DEVELOPMENT AND APPLICATION OF AN ENKF DATA ASSIMILATION SYSTEM BASED ON MARS-3D: ACHIEVEMENTS AND FUTURE PLANS

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ABSTRACT

This study deals with the development of time-evolving multivariate data assimilation of satellite derived sea surface temperature (SST) and T-S profiles over the continental shelf. This work is being conducted in the framework of PREVIMER's project, whose primary objective is the development of an operational forecasting system for the coastal environment along the French coastlines. This presentation provides a general overview of the project over the period 2008-2012. The contribution will focus on the results obtained during the initial phase of the project concerned with sequential data assimilation of satellite derived sea surface temperature (SST).

A study of SST data assimilation in the free surface primitive equation model MARS-3D using Ensemble Kalman Filter (EnKF) is presented with application to the Bay of Biscay and to the Gulf of Lions. Skill assessment of the data assimilation system is analysed over April-July 2006, a period for which independent temperature and salinity vertical profiles are available over the Continental shelf. Preliminary results of a similar data assimilation experiment for the Gulf of Lions are also discussed over April-July 2005.

The spatial and temporal structure of forecast errors is investigated using an ensemble modelling approach (Monte-Carlo). Multivariate ensemble forecast statistics associated by distinct model error sources (wind forcing, model parameters) are shown to be neither homogeneous over the Continental shelf nor stationary. In this large space dynamical system, localization and filtering of small-sized ensemble correlations is needed to provide a consistent result for EnKF analysis. The localization used is proportional to the bottom depth. Statistical analysis of the ensemble forecast reliability also reveals that SST forecast errors over the Continental Shelf of the Bay of Biscay are season-dependant: during the spring, they are mainly governed by the fraction of light lost by scattering and absorption (extinction coefficient) which occurs over the Loire and Gironde plumes, whereas they are dominated by wind stress and ocean mixing errors during the summer.

The potential of sequential data assimilation of SST to improve T-S model predictions over the shelf is investigated, using independent in-situ temperature and salinity profiles over the spring and summer test periods. The data assimilation system provides significant error reduction compared to the non assimilative one, for temperature and salinity over the shelf, but it does not improve the quality of T-S prediction over the abyssal plain. Finally, the efficiency of combined parameter and state estimation to reduce the SST model forecast biases over the shelf is shown over April-May, a period for which the forecast error is mainly governed by the extinction coefficient.