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Investigating multiscale modeling with the Kuramoto-Sivashinsky equation LAUREN PADILLA, CLARENCE ROWLEY, GEOFFREY VALLIS, Princeton University — The multiscale modeling framework (MMF), also known as superparameterization, is a new approach to solving the sub-gridscale closure problem in weather and climate simulations that are too expensive for direct numerical simulation. In the MMF, the true equations of motion for the sub-gridscale processes replace typical parameterizations which provide closure based on large-scale variables alone where no local dynamics are allowed to develop. The extent to which MMF represents improvement over conventional models is an open question that we investigate systematically in a simple fluid-like system, the Kuramoto-Sivashinsky (K-S) equation. This one-dimensional, non-linear, partial differential equation is an ideal test case for the MMF approach. The K-S equation exhibits chaotic behavior and includes the effects of production, dissipation, and advection yet is simple enough to sample many initial conditions over long time periods. We present results comparing the energy spectra, error, and turbulent kinetic energy of solutions achieved through direct numerical simulation, MMF with different coupling schemes, and conventional large-scale closure.

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