

SOCIB Western Mediterranean ocean forecasting system: Recent progress and data assimilation experiments

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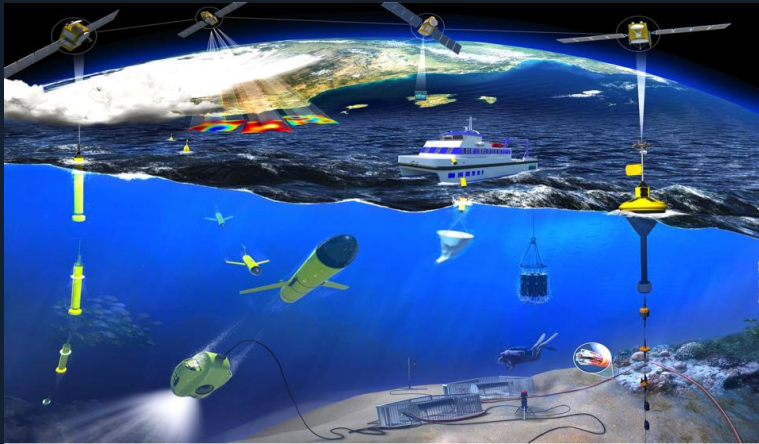
What is SOCIB ?

Balearic Islands Coastal Observing and Forecasting System



What is SOCIB ?

Balearic Islands Coastal Observing and Forecasting System



- 1 Multi-platform observing system**, from near-shore to open-ocean in the Western Mediterranean Sea
- 2 Data Centre** providing real-time and quality-controlled data streams and products, for scientific and societal applications

- 3 Modelling and forecasting facility** to help understand observed processes, integrate multi-platform observations and produce short-term predictions

→ Particular interest in the mesoscale variability, its interactions with the general circulation and impacts on ecosystems

Outline

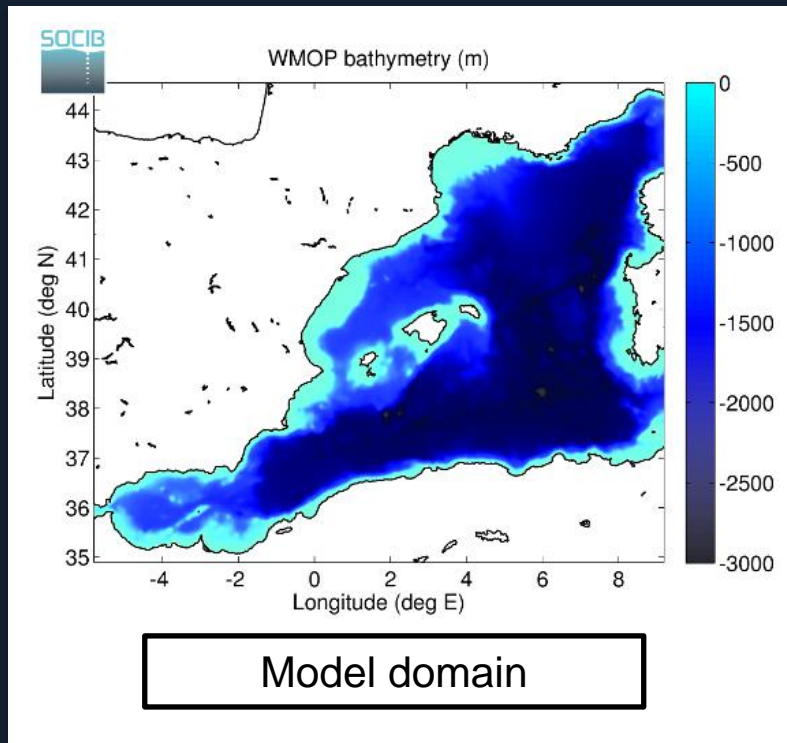
1 Western Mediterranean Operational model (WMOP)

- ✓ Hindcast [2009-2014]
- ✓ Forecast

2 ALBOREX multi-platform experiment

- ✓ Model performance
- ✓ Data assimilation experiments

WMOP: Western Mediterranean Operational model



- ✓ Regional configuration of the ROMS model
- ✓ Horizontal resolution: $\sim 2\text{km}$ ($1/50^\circ$)
- ✓ Initial & boundary conditions: Mediterranean Forecasting System ($1/16^\circ$)
- ✓ Atmospheric forcing: AEMET Hirlam (3h, 5km)
- ✓ Rivers (Var, Rhône, Aude, Hérault, Ebro, Júcar)

➤ **high-resolution mesoscale-resolving simulations**

WMOP simulations

1 **HINDCAST** 2009-2014

- ✓ free run
- ✓ daily river discharges

2 **FORECAST** oct 2013 – present

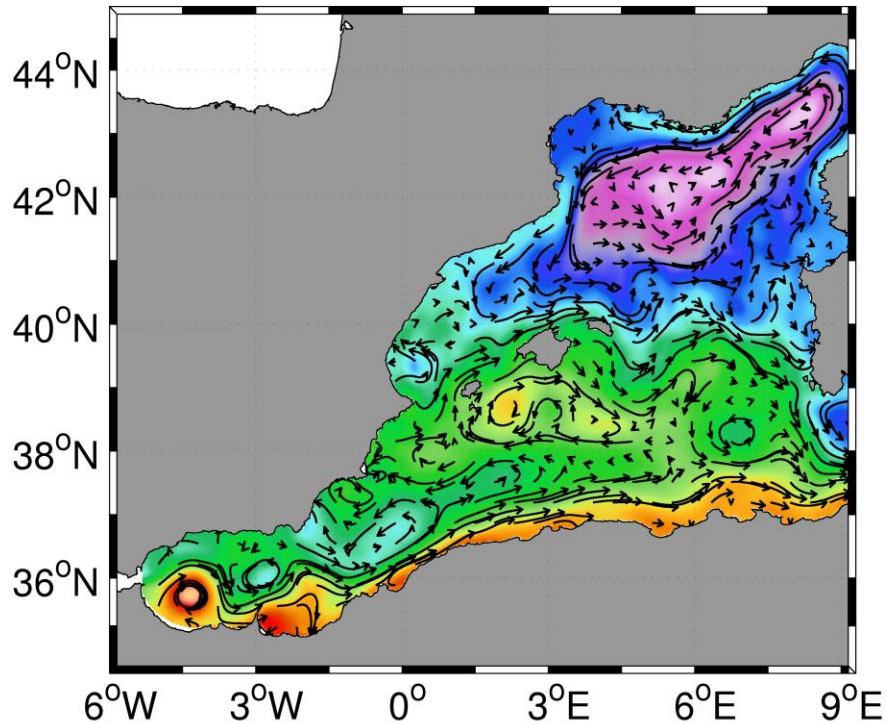
- ✓ weekly restart using initial conditions from the Mediterranean Forecasting System and a 3-week spinup
- ✓ climatological river inputs
- ✓ operational daily production of a 72-hour forecast

→ www.socib.es

WMOP simulations: HINDCAST

Mean dynamic topography
1993-2012

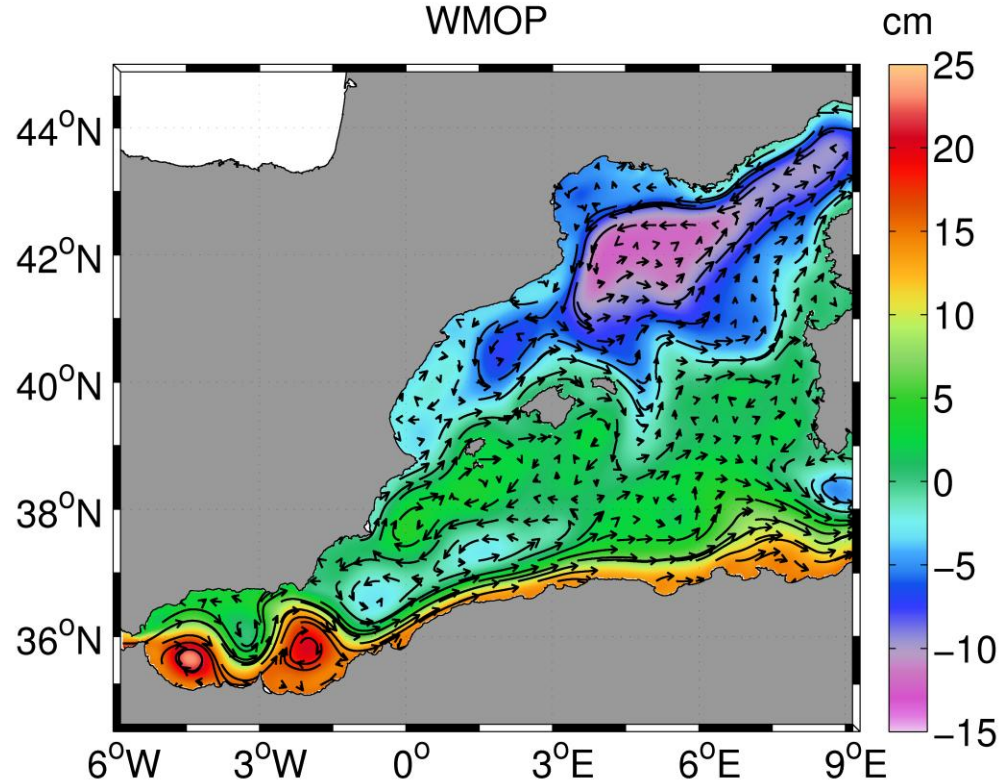
MDT (Rio et al., 2014)



(R.Escudier)

