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A new locally-adaptive method to derive direct and diffuse components from global irradiance

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Observations and estimates of solar radiation at ground level deal most frequently with global irradiance (GHI) while direct irradiance (DHI) is needed for various applications, including design of system converting solar energy in electricity. Obtaining data set on direct irradiance is an issue which is often resolved by the application of empirical global-to-direct models. Several suc models are proposed in the literature. They are obtained by fit of an empirical function onto measurements made at few stations. These models are well suited to a given climatic region, and their accuracy cannot be stated a priori when applied to other climates.
A new method is proposed. A general shape of the relationship between the clearsky index (Kc) and the ratio of the diffuse to global irradiance (fD) is derived from literature and analysis of several data sets of ground measurements. This analytical function needs two parameters. One is defined by the case of the overcast skies, where we fix fD to 0.95 when Kc is less than 0.2 or GHI less than 150 W/m2, from experience. The other is changing depending on the clear-sky conditions for the location and time under concern. A clear-sky model provides the Kc and fD for the clear-sky conditions. The new method was validated against BSRN (Baseline Surface Radiation Network) ground measurements made in Carpentras, Sede Boqer and Tamanrasset sites. It reveals itself accurate compared to other methods. For the data sets used, the bias amounts to 0%, -9% and 10%, the standard-deviation to 16%, 19% and 21% and the correlation coefficient to 0.98, 0.96 and 0.95. The proposed method is interesting because it is flexible and adaptive –meaning that it can be apply at any location or season, and it offers room for improvements.