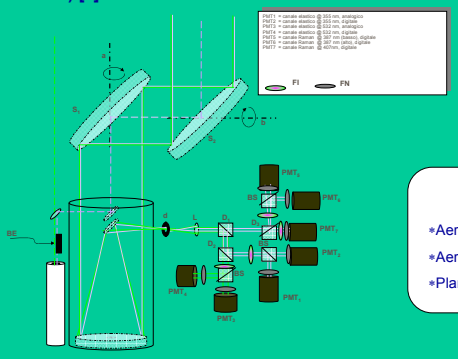
Atmospheric aerosol characterization in the urban area of Napoli

M. Armenante[1], A.Boselli[2], L. Nasti[3], G.Pica[4], N.Spinelli[3], X. Wang[5]

1 Istituto Nazionale di Fisica Nucleare – Sezione di Napoli, Italy
2 Consiglio Nazionale delle Ricerche - Istituto di Metodologie per l'Analisi Ambientale (CNR-IMAA) C.da S. Loja, 85050, Tito Scalo (PZ), Italy
3 Consorzio Nazionale Interuniversitario per le Scienze Fisiche della Materia e Dipartimento di Scienze Fisiche Università di Napoli Federico II, Napoli, Italy
4Consorzio di Ricerca sui Sistemi di Telesensori Avanzati-Co.Ri.S.T.A.,Napoli, Italia
5Coherentia - Istituto Nazionale per la Fisica della Materia – Consiglio Nazionale delle Ricerche and CNISM, Napoli, Italy

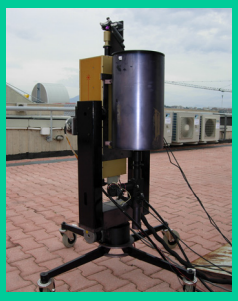
At Naples (Southern Italy, 40.84°N, 14.18°E, 118 m a.s.l.) a lidar system devoted to tropospheric aerosol characterization is operative since May 2000 in the framework of EARLINET (European Aerosol Research LIdar NETwork) [1].



UPGRADE

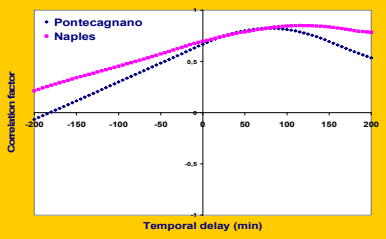
- Aerosol backscatter coefficient profile at 355 and 532nm
- Aerosol extinction coefficient profile at 355nm and 532nm
- Planetary Boundary Layer (PBL) height

In Pontecagnano (Southern Italy, 40° 37' N, 14° 53' E) , a portable lidar developed by Co.Ri.S.T.A. performed a diurnal cicle of measurements for an intercomparison campain in 9-10 May 2005



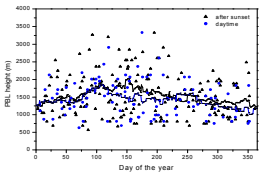
UPGRADE

- Aerosol backscatter coefficient profile at 355 and 532nm alternatively
- Planetary Boundary Layer (PBL) height



Correlation factor between the PBL height and the ground temperature as a function of the temporal delay in Naples (pink squares) and in Pontecagnano (blue squares) during intercomparison campaign between 9 and 10 May 2005.

Annual trend of the PBL height



The growing rate of the PBL is affected by the breeze regime that develops during the day. Two different annual trends are observed for diurnal and nocturnal PBL height, difference being related also to the layering structure.

STATISTICAL ANALYSIS

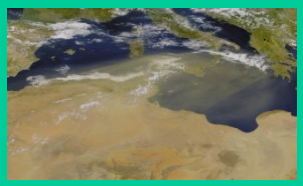
The characterization of the seasonal trend of the tropospheric aerosol profiles over the city have been performed by a statistical analysis in terms of integrated backscattering (IB), optical depth (OD), extinction to backscattering ratio (LR) in a definite set of atmospheric layers [2].

