Aerosol Measurements at 60 m During the April 1994 Remote Cloud Study Intensive Operating Period (RCS/IOP)

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In response to a request from Dr. Harvey Melfi of the University of Maryland for aerosol measurements during the April 1994 Remote Cloud Study/Intensive Operating Period (RCS/IOP), the Environmental Measurements Laboratory (EML) responded by modifying an existing EML aircraft aerosol sampler that had been previously tested. This new sampler was installed on the 60-m tower at the Southern Great Plains (SGP) site of the Atmospheric Radiation Measurement (ARM) Program. A 2-hour, battery-operated instrument package was modified into a 30-day automated package capable of sampling at 1-minute intervals. The package was returned to the ground daily for data downloading and calibration of the integrating nephelometer. Data were obtained from the integrating nephelometer (λ= 530 nm); a six-channel optical particle counter; a condensation particle counter; pressure, temperature, and relative humidity sensors; and mini-impactors. Independent computers inside the integrating nephelometer provided 15-min average data. In addition, twice daily back trajectory analy_ses (BTAs) were calculated providing some insight into the origins of the air mass sampled.

In the middle of the experiment, two of the controlling computers were destroyed by lightning. The lightning caused loss of all but the integrating nephelometer data which had its own internal computer set to record at a 15-min average interval.

Among one of many reasons for the original selection of the location of the SGP site at Lamont, Oklahoma was the fact that many different types of air masses pass over the area. As seen from Figure 1, air masses come from the Pacific Ocean, central and western Canada, and the Gulf coast. During the early period of the April RCS/IOP, extremely low aerosol scattering coefficients (Figure 2) were seen. This correlated very well with the BTA which showed air coming from very clean sectors (continent and ocean). During the middle part of the experiment, extremely polluted air, containing very high scattering coefficients, impacted the site. The BTA indicated the transport of air from the Illinois area during this period. During the month, the scattering coefficient varied by more than an order of magnitude. Local and regional plumes can be seen passing over the site. This can be seen in the daily plots of aerosol scattering coefficients and condensation particle concentrations (Figure 3).

A major effort was placed on providing some characterization of the aerosol size distribution for the RCS/IOP. Because of equipment malfunction and the lightning damage, we obtained only one full day of surface and tower measurements. In addition, limited surface measurements for four days were obtained before the instrument package was raised to 60 m. We programmed the computer to provide 1-min samples of six channels of size data during the first 6 hours of the day and then continued with 2-min sampling for the rest of the day.

The data from our sampler is now available from the experimental center. A description of the data, along with a graphical presentation of the data will be available as part of a U.S. Department of Energy/ARM publication.

Acknowledgments

The authors would like to thank the Instrumentation Division for their fine work in developing the tower aerosol package in the limited amount of time given them. Without the help of Dr. Jeff Griffin of Pacific Northwest National Laboratory, who handled the daily downloading of the data, calibration and trouble shooting, and the site operations support staff, we could not have achieved our goals.

