How does the boundary layer contribute to eyewall replacement cycles in axisymmetric tropical cyclones?

Jeffrey D. Kepert
Centre for Australian Weather and Climate Research
Bureau of Meteorology
Melbourne, Australia
J.Kepert@bom.gov.au

Eyewall replacement cycles are an important mechanism for internal variability within tropical cyclones, which strongly affect the storm's intensity, size and hence impact. This seminar will report recent work on the role of the boundary layer in this process.

Three diagnostic models of the axisymmetric tropical cyclone boundary layer, with different levels of approximation, are applied to the problem of tropical cyclones with concentric eyewalls. The outer eyewall is shown to have an inherently stronger frictional updraft than the inner, because it is in an environment of lower vorticity. Similarly, a relatively weak local enhancement of the radial vorticity gradient outside of the primary radius of maximum winds can produce a significant frictional updraft, even if there is no outer wind maximum.
Based on these results, we propose that the boundary layer contributes to the formation of outer eyewalls through a positive feedback between the local enhancement of the radial vorticity gradient, the frictional updraft, and convection. The friction-induced secondary circulation associated with the inner eyewall is shown to weaken as the outer wind maximum strengthens and/or contracts, so boundary-layer processes will contribute, along with the heating-induced secondary circulation, to the weakening of the inner eyewall during an eyewall replacement cycle.