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

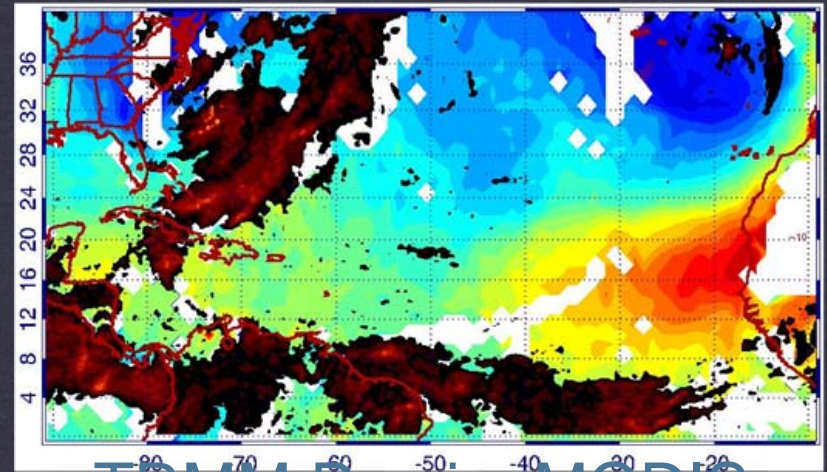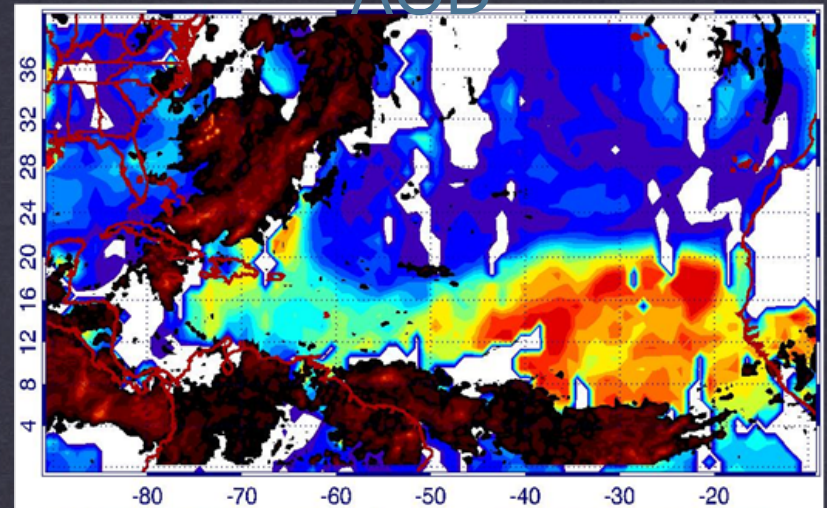Relative Humidity and Streamlines
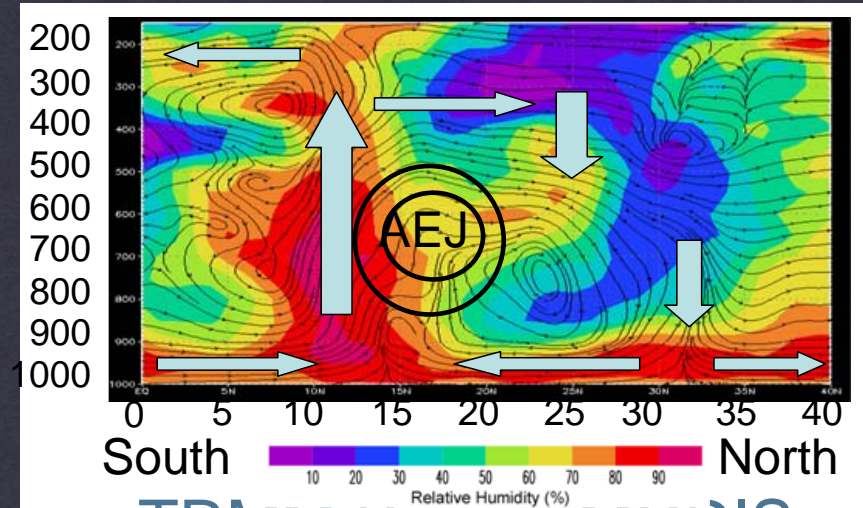
TRMM Precip, MODIS AOD
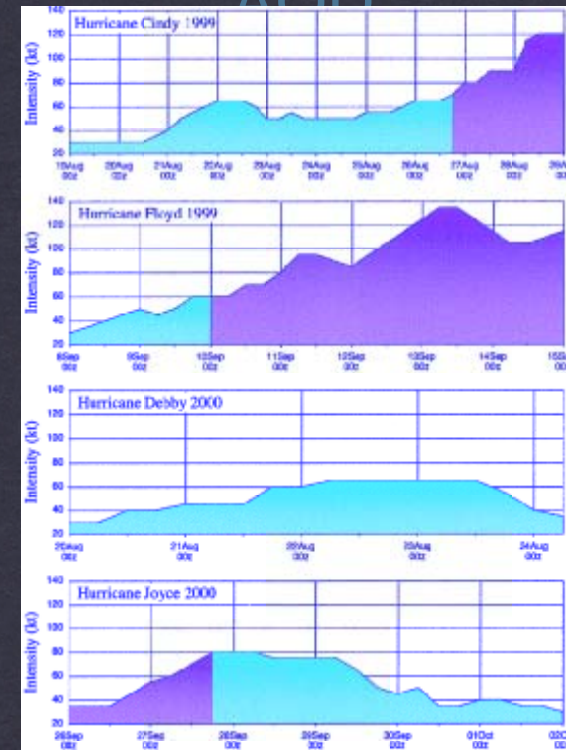
Data Sources

