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Variability of Stochastically Forced Beta-Plane Zonal Jets

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Turbulent fluid flows on a beta-plane lead to the spontaneous formation and equilibration of persistent zonal jets. However, the equilibrated jets are not steady and the nature of the time variability in the equilibrated phase is of interest both because of its relevance to the behaviour of naturally occurring jet systems and for the insights it provides into the dynamical mechanisms operating in these systems. Variability is studied within a barotropic model, damped by linear friction, in which stochastic exogenous forcing generates a kind of turbulence that in more complicated systems would be generated by internal dynamical instabilities such as baroclinic instability. This nonlinear (NL) system is used to investigate the variability of zonal jets across a broad range of parameters. Comparisons are made with a reduced quasilinear (QL) system, where eddy-eddy interactions are neglected, permitting only nonlocal interactions between eddies and the zonal mean flow. Both systems reveal a rich variety of jet variability. In particular, the NL model is found to admit the formation of systematically migrating jets, a phenomenon that is observed to be robust in subsets of parameter space. Jets migrate north or south with equal probability, a consequence of the latitudinal symmetry inherent in the system, occasionally changing their direction of migration.