Geophysical Research Abstracts
Vol. 15, EGU2013-7436, 2013
EGU General Assembly 2013

Numerical study of heat and salt exchange between the Atlantic and Mediterranean waters along the Strait of Gibraltar

Antonio Sanchez-Roman (1), Gabriel Jordà (1), Gianmaria Sannino (2), Damià Gomis (1), and Marta Marcos (1)
(1) Universitat de les Illes Balears, IMEDEA, Palma, Spain (asanchez@imedea.uib-csic.es), (2) ENEA, UTMEA-CLIM. Rome, Italy

The Mediterranean Sea is dynamically connected to the Atlantic Ocean through the Strait of Gibraltar. This area is the scenario of a very energetic baroclinic exchange between Atlantic and Mediterranean waters: fresh and warm Atlantic waters enter into the basin while salty and cold Mediterranean waters outflow to the Atlantic. Those water fluxes fluctuate at different timescales (from semi-diurnal to interannual) forced by different factors (tides, meteorological forcing and the seasonal and inter-annual variations of the baroclinic structure). Moreover, incoming and outgoing waters change their properties during their passage through the Strait due to mixing and entrainment between Mediterranean and Atlantic waters. This transformation of the water masses determines the net heat and salt exchanges of the Mediterranean with the global ocean.

The aim of this work is to analyse the spatial and temporal variability of the incoming and outgoing transports of water, heat and salt at different sections of the Gibraltar Strait. In particular we investigate the transformations that Atlantic and Mediterranean waters suffer along its path through the Strait and the physical mechanisms behind those transformations. To do that we analyse the outputs from a numerical simulation covering the entire Mediterranean basin (1/6 degrees of spatial resolution) with enhanced resolution in the area of the Strait (1/200 degrees). Another special feature of this model is that it includes tidal forcing (diurnal and semidiurnal) and atmospheric pressure as well as heat and water fluxes at the sea surface.

The results show that a net entrainment of -0.02 Sv into the lower layer occurs in the Strait, which involves a net loss of heat and salt from the Atlantic inflow. This entrainment has a strong time variability changing from 0.09 to -0.21 Sv at monthly scale. Furthermore, when the internal sections of the Strait are considered, a more complex pattern emerges: a net transfer of -0.18 Sv towards the lower layer is achieved between the western boundary and the mid-region of the Strait, whereas the opposite behaviour is found in the western part, which presents a net transfer of 0.16 Sv towards the upper layer. The model outputs also show that this entrainment significantly modifies the properties of the incoming and outgoing waters. Finally, a simple parameterization of the water mass transformations along the Strait will be proposed. This parameterization can be implemented in coarse resolution climate models which do not include tides in order to account for the complexity of the physical processes that take place in the Strait of Gibraltar and that they cannot explicitly solve.