

Sensitivity of Warm-Season Convection Simulations to Microphysics Parameterizations and Comparison to Cumulus Parameterization Sensitivity

Changhai Liu and Mitchell W. Moncrieff

National Center for Atmospheric Research, Boulder, CO 80307, USA

OBJECTIVES

- I. Assess the sensitivity to bulk microphysics parameterizations (BMPs) in high-resolution simulations of summertime convection.
- II. Compare the sensitivity to BMPs in explicit models with the sensitivity to cumulus parameterizations in modern NWP models.

Experiment Design

- Pennsylvania State University-NCAR Mesoscale Model (MM5)
- A single domain: 2,400x1,800 km²; 3-km grid spacing; 40 levels
- MRF PBL scheme
- Five-layer soil model
- The 3-hourly, 40-km NCEP ETA model analysis provides the initial and lateral boundary conditions
- A 7-day period from 00 UTC 03 to 00 UTC 10 July 2003
- Four bulk microphysics parameterizations (BMPs) are compared:
 1. Dudhia's bulk warm rain with simple ice (hereafter **DUDH**)
 2. Reisner et al.' four-class mixed phase (hereafter **RRB4**)
 3. GSFC five-class mixed phase (hereafter **GSFC**)
 4. Reisner et al.' five-class mixed phase with graupel (hereafter **RRB5**)

