A Modeling Study of Freezing Precipitation Events over the Southern Great Plains

Esther White
Peter Lamb and Lance Leslie
University of Oklahoma

Overview

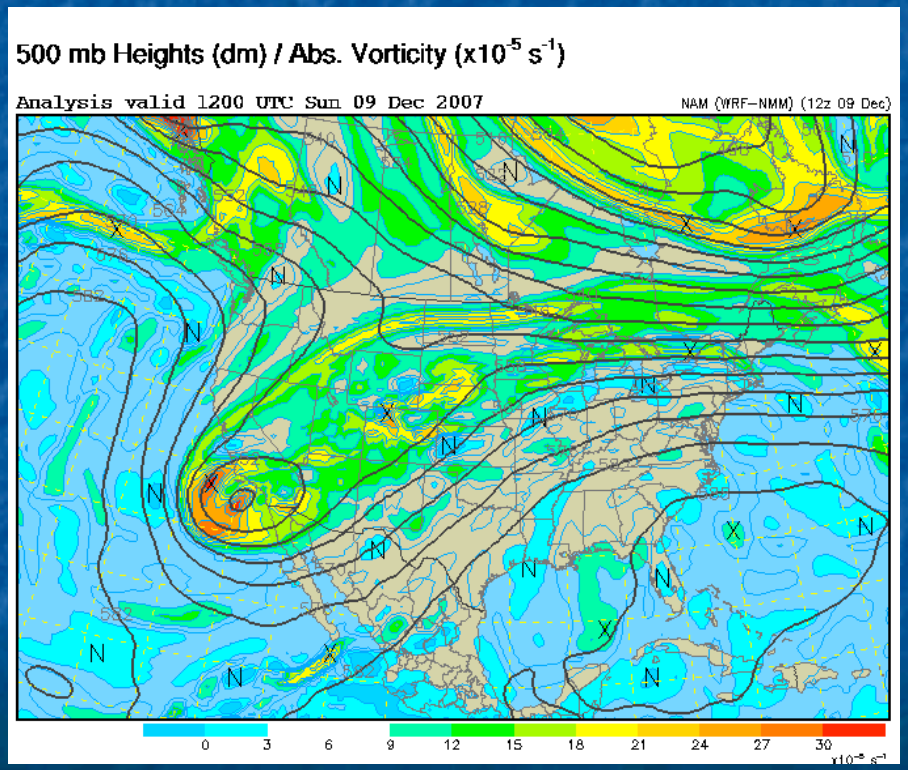
- Freezing rain events in the Southern Plains region
- Introduction to case study
- WRF model simulation and preliminary outcomes

