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Guidance on Urban Airshed Model (UAM) Reporting Requirements for Attainment Demonstration

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U.S. Environmental Protection Agency

March 1994

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1. EXECUTIVE SUMMARY

This document provides guidance to State agencies for documenting modeling procedures and results supporting 1994 revisions to State implementation plans (SIP's) for ozone. This documentation is needed for two reasons. First, it is needed to enable the U.S. Environmental Protection Agency (EPA) Regional Offices to write a technical support document (TSD) assessing the adequacy of the modeling effort and resulting control measures. Second, the documentation is intended to facilitate public review of the proposed SIP revisions by highlighting key assumptions and results leading to a State's proposed plan revisions.

The guidance identifies seven (7) broad areas which must be documented in the SIP submittal: a modeling protocol; emission preparation (including quality assurance) procedures and results; air quality and meteorological data input preparations and results; diagnostic tests performed to improve model performance; model performance results; control measures and air quality simulation results corresponding with the selected "attainment strategy"; methods for accessing data files used and produced by the model. Areas with overlapping domains must address input data consistency among the domains. Although there is no requirement that the documentation be submitted prior to the November 15, 1994 due date for the SIP revision, we recommend that each of the 7 parts of the required documentation be transmitted to the appropriate Regional Office as soon as it is ready. This practice will foster a higher quality analysis and review, as well as diminish the need for last minute changes/additions.

The accompanying table identifies the rationale for each of the 7 identified components of the required documentation. The table also identifies major issues to be addressed. To facilitate review by the EPA and the public, we recommend an executive summary be submitted which highlights key assumptions/results and summarizes the major steps which led to the attainment demonstration. An outline of the executive summary would be similar to the information in the following table. This is similar to the "preamble" or executive summary that States often provide to EPA explaining the nature of the SIP submittal and how it fulfills EPA requirements. The executive summary should be followed by appendices containing technical documents describing the details of the modeling (i.e. documentation of the afore mentioned seven (7) broad modeling tasks). This executive summary should be about ten pages of text with about twenty pages of maps and tables. It should be a summary of the information a manager or the public would need to understand the modeling process and serve as a directory to finding additional details. Appendix A lists the contents of the executive summary.

TABLE 1. REQUIRED SIP MODELING DOCUMENTATION

Subject Area	Purpose of Documentation	Issues included
Modeling Protocol	Communicate scope of the analysis and assure that the plan represents consensus of all affected States.	Days modeled and domain size; Steps followed in analysis; Names of participating agencies.
Emissions Preparations and Results	Assurance of valid consistent emissions data base, appropriately tailored for the days modeled.	Data base used and quality assurance applied; Data processing used to derive UAM inputs and deviations from guidance and underlying rationale; VOC, NO_x, CO emissions by State/county for major source categories.
Air Quality/Meteorology Preparations and Results	Assurance that air quality and meteorological inputs to the model are representative.	Extent of data base and procedures used to derive model inputs; Departures from guidance and rationale.
Diagnostic Tests	Ensure rationale used to adjust model inputs is physically justified and results make sense.	Results from initial application; Consistency with scientific understanding and expectations; Tests performed, changes made and accompanying justification; Short summary of final predictions.
Model Performance Evaluation	Show decision makers and public how well model reproduced observations on days selected for modeling.	Summary of observational data base available for comparison; Results from required statistical tests and other pertinent tests and results; Ability to reproduce observed spatial and temporal patterns.
Simulation Results	Assure the EPA and the public that the plan meets attainment tests in the EPA Guidance.	Qualitative description of attainment strategy; Reductions in VOC and NO_x emissions from each major source category for each State/county from 1990 base levels: CAA mandated reductions and other reductions; Identification of authority for implementing emission reductions in attainment strategy; Air quality predictions for each episode day reflecting attainment strategy.
Data Access	Enable the EPA or other interested parties to replicate model performance and attainment simulation results if necessary.	Assurance that files are archived and provision have been made to maintain them; Technical procedures for accessing input and output files; Computer on which files were generated and can be read; Identification of contact person and administrative procedures needed to access files.

2. Introduction

Section 182(b) of the Clean Air Act Amendments (CAAA) of 1990 requires States containing one or more nonattainment area classified as "moderate" or worse to demonstrate that the controls prescribed in their SIP revisions are sufficient to attain the ozone NAAQS. Serious or worse nonattainment areas are required to use a photochemical grid model for this purpose. The Urban Airshed Model (UAM) is the grid model recommended by the U.S. EPA for regulatory applications of this nature. This document is intended to provide assistance to the States in their development of the documentation for the 1994 SIP revision submittals. States using the UAM to determine if the implementation of nitrogen oxides reasonably available control technology (NO_x RACT) is unnecessary to attain the ozone NAAQS should describe as prescribed by this document the model runs to perform this determination and the associated results.

The Urban Airshed Model (UAM) is the most complex model released to the States for regulatory use. This will present a challenge for the U. S. Environmental Protection Agency (EPA) and the public to review complex and detailed material to determine the technical soundness underlying State recommended control measures. It is appropriate that we identify what is needed in the demonstration package to ensure that such reviews can be performed consistently, fairly and with confidence. In determining the technical soundness of a UAM application, our goal is to request sufficient information to allow us to review the modeling, but at the same time not place an undue burden on the States. The State Implementation Plan (SIP) submittal, which requires a modeling demonstration, should include sufficient information to enable the appropriate Regional Office to prepare a technical support document (TSD) which vouches for the technical adequacy of the modeling analysis underlying the SIP revision.

This guidance identifies modeling results and supporting information which should be included for review of UAM applications by the appropriate EPA Regional Office. Any circumstances where EPA guidance allows a choice of methods for developing input data or where the guidance is not followed, more detailed information as to how and why the method was applied should be reported.

