Development and Comparison of Typical Meteorological Years for Renewable Energy Applications in Oman Using Ground and Satellite Meteorological Data

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Abstract

Historical records of weather and solar radiation data are used to generate a representative year for the weather profile of a studied location. The representative year is called the typical meteorological year (TMY). The TMY is used in many applications including energy analysis and feasibility studies. The TMY is usually generated using weather and solar radiation data from ground stations.

The availability of trusted ground data has been a challenge for researchers, especially solar irradiance data. This study investigates the use of weather data from satellite data for generating typical meteorological years in place of ground source data.

The investigated parameters are solar irradiance, dry bulb temperature, dew point, humidity and wind speed. Data are investigated for 17 different locations in Oman, which are Adam, Adam Airport, Baushar, Diba, Duqm Airport, Ibri, Madha, Mahdha, Majis, Manah, Muscat Airport, Qarn Alam, Saham, Samail, Sur and Thumrait.

Most of ground stations in these locations are relatively new; therefore, the available data history from ground stations are less than five years.

The ground and satellite data are compared side by side and analyzed, the solar irradiance data are checked for their quality and the coefficient of determination ($R^2$) is calculated for the compared data.

It has been found that the quality of the satellite solar irradiance data is very good and matching with the ground data. The coefficient of determination ($R^2$) for solar irradiance data is over 0.9. The analysis revealed that the dry bulb temperature is matching very well too. The other weather parameters do not match as well. The most important parameter in the study was the solar irradiance because ground measurements for the other parameters are commonly available.

Hence, the solar irradiance and dry bulb temperatures data from satellite sources can be used in the case when ground solar irradiance are missing. Humidity, dew point and wind speed cannot be used. Satellite weather data were used to generate TMY’s for the analyzed locations in Oman.

This research will be of value in renewable energy applications and research in Oman because it eliminates the limitation encountered with data availability.