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TRANSPORT OF POLLUTANTS IN PLUMES AND PEPES

A Study of Transport of Pollutants in Power Plant Plumes, Urban and Industrial Plumes, and Persistent Elevated Pollution Episodes.

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OFFICE OF RESEARCH AND DEVELOPMENT
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RESEARCH TRIANGLE PARK, NORTH CAROLINA 27711

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A Study of Transport of Pollutants in
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by

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ABSTRACT

With the increased concern for the regional nature of secondary air pollutants (e.g. sulfates, nitrates, oxidants, aerosols, etc.) the U.S. EPA sponsored a major field program in the northeastern United States during the summer of 1980. Two EPA field programs were actually carried out simultaneously. One addressed persistent elevated pollution episodes (PEPEs) as an outgrowth of power plant studies and the other continued the 1979 Northeast Regional Oxidant Study (NEROS) in developing part of the data base for the Regional Oxidant Model (ROM). Activity centered out of Columbus, Ohio.

Ten research aircraft and several mobile and stationary surface monitoring platforms from three EPA contractors, seven federal agencies and four universities participated in the intensive measurement program between 16 July and 15 August 1980. Pollutants monitored include SO_2, NO, NO_x, O_3, sulfate, nitrate, hydrocarbons and aerosols.

This report summarizes the contractor measurement activities. Their aircraft logged over 350 flight hours in 100 mission surveys ranging as far east as Laconia, NH, south to Montgomery, AL, west to Texarkana, AR and north to Saginaw, MI.

Descriptive analyses are summarized for urban plume missions and regional missions. The quality assurance program is described showing the efforts made to develop a well-coordinated data base.

The report indicates the work to date with the data base and sources for reports and data. Many subsets of the data base can be used in model development for transport, transformation and removal processes.

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CONTENTS

ACKNOWLEDGMENTS

The scope of the PEPE-NEROS program involved many organizations. The overall cooperation was excellent and facilitated the smooth running of this large field program.

Particular appreciation must be expressed to EMI's three principle subcontractors, AeroVironment, Inc. (especially Michael Chan, Ivar Tombach, Bob Baxter and Kurt Bumiller), SRI-International (especially Bruce Cantrell, Bill Viezee and Walt Dabberdt) and WUTA (especially Noor Gillani). The special cooperation of the personnel from Ohio State University, at the airport and the dormitory, simplified the overall logistics.

The eager participation of senior scientists from the universities, federal agencies and national labs sitmulated all personnel to give their maximum effort. We thank them all.

SECTION I

INTRODUCTION

Increasing concern for the regional nature of secondary pollutant (e.g. sulfates, nitrates, oxidants, aerosol, etc.) formation and transport, has led the U.S. Environmental Protection Agency (EPA) to conduct major field studies since the mid 1970s. This report describes activities during the summer of 1980 which addressed the occurrence of persistent elevated pollution episodes (PEPEs) and continued the Northeast Regional Oxidant Study (NEROS). These activities are known as the 1980 PEPE-NEROS study.

The PEPE phase of the operations grew out of the EPA's STATE program (Sulfur Transport and Transformation in the Environment; Schiermeier, et.al. 1979). This program addressed the relationship between sulfur and nitrogen oxide emissions and the formation of sulfates and nitrates in power plant plumes while beginning to consider the regional scale impact of these pollutants. The need for a regional perspective on special air quality measurements was further indicated by broad regions of haze associated with large stagnant air masses. Satellite imagery has shown these masses (Lyons et.al., 1978) as have reports of degraded visibility and air quality (Husar,et.al., 1976a, Husar et.al. 1976b; Wolff et.al.1981). This PEPE phase of the study was sponsored by the EPA's Regional Field Studies Office(RFSO).

EPA's Meteorology and Assessment Division has been addressing the regional scale transport of oxidants. The focal point of that program is the development and application of the Regional Oxidant Model(ROM) in conjunction with the Northeast Corridor Regional Modeling Project(NECRMP). The ROM (Lamb,1983) is a regional-scale Eulerian transport and photochemistry simulation model that is intended to provide inflow boundary conditions of ozone and precursors for application of urban scale air quality simulation models to cities in the northeastern U.S. The model is formulated to treat those processes which are thought to affect photochemical oxidant concentrations over diurnal time scales (e.g. nocturnal chemistry and wind shear, the role of clouds in perturbing photochemical reactions and venting of pollutants from the boundary layer, etc.). The area being modeled extends east from about Dayton, Ohio and north from northern Virginia through southern Maine and Ontario. ROM will assess the impact of current sources within this region on oxidant concentrations in the northeast corridor, as well as the impact of oxidant control strategies for individual cities on regional concentrations.

As part of the 1980 NEROS program EPA's Meteorology and Assessment Division supported some field sampling activity to clarify and parameterize essential processes simulated in various modules of the ROM. Several sampling scenarios were followed to provide necessary inputs to the model. Simultaneously, EPA's Office of Air Quality Planning and Standards conducted intensive NECRMP measurements along the East Coast from Washington to Boston, and the Meteorology and Assessment Division obtained detailed surface and airborne measurements in the Baltimore-Washington urban plume. These activities were loosely coordinated with PEPE-NEROS activities out of Columbus, Ohio. The results are archived in separate EPA data bases (Possiel and Freas, 1982; Tichler, 1983).

The resources and sampling platforms necessary to support the PEPE and NEROS programs were combined and coordinated as the 1980 PEPE-NEROS study, using a common headquarters in Columbus, Ohio from 16 July through 15 August 1980. In this way a common weather forcasting, data processing and communications center could serve both projects. In addition, when conditions were not optimum for one project's scenario but suitable for the other, measurement platforms could be easily shifted to carry out those measurements.

This report describes the participants (Section 2), the measurement platforms (Section 3) and the parameters surveyed (Section 4). Examples of the general measurement activity are provided in Section 5. The contractor team's quality assurance program is reviewed in Section 6. The data base established by this study is introduced in Sections 7-9 as the contents of the Special Studies Data Center at Washington University are described, the descriptive analyses from urban plume and regional measurement scenarios are highlighted and, finally, a bibliography of reports from the study is presented.

This report concludes with highlights of potential areas for further analysis and research within the overall data base.

SECTION 2

PARTICIPANTS

The PEPE-NEROS study involved a mix of contractors, government agencies, and universities, as well as intern-national experts. Table 2.1 lists the participating organ-izations. The contractor team of four organizations provided measurement platforms, general support, and overall coordina-tion. The contractor team consisted of Environmental Measurements, Inc. (EMI), AeroVironment Inc. (AV), SRI-International (SRI), and Washington University Technology Associates (WUTA). William M. Vaughan of EMI served as Project Director, Ivar Tombach of AV and Bruce Cantrell of SRI as Co-Directors, and Michael Chan of AV as Field Manager.

Seven governmental agencies were involved in management, measurement, and field support roles. The RFSO and Meteor-ology Division of EPA's Environmental Sciences Research Laboratory (ESRL) provided technical direction and support activities from Francis Pooler and William E. Wilson, Jr. of RFSO, and from Ken Demerjian, Jason Ching, and John Clarke of the Meteorology Division. Also involved from EPA were the Environmental Monitoring Support Laboratories (EMSL) in North Carolina and Las Vegas.

The National Oceanic and Atmospheric Administration (NOAA) provided support from their Boulder Laboratories and the Idaho National Engineering Laboratory (INEL). The Boulder Labs specialized in turbulence, land use, and energy budget measurements, while the crew from INEL released and tracked small tetroons. EPA supported extra radiosonde launches by NOAA to achieve a six-hour sounding schedule at 10 sites within the general northeastern study area (See Figure 2.1). Additional irregular radiosondes were supported by EPA in Boston, New York and Washington,D.C. as part of parallel NECRMP activity.

The National Science Foundation (NSF) provided funding to the National Center for Atmospheric Research (NCAR) for studies of precipitation processes near the PEPE-NEROS study area.

TABLE 2.1 PARTICIPANTS IN THE PEPE/NEROS STUDY.

AGENCIES	CONTRACTORS
U.S. ENVIRONMENTAL PROTECTION AGENCY	ENVIRONMENTAL MEASUREMENTS, INC.
ESRL - RESEARCH TRIANGLE PARK	AEROVIRONMENT INC.
EMSL - RESEARCH TRIANGLE PARK	SRI-INTERNATIONAL
EMSL - LAS VEGAS	WASHINGTON UNIVERSITY TECHNOLOGY ASSOCIATES
	MESOMET INC.
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION	BATTELLE COLUMBUS LABORATORIES
BOULDER LABORATORIES	RESEARCH TRIANGLE INSTITUTE
IDAHO NATIONAL ENGINEERING LABORATORY	PEDCO ENVIRONMENTAL
NATIONAL SCIENCE FOUNDATION	UNIVERSITIES
NATIONAL CENTER FOR ATMOSPHERIC RESEARCH	WASHINGTON UNIVERSITY
	HARVEY MUDD COLLEGE
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION	OHIO STATE UNIVERSITY
LANGELEY RESEARCH CENTER	OTHERS, INDIRECTLY THROUGH THE AGENCIES.
JET PROPULSION LABORATORY	
WALLOPS ISLAND	INTERNATIONAL
	ATMOSPHERIC ENVIRONMENT SERVICE OF CANADA
DEPARTMENT OF ENERGY	
ARGONNE NATIONAL LABORATORY	MILLAN M. MILLAN OF BARRINGER RESEARCH
FEDERAL AVIATION ADMINISTRATION	N.D. VAN EGMOND, RIJKS INSTITUUT VOOR DE VOLKSGEZONDHEID
TENNESSEE VALLEY AUTHORITY	BERTIN & CIE
OHIO ENVIRONMENTAL PROTECTION AGENCY	

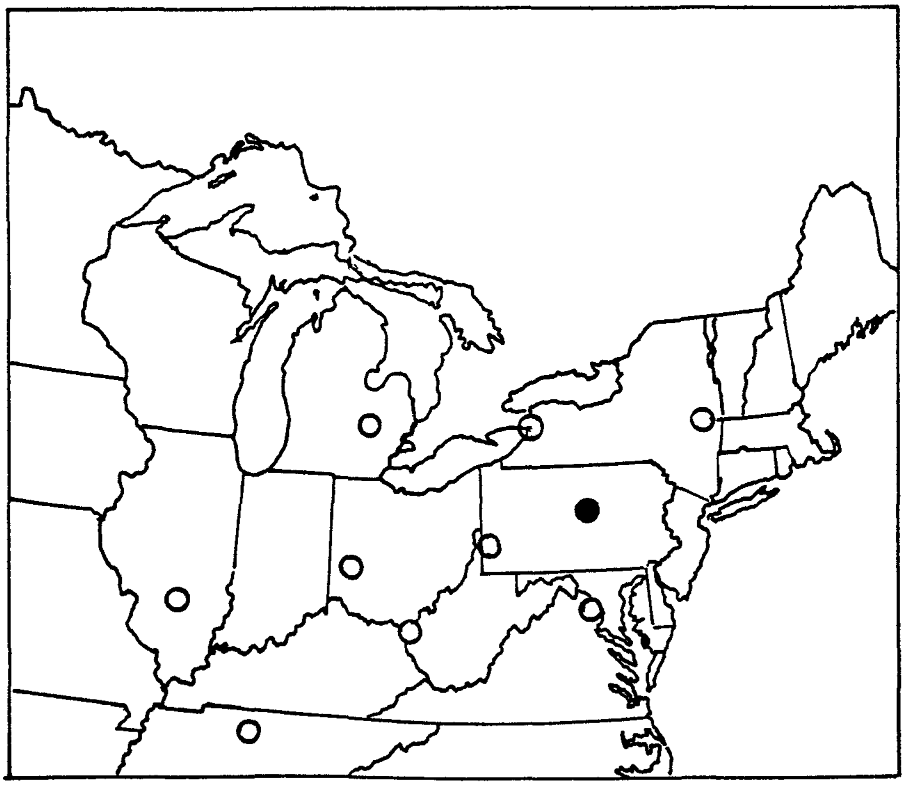


Figure 2.1 Radiosonde stations indicated by open circles are existing NWS sites which took radiosondes at 6-h intervals during the 1980 study. The site in central Pennsylvania indicated by a solid circle was a special 6-h station established for the study.

Federal Aviation Administration (FAA) facilities were used to track EPA's large tetroons, which were equipped with aircraft transponders. This tracking effort was staffed and coordinated by SRI-International at various FAA centers across the greater northeast.

The National Aeronautics and Space Administration (NASA) flew several airborne lidar systems for ozone and aerosols. NASA also flew an in situ sampling aircraft, and operated several advanced ground-based meteorological systems.

The Department of Energy, through Argonne National Laboratory (ANL), made turbulent dry deposition measurements at Croton, Ohio (NE of Columbus). At the same location, NASA conducted many of its ground-based operations, namely, tethered balloon and microwave atmospheric remote sensor (MARS).

The Tennessee Valley Authority (TVA) provided one of its monitoring helicopters to carry EPA instruments for urban air mass characterization. The Ohio Environmental Protection Agency cooperated with PEPE-NEROS participants in the use of their laboratory space and monitoring facilities.

In addition to Washington Universtiy's involvement through WUTA, there were other university groups involved in PEPE-NEROS. Washington University's Center for Air Pollution Impact and Trend Analysis (CAPITA) provided regional dispersion modeling output and specialized plots of National Weather Service data. The University of Minnesota operated its mobile laboratory, designed for sophisticated aerosol and chemical measurements, at the ANL/NASA site. Harvey Mudd College provided specialized measurements related to oxidant photochemistry at two EPA ground monitoring sites. Ohio State University provided general meteorological and tetroon trajectory support in addition to airport and operational facility support. Several other university researchers participated indirectly through various agencies.

Private contractors and consultants, outside the main contractor team were involved as well. Battelle Columbus Laboratories provided support for three $NO-NO_x$ ground stations and EPA's mobile gas chromatography laboratory. MESOMET, Inc., which was in daily contact with the project's weather room, provided verbal interpretation and hard copy information from the GOES satellites, and digitally archived meteorological conditions during the study period (Lyons and Calby, 1981). Research Triangle Institute (TRI) and PEDCO Environmental (PEDCO) provided internal system audits (Arey et al., 1981).