Mean WMOP sea level
2009-2013

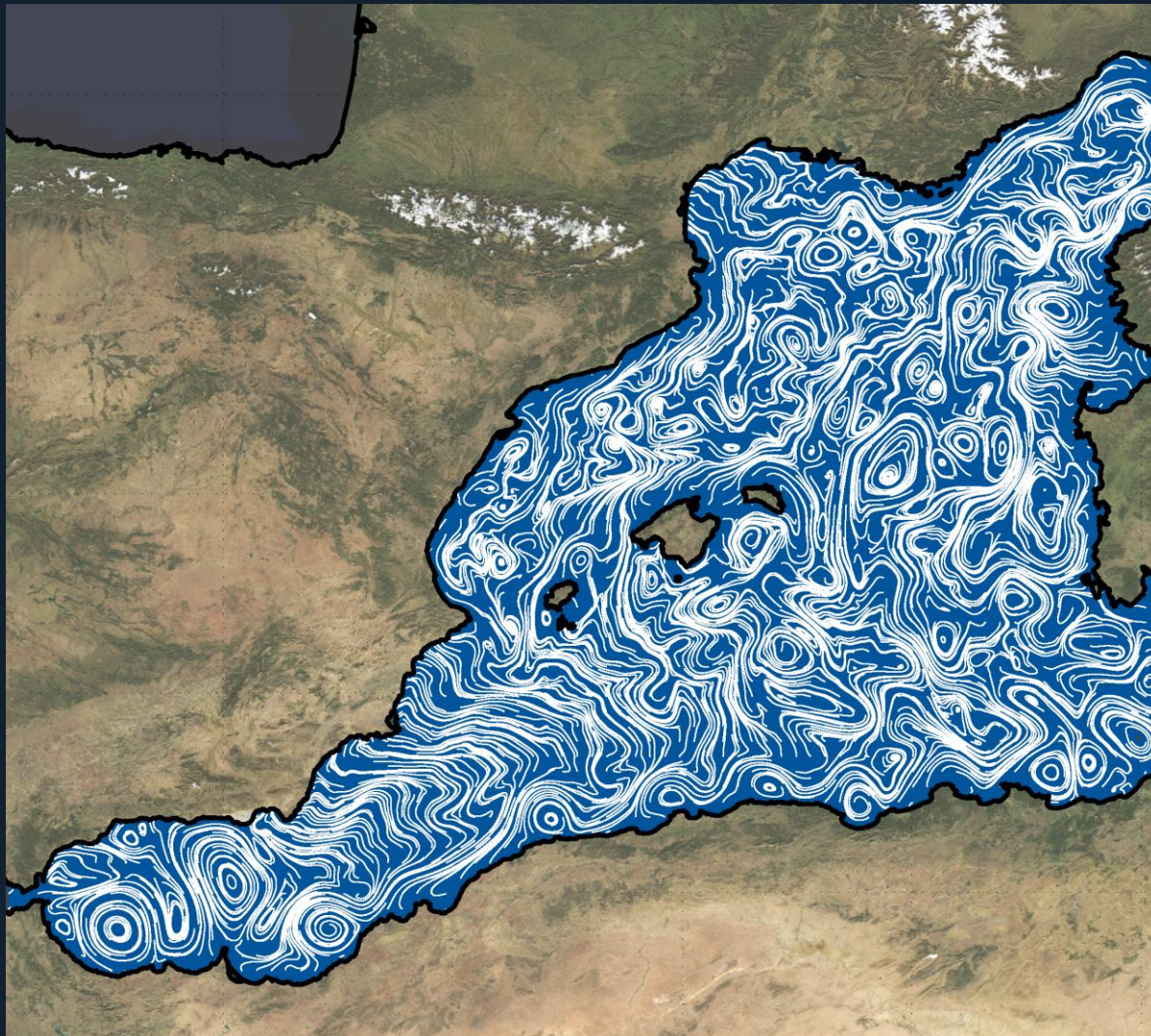
WMOP



WMOP simulations: HINDCAST

See poster Escudier et al.

Surface streamlines 17-Apr-2013



(R.Escudier)

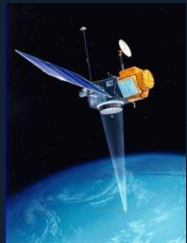
WMOP forecasts systematic evaluation

See poster Juza et al.

Delayed mode

Near real-time

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Satellite



Gliders



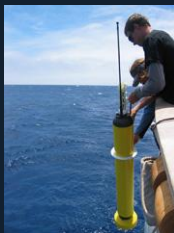
Ship-based CTDs

WMOP ocean forecasts

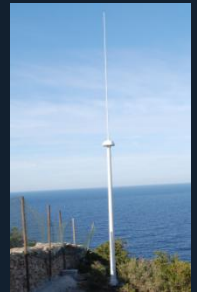
Moorings



Argo floats



HF radar



Surface drifters

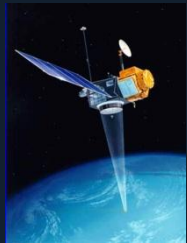


WMOP forecasts systematic evaluation

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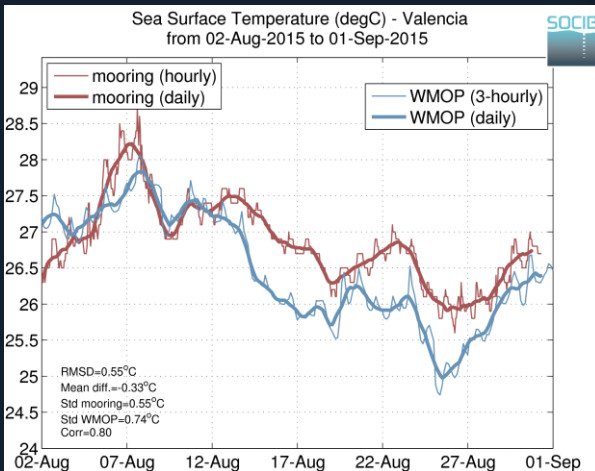
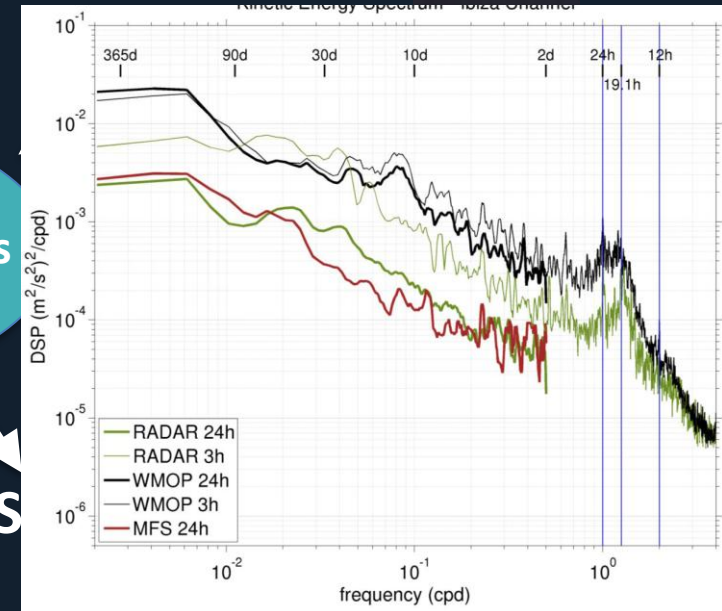
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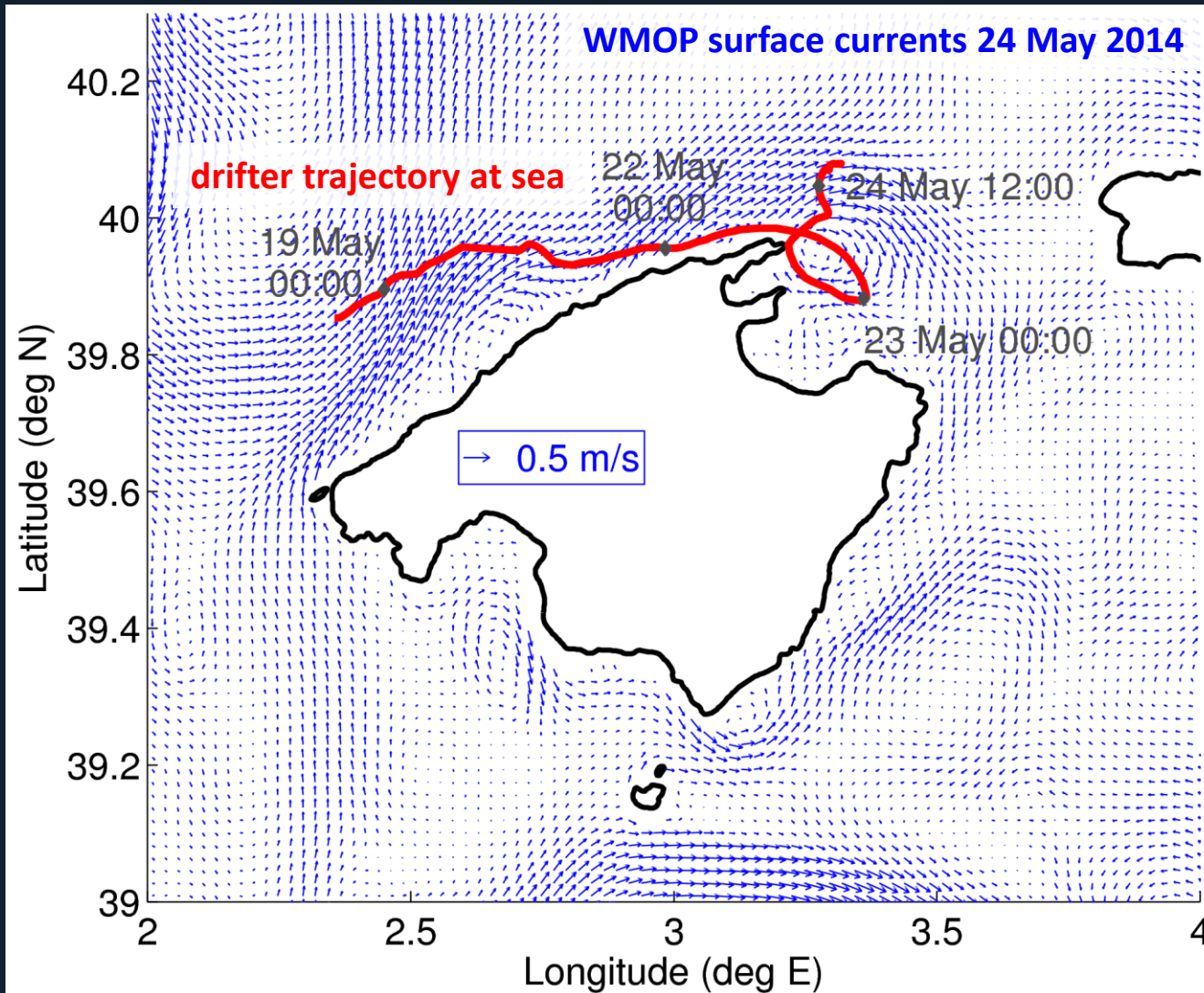
Gliders



