Geophysical Research Abstracts
Vol. 14, EGU2012-858, 2012
EGU General Assembly 2012

Role of mesoscale eddies on exchanges between coastal regions

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The general circulation in the northwestern Mediterranean Sea is characterized by a cyclonic circulation. The northern part of this gyre is formed by the Northern Current (NC), which flows along the continental slope from the Ligurian Sea towards the Catalan Shelf.
The NC has an important influence on the Gulf of Lion (GoL), a large continental margin in the northern part of the basin. The NC constitutes an effective dynamical barrier which blocks coastal waters on the continental shelf. The western part of the GoL is a key region for regulating the outflow from the continental shelf to the Catalan Basin.
These exchanges are mainly induced by partially ageostrophic processes originating from the interaction between the NC and mesoscale activity like meanders, filaments and eddies.
Both GoL and Catalan shelf are characterized by an intense mesoscale activity. Eddies in the GoL are baroclinic structures extending throughout the mixed layer (30 to 50m), often elliptic in shape and about 20-30km in diameter. Catalan eddies are characterized by a vertical extension between 70 and 100m and a diameter of about 45km.

The LAgrangian Transport EXperiment (LATEX, 2008-2011) was designed to study the mechanisms of formation of anticyclones in the western part of the GoL and their influence on cross-shelf exchanges.
Mesoscale anticyclones have been observed in the western part of the GoL and over the Catalan shelf by the combined use of data from satellite observations, in situ measurements and numerical modeling.

Recent numerical experiments show an anticyclonic circulation extending over a large part of the coastal area (latitudinal range : 41°50’ to 43°N ; longitudinal range : 3°10’ to 4°10’E). Interaction with a meander of the NC induces the separation of this circulation in two different eddies, one in the GoL and the other in the Catalan shelf. These eddies exhibit strong interaction between them, resulting in important exchanges between the two coastal regions. On one hand the Catalan eddy causes a heat transfer to the GoL; and, on the other hand, the interaction between the GoL eddy and a topographic barrier (Cap Creus) leads to a transfer of energy to the Catalan eddy. In order to quantify this exchange, a balance of kinetic energy has been analyzed from the model results.

Numerical results are also discussed in comparison with in situ observations collected during the Latex09 campaign (August 24-28, 2009). The analysis of Sea Surface Temperature (SST) satellite images, Acoustic Doppler Current Profiler (ADCP) and Lagrangian drifter trajectories, confirmed the above interpretation derived from numerical model.