ASSIMILATING IBIZA CHANNEL HF RADAR CURRENTS IN A HIGH RESOLUTION MODEL

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SOCIB Balearic Islands Coastal Observing and Forecasting System

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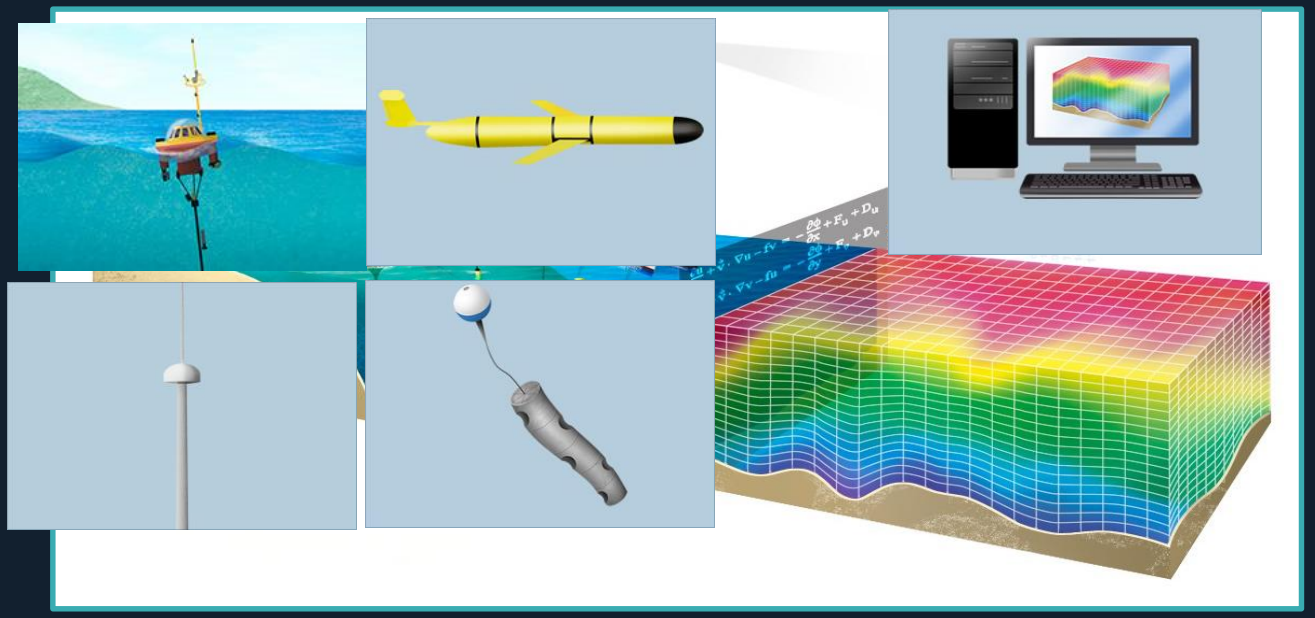
SOCIB – The Balearic Islands Coastal observing and forecasting system

- Multi-platform approach:
  - Observing facilities (HFR, gliders, RV, moorings, Lagrangian platforms)
  - Models

Merging observations and models to improve ocean prediction

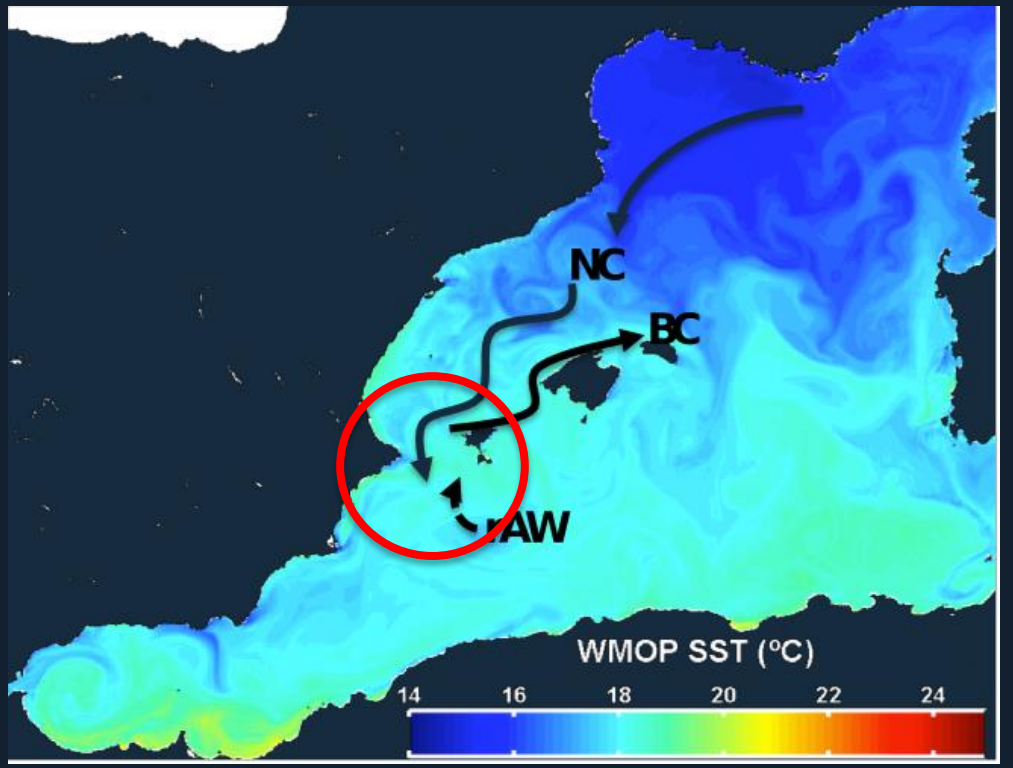


Data assimilation (DA): Aims at optimally combining dynamical ocean models with in-situ and remotely sensed observations