- 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)

TRMM Precip, 850-hPa T

TRMM Precip, MODIS AOD

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
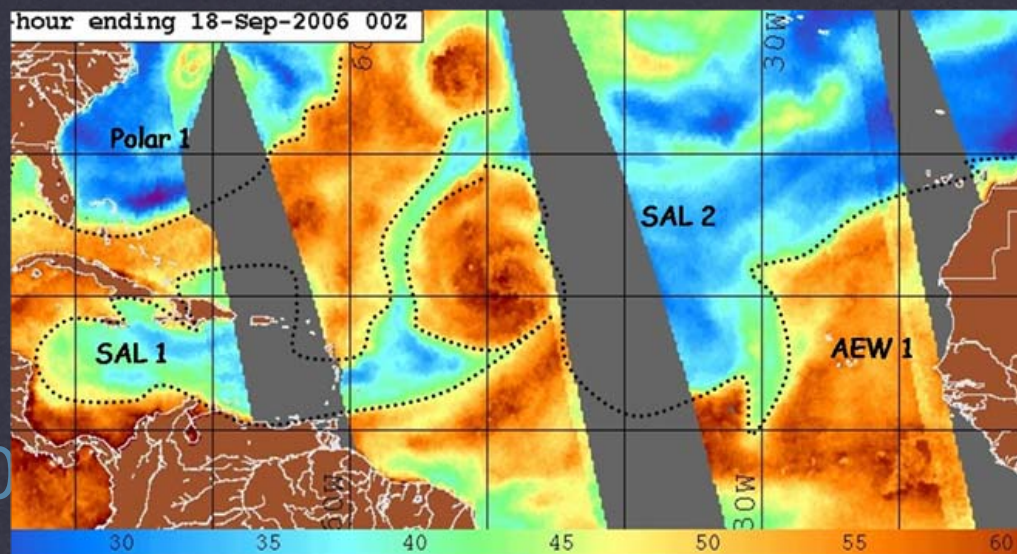
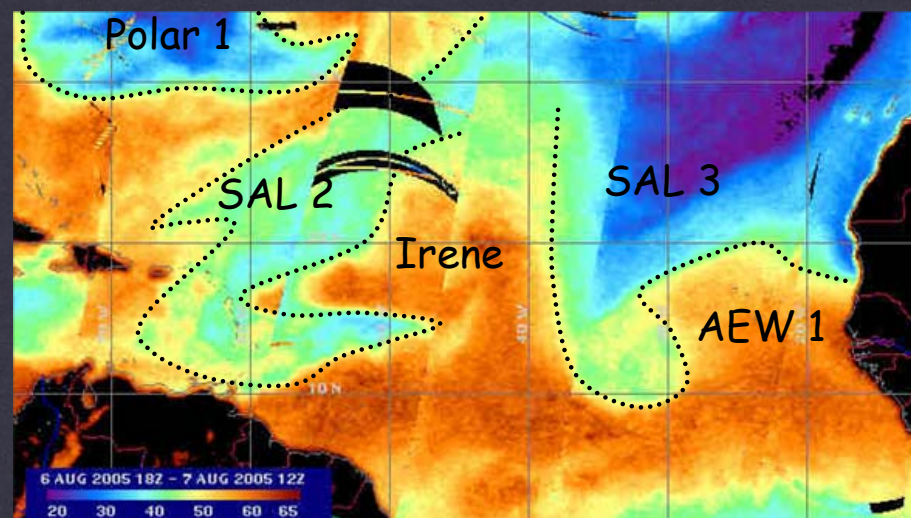TRMM Precip, 850-hPa T
