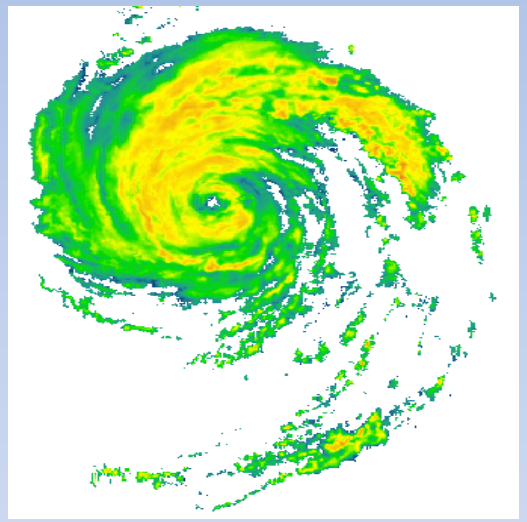
Using a GIS to Quantify the Spatial Arrangement of TC Rainbands as Detected by Ground-Based Radar



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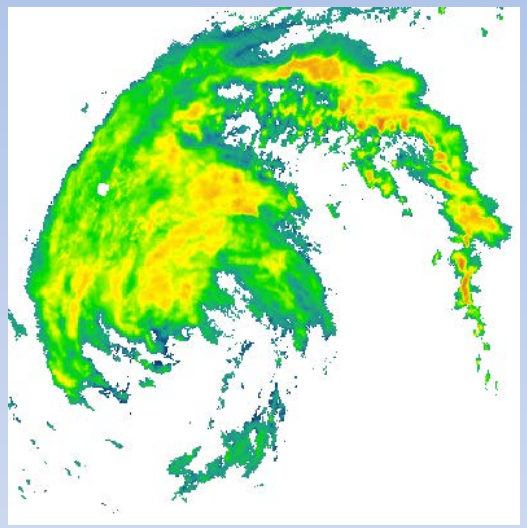


