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The role of Convective instability in Tropical Cyclone Structure Change Cycles

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High-resolution simulations of Hurricane Katrina (2005) show that, during rapid intensification period, the modelled vortex goes through structure change cycles, vacillating between symmetric and asymmetric phases. These phases are similar, respectively, to regimes 1 and 2 found by Kossin and Eastin (2001) using aircraft observations. Kossin and Eastin suggested that the transition from their regime 1 to regime 2, which typically occurs during the period of 1 to 2 h, is due to barotropic instability of the vorticity ring structure. In our simulations, this transition is accompanied by the growth of Vortical Hot Towers (VHTs) from within the eyewall. We argue that both convective instability and barotropic instability play roles in the transition. Convective instability is suggested to be coupled with barotropic instability via a positive feedback loop between the enhanced surface flux and convective circulations, thus, resulting in fast growth of VHTs. The participation of convective instability in the process explains adequately the observed fast transition as opposed to the slow growth that would be resulted otherwise by only barotropic instability.