High Frequency Radar Data Assimilation

Objectives

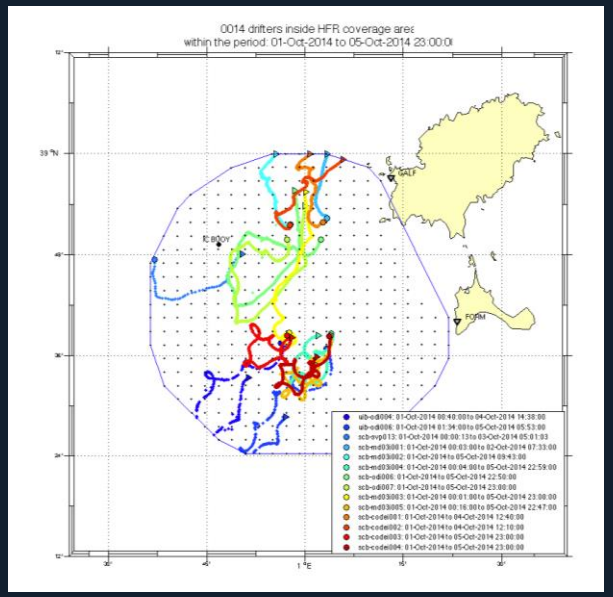
- Combine HFR measurements along with the “generic” observation sources (SLA, SST, Argo T-S)
- Evaluate the impact of HFR data
- Optimize data assimilation scheme

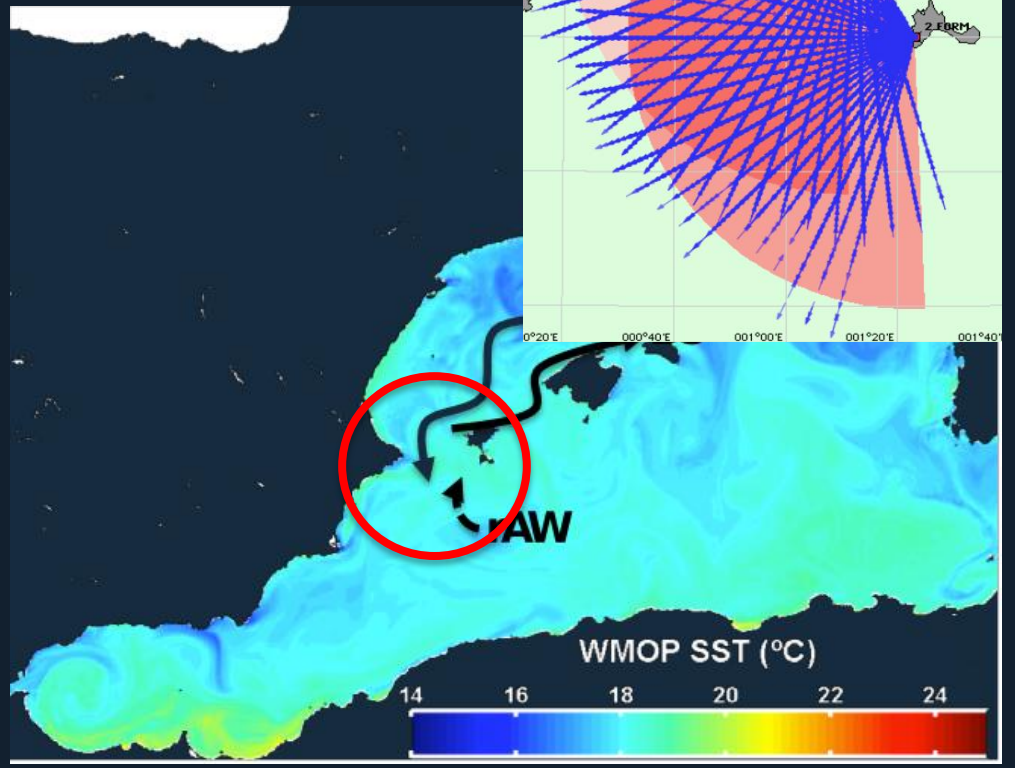


High Frequency Radar Data Assimilation

Area / data

- Area of study: Western Mediterranean Sea →Ibiza Channel
- HF radar CODAR system with 2 antennas in Ibiza and Formentera Islands
- Total daily mean fields (u-v components)
- Satellite SLA + SST & Argo T-S
- 14 Drifters: deployed in the area
  for validation

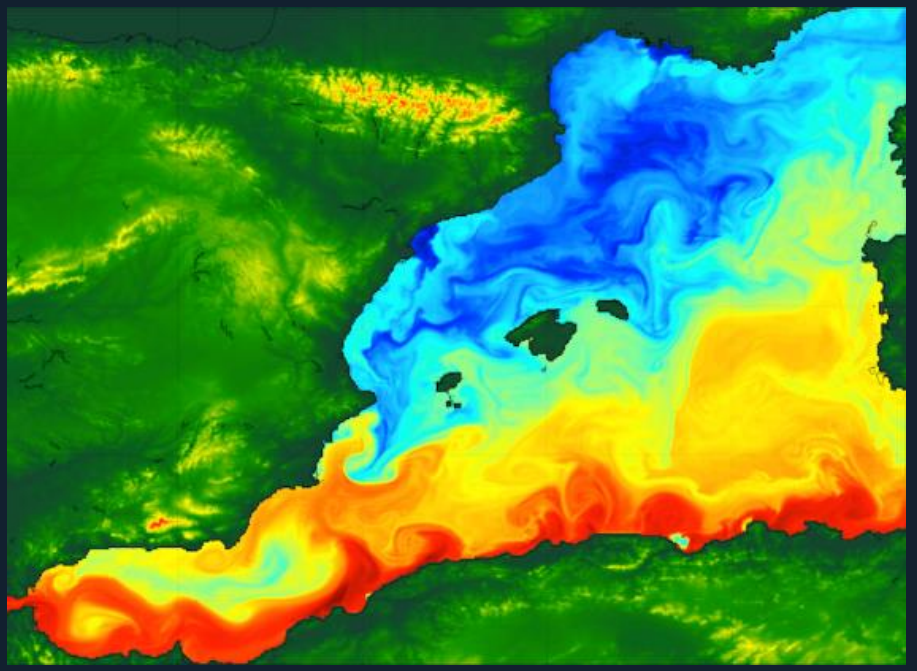




Model and data assimilation system

WMOP – Western Mediterranean Operational system

Hydrodynamics	ROMS
Spatial domain	Western Mediterranean (Gibraltar to Sardinia-Corsica)
Horizontal & vertical resolution	2km (~1/50º) 32 σ-levels
Surface forcings	HIRLAM model (3h, 5km)
Initial & boundary conditions	CMEMS Med Rea (6km, daily)



