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Fine-scale radar observations of boundary layer structures in landfalling hurricanes

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The hurricane boundary layer is comprised of coherent structures that are potentially responsible for significant transport of turbulent fluxes throughout the hurricane boundary layer as well as regions of enhanced damage at the surface.

These coherent structures are not well understood and consequently their effects are poorly represented in numerical models. Consequently, an understanding of the flow modulating processes in the hurricane boundary layer is necessary to improve hurricane intensity forecasts. Further, enhanced regions of turbulent momentum transport are hypothesized to cause areas of enhanced damage at the surface. In order to characterize these turbulent processed and quantify their effects, the Doppler on Wheels radars (DOWs) have deployed in several hurricanes, obtaining both dual-Doppler and rapid single-Doppler observations in the boundary layer of landfalling hurricanes. Results will be presented from Hurricanes Frances (2004), Gustav (2008), and Ike (2008).

During Hurricane Frances, high-resolution, dual-Doppler radar observations of the lowest hundred meters of the boundary layer allowed for the four-dimensional (time and space) analysis of the boundary layer velocity structure and for the quantification of the turbulent fluxes as Frances transitioned from ocean to land. These results will be discussed in the context of current turbulent parameterization schemes used in numerical models.

In Hurricanes Gustav and Ike, rapid, single-Doppler observations were obtained of the boundary layers. This allowed for the two-dimensional quantification rapidly evolving of boundary layer structures. Further an array of surface based instruments were deployed in Hurricanes Gustav and Ike in order to correlate observations at radar level with surface observations. Through turbulent considerations, a reduction factor was derived for the radar winds, which allowed for the comparison between radar level winds and winds observed at 1, 2, and 10 m. These results will be discussed in the context of standard hurricane wind models.