



Project Summary

Data Base for Plumes with Significant Plume and Background Particle Scattering

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Visibility Impairment due to Sulfur Transport and Transformation in the Atmosphere is a project sponsored by the U.S. Environmental Protection Agency. During the winter and summer of 1981, plume measurement programs were conducted in the vicinity of the Kincaid power plant near Springfield, IL; the Labadie power plant near St. Louis, MO; the La Cygne power plant near Kansas City, MO; the Magma copper smelter near San Manuel, AZ; and the Phelps-Dodge copper smelter near Douglas, AZ.

Airborne measurements of aerosol size distribution, chemistry, optical properties, and trace gas concentrations in the plume and in background air were recorded at the above locations. Extensive plume teleradiometer measurements, airborne measurements along teleradiometer sight paths (including plume width, pollutant concentrations, and particle light scattering [b_{sp}]), and measurements of sun-observer-plume geometry were also made.

This report describes the types of information included in a data base collected during the 1981 VISTTA field programs. Specific data were tabulated for sight paths through each of the following plumes: the Kincaid power plant plume on February 20, 24, and 25, 1981; the Labadie power plant plume on August 24 and 29, 1981; and the Magma smelter plume on September 8, 1981. This data base, presented in the project report, can be used to evaluate plume visibility models.

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 1977, the U.S. Congress amended the Clean Air Act to set as a national goal the "prevention of any future, and the remedying of any existing, impairment of visibility in mandatory class I Federal areas which impairment results from man made air pollution": (Section 169A). It is necessary to understand the effects on visibility of current and proposed emissions in order to accomplish this goal. The USEPA initiated the VISTTA (Visibility Impairment due to Sulfur Transport and Transformation in the Atmosphere) project to develop the technical information required to understand the contribution of coal-fired power plants to visibility impairment in western pristine areas. The VISTTA project is a multi-year cooperative effort involving several government agencies, private companies, and universities. Overall coordination of the program is the responsibility of Meteorology Research, Inc.

The general goals of the VISTTA project are as follows

- 1 determine the relationship between emissions of coal-fired power plants and smelters and their downwind optical effects;

2. document the current natural and anthropogenic contributors to visibility impairment and the relative contributions of these various sources; and
3. provide data for evaluation of plume visibility models

The data base from 1979 VISTTA field programs was presented by Blumenthal et al (1983).¹ This report presents the data base that was collected during the February and August-September 1981 VISTTA field programs. These programs were conducted in the vicinity of the Kincaid power plant near Springfield, IL; the Labadie power plant near St. Louis, MO; the La Cygne power plant near Kansas City, MO; the Magma copper smelter near San Manuel, AZ; and the Phelps-Dodge copper smelter near Douglas, AZ. VISTTA data are available from Sonoma Technology, Inc., Santa Rosa, CA 95401.

Results

The data base in the report consists of nine case studies. Three case studies were conducted February 20, 24, and 25, 1981, on the plume of the Kincaid power plant near Springfield, IL; two case studies were conducted on August 24 and 29, 1981 on the plume of the Labadie power plant near St. Louis, MO; and four case studies were conducted on September 8, 1981 on the plume of the Magma copper smelter near San Manuel, AZ. Only airborne measurements were made at the La Cygne power plant.

The five case studies (February 20, 24, and 25 and August 24 and 29, 1981) that included emission data can be used for overall evaluation of plume visibility models. The six case studies (February 24, August 24 and the four cases of September 8, 1981) that included data measured by the instrumental aircraft along the teleradiometer sight path can be used for evaluation of optics, dispersion, and chemistry modules.

The data base consists of information from the following categories:

1. major characteristics (location, number of stacks, and stack height) of the power plants and smelters,
2. location of the teleradiometers, and
3. emission characteristics, rate and flue gas characteristics of the power plants.
4. Physical characteristics (mass median radius and standard deviation

of the lognormal distributions, density, and index of refraction) of the plume and background aerosol.

5. Ambient temperature profiles for the five power plant case studies.
6. Meteorological data (effective wind direction, wind speed, temperature, and relative humidity) at plume height
7. Optics data (site and time of the teleradiometer measurements, geometric data, and background visual range).
8. Teleradiometer data (plume/sky radiance ratio and plume radiance).
9. Plume measurements obtained with the aircraft.

Aircraft measurements include the following: location of measurements, plume width and altitude, maximum trace gas concentrations, broad-based and UV radiation data, plume burdens (plume trace gas concentration and particle-scattering coefficients integrated along the crosswind direction) and trace gas background concentrations. Because of uncertainties in the aircraft measurements, data were collected during several flight paths that correspond to a given set of teleradiometer measurements.

The report contains comments on each case study to give additional information on the accuracy of the measurements.

Conclusions and Recommendations

The 1979 VISTTA data base has focused on plumes with low particle concentrations in clean background air. The 1981 VISTTA field programs were conducted to extend the data base to conditions where particle scattering in the plume and background is important. This report presents the 1981 VISTTA data base that should be used to evaluate plume visibility models for cases where plumes contain high concentrations of particles or are emitted into a polluted atmosphere with high particle concentrations of interest for plume visibility model evaluation.

References

1. Blumenthal, D.L., Richards, L.W., Macias, E.S., Bergstrom, R.W., Bhardwaja, P.S., Eigsti, S.L., Wilson, W.E., Seigneur, C., Hudischewskyj, A.B., and Babson, B.L. The Chemistry, Physics, and Optical Properties of Plumes and Back-

ground Air in the Southwest United States NTIS PB 83-261 768 Springfield, VA, 1983, 67 pp.

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William E. Wilson, Jr., and William D. Conner are the EPA Project Officers (see below).

The complete report, entitled "Data Base for Plumes with Significant Plume and Background Particle Scattering," (Order No. PB 84-141 159; Cost: \$8.50, subject to change) will be available only from:

*National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
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☆ U.S. GOVERNMENT PRINTING OFFICE 1984-759-015/7301

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