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COMPILING A MULTISTATE EMISSIONS INVENTORY

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The goal of the Multistate Atmospheric Power Production Pollution Study (MAP3S), a research program funded by the U. S. Department of Energy (DOE), is to develop and demonstrate an improved, verified capability of numerically simulating the present conditions and potential changes in pollutant concentration, atmospheric behavior and precipitation chemistry that result, or will result, from pollutants released to the atmosphere by large-scale power production processes. The program is divided into ten major tasks. Tasks 1 and 2 of the MAP3S Program Plan are concerned with the quantification of emissions of pollutants from power production and non-power production sources. Due to the multistate nature of the MAP3S area of interest, the emissions inventory project has been based on obtaining pertinent data gathered by other agencies (EPA, FPC, state and local governments, etc.), and computerizing, correlating and updating such data. This paper describes the development of the project to date. Topics to be covered include the acquisition of both emissions and ancillary data, techniques developed for quality assurance and data updating as well as descriptions of current and future plans in both upgrading and using the inventory.

Introduction

The Multistate Atmospheric Power Production Pollution Study (MAP3S) is under the jurisdiction of the Assistant Secretary for Environment of the U. S. Department of Energy (DOE). The goal of the MAP3S program is to develop and demonstrate an improved, verified numerical capability to simulate the present and potential future changes in pollutant concentration, atmospheric behavior and precipitation chemistry as a result of pollutant releases to the atmosphere from large-scale power production processes, primarily coal combustion. The area of study is the high population, energy intensive, northeastern

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quadrant United States. (This region, referred to as the Greater Northeast, includes the upper Midwest, the Northeast and areas directly influencing air quality in the region.)

The MAP3S program is charged with studying the entire spectrum of atmospheric pollutants ascribed to fossil-fuel electric power production or that may interact in the atmosphere with power plant emissions. These pollutants include:

- Sulfur oxides, sulfites, and sulfates;
- Nitrogen oxides and their secondary reaction products, including oxidants;
- Hydrocarbons, including polycyclic organic matter;
- Trace inorganic elements;
- Particulates, which may contain any or all of the above substances and elemental carbon or soot.

The initial priority is to study sulfur oxides, sulfates, and their associated cations.

MAP3S participating groups are concentrating their research on project elements that will clarify our understanding of the atmosphere's effect on pollutants and that will integrate with major ongoing and proposed programs of other organizations. This focus and coordination will enhance the comprehensive understanding of how coal can be used to meet the nation's energy needs with a minimum impact on human health and the environment.

The present direction of the MAP3S program, which is still evolving, is summarized in Table 1. This initial phase will serve as the major research period for developing the capability to numerically simulate the atmospheric behavior, concentration, and chemistry of the sulfur species.

By design, MAP3S is restricted to the study of atmospheric phenomena. But, its results are tailored for broad use by the other research programs, within DOE and in government agencies, to characterize pollutant sources, to control pollutant emissions, and to assess pollutant effects on human health and ecology. The full value of MAP3S lies in communicating program findings to the research community concerned with the health and environmental effects of the atmospheric pollutants studied under MAP3S.

TABLE I. CURRENT DIRECTION OF RESEARCH STUDIES
BY MAP3S PARTICIPANTS

<u>Task</u>	<u>Research Response</u>
1. Quantify emissions from power production sources	Measure power-plant plumes Compile emission inventories
2. Quantify emissions from nonpower production sources	Compile emission inventories
3. Characterize pollutant properties	Determine aerosol composition Improve measurement and analysis capabilities
4. Determine pollutant distribution	Acquire network data, including SURE data Sample pollutants, using special instruments Conduct aircraft sampling Evaluate network quality

TABLE I (continued)

<u>Task</u>	<u>Research Response</u>
5. Determine pollutant transport	Conduct inert-tracer studies Determine vertical spreading, inversion formation, and decay Verify wind field models
6. Identify pollutant transformation mechanisms	Study point-source plumes Study urban-source plumes Study oxygen isotopes Study box budgets and episodes
7. Determine mechanisms governing pollutant removal at the surface	Study dry deposition
8. Identify mechanisms of pollutant scavenging by, and effect on, precipitation	Perform field experiments in cloud systems Conduct numerical modeling Operate mesoscale precipitation and chemistry network Operate multistate precipitation chemistry network Model precipitation mechanism Analyze METROMEX precipitation chemistry data
9. Determine pollutant effects on weather and climate	Develop a turbidity network
10. Develop numerical modeling for assessment	Develop plume models Develop trajectory models Develop regional models; construct data bank

Initial Studies

Tasks 1 and 2 of the MAP3S Program Plan⁽¹⁾ are briefly described as follows:

Task 1 - Power Production Emissions

To specify and quantify the emissions of pollutants from present power production plants, and to consider pollutants that may be emitted as a result of an increased usage of coal and the introduction of new power production processes.

Task 2 - Non-power Production Emissions

To identify and quantify sources of pollutants that do not stem directly from power production but that may affect the concentration, distribution, transformation, and fate of pollutants.

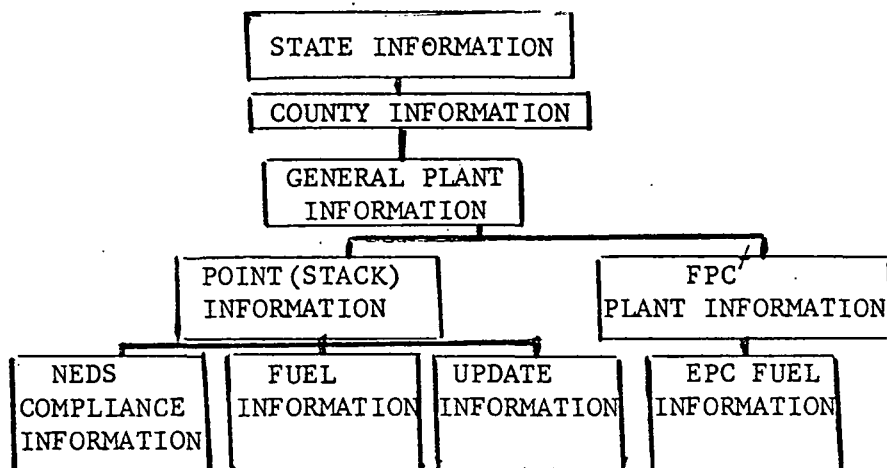
Initial emissions data at BNL had been obtained by the Regional Energy Studies Program (RESP) from the Environmental Protection Agency's (EPA) National Emissions Data System (NEDS) early in calendar 1976. These data covered the northeastern U. S. and were received in NEDS card image format on magnetic tape. Because of the diverse end uses of these data at BNL, a decision had been made to use a generalized Data Base Management System to manipulate the inventory. Initial design of a point source and an area source data bases had been accomplished and a prototype of each has been loaded using the northeast data.

