Abstract Submitted
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Zonal Flows from Spontaneous Symmetry Breaking of Homogeneous Turbulence[1] JEFFREY PARKER, JOHN KROMMES, Princeton University — To study how zonal flows (ZF) arise, we examine one of the simplest possible models, the stochastically forced Hasegawa-Mima equation, which displays the bifurcation of steady ZFs from a state of homogeneous turbulence; thus a statistical treatment is required. Here an approach [2] is adopted in which the ZFs are treated as mean fields that spontaneously break the background symmetry. The resulting inhomogeneous ensemble is treated self-consistently without assuming weak inhomogeneity. Closed statistical equations are obtained by ignoring the drift-wave self-interactions while fully retaining the drift-wave–ZF nonlinearities. We show that from the statistical point of view ZF generation can be understood as pattern formation. This leads to the surprising result that in a saturated turbulent state the ZF wavelength is not unique; a continuous band of ZF scales is allowed. Only those within a smaller sub-band are linearly stable. That stability is analyzed and the stability diagram in parameter space is calculated and successfully compared with simulations. The stability concept provides a way of interpreting the merging of zonal jets, a phenomenon commonly observed in observations and numerical studies.

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[2]K. Srinivasan & W. R. Young, J. Atmos. Sci. 69, 1633 (2012)

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