

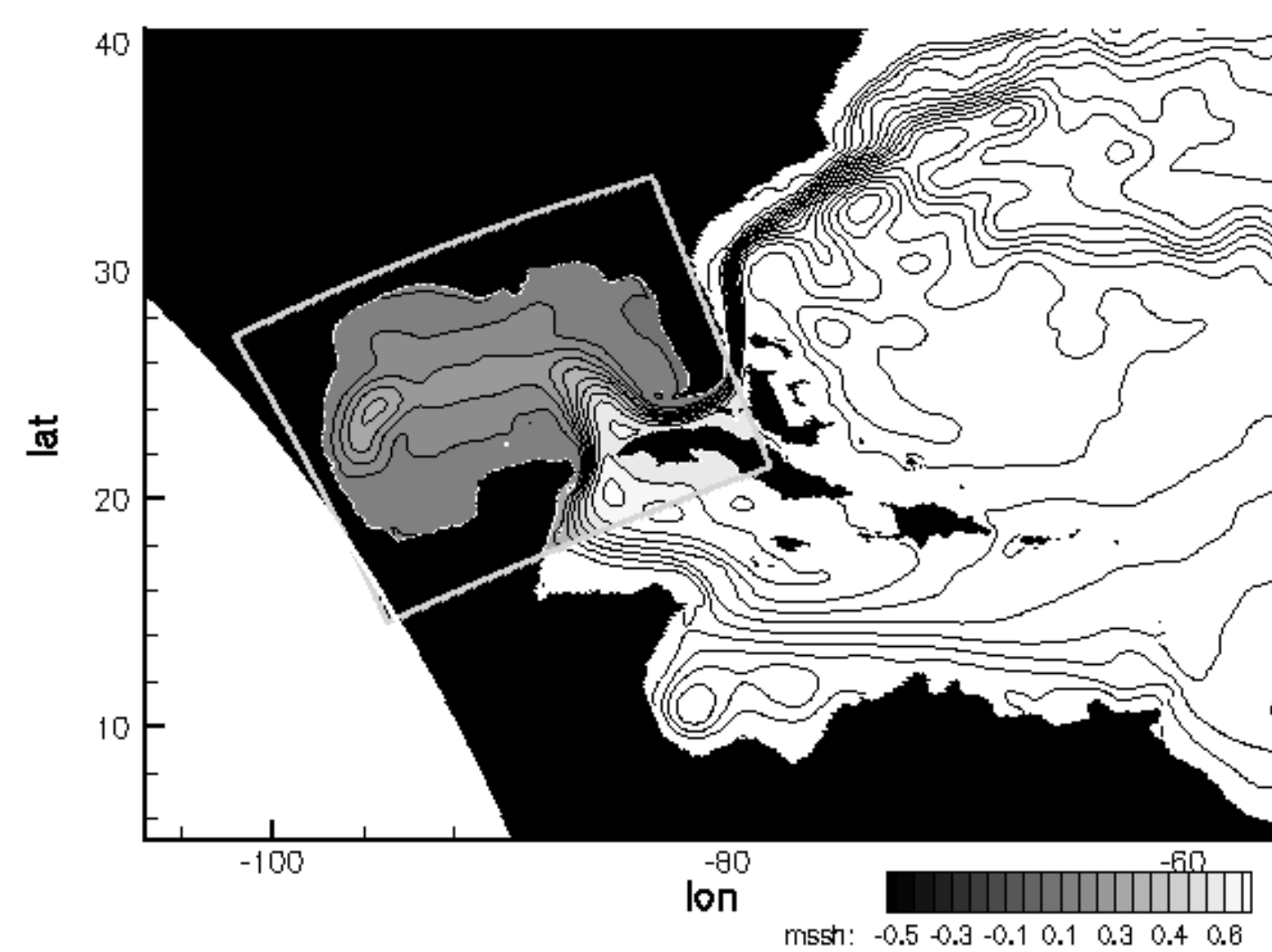
Application of a hybrid EnKF-OI to ocean forecasting