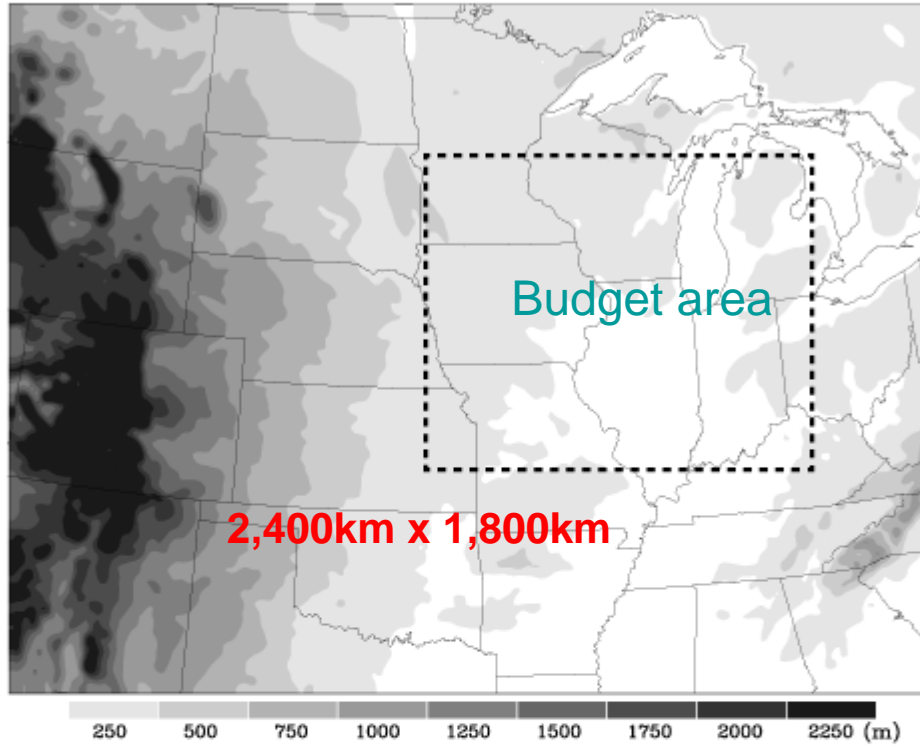
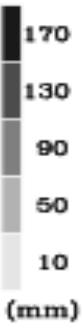
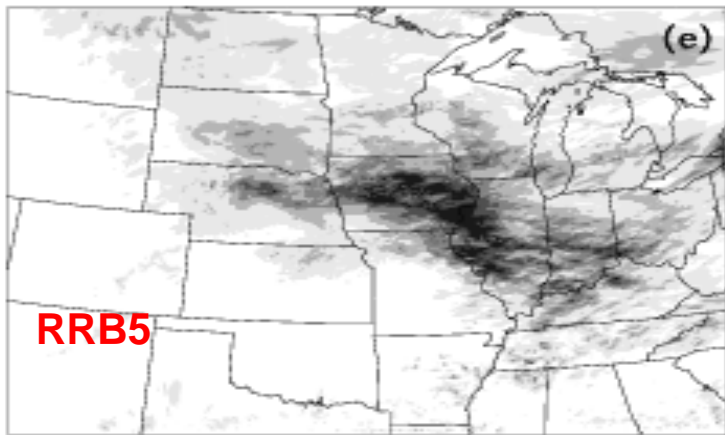
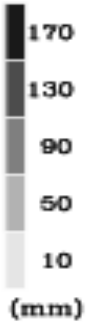
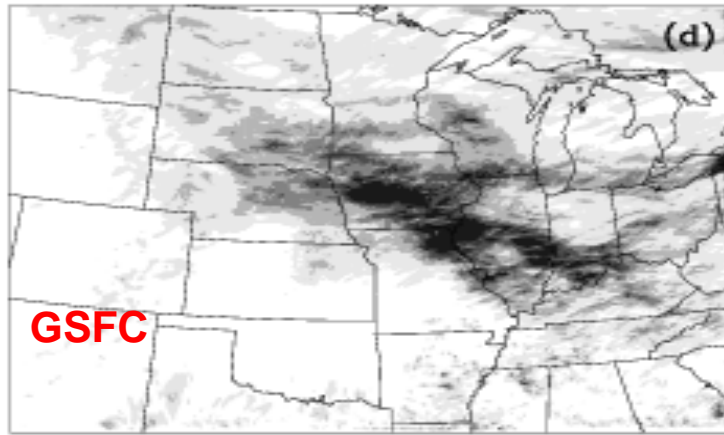
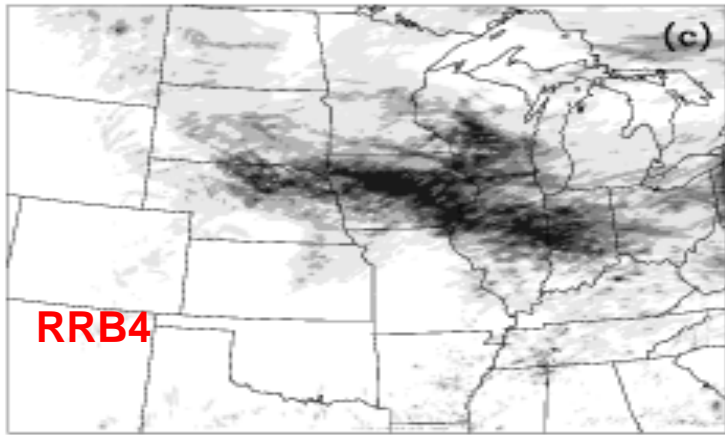
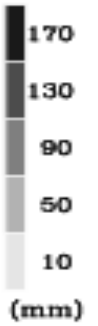
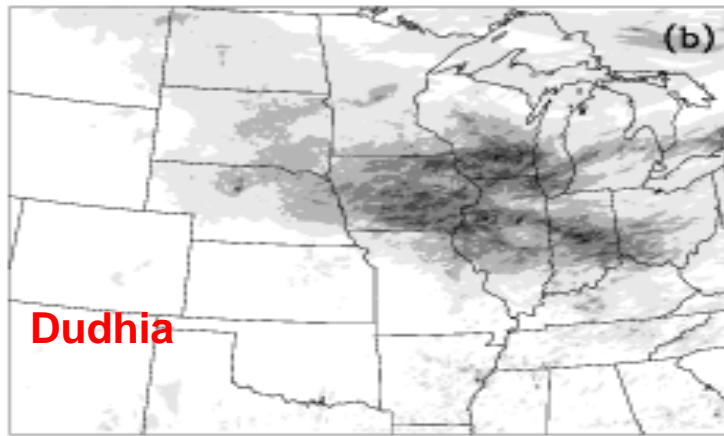
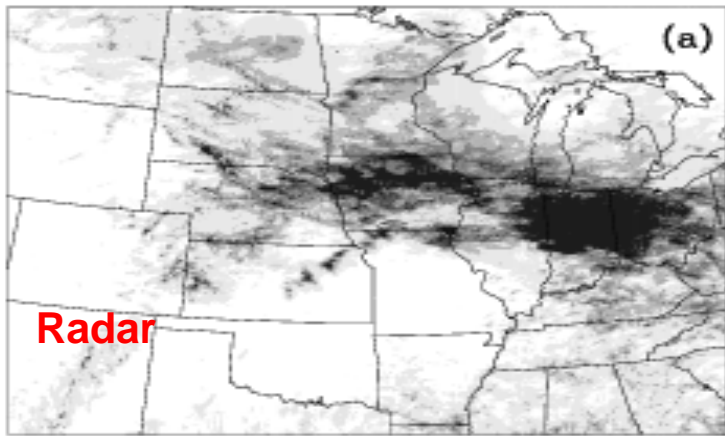
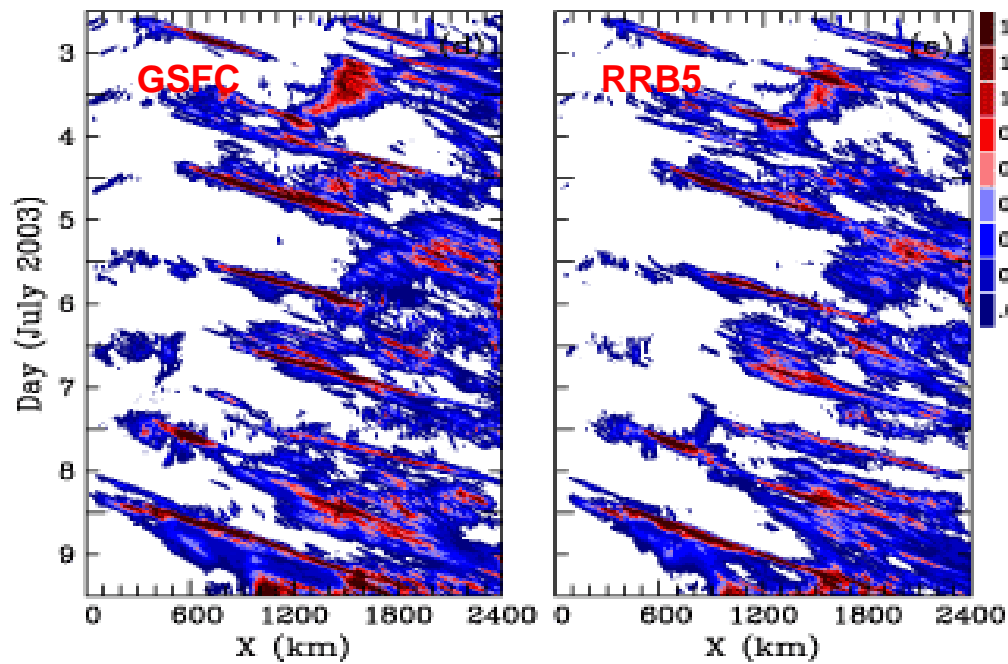
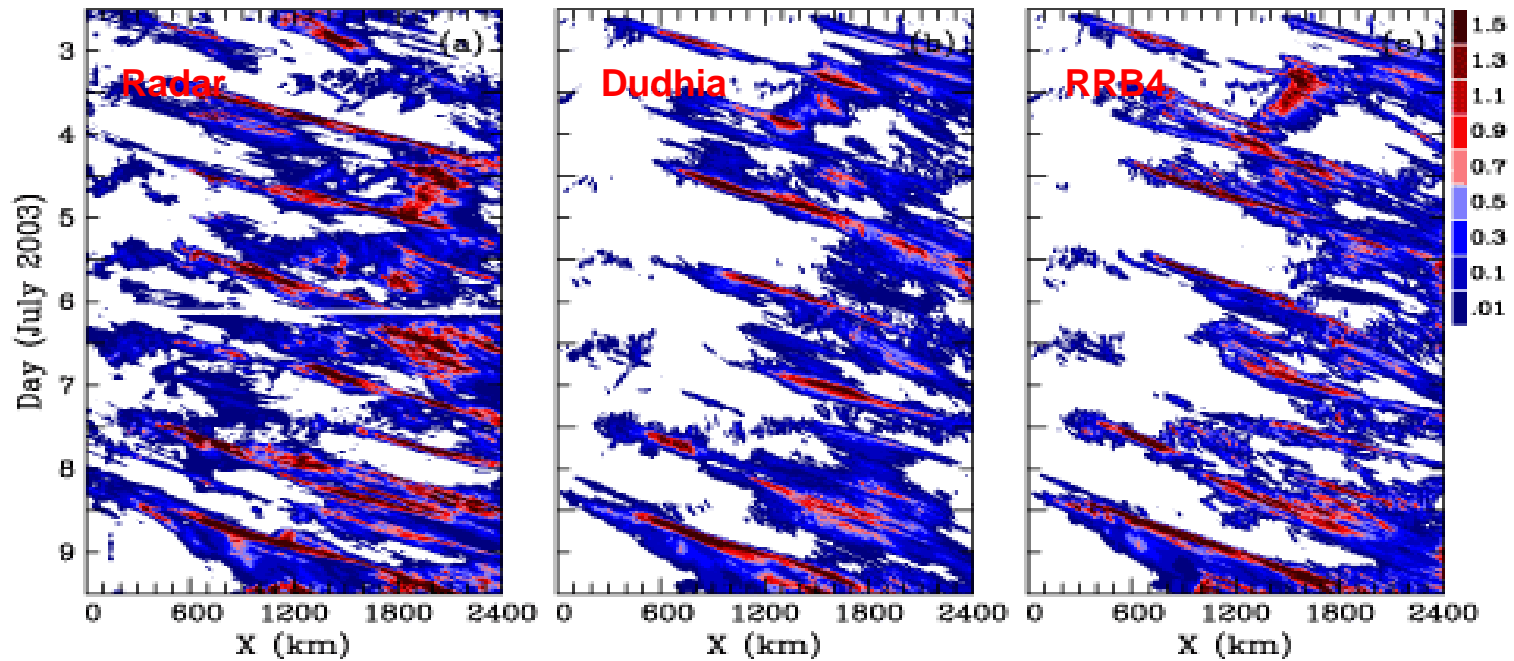


FIG. 1. Terrain of the model domain. The inset indicates the computational area for the thermodynamic budget.





