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Project Summary

Dependence of Nephelometer Scattering Coefficients on Relative Humidity: Evolution of Aerosol Bursts

George W. Griffing

Observations on the temporal dependence of the nephelometer scattering coefficient on the ambient relative humidity are presented and discussed. The observations are representative of the temporal dependence of the scattering coefficient when the weather at the Research Triangle Park is dominated by an anticyclonic weather system. By taking simultaneous nephelometer scattering coefficient observations at two different relative humidities, it was possible to conclude that with stable atmospheric conditions:

- **In general, the scattering coefficient increases from sundown to sunup due to aerosol growth and an increasing trend of the aerosol number density;**
- **In general, the relatively rapid increase and subsequent decrease of the scattering coefficient during a 2 to 3 hour period after sunup is due to a relatively rapid aerosol growth and shrinkage, and a relatively rapid increase and decrease of the aerosol number density.**

The latter behavior of the scattering coefficient was called an aerosol burst. The relationship between an aerosol burst, fumigation, and early morning visibility deterioration is also 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

According to Section 169A of the Clean Air Act Amendment of 1977 (Federal Register, 1978), the Environmental Protection Agency has the responsibility of preventing visibility degradation of designated Class I Federal areas. There can be various causes for a degradation of the visibility. One cause for visibility degradation is an increase of the aerosol number density which might be reduced by control of certain anthropogenic emissions. Another cause for visibility degradation might be due to an increase of the relative humidity. With the possible exception of the control of the emission of moisture from cooling towers or similar structures, the control of the relative humidity would not be feasible for prevention of visibility degradation.

For various Environmental Protection Agency visibility related studies, a nephelometer has been used. To interpret the nephelometer data, an understanding of the possible influence of the relative humidity is essential. If

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density increased. However, the scattering coefficient could also have increased because the relative humidity increased, which could result in an increase in the size of the aerosols. A decrease of the visibility would be expected for either of these possible reasons for an increase of the scattering coefficient.

Since December 1978, studies have been conducted at the Research Triangle Park (RTP) on the dependence of the nephelometer scattering coefficient on the ambient relative humidity. In order to extract more information from these observations, simultaneous nephelometer scattering coefficient observations are taken at a different (usually much smaller) relative humidity. Except for brief periods for calibration, maintenance, and repair, the observations have been taken continuously.

In these studies, it has been found that the most satisfactory humidity sensor was the saturated salt (lilthium chloride) humidity sensor. The cooled mirror type humidity sensor was not found to be reliable because of contamination of the mirror by atmospheric aerosols. At times, the mirror would get contaminated within a few minutes. At other times, it would be a day before the mirror got contaminated. The saturated salt humidity sensor was very much less sensitive to contamination. Usually, cleaning of the sensor was not necessary before a couple of months of operation.

The intake for atmospheric air to the nephelometers were 50 m apart and 6 m above ground level. Special attention was given to the problem of obtaining relative humidities which were characteristic of the nephelometer scattering chamber. Wind observations were taken at 6 m. Also, solar radiation data were taken at 6 m. Both wind and solar observations are useful in an interpretation of the observations.

Conclusions

By operating one nephelometer at ambient relative humidity and another nephelometer at a smaller relative humidity, it is possible to obtain an insight into some of the temporal variations of the physiochemical parameters characterizing the atmospheric aerosols. Thus, by comparing the scattering coefficient profiles of the two nephelometers it is possible to deduce what effect that relative humidity had on the scattering coefficient. In addition, it is possible to gain insight into the meteorological processes involved. The important results of the study were enumerated earlier.

*The author of this Project Summary was **George W. Griffing** who is with the Environmental Sciences Research Laboratory, EPA, Research Triangle Park, NC 27711.*
***K. L. Demerjian** is the EPA Project Officer (see below).*
The complete report, entitled "Dependence of Nephelometer Scattering Coefficients on Relative Humidity: Evolution of Aerosol Bursts," (Order No. PB 81-198 293; Cost: $6.50, 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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