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Development and evaluation of the Cloud-Aerosol-Radiation ensemble modeling system

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Most parameterization schemes have been developed on the basis of limited observational data and process understanding. None performs equally well under all conditions and their predictive skills are highly selective of climate regimes. We therefore have most recently developed an unprecedented Cloud-Aerosol-Radiation (CAR) ensemble modeling system that consists of 10^18 free choices of alternative parameterizations for cloud properties (cover, water, radius, optics, geometry), aerosol properties (type, profile, optics), and radiation transfers (solar, infrared) and their interactions. These schemes form the most comprehensive collection currently available in the literature, including those used by the world leading general circulation models (GCMs). The CAR can be used to determine (via intercomparison across all schemes) or reduce (via the optimized ensemble integration) the range of the uncertainties caused by the likely cloud-aerosol-radiation interactions. That range accounts for most of the spread in climate sensitivities among GCMs and consequently their climate change projections. This poster will provide a general description of the CAR system formulation and evaluate its performance in simulating observed cloud and radiative fluxes. A major focus will be on quantifying and understanding result differences among the schemes and with observations. These analyses will be conducted at a coarse resolution over the globe and at the mesoscale in the United States as the CAR is coupled with respectively the NCAR Community Atmospheric Model version 5 (CAM5) and the regional Climate-Weather Research and Forecasting Model (CWRF). The outcome of the study will provide critical guidelines for applying the coupled CAM5/CAR and CWRF/CAR to produce more realistic seasonal-interannual climate predictions and to quantify the likelihood and uncertainty of future climate change projections.