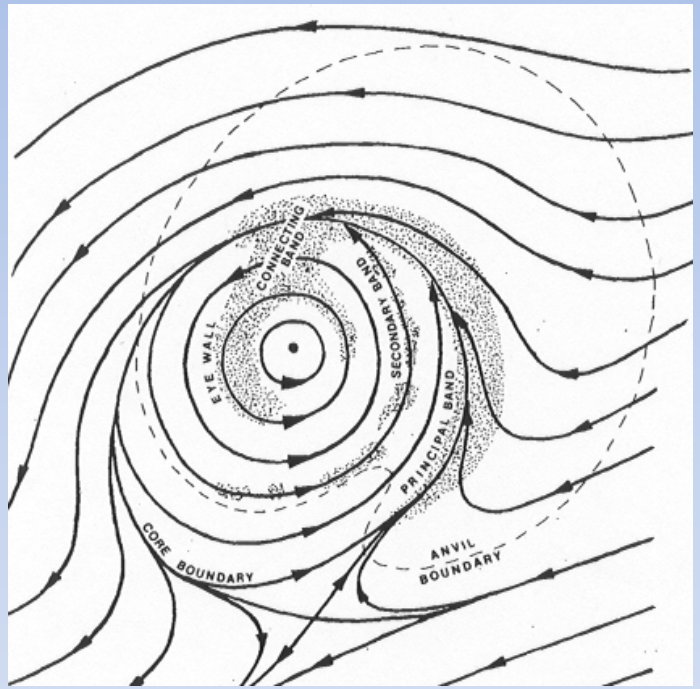
Corene Matyas and Jingyin Tang

University of Florida

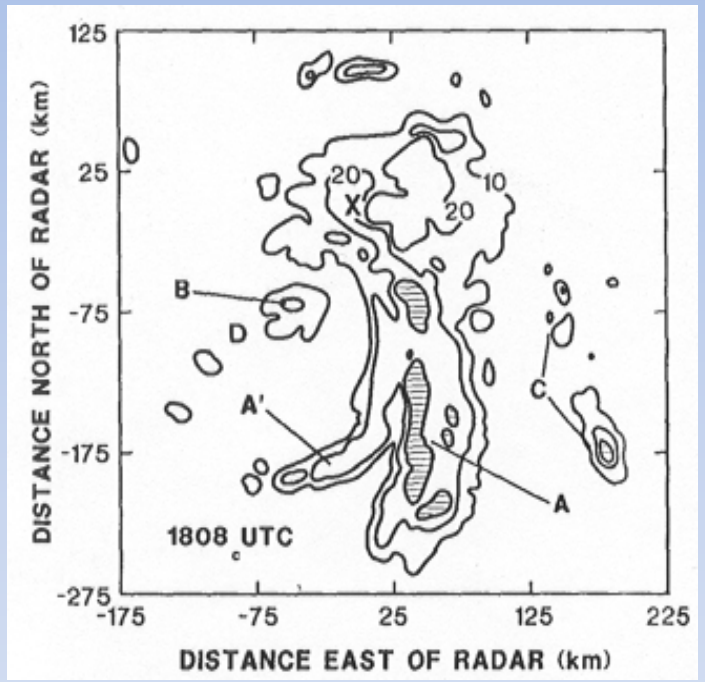
Funding: NSF CAREER Award BCS1053864

Changes in TC Rain Field Spatial Patterns Pre to Post Landfall

Principal, connecting, and secondary rainbands (Willoughby et al. 1984)



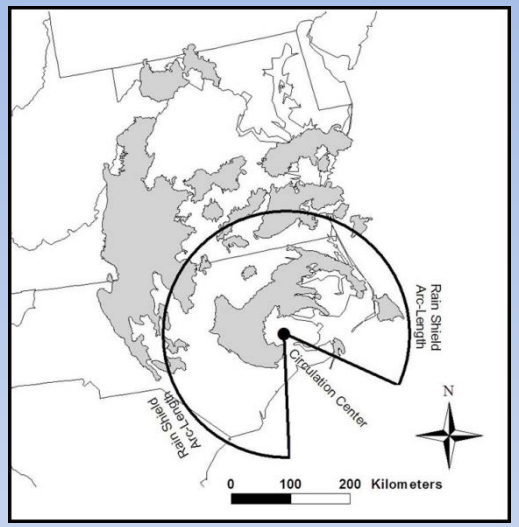
Alicia (1983) near Norman, OK 36 h post-landfall (Bluestein and Hazen 1989)



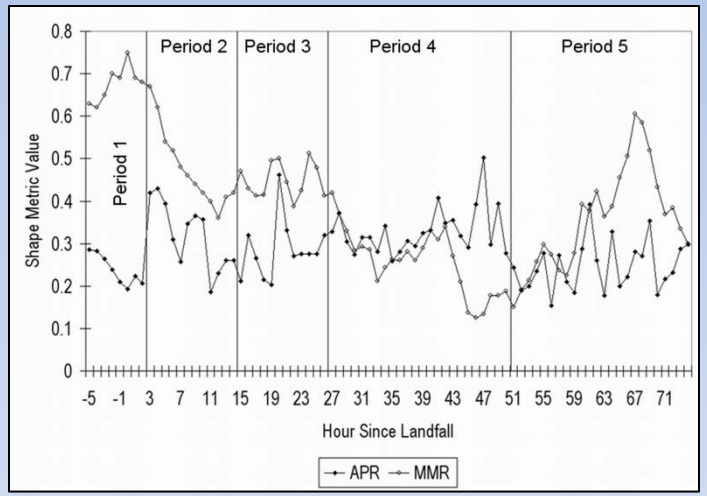
Selected citations: Blackwell (2000), Corbosiero and Molinari (2002, 2003), Powell (1987), Chen et al. (2006), Lonfat et al. (2007), Konrad et al. (2002), Bluestein and Hazen (1989), Andersen and Shepherd (2013), Rogers et al. (2003), Elsberry (2002), Marks and Shay (1998)

Previous Work

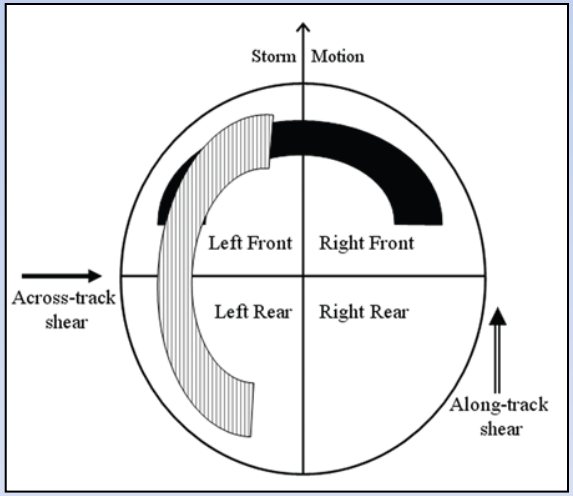
- Level III Base Reflectivity Data
- Merged in ArcView 3.0!
- Rain field shapes and their causes