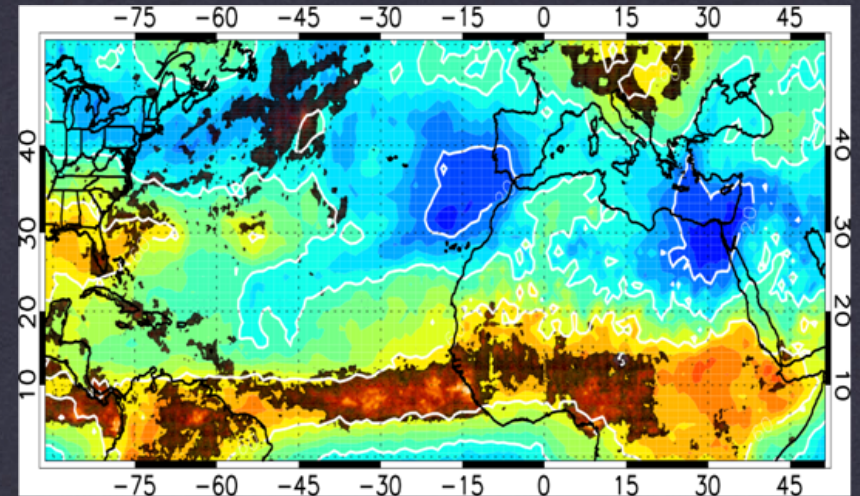
700 hPa w, streamlines
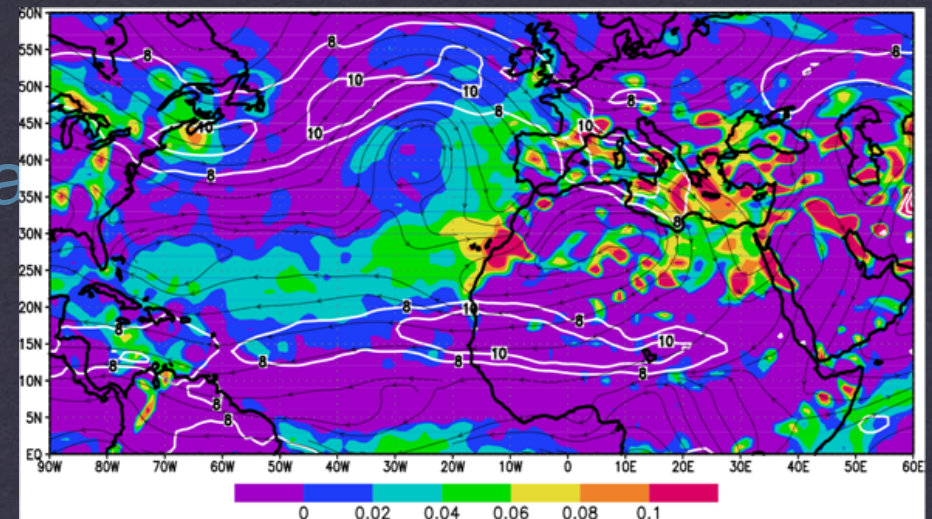
Case Studies

- Hurricane Helene (2006)

- Hurricane Irene (2005)

- Tropical Storm Debby (200[...]