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Data assimilative system

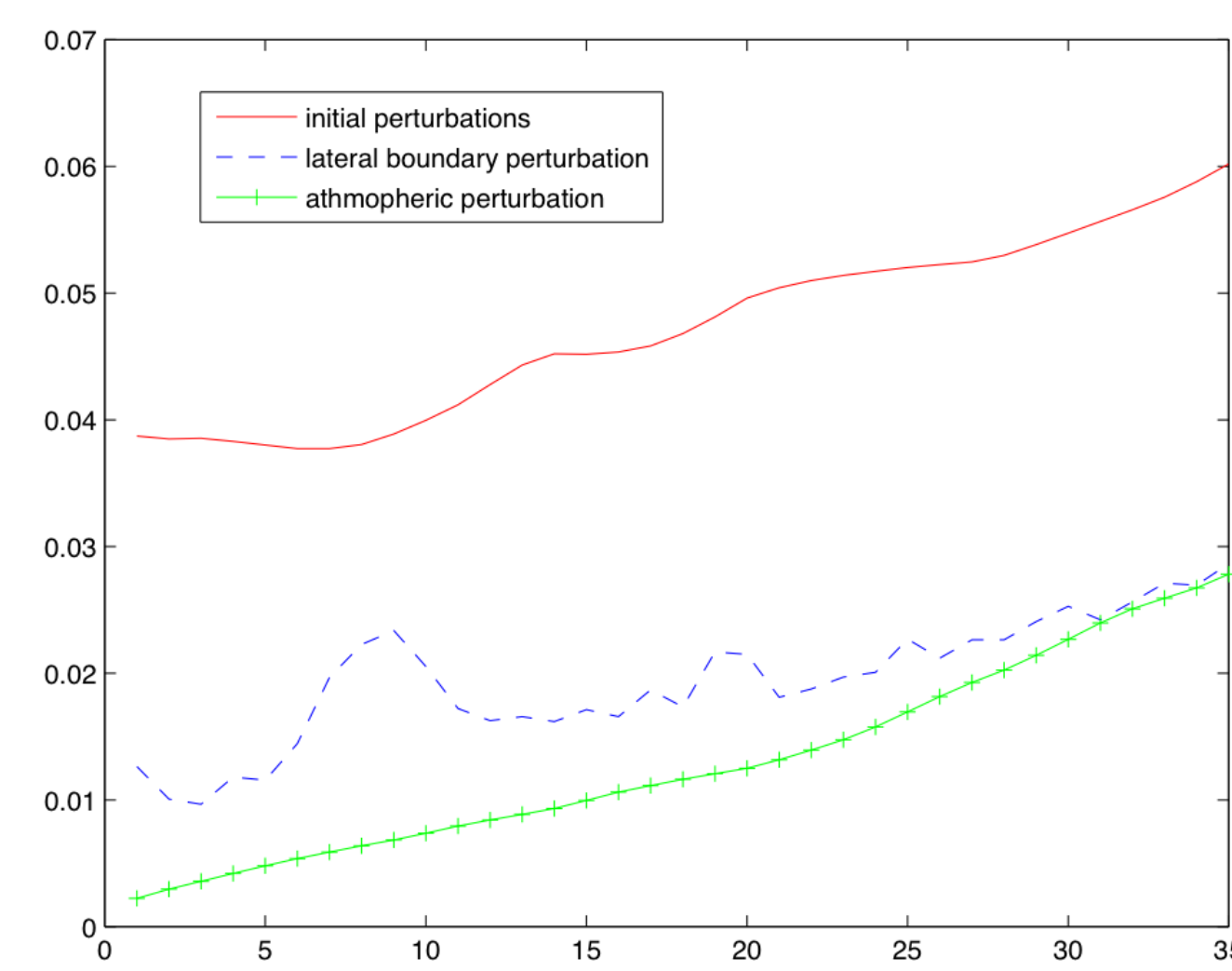
- The HYbrid Coordinate Ocean Model (HYCOM).
- High resolution model (5 km and 22 hybrid layer) of the Gulf of Mexico (GOM).
- Boundary condition provided by TOPAZ3 real-time forecasting system established for the Atlantic and Arctic basins (1/8° horizontal resolution).
- It assimilates SLA with the Ensemble Optimal Interpolation, which is 3D and multivariate (Counillon et al. 2007a).



Mean SSH of TOPAZ3 interpolated into the high-resolution local model grid delimited by the gray box.