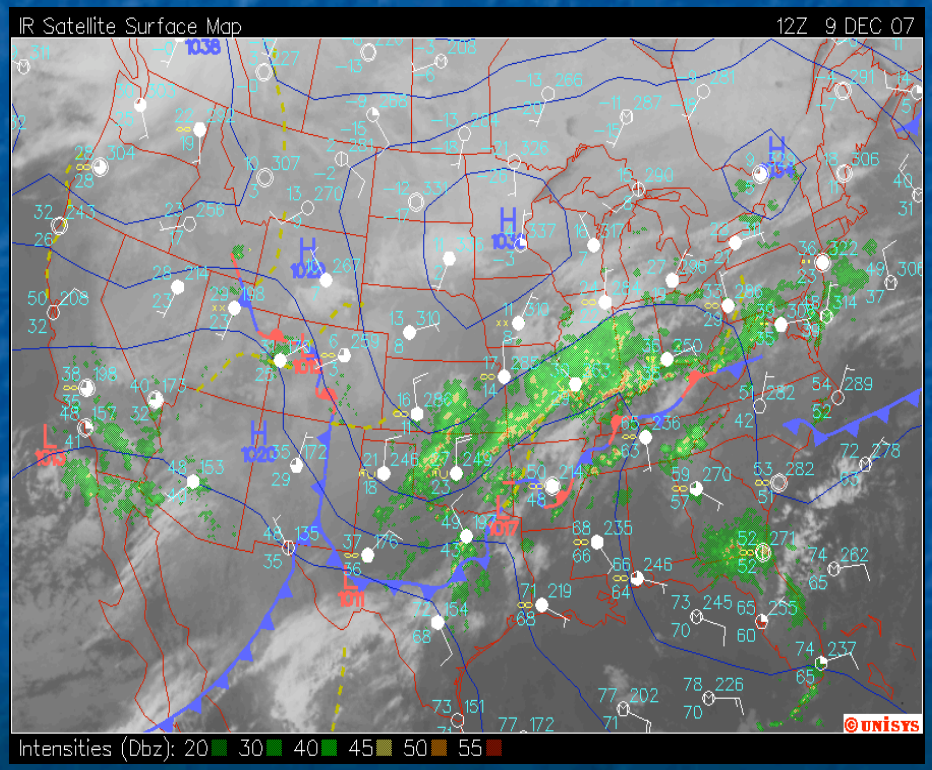
Motivation

- Freezing rain is a common occurrence over the Contiguous US in the Cold Season (November-March). The Southern Plains region experiences relatively frequent freezing rain and drizzle, eg, Rauber et al, 2001
- Freezing rain events are heavily influenced by mesoscale and cloud microphysical processes.
- High density of observations at the SGP presents an opportunity to use available observational data for cases of freezing rain/drizzle events to investigate the evolution of these events.
- Model study (WRF) will look at the processes occurring in the model environment, with respect to the vertical structure and cloud distributions and whether this is simulated well using existing schemes

Case Study

- Freezing precipitation event from December 8th-11th 2007
- Much of the rainfall resulted from elevated convection generated by instability above the low level warm layer.





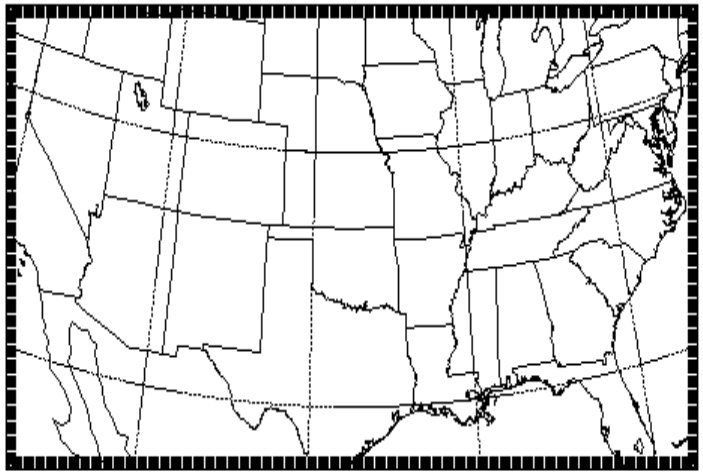
http://locust.mmm.ucar.edu/

Modeling Study

- Sensitivity study varying convective schemes in the WRF for the December 2007 case study.

Model Configuration:

- Initialised 06 12/08 and run out until 1500 12/09
- MP scheme = WSM6
- Land surface= Noah
- Resolution = 10km and 50 vertical levels
- SW radiation=Dudhia and LW=RRTM
- 3 CU schemes considered, Kain Fritsch, Betts-Miller-Janjic, and Grell-Devenyi

