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Calibrated CCD imager for aerosol optical and physical properties estimation

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Ground-based sky imagery has been used for years for cloud cover assessment. Previous work with the All-Sky Imager developed in the Atmospheric Physics Group at University of Granada (Cazorla et al, 2008) revealed the potential of the ground-based sky imagery for aerosol optical properties characterization. Considering the increasing interest in automatic ground-based devices that could provide solutions that combine the cloud and aerosol characterization in the same instrument, the development of techniques to extract aerosol characteristics from sky imagers can help the existing aerosol data bases such as AERONET (Holben et al, 1998).

The Whole Sky Imager (WSI) (Shields et al., 1998), a calibrated ground-based sky imager has been tested to determine optical properties and a preliminary test has been performed to determine physical properties of the atmospheric aerosol. Different neural network models estimate the aerosol optical depth (AOD) for three wavelengths using the radiance extracted from the principal plane of sky images from the WSI as input parameters. The models use data from a CIMEL CE318 (Holben at al., 1998) radiometer for training and validation.

The data set selected in this work comprises the period from October 1st 2001 to September 29th 2002. This data set let us model the seasonal variability of the atmospheric aerosol. Using the cloud decision images from the WSI we removed all the cases with clouds, to work with the clear-sky results. A total of 1047 clear-sky image sets (i.e. 3 spectral images acquired in one set) were associated with a synchronous CIMEL measurement, applying a ±2 minutes margin for the AOD estimation. We also associate the WSI wavelengths (450, 650 and 800 nm) with the nearest CIMEL wavelength (440, 675 and 870 nm, respectively). A total of 84 principal planes from the WSI were associated with synchronous CIMEL principal plane measurements applying the same margin and the same wavelengths association. Figure 1 shows and example of the agreement of the WSI and CIMEL principal planes.

The AODs and radiance over the principal plane are compared to those retrieved by the CIMEL. The correlation reveals that an inversion code can be applied using the images from the WSI to provide physical properties of the aerosol (size distribution).

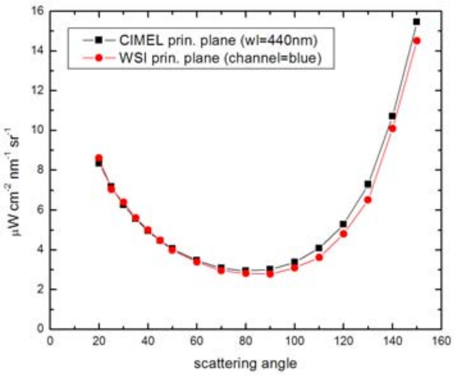

Figure 1.The agreement of the CIMEL and WSI principal planes can be see in this graph. The 440nm and blue filters of the instruments were used respectively.

The deviations between the WSI derived AOD and the AOD retrieved by AERONET are within the nominal uncertainty assigned to the AERONET AOD calculation (±0.01), in 80% of the cases. The explanation of data variance by the model is over 92% in all cases. The correlation between the WSI and CIMEL principal planes is over 95% for the 450 and 650 nm and 88% for the 800 nm channel.

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