Forecast (Juza et al.2016): 3 day daily fields available at **www.socib.es**

Hindcast: 2009-2015 (Free- run)

Model and data assimilation system

Multimodel Local 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 200-km radius

- 80 ensemble members

High Frequency Radar Data Assimilation

5 different simulations:

- 30 days (21 Sep to 20 Oct 2014)
- 3 day assimilation cycle
- Different configurations and initialization methods

NO ASSIM
(Free run)

GNR
(SLA + SST + Argo T-S)

HFR
(SLA + SST + Argo T-S + HFR)

× **2 different initialization methods after analysis**

High Frequency Radar Data Assimilation

Analysis:

3 day cycle

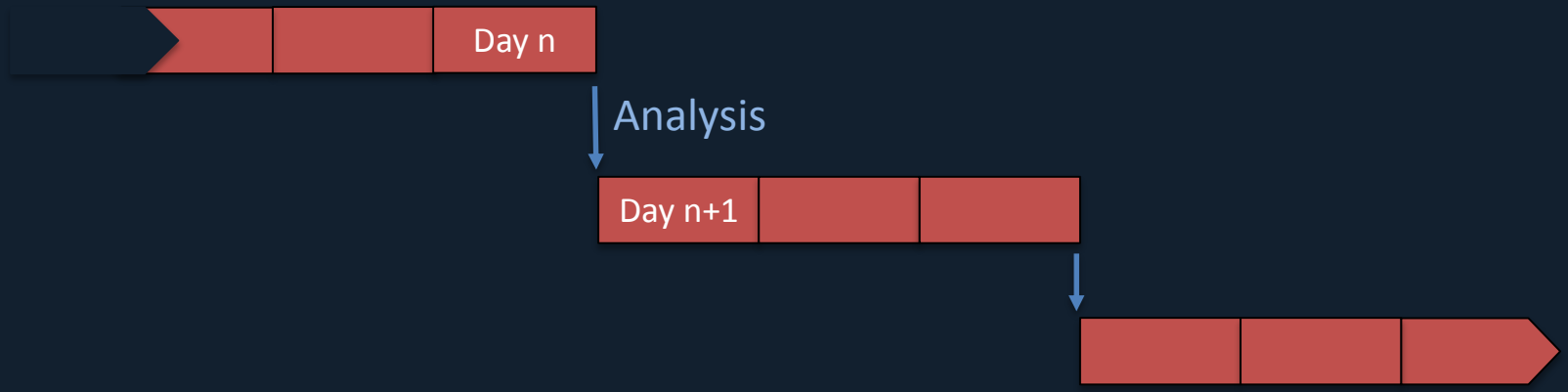
Day n average field used as background

Observations:

SLA along-track SST Argo (T-S) HFR (daily mean)

The initialization methods:

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



High Frequency Radar Data Assimilation

Analysis:

3 day cycle
Day n average field used as background
Observations:

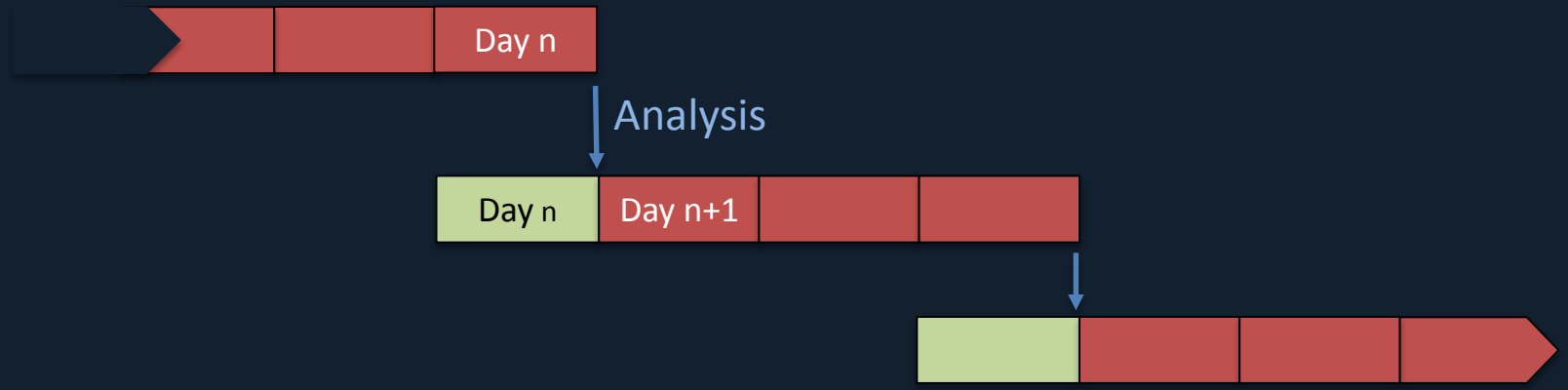
SLA along-track SST Argo (T-S) HFR (daily mean)

The initialization methods:

