Geophysical Research Abstracts
Vol. 16, EGU2014-15697, 2014
EGU General Assembly 2014

Recent advancements on modelling the exchange flow dynamics through the Turkish Strait System

Gianmaria Sannino (1), Adil Sözer (2), and Emin Özsoy (2)

(1) Italian National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA-UTMEA), Rome, Italy, (2) Institute of Marine Sciences, Physical Oceanography, Mersin, Turkey

The system composed by the two narrow Straits, Dardanelles and Bosphorus, and the Marmara Sea is known as the Turkish Straits System (TSS). The scientific questions on the role of the TSS in coupling the adjacent basins of the Mediterranean and Black Seas with highly contrasting properties, in a region of high climatic variability and materials transport depending critically on the cycle of water can only be answered by model predictions of the processes that determine the integral properties of the coupled sub-systems.
This can only be achieved if the entire TSS is modeled as a finely resolved integral system that appropriately accounts for the high contrasts in seawater properties, steep topography, hydraulic controls, fine and meso-scale turbulence, nonlinear and non-hydrostatic effects, thermodynamic states and an active free-surface in the fullest extent, based on well represented fluid dynamical principles.
In this study the MITgcm is used at very high resolution to study this extreme environment that needs to be represented as a whole and with the full details of its highly contrasting properties. The model domain chosen extends over the entire TSS, including also part of the north-east Aegean Sea at south, and the Black Sea at north of the domain. A non-uniform curvilinear orthogonal grid covers the domain at variable resolution: from less than 50 m in the two Straits up to about 1 Km in the Marmara Sea. To adequately resolve the complex hydraulic dynamics of the TSS, the model grid is made by 100 vertical z-levels.
The model is initialized with three different water masses filling the western part of the domain, the Marmara Sea and the eastern side of the domain respectively, with vertical profiles selected from CTD casts obtained during the cruise of the R/V BİLİM of the Institute of Marine Sciences in June-July 2013. With the initial condition specified as lock-exchanges at the two straits, the model is left free to adjust to the expected two-way exchange.
The capability of MITgcm to represent the two-layer exchange dynamics both in the straits and in the Marmara Sea is examined. The non-uniform curvilinear orthogonal grid and the vertical resolution implemented have demonstrated to be sufficient to capture the fine scales within the two Straits and also to well represent mesoscale in the Marmara Sea.
The response of the currents and density structure over the water column to different net flow is also examined through the setup of experiments with varying net barotropic volume fluxes.
The numerical experiments have been realized thanks to the PRACE (Partnership for Advanced Computing in Eureope) infrastructure.