Further study of the capabilities of both the NEDS system at EPA and SYSTEM 2000*, the DBMS used at BNL, resulted in the following operational decisions:

1. Under an interagency agreement between EPA and the then Energy Research and Development Administration (ERDA) BNL obtained direct access to EPA's National Computer Center (NCC) at Research Triangle Park, N. C. Access to all data and programs of the National Aerometric Data Bank was also authorized. This agreement continues under DOE.
2. Other sources of data outside EPA should be explored to obtain complementary data to NEDS. Federal Power Commission (FPC) FORM 67 data could be used in the power plant sector; individual state agencies would have to be contacted for information in the industrial, commercial and area source sectors.
3. The prototype data bases were logically redesigned to include all pertinent data and to facilitate access to the data via the use of all SYSTEM 2000 modules. Figure 1 is a schematic of the logical designs developed for the inventory data bases.

EMISSIONS INVENTORY
LOGICAL DATA BASE DESIGNS

A. Point Source Emissions Inventory.



/ Applies to power plants only.

B. Area Source Emissions Inventory

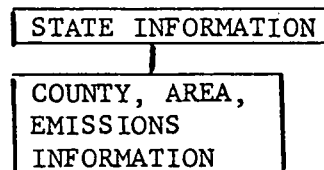


Figure 1. Emissions Inventory Logical Data Base Designs

Current Point Source Inventory

In August 1977 a successful extraction of all point and area source emissions data in NEDS was carried out. The data were brought to BNL and data bases were created covering the eastern half of the continental U. S. Initial contacts with state agencies in the northeast yielded state compiled emissions inventories from the states of New York and Connecticut and from the New York City Department of Air Resources.

*SYSTEM 2000 is a registered trademark of MRI Systems Corp., Austin, Texas.

Comparison of the New York state/city obtained data with the equivalent NEDS data showed that the NEDS inventory included both sets of state data. Study of the Connecticut data showed that the greatest discrepancies with NEDS were in the small sources; thus work of merging these data was postponed.

Loading to the computerized data base includes the following data validation checks:

1. Validity of NEDS state code is verified.
2. Point source coordinates must fall within a "rectangle window" of the state in question. Coordinate values are converted to latitude/longitude.
3. Operating schedule checks:
 $1 \leq \text{hours/day} \leq 24$
 $1 \leq \text{days/week} \leq 7$
 $1 \leq \text{weeks/year} \leq 52$
4. Emissions estimate must be 0 if corresponding method of estimating emissions is 0 or blank.
5. $10100101 \leq \text{Source Classification Code} \leq 50390099$.
6. All data are converted to metric units.

Data found in error were not included in the data base. Table 2 and Fig. 2 present the time distribution of the point source data by states.

Table 2
Time Distribution of NEDS Point Source Data

State Name	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	Un-known	State Total
Alabama						225	97	73	107	256	135	32		925
Connecticut						477		1						478
Delaware				1	2	5	366	11	10	4	181	23		603
Florida	19			87	520	831	463	358	253	479	31			3041
Georgia								19	58	791	403			1271
Illinois					2113	117	436	110	30	2				2808
Indiana					25		89	42	1530	24	989	865		3564
Kentucky			3		4	61	844	525	11	4400	1		1	5850
Maine			22		152	744	422	80	111	58	2			1591
Maryland			9	38	84	633	275	255	122			1	1	1418
Massachusetts				160	539	73	716	258	170	1				1917
Michigan					390		38	50	30		1916	28		2452
Mississippi			10	10	359	601	1547	12	320	436	290			3585
New Hampshire					103		298	4	71	66	4			546
New Jersey					198	10	24	64	286	378	3073	1		4034
New York	4	19	105	215	50	152	282	362	2738	9720	1617	7588		22852
North Carolina					504	1817	1139	822	259	66				4607
Ohio					6					2265	2212	405		4888
Pennsylvania					1366	2685	99	389	134	1		1		4675
Rhode Island				2				452	148					602
South Carolina					319	225	296	203	79	169	74			1365
Tennessee				9	154	191	936	861	779	2221	1406		1	6558
Vermont							60			616	5			681
Virginia							1669	8	106	21				1804
Wash. D. C.					3		5	4	4	69	5			90
West Virginia										1003			1	1004
Wisconsin						786	73	66	12	27	45			1009
Year Totals	23	19	149	522	6891	9633	10174	5029	7368	23073	12389	8944	4	84218

