Dick

TRIAD EARLY ACTION COMPACT

Alamance County and Municipalities

Caswell County and Municipalities

Davidson County and Municipalities

Davie County and Municipalities

Forsyth County and Municipalities

Guilford County and Municipalities

Randolph County and Municipalities

Rockingham County and Municipalities

Stokes County and Municipalities

Surry County and Municipalities

Yadkin County and Municipalities

June 30, 2003

Ms. Kay T. Prince, Chief
Air Planning Branch
US Environmental Protection Agency, Region 4
61 Forsyth St. S.W.
Atlanta, GA 30303-8960

Dear Ms. Prince:

Enclosed is a hard copy of the June 30, 2003 Progress Report from the Triad Early Action Compact. A duplicate copy was sent via e-mail.

Please let me know if you or your staff have questions.

Sincerely,

Ginger Booker

Virginia G. Booker
Assistant Director
Piedmont Triad Council of Governments

Cc: Richard Schutt, Chief Regulatory Development Section, USEPA
Sheila Holman, Chief, Planning Section, NCDAQ

AIR PLANNING BRANCH
RECEIVED
JUL 1 2003
EPA-REGION #4
ATLANTA, GA.

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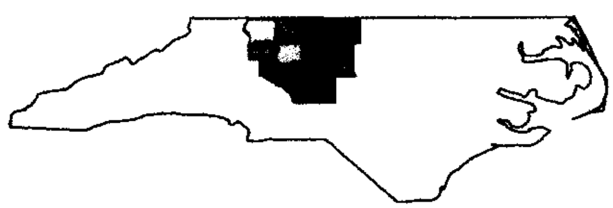
Phone 336/294-4950 ◆ Fax 336/632-0457

TRIAD EARLY ACTION COMPACT

June 30, 2003 Progress Report



TRIAD EARLY ACTION COMPACT – JUNE 30, 2003 PROGRESS REPORT

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PART A – STAKEHOLDER PROCESS

SECTION 1 - REGIONAL ORGANIZATION AND CONTACTS

The Triad Early Action Compact (EAC) includes eleven counties and their municipalities in north central North Carolina. Two councils of government (COGs) serve this region known as the Piedmont Triad Region – the Northwest Piedmont Council of Governments and the Piedmont Triad Council of Governments. The two COGs facilitated adoption of the EAC agreement in their member jurisdictions and are jointly staffing the EAC.

The primary contact for the Triad EAC is:

Virginia Booker, Assistant Director
Piedmont Triad Council of Governments
2216 W. Meadowview Road
Greensboro, NC 27407
336-294-4950
gbooker@ptcog.org

An additional contact is:

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Northwest Piedmont Council of Governments
400 W. Fourth Street
Winston-Salem, NC 27101
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SECTION 2 - LIST OF STAKEHOLDERS, AREAS OF INTEREST, ROLE OF STAKEHOLDERS GROUP

The Triad Stakeholders Group was organized in January and February 2003, following adoption of the EAC resolution by 31 jurisdictions in December 2002. There was no predecessor regional group to logically assume these responsibilities. Therefore, the two COGs identified and appointed a broad range of local government, business, industry, transportation, and environmental representatives to comprise the EAC Stakeholders Group.

The Stakeholders Group agreed that its first task was to become informed advocates for reducing ozone precursor emissions in the region. Later, they will manage the process of achieving buy-in for reduction strategies. To build a solid foundation for action, they spent the March – June 2003 period considering hundreds of reduction strategies and building a cohesive group encompassing diverse points of view. The group agreed on a two phase process:

Phase I, March – June 2003

- Education of Stakeholders Group and citizens on nature and extent of ozone problems in the region.

- Consideration and discussion of hundreds of potential ozone control measures drawn from air quality initiatives throughout the country.
- Agreement on a menu of public and private sector strategies for June 16 submission to EPA and subsequent region-wide consideration for the Triad Early Action Plan.

<u>Phase II, July 2003 – January 2004</u>

- Benchmarking and quantifying potential reduction strategies
- Meetings with local governing boards (11 counties, 20 municipalities) and other public meetings for purposes of education and input
- Developing consensus on strategies for Triad Early Action Plan

Several organizations have played a leadership role in the Triad EAC: the Forsyth County Environmental Affairs Department, PART (Piedmont Authority for Regional Transportation, regional transportation planning and service agency) and the 4 MPOs serving the 11-county region. Representatives of these agencies, along with Sheila Holman, NC Division of Air Quality, helped to educate the Stakeholders Group on the strategies contained on an extensive initial list assembled by the Piedmont Triad Council of Governments. They will also assist in benchmarking and quantifying the strategies under consideration for the Early Action Plan.

A membership list of the Stakeholders Group follows.

Name	Category	Area Representing
Dan Besse, Chair	Winston-Salem City Council Environmental Law Attorney Member, NC Environmental Management Commission	Winston- Salem
Sandy Carmany, Vice Chair	Greensboro City Council Chair, PART (regional transportation planning and service)	Greensboro
John Grogan	Chair, Piedmont Triad Council of Governments Mayor Pro Tem, Eden	Eden
Chris Jones	Chair, Northwest Piedmont Council of Governments City Council, Clemmons	Clemmons
Dan Barrett	Davie County Commissioner	Davie County
Robert Fulp	Director, Forsyth County Environmental Affairs Department	Forsyth County
Ted Johnson	Executive Director, Piedmont Triad Airport Authority	Regional
Scott Rhine	Transportation Planner, PART (regional transportation planning and service)	Regional
Cindy Holiday	Regional Economic Development Partnership	Regional
Andy Grzymski	Planner, High Point Urban Area MPO	High Point/Davidson County
GregErrett	Planner, Winston-Salem Urban Area MPO	Winston-Salem/Forsyth County
Stan Polanis	Winston-Salem City Administration	Municipal Management
Peggy Holland / Jeff Sovich	Planner, Greensboro Urban Area MPO	Greensboro/Guilford County
Mike Nunn	Planner, Burlington Alamance Urban Area MPO	Burlington/Graham/Alamance County
Bob Harkrader	Planning Director, Alamance County	Alamance County
David Mickey	Blue Ridge Environmental Defense League - Environmental Representative –	Davidson County / Northwest Piedmont Region
Danny Nicholson	Trucking Company Owner	Davidson County
Jimmy Flythe	Regional manager, Duke Power	Davie, Forsyth, Stokes, Surry, Yadkin County service area
Hoy Bohanon	Corporate environmental engineer, R.J. Reynolds Tobacco	Winston-Salem
Arthur Toompas	Corporate environmental engineer, Cone Mills	Greensboro
Allen Purser	Urban chamber of commerce, Greensboro	Greensboro
James McCoy	Urban chamber of commerce, Winston-Salem	Winston-Salem
Jeryl Covington	Municipal environmental department head	Greensboro
Angela Wynes	Municipal bus system, Assistant Transit Manager	High Point
Reid Teague	Gasoline/petroleum marketer – Rentz Eden Oil Company	Rockingham County

Name	Category	Area Representing
Vince Fallon	Manufacturing Manager, Liggett Group	Alamance County
Chris Willis	Large Road Contractor , A-PAC Carolina	Greensboro
Talmadge Baker	Asheboro City Council Rural Transportation Planning Organization	Asheboro/Randolph County
Gene Miller	Large School Bus Fleet, Operations Manager	Winston-Salem - Forsyth Co.
Jack Loudermilk	Farmer	Yadkin County
Additional participants		
Bill Purdue	Environmental Manager, American Furniture Manufacturers Assn.	High Point
Andy Peachey	Triad Area Real Estate and Building Coalition	Greensboro

SECTION 3 - STAKEHOLDER MEETINGS AND PUBLIC PARTICIPATION

Between March 3 and June 2, 2003, the Stakeholders Group met 6 times. All meetings were held at 2:00 p.m. on Monday afternoons in the conference room of the Kernersville Town Hall. Kernersville lies at the geographic center of the region, and Town Hall is less than five minutes of Interstate 40, the main east-west corridor of the region.

Stakeholder meetings were highly interactive with excellent attendance from Group members. Meetings were advertised on the web pages of the Piedmont Triad Council of Governments and the Northwest Piedmont Council of Governments. Additionally, meetings were publicized by the Winston-Salem and Greensboro Chambers of Commerce, in the Triad Sierra Club newsletter, and in e-mails to local and statewide environmental groups. There was also extensive coverage of each Stakeholder meeting in the Greensboro *News and Record*. Strong publicity and dynamic meetings contributed to attendance and participation by a number of additional interested persons.

A summary of meetings follows:

March 3 - Organizational meeting; briefing on history and reasons for creating EACs; role of transportation planning organizations and Forsyth County Environmental Affairs Department in EAC process, purpose of Stakeholders Group; additions to Group

March 31 – Div. of Air Quality presentation on (a) Triad emissions inventories 1995, 2007, 2015 and (b) modeling results; distribution of comprehensive strategies list and agreement on process to discuss and agree on strategies for June 16 list; update on web page

April 7 – Discussion of regional transportation air quality conformity strategies (PART and MPOs); potential role of state DOT and local governments in requiring higher emissions standards on major road projects; review and discussion of strategies from list

May 5 – Summary of outreach meetings held with business and industry representatives and construction/homebuilding representatives; updates on liaison with environmental groups; bus replacement strategies for 3 municipalities; discussion of "clean fuels" pricing and supply issues; continue review of strategies

May 19 – Small group meeting to edit and recommend a list of strategies for June meeting; focus on localizing strategies; adding strategies recommended by business and industry group; eliminating strategies that are not feasible

June 2 – Dick Schutt, EPA in attendance; report on EPA response to questions regarding strategies list; agreement on final content of June 16 strategies list; agreement on priorities for July meeting, which are: (1)assign responsibilities for quantification and benchmarking and (2) agree on process and schedule for public participation and local government education and buy-in.

May 13 Public Hearing - In addition to Stakeholder Group meetings, a public hearing sponsored by the Division of Air Quality was held in the region on May 13. The purpose of the hearing was to describe and seek comments on the non-attainment designation process, provide education on the harmful effects of ozone, and to describe the North Carolina 8-Hour Ozone Modeling Process.

Briefings – The following briefings were conducted for key local elected officials and staff:
Piedmont Triad Council of Governments Board meeting – April 16
Winston-Salem City Council – June 15
Greensboro City Council – June 24

SECTION 4 –OUTREACH

The Triad EAC has undertaken and benefited from the following outreach initiatives.

- Information on **web pages** of:

Northwest Piedmont Council of Governments	www.nwpcog.dst.nc.us
Piedmont Triad Council of Governments	www.ptcog.org
Forsyth County Environmental Affairs Department	www.co.forsyth.nc.us

- Extensive press coverage
  - **Greensboro *News and Record*** (page A-1 or B-1) of all EAC meetings, May 13 public hearings and other air quality issues
  - Additional coverage in **High Point *Enterprise*** and **Winston-Salem *Journal***
  - Lead story on *WFDD,* **public radio** for the Triad region, on June 3
  - Feature story on ***WFMY-TV*** *Greensboro,* June 11 on EAC process and ozone monitoring in the region

- 3 **business and industry education and input sessions**; total of 63 participants; resulting in recommended revisions and additions to strategies list accepted by Stakeholders Group. Sessions sponsored by Greensboro, Winston-Salem and High Point Chambers of Commerce and American Furniture Manufacturers Association.

- Regular communications with environmental groups from Chair of Stakeholders Group and Group member representing Blue Ridge Environmental Defense Fund, including:

  article in March 2003 **Triad Sierra Club newsletter** soliciting input and describing the EAC, **monthly email reports** to about 250 recipients such as Piedmont Conservation Voters, Sierra Club, Conservation Council of NC, and other groups.

- May 13 **public meeting** sponsored by the Division of Air Quality (see above)..

In July the Stakeholders Group will agree on a communications and outreach plan for the period July 2003 – early January 2004. Key elements of the process will be meetings with all 31 participating jurisdictions and conducting education and comment sessions for the public. During this period, the Stakeholders Group and staff will work extensively with PART, MPOs, local transportation departments, bus systems and other fleets to identify emission reduction strategies already in place and others that can be implemented with appropriate support. Every strategy on the June 16 list will be evaluated for impact and feasibility. Those with the highest impact will be strongly advocated by the EAC Stakeholders Group. In addition, other initiatives are under consideration, including helping organize a multi-region program to bring ultra-low sulfur diesel to the region earlier than scheduled, and participating in an EPA Clean School Bus project subject to EPA funding of a Division of Air Quality grant proposal.

The Triad EAC Stakeholders Group fully understands that significant local progress must be made for the Triad to avoid designation in 2007. To date, the EAC process has been characterized by strong debate and building of consensus among divergent interests. Members hope this can be an effective model for adoption of meaningful emissions reduction strategies throughout the region.

PART B – MODELING

SECTION 1 - INTRODUCTION

As a requirement of the Triad Early Action Compact (EAC), the progress report due June 30, 2003, must include a status report regarding the air quality modeling. This report satisfies this requirement. Discussed in this report are the photochemical model selection, episode selection, meteorological model development, emissions inventory development, and the modeling status.

The modeling system being used for this demonstration and the episodes being modeled are discussed below in further detail in Sections 2 and 3.

The modeling analysis is a complex technical evaluation that begins by selection of the modeling system and selection of the meteorological episodes. North Carolina Division of Air Quality (NCDAQ) decided to use the following modeling system:

- Meteorological Model: MM-5 – This model generates hourly meteorological inputs for the emissions model and the air quality model, such as wind speed, wind direction, and surface temperature.

- Emissions Model: Sparse Matrix Operator Kernel Emissions (SMOKE) - This model takes daily county level emissions and temporally allocates across the day, spatially locates the emissions within the county, and transfers the total emissions into the chemical species needed by the air quality model.

- Air Quality Model: MAQSIP (Multi-Scale Air Quality Simulation Platform) – This model takes the inputs from the emissions model and meteorological model and predicts ozone hour by hour across the modeling domain, both horizontally and vertically.

The following historical episodes were selected to model because they represent typical meteorological conditions in North Carolina when high ozone is observed throughout the State:

- July 10-15, 1995
- June 20-24, 1996
- June 25-30, 1996
- July 10-15, 1997

The meteorological inputs were developed using MM5 and are discussed in detail in Section 4.

The precursors to ozone, Nitrogen Oxides (NOx), Volatile Organic Compounds (VOCs), and Carbon Monoxide (CO) were estimated for each source category. These estimates were then spatially allocated across the county, temporally adjusted to the day of the week and hour of the day and speciated into the chemical species that the air quality model needs to predict ozone. The development of the emission inventories are discussed in detail in Section 5.
The status of modeling work and issues that have been encountered are discussed in Section 6.

SECTION 2 - MODEL SELECTION

2.1 Introduction

To be useful in a regulatory framework, photochemical grid models and their applications must be defensible. Not only must the U.S. Environmental Protection Agency (EPA) be convinced of this, but members of the regulated community (stakeholders) as well. Failure to convince EPA can result in rejection of an implementation or maintenance plan. Failure to convince the regulated community can lead to diminished rule effectiveness and litigation. In none of these cases is the state's air quality goals advanced.

To ensure that a modeling study is defensible, care must be taken in the selection of the models to be used. The models selected must be scientifically appropriate for the intended application and be freely accessible to all stakeholders. Scientifically appropriate means that the models address important physical and chemical phenomena in sufficient detail, using peer reviewed methods. Freely accessible means that model formulations and coding are freely available for review and that the models are available to stakeholders, and their consultants, for execution and verification at no or low cost.

In the following sections we outline the criteria for selecting a modeling system that is both defensible and capable of meeting the study's goals.

2.2 Selection of Photochemical Grid Model

2.2.1 Criteria

For a photochemical grid model to qualify as a candidate for use in an attainment demonstration of the 8-hour ozone National Ambient Air Quality Standards (NAAQS), a State needs to show that it meets several general criteria.

- The model has received a scientific peer review
- The model can be demonstrated applicable to the problem on a theoretical basis
- Data bases needed to perform the analysis are available and adequate
- Available past appropriate performance evaluations have shown the model is not biased toward underestimates
- A protocol on methods and procedures to be followed has been established
- The developer of the model must be willing to make the source code available to users for free or for a reasonable cost, and the model cannot otherwise be proprietary

2.2.2 Overview of MAQSIP

The photochemical model selected for this study is the Multiscale Air Quality Simulation Platform (MAQSIP). MAQSIP is a fully modularized three-dimensional system with various options for representing the physical and chemical processes describing regional- and urban-scale atmospheric pollution. The governing model equations for tracer continuity are formulated in generalized coordinates, thereby providing the capability of interfacing the model with a variety of meteorological drivers. The model employs flexible horizontal grid resolution with multiple multi-level nested grids with options for one-way and two-way nesting procedures. In the vertical, the capability to use non-uniform grids is provided. Current applications have used horizontal grid resolutions from 18-80 km for regional applications and 2-6 km for urban scale simulations, and up to 30 layers to discretize the vertical domain.

The MAQSIP framework with the detailed gas-phase and aerosol model provides a modeling system that can be used for investigating the various processes that govern the loading of chemical species and anthropogenic aerosols at various scales of atmospheric motions from urban, regional to intercontinental scales. For example, MAQSIP has been used to support the Southeastern States Air Resources Management (SESARM) project to produce seasonal simulations of ozone over eastern United States. The gas-aerosol version of the MAQSIP (hereinafter the MAQSIP-PM) has been used in urban-to-regional-scale applications over the eastern and western United States, and western Europe, to study the production and distribution of fine and coarse PM, and its effects on visibility and the radiation budget.

For regulatory application, a specific configuration of MAQSIP has been used in this study. This configuration of MAQSIP follows a series a sensitivity tests to determine the best performing modules. This configuration has the following components:

- Horizontal Coordinate System: *Lambert Conformal Projection*
- Vertical Coordinate System: *Non-Hydrostatic Sigma-Pressure Coordinates*
- Gas Phase Chemistry: *Carbon Bond IV with Isoprene updates*
- Aqueous Phase Chemistry: *Included in cloud package*
- Chemistry Solver: *Modified QSSA*
- Horizontal Advection: *Bott*
- Cloud Physics: *Kain-Fritsch parameterization and explicit, as needed*
- Horizontal Turbulent Diffusion: *Fixed* K_h
- Vertical Turbulent Diffusion: *K-Theory*
- Photolysis Rates: *Madronich*
- Dry Deposition: *Resistance*
- Wet Deposition: *Included in cloud package*

2.3 Selection of Meteorological Model

2.3.1 Criteria

Meteorological models, either through objective, diagnostic, or prognostic analysis, extend available information about the state of the atmosphere to the grid upon which photochemical grid modeling is to be carried out. The criteria for selecting a meteorological model are based on both the models ability to accurately replicate important meteorological phenomena in the region of study, and the model's ability to interface with the rest of the modeling systems -- particularly the photochemical grid model. With these issues in mind, the following criteria were established for the meteorological model to be used in this study:

- Non-Hydrostatic Formulation
- Reasonably current, peer reviewed formulation
- Simulates Cloud Physics
- Publicly available on no or low cost
- Output available in I/O API format
- Supports Four Dimensional Data Assimilation (FDDA)
- Enhanced treatment of Planetary Boundary Layer heights for AQ modeling

2.3.2 Overview of MM5

The meteorological model selected for this study is the nonhydrostatic PSU/NCAR Mesoscale Model Version 5 (MM5). MM5 (Dudhia 1993; Grell et al. 1994) is one of the leading three-dimensional prognostic meteorological models available for air quality studies. It uses an efficient split semi-implicit temporal integration scheme and has a nested-grid capability that can use up to ten different domains of arbitrary horizontal resolution. This allows MM5 to simulate local details with high resolution (as fine as ~1 km), while accounting for influences from great distances, using horizontal resolutions ranging to about 200 km.

MM5 uses a terrain-following nondimensionalized pressure, or "sigma", vertical coordinate similar to that used in many operational and research models. In the nonhydrostatic MM5, the sigma levels are defined according to the initial hydrostatically balanced reference state so that these levels are also time-invariant. The meteorological fields also can be used in other photochemical grid models with different coordinate systems by performing a vertical interpolation followed by a mass-consistency reconciliation step.

The model contains two types of planetary boundary layer (PBL) parameterizations suitable for air-quality applications, both of which represent subgrid-scale turbulent fluxes of heat, moisture, and momentum. A modified Blackadar PBL (Zhang and Anthes 1982) uses a first-order eddy diffusivity formulation for stable and neutral environments and a nonlocal closure for unstable regimes. The Gayno-Seaman PBL (Gayno, 1994) uses a prognostic equation for the second-order turbulent kinetic energy, while diagnosing the other key boundary layer terms. This is referred to as a 1.5-order PBL, or level-2.5, scheme (Mellor and Yamada 1974).

Initial and lateral boundary conditions are specified for real-data cases from mesoscale 3-D analyses performed at 12-hour intervals on the outermost grid mesh selected by the user. Surface fields are analyzed at three-hour intervals. A Cressman-based technique is used to analyze standard surface and radiosonde observations, using the National Meteorological Center's spectral analysis, as a first guess (Benjamin and Seaman 1985). The lateral boundary data are introduced using a relaxation technique applied in the outermost five rows and columns of the coarsest grid domain.

For most traditional (1-hour standard) high-ozone episodes, precipitation is not the dominant factor. On the other hand, precipitation events may have a greater impact on 8-hour average ozone episodes. The MM5 contains five convective parameterization schemes (Kuo, Betts-Miller, Fritsch-Chappell, Kain-Fritsch, and Grell). It also has an explicit resolved-scale precipitation scheme (Dudhia 1989) that solves prognostic equations for cloud water/ice (q_c) and larger liquid or frozen hydrometeors (q_r). In addition the model contains a short- and long-wave radiation parameterization (Dudhia 1989).

2.4 Selection of Emissions Processing System

2.4.1 Criteria

The principal criterion for an emissions processing system is that it accurately prepares emissions files in a format suitable for the photochemical grid model being used. The following list includes clarification of this criterion and additional desirable criteria for effective use of the system.

