

The Gulf of Mexico Pilot Prediction Project: Evaluation of 60-day Ensemble Forecasts of the Loop Current System

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Summary

The Gulf of Mexico Pilot Prediction Project (GOMEX-PPP) is investigating the performance of ocean forecast systems for predicting the evolution of the Loop Current in the Gulf of Mexico. Long-range forecasts of 2- to 3-months are sought to support end-users impacted by strong currents associated with the Loop Current and its eddies, and to provide boundary conditions for coastal ocean models within the Gulf.

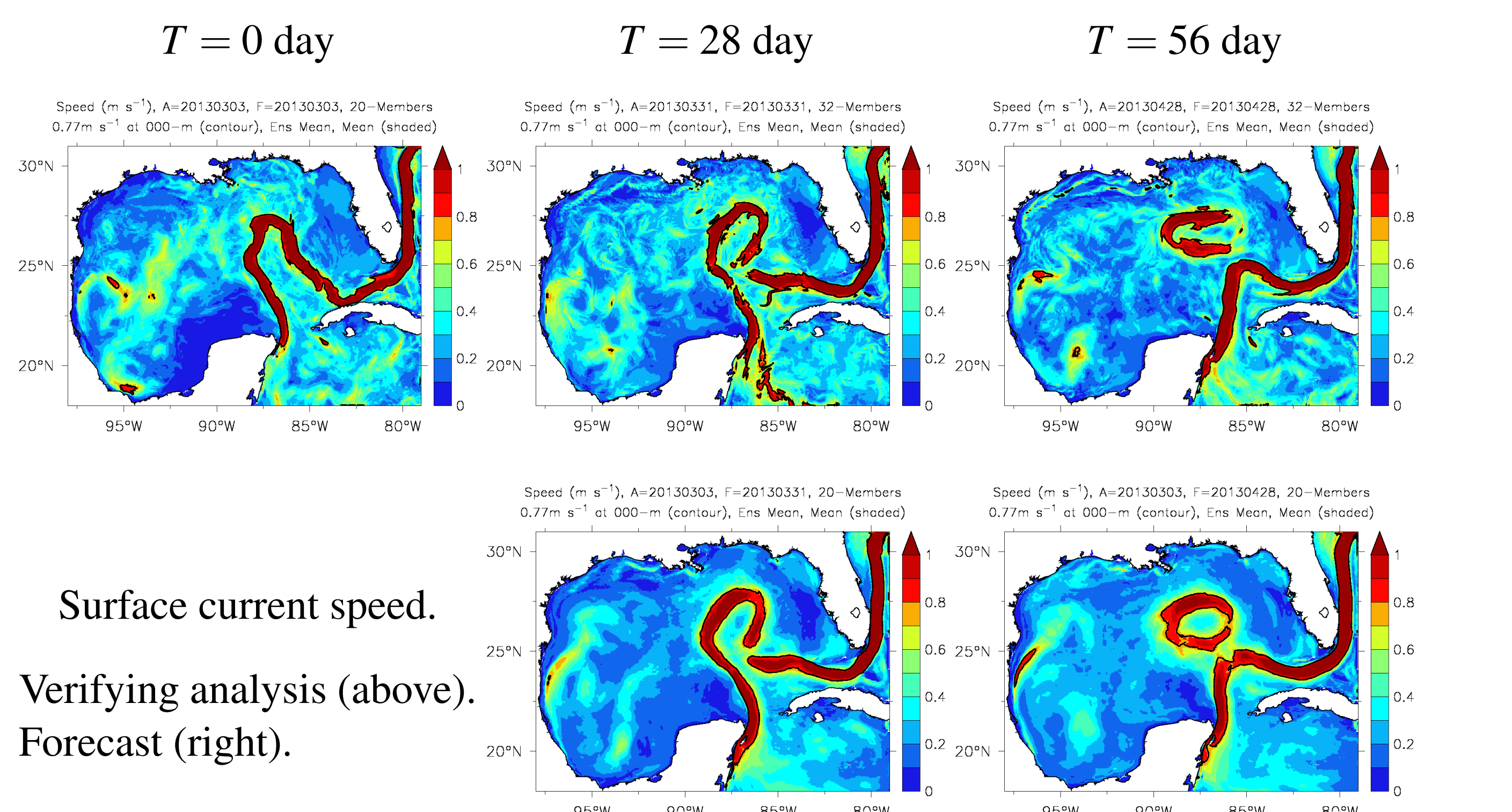
This poster reports on the Gulf of Mexico – Long Range Ensemble Forecasting System (GOM-LERFS) developed at the Naval Research Laboratory, Stennis. GOM-LERFS has been providing 60-day forecasts since 1/27/2013, and in the period analyzed, 1/27/2013-9/15/2013, it is found to provide skillful forecasts (anomaly correlation in excess of 0.6) out to 40 day lead-time.

