Geophysical Research Abstracts
Vol. 17, EGU2015-3265, 2015
EGU General Assembly 2015

Decadal Variability of Surface Incident Solar Radiation over China

Kaicun Wang
Beijing Normal University, College of global change and earth system science, Beijing, China (kcwang@bnu.edu.cn)

Observations have reported a widespread dimming of surface incident solar radiation (Rs) from the 1950s to the 1980s and a brightening afterwards. However, none of the state-of-the-art earth system models, including those from the Coupled Model Intercomparison Project phase 5 (CMIP5), could successfully reproduce the dimming/brightening rates over China. This study provides metadata and reference data to investigate the observed variability of Rs in China. From 1958 to 1990, diffuse solar radiation (Rsdif) and direct solar radiation (Rsdir) was measured separately in China, from which Rs was calculated a sum. However, pyranometers used to measure Rsdif had a strong sensitivity drift problem, which introduced a spurious decreasing trend to Rsdif and Rs measurements. The observed Rsdir did not suffer from such sensitivity drift problem. From 1990 to 1993, the old instruments were replaced and measuring stations were relocated in China, which introduced an abrupt increase in the observed Rs. After 1993, Rs was measured by solid black thermopile pyranometers. Comprehensive comparisons between observation-based and model-based Rs performed in this research have shown that sunshine duration (SunDu)-derived Rs is of high quality and provide accurate estimate of decadal variability of Rs over China. SunDu-derived Rs averaged over 105 stations in China decreased at -2.9 W m-2 per decade from 1961 to 1990 and remained stable afterward. This decadal variability has been confirmed by the observed Rsdir, independent studies on aerosols and diurnal temperature range, and can be reproduced by certain high-quality earth system models. However, neither satellite retrievals (the Global Energy and Water Exchanges Project Surface Radiation Budget (GEWEX SRB)) nor reanalyses (ERA-Interim and Modern-Era Retrospective analysis for Research and Applications (MERRA)) can accurately reproduce such decadal variability of Rs over China for their exclusion of annual variability of tropospheric aerosols.