To the extent possible, the States should provide the Regional Office with deliverables following each of seven modeling activities identified in this guidance. These deliverables include the modeling protocol; emission preparation procedures and results; air quality and meteorological data input preparations and results; diagnostic tests performed to improve model performance; model performance results; control measures and air quality simulation results corresponding with the selected "attainment strategy"; and methods for accessing data files used and produced by the model. Areas with overlapping domains must address input data consistency among the domains. Early review of these materials will allow the Regional Office to alert the States of any problems. This should speed up the final review and approval process. Although the guidance is intended to facilitate Regional Office review of the attainment demonstration, as with other regulatory model applications, the EPA Model

Clearinghouse will continue to serve as the mechanism for resolving controversial issues.

The executive summary presented the rationale behind the need for documentation for each modeling activity. The following sections contain detailed examples of the types of materials and ways in which the appropriate information may be presented. In addition to technical documentation for each modeling activity we are recommending the submittal of an executive summary which highlights key assumptions/results, summarizes the modeling process and identifies revisions to the modeling protocol. This guidance document is intended to describe all possible types of documentation which may be needed to document the modeling portion of the SIP submittal. The Regional Offices will help tailor the guidance to the individual needs of a particular application.

3. Modeling Protocol

The protocol should be developed and approved by all State/local agencies with nonattainment areas in the domain. The lead state should formally submit the protocol to the EPA for approval. The protocol should follow the recommendations of the EPA guideline for regulatory application of the UAM (Reference 1). The recommendations include the following:

- Episode dates with the meteorology, air quality analyses, and reasoning/rationale for the selections;
- Domain definition and reasoning/rationale for its size and location;
- Procedures for diagnostic analyses and model performance evaluation;
- Description of attainment year mandated control measures;
- Procedures for interpreting the model simulation results for use in demonstrating attainment;
- Description of the background, objectives, and procedures to be followed while performing the modeling;
- List of deliverables and a schedule for completion of the modeling;
- Procedures used to coordinate and develop consistent data bases within the domain for multi-State areas;
- Organizational structure for oversight and technical review.

- Revisions made to the original protocol approved by EPA at the start of the modeling process should be documented in the original protocol and addressed in the executive summary.

Maps of the location and extent of the domain, maps of synoptic wind patterns, tables displaying the peak ozone values monitored during the design year and after, and maps of the location of the meteorological stations, air quality monitors and major sources in the area should be included with the descriptions of domain location and episode selection criteria.

4. Emissions Preparations

Information needed to review emissions preparations include, 1) documentation of the procedures used to develop the emission estimates and 2) summary tables and graphics which allow a quick look and quality assurance of the estimates. These are needed for both the model performance simulation and the attainment demonstration simulation. This section describes information needed to document the emissions inventory used for the model performance evaluation. Section 8 contains information needed to document the attainment demonstration inventory.

Documentation for the development of the emissions inventories (anthropogenic and biogenic) for the model performance evaluations should detail the methodologies and procedures used in preparing emissions for modeling the historical episodes. The UAM Emissions Preprocessor System version 2.0 (EPS) is the EPA recommended system/method for processing the inventories. Other systems/methods that may be used should be fully documented with technical description and implementation procedures. At a minimum, the following factors should be addressed regardless of the method/system used to process the emissions.

- Identify data bases from which the inventories were accessed (e.g., extracted from the Aerometric Information Retrieval System (AIRS), from State emission inventory systems, historical data, UAM Biogenic Emissions Inventory System (BEIS), Regional Oxidant Model (ROM)-UAM Interface Biogenics, etc.).

- Discuss modifications/adjustments used to derive the model performance inventories from the 1990 State Emission Inventory with reference to detailed documentation for the 1990 State Emission Inventory.

- Discuss procedures used to compile and guarantee consistency among inventories for each State within the modeling domain including implementation of existing controls, types of sources inventoried and how estimates were derived.

- Discuss quality assurance and validity checks performed on the inventories, include responses to public and Regional Office review comments.

- Discuss MOBILE model inputs (summarize to identify Inspection and Maintenance (I/M), Reid Vapor Pressure (RVP), speeds and other MOBILE input variables). Provide information listing the I/M, RVP and other input variables, for each county. Summarize Vehicle Miles Traveled (VMT) information and how mobile sources were processed for modeling.

- If used, describe how day-specific adjustments were applied.

- Discuss deviations from EPA guidance in developing inventories.

- Discuss use or replacement of EPA suggested default data (such as speciation profiles, spatial allocation surrogates and temporal profiles).

- Provide emissions summary reports by county for EPA tier 1 and 2 categories (Reference 5) for nitrogen oxides (NO_x), volatile organic compounds (VOC), and carbon monoxide (CO), both before and after processing through EPS. Summary for each State's nonattainment areas should be presented for each pollutant in the same format required for the 1990 inventory (point, area, highway mobile and off-highway mobile).

The emissions summary reports may be generated by the UAM EPS RPRTEM module. For a list of source classification codes (SCC's) in each tier refer to the Office of Air Quality Planning and Standards Technology Transfer Network, Clearinghouse for Inventory/Emission Factors (CHIEF) Bulletin Board Service. Appendix C contains an example of the tier 1 and tier 2 summaries.

Below are examples of tables/graphics that it would be helpful to include in the SIP submittal to support emission preparations and results. It is encouraged but not required that graphics listed below be submitted or representative graphics containing the information in a similar fashion be submitted.