International participation in PEPE-NEROS came from several countries. The Atmospheric Environment Service (AES) of Canada was involved on a daily basis by providing hard copies of trajectory, SO_2, and sulfate predictions from the Canadian LRTAP trajectory and concentration model (Olson and Oikawa, 1980). Bertin and Cie of France shipped a Doppler acoustic sounder to the Columbus, Ohio area for continuous operation during the field study. Individuals from Canada (Millan M. Millan) and the Netherlands (N.D. van Egmond) provided advisory guidance in the planning stages of the overall program.

SECTION 3

PLATFORMS

The participants (Table 2.1) carried out air quality and meteorological measurements from surface platforms (fixed, mobile, and moving) and airborne platforms. Some provided support services involving data acquisition and archiving at the field headquarters. Table 3.1 provides a summary of these measurement platforms and data centers, indicating the organization and principal investigator responsible for each set of data gathered.

Most platforms operated were based in the vicinity of Columbus, Ohio. The major exceptions were the NEROS operations in the Baltimore-Washington, D.C. corridor (only loosely coordinated out of Columbus, Ohio) and the NCAR precipitation chemistry measurements, which operated in the greater Northeast but were not coordinated with the bulk of the program. Figure 3.1 indicates when the program platforms were operating, with the exception of the two activities mentioned above. If any measurements were made on a given day, the appropriate date column is marked.

TABLE 3.1 PLATFORMS AND DATA CENTERS OPERATED DURING PEPE/NEROS.

AIRBORNE LABORATORIES	SOURCE	PRINCIPAL INVESTIGATOR
CHEM-1 (CHEMISTRY AIRCRAFT)	EMI	WILLIAM VAUGHAN
CHEM-2 (CHEMISTRY AIRCRAFT)	AV	IVAR TOMBACH
SCOUT (CHEMISTRY AIRCRAFT)	SRI	BRUCE CANTRELL
ELECTRA (LIDAR SYSTEM)	NASA	ED BROWELL (UV-DIAL*)
		JEFFREY SCROGA (HSRL*)
CHEM-3 (CHEMISTRY AIRCRAFT)	NASA	GERALD GREGORY
LAS* QUEENAIR	NASA-JPL	MIKE SCHUMATE
EPA-LIDAR	EPA-LAS VEGAS	JIM MCELROY
TURBULENCE AIRCRAFT	NOAA-BOULDER	BRAD BEAN
CLOUD CHEMISTRY AIRCRAFT	NCAR	AL LAZRUS
CHOPPER	EPA-TVA-EMI	WILLIAM VAUGHAN

SURFACE-BASED LABORATORIES	SOURCE	PRINCIPAL INVESTIGATOR
MOVING LABORATORY	EMI	GARY KLAUBER
DOPPLER SODAR 1 AND 2	AV	MICHAEL CHAN
AEROSOL LABORATORY	UNIV. OF MINN.	PETER MCMURRY
LIDAR VAN	SRI	ED UTHE
SMALL TETROON TRACKING	NOAA-IDAHO	GENE START
LARGE TETROON TRACKING	SRI	WALT DABBERDT
GC LABORATORY	ESRL-RTP	WILLIAM LONNEMAN
SPECIAL PHOTOCHEMISTRY PRECURSORS	HARVEY MUDD COLLEGE	GREGORY KOK
TETHERED BALLOON	NASA	OTTO YOUNGBLUTH
NO_x, OZONE NETWORK	EMI-BCL	WILLIAM VAUGHAN

TABLE 3.1 CONT.

SURFACE-BASED LABORATORIES	SOURCE	PRINCIPAL INVESTIGATOR
BERTIN SODAR	BERTIN & CIE	PIERRE HUGUET
DRY DEPOSITION EXPERIMENT	ANL	MARVIN WESLEY
MARS*	NASA-JPL	BRUCE GARY
SUN PHOTOMETRY	NASA-U. OF MIAMI	JOE PROSPERO
DATA CENTER	WUTA	NOOR GILLANI
WEATHER CENTER	SRI	WILLIAM VIEZEE

* UV-DIAL = ULTRAVIOLET-DIFFERENTIAL ABSORPTION LIDAR

HSRL = HIGH SPECTRAL RESOLUTION LIDAR

LAS = LASER ABSORPTION SPECTROMETER

MARS = MICROWAVE ATMOSPHERIC REMOTE SENSOR

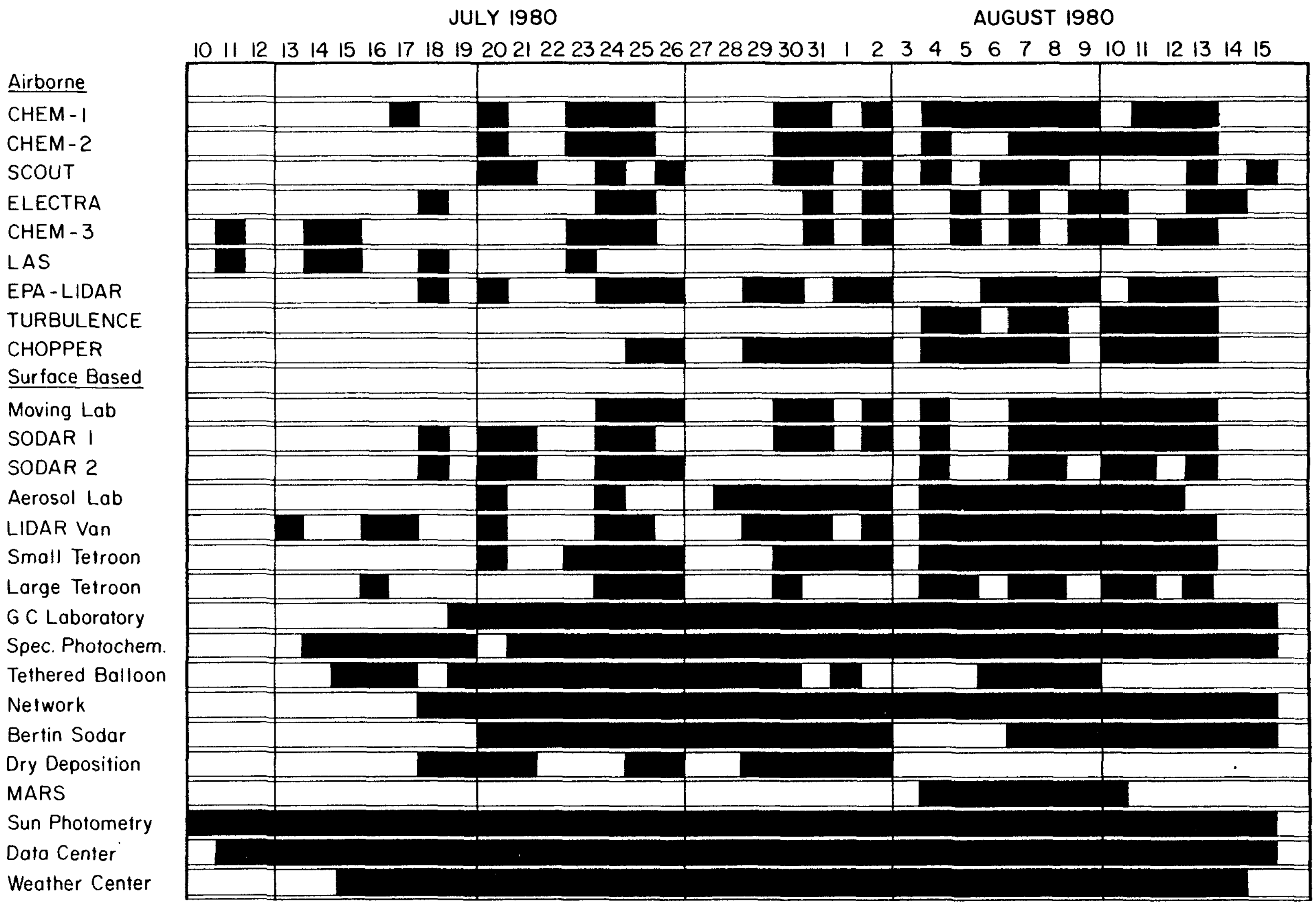


Figure 3.1 Days of operation of platforms during PEPE/NEROS.

SECTION 4

PARAMETERS

A diverse mixture of measurements is possible from the platform list (Table 3.1). Within the collection of measurements from PEPE-NEROS is information on gaseous pollutants (particularly SO_2, NO, NO_x, O_3 and hydrocarbons); aerosol indicators (b_{scat}, SO_4, Aitken nuclei count, aerosol filters, chemical analyses, and particle size distribution); and meteorological parameters (multiple tetroon trajectories, temperature, wind speed, dew point, and mixing height (from the various lidar measurements)). All the aircraft automatically recorded their position (x,y,z) and time (CDT) so that spatial and temporal linking of the data base is possible. A total of 353 flight hours were logged by CHEM-1, CHEM-2, SCOUT, and CHOPPER in 100 missions flown by the EPA contractor teams.

Vertical profiles of most meteorological and air quality parameters were obtained from spiral flights and ramping flights (i.e. changing altitude while moving horizontally as opposed to staying over one spot.). Several of the measurements involved remote sensing instruments which also provided profiles. These included the NASA Electra's use of a multipurpose DIAL system for measurement of ozone and aerosol profiles (Browell, et al., 1983) and a high spectral resolution lidar for aerosols alone (Sroga, et al., 1983) which used reflected laser pulses at different wavelengths to quantify various parameters. EPA also operated a dual wavelength lidar to determine aerosol back scatter and to infer some information on rough size distribution in the profile. SRI's surface based lidar gave the aerosol profile which was also used to estimate mixing height. Acoustic remote sensors (AV's Sodar-1 and 2 along with the Bertin unit) were used to obtain profiles of wind speed and direction. Finally, the Microwave Atmospheric Remote Sensor (MARS) used microwaves to obtain an estimate of temperature and dewpoint profiles in the lower atmosphere. The remote sensing correlation spectrometers obtained the vertical integral of the SO_2 profile known as the SO_2 burden.

Table 4.1 indicates which air quality and meteorological parameters were recorded by each platform. Not all parameters

TABLE 4.1. AIR QUALITY AND METEOROLOGICAL PARAMETERS AVAILABLE FOR EACH PLATFORM

Platforms	Measurement Interval (sec)	SO_2	SO_4	NO-NO_x	O_3	b-scat	ANC	Hydrocarbons[b]	Filters[c]	Temp.	Dew Point	Light Levels	Turbulence	Wind Speed	Wind Dir.
Airborne															
CHEM-1[a]	2-8	X	X	X	X	X	X	X	X	X	X				
CHEM-2	12	x	X	X	X	X	X	X	X	X	X		X		
SCOUT	0.4	X			X	X		X	X	X	X		X		
ELECTRA	1-60				PRO	PRO[e]									
CHEM-3	10				X	HTD				X	X				
LAS	10-30				INT										
TURBULENCE	<1				X					X	X		X	X	X
CHOPPER	5			X	X	X		X							
EPA LIDAR						PRO[e]									
Surface-based															
MOVING LAB	8-15	X +INT	X	X	X	X		X	X						
SODAR 1	300[d]									PRO				PRO	PRO
SODAR 2	300[d]									PRO				PRO	PRO
Aerosol Lab[a]		X	X	X	X	X	X								
LIDAR Van		INT				PRO[e]									
Special Photochemical				X	X			X				X			
Tethered balloon	30				X					PRO	PRO			PRO	PRO
Network				X	X							X			
Bertin Sodar	900[d]													PRO	PRO
Dry Dep.		X			X					PRO	PRO			X	X
MARS	600									PRO	PRO				

X = Point measurement available.
PRO = Profile showing variations with altitude.
HTD = Heated nephelometer.
SO_4 = Continuous readings from a modified Meloy 285.
INT = Integrated burden (for SO_2 these measurements were from correlation spectrometers).
a = Aerosol size distribution measurements were conducted as well.
b = Hydrocarbon cannisters were analysed in EPA's GC Laboratory in Columbus, Ohio.
c = Filters were collected with a 3.5 micron cut point and analysed for $SO_4^=$ and NO_3^-.
d = Seven second readings reported as 15-minute averages.
e = The lidar signal is not a true profile of the parameter "b_{scat}" but is related to it since it records the backscatter of light from layers of atmospheric aerosol. It gives a good indication of mixing depth.

were necessarily recorded for each day, but most parameters for most days should be generally available.

WUTA's Data Center provided 24-hour processing of data tapes from the principal contractor aircraft (CHEM-1, CHEM-2, and SCOUT) to rapidly pinpoint problem areas with instrumentation. This activity assured timely repair so that there would be maximum recovery of data on each parameter. SRI's weather center archived the NWS observations, soundings, maps, progs, and satellite photos received during the program. These real-time records are complemented by a computerized satellite and weather service data base compiled during the program by MESOMET, Inc., using the University of Wisconsin McIDAS system.

SECTION 5

OPERATIONS AND FLIGHTS

A full operational headquarters was set up in a dormitory on the Ohio State University campus. Included in this headquarters were a complete radio and phone communications center; a complete weather center with multiple NWS wire service imputs, including GOES satellite imagery and facsimiles from AES Canada; a computer center; project office; and space for general briefings.

The daily schedule involved gathering information on platform status for each parameter (Table 4.1) and on forecast weather conditions. Platform operators and the data center provided information on those platforms that could be deployed for a survey mission. The study's forecaster and his staff prepared a forecast of local (Columbus, Ohio) and regional weather conditions expected for the next 24-48 hour period. Input from the senior scientists in the field was utilized to plan the next day's mission, taking advantage of operating instruments, weather conditions, and various PEPE and NEROS monitoring objectives.

