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Numerical study of particle transport due to periodic movement of water in a system of two oceanic basins connected by a channel

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An estimation of lagrangian transport in the ocean is important for a number of practical problems such as dispersion of pollutants, movement of biological species and sedimentation. Using the velocity field obtained numerically by solving the momentum and continuity equations, we model the transport of particles in a system of two basins connected by a narrow channel, taking into account the forcing of the tide. Tidal changes in water elevation lead to periodic flow in and out of the bay through the narrow channel. An asymmetry between the flow entering and leaving the channel on different phases of the tide is observed. A consequence of this asymmetry is that every tidal cycle a fraction of fluid is not returned through the channel, so that a passive tracer in the bay is successively flushed away [1].
The particle motion is influenced by both the current through the channel and by the dipole formed at the outlet. At this stage fluid particle trajectories are obtained. The ultimate goal is to track the particles since they are at rest on the bottom and are raised by a same agent as the dipole or the waves breaking on shore.
We assume the case of shallow water, and we analyze the fluid particle trajectories and solid particles trajectories in two dimensions, the later by solving an ordinary differential equation [2]. The vortex causes a suction effect, which can be seen in the trajectories of fluid particles.
The tidal forcing is reflected in the fact that Reynolds number becomes time dependent. We obtained results that are consistent with previous works [1]. For example the formation and displacement of a dipole at the exit of the channel is observed.

[1] Wells, M. G. and Van Heijst, G.J.F., Dynamics of Atmospheres and Oceans, 37 (2003) 223-244
[2] Mordant, N. (2001). Mesure lagrangienne en turbulence: mise en ouvre et analyse. Ph. D. Thesis. ENS de Lyon, France.