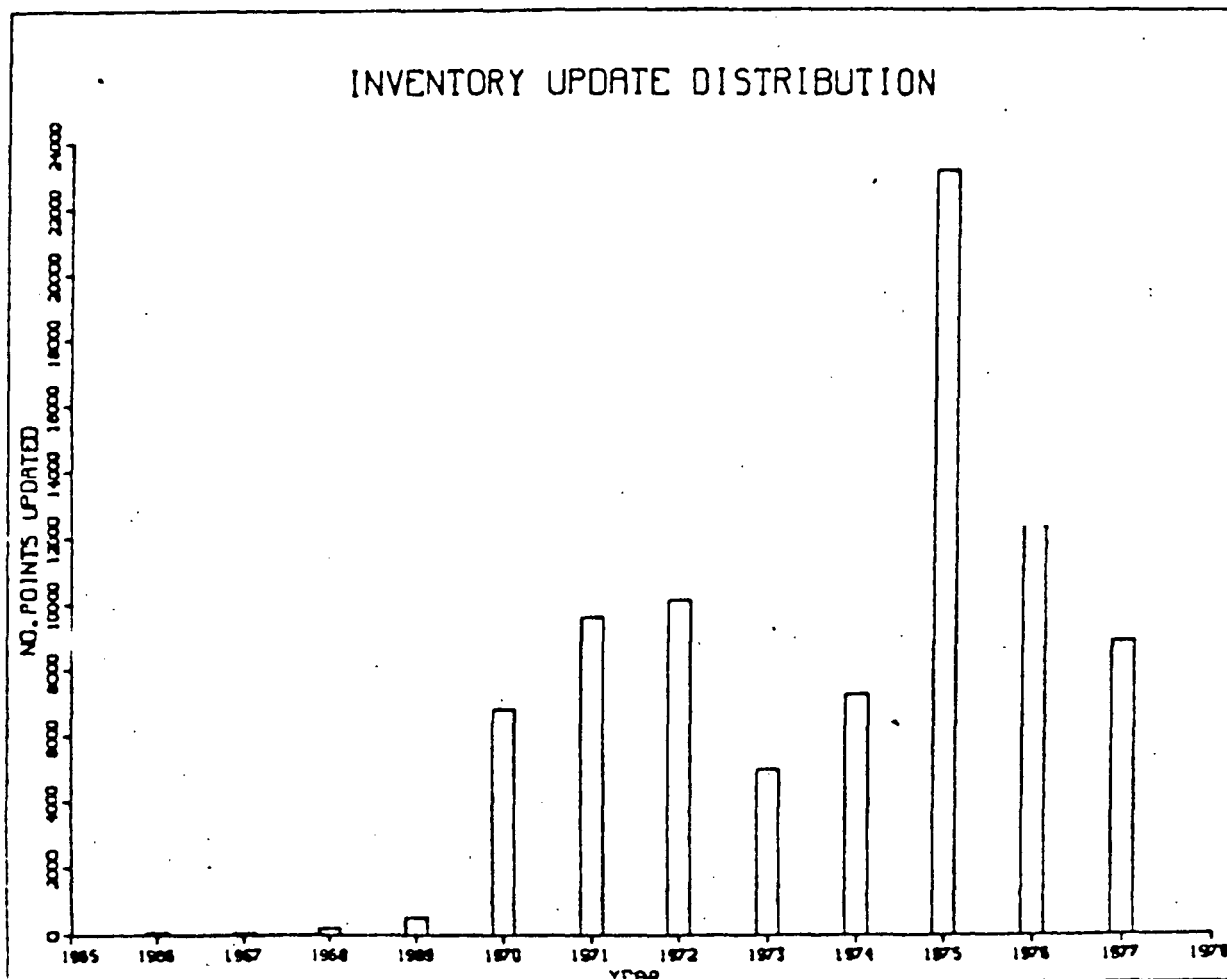


Figure 2. Inventory Update Distribution.

-On initial examination of the data the most common errors were lack of coordinates for the source. This is a critical error for atmospheric modeling, particularly for the long-range transport models of the type being developed for the MAP3S program. Therefore, the first updating task was concentrated on attempting the location of all non-located major sources. For this updating effort a major source was defined as a source emitting at least 5×10^6 kgs SO_2 /year.

Locating criteria were based on the use of data from the special version of the U. S. Bureau of the Census Master Enumeration District List (MED-X). This file contains latitude/longitude of the population center points for political and statistical subdivisions down to the enumeration district and block group. The Census Bureau place level was chosen as the most feasible division for comparison purposes since SAROAD has developed codes to a similar level.⁽⁴⁾

In order to computerize as much of the search as possible the following ancillary data files were obtained or developed:

1. SAROAD/FIPS state/county codes correspondence (obtained from EPA via Lawrence Berkeley Laboratory).
2. SAROAD/MED-X city codes correspondence (being developed locally).
3. Latitude/longitude data for state and county outlines (obtained from

Lawrence Berkeley Laboratory).

4. ZIP code/state/county/MED-X place correspondence file (obtained from Oak Ridge National Laboratory).

Computerized matching to locate a point source is done on three possible areas:

1. If available, SAROAD city code/MED-X place code.
2. Place name in plant address/MED-X place name.
3. ZIP code in plant address/MED-X place code.

If all of the above fail, hand matching is attempted on a time available basis.

The initial implementation of our location criteria was done before the ZIP code file was available. 7239 plants were found to be missing coordinate information. Using criteria 1 and 2 above, 1965 plants (27.1%) were assigned locations; 480 (24.4% of locations) by hand match. Table 3 presents details.

Table 3
Update of Plant Location

State Name	No. Plants	No. of Points	Updated Coord. ⁽¹⁾	Missing Coord.	State Name	No. Plants	No. of Points	Updated Coord. ⁽¹⁾	Missing Coord.
Alabama	395	925	61	96	New Jersey	633	4034	0	98
Connecticut	153	478	0	2	New York	5844	22852	22	220
Delaware	137	603	2	29	North Carolina	2056	4607	296	874
Florida	1232	3041	146	446	Ohio	1243	4888	3	16
Georgia	303	1271	11	23	Pennsylvania	1566	4675	39	191
Illinois	699	2808	44	87	Rhode Island	262	602	0	24
Indiana	1501	3564	79	159	South Carolina	524	1365	63	95
Kentucky	1802	5850	22	55	Tennessee	2203	6558	722	777
Maine	657	1591	12	106	Vermont	185	681	1	12
Maryland	214	1418	2	2	Virginia	664	1804	3	18
Massachusetts	1098	1917	1	58	Wash. D. C.	31	90	0	2
Michigan	1048	2452	390	431	West Virginia	313	1004	4	17
Mississippi	1699	3585	13	1403	Wisconsin	309	1009	29	33
New Hampshire	301	546	0	6					
					Totals	27102	84218	1965	5274

⁽¹⁾ Only plants emitting over 5×10^6 kgs/year of SO₂ were candidates for this update.

To further quality check the locations of point sources computerized procedures have been developed to test relationship of a given point to a defined polygon and to provide keyed maps, by county, of the point sources already located. Figures 3-6 are working examples of outputs from these procedures. Iterations through the locating, checking and display procedures are being continued until all possible matching has been accomplished.

