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Solar resource assessment through long-term statistical analysis and typical data generation with different time resolutions using GHI measurements

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Abstract

This work addresses the solar resource assessment through long-term statistical analysis and typical weather data generation with different time resolutions, using measurements of Global Horizontal Irradiation (GHI) and other relevant meteorological variables from eight ground-based weather stations covering the south and north coasts and the central mountains of Madeira Island, Portugal. Typical data are generated based on the selection and concatenation of hourly data considering three different time periods (month, five-day and typical days) through a modified Sandia method. This analysis was carried out by computing the Root Mean Square Difference (RMSD) and the Normalized RMSD (NRMSD) for each time slot of the typical years taking the long-term average as reference. It was found that the datasets generated with typical days present a lower value of overall NRMSD. A comparison between the hourly values of the generated typical data and the long-term averages was also carried out using various statistical indicators. To simplify this analysis, those statistical indicators were combined into a single Global Performance Index (GPI). It was found that datasets based on typical days have the highest value of GPI, followed by the datasets based on typical five-day periods and then those based on typical months.

Keywords

Solar resource assessment; Global Horizontal Irradiation; Typical Meteorological Year; Madeira Island

Nomenclature

FS Finkelstein-Schafer statistics

GPI Global Performance Index

H Hourly global horizontal irradiation (kWh/m²-hour)

\bar{H} Long-term average of hourly global horizontal irradiation (kWh/m²-hour)

k Ranked order number

MBE Mean Bias Error (kWh/m²-hour, °C, % or m/s)

n Total number of data records

N Number of daily records in a month

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