WMOP ocean forecasts



WMOP forecasts: surface currents validation



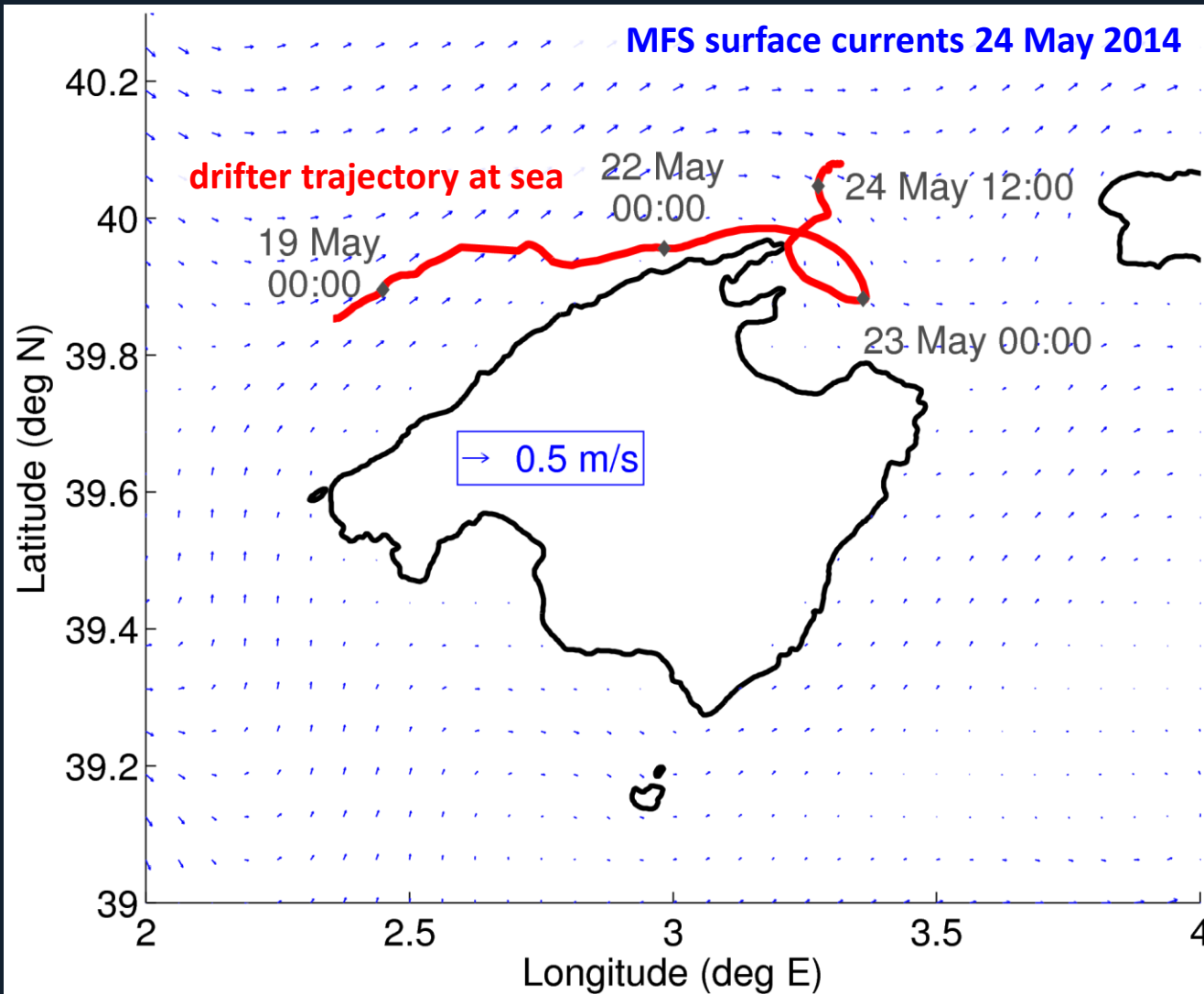
Mean velocity along
the drifter trajectory:

drifter → 0.30 m/s

WMOP → 0.28 m/s

MFS → 0.16 m/s

WMOP forecasts: surface currents validation



Mean velocity along
the drifter trajectory:

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Outline

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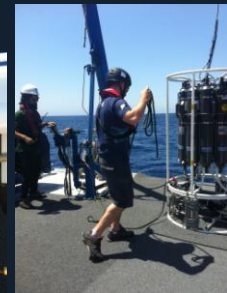
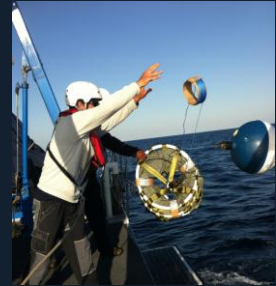
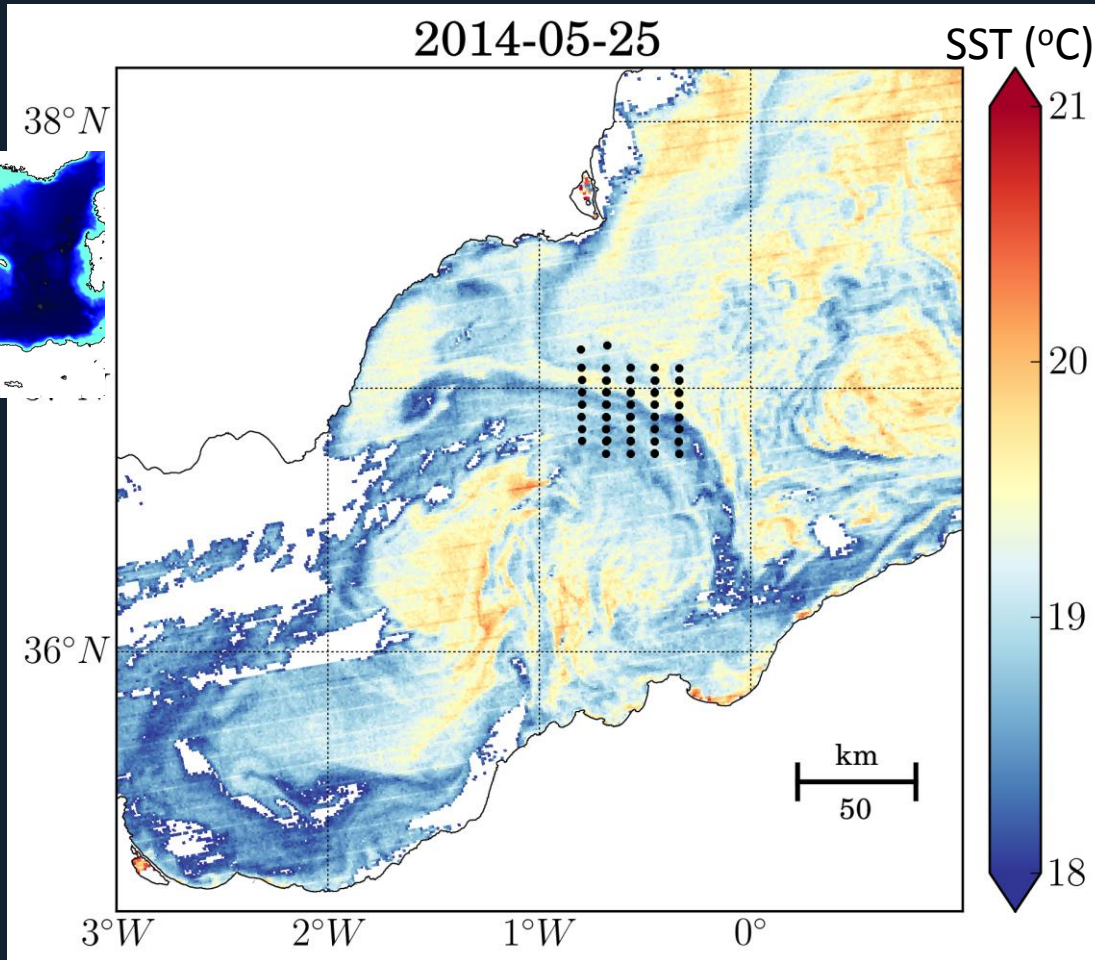
- ✓ Hindcast [2009-2014]
- ✓ Forecast

2 ALBOREX multi-platform experiment

- ✓ Model performance
- ✓ Data assimilation experiments

ALBOREX experiment

(27 May - 3 June 2014)



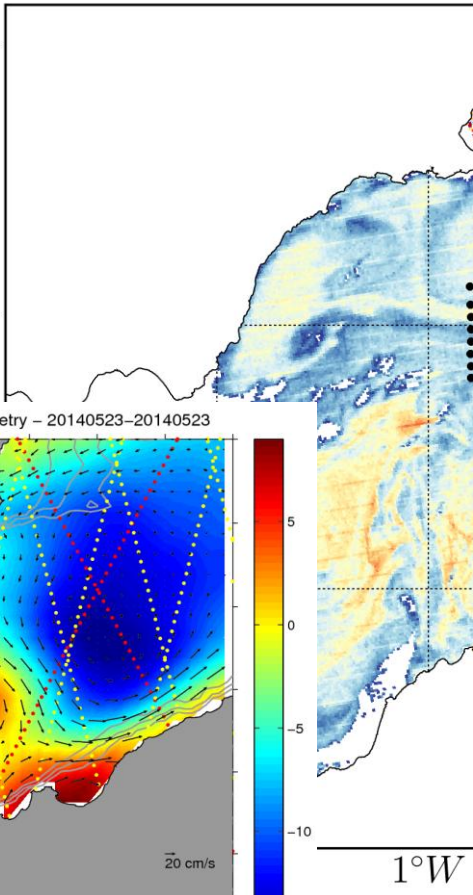
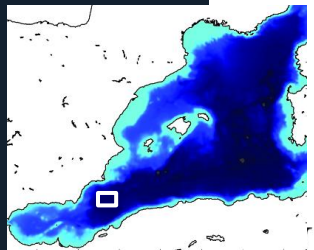
ALBOREX experiment

(27 May - 3 June 2014)

