



## **Evaluating aerosol histories with modeled and observed clear-sky surface solar radiation fluxes in Asia and Europe**

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Aerosol radiative forcings are key uncertainties in climate change. IPCC-AR4 20th century simulations, for example, largely fail to reproduce the recent observed trends in surface solar irradiance, even when radiative effects of cloud cover variations are removed. Incorrect aerosol histories are the most likely cause for the disagreement between models and observations. We test this hypothesis by running the Community Atmosphere Model CAM3.1 with four different sulfate and black carbon aerosol histories. Three of the aerosol histories were used in the fourth IPCC assessment report, whereas the fourth aerosol history is prepared for the forthcoming fifth IPCC assessment report (AR5). We constrain the aerosol histories by comparing modeled clear-sky solar irradiance at the Earth's surface with the observed fluxes in China, Japan, and Europe, from which cloud cover radiative effects have been removed. Model results show that CAM3.1 simulations forced with the different aerosol histories all tend to produce clear-sky dimming in China that is much smaller than observed. The latest AR5 emission history produces an underestimation of the solar dimming in China by about a factor of four. Solar dimming in Europe is also largely underestimated, but the disagreement between modeled and observed clear-sky solar irradiance trends is mainly caused by incorrect timing of the transition from increasing to decreasing aerosol emissions.