



Project Summary

Project MISTT: Measurements and Data Base

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Project MISTT (Midwest Interstate Sulfur Transformation and Transport) was an EPA-sponsored research program of field measurement and data analyses carried out in the mid-seventies in the St. Louis region. The objective was to investigate quantitatively the dynamics and kinetics of sulfur compounds in the plumes of large power plants and of the St. Louis urban complex during their mesoscale transport. Major field programs were carried out in the summers of 1975 and 1976, involving the participation of about a dozen organizations from around the country. The main approach was to make detailed three-dimensional measurements, both chemical and meteorological, primarily from instrumented airborne platforms, and including support from ground platforms. This report consists of three parts: Part I describes the platforms and the measurements; Part II gives a complete description and documentation of the General Distribution Data Base archived on magnetic tapes; and Part III is an unpublished Appendix providing a summary of each daily mission of the primary sampling aircraft for each of the two summer measurement periods.

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

Project MISTT (Midwest Interstate Sulfur Transformation and Transport) was principally an integrated, multidisciplinary,

mesoscale field measurements and data analysis program, carried out in the St. Louis area in mid-1970s, under the sponsorship of the U.S. Environmental Protection Agency's Environmental Sciences Research Laboratory (EPA-ESRL). The immediate goal of the program was to quantify the dynamics (rates and mechanisms of transport and dispersion processes) and the kinetics (rates and mechanisms of the chemical transformation and removal processes) of sulfur emissions from large point and area sources such as power plants and urban-industrial complexes. The approach was centered around detailed, in-situ chemical and meteorological measurements within such plumes from instrumented aircraft, and with a wide variety of pertinent supporting chemical and meteorological measurements, both in-situ and remote-sensing, from surface platforms. All these measurements were to be made within the context of a coordinated experimental design, in an intensive mode, during field studies lasting about one month each. Such measurements, for practical reasons, were to cover a mesoscale range (typically < 200 km and < 10 h of plume transport). A broader, longer range goal was to interpret the observed physical-chemical behavior of plumes as middle ground or bridge between controlled laboratory studies of the fundamental processes on the one hand, and synoptic scale observations of secondary pollutant distributions, on the other. To this end, MISTT also supported laboratory studies and analyses of existing synoptic-scale data.

Measurements

The measurement programs of Project MISTT proper took place in 1975 and 1976, principally during summer. MISTT

evolved out of the earlier St. Louis Aerosol Characterization Study (1973, 1974). This report pertains only to MISTT activities during the summers of 1975 and 1976. Project MISTT ran concurrently with another major St. Louis-based, EPA-sponsored, measurements program, viz. the Regional Air Pollution Study (RAPS). The RAPS program was more of a metropolitan-scale monitoring study for the development and evaluation of air quality simulation models on the scale of an air quality control region, while MISTT was more a study devoted to investigating the processes influencing pollutant emissions during their downwind transport. The experimental design and plans of MISTT clearly presumed the support of RAPS in providing data related, in particular, to the emissions field, to local-scale ground-level pollutant distributions, and to prevailing meteorology. In this sense, MISTT and RAPS were complimentary studies.

Two major intensive summer field studies were carried out in MISTT, in 1975 and in 1976. Participation in these studies was broad, representing the government sector (EPA/RTP, EPA/Las Vegas, and Argonne National Laboratory), the industrial sector (Battelle Columbus Laboratories, Environmental Measurements, Inc. (EMI), Meteorology Research Inc. (MRI), Rockwell International, and SRI International), and universities (California Institute of Technology, Florida State University, University of Minnesota, Washington State University, and Washington University (WU)). The range of measurements was also broad, including field and laboratory measurements, airborne and surface measurements, in-situ and remote measurements, chemical and meteorological measurements, gas and aerosol measurements, meso- and micro- meteorological measurements.

The heart of MISTT project was the aircraft measurements program. In 1975, there was one primary sampling aircraft (MRI) and one "scout" aircraft (WU); in 1976, there were two primary sampling aircraft (MRI and WU) and a "scout" aircraft (EMI). The primary sampling aircraft measurements included gaseous parameters (SO_2 , NO/NO_x , ozone, hydrocarbons/halocarbons), aerosol parameters (particulate sulfur, light scattering coefficient, aerosol charge, condensation nuclei count, detailed aerosol-size distribution, and chemical composition), meteorological parameters (temperature, humidity, turbulence), and, of course, navigational parameters (time, altitude, VOR/DME, air speed, etc.). The desired

goal in aircraft sampling was to perform three-dimensional plume mapping in a quasi-Lagrangian framework, involving detailed cross-sectional characterizations of a Lagrangian plume parcel at successive downwind distances. Such sampling was done to distances ranging up to 300 km, and generally in sufficient detail that rates and even mechanisms of gas-to-particle conversion of sulfur could be estimated with reasonable confidence.

