LAGRANGIAN AND EULERIAN OBSERVATIONS OF THE SURFACE CIRCULATION IN THE TYRRHENIAN SEA

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Abstract
In this paper the Tyrrhenian Sea surface circulation is investigated by means of lagragian and altimeter data. Respect to the traditional cyclonic circulation, the analysis reveals a significant and unexpected complexity. The circulation is modulated by a series of mesoscale/sub-basin structures, of both transient and semi-permanent nature. The pseudo-Eulerian statistics computed with the two datasets evidenced the representativeness of a joint analysis of altimeter and drifter data
Keywords: Circulation, Remote Sensing

Introduction
This paper focuses on the study of the Tyrrhenian Sea, a sub-basin of the western Mediterranean whose surface and near surface dynamics are still relatively poorly known [1, 2], in particular as to its southern region. A set of 53 surface drifters deployed in the Tyrrhenian Sea between December 2001 and February 2004 was analyzed. Simultaneous satellite remotely-sensed altimeter, covering the period 2001-2004, was associated to this dataset in order to supplement the drifter data with continuously and uniformly sampled observations, and to characterize the seasonal and the higher frequency variability of the surface circulation. The investigation was based on trajectory analysis and on the computation of the pseudo- Eulerian statistics using the same binning and space-time averaging for drifter and altimeter data.

Results and discussion
The analysis reveals a new more complex circulation pattern respect that drawn in literature [3, 4]. In fact the cyclonic circulation is modulated by a series of mesoscale/sub-basin structures, of both transient and semi-permanent nature. These structures are particularly important in the southern region of the basin where they overcome by far the mean flow pictures. The North Tyrrhenian Cyclone (NTC) and the North Tyrrhenian Anticyclone (NTA) are the main structures in the northern region of the Tyrrhenian Sea. In the south-western side of the basin a double core cyclonic gyre is present that captures the major portion of the AW entering in the basin. New structures of the circulation are picked out in the southern region of the Tyrrhenian Sea as the South Tyrrhenian Anticyclone (STA), between 12-13 E and 39-40 N, an anticyclonic circulation near the northern coast of Sicily, and finally a gyre having a cyclonic rotation offshore the Calabrian coasts.

The study of altimeter data has highlighted a certain degree of seasonal variability in the circulation pattern. The circulation structures present in the western side of the basin are stronger in summer than in winter, contrarily the circulation features in the south eastern region are more important in winter than in summer.

The pseudo-Eulerian statistic computed with drifter and altimeter measurements has highlighted the sampling and dynamical differences between this two dataset. The value of MKE is greater for the altimeter data than for drifters, on the contrary the EKE energy levels computed from the altimeter are lower than those obtained from drifters. To ascertain the consistency between the Lagrangian measurements and the altimeter dataset, and to evaluate if the observed differences can be related to different sampling capability or dynamical processes, the pseudo-Eulerian statistics derived from the drifters have been spatially smoothed and the altimeter data have been resampled along drifter trajectories. Altimeter data sampled over drifter trajectories and the spatially smoothed pseudo-Eulerian statistics derived from drifter have quite similar values of MKE levels of energy, but the variance ellipses and the EKE levels are very different, in fact the levels of energy computed from altimeter measurements are always smaller than those from drifters.

Therefore, it is possible to conclude that the standard interpolated products of altimeter data lose a considerable part of the signal, even if they ensure a wider and more regular sampling than drifters.

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