Geophysical Research Abstracts
Vol. 18, EGU2016-6433, 2016
EGU General Assembly 2016

Surface connection between different areas in Mediterranean Sea derived from drifter data

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The surface connection of five study areas in the Mediterranean Sea (Sicily Strait, Gulf of Lyon, Ionian Sea, Alborán Sea and Crete Passage) is studied by looking at the statistical properties of near-surface lagrangian trajectories. The choice of the areas is due to the geographical distribution of data and the key role of these sub-basins in the dynamics of the Mediterranean. We used Lagrangian drifter data taken from the Mediterranean Surface Velocity Programme (http://nettuno.ogs.trieste.it/sire/medsvp/). The most common surface drifter used is the CODE-type drifter (Davis, 1985), designed to follow the vertical average velocity of the upper 1 m layer of the water column. The dataset consist of 1547 trajectories, deployed between 1986 and 2015 in all Mediterranean sub basins.

By examining the drifter paths through the study areas, we computed transit and residence time, pseudo-Eulerian statistics and connection probabilities.

Given the small number of drifters and the non-normal distribution of transit times, it is possible to use a bootstrap method (Efron and Tibshirani, 1986) to estimate the average transit time. In particular, we divided it into forward and backward transit times to consider the time taken by drifters respectively, from the exit of study area to end of its trajectory and from the deployment position to the study area.

The main results indicate that the transit time between Sicily Strait and coast of Libya is about 83-103 days and between the Strait and the Gulf of Lyon is approximately 134 days. The time to reach the Adriatic Sea from the Ionian is around 30-40 days; the drifters take around 70 days to go from Alborán Sea to Sardinia channel and 43 days between Crete and the Ionian Sea.

The Ionian Sea due has the highest number of drifter trajectories and the highest residence time, about 42 days. Also the Crete Passage has a high value of residence time, approximately 35 days; the other study areas are characterized by residence times of the order of 15-20 days. For this reason, we divided the trajectories into yearly tracks to study specific processes, such as the bimodal Oscillating System (BiOS) mechanism responsible for decal reversal of Ionian Basin wide circulation.