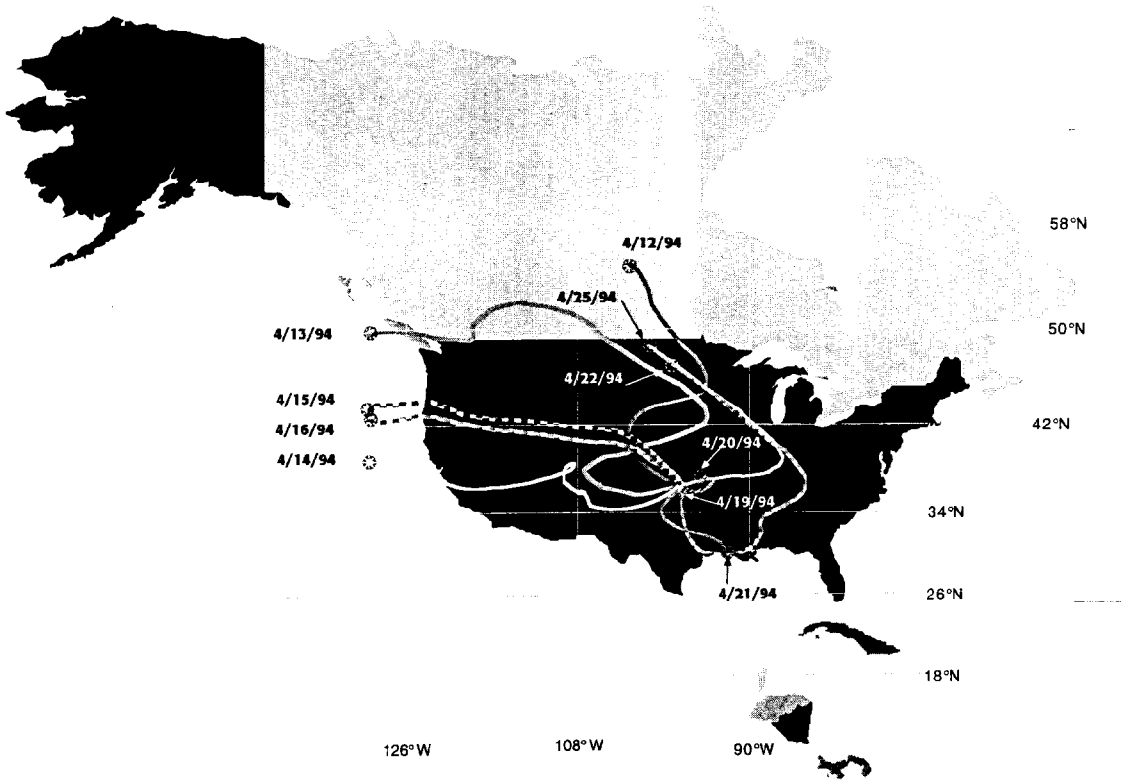

Figure 1. Backward trajectories (BT) for Lamont, Oklahoma. All dates shown are starting times for the BT. The length of the trajectories represents the following times: 4/12/94 lasted 3.5 days, 4/13/94 lasted 9.5 days, 4/14/94 lasted 7.3 days, 4/15/94 lasted 3.6 days, 4/19/94 lasted 0.5 days, 4/20/94 lasted 1.5 days, 4/21/94 lasted 2.5 days, 4/22/94 lasted 3.5 days, 4/23/94 lasted 4.3 days, 4/24/94 lasted 4.5 days, 4/25/94 lasted 6 days.