- Pie charts illustrating emissions by source category, (e.g., point, area, mobile, off-highway, biogenic, etc.) or by EPA tier 1 categories (Reference 5);

- A chart to facilitate comparisons between 1990 emissions and base case modeling inventories (see Appendix B);

- List of elevated point sources with annual/daily emission totals, maps of point source locations with total VOC, NO_x and CO emissions indicated;

- List of historical or day-specific data included in the inventories;

- List of significant shutdown sources in which emissions can be counted as reductions (nonbankable);

- Emission density plots (by grid and by county) for VOC, NO_x, and CO;

- Time series (24-hour) plots of county total emissions by source category (i.e., mobile, point, area, off-highway);

- Time series plots of day-specific diurnal patterns for emissions sources such as electric utilities (turbines, boilers);

- Summary tables by source category for methods used for speciation, temporal and spatial allocation when EPA defaults are not used.

5. Air Quality and Meteorological Data Preparations

The SIP modeling documentation should identify problems encountered, as well as deviations from EPA guidance (such as the use of a prognostic wind model instead of the UAM Diagnostic Wind Model (DWM)) along with the following information on air quality and meteorological data preparations.

- Sources of Meteorological Data: Identify and list sources of meteorological data (National Weather Service (NWS), AIRS, utilities, etc.) and indicate quality assurance and validity checks made on the data.

- Sources of Air Quality Data: Identify and list networks which provided monitored air quality data and indicate if data were quality assured per EPA guidance (Reference 4).

- Boundary and Initial Conditions: Discuss the methodology used to develop these fields for the model performance runs (e.g., measurements from air quality monitoring networks, ROM predictions, etc.). Methods used to develop the future year boundary and initial conditions should be documented. Changes to these input fields from that used in the model performance simulations should be described through both narrative and tabular displays.

- Density of Data: Present maps indicating the locations of the meteorological stations and air quality monitors with county boundaries annotated.

- Selection of Wind Model: Explain how the wind fields were obtained (ROM,

UAM DWM, prognostic), and provide the rationale for the approach used.

- Mixing Heights: Explain how mixing heights were obtained listing the upper air stations and the algorithms (i.e., RAMMETX, MIXEMUP, etc.) used. The rationale for any method differing from the default method (RAMMETX) should be fully documented with technical description and implementation procedures.

Graphics illustrating patterns of wind fields, temperatures, mixing heights, etc. throughout each episode day should be presented. Examples are 1) maps of wind direction and speed, 2) time series plots of hourly variations in mixing heights and temperatures, and 3) tile maps/isopleth of spatial patterns of air quality. References 6 and 7 may be used in developing these and other graphics.

6. Diagnostic Analysis

The documentation of the model diagnostic/sensitivity analyses should recapitulate for EPA review and for public comment the rationale used in developing the input data files for the model application. The submitting agency should document their conclusions based on valid and thorough reasoning, and provide evidence of the reliability of the model performance for a SIP attainment demonstration.

Rather than relying solely on a few performance statistics, a qualitative understanding of ozone formation in the particular area must be established. A "conceptual model" describing the principal features of the interaction of emissions, ozone chemistry, wind patterns (strength, convergence, recirculation) that qualitatively characterize an ozone episode should be included. It should highlight key factors in ozone formation for the particular episode, and their relative importance. A description of the overall urban plume direction, hour of occurrence for peak ozone concentration and distance downwind, typical wind flow patterns, expected influence of major sources or emissions categories, relationship between ozone concentrations to diurnal temperature and growth of mixing layer, the importance of ozone and precursors aloft, and multiple day carry-over of pollutants are a few items that should be used to discuss this conceptual model.

The diagnostic analysis should include quality assurance checks of input fields, the sensitivity simulations listed in EPA's UAM Guideline (Reference 1), and additional diagnostic simulations as needed to improve model performance. These additional simulations should use inputs altered as a result of sound technical reasoning, and/or alternative methodologies or interpretations of data. The results and conclusions from quality assurance tests of the input fields (e. g., emissions, meteorology) should be provided. In other words, any "problem" leading to poor model performance and the "solution" need to

be clearly discussed. Plots of emission patterns, wind vectors, wind trajectories, initial conditions, etc., can provide qualitative tests. Performance statistics, plots of residuals stratified by concentration or other variables, mass flux through boundaries, and correlation between pollutants, their ratios, and other variables are examples of more quantitative information that can be examined in the diagnostic analysis. For each episode considered, documentation of the diagnostic evaluation should address the following items that resulted in alteration of key model inputs.

- Describe the "conceptual model" of ozone formation for the episodes in each meteorological regime.
- Describe the initial simulation results.
- Illustrate ozone and precursor concentrations temporal and spatial patterns.
- Describe consistencies or inconsistencies of temporal and spatial variations with the conceptual model and expectations about ozone formation.
- Discuss input data modifications and rationale for making the changes (in terms of data and reasoning, for the particular variables chosen and for the new values or methods used).
- Describe conclusions reached as a result of simulation of the changed inputs by providing qualitative summary of results: changes in model estimates, and key features of plots or computations made from the estimates.
- Describe any performance measures used to evaluate the input data such as wind fields, mixing heights, or air quality boundary conditions.
- Discuss conclusions reached on model performance, with problems or concerns noted.
- Summarize inputs changed relative to the initial simulation.
- Describe any methods and results used to examine model uncertainty to particular parameters and the model's sensitivity to these parameters.

7. Model Performance Evaluations

The evaluation of model performance is needed in order to determine the utility of the model for evaluating the impact of emission control strategies. Model evaluation takes place after all sensitivity tests and refinements to model inputs. As a first step, the modeler must

choose input data which are most representative of actual conditions. That is, the 'best' initial and boundary conditions, meteorology, and emissions. Once the best conditions are defined, an assessment of model performance is required for each primary episode day.

The SIP modeling documentation must describe the model performance with both graphical and statistical measures. EPA recommends the use of a four-cell weighted average to determine the predicted concentration to be used in comparison with observed values. While prediction of ozone is of primary importance for the SIP, concentrations of ozone precursors should be evaluated whenever quality assured observations are available which are representative of spatial scales comparable to those treated in the model. The following measures should be applied for evaluating modeling results. Please refer to References 1 and 7 for additional details.