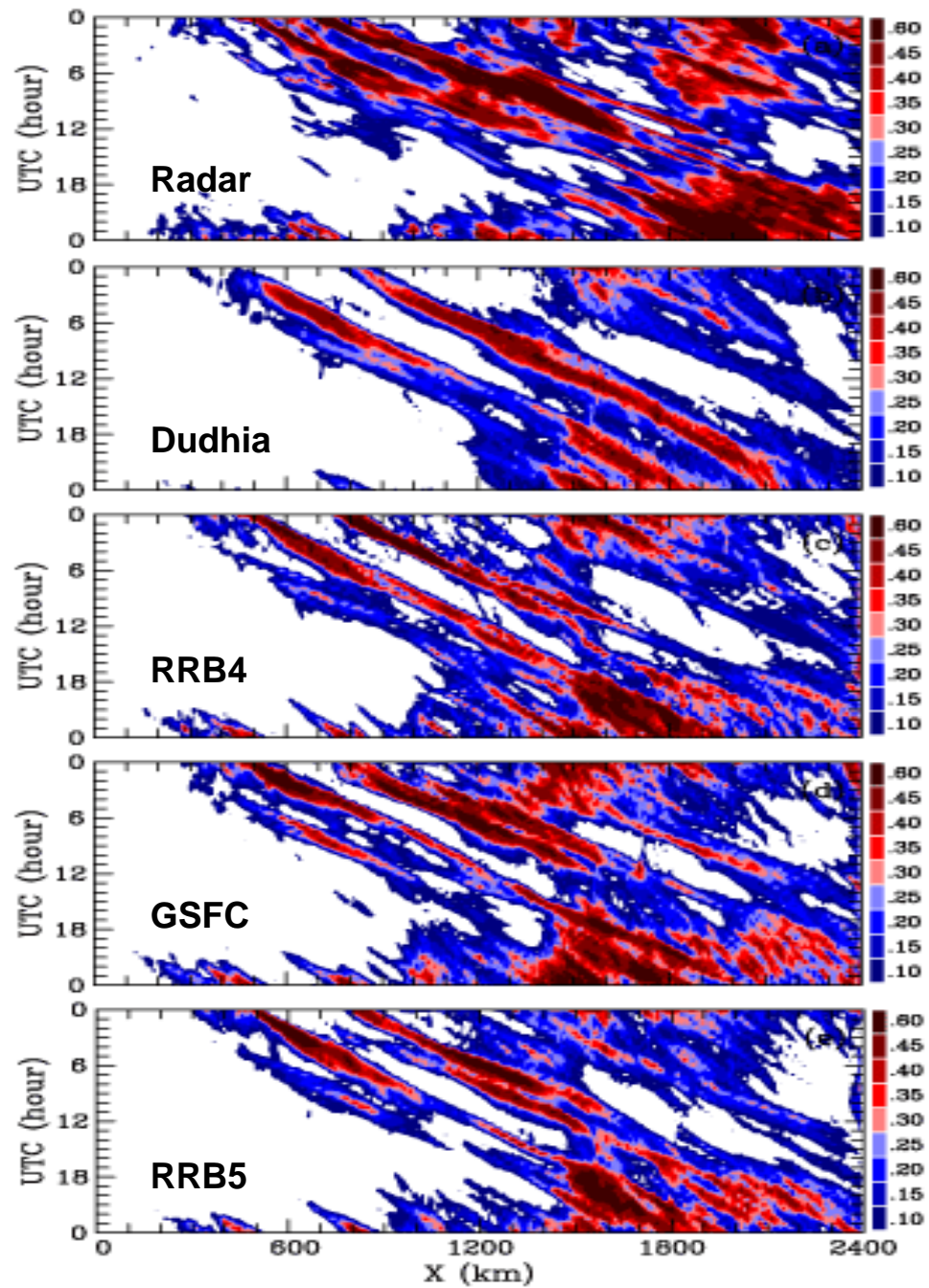
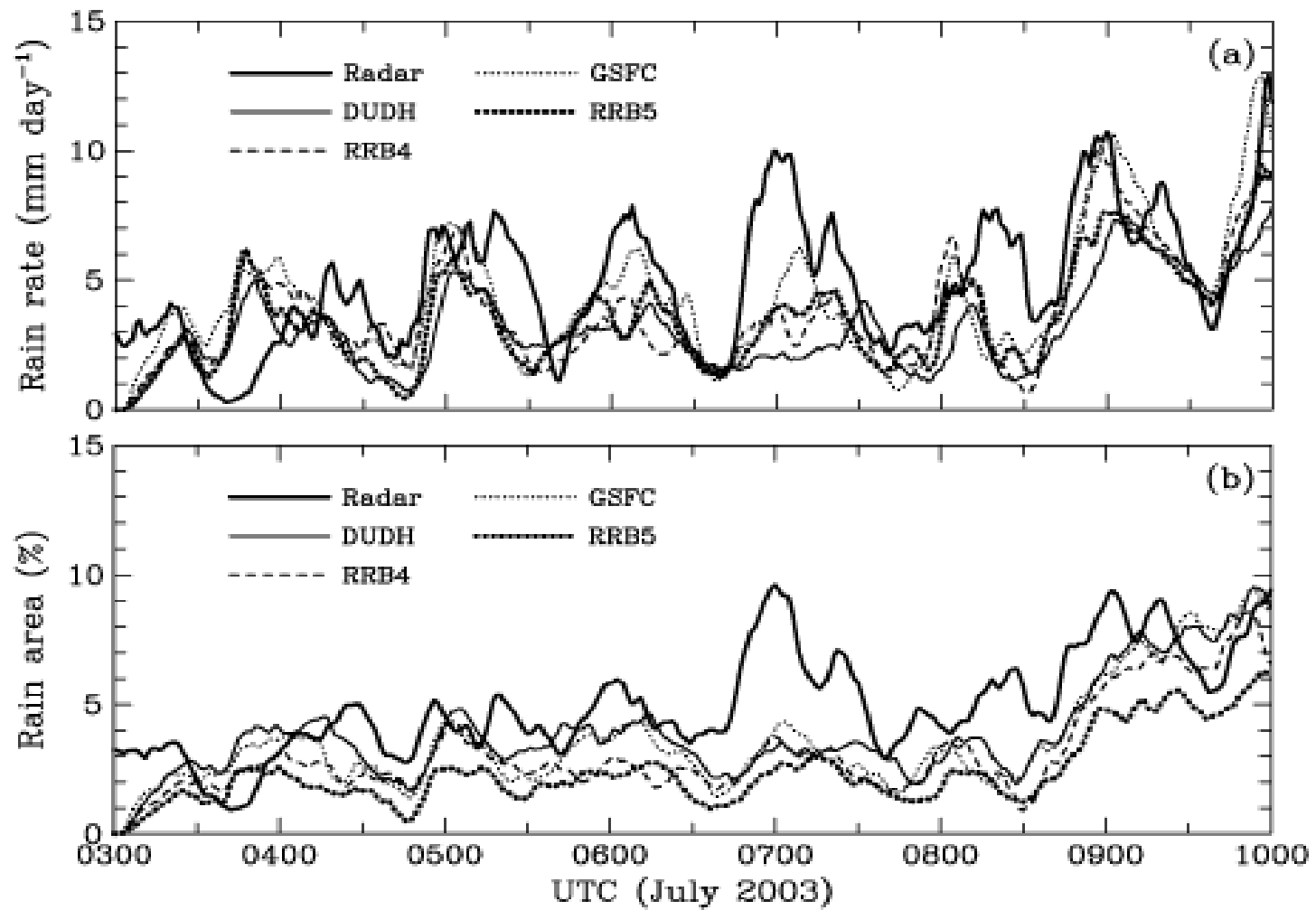
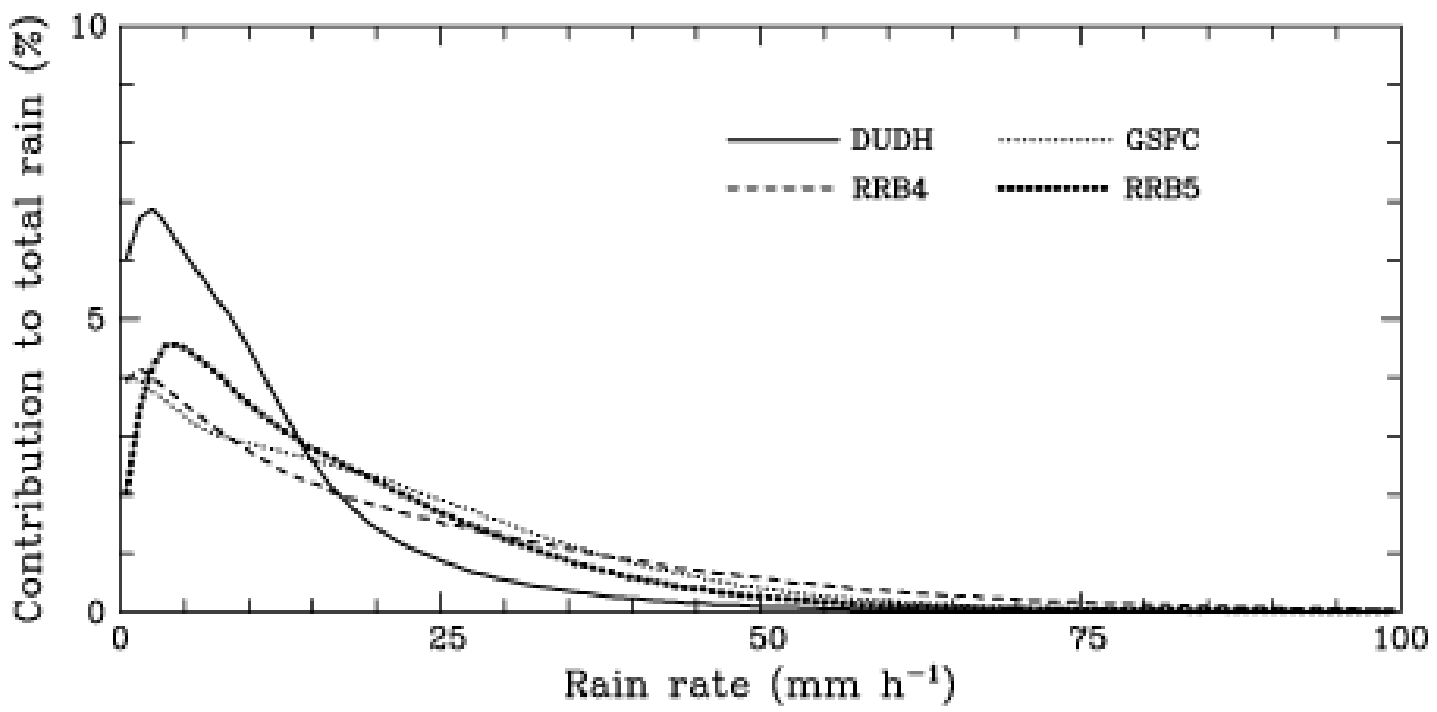
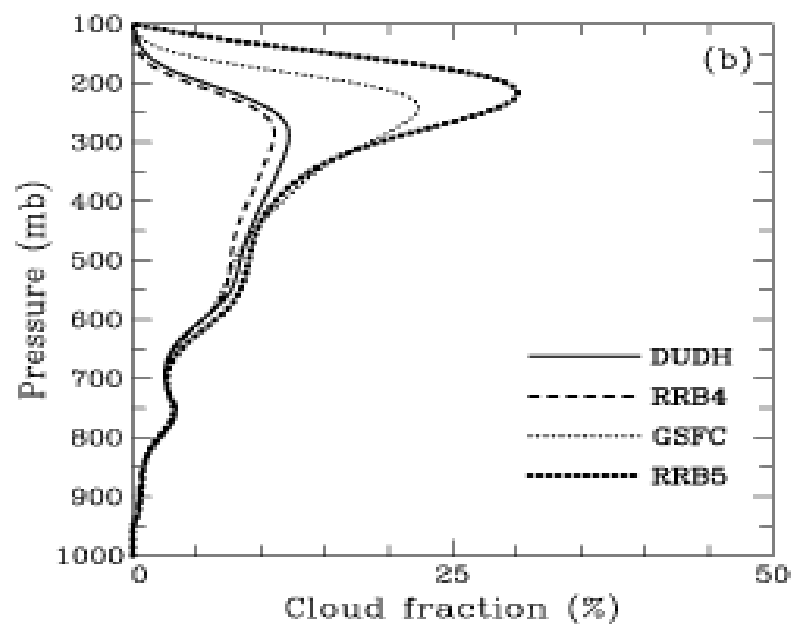
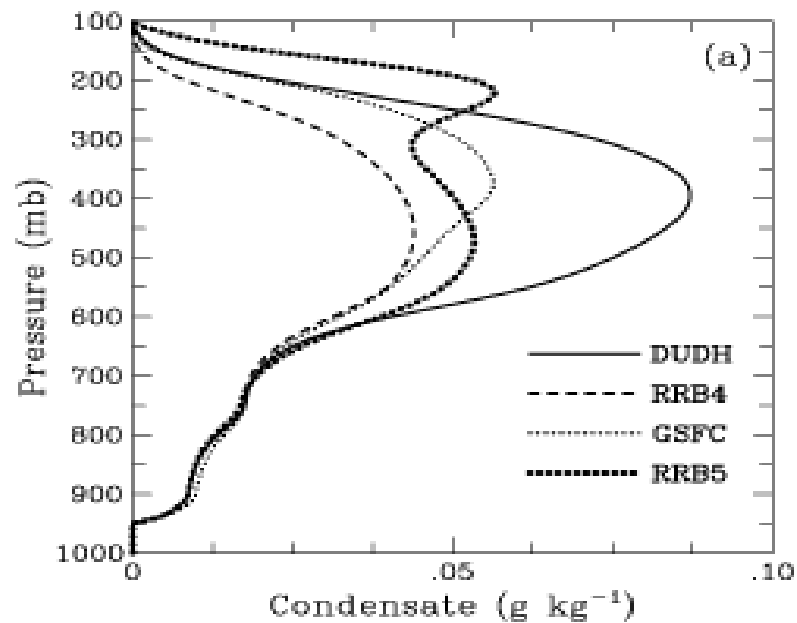


