Analysis of Atlantic Tropical Cyclone Genesis and Evolution Using NASA Satellite and Field Program Data

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Objectives

- To examine the role of the Saharan Air Layer in tropical cyclogenesis and evolution
- To examine the “Marsupial Hypothesis” and its relationship to the SAL
- To participate in analysis of new cases from GRIP
The SAL and TCs

- Karyampudi and Carlson (1983), Karyampudi and Pierce (1999) suggest positive influence of SAL
- Dunion and Velden (2004) suggest negative influences
- Vertical shear
- High stability
- Dry air
Data Sources

- TRMM 3B42 Multi-Satellite Precipitation (0.25°, 3-hourly resolution)
- AIRS L2 and L3 temperature and relative humidity profiles
- MODIS (Terra and Aqua) L2 and L3 aerosol optical depths
- NCEP Global analyses (1°, 6-hourly resolution)
Initial Results

- Yet to find convincing evidence that warm air or AEJ shear inhibits storms

- AIRS data suggest that Atlantic is normally a dry, hostile environment

- Large-scale subsidence plays a significant role in drying the air

- Case studies (few so far) have yet to find clear negative SAL impact
Case Studies

- Hurricane Helene (2006)
- Hurricane Irene (2005)
- Tropical Storm Debby (2006)
- Other cases examined so far with less scrutiny
  - Hurricanes Fabian and Isabel (2003)
  - Hurricanes Frances and Ivan (2004)
Helene 12 UTC Sept. 17, 2006

- Trajectory based approach
  - Diagnose ascent/descent along trajectories
  - Diagnose origin of air (SAL or not SAL)
Helene

- WRF Simulation
  - 3 km horizontal resolution
  - Produces very realistic evolution of large-scale flow
  - Good track, OK intensity simulation

- SST cooling as storm slows

- Discussion with I. Guinness about running coupled and uncoupled simulations

Simulated 700-hPa RH, 12Z Sept. 17, 2006

TMI 3-Day Avg. SST
Debby

- WRF Simulation
  - 9 km horizontal resolution
  - 30-member ensemble
  - Good range of tracks, intensities

- Examination of correlation between storm intensity and environmental factors such as the SAL.
Idealized simulations

- WRF Simulation
  - 2 km horizontal resolution
  - Rankine vortex, 15 m s⁻¹ at surface
  - Non-SAL sounding, SST=29°C
  - Dry layer of 25% RH between 850-600 hPa situated 270 km north of vortex

Mid-level RH

Time series of SLP

QuickTime™ and a MPEG-4 Video decompressor are needed to see this picture.

If you are having trouble viewing the video, you can access it here.
Marsupial Research

- Research led by M. Montgomery and M. Reimer

- Idealized simulations of the marsupial origins of TCs

- The role of the marsupial pouch in interaction of storms with the SAL
QUESTIONS?