Abstract Submitted
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Deriving statistical closure from dynamical optimization BRUCE TURKINGTON, University of Massachusetts Amherst — Turbulence theorists have traditionally deduced statistical models by generating a hierarchy of moment equations and invoking some closure rules to truncate the hierarchy. In this talk a conceptually different approach to model reduction and statistical closure will be presented, and its implications for coarse-graining fluid turbulence will be indicated. The author has developed this method in the context of nonequilibrium statistical descriptions of Hamiltonian systems with many degrees of freedom. With respect to a chosen parametric statistical model, the lack-of-fit of model paths to the full dynamics is minimized in a time-integrated, mean-squared sense. This optimal closure method is applied to coarse-grain spectrally-truncated inviscid dynamics, including the Burgers-Hopf equation and incompressible two-dimensional flow, using the means and/or variances of low modes as resolved variables. The derived reduced dynamics for these test cases contain (1) scale-dependent dissipation which is not a local eddy viscosity, (2) modified nonlinear interactions between resolved modes, and (3) coupling between the mean and variance of each resolved mode. These predictions are validated against direct numerical simulations of ensembles for the fully resolved dynamics.

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