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Stirring inertia in time-dependent low Reynolds number flows[1]
PHILIP YECKO, DIRK MARTIN (MARK) LUCHTENBURG, Cooper Union, ERIC FORGOSTON, LORA BILLINGS, Montclair State University — Diagnosis of a kinematic flow and its transport using Lagrangian coherent structures (LCS) based on finite-time Lyapunov exponents (FTLE) neglects dynamical effects, such as pressure, as well as dynamically important constraints, such as potential vorticity conservation. Chaotic advection, on the other hand, often neglects inertial effects, which are prominent in LCS. We present results for very low Reynolds number laboratory flows, including a Stokes double gyre, vertically sheared strain and a four roll mill. Images of tracer (dye) and FTLE fields computed from particle image velocimetry (PIV) reveal complementary sets of flow structures, giving a more complete picture of transport in these flows. We confirm by computing FTLE of an exact time-dependent Stokes flow solution and present implications of these findings for inertial object transport in flows.

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