Systematic tropospheric aerosol lidar measurements over Potenza, within the EARLINET project

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In the frame of the EARLINET project, systematic lidar measurements of aerosol backscatter and extinction in the troposphere have been performed since May 2000 using the lidar system operational at IMAA-CNR in Tito Scalo (Potenza) (Southern Italy, 40°36'N, 15°44'E, 820 m above sea level).

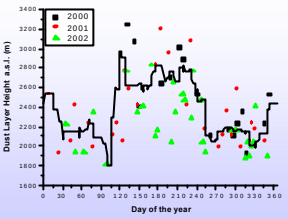
Measurements are performed on a regular base of three measurements per week according to the EARLINET schedule, with the only exception of prohibitive meteorological conditions. Two measurements are performed around the sunset and one is a daytime measurement (around 13:00 UTC). At this moment we have collected more than 900 hours of measurements in almost three years.

For daytime measurements, aerosol backscatter profiles at both 355 nm and 532 nm are retrieved starting from elastic lidar signals by using an iterative procedure based on the assumption of constant lidar ratio within the aerosol layer. The assumed lidar ratio values are taken from literature with the support of direct and indirect extinction measurements at 355 nm performed in Tito Scalo during night time, when Raman measurements are available. In this case, no assumption on lidar ratio values has to be done to retrieve the backscatter profile in the UV. At 532 nm the iterative procedure is still employed, but with lidar ratio values related to those measured at 355 nm.

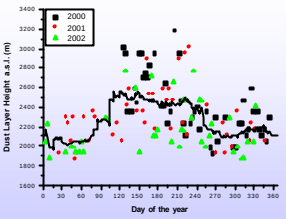
The extinction profiles are determined from the Nitrogen Raman backscattered signals, through the application of the algorithm proposed by Ansmann. For night time measurements the aerosol backscatter coefficients at 355 nm are retrieved using the ratio between elastic signal and inelastic N_2 Raman signal at 386.6 nm. Typical resolution for aerosol backscatter profiles is 60 m whereas for the aerosol extinction profiles the resolution ranges from 120 m up to 400 m depending on the statistics.

Both the algorithms for the aerosol backscatter and extinction retrieval have been successfully compared within the EARLINET community.

DAYTIME MEASUREMENTS

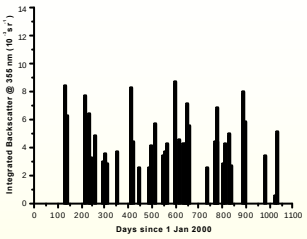


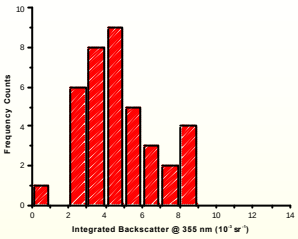
NIGHT TIME MEASUREMENTS

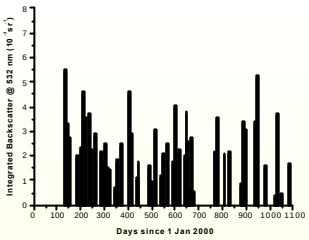


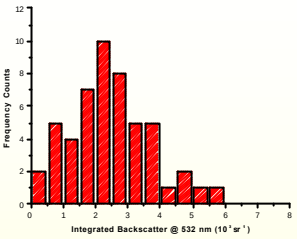
Starting from the daytime and night time measurements, the height of the dust layer has been obtained. The six-weeks sliding average calculated on both daytime and night time dust layer height data, show highervalues for the summer period respect to the winter one. In particular in the summer period the mean height of the daytime dust layer is higher, around 2700 m a.s.l., respect to that calculated starting from the night time measurements, around 2500 m a.s.l.

