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Probing the Chaotic Dynamics of Fluids using Insights from Coupled Map Lattices[1] JOHNATHON BARBISH, MU XU, MARK PAUL, Virginia Tech — Many difficult fluid challenges exhibit high-dimensional spatiotemporal chaos. Natural examples include the dynamics of the atmosphere and oceans. New insights have been gained by studying canonical fluid problems such as Rayleigh-Bénard convection where significant progress has been made using large-scale computations of the partial differential equations that describe the fluid flow. However, these computations remain very expensive which makes it difficult, if not currently impossible, to explore new ideas that require large sample sets, vast sweeps of parameter space, and long-time statistics. We study these questions using coupled map lattices (CML) in one and two dimensions. We compute the covariant Lyapunov vectors to probe fundamental features of the CML's including the Lyapunov spectrum, fractal dimension, and the principal angle between the stable and unstable manifolds. We are particularly interested in the role of a conservation law on the chaotic dynamics, the use of ideas from equilibrium thermodynamics to yield a coarse-grained representation, and in the development of reduced order models.

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