Use of C-Pol and S-Band Radar Data to Constrain Simulated Cloud Properties During TWP-ICE

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Convective and stratiform columns in 3-D radar and model fields

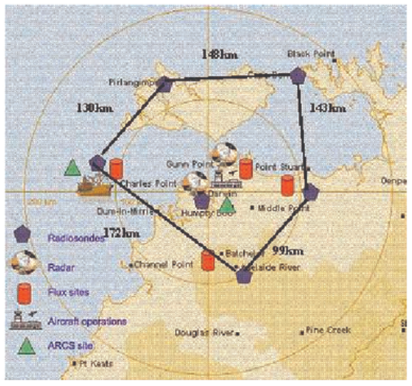

Figure 1. TWP-ICE domain
Source: S. Xie, LLNL

- what is the fidelity of simulated structures?
- convective and stratiform areas are an important indicator
- Steiner et al. (1995) algorithm can be used to quantify convective area
  - step 1: grid cells with reflectivity > 40 dBZ
  - step 2: within 11-km radius > local threshold
  - step 3: cells additionally within local radius
  - step 4: remaining cells > 0 dBZ are stratiform
- apply this to 2.5-km resolution
  - measurements (Figure 2) and model (Figure 3)
  - baseline simulation with large-scale forcings
  - sensitivity test nudged back to observations
- results (Figure 4)
  - convective area too large in both simulations
  - stratiform area better in sensitivity test

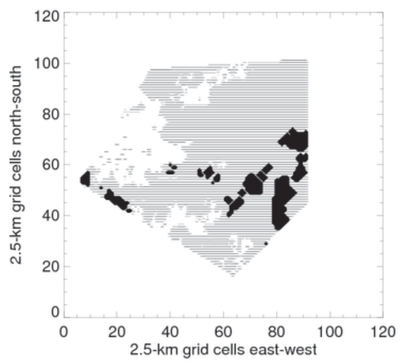

Figure 2. An application to C-pol (13:40 1/22/06, solid=convective, hatched=stratiform)

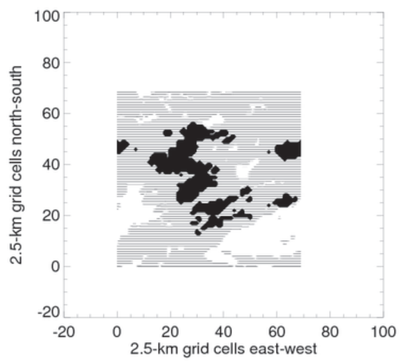

Figure 3. An application to model (13:45 1/22/06, baseline simulation, areas as in Figure 2)

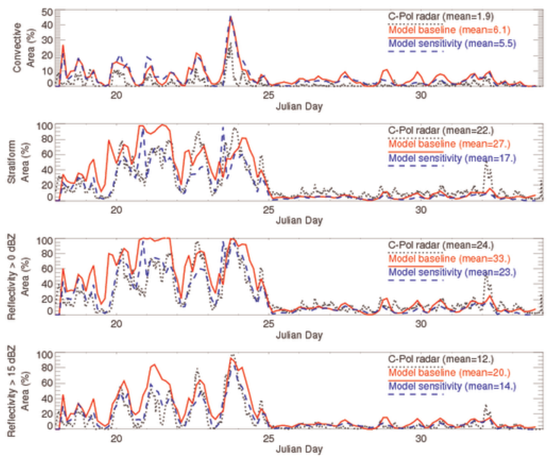

Figure 4. Summary of results for C-pol and simulations (area > 0 and 15 dBZ also shown)

Convective and stratiform columns in 1-D radar time series

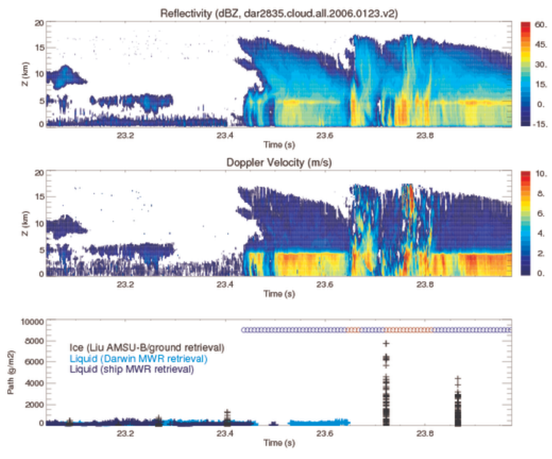

Figure 5. Example S-band column identification (red/blue circles = convective/stratiform)