DAYTIME MEASUREMENTS

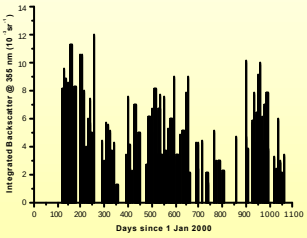


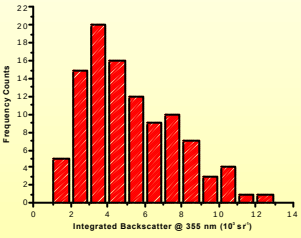


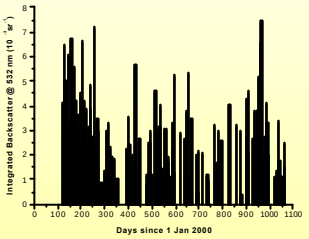


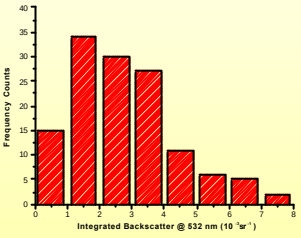


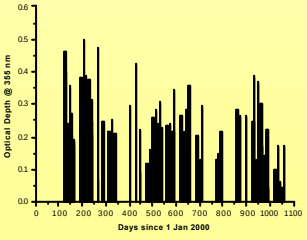
NIGHT TIME MEASUREMENTS

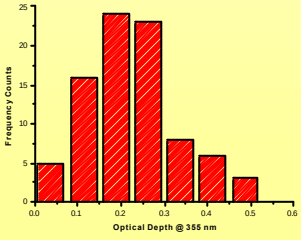


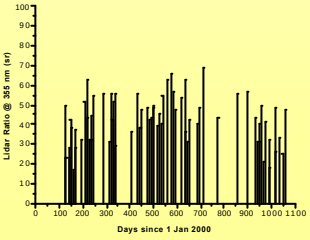


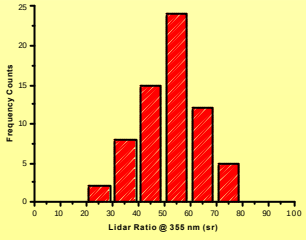












A statistical analysis for both daytime and night time measurements has been performed. We report the evolution and the frequency counts for the integrated backscatter at both 355 nm and 532 nm, as well as for the optical depth and for the mean lidar ratio values at 355 nm in the dust layer. The integrated backscatter and the optical depth have been calculated by integrating the aerosol backscatter and extinction up to the dust layer height. It was assumed that the lowest backscatter and extinction values were representative down to the ground level of the lidar station. For the integrated aerosol backscatter at both 355 nm and 532 nm the statistical analysis was carried out distinguishing between daytime and night time measurements, while the extinction and lidar ratio measurements have been performed only around sunset. The analysis is based on a set of 38 and 51 daytime aerosol backscatter profiles at 355 nm and 532 nm respectively, while 103 are the night time aerosol backscatter profiles at 355 nm and 130 those night time at 532 nm. The 355 nm aerosol extinction profiles used for the statistic are 85 and 66 are the lidar ratio profiles.

The integrated aerosol backscatter and extinction show a seasonal variation with higher values in spring and summer period. For the lidar ratio, the mean values calculated in the dust layer do not show a seasonal dependence. The mean lidar ratio value for the entire set of measurements is 42.6 sr, while 43.3 sr and 42.3 sr are the mean values calculated for the winter and summer period respectively.

The statistical analysis for all measurements has been carried out in the dust layer as well as in 4 fixed ranges of heights above lidar station: 0-1 km, 1-2 km, 2-5 km and 5-12 km. The mean and median values, the standard deviation and the skewness related to the integrated backscatter, optical depth and lidar ratio are reported in the tables.

Integrated Backscatter @ 355nm	Mean Value (10^{-3} sr^{-1})	Stand.Dev. (10^{-3} sr^{-1})	Skewness	Median Value (10^{-3} sr^{-1})	Number of measurements
0 – 1 km	3.76	1.66	0.71	3.50	87
1 – 2 km	2.00	1.41	1.53	1.67	150
2 – 5 km	1.41	1.79	2.28	0.76	149
5 – 12 km	0.17	0.24	2.75	0.084	46
Dust Layer	5.10	2.39	0.66	4.53	141

Integrated Backscatter @ 532 nm	Mean Value (10^{-3} sr^{-1})	Stand.Dev. (10^{-3} sr^{-1})	Skewness	Median Value (10^{-3} sr^{-1})	Number of measurements
0 – 1 km	1.82	0.99	0.98	1.67	163
1 – 2 km	1.11	0.82	1.28	0.99	185
2 – 5 km	0.79	1.12	2.53	0.32	186
5 – 12 km	0.076	0.1	2.99	0.041	150
Dust Layer	2.63	1.50	0.85	2.49	181

Optical Depth @ 355 nm	Mean Value	Stand. Dev.	Skewness	Median Value	Number of measurements
0 – 1 km	0.14	0.05	0.32	0.15	26
1 – 2 km	0.08	0.05	0.70	0.08	87
2 – 5 km	0.08	0.08	1.33	0.06	74
5 – 12 km	0.01	0.01	0.11	0.007	6
Dust Layer	0.23	0.10	0.47	0.22	85

Lidar Ratio @ 355 nm (sr)	Mean Value (sr)	Stand. Dev. (sr)	Skewness	Median Value (sr)	Number of measurements
0 – 1 km	45.3	12.7	-0.38	48	19
1 – 2 km	43.5	12.4	0.50	40.9	79
2 – 5 km	45.0	15.6	0.47	43.0	76
5 – 12 km	41.6	26.2	0.24	35.2	9
Dust Layer	42.6	12.0	-0.06	42.9	66

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