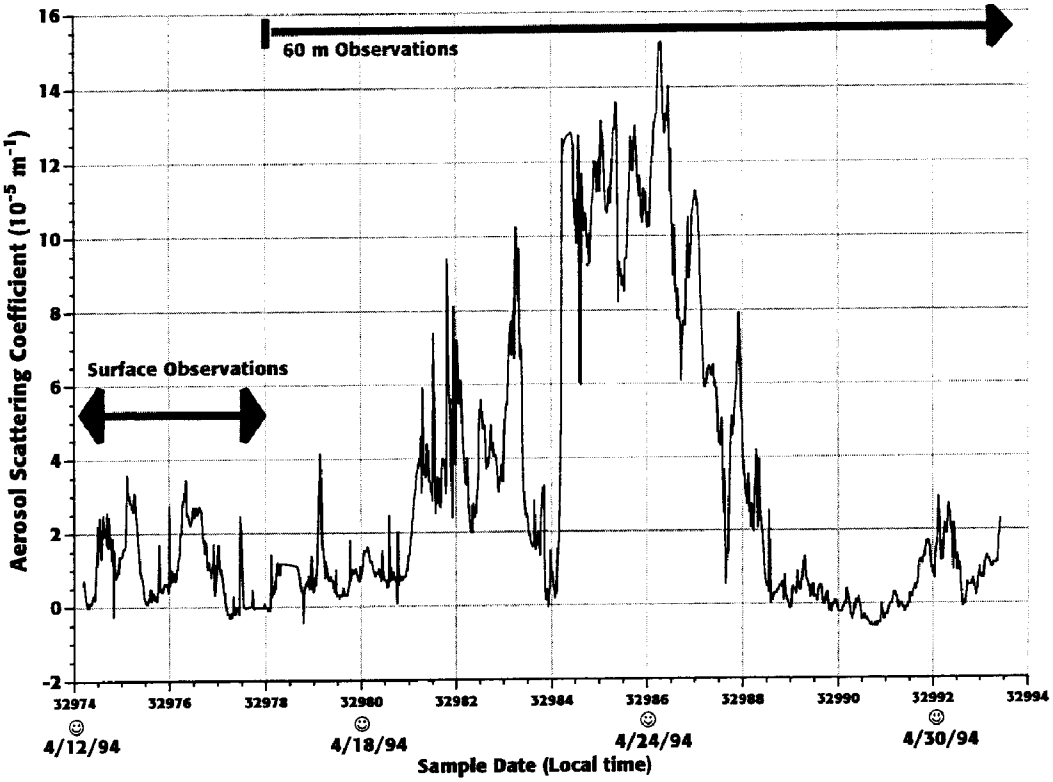

Figure 2. Fifteen-minute average aerosol scattering coefficient (λ = 530 nm) observations during the April 1994 Remote Cloud Study Intensive Operating Period experiment at the ARM SGP site at Lamont, Oklahoma.

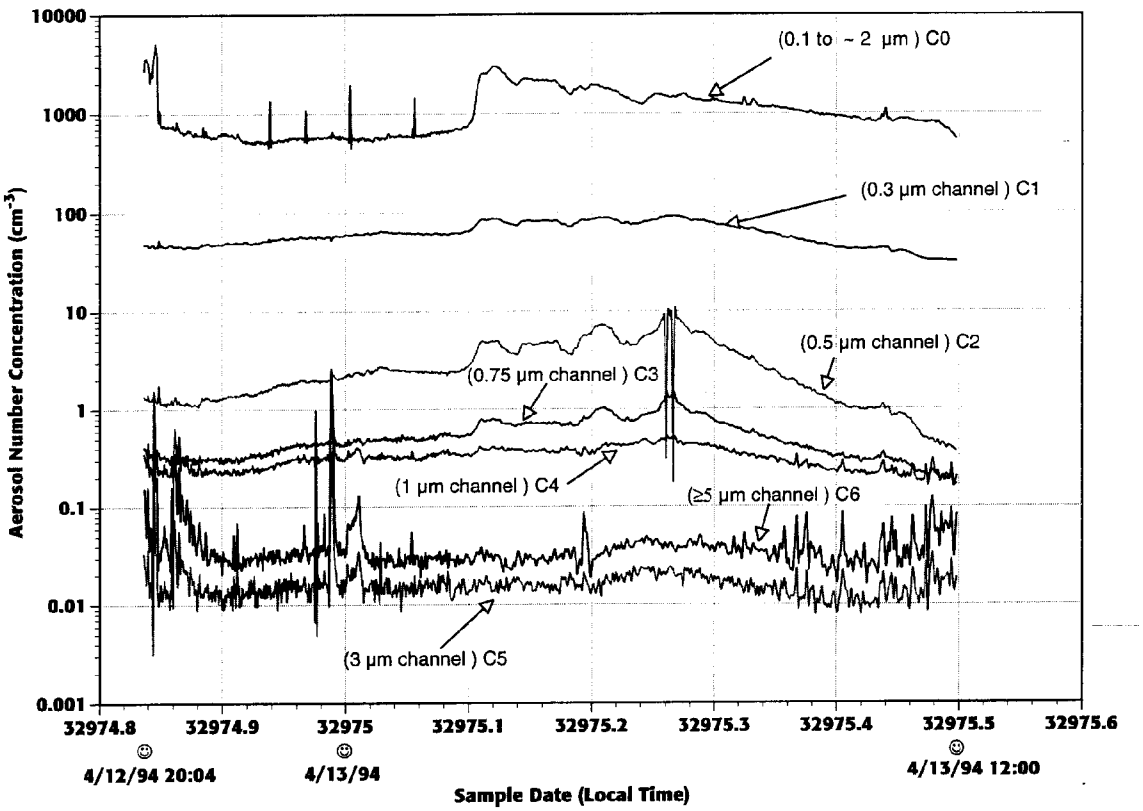

Figure 3. One-minute surface observations of the aerosol scattering coefficients and condensation particle concentration for April 12 and April 13, 1994, at the Remote Cloud Study Intensive Operating Period experiment at the ARM SGP site at Lamont, Oklahoma.