The NEROS missions for urban and regional studies involved release of small tetroon clusters at various altitudes (some 97 releases were tracked by NOAA-Idaho) and a large EPA tetroon to be tracked by FAA centers. These tetroons helped define the transport conditions during measurements. Figure 5.1 illustrates the tracks of 10 of 13 large EPA tetroons (Clarke, et al. 1983a,b). Their positions could be phoned to the field headquarters from the FAA centers for plotting and tracking during actual operations. Once the transport field was marked with tetroons, the aircraft and mobile platforms were deployed to document the air quality and mixing conditions in the air mass. CHOPPER and NOAA-Turbulence were fairly heavily dedicated to urban plume surveys. EPA Lidar carried out mostly plume-oriented studies, but occasionally conducted regional studies outside Ohio. Moving Lab conducted frequent ground-level surveys near Columbus, but also was deployed to West Virginia and Kentucky for PEPE-oriented regional surveys.

NEROS regional measurements were carried out to characterize the northeastern grid used in the ROM between

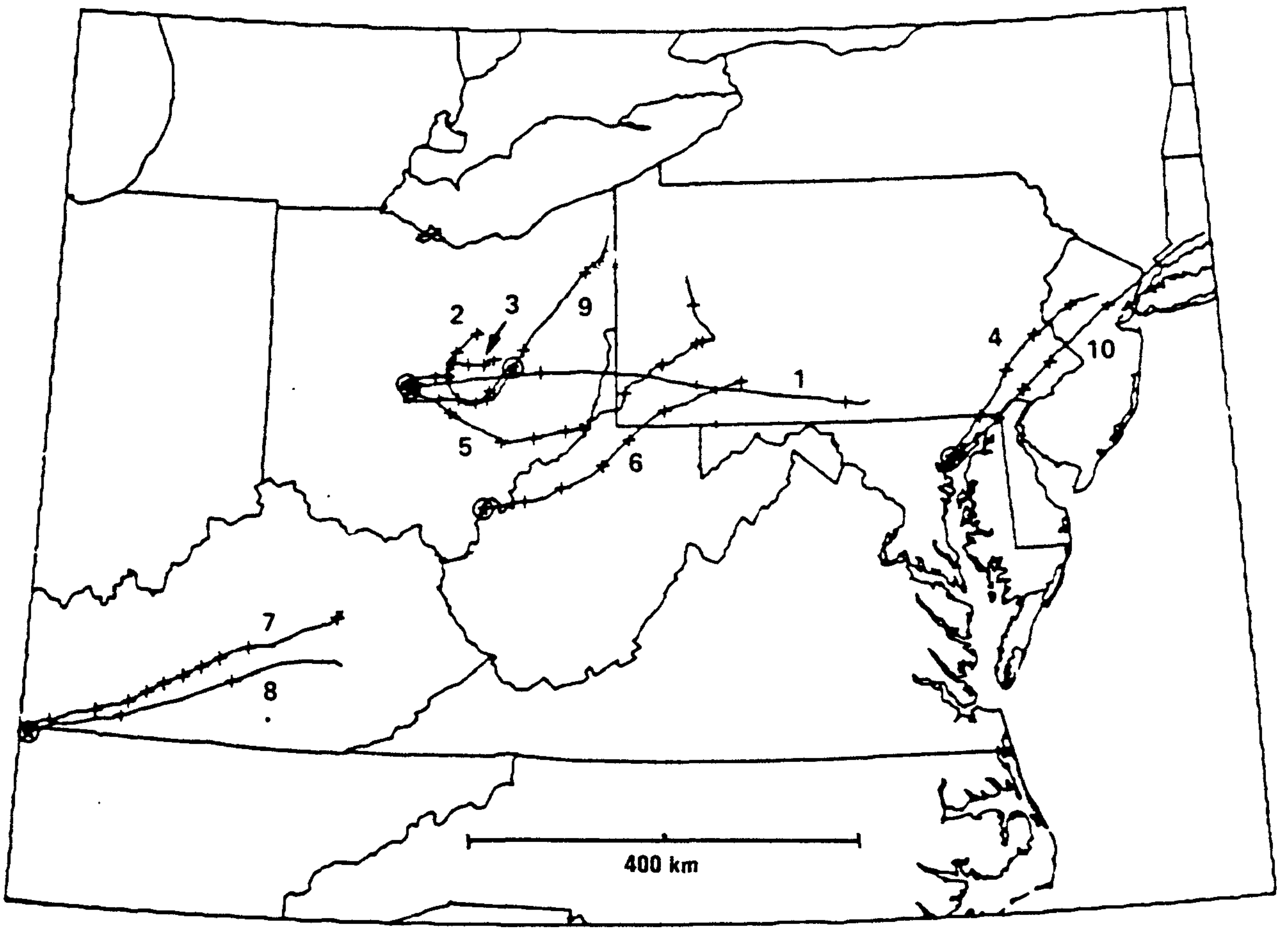


Figure 5.1 Flight tracks of tetroons with positions every three hours marked by (+).

about 70°W and 85°W longitude, and 38°N and 45°N latitude. SCOUT, CHEM-1, and CHEM-2 provided frequent in situ surveys across various parts of this NEROS box. They were usually vectored back to the location of the large EPA tetroon, in order to follow the aging of the air mass in the vicinity of this specific marker. Moist air masses moving in from the west and south west, and Canadian polar air masses were characterized by these flights.

ELECTRA was deployed for its regional surveys out of Wallops Island, Va., in support of NEROS and PEPE regional objectives. CHEM-3 provided correlative in situ measurements at selected locations below ELECTRA's flight path, as it had done earlier in the program for LAS-Queenair flights (Gregory et al. 1981).

PEPE regional surveys were less restricted, and involved flights into stagnant air masses (two to five days old) or into moving air masses that experienced regional visibility degradation, as reported by FAA and NWS wire services and by satellite imagery. These regional surveys extended into New York and New England during the first week in August 1980, following development of large-scale haziness in the area. In the middle of the second week in August, several flights into Tennessee, Alabama, and Arkansas were carried out to characterize a maritime tropical air mass, associated with an extension of the Bermuda High, that had stagnated over Georgia and Tennessee for four days. Measurements also were made as this aged air mass swept out to the Atlantic. On two occasions, 24-25 July and 10-11 August, tetroons were placed in or near power plant plumes, (Figure 5.1 Tracks 2 and 3 for 25 July and 7 and 8 for 11 August) and flights were made to characterize the mixing of these plumes into the general air mass.

A summary of the types of missions flown during the study period is shown in Table 5.1. It is obvious that with the resources available to the project, limited urban plume flights could be carried out while regional surveys were in progress. This calendar starts on 20 July, because coordinated mission-oriented activity did not start until then.

Figures 5.2-5.5 show sample flight routes of CHEM-1, CHEM-2 and ELECTRA. They indicate the range of a typical urban plume mission on 31 July (Fig.5.2) and the scale of PEPE flights on 10-11 August (Figs.5.3-5.5).

TABLE 5.1. SCHEDULE OF MISSIONS FLOWN

	July								August												
	20	23	24	25	26	29	30	31	1	2	4	5	6	7	8	9	10	11	12	13	15
<u>Urban Plume</u>																					
Limited	X	X				X			X	X		X	X	X	X		X	X			
Full Scale				X			X	X			B								X	X	(X)
<u>Regional</u>																					
PEPE			P						X			X	X	X	X	X	P	P			
NEROS				P			P			X					X						X

P = Power plant plumes were specifically monitored in the course of regional measurements.

B = Urban plume budget measurements.

()= Poor data recovery from aircraft.

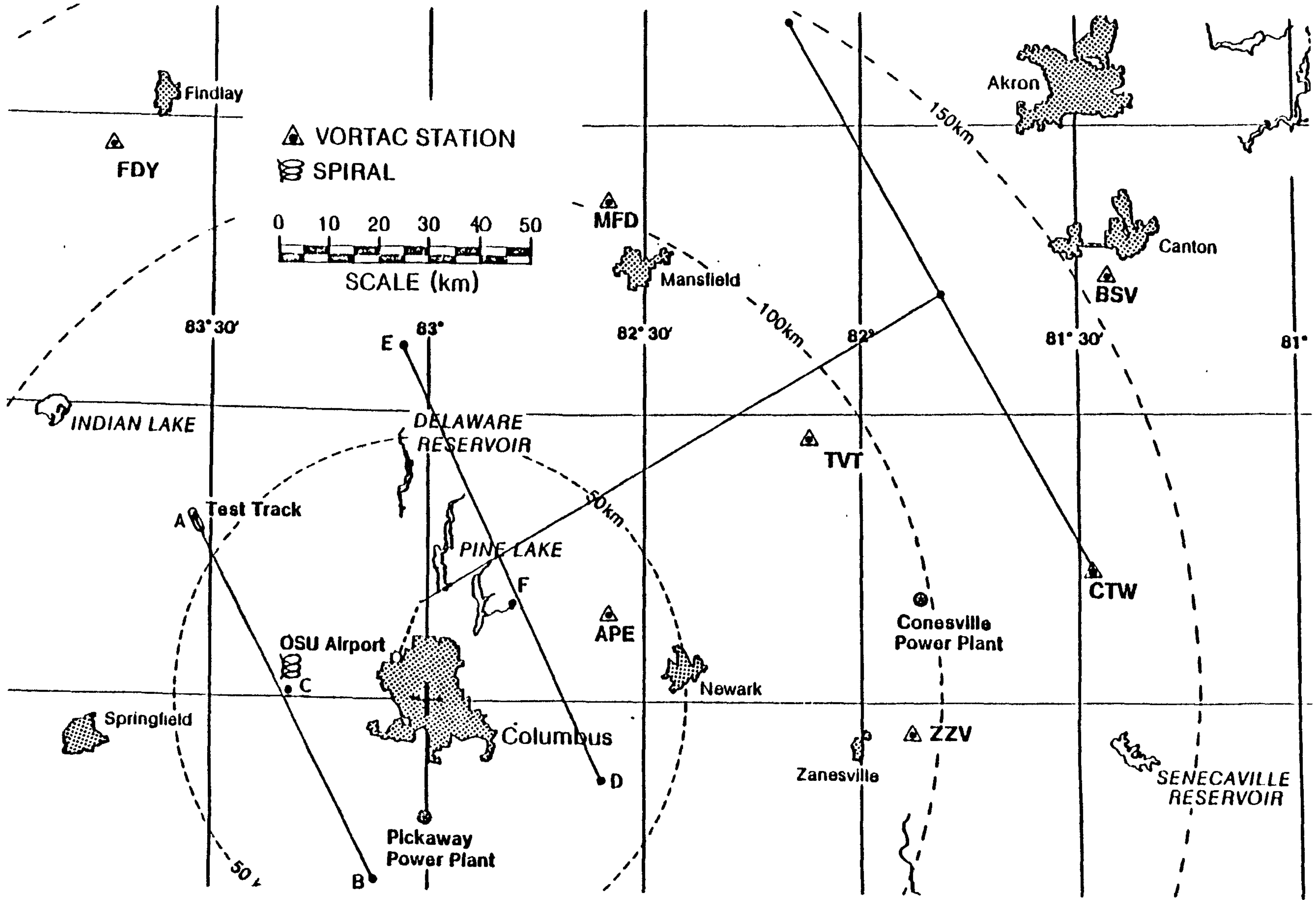
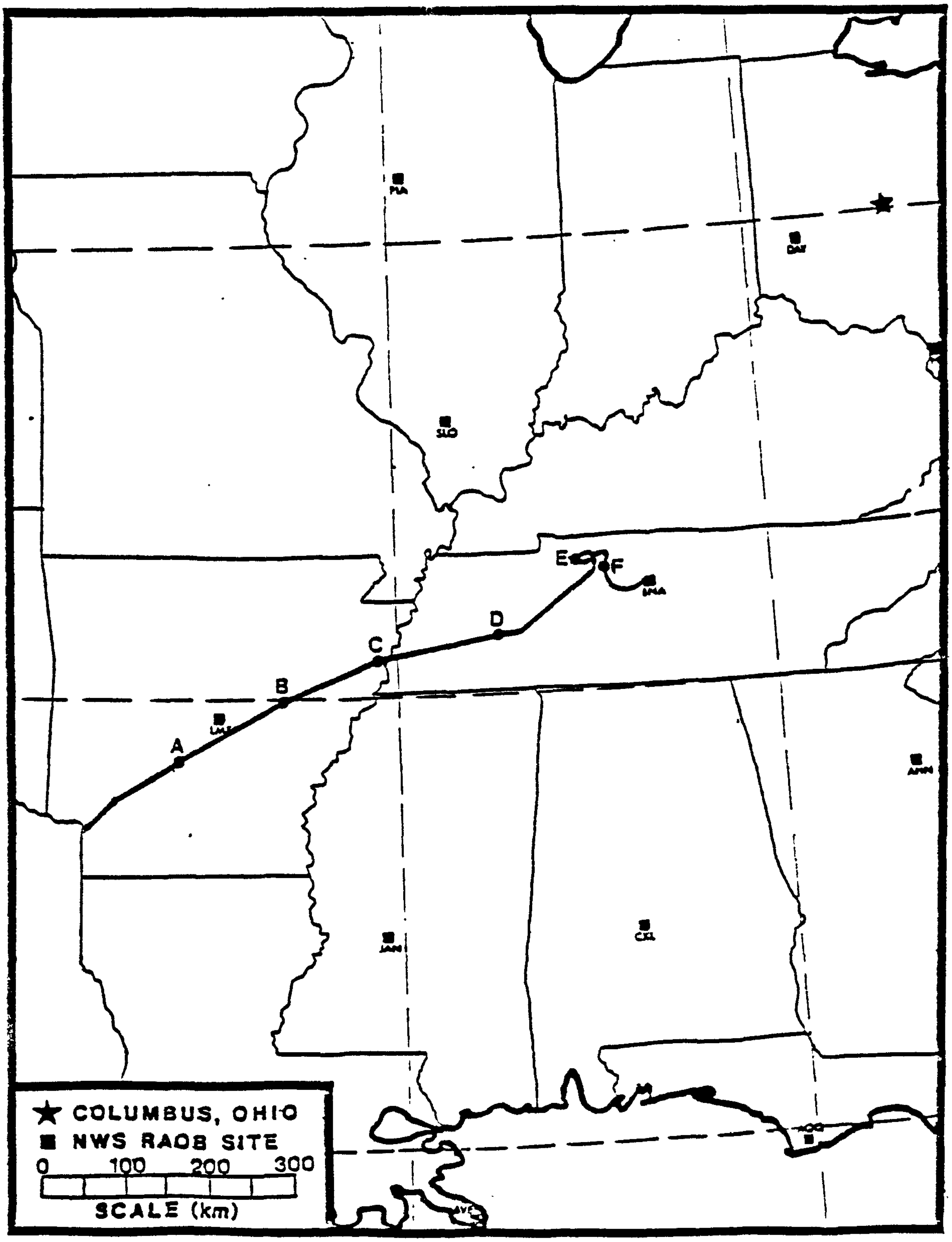


Figure 5.2 CHEM-1 Flight 1 on 31 July 1980, 1224-1705 EDT.