Graphical:

- Time-series plots comparing hourly predicted and observed concentrations for each monitoring station;
- Isopleths or tile maps of observed and predicted (lowest layer) concentrations for selected hours and for daily maxima;
- Scatter plots of predictions and observations;
- Quantile plots;
- Additional graphical displays, such as paired predictions of daily maxima, are encouraged.

Statistical:

- Unpaired highest-prediction accuracy;
- Normalized bias test of all pairs with observations above 60 parts per billion (ppb);
- Gross error of all pairs with observations above 60 ppb;
- Additional tests are encouraged.

Caution should be used when interpreting the statistical measures for a sparse monitoring network. EPA recommends that the statistical performance be compared with the following ranges:

- Unpaired highest prediction accuracy: $\pm$ 15 - 20 percent

- Normalized bias: $\pm$ 5 - 15 percent
- Gross error for all pairs with observations >60 ppb: 30 - 35 percent

The SIP modeling documentation should state a conclusion as to the usefulness of each episode for regulatory purposes.

If, after review of the input data, significant uncertainty remains as to the 'best' conditions, the State may choose to perform additional modeling to assess the effect of this uncertainty on model performance. One way to address uncertainty is to develop additional, yet, reasonable input conditions. While uncertainty analyses are not required by the EPA as part of the model performance evaluation, the results of such tests may provide the State with additional support for various control strategies. If uncertainty analyses are performed, the State should document the range of uncertainty considered in the model inputs and reasons underlying the selected range. Meteorology, emissions, etc., should not be altered without providing justification. Procedures and documentation requirements are similar to those discussed in the previous section on diagnostic analysis. Model performance must still be evaluated for the 'best' input conditions regardless of any uncertainty analyses.

8. Attainment Demonstration

In the Clean Air Act (CAA) each ozone nonattainment area is assigned a date by which the area must reach attainment. After identifying the "best" input conditions and completing a model performance evaluation, the input emissions data must be projected into the future to the attainment date. This requires the emissions to be adjusted to reflect expected future year emissions accounting for growth and CAA mandated controls. If necessary, the modelers and control strategy development staff must work together to identify additional economical and enforceable control measures that demonstrate attainment. Attainment is demonstrated when the modeled predictions result in ozone concentration below 0.12 parts per million (ppm) for each grid cell in the domain for all hours of each primary day. Supporting documentation for the attainment simulation for each episode must describe how the emissions were adjusted and the resulting air quality predictions as well as the development of future year boundary conditions. To the extent that contingency measures are required for a nonattainment area, it would be helpful if these control measures were modeled and documented as well.

States may opt to conduct more comprehensive statistical testing of the modeling results for the attainment demonstration. The focus of the ozone attainment demonstration is on the daily maximum 1-hour concentration predicted at each location in the modeling domain. Responsible parties are encouraged to broaden the scope of the attainment demonstration to examine the impact on other important metrics, such as different concentration averaging times, population exposure, subdomain and temporal impacts, effects on other pollutant species, and other important measures that are sensitive to emission control

strategies. To the extent that other metrics are used they should be described in the SIP modeling documentation.

Emissions Adjustments:

Documentation for the development of the future/projection emission inventories should detail the methodologies and procedures used in projecting the inventories to the attainment date. For the attainment demonstration strategy the emission control measures applied to reach attainment should also be described. The following items should be addressed.

- Describe procedures used to project 1990 emissions to future year(s) (i.e., Bureau of Economic Analysis (BEA), Economic Growth Analysis System (EGAS), and local data with rationale for the use of said data). This should include a table of growth rates.

- Discuss how controls were applied by source classification code (SCC) and geographic extent (i.e., statewide, county, nonattainment area)

- Discuss how the projection inventories reflect or differ from the following:

  - 15% and 3% Rate-of-Progress Inventories;
  - 1990 Clean Air Act mandated controls;
  - NO_x substitution provisions.

- Discuss the consistency among the States in the implementation of the Clean Air Act mandated controls and additional controls adopted by the States.

- Discuss MOBILE model inputs (summarize to identify Inspection and Maintenance (I/M), Reid Vapor Pressure (RVP), speeds and other MOBILE input variables). Provide information listing the I/M, RVP and other input variables, for each county. Summarize VMT information and how mobile sources were processed for modeling.

- List any new sources and expected emissions (e.g., utilities, etc.) added to the inventory for future years.

- Discuss deviations from EPA guidance (Reference 3) in developing projection and control factors.

- Discuss deviations from methods used to develop the model performance inventories (such as speciation, temporal and spatial allocation).

- Provide a table of attainment control measures indicating which measures are

mandated under each CAA Title and which are additional measures required to demonstrate attainment;

- Provide summary reports by county for EPA tier 1 and tier 2 categories along with emission reduction percentages for each primary day;

Below are examples of tables/graphics that it would be helpful to include in the SIP submittal to support emission preparations and results. It is encouraged but not required that graphics listed below be submitted or representative graphics containing the information in a similar fashion be submitted.

- Pie charts illustrating emissions by source category, (e.g., point, area, mobile, non-road, biogenic, etc.) or by EPA tier 1 categories (see Appendix C); Pie charts illustrating reductions in VOC and NO_x emissions from each general category, (e.g., point, area, mobile, off-highway, etc.);

- Summary charts presenting future year emissions, with and without controls, in the same format as the 1990 State Emission Inventory (see Appendix B);

- List of new elevated point sources with annual/daily emissions totals; maps of location of major sources with total emissions indicated;

- Emission density plots (gridded and by county) for VOC, NO_x and CO;

- Time series (24-hour) plots of county total emissions by source category (i.e., mobile, point, area, non-road);

- Summary tables by source category for methods used for speciation, temporal and spatial allocation when EPA defaults are not used.