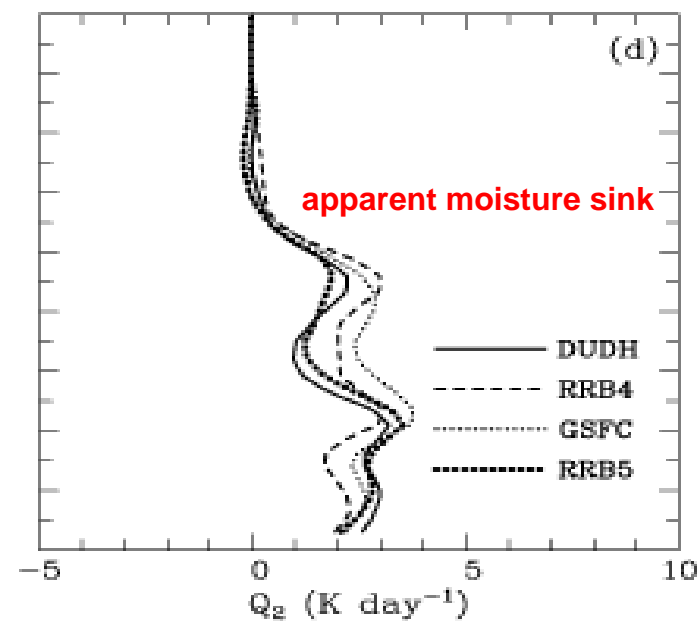
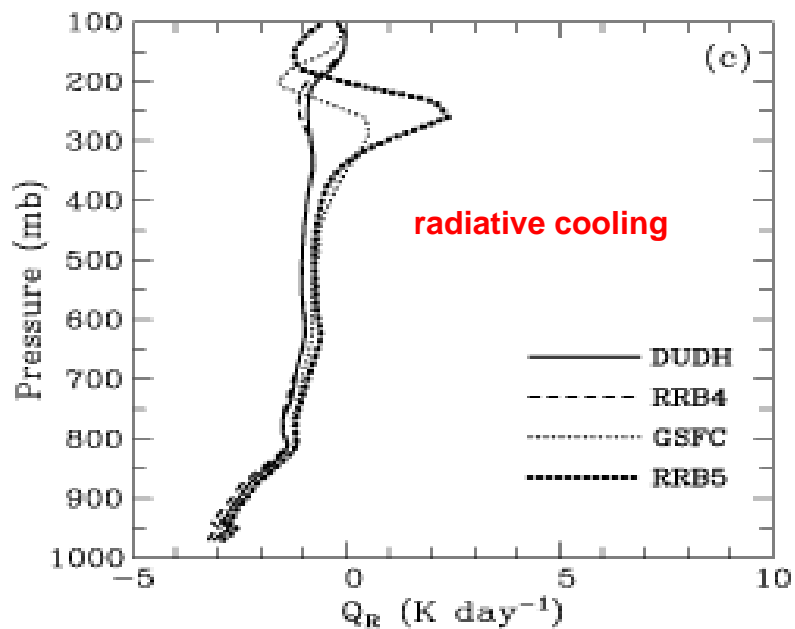
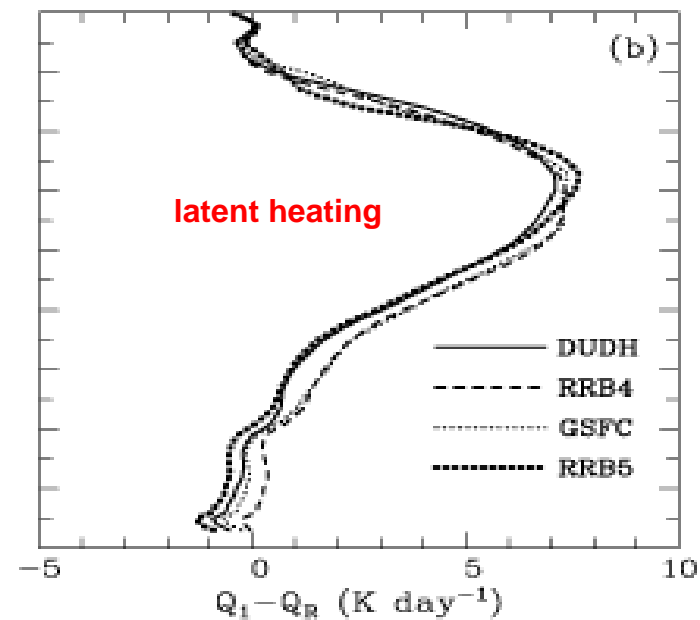
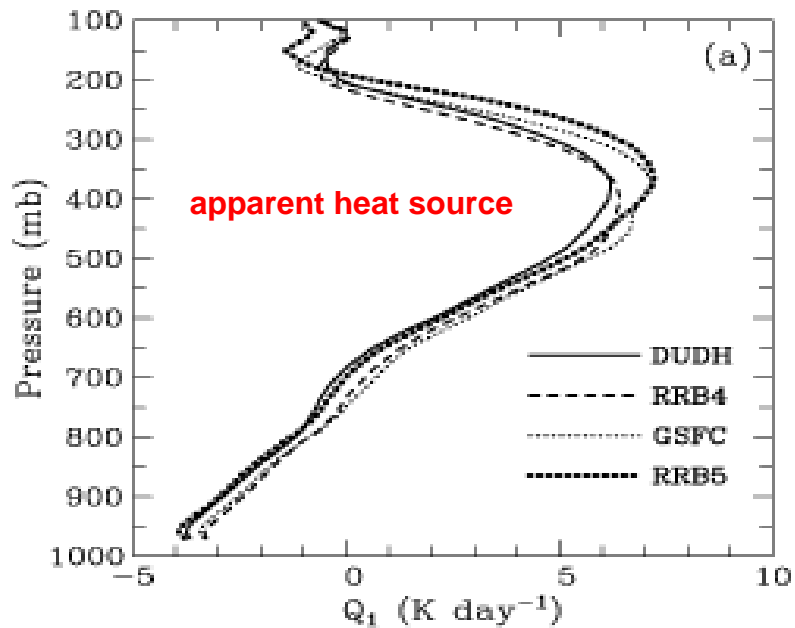
Table 1: Statistics of observed and simulated rain streaks greater than 500 km in the zonal span. The values in the brackets correspond to the medians.

