MODEL INTERCOMPARISON OF AEROSOL EFFECTS ON LIQUID AND MIXED-PHASE CLOUDS

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While aerosol effects on liquid clouds have been the subjects of numerous studies in recent years, aerosol effects on mixed-phase clouds have received far less attention in studies of aerosol-cloud interaction. We have conducted an extensive model intercomparison focusing on aerosol effects on mixed-phase clouds, including results from six global climate models (GCMs). The intercomparison project was conducted in such a manner that aerosol influence on mixed-phase clouds could be separated from those of liquid clouds; in the first experiment conducted, the concentration of ice nuclei (IN) and the heterogeneous freezing parameterization were prescribed. In the second experiment, all models predicted their own IN concentrations, but the heterogeneous freezing parameterization was kept the same in all six models. In the third and final experiment, all models used their own internal IN concentrations and heterogeneous freezing parameterizations. All experiments were conducted twice, once with present-day aerosol emissions and once with pre-industrial emissions, so that an aerosol indirect effect could be calculated for each experiment. Model output for the PD simulation of each experiment have been compared to and validated against observations taken by the Cloud and Aerosol Lidar with Orthogonal Polarization (CALIOP) onboard the CALIPSO satellite.
This study effectively doubles the number of global estimates of aerosol indirect effect on mixed-phase clouds available in the literature, and thus significantly contributes to this frontier in the field of aerosol-cloud interactions. Furthermore, it seeks to identify the cause of differences in estimates among the models, and to use CALIOP data to identify model deficiencies in the representation of mixed-phase clouds.