

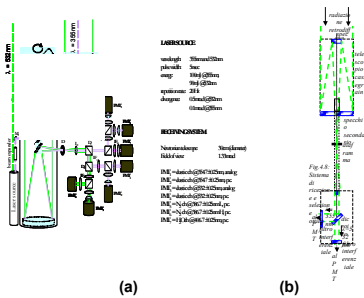
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INFN; *CNR-ISAFOM; ****CORISTA; *****CNR-INFM Coherentia

Recently there is a growing interest in the study of aerosol compounds in the troposphere because of their influence in many atmospheric processes. The monitoring of aerosol particles in the atmosphere can be realised in real time with lidar systems using optical backscattering for the study of atmospheric properties. Furthermore, lidar technique is becoming a powerful tool for study the aerosols optical properties in urban area giving time-dependent aerosols mapping of the urban atmosphere. A field measurements campaign aimed to study comparatively the PBL structure and evolution in two sites differing for orography and urbanization level has been worked out in Southern Italy by applying the lidar technique. The two sites (Naples and Pontecagnano) are located 50 km apart on the Tyrrhenian coast. Naples (40°50'N-14°10'E, 118m a.s.l.) is an urban area with a very high level of urbanization and a huge aerosol content located mainly below the PBL. Pontecagnano (40°37'N-14°53'E) is a rural and flat area. The effect of the orography and the closeness of the sea influence the local circulation phenomena related to diurnal changes in surface temperature and the PBL evolution and affect the aerosol vertical distribution. Using aerosols as tracers, the lidar technique has been applied in order to follow the evolution of the Planetary Boundary Layer in both sites during a complete diurnal cycle. Furthermore, airborne atmospheric measurements of mass, momentum, and energy fluxes of boundary layer research have been available by the use of a Sky Arrow 650 Environmental Research Aircraft (ERA) flying over Pontecagnano. A study of correlations between PBL height and the temperature measured at ground level in Naples and sensible heat in Pontecagnano has been performed by evaluating the correlation coefficient between these parameters as a function of the relative delay. We found the maximum correlation for a delay of about 100 min in Naples and of about 180 min in Pontecagnano. This difference in the response of PBL to the heat flux from the surface to atmosphere is due to the different kind of use of soil.

EXPERIMENTAL SETUP

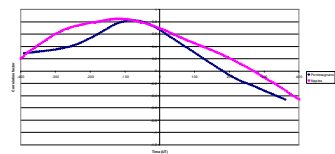
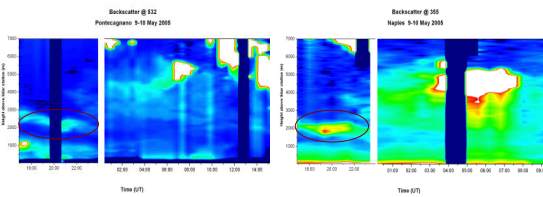


On the left (picture a), the multiwavelength Raman Lidar system of the CNISM - University of Naples, operating in Naples is shown. It is based on a Nd:YAG laser, working simultaneously at the fundamental wavelength (1064nm) and at doubled and tripled frequency, corresponding to 532nm and 355 nm, respectively. Fast photomultipliers are used for detection at any wavelength. Data acquisition is achieved both in analogic and in photon counting mode in order to extend the sounded range from 200 m to about 20 km above the ground . To relate the lidar data to atmospheric parameters, temperature, pressure, relative humidity, speed and direction of the wind are measured by means of ground based sondes.

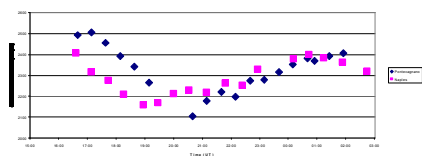
On the left (picture b) the Elastic Lidar moving system of CORISTA, operating in Pontecagnano is shown. It is based on a Nd:YAG laser, working for this experiment at the wavelength of 532nm. The apparatus has been used for the first time during this campaign. Also measurements of air speed, temperature, CO2 and H2O concentration, altitude, latitude, longitude, pressure, potential temperature, wind speed and direction, radiation by means of airborne instrumentation have been performed over Pontecagnano.

Furthermore, also a Sky Arrow 650 Environmental Research Aircraft (ERA), produced by Iniziative Industriali Italiane Spa, and instrumented by NOAA's Atmospheric Turbulence and Diffusion Division was operating. The Sky Arrow is a two-seat aircraft, made of carbon fibre and epoxy resin and is operating altitudes range from 10 m above ground level to more than 3500 m above sea level. The NOAA/ATDD Mobile Flux Platform system mounted on Sky Arrow ERA for monitoring of atmosphere consists of the MFP computer, the Auxiliary box, and the BAT probe assembly.

RESULTS



Lidar measurements have been performed during a complete diurnal cycle starting at 16:37 UT in both sites. Vertical profiles of the backscattering coefficient have been obtained in Naples by applying Raman algorithm (Ansmann A., Wandinger U., 1992) while in Pontecagnano by Klett-Fernald (Klett, 1991) algorithm because in this case only the elastic signal is available.



Since the beginning of measurements until 04:00 UT, a same aerosol layer has passed from Naples to Pontecagnano as can be seen by the backscatter maps. The graph on the left shows the temporal evolution of the height of the center-of-mass of the aerosol layer in Pontecagnano and in Naples. The temporal evolution is rather similar with a temporal delay of about 90 minutes, in according to wind velocity as measured by radiosonde at Pratica di Mare.

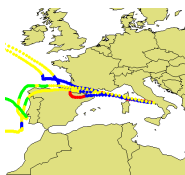
The PBL height has been evaluated as a function of time in both sites. In the figure above is reported the correlation factor between the temperature at ground level and the PBL height as a function of the relative delay, in Pontecagnano and in Naples. The maximum of the correlation factor was found for a delay of about 100 min in Naples and of about 180 min in Pontecagnano. This difference could be linked to the different kind of soil.

REFERENCES

Ansmann A., U. Wandinger. **Combined Raman Elastic Backscatter LIDAR for vertical profiling of moisture, aerosol extinction, backscatter and lidar ratio.** Appl. Phys.B, 55, 18-28, 1992
 Klett J. **Stable analytic inversion solution for processing lidar returns.** Appl. Opt., vol. 20, No.2, 1981

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To identify the nature and the source regions of the aerosol layer we used the analysis of backtrajectories. Trajectory models are important tools for studying transport phenomena in the atmosphere (Stohl, 1998). The picture on the left show the backtrajectories calculated by FLEXTRA model (Stohl et al.), based on model level data of the numerical weather prediction model of the European Centre for Medium-Range Weather Forecasts (ECMWF) These backtrajectories are related to 18:00 UT and the different colours are related to different heights. Backtrajectories are practically the same for Pontecagnano and Naples; they show that the origin of the aerosol structure is continental, in agreement with the value of the lidar ratio as determined by simultaneous measurement of extinction and backscattering coefficient performed in Naples.