Simulations to Predict Solar Energy Potential by ERA5 Application at North Africa

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Abstract : The design of any solar energy conversion system requires the knowledge of solar radiation data obtained over a long period. Satellite data has been widely used to estimate solar energy where no ground observation of solar radiation is available, yet there are limitations on the temporal coverage of satellite data. Reanalysis is a "retrospective analysis" of the atmosphere parameters generated by assimilating observation data from various sources, including ground observation, satellites, ships, and aircraft observation with the output of NWP (Numerical Weather Prediction) models, to develop an exhaustive record of weather and climate parameters. The evaluation of the performance of reanalysis datasets (ERA-5) for North Africa against high-quality surface measured data was performed using statistical analysis. The estimation of global solar radiation (GSR) distribution over six different selected locations in North Africa during ten years from the period time 2011 to 2020. The root means square error (RMSE), mean bias error (MBE) and mean absolute error (MAE) of reanalysis data of solar radiation range from 0.079 to 0.222, 0.0145 to 0.198, and 0.055 to 0.178, respectively. The seasonal statistical analysis was performed to study seasonal variation of performance of datasets, which reveals the significant variation of errors in different seasons—the performance of the dataset changes by changing the temporal resolution of the data used for comparison. The monthly mean values of data show better performance, but the accuracy of data is compromised. The solar radiation data of ERA-5 is used for preliminary solar resource assessment and power estimation. The correlation coefficient (R^2) varies from 0.93 to 99% for the different selected sites in North Africa in the present research. The goal of this research is to give a good representation for global solar radiation to help in solar energy application in all fields, and this can be done by using gridded data from European Centre for Medium-Range Weather Forecasts ECMWF and producing a new model to give a good result.
Keywords : solar energy, solar radiation, ERA-5, potential energy
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