- Other cases examined so far with less scrutiny
    - Hurricanes Fabian and Isabel
      (2003)
    - Hurricanes Frances and Ivan
      (2004)

TRMM Precip, 850-hPa T
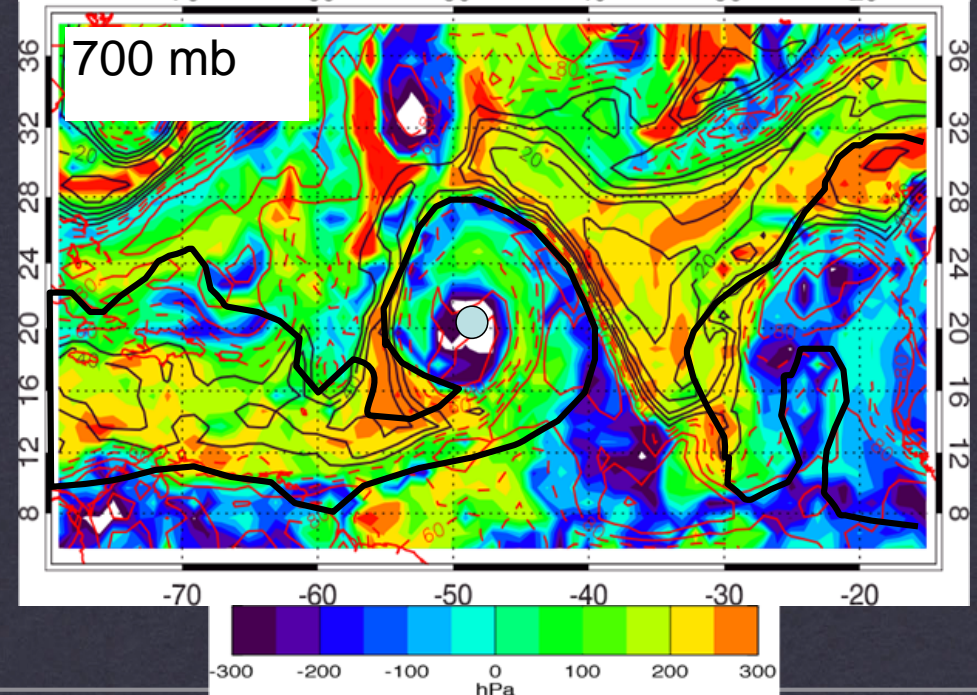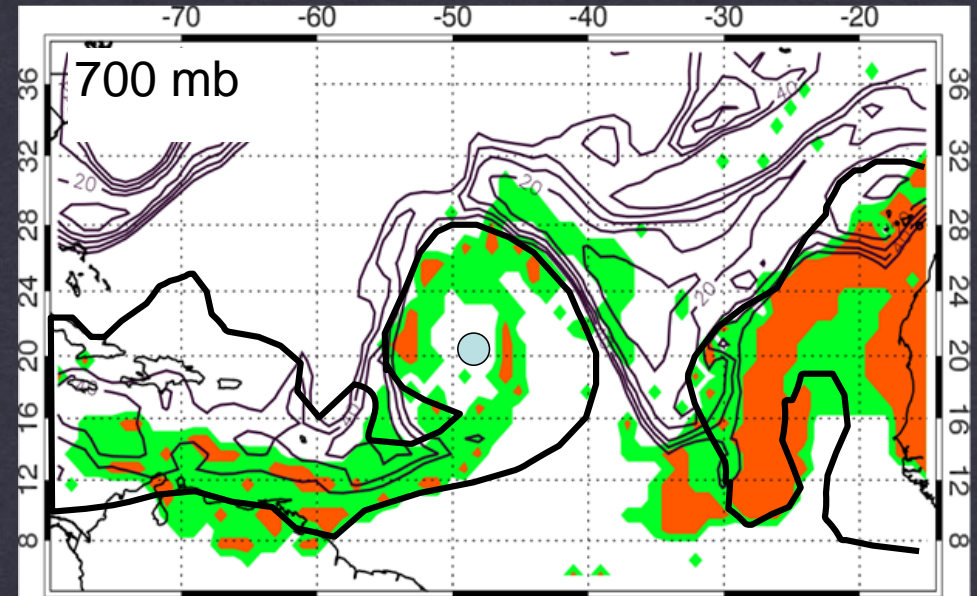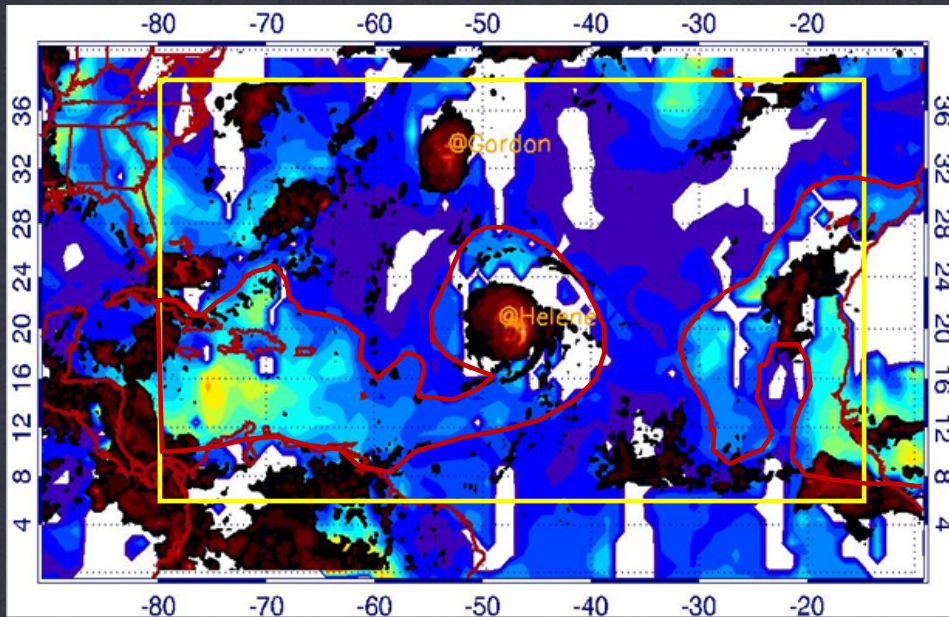