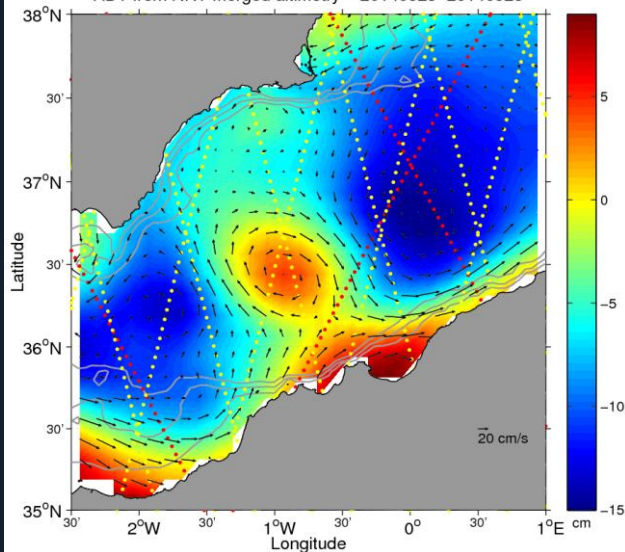


2014-05-25

38°N

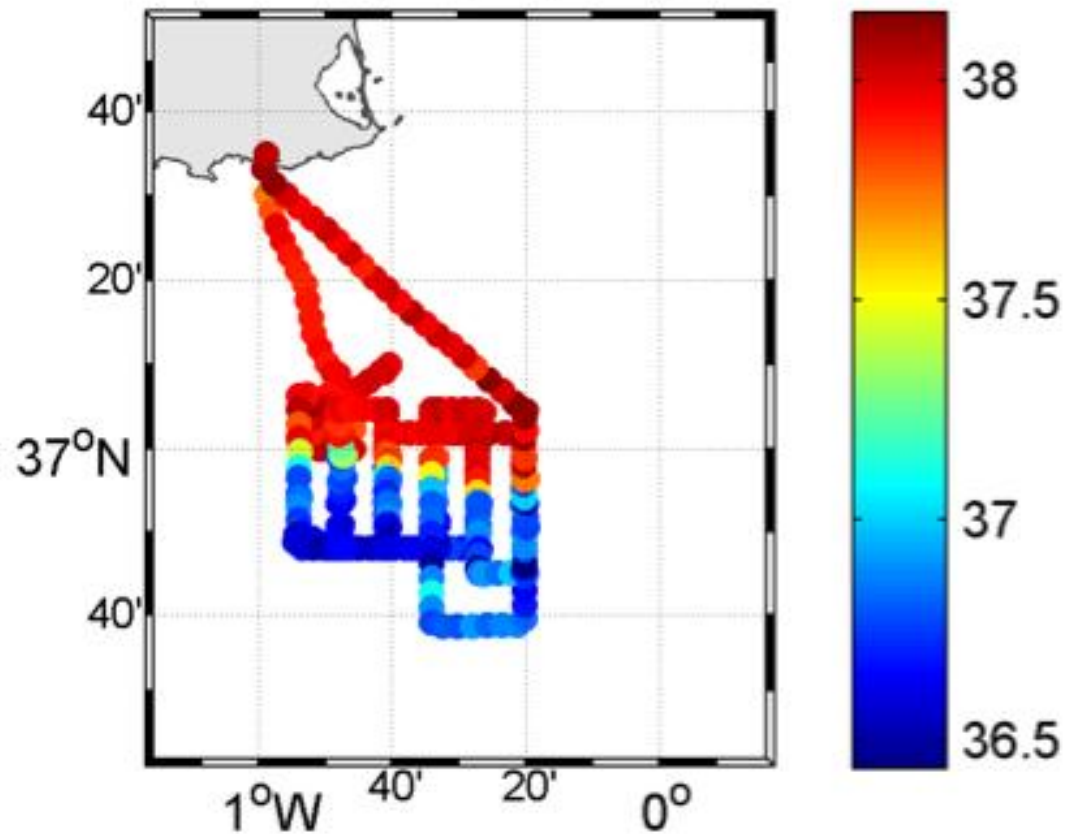


ADT from NRT merged altimetry - 20140523-20140523

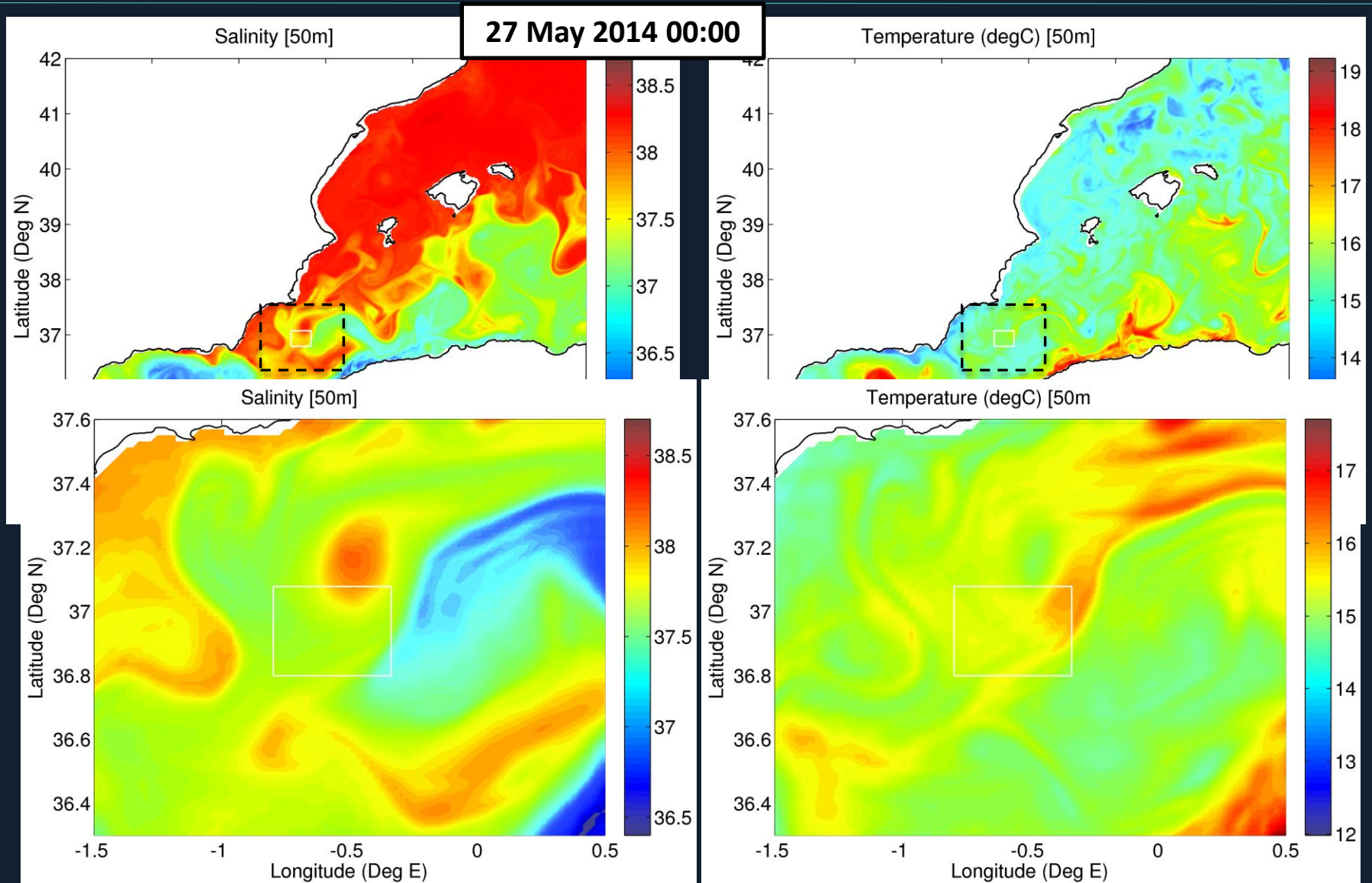


Surface salinity

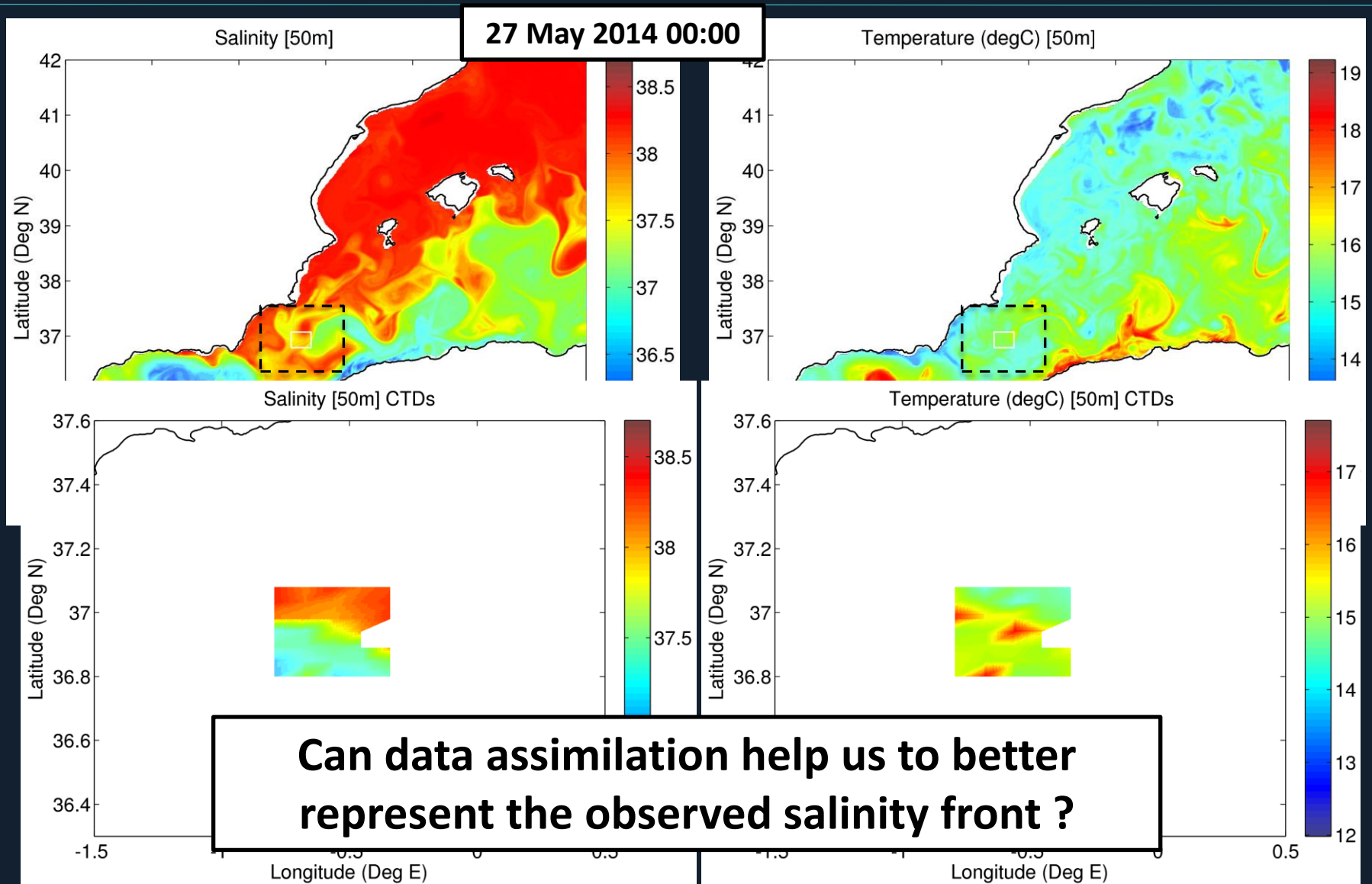
→ Sharp front: $\Delta SSS = 1.6$



WMOP performance during ALBOREX experiment

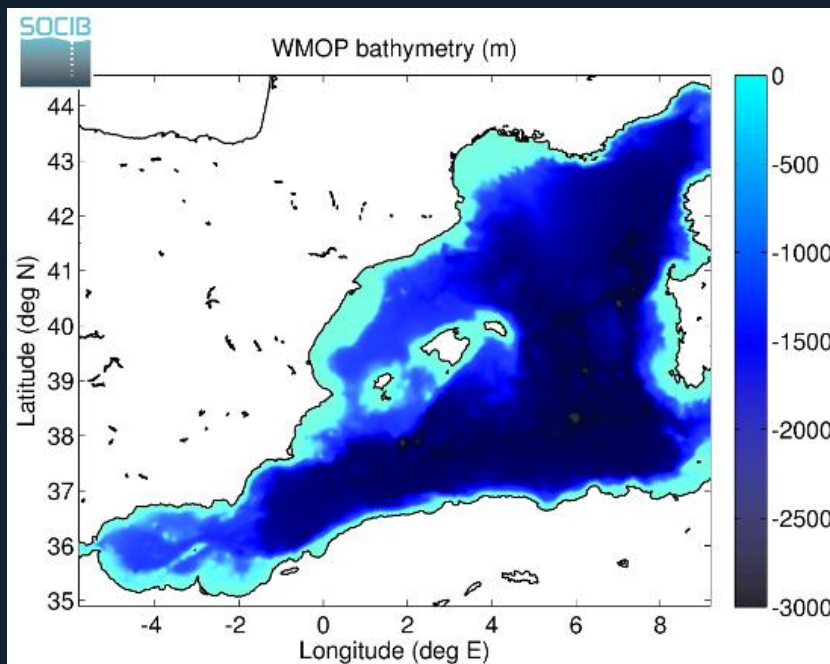


WMOP performance during ALBOREX experiment



ALBOREX data assimilation experiment

No data assimilation system developed for the WMOP model at that time...



Constraints:

Large dimension of the model

Limited local computing resources

Multi-platform data assimilation

Likely to be applied operationally

Several hindcast simulations available

ALBOREX data assimilation experiment

Data assimilation approach:

Local Multimodel Ensemble Optimal Interpolation

→ Ensemble anomalies sampled from three 2009-2014 WMOP hindcast simulations.

The anomalies are considered within the same season as the analysis date after having removed the seasonal cycle.

→ Multivariate, inhomogeneous and anisotropic model error covariances characteristic of the mesoscale variability of the season under consideration.