- File System Compatibility with the I/O API
- File Portability
- Ability to grid emissions on a Lambert Conformal projection
- Report Capability
- Graphical Analysis Capability
- MOBILE6 Mobile Source Emissions
- BEIS-2 Biogenic Emissions
- Ability to process emissions for the proposed domain in a day or less.
- Ability to process control strategies
- No or low cost for acquisition and maintenance
- Expandable to support other species and mechanisms

2.4.2 Overview of SMOKE

The emissions processing system selected for this study is the Sparse Matrix Operator Kernel Emissions (SMOKE). SMOKE was developed to reduce the large processing times required to prepare emissions data for photochemical grid models. SMOKE processes both anthropogenic and biogenic emissions. Biogenic emissions are processed using an implementation of BEIS-3.

The modular structure of SMOKE (see Appendix A) removes much of the redundant processing found in other systems. This will provide even greater savings of CPU time and disk space when SMOKE is used to process control strategies. Unlike other emission processing systems, SMOKE's structure makes each process (i.e., gridding, speciation, temporal allocation, and control application) independent from the others. For example, to run a new control strategy, only the control model must be rerun, and the time-stepped emissions multiplied by the matrices. This whole process takes only a few minutes to process a new point source strategy and a few additional minutes if area and mobile sources are also changed.

SMOKE has undergone an extensive process of testing and validation. It has been validated on a regional scale against EMS-95 using the OTAG 1990 inventory, and on a large urban scale against EPS 2.0 using North Carolina's State Implementation Plan (SIP) inventory. SMOKE can be driven with inputs in EMS-95, EPS 2.0 or IDA format, and it can produce photochemical grid model-ready emissions in forms suitable to drive UAM-IV, UAM-V, MAQSIP, CMAQ and SAQM. SMOKE has adopted the Models-3 Input/Output Application Program Interface (I/O API) so the emissions files created by SMOKE are directly readable by Models-3, MCNC's MAQSIP, and the supporting analysis tools developed for these systems.

SECTION 3 - EPISODE SELECTION

3.1 Introduction

The episode selection process is critical to the success of the modeling study. Correctly identifying representative ozone episodes to model for several areas in North Carolina allows us to evaluate with confidence various control strategies for maintaining the NAAQS for ozone. Several factors influenced episode selection for this modeling study. In the following sections we outline the factors and considerations for episode selection, and then outline in detail the episodes selected for this modeling study.

3.2 Factors Influencing Episode Selection

Several factors influenced episode selection for this modeling study. The primary factor influencing episode selection was the promulgation of an 8-hour standard for ozone and the litigation that followed. This led to uncertainties surrounding the implementation of the standard. Also, the form of the new 8-hour standard makes it less dependent on extreme events than the 1-hour standard. Therefore, meteorological scenarios associated with 8-hour exceedances were reviewed and considered for modeling. A combination of these factors led to choosing episodes where both the 1-hour and 8-hour standards were exceeded.

The EPA issued a new ambient air quality standard based on the daily maximum 8-hour averaged concentration for ozone in July 1997. In June of 1998, EPA revoked the 1-hour standard in North Carolina since all areas of the state had attained that standard. However, in the 1998 ozone season, North Carolina experienced its first violation of the 1-hour ozone standard since 1990 in the Charlotte area. Later, in May 1999, a D.C. District Court ruling instructed EPA that an intelligible principle for the setting of the new 8-hour standard had to be defined and that enforcement of the 8-hour standard was prohibited by the court until EPA had done so. In 1999, EPA reinstated the old 1-hour standard. The result of all of the changing policy and litigation is that the modeling study must shift its primary focus from a traditional analysis solely targeted at 1-hour averaged ozone values, to an analysis of both 1-hour and 8-hour averaged values. Analysis of episodes with exceedances of 1-hour and 8-hour standards will also allow an assessment of the differences that two standards may have on control strategy development and will indicate whether control strategies designed to meet the 8-hour standard will also be effective at reducing ozone levels below the 1-hour standard. The "dual" need to model 1-hour and 8-hour exceedances was a primary criterion in the episode selection process.

A second factor affecting the selection process was the form of the new standard. The 1 hour standard allowed 1 exceedance per year in a region on average with the design value being the 4th highest 1 hour value in that region over 3 years. This means that, in theory, only the 3 worst case episodes in a 3-year period can be removed from consideration for modeling. The design value under the 8-hour standard is calculated differently. It is the yearly 4th highest 8-hour value at each monitor, averaged over 3 years. With the new standard it is possible to "throw out" the 3 worst case episode days of each year, or approximately 9 days over 3 years for each monitor. Because the 4th high value is determined for each individual monitor, discarding days with higher values can result in the removal of more than 9 worst case days if the high readings for all monitors do not occur on the same days. For example, exceedances may be measured north of a city during days when the wind blows predominately from the south, but measured at monitors south of the city on other days when winds are northerly. Discarding days above the 4th highest measurement in this example could result in removal of more than 9 worst case episode days in three years. This makes the standard less dependent on extreme events.

3.3 Episode Selection Considerations

The methodologies suggested in EPA's draft guidance for episode selection is the same for both the 1-hour and 8-hour standards. These methodologies were applied to the extent possible when attempting to choose episodes. The episode selection criterion was compromised to some extent by the need to simultaneously model multiple areas in North Carolina.

First, we considered a mix of episodes reflecting a variety of meteorological scenarios which frequently correspond with observed 8-hour daily maxima > 84 ppb at different monitoring sites. An analysis of each ozone episode was made using several sources of air quality and meteorological data to determine the episodes that would contribute the most to the modeling effort.

Secondly, we considered periods in which observed 8-hour daily maximum concentrations were within ±10 ppb of each area's design value. Because modeling for the new 8-hour standard may capture some 1-hour exceedances, 8-hour averaged ozone concentrations were given primary consideration. The 8-hour design values were calculated statewide, with a focus on the three major urban areas of NC; Charlotte/Gastonia, Greensboro/Winston-Salem (the Triad), and Raleigh/Durham (RDU), using monitored values from 1994-2002. The average of each year's fourth highest daily 8-hour averaged maximum concentration for each monitor statewide was calculated and used as a guide for determining the episodes with concentrations within ±10 ppb of the area's design value.

Finally, the temporal and spatial distribution of ozone throughout NC was also an important consideration. The new 8-hour standard brings areas such as Asheville, Fayetteville, Greenville/Rocky Mount/Wilson (Down East), Hickory, and other various areas into non-attainment. Therefore, it was necessary to choose episodes affecting those areas as well as the three major urban areas mentioned above. Episodes containing widespread ozone exceedances were given priority over those containing isolated exceedances. Also, the need to study the cumulative effects of ozone build-up over a number of days was recognized, so episodes of extended duration were given preference over single day exceedances.

Meeting all of the criteria in all areas is sometimes difficult. The episode selection criterion was compromised to some extent by the need to simultaneously model multiple areas. For example, during many "moderate" ozone events, ozone exceedances are not widespread throughout NC. Selection of these episodes can dramatically increase the number of modeled episodes needed to complete a thorough analysis of all non-attainment areas across the state. On the other hand, episodes with exceedances in all non-attainment areas often contain scattered extreme values.

To reduce the number of episodes to a manageable number, while also performing a complete analysis on each major urban area of NC, we made some compromise in the selection criteria. Ideally, no days with concentrations well above an area's design value would have been included in the selected episodes. However, on some days concentrations in one or two areas were found to be ideal for modeling while another area had observed concentrations well above its' ozone design value. Days such as these were included in the selected episodes due to the days' overall positive attributes.

3.4 Episode Selection Procedures

Ambient data was used to determine the days that exceedances of the 1-hour and/or 8-hour standard occurred in any of the major urban areas of NC from 1995 through 1997. These days were grouped into episodes and evaluated using the selection criteria discussed in the preceding section. An analysis of each ozone episode was made using several sources of air quality and meteorological data to determine the episodes that would contribute the most to the modeling effort.

Sets of ambient ozone data from 1995-1997 for the eastern US were plotted using Voyager Viewer software. The data were plotted for the eastern US using both hourly and 8-hour peak ozone concentrations. This permitted easy assessment of the spatial and temporal distribution of ozone throughout North Carolina as well as other areas of the eastern US and made it possible to easily determine whether the event was regional, sub-regional, or local in nature. These plots combined with meteorological plots also indicated the potential for recirculation. In one episode, shifts in wind direction corresponded to shifts in the location of ozone peaks in the Charlotte area, suggesting that recirculation may have contributed to exceedances of both ozone standards.

In addition to the ambient data plots, several surface and upper air meteorological data sets were used to assess the atmospheric conditions contributing to the build-up of ozone in each episode. Local Climatological Data sheets were used to collect diurnal data on temperatures, precipitation, and wind speed and direction. Daily weather maps were used to determine the location of surface fronts, troughs, and ridges as well as daily peak temperatures, precipitation, and the location of high and low pressure areas. Analysis charts (0000 Z and 1200 Z) for the surface, 850 mb, 700 mb, and 500 mb levels from the NOAA-NCEP ETA meteorological computer model were also used to assess conditions such as surface and upper air wind fields, temperatures, moisture, and the location of ridges and troughs. The conditions contributing to high levels of ozone were determined through chart analysis, and the type of meteorology was used to group episodes.

3.5 Episode Selection

All days with ozone exceedances in any of the major urban areas of NC were considered in the episode selection process. These days were divided into episodes based on the distribution of measured ozone and the meteorological conditions that occurred throughout the period of exceedance. The meteorological characteristics of each episode were studied using the tools outlined in the previous section. All episodes will have some common characteristics. Warm temperatures, little or no precipitation, and relatively light winds are needed to produce ozone episodes. Typically, those conditions are characteristic of a surface high-pressure area. The differences in the position, strength, and movement of the surface high-pressure areas, along with differences in the mid-to-upper level wind patterns, allow us to discern several meteorological scenarios in which ozone episodes are likely. These meteorological scenarios are discussed in the following paragraphs.

Conditions that traditionally lead to large-scale exceedances of the 1-hr standard result from the development of a broad surface high pressure area sprawled over the eastern third of the US and a large mid-to-upper level high pressure area near the Midwest (Scenario 1 – Eastern Stacked High). The mid-to-upper level ridge blocks the movement of fronts into the Eastern US and often results in very hot temperatures, little precipitation, and the buildup of high 1-hr and 8-hr ozone concentrations over much of the Midwest, Northeast, and South. As the mid-to-upper level ridge slowly slides eastward, it situates itself over the surface high-pressure creating a "stacked high" over the Eastern US. The resulting large-scale subsidence leads to very low vertical mixing heights prohibiting dispersion of precursor pollutants. The stagnant air mass from the "stacked high" scenario is prime for ozone episodes in the Eastern US. A trough can develop in east/central NC during this scenario producing south-southwesterly flow east of the trough and causing a large ozone concentration gradient. The presence of the trough can limit ozone readings east of the trough axis below the 1-hour and 8-hour standards throughout the episode. (An example of these conditions is recorded in the July 14, 1995 Daily Weather Map [Figure 3.5-1]. The 500-mb chart clearly shows the presence of a large high pressure area over the Midwest.)

The most frequently occurring meteorological scenario (Scenario 2 – Frontal Approach) is characterized by the movement of cold fronts toward NC and the presence of high pressure to the south or southwest of the state. Cold fronts often move toward NC during the summer months but are typically not strong enough to move completely through the state. They commonly become east-west oriented and stall as far south as southern Virginia or northern sections of NC. The front may dip into northern portions of NC and then retreat as a warm front creating wind shifts or re-circulation patterns. A southwesterly surface flow predominates as the front approaches, but as the front moves into northern sections of NC, winds become more northerly. When the front retreats back to the north as a warm front, southwesterly winds return to the entire state. In the meantime, a zonal flow exists in the mid-to-upper levels. High temperatures range from the low to upper 90's and dew points are in the upper 60's to mid 70's. Scattered exceedances of the 1-hour standard and widespread exceedances of the 8-hour standards may be realized in NC during these conditions. (These conditions can be seen in the June 23, 1996 Daily Weather Map in [Figure 3.5-2]. Note the presence of a stationary front along the NC/VA border.)

A third meteorological scenario (Scenario 3 – Canadian High) resulting in high buildups of ozone in NC is characterized by a surface high-pressure area building in from the north, and a mid-to-upper level ridge that builds and sprawls to the west of NC in the Mid-Mississippi Valley area. The position of the mid-to-upper level ridge produces a northerly flow aloft throughout this scenario. As the Canadian-born surface high-pressure builds into NC, it brings with it milder and drier air by means of a north-northeasterly breeze. These conditions can lead to scattered exceedances of the 8-hour standard in NC. Temperatures are typically in the low to mid 80's (with dew points in the low to mid 60's) during the beginning of this type of episode. However, as the center of the surface high-pressure slides into NC, and the winds become light and variable, highs may reach the upper 80's to low 90's (with dew points in the upper 60's to low 70's). Scattered exceedances of the 1-hour standard and widespread exceedances of the 8-hour standards may be realized in NC during these conditions. (An example of these conditions is shown in Figure 3.5-3 [June 28, 1996].)

The fourth meteorological scenario (Scenario 4 – Modified Canadian High with slight Tropical Influence), initially, is very similar to Scenario 3 above. Canadian born surface high-pressure builds into NC delivering lower dew points and milder temperatures with a light north-northeasterly wind. This cool down is short-lived however. As the high-pressure center moves south of NC, a light southwesterly flow dominates, temperatures soar, and dew points increase. A mid-to-upper level ridge slowly sprawls eastward across the country, resulting in a very weak flow aloft. Occasionally, when the mid-to-upper level flow is very weak along the East Coast during the mid-to-late summer, tropical systems that work their way across the Atlantic Ocean can approach the Southeast US. Although it does not occur frequently, a tropical system lurking off the Carolina coast may influence conditions over NC in the form of subsidence in the mid-to-upper levels. Subsidence is usually distributed over a wide area away from tropical systems, and leads to cloudless skies and hot dry weather. The strength and proximity of the tropical system will influence the magnitude and extent of the subsidence and its' role in ozone formation in NC. (An example of these conditions is shown in Figure 3.5-4 [July 14, 1997].)

Meteorological scenarios other than the four identified above can result in ozone episodes. These "other" episodes, however, commonly do not meet the temporal or spatial requirements of the episode selection criteria for modeling defined in the U.S. EPA Draft Modeling Guidance for Ozone Attainment Demonstrations. One-day ozone episodes can occur during a progressive meteorological pattern (Scenario 5 – Continental High in a progressive pattern). A surface high-pressure area moving across the US and into NC for one day characterizes this scenario. This results in clear skies, light winds, and isolated 8-hour ozone exceedances.

An initial analysis of ambient data and Daily Weather Maps was used to place each of the ozone episodes into one of the four meteorological scenarios identified above. A list of the number of monitors with exceedances of the 8-hour standard in each of the major urban areas was compiled and reviewed. This information was used to exclude those episodes from each category that did not have sufficient spatial or temporal distribution to justify further study. A more detailed analysis of each of the remaining episodes was made using all sources of air quality and meteorological data to select the episodes that would best meet modeling objectives.

To better understand the impact of emission controls under the full range of meteorological conditions, one episode from each meteorological scenario was selected for modeling. The four episodes were selected because they represented a good cross-section of events from both an air quality and meteorological perspective. They were also selected because observed ozone concentrations were close to the areas design value, and high ozone values were widespread throughout NC. One episode was selected from 1995 (Scenario-1), two from 1996 (Scenario-2 & Scenario-3), and one from 1997 (Scenario-4). The two episodes selected from 1996 were separated by only two days during which time a strong cold front cleaned out the atmosphere as it passed through the state. The two episodes will be modeled simultaneously. This presents a good opportunity to test the ability of the air quality model to produce clean conditions in the middle of an episode.

These episodes provide a wide range of conditions that will provide the basis for a thorough analysis of the variety of factors that lead to ozone exceedances in NC. Control strategies can be tested under conditions that range from short duration ozone peaks above the 1-hour standard to extended periods of moderate levels of ozone producing widespread exceedances of the 8-hour standard. These episodes also range from multi-regional to exceedances confined primarily to the state of NC.

The first episode (Episode-E1) is a 3-day episode that occurred from June 13 – 15, 1995. (See the July 14 Daily Weather Map in Figure 3.5-1.) This episode was modeled by the Northeast Modeling Center as part of the OTAG study of ozone transport. This episode is a traditional ozone episode with high 1-hour and 8-hour averages throughout almost all areas of the South, East, and Midwest. A very strong upper level ridge developed to the west of NC and moved slowly to the east throughout the episode. On July 15th, the 1-hour peak reached 166 ppb in Atlanta, 179 ppb in Baltimore, and 154 ppb near Chicago. The highest readings were recorded in NC on July 14th; 129 ppb in Charlotte (99 ppb 8-hour) and 130 ppb in the Triad area (112 ppb 8-hour). A trough developed in eastern NC on July 14th producing south-southwesterly flow east of the trough and causing a large ozone concentration gradient. Although a 1-hour peak of 129 ppb was measured in Charlotte, the peak ozone was only 39 ppb 100 miles to the east. The presence of the trough kept ozone readings in the Raleigh/Durham area below the 1-hour and 8-hour standards throughout the episode. The trough moved to the west on July 15th and dropped 1-hour averages in Charlotte and the Triad below the standard; however, 8-hour concentrations remained above 0.085 ppm.

The first 1996 episode (Episode-E2) occurred June 21 – 24 1996. It is primarily a NC episode. (See the June 23 Daily Weather Map in Figure 3.5-2.) Concentrations in most other areas of the South and East were lower than those in NC. This episode is dominated by the presence of a front to the north and high pressure to the southwest of the state. The movement of the front and the monitored ozone readings indicate possible recirculation during the episode. Light southwesterly flow was present on 22 June and resulted in a 1-hour/8-hour peak of 133/110 ppb and 113/99 ppb northeast of Charlotte and Durham, respectively. As the front moved into northern portions of NC on the 23rd, winds became more northerly and concentrations in the Triad and Raleigh/Durham area's fell. Ozone and precursor pollutants were pushed back into Charlotte and resulted in exceedances of the 1-hour and 8-hour standard at all three Mecklenburg county ozone monitors. On the 24th, the front retreated north as a warm front and southwesterly winds returned to the entire state. Ozone levels increased throughout northern portions of NC and 8-hour averaged concentrations between 90 and 100 ppb were recorded in the major urban areas of the Piedmont. One exceedance of the 1-hour standard (134 ppb) was measured at the Rockwell site, northeast of Charlotte.

A stronger front moved toward NC on the 25th touching off storms and dropping ozone readings. The front passed through the state by the 26th and concentrations remained low. An upper level ridge began to build to the west of NC and surface high pressure over Canada moved southward throughout episode (Episode-E3) (June 27 – 29, 1996) and settled into western NC by the 29th. (See the June 28 Daily Weather Map in Figure 3.5-3.) Northerly winds were predominant at the surface and upper levels. High temperatures remained 90 and below in NC and much of the eastern half of the US during this period. Dew point temperatures were relatively low and winds were light enough to produce 8-hour exceedances in many areas of NC on the 28th and 29th. As high pressure remained over western NC, ozone concentrations continued to rise throughout the episode. Exceedances of the 1-hour standard were measured at two monitors in Charlotte on the 29th.

The final episode selected for analysis (Episode-E4) occurred July 11 – 15, 1997. (See the July 14 Daily Weather Map in Figure 3.5-4.) The previous three episodes did not capture typical ozone behaviors in the center city areas of the Triad and the Triangle. The selection of this episode also was driven by the need to model an episode that captured ozone events in areas such as Greenville, Fayetteville, and Hickory. The most distinctive aspect of this episode, however, is that a 1-hour exceedance occurred in the Triangle area on the July 14th. No other episode captures a 1-hour exceedance in this region. On the first three days of the episode, meteorological conditions were very similar to those in episode E3. On the 14th and 15th, however, the surface high-pressure center moved over NC, the mid-to-upper level flow relaxed, and a tropical depression off the NC coast strengthens into Tropical Storm "Claudette". It is possible that the tropical system influenced conditions in NC (especially Eastern NC) on the 14th and 15th. Temperatures soared into the mid 90's with dew points in the mid-to-upper 60s. The backward air parcel trajectories from Rocky Mount, NC (shown in Figure 3.5-5), illustrates the possible influence from the tropical system (Note the subsidence at mid-levels from 0Z –20Z on the 14th.) Exceedances of the 8-hour standard were recorded in North Carolina, South Carolina and Virginia as the surface high-pressure center moved over NC, the mid-to-upper level flow aloft weakened, and the tropical system made it's nearest approach.

