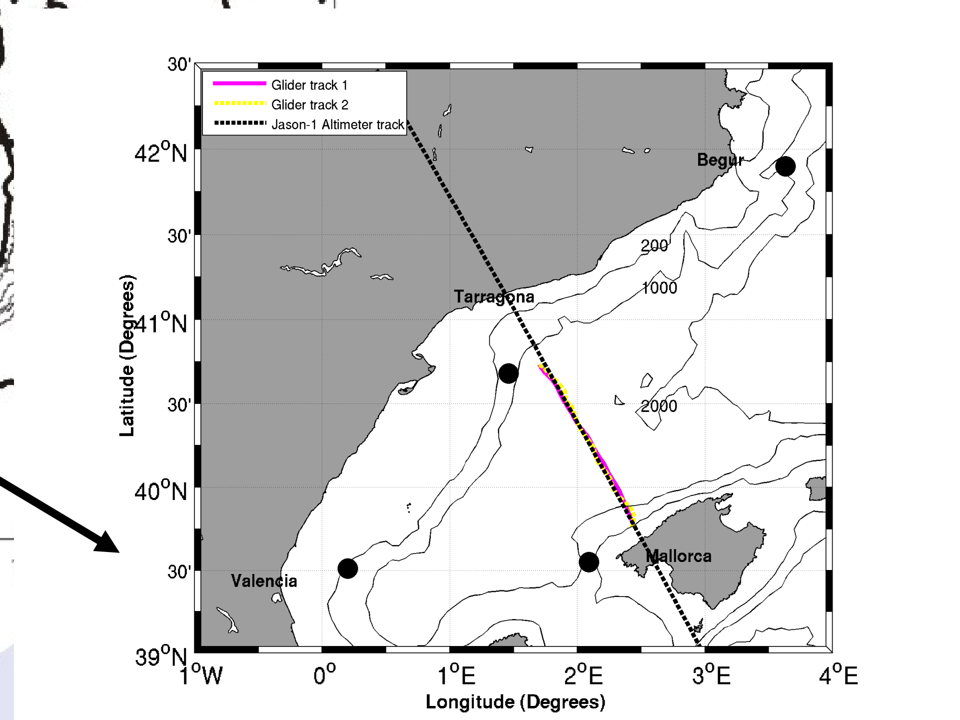
Multi-platform approach
Pascual et. al., 2010, Sea Tech.
Pascual et al., 2011, JGR (in preparation)

Thermal lag
Garau et al., 2011, JAOTech (accepted)

Summary of 5 years of glider activities
Ruiz et al., 2011, Sci. Mar.(submitted)

Study area and scientific objective





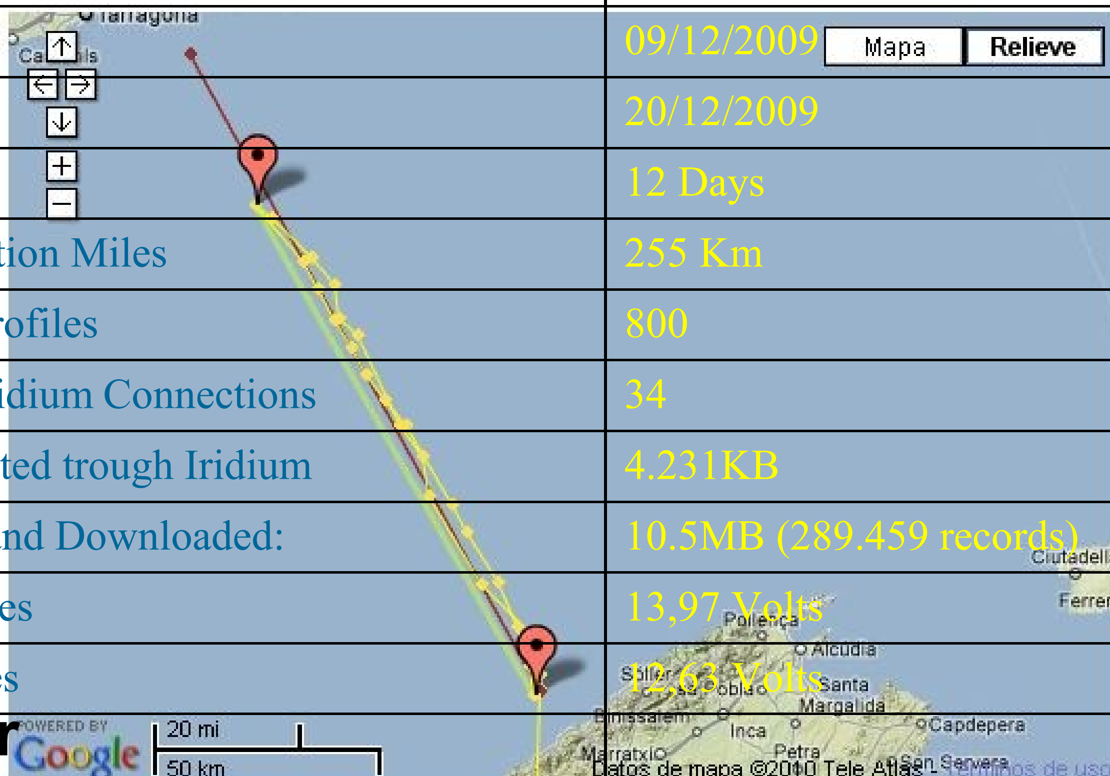
Atmosphere-Ocean interactions

- To investigate the impact of an atmospheric front on the ocean mixed layer
    - Atmospheric forcing.
    - Mixed layer (high resolution from glider data).
    - Heat content.

