Severe Weather in a Changing Climate:
The Need for RCMs at Convection Allowing Resolution

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Abstract:
Warm season impacts from climate change are highly localized and depend on the correct depiction of mesoscale convective precipitation systems. These systems are present on five continents and are responsible for the bulk of warm season precipitation, flash floods, and severe winds. It is essential that the dynamics of such systems are simulated in order to assess regional climate change impacts. Using existing regional climate model (RCM) output to drive convection allowing models (CAM) to better simulate the diurnal cycle of convection including propagating mesoscale convective systems will provide a much better depiction of climate change and its impacts. However, there is much work needed to build a skillful RCM with which to drive a CAM, and many improvements needed to the CAM to make it an RCM.

My presentation will highlight results from a suite of WRF RCM simulations using the Reanalysis 2 dataset and the CCSM3 A2 scenario simulation. Important processes to MCS initiation and maintenance are the northward transport of water vapor and moisture convergence by the low level jet (LLJ). Faithfully reproducing the LLJ is critical and the coarse RCM has difficulty maintaining the LLJ into the northern Great Plains, thus poorly representing the fundamental mesoscale processes driving the precipitation maximum in the northern Great Plains. Since the LLJ is still present, but misdirected, downstream areas have increased and more frequent precipitation. Correctly simulating the mesoscale processes is crucial in order to drive a limited area CAM, as the skill of the parent model contributes to the skill of the downscaling model. The CAM can account for some but not all of the errors of the driving model.

Moving to fine resolution offers the possibility of diagnosing the presumed new environments that deep convection will be developing within. Of first order importance, however, is that convection allowing models need to prove their value, and then be evaluated for use as downscaling tools for RCMs. I will highlight existing challenges with the WRF model through an example of convective initiation of an MCS at 4 km grid spacing.