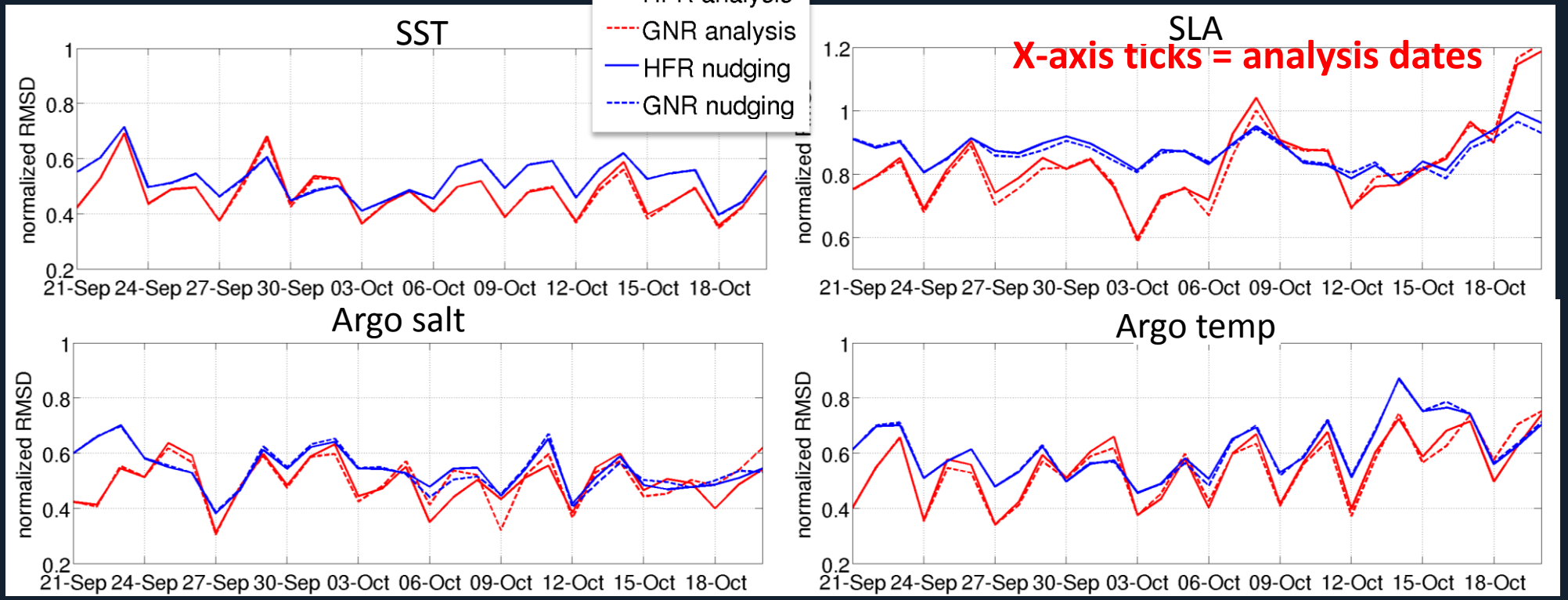
Raw analysis outputs: Day n+1 restarts directly from the outputs of the analysis (T, S, SSH, U and V)

"Nudging": Day n is simulated again applying a strong nudging towards T-S and SSH analysed values, velocities adjust according to model dynamics.