# file	season	LR (sr)				OD ($x10^{-1}$)			
		<1km	1-2km	2-5km	PBL	<1km	1-2km	2-5km	PBL
37	Spring	84±7	55±4	52±5	69±6	1.6±0.2	1.1±0.1	1.1±0.2	2.8±0.2
39	Summer	84±6	51±3	53±5	78±6	2.3±0.2	1.1±0.1	1.7±0.3	3.6±0.4
45	Autumn	76±6	52±4	37±4	74±6	1.9±0.2	1.0±0.2	0.5±0.1	2.5±0.2
39	Winter	87±7	72±5	57±8	85±6	2.0±0.2	0.9±0.1	0.9±0.3	2.5±0.2

# file	season	IB ($x10^{-3}sr^{-1}$)			
		<1km	1-2km	2-5km	PBL
93	Spring	3.6±0.2	2.0±0.1	2.1±0.2	5.1±0.3
69	Summer	4.0±0.2	2.5±0.2	2.6±0.3	5.9±0.4
71	Autumn	3.3±0.2	1.5±0.2	1.3±0.2	4.1±0.3
61	Winter	3.6±0.3	1.5±0.1	1.1±0.2	4.6±0.4

In the low troposphere: maximum values of IB and OD are found during summer/spring days. LR values are larger in winter than in summer, as expected in case of small dimension of pollution particles produced by local sources as combustion product, vehicular traffic, domestic heating.

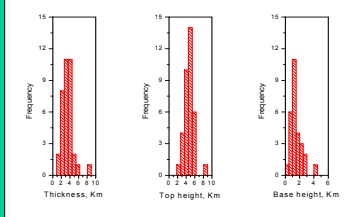
SAHARAN DUST EVENTS



- Number of masured events **36**
- Mean lenght **4.5±0.5 days**
- Predominance (~40%) of sand transport events during spring time
- Large variability of the Saharan dust clouds vertical extension
- About 40% of measured Saharan dust events seeped into the boundary layer.

Two main directions from the source to Southern Italy:

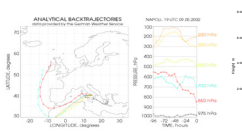
1. the first pattern is related to a combination of a depression system located in the Atlantic and an Anti-Cyclonic system located in North Africa,
2. the second one correspond to a depression system located mainly in Western or Central Mediterranean.



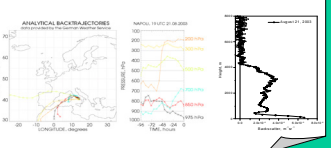
Dust has been revealed up to 8700m, nevertheless in 70% of the observed events the dust layer was confined below 5000m of height. On the other hand, 90% of the dust plumes had a base height lower than 2000m [3].

The dust plume appears to be thicker in summer (4300±200m), with respect to autumn (3500±500m), winter (3170±700m) and spring (3190±200m).

Well-separated PBL



Saharan Dust intrusion in thePBL



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REFERENCES

1. J. Bösenberg, et al., "EARLINET: A European Aerosol Research Lidar Network" *in Advanced in Laser Remote Sensing*, 155-158, A.Dabas, C. Loth and J. Pelon (Eds.), 2001.
2. A. Boselli, et al.Characterization of atmospheric aerosol in the urban area of Naples in the framework of EARLINET Project. 10th International Symposium REMOTE SENSING 2003- 8-12 September Barcelona- Proc. SPIE Vol.5235, 2003.
3. G. Pisani, et al. Atmospheric aerosol characterization during Saharan dust outbreaks at Napoli EARLINET station, in LIDAR Technologies, Techniques, and Measurements for Atmospheric Remote Sensing III, edited by Upendra N. Singh, G. Pappalardo, Proc. of SPIE Vol. 6750, 675012, doi: 10.1117/12.738174, 2007.