Another problem currently being addressed is missing data in the power plant sector. To compliment NEDS FPC FORM 67 data (Steam-Electric Plant Air and Water Quality Control Data) were obtained for the years 1969-1974. (Data beyond 1974 are not currently available) A SYSTEM 2000 data base design was developed for the air quality components of the FORM 67 data and loading operations are proceeding. From these FPC data bases the following information is being extracted and loaded to the point source data bases:

MARYLAND						
PLANT ID	NAME AND ADDRESS	FIPS COUNTY	LON	LAT		
2101000006	BALTIMORE GAS ELECTRIC WAGNER STATION	24003 ANNE ARUNDEL	76.53	39.18	---FALLS OUTSIDE COUNTY	---
2101200001	GOULD ST PLT HLT GAS ELEC BALT 21203	24000 BALTIMORE	76.60	39.26	---FALLS OUTSIDE COUNTY	---
2101200002	CHEVRON ASPHALT CO	24000 BALTIMORE	76.58	39.23	---FALLS OUTSIDE COUNTY	---
2101200003	BETH STEEL 1101 KEY HWY	24000 BALTIMORE	76.60	39.27	---FALLS OUTSIDE COUNTY	---
2101200005	AMERICAN SUGAR CO 1100 KEY HWY E BALT	24000 BALTIMORE	76.60	39.27	---FALLS OUTSIDE COUNTY	---
2101200008	GLIDDEN DURKEE HAWKINS PT	24000 BALTIMORE	76.56	39.21	---FALLS OUTSIDE COUNTY	---
2101200010	SHELL OIL CO PETROLIA AVE	24000 BALTIMORE	76.57	39.24	---FALLS OUTSIDE COUNTY	---
2101200011	MORIL OIL CORP FAIRFIELD	24000 BALTIMORE	76.58	39.24	---FALLS OUTSIDE COUNTY	---
2101200012	MO SHIPYARD DRYDOCK 2900 CHILDS ST	24000 BALTIMORE	76.58	39.24	---FALLS OUTSIDE COUNTY	---
2101200013	DAVISON CHEM WR GRACE CO BALTIMORE	24000 BALTIMORE	76.56	39.21	---FALLS OUTSIDE COUNTY	---
2101200016	TENNECO OIL CO VPRR ST	24000 BALTIMORE	76.58	39.24	---FALLS OUTSIDE COUNTY	---
2101200017	OLIN CORP PENNINGTON AVE	24000 BALTIMORE	76.58	39.22	---FALLS OUTSIDE COUNTY	---
2101200019	TEXACO INC 4TH AVE	24000 BALTIMORE	76.57	39.21	---FALLS OUTSIDE COUNTY	---
2101200027	CONTINENTAL OIL CO CURTIS HAY HALTO	24000 BALTIMORE	76.61	39.25	---FALLS OUTSIDE COUNTY	---
2101200029	CUMMCO SUN TERMINAL FAIRFIELD	24000 BALTIMORE	76.58	39.23	---FALLS OUTSIDE COUNTY	---
2101200031	FMC CORP URG CHEM DIV 1701 PATAPSCO	24000 BALTIMORE	76.58	39.23	---FALLS OUTSIDE COUNTY	---
2101200035	AMOCO OIL REFINERY 3901 ASIATIC AV 21226	24000 BALTIMORE	76.57	39.23	---FALLS OUTSIDE COUNTY	---
2101200038	NATIONAL GYPSUM CO BALTO	24000 BALTIMORE	76.56	39.26	---FALLS OUTSIDE COUNTY	---
2101200039	PROCTER GAMBLE 1422 NICHOLSON ST	24000 BALTIMORE	76.59	39.27	---FALLS OUTSIDE COUNTY	---
2101200040	BP OIL CORP 2155 NORTHBRIDGE AVE	24000 BALTIMORE	76.57	39.23	---FALLS OUTSIDE COUNTY	---
2101200043	M T CHEMICAL CO BALT MD	24000 BALTIMORE	76.58	39.24	---FALLS OUTSIDE COUNTY	---
2101200043	SOUTHERN INDUSTRIES OYSTER SHELL	24000 BALTIMORE	76.56	39.26	---FALLS OUTSIDE COUNTY	---
2101200044	SWIFT AGRICULTURAL CHEMICALS	24000 BALTIMORE	76.57	39.24	---FALLS OUTSIDE COUNTY	---
2101200047	KERR MCGEE CHEMICAL CLINTON ST	24000 BALTIMORE	76.57	39.26	---FALLS OUTSIDE COUNTY	---
2101200048	SOUTHERN STATES CORP FORT AVE	24000 BALTIMORE	76.59	39.27	---FALLS OUTSIDE COUNTY	---
2101400006	NOTCH CLIFE HLT GAS ELEC CO	24005 BALTIMORE	76.56	39.30	---FALLS OUTSIDE COUNTY	---
2101400007	JOSEPH P SEAGRAM INC BOX208 BALT MD	24005 BALTIMORE	76.70	39.22	---FALLS OUTSIDE COUNTY	---
2101400009	MARYLAND SLAG ARUNDEL CORP SPARROWS PT	24005 BALTIMORE	76.47	39.21	---FALLS OUTSIDE COUNTY	---
2101400011	PETROLEUM STEEL CORP SHIPBUILDING DEPT	24005 BALTIMORE	76.49	39.22	---FALLS OUTSIDE COUNTY	---
2101400024	INTERSTATE AMESITE SPARROWS POINT	24005 BALTIMORE	76.47	39.21	---FALLS OUTSIDE COUNTY	---
2101400030	PETROLEUM STEEL SPARROWS POINT DUMM	24005 BALTIMORE	-0.00	-0.00	---LON OR LAT IS LE ZERO	---
2106000005	KERR MCGEE CHEMICAL CAMBRIDGE	24019 DORCHESTER	76.08	39.58	---FALLS OUTSIDE COUNTY	---
2109000001	BRUMMING PAVING MATERIALS ELKPIEDGE	24027 HOWARD	76.70	39.21	---FALLS OUTSIDE COUNTY	---
2113000008	BITUMINOUS CONSTRUCTION MITCHELLVILLE	24033 PRINCE GEORGES	76.69	38.95	---FALLS OUTSIDE COUNTY	---
2113000013	A H SMITH ASPHALT PRIEST BRIDGE	24033 PRINCE GEORGES	76.71	38.99	---FALLS OUTSIDE COUNTY	---
2114000002	STEWART PETROLEUM CO PINEY POINT	24037 ST MARYS	-0.00	-0.00	---LON OR LAT IS LE ZERO	---
2114000001	CHESAPEAKE NAT PETROLEUM POCOMOKE CITY	24039 SOMERSET	75.59	38.97	---FALLS OUTSIDE COUNTY	---
2118000007	LANCE J ELLER POCOMOKE CITY	24047 WORCESTER	75.54	38.00	---FALLS OUTSIDE COUNTY	---
SUMMARY FOR MARYLAND						
214 PLANTS						
174 82.2% PLANTS WITHIN COUNTY (OK).						
7 .9% PLANTS WITH LON=LAT LE ZERO.						
16 16.8% PLANTS OUTSIDE GIVEN COUNTY.						
0 0.0% PLANTS WHOSE GIVEN COUNTY WAS NOT FOUND.						