→ Limits initialization shocks

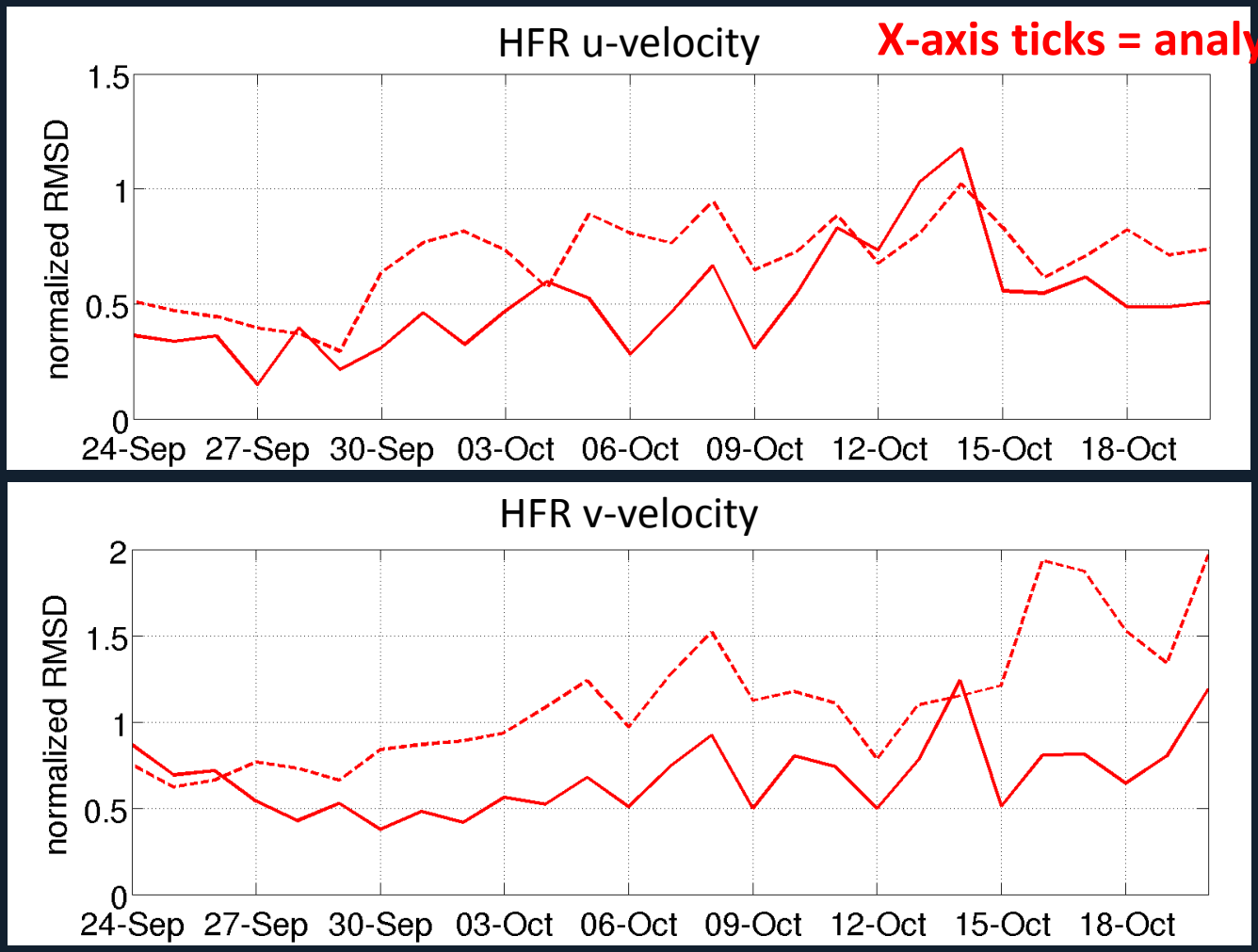


Performance over the whole domain



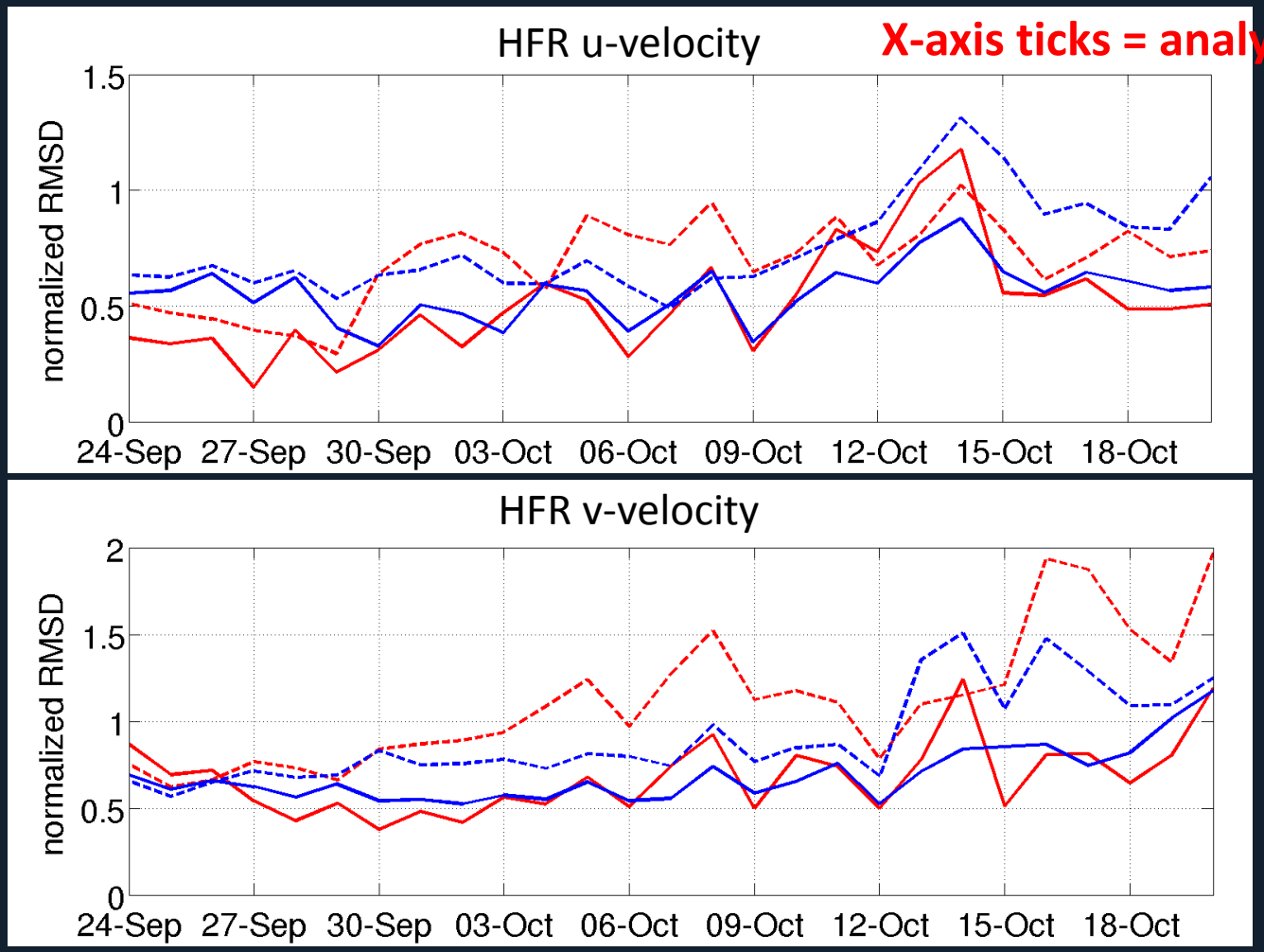
- Continuous improvement (normalized RMSD<1) for all variables in the four data-assimilative simulations
- Assimilating HFR data does not degrade the improvement achieved with the generic data assimilation
- Different initialization strategies give similar results in terms of RMSD.
- A slight improvement is obtained in SST without applying the nudging strategy

Performance over the whole domain



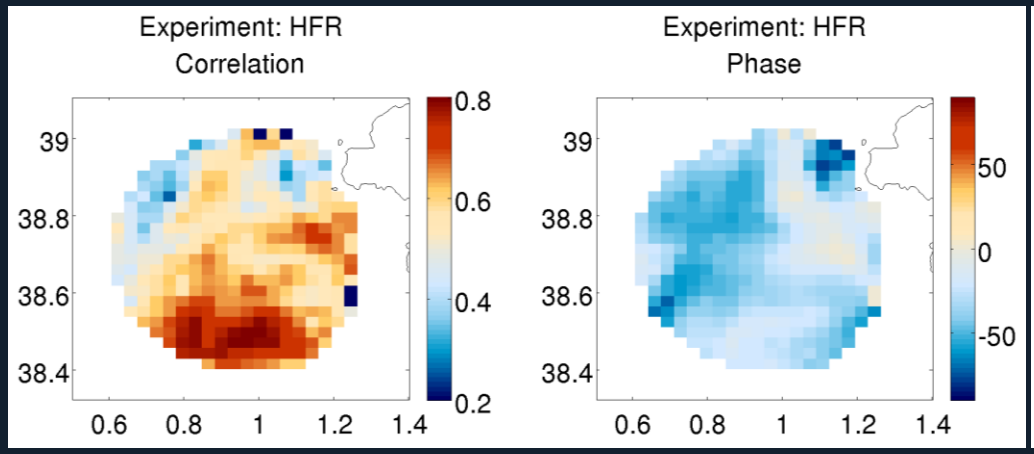
- The assimilation of HF radar improves u and v velocities in the HF radar area

