REGIONAL CLIMATE SIMULATIONS OF THE 1990 NORTH AMERICAN SUMMER MONSOON

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The NCEP Regional Spectral Model (RSM) is used to simulate the North American summer monsoon for the year 1990. This year was proposed by the NAME (North American Monsoon Experiment) for regional climate modeling. Two domains are proposed for all regional models to integrate during the summer monsoon. The big domain covers the area of 15-40 N and 125-70 W, and the RSM is configured with 40 km grid spacing over this domain. The small domain covers the area of 18-37N and 117-101W, and the RSM is configured with 20 km grid spacing over the smaller domain.

The big domain is tested with a multi-month integration from May to October. The result from the continuous run over this period showed a bias toward drying out the soil moisture with less rainfall after August. The run from day one of each month provides a better result when compared to observations. The bias in the continuous multi-month integration may be due to the soil moisture problem in the land model. However, the single month runs show nearly no monsoon rainfall over the Arizona and New Mexico (AZNM) areas, which are in the geographic area of the summer monsoon.

In order to investigate the ill-simulated monsoon over AZNM, the small domain, higher resolution integration is performed using better surface conditions including terrain. The high-resolution terrain provided better resolution of the surface temperature gradient, which resolves the low level jet along the Gulf of California, that carries moisture from south to north. The low-level moisture jet provides low level atmospheric instability over the AZNM to produce ample rainfall. Thus, the high resolution of the model to resolve the low-level jet along the Gulf of California is essential. Though the time sequence of the rainfall events are well simulated, the intensity of the significant event still is not simulated well.

The problem of the horizontal diffusion over the model sigma coordinate is identified as a possible error causing less rainfall in the significant event. The modification of the horizontal diffusion on the pressure surface instead of the model sigma coordinate was developed and tested successfully (see Fig. 1), thus the rainfall intensity of the significant event is better simulated (see Fig. 2). A simple diagnosic study shows that the moisture is better distributed in the case of horizontal diffusion on the pressure surface than is the case on the sigma surface. Thus the low-level jet carried more moisture northward, causing a better rainfall distribution and intensity, especially over AZNM areas.

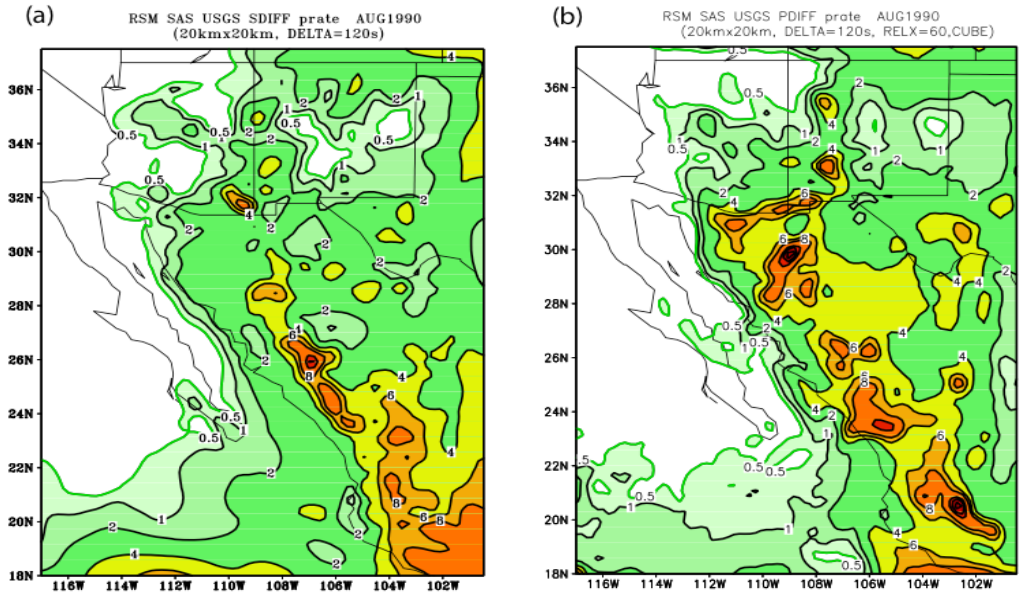

Fig. 1 Monthly accumulated rainfall for (a) perturbation diffusion on sigma surface and (b) full field diffusion on pressure surface for August 1990 from RSM with 20 km resolution.

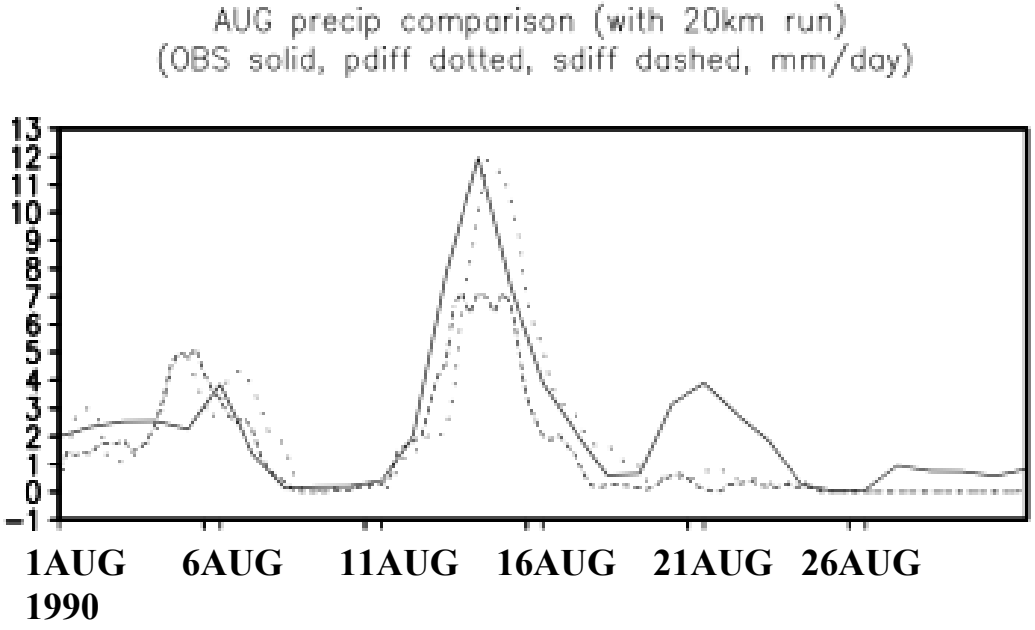

Fig. 2 Daily rainfall for August 1990 from observations (solid curve), results of diffusion on sigma surface (dashed curve) and results of diffusion on pressure surface (dotted) curve.