- what is the fidelity of simulated microphysics?
- colocated Doppler velocity and reflectivity provide powerful constraints
- approach
  - use S-band location in C-pol fields to identify convective and stratiform columns (Figure 5)
  - use C-pol reflectivity fields to evaluate representativeness of S-band statistics (Figures 6-7)
- results
  - some S-band columns are mis-categorized (Figure 5)
  - but S-band fairly representative of monsoon (Figures 6-7)
  - and S-band agrees with C-pol for monsoon (Figures 8-9)
  - model convective area is too broad, not deep (Figures 6)
  - model stratiform area is not deep enough (Figures 6-7)
  - model reflectivities are often reasonable (Figures 8-9)
  - model Doppler velocities are often small (Figures 10-11)
  - model stratiform areas are not uniform enough (Figures 12-14)

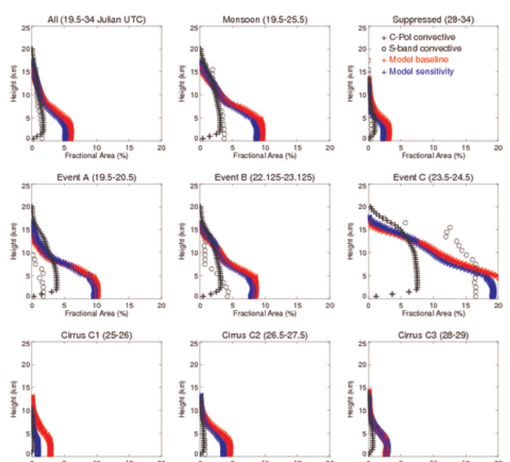

Figure 6: Fractional area > 0 dBZ in convective columns

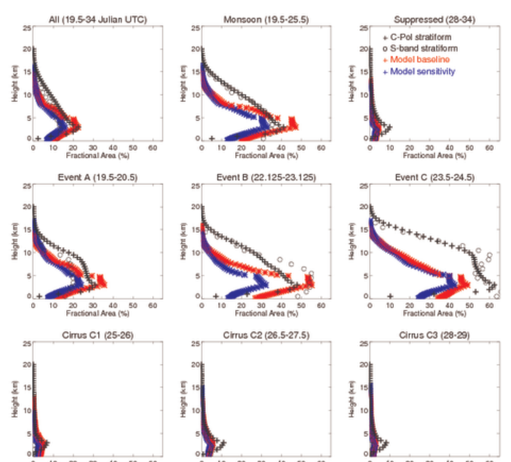

Figure 7: Fractional area > 0 dBZ in stratiform columns

Mean reflectivity and Doppler velocity profiles in convective and stratiform columns

