10.0 Attainment Demonstration

The 8-Hour Ozone Standard Attainment Plan analyzes the potential of the Washington metropolitan area to achieve attainment of the 8-hour ozone standard. The demonstration of achieving the 8-hour ozone standard is based both Community Multiscale Air Quality Model (CMAQ) and a number of Weight of Evidence tests supporting the attainment modeling results. Details of both CMAQ model and the Weight of Evidence tests are being provided below.

10.1 Modeling Demonstration

On June 15, 2004, EPA revoked the 1-hour ozone standard and re-designated the Washington D.C. MSA as a "Moderate" ozone non-attainment area for the new 8-hour ozone standard. Moderate ozone non-attainment areas are required to demonstrate attainment of the new 8-hour ozone standard using photochemical modeling and Weight-of-Evidence analyses.

For the reason mentioned above, a photochemical modeling study was undertaken by Virginia Dept. of Environmental Quality on behalf of the Washington metropolitan area to demonstrate attainment of the 8-hour ozone NAAQS. Details of this modeling are being provided below:

10.2 Local Modeling Tools

Virginia Department of Environmental Quality (VADEQ), in consultation with the Maryland Department of the Environment (MDE), District Department of the Environment (DCDOE) and MWCOG was responsible for conducting the CMAQ runs for the Washington, D.C. domain. This effort was pursued in conjunction with the modeling effort of Ozone Transport Commission (OTC). A similar modeling effort was also undertaken at the University of Maryland (UMD) in conjunction with OTC, which supplemented the effort taken at VADEQ.

The selected modeling tool for attainment modeling is the EPA's Models-3/Community Multi-scale Air Quality (CMAQ) modeling system, which is a 'One-Atmosphere' photochemical grid model capable of addressing ozone at regional scale and is considered one of the preferred models for regulatory modeling applications. The model is recommended by the Guidance on the Use of Models and Other Analyses in Attainment Demonstrations for the 8-hour Ozone NAAQS (EPA-454/R-05-002, October 2005).

Furthermore, following other factors were also considered while choosing CMAQ as a qualifying air quality model to support the Washington, D.C. attainment demonstration for the 8-hour ozone NAAQS:

1. Documentation and past track record of in similar applications;
2. Advanced science and technical features available in the modeling system;
3. Experience of staff; and
4. Required time and resources versus available time and resources.

CMAQ was thoroughly validated and tested for this modeling application to ensure acceptable performance. The model evaluation was conducted in accordance with EPA guidance.

Detailed CMAQ configurations for the OTC platform are provided in Appendix ? (Protocol for Regulatory Photochemical Air Quality Modeling of the Washington, DC Metropolitan Region, November 15, 2005), which was also the modeling platform used by VADEQ. The protocol documents the procedures for conducting the modeling study including:

- background, objectives and organizational structure for the study;
- methods for developing the input databases;
- techniques for quality assurance and diagnostic model analyses; and,
- model performance evaluations and interpreting model results.

Though the modeling runs were performed for the entire 12 km OTC modeling domain using the projection modeling inventories for the entire domain, analyses of the results were focused on the Washington nonattainment region. The boundaries of the OTC 12 km modeling domain are shown in Figure 10-1.

10.3 Inputs to the Local Model

To use the CMAQ to perform the modeling study, following inputs must be decided:

- Conceptual Model
- Domain
- Episodes
- Initial and Boundary Conditions
- Meteorological Model
- Inventory

Once a domain and base case (real) episodes are selected, the modelers input the weather conditions, emissions inventories and boundary conditions during those episodes and compare the model results with the actual monitor readings (real air quality observations). In this way they can test the model performance or accuracy. If the model can faithfully reproduce actual episode conditions, then the amount and type of emissions in the inventory can be modified to test the effect such changes might have on air quality.

<u>Conceptual Model</u>

EPA recommends that a conceptual description of the area's ozone problem be developed prior to the initiation of any air quality modeling study. A "conceptual description" is a qualitative way of characterizing the nature of an area's nonattainment problem. Within the conceptual description of a particular modeling exercise, it is recommended that the specific meteorological parameters that influence air quality be identified and qualitatively ranked in importance.

