Balanced and unbalanced aspects of secondary eyewall formation

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Secondary eyewall formation (SEF) is widely recognized as an important research problem in the dynamics of mature tropical cyclones, but as of yet there is not a consensus on the phenomenon's fundamental physics. Recent research suggests that, from a system scale perspective, both balanced and unbalanced dynamics play an important role in SEF. However, there is no complete quantification of the extent to which the evolution of the fields during SEF deviate from those diagnosed assuming balanced dynamics.

To address this question, we solve the Eliassen balanced equation using the vortex structure and forcing functions (diabatic heating rate and tangential momentum source) diagnosed from convection-permitting models undergoing SEF. The resulting secondary circulation and tangential wind tendency is compared with the azimuthal averages of the three-dimensional simulations. In this presentation, we show such comparisons and describe to what extent, and in which parts of the storm, the evolution of azimuthally-averaged fields departs from balanced dynamics.