Summary glider mission

Jason 1 Dec09 mission – Western Med

Area	Balearic Sea –Western Mediterranean
Project	ECOOP
Start Date	09/12/2009
End Date	20/12/2009
Total Days	12 Days
Total Navigation Miles	255 Km
Number of Profiles	800
Number of Iridium Connections	34
Data transmitted trough Iridium	4.231KB
Data Stored and Downloaded:	10.5MB (289.459 records)
Initial Batteries	13,97 Volts
Final Batteries	12,63 Volts
Events	



0-200m Coastal glider

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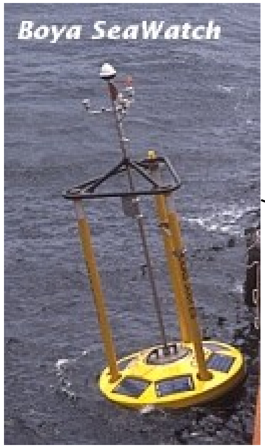
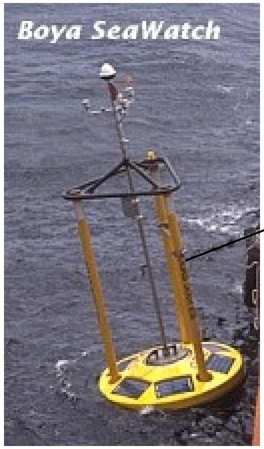
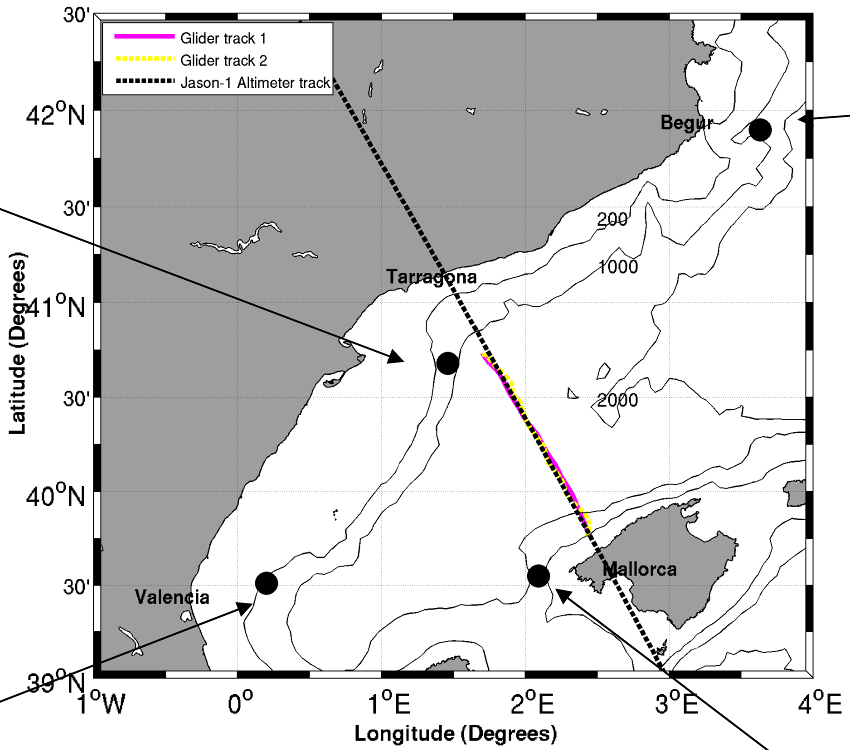
Deep buoys network in the WMED - Puertos del Estado







- **Meteorologic, oceanographic and waves data**
- Hourly data
- Northwestern Mediterranean Sub-basin

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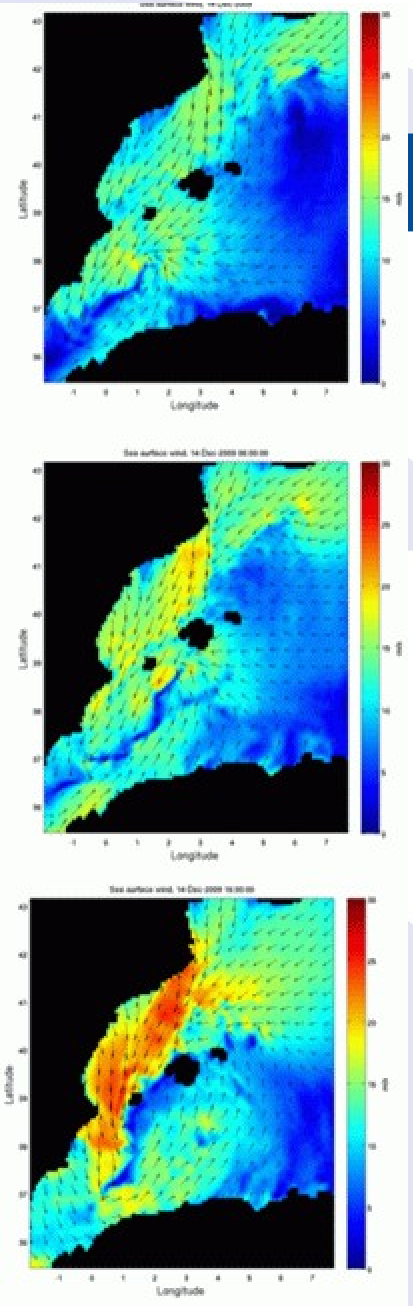
Outputs from atmospheric model: WRF

- 6 km resolution
- hourly
- 47 levels
- (NCEP as boundary conditions)



