Combined assimilation of real-time altimeter and in situ data in the MERCATOR system

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MERCATOR is an operational forecasting system that provides in near real time realistic and 3D view of the ocean state: temperature (T), salinity (S) and currents. It is currently implemented for the North Atlantic ocean, based on primitive equations OCGM (OPA) including 43 levels on the vertical, a 1/10° horizontal resolution, and a sequential data assimilation system based on Optimal Interpolation. Assimilation occurs every week on Wednesday, the model forecast being updated to reflect the newly collected near-real-time observations. Real-time analysis and forecast product can be found on the WEB (www.mercator-ocean.fr).

In the current operational version of the MERCATOR Assimilation System, satellite altimetry Sea Level Anomalies (SLA) are assimilated using a Reduced Order Optimal Interpolation and Cooper and Haines method. The system has been recently improved to assimilate T and S observations, in particular, ARGO data transferred in real-time to CORSIOL.

The lack of Jason-1 data during the summer, related to a 1/3° horizontal resolution, and a sequential data assimilation system based on Optimal Interpolation. Assimilation occurs every week on Wednesday, the model forecast being updated to reflect the newly collected near-real-time observations. Real-time analysis and forecast product can be found on the WEB (www.mercator-ocean.fr).

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In the most recent version (PSY2v1), the system assimilates SLA from recent satellites: Jason-1, Envisat and GFO, weekly Reynolds Sea Surface Temperature (SST), analytic Sea Surface Salinity (SSS) from the Reynaud climatology; and T and S vertical profiles provided by the CORIOLIS centre, including the ARGO profilers, in a fully multivariate way. This is a new statistical method based on vertical empirical modes (EDFs of T(z), S(z)) and the barotropic streamfunction ψ(z).

Methodology

The MERCATOR forecasting system is operated weekly. Sequential assimilation is used to provide a more realistic ocean state using real-time data collected over the previous week.

1) The differences between SLA, T and S observations and model forecast are computed at appropriate time and space locations for a full-week model integration.
2) These differences “the residuals” are projected in a 2D reduced space using a fully multivariate OI.
3) Starting from this new ocean state, the model runs for the next week of prediction, using the atmospheric forcing field provided by the ECMWF.
4) A new model state analysis is updated, using the innovation vector computed above.

Across the north Atlantic ocean, the model salinity is modified by the assimilation of in-situ data.

The low resolution (PSY2v1) configuration is strongly improved by in-situ observations and ARGO data, compared to the altimetry-only assimilation configuration (PSY2v2), getting closer to the climatology and providing a description of the mesoscale variability at depth. The Mediterranean water and meddy signatures are clearly reproduced at the right depth.

References


This poster presents the new assimilation scheme. It gives good results, better and more detailed than the operational one. It is still CPU consuming which limits to 12 the number of models that can be used for real-time operation.