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Lagrangian coherent structures in geophysical flows PHILIP DU TOIT, California Institute of Technology — In aperiodic flows, particle trajectories may appear to be chaotic and unstructured. However, using finite time Lyapunov exponents we are able to detect sharp separatrices that determine the underlying structure of the flow. These separatrices are barriers to transport and form the boundaries of almost invariant regions. Computing these Lagrangian Coherent Structures (LCS) for oceanic and atmospheric flows in two and three dimensions allows us to visualize the mixing processes and elucidates the underlying mechanisms by which particle transport and mixing occur. We will show that the LCS reveal many of the familiar elements from classical geometric dynamics including hyperbolic points, intersections of stable and unstable manifolds, homoclinic tangles, and transport via lobe dynamics. These methods have broad application to many geophysical flows. In particular, we observe that mixing in hurricanes and tropical storms is dominated by transport via lobe dynamics. Identifying the LCS allows us to quantify material entrainment and detrainment from the storm center. Precisely the same transport mechanism is also observed in flows surrounding ocean eddies.

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