	Total Streaks	Zonal Span (km)	Duration (h)	Speed (m s^{-1})
RADAR	18	927 (779)	14.6 (13.1)	17.9 (18.4)
DUDH	13	1131 (1116)	19.0 (17.5)	17.3 (17.3)
RRB4	20	905 (788)	16.9 (15.3)	15.5 (15.1)
GSFC	18	935 (744)	15.7 (12.5)	16.7 (15.0)
RRB5	18	924 (870)	15.8 (15.0)	16.7 (16.6)



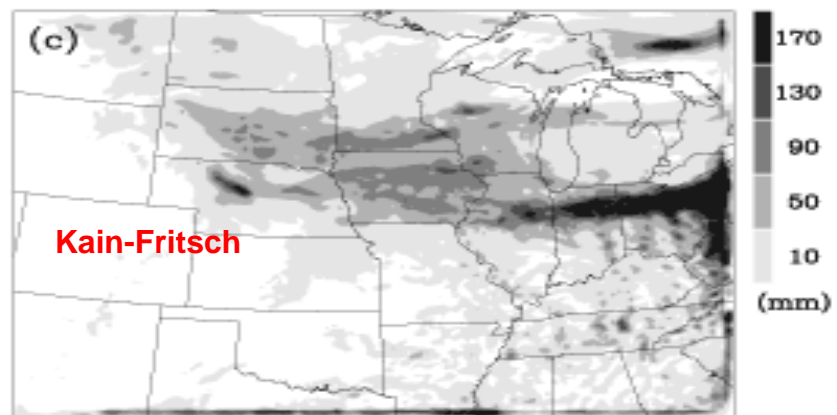
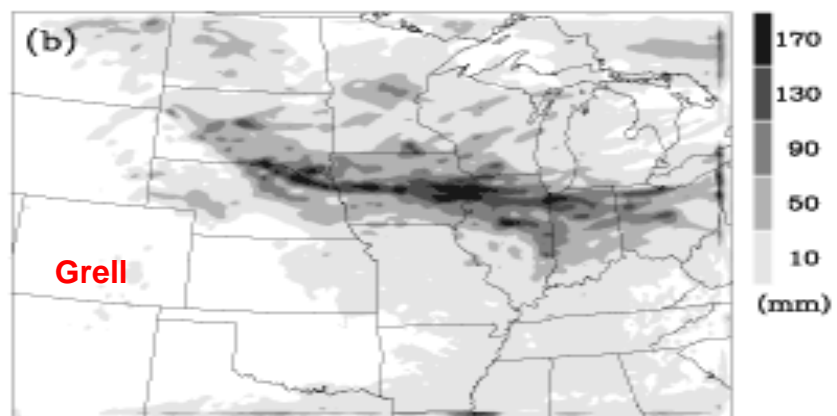
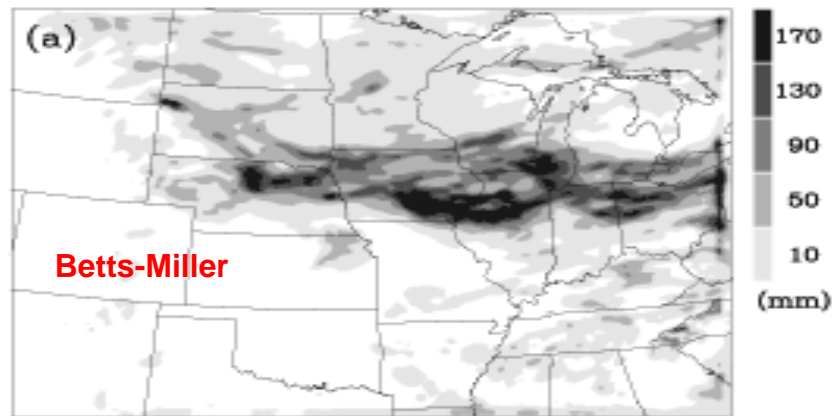


