IMPACT OF HF RADAR DATA ASSIMILATION ON SURFACE CURRENTS IN THE IBIZA CHANNEL

Jaime Hernandez Lasheras[1] (jhernandez@socib.es) , Baptiste Mourre[1], Emma Reyes[1], Alejandro Orfila[2], Joaquín Tintoré[1,2]

[1]SOCIB, Balearic Islands Coastal Observing and Forecasting System, Palma de Mallorca, Spain. [2]IMEDEA (CSIC-UIB), Esporles, Spain.

1 Motivation

High Frequency radars (HFR) provide continuous and high-resolution surface current measurements in coastal areas, allowing to better understand surface ocean dynamics and providing valuable data to improve numerical model predictions through data assimilation. Since 2012, **SOCIB** operates two coastal HFR antennas with the purpose of monitoring the surface currents in the **Ibiza Channel** (Western Mediterranean Sea).

Several experiments have been carried out to evaluate the improvement in model forecasts when assimilating HFR measurements in addition to multiplatform observations from satellite and ARGO floats, with the objective of being able to be implemented in the operational system. A control simulation assimilating multiplatform observations without including HFR velocities allow to characterize the influence of HFR measurements on the forecast performance. Results have been assessed comparing against HFR fields and independent surface drifter.

2 Model and data assimilation system

1 WMOP model

- Regional configuration of the ROMS model, hindcast 2009-2015
- Horizontal resolution: ~2km (1/50º), 32 σ-levels
- Initial & Boundary conditions: CMEMS MED-MFC (1/16º)
- Atmospheric forcing: AEMET Hirlam (1/3h,5km)
- Rivers: Var, Rhône,Aude,Hérault, Ebro, Jucar

2 Ensemble Optimal Interpolation

- Ensemble anomalies sampled from three WMOP hindcast simulations (2009-2015) with different initial/boundary forcing and mixing parameters
- Anomalies selected within the same season as the analysis date after having removed the seasonal cycle
  → Multivariate, inhomogeneous and anisotropic 3-dimensional model error covariances characteristic of the mesoscale variability
- Domain localization with a 250-km radius
- 80 ensemble realizations

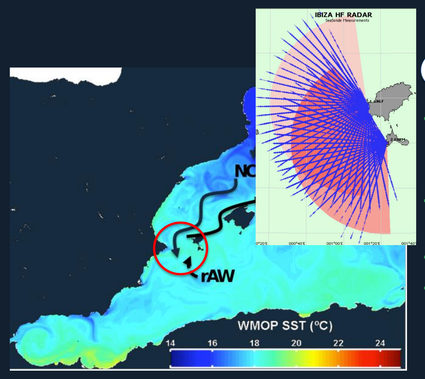


Figure 1. WMOP domain is show overlapped by a scheme of the HFR measurements

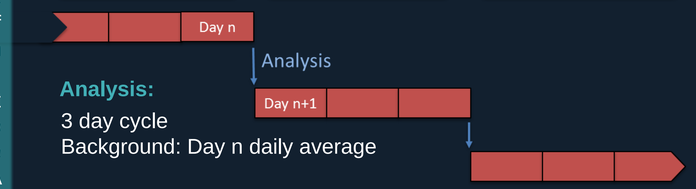
3 Observations

- **SLA:** AVISO products, mapped (1/8º) and along-track
- **SST**: 10km resolution, JPL-MUR
- **Argo:** TS profiles
- **HFR:** Ibiza Channel (3km, daily total velocities: u & v components)

3 Experimental set-up

3 simulations from 21 Sep to 20 Oct 2014:

NO ASSIM (Free run)	GNR ASSIM (SLA + SST + Argo T-S)	HFR ASSIM (SLA + SST + Argo T-S + HFR)



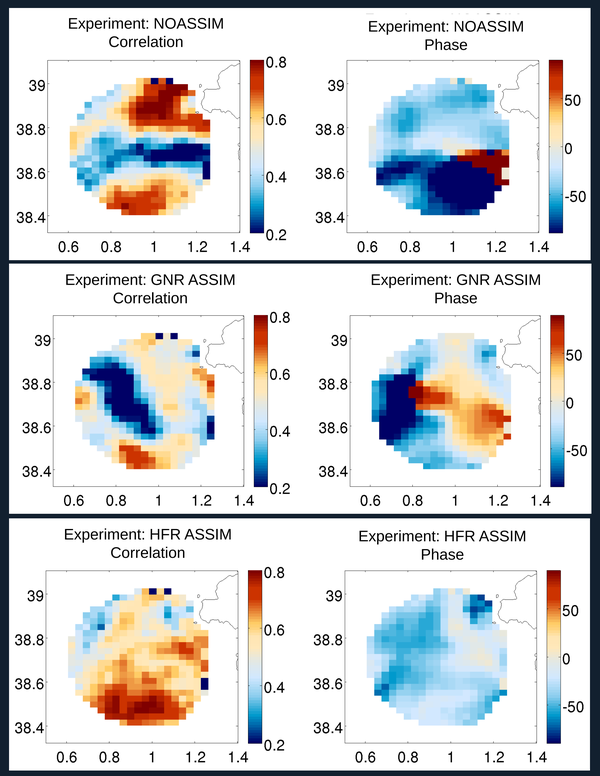
Analysis:
3 day cycle
Background: Day n daily average

