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*The Structure and Dynamics of Coherent Vortices in the Eyewall Boundary  
Layer of Tropical Cyclones*

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Convection within tropical cyclones is typically much weaker than within mid-latitude continental thunderstorms. Nevertheless, relatively strong vertical motions have been found to occur within some tropical cyclones. We examine all available dropsondes (~10,000) within tropical cyclones from 1997-2013 to create a dataset of extreme updrafts ( $w > 10$  m/s; 170 sondes) and wind speeds ( $ws > 90$  m/s; 64 sondes). Updrafts of 10-25 m/s can occur in the lowest 2 km, sometimes as low as a few hundred meters above the surface. These extreme updrafts, which are almost exclusively found in the eyewall of major hurricanes, are sometimes collocated with local extrema in horizontal wind speed, which may exceed 100 m/s.

We hypothesize that the extremes sampled by the dropsondes are associated with coherent small-scale (order 1 km) vortices. To gain further insight, we use the CM1 model to simulate intense tropical cyclones in an idealized framework, with horizontal grid spacing as fine as ~60 meters. By examining individual features and compositing over many updrafts, we find that there is a consistent structure and relationship between vorticity, vertical velocity, and near-surface windspeeds. We quantitatively show that buoyancy is not responsible for the acceleration of strong boundary layer updrafts.

Instead, the updrafts are forced by dynamical pressure gradients associated with strong gradients in the velocity fields. Using simulated dropsonde trajectories, we show that sondes are likely to be horizontally advected through rather than remaining within an updraft as they fall, and therefore, apparent vertical variability in observed kinematic and thermodynamic profiles may actually be horizontal variability. Based on our observational and numerical results, we believe that these vortices may be responsible for generating some of the strongest surface wind speeds found anywhere on earth.

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**Thursday, 11 June 2015, 3:30 PM**  
Refreshments 3:15 PM  
NCAR-Foothills Laboratory  
3450 Mitchell Lane  
Bldg 2 Small Seminar Room 1001

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