CLIMATE MODELING WITH SPECTRAL ELEMENTS

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Toward improving climate model-component performance and accuracy, we have developed an atmospheric component climate model entitled the Spectral Element Atmospheric Climate Model and denoted it as (CAM_SEM). CAM_SEM includes a unique dynamical core, previously reported as SEAM (Spectral Element Atmospheric Model), and we have now coupled it to the physics component of the Community Atmosphere Model (CAM) as well as its land surface component (CLM) available from NCAR. We have also included in this model the capability for local mesh refinement to seamlessly study imbedded higher-resolution regional climate concurrently with the global climate. Additionally, the numerical structure of the model based on spectral elements allows for application of state-of-the-art computing hardware most effectively and economically to produce the best prediction/simulation results with minimal expenditure of computing resources. The model has now been tested under various conditions beginning with the shallow water equations and ending with an AMIP style run that uses the initial conditions and physics used in the CAM2 AMIP experiments. For uniform resolution, the output of the model compares favorably with the published output from the corresponding CAM2 experiments. Integrations with local mesh refinement included indicate that while greater detail in the prediction of mesh refined regions, i.e., regional climate, is observed, the remaining course grid results are similar to

results obtained from a uniform grid integration of the model with identical conditions. The following figure demonstrates this result, showing the comparison of the model integration of total precipitation rate with and without LMR (local mesh refinement) over the North American region. For the complete story on the model's performance, see Baer, F., H. Wang, J. J. Tribbia, and A. Fournier, 2006: Climate modeling with spectral elements. *Mon. Wea. Rev.*, **134**, 3610–3624.