Aircraft: Chem 2
Date: 8/10/80
Flight: 2

Figure 5.3 CHEM-2 Flight 2 on 10 August 1980, 1656-2029 EDT.

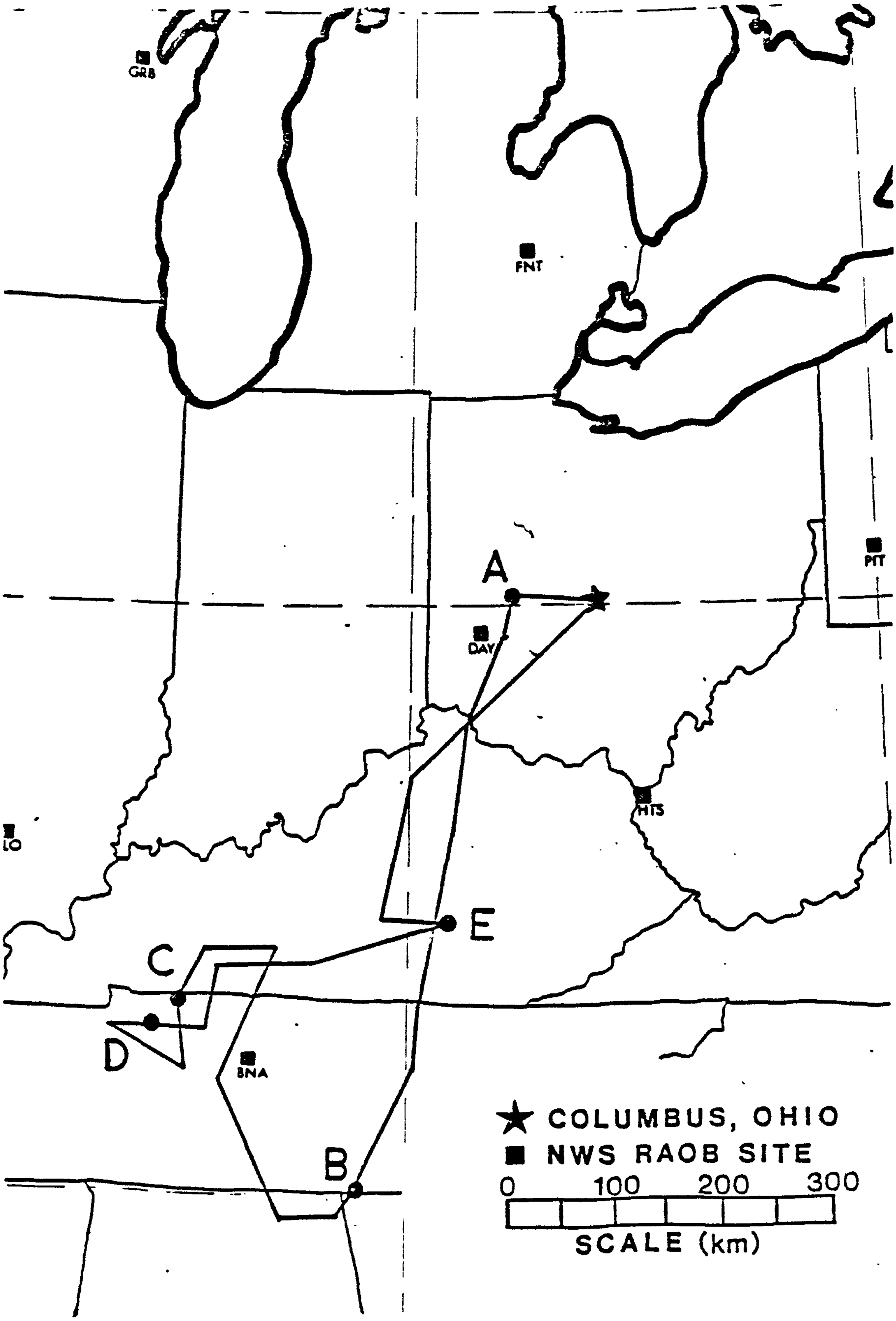


Figure 5.4 CHEM-1 Flight on 11 August 1980, 1115-2348 EDT.

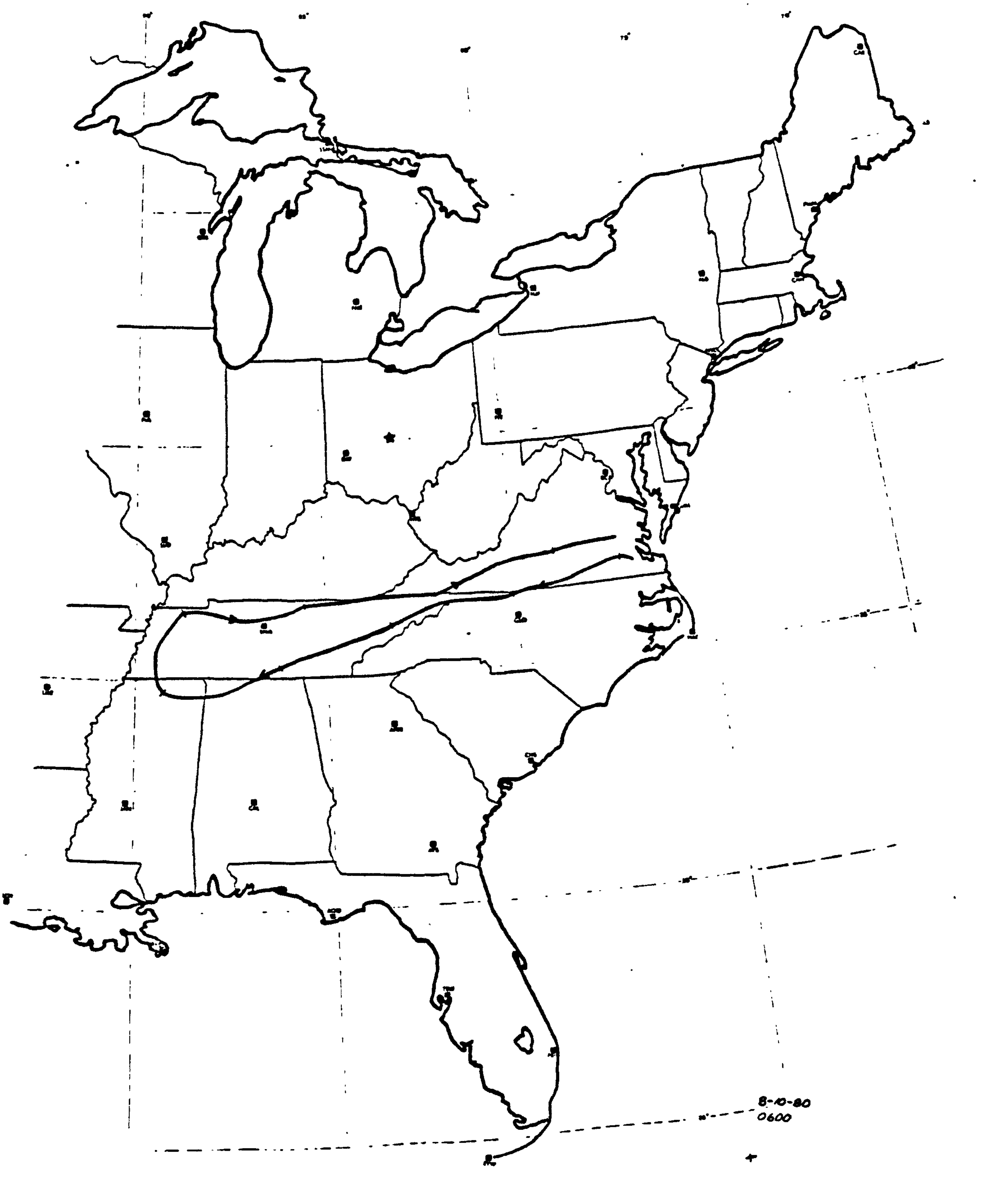


Figure 5.5 ELECTRA Flight on 10 August 1980, 0555-1020 EDT.

SECTION 6

QUALITY ASSURANCE ACTIVITIES

A thorough quality assurance program was followed throughout the program that involved at least one level of outside auditing. In the case of the contractor team there was a second layer of independent audits in addition to the routine calibration and internal quality assurance procedures followed by the individual groups.

6.1 External audits

External audits were performed for EPA's Quality Assurance Division (QAD) by Research Triangle Institute and their sub-contractor, Pedco. RTI verified the accuracy of their audit system either at QAD's facility or at RTI's Audit System Verification Center (ASVC). These verifications occurred both before and after the actual field audits.

Audits were conducted for the major platforms and sites in the Columbus area and for some NECRMP components along the East Coast. The audits for the contractor team specifically evaluated 30 criteria parameters (namely, parameters associated with monitoring criteria pollutants) in addition to light scattering measurements by nephelometer. Of the criteria parameters audited when instruments were functional, 56% had excellent agreement with the audit concentration and 26% were satisfactory. Only 4 parameters (or 17%) were unsatisfactory; and one of these was an experimental instrument and two were reaudited as satisfactory at a later time. The detailed results appear in the RTI audit report (Arey et al. 1981).

6.2 Internal audit activities

The contractor team platforms received additional audit attention from the AeroVironment Quality Assurance Department which reported directly to the Project Director, William M. Vaughan. AV established their master calibration system as an appropriate transfer standard through a direct performance evaluation audit of personnel, equipment and procedures at QAD's facilities at Research Triangle Park, just as RTI had done. All parameters checked in this pre-study audit agreed within 5% of the QAD standards and many within 2.5%.

In the field AV completed two to three audits on most contractor platforms thus cross checking each crew's quality assurance procedures and calibration results. Each crew operated an independent calibration and QA activity which was cross-checked by these internal auditors. For a few sites as an extra task order, AV's QA team provided audit calibrations during the field program. These sites included CHOPPER, (O_3, NO, NO_x), CHEM-3 (O_3), Harvey Mudd's WCVO Site (NO, NO_x) and NASA's ozonesonde at Croton, Ohio.

The AV QA team took on the additional task of evaluating the altitude response and time response of some instruments and establishing a common data processing protocol to account for these responses (Tombach and Pettus, 1982). This effort combined with the more traditional auditing tied together these critical platforms in measurement and processing functions.

One special activity and evaluation required by the internal QA program was the execution of parallel flys of the team's three principal fixed wing aircraft - CHEM-1, CHEM-2 and SCOUT. Three attempts were made at such flights ending in good comparisons of CHEM-1 and CHEM-2 on 31 July and all three on 4 August. A comparison with about 12 minute separation was conducted by CHEM-2 and SCOUT on 13 August. These in-flight intercomparisons in the same air mass indicated generally good tracking of variations in parameters with occasional minor offset differences. These flights further helped establish the comparison between separate instrument readings which would be audited on the ground and cross-checked those which could not be rigorously audited.

The AV QA report describes these activities and evaluations in more detail (Pettus and Tombach 1984). An overall evaluation of the quality of the data is also provided in that report. Such an evaluation is important because measurements made with fast response times and short averaging times, under conditions of varying temperature and pressure, accompanied by vibration and less-than-perfect electrical power, often with modified or experimental instruments, could well be expected to be of significantly poorer accuracy and precision than those made by standard pollutant analyzers in a fixed network. Nevertheless, with a few exceptions, the quality of the data that have been incorporated into the data base is quite good -in many cases of quality comparable to that of fixed networks.

SECTION 7

PEPE-NEROS DATA BASE

The data collected during this study has been gathered together in one location - the Special Studies Data Center (the Data Center) at Washington University under the direction of Dr. Noor Gillani. In addition the contractor team's data base has been centralized at AeroVironment. It was decided, that these data should also be brought to a common format which is easy to use. This format is a variation of the STATE-10 format developed for the EPA's Sulfur Transport and Transformation in the Environment program (Schiermeier, et al. 1979).

Security for the data base is provided in a decentralized manner as all participants also retain a final copy of their data and the contractor team's data base has been separately centralized at AeroVironment.

The PEPE-NEROS archive in the Washington University Data Center consists of the following major components:

1. The Field Data Base - the raw and partially processed aircraft data acquired by the on-site data center during the field study itself;

2. The Original Data Base - the processed data submitted to the Data Center by the individual data collecting organizations;

3. The Intermediate Data Base - the original data base reformatted into internal direct access format compatible with EDITR (the Data Center's display/edit software package);

4. The Final Data Base by Organization - the original data base reformatted into the standardized STATE (-20 and -VS) formats;

5. The Final Data Base by Day - the final data base reorganized to group the data of all organizations for each day into a daily data base subset;

6. The PEPE-NEROS software library;

7. The PEPE-NEROS hard copy data base.

The General Distribution Data Base (GDDB) (See Section 7.2) is essentially complete and ready for distribution. The GDDB is composed chiefly of the Final Daily Data Base (5), with some supplementary items out of the Final Data Base by Organization (4).

Appendix A presents a tabulation of the current status of the overall PEPE-NEROS archive at the Data Center in a synopsis form. The only significant data collections not resident in the archive as of May 1984 are the bulk of the AES-Canada data and the detailed data of the EPA-LV lidar.

Appendix B lists the hard copy documents in the Data Center as of May 1984. Much of the hard copies contain graphic presentation of the same data as in the magnetic form. The hard copy documents do include reports from AES-Canada and EPA-Las Vegas lidar.

