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Periodicity disruption of a model quasi-biennial oscillation of equatorial winds

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In the Earth's atmosphere, fast propagating equatorial waves generate slow reversals of the large scale stratospheric winds with a period of about 28 months. This quasi-biennial oscillation is a spectacular manifestation of wave-mean flow interactions in stratified fluids, with analogues in other planetary atmospheres and laboratory experiments. Recent observations of a disruption of this periodic behavior have been attributed to external perturbations, but the mechanism explaining the disrupted response has remained elusive. We show the existence of secondary bifurcations and a quasiperiodic route to chaos in simplified models of the equatorial atmosphere ranging from the classical Holton-Lindzen-Plumb model to fully nonlinear simulations of stratified fluids. Perturbations of the slow oscillations are widely amplified in the proximity of the secondary bifurcation point. This suggests that intrinsic dynamics may be equally influential as external variability in explaining disruptions of regular wind reversals [1].

[1] Renaud, A., Nadeau, L. P., & Venaille, A. (2019). Periodicity Disruption of a Model Quasibiennial Oscillation of Equatorial Winds. Physical Review Letters, 122(21), 214504.