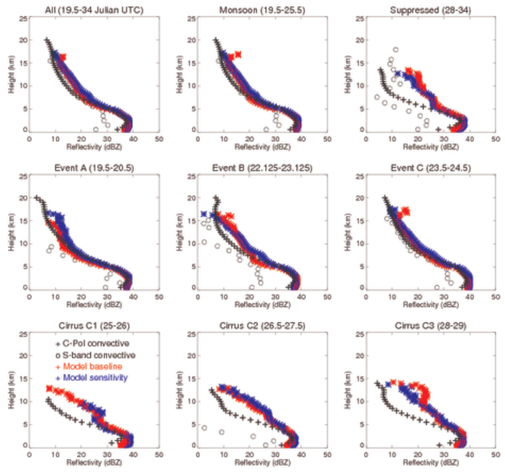

Figure 8: Mean reflectivity in convective columns

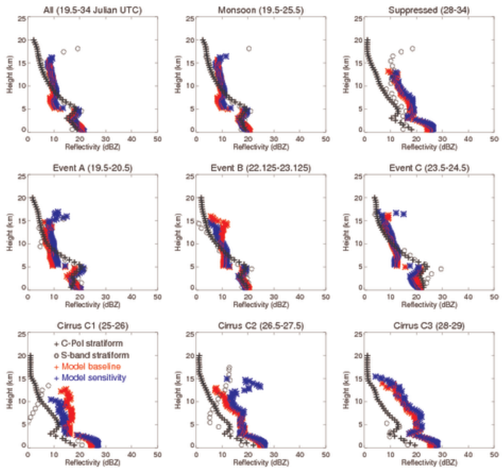

Figure 9: Mean reflectivity in stratiform columns

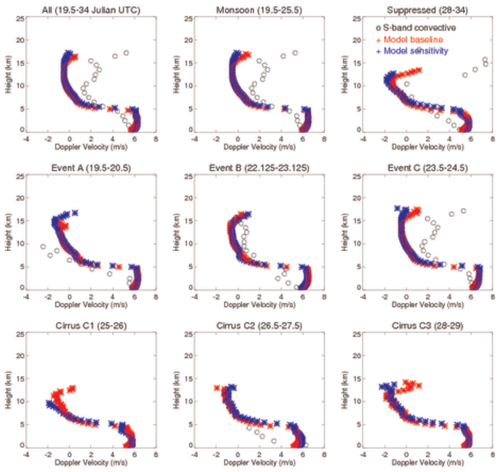

Figure 10: Mean Doppler velocity in convective columns

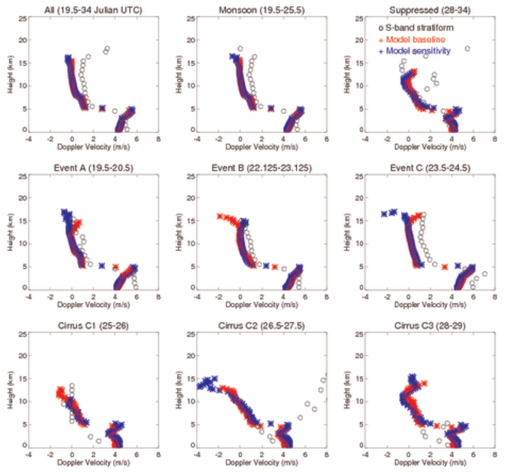

Figure 11: Mean Doppler velocity in stratiform columns

Colocated reflectivity and Doppler velocity in convective and stratiform columns

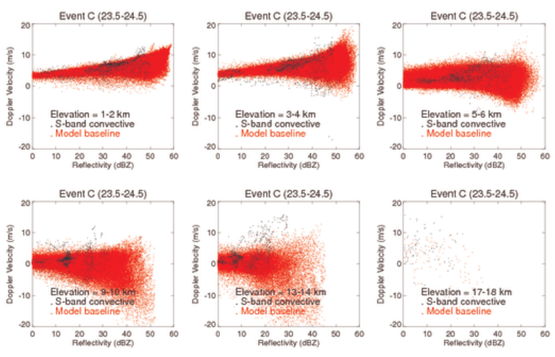

Figure 12: S-band and model in convective columns

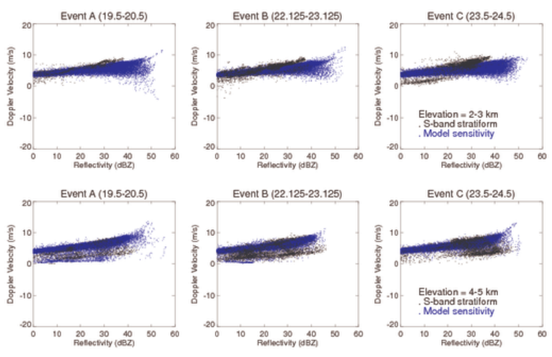

Figure 13: S-band and model in stratiform columns

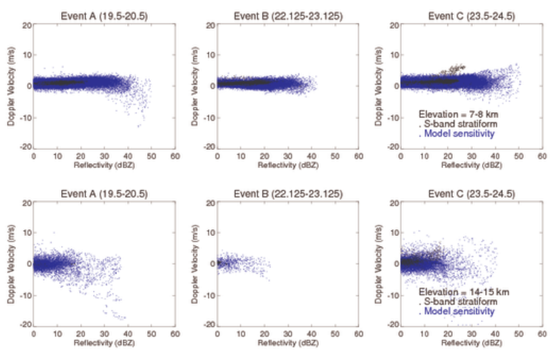

Figure 14: S-band and model in stratiform columns

Future work

- consolidate key data targets into fewer plots
- similar to van Diedenhoven et al. (2009)
- use agreement with 'data targets' to improve fidelity

Acknowledgments

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