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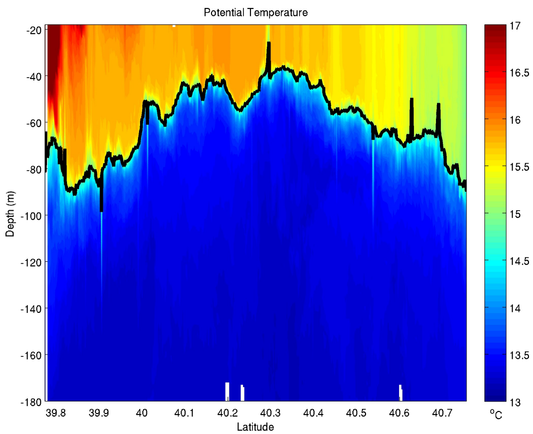
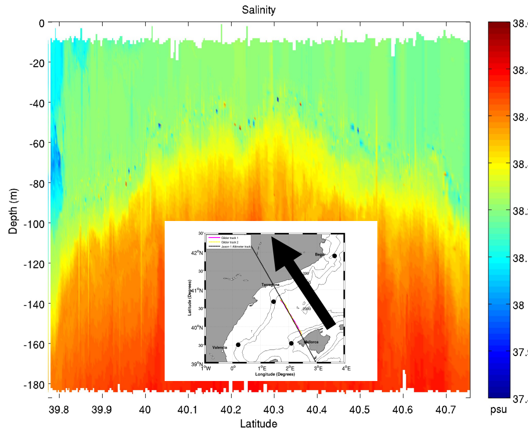
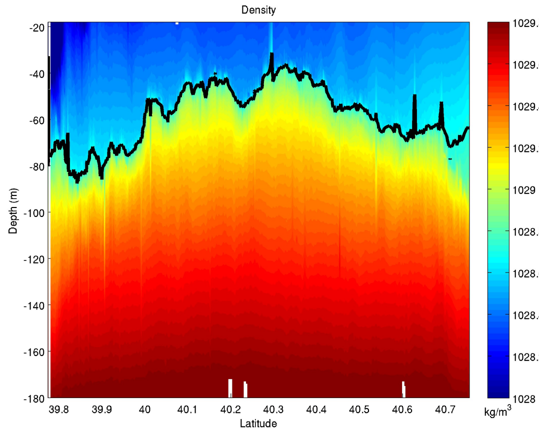
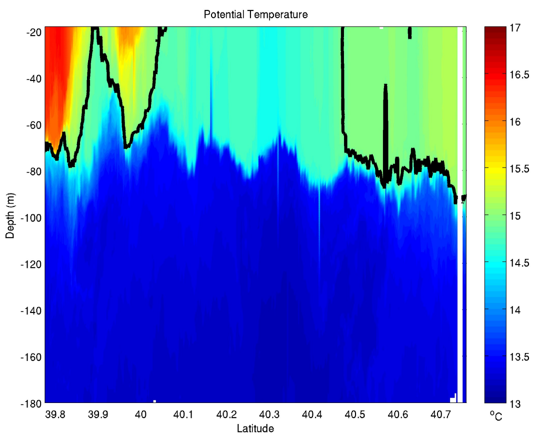
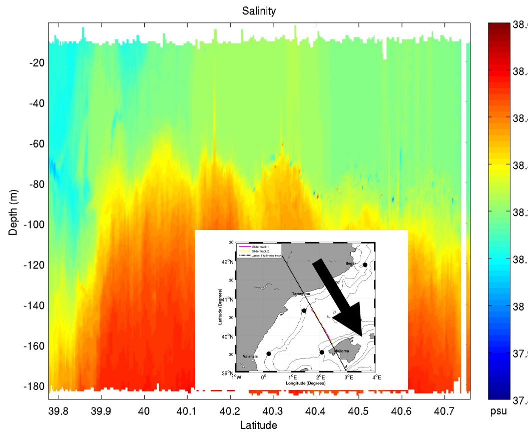
Glider Results: Hydrography

