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The Community Earth System Model: Evaluation and CMIP5 simulations. Activities of the Atmosphere Model Working Group

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The latest releases of the Community Atmosphere Model (CAM), versions 4 and 5, have introduced significant simulation improvements and new capabilities to the Community Earth System Model (CESM) framework. Enhancements to the representation of deep convection in CAM4 enable more realistic simulations of tropical modes of variability including ENSO, the Madden Julian Oscillation and the diurnal cycle of rainfall. The new capability of CAM4 and CAM5 to perform simulations with the spectral element HOMME dynamical core enables them to scale efficiently on many tens of thousands of processors. This is providing a breakthrough capability to address regional earth system climate change in a global modeling framework. CAM5 is a revolution in the representation of physical processes. It includes new representations for the boundary layer, shallow convection, microphysics, radiation and for the prediction of aerosol properties. With these new process representations a whole class of research problems associated with aerosol-cloud-radiation impacts on climate and climate change can now be addressed. Mean climate simulations utilizing CAM5 have a much more realistic representation of cloud properties ranging from marine boundary layer clouds to shallow convection transition regions. In addition predictions of in-cloud microphysical and aerosol properties (particle size and number) show realistic regional distributions. Coupled CESM (CAM5) reproductions of the 20th century climate using CMIP5 emission and forcing protocols demonstrate a clear regional role for aerosol indirect effects in the evolution of the 20th century surface temperature changes. A selection of results from CAM4 and CAM5 simulations will be presented.