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What are the most suitable basic solar irradiance models for Southern Africa?

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Solar irradiance modelling is critical for determining local solar energy potential. Several past studies have analysed the more easily attainable Global Horizontal Irradiance (GHI) within Southern Africa. However, less research has been carried out on the physically more useful Direct Normal Irradiance (DNI) and Diffuse Horizontal Irradiance (DHI). This study aims to alleviate this by investigating for these local sites simple clear sky models which are solely dependent on the solar zenith angle and identifying the appropriate scaling parameters for DNI and DHI. The accuracy of the Meinel model for DNI and a Logarithmic model for DHI are evaluated and compared to the Power Law model more commonly used in solar irradiance modelling. The model evaluations were conducted using 1-minute resolution data taken from 5 stations within the SAURAN network: Vanrhynsdorp, Richtersveld, Graaff-Reinet (all located in South Africa), Gaborone (Botswana) and Windhoek (Namibia) over the period 2014-2021, with a minimum of 13 clear sky days selected per station covering all seasons.

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