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Estimation of aerosol optical properties from all-sky imagers

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Aerosols are one of the most important constituents in the atmosphere that affect the incoming solar radiation, either directly through absorbing and scattering processes or indirectly by changing the optical properties and lifetime of clouds. Under clear skies, aerosols become the dominant factor that affect the intensity of solar irradiance reaching the ground. It has been shown that the variability in direct normal irradiance (DNI) due to aerosols is more important than the one induced in global horizontal irradiance (GHI), while the uncertainty in its calculation is dominated by uncertainties in the aerosol optical properties.
In recent years, all-sky imagers are used for the detection of cloud coverage, type and velocity in a bouquet of applications including solar irradiance resource and forecasting. However, information about the optical properties of aerosols could be derived with the same instrumentation.
In this study, the aerosol optical properties are estimated with the synergetic use of all-sky images, complementary data from the Aerosol Robotic Network (AERONET) and calculations from a radiative transfer model. The area of interest is Plataforma Solar de Almería (PSA), Tabernas, Spain and data from a 5 month period are analyzed.
The proposed methodology includes look-up-tables (LUTs) of diffuse sky radiance of Red (R), Green (G) and Blue (B) channels at several zenith and azimuth angles and for different atmospheric conditions (Angström α and β, single scattering albedo, precipitable water, solar zenith angle). Based on the LUTS, results from the CIMEL photometer at PSA were used to estimate the RGB radiances for the actual conditions at this site. The methodology is accompanied by a detailed evaluation of its robustness, the development and evaluation of the inversion algorithm (derive aerosol optical properties from RGB image values) and a sensitivity analysis about how the pre-mentioned atmospheric parameters affect the results.