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Stirring, Stretching and Transport Generated by a Vortex Pair LUCA CORTELEZZI, McGill University, FRANCESCO RIZZI, Johns Hopkins University — We consider a pair of like-signed, initially elliptical vortices with uniform vorticity distribution embedded in an incompressible, inviscid fluid occupying a two-dimensional, infinite domain. The rotational and co-rotational motion of the vortices stir the fluid and subdivide the domain into inner core, inner recirculation, outer recirculation regions and outer flow. We quantify stirring using stretching of the interface and the mix-norm. Our numerical simulations show that stretching is dominated by the chaotic advection induced within the inner core and inner recirculation regions, whereas the mixnorm is dominated by the laminar transport induced within the outer recirculation regions. Stirring is sensitive to the geometry of the initial concentration field. We consider, as an initial scalar field, two concentrations delimited by a straight-line interface of adjustable orientation and show that the interface passing through the centroids of the vortices is the one most efficiently stretched, while the initial concentration field with an orthogonal interface is the most efficiently stirred. Finally, we investigate the effects of the angular impulse on the stirring performance of the vortex pair. Stretching is very sensitive to the angular impulse, while the mix-norm is not. We show that there is a value of the angular impulse which maximizes stretching and argue that this is due to two competing mechanisms. Funding provided by NSERC, contract RGPIN217169.

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