Figure 3.5-1 Daily Weather Maps for July 14, 1995

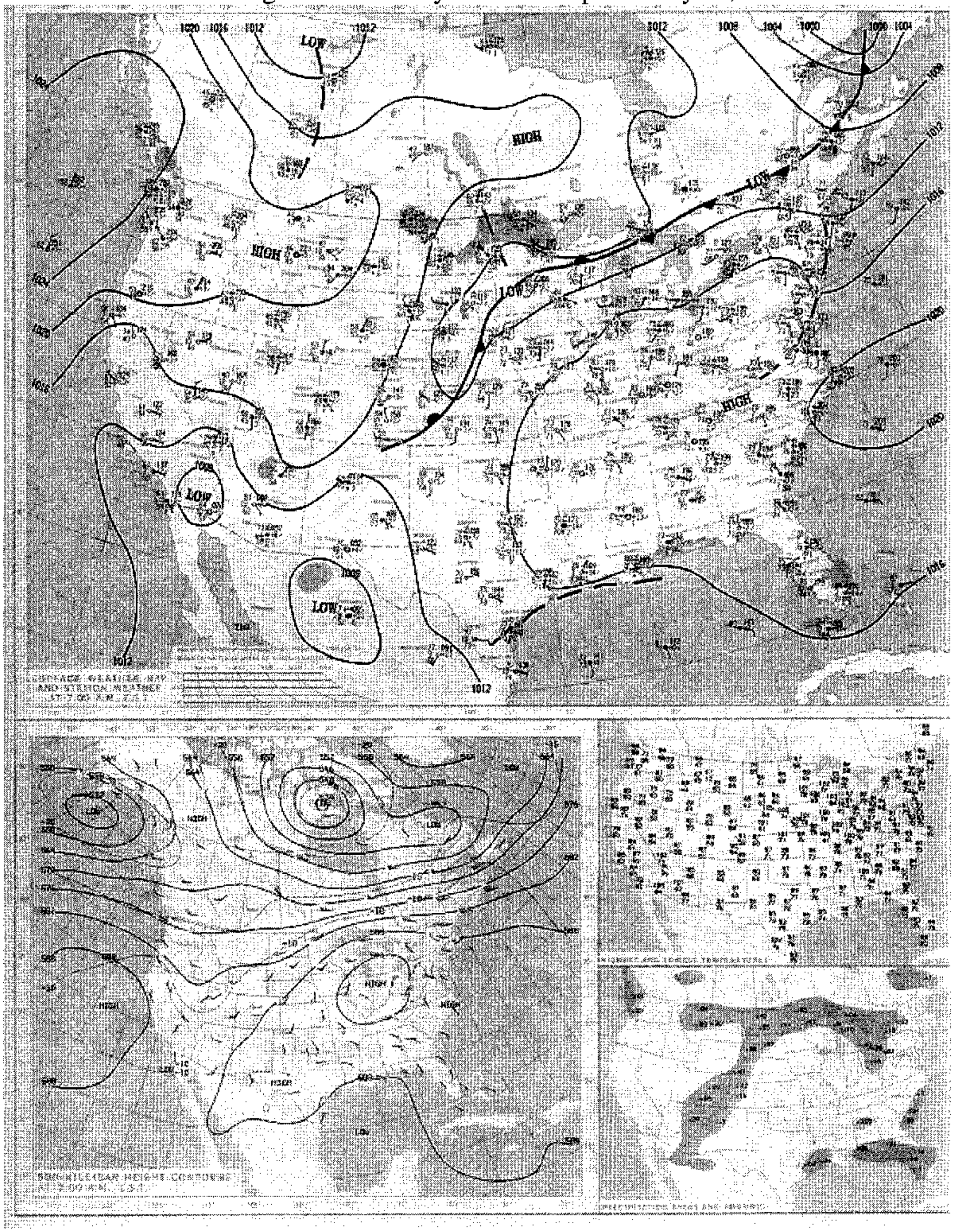


Figure 3.5-2 Daily Weather Maps for June 23, 1996

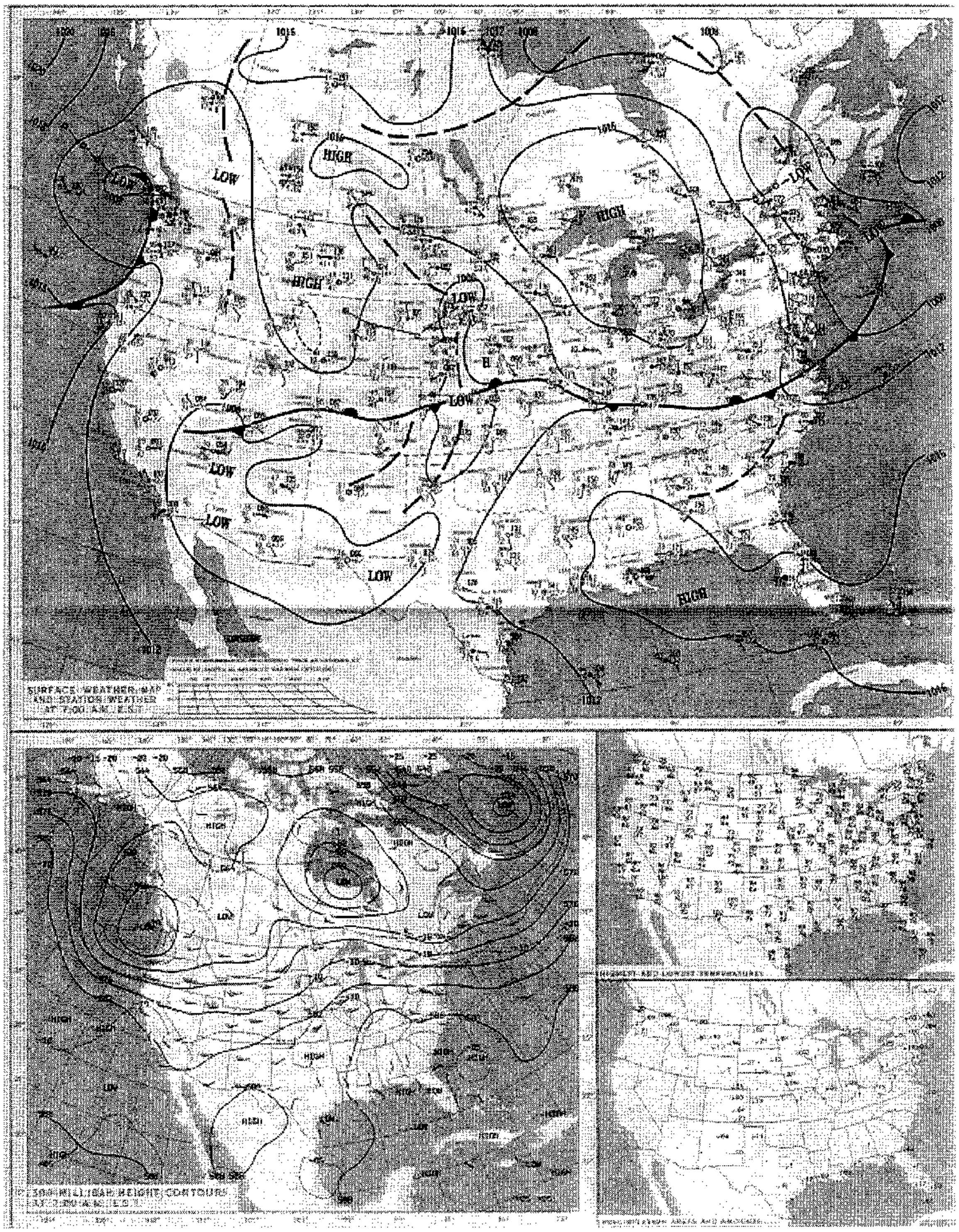


Figure 3.5-3 Daily Weather Maps for June 28, 1996

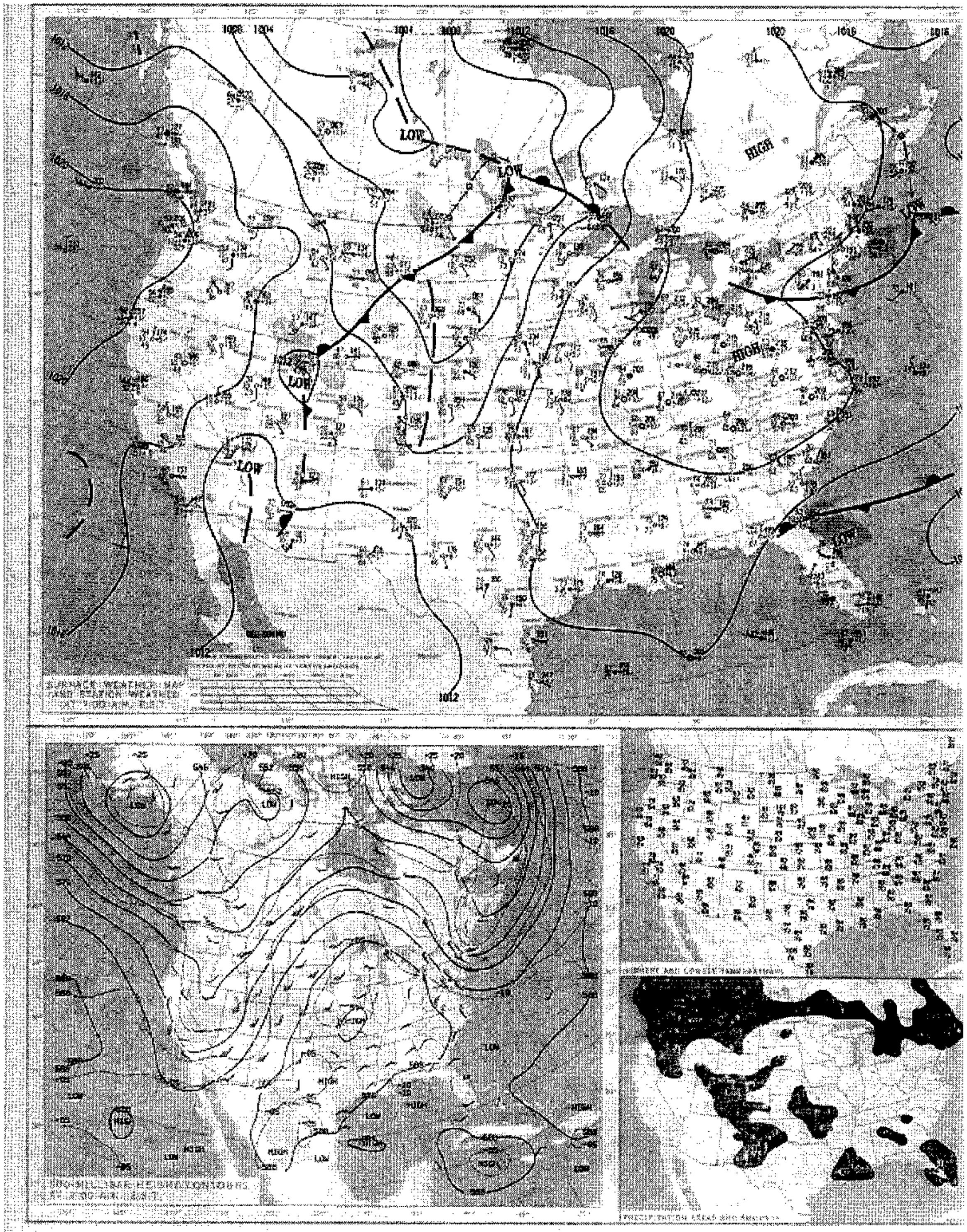


Figure 3.5-4 Daily Weather Maps for July 14, 1997

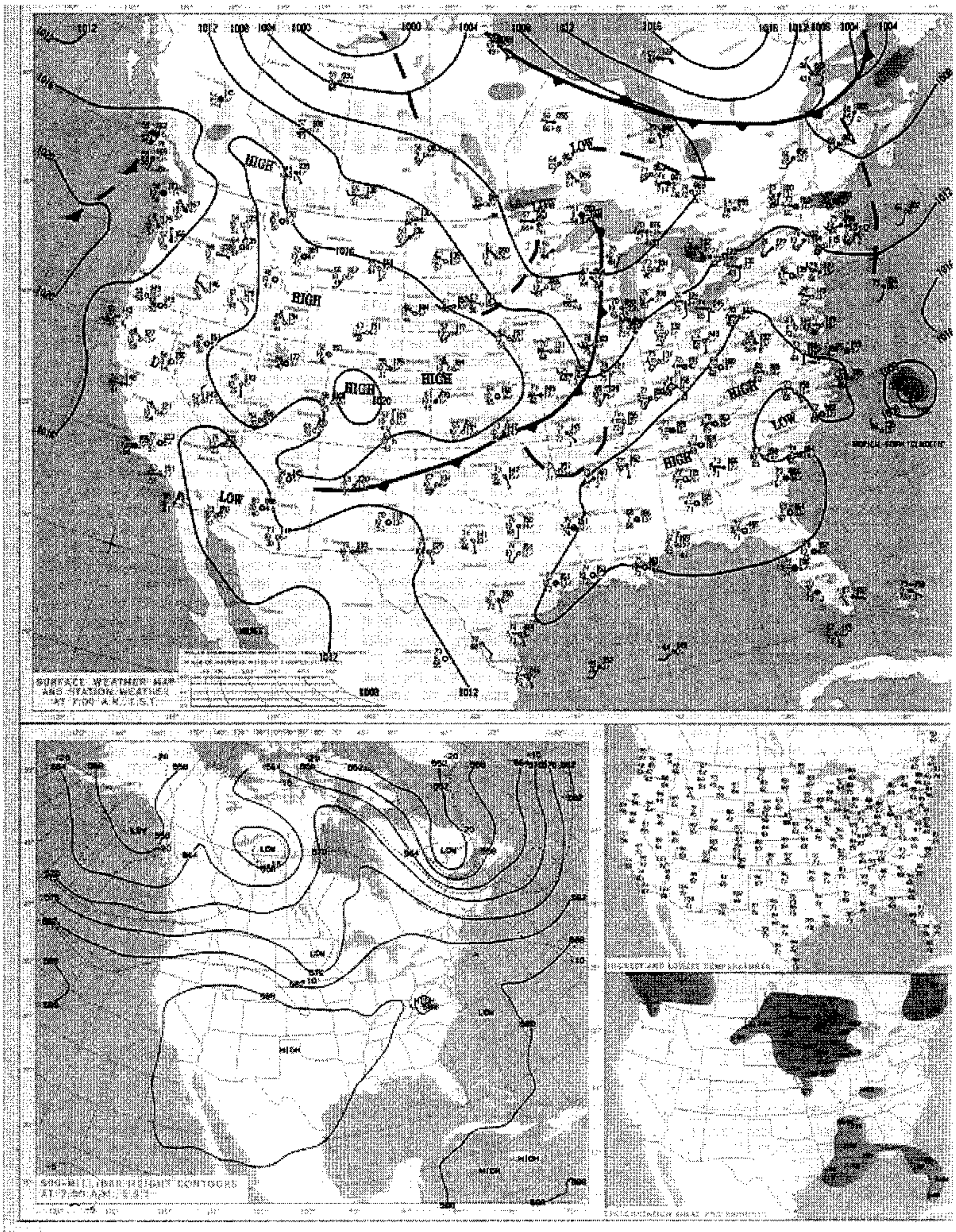


Figure 3.5-5 Backward Air Parcel Trajectories for July 14, 1997

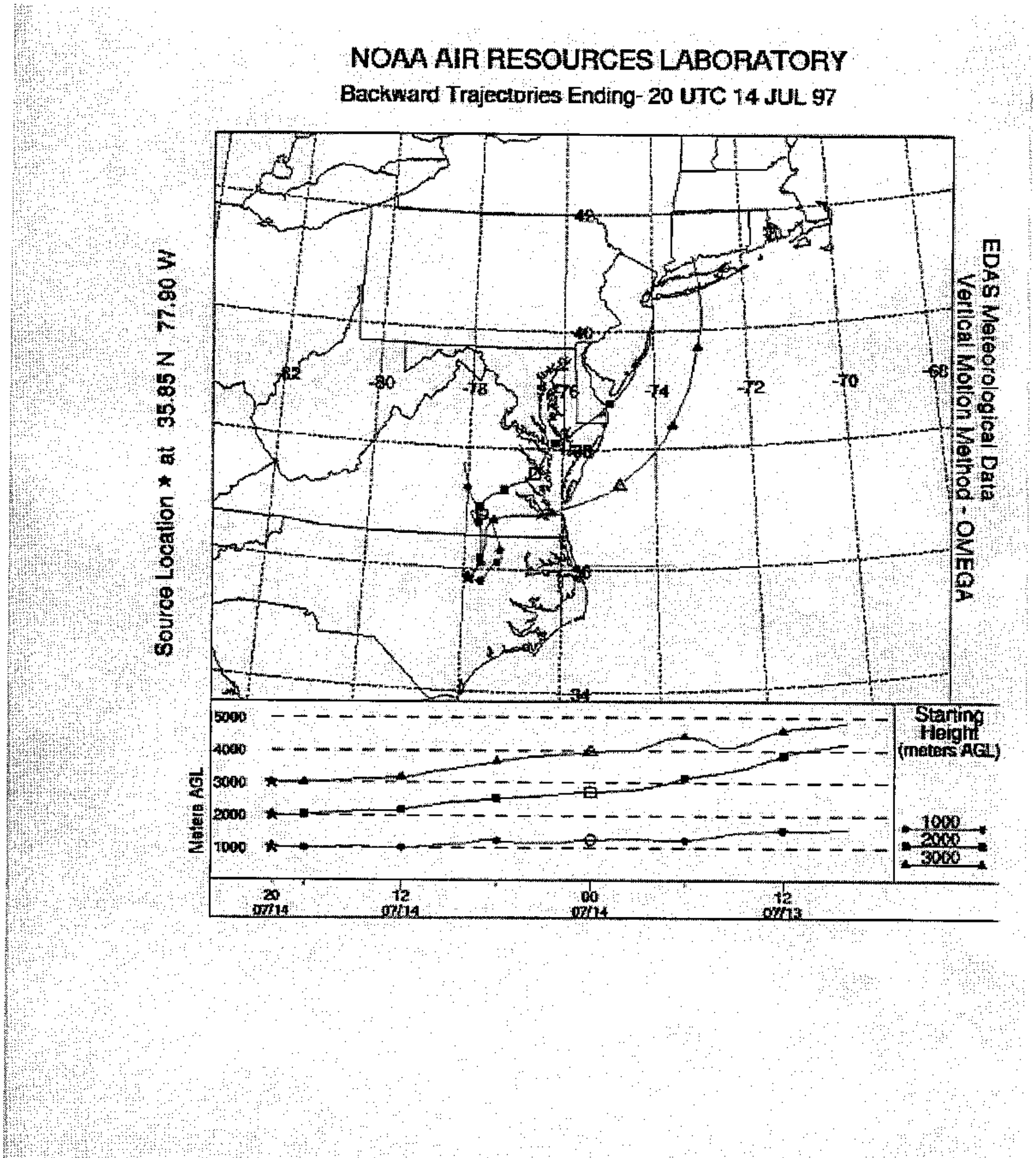


Table 3.5-1 Features of Each Selected Episode

	E1	E2	E3	E4
Synoptic Features	Large blocking upper level High over Midwest slides eastward over the large surface High over Eastern US.	Front to the north. High pressure center SW of NC. Front moves into NC, then retreats as a warm front.	Canadian surface High moves south into NC. Upper level ridge over middle of country.	Canadian surface High moves south of NC. Upper level flow weakens. Possible influence from tropical system of the coast.
Scale	Multi-regional exceedances of 1-hr & 8-hr standard.	Primarily NC.	Primarily NC.	Multi-regional exceedances of 1-hr and 8-hr standard.
Temperatures	Mid - upper 90's in NC. 90's to 100's throughout MW, NE, & South.	Low - mid 90's in NC and South. mid 80's - low 90's MW & NE.	Upper 80's in NC. Mid - upper 80's NE & MW. Low 90's in South.	Initially upper 80's, then mid-to-upper 90's for NC and Mid-Atlantic.
Dew Pt Temps	Upper 60's - low 70's in NC. As high as low 80's NE & MW.	Low 70's.	Low-to-mid 60's.	Upper 60's – low 70's in NC and Mid-Atlantic.
Local Features	North to South trough over east/central NC. Clean air east of trough effects O3 in CLT & RDU.	Front dips into northern NC & retreats as warm front creating wind shifts and re-circulation patterns.	Influence of Canadian High. Dry air & northerly winds at surface & upper levels.	Stagnating winds throughout atmosphere. Possible influence from tropical system in eastern NC.
Ozone Conc's	1-hr around 130 in GSO, CLT. 170's in Baltimore, 160's in Atlanta, 150's in MW.	Multi-day exceedances of 8-hr in 3 major areas of NC. 1-hr exceedances on 3 days in CLT.	Multi-day exceedances of 8-hr in 3 major areas of NC. 1-hr exceedances in GSO & CLT on last day.	Multi-day exceedances of 8-hr in all major NC metro areas. 1-hr exceedances on 2 days (1 RDU & 1 CLT).

SECTION 4 - METEOROLOGICAL MODELING

4.1 Introduction

Meteorological data needed for the MAQSIP application were obtained from the MM5 modeling system. Numerical meteorological models solve the governing equations of atmospheric physics over time and space in order to provide cell-specific meteorological inputs into the photochemical model.

Prognostic models such as MM5 are particularly advantageous (as opposed to objective/diagnostic techniques for meteorological input development) over domains in which atmospheric circulation not adequately characterized by existing data networks play an important role in pollutant transport. Within the modeling domain topographical flow, sea breeze circulation, and the effects of differential UV attenuation due to clouds will need to be accurately simulated in order to successfully model ozone formation, transport, and destruction within the airshed.

4.2 Grid Definition

Table 4.2-1 lists the specifications of each of the four MM5 nested grids. Figure 4-1 through 4-3 illustrates the MM5 domains utilized for the modeling. Grids 01 (108 km) and 02 (36 km) are more expansive than the outermost MAQSIP grid and are intended to capture the broad, synoptic scale meteorological features of the episodes. Grids 03 (12 km) and 04 (4km) encompass the corresponding fine-mesh domains within MAQSIP and are required to capture the mesoscale elements of pollutant transport within the airshed. Since the 4km-domain configuration varies with each episode, the numbers in Table 4.2-1 for D 04 represent the differing specifications, starting with the 1995 case.