Model Results:

A description of the resulting air quality predictions from the "attainment strategy" simulation should be included in the attainment demonstration portion of the SIP modeling documentation. For each primary day provide the following.

- Isopleth plots or tile maps for the hour which contained the maximum ozone concentration as well as, the hour before and after the maximum occurred (Similar plots for maximum VOC and maximum NO_x would be helpful.);

- A table listing the peak domain concentrations of ozone, VOC, and NO_x, both before and after controls;

- Daily peaks of ozone, VOC, and NO_x for each grid cell (either isopleths or

maps of the daily maximum in each cell for each pollutant);

- Time series plots of the grid cell where the maximum pollutant concentration occurs for ozone, VOC, NO_x.

If possible, the concentration isopleths\maps of grid cell data should outline the location of the model domain with political boundaries to identify concentrations within each county.

9. Data Access Procedures

The data files used in the model performance and attainment simulations are not required as a part of the SIP submittal. However, EPA and public officials may need to obtain key information used for modeling so as to replicate the model performance and attainment simulations. Therefore, documentation concerning accessibility of key data/information used for modeling should be included in the SIP submittal. To be "accessible" a data file must be maintained electronically with sufficient instructions/assistance for reviewing agencies to access the files to replicate results. A contact person should be identified to assist an interested party in obtaining referenced information. When appropriate, so as to lend additional assistance and answer technical questions in regard to the UAM application, the lead State person should be identified.

Ideally, all data, even raw data, used in the development of the input files should be maintained. At a minimum, the standard UAM input files should be maintained with a description of the raw data sources. For example, the 1990 emissions, from which model input emissions are derived, should be made available through the AIRS Area and Mobile Source Subsystem (AMS) and AIRS Facility Subsystem (AFS) or otherwise documented. Modelers are encouraged to present a table showing where the data was accessed and where the final processed data resides with file naming conventions. Files defining how each UAM preprocessor was implemented and which options were invoked within the program, should be maintained. A listing of all programs used to process the data and the type of computer used to process the data should be included. A detailed description of the contents and format of each file should be included. States/local agencies might consider the possibility of using the National Technical Information Service for storage and distribution of these files and associated documentation.

The following data files should be maintained by the State/local agency.

- Input files and control input packet files to all of the UAM preprocessor programs including those supplied with the UAM modeling system as well as other preprocessors (i.e., RAMMETX as well as MIXEMUP) including for example, AIRS AMS and AFS work files input into EPS, link-based emissions

data in the LBASE input file and MOBILE model input/output files for episode-specific simulations, projection factor files used to project emissions to future attainment year (input to CNTLEM module of EPS) and control factor file used for input into CNTLEM module of EPS;

- All UAM ready input files for each episode used for model performance and attainment simulations (i.e., gridded, speciated and temporally allocated UAM-ready output files from the EPS);

- Default or modified EPA supplied data files (such as speciation profiles, and assumed diurnal or seasonal patterns).

10. References

1. U. S. Environmental Protection Agency, 1991, Guideline for Regulatory Application of the Urban Airshed Model, EPA-450/4-91-013, Office of Air Quality Planning and Standards, Research Triangle Park, NC.

2. U. S. Environmental Protection Agency, 1992, Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone, Volume II: Emission Inventory Requirements for Photochemical Air Quality Simulation Models, EPA-454/R-92-026, Office of Air Quality Planning and Standards, Research Triangle Park, NC.

3. U. S. Environmental Protection Agency, 1993, Guidance for Growth Factors, Projections and Control Strategies for the 15 Percent Rate-of-Progress Plans, EPA-452/R-93-002, Office of Air Quality Planning and Standards, Research Triangle Park, NC.

4. Finkelstein, P. L., D. A. Mazzarella, T. J. Lockhart, W. J. King and J. H. White. Quality Assurance Handbook for Air Pollution Measurement Systems, Volume IV: Meteorological Measurements, EPA-600/4-82-060, U. S. Environmental Protection Agency, Research Triangle Park, NC.

5. E. H. Pechan and Associates, Inc., 1993 Regional Interim Emissions Inventories (1987-1991), Volume I: Emission Summaries, EPA-454/R-93-02/a, U. S. Environmental Protection Agency, Research Triangle Park, NC.

6. U. S. Environmental Protection Agency, 1992, User's Guide for the Urban Airshed Model, Volume VI: User's Manual for the Postprocessing System, EPA-450/4-90-007F, Office of Air Quality Planning and Standards, Research Triangle Park, NC.

7. U. S. Environmental Protection Agency, 1992, User's Guide for the Urban Airshed Model, Volume VII: User's Manual for the Performance Evaluation System, EPA-450/4-90-007G, Office of Air Quality Planning and Standards, Research Triangle Park, NC.

8. U. S. Environmental Protection Agency, 1991, Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone, Volume I: General Guidance for Stationary Sources, EPA-450/4-91-016, Office of Air Quality Planning and Standards, Research Triangle Park, NC.

9. U. S. Environmental Protection Agency, 1992, Procedures for Emission Inventory Preparation, Volume IV: Mobile Sources, EPA-454/R-92-026, Office of Air Quality Planning and Standards, Research Triangle Park, NC.

Appendix A
Contents of Executive Summary

The executive summary should provide a summary of the information a manager or the public would need to understand the modeling process and results. A list of the contents of the executive summary is as follows. Each section should highlight key aspects of the modeling and reference additional technical support documents for more details.

INTRODUCTION:

Explain the Clean Air Act Amendments of 1990 requirements and their relationship to the SIP modeling.

