Lidar depolarization evolution during the CHARMEX intensive field campaign

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Atmospheric aerosol directly and indirectly affects the Earth-Atmosphere energy budget. Regarding the direct effect, the uncertainties related to the radiative forcing of the atmospheric aerosol are still too large as the IPCC showed up in 2007. A better knowledge about the radiative and physical properties of the atmospheric aerosol (e.g. refractive index, volume size distribution and shape) is necessary to reduce these uncertainties. Particularly, microphysical inversion codes developed in recent years model aerosol particles as spheroids. In this sense, particle linear depolarization ratio (δ^p), directly related to its shape, is becoming a key property for the microphysical characterization.

The main objective of CHARMEX (Chemistry-Aerosol Mediterranean Experiment) is developing and coordinating regional research actions for a scientific assessment of the present and future state the atmospheric environment in the Mediterranean Basin, and of its impacts on the regional climate, air quality, and marine biogeochemistry. Concretely, CHARMEX intensive campaign provides a real data base with vertical resolution for checking 3-D modelling of African dust aerosol radiative impact. During this campaign, lidar measurements were performed continuously during 72 hours.

In this work, the temporal evolution of δ^p is analysed in order to investigate the variability of this property. δ^p is calibrated by means of ±45º-calibration method (Bravo-Aranda *et al.*, 2012) and only values where the backscattering ratio (aerosol-to-molecular backscatter coefficient ratio) is higher than 1.2 are used as the equation is instable for lower backscattering ratios. This property is analysed in synergy with the backscatter-related Angström exponent ($å_\beta$) derived from lidar. Also, air masses analysis is performed using the backward trajectories from HYSPLIT model (www.arl.noaa.gov/HYSPLIT.php).

Figure 1 shows δ^p at 532 nm obtained during CHARMEX campaign. The upper layer (3.52-5.49 km asl), detected at 12:30-13:00 on 9th July, presented δ^p and $å_\beta$ values with mean and standard deviation of 0.36±0.01 and -0.06±0.05, respectively. These values are typically representative of pure Saharan dust. In fact, backward trajectories show that air masses that reached Granada between 3 and 5 km asl came from the centre of the Sahara Desert between 2 and 4 km asl. However, during following days, δ^p in the upper layers decreases up to values around 0.25 whereas $å_\beta$ increases up to values around 0.5. This change can be related to mixing process of dust particles with marine or biomass burning aerosol. In this sense, backward trajectories show that air masses came from Atlantic Ocean or regions near to Central Africa where FIRMS locates several forest fires (http://firms.modaps.eosdis.nasa.gov/firemap).

In the lowermost troposphere, δ^p remains almost constant (during the whole period) around 0.12 with $å_\beta$ values around 2. Low values of $å_\beta$ indicate the predominance of the fine mode while lower δ^p indicate more spherical particles. Therefore, the mixing between the anthropogenic and Saharan aerosol was detected in these layers.

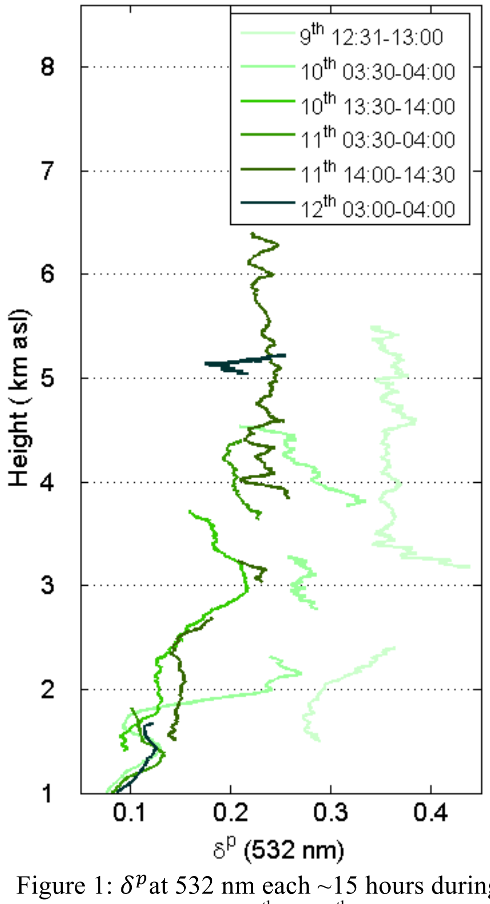

Figure 1: δ^p at 532 nm each ~15 hours during CHARMEX from 9th to 12th July 2012.

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