Table 4.2-1. MM5 Grid Specifications

Grid	Resolution (km)	East-West Cells (#)	North-South Cells (#)	Time Step (s)
D 01	108	54	42	300
D 02	36	60	60	100
D 03	12	81	63	36
D 04	4	69, 126, 114	69, 75, 75	12

Figure 4.2-1 The 1995 MM5 Modeling Domain and Grids

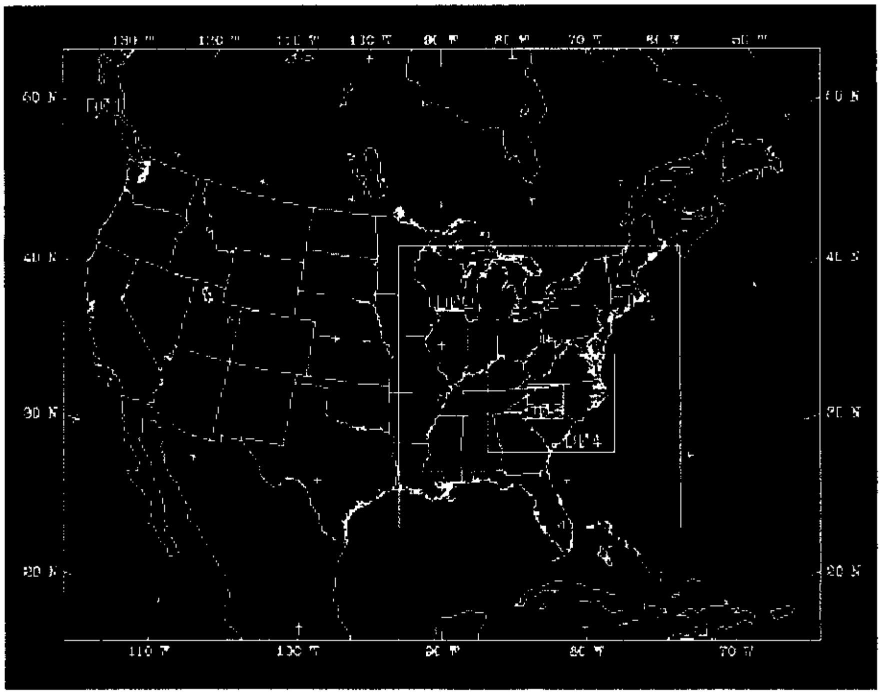


Figure 4.2-2 The 1996 MM5 Modeling Domain and Grids

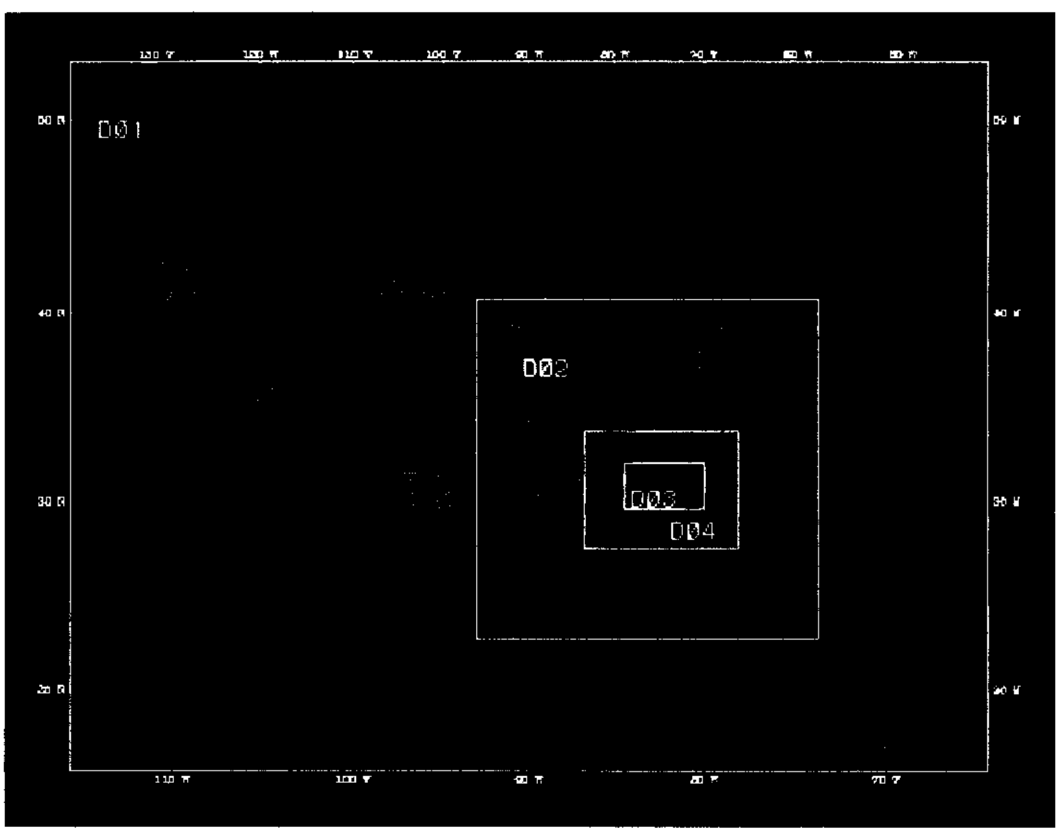
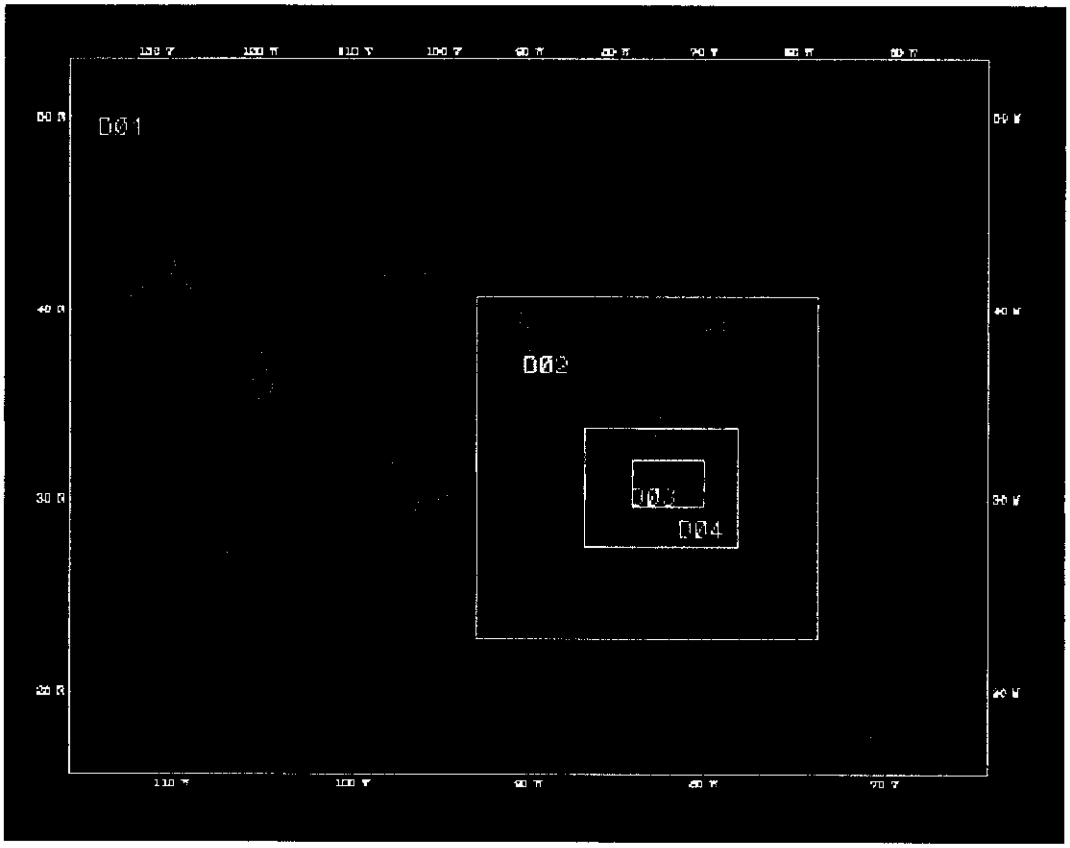


Figure 4.2-3 The 1997 MM5 Modeling Domain and Grids



Given that the emphasis of the meteorological modeling is mid-latitudinal, a Lambert Conformal map projection has been chosen. The horizontal grid uses an Arakawa-Lamb B-staggering of the wind vector components; scalar variables are defined at cell centers. In the vertical, 26 layers are modeled using terrain following coordinates (sigma coordinates). With the exception of vertical velocity, all state variables are defined at half-sigma levels (i.e., the midpoint of layer depth). The pressure at the top of the model is 100 millibars.

Table 4.2-2 shows an estimated vertical grid resolution for the meteorological model assuming standard atmosphere.

Table 4.2-2. Vertical Grid Resolution for the Meteorological Model (MM5)

Level	SIGMA	Pressure (mb)	Height (m)	Thickness (m)
0	1.000	1000.0	**0.0**	0.0
1	0.995	995.5	**38.0**	38.0
2	0.987	988.3	**99.2**	61.1
3	0.974	976.6	**199.3**	100.1
4	0.956	960.4	**339.5**	140.2
5	0.936	942.4	**497.5**	158.1
6	0.913	921.7	**682.4**	184.8
7	0.887	898.3	**895.4**	213.0
8	0.857	871.3	**1146.8**	251.4
9	0.824	841.6	**1430.8**	284.0
10	0.790	811.0	**1732.0**	301.2
11	0.750	775.0	**2098.3**	366.3
12	0.700	730.0	**2576.1**	477.8
13	0.650	685.0	**3078.3**	502.2
14	0.600	640.0	**3607.9**	529.6
15	0.550	595.0	**4168.6**	560.7
16	0.500	550.0	**4764.7**	596.1
17	0.450	505.0	**5401.6**	636.9
18	0.400	460.0	**6086.2**	684.6
19	0.350	415.0	**6827.3**	741.0
20	0.300	370.0	**7636.3**	809.1
21	0.250	325.0	**8529.1**	892.8
22	0.200	280.0	**9528.0**	998.8
23	0.150	235.0	**10665.7**	1137.7
24	0.100	190.0	**12021.8**	1356.1
25	0.050	145.0	**13742.3**	1720.5
26	0.000	100.0	**16094.8**	2352.5

The meteorological model used for the 1995 modeling episode, MM5 version1, used the post-processor Meteorology Chemistry Interface Processor (MCIP) to prepare the MAQSIP model inputs. This post-processor could collapse some of the meteorological layers so that the MAQSIP model could run with fewer layers and reduce the processing time. North Carolina ran a number of sensitivity runs, collapsing some of the upper layers, to see if the air quality predictions were adversely affected. From this analysis, it was determined that the minimum number of layer that the MAQSIP model could run with was 16 layers without differing significantly from running the model with all 26 layers. The first 12 layers of the meteorological model are mapped directly and the upper 14 MM5 layers are collapsed into 4 MAQSIP layers. The estimated vertical grid resolution for the MAQSIP model for the 1995 modeling episode is shown in Table 4.2-3.

Table 4.2-3. Vertical Grid Resolution for MAQSIP for the 1995 Episode

Level	Height (m)	Thickness (m)
0	**0.0**	0.0
1	**38.0**	38.0
2	**99.2**	61.1
3	**199.3**	100.1
4	**339.5**	140.2
5	**497.5**	158.1
6	**682.4**	184.8
7	**895.4**	213.0
8	**1146.8**	251.4
9	**1430.8**	284.0
10	**1732.0**	301.2
11	**2098.3**	366.3
12	**2576.1**	477.8
13	**4168.6**	1592.5
14	**6827.3**	2658.7
15	**10665.7**	3838.4
16	**16094.8**	5429.1

For the 1996 and 1997 modeling episodes, newer versions of the meteorological model were used. The post-processor for the new versions is Meteorology-Coupler (MCPL) and it cannot collapse the meteorological data into a format that the MAQSIP model can use. Therefore, the photochemical model runs with 26 layers, mapping the meteorological data directly, for the 1996 and 1997 episodes.

4.3 MM5 Physics Options

One-way nested grids
Non-hydrostatic dynamics
Four-dimensional data assimilation (FDDA):

- analysis nudging of wind, temperature, and mixing ratios every 12 hours
- nudging coefficients range from $1.0 * 10^{-5}\ s^{-1}$ to $3.0 * 10^{-4}\ s^{-1}$
- No initial FDDA for 12 km and 4 km grids

Explicit moisture treatment:

- 3-D predictions of cloud and precipitation fields
- simple ice microphysics
- cloud effects on surface radiation
- moist vertical diffusion in clouds
- normal evaporative cooling

Boundary conditions:

- relaxation inflow/outflow (Grid 01)

- time-dependent (Grids 02, 03, & 04)
- rigid upper boundary

Cumulus cloud parameterization schemes:

- Anthes-Kuo (Grid 01)
- Kain-Fritsch (Grids 02 and 03) 1995 & 1996 episodes, Grell (Grids 02 and 03) 1997
- no cumulus parameterization (Grid 04)

Full 3-dimensional Coriolis force
Drag coefficients vary with stability
Vertical mixing of momentum in mixed layer
Virtual temperature effects
Planetary boundary layer process parameterization:

- Modified Blackadar scheme (Grids 02, 03 and 04) for 1996 and 1997 episodes and Grid 02 for 1995 episode; Gayno-Seaman scheme (Grids 03 and 04) for 1995 episode.

Surface layer parameterization:

- fluxes of momentum, sensible and latent heat
  - ground temperature prediction using energy balance equation
  - 13 land use categories

Atmospheric radiation schemes:

- Simple cooling
- Long- and short-wave radiation scheme

Several application specific modifications:

- m5_dry.mods -- lowers MM5 soil moisture when appropriate locally
- mavail_adj.mods -- changes soil moisture as a function of soil type as needed
- m5_flyer.mods -- modifications to optimize on NCSC CRAY T-90
- kfbm_edss.mods -- writes special Kain-Fritsch meteorological data
- m5_height.mods -- calculates MM5 layer heights correctly for non hydrostatic
- m5_epafiles.mods -- writes additional data out to air quality model
- m5_blkdr_hts.mods -- modifies PBL height calculations to a VMM scheme

4.4 Inputs

Table 4.4-1 describes the terrain and land use fields input into MM5 for the modeling.

Table 4.4-1 Terrain and Land Use Inputs to MM5

Grid	Terrain origin	Terrain resolution	Land use origin	Land use resolution
G 01	PSU/NCAR	30 minute	PSU/NCAR	30 minute
G 02	GDC	10 minute	PSU/NCAR	10 minute
G 03*	GDC	5 minute	PSU/NCAR	5 minute
G 04*	GDC	5 minute	PSU/NCAR	5 minute

*Land use data were slightly modified in the Charlotte area to minimize the number of cells characterized as urban. Also, several cells along the NC/SC coastline were modified to reflect mixed forest - wetland as opposed to water.

The TOGA (2.5 by 2.5 degrees) data set was used to provide a first-guess interpolation of meteorological data to the horizontal modeling grid. Climatological averages of sea-surface temperature were used to characterize ocean temperatures. Three- and six-hourly NWS data (first-order) were used to develop the surface analysis fields. Standard twice-daily rawinsonde data from the NWS were used in the preparation of aloft FDDA analysis fields.

4.5 Performance Evaluation

The standard set of objective metrics to evaluate model performance for various meteorological parameters were generated for this project. The basic methodology employed used the base variables that were available for observational nudging. These variables include temperature, water vapor mixing ratio, east-west wind and south-north wind. Note that only the wind components are actually used for observational nudging. The observed winds have been rotated to the model projection (Lambert Conformal). The model/obs pairs are matched on a grid cell basis; no bilinear interpolation is performed. If more than one observation lies within a cell, the observations are averaged and the value is treated as if it were a single observation. For the wind components and mixing ratio, layer 1 (~38m) values are used. Temperatures are adjusted to 1.5 meters by logarithmically interpolating between the layer 1 temperature and the "skin" temperature. The results of this interpolation were compared with a more sophisticated methodology in which the interpolation varies with stability class, and we found little significant differences between the two. Since observational nudging was employed only at 12-km and 4-km resolutions, performance statistics were produced only for those grids.

A limited sample of the performance metrics for each episode is provided in Figures 4.5-1 through 4.5-7 below. For an exhaustive review of the meteorological modeling results, please visit: http://www.emc.mcnc.org/projects/NCDAQ/PGM/results/index.htm