→ Localization radius = 280km

→ 80 ensemble members

Assimilated data

One single analysis on 27 May 2014 00:00, assimilating:

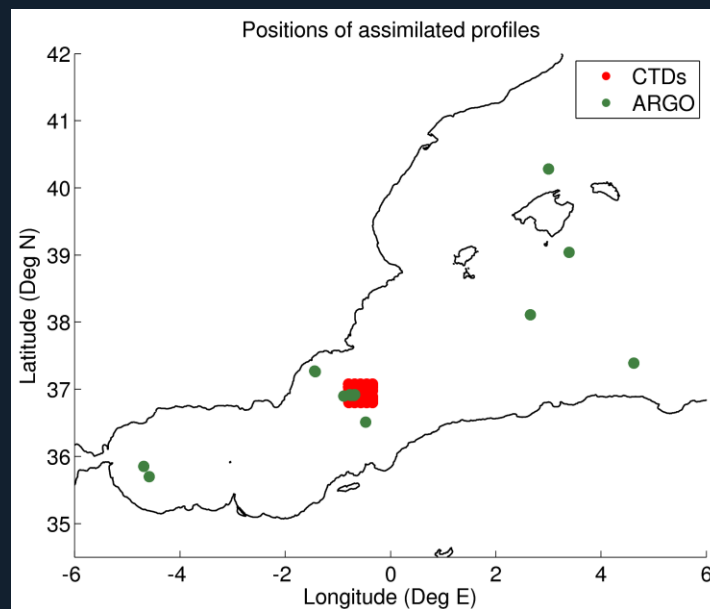
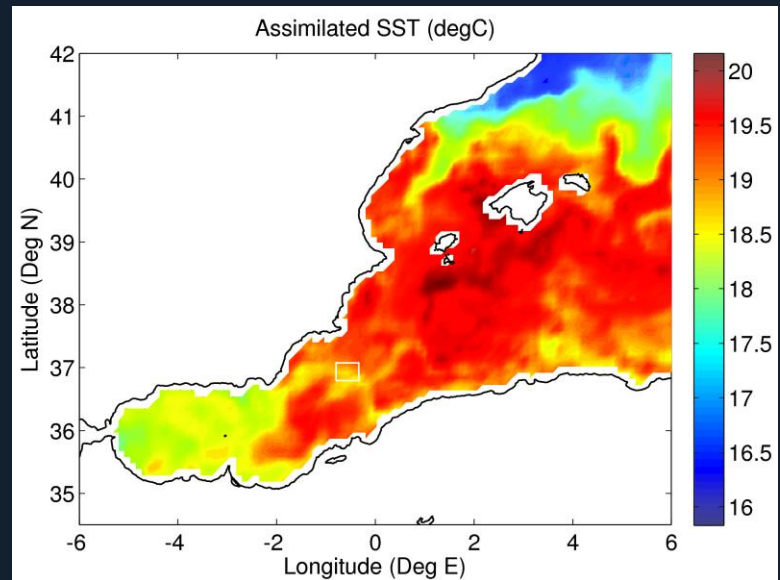
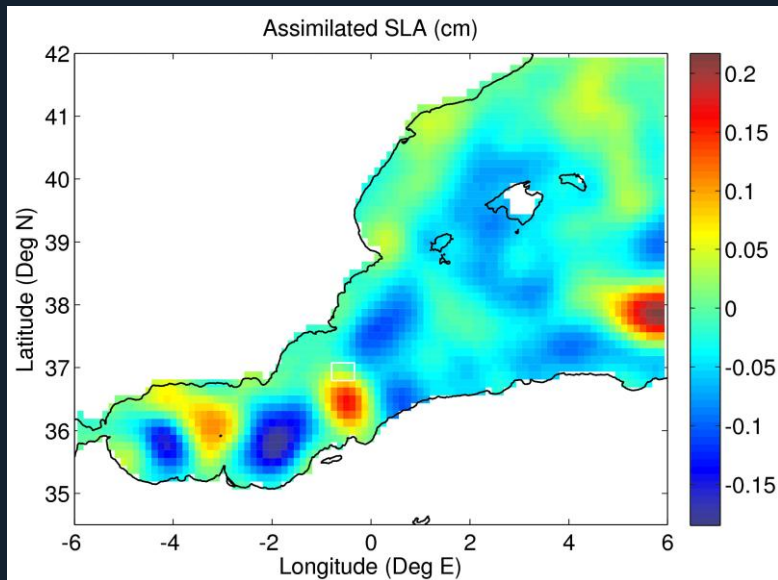
→ Gridded Sea Level Anomaly (AVISO)

→ Satellite-derived interpolated Sea Surface Temperature (GHRST-JPL)

→ ARGO TS profiles (5-day window)

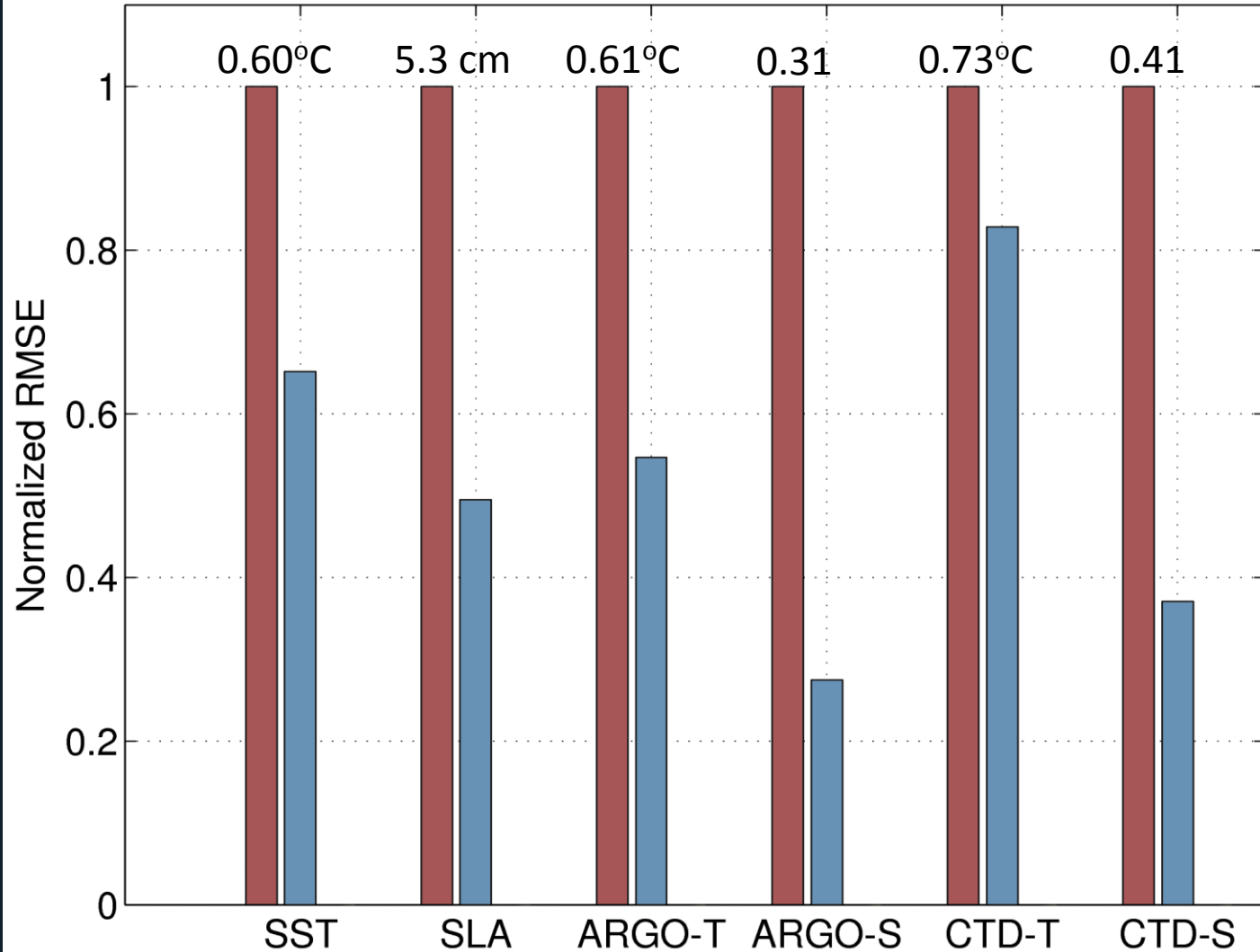
+ dense ALBOREX CTDs data
(considered as synoptic over the 24-hour sampling period)

