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Surface transport in the Ria de Vigo - Transport barriers in a tidal estuary with a complex geometry

F. Huhn (1), A. von Kameke (1), P. Montero (2), S. Allen-Perkins (3), A. Venancio (4), V. Pérez-Muñuzuri (1,4)

(1) Group of Non-Linear Physics, Faculty of Physics, University of Santiago de Compostela, Spain , (2) INTECMAR, Xunta de Galicia, Spain, (3) TRAGSATEC, Santiago de Compostela, Spain, (4) MeteoGalicia, Santiago de Compostela, Spain

We study the submesoscale surface transport in the Ria de Vigo, NW Spain, an estuary with tidal and wind-driven circulation, analyzing the output of the coastal model MOHID with state-of-the-art Lagrangian methods, and comparing the results to drifter experiments. We extract Lagrangian Coherent Structures (LCS) as ridges in fields of the Finite-Time Lyapunov Exponent (FTLE) that can be identified with transport barriers. The LCS reveal the fundamental structure of the modelled circulation in the estaury that is a superposition of the tidal inflow and outflow, the wind-driven currents and the long-term drift on the shelf. In the Ria de Vigo, LCS are attached to prominent coastal boundaries, as islands or capes, indicating that the geometry of the flow patterns is dominated by bathymetry. Although the vertical flow which is not represented in the horizontal surface flow can be important at the coast, the found transport patterns can be seen as the surface footprint of the 3D circulation in the estaury.
Comparing the trajectories of real surface drifters from four deployments to the computed transport barriers in different typical meteorological sitiations, we find that the drifter trajectories are in agreement with the different coherent water masses predicted by the model.
The knowledge of the global transport patterns of water masses in this highly populated coastal region is indispensable for the assessment of the fate of contaminations, like possible oil spills or released waste water, but also for biological studies that deal with the drift of eggs and larvae of fish and other marine species, or investigate plankton blooms.