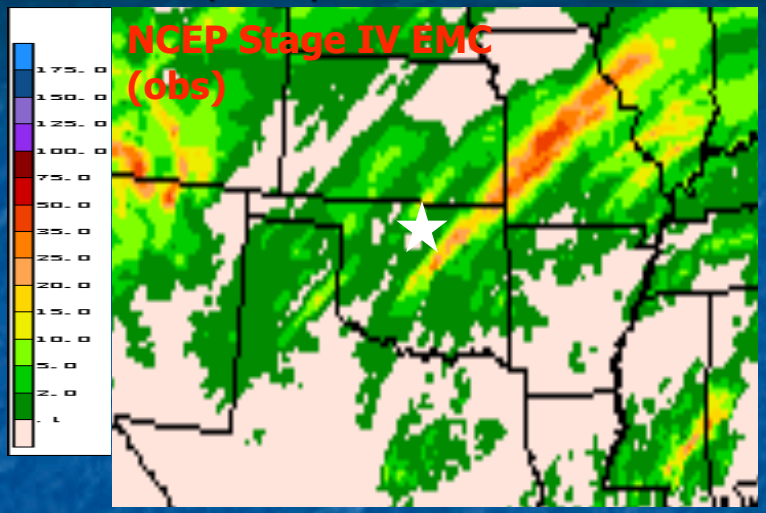


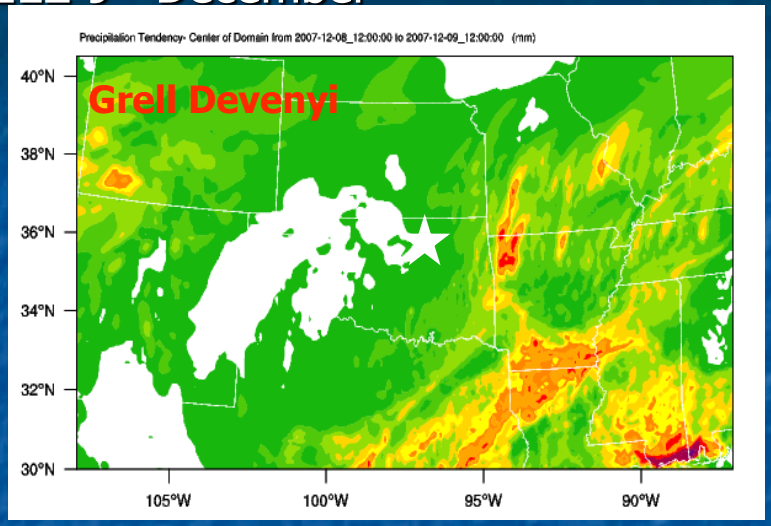
Model Domain

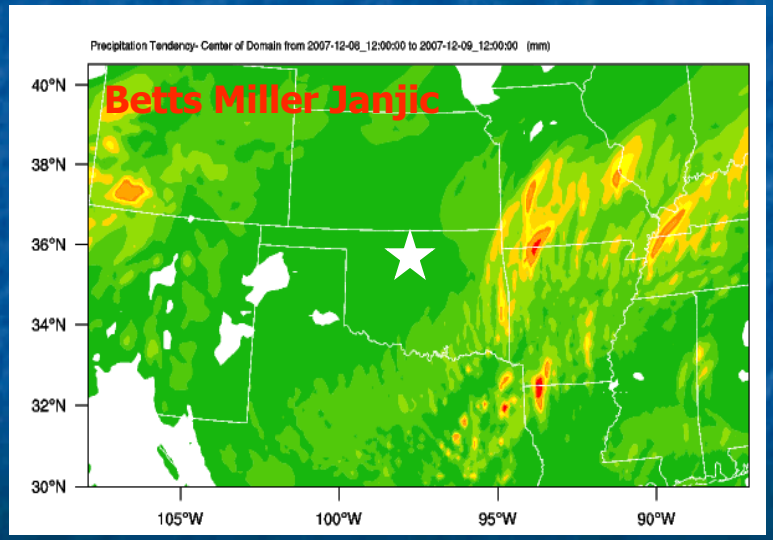
- Input data is NCEP Eta/NAM 212 grid (40km) model analysis (**AWIP**). 6 hour intervals

