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0.1 IMAA-CNR EARLINET lidar station: lidar systems and ancillary facilities

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Introduction

IMAA-CNR participates in the EARLINET project since its beginning on May 2000. The IMAA-CNR elastic/Raman lidar system for aerosol study has been successfully tested by means of intercomparison experiments at system level performed within EARLINET [Matthias et al., 2004]. A further lidar system and ancillary instruments are operative besides this EARLINET "certificated" lidar system. At the present time, the upgrade of the EARLINET lidar system and the development of a new compact unattended lidar system are in progress.

Aerosol Elastic/Raman lidar

Since the beginning of the EARLINET project in May 2000, the lidar station of the IMAA-CNR in Tito Scalo, Potenza (40˚36'N, 15˚44'E, 820 m a.s.l.) provides independent measurements of aerosol extinction and backscatter coefficient profiles at 355 nm and backscatter profiles at 532 nm in the troposphere. Regular measurements and special measurement campaigns, collected in more than 4 years, allowed to study the aerosol content typically present in the PBL over Potenza as well as the Saharan dust intrusions at our site [Pandolfi et al., 2004; Pappalardo et al., 2004a].

An upgrade of the system is planned in order to obtain more information about microphysical properties of the particles. The receiving system will be upgraded in order

to maximize the number of retrievable parameters. In particular, one channel for the detection of the elastically backscattered signal at 1064 nm and another one at 607 nm for the nitrogen Raman signal will provide the aerosol backscatter coefficient at 1064 nm and the independent measurements of aerosol extinction coefficient at 532 nm respectively. In this way, simultaneous profiles of aerosol backscatter coefficient at 3 wavelengths and of aerosol extinction coefficient at 2 wavelengths will be provided. For the depolarization ratio measurement finally, two receiving channels will be added in order to detect the components of backscattered light polarized perpendicular and parallel to the direction of the linearly polarized transmitted laser beam. First preliminary measurements at 1064 and 607 nm have been already performed. The depolarization channels will be added by the beginning of March, so that the system will be completely operative on time for the validation program of aerosol data products from the CALIPSO (Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations) satellite mission.

Water Vapor Raman lidar

Since May 2002, a further lidar system is operative at IMAA-CNR. This system is primarily devoted to water vapor mixing ratio measurements characterized by a high vertical and temporal resolution and extended up to the tropopause. This system performs also measurements of aerosol extinction and backscatter coefficient profiles at 355 nm in both troposphere and stratosphere. The IMAA Raman lidar for the water vapor retrieval has been calibrated by means of an intensive measurement campaign (May-June 2002) of simultaneous and co-located radiosonde launches. More than 100 lidar and radiosonde simultaneous measurements performed since July 2002 demonstrate the stability within 5% of the lidar calibration constant. The retrieval algorithm has been successfully tested in the first algorithm intercomparison exercises in progress within Italian participants of Network for the Detection of Stratospheric Change (NDSC) Lidar Working Group [Keckhut et al., 2004; D'Aulerio et al., 2004].

This system is involved in the calibration and validation program (CAL/VAL) of ENVISAT atmospheric instruments [Cuomo et al., 2004; Pappalardo et al., 2004b]. According to the validation program, 2 radio soundings and 2 lidar measurements of water vapor mixing ratio vertical profiles per week have been performed in coincidence with satellite overpasses, during the first six months of the satellite activity. Afterwards 1 radio sounding and 1 lidar measurement per week are performed. In addition, water vapor measurement are performed simultaneously to EARLINET regular and special measurements, in order to obtain information about aerosol hygroscopic properties. Since July 2002, more than 900 hours of measurements have been collected. This large dataset is a good opportunity to perform a climatological study of water vapor, in particular in the boundary layer, where both aerosol and water vapor contents

are higher and more variable. A first analysis on relation between relative humidity and aerosol microphysical properties within the boundary layer has been carried out starting from one year of simultaneous lidar measurements of water vapor and aerosol backscatter and extinction [Pandolfi et al., 2004].

Unattended aerosol lidar

The realization of a compact and unattended Raman lidar for independent measurements of aerosol extinction and backscatter coefficient at 532 nm and for particles depolarization ratio measurements is in progress. Particular attention in the design has been devoted in order to characterize the Planetary Boundary Layer, where the aerosol load is higher and more variable. The compactness of system will allow to easily move it for measurement campaigns in site of particular interest.

Ancillary instrumentation

Ancillary instruments are operative at IMAA-CNR. In particular, a Sun photometer is operative since December 2004 in the framework of AERONET. This system provides optical thickness at 4 wavelengths (440, 670, 870 and 1020 nm). By means of both spherical and aspherical models, aerosol size distribution is retrieved.

A 12 channels microwave radiometer, providing temperature and relative humidity profiles up to 10 km of altitude, is operative at IMAA since February 2004.

More than 150 PTU measurements have been performed since 1998, by means of a radiosounding system, located at IMAA-CNR, using RS-80 and RS-90 Vaisala sonde type and today RS-92 that provides also wind measurements.

Conclusion

Two lidar systems are operative at IMAA-CNR: the first is devoted to tropospheric aerosol characterization, in the framework of EARLINET, and the second performs water vapor measurements. A compact and unattended Raman lidar for the characterization of the PBL aerosol load will be soon realized. Some ancillary information are available by means of automatic instrumentation. The upgrade of the aerosol lidar system will be completed by next March. The first measurements realized with this multiwavelength lidar in synergy with the water vapor Raman lidar and automatic instrumentation will be presented at the conference.

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