Geophysical Research Abstracts
Vol. 12, EGU2010-5122, 2010
EGU General Assembly 2010

Impact of tidally-induced local-scale processes on the spreading of the Mediterranean Outflow water

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It is widely accepted that the Mediterranean Outflow (MO) water has influence on deep water production in the North Atlantic (NA), and therefore on NA climate, but the extent of that influence remains controversial and closely linked to the dispute about preferred MO pathways to the Nordic seas.

Climate models addressing this issue are unable to resolve adequately the Strait of Gibraltar and the Gulf of Cadiz – key areas where local-scale processes may impact on MO properties and spreading – and fail to represent adequately the MO signatures in the NA as compared to observations. Model results show higher salinities, mainly southward from the Strait of Gibraltar and an exaggerated MO diffusive spreading pattern. On the other hand, the interpretation of the regional/process models results with higher resolution is hampered by the necessity of open boundary conditions, the short length of the runs and the lack of feedback with the large scale circulation.

Considering that tidally-driven processes might be relevant at places where the width of the MO plume is few ten km, we propose an integral approach allowing to resolve simultaneously the local-scale processes as well as the larger-scale processes which may influence the NA climate, using an efficient ocean GCM (MPIOM) with regional high resolution allowing for long-term runs. The model is formally global. The placement of one pole in the center of Spain allows for regional high resolution in the Strait of Gibraltar and along the Iberian coasts (7 km at the Strait of Gibraltar). In a set of experiments with and without tides the spreading of the MO plume is investigated. Short sensitivity experiments (20 years) indicate a marked difference in the MO spreading due to the inclusion of tides. The tidal case shows a MO spreading pattern in closer agreement with observations. In the run without tides, an unrealistic high salt flux to the south in the Gulf of Cadiz appears, similar to the simulations with the standard global climate models.

It can be shown that local-scale tidally-induced processes in the Gulf of Cadiz cause the remarkable differences in the MO spreading. A detailed analysis of the underlying mechanisms will be presented.