Certain other data sets are currently in the general archive, but are not included in the GDDB on the grounds that they are not judged to be of general interest. This category includes the following:

- 5 Hz data of the UV-DIAL aerosol backscatter profiles (NASA);
- 1-min average UV-DIAL ozone profiles (NASA);
- 40 Hz data of the Turbulence Aircraft (NOAA-ERL);
- the raw SRI ground lidar aerosol data (SRI).

These data sets are extremely voluminous, and largely in raw form. They will be made available to serious, interested users upon specific request. These data sets, though not generally in standardized formats, are nevertheless, reasonably well-documented.

7.1 Data Formats

The GDDB is in a highly standardized form. All data sets, except the routine NWS surface and upper air data, are in one of two standard formats - the STATE-20 and the STATE-VS. The former is most suited to data of the time-series type (the majority of the PEPE-NEROS data), and the latter is most suited to the data of vertical soundings. STATE-20 is well known to most potential PEPE-NEROS data users and is an upgraded version of the STATE format promulgated during the Tennessee Plume Study. STATE-VS has been formulated by the Data Center specifically for the PEPE-NEROS data base. Complete documentation of the STATE formats can be found in Gillani, 1983.

The NWS surface and upper air data formats are long-standing and quite familiar to many potential users, who probably also have specific software to handle these formats. For this reason, it was decided that routine NWS data be left in their NWS formats. Documentation of these formats are also included in Gillani, 1983. All physical records in the STATE and NWS formats are 80 character card images in simple FORTRAN formats.* Logical record lengths are variable for the different data sets.

7.2 The General Distribution Data Base

The GDDB consists of two major components:

- the Final Daily Data Base (data grouped by day)
- other data not broken up into day files.

The files in the Daily Data Base are identified and defined in Table 7.1 along with the identification of the format type for each file. The remaining data files (those not broken up by day) are listed in Table 7.2.

Since not every platform was operational each day, the actual files present in any given daily data group constitute a subset of the total possible day file group outlined in Table 7.1. Table 7.3 outlines, in matrix form, the actual files existent for each day of the period 7/15/80 through 8/15/80. The information in the matrix elements actually identifies the specific file number for each platform for each day.

The first file for each day is a summary file (SUMARY. MDD) which explicitly lists the actual data files extant for that day which make up the rest of the data base of that day.

The Daily Data Base can be packed into 2 industry-standard 1/2-inch mag tapes (2400 ft). These tapes are 9 track. The data density is 1600 bpi. The data coding is in ASCII. The data are blocked in variable sizes which are given in Gillani 1983.

A third tape would contain the non-daily data files (listed in Table 7.2). The tape format is similar to that of the other two tapes. All files in this tape, with the

*Exception: NWS surface data records are 128 characters long.

TABLE 7.1

PEPE-NEROS 1980

LIST OF FILES ON DAILY DATA BASE TAPES

FILENAME	ORGANIZATION	PLATFORM/DATA	FORMAT
SUMMARY.MDD	-	LIST OF FILES FOR GIVEN DATE	
EMIAxx	EMI	CHEM I AIRCRAFT DATA	STATE-1Ø
AVNAxx	AV	CHEM II AIRCRAFT DATA	STATE-1Ø
SRIAxx	SRI	SCOUT AIRCRAFT DATA	STATE-1Ø
CHOPxx	EPA/EMI	CHOPPER HELICOPTER DATA	STATE-1Ø
LASAØ1	NASA/JPL	QUEEN AIR LAS DATA	STATE-1Ø
UVDAxx	NASA-LaRC	ELECTRA UV-DIAL DATA	STATE-1Ø
HRLAxx	NASA/U.WIS	ELECTRA HSRL DATA	STATE-1Ø
ERLUxx	NOAA-ERL	TURBULENCE AIRCRAFT (UNFILTERED)	STATE-1Ø
ERLFxx	NOAA-ERL	TURBULENCE AIRCRAFT (FILTERED)	STATE-1Ø
EMIGxx	EMI	AQML DATA	STATE-1Ø
UMCGxx	U.MINN	UMHL CONTINUOUS (SUMMARY)	STATE-1Ø
UMPGxx	U.MINN	UMHL PARTICULATE (SUMMARY)	STATE-1Ø
UMSDxx	U.MINN	UMHL SIZE DISTRN (SUMMARY)	STATE-1Ø
ANLGxx	ANL	SURFACE FLUX DATA	STATE-1Ø
MUDDxx	H.MUDD	SPECIAL PHOTOCHEM LAB	STATE-1Ø
SP8GØ1	NASA-GSFC	8-CH. RADIOMETER NETWORK	STATE-1Ø
SP4GØ1	NASA-GSFC	4-CH. SUN-PHOTOMETER	STATE-1Ø
RMSGØ1	NASA/JPL	MARS - REMOTE SPECTROMETER	STATE-1Ø
PMRGØ1	NASA/JPL	MARS - PASSIVE SPECTROMETER	STATE-1Ø
ARLxxx	NOAA-ARL	SMALL TETROON DATA	STATE-1Ø
EPAOxx	EPA/FAA/SRI	LARGE TETROON DATA	STATE-1Ø
STBGVS.MDD	NASA-LaRC	SMALL TETHERED BALLOON DATA	STATE-VS
CORAVS.MDD	NASA-LaRC	CHEM III B_{SCAT}, O_3 CORRELATIVE WITH UVDIAL	STATE-VS
CRTAVS.MDD	NASA-LaRC	CHEM III TEMP CORRELATIVE WITH UVDIAL	STATE-VS
CCLAVS.MDD	NASA-LaRC	CHEM III B_{SCAT}, O_3 CORRELATIVE WITH LAS	STATE-VS
CLTAVS.MDD	NASA-LaRC	CHEM III TEMP CORRELATIVE WITH LAS	STATE-VS
AVPIØ1.MDD	AV	SODAR 1 PIBAL DATA	STATE-VS
AVPIØ2.MDD	AV	SODAR 2 PIBAL DATA	STATE-VS
AVASØ1.MDD	AV	SODAR 1 AIRSONDE DATA	STATE-VS
AVASØ2.MDD	AV	SODAR 2 AIRSONDE DATA	STATE-VS
BERTIN.MDD	BERTIN	3-D SODAR DATA	STATE-VS
UAWIND.MDD	NWS	UPPER AIR WIND DATA	NWS-WIND
UATEMP.MDD	NWS	UPPER AIR TEMP DATA	NWS-TEMP

Notes:

xx,xxx = variable numerical identifiers of specific missions

MDD = Date (Month,Day), e.g. MDD=724 indicates July 24.

TABLE 7.2

PEPE/NEROS 1980

SUPPLEMENT(*) TO DAILY DATA BASE

FILENAME	ORGANIZATION	DATA DESCRIPTION		FORMAT
AVNA28	AV	CHEM II - FILTER AEROSOL DATA		STATE-1Ø
AVNA29	AV	CHEM II - HYDROCARBON DATA		STATE-1Ø
AVNGØ1	AV	SODAR1, DOPPLER WIND SPEED		STATE-1Ø
AVNGØ2	AV	SODAR1, DOPPLER WIND DIRN		STATE-1Ø
AVNGØ3	AV	SODAR2, DOPPLER WIND SPEED		STATE-1Ø
AVNGØ4	AV	SODAR2, DOPPLER WIND DIRN		STATE-1Ø
HCFTHS	EPA-GKPB	HYDROCARBON DATA, FT. HAYES		STATE-1Ø
HCWJEF	EPA-GKPB	HYDROCARBON DATA, W. JEFF.		STATE-1Ø
HCWCVO	EPA-GKPB	HYDROCARBON DATA, WCVO		STATE-1Ø
HCEMI	EPA-GKPB	HYDROCARBON DATA, CHEM I		STATE-1Ø
HCAV	EPA-GKPB	HYDROCARBON DATA, CHEM II		STATE-1Ø
HCSRI	EPA-GKPB	HYDROCARBON DATA, SCOUT		STATE-1Ø
HCCHOP	EPA-GKPB	HYDROCARBON DATA, CHOPPER		STATE-1Ø
-	NWS	SURFACE	COLUMBUS, OH	NWS/SWON
-	NWS	WEATHER	MANSFIELD, OH	NWS/SWON
-	NWS	OBSERVATION	CINCINNATI, KY	NWS/SWON
-	NWS	NETWORK	DAYTON, OH	NWS/SWON

(*) The files listed above individually contain data of the entire field period (7/15 - 8/15/80). These data sets are not included in the daily data base, and are supplementary to the daily data base.

TABLE 7.3

PEPE-NEROS 1980

SUMMARY OF DATA FILES ON DAILY DATA BASE

TABLE IV

DATE 1980, JULY

		FILENAME	15	16	17	18	19	2Ø	21	22	23	24	25	26	27	28	29	3Ø	31
STATE - 1Ø FORMAT	AIRCRAFT DATA	EMIAxx																Ø1	Ø2
		AVNAxx									Ø1	Ø2	Ø3 Ø4					Ø5 Ø6	Ø7 Ø8
		SRIAxx																Ø6 Ø7,Ø8	Ø9
		CHOPxx										ØØ	Ø1 Ø2				Ø4	Ø5 Ø6	
		LASAØ1	✓			✓		✓			✓								
		UVDAxx				Ø1						Ø1	Ø1						Ø1,Ø2
		HRLAxx										Ø1	Ø1						Ø1,Ø2
		ERLUxx																	
		ERLFxx																	
	MEASUREMENTS	EMIGxx										Ø1	Ø2	Ø3				Ø4	Ø5
		UMCGxx						1				2	3		4,5	6			
		UMPGxx						1				2	3		4,5	6			
		UMSDxx						1				2	3		4,5	6			
		ANLGxx			Ø1	Ø2	Ø3	Ø4	Ø5				Ø6	Ø7			Ø8	Ø9	1Ø
		MUDDxx	Ø3	Ø4	Ø5	Ø6	Ø7	Ø8	Ø9	1Ø	11	12	13	14	15	16	17	18	19
	SURFACE	SPBGØ1												✓				✓	✓
		SP4GØ1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		RMSGØ1																	
		PMRGØ1																	
	TETR	ARLxxx		ØØ1		ØØ2		ØØ3-ØØ5				ØØ6-Ø12	Ø13-Ø19	Ø2Ø-Ø24			Ø25-Ø33	Ø34-Ø43	Ø44-Ø52
		EPADxx		Ø1								Ø2	Ø3	Ø4				Ø5	
STATE - VS	CHEM 3 CORR	CORAVS.MDD										✓	✓						✓
		CRTAVS.MDD										✓	✓						✓
		CCLAVS.MDD	✓																
		CLTAVS.MDD	✓																
	SOUNDINGS	STBGVS.MDD		✓	✓	✓		✓	✓		✓	✓	✓	✓			✓	✓	
		AVPIØ1.MDD				✓		✓	✓			✓	✓					✓	✓
		AVASØ1.MDD				✓		✓	✓			✓	✓					✓	✓
		AVPIØ2.MDD						✓	✓				✓	✓					
		AVASØ2.MDD						✓	✓				✓	✓					
	VERTICAL	BERTIN.MDD							✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
NWS	VERTICAL	UAWIND.MDD	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		UATEMP.MDD	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

AUG.

		FILENAME	1	2	3	4	5	6	7	8	9	1Ø	11	12	13	14	15
STATE - 1Ø FORMAT	AIRCRAFT DATA	EMIAxx		Ø3		Ø4,Ø5	Ø6		Ø7	Ø8	Ø9		1Ø	11	12		
		AVNAxx	Ø9 1Ø	11		12,13			14,15	16 17,18	19 2Ø	21 22	23	24	25		26,27
		SRIAxx		1Ø		11,12			14 15,16	17,18					19 2Ø,21		
		CHOPxx	Ø7	Ø8		Ø9,1Ø	11						18,19	2Ø 21,22	23		
		LASAØ1															
		UVDAxx		Ø1			Ø1		Ø1		Ø1	Ø1		Ø1	Ø1 Ø2,Ø3		
		HRLAxx		Ø1			Ø1		Ø1		Ø1			Ø1	Ø1,Ø2		
		ERLUxx				Ø1	Ø2		Ø3	Ø4		Ø5	Ø6	Ø7	Ø8		
		ERLFxx				Ø1	Ø2		Ø3	Ø4		Ø5	Ø6	Ø7	Ø8		
	MEASUREMENTS	EMIGxx		Ø6		Ø7			Ø8	Ø9	1Ø	11	12	13	14		
		UMCGxx	7	8		9	1Ø	11		12					13		
		UMPGxx	7	8		9	1Ø	11		12					13		
		UMSDxx	7	8		9	1Ø	11		12					13		
		ANLGxx	11	12		13	14										
		MUDDxx	2Ø	21	22	23	24	25	26	27	28	29	3Ø	31	32	33	34
	SURFACE	SPBGØ1		✓			✓		✓	✓						✓	
		SP4GØ1	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓
		RMSGØ1						✓	✓	✓	✓	✓					
		PMRGØ1						✓	✓	✓	✓	✓					
	TETR	ARLxxx		Ø53-Ø59		Ø6Ø-Ø7Ø			Ø71-Ø75	Ø76-Ø81		Ø82-Ø88	Ø89-Ø93	Ø94-1ØØ	1Ø1-11Ø		
		EPADxx				Ø9	1Ø		13,14	Ø6,11		Ø7	Ø8	12	15	14	
STATE - VS	CHEM 3 CORR	CORAVS.MDD		✓			✓		✓					✓	✓		
		CRTAVS.MDD		✓			✓		✓					✓	✓		
		CCLAVS.MDD															
		CLTAVS.MDD															
	SOUNDINGS	STBGVS.MDD	✓			✓		✓	✓	✓	✓						
		AVPIØ1.MDD	✓	✓		✓			✓	✓	✓	✓	✓	✓	✓		
		AVASØ1.MDD	✓	✓		✓			✓	✓	✓	✓	✓	✓	✓		
		AVPIØ2.MDD				✓			✓	✓		✓	✓				
		AVASØ2.MDD				✓			✓	✓		✓	✓				
	VERTICAL	BERTIN.MDD	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
NWS	VERTICAL	UAWIND.MDD	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		UATEMP.MDD	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

1. xx or xxx indicate the variable part of the filename. The actual corresponding daily values appear in the matrix elements.
2. .MDD represents the variable date (month, day) of the filename.

exception of the NWS surface weather data, are in STATE-20 format.