Figure 4.5-1 Temperature performance metric – 1995 episode - 4km domain

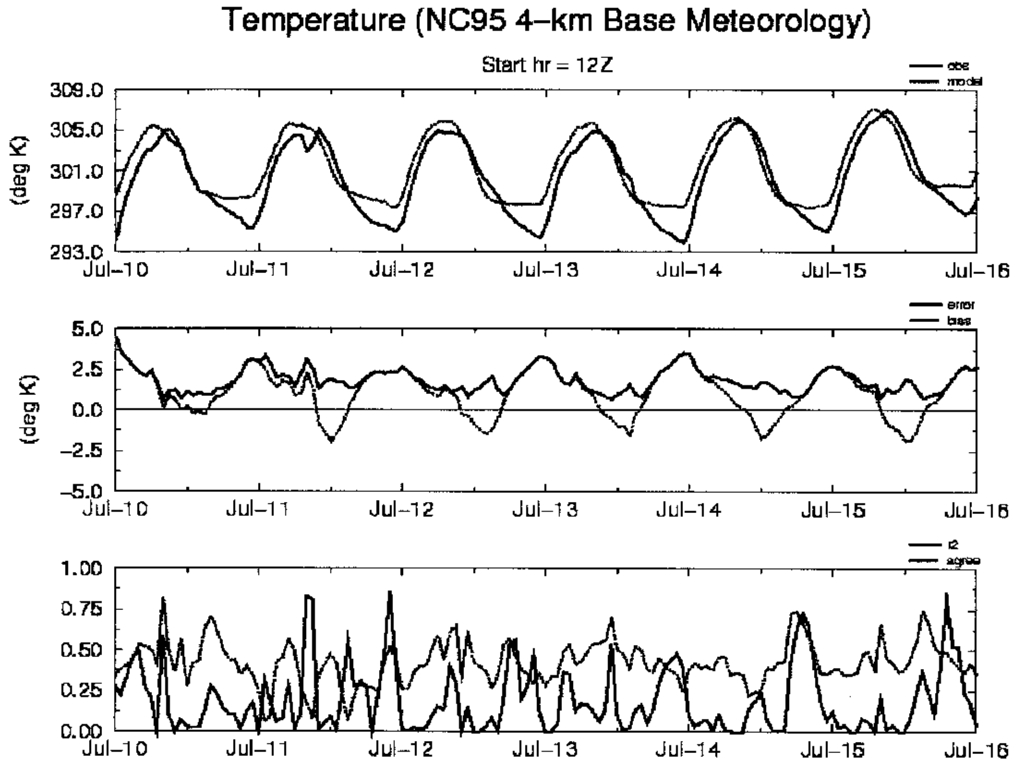


Figure 4.5-2 Example Temperature Metric - 1995 episode - 12 km domain

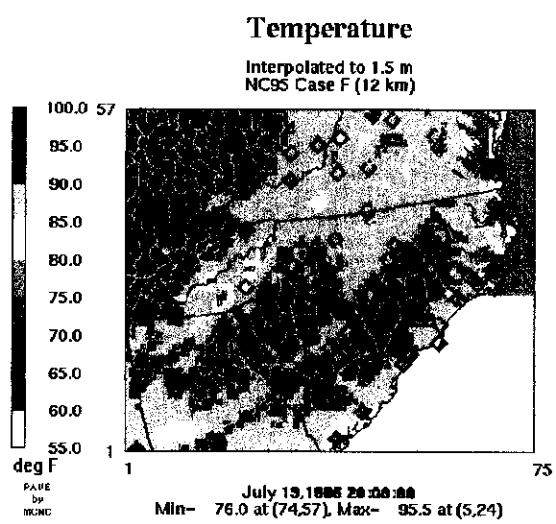


Figure 4.5-3 Temperature performance metric – 1996 episode - 4km domain

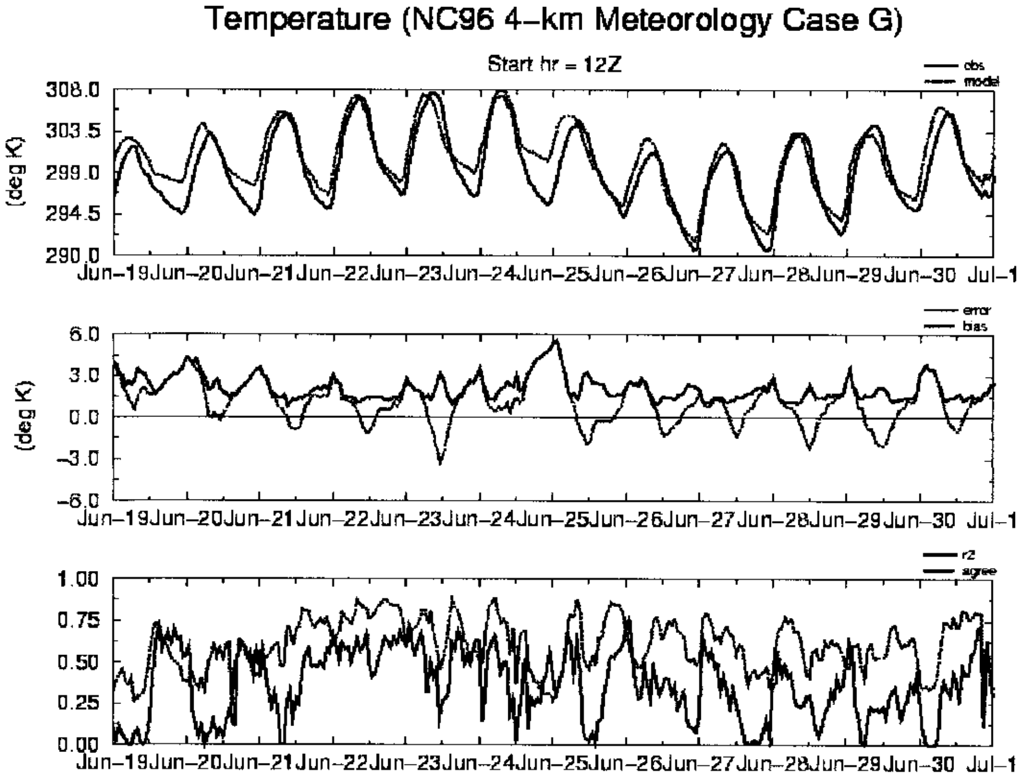


Figure 4.5-4 Example Temperature Metric - 1996 episode - 12 km domain

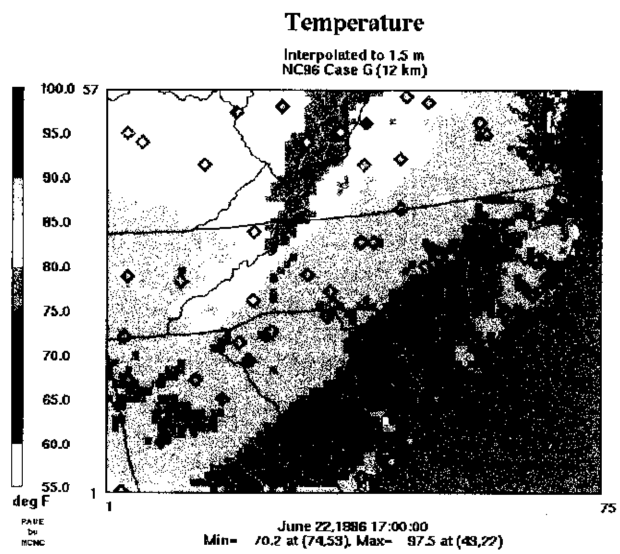


Figure 4.5-5 Temperature performance metric – 1996 episode - 4km domain

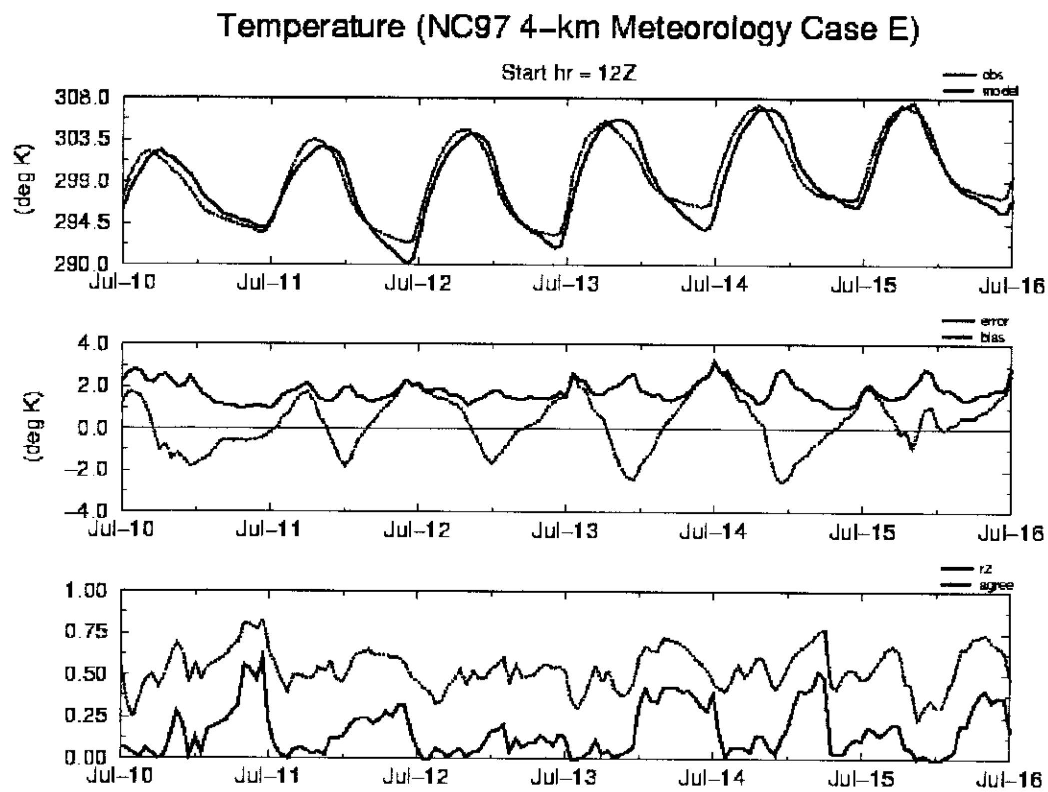


Figure 4.5-6 Example Temperature Metric - 1997 episode - 12 km domain

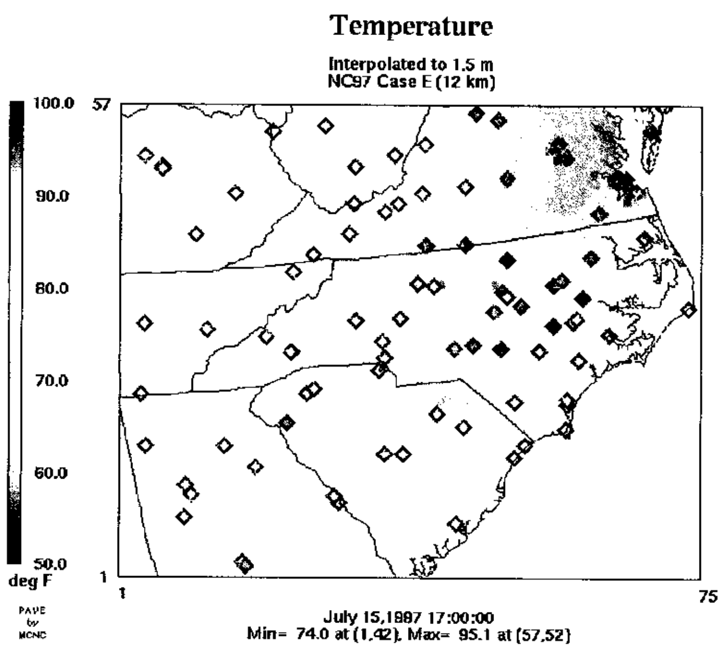
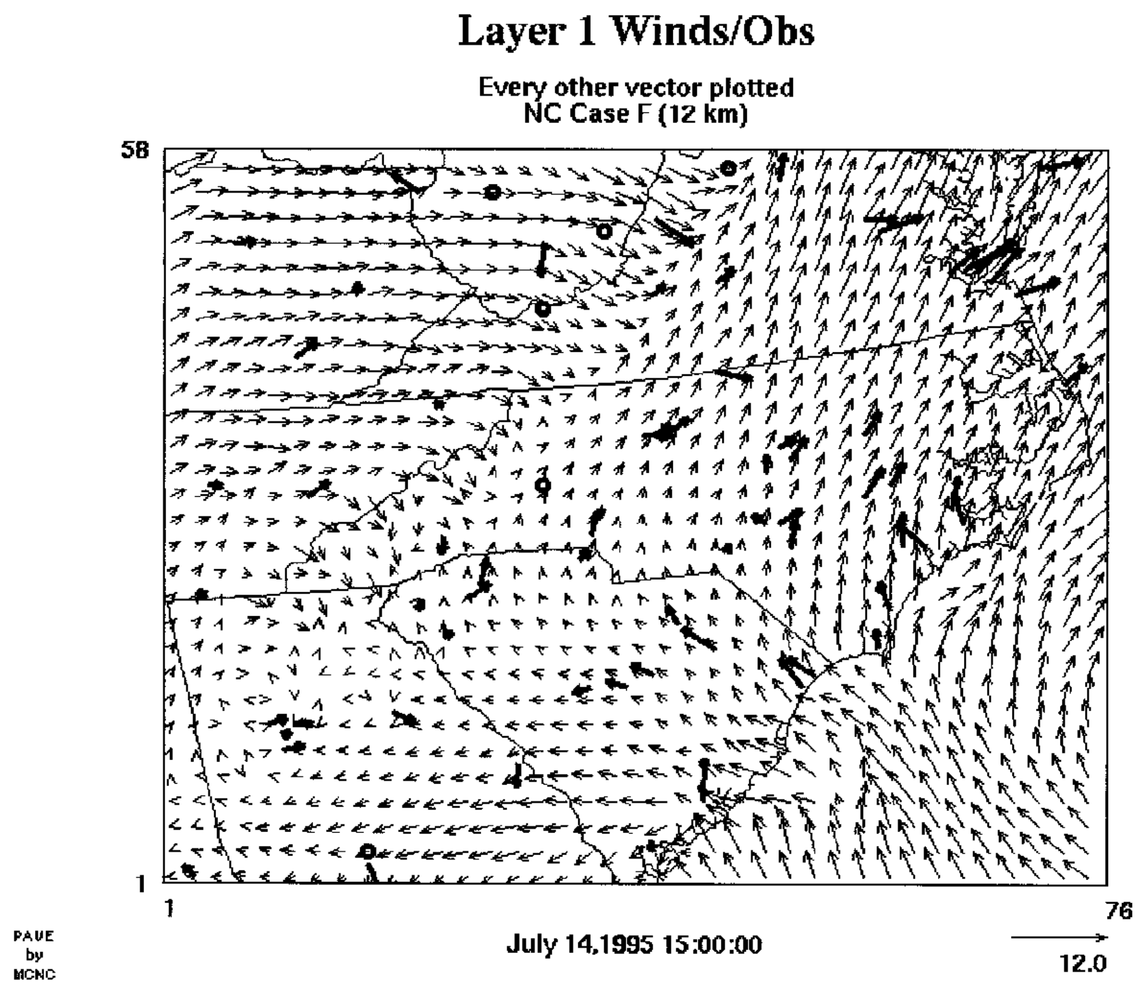


Figure 4.5-7 Example Layer 1 Wind Vector Metric - 1995 episode - 12 km domain
Blue vectors=observations, black vectors=model



Currently, there is no accepted standard by which to judge meteorological model performance. Modelers usually calculate the basic statistics such as bias, error, or index of agreement and compare their results with the same quantities from prior and similar modeling exercises. The problem with such an approach is that these numbers are a function of the domain size modeled, the length of the simulation, and the meteorology being modeled. In this modeling study, the modeling team, including a number of air quality meteorologists, examined all of the meteorological modeling output both quantitatively through statistical metrics and qualitatively through a series of graphical metrics.

When passing final judgment regarding the accuracy of a meteorological simulation, the modeling team concluded that the results satisfactorily address the following questions:

A. *Do the model results fit our conceptual understanding?* The model replicates the observed synoptic pattern, placing surface pressure systems in the proper location and matches the upper air pattern.

B. *Are diurnal features adequately captured?* The diurnal cycle is adequately represented in the model. For example, the mixing heights increase during the day and collapse at night in a reasonable way. Similarly temperatures, summertime convection, and winds show diurnal variation.

C. *Is the vertical mixing appropriate?* The PBL depth and evolution is well modeled.

D. *Are clouds reasonably well modeled?* Secondary quantities such as clouds are particularly useful to analyze since they are not "nudged" to the observations. We see that on a synoptic scale the model clouds will generally match the observations. Convective clouds are unlikely to occur precisely in the right place and at the right time, but the general region/time of convective development is adequate.

E. *Do the wind fields agree with the observations?* The model adequately captures the observed wind fields so that transport in the subsequent air quality runs is done correctly.

G. *Do the temperature and moisture fields generally match the observations?* These first order scalar quantities are well captured by the model.

H. *Do the meteorological fields produce acceptable air quality results?* While air quality models can have problems of their own, many times poor air quality modeling results occur due to problems with the input meteorological fields. This is often a good test to determine whether the meteorological model adequately predicts the fields to which the air quality model is most sensitive. A number of air quality runs were conducted to test the sensitivity to different meteorological inputs.

SECTION 5 - EMISSIONS INVENTORY

5.1 Introduction

There are five different emission inventory source classifications, stationary point and area sources, off-road and on-road mobile sources, and biogenic sources.

Stationary point sources are those sources that emit greater than a specified tonage per year and the data is provided at the facility level. Stationary area sources are those sources whose emissions are relatively small but due to the large number of these sources, the collective emissions could be significant (i.e., dry cleaners, service stations, etc.) These type of emissions are estimated on the county level. Off-road mobile sources are equipment that can move but do not use the roadways, i.e., lawn mowers, construction equipment, railroad locomotives, aircraft, etc. The emissions from these sources, like stationary area sources, are estimated on the county level. On-road mobile sources are automobiles, trucks, and motorcycles that use the roadway system. The emissions from these sources are estimated by vehicle type and road type and are summed to the county level. Biogenic sources are the natural sources like trees, crops, grasses and natural decay of plants. The emissions from these sources are estimated on a county level.

In addition to the various source classifications, there are also various types of emission inventories. The first is the base year or episodic inventory. This inventory is based on the year of the episode being modeled and is used for validating the photochemical model performance.

The second inventory used in this project is the "current" year inventory. For this modeling project it will be the 2000 emission inventory, which is the most current. This inventory is processed using all of the different meteorological episodes being studied. The photochemical modeling is processed using the current year inventory and those results are used as a representation of current air quality conditions.

Next is the future year base inventory. For this type, an inventory is developed for some future year for which attainment of the ozone standard is needed. For this modeling project the future years will be 2007 and 2012. It is the future year base inventories that control strategies and sensitivities are applied to determine what controls, to which source classifications, must be made in order to attain the ozone standard.

In the sections that follow, the base year inventories used for each source classifications are discussed. Emission summaries by county for the entire State are in Appendix A.

5.2 Stationary Point Sources

Point source emissions are emissions from individual sources having a fixed location. Generally, these sources must have permits to operate and their emissions are inventoried on a regular schedule. Large sources having emissions of 100 tons per year (tpy) of a criteria pollutant, 10 tpy of a single hazardous air pollutant (HAP), or 25 tpy total HAP are inventoried annually. Smaller sources have been inventoried less frequently. The point source emissions data can be grouped into the large electric utility sources and the other point sources.

5.2.1 Large Utility Sources

The inventory used for the large utility sources is the May 1999 release of the NOx SIP call base year modeling foundation files obtained from the USEPA Office of Air Quality Planning and Standards (OAQPS). The base year for this utility data is 1996. This data is provided in EMS 95 format. The emissions data for the utilities is episode specific CEM data and is specific for each source for each hour of the modeling episode. This data comes from the USEPA Acid Rain Division (ARD). Since only NOx emissions are measured, the CO and VOC emissions are calculated from the NOx emissions using emission factor ratios (CO/NOx and VOC/NOx) for the particular combustion processes at the utilities.

5.2.2 Other Point Sources

The inventory used to model the other point sources is the May 1999 release of the NOx SIP call base year modeling foundation files obtained from the USEPA OAQPS. This data is based on 1995 emissions and is provided in EMS 95 format. For the 1996 and 1997 modeling episode, emissions were grown using Bureau of Economic Analysis (BEA) growth factors. The North Carolina sources were an exception. These emissions are true 1996 emissions for the larger VOC and NOx sources. In addition, emissions for forest fires and prescribed burns are treated as point sources and are episode specific similar to CEM data.

The emissions summary for the 1996 episodes for the counties in the Triad EAC area is listed in Table 5.2-1. These emissions represent a typical weekday, Thursday's (June 20th), emissions and are in tons per day. In some instances a county may not have had emissions for the 20th but did have emissions during the modeling episode due to forest fires or prescribed burns that were treated as point sources.

Table 5.2-1 Stationary Point Source Emissions

County	CO	NOx	VOC
Alamance	0.061	0.676	0.960
Caswell	0.000	0.000	0.000
Davidson	2.466	12.859	23.927
Davie	0.078	0.039	3.841
Forsyth	1.917	8.835	20.874
Guilford	0.158	1.829	40.535
Randolph	0.021	0.058	2.528
Rockingham	5.954	33.903	7.896
Stokes	7.872	341.620	0.945
Surry	5.356	0.942	5.817

County	CO	NOx	VOC
Yadkin	0.000	0.000	0.092
Total	23.883	400.760	107.413

5.3 Stationary Area Sources

The base year inventory for the stationary area sources is the May 1999 release of the NOx SIP call base year modeling foundation files obtained from the USEPA OAQPS. This data is based on 1995 and is provided in EMS 95 format. For the 1996 and 1997 base years, the NOx SIP call foundation files will be grown to the respective year by use of Bureau of Economic Analysis (BEA) growth factors or projected population growth obtained from the US Census Bureau.

The exception to this is for North Carolina where a 2000 base year inventory was generated by NCDAQ following the current methodologies outlined in the Emissions Inventory Improvement Program (EIIP) Area Source Development Documents, Volume III (http://www.epa.gov/ttn/chief/eiip/techreport/volume03/index.html). This data was backcasted to the base years via growth factors developed with EPA's Economic Growth Analysis System (EGAS) version 4.0.

The emissions summary for the 1996 episodes for the counties in the Triad EAC area is listed in Table 5.3-1. These emissions represent a typical weekday, Thursday's (June 20th), emissions and are in tons per day.

Table 5.3-1 Stationary Area Source Emissions

County	NOx	VOC	CO
Alamance	0.74	7.71	3.51
Caswell	0.23	1.65	2.46
Davidson	1.35	10.66	6.02
Davie	0.26	2.57	2.52
Forsyth	1.54	14.36	5.33
Guildford	4.13	26.45	10.27
Randolph	0.78	9.82	5.89
Rockingham	1.03	5.91	6.30
Stokes	0.27	2.65	2.26
Surry	0.25	6.09	3.87
Yadkin	0.16	3.54	2.82
Total	10.75	91.42	51.24

5.4 Off-Road Mobile Sources

The off-road mobile sources can be broken down into two types of sources; those calculated within the USEPA NONROAD mobile model and those that are not. For the sources that are calculated within the NONROAD mobile model, a base year inventory was generated for the entire domain for each of the base years. The model version used is the Draft NONROAD2002 distributed for a limited, confidential, and secure review in November 2002. If the final version or any newer draft versions of this model is released by the USEPA, an assessment of the difference in the emission estimations will be made to determine if a new inventory must be generated and processed through the photochemical model.

The sources not calculated within the NONROAD model include aircraft engines, railroad locomotives and commercial marine vessels. The base year inventory for these sources was the May 1999 release of the NOx SIP call base year modeling foundation files obtained from the USEPA OAQPS. This data is based on 1995 and is provided in EMS 95 format. For the 1996 and 1997 base years, the NOx SIP call foundation files were grown to the respective year by use of Bureau of Economic Analysis (BEA) growth factors.

The exception to this was for North Carolina where a 1995 base year inventory was generated by NCDAQ for aircraft engines and railroad locomotives. This data was then grown to the other base years via BEA growth factors or other State specific data.

The emissions summary for the 1996 episodes for the counties in the Triad EAC area is listed in Table 5.4-1. These emissions represent a typical weekday, Thursday's (June 20th), emissions and are in tons per day.

Table 5.4-1 Off-Road Mobile Source Emissions

County	NOx	VOC	CO
Alamance	0.20	2.59	29.18
Caswell	0.13	0.22	2.26
Davidson	0.69	2.88	30.28
Davie	0.14	0.84	7.20
Forsyth	0.47	7.62	89.05
Guildford	1.51	16.10	182.94
Randolph	0.25	2.43	27.26
Rockingham	0.37	1.54	15.60
Stokes	0.12	0.77	7.77
Surry	0.05	2.63	28.72
Yadkin	0.05	0.58	6.52
Total	3.99	38.19	426.77

5.5 Highway Mobile Sources

In order to accurately model the mobile source emissions in the EAC areas, the newest version of the MOBILE model, MOBILE6.2, was used. This model was released by EPA in 2002 and differs significantly from previous versions of the model. Key inputs for MOBILE include information on the age of vehicles on the roads, the speed of those vehicles, what types of road those vehicles are traveling on, any control technologies in place in an area to reduce emissions for motor vehicles (e.g., emissions inspection programs), and temperature. Baseline estimates were created for the episode June 19 – July 1, 1996.

5.5.1 Speed Assumptions

Emissions from motor vehicles vary with the manner in which the vehicle is operated. Vehicles traveling at 65 mph emit a very different mix of pollutants than the car that is idling at a stoplight. In order to estimate emissions from vehicles for a typical day, North Carolina Department of Transportation (NCDOT) provided speeds for each of the urban areas across the state and in some cases for different times of the day. To reflect the most current assumptions on the speed of vehicles in different areas across the state, the latest conformity report was used which reflected speeds developed through travel demand modeling for the urban areas. Separate speed profiles were created for Wake County (covering Durham and Orange Counties) Greensboro, Winston-Salem, Mecklenburg County (covering Gaston County), and "rest of state". In Wake, Durham, Orange, Mecklenburg and Gaston Counties, a profile was created based on a morning traffic peak, an afternoon traffic peak, and an offpeak for the remainder of the day. In Wake, Durham, and Orange Counties the morning peak covered the period from 6 am – 10 am, and the afternoon peak from 4 pm – 8 pm. In Mecklenburg and Gaston Counties the morning peak covered the period from 6 am – 9 am, and the afternoon peak covered the period from 4 pm – 7 pm. These assumptions were provided by the Metropolitan Planning Organizations (MPOs) in each of the areas. For the rest of the state, NCDAQ chose to use the Wake County speed profile developed in 1998. This was assumed to be a conservative estimate of speeds in areas that do not have a travel demand model.

Table 5.5-1 provides a summary of the speeds used in this episode run.

Table 5.5-1: 1996 Speed Assumptions for Mobil Model

Wake, Durham, Orange Counties (based on 1995 speeds)			
Road Type	**Morning Peak**	**Afternoon Peak**	**Offpeak**
Urban Interstate	55	55	55
Urban Freeway	48	47	54
Urban Other P. Art	38	39	44
Urban Minor Art	40	40	43
Urban Collector	36	36	36
Urban Local	36	36	37
Rural Interstate	56	59	64
Rural Other P. Art	53	52	57
Rural Minor Art	48	47	50
Rural Major Coll	46	46	46

Wake, Durham, Orange Counties (based on 1995 speeds)			
Rural Minor Coll	43	43	43
Rural Local	44	44	44

Greensboro (based on 1994 speeds)	
Road Type	**Speed**
Urban Interstate	41
Urban Freeway	46
Urban Other P. Art	27
Urban Minor Art	30
Urban Collector	31
Urban Local	33
Rural Interstate	56
Rural Other P. Art	53
Rural Minor Art	41
Rural Major Coll	44
Rural Minor Coll	44
Rural Local	44

Winston-Salem (based on 1994 speeds)	
Road Type	**Speed**
Urban Interstate	55
Urban Freeway	48
Urban Other P. Art	29
Urban Minor Art	22
Urban Collector	29
Urban Local	24
Rural Interstate	55
Rural Other P. Art	55
Rural Minor Art	44
Rural Major Coll	41
Rural Minor Coll	39
Rural Local	26

Mecklenburg and Gaston			
Road Type	Morning Peak	Afternoon Peak	Offpeak
Urban Interstate	55	55	55
Urban Freeway	48	47	54
Urban Other P. Art	38	39	44
Urban Minor Art	40	40	43
Urban Collector	36	36	36
Urban Local	36	36	37
Rural Interstate	56	59	64
Rural Other P. Art	53	52	57
Rural Minor Art	48	47	50
Rural Major Coll	46	46	46
Rural Minor Coll	43	43	43
Rural Local	44	44	44

Rest of State			
Road Type	Morning Peak	Afternoon Peak	Offpeak
Urban Interstate	60	61	63
Urban Freeway	55	59	61
Urban Other P. Art	34	35	32
Urban Minor Art	34	35	34
Urban Collector	35	34	33
Urban Local	30	37	37
Rural Interstate	49	62	67
Rural Other P. Art	38	41	42
Rural Minor Art	49	50	53
Rural Major Coll	32	46	46
Rural Minor Coll	33	41	44
Rural Local	42	45	42

5.5.2 Vehicle Age Distribution

The vehicle age distribution comes from annual registration data from the NCDOT. NCDOT has provided registration data specific to the area. For this analysis, the data was from 2000. NCDOT provides the data by vehicle type; however, these types do not match the EPA MOBILE types. Therefore, the data is manipulated to match the input requirements as follows:

- NCDOT provides at least 25 years for all vehicle types, however MOBILE5 only recognizes 12 years for motorcycles. Therefore, the first 13 years are combined into one number.
- If more than 25 years are provided, the early years are combined and included in the 25th model year.
- NCDOT does record model years beyond the year of the report, for this set of data, 2001 model year was added to the 2000 model year information.
- The same registration distribution by age must be entered for Light Duty Gasoline Vehicles (LDGV), Light Duty Diesel Vehicles (LDDV), and for Light Duty Gasoline Trucks 1 and 2 (LDGT1 and LDGT2) according to the MOBILE5 User's Guide.

