

# Lidar measurements of tropospheric water vapor and aerosol profiles over southeastern Italy

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A combined Rayleigh-Raman lidar based on a XeF excimer laser (351 nm) has been used for the regular monitoring of tropospheric aerosols and water vapor profiles over Southern Italy (40° 20' N, 18° 6' E), in the framework of the European Aerosol Research Lidar Network (EARLINET). Coincident measurements of vertical profiles of the aerosol backscattering ratio  $R(z)$ , the aerosol extinction coefficient  $\alpha_{\lambda 0}^{aer}(z)$  and the water vapor mixing ratio  $w(z)$  have been performed during several months to investigate the correlation of  $R(z)$  and  $\alpha_{\lambda 0}^{aer}(z)$  with water vapor and characterize the aerosol optical properties.

A strong correlation has been found between the spatial and temporal evolution of  $R(z)$  and  $w(z)$  both in summer and in autumn regime. The experimental results have revealed that  $R(z)$  increases with  $w(z)$  and that the aerosol and water vapor burdens are lower in autumn than in the summer. The analysis of the data by using the 4-day analytical backward trajectories has revealed that the dependence of  $\alpha_{\lambda 0}^{aer}(z)$  and  $R(z)$  on  $w(z)$  is quite affected by the typical advection patterns over the lidar site.

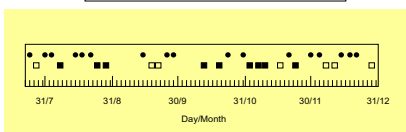
Aerosols providing a larger contribution to backscattering ratio and extinction coefficient as  $w(z)$  increases have been monitored when air masses coming from the European Countries located at latitudes larger than 40° were advected over Lecce.

The findings in terms of the lidar ratio  $S(z)$  have revealed that aerosols with average lidar ratio values ranging from 50 to 63 sr have been monitored when air masses from North and East European Countries were advected over Lecce and the dependence of  $S(z)$  on RH for these aerosols appears to be consistent to that for a "continental" aerosol type as modeled by Ackermann (1998).

On the contrary, average  $S(z)$  values ranging from 48 to 74 have been retrieved for air masses advected from North Africa.

The non spherical shape of the dust particles can mainly be considered responsible of the high  $S(z)$  values found for the air masses advected from North Africa with respect to the one provided by Ackermann (1998).

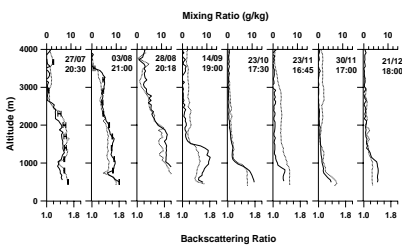
Lidar measurements' distribution



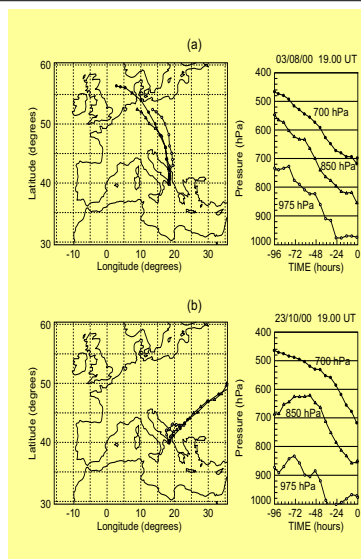
The measurements acquired on days characterized by:

- advection patterns coming from the European Countries located at latitudes larger than 40°;
- advection patterns coming from the Atlantic Ocean and Mediterranean Sea;
- advection patterns coming from North Africa.

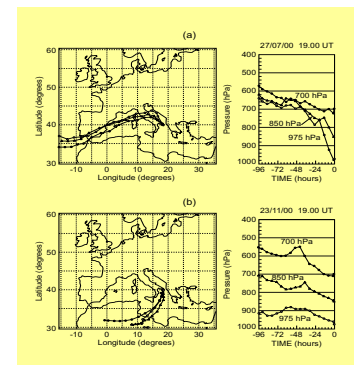
Example of the 45-minute average profiles of the aerosol scattering ratio (solid line) and of the water vapor mixing ratio (dotted line).



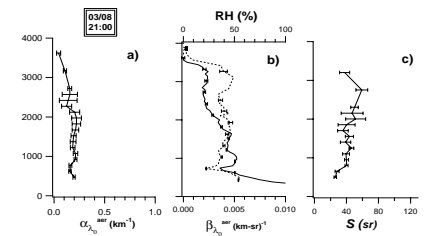
Typical 4-day backward trajectories for discrete arrival pressure levels, for the 19:00 (UT) arrival time, and for the arrival at Lecce of (a) North Europe, and (b) East-Europe air masses.



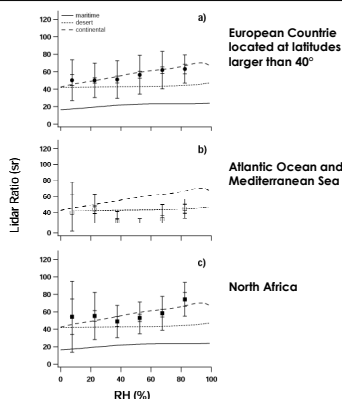
Typical 4-day backward trajectories for discrete arrival pressure levels, for the 19:00 (UT) arrival time, and for the arrival at Lecce of (a) Atlantic Ocean and Mediterranean Sea, and (b) North Africa air masses.



45-minute average profiles (a) of the aerosol extinction coefficient, (b) of the aerosol backscatter coefficient (solid line) and of the relative humidity (dotted line), and (c) of the lidar ratio.

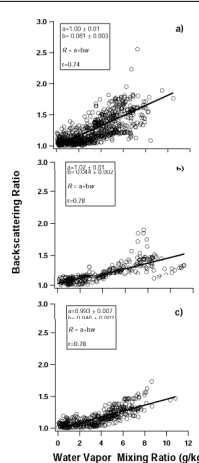


Plot of the lidar ratio data versus the relative humidity RH for the measurements performed on days characterized by advection patterns arriving at Lecce from:



$S(z)$  modeled by Ackermann (1998) for continental (dashed line), desert (dotted) and maritime (solid line) aerosols.

Scatter plot of the backscattering ratio versus the water vapor mixing ratio for the measurements performed on days characterized by advection patterns coming from:



Temporal evolution from July to December 2000 of (a) the aerosol integrated backscatter coefficient between 500 m and 4000 (open dots) and of the altitude at which the backscattering ratio value reduces to 1.3 (full dots), and of (b) the water vapor column content between 500 m and 4000 (open boxes) and the altitude at which the water vapor mixing ratio reduces to 4g/kg (full boxes).