Figure 3

**** FIPS STATE= 13 COUNTY= 51

1	1109800001	-81.13	32.11	13	051
2	1109800002	-81.10	32.10	13	051
3	1109800004	-81.09	32.08	13	051
4	1109800005	-81.15	32.08	13	051
5	1109800006	-81.15	32.15	13	051
	13 051	-0.000	-0.000	1109800007	***REJECTED***
6	1109800008	-81.03	32.08	13	051
7	1109800009	-81.18	32.10	13	051
8	1109800010	-81.15	32.15	13	051
	13 051	-0.000	-0.000	1109800011	***REJECTED***
9	1109800012	-81.13	32.12	13	051
10	1109800014	-81.12	32.09	13	051
11	1109800015	-81.14	32.11	13	051
12	1109800016	-81.13	32.11	13	051
13	1109800018	-81.10	32.08	13	051
14	1109800019	-81.05	32.10	13	051
15	1109800042	-81.16	32.15	13	051
16	1109800044	-81.12	32.10	13	051
17	1109800047	-81.14	32.16	13	051
18	1109800054	-81.14	32.10	13	051
19	1109800055	-81.17	32.13	13	051
20	1109800059	-81.11	32.07	13	051
21	1109800077	-81.06	32.09	13	051
	13 051	85.490	0.000	1109800078	***REJECTED***
22	1109800107	-81.16	32.08	13	051
23	1109800110	-81.15	32.14	13	051
24	1109800131	-81.21	32.18	13	051

**** FIPS STATE= 1 COUNTY= 97

1	0124000003	-88.07	30.72	01	097
	01 097	-0.000	-0.000	0124000007	***REJECTED***
2	0124002004	-88.05	30.73	01	097
3	0124002011	-88.07	30.79	01	097
4	0124003031	-88.02	31.03	01	097
5	0124003032	-88.03	30.72	01	097
6	0124004004	-88.08	30.89	01	097
7	0124005006	-88.04	30.67	01	097
8	0124005010	-88.02	30.98	01	097
9	0124006001	-88.03	30.68	01	097
10	0124006002	-88.04	30.68	01	097
11	0124006006	-88.07	30.64	01	097
12	0124008003	-88.05	30.72	01	097
13	0124008006	-88.03	30.69	01	097

Figure 4

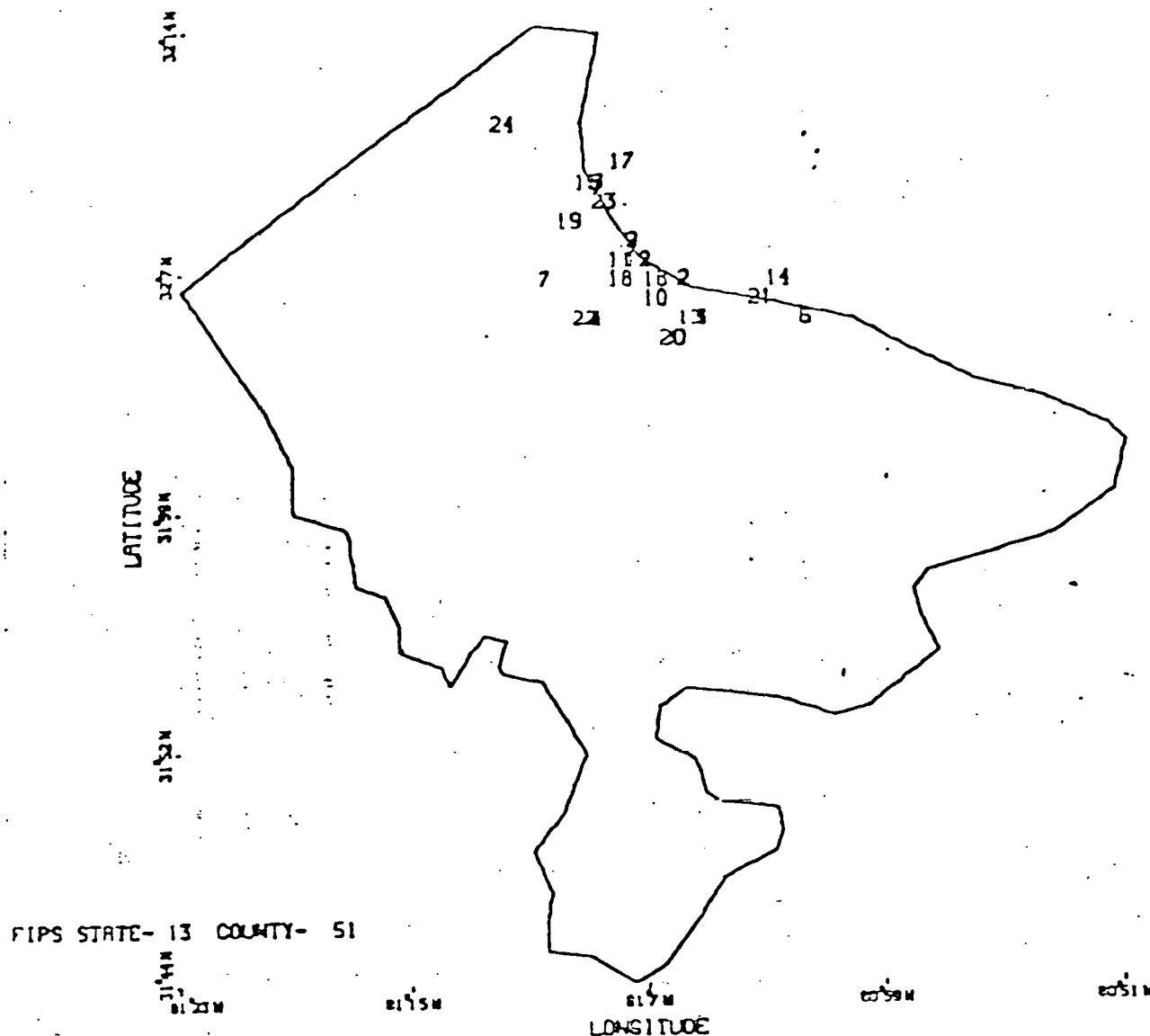


Figure 5.