Then using the MOBILE6.2 utility provided by EPA the vehicle types were distributed across the 16 types in MOBILE6.2. A separate age distribution was created for each of the urban areas and for the rest of the state (see Appendix B).

5.5.3 Vehicle Mix Assumptions

For all of North Carolina, vehicle mix has incorporated the increase in sales of sport utility vehicles and minivans for all years of evaluation.

To calculate the vehicle mix to account for the large percentage of sport utility vehicles and minivans being purchased, NCDAQ used the following documentation from EPA: Fleet Characterization Data for MOBILE6: Development and Use of Age Distributions, Average Annual Mileage Accumulation Rates, and Projected Vehicle Counts for Use in MOBILE6 (EPA420-P-99-011). This document includes a breakdown by year from 1983 to 2050 of the number of light duty vehicles (according to MOBILE6 five vehicle types) on the roads on a national basis. NCDAQ used this data and combined vehicle types to reflect the three MOBILE5 light duty vehicle types. These calculated values for LDGT1 and LDGT2 are used for all road types. No changes were made to this file for this modeling effort because of the way in which the SMOKE model has incorporated MOBILE6.2. Table 5.5-2 provides the vehicle mix for North Carolina.

Table 5.5-2: 1996 North Carolina Vehicle Mix

Rural	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC
Interstate(-0.001)	0.458	0.174	0.062	0.031	0.002	0.002	0.266	0.005
Oth Prin Art(+0.001)	0.557	0.211	0.075	0.04	0.002	0.002	0.109	0.004
Minor Ar(-0.001)	0.571	0.219	0.078	0.045	0.003	0.003	0.076	0.005
Major Col (+0.001)	0.591	0.225	0.08	0.044	0.002	0.002	0.052	0.004
Minor Col	0.591	0.225	0.08	0.042	0.002	0.002	0.053	0.005
local	0.589	0.227	0.081	0.049	0.003	0.003	0.042	0.006

Urban	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC
Interstate (-0.002)	0.534	0.201	0.072	0.033	0.002	0.002	0.152	0.004
Oth Freeway	0.583	0.218	0.078	0.035	0.002	0.002	0.079	0.003
Oth Prin Art(+0.001)	0.6	0.224	0.08	0.036	0.002	0.002	0.053	0.003
Minor Art(-0.001)	0.614	0.229	0.082	0.035	0.002	0.002	0.032	0.004
Collectors(-0.001)	0.622	0.231	0.082	0.033	0.002	0.002	0.025	0.003
local (+0.001)	0.602	0.228	0.081	0.041	0.002	0.002	0.038	0.006

HDGV – Heavy Duty Gasoline Vehicles, LDDT – Light Duty Diesel Trucks, HDDV – Heavy Duty Diesel Vehicles, MC - Motorcycles

5.5.4 Temperature Assumptions

Temperatures are extracted from the MM5 meteorological model files.

5.5.5 Vehicle Inspection and Maintenance Program Assumptions

In the early 1990's, North Carolina adopted emissions inspection requirements for vehicles in 9 urban counties. This program tests emissions at idle for 1975 and newer gasoline powered light duty vehicles. The program is a basic, decentralized tailpipe test for Hydrocarbon (HC) and CO only. The waiver rates are consistent with the SIP. However, the compliance rates have been changed to more accurately reflect what is happening at the stations. Compliance rates have been changed from 98 percent in the SIP to 95 percent. In addition, the inspection stations are required to administer an anti-tampering check to ensure that emissions control equipment on any vehicle 1968 and newer has not been altered.

5.5.6 RVP Assumptions

Reid vapor pressure (RVP) reflects a gasoline's volatility, so as a control measure North Carolina has adopted the Phase II RVP of 7.8 psi in the 1-hour ozone maintenance counties.

The emissions summary for the 1996 episodes for the counties in the Triad EAC area is listed in Table 5.5-4. These emissions represent a typical weekday, Thursday's (June 20th), are in tons per day.

Table 5.5-4 Highway Mobile Emissions

County	CO	NOx	VOC
Alamance	107.43	14.92	9.43
Caswell	18.33	1.95	1.65
Davidson	150.84	27.56	12.92
Davie	37.20	8.36	3.07
Forsyth	207.45	32.63	20.60

County	CO	NOx	VOC
Guilford	274.51	44.36	27.54
Randolph	122.08	17.26	10.75
Rockingham	77.73	7.94	7.21
Stokes	28.49	2.87	2.57
Surry	78.33	12.38	6.98
Yadkin	39.27	7.03	3.44
Total	1141.65	177.25	106.14

5.6 Biogenic Emission Sources

Biogenic emissions will be prepared with the SMOKE-BEIS3 (Biogenic Emission Inventory System version3) preprocessor. SMOKE-BEIS3 is basically the Urban Airshed Model (UAM)-BEIS3 model but also includes modifications to use Meteorological Model version 5 (MM5) data, gridded land use data, and one important science update. The emission factors that are used in SMOKE-BEIS3 are the same as the emission factors in UAM-BEIS3.

The emission rates within SMOKE-BEIS3 are adjusted for environmental conditions prevailing during the episode days with meteorological data supplied by the MM5 model. The gridded data used from MM5 include the estimated temperature at 10 meters above the surface and short-wave radiation reaching the surface. Ten meters temperatures will be used instead of the ground temperatures because it is believed that 10 meters above the surface is a good approximation of the average canopy height. The use of 10 meters temperatures was discussed with and approved by the USEPA Office of Research and Development (ORD).

The gridded land use data has been obtained from Alpine Geophysics at the 4-km resolution for the entire domain. The basis for the gridded data is the county land use data in the Biogenic Emissions Landcover Database version 3 (BELD3) provided by the USEPA. A separate land classification scheme, based upon satellite (AVHRR, 1 km spatial resolution) and census information, aided in defining the forest, agriculture and urban portions of each county. The 12-km and 36-km domains will be created by aggregating the 4-km resolution data up to the respective grid sizes.

The emissions summary in for the 1996 episodes for the counties in the Triad EAC area is listed in Table 5.6-1. These emissions represent a normalized emission and are in tons per day.

Table 5.6-1 Biogenic Emissions

County	NOx	VOC
Alamance	0.4	73.9
Caswell	0.3	57.2
Davidson	0.4	78.6
Davie	0.4	55.4
Forsyth	0.4	59.3
Guildford	0.5	78.7
Randolph	0.5	109.1
Rockingham	0.4	64.3
Stokes	0.4	64.1
Surry	0.5	71.2
Yadkin	0.4	58.1
Total	4.6	769.9

SECTION 6 - MODELING STATUS

6.1 Status of Current Modeling

NCDAQ realized that the May 31, 2003 date for completing the base case model evaluation was not realistic due to the issues described in Section 6.2 below. Sheila Holman sent a letter to Kay Prince requesting an adjustment to the modeling schedule due to these issues. Ms. Holman's letter and Ms. Prince's response are included in Appendix C. NCDAQ continues to believe that completing the four 2007 base year modeling runs is achievable by August 29, 2003.

6.2 Issues Being Encountered

There have been a number of issues encountered during this modeling effort. The first was the integration of MOBILE6.2 into SMOKE. It is a requirement of the EAC that MOBILE6.2 be used to estimate the mobile emissions and if transportation conformity is ever needed in the EAC areas, it will be based on the emission estimates from this modeling effort. It took much longer than anticipated to get the integration completed.

Another issue was porting SMOKEv1.5 to the NCDAQ HP UNIX workstation. Compiling on the HP was not very straight forward and actually turned up some errors in the SMOKEv1.5 code. It took several weeks before the code was completely compiled and tested on the HP workstation and was ready for the NCDAQ emissions staff to use.

The next issue encountered dealt with the installation and use of MIMS. MIMS is a gui interface that aids the user in choosing the files that will be used in SMOKE to process the emissions. Since most of the NCDAQ emissions staff is not very familiar with the UNIX environment, it was believed that the MIMS interface would aid in processing the emissions. NCDAQ was never able to get MIMS to work on their system and therefore had to use scripts to process the emissions.

Another issue was the discovery of errors in the mobile and point source emissions during the quality assurance (QA) of the emissions data. For the mobile inventory, VMT was inadvertently left off for two of the urban counties, Guilford and Forsyth Counties. For the point source inventory, it was discovered that stack data for some of the utilities did not read in correctly and default stack parameters were used. This would result in the emissions being dumped into the lower layer of the model. These errors resulted in the emissions having to be reprocessed through SMOKE and re-merged with the other data.

6.3 Geographic Area Needing Further Controls

At this point in the project, NCDAQ is unable to identify the geographic area that will need controls beyond what is already in North Carolina's rules. The controls that will be included in the base 2007 emissions inventory are the NOx SIP Call, a NOx Inspection and Maintenance

(I/M) program that will cover 48 counties in North Carolina and the North Carolina Clean Smokestacks Act that requires year-round controls on the major utilities in North Carolina.

By the December 2003 Progress Report, NCDAQ should be able to provide modeling results that show where additional controls are needed over what geographic area.

6.4 Anticipated Resource Constraints

The resource constraint of most concern is the funding needed to implement some of the local control measures. NCDAQ and the local EAC areas are both looking for grant opportunities to help fund EAC initiatives.

APPENDIX A
EMISSION SOURCES BY COUNTY

Stationary Point Sources Emissions

County	CO	NOx	VOC
Alamance Co	0.061	0.676	0.960
Alexander Co	0.014	0.004	2.099
Ashe Co	0.030	0.006	1.289
Beaufort Co	1.162	1.969	0.859
Bertie Co	0.162	0.227	1.101
Bladen Co	0.181	1.857	0.520
Brunswick Co	3.758	7.786	3.453
Buncombe Co	1.336	57.016	3.135
Burke Co	5.753	0.516	12.838
Cabarrus Co	0.173	2.867	5.213
Caldwell Co	0.444	0.139	30.539
Carteret Co	0.008	0.083	0.000
Catawba Co	4.192	112.800	22.153
Chatham Co	7.014	20.487	3.800
Chowan Co	0.028	0.137	0.010
Cleveland Co	0.687	3.790	2.486
Columbus Co	12.211	6.987	3.885
Craven Co	3.585	4.175	4.196
Cumberland Co	0.412	2.956	7.072
Dare Co	0.008	0.271	0.004
Davidson Co	2.466	12.859	23.927
Davie Co	0.078	0.039	3.841
Duplin Co	0.888	1.978	0.017
Durham Co	0.301	1.046	5.706
Edgecombe Co	0.347	5.818	0.020
Forsyth Co	1.917	8.835	20.874
Franklin Co	0.009	0.101	0.122
Gaston Co	3.083	70.313	8.958
Graham Co	0.017	0.020	1.450
Granville Co	0.294	0.105	2.661
Guilford Co	0.158	1.829	40.535
Halifax Co	12.957	11.343	1.002
Harnett Co	0.204	0.563	0.464
Haywood Co	6.879	11.915	4.067
Henderson Co	0.023	0.400	5.133
Hertford Co	0.017	0.148	0.828

County	CO	NOx	VOC
Hoke Co	0.004	0.019	3.829
Iredell Co	2.927	8.949	5.109
Jackson Co	0.004	0.045	0.000
Johnston Co	0.018	0.145	2.218
Lee Co	0.971	0.235	1.403
Lenoir Co	0.110	2.429	0.592
Lincoln Co	0.118	2.551	2.368
Mc Dowell Co	0.645	0.609	2.221
Martin Co	23.577	9.479	6.539
Mecklenburg Co	2.616	2.914	22.978
Mitchell Co	0.113	0.015	2.193
Montgomery Co	0.047	0.008	0.017
Moore Co	0.015	0.003	1.826
Nash Co	0.442	0.928	0.491
New Hanover Co	36.352	76.530	5.676
Northampton Co	0.123	0.273	0.195
Onslow Co	0.073	0.955	0.016
Orange Co	3.223	0.748	0.009
Pasquotank Co	0.011	0.018	1.122
Pender Co	0.012	0.022	0.007
Person Co	5.063	188.510	1.706
Pitt Co	0.322	0.624	1.549
Randolph Co	0.021	0.058	2.528
Richmond Co	0.025	0.101	0.002
Robeson Co	0.612	18.817	1.994
Rockingham Co	5.954	33.903	7.896
Rowan Co	1.290	30.602	10.634
Rutherford Co	1.890	41.944	3.548
Scotland Co	0.501	7.276	5.356
Stanly Co	14.149	1.178	2.002
Stokes Co	7.872	341.620	0.945
Surry Co	5.356	0.942	5.817
Transylvania Co	0.183	5.212	2.858
Union Co	0.030	0.152	2.483
Vance Co	0.035	1.242	0.000
Wake Co	0.237	0.810	10.774
Washington Co	0.001	0.004	0.000
Watauga Co	0.015	0.051	0.001
Wayne Co	6.873	37.740	3.048
Wilkes Co	3.232	0.731	7.472

County	CO	NOx	VOC
Wilson Co	0.177	2.020	2.376
Yadkin Co	0.000	0.000	0.092
State total	**196.096**	**1172.466**	**357.102**

Stationary Area Sources Emissions

County	CO	NOx	VOC
Alamance Co	3.51	0.74	7.71
Alexander Co	1.47	0.15	2.95
Alleghany Co	0.50	0.09	0.89
Anson Co	2.62	0.53	2.24
Ashe Co	1.25	0.14	1.50
Avery Co	0.81	0.11	1.02
Beaufort Co	17.77	0.61	12.42
Bertie Co	2.12	0.14	2.90
Bladen Co	4.26	0.42	4.46
Brunswick Co	5.08	0.64	4.57
Buncombe Co	4.71	1.31	14.23
Burke Co	3.15	0.55	6.27
Cabarrus Co	3.80	1.07	6.84
Caldwell Co	2.53	0.31	4.78
Camden Co	4.87	0.08	2.55
Carteret Co	10.09	0.61	6.93
Caswell Co	2.46	0.23	1.65
Catawba Co	4.60	0.90	12.14
Chatham Co	2.46	0.50	3.65
Cherokee Co	1.14	0.13	2.15
Chowan Co	1.63	0.10	1.42
Clay Co	0.40	0.08	0.56
Cleveland Co	5.14	0.84	7.25
Columbus Co	6.50	0.41	7.36
Craven Co	5.04	0.77	6.98
Cumberland Co	15.31	3.34	22.74
Currituck Co	4.30	0.13	2.46
Dare Co	1.65	0.13	2.13
Davidson Co	6.02	1.35	10.66
Davie Co	2.52	0.26	2.57
Duplin Co	8.32	0.45	6.68
Durham Co	2.61	1.88	16.40
Edgecombe Co	5.67	1.22	5.88
Forsyth Co	5.33	1.54	14.36

County	CO	NOx	VOC
Franklin Co	5.19	0.29	3.63
Gaston Co	4.10	1.76	12.04
Gates Co	1.18	0.09	1.34
Graham Co	0.45	0.08	0.45
Granville Co	3.50	0.38	3.15
Greene Co	6.06	0.17	3.11
Guilford Co	10.27	4.13	26.45
Halifax Co	3.57	0.91	4.17
Harnett Co	6.80	0.78	6.02
Haywood Co	2.06	0.32	4.36
Henderson Co	3.44	0.75	5.20
Hertford Co	1.17	0.12	1.90
Hoke Co	3.32	0.20	2.29
Hyde Co	6.38	0.07	3.63
Iredell Co	5.28	0.99	8.84
Jackson Co	1.49	0.23	2.00
Johnston Co	9.60	1.08	10.43
Jones Co	1.44	0.11	1.48
Lee Co	2.19	0.75	4.24
Lenoir Co	7.82	0.41	6.24
Lincoln Co	3.17	0.48	4.09
Mc Dowell Co	1.81	0.72	3.06
Macon Co	1.31	0.14	1.95
Madison Co	1.05	0.30	1.46
Martin Co	3.28	0.38	2.69
Mecklenburg Co	13.05	11.58	32.00
Mitchell Co	0.81	0.40	1.00
Montgomery Co	1.55	0.14	1.91
Moore Co	3.76	0.57	5.33
Nash Co	5.64	0.97	7.73
New Hanover Co	2.25	1.00	7.77
Northampton Co	2.75	0.39	1.91
Onslow Co	4.81	0.34	8.71
Orange Co	3.91	0.87	6.69
Pamlico Co	8.65	1.87	4.18
Pasquotank Co	9.77	0.13	5.21
Pender Co	4.66	0.21	3.74
Perquimans Co	4.64	0.10	3.12
Person Co	4.45	0.41	2.74
Pitt Co	13.70	0.82	10.06

County	CO	NOx	VOC
Polk Co	0.99	0.20	1.09
Randolph Co	5.89	0.78	9.82
Richmond Co	3.11	1.75	3.17
Robeson Co	19.68	1.45	16.70
Rockingham Co	6.30	1.03	5.91
Rowan Co	6.17	1.16	7.78
Rutherford Co	2.60	0.68	4.32
Sampson Co	10.48	0.36	7.84
Scotland Co	3.44	0.46	3.01
Stanly Co	5.11	0.29	4.81
Stokes Co	2.26	0.27	2.65
Surry Co	3.87	0.25	6.09
Swain Co	0.65	0.10	0.86
Transylvania Co	1.15	0.21	1.70
Tyrrell Co	7.03	0.07	3.50
Union Co	12.04	0.83	10.72
Vance Co	2.70	0.52	3.21
Wake Co	14.01	6.55	30.98
Warren Co	2.03	0.21	1.97
Washington Co	9.82	0.30	4.33
Watauga Co	1.38	0.15	2.71
Wayne Co	15.36	2.66	12.00
Wilkes Co	3.08	0.25	4.23
Wilson Co	7.26	1.30	6.96
Yadkin Co	2.82	0.16	3.54
Yancey Co	0.83	0.14	1.19
State Total	**479.96**	**79.33**	**596.72**

Nonroad Sources Emissions

County	CO	NOx	VOC
Alamance Co	29.18	0.20	2.59
Alexander Co	4.11	0.05	0.40
Alleghany Co	2.58	0.05	0.21
Anson Co	4.38	0.38	0.52
Ashe Co	3.94	0.05	0.42
Avery Co	5.29	0.05	0.59
Beaufort Co	13.65	0.39	2.76
Bertie Co	6.31	0.05	1.15
Bladen Co	8.67	0.27	1.32
Brunswick Co	26.98	0.36	4.76

County	CO	NOx	VOC
Buncombe Co	47.91	0.49	4.76
Burke Co	14.94	0.22	1.54
Cabarrus Co	41.70	0.34	3.69
Caldwell Co	16.69	0.06	1.78
Camden Co	2.96	0.05	1.01
Carteret Co	46.97	0.28	14.15
Caswell Co	2.26	0.13	0.22
Catawba Co	46.58	0.41	4.49
Chatham Co	12.56	0.32	1.51
Cherokee Co	4.23	0.05	0.57
Chowan Co	3.97	0.05	1.13
Clay Co	2.18	0.05	0.39
Cleveland Co	21.14	0.37	1.92
Columbus Co	9.81	0.20	1.14
Craven Co	23.26	0.46	2.93
Cumberland Co	64.64	2.73	11.73
Currituck Co	14.97	0.06	4.58
Dare Co	45.32	0.05	17.81
Davidson Co	30.28	0.69	2.88
Davie Co	7.20	0.14	0.84
Duplin Co	9.94	0.27	1.04
Durham Co	67.33	0.49	6.52
Edgecombe Co	10.95	0.73	1.03
Forsyth Co	89.05	0.47	7.62
Franklin Co	7.82	0.14	0.81
Gaston Co	49.26	0.64	4.29
Gates Co	1.56	0.05	0.23
Graham Co	1.40	0.05	0.25
Granville Co	12.71	0.19	1.31
Greene Co	2.43	0.09	0.25
Guilford Co	182.94	1.51	16.10
Halifax Co	8.66	0.55	0.95
Harnett Co	21.12	0.34	1.88
Haywood Co	11.23	0.16	1.18
Henderson Co	29.86	0.25	3.64
Hertford Co	4.12	0.05	0.49
Hoke Co	3.44	0.08	0.31
Hyde Co	24.88	0.05	11.57
Iredell Co	23.40	0.30	2.31
Jackson Co	6.85	0.12	0.78

County	CO	NOx	VOC
Johnston Co	32.64	0.69	3.13
Jones Co	1.82	0.07	0.17
Lee Co	16.36	0.43	1.51
Lenoir Co	15.85	0.23	1.48
Lincoln Co	13.58	0.24	1.36
Mc Dowell Co	7.94	0.54	1.03
Macon Co	10.84	0.05	1.03
Madison Co	1.72	0.21	0.18
Martin Co	4.61	0.27	0.50
Mecklenburg Co	325.43	3.57	29.32
Mitchell Co	3.54	0.31	0.45
Montgomery Co	4.99	0.05	0.60
Moore Co	27.58	0.27	2.28
Nash Co	21.08	0.54	1.94
New Hanover Co	56.63	0.81	6.90
Northampton Co	4.28	0.27	0.69
Onslow Co	25.81	0.12	4.08
Orange Co	29.41	0.23	3.25
Pamlico Co	13.06	1.81	5.40
Pasquotank Co	9.74	0.06	1.51
Pender Co	12.46	0.05	1.85
Perquimans Co	3.91	0.06	1.28
Person Co	8.34	0.20	0.88
Pitt Co	23.99	0.46	2.19
Polk Co	2.89	0.11	0.25
Randolph Co	27.26	0.25	2.43
Richmond Co	14.22	1.40	1.60
Robeson Co	19.58	0.82	1.97
Rockingham Co	15.60	0.37	1.54
Rowan Co	27.64	0.70	2.72
Rutherford Co	12.77	0.38	1.25
Sampson Co	10.29	0.11	1.01
Scotland Co	8.53	0.25	0.91
Stanly Co	15.92	0.12	1.63
Stokes Co	7.77	0.12	0.77
Surry Co	28.72	0.05	2.63
Swain Co	4.71	0.05	1.13
Transylvania Co	14.82	0.10	2.40
Tyrrell Co	6.53	0.05	2.92
Union Co	45.86	0.42	4.03