700 hPa w, streamlines

Helene   12 UTC Sept. 17, 2006

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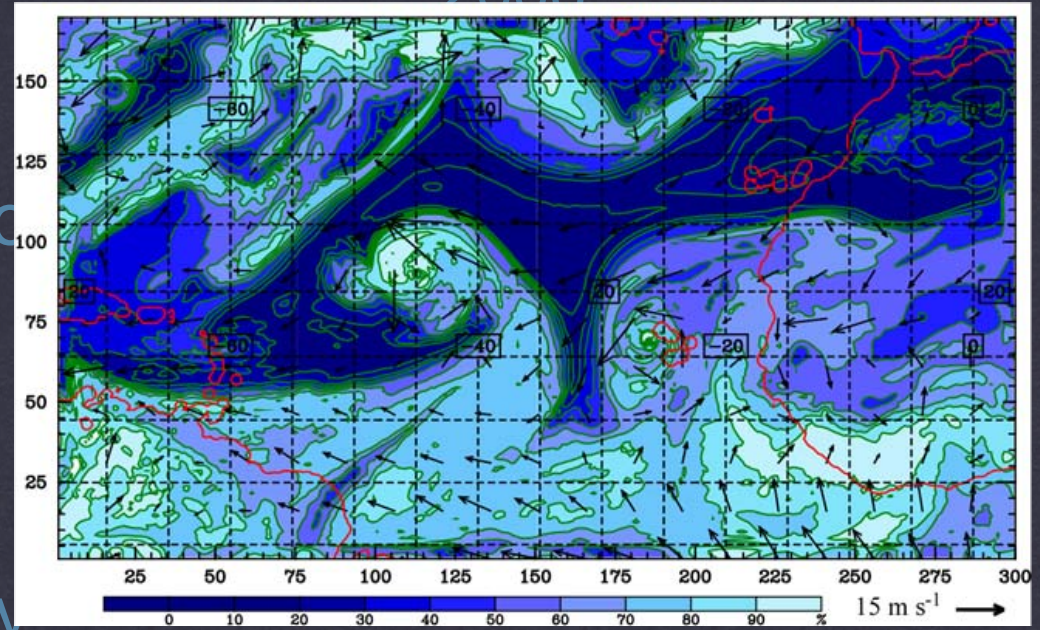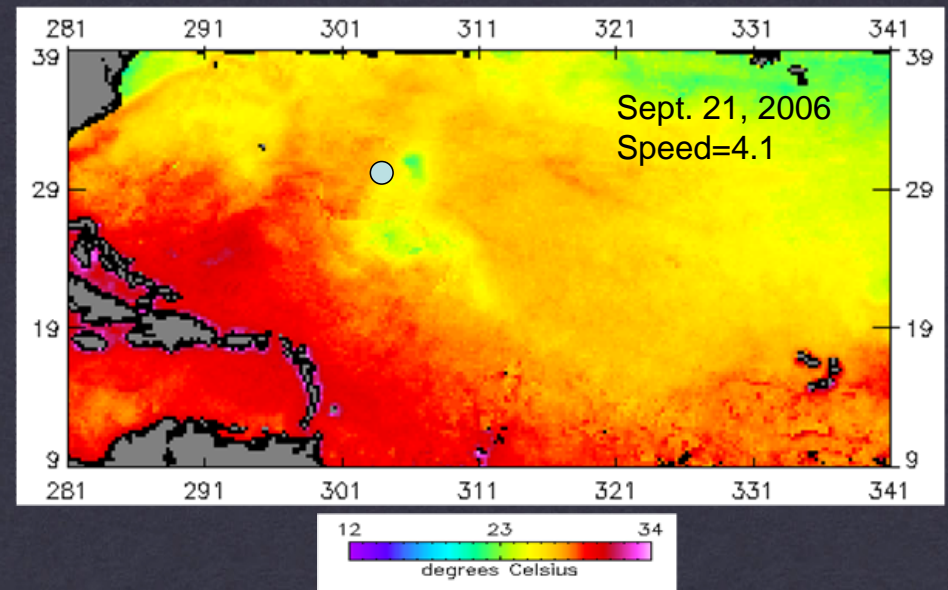 - Diagnose origin of air (SAL or not SAL)

Helene

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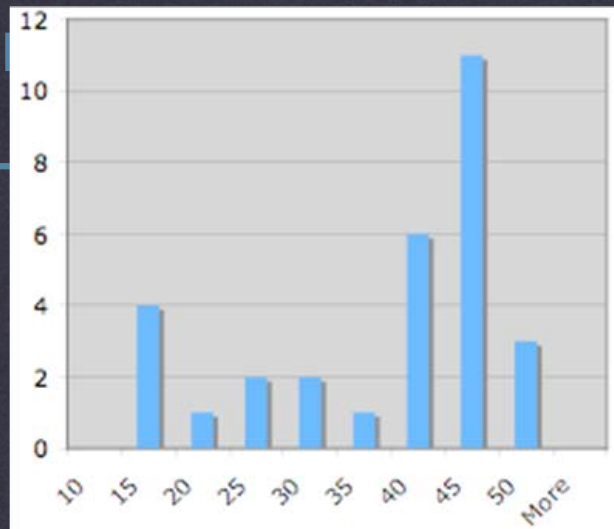