Perturbing the system

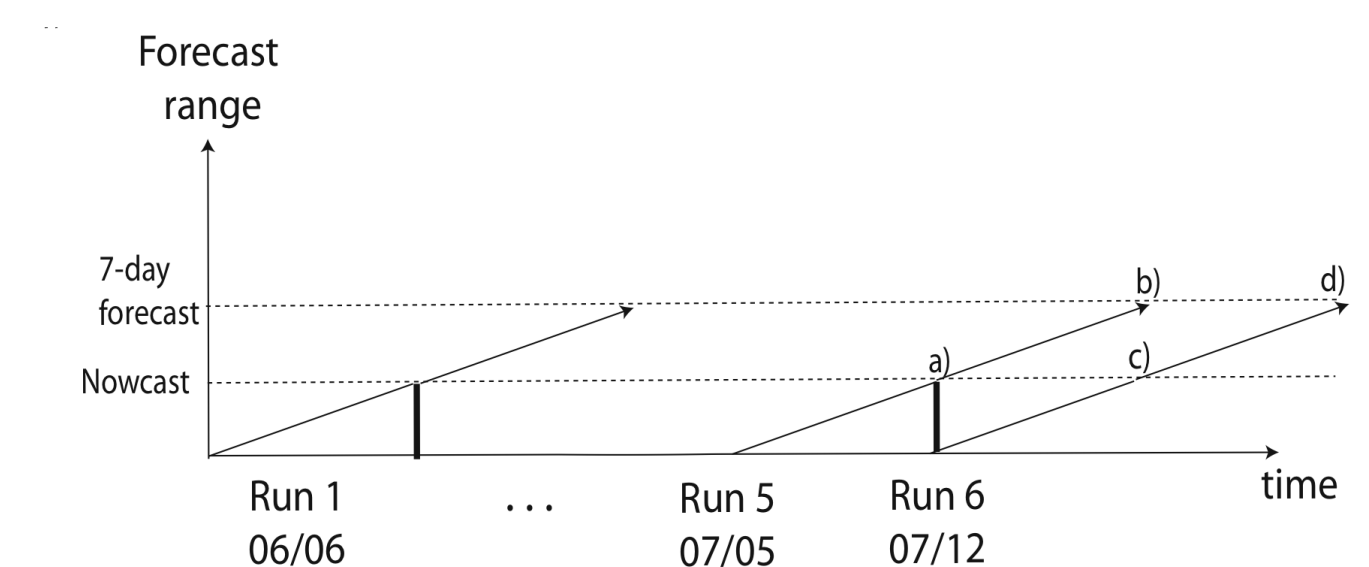
- Perturbation of the initial state by tuning the "assimilation strength" parameter. It controls the position and the orientation of the main feature in GOM (LC and eddies).
- Perturbation of the lateral boundary condition by a time lag. It controls the meandering of the flow, and the growth of cyclonic eddies at the boundary of the LC.
- Perturbation of the atmospheric forcing using a spectral method. Controls the production of mesoscale variability at the boundary of the fronts.



Anomaly evolution from each perturbation systems.

Experiment description

- Reproducing Eddy Yankee shedding event (2006) with 6 ensemble runs of 10 members.
- Each member is weekly assimilated and run for 14 days.



Conclusions

- The Loop Current and eddy front observed from ocean color and altimetry are almost always found within the ensemble forecast envelope
- The ensemble spread is correlated in space and time to the SSH RMS error. It implies that confidence indices can be provided in addition to the normal forecast.
- The ensemble forecast has allowed for optimization of data assimilation parameters depending on the forecast horizon.
- It suggests that the ensemble spread can be used to tune (spatially and temporally) the data assimilation parameters.