7.3 Availability

This highly usable and standardized data base is available for immediate use. Further information on its distribution is available from:

Noor N.V. Gillani, Sc.D.
Washington University
Campus Box 1185
St. Louis, MO 63130
314/889-6079 or

Joan Novak
Chief, Data Management Branch
Meteorology and Assessment Div.
EPA-ESRL (MD-80)
Research Triangle Park, NC 27711
919/541-4545

SECTION 8

OVERVIEW OF SELECTED MISSIONS

With the size of the data base generated by this work, it is difficult to know where to begin in processing, reviewing, analysing and utilizing the data. To begin the whole process, the contractor team focused on a few priority days that appeared to have the largest data recovery and seemed to involve multiple platforms. These days were:

Priority I -to be processed completely by all three platforms
30 July-4 August 1980

Priority II -Would have been processed completely in order if funds remained (Platforms in parenthesis completed processing of that day.)
5-6 August (CHEM-1)
26 July
25 July (CHEM-2)
24 July (CHEM-2)
15 August (CHEM-2)

Priority III-Marginal days not really worth processing.
20, 21, 18, 17, 23 July (with the latter three being shakedown days).

These days were grouped according to mission type, either urban plume or regional (See Table 5.1), for selecting the best days for carrying out descriptive analyses.

Within that framework AV prepared a descriptive analysis report for the urban plume surveys on 30-31 July and 4, 12 and 13 August 1980. (B.M. Muller, et al. 1984). Because of budget constraints they could only focus on the activities of CHEM-2. SRI prepared a regional descriptive analysis for the regional missions on 1 August and 7-11 August 1980 (B. Cantrell et at. 1984). These reports will be introduced below with a brief synopsis.

8.1 Urban Plume Descriptive Analysis

AV closely reviewed data from CHEM-2 for chemical information and incorporated data from LIDAR VAN, SODAR-1, SODAR-2, and NWS soundings from Dayton along with tetroon releases to evaluate the meteorological data. AV constructed air parcel trajectories for the five urban plume days noted above. They also summarized the air quality parameters measured by CHEM-2 when they felt it was indeed in the urban plume.

The vertical extent of the plume was determined from reported aircraft soundings and used to select the altitude range of winds for trajectory calculations. The horizontal extent of the urban plume was presented graphically to show average concentration in the plume, maxima, mean and "background" values to either side and upwind of Columbus. Seven air quality parameters were evaluated and values tabulated for each CHEM-2 urban plume traverse. These values for the plume were sometimes difficult to determine since the gradients were quite small and often required subjective judgements. A sample figure from the AV report is shown in Figure 8-1 to illustrate the display of ozone data for the 30 July traverses. Ozone was used as the best indicator of the urban plume.

In developing the descriptive analysis for each day AV provides a meteorological overview and a condensation of other contractor platform activity.

On several occasions trajectory evaluation indicates that measurements may well have been made to the side of the urban plume. Those measurements that did occur within the urban plume indicate that higher ozone levels tend to occur lower in the plume and that the plume width, as defined by elevated ozone values, doesn't vary all that much, averaging 25-30 km. Some farther distances show apparently narrower ozone plumes (13-18 km), probably because only the more concentrated, narrow core of the plume is distinguishable. Of course, data from other platforms may improve the overall plume resolution as more traverses are tabulated.

The plume was definitely easier to track with a clean continental air flow from the northwest than under southwesterly flow when Cincinnati and Dayton plumes form the background air mass.

8.2 Regional Descriptive Analysis

SRI carried out the regional descriptive analysis for 11 August and 7-11 August 1980. Their report (B. Cantrell, et al. 1984) includes a separate meteorological description focused on these two time periods that sets the tone for the measurement discussion to follow. An extensive array of meteorological data are evaluated for each period including

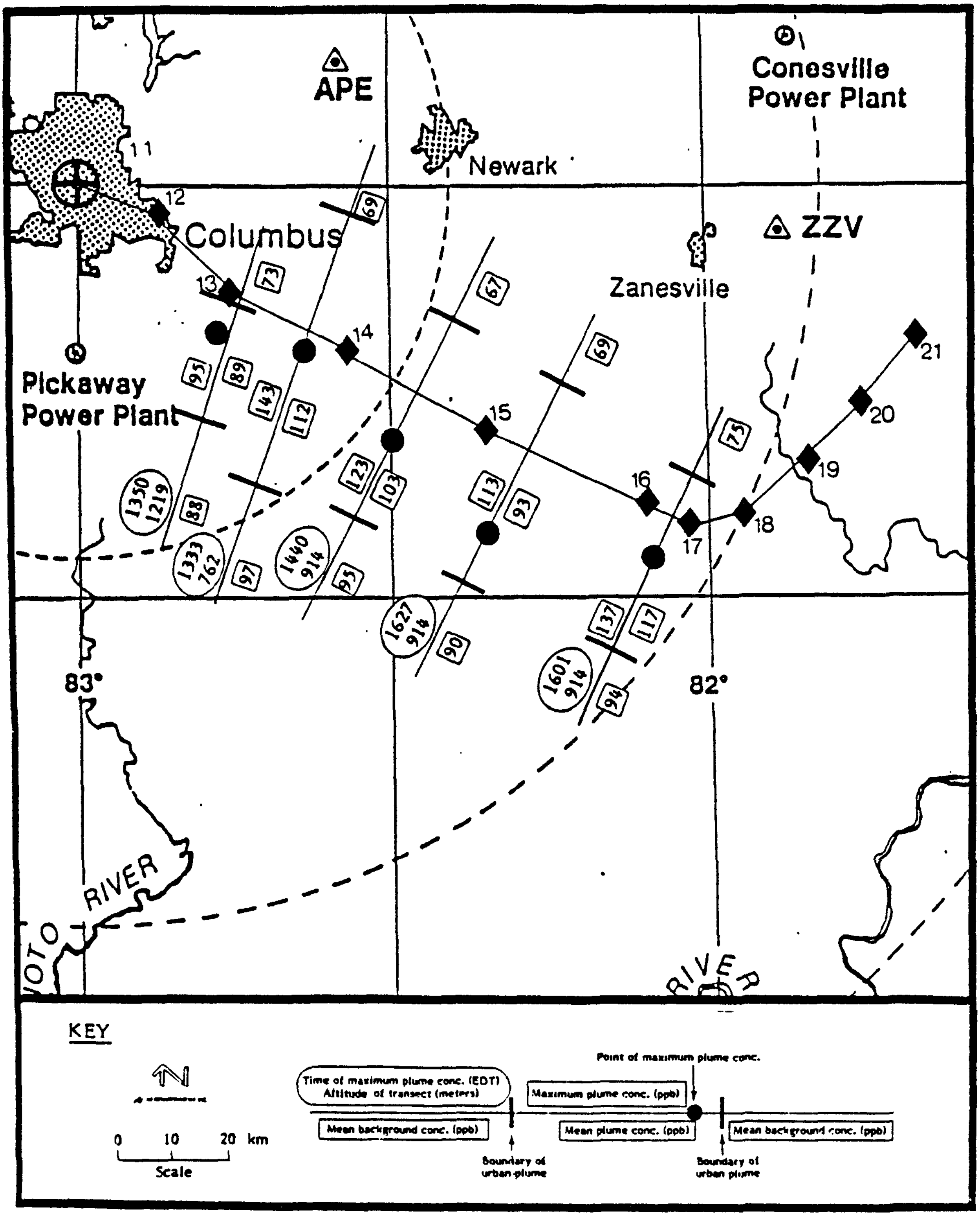


Figure 8.1 Urban plume boundaries on 30 July 1980, as determined from ozone concentrations. Relevant concentration values are shown superimposed on an air parcel trajectory originating at 1100 EDT from Columbus. Numerals adjacent to diamonds indicate times.

probabilistic treatment of trajectories which were transporting air to several receptor regions.

SRI summarizes the general measurement activity of relevant platforms in the air and at the surface. Graphic summaries of platform survey areas are provided such as shown in Figure 8-2 and 8-3 for 8 August. Tables summarize the average, maximum and minimum of up to six air quality parameters (O_3, NO_x, SO_2, b_{scat}, sulfate, and nitrate) along various segments of the surveys.

The 1 August measurements, primarily by CHEM-2, involved following a region of low visibility which was exiting the East Coast. It did not linger long enough to become a major PEPE over the Ohio valley.

Air sampling proceeded from "cleaner" air into the "dirtier" trailing edge of that air mass. Because the flight was approximately parallel to the westerly transport wind, their measurements were made in older air parcels originating in Ohio 6-12 hours earlier. Definite trends of increasing ozone, sulfate, nitrate and light scattering show the penetration of aged air parcels. Ozone went from about 90 ppb in eastern Ohio to about 115 ppb in eastern Pennsylvania and New Jersey, while b_{scat} went from 1 to $5x10^{-4}m^{-1}$, aerosol sulfate went from about 23 peaking at about 50 and dropping to about 32 $\mu g/m^3$, and nitrate went from 3 to about 8 ppb. Vertical profiles showed little stratification within the mixed layer. The return flight documents the "cleaner" air to the west but also, within that trend, an indication of "dirtier" air toward the surface. Aerosol sulfate dropped from about 35 $\mu g/m^3$ in New Jersey to about 15 $\mu g/m3$ in central Pennsylvania but increased to about 31$\mu g/m^3$ below 900m in eastern Ohio.

Meteorological conditions of 7-11 August led to a broad region over the general southeastern region of relatively stagnant air which was strongly influenced by the diurnal heating cycle. Horizontal transport was slow during this period. Vertical dynamics due to diurnal heating distributed the lower visibility air into a thick layer. This mixing prevented the buildup of aerosols in a layer near the surface which could have led to worsening visibility conditions. This, coupled with thunderstorm and associated wash out events led to a patchy pattern of low visibility and elevated pollutants.

The northern part of the stagnant air was systematically monitored on 7-8 August initially following a RAMC (Regional Air Mass Characterization) scenario with a shift to Regional PEPE missions as the stagnant air mass developed. The PEPE missions were conducted through 11 August when a cold front

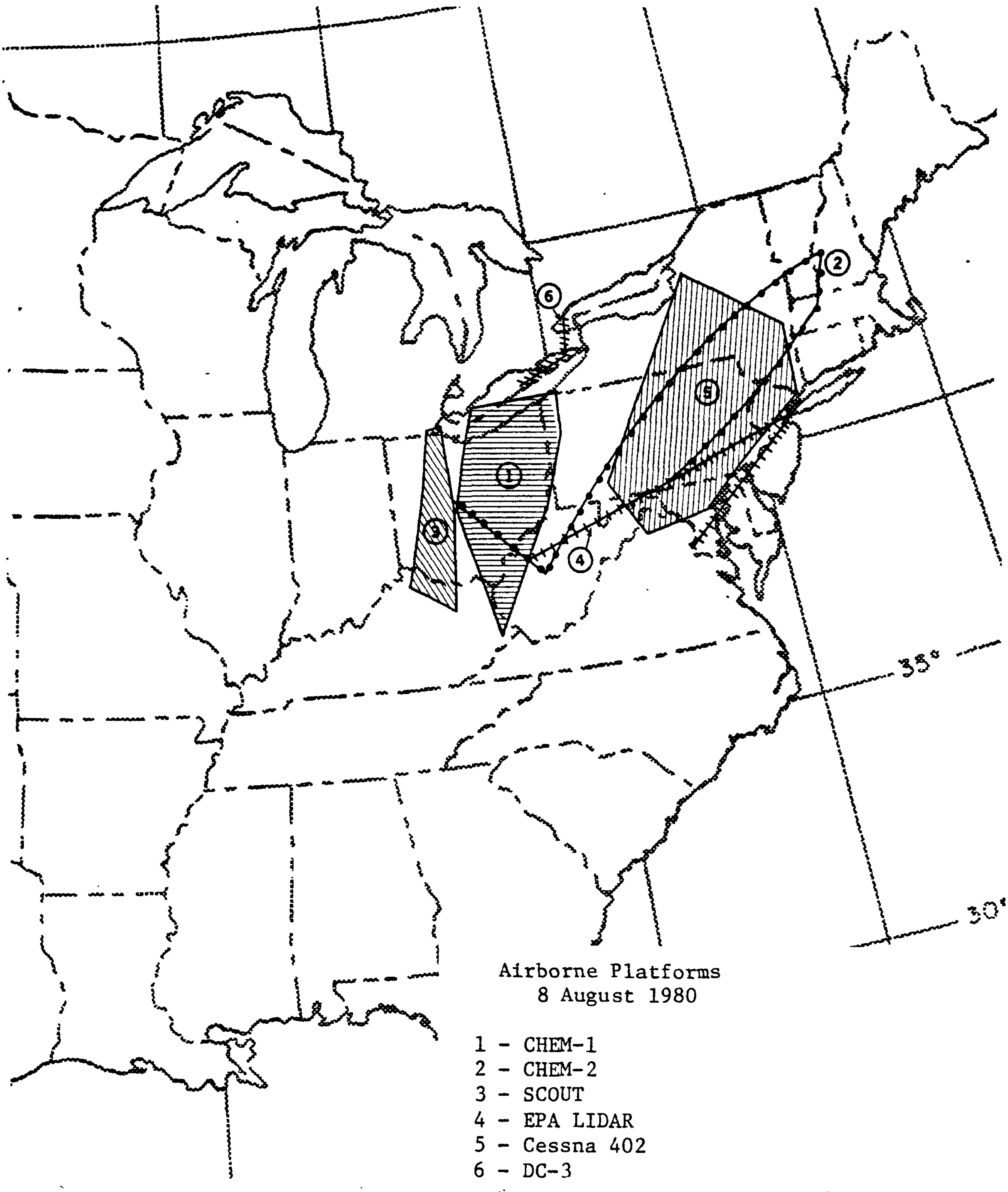
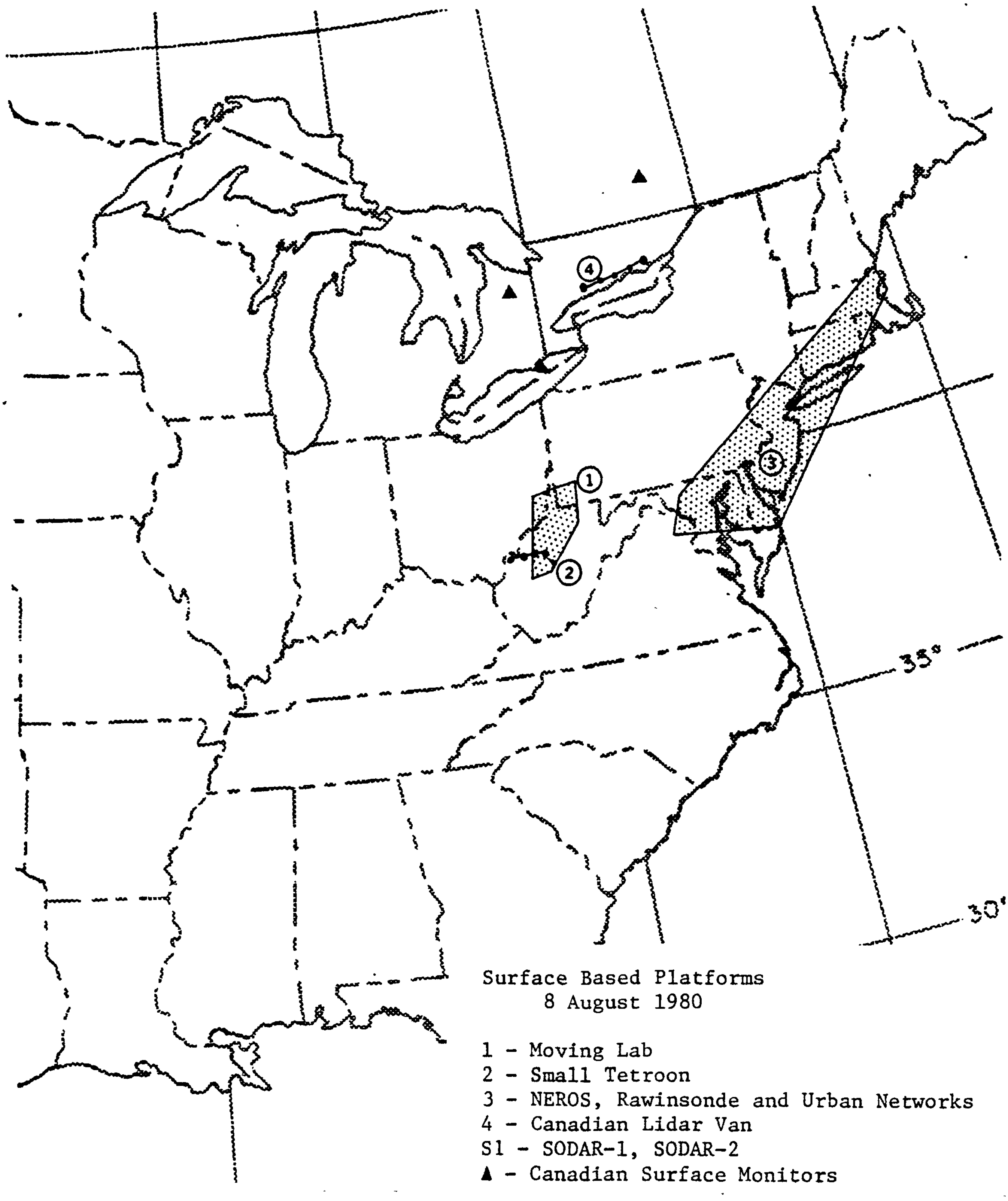