Gulf of Mexico – Long Range Ensemble Forecasting System (GOM-LERFS)

- Dynamical core: Navy Coastal Ocean Model (R-NCOM).
- 3 km resolution, 64 vertical levels (output archived at 28 depths and 6 hr resolution).
- Model initialization using the NCODA system with 5-day assimilation window.
- Boundary conditions from operation global NCOM, with relaxation to climatology after 96 hours, plus TPXO tides.
- Atmospheric forcing from regional COAMPS, with relaxation to climatology after 96 hours.
- 60 day forecasts are re-initialized weekly.
- A 32 member ensemble provides a probabilistic forecast.

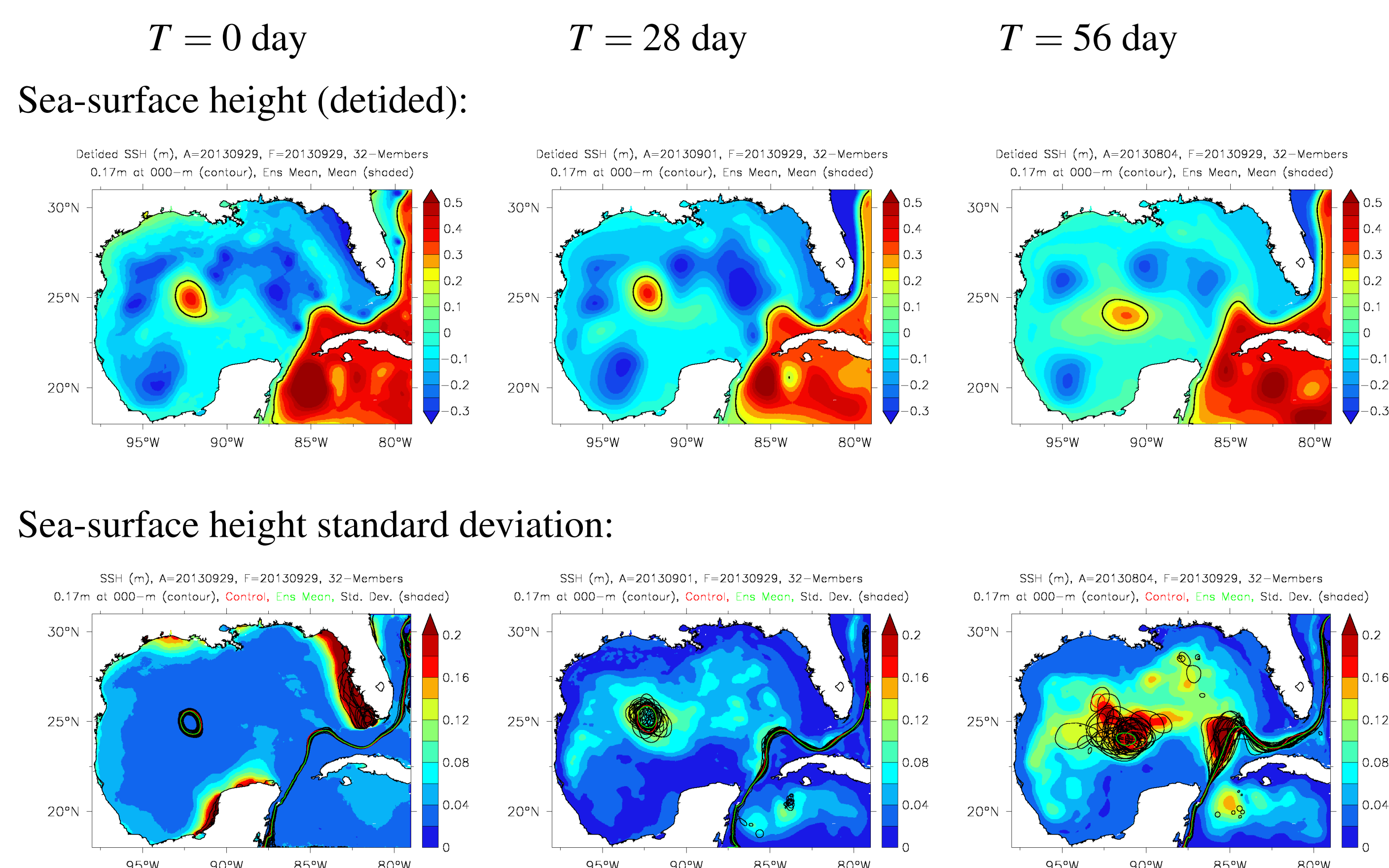
Formation of Eddy Kraken forecast at 28-day lead-time