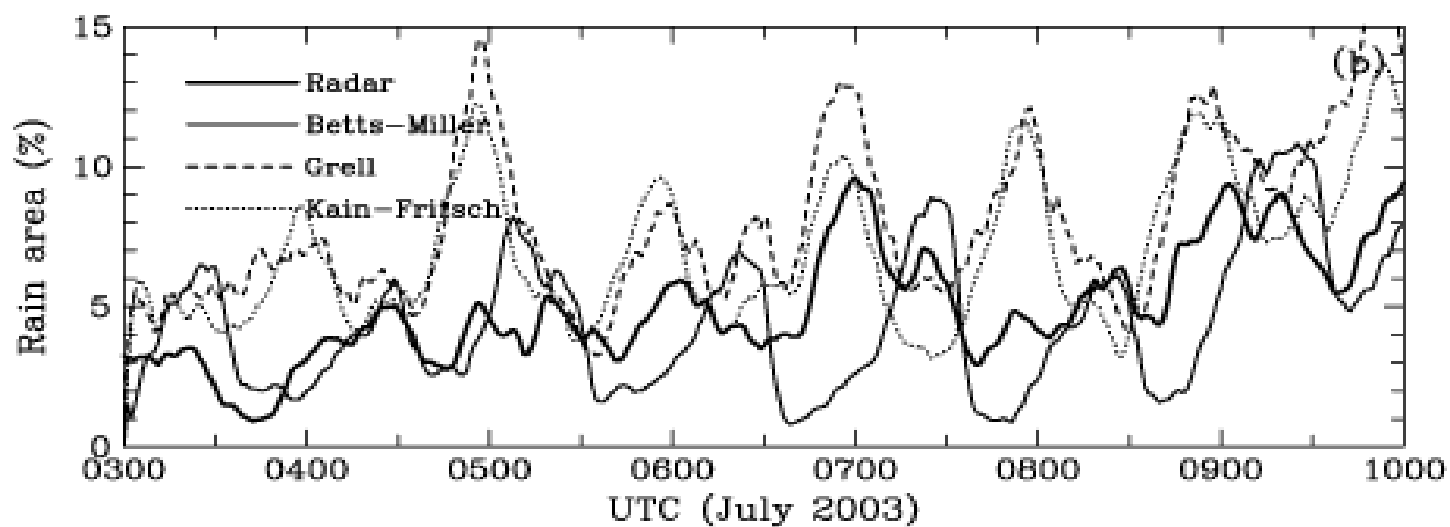
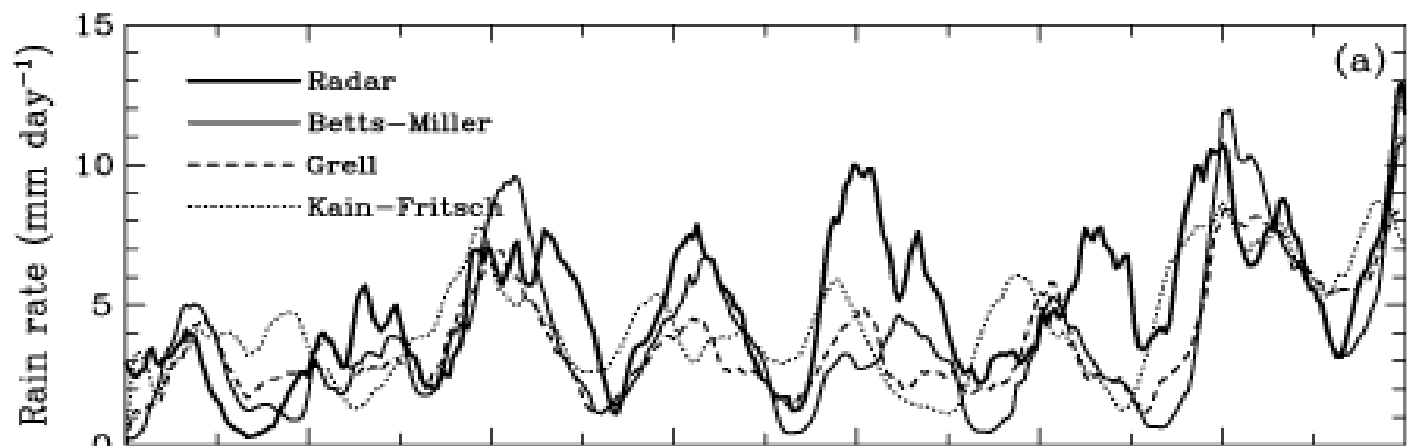


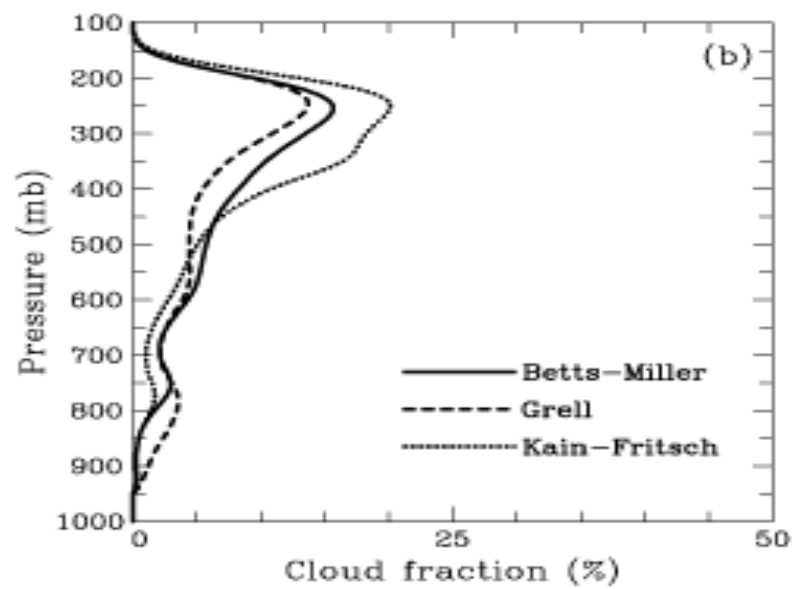
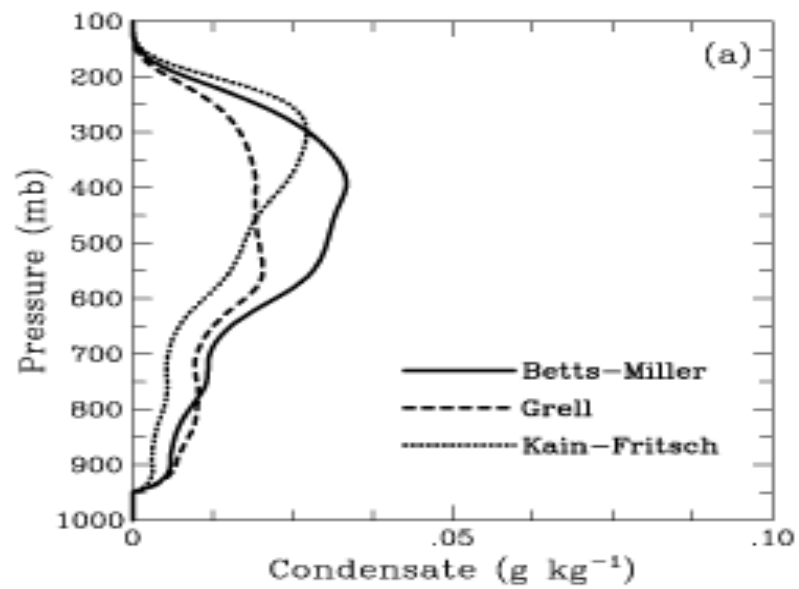


