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Real-time *in-situ* tracking of Lagrangian coherent structures in a coastal region

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In recent years Lagrangian techniques have become increasingly important for the analysis of horizontal mixing and transport properties in the oceans. In particular, the Finite Size and Finite Time Lyapunov Exponent methods (FSLE and FTLE respectively) have been frequently applied to identify Lagrangian coherent structures (LCSs: i.e. stable and unstable manifolds of hyperbolic points) from satellite derived velocity fields and from numerical simulation results. LCSs can be reliably detected (with errors of $\sim$ 10s km) in the open ocean from satellite altimetry, and several studies have shown a tight correlation between these structures and advected tracers. However, as altimetry missions are primarily designed to operate over the open ocean, altimetry data are less reliable closer to the coast, limiting the accuracy with which LCSs can be located in coastal regions. This is a severe problem that affects our understanding and monitoring capabilities of neritic ecology and biogeochemistry, as well as of dispersal of urban and river discharged pollutants.

The LAgrangian Transport EXperiment (LATEX, 2008-2011) was designed to study the anticyclonic mesoscale eddies which form on the continental shelf in the western part of the Gulf of Lion, and their influence on mixing and cross-shelf exchanges. During the Latex10 campaign (September 1-24, 2010) we attempted a mapping of coastal LCSs with an adaptive strategy that combined satellite data, ship-based Acoustic Doppler Current Profiler (ADCP) measurements, and iterative Lagrangian drifter releases. The position of the LCS tangle was first guessed by combining altimetry derived FSLE with satellite images of sea surface temperature and chlorophyll concentration. Three arrays of drifters (14 drifters total) were then released at interval of few days to obtain *in-situ* estimates of the structure. The deployment position and configuration of each array was chosen on the basis of the outcome of the previous launch. Drifter trajectories were integrated with ADCP mapping to obtain a synoptic picture of the LCS.

This iterative process allowed to successfully localize and track the repelling and attracting LCSs present in the region for about 12 days from September 12 to 24. Their intersecting point was characterized by a slow southwestward migration ($\sim 1/3^{\circ}$ in about 6 days, corresponding to ~ 5 cm s^{-1}). Our analysis showed that cross-shelf exchanges were constrained by the presence of a corridor ~ 30 km wide, roughly parallel to the coast, maintained by the attracting LCS. Future work will include a quantification of the flux within this corridor by combining the surface transport information with the temperature vertical profiles also collected during the cruise; furthermore, in order to obtain better estimates of LCS from FSLE, methods to improve satellite derived velocity fields in coastal regions will also be explored.