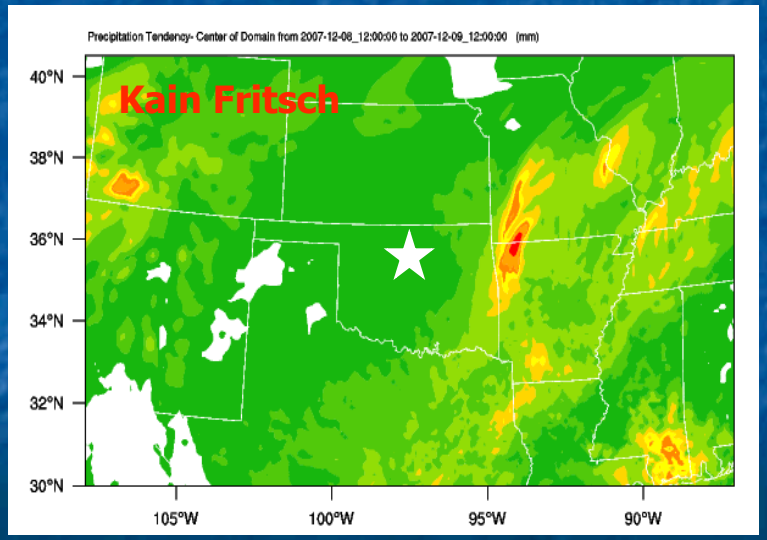
Model Simulations

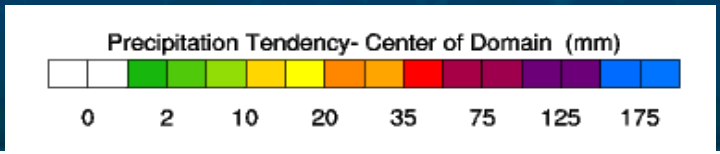
24 hour precipitation accumulation 12Z 8th-12Z 9th December