1. For FPC Plant Information:

- a. Year of FPC data.
- b. Capacity of plant.
- c. Plant SO₂ emissions.
- d. Plant particulate emissions.
- e. Plant NO_x emissions.
- f. Number of stacks in plant.
- g. Lowest stack height.
- h. Highest stack height.

2. For FPC Fuel Information:

- a. Fuel name (coal, oil, gas, etc.).
- b. Amount of fuel used by plant.
- c. Average heat content of fuel.
- d. Average sulfur content of fuel, if applicable.
- e. Average ash content of fuel, if applicable.
- f. Average moisture content of fuel, if applicable.

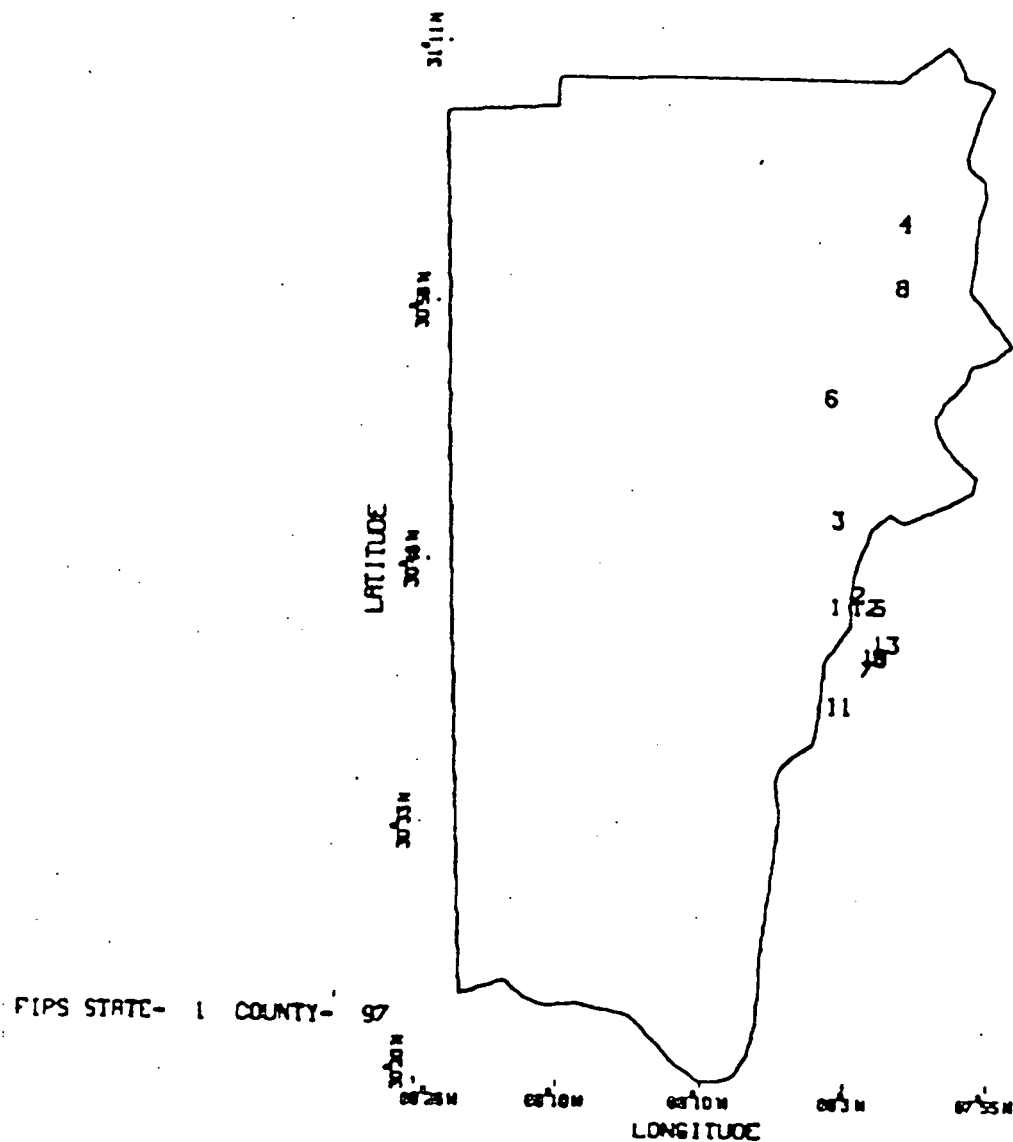


Figure 6.

The choice of what FPC data to include in the over-all point source inventory was a compromise between data most frequently accessed and space considerations within the data bases. However, all FPC data mentioned are available as separate data bases or on magnetic tape.

To facilitate matching of FPC and NEDS codes for power plants, EPA's Energy Data System (EDS) ⁽³⁾ data base was used at the NCC to generate an initial cross-matched list of these two codes. The list was brought to BNL where it was verified and is being used and expanded.

To facilitate working at the plant level two functions and a component were created in the data bases at this level. Plant latitude and longitude are defined as the average of the latitude and longitude of the points within that plant. The Standard Industrial Classification (SIC) code for a plant will be the SIC code assigned to the maximum number of point sources within a plant.

At the completion of the above-described updating, a "check-point" is to be taken on the emissions inventory. A subset of the data will be saved in

order to provide the MAP3S modeling community with a "base emissions inventory." The following set of data will be included in the check-point:

1. For each point source:
 - a. NEDS code for point.
 - b. Point location--latitude and longitude.
 - c. Point SIC code.
 - d. Point emissions--yearly emissions of particulates, SO_x, NO_x, HC and CO.
 - e. Point operating schedule--hrs/day, days/week, weeks/year, % production in each calendar quarter.
 - f. Stack parameters--height, diameter, flow rate, temperature.
 - g. Year data a-f was compiled.
 - h. FIPS state and county code where point resides.
2. For each plant:
 - a. NEDS code for plant.
 - b. Plant location--average latitude/longitude of all points in plant.
 - c. Plant SIC code--SIC code of maximum number of points in plant.
 - d. Plant emissions--yearly emissions of particulate, SO_x, NO_x, HC and CO for all points within plant.
 - e. Plant operating schedule--maximum of same information for points.
 - f. Stack parameters--average stack height, diameter, flow rate, temperature.
 - g. Year of latest point update.
 - h. FIPS state and county code where plant resides.
 - i. If power plant, plant code, particulate, SO_x and NO_x emissions from FPC.