MODELING PROTOCOL:

Explain how the protocol was adopted by the States and approved by EPA. State when the protocol was approved. Discuss the extent of the domain, the grid cell size and the reasons for how and why these were set as they are. List the days originally selected for modeling and explain how and why they were chosen. List days actually modeled and discuss why this list is different from the original list of days. Note any additional revisions to the original protocol approved by the EPA at the start of the modeling process. Include illustrations such as map of model domain with grid cell size and UTM coordinates.

EMISSIONS:

Identify the sources of the modeling inventory (e.g., AIRS, State draft, State prepared EPS compatible format). Include date inventory was frozen, if applicable. Provide a tabular summary of the emissions data. Illustrations should include pie chart of VOC, NOX, CO emissions by source type (point, area, highway mobile and off-highway mobile, biogenics) for the entire domain, if possible, by State.

AIR QUALITY/METEOROLOGY:

Describe the air quality and meteorology data used. Quantify number of sites and indicate how, when and where these data were collected. This information may be represented in tabular form. Illustrations might include map of air quality monitors and meteorological sites.

DIAGNOSTIC TESTS/MODEL PERFORMANCE:

Summarize results of diagnostic tests and list improvements made from the original simulations.

SIMULATION RESULTS:

List control measures and programs used to reduce ozone to meet the standards. Describe predicted air quality after controls from the attainment demonstration. Explain basis for attainment demonstration, specifically if all grid cells in the domain do not attain in every episode. Illustrations should include pie charts of emissions with attainment controls by source type and maps of the resulting peak ozone by episode.

DATA ACCESS:

List of technical support documents submitted to EPA to support the SIP revisions. List technical papers or other scientific advances that occurred during the modeling process. Provide references describing how the public can obtain access to technical files.

Appendix B
Emission Comparison Summary Tables

To assist with the review of emissions data for the episode year and the future attainment year(s), it would be useful to provide comparison tables for VOC, NO_x and CO for each year of interest. Two examples are presented in this appendix. One contains annual totals for each major source type (i.e., point, area, mobile and off-highway). The other example contains annual totals for each tier 1 and tier 2 source category.

EXAMPLE 1 - Major Source Type

For each nonattainment area provide the following total VOC emissions summaries with detailed listings as indicated. In the example, "State" represents State Name, "XYZ" represents name of nonattainment area, "ZZZ" is species name (VOC, NO_x, or CO) and "xx" is the name of a particular listing. Example:

State Nonattainment Area XYZ - Total ZZZ Emissions Summary

Table I - Projection Year Emissions without Controls

Year	1988	1990	1996	1999	2005	2007
Point						
Area						
Highway						
Off-Highway						

1988 and 1990 are actual emission estimates. See listing "xx" for emissions growth rates and methodologies.

Table II - Projection Year Emissions with 15% Rate-of-Progress (ROP) Controls and other Clean Air Act (CAA) Mandated Controls

Year	1988	1990	1996	1999	2005	2007
Point						
Area						
Highway						
Off-Highway						

1988 and 1990 are actual emission estimates. See listing "xx" for 15% ROP and CAA mandated controls.

Table III - Projection Year Emissions with 15% ROP, CAA Mandated and Additional Controls

Year	1988	1990	1996	1999	2005	2007
Point						
Area						
Highway						
Off-Highway						

1988 and 1990 are actual emission estimates. See listing "xx" for additional controls.

EXAMPLE 2 - Tier 1 and Tier 2 Categories

DATE: 01/04/1994
TIME: 10:22:04

Interim Inventory VOC Report For Point + Area (Tons/Year)
"State Name"

	1987	1988	1989	1990	1991
01 FUEL COMB. ELEC. UTIL.					
01 Coal	41.3	42.6	40.9	41.3	44.8
02 Oil	98.7	124.3	130.9	108.5	78.0
	140.0	166.9	171.8	149.8	122.8
02 FUEL COMB. INDUSTRIAL					
02 Oil	506.1	502.5	496.4	475.4	464.8
03 Gas	20.8	23.6	27.1	38.9	51.7
04 Other	134.0	133.6	131.9	126.3	123.3
	660.9	659.7	655.4	640.6	639.8
03 FUEL COMB. OTHER					
01 Commercial/Institutional Coal	0.1	0.1	0.1	0.1	0.1
02 Commercial/Institutional Oil	24.2	17.3	18.2	25.8	30.5
03 Commercial/Institutional Gas	5.9	6.2	6.6	6.5	6.6
04 Misc. Fuel Comb.(Except Residential)	39.6	41.4	44.3	48.1	46.4
05 Residential Wood	3829.1	3790.2	3698.8	3542.4	3542.4
06 Residential Other	134.0	126.9	143.8	151.6	162.1
	4032.9	3982.1	3911.8	3774.5	3788.1
04 CHEMICAL & ALLIED PRODUCTS MFG					
01 Organic Chemical Mfg	959.4	1067.6	1172.8	1295.9	1265.5
03 Polymer & Resin Mfg	9.6	10.7	11.8	13.1	12.8
	969.0	1078.3	1184.6	1309.0	1278.3
06 PETROLEUM & RELATED INDUSTRIES					
01 Oil & Gas Production	1.4	1.3	1.3	1.1	1.1
	1.4	1.3	1.3	1.1	1.1
07 OTHER INDUSTRIAL PROCESSES					
01 Agriculture, Food, Kindred Products	38.1	39.0	37.7	35.5	34.6
02 Textiles, Leather, Apparel Products	470.4	452.9	446.1	403.7	394.2
04 Rubber & Misc. Plastic Products	222.5	256.4	250.4	235.5	228.0
10 Misc. Industrial Processes	16.8	16.6	16.2	15.6	15.6
	747.8	764.9	750.4	690.3	672.4

DATE: 01/04/1994
TIME: 10:22:06

Interim Inventory VOC Report For Point + Area (Tons/Year)
"State Name"

