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Deep Convection in Elliptical andPolygonal Eyewalls of Tropical Cyclones

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In observations, tropical cyclones with cyclonically-rotating elliptical eyewalls are often characterized by wavenumber-two (WN2) deep convection located at the edge of the major axis.A simple modeling framework is used to understand this phenomenon, where anondivergentbarotropic model (NBM) is employedtorepresentthe elliptical vortex in the free atmosphere, and anasymmetric slab boundary layer(SBL) modelis used to simulate the frictional boundary layer (BL) underneath the free atmosphere. The interaction is one-way in that the overlying cyclonicflow drives the BL, but the BL pumpingdoesnot feedback to the overlying flow.The nonlinear-balanced pressure field from the NBMdrives thewindsin the SBL model, which then causes BL convergence and pumpingnear the eyewall. The strong updraftsatthe edge of the major axis for the elliptic vortex in the BL isinduced by thelarger convergent radial wind from the asymmetric distribution of the pressure fields of the free atmosphere with noncircular vortex.The large radial inflow maintains the supergradient windat the edge of the elliptical vortex. The results emphasize the cyclonic rotationof the WN2 feature ofstrong updraftsatthe top of the BLfrom the localshock-likeBL radial wind structure.Similar radial profiles and strong BL top updrafts occur at the edges of higher-order polygonal eyewallswiththe magnitude of the peak updraft decreasing as thewavenumber structure of the vortex increases.