



Projections of long-term changes in solar radiation based on CMIP5 climate models and their influence on energy yields of photovoltaic systems

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Traditionally, for the planning and assessment of solar energy systems, the amount of solar radiation (sunlight) incident on the Earth's surface is assumed to be constant over the years. However, with changing climate and air pollution levels, solar resources may no longer be stable over time and undergo substantial decadal changes. Observational records covering the past decades confirm long-term changes in this quantity. Here we examine, how the latest generation of climate models used for the 5th IPCC report projects potential changes in surface solar radiation over the coming decades, and how this may affect, in combination with the expected greenhouse warming, solar power output from photovoltaic (PV) systems. For this purpose, projections up to the mid 21st century from 39 state of the art climate models from the Coupled Model Intercomparison Project Phase 5 (CMIP5) are analysed globally and for selected key regions with major solar power production capacity. The large model ensemble allows to assess the degree of consistency of their projections. Models are largely consistent in the sign of the projected changes in solar radiation under cloud-free conditions as well as in surface temperatures over most of the globe, while still reasonably consistent over a considerable part of the globe in the sign of changes in cloudiness and associated changes in solar radiation. A first order estimate of the impact of solar radiation and temperature changes on energy yields of PV systems under the RCP8.5 scenario indicates statistically significant decreases in PV outputs in large parts of the world, but notable exceptions with positive trends in parts of Europe and the South-East of China. Projected changes between 2006 and 2049 under the RCP8.5 scenario overall are on the order of 1 % per decade for horizontal planes, but may be larger for tilted or tracked planes as well as on shorter (decadal) timescales.

Related References:

Wild, M., Folini, D., Henschel, F., and Müller, B. 2015: Projections of long-term changes in solar radiation based on CMIP5 climate models and their influence on energy yields of photovoltaic systems, submitted.

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