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Using Covariant Lyapunov Vectors to Understand Spatiotemporal Chaos in Fluids[1] MARK PAUL, MU XU, JOHNATHON BARBISH, SAIKAT MUKHERJEE, Virginia Tech — The spatiotemporal chaos of fluids present many difficult and fascinating challenges. Recent progress in computing covariant Lyapunov vectors for a variety of model systems has made it possible to probe fundamental ideas from dynamical systems theory including the degree of hyperbolicity, the fractal dimension, the dimension of the inertial manifold, and the decomposition of the dynamics into a finite number of physical modes and spurious modes. We are interested in building upon insights such as these for fluid systems. We first demonstrate the power of covariant Lyapunov vectors using a system of maps on a lattice with a nonlinear coupling. We then compute the covariant Lyapunov vectors for chaotic Rayleigh-Bénard convection for experimentally accessible conditions. We show that chaotic convection is non-hyperbolic and we quantify the spatiotemporal features of the spectrum of covariant Lyapunov vectors.

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