The Aegean Sea –Poseidon model

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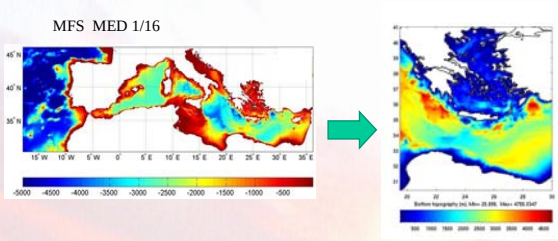
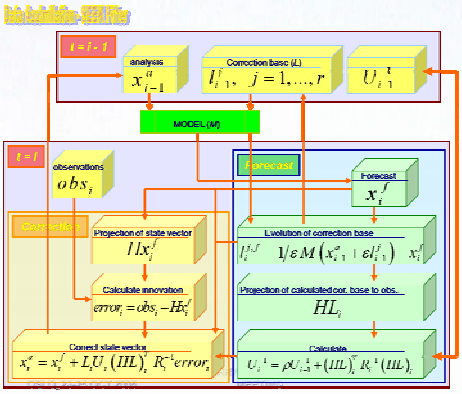
In this work we present the development and validation of an eddy-resolving sequential data assimilation system for the Aegean Sea hydrodynamics that has been developed as part of the ECOOP EU project and the Greek POSEIDON operational system. The assimilation scheme is based on the Singular Evolutive Extended Kalman (SEEK) filter which is an error subspace extended Kalman filter that operates with low-rank error covariance matrices as a way to reduce the computational burden. The filter is used to correct the forecast state of a 1/30º Princeton Ocean Model (POM) of the Aegean Sea on a weekly basis. The model is forced with hourly fluxes from a 1/20º ETA regional non-hydrostatic atmospheric model and is one-way nested to the 1/16º Mediterranean ocean Forecasting System (MFS) model of the Mediterranean Sea. The assimilated data set is multivariate including AVISO sea surface height maps, AVHRR sea surface temperature, and **MedArgo T/S profiles**. Experiments with (system **Version V1**) and without (system **Version V1(-)**) are performed to validate the system over one year period (January – December, 2008).

The Aegean Sea operational system

Nesting procedures

Boundary conditions at the western and eastern open boundaries of the Aegean Sea hydrodynamic model are provided on a daily basis (daily averaged fields) by the MFS model covering the whole Mediterranean Sea with a resolution of 1/16º and 72 levels in the vertical. The nesting between the two models involves the zonal/meridional external (barotropic) and internal velocity components, the temperature/salinity profiles and the free surface elevation





The core of the assimilation system: SEEK filter

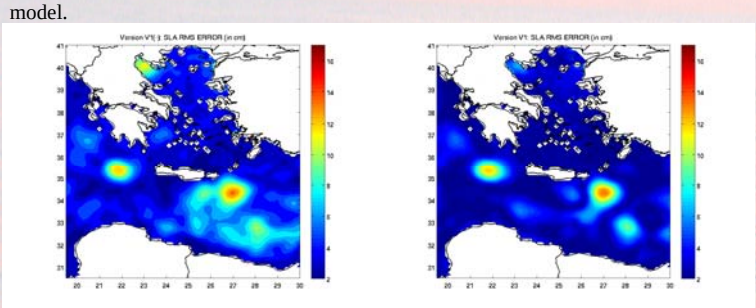
Model initialization

The Aegean Sea model **Version V1(-)** is re-initialized from the OGCM analysis results once every week. In order to filter out spurious oscillations that may occur during the re-initialization procedure, the VIFOP optimization tool has been implemented in the forecasting system. VIFOP is a variational initialization technique based on the minimization of a cost function involving data constraints as well as a dynamical penalty involving the tangent linear model.

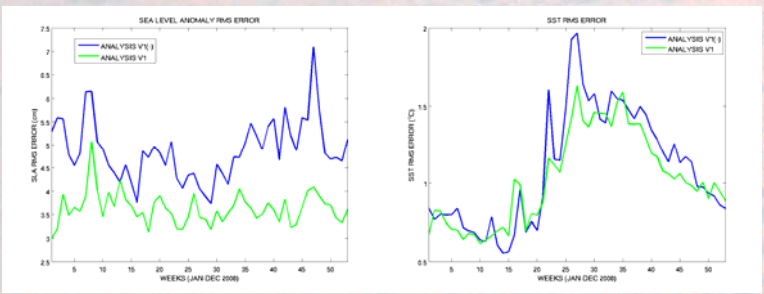
Version V1 of the Aegean Sea forecasting system uses data assimilation. The assimilation scheme is based on the Singular Evolutive Extended Kalman (SEEK) filter which is an error subspace extended Kalman filter that operates with low-rank error covariance matrices as a way to reduce the computational burden. The filter is additionally using covariance localization (cut-off radius of 200 km) and partial evolution of the correction directions (EOFs). The error covariance matrix is factorized using 60 multivariate EOFs and 10 out of these modes evolve with the model dynamics. The assimilation is performed on a weekly basis using satellite SSH, SST and T/S in situ data (Argo Floats and XBTs').

Results from one year testing period (Jan – Dec 2008)

The Aegean Sea model Version V1 performance during Jan – Dec 2008 is assessed using satellite Sea Level Anomaly (SLA), Sea Surface Temperature (SST) observational data and Argo T/S in situ profiles. The performance of Versions V1 and V1(-) are inter-compared in order to show to positive impact of data assimilation into the Aegean Sea model. However it is important to stress that Version V1(-) already benefits from the data assimilation performed in the MED MFS model as it is weekly re-initialized from this model.

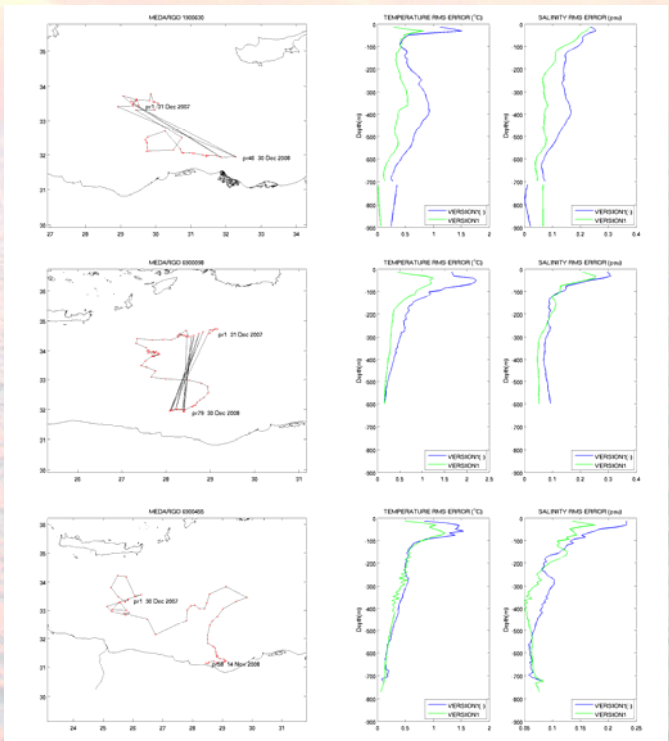


SLA RMS error estimated over 2008 corresponding to Versions V1(-) and V1



Time evolution of the SLA (left) and SST (right) RMS misfits as they result from system versions V1(-) and V1.

SYSTEMS PERFORMANCE WITH RESPECT TO T/S ARGO PROFILES



Average temperature and salinity RMS error profiles (right panels) corresponding to model Versions V1(-) and V1 along three ARGO floats tracks (left panels).

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