Time, T , is given as days after forecast on 3/3/2013.



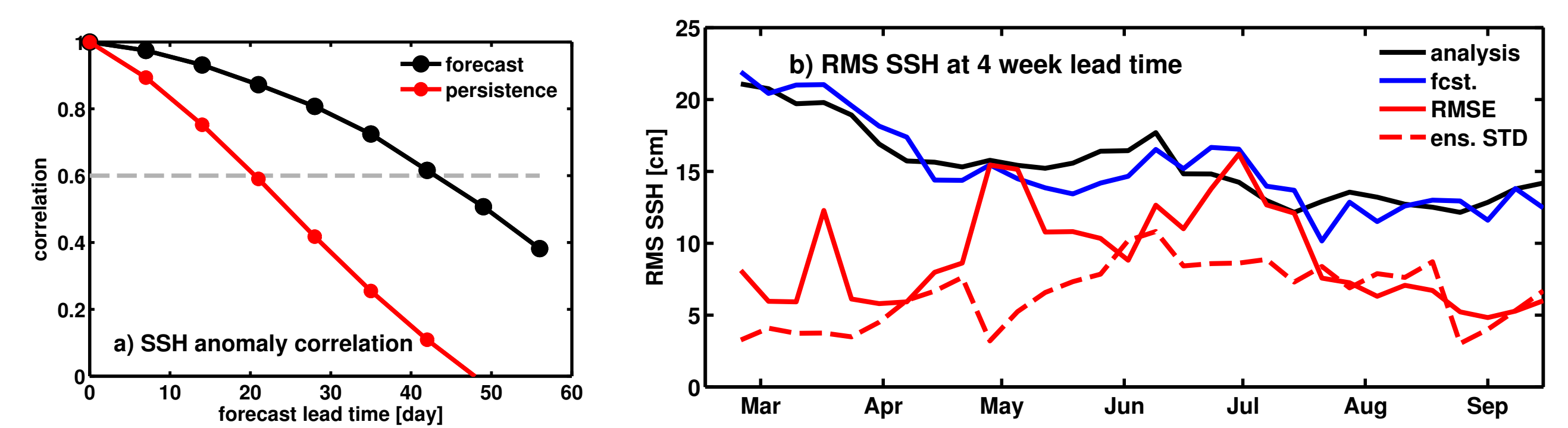
During the spring of 2013, a large Loop Current intrusion occurred in the Gulf of Mexico which formed an enclosed eddy. During June and July the eddy interacted with the Loop Current, apparently detaching and re-attaching to the main current, before propagating westward. The formation of Loop Current Eddy Kraken was stably forecast by the GOM-LERFS system.

