COASTAL CIRCULATION OFF THE CITY OF MARSEILLE FROM 3D MODELING AND OBSERVATIONS

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Abstract

In the framework of the protection and management of coastal waters in the Mediterranean Sea, the city of Marseille (south of France) has been chosen to study the fate of chemical contaminant inputs and its impact over the adjacent marine ecosystems. A numerical tool is developped, based on the coupling of a hydrodynamical model, a sediment model, a biological model and a model of chemical contamination. The present work deals with the validation of the hydrodynamics' compartment by comparisons with observations, which constitutes a prerequisite for the future operational system.

Keywords: Coastal Models, Circulation, Coastal Processes, Gulf Of Lions

The geomorphology and density of contaminant-generating industries of the city of Marseille is highly representative of large modern mediterranean cities. Marseille was thus chosen as a laboratory area for the development of a numerical tool dedicated to the assessment of the chemical contaminant raw inputs (from city to sea) and exports (from midsea to open sea) from the city. This tool is developed based on the coupling of a hydrodynamical model, a sediment model, a biological model and a model of chemical contamination. The present work deals with the validation of the hydrodynamics' compartment, based on the comparison with data issued from observational networks and campaigns at sea for the years 2007 and 2008.

The high resolution 3D coastal ocean model MARS3D (for 3D hydrodynamic Model for Applications at Regional Scale) has been applied to forecast the oceanic circulation off Marseille from the Rhone river to the Cap Sicié (south of France). For the RHOMA configuration (Fig 1), realistic numerical simulations were performed for the years 2007 and 2008, with forcing by the Rhone river, meteorological fields and by the surrounding general circulation known to be strongly constrained by the Northern Current.

A lot of observations providing the stratification and currents off Marseille were acquired from in situ oceanographic networks and from vessel cruises during the last decade. In order to validate the nested forecasting system, quantitative comparisons between observations and model results were perfomed. Statistics over long time series of temperature at three moorings (SOMLIT and MEDCHANGE stations) were computed to show the model skills in capturing the monthly to seasonal variability of the thermal structure. This comparison also shows that the model reproduces well the observed features associated with the shelf processes.

In particular, the wind strongly constrains the shelf circulation off Marseille [1] and the model reproduces the cooling of the sea surface waters due to upwelling caused by a wind blowing parallel to the coast when the ocean is stratified (in summer and fall).

During the strong Rhone river discharge of June 2008, we reproduced an intrusion of the Rhone river diluted (low salinity) waters observed into the southern bay of Marseille for several days under westerlies and south-easterlies at the Frioul island station.

In addition to those forcings, the general circulation is also of great influence. Intrusions of the northern current off Cassis from the south of the domain are observed and reproduced by the model in winter, due to the penetration of meanders over the narrow eastern part of the shelf [2].

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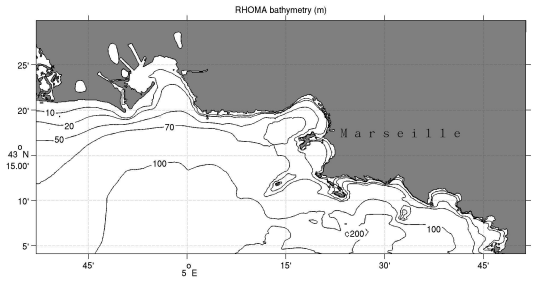

Fig. 1. Bathymetry of the RHOMA modeling domain.

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