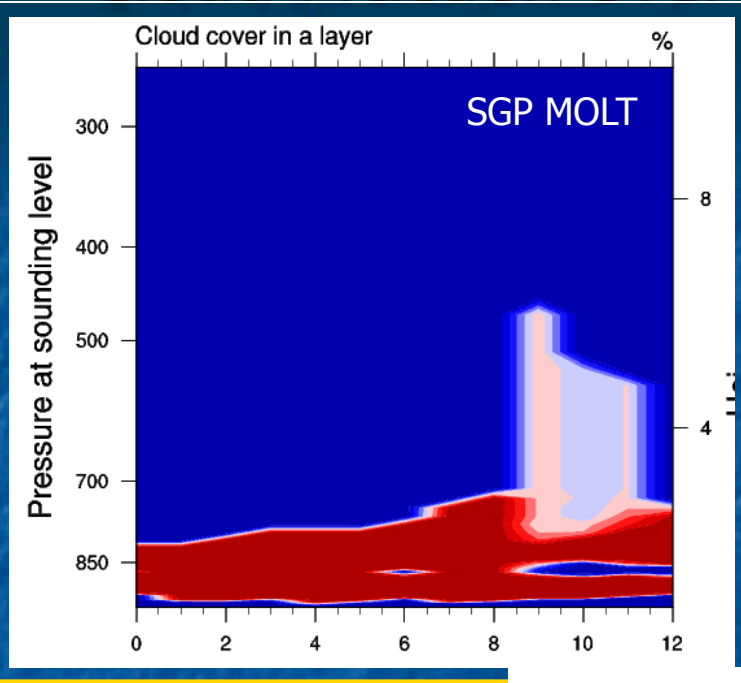


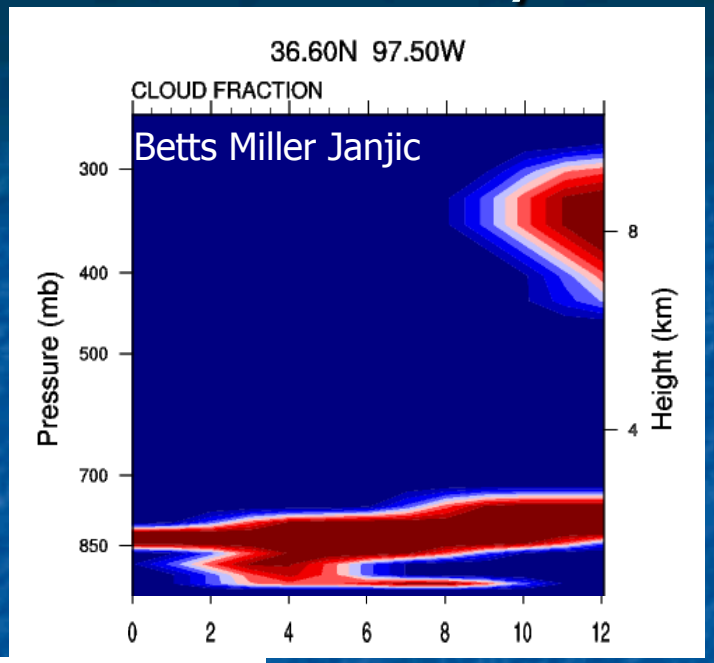


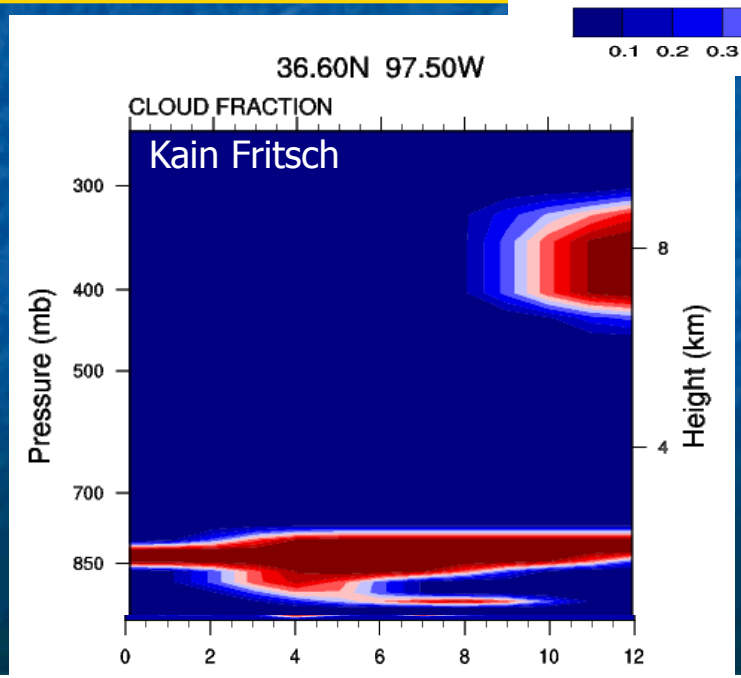


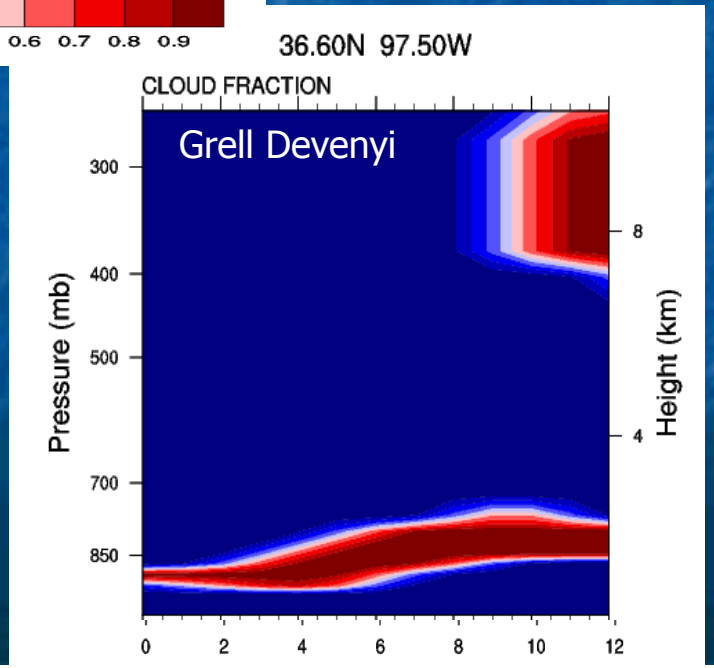


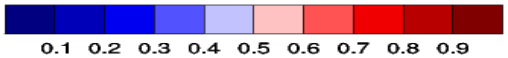
Cloud Fraction over SGP Central Facility



