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Modeler's clear sky = observer's clear sky? A CMIP5 perspective

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Clouds play a key role for Earth's energy balance, for the net incoming solar and outgoing long-wave radiation. The enhanced reflection of shortwave radiation due to clouds as compared to cloud free conditions is known as cloud radiative effect. Quantification of this effect requires knowledge of solar absorption under clear sky conditions. The definition of 'clear sky' differs, however, slightly between observations and model: a blue sky without clouds in the case of observations, and 'any sky' with clouds removed by hand in the model world. These slightly different definitions of clear sky may hamper the comparison of model and observations.

To estimate the impact of the two clear sky definitions on clear sky absorption, we exploit the long time series of the CMIP5 pre-industrial control experiments (piControl, monthly mean data). We duplicated one of the piControl simulations (MPI-ESM-LR model) to obtain another 150 years of daily data. Clear sky data corresponding to the modeler's definition is just the corresponding data in the CMIP5 archive. The observer's definition of clear sky we mimic by identifying times with very little cloud cover in the model. Comparing the two data sets we find that modeler's definition of clear sky results in a higher atmospheric absorption than the observer's definition. Differences depend on geographical location and time resolution (daily or monthly) of the underlying data. Averaged over the location of Baseline Surface Radiation Network sites, the difference reaches 1.5 to 2.5 W/m^2.