Matyas (2007)
Professional Geographer



Matyas (2008)
Meteorological Applications

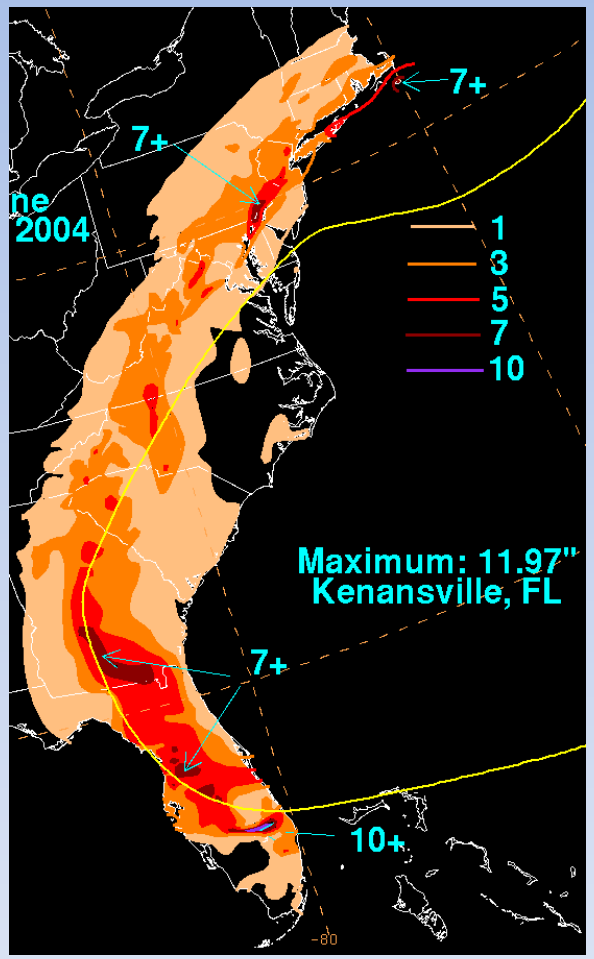


Matyas and Cartaya (2009)
Southeastern Geographer

Research Goals

- Quantify the changes in rain field structure in terms of exposing the inner core to environmental air after landfall
  - Measure the size and location of any gaps in the lighter and heavier rainfall that encircles a well-formed hurricane
  - Monitor changes in these gaps over time
  - Relate these gaps to storm motion and vertical wind shear

Case Study: Jeanne 2004



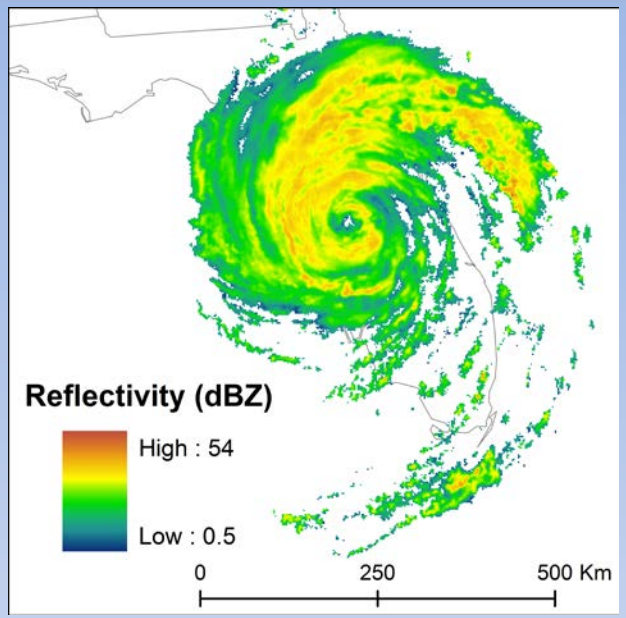
http://www.wpc.ncep.noaa.gov/tropical/rain//jeanne2004.html