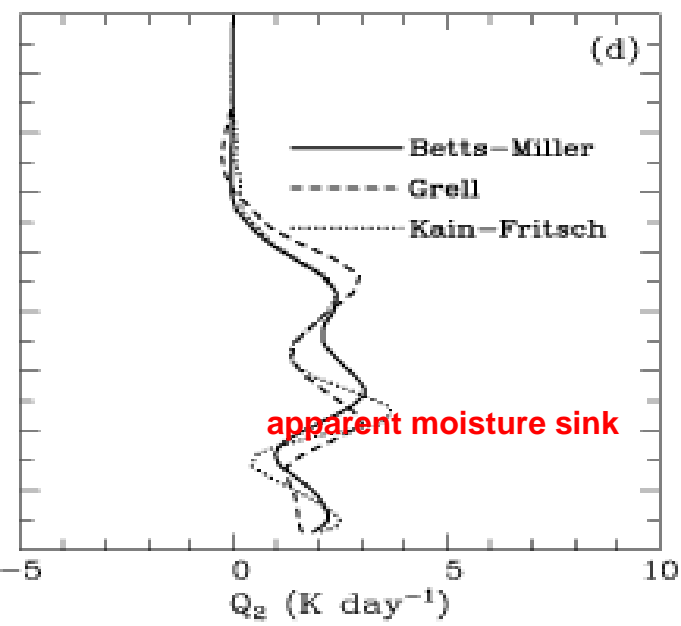
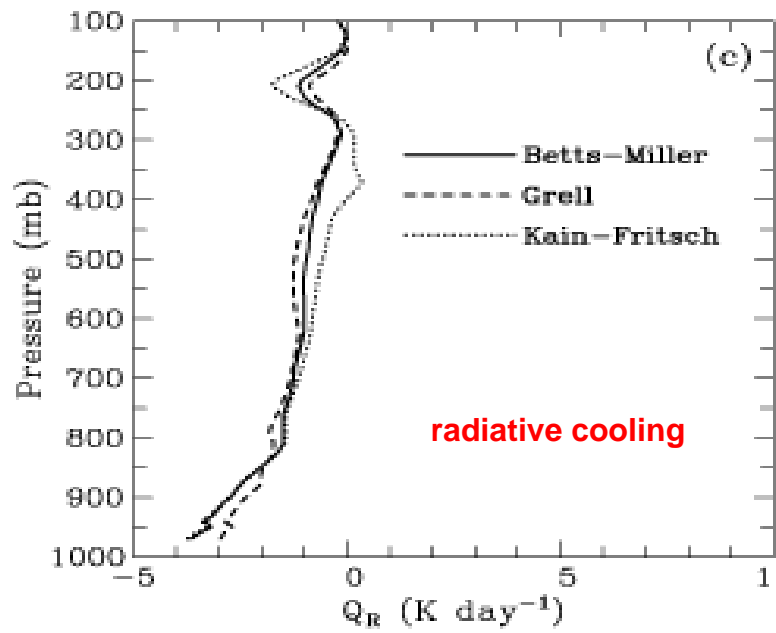
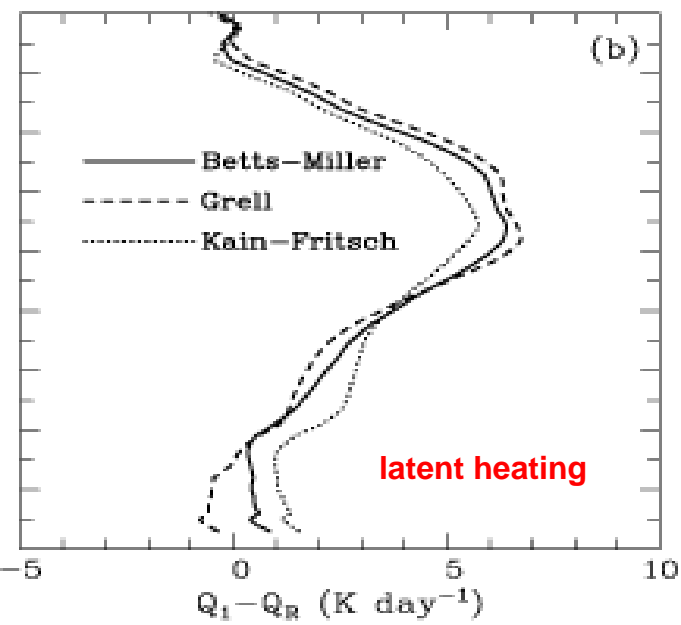
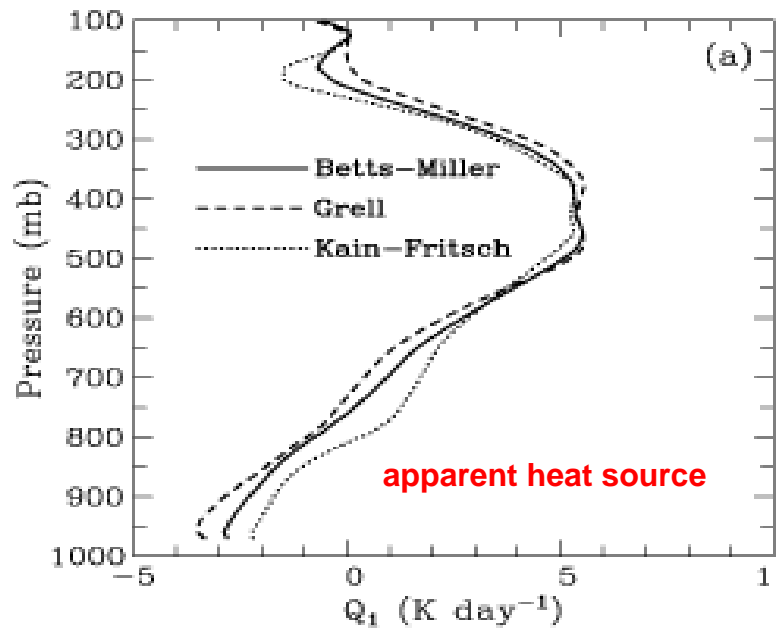
Experiment Design