County	CO	NOx	VOC
Vance Co	6.31	0.28	0.79
Wake Co	233.69	2.82	23.24
Warren Co	3.44	0.12	0.59
Washington Co	5.57	0.24	1.47
Watauga Co	9.95	0.05	1.16
Wayne Co	28.11	2.27	2.84
Wilkes Co	16.07	0.05	1.50
Wilson Co	22.44	0.75	2.14
Yadkin Co	6.52	0.05	0.58
Yancey Co	7.33	0.08	0.84
State Total	**2411.70**	**39.09**	**293.67**

Highway Mobile Sources Emissions

County	CO	NOx	VOC
Alamance Co	107.43	14.92	9.43
Alexander Co	21.16	2.17	1.83
Alleghany Co	8.95	0.90	0.78
Anson Co	26.77	3.05	2.46
Ashe Co	19.45	1.89	1.72
Avery Co	17.39	1.87	1.56
Beaufort Co	38.64	3.91	3.54
Bertie Co	24.72	2.65	2.22
Bladen Co	37.65	3.75	3.29
Brunswick Co	74.31	8.08	6.67
Buncombe Co	178.76	27.37	15.47
Burke Co	80.26	13.91	6.89
Cabarrus Co	63.42	11.80	5.86
Caldwell Co	53.96	5.51	5.05
Camden Co	9.34	1.00	0.84
Carteret Co	55.26	6.04	5.06
Caswell Co	18.33	1.95	1.65
Catawba Co	122.92	15.90	11.16
Chatham Co	43.63	4.87	4.01
Cherokee Co	19.38	2.22	1.78
Chowan Co	10.51	1.07	0.95
Clay Co	6.42	0.67	0.55
Cleveland Co	77.65	10.50	6.91
Columbus Co	50.24	5.25	4.60
Craven Co	64.58	6.80	6.10
Cumberland Co	223.26	30.32	20.98

County	CO	NOx	VOC
Currituck Co	21.99	2.38	1.85
Dare Co	49.33	5.11	4.33
Davidson Co	150.84	27.56	12.92
Davie Co	37.20	8.36	3.07
Duplin Co	51.46	8.29	4.53
Durham Co	142.33	24.90	12.74
Edgecombe Co	45.16	4.52	4.15
Forsyth Co	207.45	32.63	20.60
Franklin Co	34.03	3.57	3.01
Gaston Co	90.70	17.44	8.71
Gates Co	10.46	1.17	0.95
Graham Co	5.44	0.52	0.49
Granville Co	48.29	9.91	4.14
Greene Co	16.62	1.68	1.46
Guilford Co	274.51	44.36	27.54
Halifax Co	60.25	12.55	5.15
Harnett Co	70.89	10.13	6.33
Haywood Co	67.59	14.74	5.71
Henderson Co	64.43	10.18	5.67
Hertford Co	19.29	2.00	1.70
Hoke Co	20.66	2.23	1.85
Hyde Co	5.58	0.57	0.48
Iredell Co	135.50	30.72	11.44
Jackson Co	35.85	4.13	3.18
Johnston Co	131.26	27.54	11.23
Jones Co	16.28	1.83	1.50
Lee Co	44.31	4.53	4.19
Lenoir Co	52.16	5.06	4.96
Lincoln Co	40.85	4.19	3.69
Mc Dowell Co	47.19	10.22	4.03
Macon Co	26.13	2.85	2.35
Madison Co	15.11	1.64	1.35
Martin Co	26.79	2.83	2.48
Mecklenburg Co	392.69	73.30	38.40
Mitchell Co	11.18	1.14	1.02
Montgomery Co	29.30	3.61	2.59
Moore Co	61.28	6.19	5.59
Nash Co	104.62	17.95	9.32
New Hanover Co	87.27	9.11	8.50
Northampton Co	28.88	5.33	2.48

County	CO	NOx	VOC
Onslow Co	80.37	8.05	7.73
Orange Co	62.77	18.46	5.55
Pamlico Co	10.44	0.97	0.94
Pasquotank Co	20.29	2.00	1.98
Pender Co	47.14	8.32	4.10
Perquimans Co	10.17	1.13	0.94
Person Co	24.33	2.42	2.22
Pitt Co	91.52	8.97	8.59
Polk Co	21.35	4.74	1.83
Randolph Co	122.08	17.26	10.75
Richmond Co	39.91	4.17	3.80
Robeson Co	127.44	22.67	11.10
Rockingham Co	77.73	7.94	7.21
Rowan Co	102.00	17.76	9.08
Rutherford Co	49.44	5.02	4.50
Sampson Co	61.77	8.73	5.44
Scotland Co	34.46	3.59	3.21
Stanly Co	42.33	4.14	3.95
Stokes Co	28.49	2.87	2.57
Surry Co	78.33	12.38	6.98
Swain Co	16.94	1.88	1.50
Transylvania Co	23.80	2.44	2.13
Tyrrell Co	4.24	0.48	0.39
Union Co	54.05	7.20	5.23
Vance Co	38.11	6.67	3.34
Wake Co	306.80	57.16	27.42
Warren Co	17.90	3.68	1.54
Washington Co	13.77	1.55	1.27
Watauga Co	33.04	3.63	3.10
Wayne Co	81.79	7.98	7.66
Wilkes Co	56.78	5.89	5.12
Wilson Co	71.21	10.72	6.54
Yadkin Co	39.27	7.03	3.44
Yancey Co	13.30	1.48	1.22
State Total	**6138.89**	**924.70**	**559.38**

APPENDIX B

Conversion of MOBILE5 Registration Fractions to MOBILE6-Based Registration Fractions

Mecklenburg County

*Convert MOBILE5 Registration Fractions to MOBILE6-Based Registration Fractions
*
*Calendar Year: 1996.000User-Input
*
*MOBILE5b Reg Fractions

*	0.114	0.097	0.086	0.083	0.077	0.084	0.069	0.062	0.051	0.044
*	0.040	0.039	0.033	0.027	0.022	0.016	0.012	0.007	0.004	0.003
*	0.003	0.004	0.003	0.002	0.018					
*	0.090	0.080	0.076	0.075	0.062	0.066	0.066	0.048	0.040	0.037
*	0.034	0.042	0.040	0.035	0.033	0.024	0.021	0.013	0.009	0.008
*	0.008	0.012	0.012	0.009	0.060					
*	0.123	0.148	0.096	0.088	0.065	0.071	0.054	0.039	0.023	0.021
*	0.030	0.034	0.031	0.021	0.021	0.020	0.013	0.008	0.007	0.006
*	0.007	0.012	0.010	0.010	0.042					
*	0.123	0.104	0.061	0.093	0.060	0.077	0.058	0.046	0.025	0.023
*	0.023	0.030	0.047	0.027	0.025	0.023	0.018	0.008	0.008	0.009
*	0.009	0.014	0.011	0.009	0.069					
*	0.114	0.097	0.086	0.083	0.077	0.084	0.069	0.062	0.051	0.044
*	0.040	0.039	0.033	0.027	0.022	0.016	0.012	0.007	0.004	0.003
*	0.003	0.004	0.003	0.002	0.018					
*	0.090	0.080	0.076	0.075	0.062	0.066	0.066	0.048	0.040	0.037
*	0.034	0.042	0.040	0.035	0.033	0.024	0.021	0.013	0.009	0.008
*	0.008	0.012	0.012	0.009	0.060					
*	0.155	0.141	0.081	0.100	0.066	0.083	0.056	0.041	0.030	0.032
*	0.055	0.048	0.027	0.028	0.016	0.014	0.008	0.004	0.003	0.002
*	0.002	0.003	0.002	0.001	0.002					
*	0.141	0.111	0.088	0.081	0.074	0.061	0.049	0.035	0.027	0.017
*	0.015	0.301	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
*	0.000	0.000	0.000	0.000	0.000					

*
*
* MOBILE6 Vehicle Classes:
* 1 LDV Light-Duty Vehicles (Passenger Cars)
* 2 LDT1 Light-Duty Trucks 1 (0-6,000 lbs. GVWR, 0-3750 lbs. LVW)
* 3 LDT2 Light Duty Trucks 2 (0-6,000 lbs. GVWR, 3751-5750 lbs. LVW)
* 4 LDT3 Light Duty Trucks 3 (6,001-8500 lbs. GVWR, 0-3750 lbs. LVW)
* 5 LDT4 Light Duty Trucks 4 (6,001-8500 lbs. GVWR, 3751-5750 lbs. LVW)
* 6 HDV2B Class 2b Heavy Duty Vehicles (8501-10,000 lbs. GVWR)
* 7 HDV3 Class 3 Heavy Duty Vehicles (10,001-14,000 lbs. GVWR)
* 8 HDV4 Class 4 Heavy Duty Vehicles (14,001-16,000 lbs. GVWR)
* 9 HDV5 Class 5 Heavy Duty Vehicles (16,001-19,500 lbs. GVWR)
* 10 HDV6 Class 6 Heavy Duty Vehicles (19,501-26,000 lbs. GVWR)
* 11 HDV7 Class 7 Heavy Duty Vehicles (26,001-33,000 lbs. GVWR)

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* 12  HDV8A  Class 8a Heavy Duty Vehicles (33,001-60,000 lbs. GVWR)
* 13  HDV8B  Class 8b Heavy Duty Vehicles (>60,000 lbs. GVWR)
* 14  HDBS   School Busses
* 15  HDBT   Transit and Urban Busses
* 16  MC     Motorcycles (All)
*
REG DIST
*              RESULTING MOBILE6-BASED REGISTRATION FRACTIONS
*
*MOBILE6 REGISTRATION FRACTIONS BY VEHICLE CLASS AND AGE
* LDV        M5 LDGV
   1  0.114  0.097  0.086  0.083  0.077  0.084  0.069  0.062  0.051  0.044
      0.040  0.039  0.033  0.027  0.022  0.016  0.012  0.007  0.004  0.003
      0.003  0.004  0.003  0.002  0.018
* LDT1       M5 LDGT1
   2  0.090  0.080  0.076  0.075  0.062  0.066  0.066  0.048  0.040  0.037
      0.034  0.042  0.040  0.035  0.033  0.024  0.021  0.013  0.009  0.008
      0.008  0.012  0.012  0.009  0.060
* LDT2       M5 LDGT1
   3  0.090  0.080  0.076  0.075  0.062  0.066  0.066  0.048  0.040  0.037
      0.034  0.042  0.040  0.035  0.033  0.024  0.021  0.013  0.009  0.008
      0.008  0.012  0.012  0.009  0.060
* LDT3       M5 LDGT2
   4  0.123  0.148  0.096  0.088  0.065  0.071  0.054  0.039  0.023  0.021
      0.030  0.034  0.031  0.021  0.021  0.020  0.013  0.008  0.007  0.006
      0.007  0.012  0.010  0.010  0.042
* LDT4       M5 LDGT2
   5  0.123  0.148  0.096  0.088  0.065  0.071  0.054  0.039  0.023  0.021
      0.030  0.034  0.031  0.021  0.021  0.020  0.013  0.008  0.007  0.006
      0.007  0.012  0.010  0.010  0.042
* HDV2B        M5 HDVs (Combined HDGV and HDDV)
   6  0.137  0.120  0.070  0.096  0.063  0.080  0.057  0.044  0.027  0.027
      0.037  0.038  0.039  0.027  0.021  0.019  0.013  0.007  0.006  0.006
      0.006  0.009  0.007  0.006  0.040
* HDV3       M5 HDVs (Combined HDGV and HDDV)
   7  0.137  0.120  0.070  0.096  0.063  0.080  0.057  0.044  0.027  0.027
      0.037  0.038  0.039  0.027  0.021  0.019  0.013  0.007  0.006  0.006
      0.006  0.009  0.007  0.006  0.040
* HDV4       M5 HDVs (Combined HDGV and HDDV)
   8  0.137  0.120  0.070  0.096  0.063  0.080  0.057  0.044  0.027  0.027
      0.037  0.038  0.039  0.027  0.021  0.019  0.013  0.007  0.006  0.006
      0.006  0.009  0.007  0.006  0.040
* HDV5       M5 HDVs (Combined HDGV and HDDV)
   9  0.137  0.120  0.070  0.096  0.063  0.080  0.057  0.044  0.027  0.027
      0.037  0.038  0.039  0.027  0.021  0.019  0.013  0.007  0.006  0.006
      0.006  0.009  0.007  0.006  0.040
* HDV6       M5 HDVs (Combined HDGV and HDDV)
  10  0.137  0.120  0.070  0.096  0.063  0.080  0.057  0.044  0.027  0.027
      0.037  0.038  0.039  0.027  0.021  0.019  0.013  0.007  0.006  0.006
      0.006  0.009  0.007  0.006  0.040
* HDV7       M5 HDVs (Combined HDGV and HDDV)
```

11 0.137 0.120 0.070 0.096 0.063 0.080 0.057 0.044 0.027 0.027
0.037 0.038 0.039 0.027 0.021 0.019 0.013 0.007 0.006 0.006
0.006 0.009 0.007 0.006 0.040
* HDV8a M5 HDVs (Combined HDGV and HDDV)
12 0.137 0.120 0.070 0.096 0.063 0.080 0.057 0.044 0.027 0.027
0.037 0.038 0.039 0.027 0.021 0.019 0.013 0.007 0.006 0.006
0.006 0.009 0.007 0.006 0.040
* HDV8b M5 HDVs (Combined HDGV and HDDV)
13 0.137 0.120 0.070 0.096 0.063 0.080 0.057 0.044 0.027 0.027
0.037 0.038 0.039 0.027 0.021 0.019 0.013 0.007 0.006 0.006
0.006 0.009 0.007 0.006 0.040
* HDBS M5 HDVs (Combined HDGV and HDDV)
14 0.137 0.120 0.070 0.096 0.063 0.080 0.057 0.044 0.027 0.027
0.037 0.038 0.039 0.027 0.021 0.019 0.013 0.007 0.006 0.006
0.006 0.009 0.007 0.006 0.040
* HDBT M5 HDDVs
15 0.155 0.141 0.081 0.100 0.066 0.083 0.056 0.041 0.030 0.032
0.055 0.048 0.027 0.028 0.016 0.014 0.008 0.004 0.003 0.002
0.002 0.003 0.002 0.001 0.002
* Motorcycles M5 MC
16 0.141 0.111 0.088 0.081 0.074 0.061 0.049 0.035 0.027 0.017
0.015 0.301 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000 0.000

<u>Triad</u>

*Convert MOBILE5 Registration Fractions to MOBILE6-Based Registration Fractions
*
*Calendar Year: 1996.000User-Input
*
*MOBILE5b Reg Fractions
* 0.101 0.080 0.075 0.073 0.070 0.081 0.066 0.063 0.054 0.048
* 0.045 0.046 0.040 0.034 0.028 0.021 0.016 0.009 0.005 0.004
* 0.004 0.005 0.004 0.004 0.024
* 0.077 0.066 0.065 0.066 0.054 0.062 0.067 0.047 0.043 0.037
* 0.034 0.045 0.044 0.039 0.039 0.027 0.025 0.016 0.012 0.010
* 0.010 0.014 0.014 0.012 0.075
* 0.081 0.089 0.078 0.078 0.065 0.080 0.064 0.050 0.033 0.032
* 0.037 0.041 0.038 0.030 0.031 0.029 0.018 0.011 0.009 0.009
* 0.006 0.014 0.013 0.012 0.052
* 0.078 0.079 0.049 0.062 0.058 0.080 0.051 0.041 0.033 0.027
* 0.034 0.043 0.040 0.031 0.038 0.029 0.018 0.013 0.011 0.016
* 0.014 0.020 0.016 0.015 0.104
* 0.101 0.080 0.075 0.073 0.070 0.081 0.066 0.063 0.054 0.048
* 0.045 0.046 0.040 0.034 0.028 0.021 0.016 0.009 0.005 0.004
* 0.004 0.005 0.004 0.004 0.024
* 0.077 0.066 0.065 0.066 0.054 0.062 0.067 0.047 0.043 0.037
* 0.034 0.045 0.044 0.039 0.039 0.027 0.025 0.016 0.012 0.010
* 0.010 0.014 0.014 0.012 0.075
* 0.170 0.141 0.087 0.100 0.074 0.079 0.067 0.042 0.032 0.027

```
*       0.033  0.032  0.029  0.024  0.018  0.014  0.010  0.004  0.004  0.003
*       0.002  0.002  0.002  0.001  0.003
*       0.134  0.102  0.072  0.070  0.071  0.051  0.049  0.041  0.027  0.021
*       0.018  0.344  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
*       0.000  0.000  0.000  0.000  0.000
*
*
* MOBILE6 Vehicle Classes:
*  1  LDV    Light-Duty Vehicles (Passenger Cars)
*  2  LDT1   Light-Duty Trucks 1 (0-6,000 lbs. GVWR, 0-3750 lbs. LVW)
*  3  LDT2   Light Duty Trucks 2 (0-6,000 lbs. GVWR, 3751-5750 lbs. LVW)
*  4  LDT3   Light Duty Trucks 3 (6,001-8500 lbs. GVWR, 0-3750 lbs. LVW)
*  5  LDT4   Light Duty Trucks 4 (6,001-8500 lbs. GVWR, 3751-5750 lbs. LVW)
*  6  HDV2B  Class 2b Heavy Duty Vehicles (8501-10,000 lbs. GVWR)
*  7  HDV3   Class 3 Heavy Duty Vehicles (10,001-14,000 lbs. GVWR)
*  8  HDV4   Class 4 Heavy Duty Vehicles (14,001-16,000 lbs. GVWR)
*  9  HDV5   Class 5 Heavy Duty Vehicles (16,001-19,500 lbs. GVWR)
* 10  HDV6   Class 6 Heavy Duty Vehicles (19,501-26,000 lbs. GVWR)
* 11  HDV7   Class 7 Heavy Duty Vehicles (26,001-33,000 lbs. GVWR)
* 12  HDV8A  Class 8a Heavy Duty Vehicles (33,001-60,000 lbs. GVWR)
* 13  HDV8B  Class 8b Heavy Duty Vehicles (>60,000 lbs. GVWR)
* 14  HDBS   School Busses
* 15  HDBT   Transit and Urban Busses
* 16  MC     Motorcycles (All)
*
REG DIST
*              RESULTING MOBILE6-BASED REGISTRATION FRACTIONS
*
*MOBILE6 REGISTRATION FRACTIONS BY VEHICLE CLASS AND AGE
* LDV          M5 LDGV
  1  0.101  0.080  0.075  0.073  0.070  0.081  0.066  0.063  0.054  0.048
     0.045  0.046  0.040  0.034  0.028  0.021  0.016  0.009  0.005  0.004
     0.004  0.005  0.004  0.004  0.024
* LDT1         M5 LDGT1
  2  0.077  0.066  0.065  0.066  0.054  0.062  0.067  0.047  0.043  0.037
     0.034  0.045  0.044  0.039  0.039  0.027  0.025  0.016  0.012  0.010
     0.010  0.014  0.014  0.012  0.075
* LDT2         M5 LDGT1
  3  0.077  0.066  0.065  0.066  0.054  0.062  0.067  0.047  0.043  0.037
     0.034  0.045  0.044  0.039  0.039  0.027  0.025  0.016  0.012  0.010
     0.010  0.014  0.014  0.012  0.075
* LDT3         M5 LDGT2
  4  0.081  0.089  0.078  0.078  0.065  0.080  0.064  0.050  0.033  0.032
     0.037  0.041  0.038  0.030  0.031  0.029  0.018  0.011  0.009  0.009
     0.006  0.014  0.013  0.012  0.052
* LDT4         M5 LDGT2
  5  0.081  0.089  0.078  0.078  0.065  0.080  0.064  0.050  0.033  0.032
     0.037  0.041  0.038  0.030  0.031  0.029  0.018  0.011  0.009  0.009
     0.006  0.014  0.013  0.012  0.052
* HDV2B          M5 HDVs (Combined HDGV and HDDV)
  6  0.118  0.106  0.065  0.079  0.065  0.079  0.058  0.042  0.032  0.027
```

0.033 0.038 0.035 0.028 0.029 0.022 0.015 0.009 0.008 0.010
0.009 0.012 0.010 0.009 0.060
* HDV3 M5 HDVs (Combined HDGV and HDDV)
7 0.118 0.106 0.065 0.079 0.065 0.079 0.058 0.042 0.032 0.027
0.033 0.038 0.035 0.028 0.029 0.022 0.015 0.009 0.008 0.010
0.009 0.012 0.010 0.009 0.060
* HDV4 M5 HDVs (Combined HDGV and HDDV)
8 0.118 0.106 0.065 0.079 0.065 0.079 0.058 0.042 0.032 0.027
0.033 0.038 0.035 0.028 0.029 0.022 0.015 0.009 0.008 0.010
0.009 0.012 0.010 0.009 0.060
* HDV5 M5 HDVs (Combined HDGV and HDDV)
9 0.118 0.106 0.065 0.079 0.065 0.079 0.058 0.042 0.032 0.027
0.033 0.038 0.035 0.028 0.029 0.022 0.015 0.009 0.008 0.010
0.009 0.012 0.010 0.009 0.060
* HDV6 M5 HDVs (Combined HDGV and HDDV)
10 0.118 0.106 0.065 0.079 0.065 0.079 0.058 0.042 0.032 0.027
0.033 0.038 0.035 0.028 0.029 0.022 0.015 0.009 0.008 0.010
0.009 0.012 0.010 0.009 0.060
* HDV7 M5 HDVs (Combined HDGV and HDDV)
11 0.118 0.106 0.065 0.079 0.065 0.079 0.058 0.042 0.032 0.027
0.033 0.038 0.035 0.028 0.029 0.022 0.015 0.009 0.008 0.010
0.009 0.012 0.010 0.009 0.060
* HDV8a M5 HDVs (Combined HDGV and HDDV)
12 0.118 0.106 0.065 0.079 0.065 0.079 0.058 0.042 0.032 0.027
0.033 0.038 0.035 0.028 0.029 0.022 0.015 0.009 0.008 0.010
0.009 0.012 0.010 0.009 0.060
* HDV8b M5 HDVs (Combined HDGV and HDDV)
13 0.118 0.106 0.065 0.079 0.065 0.079 0.058 0.042 0.032 0.027
0.033 0.038 0.035 0.028 0.029 0.022 0.015 0.009 0.008 0.010
0.009 0.012 0.010 0.009 0.060
* HDBS M5 HDVs (Combined HDGV and HDDV)
14 0.118 0.106 0.065 0.079 0.065 0.079 0.058 0.042 0.032 0.027
0.033 0.038 0.035 0.028 0.029 0.022 0.015 0.009 0.008 0.010
0.009 0.012 0.010 0.009 0.060
* HDBT M5 HDDVs
15 0.170 0.141 0.087 0.100 0.074 0.079 0.067 0.042 0.032 0.027
0.033 0.032 0.029 0.024 0.018 0.014 0.010 0.004 0.004 0.003
0.002 0.002 0.002 0.001 0.003
* Motorcycles M5 MC
16 0.134 0.102 0.072 0.070 0.071 0.051 0.049 0.041 0.027 0.021
0.018 0.344 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000 0.000

Wake County

*Convert MOBILE5 Registration Fractions to MOBILE6-Based Registration Fractions
*
*Calendar Year: 1996.000User-Input
*
*MOBILE5b Reg Fractions
* 0.114 0.091 0.085 0.080 0.075 0.083 0.069 0.063 0.052 0.047
* 0.042 0.040 0.034 0.029 0.023 0.017 0.012 0.007 0.004 0.003

