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Ground-based measurements of Saharan dust optical properties in the frame of the European MEDUSE Project

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The Sahara and its peripheral regions export several million tons of dust particles per year [*d'Almeida et al.*, 1985]. Those particles represent the most important component of non anthropogenic aerosols and their characterization is important for many fields of Earth science. They play a major role on the local radiative forcing [*IPCC*, 1996] and influence significantly the biogeochemical trace elements in the ocean [*Buat-Menard and Chesselet*, 1979].

The overall objective of MEDUSE (MEditerranean DUSt Experiment) since March 1996 is to develop and implement a prototype system for monitoring and forecasting the atmospheric transport of desert dust in the Mediterranean region. It is based on a numerical weather prediction model enhanced by modules of dust uptake, transport, and wet and dry deposition. A dust alert is given when according to the forecast of the model dust events are likely to be observed. Those simulated dust events are being validated by means of an extensive and intensive measurement program, including aerosol remote sensing using Meteosat platform [*Dulac et al.*, 1992], ground based measurements using lidars and sun photometers, chemical characterization of aerosol particles, and deposition flux measurements.

Lidar measurements allow us to determine the structural and optical properties of scattering layers [Chazette et al., 1995] such as Saharan dust cloud. These lidar profiles will be used to validate the dust transport model over the two lidar stations of Obervatoire de Haute Provence (-OHP- southern France) and Thessaloniki (Greece). Simultaneously, optical thickness and mean Angström coefficient are retrieved from sun photometer measurements at Thessaloniki and are used to point out Saharan dust events, thus validating the model prediction. Figure 1 gives the temporal evolution from April to October 1996 above Thessaloniki of mean optical thickness at 532 nm and mean visible Angström coefficient.

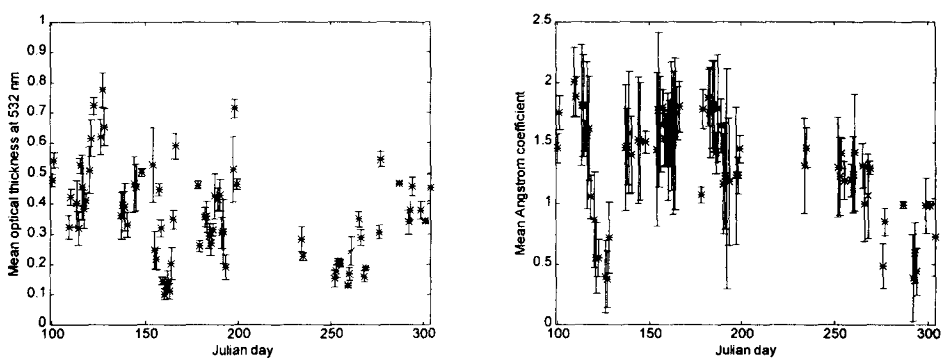

Figure 1: Optical thickness and Angström coefficient in the visible domain obtained from sun photometer measurements over Thessaloniki. Bars stand for the associated standard deviations.

The Saharan dust events are associated to a small Angström coefficient (smaller than 0.5) and an enhancement of the optical thickness. Three Saharan dust events have been observed: 1) from the 1st to the 8th of May (Julian days 122 to 130); 2) around the 2nd of October (Julian day 276); 3) from the 17th to 22nd of October (Julian days 291 to 296).

Unfortunately clouds and aerosols associated with pollution events have that same signature on both optical thickness and Angström coefficient. The use of corresponding lidar measurements helps to minimize this uncertainty. Thus available lidar measurements on the 19th of October (Julian day 293) showed the appearance of a low intensity dust event above Thessaloniki. On figure 2, the backscattering coefficient above Thessaloniki at that date is given as a function of altitude. The simulated molecules contribution (Rayleigh scattering) is also plotted to help the analysis separating the aerosol contribution. On the lower part of the lidar profile one can observe the Planetary Boundary Layer (PBL) and on the upper part the Saharan dust cloud.

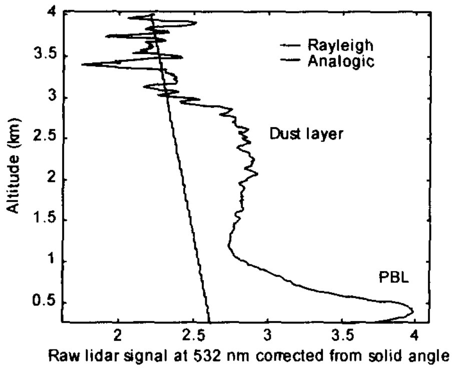

Figure 2: Raw lidar signal of the 19th of October at the emitted wavelength of 532 nm. It is proportional to the backscattering coefficient. Thus it lightens a dust layer near 2.5 km high.

The simultaneous use, on the same site, of lidar and sun photometer instruments to study Saharan dust clouds is very convenient because these instruments allow complementary measurements - respectively integrated content and vertical distribution of the atmospheric extinction. Moreover sun photometer data will enable us to retrieve the aerosol phase function and improve the retrieval of the vertical optical properties from lidar measurements. The latter will be used for validating the transport model and the Meteosat inversion procedure. In the future, further attempts will be made to validate the POLDER products [*Deschamps et al.*, 1994] and to use them for assessing the error due to the dust cloud vertical inner structure in radiative transfer models.

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