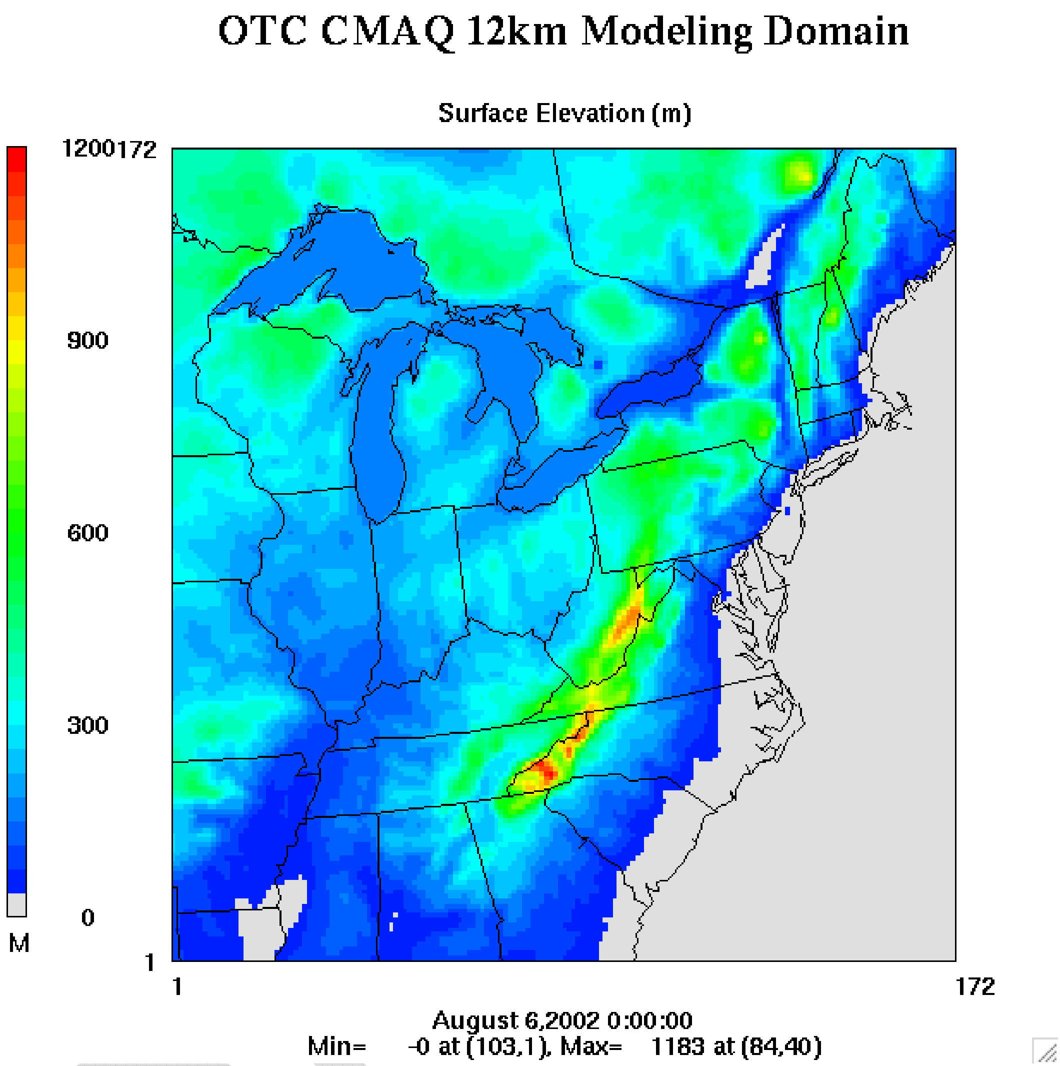
The conceptual model for this study consists of the following components as provided in Appendix D of the modeling protocol document:

1. A qualitative analysis of the 2002 ozone season (Ryan and Piety 2002, 2005)
2. The Ozone <u>Episode Classification Project for Ozone Transport Commission</u> (Environ 2005)
3. Portions of the MDE conceptual model presentation.

<u>Modeling Domain</u>

The boundaries of the OTC and ASIP CMAQ modeling domains are provided in Figure 10-1. Final SIP modeling analysis utilized the modeling domain boundaries established by OTC.