Assimilated data



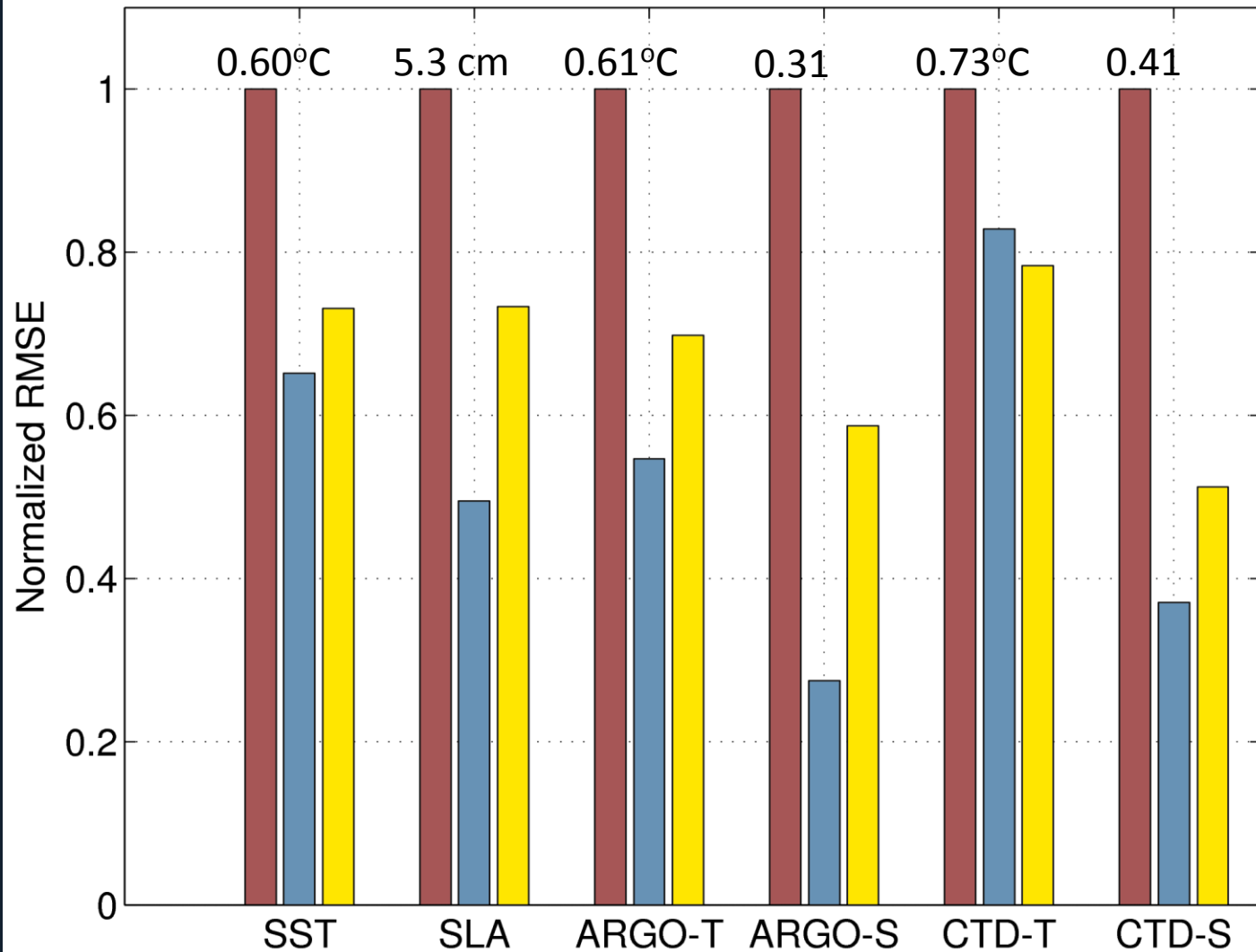
Consistency check

RMSE against assimilated data

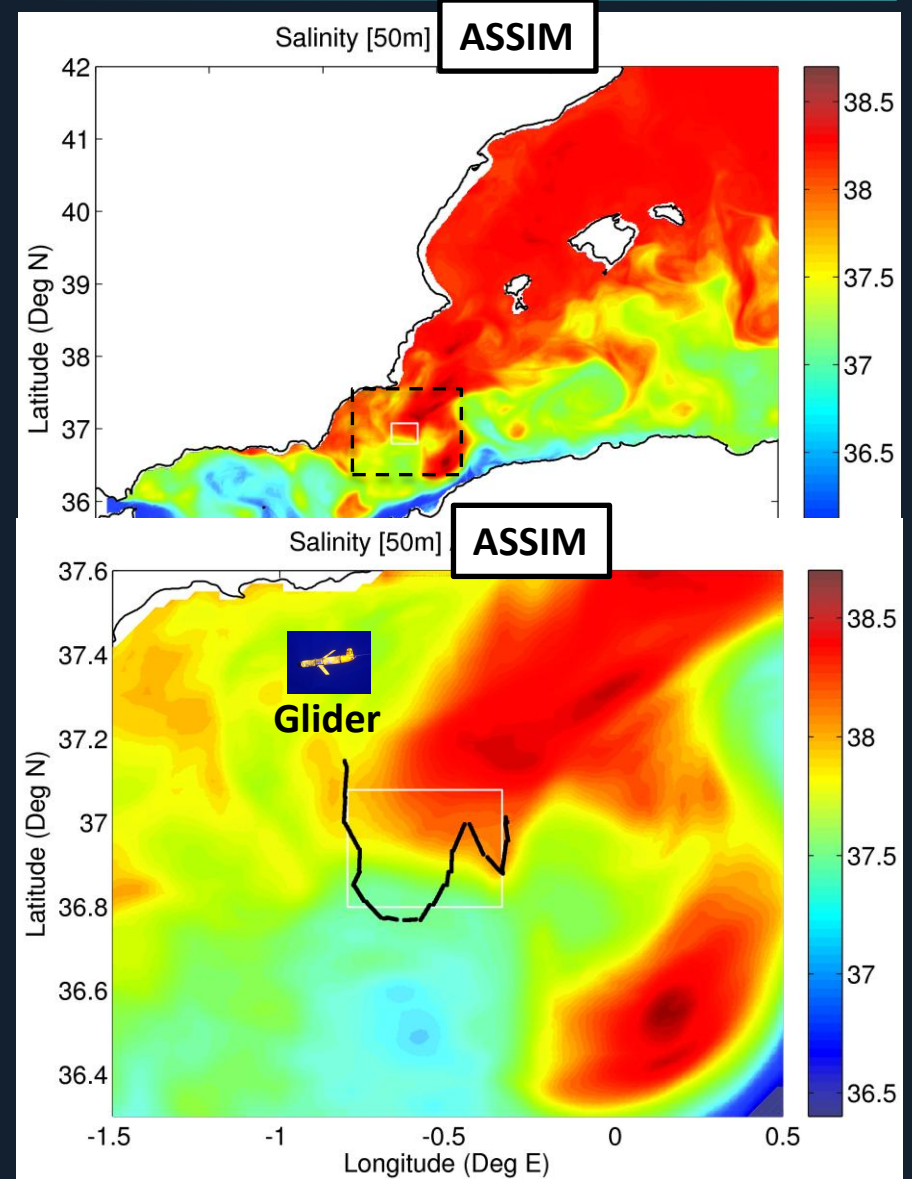
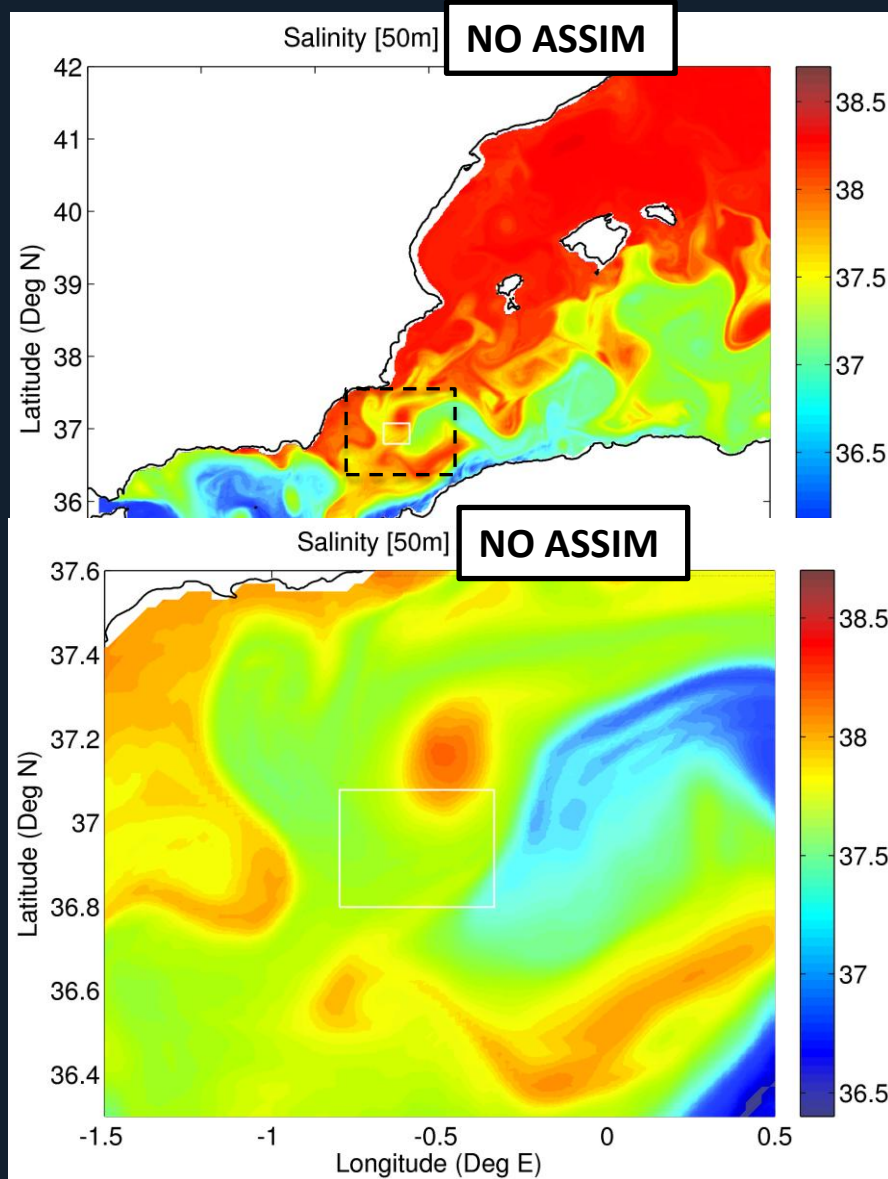


Analysis + initialization

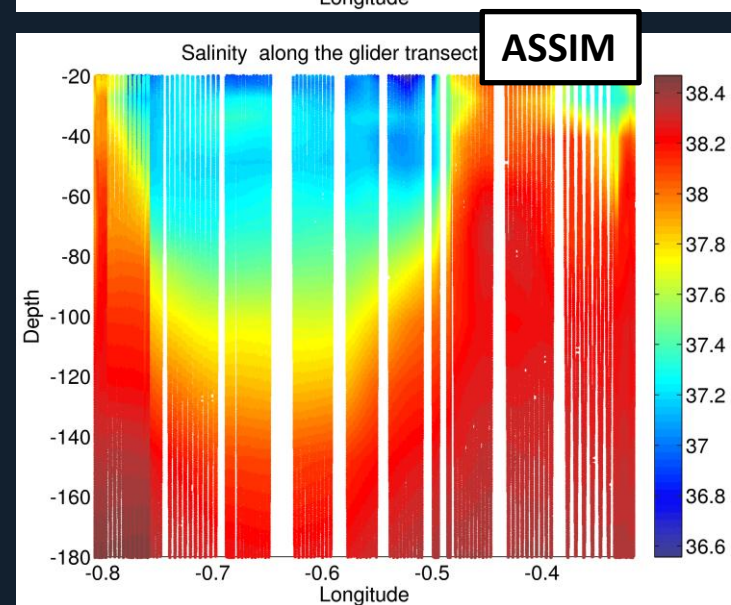
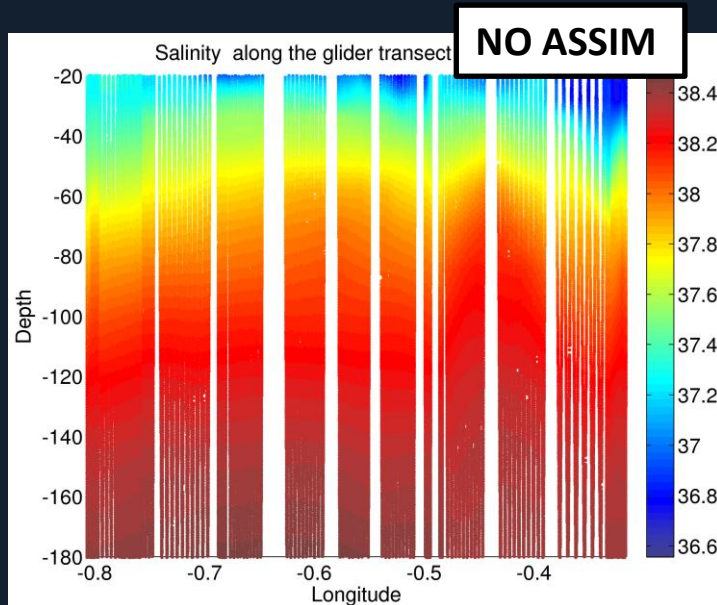
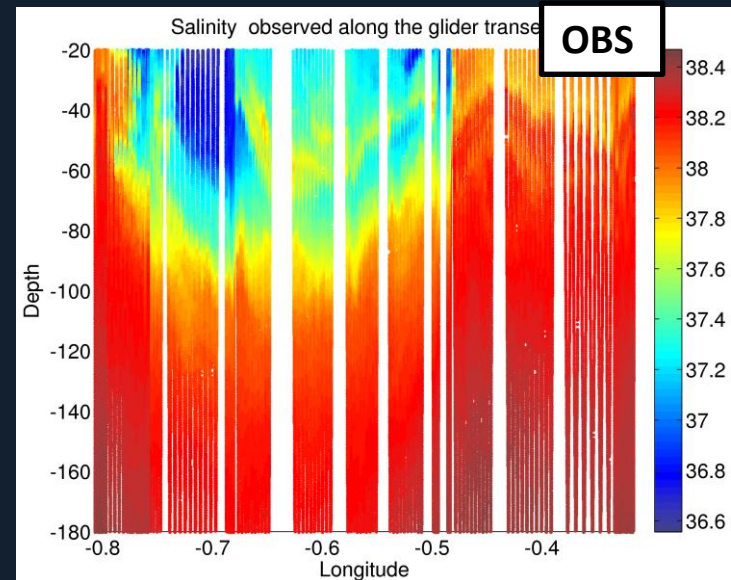
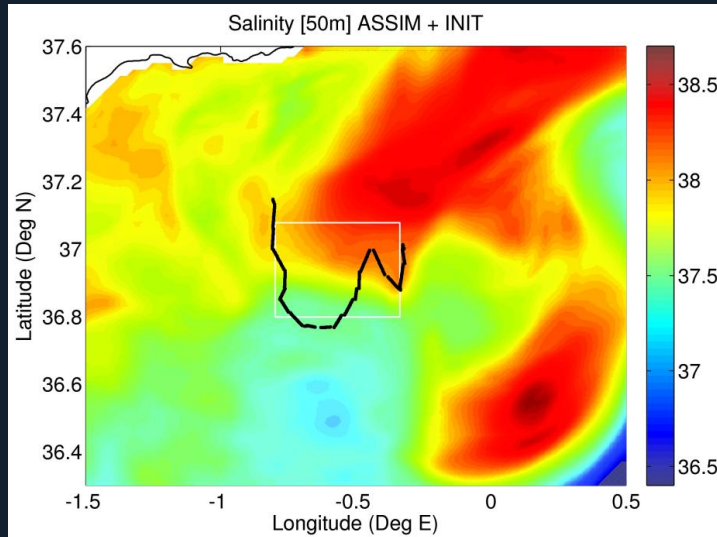
RMSE against assimilated data