TMI 3-Day Avg. SST

- SST cooling as storm slows

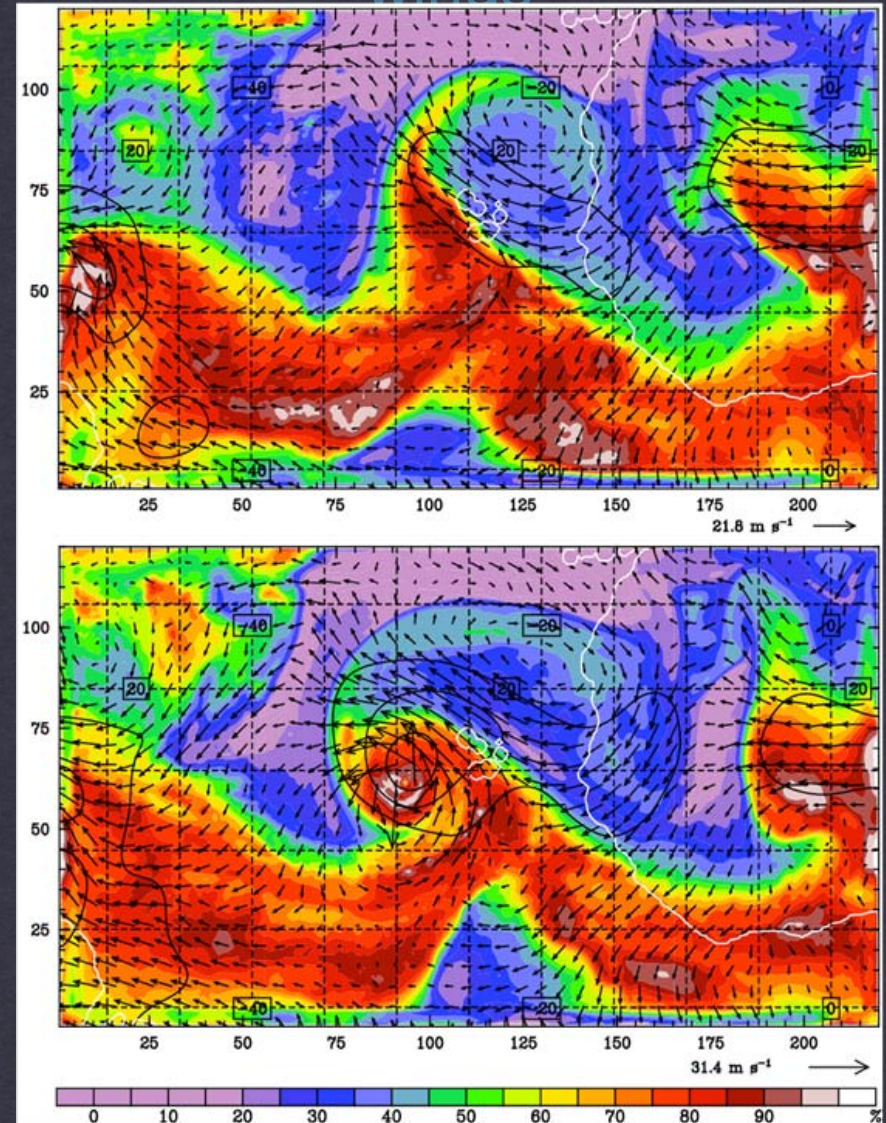- Discussion with I. Guinness about running coupled and uncoupled simulations