	1987	1988	1989	1990	1991
08 SOLVENT UTILIZATION					
01 Degreasing	3591.0	4013.9	4013.3	3932.2	3775.3
02 Graphic Arts	693.3	778.6	737.7	710.9	701.2
03 Dry Cleaning	952.0	969.2	964.8	935.1	905.3
04 Surface Coating	10723.2	10858.3	10734.1	10398.8	10298.0
05 Other Industrial	1461.4	1463.8	1380.2	1288.5	1206.4
06 Nonindustrial	6381.5	6805.1	7011.1	7129.0	7471.9
	23802.4	24888.9	24841.2	24394.5	24358.1
09 STORAGE & TRANSPORT					
01 Bulk Terminals & Plants	2013.5	2063.0	1929.6	1855.4	1787.8
02 Petroleum & Petroleum Prod. Storage	530.1	555.5	595.2	644.5	619.1
04 Service Stations: Stage I	1851.1	1930.9	1920.3	2068.6	2163.7
05 Service Stations: Stage II	2535.9	2645.2	2236.1	2267.1	2371.3
06 Service Stations: Breath/Emptying	253.6	264.4	263.0	283.5	296.4
	7184.2	7459.0	6944.2	7119.1	7238.3
10 WASTE DISPOSAL & RECYCLING					
01 Incineration	260.6	259.0	254.1	244.3	244.3
02 Open Burning	1824.6	1806.4	1763.3	1688.9	1688.9
03 POTW	51.8	54.3	58.3	63.0	60.6
05 TSDF	87.1	89.5	87.6	83.7	78.3
	2224.1	2209.2	2163.3	2079.9	2072.1
11 HIGHWAY VEHICLES					
01 Light-Duty Gas Vehicles/Motorcycles	21482.1	10742.5	9343.3	19362.3	19475.7
02 Light-Duty Gas Trucks	9295.8	4526.4	3969.7	8319.2	8373.3
03 Heavy-Duty Gas Vehicles	904.9	426.1	358.4	748.1	724.6
04 Diesels	1312.4	638.8	616.9	1343.2	1350.3
	32995.2	16333.8	14288.3	29772.8	29923.9
12 OFF-HIGHWAY					
01 Non-Road Gasoline	4437.2	4403.2	4293.0	4105.1	4083.2
02 Non-Road Diesel	209.7	217.6	190.1	161.6	132.7
03 Aircraft	643.3	632.7	620.3	565.5	500.0
04 Marine Vessels	4.0	4.2	4.3	4.4	4.5
05 Railroads	3.7	4.0	4.0	4.3	4.4
	5297.9	5261.7	5111.7	4840.9	4724.8
14 MISCELLANEOUS					
02 Other Combustion	166.1	166.1	166.1	166.1	166.1
	166.1	166.1	166.1	166.1	166.1

Appendix C

Summary of Emissions by Tier 1 and Tier 2 Source Categories

		Point Source Emissions (tons)			Area Source Emissions (tons)		
Tier 1	Tier 2	VOC	NO_x	CO	VOC	NO_x	CO
1 Fuel Comb. Electric Utilities		32,882	7,516,334	313,164	0	0	0
	1 Coal	27,125	6,712,495	232,781	0	0	0
	2 Oil	2,770	195,526	18,807	0	0	0
	3 Gas	1,770	559,390	50,621	0	0	0
	4 Other	0	0	0	0	0	0
	5 Internal Combustion	1,217	48,923	10,956	0	0	0
2 Fuel Comb. Industrial		234,916	1,670,488	422,468	20,549	1,602,265	240,614
	1 Coal	12,446	472,244	70,151	636	123,938	15,958
	2 Oil	9,892	157,727	25,129	3,731	87,930	15,273
	3 Gas	104,585	268,625	46,732	16,070	1,389,942	208,845
	4 Other	92,810	209,108	182,137	112	455	538
	5 Internal Combustion	15,182	562,783	98,319	0	0	0
3 Fuel Comb. Other		10,869	101,301	91,040	426,789	632,271	5,636,360
	1 Commercial/ Institutional Coal	1,177	29,199	11,702	273	9,886	3,506
	2 Commercial/ Institutional Oil	1,326	24,226	3,443	2,415	71,021	13,414
	3 Commercial/ Institutional Gas	1,037	18,436	2,615	3,418	133,088	26,612
	4 Misc. Fuel Comb. (Except Residential)	7,328	29,440	73,280	0	0	10
	5 Residential Wood	0	0	0	405,251	65,843	5,434,658
	6 Residential Other	0	0	0	15,432	352,433	158,160
4 Chemical & Allied Products Mfg.		1,492,417	154,474	1,989,447	455,983	0	0
	1 Organic Chemical Mfg.	515,330	32,503	285,714	185,121	0	0
	2 Inorganic Chem. Mfg.	40,463	18,052	95,103	0	0	0
	3 Polymer & Resin Mfg.	274,576	15,548	19,067	39,605	0	0
	4 Agri. Chem. Mfg.	25,177	46,064	17,320	0	0	0
	5 Paint, Varnish, Lacquer, Enamel Mfg.	10,779	59	0	0	0	0
	6 Pharmaceutical Mfg.	22,596	25	19	231,257	0	0
	7 Other Chem. Mfg.	603,497	42,224	1,572,225	0	0	0
5 Metals Processing		73,204	65,317	2,090,818	0	0	0
	1 Non-Ferrous Metals	19,962	14,343	685,855	61,077	0	0
	2 Ferrous Metals	51,849	45,212	1,398,763	353,119	0	0
	3 Metals NEC	1,394	5,763	6,200	0	0	0

Summary of Emissions by Tier 1 and Tier 2 Source Categories (Continued)