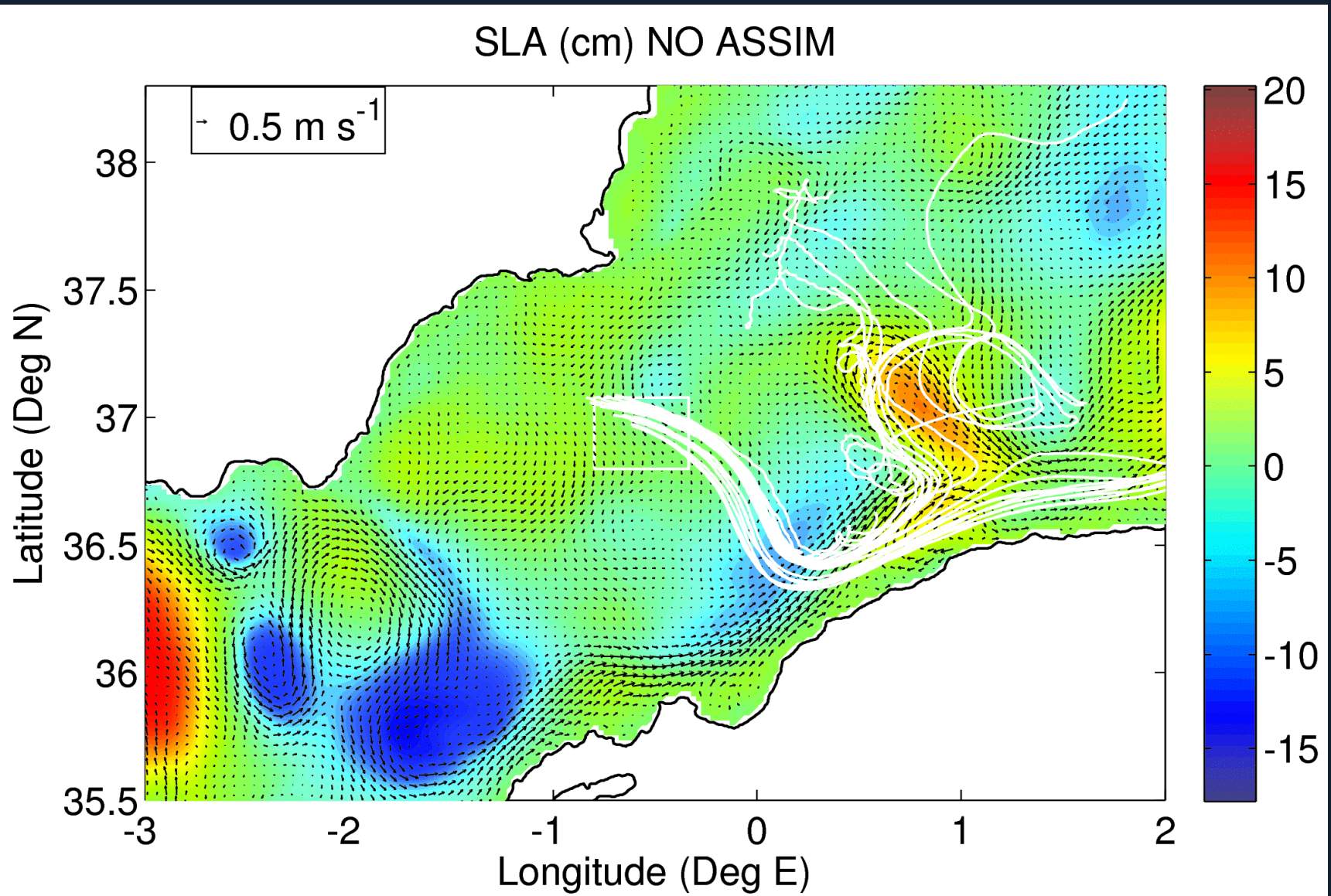
ALBOREX data assimilation experiment



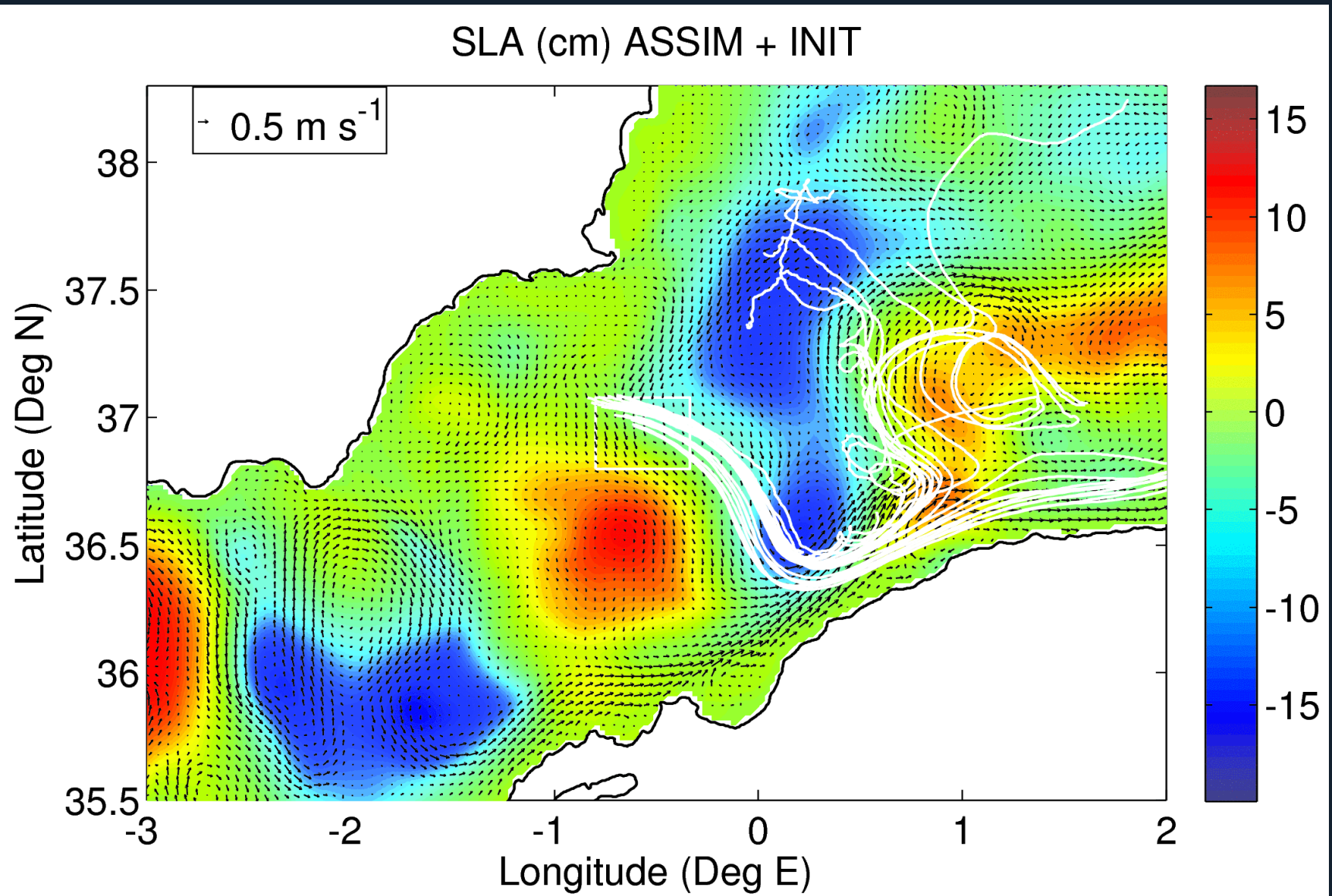
ALBOREX coastal glider validation



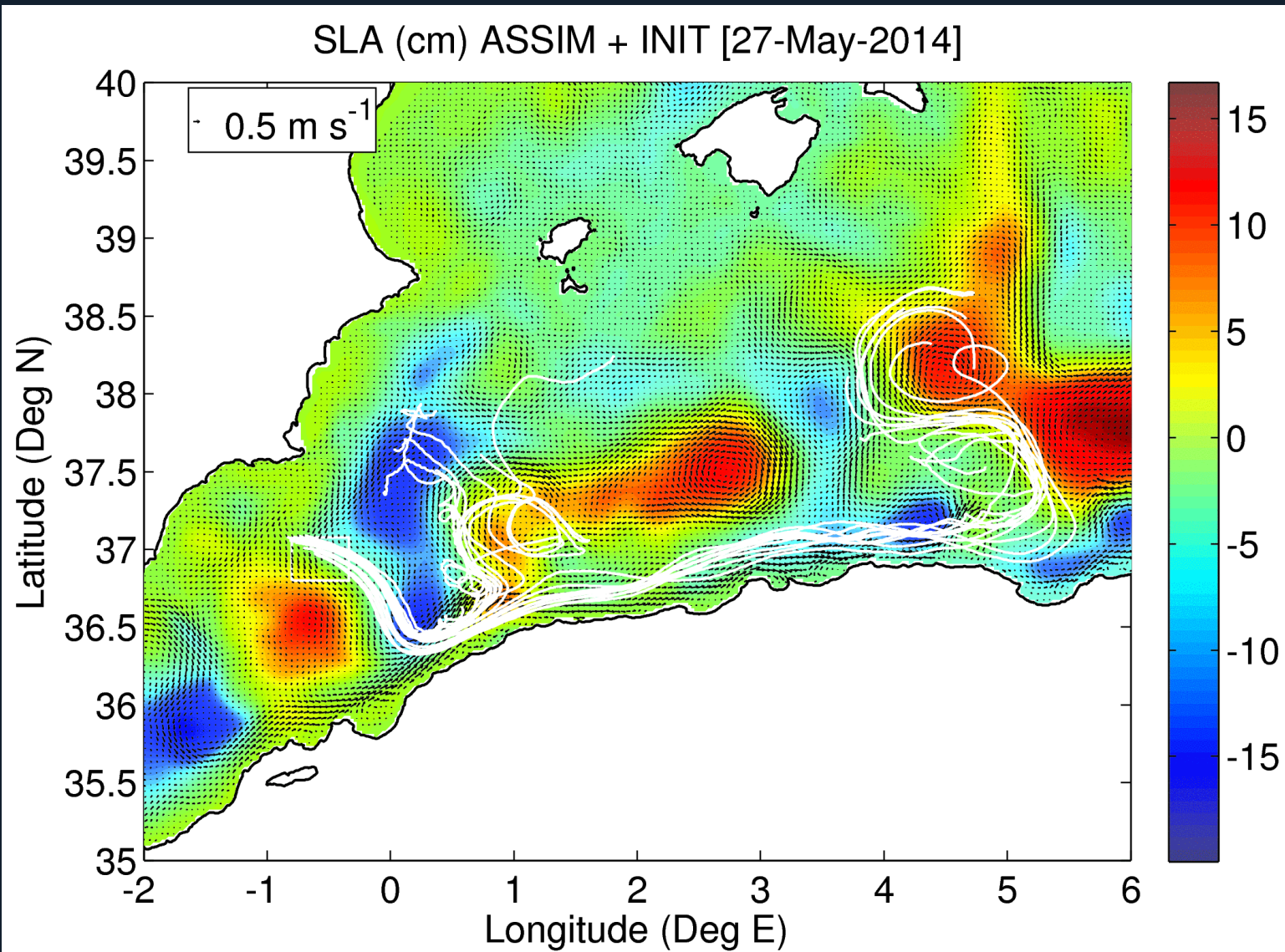
ALBOREX drifter validation



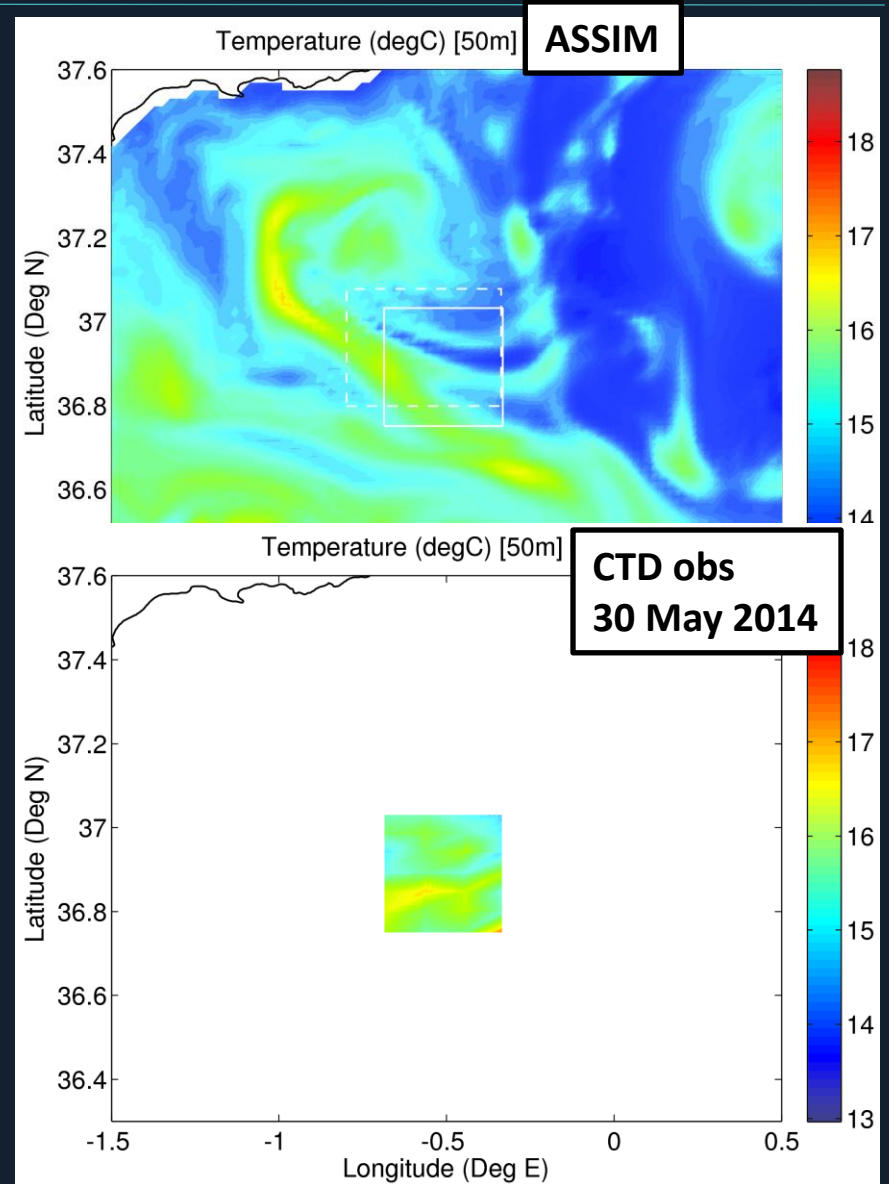
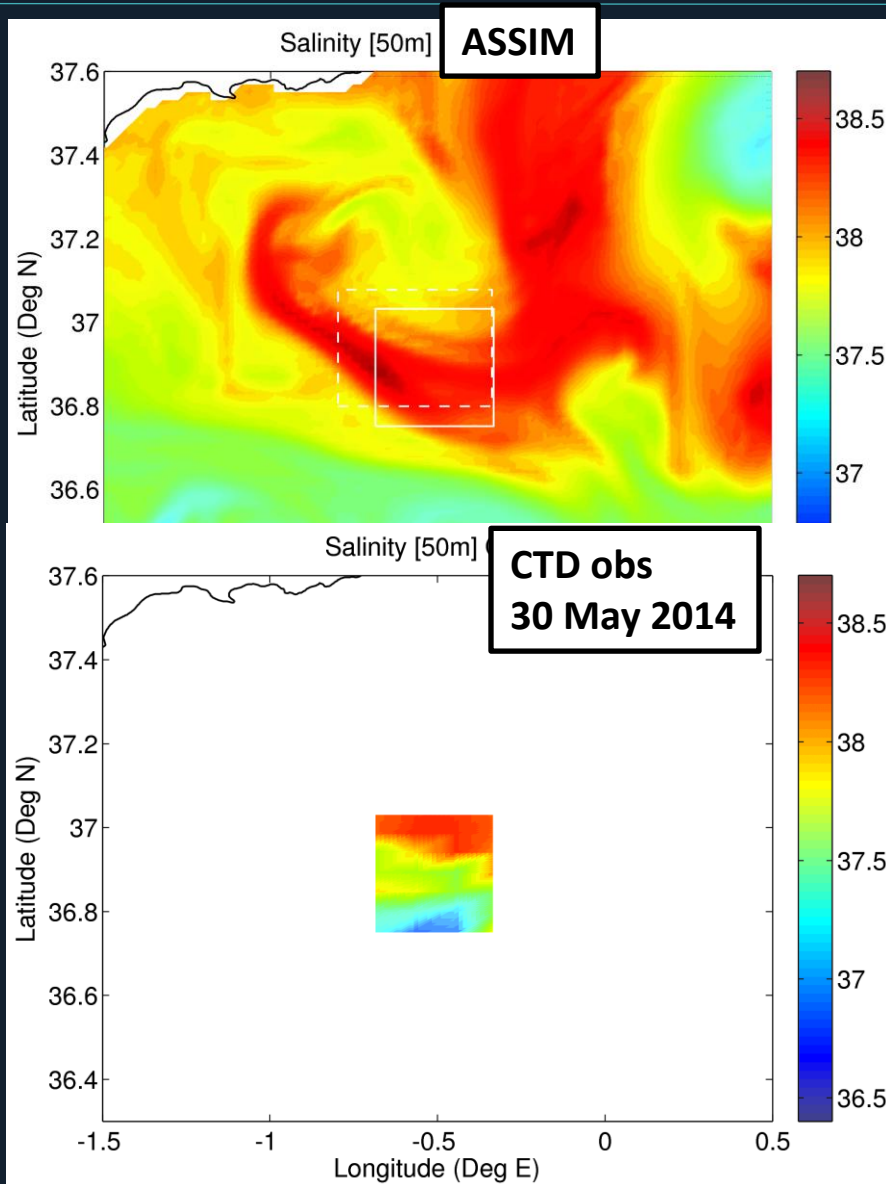
ALBOREX drifter validation



ALBOREX drifter validation



ALBOREX 3.5-day forecast

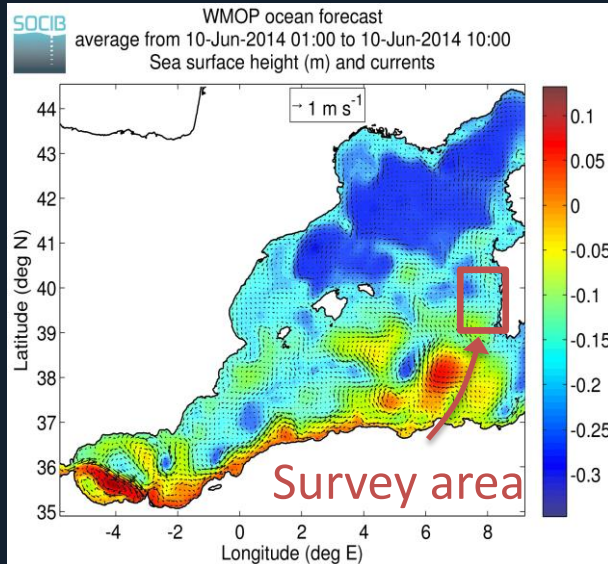


Conclusions

- ✓ SOCIB: a coastal observing and modelling system in the Western Mediterranean Sea
- ✓ 2-km resolution hindcast and forecast simulations available, with systematic evaluation using multiplatform observations
- ✓ The ALBOREX experiment motivated the development of a data assimilation system for WMOP
 - ✓ Local Multimodel Ensemble Optimal Interpolation approach
 - ✓ Proper ingestion of the observations (multivariate, dense, local and larger scale)
 - ✓ Synergetic use of multi-platform data including altimetry to constrain the mesoscale and reconstruct the observed local salinity front
 - ✓ The evolution of the front in the model is not fully realistic

REP14-MED experiment

(6-25 June 2014)



Thank you for your
attention