COORDINATED LIDAR OBSERVATIONS OF SAHARAN DUST OVER EUROPE IN THE FRAME OF EARLINET-ASOS PROJECT DURING CALIPSO OVERPASSES: A CASE STUDY ANALYSIS WITH MODELING SUPPORT

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Abstract

Coordinated lidar observations of Saharan dust over Europe are performed in the frame of the EARLINET (2000-2003) and the EARLINET-ASOS (2006-2011) projects. At present, EARLINET-ASOS consists of 25 stations: 16 Raman lidar stations, including 8 multi-wavelength (3+2 station) Raman lidar stations which are used to retrieve aerosol microphysical

properties. Since the launch of the CALIOP, the two-wavelength space-borne lidar on board the CALIPSO satellite on June 2006, the EARLINET-ASOS lidar network has been performing correlative aerosol measurements during CALIPSO overpasses over the individual stations. The measurement strategy of EARLINET is as follows: Measurements are performed at all stations within 80 km from the overpasses and additionally at the lidar station which is closest to the actually overpassed site. If a multi-wavelength Raman lidar station is overpassed then also the next closest 3+2 station performs a measurement. Previous work based on direct intercomparisons between CALIPSO profiles and attenuated backscatter profiles obtained by EARLINET lidars looked very promising.

Previous systematic dust observations over Europe in the frame of EARLINET showed that multiple aerosol dust layers of variable thickness (300-7500 m) were observed. The center of mass of these layers was located in altitudes between 850-8000 m. However, the mean thickness of the dust layer typically stayed around 1500-3400 m and the corresponding mean center of mass ranged from 2500 to 6000 m. Mean aerosol optical depths (AOD), extinction-to-backscatter ratios (lidar ratios, LR) and linear depolarization ratios of desert aerosols ranged from 0.1 to 0.25 at the wavelength of 355 or 351 nm, 30 to 80 sr at 355 or 351 nm and 10 to 25% at 532 nm respectively, within the lofted dust plumes. In these plumes typical Saharan dust backscatter coefficients ranged from 0.5 to 2 $Mm^{-1}sr^{-1}$. Southern European stations presented higher variability of the LR values and the backscatter-related Ångström exponent values (BRAE) (LR: 20-100 sr; BRAE: -0.5 to 3) than northern ones (LR: 30-80 sr; BRAE: -0.5 to 1).

Several observations of the horizontal and vertical extent of the Saharan dust intrusions over Europe during the period June 2006 to May 2008 have been performed. The number of dust events is generally greatest in late spring, summer and early autumn periods, mainly in Southern (S) and South-eastern (SE) Europe. We report on correlative aerosol lidar measurements performed during the CALIPSO overpasses over the EARLINET-ASOS stations obtained during Saharan dust intrusions. A measurement example is presented and analyzed to show the potential of a ground based lidar network to follow a dust event over a specific study area, in correlation with the CALIOP measurements. The dust transport over the studied area was simulated by the DREAM forecast model which predicts the three-dimensional field of the dust concentration in the troposphere taking into account all major processes of the dust life cycle, such as dust production, horizontal and vertical diffusion and advection and wet and dry deposition, while the smoke aerosol plumes were simulated by the FLEXPART code, run in the backward mode. Cross-section analyses of CALIOP over the study area were used to assess the model performance for describing and forecasting the vertical and horizontal distribution of the dust field over the Mediterranean. Our preliminary results can be used to reveal the importance of the synergy between the CALIOP measurement and the dust model, assisted by ground-based lidars, for clarifying the overall transport of dust over the European continent.

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