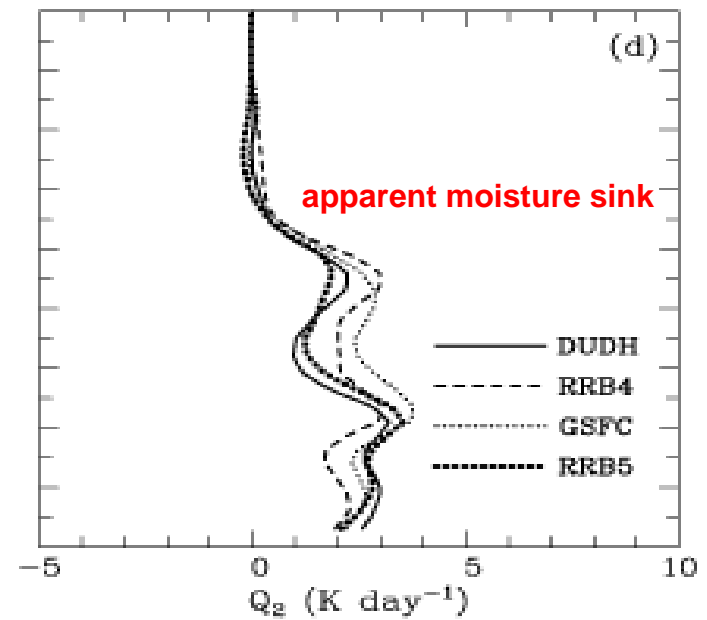
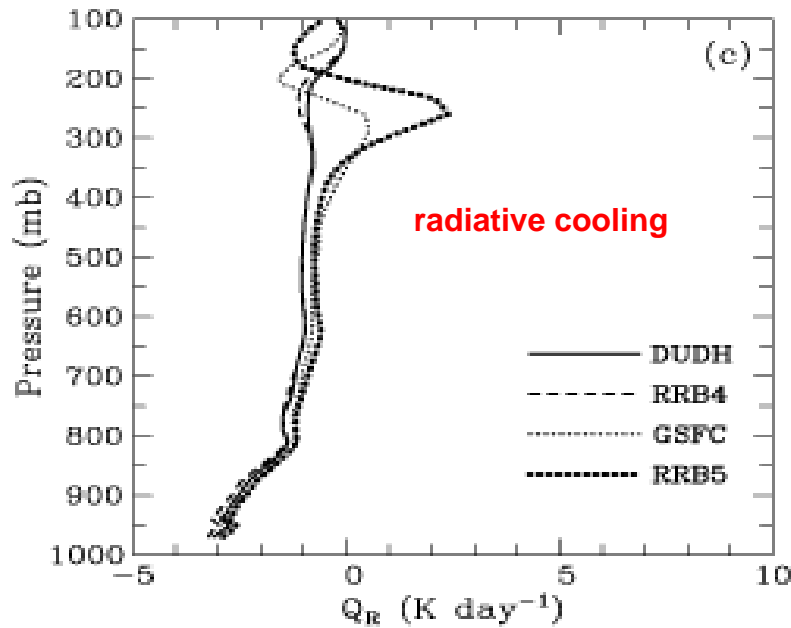
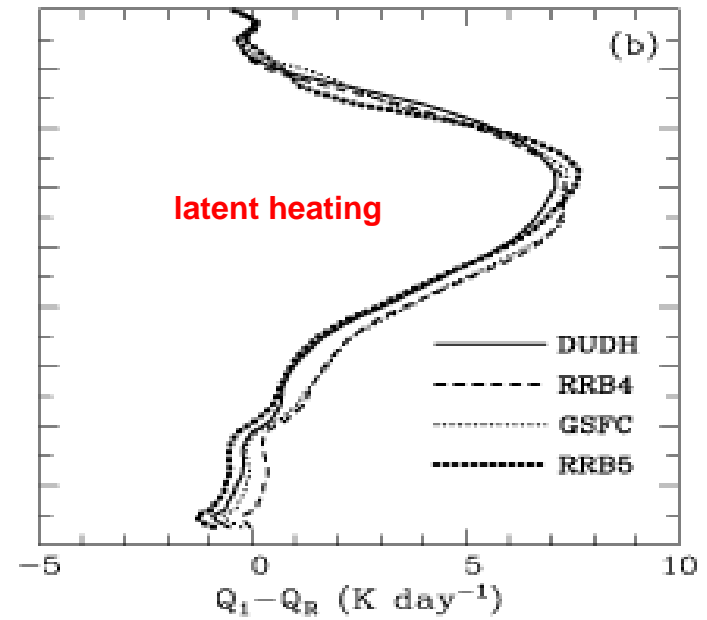
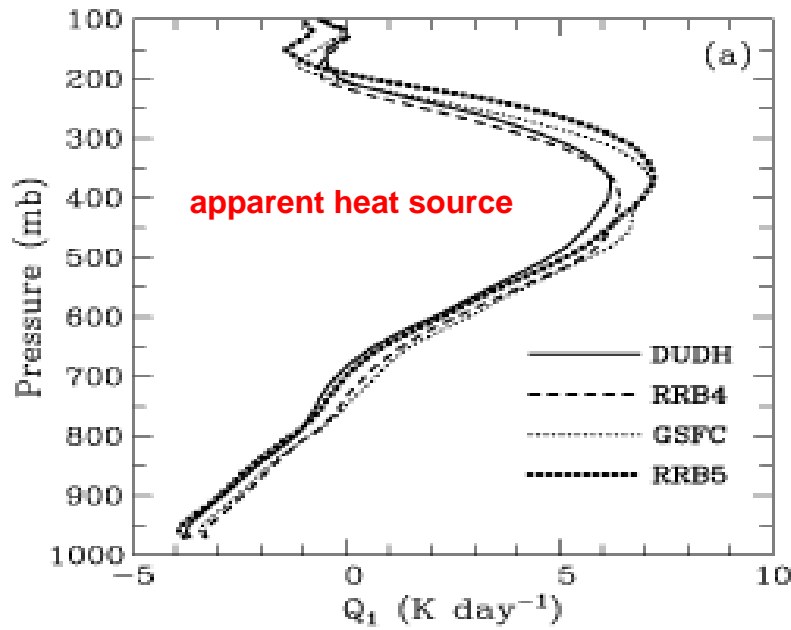
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- MRF PBL scheme
- Five-layer soil model
- The 3-hourly, 40-km NCEP ETA model analysis provides the initial and lateral boundary conditions
- A 7-day period from 00 UTC 03 to 00 UTC 10 July 2003
- GSFC five-class mixed-phase microphysics
- Three cumulus parameterizations are tested:
 - Betts-Miller, Grell & Kain-Fritsch







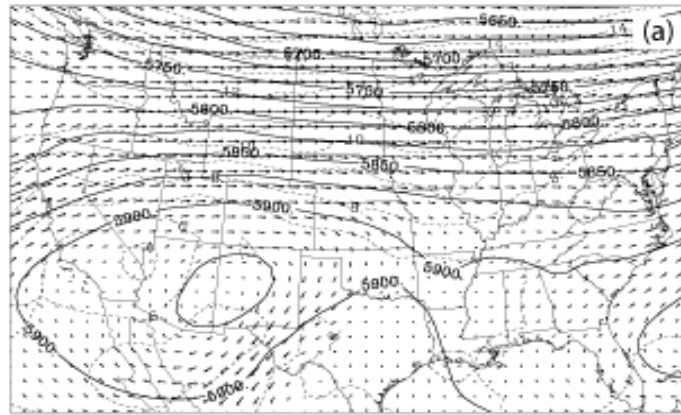




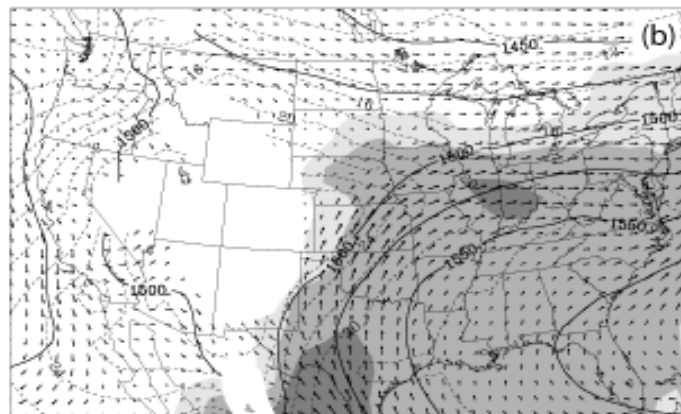
Summary

- The rainfall coherency is insensitive to the choice of BMPs.
- The mixed-phase BMPs are superior to the simple ice BMP.
- The rain-rate, rain area, and rain spectrum show moderate sensitivities among the three mixed-phase schemes.
- Strong sensitivities occur in the upper-level condensate and cloudiness.
- The latent heating profiles are similar, and the major uncertainty in Q_1 results from the distinct radiative heating/cooling.
- The 10-km model results show a greater sensitivity to cumulus parameterizations than the explicit model results do to the cloud microphysics.

500 mb



850 mb



rainfall

