Inconsistencies of the incoming solar radiation boundary condition in global modeling

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An examination of global fields for the incoming solar radiation of models participating in the IPCC-FAR model intercomparison revealed inconsistencies with respect to the absolute value (solar constant) and its horizontal distribution. Particularly worrisome are significance differences during transient seasons (Feb-May, Aug-Nov) for zonal averages as function of latitude. The differences are likely to impact meridional transport processes so that biases in long-term climate simulations cannot be excluded. Possible explanations include differences in temporal sampling, differences in assumed Earth orbital parameters (eccentricity, obliquity, perihelion) and implementation issues resulting from differences in spatial and temporal (model) resolution, affecting onsets of sunrise and sunset.

Thus, model sensitivity studies were conducted to address the impact from differences to assumptions in orbital parameters to the solar irradiance cut-off at low sun-elevations. It was found that the differences in assumed orbital parameters among the different IPCC models are not large enough to explain the irradiance field discrepancies. In addition, initial simulations with modified assumptions at low sun-elevations applying two local global models (ECHAM-5 and simplified version) remained inconclusive with respect to its impact on long-term climate simulations.

There is a need to understand and eliminate these solar irradiance inconsistencies in modeling (even though their overall impact is expected to be minor in comparison to impacts from inconsistencies introduced by the representation of clouds).