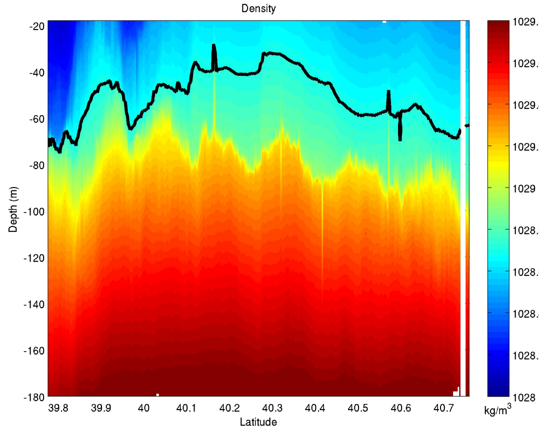






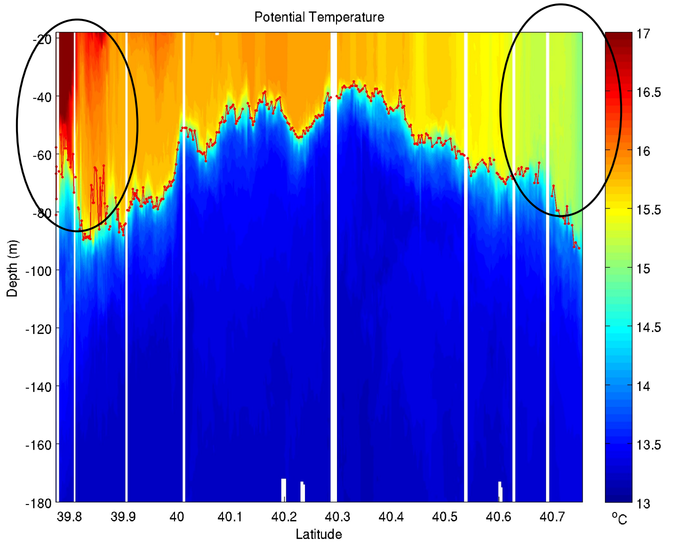


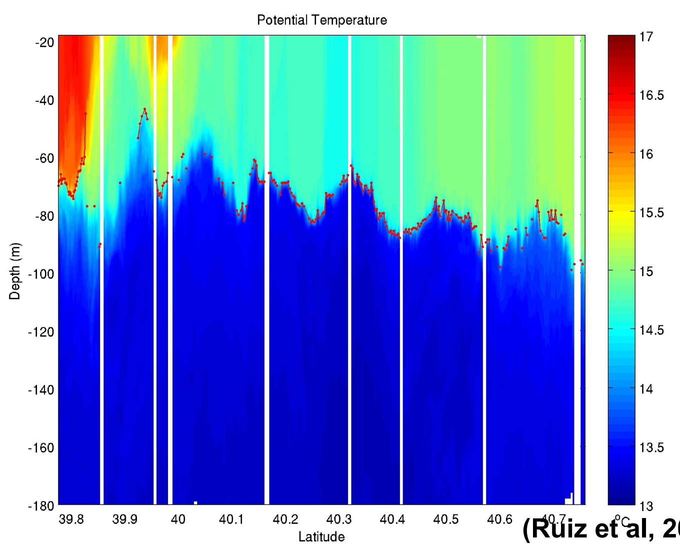




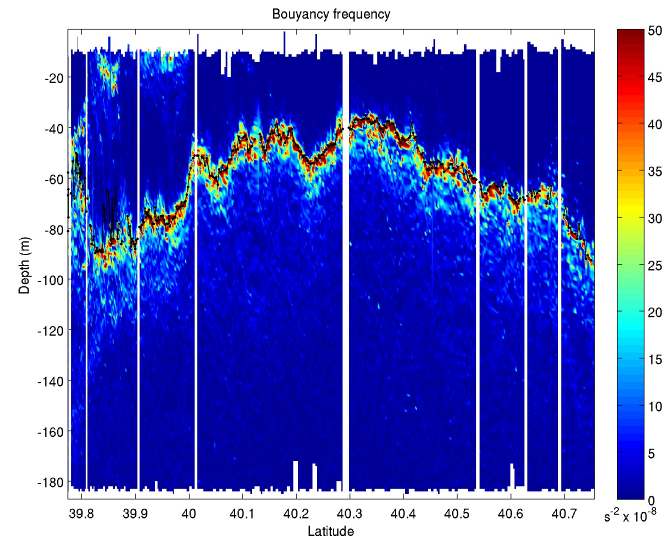
Results: hydrography and estimated mixed layer (criteria Δ0.2ºC)

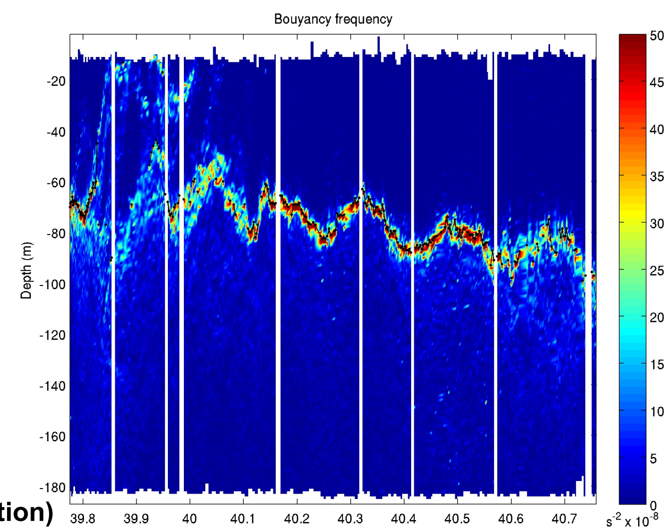
TEMPERATURE (ºc)