A prototype file was created that included location and SO₂ emissions at the plant level. Table 4 shows the output from a sample SPSS(10) study of this file.

TABLE 4. DISTRIBUTION OF PLANT LEVEL SO₂ EMISSIONS

(Yearly SO ₂ emissions in millions kgs)					
Category Label	Code	Absolute Freq.	Relative Freq. (PCT)	Adjusted Freq. (PCT)	Cumulative Freq. (PCT)
0 through 5.	1.	7701	28.4	94.2	94.2
5 through 25.	2.	291	1.1	3.6	97.8
25 through 45.	3.	71	.3	.9	98.6
45 through 65.	4.	27	.1	.3	99.0
65 through 85.	5.	22	.1	.3	99.2
85 through 105.	6.	15	.1	.2	99.4
105 through 125.	7.	9	.0	.1	99.5
125 through 145.	8.	9	.0	.1	99.6
145 through 165.	9.	6	.0	.1	99.7
165 through 185.	10.	4	.0	.0	99.8
185 through 205.	11.	6	.0	.1	99.8
205 through 305.	12.	8	.0	.1	99.9
305 through Highest	13.	6	.0	.1	100.0
		<u>18927</u>	<u>69.8</u>	<u>Missing</u>	100.0
Total		27102	100.0	100.0	

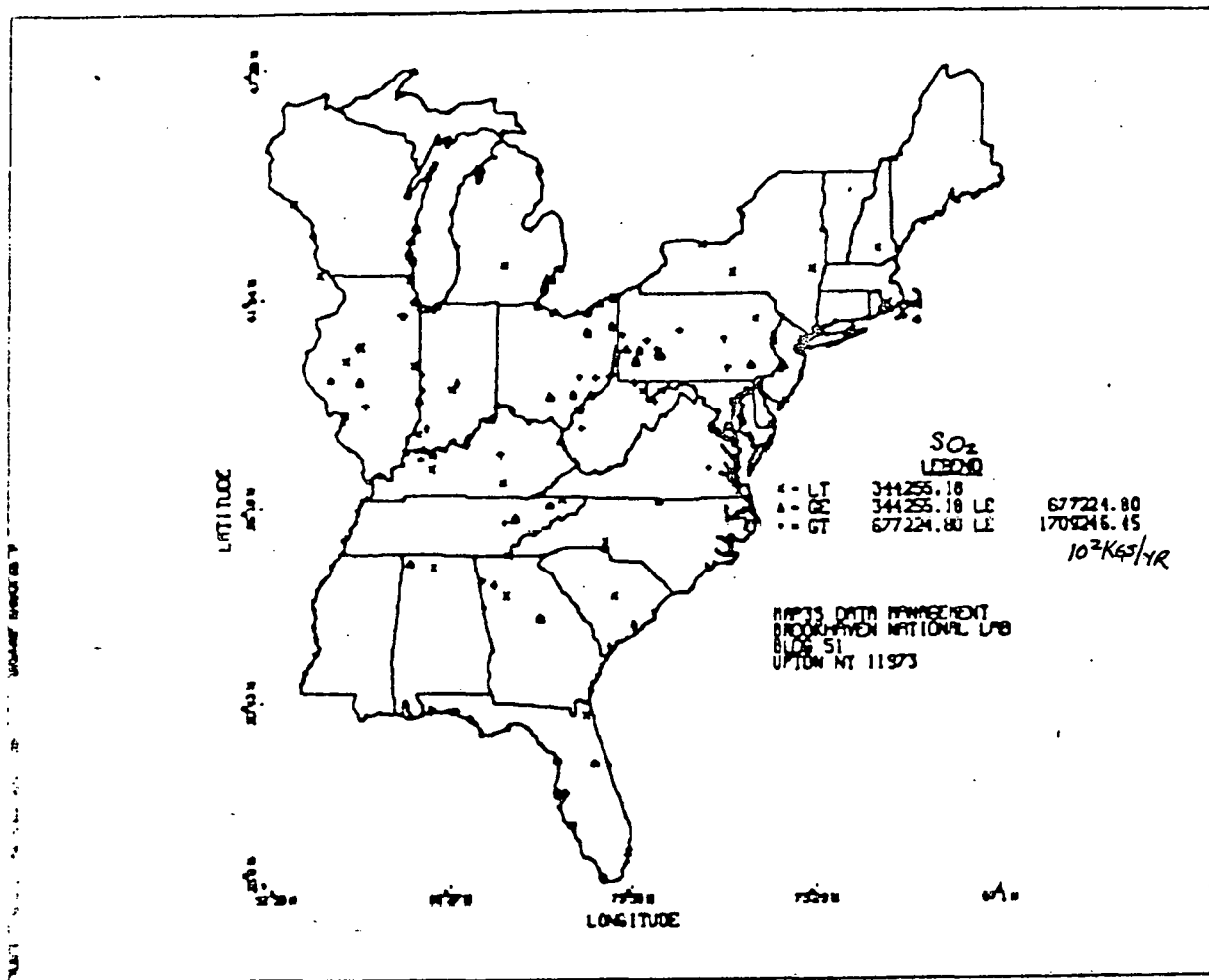


Figure 7.

Current Area Source Inventory

Area source emissions data as obtained from NEDS in August 1977 were loaded to a computerized data base covering the same geographical area as the point source inventory. Initial scan showed that for three states--Connecticut, Rhode Island, New York--no data had been received. Contact with local state agencies yielded the following:

1. For New York State--hard copy of preliminary area source emissions for fifteen counties in the state (N. Y. has 62 counties).
2. Rhode Island--hard copy report including area source emissions data on a gridded basis.
3. Connecticut--gridded area source emissions data on computer magnetic tape.

The New York State data were manually added to the data base. The Connecticut data were found almost unusable because of the form in which it was presented, including errors in the grid cell coordinates. The Rhode Island data were transferred to computer compatible form and manipulated for trail modeling runs by using a computerized grid-to-grid transformation procedure.

