EFFECTS OF THE ASSIMILATION OF SEA LEVEL ANOMALY IN THE SICILY CHANNEL REGIONAL MODEL

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Abstract
Analyses assimilating remotely sensed sea level anomaly observations have been performed in the Sicily Channel for 2008 using a 3D eddy-resolving regional model. The output fields have been compared with those of a free run covering the same period. As expected the assimilation has a substantial effect on the spatial features produced. The root-mean-square difference map puts in evidence the areas where assimilation has larger influence.
Keywords: Circulation, Models, Sea Level

Preface
Operational oceanography systems encompass three main components: systematical observational data, numerical models, and robust data assimilation modules. The Sicily Channel Regional Model (SCRM), a nested eddy-resolving 3D model based on Princeton Ocean Model and developed during the Mediterranean Forecasting System projects, is the core of the system. Seasonal variability [1], inter-annual variability [2], and forecasting skills [3] have been verified in recent studies by means of the synergistic use of SCRM fields and observations. In order to provide the best estimate of the sea true state, the assimilation of along track sea level anomalies (SLA) has been implemented in the system. Two experiments, A1 (analysis) and A2 (free run), respectively with and without the assimilation of SLA, have been conducted simulating the year 2008.

Model setup
SCRM is driven at the surface by momentum, heat and water fluxes computed through the 6-hourly atmospheric fields (mean sea level pressure, air temperature at 2m, wind speed and direction at 10 m and cloud cover) by using the well known bulk formulae [4]. At the open boundaries, SCRM is nested with the coarse model MFS1671 [5] through an off-line one way nesting technique of the analyses daily mean fields of temperature, salinity and total velocity. The data assimilation software used is based on a 3D Variational scheme (OceanVAR) [6]. Vertical background error covariance is represented through Empirical Orthogonal Functions (EOFs), computed from the model outputs of a previous long-term simulation. Only the most significant EOFs are used. Horizontal covariance is modeled as a Gaussian function. The state vector contains all the state model variables (temperature, salinity, free surface elevation, velocity components), so the corrections are performed on all these variables. The 3D-VAR scheme finds its solution minimizing a cost function. The assimilated data is the Along Track Sea Level Anomaly (SLA) from Jason-1 satellite.

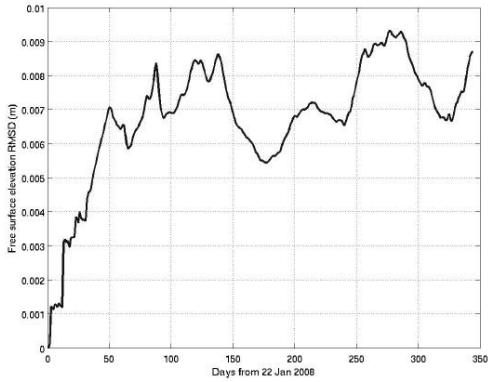

Fig. 1. Free surface elevation RMSD between experiments A1 and A2

Results
The Root Mean Square Difference (RMSD) time series of the free surface elevation shows the evolution of the SLA assimilation effects in time. A two months initial divergence of the two solutions is evident, during which the RMSD progressively increases. After this initial period the surface elevation RMSD ranges between 0.6 and 1 cm. Differences between the two experiments A1 and A2 are better evident by considering the variability of the spatial features produced. An useful way to locate the areas where the assimilation has a larger impact is representing the RMSD map of the surface elevation (Fig.2). Largest values of RMSD (2.5 cm) are found in the area off the Lybian coast, in the Ionian Sea and between Sardinia and Corsica.

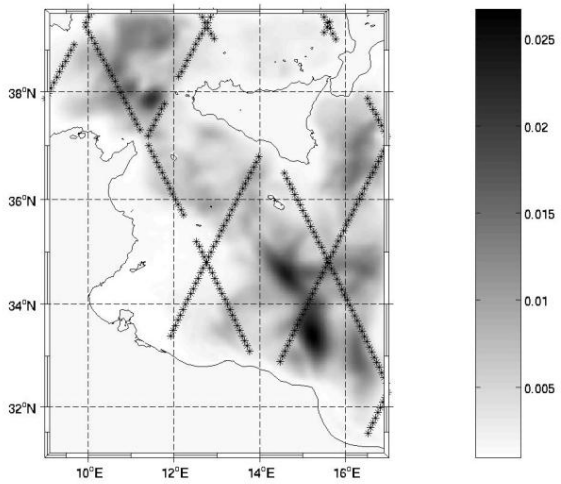

Fig. 2. RMSE map of the free surface elevation between experiments A1 and A2. Tracks of the assimilated SLA observations are also shown.

Final Remarks
Remotely sensed observations of sea-level anomaly have been assimilated into the SCRM by using a 3D Variational scheme. The system has been applied in a numerical experiment to examine the effects of the assimilation scheme. Changes observed in the surface elevation fields have a patchy distribution, which in first instance was found correlated to the presence/number of assimilated observations. The effects of such changes on surface circulation should be deeply investigated.

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