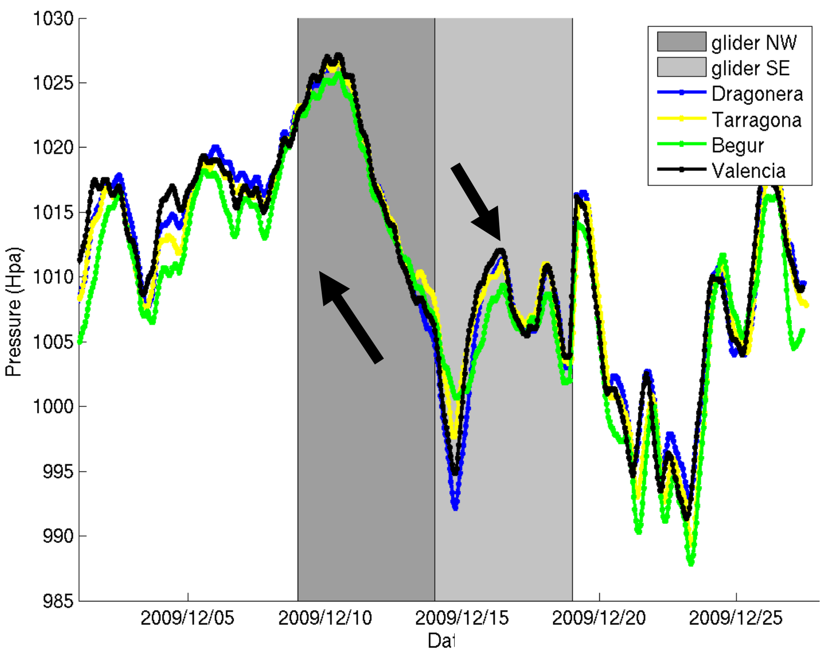
BOUYANCY FREQUENCY

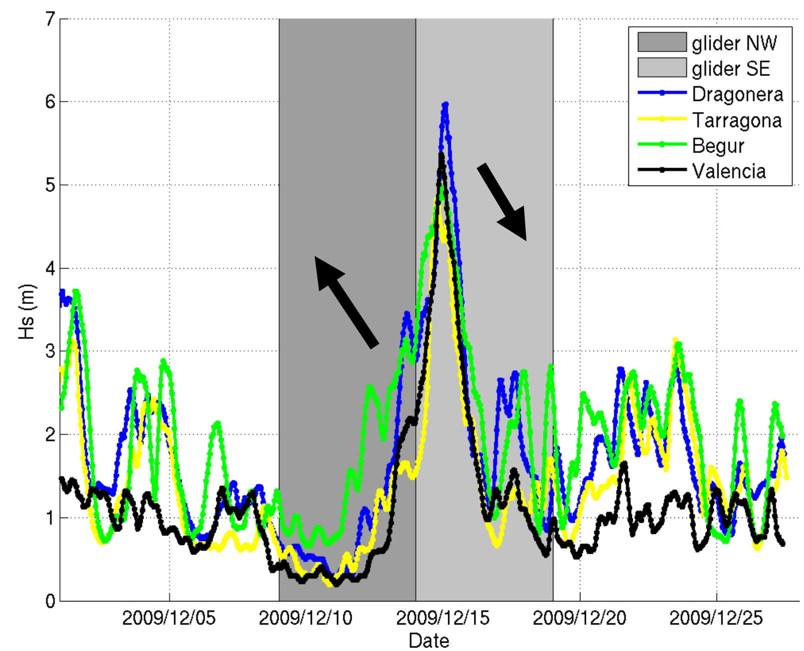


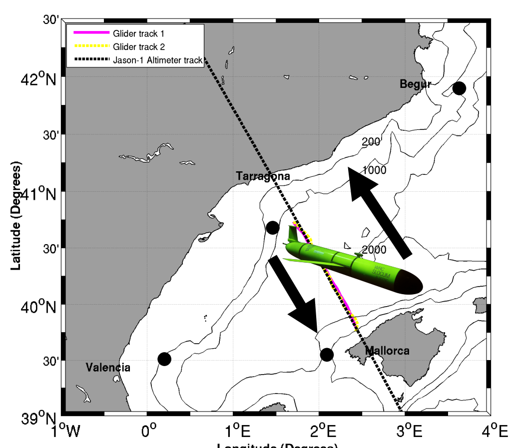


(Ruiz et al, 2011, in preparation)