Figure 8-2 Deployment of airborne platforms participating in the PEPE/NEROS regional mission on 8 August 1980.



Surface Based Platforms
8 August 1980

1 - Moving Lab
2 - Small Tetroon
3 - NEROS, Rawinsonde and Urban Networks
4 - Canadian Lidar Van
S1 - SODAR-1, SODAR-2
▲ - Canadian Surface Monitors

Figure 8-3 Deployment of surface based platforms participating in the PEPE/NEROS regional mission on 8 August 1980.

terminated the episode. Upwind air mass was characterized by SCOUT. Other contractor and NECRMPS platforms characterized three regions of low visibility and high ozone over the Washington, D.C. to New York corridor, the southeast portion of the Ohio Valley and finally into northern Alabama. Ozone values in the PEPE proper were generally above 90 ppb and reached 150 ppb in some areas. Light scattering coefficients ranged over a factor of five from 1 to 5×10^{-4}/m. In the 1 August episode there was little daytime vertical stratification in the mixed layer.

SECTION 9

PEPE-NEROS RELATED PUBLICATIONS

While this report has focused on the activities of EPA's contractor team, the discussion of Sections 2, 3 and 5 indicates the breadth of activities involved. Several groups have had an opportunity to report on their activity, measurements and/or analyses since the summer of 1980. Appendix C provides a bibliography of all those reports to facilitate the further integration of the many components of this data base.

SECTION 10

IMPLICATIONS FOR FURTHER RESEARCH

The extensive and relatively homogeneous and easy to access data base which now exists as a result of this large field program is primed for further evaluation. It is a uniquely valuable data base because great care was taken to integrate it into a useable whole from the design through implementation.

To be sure, the weather did not cooperate and provide dramatic regional episodes to be probed while headlines were made. To be sure, the Columbus urban plume's gradients were broad and shallow for most pollutants and difficult to define under the summer 1980 transport conditions.

But here is a singular collection of atmospheric measurements that can and do speak to:

- Transformation processes associated with acid rain issues.
- Transport processes with oxidant and visibility implications.
- Mixing and removal mechanisms.
- Aerosol growth by heterogeneous and homogeneous mechanisms.
- The interaction of forecasts and realtime trajectories to field sampling strategies.

. . .and a score of other topics to be defined as atmospheric chemists and modelers become aware of this resource.

It is appropriate to present these data to the air pollution and meteorological communities with the challenge to mine them for all their value and in so doing to improve their potential value as new insights develop.

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Appendix A

Magnetic Copy Archive

PEPE/NEROS
DATA BASE STATUS REPORT
May 1984

WU/EPA Special Studies Data Center
Washington University
St. Louis, MO

TABLE I

Data Classification	Organization	Platform/File I.D.	Data Description	Archive Form & Availability
AIRBORNE PLATFORM (In-situ measurements)	EMI	Chem I Chemical Aircraft EMIAxx	12 flight days Continuous data: (Every 2 sec.) Time, location, altitude, temp, dew point SO_2, NO/NO_x, O_3, B_{scat}, ANC, SO_4, H_2SO_4; Intermittent: Aerosol size distribution: EAA, OPC (Knollenberg), Detailed hydrocarbons (Grab samples), Sulfates, nitrates, ammonium, ammonia, nitric acid (Filter samples)	Mag tape ✓ Data volume (D.V.) ✓ Overview volume ✓ Not Processed Mag tape ✓ Tabulation in D.V. ✓
	AV	Chem II Chemical Aircraft AVNAxx	14 flight days Continuous: (Every 12 sec.) Time, location, altitude, temp, dew point, turbulence, SO_2, NO/NO_x, O_3, B_{scat}, ANC, SO_4, H_2SO_4; Intermittent: Detailed hydrocarbons (Grab samples) sulfate, nitrates (Filter samples)	Mag tape ✓ Data volume ✓ Overview volume ✓ Mag tape ✓ " ✓
	SRI	SCOUT Chemical Aircraft SRIAxx	13 flight days Continuous: (Every sec.) Time, location, altitude, temp, dew point, SO_2, O_3, B_{scat}; Intermittent: Detailed hydrocarbons (Grab samples) Sulfates, nitrates (Filter samples)	Mag tape ✓ Data volume ✓ Overview volume ✓ Mag tape ✓ Tabulation in D.V. ✓
	EPA/EMI	Chopper (TVA helicopter) CHOPxx	15 flight days Continuous: Time, altitude, temp, dew point, NO/NO_x, O_3, B_{scat}. Intermittent: Detailed hydrocarbons (Grab samples)	Mag tape ✓ Data volume Overview volume ✓ Mag tape ✓
	NASA-LaRC	Chem III Chemical Aircraft (Correlative with UV-DIAL & LAS) CORA,CRTA (UV-DIAL) CCLA,CLTA (LAS)	16 correlative missions Continuous vertical profiles: Temp, dew point Average vertical profiles: Ozone, B_{scat} heated (average of multiple co-located profiles)	Mag tape ✓ Report ✓
	NCAR	Cloud Chemistry Aircraft	10 days in N.E. US, 3 days in Ohio Parameters: Temp, dew point, WS, WD, (gas phase SO_2, NO, NO_2, O_3, NH_3, HNO_3, H_2O_2, HCL), (Aerosol NH_4^+, Ca^{++}, Mg^{++}, Na^+, $SO_4^=$, NH_3^-, CL^-, NO_2^-), (Rain/cloud water NH_4^+, Ca^{++}, Mg^{++}, K^+, Na^+, pH, conductivity, $SO_4^=$, NO_3^-, Cl^-, $PO_4^=$)	Partial tabulated data for 8/13/80 only ✗ All other data from this set are not available. ✗
	NOAA-Boulder	Turbulence Aircraft ERLUxx (unfiltered) ERLFxx (filtered)	15 flight days (Aug. 4-25, 1980) 40 per sec.: u, v, w, $\rho_{water\ vapor}$, $T_{ambient}$, $T_{virtual}$, O_3, Radiometer (upward-looking, downward-looking) 1 per sec.: Time, location, altitude, pressure airspeed, heading, wind speed (north, east) Statistical averages for each "event" (aircraft traverse of variable duration) Time, altitude, vertical eddy fluxes ($\overline{\rho'w'}$, $\overline{T'w'}$, $\overline{u'w'}$, $\overline{O_3'w'}$)	Mag tapes ✗ " ✗ Tabulated in Data volume ✓ ✓
	AES-Canada	Chemical Aircraft	9 flight days (20 sec averages): Time, location, altitude, temp, RH, SO_2, NO/NO_x, O_3, B_{scat}	Mag tape ✗

Data Classification	Organization	Platform/File I.D.	Data Description	Archive Form & Availability	
AIRBORNE PLATFORM (Remote-sensing measurements)	EPA-LV	Lidar Aircraft	14 flight missions Detailed data: Time, location, aircraft ground speed, ground temp, dual frequency lidar return data at 20 ft intervals (10,000 ft to ground level)	Mag tapes	✓
			Flight maps, photographic data plots	Data volume	✓
	NASA-LaRC	Lidar Aircraft (Electra)	14 flight missions (lidars looking down from 10,000 ft)		
		UV-DIAL (Differential Absorption Lidar)	5 min. averages: Time, location, altitude, aerosol mixed layer height (mean & s.d.), lowest cloud condensation level, maximum cloud height, top of upper stable layer.	Mag tape	✓
		UVDAxx UVO3VS.MDD	1 min average: Vertical profile of ozone	Mag tape	✓
		Down-looking lidar systems	1 sec. data: (100 m travel) Time, location, aerosol return signals at vertical intervals of about 15 m	Mag tapes (8)	✓
			Data plots: Vertical profiles of aerosol and ozone	Data Report	✓
		HRSL (High Resolution Spectral Lidar) HRLAxx	2 min averages: Time, aerosol layer height (mean & s.d.) 15 min averages: Time, vertical profile of aerosol backscatter, ratio of particulate to molecular backscatter, aerosol optical depth	Mag tape	✓
	NASA/JPL LAS (Laser Absorption Spectrometer)	Lidar Aircraft (Queen Aire) LASA01	6 flight missions (correlative with Chem III) Time, Location, altitude, vertically-integrated ozone burden under 15-30 km flight legs	Mag tape Report	✓ ✓
AIRBORNE PLATFORMS (Tetroons)	NOAA-ERL	Small tetroons and pilot balloons tracked by mobile radars ARLxxx	110 releases tracked Date, time, location, tetroon height, ground elevation, WS, WD	Mag tape	✓
	EPA/SRI/FAA	Large tetroons tracked by FAA fixed radars $EPAO_{xx}$	13 releases tracked Date, time, location, tetroon height	Mag tape	✓
GROUND PLATFORM (In-situ mobile)	EMI	AQML (Mobile Lab) EMIGxx	14 days Continuous: Time, location, SO_2, NO/NO_x, O_3, B_{scat},	Mag tape	✓
			(10 sec intervals) Aerosol sulfate, COSPEC-SO_2 (integrated overhead burden) Grab samples: Detailed HC Filter samples: Sulfate, nitrate	Data volume Overview volume	✓ ✓
	U. MINN.	UMML (Mobile Lab) UMMH (Mobile Home)	13 days Continuous data: (1 min. averages) Time, location, temp, dew point, RH, UV and broadband radiation, WS, WD, SO_2, NO/NO_x, O_3, ANC, B_{scat}, EAA-RH EAA-B_{scat};	Mag tape Report/Data Volume	✓ ✓
		Most U. MINN. data were collected in the stationary mode at the Croton site			
		a) UMCGxx	a) Cont. data summary: (as above) (Event averages)		
		b) UMSDxx	b) Particulate data: Aerosol size distribution data for each bag fill (based on EAA and ROYCO-OPC).		
		c) UMPGxx	c) Part. data summary: Derived aerosol parameters (e.g. aerosol volume distribution, mass mean diameter, etc.)		
GROUND PLATFORM (In-situ stationary)	EMI/EPA	1. Ft. Hayes Monitoring Station HCFTHS	NO/NO_x, O_3, UV, Detailed NMHC, ald.	Mag tape	✓
		2. N. Albany (WCVO) Monitoring Station HCWCVO	O_3, NO/NO_x (July 18-20 only)	Mag tape	✓
		3. GC Lab at W. Jefferson HCWJEFF	NO/NO_x, O_3, CO, CH_4, Detailed NMHC, ald., VIS, SOLAR RAD (UV, Broadband), WS, WD, T, DP	Mag tape	✓ ✓
	Harvey Mudd College	1. Special Photochem. Lab. (W. Jeff)	High sensitivity NO/NO_x, UV	Mag tape	✓
		2. Special Photochem. Lab. (N. Albany) MUDDxx	H_2O_2, HCHO, UV	Report	✓

