Abstract Submitted
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**Hyperbolic neighborhoods as organizers of finite-time exponential stretching**[1] SANJEEVA BALASURIYA, Univ of Adelaide, NICHOLAS OUELLETTE, Stanford University — Hyperbolic points and their unsteady generalization, hyperbolic trajectories, drive the exponential stretching that is the hallmark of nonlinear and chaotic flow. Typical experimental and observational velocity data is unsteady and available only over a finite time interval, and in such situations hyperbolic trajectories will move around in the flow, and may lose their hyperbolicity at times. Here we introduce a way to determine their region of influence, which we term a hyperbolic neighborhood, which marks fluid elements whose dynamics are instantaneously dominated by the hyperbolic trajectory. We establish, using both theoretical arguments and numerical verification from model and experimental data, that the hyperbolic neighborhoods profoundly impact Lagrangian stretching experienced by fluid elements. In particular, we show that fluid elements traversing a flow experience exponential boosts in stretching while within these time-varying regions, that greater residence time within hyperbolic neighborhoods is directly correlated to larger Finite-Time Lyapunov Exponent (FTLE) values, and that FTLE diagnostics are reliable only when the hyperbolic neighborhoods have a geometrical structure which is regular in a specific sense.

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