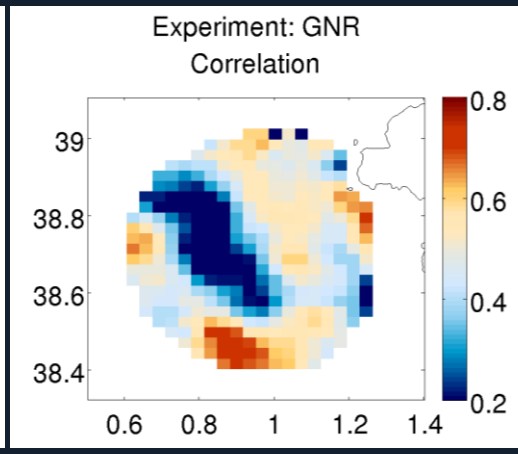
Performance over the whole domain

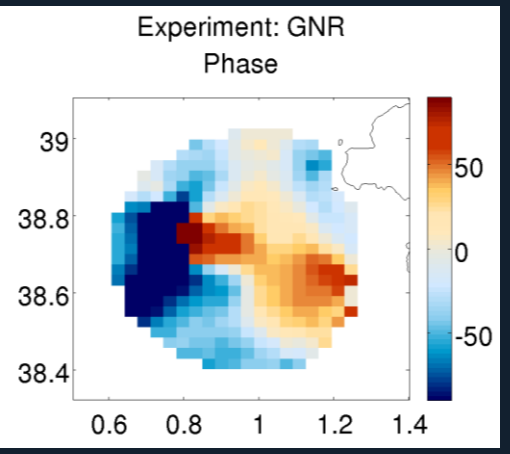


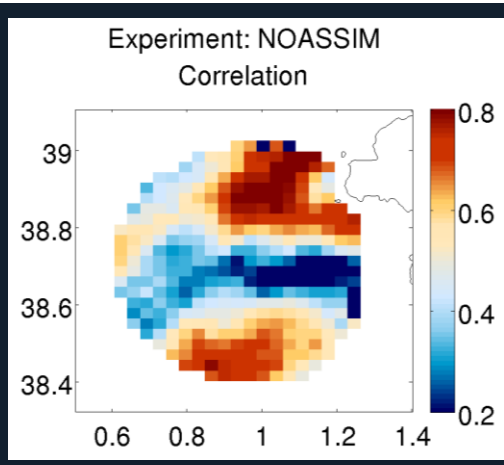
- The assimilation of HF radar improves u and v velocities in the HF radar area
- The application of the 1-day nudging leads to a similar performance in the simulation assimilating HFR data

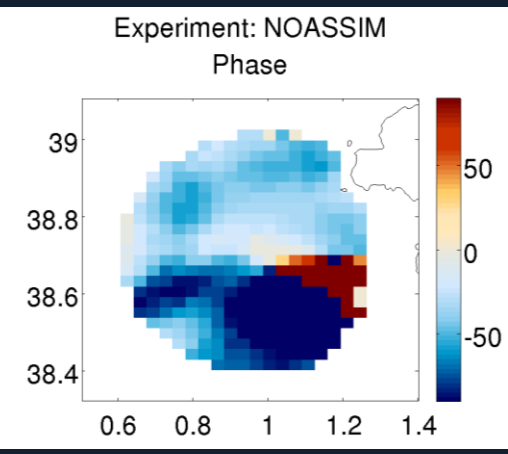
HFR area. Eulerian assesment: complex correlations





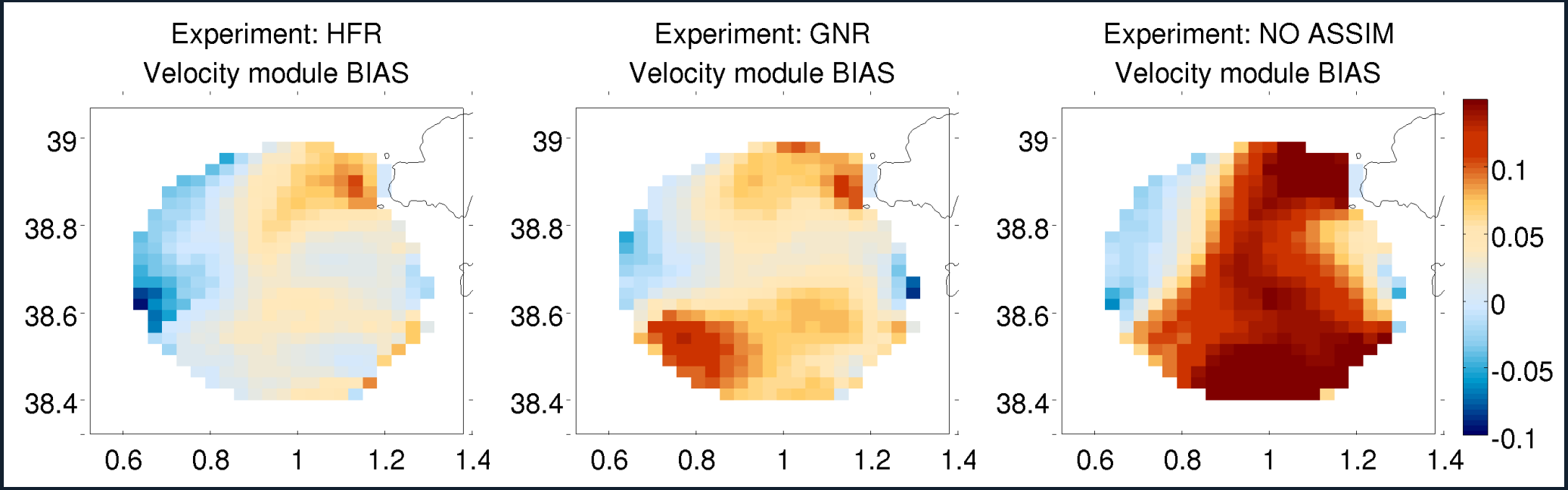






HFR assimilation improves the overall correlation both in magnitude and phase.

