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Extraction of coherent vortices from altimetric measurements in the Mediterranean sea: the Coherent Vortex Simulation technique.

V. Nieves (1), A. Turiel (1), J. Isern-Fontanet (2,3), and E. Garcia-Ladona (1)

(1) Institut de Ciencies del Mar (CSIC). Passeig Maritim de la Barceloneta, 37-49. 08003 Barcelona. Spain. (2) Laboratoire de Physique des Océans (Ifremer). BP 70, F-29280 Plouzane, France. (3) Laboratoire d'Océanograpie Spatiale (Ifremer). BP 70, F-29280 Plouzane, France.

Recent observational studies have shown that in the Mediterranean sea velocity Probability Density Functions exhibit non-Gaussian shapes attributed to the presence of coherent vortices. This suggests that eddies in the Mediterranean can play a greater role in the dynamics of the whole basin that what has been previously considered. Indeed, coherent vortices are known to play a key role in the ocean dynamics due to their effectiveness in moving energy and matter through the ocean and their impact on mixing. For these reasons, the study of the Mediterranean sea might be approached by considering coherent vortices as a fundamental building blocks of the flow dynamics. This approach requires an adequate technique to extract the field associated to coherent vortices.

In this context, wavelet-based representations seem rather natural, as wavelet bases are by construction scale-invariant, and scale invariance is one the most relevant emerging flow symmetries proper to 2D turbulence and to geophysical flows. A recent wavelet-based technique, the Coherent Vortex Simulation (CVS), which has been introduced by M. Farge and collaborators, has proved to be valuable for the vortex separation problem. The CVS is intended to produce a more compact representation of the flow in terms a coherent part, which comprises a small amount of degrees of freedom but which is anyway representative of the whole, and an incoherent part. The coherent part (the vortex-associated one) extracted from Direct Numerical Simulations on 2D turbulence describes the vast majority of the energy and the enstrophy of such flows. But

in spite of the close analogy between 2D turbulence and geophysical fluid dynamic, so far no effort had been done to apply CVS to study observational ocean data.

We have applied the CVS to sea surface velocity data in the Mediterranean basin. As velocity data for our study, we have mainly used velocity fields derived from Sea Surface Height maps provided by satellite altimetry and we also present some tests on velocity data estimated by dynamical considerations from SST data. Our results show that, when appropriate wavelets are used, the main circulation patterns in the Mediterranean are well approximated by the coherent velocity field, even using a small number of degrees of freedom. However, in terms of dynamics, at least one third of the total energy and about 15description. We finally discuss the advantages and limitations of CVS as an appropriate technique for understanding the dynamics of the Mediterranean basin.