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Equilibration of the jet forming instability in barotropic beta-plane turbulence

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Planetary turbulent flows are observed to self-organize into large scale structures such as zonal jets and coherent vortices. Recently, it was shown that a comprehensive understanding of the properties of these large scale structures and of the dynamics underlying their emergence and maintenance is gained through the study of the dynamics of the statistical state of the flow. Previous studies ad-dressed the emergence of the coherent structures in barotropic turbulence and showed the zonal jets emerge as an instability of the Statistical State Dynamics (SSD). In this work, the equilibration of the incipient instabilities and the stability of the equilibrated jets near onset is investigated. It is shown through a weakly nonlinear analysis of the SSD that the amplitude of the jet evolves according to a Ginzburg-Landau equation. The equilibrated jets were found to have a harmonic structure and an amplitude that is an increasing function of the planetary vorticity gradient. It is also shown that most of the equilibrated jets are secondarily unstable and will evolve through jet merging and branching to the stable jets that have a scale close to the most unstable (refering to the jet forming primary instability) emerging jet.