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Project Summary

Dependence of Nephelometer Scattering Coefficients on Relative Humidity: Fronts, Nocturnal Disturbance and Wood Smoke

George W. Griffing

The dependence of the nephelometer scattering coefficient of atmospheric air on the relative humidity at Research Triangle Park is discussed for four different meteorological examples. These examples feature (1) the passage of a low-pressure system with thunderstorms, (2) the passage of a cold, dry front, (3) a nocturnal weather disturbance due to an unknown source, and (4) wood-smoke aerosols from burning tree piles. Nephelometer scattering coefficient data were obtained using two nephelometers. One was operated at the ambient outside relative humidity and the other at a relative humidity inside an air conditioned building. Using this operational mode of data acquisition, qualitative temporal information can be deduced on the variations of aerosol size and number density as the various meteorological parameters vary. In addition to the variations of the aerosol physiochemical parameters, the temporal trend of the visibility for each example is discussed.

This Project Summary was developed by EPA's Environmental Sciences Research Laboratory, Research Triangle Park, NC, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

In general, the nephelometer scattering coefficient measured for atmospheric air varies with time. Temporal variations of the atmospheric optical properties of the ambient aerosols are the source of the temporal variations of the nephelometer scattering coefficient. Aerosol parameters, which characterize the optical properties, are the number density, size, shape, and chemical composition.

The studies presented are concerned with the dependence of the scattering coefficient on the relative humidity. For a given aerosol, if moisture condenses onto or evaporates from an aerosol, it is conceivable that the size, shape, and chemical composition of the aerosol changes. Whether moisture condenses onto or evaporates from an aerosol depends upon the magnitude of the relative humidity.

In situ observations of the scattering coefficient and the relative humidity were taken for December 1978 until September 1981. Except for occasional downtime for equipment maintenance, the measurements were taken continually. To determine the dependence of the scattering coefficient on the relative humidity, measurements of the scattering coefficient are required at two different relative humidities.

Procedure

To measure scattering coefficients at two different relative humidities, one nephelometer was operated in an out-of-doors environment and another nephelometer was operated simultaneously inside a building with air conditioning. The relative humidity was determined by measuring the temperature and dewpoint of the air flowing through the nephelometer. Orifices for sampling the outside air for both nephelometers were located about 6 m above ground level and separated by about 50 m horizontally. Before passing the outside air through the inside nephelometer, the air was heated. By heating the air, the relative humidity of the air flowing through the inside nephelometer was usually less than the relative humidity of the air flowing through the outside nephelometer. Duplicate scattering coefficient and relative humidity data were taken for quality assurance of the data.

Various other ancillary data were also observed. The wind speed and direction were measured at about 10 m above ground level. Solar radiation data were observed. At various times, temperatures were measured at 1 m and at 6 m above ground level. Facsimile recordings of an acoustic sounder were also taken. Except for the acoustic data, the data were stored on a floppy disk of an electronic recorder. The rate of data acquisition was usually about 500 observations for each parameter in 24 hours.

Conclusions

Should the scattering coefficient increase, the reason for the increase should be determined; e.g., an increase of anthropogenic emissions might account for the scattering coefficient increase, or it might be caused by an increase of the relative humidity due to meteorological conditions. Operating nephelometers at two different relative humidities permits increased scattering coefficient to be explained by an increase in the relative humidity.

*The EPA author **George W. Griffing** (also the EPA Project Officer, see below) is with the Environmental Sciences Research Laboratory, Research Triangle Park, NC 27711.*

The complete report, entitled "Dependence of Nephelometer Scattering Coefficients on Relative Humidity: Fronts, Nocturnal Disturbance and Wood Smoke," (Order No. PB 82-188 913; Cost: $7.50, subject to change) will be available only from:

National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
Telephone: 703-487-4650

The EPA Project Officer can be contacted at:

Environmental Sciences Research Laboratory
U.S. Environmental Protection Agency
Research Triangle Park, NC 27711

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