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Estimation of cloud coverage/ type and aerosol optical depth with all-sky imagers at Plataforma Solar de Almeria, Spain

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Aerosols and clouds affect strongly the incoming solar radiation. Under cloud-free skies, aerosols become the dominant factor that affect the direct normal and the global horizontal irradiance (DNI and GHI respectively). For cloudy skies, the spatial and temporal variability of clouds is a challenging issue on solar irradiance resource and forecasting.
In recent years, all-sky imagers are used for the detection of aerosol optical properties, cloud coverage, type and velocity in numerous applications including meteorological observations and solar energy control systems. In this presentation, a detailed overview of the methodologies developed at the Plataforma Solar de Almeria (PSA), in the framework of the EU project “Direct Normal Irradiance Nowcasting methods for optimized operation of concentrating solar technologies” (DNICast, http://www.dnicast-project.net/) is presented.
In the framework of DNICast, we develop and provide aerosol optical depth (AOD) as intermediate product of cloud camera images as a basis for an AOD/DNI nowcasting scheme. Our main purpose is to analyze sky images being created and produced by a low-cost Mobotix Q24M off-the-shelf surveillance camera in order to estimate the AOD at different wavelengths from RGB intensities (Red, Green, Blue channels) of the photo. We use the RGB intensities/radiances from the zenith point and the size of the saturated area around the sun as input for the AOD determination. These data are taken into account in a multi-linear approach to estimate the AOD values at 440, 500 and 675nm and compared with the measurements of a CIMEL sun photometer at the same wavelengths. According to results, the mean/median difference and the standard deviation are less than 0.01 and 0.03 for all wavelengths.
For the estimation of cloud coverage and type, we used several spectral and textural metrics mainly based on the method proposed by Kazantzidis et al. (2012). Notably, the spectral metrics are now only applied on cloudy pixels instead of on the full image. The classification algorithm provided two possible implementations of cloud type classification: i) Global cloud classification: classification of dominant cloud type and ii) Grid-based cloud detection: a classification of the cloud type is provided per grid element in the image. Based on visual human observation, the accuracy of the global cloud classifier ranges between 76 % (for cirrus cloud) and 84 % (for cumulus).