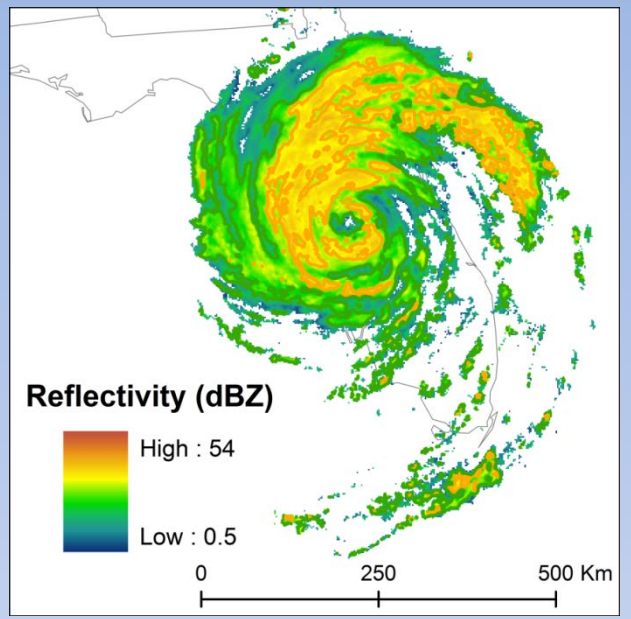
- Landfall: 9/26 0400 UTC
- Eye Diameter: 74 km
- Radius of Outermost Closed Isobar: 370 km
- Within radar range for 66 hours post-landfall
- ET declared: 9/29 0000 UTC

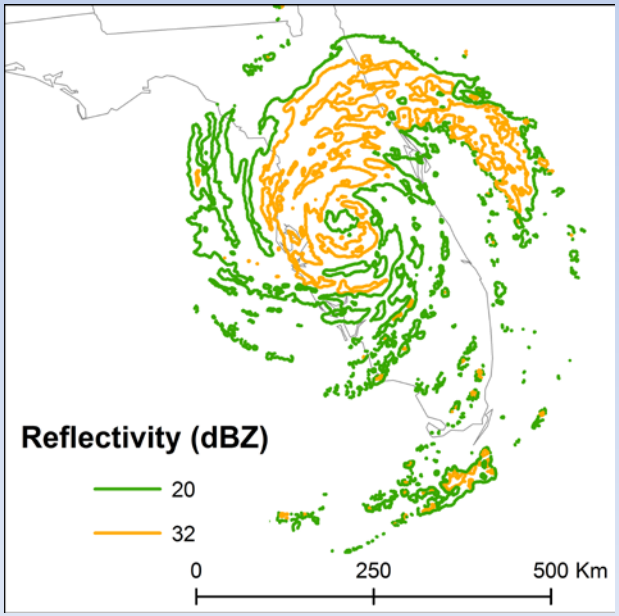
Good case study to test our method

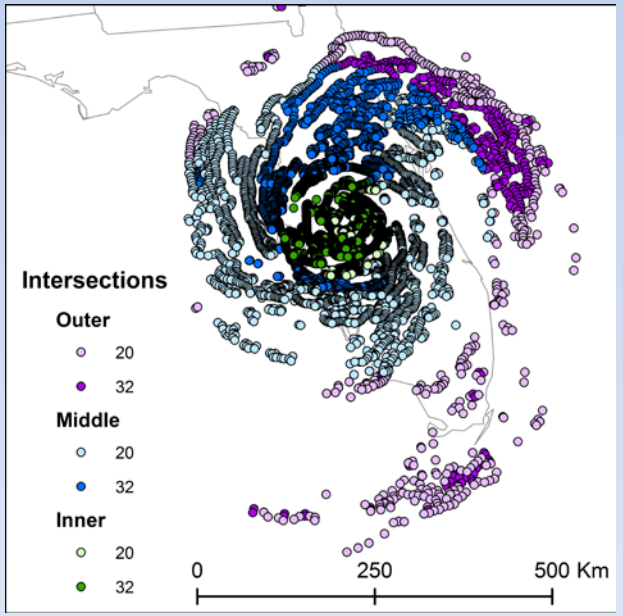
Data and Analytical Tools

- Level II radar reflectivity data: National Climatic Data Center
- Developed tool to preview and order data directly from ArcGIS http://hurricane.geog.ufl.edu/products/
- WDSS2 (Univ. of Oklahoma) – radar data quality control
- Contours and intersection points calculated in ArcGIS with Python scripts, 3.5 km slice
- Extended Best Track Dataset (Demuth et al. 2006): Radius of outermost closed isobar and diameter of the eye