Figure 10-1



A. Horizontal Grid Size

The OTC and ASIP platforms which provide the basic platform for the Washington, D.C. modeling analysis both utilized a coarse grid continental United States (US) domain with a 36-km horizontal grid resolution. The CMAQ domain is nested in the MM5 domain. A larger MM5 domain was selected for both MM5 simulations to provide a buffer of several grid cells around each boundary of the CMAQ 36 km domain. This is designed to eliminate any errors in the meteorology from boundary effects in the MM5 simulation at the interface of the MM5 model. The buffer region used in both the OTC and ASIP simulations exceed the EPA suggestion of at least a 5 grid cell buffer at each boundary.

The horizontal grid size for the both regional modeling domains is 12-km. As part of this modeling exercise and to address EPA recommendations, diagnostic and sensitivity tests were conducted for both 12-km and 4-km grid resolutions. The results of these analyses resulted in the following conclusions:

1. The modeling results with 12-km grid cell size are slightly better than the modeling results using a 4-km grid resolution.

2. The increased computer costs, run times and data base management needs associated with the finer grid scales in combination with the performance results do not support the use of 4-km grid resolution modeling.

Appendix G of the modeling protocol contains the horizontal grid definitions for the MM5 and CMAQ modeling domains used in the OTC/MANE-VU and ASIP/VISTAS modeling analyses.

B. Vertical Resolution

The CMAQ vertical structure is primarily defined by the vertical grid used in the MM5 modeling. The MM5 model employed a terrain following coordinate system defined by pressure. The layer averaging scheme adopted for CMAQ is designed to reduce the computational cost of the CMAQ simulations. The effects of layer averaging have a relatively minor effect on the model performance metrics when compared to ambient monitoring data.

Appendix H of the modeling protocol contains the vertical layer definitions for the MM5 and CMAQ modeling domains used in the two regional modeling analyses.

Episodes

The procedures for selecting 8-hr ozone modeling episodes seek to achieve a balance between good science and regulatory needs and constraints. Recent research has shown that model performance evaluations and the response to emissions controls need to consider modeling results from long time periods. In order to examine the response to ozone control strategies, it may not be necessary to model a full ozone season (or seasons), but it is recommended by EPA to model "longer" episodes that encompass full synoptic cycles.

The policy and technical criteria that influenced episode selection for this study include:

1. Choose a mix of episodes reflecting a variety of meteorological conditions which frequently correspond with observed 8-hour daily maxima greater than 84 ppb at multiple monitoring sites.
2. Model periods in which observed 8-hour daily maximum concentrations are close to the average 4th high 8-hour daily maximum ozone concentrations.
3. Model periods for which extensive air quality/meteorological data bases exist.
4. Model a sufficient number of days so that the modeled attainment test applied at each monitor violating the NAAQS is based on at least several days (i.e., 10 days).

A two-tiered approach was applied in the selection of modeling episodes. A major portion of the 2002 ozone season (May 1 to September 30) was simulated in the final SIP modeling analysis. However, it may be beneficial to model smaller episode periods during the control strategy evaluation process to maximize the number of strategies that can be modeled. Therefore, individual modeling episodes were also evaluated as part of this process.

The individual smaller episode selection process gave preference to episodes occurring during the current average design value period. Additionally, multi-day episodes were given preference to attempt to ensure that there were several days with monitored ozone concentrations near the site-specific design value at each monitoring site in the nonattainment area.

The rationale for distinguishing among individual modeled episodes was conducted using a qualitative analysis (Ryan and Piety 2002) (Appendix D of modeling protocol) and a quantitative analysis conducted by the consultant for OTC (Environ 2005) (Appendix D of modeling protocol).

The qualitative analysis was conducted through an evaluation of weather maps (surface and aloft) and air quality measurements, in order to distinguish between individual episodes with distinctively different meteorological regimes. Specifically, the qualitative analysis involved the evaluation of phenomenological variables, some of which are present during each high ozone weather pattern in Washington, D.C. These include, but are not limited to, the following:

1. The presence of a migrating continental surface high pressure
2. The strength and location of the upper air (500 mb) ridge
3. Warm air advection in boundary layer prior to the episode onset
4. Residual layer of high ozone aloft indicating transport of ozone and ozone precursors
5. Appalachian Lee Trough (ALT) associated with a pollutant convergence zone east of the Appalachians.
6. Easterly Flow Reversal indicating transport from Northeast Corridor
7. Low-Level Jet indicating transport from a southerly direction
8. Re-circulation and frontal boundaries

The result of this process produced the following proposed individual episodes:

4. Episode of June 10-12, 2002
5. Episode June 22-26, 2002
6. Episode of July 1-3, 2002
7. Episode of July 31-August 5, 2002
8. Episode of August 10-14, 2002
9. Episode of September 9-10, 2002

The individual episodes were run in a "hot start" mode. Therefore, no "spin-up" days were required. The initial and boundary conditions for the individual episodes were obtained from either the OTC or the ASIP annual simulation.

