



Validation of Hourly Global Horizontal Irradiance for two Satellite-Derived Database over nine Stations in two Climate Regions in Iraq

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Abstract: Several sectors need Global Horizontal Irradiance (GHI) data for various purposes namely solar energy, architecture and agriculture. The availability of long term time series of high quality in-situ GHI measurements are limited. Therefore, several studies have tried to estimate it from reanalysing climate data or from satellite images. Validation is essential for later use of GHI data in the regions with a scarcity of ground recorded data. This study contributes to previous studies carried out in the past to validate HelioClim-3 version 5 (HC3v5) and Copernicus Monitoring Atmospheric Service radiation service version3 (CAMS radiation service v3) Satellite-Derived Datasets (SDD) with nine ground stations in northeast Iraq which have not been used previously. The validation not only done with station pixel data but it covers two other data points around each station, which is limited in the literature. This aims at checking the spatial reliability of GHI for all sky, clear and cloudy sky conditions. The three sky situations are identified using appropriate thresholds on the clearness index. Hourly data have been used for validation, and monthly means of hourly GHI are also computed to show the variability according to standard deviation between satellite and ground data. The temporal and spatial trends of ground data are well presented by the two SDDs. Correlation ranges from 0.94 to 0.97 in all sky and clear sky conditions in most cases while for the cloudy sky is between 0.51–0.72 and is between 0.82–0.89 for clearness index. Bias is negative for most cases except three stations were positive, and it ranges are from -7% to 4% (Mean 510 W/m²) and -8% to 3% (Mean 675 W/m²) respectively for all sky and clear sky conditions. For cloudy conditions, bias are positive and varies from one station to another, from 16% to 85% (Mean 117 W/m²). The cases are nearly the same for RMSE. It ranges between 14–18% and 8%–12% respectively for all and clear sky conditions. In contrast, ranges are much higher in cloudy conditions and are above 56%. The bias and RMSE in clearness index are nearly the same of all sky conditions. The spatial variability of GHI SDD differs only by 2% for station location compared to data points around each station by validation them with measured data separately. The variability of two SDD is quite similar to the ground data based on a mean and standard deviation of hourly GHI in a month. Having different timescale stations data, unavailability of other components of solar radiation and the limited number of stations with GHI records in the region are the main limitations of this analysis.

Keywords: global horizontal irradiance, satellite-derived database, validation