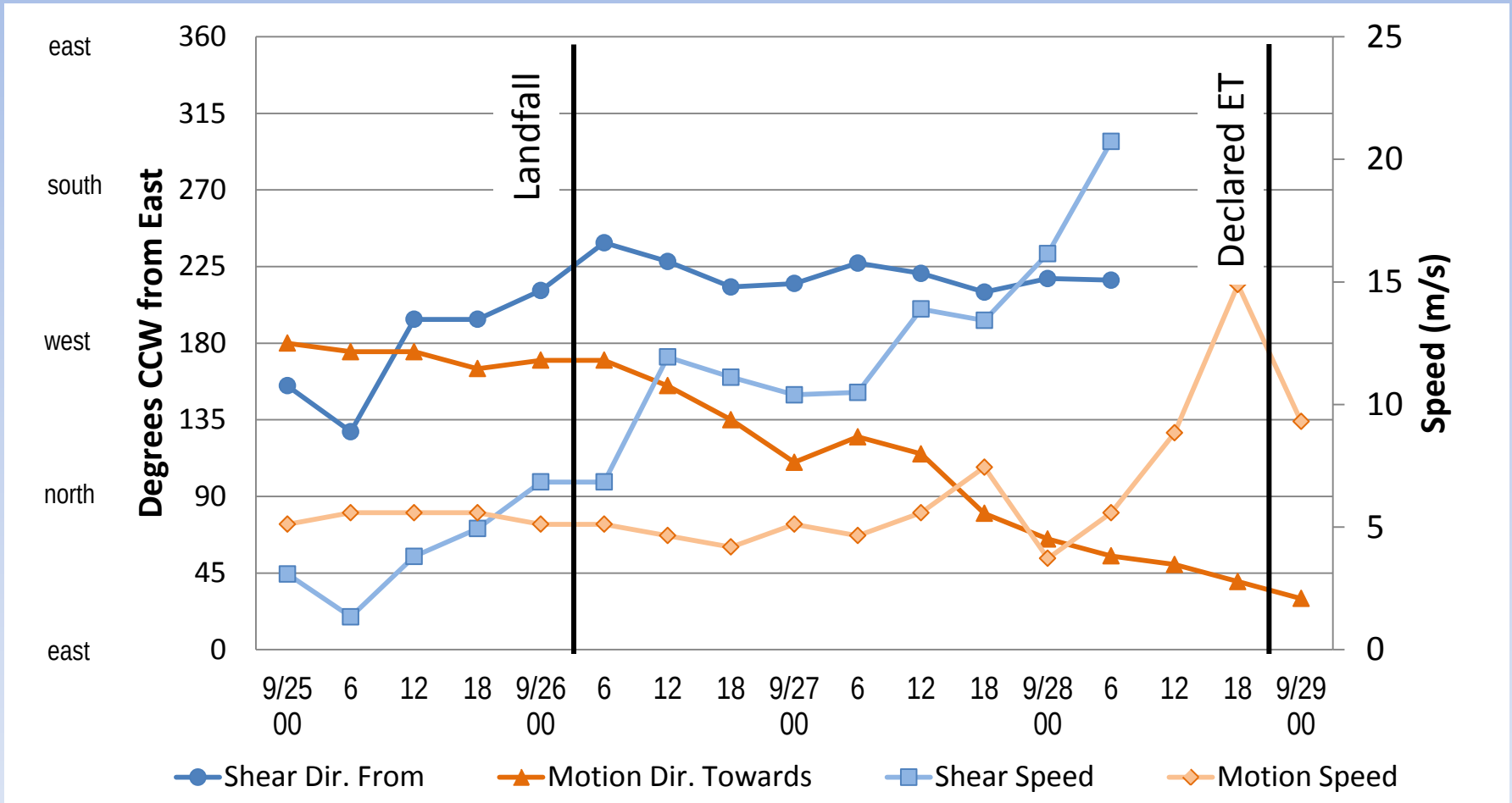

Reflectivity (dBZ)
High : 54
Low : 0.5
0
250
500 Km


Reflectivity (dBZ)
High : 54
Low : 0.5
0
250
500 Km


Reflectivity (dBZ)
20
32
0
250
500 Km


Intersections
Outer
20
32
Middle
20
32
Inner
20
32
0
250
500 Km

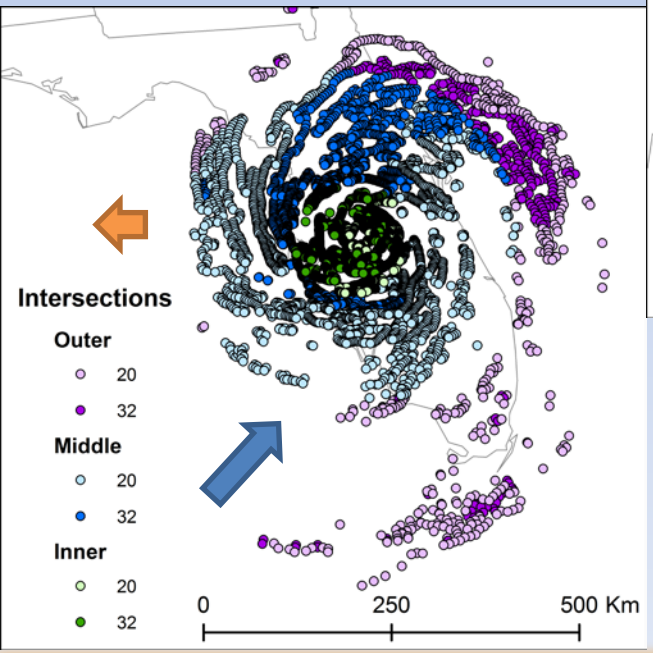
