



## Assessment of global dimming and brightening in IPCC-AR4/ CMIP3 models and ERA40

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Observations indicate that solar radiation incident at the Earth surface underwent substantial decadal variations in the second half of the twentieth century, with a tendency towards reduction from the 1950s to the 1980s (global dimming) and a partial recovery thereafter (brightening) at widespread locations. The most reliable observational records from the Global Energy Balance Archive (GEBA) are used to evaluate the ability of the climate models participating in CMIP3/IPCC-AR4 as well as the ERA40 reanalysis to reproduce these decadal variations. The results from 23 models and reanalysis are analyzed in five different climatic regions where strong decadal variations in surface solar radiation have been observed. Only about half of the models are capable of reproducing the observed decadal variations in a qualitative way, and all models show much smaller amplitudes in these variations than seen in the observations. Largely differing tendencies between the models are not only found under all-sky conditions, but also in cloud-free conditions and in the representation of cloud effects. The ERA40 reanalysis neither reproduces the major decadal variations in surface solar radiation, despite strong observational constraints on the temporal evolution of the state of the atmosphere, since time varying aerosol loadings are missing. Climate models and reanalyses are therefore not yet at a stage to provide regionally consistent estimates of decadal changes in surface solar radiation. Reproduction of these changes would be essential for an adequate representation of regional scale climate variations and impacts, and short-term (decadal) climate projections.

### References:

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