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Assimilation of Sea Surface Temperature in the MARS3D Modelling System using EnKF with application to the Continental Shelf of Bay of Biscay

p. craneguy (1) and y.h. De Roeck (2)

(1) ACTIMAR, Brest, France (craneguy@actimar.fr / +33 (0)298469104, (2) IFREMER, Plouzané, France (yhdr@ifremer.fr / +33 (0)298224545

A study of sequential data assimilation of satellite derived sea surface temperature (SST) in the free surface primitive equation model MARS-3D [Lazure and Dumas, 2007] using Ensemble Kalman Filter [Evensen, 2003] is presented with application to the Bay of Biscay. Skill assessment of the data assimilation system is analysed over April-July 2006, a period for which independent temperature and salinity profiles are available over the Continental shelf.

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 inversely 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: in spring they are mainly governed by the fraction of light loss due to scattering and absorption (extinction coefficient) which occurs over the Loire and Gironde plumes although they are dominated by wind stress and ocean mixing errors in 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 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. 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.