Storm Motion and 200-850 hPa Vertical Wind Shear

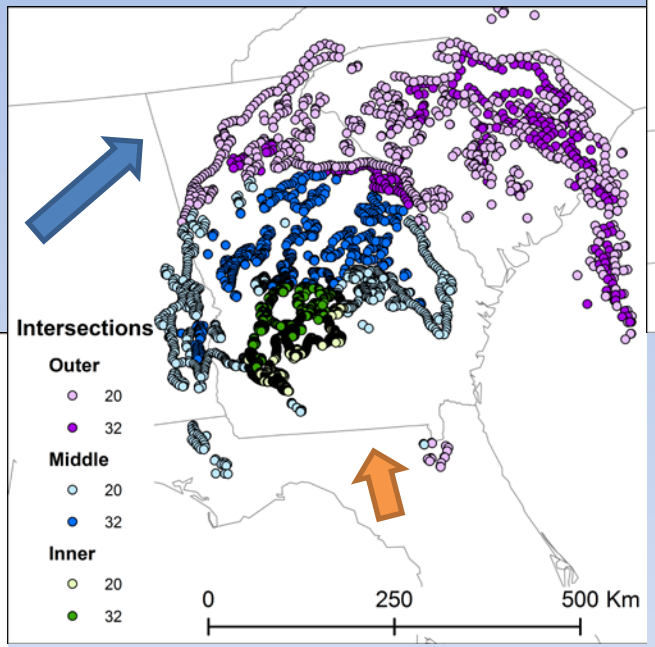


Data Source: Statistical Hurricane Intensity Prediction Scheme (DeMaria and Kaplan 1994)

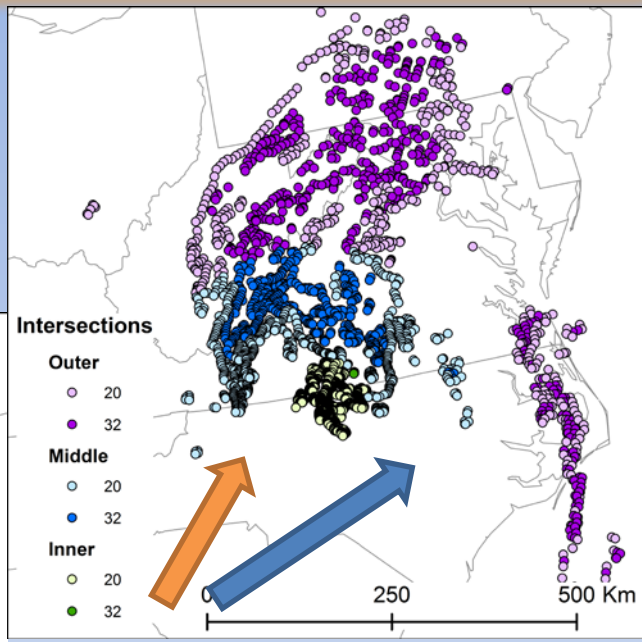
From Tropical Storm to Extratropical Cyclone