Results

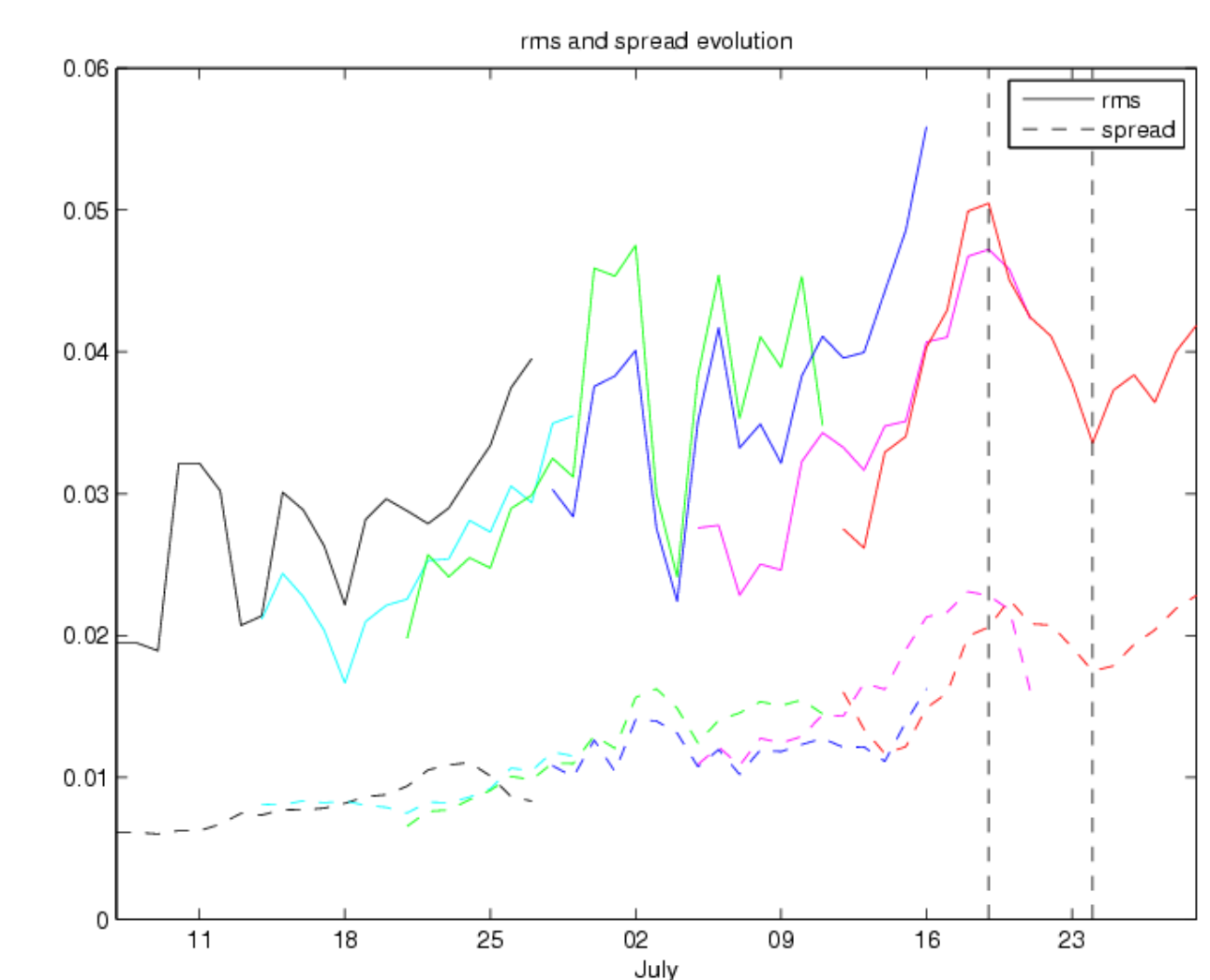
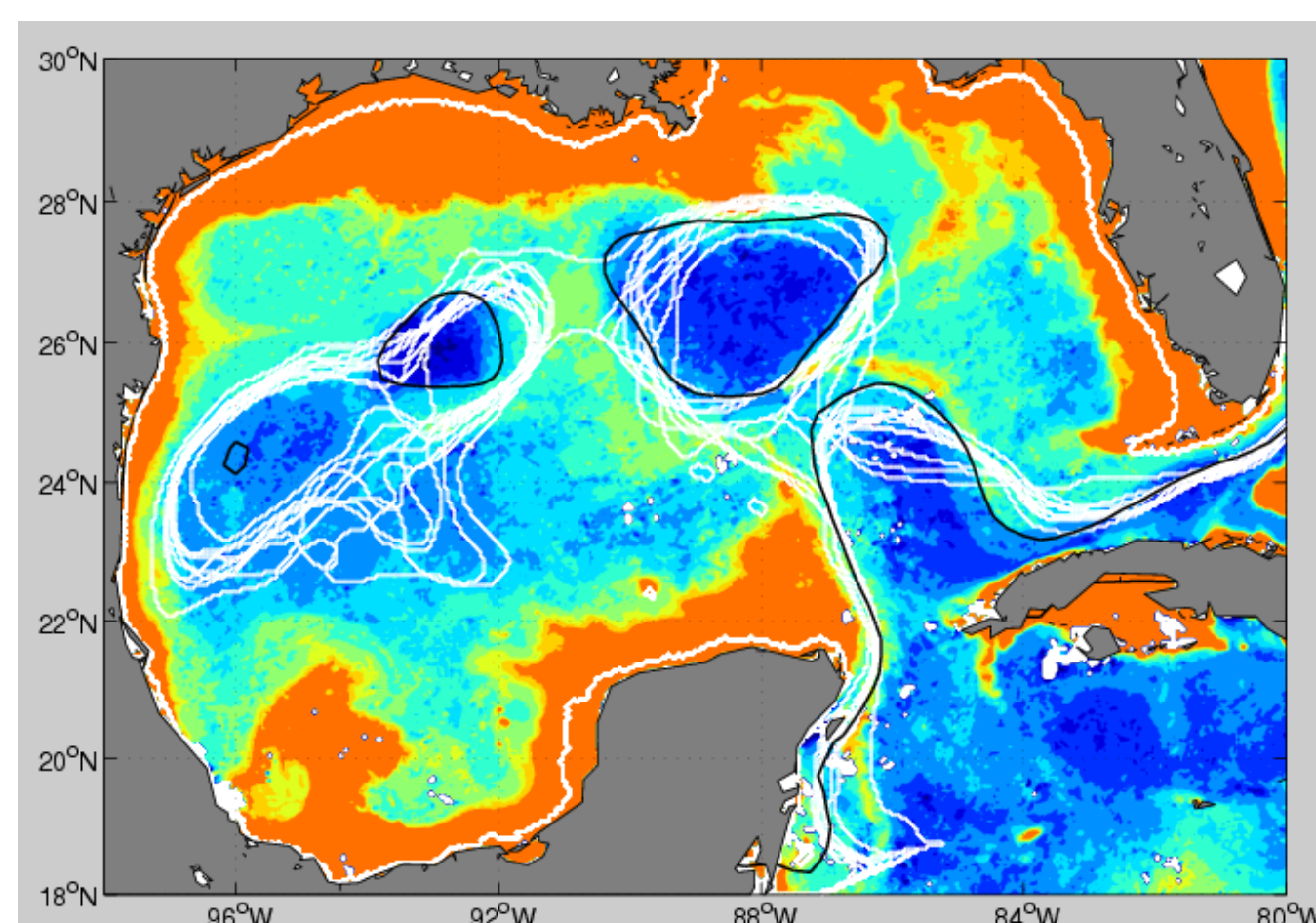
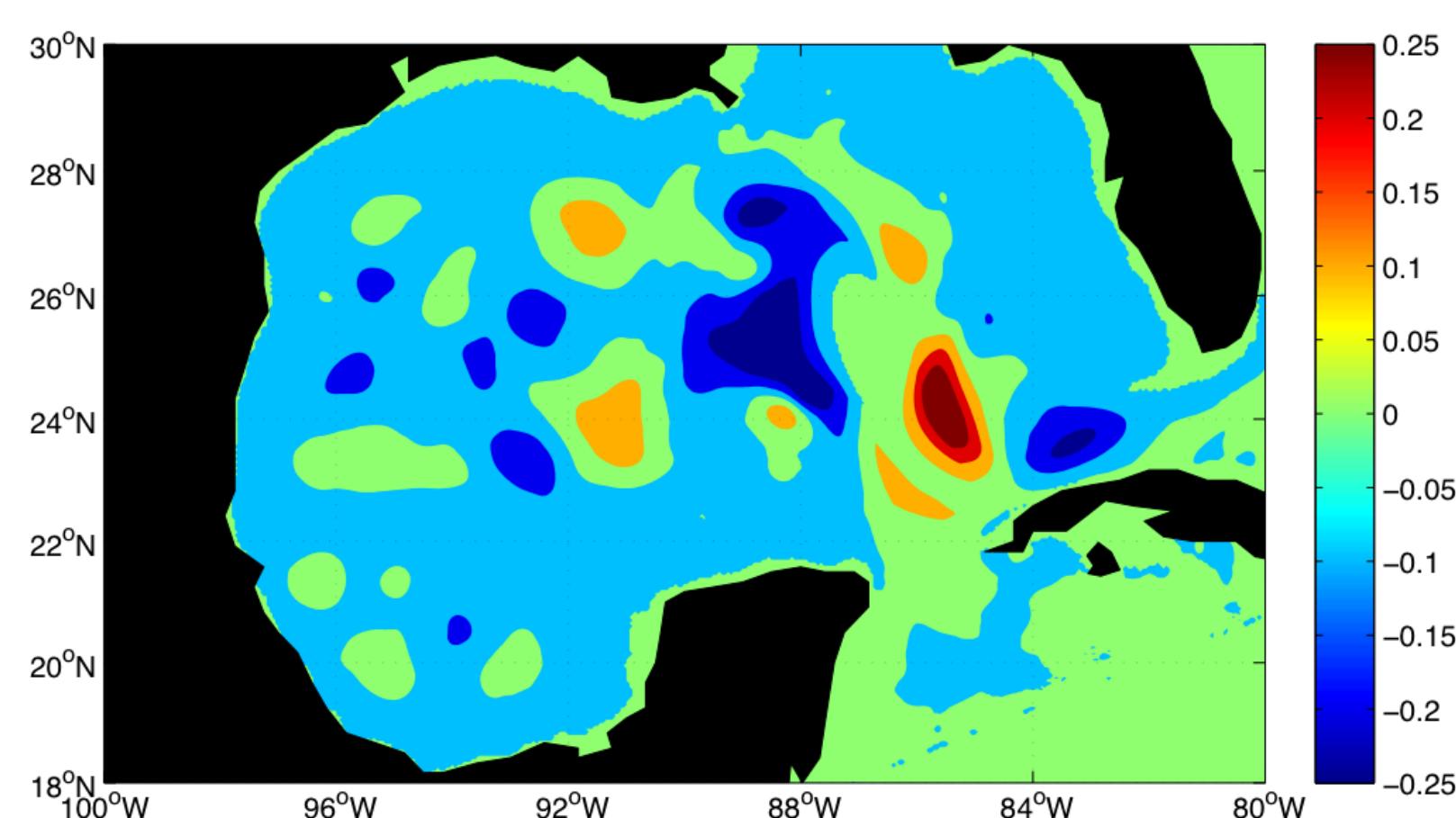
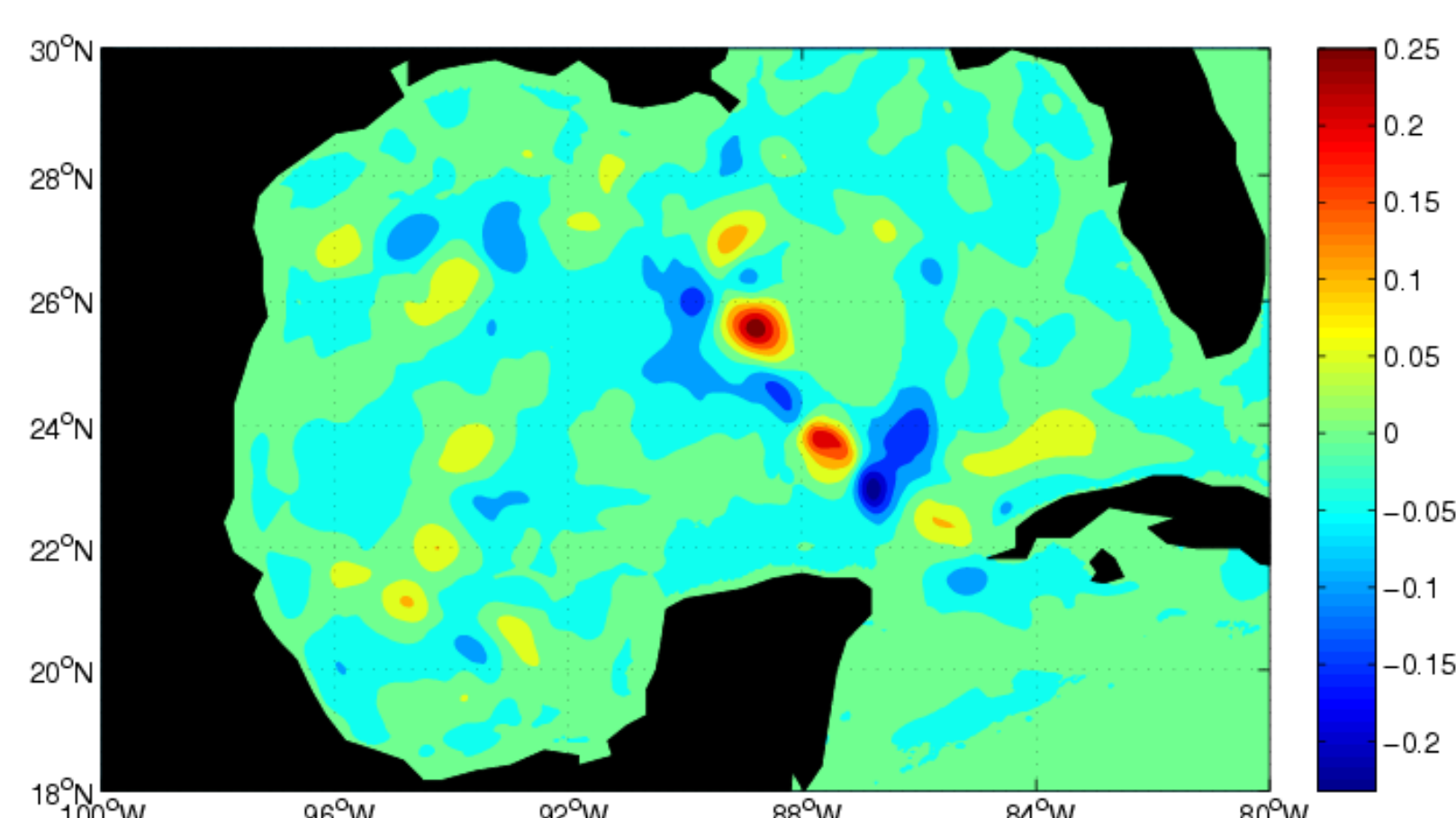
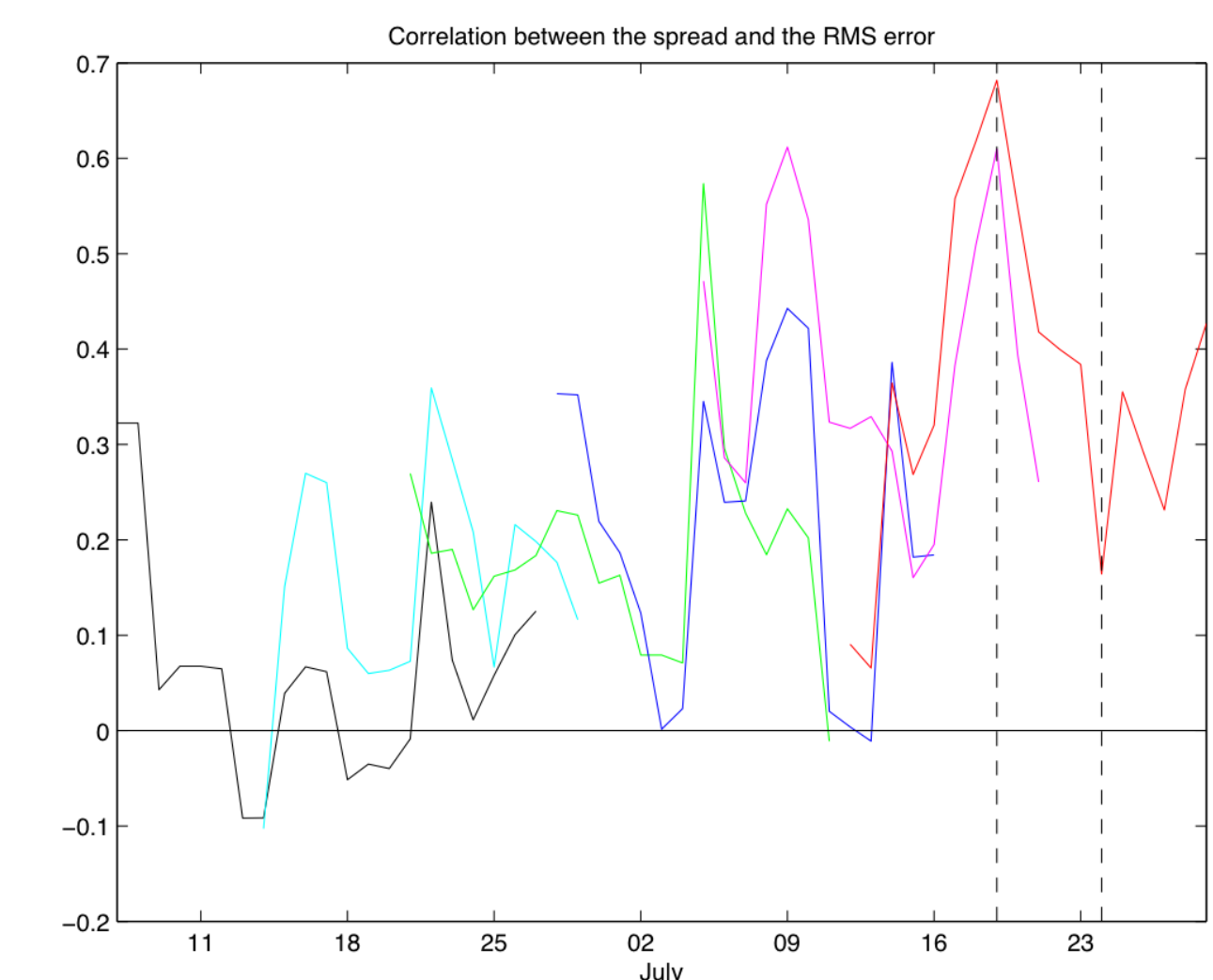
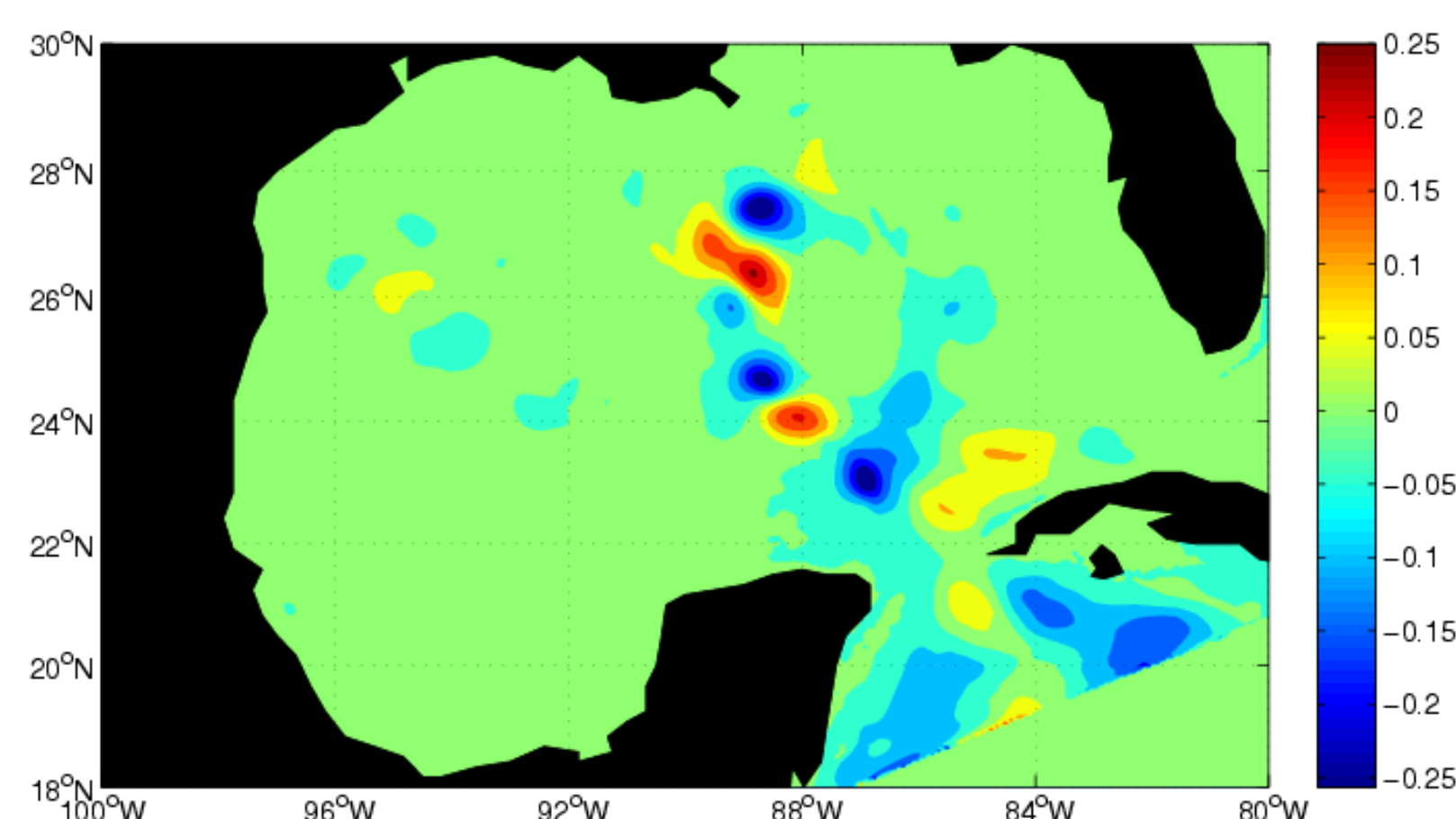


Figure captions

Left: Anomalies developed after 4 weeks with perturbations of the initial state (top), of the lateral boundary conditions (middle), of the atmospheric forcing field (bottom).

Middle: Overlay of the ensemble spaghetti (white line) with the non-assimilated SST map (contour) and the front derived from altimetry (black line).

Right: SSH RMS error of the ensemble mean (solid) and ensemble spread (dash) over time for the 6 the successive runs (top), and their correlation (middle). RMS error of each value of initial perturbation, averaged over the analyzed period (0 to 7 days, in red), and the forecast period (7 to 14 days, in blue) (bottom).



References

- Counillon, F., and L. Bertino, Ensemble Optimal Interpolation: multivariate properties in the Gulf of Mexico *Tellus*, Submitted 2007a.
- Counillon, F., and L. Bertino, High resolution ensemble forecasting for the Gulf of Mexico eddies and fronts, to be Submitted 2007b.
- Yin, X., and L. Oey, Bred-ensemble ocean forecast of loop current and rings, *Ocean Model* 17, 300326, 2007.

