One Year of Ground-Based Solar Irradiance Measurements: Data Quality Assessment and Insights from Limassol Cyprus Site

G. Charalampous[1,2*]; K. Fragkos[3,1]; I. Fountoulakis[4,5] ; D. Hadjimitsis[1,2]; S. Kazadzis[6]

[1]Department of Resilient Society /Department of Environment and Climate Eratosthenes Centre of Excellence, Fragklinou Rousvelt 82, 3012 Limassol, Cyprus
[2]Department of Civil Engineering & Geomatics, Cyprus University of Technology, 3036 Limassol, Cyprus
[3] Climate and Atmosphere Research Center, the Cyprus Institute, Konstantinou Kavafi 20, 2121 Aglantzia, Nicosia, Cyprus
[4]Institute for Astronomy, Astrophysics, Space Applications and Remote Sensing, National Observatory of Athens (IAASARS/NOA), GR15236 Athens, Greece
[5]Research Centre for Atmospheric Physics and Climatology, Academy of Athens, 106 79 Athens, Greece
[6]Physikalisch-Meteorologisches Observatorium Davos, World Radiation Center (PMOD/WRC), Davos 7260, Switzerland

Georgia.charalambous@eratosthenes.or.cy

This study presents a comprehensive evaluation of the first year (2024) of ground-based solar radiation measurements conducted at Limassol, Cyprus [34.67° N, 33.04°E, altitude of 31m]. The data include global horizontal irradiance (GHI), direct normal irradiance (DNI), and diffuse horizontal irradiance (DHI), with an annual availability exceeding 99%. The measurements underwent rigorous quality control procedures, including range, closure, and consistency tests, ensuring the reliability of the dataset. Annual sums of irradiance reveal a total of [1941 kWh/m²], with DNI contributing [2266 kWh/m²], emphasizing the region's high solar energy potential. Temporal variations indicate peak solar energy availability during summer, with marked diurnal and seasonal patterns influenced by solar zenith angle and atmospheric conditions.

The station follows the Baseline Surface Radiation Network (BSRN) recommendations for quality control procedures, ensuring robust and reliable data for long-term analysis. Closure tests were performed to verify the consistency among the radiation components by assessing the ratio of diffuse to global horizontal irradiance (DHI/GHI) and the ratio of global horizontal irradiance to the sum of direct and diffuse irradiance (GHI/(DNI + DHI)). Both ratios are expected to remain close to 1 under normal conditions, indicating the physical coherence of the measurements. The results confirmed the dataset's accuracy, with minimal deviations observed under specific atmospheric conditions.

These measurements represent the first year of operation, but the station is designed for long-term monitoring to support ongoing research and regional energy planning. The dataset serves as a benchmark for validating solar energy forecasting models and investigating atmospheric radiative transfer processes. Furthermore, the findings underscore the value of continuous, high-quality ground-based measurements in addressing regional energy planning and climatic research needs.

Keywords: Solar Radiation Measurements, solar energy, climatic research, Cyprus

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