Results: Observations from Buoys PdE network

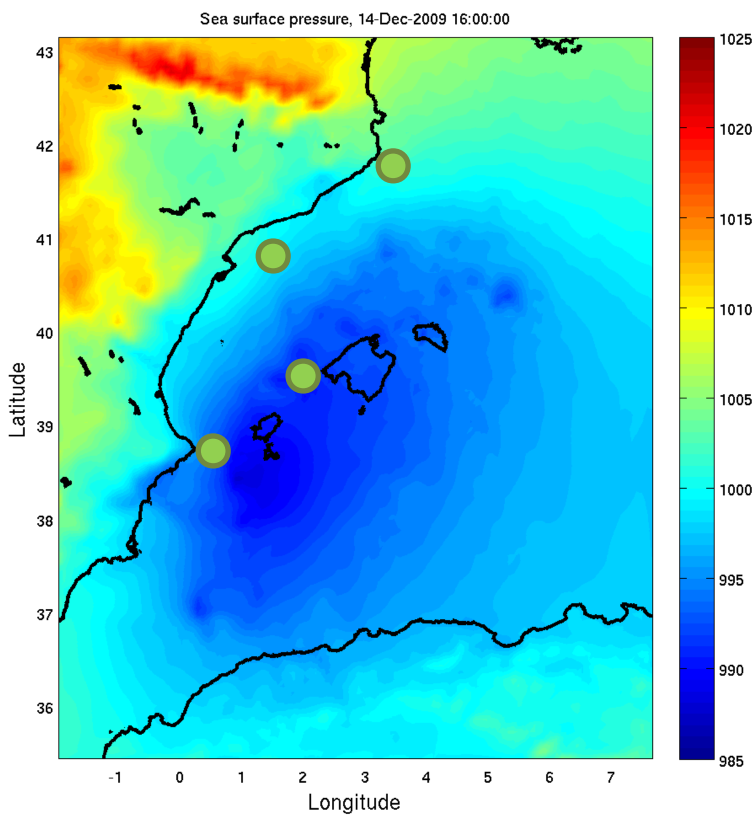


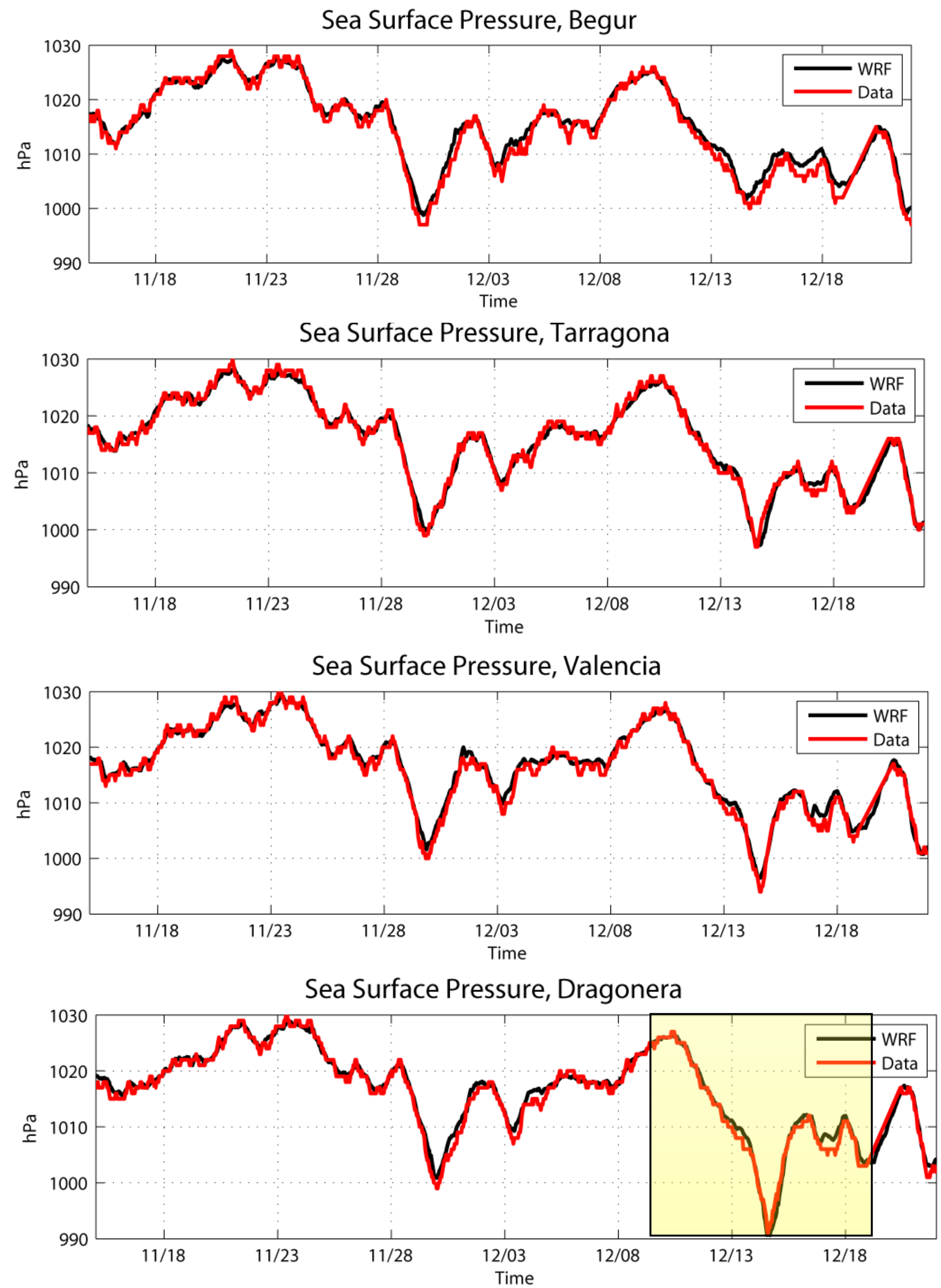




Atmospheric forcing over the sub-basin

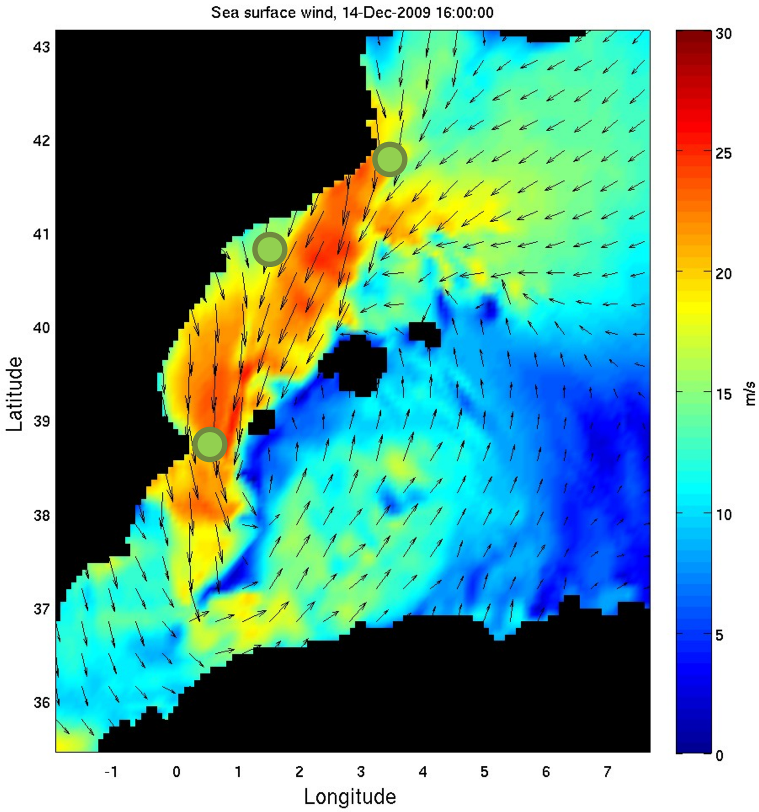
Results: atmos. model outpus

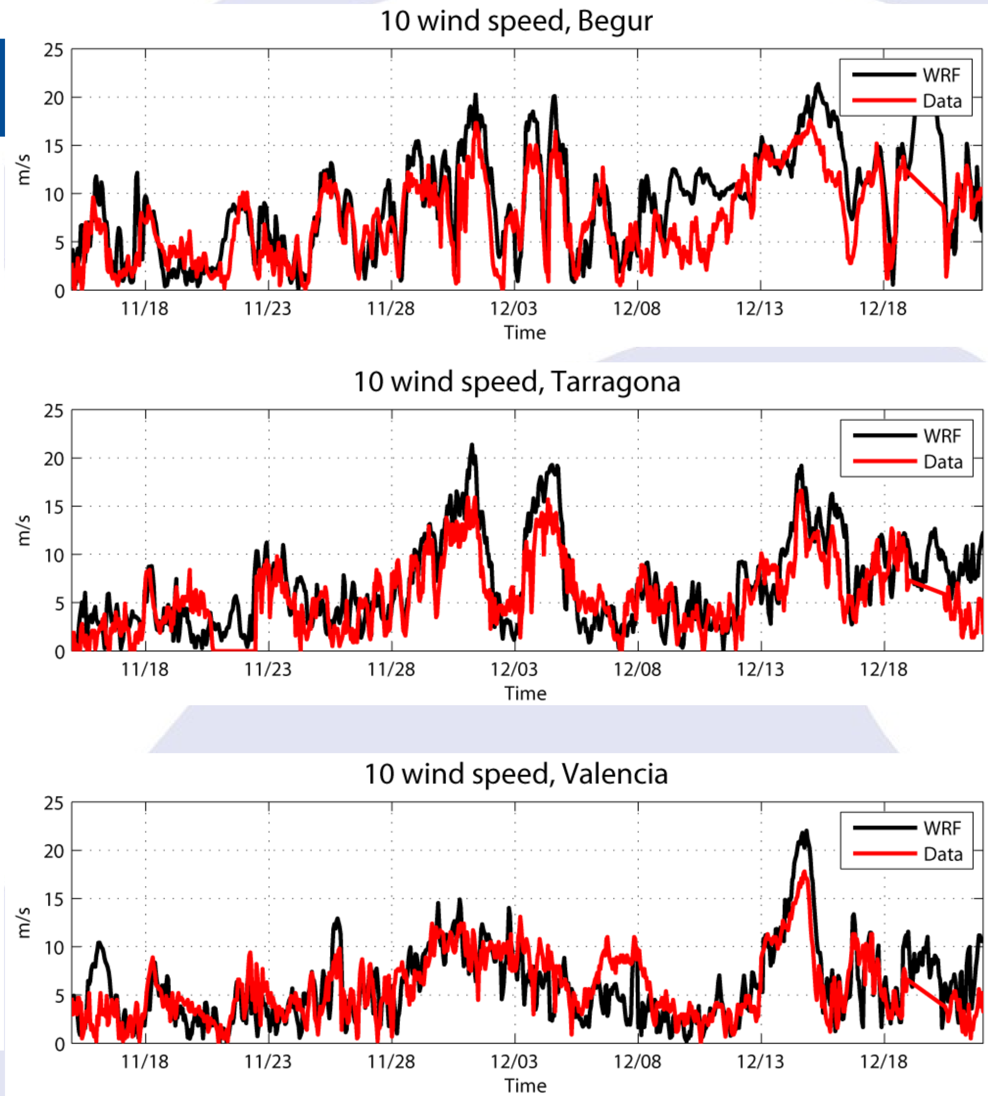




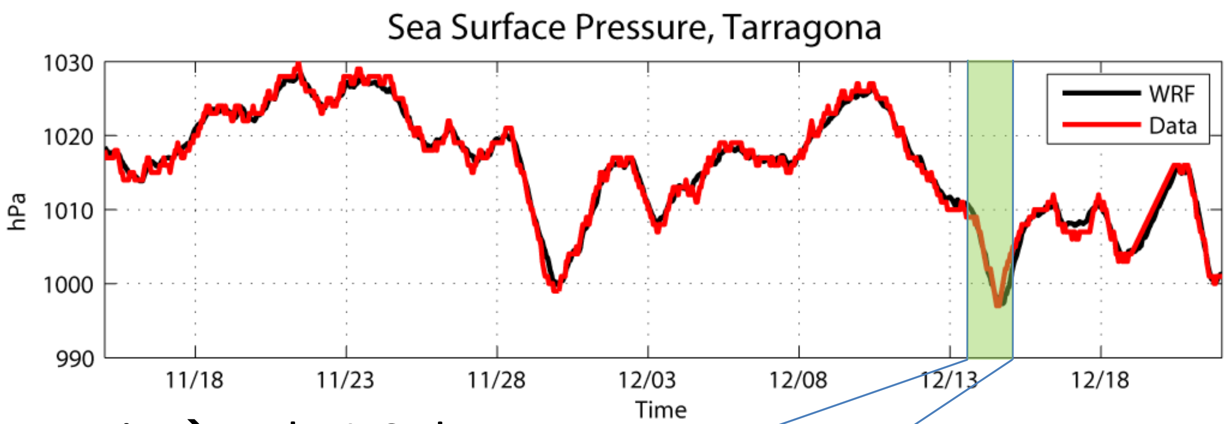
- Very good agreement with the observations