9/26 1500 UTC





9/27 1500 UTC

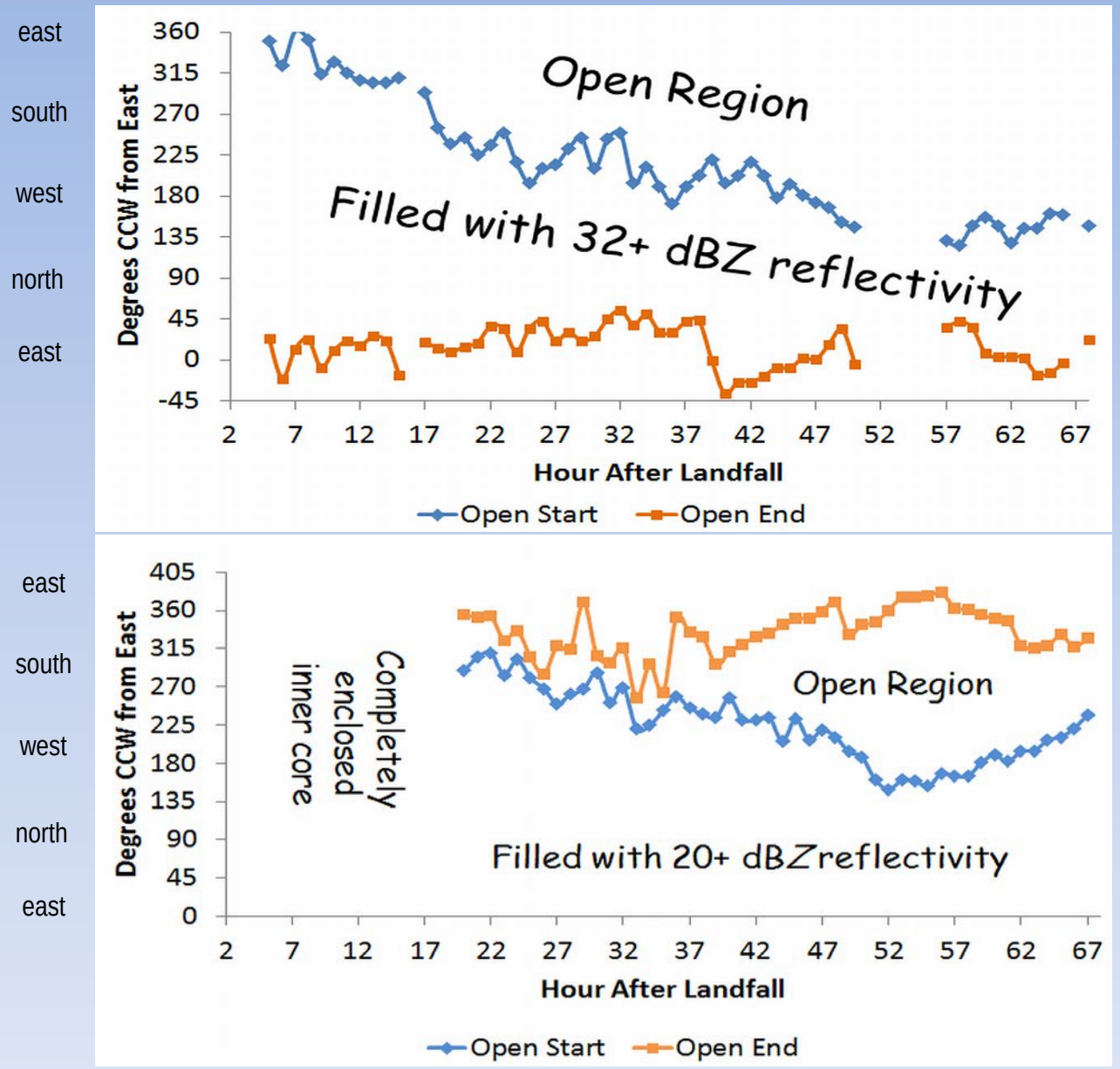


9/28 1500 UTC

Storm Motion

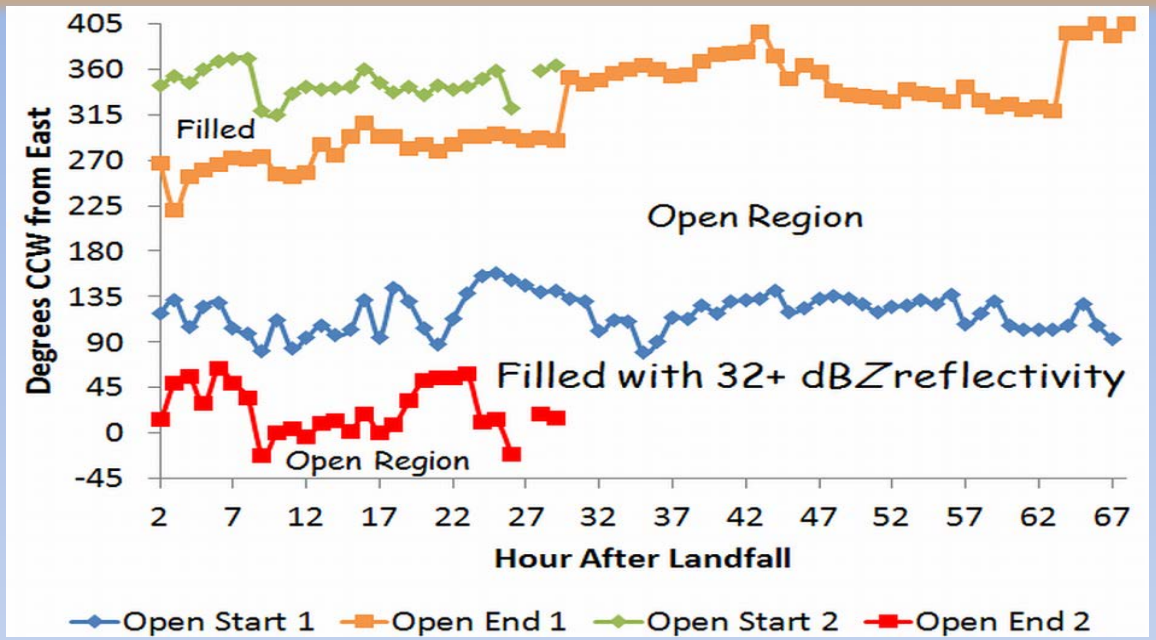
200-850 hPa Shear

Middle Region 74-222 km

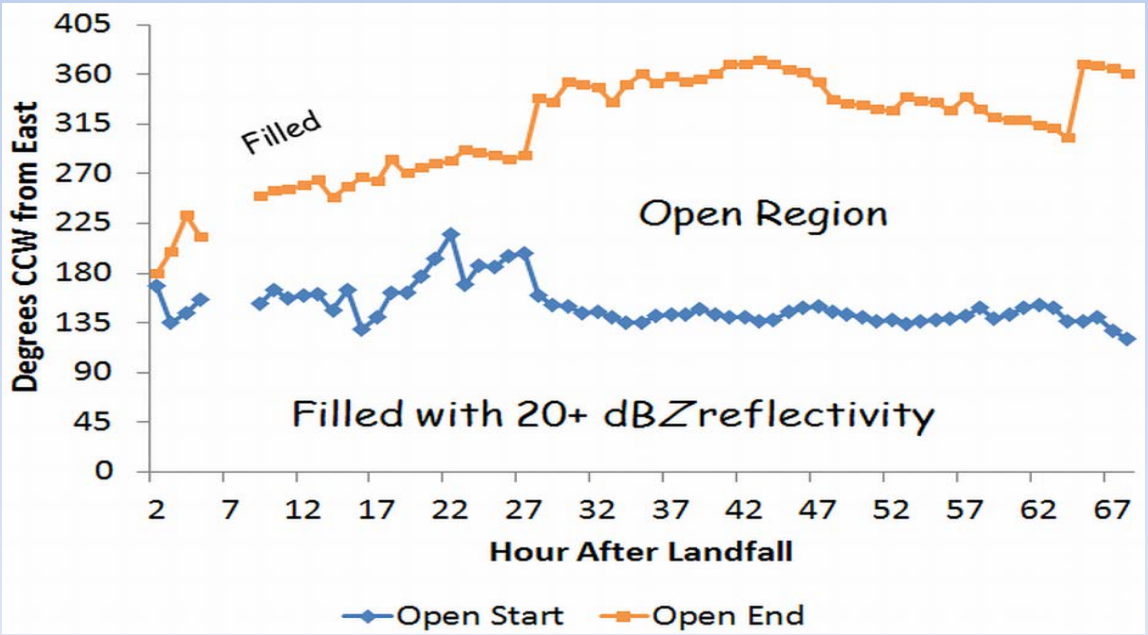


Outer Region 222 – 545 km

east
south
west
north
east



east
south
west
north
east



Conclusions

- Gaps in reflectivity correspond to motion and shear vectors
- Outer region exposed at landfall
- Middle region exposed ~ 1 day post-landfall
- Size measures good approximation for division
- One hour is appropriate time increment
- Caution: outer region beyond radar range

Future Work

- Detect circulation center using Doppler velocities (Bell 2012, *JAMC*)
- Experiment with temporal smoothing
- Look at vertical alignment of convective cells
- Use to assess accuracy of rainband representation in WRF

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UF
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