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Project Summary

Joint EPA-EPRI Cold Weather Plume Study (CWPS): Overview of Measurements and Data Base

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The Cold Weather Plume Study (CWPS) was a field measurement program carried out in February 1981 under the joint sponsorship of the U.S. Environmental Protection Agency and the Electric Power Research Institute. Its objective was to generate a data base suitable for quantitative analysis of the mesoscale physical dynamics and SO_x, NO_x chemistry of the plume of the 1320 MW coal-fired Kincaid power plant near Springfield, Illinois. The data base was intended to complement similar measurements made by other EPA and EPRI studies in the same region during other seasons. Measurements included in-situ chemical measurements from two instrumented aircraft, remote-sensing lidar measurements and meteorological measurements from a surface station, two towers, and from vertical soundings. This report provides a brief overview of the measurement platforms, the measured parameters, and the daily experiments, and describes and documents the data base available on magnetic tapes and in hard copy form.

This Project Summary was developed by EPA's Atmospheric 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

A Cold Weather Plume Study (CWPS) was carried out from a St. Louis base in February, 1981 under the joint sponsorship of the Environmental Protection Agency (EPA) and the Electric Power Research Institute, Inc. (EPRI). The main objective of the field measurement program was to generate a data base appropriate for quantitative characterization of the mesoscale transport and chemical transformations of SO_x and NO_x in the plume of the 1320 MW, coal-fired Kincaid power plant near Springfield, Illinois, under winter conditions. The measurements included in-situ airborne chemical sampling in the plume and its background, as well as a variety of meteorological measurements characterizing the PBL structure and dynamics of the wind, temperature and humidity fields. Previous extensive power plant plume measurements had been carried out in power plant plumes in the same region in summer and spring periods. Analyses of the data of these previous studies had already yielded valuable quantitative empirical descriptions of the plume atmospheric transmission processes, particularly for SO_x. A more specific objective of the winter study was to test the validity of such quantitative parameterizations under winter conditions and, if necessary, to revise the formulations to make them seasonally more general. Another important aspect of the winter study was a more balanced emphasis on SO_x as well as NO_x atmospheric chemistry. This report overviews the measurement program, identifies other reports which contain more detailed program description and data, and most importantly, describes and documents the formal overall centralized data base of CWPS.

Participants

There were two teams of participating groups in the field program, one supported

by EPA and the other by EPRI. Each participating group had a specific role in the study, yet all measurements of a given daily mission were performed within the context of a coordinated overall mission plan. The two teams shared the same overall program objectives, but emphasized different specific objectives. The EPA team's focus was more on SO_x chemistry, while the EPRI team placed greater emphasis on NO_x chemistry. Overall, the measurement strategy was focused on detailed aircraft chemical sampling in the plume over a mesoscale range; two primary sampling aircraft were typically deployed in each experiment. Supporting measurements included stack sampling, monitoring of ambient meteorological parameters, and remote sensing of PBL aerosol structure and dynamics.

The participating groups and their principal roles are outlined below:

EPA Team	
EPA-Research Triangle Park	*Technical direction.*
EPA-Las Vegas	*Airborne lidar measurements.*
Environmental Measurements, Inc.	*Program planning; in-situ aircraft measurements.*
AeroVironment	*Field program management; meteorological support.*
SRI International	*Meteorological support.*
Washington University	*On-site data processing and review; program data management; data interpretation.*
EPRI Team	
Battelle, Columbus	*Program planning; on-site organic sample analysis; MRI aircraft instrumentation for NO_x and HNO_3; data management for EPRI team; data interpretation.*
Meteorology Research, Inc.	*In-situ aircraft measurements.*
Rockwell International	*Stack sampling; meteorological support.*

Measurements

The in-situ aircraft measurements included continuous monitoring of gas concentrations (SO_2, NO, NO_x, N_{Total}, O_3) aerosol parameters (ANC, Charge, B_{scat}), meteorological variables (temperature, humidity, pressure, turbulence, solar radiation) and navigational parameters (altitude, VOR, DME). Integrated filter samples were collected and analyzed for aerosol sulfate, nitrate, chloride and ammonium; for gaseous ammonia and nitric acid; and for elemental composition. Automatic bag samples were also collected nearly instantaneously at regular intervals and analyzed on-line for aerosol size distribution. In addition, integrated samples were collected in Teflon bags and analyzed daily at a ground laboratory for detailed speciation of organic vapors, including PAN.

Stack measurements of SO_2, NO, O_2 and exit gas velocity and temperature were made at Kincaid. Meteorological support measurements included measurements near the power plant by ROCKWELL, and at downwind locations near prevailing plume trajectories by AV. Measurements near the power plant were made at a surface station (pressure, temperature, net/solar/sky radiation, cloud cover and precipitation), from 10 to 100 m meteorological towers (mean temperature, dewpoint, wind speed/direction, and u,v,w components of the wind field), and from tracked T-sondes (T, wind speed/direction). Downwind meteorological measurements by AV included frequent pibal (wind speed/direction) and airsonde (temperature and relative humidity) sounding during the experiment periods. Synoptic weather data were gathered and interpreted by SRI at the local NWS forecasting office. SRI provided weather forecasts and summaries tailored to the needs of the daily missions.

PBL and plume structure and dynamics were "visualized" by remote sensing of atmospheric aerosol distribution based on lidar returns of aerosol backscattering monitored in the lidar aircraft (EPA-LV) flying well above the PBL.

The Kincaid power plant has two generating units rated at 660 MW each, both feeding into a single 187 meter tall stack. During the CWPS period, however, one of the units was inoperative.

The field study period was 9-21 February, 1981. During this period, a total of six independent field experiments were carried out on five separate days (February 12, 13, 14, 16, and 20). There were two separate experiments on the 20th. In four of these experiments, both primary sampling aircraft (EMI and MRI) performed coordinated measurements. In three separate missions, the two aircraft flew side-by-side to provide data for cross-comparison. The first three experiments were conducted under very cold daytime winter conditions. Ambient conditions were unseasonably warm during the last three experiments. One of these experiments was during the night. During the first and the last experiments, the Kincaid plume was sampled within the convective daytime mixing layer; bulk plume transport was in the stable layers aloft during all other sampling missions. Plume background was fairly clean during all field missions.

Data

Each participating group was responsible for quality assurance, post-processing, and validation of its own data. The final data of the EPA team was centralized at the WU-ME Special Studies Data Center at Washington University in St. Louis. The data of the EPRI team was centralized at Battelle, Columbus Laboratories. The EPA and EPRI data bases were formally exchanged in 1984. Subsequently, both these subsets of the overall data base were reformatted and standardized into a single unified CWPS data base at our data center. All data files in this CWPS data base conform to the standard STATE formats common also to three other data bases of major EPA-sponsored Studies (MISTT, Tennessee Plume Study, and PEPE-NEROS). This report provides a full documentation of the final CWPS data base. Future distribution of the data base will be administered by EPA.

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The complete report, entitled "Joint EPA-EPRI Cold Weather Plume Study (CWPS): Overview of Measurements and Data Base," (Order No. PB 87-168 753/AS; Cost: $13.95, subject to change) will be available only from:
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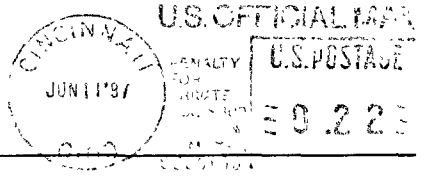

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