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Assessment of variations in surface solar irradiance in coupled climate models

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There has been increased interest in the scientific community regarding the long-term variability of shortwave surface irradiance. Observations indicate that solar irradiance has been decreasing in stations worldwide by about 4% from 1961 to 1990. Cloud and aerosol changes seem the main reasons for this decline also coined global "dimming". Current research (from satellites and in situ measurements) shows a reversal of this tendency from the late 1980s during the 1990s. Up-to-date observations from satellite (ISCCP-FD from 1984 to 2000) and in situ measurements (monthly means GEBA, BSRN) of surface down-welling irradiance are analyzed and compared with global general circulation coupled model simulations (GFDL, NCAR and GISS models). The goal is to evaluate the model climatology, variability and cloud, water vapor and aerosol effects of these late 20th century transient ensemble runs. Incoming shortwave irradiance at the surface is one driving mechanism of the ocean/ice and land submodels and while it is directly affected by the physics of the atmosphere (clouds, aerosols, water vapor, ozone, gases) it is only indirectly affected by ocean/ice/land. Hence, aerosols and cloud variations have strong "direct" signals on the down-welling shortwave surface irradiance, which can be easily interpreted. At the same time, surface solar irradiance and its link to clouds and aerosols represents one crucial part of the cloud feedback loop. This study will present results of the quantification of these feedbacks and will evaluate the performance and differences of various modeling endeavors.