# Transport dynamics in the Western Mediterranean: Stretching fields and hyperbolic lines

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Hyperbolic points and their manifolds organize the phase space of dynamical systems. In the Lagrangian description of fluid transport they determine transport routes and mixing properties. Stretching fields are correlated with these structures and thus provide an heuristic method to approximate them. Calculations of the above mentioned objects has been performed in simplified model flows since some time ago. More recently, increased computer power and theoretical insight are allowing their identification in realistic and in observed fluid flows. In this talk I will describe recent work on the location of Lagrangian structures in velocity fields obtained from realistic simulations and from satellite altimetry of the surface layers of the Mediterranean sea. Finite Size Lyapunov exponents are found to be useful quantities to characterize stretching and compressing distributions, and their implications for mixing. Direct calculation of hyperbolic points and their stable and unstable manifolds turns out to be more complex, but allows the use of the tools of lobe dynamics to characterize fluid transport. This is illustrated here for the surface circulation in the Balearic front area. Parts of this work have been done in collaboration with C. Lopez, V. Fernandez, F. d'Ovidio, J. Isern-Fontanet, A.M. Mancho, D. Small, and S. Wiggins.