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Disentangling Resolution, Precision, and Inherent Stochasticity in Fluid Mixing NICHOLAS OUELLETTE, LEI FANG, Stanford University, SANJEEVA BALASURIYA, University of Adelaide — Reliable measurement, simulation, and analysis of dynamical systems rely on appropriately bounded uncertainty. Errors that lead to uncertainty naturally arise from finite precision or resolution, but an additional unappreciated source of uncertainty is the effective stochasticity associated with nonlinear dynamics. Here we describe and quantify the interplay between these three sources of uncertainty using a recently developed framework known as stochastic sensitivity theory. Using fluid mixing as a test case and considering data from an analytical flow, a laboratory experiment, and geophysical observations, we show how to delimit regimes that are limited by finite resolution or by inherent stochasticity. We arrive at the surprising conclusion that in some cases, refining the resolution of a measurement or simulation can actually be counterproductive and lead to an outcome that is less faithful to the true dynamics.

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