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Direct Statistical Simulation of Geophysical Flows[1] BRAD MARSTON, Brown University, GREG CHINI, University of New Hampshire, STEVE TOBIAS, University of Leeds — Statistics of models of geophysical and astrophysical fluids may be directly accessed by solving the equations of motion for the statistics themselves as proposed by Lorenz nearly 50 years ago. Motivated by the desire to capture seamlessly multiscale physics we introduce a new approach to such Direct Statistical Simulation (DSS) based upon separating eddies by length scale. Discarding triads that involve only small-scale waves, the equations of motion generalize the quasi-linear approximation (GQL) and are able to accurately reproduce the low-order statistics of a stochastically-driven barotropic jet. Furthermore the two-point statistics of high wavenumber modes close and thus generalize second-order cumulant expansions (CE2) that employ zonal averaging. This GCE2 approach is tested on two-layer primitive equations. Comparison to statistics accumulated from numerical simulation finds GCE2 to be quantitatively accurate. DSS thus leads to new insight into important processes in geophysical and astrophysical flows.

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