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Statistics of Macroturbulence from Flow Equations[1]
BRAD MARSTON, THOMAS IADECOLA, WANMING QI, Brown University — Probability distribution functions of stochastically-driven and frictionally-damped fluids are governed by a linear framework that resembles quantum many-body theory. Besides the Fokker-Planck approach, there is a closely related Hopf functional method[2]; in both formalisms, zero modes of linear operators describe the stationary non-equilibrium statistics. To access the statistics, we generalize the flow equation approach[3] (also known as the method of continuous unitary transformations[4]) to find the zero mode. We test the approach using a prototypical model of geophysical and astrophysical flows on a rotating sphere that spontaneously organizes into a coherent jet. Good agreement is found with low-order equal-time statistics accumulated by direct numerical simulation, the traditional method. Different choices for the generators of the continuous transformations, and for closure approximations of the operator algebra, are discussed.

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