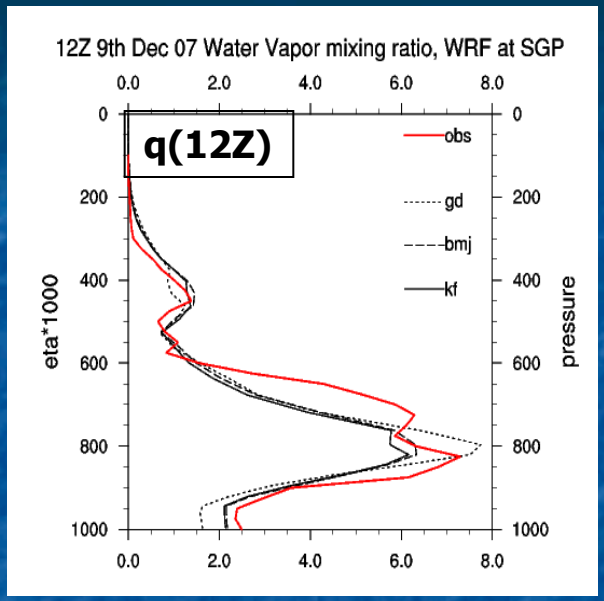


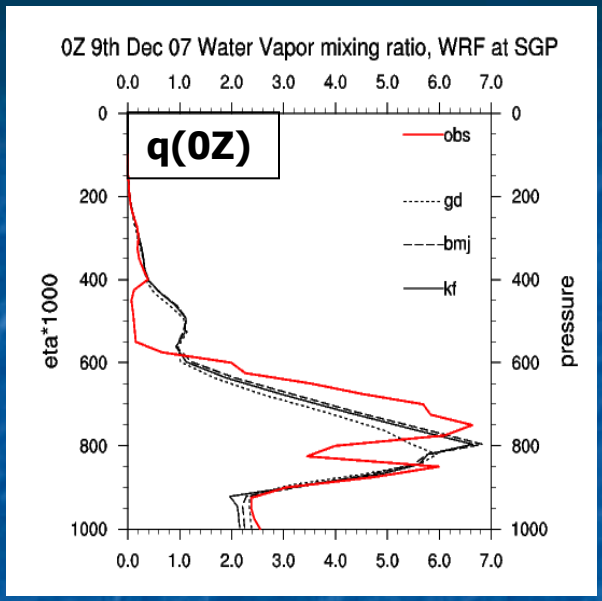


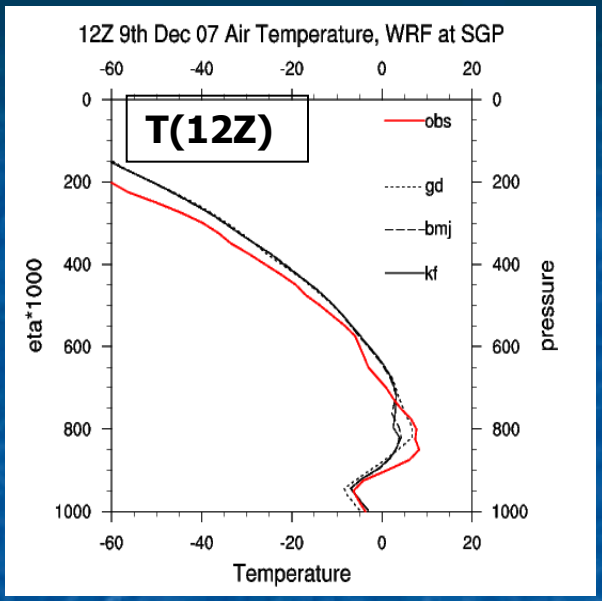


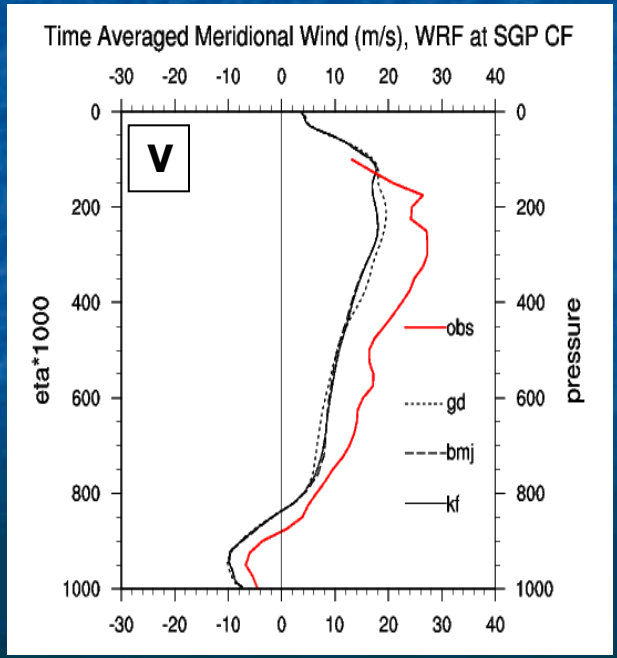


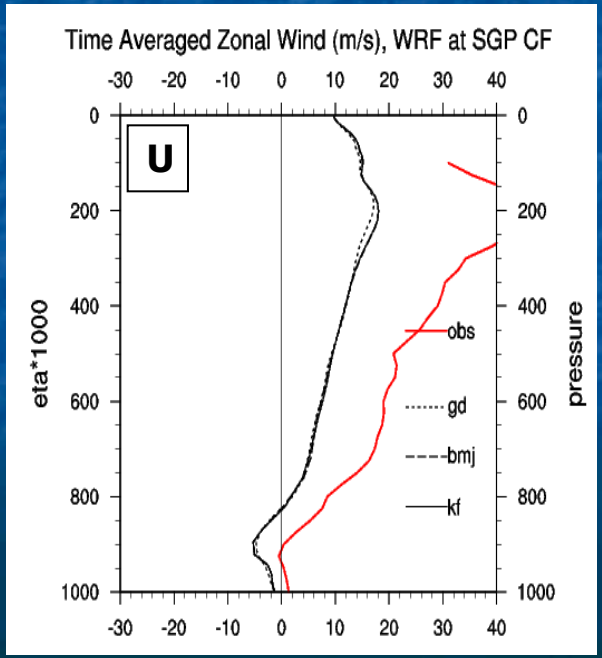
Vertical Profiles at the SGP-Central Facility