- Dragonera : 1020hPa → 990 hPa

Results: atmos. model output

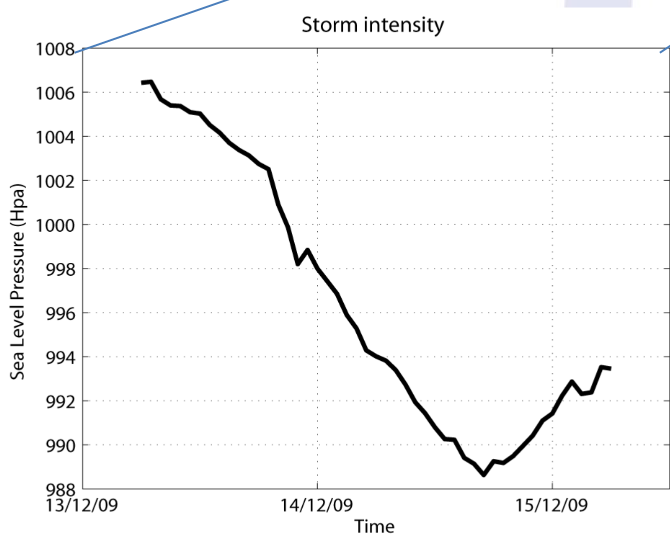


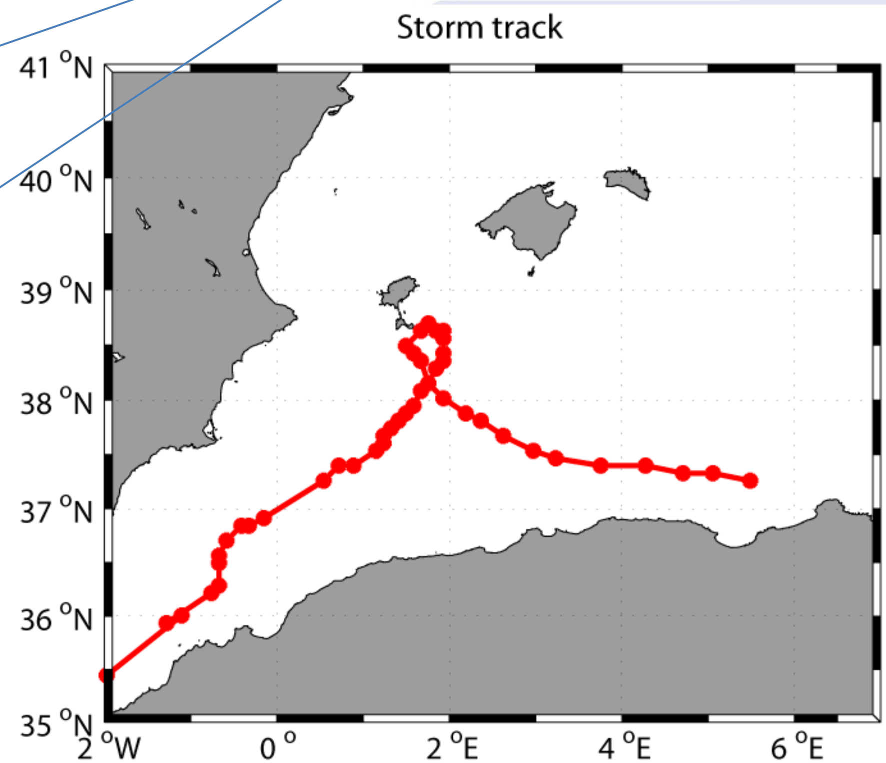


- Very good agreement with the observations
- Wind >20m/s during the storm



Kind of cyclogenesis → only 1-2 days
Low pressure traveled NE from Marroco to Ibiza and next to SE until the African coast and dissipated