```
*       0.003  0.003  0.003  0.002  0.019
*       0.090  0.081  0.080  0.083  0.060  0.066  0.069  0.049  0.037  0.037
*       0.034  0.041  0.039  0.034  0.037  0.025  0.021  0.013  0.009  0.008
*       0.006  0.011  0.010  0.009  0.051
*       0.101  0.117  0.083  0.095  0.057  0.121  0.069  0.048  0.034  0.034
*       0.025  0.037  0.032  0.019  0.018  0.017  0.010  0.007  0.004  0.005
*       0.006  0.010  0.008  0.007  0.036
*       0.109  0.076  0.057  0.088  0.069  0.088  0.049  0.041  0.041  0.030
*       0.036  0.039  0.035  0.027  0.028  0.026  0.016  0.009  0.007  0.009
*       0.010  0.014  0.012  0.010  0.074
*       0.114  0.091  0.085  0.080  0.075  0.083  0.069  0.063  0.052  0.047
*       0.042  0.040  0.034  0.029  0.023  0.017  0.012  0.007  0.004  0.003
*       0.003  0.003  0.003  0.002  0.019
*       0.090  0.081  0.080  0.083  0.060  0.066  0.069  0.049  0.037  0.037
*       0.034  0.041  0.039  0.034  0.037  0.025  0.021  0.013  0.009  0.008
*       0.006  0.011  0.010  0.009  0.051
*       0.163  0.137  0.087  0.103  0.067  0.074  0.044  0.035  0.032  0.054
*       0.040  0.044  0.029  0.026  0.018  0.016  0.010  0.004  0.004  0.003
*       0.002  0.002  0.001  0.001  0.004
*       0.138  0.105  0.080  0.070  0.068  0.053  0.053  0.041  0.029  0.021
*       0.022  0.320  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
*       0.000  0.000  0.000  0.000  0.000
*
*
* MOBILE6 Vehicle Classes:
*  1 LDV    Light-Duty Vehicles (Passenger Cars)
*  2 LDT1   Light-Duty Trucks 1 (0-6,000 lbs. GVWR, 0-3750 lbs. LVW)
*  3 LDT2   Light Duty Trucks 2 (0-6,000 lbs. GVWR, 3751-5750 lbs. LVW)
*  4 LDT3   Light Duty Trucks 3 (6,001-8500 lbs. GVWR, 0-3750 lbs. LVW)
*  5 LDT4   Light Duty Trucks 4 (6,001-8500 lbs. GVWR, 3751-5750 lbs. LVW)
*  6 HDV2B  Class 2b Heavy Duty Vehicles (8501-10,000 lbs. GVWR)
*  7 HDV3   Class 3 Heavy Duty Vehicles (10,001-14,000 lbs. GVWR)
*  8 HDV4   Class 4 Heavy Duty Vehicles (14,001-16,000 lbs. GVWR)
*  9 HDV5   Class 5 Heavy Duty Vehicles (16,001-19,500 lbs. GVWR)
* 10 HDV6   Class 6 Heavy Duty Vehicles (19,501-26,000 lbs. GVWR)
* 11 HDV7   Class 7 Heavy Duty Vehicles (26,001-33,000 lbs. GVWR)
* 12 HDV8A  Class 8a Heavy Duty Vehicles (33,001-60,000 lbs. GVWR)
* 13 HDV8B  Class 8b Heavy Duty Vehicles (>60,000 lbs. GVWR)
* 14 HDBS   School Busses
* 15 HDBT   Transit and Urban Busses
* 16 MC     Motorcycles (All)
*
REG DIST
*               RESULTING MOBILE6-BASED REGISTRATION FRACTIONS
*
*MOBILE6 REGISTRATION FRACTIONS BY VEHICLE CLASS AND AGE
* LDV          M5 LDGV
   1  0.114  0.091  0.085  0.080  0.075  0.083  0.069  0.063  0.052  0.047
      0.042  0.040  0.034  0.029  0.023  0.017  0.012  0.007  0.004  0.003
      0.003  0.003  0.003  0.002  0.019
* LDT1         M5 LDGT1
```

```
   2  0.090  0.081  0.080  0.083  0.060  0.066  0.069  0.049  0.037  0.037
      0.034  0.041  0.039  0.034  0.037  0.025  0.021  0.013  0.009  0.008
      0.006  0.011  0.010  0.009  0.051
* LDT2       M5 LDGT1
   3  0.090  0.081  0.080  0.083  0.060  0.066  0.069  0.049  0.037  0.037
      0.034  0.041  0.039  0.034  0.037  0.025  0.021  0.013  0.009  0.008
      0.006  0.011  0.010  0.009  0.051
* LDT3       M5 LDGT2
   4  0.101  0.117  0.083  0.095  0.057  0.121  0.069  0.048  0.034  0.034
      0.025  0.037  0.032  0.019  0.018  0.017  0.010  0.007  0.004  0.005
      0.006  0.010  0.008  0.007  0.036
* LDT4       M5 LDGT2
   5  0.101  0.117  0.083  0.095  0.057  0.121  0.069  0.048  0.034  0.034
      0.025  0.037  0.032  0.019  0.018  0.017  0.010  0.007  0.004  0.005
      0.006  0.010  0.008  0.007  0.036
* HDV2B      M5 HDVs (Combined HDGV and HDDV)
   6  0.133  0.102  0.070  0.095  0.068  0.082  0.047  0.039  0.037  0.040
      0.038  0.041  0.032  0.027  0.023  0.022  0.014  0.007  0.006  0.006
      0.007  0.009  0.007  0.006  0.043
* HDV3       M5 HDVs (Combined HDGV and HDDV)
   7  0.133  0.102  0.070  0.095  0.068  0.082  0.047  0.039  0.037  0.040
      0.038  0.041  0.032  0.027  0.023  0.022  0.014  0.007  0.006  0.006
      0.007  0.009  0.007  0.006  0.043
* HDV4       M5 HDVs (Combined HDGV and HDDV)
   8  0.133  0.102  0.070  0.095  0.068  0.082  0.047  0.039  0.037  0.040
      0.038  0.041  0.032  0.027  0.023  0.022  0.014  0.007  0.006  0.006
      0.007  0.009  0.007  0.006  0.043
* HDV5       M5 HDVs (Combined HDGV and HDDV)
   9  0.133  0.102  0.070  0.095  0.068  0.082  0.047  0.039  0.037  0.040
      0.038  0.041  0.032  0.027  0.023  0.022  0.014  0.007  0.006  0.006
      0.007  0.009  0.007  0.006  0.043
* HDV6       M5 HDVs (Combined HDGV and HDDV)
  10  0.133  0.102  0.070  0.095  0.068  0.082  0.047  0.039  0.037  0.040
      0.038  0.041  0.032  0.027  0.023  0.022  0.014  0.007  0.006  0.006
      0.007  0.009  0.007  0.006  0.043
* HDV7       M5 HDVs (Combined HDGV and HDDV)
  11  0.133  0.102  0.070  0.095  0.068  0.082  0.047  0.039  0.037  0.040
      0.038  0.041  0.032  0.027  0.023  0.022  0.014  0.007  0.006  0.006
      0.007  0.009  0.007  0.006  0.043
* HDV8a      M5 HDVs (Combined HDGV and HDDV)
  12  0.133  0.102  0.070  0.095  0.068  0.082  0.047  0.039  0.037  0.040
      0.038  0.041  0.032  0.027  0.023  0.022  0.014  0.007  0.006  0.006
      0.007  0.009  0.007  0.006  0.043
* HDV8b      M5 HDVs (Combined HDGV and HDDV)
  13  0.133  0.102  0.070  0.095  0.068  0.082  0.047  0.039  0.037  0.040
      0.038  0.041  0.032  0.027  0.023  0.022  0.014  0.007  0.006  0.006
      0.007  0.009  0.007  0.006  0.043
* HDBS       M5 HDVs (Combined HDGV and HDDV)
  14  0.133  0.102  0.070  0.095  0.068  0.082  0.047  0.039  0.037  0.040
      0.038  0.041  0.032  0.027  0.023  0.022  0.014  0.007  0.006  0.006
      0.007  0.009  0.007  0.006  0.043
```

```
* HDBT        M5 HDDVs
   15  0.163  0.137  0.087  0.103  0.067  0.074  0.044  0.035  0.032  0.054
       0.040  0.044  0.029  0.026  0.018  0.016  0.010  0.004  0.004  0.003
       0.002  0.002  0.001  0.001  0.004
* Motorcycles  M5 MC
   16  0.138  0.105  0.080  0.070  0.068  0.053  0.053  0.041  0.029  0.021
       0.022  0.320  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
       0.000  0.000  0.000  0.000  0.000
```

North Carolina

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REG DIST
*Convert MOBILE5 Registration Fractions to MOBILE6-Based Registration Fractions
*
*Calendar Year:       1995.000User-Input
*
*MOBILE5b Reg Fractions
*      0.064  0.057  0.066  0.063  0.067  0.065  0.074  0.064  0.061  0.052
*      0.048  0.046  0.049  0.044  0.037  0.031  0.025  0.019  0.011  0.006
*      0.005  0.005  0.007  0.006  0.028
*      0.060  0.052  0.056  0.055  0.060  0.049  0.054  0.059  0.045  0.038
*      0.036  0.035  0.045  0.046  0.042  0.043  0.033  0.031  0.021  0.014
*      0.013  0.011  0.018  0.017  0.067
*      0.245  0.038  0.057  0.040  0.046  0.028  0.059  0.034  0.023  0.016
*      0.017  0.012  0.018  0.016  0.009  0.009  0.008  0.005  0.004  0.002
*      0.002  0.003  0.005  0.004  0.300
*      0.118  0.032  0.027  0.020  0.031  0.024  0.031  0.017  0.015  0.015
*      0.011  0.013  0.014  0.012  0.010  0.010  0.009  0.006  0.003  0.003
*      0.003  0.004  0.005  0.004  0.563
*      0.064  0.057  0.066  0.063  0.067  0.065  0.074  0.064  0.061  0.052
*      0.048  0.046  0.049  0.044  0.037  0.031  0.025  0.019  0.011  0.006
*      0.005  0.005  0.007  0.006  0.028
*      0.060  0.052  0.056  0.055  0.060  0.049  0.054  0.059  0.045  0.038
*      0.036  0.035  0.045  0.046  0.042  0.043  0.033  0.031  0.021  0.014
*      0.013  0.011  0.018  0.017  0.067
*      0.115  0.095  0.110  0.060  0.083  0.057  0.067  0.052  0.040  0.029
*      0.029  0.041  0.041  0.040  0.034  0.024  0.023  0.018  0.007  0.007
*      0.006  0.005  0.006  0.003  0.008
*      0.223  0.028  0.024  0.018  0.016  0.016  0.012  0.012  0.009  0.007
*      0.005  0.630  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
*      0.000  0.000  0.000  0.000  0.000
*
*
* MOBILE6 Vehicle Classes:
*  1  LDV    Light-Duty Vehicles (Passenger Cars)
*  2  LDT1   Light-Duty Trucks 1 (0-6,000 lbs. GVWR, 0-3750 lbs. LVW)
*  3  LDT2   Light Duty Trucks 2 (0-6,000 lbs. GVWR, 3751-5750 lbs. LVW)
*  4  LDT3   Light Duty Trucks 3 (6,001-8500 lbs. GVWR, 0-3750 lbs. LVW)
*  5  LDT4   Light Duty Trucks 4 (6,001-8500 lbs. GVWR, 3751-5750 lbs. LVW)
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*  6  HDV2B  Class 2b Heavy Duty Vehicles (8501-10,000 lbs. GVWR)
*  7  HDV3   Class 3 Heavy Duty Vehicles (10,001-14,000 lbs. GVWR)
*  8  HDV4   Class 4 Heavy Duty Vehicles (14,001-16,000 lbs. GVWR)
*  9  HDV5   Class 5 Heavy Duty Vehicles (16,001-19,500 lbs. GVWR)
* 10  HDV6   Class 6 Heavy Duty Vehicles (19,501-26,000 lbs. GVWR)
* 11  HDV7   Class 7 Heavy Duty Vehicles (26,001-33,000 lbs. GVWR)
* 12  HDV8A  Class 8a Heavy Duty Vehicles (33,001-60,000 lbs. GVWR)
* 13  HDV8B  Class 8b Heavy Duty Vehicles (>60,000 lbs. GVWR)
* 14  HDBS   School Busses
* 15  HDBT   Transit and Urban Busses
* 16  MC     Motorcycles (All)
*
*              RESULTING MOBILE6-BASED REGISTRATION FRACTIONS
*
*MOBILE6 REGISTRATION FRACTIONS BY VEHICLE CLASS AND AGE
* LDV        M5 LDGV
   1  0.064  0.057  0.066  0.063  0.067  0.065  0.074  0.064  0.061  0.052
      0.048  0.046  0.049  0.044  0.037  0.031  0.025  0.019  0.011  0.006
      0.005  0.005  0.007  0.006  0.028
* LDT1       M5 LDGT1
   2  0.060  0.052  0.056  0.055  0.060  0.049  0.054  0.059  0.045  0.038
      0.036  0.035  0.045  0.046  0.042  0.043  0.033  0.031  0.021  0.014
      0.013  0.011  0.018  0.017  0.067
* LDT2       M5 LDGT1
   3  0.060  0.052  0.056  0.055  0.060  0.049  0.054  0.059  0.045  0.038
      0.036  0.035  0.045  0.046  0.042  0.043  0.033  0.031  0.021  0.014
      0.013  0.011  0.018  0.017  0.067
* LDT3       M5 LDGT2
   4  0.245  0.038  0.057  0.040  0.046  0.028  0.059  0.034  0.023  0.016
      0.017  0.012  0.018  0.016  0.009  0.009  0.008  0.005  0.004  0.002
      0.002  0.003  0.005  0.004  0.300
* LDT4       M5 LDGT2
   5  0.245  0.038  0.057  0.040  0.046  0.028  0.059  0.034  0.023  0.016
      0.017  0.012  0.018  0.016  0.009  0.009  0.008  0.005  0.004  0.002
      0.002  0.003  0.005  0.004  0.300
* HDV2B        M5 HDVs (Combined HDGV and HDDV)
   6  0.117  0.059  0.062  0.037  0.053  0.038  0.046  0.032  0.025  0.021
      0.018  0.025  0.025  0.024  0.020  0.016  0.015  0.011  0.005  0.005
      0.004  0.004  0.005  0.004  0.327
* HDV3       M5 HDVs (Combined HDGV and HDDV)
   7  0.117  0.059  0.062  0.037  0.053  0.038  0.046  0.032  0.025  0.021
      0.018  0.025  0.025  0.024  0.020  0.016  0.015  0.011  0.005  0.005
      0.004  0.004  0.005  0.004  0.327
* HDV4       M5 HDVs (Combined HDGV and HDDV)
   8  0.117  0.059  0.062  0.037  0.053  0.038  0.046  0.032  0.025  0.021
      0.018  0.025  0.025  0.024  0.020  0.016  0.015  0.011  0.005  0.005
      0.004  0.004  0.005  0.004  0.327
* HDV5       M5 HDVs (Combined HDGV and HDDV)
   9  0.117  0.059  0.062  0.037  0.053  0.038  0.046  0.032  0.025  0.021
      0.018  0.025  0.025  0.024  0.020  0.016  0.015  0.011  0.005  0.005
      0.004  0.004  0.005  0.004  0.327
```

* HDV6 M5 HDVs (Combined HDGV and HDDV)
10 0.117 0.059 0.062 0.037 0.053 0.038 0.046 0.032 0.025 0.021
0.018 0.025 0.025 0.024 0.020 0.016 0.015 0.011 0.005 0.005
0.004 0.004 0.005 0.004 0.327
* HDV7 M5 HDVs (Combined HDGV and HDDV)
11 0.117 0.059 0.062 0.037 0.053 0.038 0.046 0.032 0.025 0.021
0.018 0.025 0.025 0.024 0.020 0.016 0.015 0.011 0.005 0.005
0.004 0.004 0.005 0.004 0.327
* HDV8a M5 HDVs (Combined HDGV and HDDV)
12 0.117 0.059 0.062 0.037 0.053 0.038 0.046 0.032 0.025 0.021
0.018 0.025 0.025 0.024 0.020 0.016 0.015 0.011 0.005 0.005
0.004 0.004 0.005 0.004 0.327
* HDV8b M5 HDVs (Combined HDGV and HDDV)
13 0.117 0.059 0.062 0.037 0.053 0.038 0.046 0.032 0.025 0.021
0.018 0.025 0.025 0.024 0.020 0.016 0.015 0.011 0.005 0.005
0.004 0.004 0.005 0.004 0.327
* HDBS M5 HDVs (Combined HDGV and HDDV)
14 0.117 0.059 0.062 0.037 0.053 0.038 0.046 0.032 0.025 0.021
0.018 0.025 0.025 0.024 0.020 0.016 0.015 0.011 0.005 0.005
0.004 0.004 0.005 0.004 0.327
* HDBT M5 HDDVs
15 0.115 0.095 0.110 0.060 0.083 0.057 0.067 0.052 0.040 0.029
0.029 0.041 0.041 0.040 0.034 0.024 0.023 0.018 0.007 0.007
0.006 0.005 0.006 0.003 0.008
* Motorcycles M5 MC
16 0.223 0.028 0.024 0.018 0.016 0.016 0.012 0.012 0.009 0.007
0.005 0.630 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000 0.000

APPENDIX C

MODELING SCHEDULE ADJUSTMENT CORRESPONDENCE
(attached)

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 4
ATLANTA FEDERAL CENTER
61 FORSYTH STREET
ATLANTA, GEORGIA 30303-8960

MAY 2 9 2003

4APT-APB

Sheila Holman
Acting Chief
Planning Section
Division of Air Quality
NC Department of Environment and Natural Resources
1641 Mail Service Center
Raleigh, NC 27699-1641

Dear Ms. Holman:

Thank you for your May 19, 2003, letter requesting a modification to the modeling schedule for the Early Action Compact (EAC) areas within North Carolina. According to the revised schedule all of the photochemical modeling needed for the EAC will now be complete by August 29, 2003. EPA has reviewed your request and determined that this change is acceptable. This change does not impact the schedule in the protocol that determines the deferral of the effective date of the redesignations for the EAC areas. As you are aware the critical dates and milestones approaching are:

1. June 16, 2003 - Identify and describe local strategies being considered for inclusion in local clean air plans.
2. January 31, 2004 - Select local emission reduction strategies.
3. March 31, 2004 - Submit final EAP to NCDENR and EPA.

We appreciate the tremendous effort by North Carolina and the four EAC areas to meet these milestones and look forward to continuing to work with you on this effort. If you have any questions, please contact Dick Schutt, Chief, Regulatory Development Section, at 404/562-9033, or me at 404/562-9026.

Sincerely,

Kay T. Prince

Kay T. Prince, Chief
Air Planning Branch

NCDENR
North Carolina Department of Environment and Natural Resources
Division of Air Quality

Michael F. Easley, Governor

William G. Ross, Jr., Secretary
B. Keith Overcash, P.E., Director

May 19, 2003

Kay Prince
USEPA REGION 4
61 Forsyth Street, S.W.
Atlanta, GA 30303-8960

Ms. Prince:

This letter is to request an adjustment to the modeling schedule for the Early Action Compact (EAC) areas within North Carolina. North Carolina Division of Air Quality (NCDAQ) has been working with the developers of SMOKE to fully integrate MOBILE6.2 into the emissions preprocessor model and have successfully been able to complete this integration however it took much longer then at first believed. Additionally, the developers ran into problems porting this version of SMOKE to NCDAQ's HP UNIX workstation. It is believed that issues dealing with porting the software will be worked out this week at the latest.

Due to these unexpected delays, NCDAQ had not had the opportunity to process the base case episodes through SMOKE and therefore the photochemical modeling has not been able to begin. In the FAQs on Implementing the DRAFT 8-hour Ozone Modeling Guidance to Support Attainment Demonstrations for Early Action Compact (EAC), it states "EPA will work with State/Tribal/Local agencies to accommodate changes to schedules in EAC protocols that are internally set by these agencies (such as the May 31, 2003 date for completion of certain modeling activities) ....". NCDAQ would like to request such a change in schedule. Below is NCDAQ's suggested revised schedule through August, 2003.

June 17, 2003	Complete photochemical modeling performance on the June, 1996 modeling episodes
June 30, 2003	Complete photochemical modeling performance on the July, 1997 modeling episode
July 14, 2003	Complete photochemical modeling performance on the July, 1995 modeling episode
July 31, 2003	Complete photochemical modeling runs for the current year (2000) inventories with the meteorology from the four base year episodes
August 29, 2003	Complete photochemical modeling runs for the future year (2007) base case for all four episodes and review future year design values through the attainment test protocol.

Please let me know if EPA Region 4 has any issues with the above schedule.

Sincerely,

Sheila Holman
NC Department of Environment and Natural Resources
Division of Air Quality/Acting Chief of Planning Section

AIR PLANNING BRANCH
MAY 27 2003
EPA-REGION #4
ATLANTA, GA.

Cc: Brock Nicholson
Laura Boothe

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