Data Base

One shortcoming of MISTT was that no plans had been laid out, up front, to centralize the entire data base, and archive and document it as such immediately following the measurements programs. In general, each organization collected, processed, validated, and analyzed its own data. Only the primary aircraft data and the wind data were more widely used. The present report is an attempt to produce a unified, documented MISTT data base. The result of this long delayed effort, we believe, is less than perfect, but more than adequate, to permit meaningful data analysis of the essential MISTT data base in the future. The final data base now exists in two forms — a General Distribution Data Base (GDDB) on magnetic tapes, and a less easily communicable hard copy data base consisting of reports and other publications.

The belated preparation of the GDDB has been accompanied by at least one redeeming feature. The preparation of GDDB/MISTT has proceeded more or less hand-in-hand with the preparation of similar GDDB's for three other major EPA-sponsored field measurement programs, viz. Project STATE-Tennessee Plume Study (TPS), Project PEPE/NEROS, and Project CWPS (Joint EPA/EPRI Cold Weather Plume Study). GDDB/MISTT has been completely unified in structure and format with the other GDDB's. All data files in GDDB/MISTT, and indeed almost all data files in the other GDDB's have been cast into one or the other of two file formats. These formats are the STATE-20 (for time-series type of data) and the STATE-VS (for data of vertical soundings). Both of these formats are simple, sequential, 80-character card image formats which are designed for ease of use, and are essentially machine-independent. The familiar task of producing separate software to read each of many files in a large and varied data base is avoided here.

This report is presented in two parts. Part I describes the MISTT measurement programs of 1975, 1976 summers, and

Part II gives a thorough documentation of GDDB/MISTT. Part I includes a clear definition of what measurements were made in each year, by whom, on what platform, using what instrumentation, and in what form (magtape and/or hard copy) and detail the data available. To the extent that the data-collecting organizations documented the quality assurance procedures and data quality assessments, these are either summarized or referenced in this report. The report attempts to avoid detailed duplication of what is available elsewhere, but that elsewhere is defined in this report in a section listing all major reports and publications directly related to MISTT which we could obtain. The main objective of this report is to familiarize anyone interested (not just MISTT participants) with MISTT activities and data, in sufficient (but not elaborate) detail, to direct them to specific parts of the overall data base (GDDB) or hard copy or original source) which fall in their particular interest area. As part of the overall data base, Part III, an unpublished Appendix, provides a mission-by-mission summary (flight map and outline flight log) of the activities of each primary sampling aircraft (MRI in 1975 and 1976, WU in 1976), as well as a meteorological summary for each day. Copies of this approximately 400-page Appendix can be provided by the Project Officer. In using these daily mission summaries, the reader must bear in mind that the activities of the other platforms were generally coordinated with the primary aircraft missions, unless they were conducting independent experiments.

Part II documents the GDDB of MISTT. It includes the data of the primary sampling aircraft (MRI and WU), the data reported by EMI (mobile ground lab in 1975 and airborne COSPEC data of the "scout" in 1976), the mobile pibal data reported by Rockwell (1975 and 1976), and the micrometeorological data of ANL (1975 and 1976). The aircraft and pibal data are organized by mission. The data of the two years are separately presented. The GDDB data files are all in STATE-20 or STATE-VS formats; thorough descriptions of these file formats are included. Complete file directories are listed for each magnetic tape in GDDB, and for each type of file (i.e. representing the data of a given platform), a sufficient dump is given to show file header, file comments, and sample data records. File headers and comments are self-documenting. Part II has appendices which give information related to the data in the

GDDDB, but not available anywhere else. For example, the results of the analysis of MRI aircraft filter samples for particulate sulfur are not in the data files. These are fully tabulated, for all missions and all analyzed samples, in an appendix. Also, the aircraft position data are in VOR/DME, but the data files contain no or insufficient information concerning the ground VOR station relative to which the VOR/DME data are referenced. The VOR station information for all times of all missions is given in another appendix.

Epilogue

Project MISTT was an outstandingly successful scientific study, with dividends and results which in several respects went beyond expectations. The authors of this report have used the data base extensively, but continue to marvel at the new insights revealed by the data at each successive use of the data base, whenever such use is motivated by specific questions. We have no doubt at all that future users will find answers to many new questions in this data base. We heartily encourage its use for many more years to come. In case of problems in the use of the data base, or questions concerning MISTT data, please feel free to contact the primary author.

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The complete report, entitled "Project MISTT: Measurements and Data Base," (Order No. PB 87-133 088/AS; Cost: \$18.95, subject to change) will be available only from:

*National Technical Information Service
5285 Port Royal Road
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Telephone: 703-487-4650*

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