Storm track

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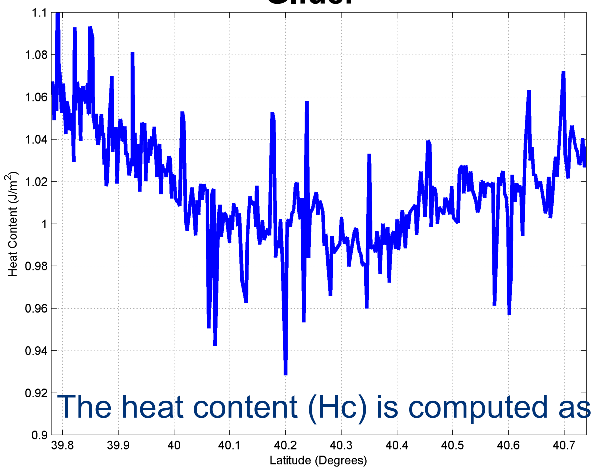
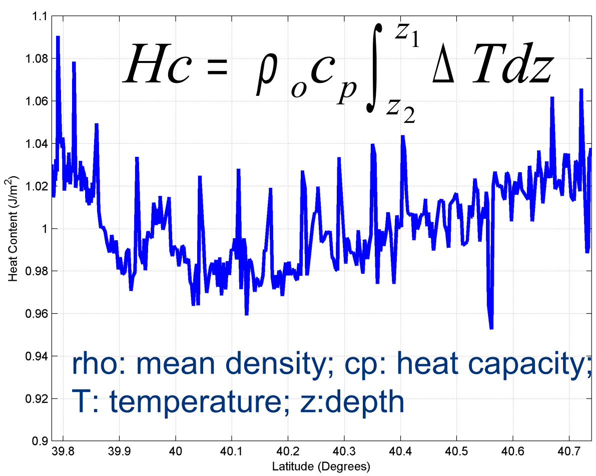
Heat content - Preliminary Results

Glider



The heat content (Hc) is computed as:



$$Hc = \rho_o c_p \int_{z_2}^{z_1} \Delta T dz$$

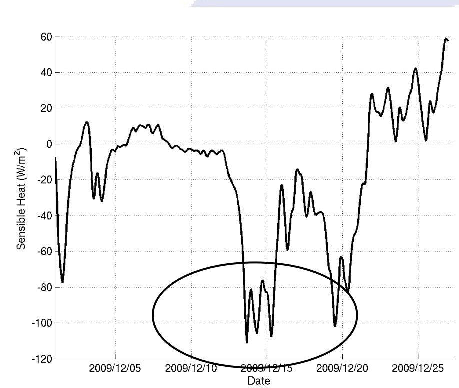
rho: mean density; cp: heat capacity; T: temperature; z:depth

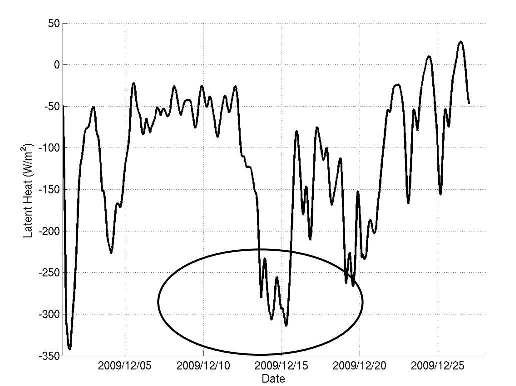
WRF model

The total heat budget $\mathbf{Q_T}$ consists of two **radiation components** and two turbulent components.

The first are the solar net radiation flux $\mathbf{Q_S}$ absorbed by the sea (shortwave) and the net terrestrial flux radiation $\mathbf{Q_B}$ emitted by the sea (longwave).

The **turbulent components** are the latent heat flux $\mathbf{Q_E}$ and the sensible heat $\mathbf{Q_H}$, which are related to energy losses of the sea by evaporation and convection, respectively. Hence, the budget can be represented by:





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Summary

• High resolution glider data from a mission performed in the Northwestern Mediterranean allow to characterize the upper ocean response to the pass of an atmospheric front.

• Potential temperature change observed by CTD glider data in the upper layer: 16ºC to 14.5ºC.

•Abrupt change (~30 m) of the mixed-layer-depth after the pass of the Atmospheric front

•WRF model reproduces an atmospheric cyclogenesis event (validated with buoys observations) that could be responsible of the mixing process observed in the upper ocean.

•Preliminary analysis of heat content from glider data and modelled heat fluxes (WRF and NCEP) demonstrate that latent and sensible heat loss dominate the net surface heat balance.

Next step: Using WRF as atmospheric forcing

High resolution ocean numerical mode (ROMS) to reproduce the mixed process

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Garau et al., 2011, J. Atmos. Oce. Tech. (accepted)
Thermal Lag Correction on Slocum CTD Glider Data

Master index | Index for gliderToolbox/ctdTools/thermalLagTools

Index for gliderToolbox/ctdTools/thermalLagTools

Matlab files in this directory:

adjustThermalLagParams	ADJUSTTHERMALLAGPARAMS - CTDs Thermal lag parameters adjustment.
buildMinimizationOptions	BUILDMINIMIZATIONOPTIONS - Builds a set of options for minimization
buildPolygon	BUILDPOLYGON - Builds a polygon based on two lines and computes its area
computeAvailablePotentialEnergy	COMPUTEAVAILABLEPOTENTIALENERGY - Potential energy wrt no density inversion
computeTCLag	COMPUTETCLAG - Compute time lag between Temperature and conductivity signals
correctThermalLag	CORRECTTHERMALLAG - CTDs Thermal lag correction.
fitThermalLagParams	FITTHERMALLAGPARAMS - CTDs Thermal lag parameters fitting.

Dependency Graph

View the Graph.

*Generated on Fri 11-Mar-2011 12:05:10 by **m2html** © 2005*

http://www.socib.es/~glider/doco/gliderToolbox/ctdTools/thermalLagTools/index.html