Session: B7 Oral presentation

Evaluation of multidecadal variability in surface solar radiation and inferred aerosol emission history

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Earth's climate sensitivity and projections of future warming would be more narrowly constrained if we had a better understanding of the time history of anthropogenic aerosol radiative forcing during the latter part of the 20th century. A key task of the CMIP5 effort should be to determine how well the input aerosol emissions and their radiative forcing for the 20th century simulations reproduces what actually occurred in the real world. Since aerosols have a substantial impact on the scattering and absorption of solar radiation, this evaluation could be accomplished by comparing multidecadal variability in surface solar radiation produced by models with that seen in observations. Models that exhibit the observed magnitude and timing of surface solar "dimming" and "brightening" would likely have more realistic aerosol radiative forcing. Observed and simulated surface solar radiation variability over Europe and East Asia are compared for the CMIP5 models, as was previously done for the CMIP3 models. These two regions have experienced substantial changes in aerosol emissions in the decades since 1960 and have long and reliable solar radiation measurement records. One innovative approach is the removal of the effects of cloud cover variability on surface solar flux, thus allowing a more accurate assessment of aerosol radiative effects. This will be useful for model evaluation since models will not have the same cloud and weather history as the observations. Examination of multiple runs for the same model and aerosol emission history enables an assessment of the impact of differing meteorology, and examination of different models with the same aerosol history enables an assessment of the importance of the particular representation of aerosol processes. Previous results for CMIP3 models indicate that the timing and magnitude of decreasing and increasing surface solar radiation in the 20th century simulation for a model is largely independent of meteorological history and particular aerosol parameterizations but instead corresponds to the timing and magnitude of whatever input aerosol emission history was used in that model. The fact that most CMIP3 models did not reproduce the observed "dimming" and "brightening" trends over Europe and East Asia suggests that the input aerosol histories were not correct. It is critical to see whether there is improvement in the CMIP5 models.