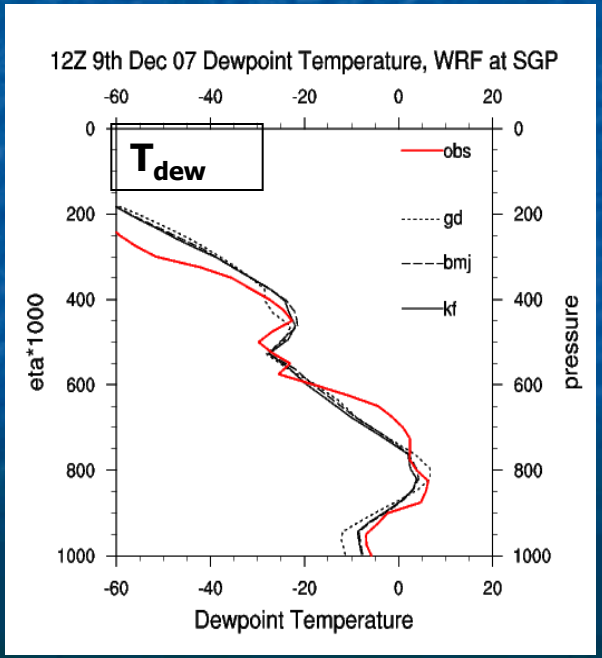




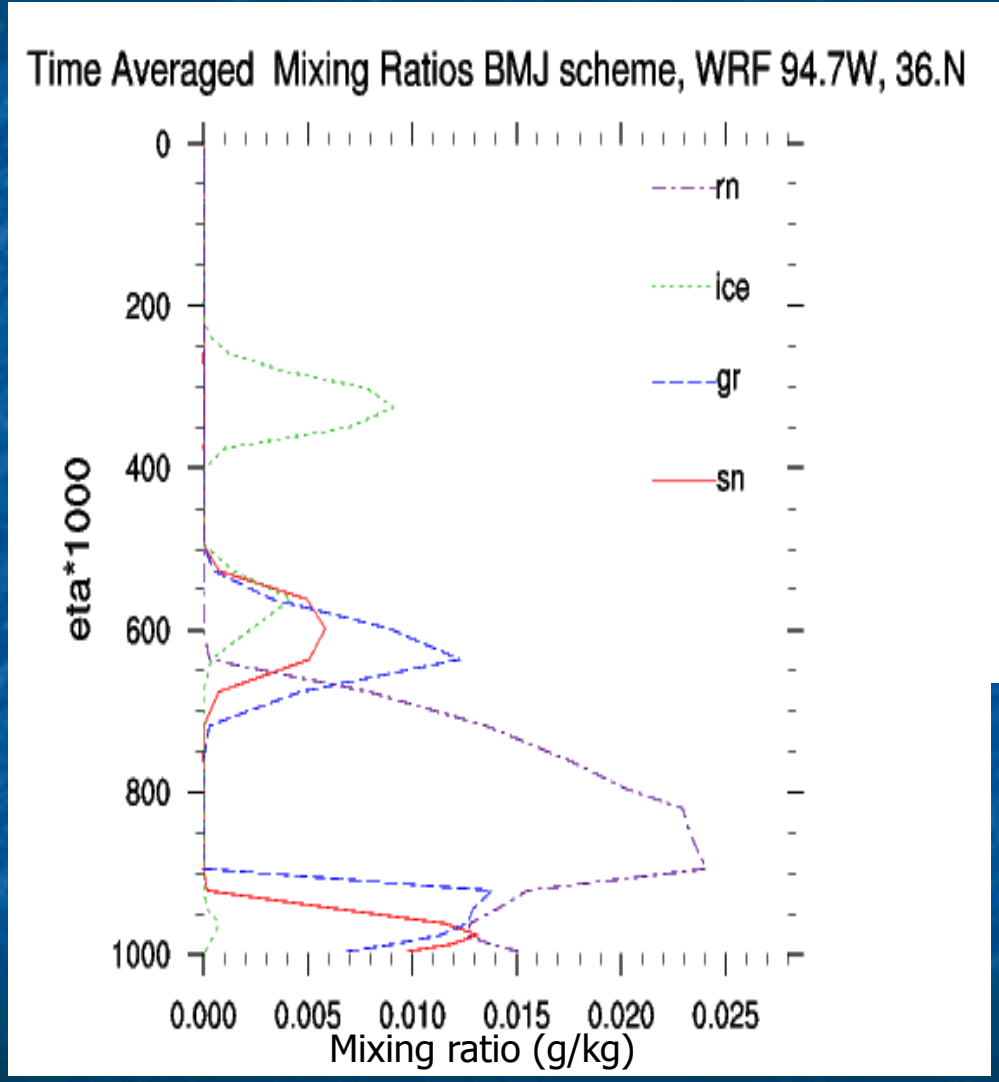


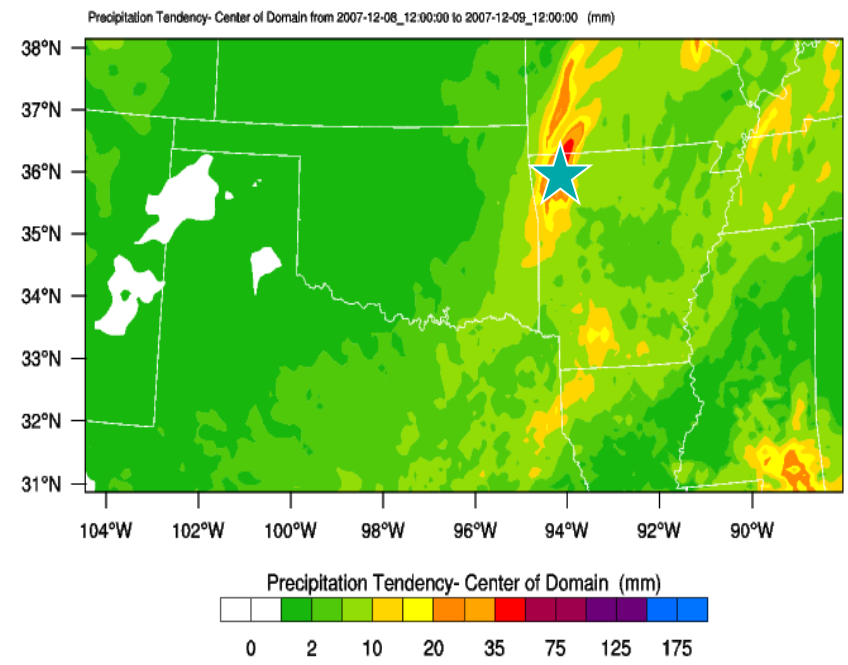






Mixing Ratios under convective region





- Hydrometeor phase changes physically consistent with this region.
- Other convective schemes show similar distribution although magnitudes differ

Conclusion

- All schemes simulate cloud cover over the ARM facility reasonably well, with slight underestimation of depth at low level
- Precipitation mode is well simulated but maxima is displaced compared to observations-fails to capture convection over central OK
- Most environmental vertical profiles agree well with observations

Future Work

- Investigate sensitivity of model environment to changes in the microphysical scheme at higher resolution with explicit convection
- Investigate source of displacement error
- Climatology of events over 15 years of SGP measurements ongoing; other cases will be modeled.