Example Forecast Products: Sea-Surface Height (SSH)



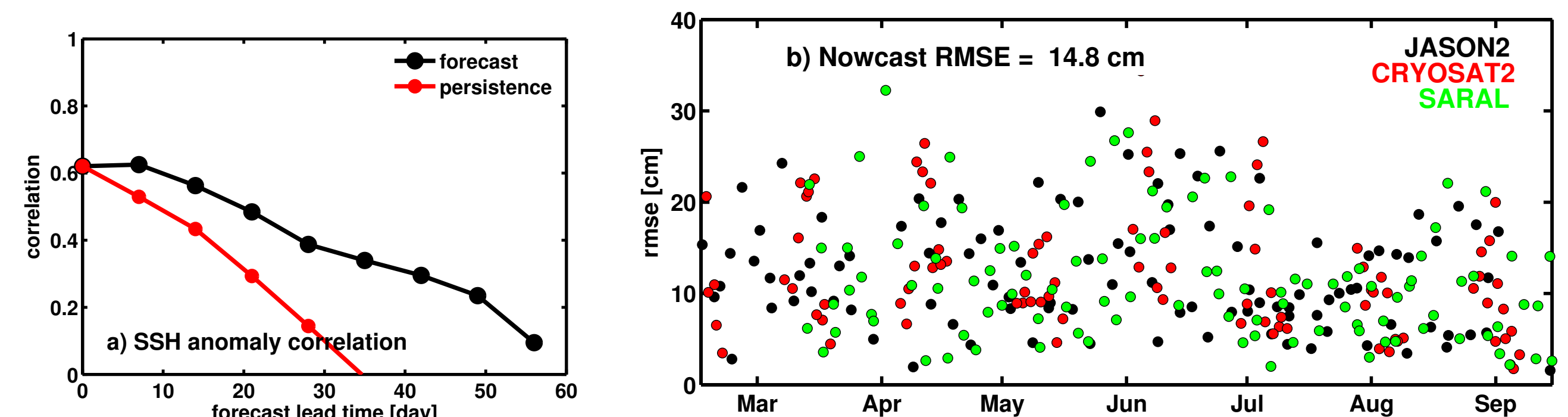
GOM-LERFS forecasts are presently distributed via a web interface and are undergoing internal evaluation before transition to a public system. Major features of the evolving Loop Current may be inferred from the sea-surface height (top row; forecasts for 9/29/2013 shown for different lead-times, T). Probabilistic forecasts are being developed which utilize the ensemble spread (bottom row). Additional forecast products are being developed to forecast the risk of strong upper-ocean currents.

