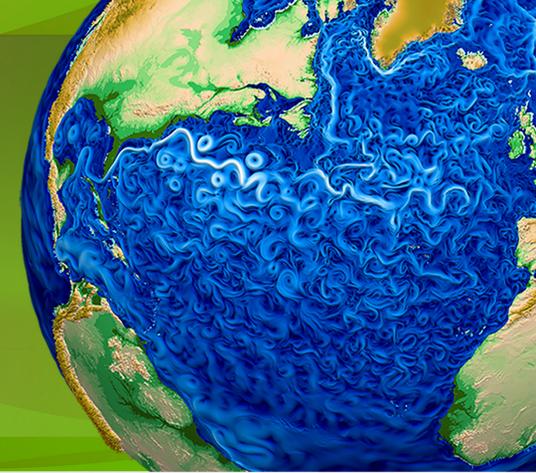


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Understanding the Cloud and Precipitation Biases over the Central US in ACME v1 with the CONUS RRM Grid

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Abstract:

This study conducts several sets of ACME v1 simulations including 5-year free run, short-term hindcasts (i.e. CAPT simulations) with the 1-degree regular grid (ne30) and the CONUS RRM grid. Compared with observations, the RRM simulations improve the precipitation and 2 meter temperature biases. RRM simulations with the inhibited ZM scheme can better represent the precipitation propagation and the diurnal cycle of precipitation over the central US. The mean surface precipitation and 2 m temperature from all CAPT RRM simulations are similar compared with these from CAPT simulation with 1-degree regular grid. Based on ARM observations during the MC3E period, the surface temperature bias over the SGP in these CAPT simulations is more relevant to cloud radiative forcing than to the precipitation bias.

Approach

Regionally Refined CONUS Grid

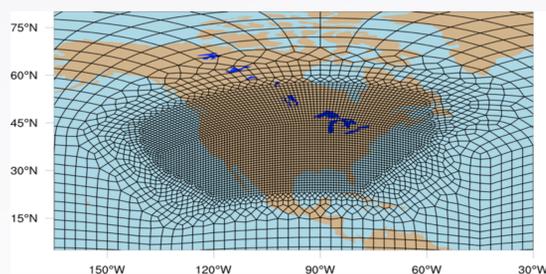


Figure 1. regional refined mesh centered over the CONUS

CAPT simulations

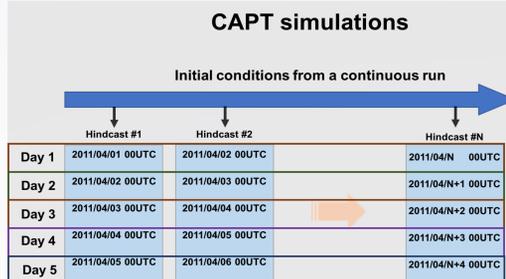


Figure 2. Schematic diagram for the CAPT_Core procedure

The Cloud-Associated Parameterizations Testbed (CAPT) approach:

CAPT approach is the short-term hindcast approach. These hindcasts are initialized with operational numerical weather prediction reanalysis. Thus, the large-scale state remains close to the observations within the first few days of the hindcast. Therefore, CAPT simulations can be directly compared with the continuous ARM observations and reveal deficiencies in cloud parameterizations.

Model simulation setup

- Three sets of RRM CAPT simulations on CONUS grids with ACME compset FC5AV1C-04P2: Default setting (CTL-RRM); R5 setting (R5-RRM); ZM tau =14400 s (4TAU-RRM)
- One CAPT simulations on ne30 grids with FC5AV1C-04P2 default setting (NE30)
- One RRM 5-year free run with FC5AV1C-04P2 default setting (5yr-RRM).

For CAPT simulations, we conduct a five-day hindcast at 00UTC each day from 27 March 2011 to 31 August 2011.

Observations

The observations used in this study include NEXRAD surface precipitation and NOAA QCLCD 2 meter temperature during the time period of April - August 2011. We also use ARM observations at SGP site during the MC3E field campaign from 22 April to 6 June 2011.

Acknowledgements This work is supported by the Climate Model Development and Validation – Regionally Refined Meshes (CMDV-RRM) project. This work was performed under the auspices of the U. S. Department of Energy by Lawrence Livermore National Laboratory under contract DE-AC52-07NA27344. LLNL-POST-732279

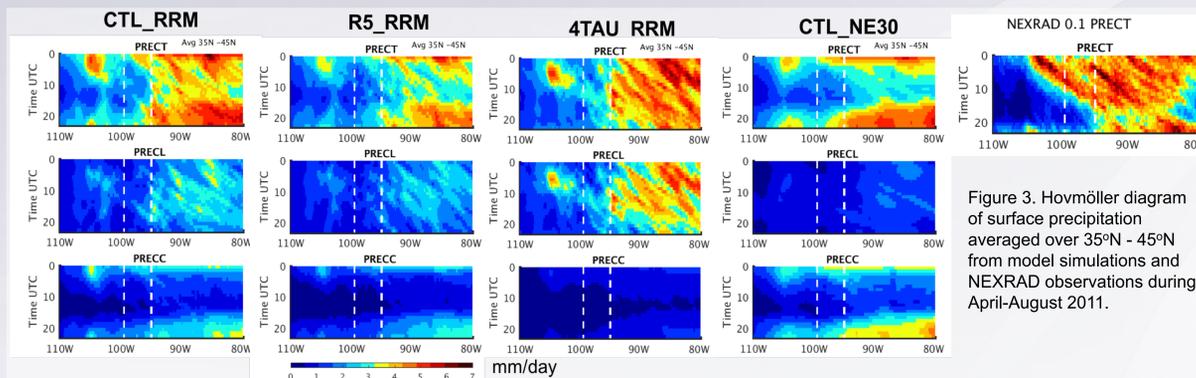


Figure 3. Hovmöller diagram of surface precipitation averaged over 35°N - 45°N from model simulations and NEXRAD observations during April-August 2011.

