Numerical Simulations Of Recent Warm-season Weather: Impacts Of A Dynamic Vegetation Parameterization

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1. Background and objectives

Several studies have demonstrated that significant feedbacks occur on seasonal time scales when vegetation is allowed to evolve as part of the dynamic modeling system (Lu et al. 2001, Eastman et al. 2001).

Prescription of the vegetation phenology based on climatology can result in strong atmospheric biases in atmospheric variables and surface fluxes (i.e., Xue et al. 1996, Lu and Shuttleworth 2002).

The impact of dynamic vegetation on ensemble dynamical forecasts of recent warm-season weather over the continental United States was assessed using the Regional Atmospheric Modeling System (RAMS) and a fully coupled dynamic vegetation version of RAMS, the General Energy and Mass Transfer-RAMS (GEMRAMS).

2. Experimental design

Two 10-member ensembles were produced for the June-August periods of both 2000 and 2001. For each period, one of the members used the standard RAMS, and the other the GEMRAMS version.

Initial and lateral boundary conditions for the regional model domain for each June-August period were provided by a 10-member global ensemble reforecast produced with the NCEP Seasonal Forecast Model (SFM), which was the operational global dynamical forecast system in use by the Climate Prediction Center during 2000-2001.

For each period, a pair of “baseline” simulations (not forecasts), one with GEMRAMS and one with RAMS, were created using the NCEP Reanalysis as initial and lateral boundary conditions.

3. Results

3.1 Precipitation: Observed vs. simulated

Both GEMRAMS and RAMS capture the general precipitation pattern, as shown by the observed precipitation (Fig. 8). However, in both cases simulated domain-averaged precipitation was higher than the observations, in particular over the southeast. Precipitation in the regional ensemble was largely controlled by the driving large-scale forcing. A large precipitation bias exists over the regional domain in the NCEP reanalysis and SFM themselves that it is amplified in the RAMS and GEMRAMS simulations. Similar results are found for July 2000 and 2001 (not shown).

3.2 Precipitation: SFM ensemble spread

The areas with the largest spread of the ensemble members tended to coincide with the areas with the largest biases, over the SE, but also over the semiarid areas on the W.

3.3 Surface latent and sensible heat fluxes

As expected from the precipitation results, simulated daytime averaged latent heat flux (LH) was higher for RAMS/GEMRAMS-SFM than for RAMS/GEMRAMS-Reanalysis. Areas with high LH values coincide with the maximum precipitation areas. Differences between RAMS and GEMRAMS simulations tended to be more noticeable over the SE, particularly when SFM boundary conditions were used. Lowest LH values are located in the western part of the domain, an area dominated by semiarid conditions. Similar results are found for sensible heat fluxes (SH); see Fig. 9.

4. Conclusions

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