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AEROSOL CHARACTERIZATION WITH A CALIBRATED CCD SKY IMAGER

Alberto Cazorla, Francisco Olmo, Lucas Alados-Arboledas,
University of Granada, Centro Andaluz de Medio Ambiente
Richard Wagener, *Brookhaven National Laboratory*
Janet Shields, *University of California, San Diego*

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Brookhaven National Laboratory
P.O. Box, Upton, NY
www.bnl.gov

ABSTRACT

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 (University of Granada) revealed the potential of the ground-based sky imagery for aerosol optical properties characterization. By developing techniques to extract aerosol characteristics from sky imagers, we can supplement the existing aerosol data bases such as the Aerosol Robotic Network (AERONET). The whole sky imager (WSI), 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 radiometer for training and validation. The AODs and radiance over the principal plane are compared to those retrieved by the CIMEL. The correlation reveals that an inversion code can converge and provide physical properties of the aerosol (size distribution). The data set selected in this work comprises the period from October 1, 2001 to September 29, 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., three 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. 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.