HFR area. Eulerian assesment: mean error (bias)



The model without data assimilation overestimates the intensity of the current.

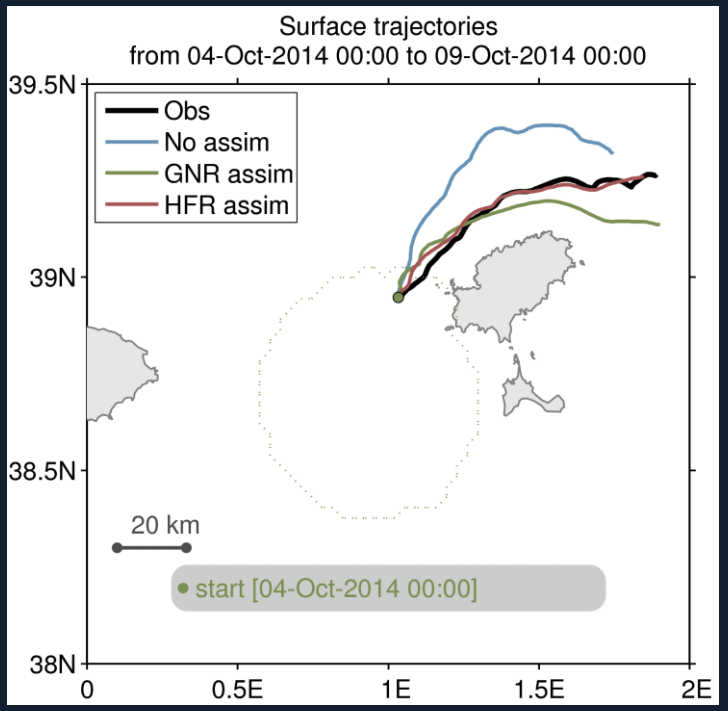
The “generic” assimilation reduces the velocity bias in HFR area.

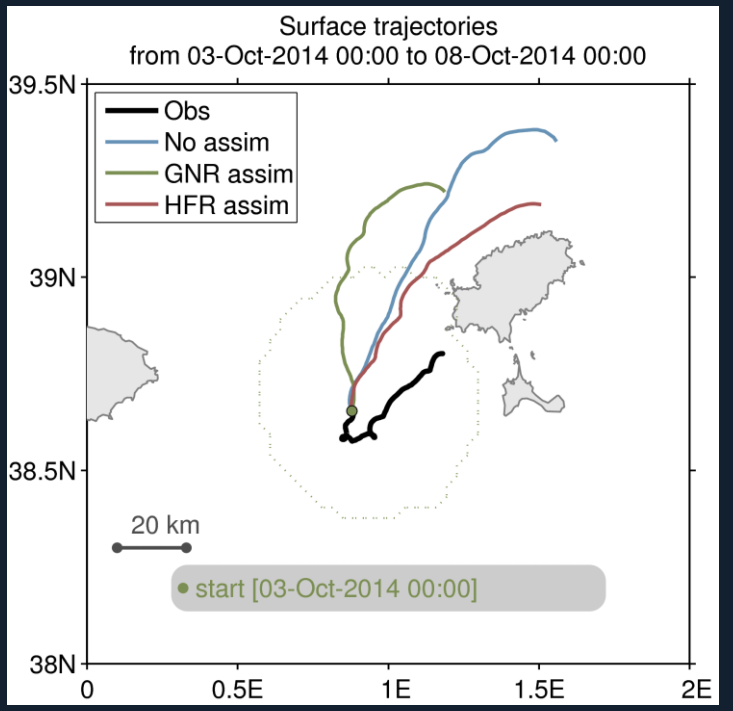
The mean error in the module of the velocity is further reduced by the assimilation of HFR data.

HFR area. Lagrangian assesment

8 Simulations:

- 1 for each consecutive day, with starting points at the locations of the drifters on that day
- 14 drifters
- 100 model particles launched at each drifter location
- 5-day trajectories





Some simulations with a very clear improvement, … but this is not systematic.

