

Determination of Direct Solar Radiation Using Atmospheric Physics Models

Authors : Pattra Pukdeekiat, Siriluk Ruangrungrrote

Abstract : This work was originated to precisely determine direct solar radiation by using atmospheric physics models since the accurate prediction of solar radiation is necessary and useful for solar energy applications including atmospheric research. The possible models and techniques for a calculation of regional direct solar radiation were challenging and compulsory for the case of unavailable instrumental measurement. The investigation was mathematically governed by six astronomical parameters i.e. declination (δ), hour angle (ω), solar time, solar zenith angle (θ_z), extraterrestrial radiation (I_{so}) and eccentricity (E_0) along with two atmospheric parameters i.e. air mass (m_r) and dew point temperature at Bangna meteorological station (13.67° N, 100.61° E) in Bangkok, Thailand. Analyses of five models of solar radiation determination with the assumption of clear sky were applied accompanied by three statistical tests: Mean Bias Difference (MBD), Root Mean Square Difference (RMSD) and Coefficient of determination (R^2) in order to validate the accuracy of obtainable results. The calculated direct solar radiation was in a range of 491-505 Watt/m² with relative percentage error 8.41% for winter and 532-540 Watt/m² with relative percentage error 4.89% for summer 2014. Additionally, dataset of seven continuous days, representing both seasons were considered with the MBD, RMSD and R^2 of -0.08, 0.25, 0.86 and -0.14, 0.35, 3.29, respectively, which belong to Kumar model for winter and CSR model for summer. In summary, the determination of direct solar radiation based on atmospheric models and empirical equations could advantageously provide immediate and reliable values of the solar components for any site in the region without a constraint of actual measurement.

Keywords : atmospheric physics models, astronomical parameters, atmospheric parameters, clear sky condition

Conference Title : ICGG 2016 : International Conference on Geology and Geophysics

Conference Location : Barcelona, Spain

Conference Dates : February 15-16, 2016