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Topological Chaos in a Three-Dimensional Spherical Vortex SPENCER SMITH, Mt Holyoke College, JOSHUA ARENSON, KEVIN MITCHELL, University of California Merced — Topological techniques have proven to be powerful tools for characterizing the complexity of advection in many 2D fluid flows. However, the path to extending many techniques to three dimensions is filled with roadblocks, which prevent their application to a wider variety of interesting flows. We successfully extend the homotopic lobe dynamics (HLD) technique, previously developed for 2D area-preserving flows, to 3D volume-preserving flows. Specifically, we use intersecting two-dimensional stable and unstable invariant manifolds to construct a symbolic representation of the topological dynamics. This symbolic representation can be used to classify the trajectories of passively advected particles and to compute mixing measures, such as the topological entropy. In this talk, we apply the 3D HLD technique to an explicit numerical example: a time-periodic perturbation of Hill's spherical vortex, modified to break both rotational symmetry and integrability. For this system, the 3D HLD technique is able to detect a distinction between the topologically forced 2D stretching rate of material surfaces and the 1D stretching rate of material curves, illustrating the truly 3D nature of our approach.

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