HFR area. Lagrangian assesment

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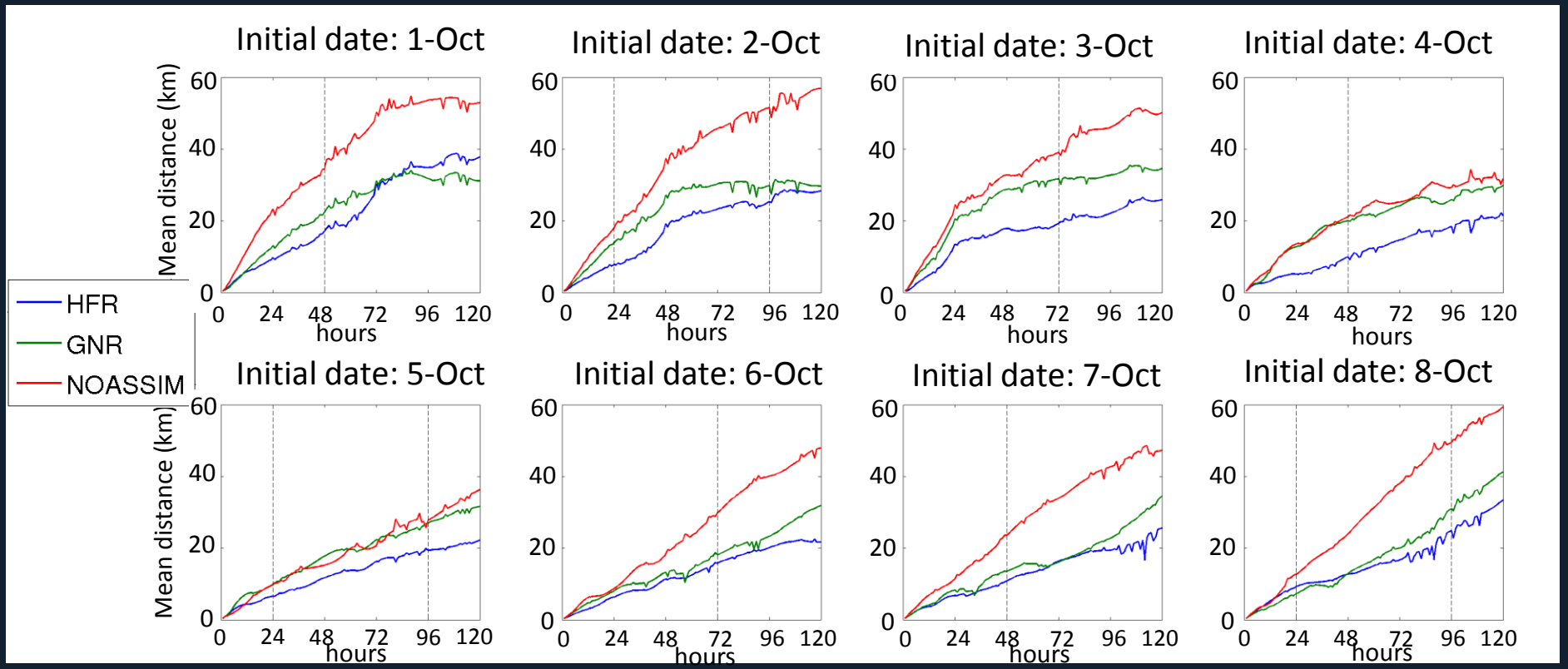
Average over the number of drifters



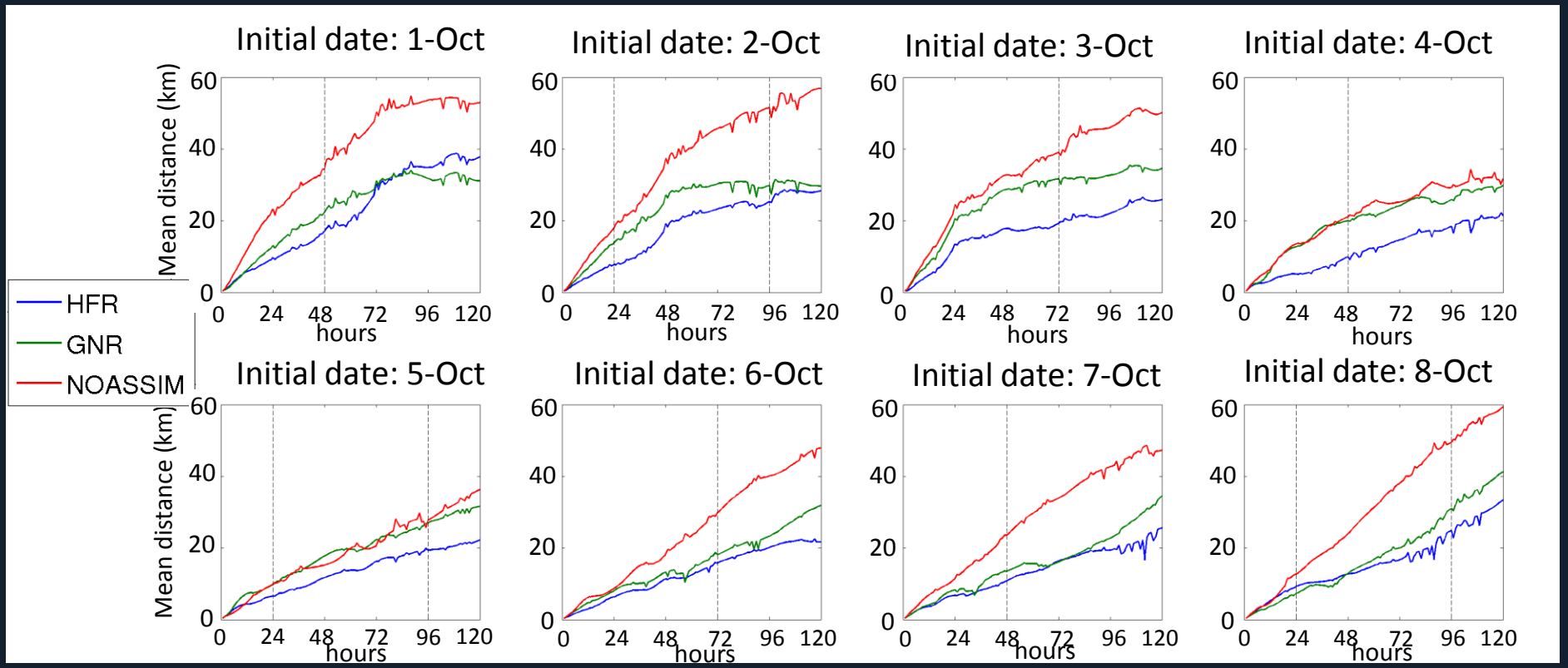
- Proximity to the analysis date does not clearly affect the prediction
- HFR data assimilation improves the forecast (even beyond its coverage area)

HFR area. Lagrangian assesment

Data Assimilation leads to improvements in lagrangian prediction

HFR data assimilation significantly improves the performance

Average over the number of drifters



- Proximity to the analysis date does not clearly affect the prediction
- HFR data assimilation improves the forecast (even beyond its coverage area)

Conclusions

The WMOP DA system is able to correct Surface 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.

The application of a “nudging” initialization procedure after analysis also leads to an improvement of ocean currents.

HFR data assimilation improves the prediction of Lagrangian trajectories.

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THANKS FOR YOUR ATTENTION

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