Modeling efforts and objectives: PLOWS 2009-10

Brian Jewett
Modeling objectives

1. Forecasting objectives (later: 10am)

2. Research objectives:
   - Modeling fine-scale snowbands
   - Comparison to PlOWS field observations
   - Improved understanding

Chicago, 1967
Getting there

• We will -
  – First simulate the entire cyclone structure down to scale of individual fine snowbands*
  – SNOWBAND modeling efforts revealed a need for extremely high resolution – particularly in the *vertical* dimension

*easier said than done!
Modeling and observations

• We will assess the degree to which WRF simulations reproduce band structures and behavior measured by PLOWS airborne and ground-based platforms
  – How should we quantify and compare obs to model results?
  – Compare scale, intensity, longevity
  – Utilize methods from BAMEX, incl. statistical measures to complement traditional measures
Modeling and observations

• **We can use** simulations to help interpret observations in the **context** of the cyclone.

• **Observations will be crucial** to evaluate the simulations - if we are to trust our findings from the modeling study.

• **We are working from** several **hypotheses**; PIOWS observations will inspire more.
Band formation

- Investigate the origins of the instability responsible for band formation
Band formation

• Investigate the origins of the instability responsible for band formation

• ... Use model trajectories to investigate source regions for air arriving near dry slot boundary, and the properties of that air.

• ... Compare modeled vertical velocities to those determined from PIOWS obs: magnitude, temporal and spatial scales (how scale-dependent are the modeled vertical motions?)
Band formation

• Is one instability **dominant**, or does it vary with **cyclone** type, origin, intensity?

• Will we see enough **variability** during PIOWS 2009-10 to draw conclusions? (or will we need to model other cases?)
Band behavior / maintenance

• Do the bands remain tied to the instability responsible for their formation?
  ... Use high temporal and spatial resolution from the model fields to assess the persistence of the instability and relationship to the bands

• Is the initial instability continually regenerated? Periodically restored? Modulated by the bands that develop?
Band propagation

• What is the association between bands & gravity waves?

• We will compare modeled band structure and movement to (1) obs and (2) theory

• We will need extraordinary resolution to avoid spurious gravity waves.

\[ (a) \ w \ at \ \beta=1.4; \ \Delta z=322 \ m \]
\[ (b) \ w \ at \ \beta=1.4; \ \Delta z=50 \ m \]
Fine-scale bands

- We seek to model generating cells within the larger wraparound region.

"cell shown is 2 km wide, 1 km tall."

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Evans et al. 2005

Businger & Hobbs 1987