Characterizing the Structure of Hurricane Karl (2010)
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Introduction
In the literature, the orographic modification of the three-dimensional structure of tropical cyclones is understudied. In order to improve prediction of surface precipitation, the manner in which topography impacts dynamical and microphysical processes must be better understood. Hurricane Karl’s landfall in southern Mexico in 2010 provides an opportunity to study this interaction in greater detail. Before teasing out the relative contribution of the topography, this study first seeks to characterize the existing thermodynamic, microphysical and dynamical structures. This will enable further study of the role the Mexican mountains and plateau play in organizing and enhancing precipitation.

Hurricane Karl
- Hurricane Karl made landfall in Mexican state of Veracruz on September 17th, 2010.
- Rainfall totals were highest near Misantla, MX (Stewart 2010).

Rainfall associated with Hurricane Karl from Stewart 2010

Conclusions and Future Work
- WRF modeling study to examine structure of Karl.
- Different microphysical schemes produce similar tracks
- General intensity captured, but falls a bit short

WRF Simulations
- Comparison of the simulated structures with airborne radar data from APR-2 on the NASA DC-8
- Isolate the role that orography plays in the structural patterns by modifying the terrain in WRF experiments

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Characteristic Structure – WSM

Rain Mixing Ratio

Above: Rain mixing ratio at four altitude levels at hour 63.
Bottom: Rain mixing ratio profiles from data in boxes drawn above.

- Strong rain signature in the inner core / outer bands
- Box 1 has higher average mixing ratios through 4 km

Graupel Mixing Ratio

Left: Graupel at 6 km altitude at hour 63.
Right: Graupel profiles in denoted areas.

- Graupel more prevalent in Box 1

Snow Mixing Ratio

Left: Snow at 6 km altitude at hour 63.
Right: Snow profiles in denoted areas.

- Lighter particles like snow have a tendency to circle away from origin

Theta-E and W

Top Left: θ_e at 1 km altitude at hour 63.
Top Right: θ_e profiles from data in denoted areas.
Bottom: W profiles from data in denoted areas.

- Stronger decrease in θ_e in Box 1
- Mean w is stronger in Box 1

Characteristic Structure – WSM

Bottom:

KG

Graupel

Snow

Kg/kg

Graupel Mixing Ratio

Snow Mixing Ratio

Theta-E and W

Rain Mixing Ratio

Graupel Mixing Ratio

Snow Mixing Ratio

Theta-E and W

Rainfall associated with Hurricane Karl from Stewart 2010

Track and Intensity of Hurricane Karl from NHC Best Track data and simulations.