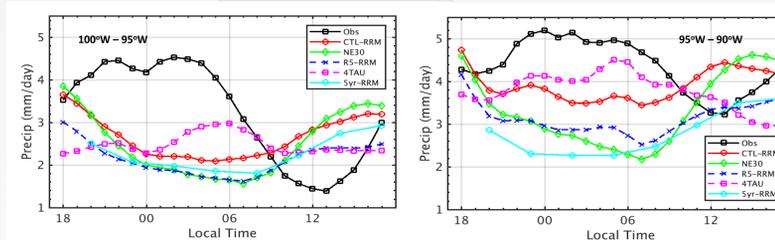


Figure 4. The diurnal cycle of surface precipitation averaged over (left) the US Great Plains (35°N-45°N and 100°W-95°W) and (right) (35°N-45°N and 95°W-90°W) from model simulations and NEXRAD observations during April-August 2011.

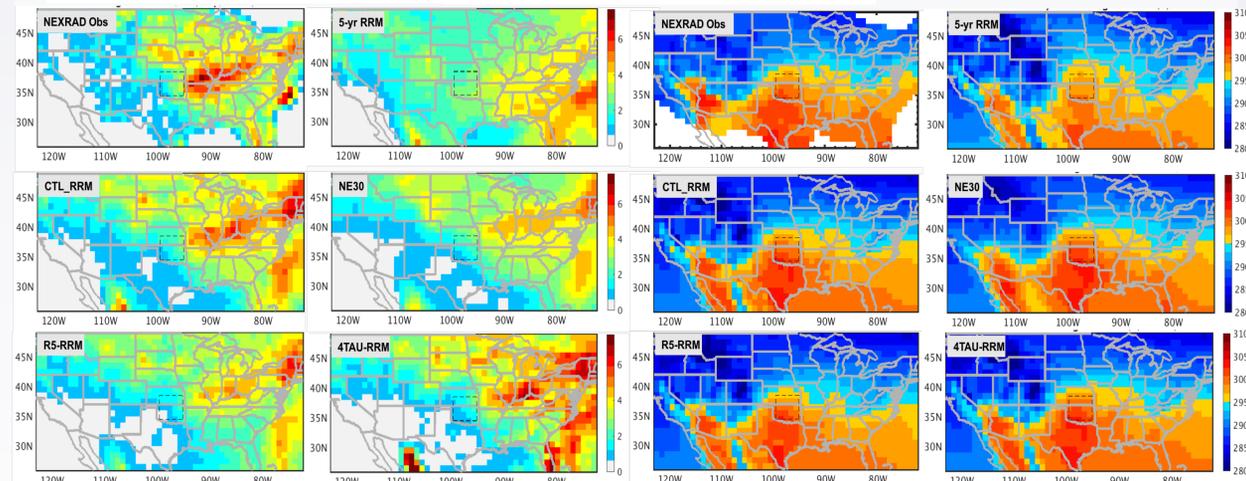


Figure 5. Mean surface precipitation from model simulations and NEXRAD observations during April-August 2011.

Figure 6. Same as Figure 5 except for 2-meter temperature

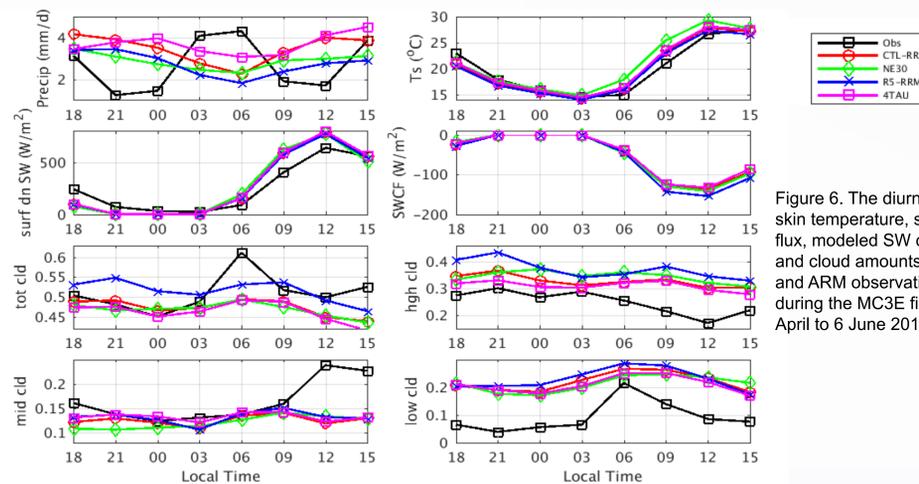


Figure 6. The diurnal cycles of precipitation, skin temperature, surface downwelling SW flux, modeled SW cloud radiative forcing, and cloud amounts from model simulations and ARM observations over the SGP site during the MC3E field campaign from 22 April to 6 June 2011.