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

- 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 of 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 1. TWP-ICE domain Source: S. Xie, LLNL](image)

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

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

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

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