Data Classification	Organization	Platform/File I.D.	Data Description	Archive Form & Availability	
GROUND PLATFORM (In-situ stationary)	EPA/U. of S. Fla.	1. Croton site 2. EMI Chem I	NH_3, HNO_3 and aerosol NH_4^+, NO_3^- -same-	Report In EMI Data Volume	✓
	ANL	Croton site ANLGxx	Surface flux measurements on 14 days Time, temp, dew point, WS, WD, Radiation, U_*, H_0 (sensible heat flux), O_3, O_3 deposition flux	Mag tape	✓
	AES	Ground filter packs	6h averages at 3 sites: Time, location, SO_2, HNO_3, aerosol sulfate	Report	X
GROUND PLATFORMS (vertical soundings)	NASA/LaRC	Small tethered balloon	81 launches (ascents & descents) at Croton, OH	Mag tape	✓
		("Red Guppy", $4m^3$) (STBGVS.MDD)	Vertical profile data: Altitude, temp, RH, WS, WD, O_3 up to 900 m	Report	✓
		Large tethered balloon	89 launches (ascents & descents) at Aberdeen, MD	Mag tape	✓
		("Great White", 100 m^3) LTBGxx	Vertical profile data: Altitude, temp, dew point, WS, WD, O_3 up to 1500 m	Report	✓
	AV	Sodar/Minisonde AVPIØ1,Ø2 AVASØ1,Ø2 AVNGØ3,Ø4	Vertical profiles of WS, WD, T, RH	Mag tape	✓
	BERTIN-CIE	3-D Sodar BERTIN.MDD	Vertical profiles of ECHO, WS, WD, W (vertical wind)	Mag tape	✓
	AES, Canada	Minisonde	Vertical profiles of WS, WD, T, RH	Mag tape	✓
GROUND PLATFORMS (Remote-sensing measurements)	SRI	Mark-IX Ground Lidar (Stationary and mobile modes)	Lidar aerosol backscatter data - vertical profiles Boundary Layer aerosol distribution - time-height plane profiles	Mag tapes Photo Album	✓ ✓
	AES, Canada	Ground Lidar	11 days, 54 profiles: Time, location, aerosol profile	Report	✓
	NASA-JPL	MARS (Microwave Atmospheric Remote Sensor) RMSGØ1 PMRGØ1	12 missions: vertical profiles of temp, dew point 5 missions: precipitable water vapor column	Mag tape Report	✓ ✓
	NASA-GSFC	Sun Photometer Network SP4GØ1 Sun Transmissometer SP8GØ1	9 stations across eastern U.S.: 4-channel aerosol optical depth At GSFC: 8-channel aerosol optical depth	Mag tape & Report	✓ ✓
SYNOPTIC WEATHER DATA	SRI	PEPE/NEROS Weather Center	Meteorological Overview: Synoptic weather description with emphasis on winds, 3-D air parcel trajectories, cloudiness and precipitation; Original Weather Center archives	Overview Volume Original Material	✓ Mid 1984
	MESOMET	-	Synoptic Data Archive NAFAX analyses and forecast products; DIFAX products; NWS numerical forecasts; Computer Surface Data Plots; 24-h NWS Surface & Radiosonde Data Listings; GOES satellite data	To be maintained and distributed by MESOMET (catalog of available products is in PEPE Central Data Box)	
	WU (Washington University)	PEPE/NEROS Data Center	Synoptic weather plots based on NWS Surface Weather Obs. (Wind vectors, contours of pressure, temp, dew point, B_{ext})	Plots	✓
			Mission Control Logs Chem I, Chem II, SCOUT Data Volumes	Original material from field study period	✓
		UAWIND, UATEMP	NWS Upper Air and Surface Weather Observation Data	Mag tape	✓
QUALITY ASSURANCE REPORTS	RTI/PEDCO AV	Audit Lab	PEPE/NEROS Project Performance Audits (External) Project QA report	Report Report	✓ Mid 1984
DATA REVIEW	WU	-	Copies of viewgraphs presented at the 1st PEPE/NEROS Data Review Meeting, Quail Roost, NC; Sept. 1981	Viewgraph copies	✓
	AV	-	Descriptive Analysis of Urban Plume Missions	Report	✓
	SRI	-	Descriptive Analysis of Prevailing Synoptic Conditions	Report	✓

Footnote: ✓ - Data is available in the archive form indicated.
✓̸ - Tabulation of part of the data for 8/13/80 only.
X - Not submitted.

Appendix B

PEPE/NEROS 1980
HARD COPY ARCHIVE
May 1984

WU/EPA Special Studies Data Center
Washington University
St. Louis, MO

Reporting Organization		Title/Date/Description of Document
		A. CONTRACTOR TEAM
1.	EMI/AV/SRI	"An Overview of the PEPE/NEROS Program", Wm. Vaughan et al., Sept. 1981 (7 Appendices, A through G).
1.A	EMI	Appendix A : "CHEM-I Data Volume", W. Vaughan et al. (EMI), Mar. 1983
1.B	AV	Appendix B : "CHEM-II Data Volume", W.C. Brick et al. (AV), June 1983
1.C	SRI	Appendix C : "SCOUT Data Volume", B. Cantrell et al (SRI), Sept. 1983
1.D	EMI	Appendix D : "CHOPPER Data Volume", W. Vaughan et al. (EMI), Aug. 1983
1.E	EMI	Appendix E : "MOVING LAB Data Volume", W. Vaughan et al. (EMI) May 1983
1.F	SRI	Appendix F : "Surface-based LIDAR Measurements", E.E.Uthe (SRI), June 1983
1.G	AV	Appendix G : "SODAR-1 and SODAR-2 Data Volume", W. Brick et al., (AV), July 1983
2.	EMI/AV/SRI/EPA	"A Study of Persistent Elevated Pollution Episodes in the Northeastern U.S." Bulletin American Meteorological Society 63(3), 258-266, 1982
3.(A&B)	EMI/AV/SRI	Descriptive Analyses of Meterological Data Base for the 1980 Summer PEPE/NEROS Experiment A. Urban Plume Priority I Mission Days (July 30,31;Aug. 2,4,12,13) B. Regional Priority I Mission Days (Aug. 1,7,8,9,10,11)
4.	SRI	Report on FAA Tetroon Tracking Task, Mar. 1981 (Large Tetroons)
5.	EMI	PEPE/NEROS Project: Fixed Station Data, Gary Klauber, Dec. 1980

B. NASA

1.	NASA/LaRC	NASA Participation in the 1980 PEPE/NEROS Project: Operational Aspects G.L. Maddrea, Jr. and R.J. Bendura, NASA-TM 83170, Sept. 1981
2.	"	NASA Participation in the 1980 PEPE/NEROS Project: Data Archive D.A. Brewer, et al., NASA-TM 83189, July 1982
3.	"	An Airborne Lidar System for Ozone and Aerosol Profiling in the Troposphere and in the Lower Stratosphere. E.V. Browell, et al., Proceedings of the Quadrennial International Ozone Symposium, Vol. 1, J. London (ed.), Boulder, CO, Aug. 1980
4.	"	UV-DIAL Aerosol Data from 1980 PEPE/NEROS Field Experiment (Data Volume) E.V. Browell, et al. (1982)
5.	"	1980 PEPE/NEROS DIAL Ozone profiles (Data Volume) E.V. Browell et al. (1982)
6.	"	UV-DIAL Mixing Height, Cloud, and Stable Layer Data Summary, E.V. Browell and S.T. Shipley
7.	"	In-situ Correlative Measurements for the UV-DIAL Absorption Lidar and the HSRL Air Quality Remote Sensor: 1980 PEPE/NEROS Program G.L. Gregory, et al., NASA-TM 83107, April 1981
8.	"	Tethered-balloon Measurements fo Meteorological Variables and Aerosols R.J. Sentell, et. al., NASA-TM-X-73999, Sci. 1976
9.	JPL	Participation of the JPL Laser Absorption Spectrometer in the 1980 PEPE/NEROS Program in Columbus, Ohio. M.S. Schumate, JPL 715-84, Dec. 1980.
10.	"	Microwave Atmospheric Remote Sensing of Vertical Temperature Profiles during the 1980 PEPE/NEROS Experiment, B.L. Gary, Final Report to EPA, JPL 5030-498, May 1981.
11.	U. of Miami	Aerosol Optical Depth Measurements in Pollution Eposides, J.M. Prospero, et al., Rosentiel School of Marine and Atmospheric Science, U. of Miami, Final Report to NASA, January 1981
12.	NASA/LaRC	NASA PEPE/NEROS Data Review Meeting, March 1981, (Copies of Handouts and Viewgraphs)

C. WASHINGTON UNIVERSITY

I. Materials Generated During PEPE/NEROS Field Study (July 15-Aug. 15, 1980)

1. Mission Control Logs - a) Aircraft Communications
   - b) Surface Communications

2. NWS Surface Weather Data - a) Data Listings
   - b) Visibility contour plots and surface wind plots

3. Real Time Monte Carlo Model Prediction Plots

4. Aircraft Data Volumes - a) EMI Chem 1, Vols 1,2,3,4
   - b) AV Chem 2, Vols 1,2,3,4
   - c) SRI SCOUT, Vols 1,2
   - d) EPA CHOPPER

II. Other Materials

1. PEPE/NEROS Data Review Meeting (Quail Roost, Sept. 1981), Record of Proceedings (Handouts and Viewgraph copies).

2. "Eastern U.S. Maps of Meteorological Parameters Pertinent to Regional Air Pollution Episodes", J. Holloway et al. (Sept. 1981)

3. "Concentration profiles of sulfuric acid aerosol in elevated plumes and haze polls over the eastern U.S." W.G. Cobourn et al., CAPITA Report (1981)

D. OTHER PARTICIPANTS

1.	EPA-LV	Airborne Downward-looking Lidar Measurements During PEPE/NEROS, Data Volume, J.L. McElroy et al., EPA/EMSL Ts-AMD-82026, Dec. 1981
2.	EPA-RTP/NOAA-ARL	PEPE Tetroon Flight Paths (Trajectory Plots of Small Tetroons), Sept. 1981.
3.	NOAA-ERL	NEROS II Airborne Turbulence Measurements, Statistical Data Summary R.E. McGavin and K.D. Hanson, NOAA-ERL, Boulder, Co., November 1981.
4.	U. Minn.	University of Minnesota - Mobile Laboratory Data Report: PEPE/NEROS Study, D.J. Rader, et al. Particle Technology Laboratory Publ. No. 443, Aug. 1981
5.	U. Minn.	"Droplet-Phase (Heterogeneous) and Gas-Phase (Homogeneous) Contributions to Secondary Ambient Aerosol Formation as Functions of Relative Humidity", P.H. McMurry and J.C. Wilson, Journal of Geophysical Research, 88(C9), 5101-5108, June 1983.
6.	Harvey Mudd	PEPE/NEROS Data Report, WCVO Site, G.L. Kok, Harvey Mudd College, (1981)
7.	U. of S. Florida	Gaseous and Particulate Ammonia and Nitric Acid in the Columbus, Ohio Area, Summer 1980, R.S. Braman and T.J. Shelley, Draft Report to EPA-ESRL (W. McClenny, P.O.), Oct. 1980
8.	MESOMET	PEPE/NEROS-80 General Data Archive Catalog, Vols. 1&2. R.H. Calby and W.A. Lyons (1981).
9.	"	Meteorological Conditions and Episode Morphology for PEPE/NEROS 1980, W.A. Lyons and R.H. Calby, Final Report to EPA (1983)
10.	"	Impact of Mesoscale Convective Precipitation Systems on Regional Visibility and Ozone Distributions, W.A. Lyons and R.H. Calby, Joint Report to EPA and NASA (1983) - contains a case study from PEPE period.
11.	"	"Air quality applications of meteorological satellite data", W.A. Lyons and R.H. Calby, Paper presented at 75th Annual APCA Meeting, New Orleans, June 1982. (contains correlations of satellite and PEPE ground data).
12.	RTI	Performance Audits of the NEROS/PEPE Sites, F.K. Arey, et al., Research Triangle Institute, RTI/1808/98, Dec. 1980 (Rev. March 1981).

D. OTHER PARTICIPANTS (cont.)

13.	REMTECH	EPA PEPE/NEROS Field Study, Processing of the REMTECH Doppler Sodar, P. Huguet, REMTECH (formerly BERTIN), DT 82.109, Paris, France, Dec. 1982
14.	AES-Canada	Appendix (Data Volume) to: Lidar Profiles of Vertical Aerosol Structure Obtained During the PEPE Project, R.M. Hoff and F.A. Froude, Atmospheric Environment Service, AQRB-81-024-T, Environment Canada, Toronto, Canada.

Appendix C

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16. ABSTRACT

Because of the increased concern for the regional nature of secondary air pollutants (e.g., sulfates and oxidants) the U.S. Environmental Protection Agency (EPA) sponsored a major field program in the northeastern United States during the summer of 1980. Two EPA field programs were actually carried out simultaneously. One addressed persistent elevated pollution episodes, and the other continued the 1979 northeast regional oxidant study in developing part of the data base for the regional oxidant model. Field activities were based in Columbus, OH.

Ten research aircraft and several mobile and stationary surface monitoring platforms from three EPA Contractors, seven Federal Agencies and four Universities participated in the intensive measurement program between 16 July and 15 August 1980. Pollutants measured included SO_2, NO, NO_x, O_3, sulfate, nitrate, and aerosols. This report describes the Contractors' activities. Their aircraft logged over 350 flight hours in 100 missions ranging as far east as Laconia, NH, as far south as Montgomery, AL, as far west as Texarkana, AR, and as for north as Saginaw, MI.

Descriptive analyses are summarized for urban plume missions and regional missions. The quality assurance program is described, showing the efforts made to develop a well coordinated data base. Sources for reports and data are provided.

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