SSH Forecast Validation: Comparison with Verifying Analyses

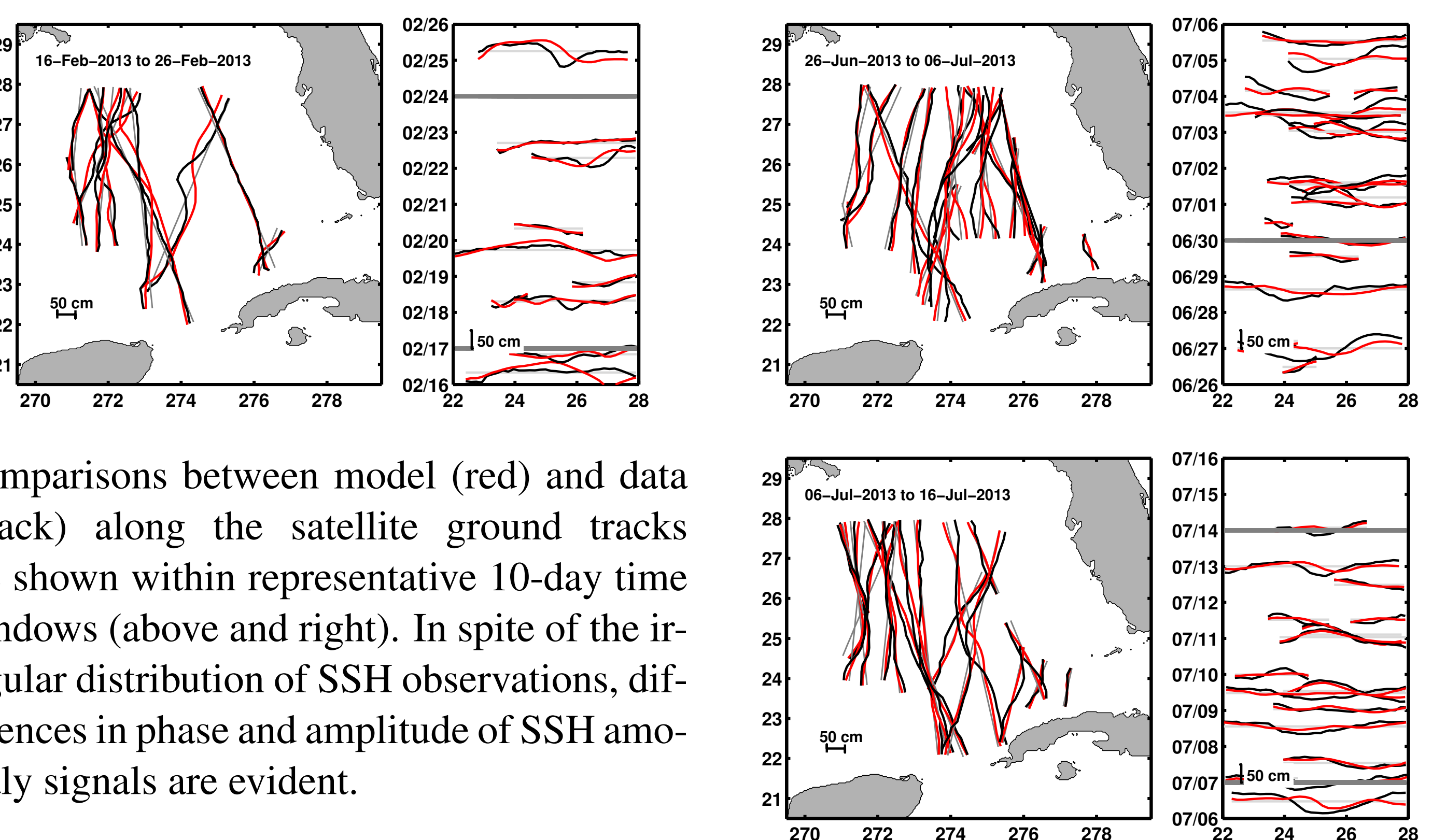


At weekly intervals the NCODA system is used to compute a verifying analysis which incorporates NRT altimetry, satellite derived SST, and in situ data obtained from the GTS. To date, 34 verifying analyses and forecasts have been compared and the SSH anomaly correlation computed (above, a). The region of comparison is restricted to water deeper than 200m in the subdomain, 82W to 89W and 22N to 28N. The GOM-LERFS forecast remains skillful for approximately twice as long as persistence. The SSH anomaly variance agrees closely in the forecast and verifying analysis (above, b; cf., black and blue lines). The ensemble standard deviation does not appear to predict the forecast error (cf., solid and dashed red lines).

SSH Forecast Validation: Comparison with Along-Track Altimetry



GOM-LERFS forecasts have been evaluated by comparison against the three currently operational altimeter missions, Jason-2 (10-day exact repeat), SARAL/AltiKa (35-day exact repeat), and Cryosat-2 (geodetic orbit), where standard corrections have been applied (GOT4.9 tides, CLS11 mss., ECMWF wet. tropo., etc.). Small-scale noise in the altimeter data has been suppressed by decimating the 6 km-resolution data to 18 km using a 3-point median filter. Anomaly SSH in the model and data has been defined with respect to the along-track mean, with comparison over the same subdomain as used above. Anomaly correlation is relatively low (above, a), but the model forecast is easily distinguished from persistence. Model-data differences at the times of the satellite passes (above, b) are consistent amongst the satellites, except possibly early in the SARAL mission.



Conclusions

- The Gulf of Mexico – Long Range Ensemble Forecasting System (GOM-LERFS) is currently being assessed within the GOMEX-PPP project for 60-day forecasts of the Loop Current system.
- Validation of sea-surface height (SSH) nowcast and forecast skill is being conducted with reference to a verifying analysis as well as along-track altimeter data.
- The SSH anomaly correlation with verifying analyses is larger than 0.6 for forecasts up to 40 days.
- Comparison with along-track altimetry finds a much lower anomaly correlation, but the forecast correlation exceeds persistence correlation.

Acknowledgements

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