EARLINET: the European aerosol research lidar network

Gelsomina Pappalardo

A coordinated network of advanced remote-sensing stations tracks, measures, and characterizes atmospheric aerosol for use in climate and environmental research.

Present knowledge concerning aerosols and their distribution patterns in the earth’s atmosphere is far from adequate to properly assess their role in changing climate and environmental conditions, both regionally and globally. Information about vertical concentrations is particularly lacking. Lidar (light detection and ranging) remote sensing is the most appropriate tool to close this observational gap, and networks that deploy this technology are fundamental to the scaled-up study of aerosol concentrations, transport, and modification.1

Established in 2000, the European Aerosol Research Lidar Network (EARLINET) currently comprises 25 stations and has as its main objective the development of a qualitatively and quantitatively significant database that details the horizontal, vertical, and temporal distribution of atmospheric aerosol over the entire continent (see Figure 1). Station observation capabilities vary. EARLINET currently includes 10 single backscatter stations and 8 stations with a UV Raman channel for independent measurements of aerosol extinction and backscatter. In addition, for retrieval of aerosol microphysical properties, 7 multiwavelength Raman stations include elastic channels at 1064, 532, and 355nm, with Raman channels at 532 and 355nm, and a depolarization channel at 532nm.

Network-wide observations take place systematically on a fixed schedule. For collection of unbiased data, all stations perform measurements three fixed days per week. Lidar surveillance adheres to a regular timetable: once each week around noon when the boundary layer is usually well developed, and twice weekly at night under low background light conditions in order to perform Raman extinction measurements. Other network activities monitor special events such as Saharan dust outbreaks (see Figure 2), forest fires, photochemical smog, and volcanic eruptions. A rigorous quality assurance program applies to both instruments and evaluation algorithms,2–4 and a standardized data exchange format has been implemented. EARLINET measurements, which began in May 2000, represent the largest database for the aerosol distribution on a continental scale in the world.

The EARLINET Advanced Sustainable Observation System (ASOS), a project inaugurated in 2006 and funded under the European Commission’s Sixth Framework Programme, will further improve observations and methodological developments urgently needed for the multiyear, continental-scale data set that is required to assess the impact of aerosols on the European and global environment, and to support future satel-
lite missions. EARLINET data has been already used to make the first climatological studies of aerosol optical properties over Europe.\(^5\) The data set has also helped evaluate long-range transport and to investigate the implications of dust in weather forecast modeling.\(^6\)–\(^8\) Retrieval algorithms for aerosol microphysical properties have been developed and extensively tested with both synthetic and natural multiwavelength lidar data.\(^9\)

In addition, EARLINET represents the best available tool for validation and exploitation of data from the Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation (CALIPSO) mission. In particular, extinction and lidar ratio measurements\(^10\) will be important for aerosol retrievals from the backscatter Cloud-Aerosol Lidar with Orthogonal Polarization (CALIOP) that rides on board CALIPSO. Since CALIOP began operating in June 2006, EARLINET has made approximately 2000 correliative measurements. Initial comparisons between EARLINET and CALIPSO level 1 data show considerable promise for spaceborne lidar investigation of aerosols and clouds.\(^11\)

In cooperation with a number of networks distributed worldwide, EARLINET is also making a significant contribution toward implementation of the Global Atmosphere Watch (GAW) Atmospheric Lidar Observation Network (GALION). Other participating networks include the Molecular Pathology Laboratory Network (MPLNET), the Asian Lidar Network (ALN), the Commonwealth of Independent States Lidar Network (CIS-LINET), the Regional East Atmospheric Lidar Mesonet (REALM), and the Americas Lidar Network (ALINE).

EARLINET will also contribute to future satellite missions with lidar instrumentation aboard, such as Atmospheric Dynamics Mission (ADM)-Aeolus and the joint European-Japanese mission EarthCARE. The multiwavelength EARLINET data represents validation for these missions and provides the conversion factors that allow aerosol data at 532 and 1064nm from CALIOP to link with data at 355nm from ADM-Aeolus and EarthCARE, with a view to creating a consistent long-term global data set.

In brief, climatological measurements and analysis continue within EARLINET, in consonance with the aim of developing the most comprehensive data source for 4D spatiotemporal distribution of aerosols on a continental scale.

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**Author Information**

Gelsomina Pappalardo  
CNR - Istituto di Metodologie per l’Analisi Ambientale  
Tito Scalo, Italy  
http://www.imaa.cnr.it

Gelsomina Pappalardo is a physicist whose main research interests include lidar remote sensing of aerosols, clouds, and water vapor. She is the EARLINET speaker and coordinator of the EC FP6 EARLINET-ASOS project.\(^12\)

**References**


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**Figure 2. Saharan dust observed at altitudes up to 9km via the Potenza EARLINET station on 26 June 2006.**