Future Development

Work to enhance the emissions inventory will continue as part of the MAP3S program. Subject to manpower constraints, future development work is being planned along the following tasks:

1. The Sulfate Regional Experiment (SURE) program, sponsored by the Electric Power Research Institute (EPRI), is one of the ongoing programs which is being coordinated with the MAP3S program. Exchange of information is taking place between BNL and the SURE Emissions Inventory contractor, GCA/Technology Division. Evaluation and integration of GCA corrections to the NEDS data are scheduled.
2. Table 5 presents a brief summary of the current status of the data acquisition requests with local and state agencies. These contacts will be pursued and others started.
3. Quality checks of data already in the inventory will be started. Items to be checked include:
 - a. stack parameters--height, height/diameter ratio, velocity, temperature.
 - b. material and energy data--design capacity, operating rates.
 - c. emissions/fuel data--emission factors, ash and sulfur content of fuel.
4. Additional work with FPC data will include expansion of the NEDS/FPC codes correspondence file, checks to insure all plants listed in FPC are included in the inventory and emissions and fuel data checks between the two data sources. Table 6 includes some preliminary counts that have been performed in this area.
5. Area source data will be scanned for completeness. Computerized procedures will be developed to handle polygon-to-grid and grid-to-polygon transformation. Additional sources of such data and/or procedures will be searched for and explored.
6. A complete set of current NEDS data is being transferred to BNL. Data updated by NEDS after August 1977 will be incorporated into our emissions inventories.
7. To facilitate input of source emissions data to atmospheric models, a cooperative effort with the MAP3S Modeling and Analysis Group is anticipated to develop the appropriate computer procedures for data preparation.

The emissions inventory project was started under RESP with all personnel involved being unfamiliar with both the emissions data field and the data base management field. Our biggest investment to date has been in the data acquisition and computerization. The choice of a DBMS and the logical design of the data bases facilitate both data retrieval and data updating. The existing data bases are being actively used by our group both to fill user requests and to continue our study and upgrading of the inventory. The data bases are also available for direct end user scan and retrieval.

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TABLE 5. DATA ACQUISITION STATUS AT STATE LEVEL

<u>State</u>	<u>Status of Requests</u>
Connecticut	Work to gather data to fill our request. Will check back.
Maryland	1977 data received on computer magnetic tape 9/18/78.
Massachusetts	Sent blank reel of magnetic tape and request for data.
New Jersey	Work on state inventory in progress. Check back in a few months.
New York City	Emissions data updated to 1975/76 levels. Printed report received 8/21/78. Will supply data on magnetic tape as soon as available.
Pennsylvania	Data acquisition 59% complete. Check back in about 1 month.
Province of Ontario, Can.	Received point and area source inventory on computer magnetic tape April 1978.

TABLE 6.

<u>State</u>	<u>NEDS DATA</u>		<u>FPC DATA</u>
	<u># plants with some electric power SIC codes.</u>	<u># plants with all electric power SIC codes</u>	<u>1973 # plants</u>
Alabama	3	2	12
Connecticut	27	27	10
Delaware	5	4	4
Florida	46	35	40
Georgia	14	14	11
Illinois	50	48	34
Indiana	48	47	27
Kentucky	20	17	19
Maine	11	10	4
Maryland	16	16	10
Massachusetts	28	28	19
Michigan	62	58	29
Mississippi	12	12	9
New Hampshire	7	7	2
New Jersey	26	26	17
New York	59	58	31
North Carolina	14	14	12
Ohio	30	29	33
Pennsylvania	65	60	39
Rhode Island	4	4	2
South Carolina	14	14	13
Tennessee	9	8	8
Vermont	5	4	0
Virginia	14	14	13
D.C.	2	2	2
West Virginia	12	12	13
Wisconsin	27	27	22

Although the emissions inventory work described in this paper is currently funded by the MAP3S program, the data have been made available, subject to the appropriate caveats, to other programs funded by the Department of Energy. We welcome cooperation with other agencies and programs involved in this type of project. We hope to create a nucleus of data that will be useful to a broad span of research activities both within and outside BNL.

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References

1. M. C. MacCracken, "The Multistate Atmospheric Power Production Pollution Study Program Plan, DOE/EV-0008/1 (January 1978).
2. "Guide for Compiling a Comprehensive Emissions Inventory, 2nd Ed., APTD-1135, U. S. Environmental Protection Agency Monitoring and Data Analysis Division.
3. T. C. Holland, J. D. Crenshaw, A. H. Wehe, and J. D. Potter, "Energy Data System (EDS) Terminal Users Manual," U. S. Environmental Protection Agency, Office of Air and Waste Management (Nov. 1976).
4. D. H. Fair, "SAROAD Station Coding Manual for Aerometric Sampling Networks," U. S. Environmental Protection Agency, Office of Air Programs, (Feb. 1972).
5. T. C. Tucker and L. J. Campbell, "CATCH: Computer Assisted Topography, Cartography and Hypsography, Part I.: MAPROJ-A Subroutine Package for a Number of Common Map Projections," Oak Ridge National Laboratory, Oak Ridge, Tenn., ORNL/TM-3790 Part I. (June 1976).
6. R. G. Mashburn, R. C. Durfee and R. G. Edwards, "REGRID-A Generalized Grid-to-Grid Transformation Procedures, Oak Ridge National Laboratory, Oak Ridge, Tenn., ORNL/RUS-18 (July 1976).
7. P. H. Guldberg, B. L. Kemerer and M. C. Shah, "Technical Support to the State of Rhode Island on Development of an Air Quality Maintenance Plan," Walden Research Div., Abcor, Inc., EPA-901/9-75-001 (Sept. 1975).
8. J. Felderbaum, "Compilation of Major Point Source of Air Pollution in New York City," Science and Technology Reports, Report T.S. No. 19, Department of Environmental Protection, City of New York (Dec. 1977).
9. V. Corbin, R. Hall and N. F. Surprenant, "Emissions Inventory in the SURE Region," Quarterly Progress Report No. 3, GCA/Technology Division, Bedford, Mass. (July 1978).
10. N. H. Nie, C. H. Hull, J. G. Jenkins, K. Sluntrenner and D. H. Bent., Statistical Package for the Social Sciences, Second Edition.

11. F. E. Littman, "Regional Air Pollution Study Point Source Methodology and Inventory," U. S. Environmental Protection Agency, Office of Air and Waste Management, EPA-450/3-74-054, (Oct. 1974).