Sept. 21, 2006
Speed=4.1

Debby

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

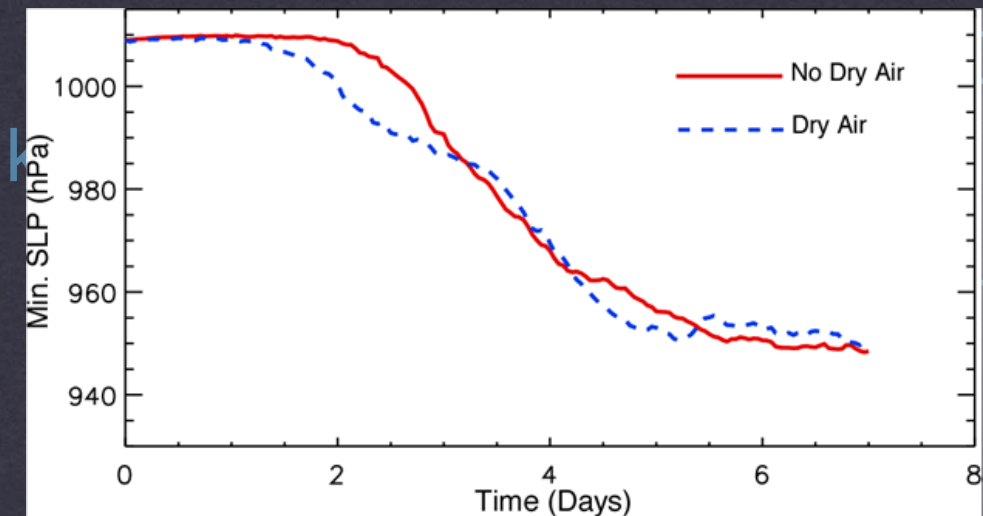- Examination of correllation between storm intensity and environmer as the SAL

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

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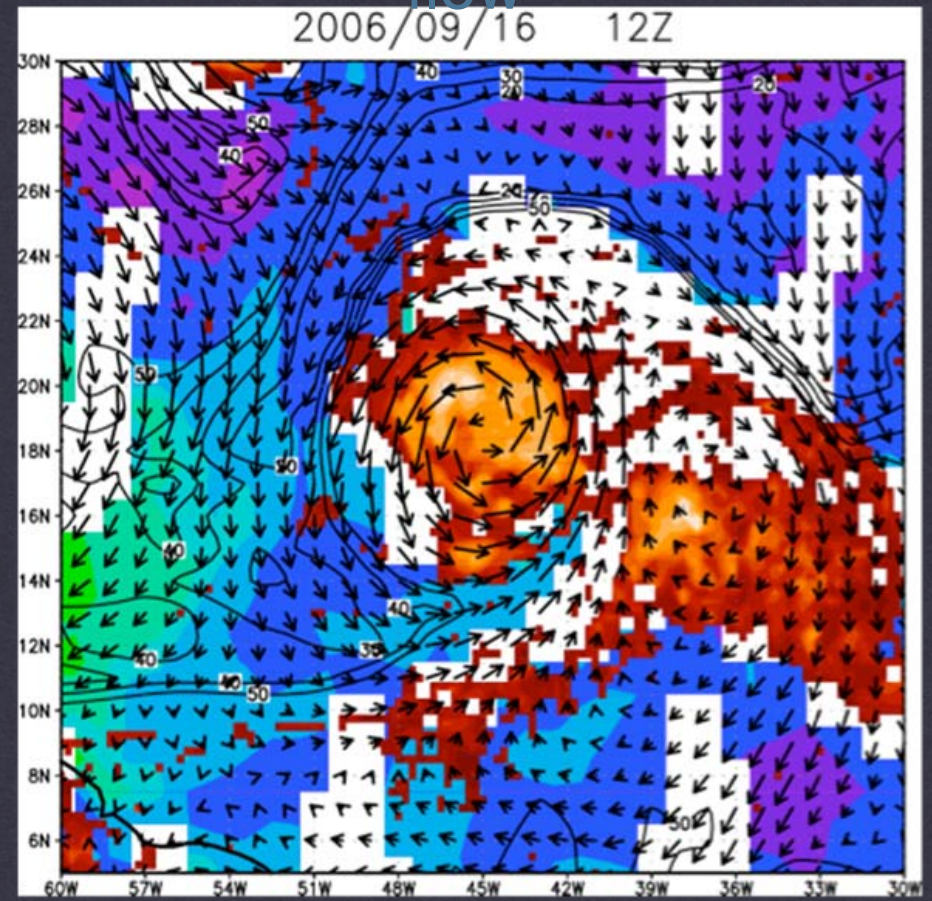MPEG-4 Video decompressor
are needed to see this picture.

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

Time series of SLP

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

MODIS AOD, TRMM Precip. and 700-hPa storm-relative flow

QUESTIONS?