Evaluation of Satellite-Based, Modeled-Derived Daily Solar Radiation Data for the Continental United States

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ABSTRACT

Decision support tools for agriculture often require meteorological data as inputs, but data availability and quality are often problematic. Difficulties arise with daily solar radiation (SRAD) because the instruments require electronic integrators, accurate sensors are expensive, and calibration standards are seldom available. NASA's Prediction of Worldwide Energy Resources (NASA/POWER; power.larc.nasa.gov) project estimates SRAD based on satellite observations and atmospheric parameters obtained from satellite observations and assimilation models. These data are available for a global 1° × 1° coordinate grid. The SRAD can also be generated from atmospheric attenuation of extraterrestrial radiation (Q_0). We compared daily solar radiation data from NASA/POWER ($SRAD_{NP}$) with instrument readings from 295 stations (observed values of daily solar radiation, $SRAD_{OB}$) and values estimated by Weather Generator for Solar Radiation (WGENR) generator. Two sources of air temperature and precipitation records provided inputs to WGENR: the stations reporting solar data and the NOAA Cooperative Observer Program (COOP) stations. The resulting data were identified as solar radiation valaues obtained using the Weather Generator for Solar Radiation software in conjunction with daily weather data from the stations providing values of observed values of daily solar radiation ($SRAD_{WG}$) and solar radiation values obtained using the Weather Generator for Solar Radiation software in conjunction with daily weather data from NOAA COOP stations ($SRAD_{CO}$), respectively. Values of $SRAD_{NP}$ for individual grid cells consistently showed higher correlations (typically 0.85–0.95) with $SRAD_{OB}$ than did $SRAD_{WG}$ or $SRAD_{CO}$. Mean values of $SRAD_{OB}$, $SRAD_{WG}$, and $SRAD_{NP}$ for a grid cell usually were within 1 MJ m^{-2} d^{-1} of each other, but NASA/POWER values averaged 1.1 MJ m^{-2} d^{-1} lower than $SRAD_{OB}$. This bias increased at lower latitudes and during summer months and is partially explained by assumptions about ambient aerosol properties. The NASA/POWER solar data are a promising resource for studies requiring realistic accounting of historic variation.