		Point Source Emissions (tons)			Area Source Emissions (tons)		
Tier 1	Tier 2	VOC	NO_x	CO	VOC	NO_x	CO
6 Petroleum & Related Industries		336,249	247,953	461,533	414,196	0	0
	1 Oil & Gas Production	13,707	53,294	9,561	61,077	0	0
	2 Petroleum Refineries & Related Industries	319,289	194,095	450,277	353,119	0	0
	3 Asphalt Mfg.	3,254	565	1,695	0	0	0
7 Other Industrial Processes		405,724	353,558	731,199	79,228	4,627	2,155
	1 Agriculture, Food, Kindred Products	203,555	4,696	269	50,278	0	0
	2 Textiles, Leather, Apparel Products	9,975	59	5	0	0	0
	3 Wood, Pulp & Paper, & Publishing Products	43,995	76,030	656,921	0	0	0
	4 Rubber & Misc. Plastic Products	45,629	45	80	0	0	0
	5 Mineral Products	13,971	214,726	42,795	0	0	0
	6 Machinery Products	3,445	1,594	115	0	0	0
	7 Electronic Equipment	321	0	11,977	0	0	0
	8 Transportation Equipment	405	0	7	0	0	0
	9 Construction	0	0	0	0	0	0
	10 Misc. Industrial Processes	84,429	56,409	19,031	28,950	4,627	2,155
8 Solvent Utilization		1,203,524	7,593	1,734	4,863,848	0	0
	1 Degreasing	67,805	45	983	683,768	0	0
	2 Graphic Arts	285,549	283	189	134,980	0	0
	3 Dry Cleaning	1,521	0	0	207,701	0	0
	4 Surface Coating	712,303	7,250	552	1,539,678	0	0
	5 Other Industrial	136,347	14	10	397,720	0	0
	6 Nonindustrial	0	0	0	1,900,001	0	0

Summary of Emissions by Tier 1 and Tier 2 Source Categories (Continued)

		Point Source Emissions (tons)			Area Source Emissions (tons)		
Tier 1	Tier 2	VOC	NO_x	CO	VOC	NO_x	CO
9 Storage & Transport		573,818	2,037	1,516	1,412,815	0	0
	1 Bulk Terminals & Plants	100,189	0	30	0	0	0
	2 Petroleum & Petroleum Prod. Storage	332,549	1,210	534	0	0	0
	3 Petroleum & Petroleum Prod. Transport	2,384	0	0	0	0	0
	4 Service Stations:Stage I	2,306	0	0	227,423	0	0
	5 Service Stations:Stage II	337	0	0	625,821	0	0
	6 Service Stations: Breath/Emptying	0	0	0	0	0	0
	7 Organic Chemical Storage	120,444	194	809	559,571	0	0
	8 Organic Chemical Transport	14,940	0	0	0	0	0
	9 Inorganic Chemical Storage	271	94	0	0	0	0
	10 Inorganic Chemical Transport	0	0	0	0	0	0
	11 Bulk Materials Storage	400	539	143	0	0	0
	12 Bulk Materials Transport	0	0	0	0	0	0
10 Waste Disposal & Recycling		13,357	18,800	76,370	2,253,881	62,541	1,610,601
	1 Incineration	12,639	17,964	75,045	51,284	12,705	775,054
	2 Open Burning	127	572	847	262,871	49,836	835,547
	3 POTW	26	0	0	10,862	0	0
	4 Industrial WW	0	0	0	0	0	0
	5 TSDF	0	0	0	1,928,864	0	0
	6 Landfills	353	219	465	0	0	0
	7 Other	212	45	13	0	0	0
11 Highway Vehicles		0	0	0	5,075,305	6,411,070	43,719,292
	1 Light-Duty Gas Vehicles/Motorcycles	0	0	0	3,274,610	2,627,043	30,205,337
	2 Light-Duty Gas Truck	0	0	0	1,235,772	881,900	9,802,382
	3 Heavy-Duty Gas Vehicles	0	0	0	205,164	184,617	2,197,742
	4 Diesel	0	0	0	359,759	2,717,510	1,513,831
12 Off-Highway		0	0	0	1,239,073	2,498,668	6,511,305
	1 Non-Road Gasoline	0	0	0	608,688	1,241,197	4,095,312
	2 Non-Road Diesels	0	0	0	192,391	139,372	965,531
	3 Aircraft	0	0	0	395,874	188,809	1,328,595
	4 Marine Vessels	0	0	0	42,120	929,290	121,867
	5 Railroads	0	0	0	0	0	0

Summary of Emissions by Tier 1 and Tier 2 Source Categories (Continued)

		Point Source Emissions (tons)			Area Source Emissions (tons)		
Tier 1	Tier 2	VOC	NO_x	CO	VOC	NO_x	CO
13 Natural Sources		0	0	0	0	0	0
	1 Biogenic	0	0	0	0	0	0
	2 Geogenic	0	0	0	0	0	0
	3 Miscellaneous	0	0	0	0	0	0
14 Miscellaneous		0	0	0	575,596	133,007	4,266,745
	1 Agriculture & Forestry	0	0	0	76,573	11,780	551,918
	2 Other Combustion	0	0	0	499,023	121,227	3,714,827
	3 Catastrophic/Accidental Releases	0	0	0	0	0	0
	4 Repair Shops	0	0	0	0	0	0
	5 Health Services	0	0	0	0	0	0
	6 Cooling Towers	0	0	0	0	0	0
	7 Fugitive Dust	0	0	0	0	0	0

TECHNICAL REPORT DATA

(Please read Instructions on reverse before completing)

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16. ABSTRACT

This document provides guidance to State agencies for documenting modeling procedures and results supporting the 1994 revision to State implementation plans (SIP's) for ozone. The Urban Airshed Model is an urban-scale, grid-based photochemical dispersion model. The model provides a means for studying the relationship of volatile organic compound and nitrogen oxide emissions to ambient levels of ozone. This document provides guidance on the reporting requirements for regulatory use.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/ Group
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