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Comparative Study on the Accuracy of Selected Solar Radiation Models Against Measured Data Under Tropical Climate

Abstract
Availability of high accuracy time-series solar radiation data is of primary importance in the prediction of energy produced by solar energy conversion devices. Since performance of any solar energy system is site-dependent, it is beneficial if local operating conditions are known at the planning stage. Unfortunatîely, ground-based measurements of solar radiation are lacking in most locations where solar appliances are installed due to high cost and maintenance of the solar radiation measurement equipment. To overcome this limitation, solar radiation data can be obtained by several sources such as numerical weather prediction models, satellite base forecast, all sky images and ground measurements at nearby public weather stations. However, these data are characterized by the type of data they produce and spatial-temporal granularity, hence generated data may be more or less accurate at the application site given the variability of the weather phenomena. Numerical radiation models are widely used to estimate solar radiation, but need to be validated by high-quality solar radiation data measured at different climates in order to improve their accuracies. In this work, comparison of one year solar radiation data measured using a reference solar cell at a location in western Kenya with the corresponding data generated from four selected models are presented. Reasonable agreements between measured and modeled data were realized with absolute uncertainties of 12.6%, 8.5%, 15.5% and 11% for Hargreaves-Samanni, Angstrom, Iqbal, and ASHRAE models respectively. Hence, the Angstrom model yields more accurate prediction of solar radiation at the site compared to the other models.
Keywords: Solar, irradiance, data, measurement, model, devices.

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