Initalization method: Day n+1 restarts directly from the outputs of the analysis (T, S, SSH, U and V)

4 Eulerian assessment. Complex correlations

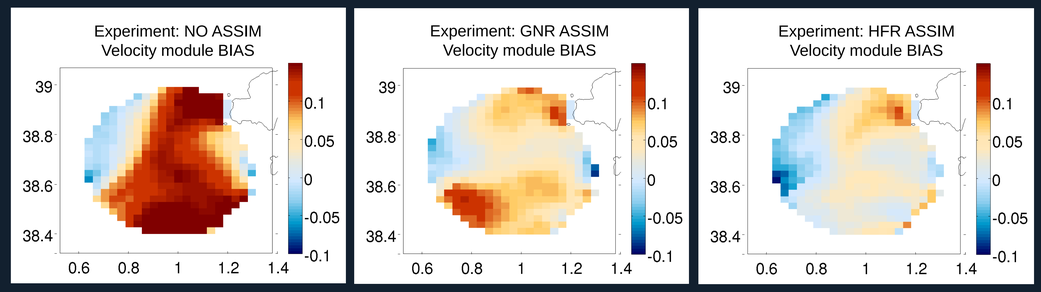
Complex correlations for the whole simulation period are calculated between HFR daily mean observations and WMOP daily average surface velocities. Thus, in the case of HFR ASSIM simulation the observations can't been considered as independent

HFR assimilation improves correlation both in magnitude and phase in the southern part of the domain. It degrades the good agreement of the NOASSIM simulation in the northern part.



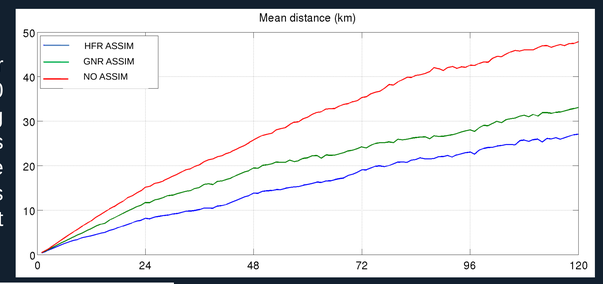
5 Eulerian assessment. Mean error (bias)

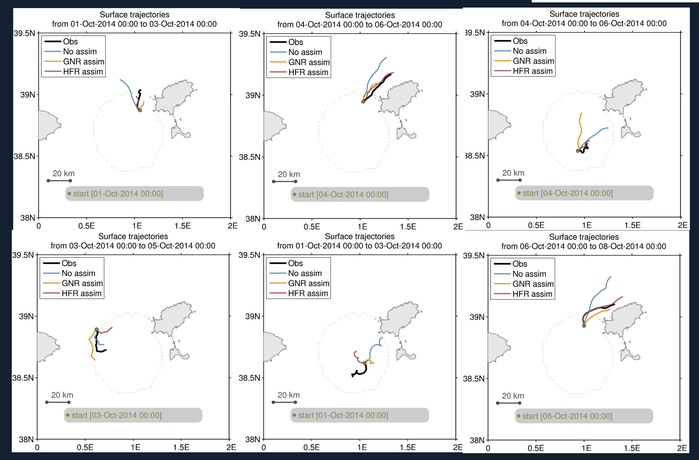
Complex correlations should be completed with other metrics as the mean error to make a more complete overview.
We can observe that the model without assimilation overestimates intensity of the current.
Assimilation of HFR leads to a strong correction in all the coverage.
Although not improving the correlation, the generic assimilation helps the model to aproach HFR obervations.



6 Lagrangian Assesment

The trajectories of virtual buoys were simulated for eight consecutive starting days. Every day 100 virtual particles were launched at the corresponding position of every of the 14 real drifters. Particles were left to drift for 5 days. The figure shows the mean distance over the time of the virtual particles to the real drifters for each of the three different experiment simulations





- This validation against independent data shows how the prediction of lagrangian particles improves when using data assimilation. The generic assimilation already improves the prediction and adding the HFR to the observations assimilated significantly enhanced it.
- However, the improvement in the prediction of lagrangian trajectories is not systematically as we can observe in the different pannels on the left hand side. Although giving in mean a much better result, in cases, the simulation without assimilation can give better results than the ones using data assimilation

7 Conclusions and perspectives

- The WMOP DA system (EnOI) is able to correct currents in the Ibiza Channel
- The assimilation of HFR data together with "generic" observations does not degrade the improvement achieved with the "generic" observations only in terms of SLA, SST and profiles.
- HFR data assimilation improves the prediction of Lagrangian trajectories
- Two other similar simulations using a "nudging" initialization procedure after analysis have been run (not shown). Analogous results have been obtained leading to an improvement of ocean currents
- The assimilation of radial currents is to be implemented in the near future