The following three individual episode "periods" were selected to encompass these individual episodes:

1. Episode of June 6-July 5, 2002
2. Episode of July 27-August 16, 2002
3. Episode of September 5-12, 2002

Initial and Boundary Conditions

The influence of boundary conditions shall be minimized to the extent possible. The modeling domains for both OTC and ASIP are large enough to allow the use of clean or relatively clean boundary conditions.

Prior experiences have shown that a 3-day ramp-up period is sufficient to establish pollutant levels that are encountered in the beginning of the ozone episode. The initial conditions at the startup would be for "clean" conditions.

In prior studies attempts have been made to include any information that is available from ozonesonde and from monitors that are near the boundaries of the modeling domain. For this study, similar attempts will be made to obtain pollutant data at the boundaries. In the absence of reliable boundary condition data, "clean conditions" will be assumed for boundary conditions.

Meteorological Model

The Pennsylvania State University/National Center for Atmospheric Research (PSU/NCAR) Mesoscale Meteorological Model (MM5) was selected for application in the Washington, D.C. nonattainment modeling analysis. MM5 is a non-hydrostatic, prognostic meteorological model routinely used for urban- and regional-scale photochemical regulatory modeling studies.

Results of detailed performance evaluations of the MM5 modeling system in regulatory air quality application studies have been widely reported in the literature (i.e., Emery et al. 1999; Tesche et al., 2000, 2003) and many have involved comparisons with other prognostic models such as RAMS and SAIMM. The MM5 enjoys a far richer application history in regulatory modeling studies compared with RAMS or other models. Furthermore, in evaluations of these models in over 60 recent regional scale air quality application studies since 1995, it has been generally found that MM5 model tends to produce somewhat better photochemical model inputs than alternative models. For these reasons MM5 was selected as the meteorological modeling system for this modeling application.

Based on model validation and sensitivity testing, the MM5 configurations provided in Appendix I of the modeling protocol were selected by OTC and ASIP.

Inventory

The estimate of ozone forming emissions (emissions inventory) is a third component of the inputs to the model exercise. In this case, the information for the emissions inventory came from a number of sources, depending on the type of emissions. Methodology to prepare these inventories is provided in detail in Chapters 3 and 4.

Tables 10-1 summarizes 2002 and 2009 inventories used as the basis for the model analysis. This description of inventory data is very simplified. The details of inventory preparation and use are contained in Section 10.6.

Table 10-1
2002 and 2009 Anthropogenic Emissions Inventories in Tons per Day

Washington Nonattainment Area used for Modeling

Emissions Type	VOC (tpd)		NOx (tpd)	
	2002	2009	2002	2009
Point				
Area				
Mobile				
Non-road				
Total				
Change				

10.4 Local Model Results

The Virginia Department of Environmental Quality (VADEQ) performed the model runs for the episodes selected using the 2002 (base) inventories and the projection emissions inventories. The results of that work are contained in (*name of the Attainment Demonstration Modeling Report for the Washington DC-MD-VA Ozone Nonattainment Area)* (Appendix ?). Following are the main conclusions of that report.

10.5 Regional Modeling: Tools and Results

10.6 Development of the Modeling Emissions Inventory

Developing emissions inventories for the modeling domain is a crucial step in the modeling process. Ozone precursor emission inventories for the base year 2002 and attainment year 2009 were needed to pursue the attainment modeling. Methodology to prepare these two inventories along with inventory data is provided in detail in Chapters 3 and 4. These inventories need to be processed in order to be accepted by the photochemical model. Temporal and spatial profiles of these inventories are developed for this purpose using an emissions processor, SMOKE 2.1, which processes point, area, mobile, and biogenic emissions.

10.7 Weight of Evidence Tests

All photochemical models including the CMAQ 4.5 model has inherent uncertainties. Over or under prediction may result from uncertainties associated with emission inventories, meteorological data, and representation of ozone photochemistry in the model. Therefore, EPA photochemical modeling guidance document provides for other evidence (Weight of Evidence) to address these model uncertainties so that proper assessment of the probability to attain eight-hour ozone standard can be made.

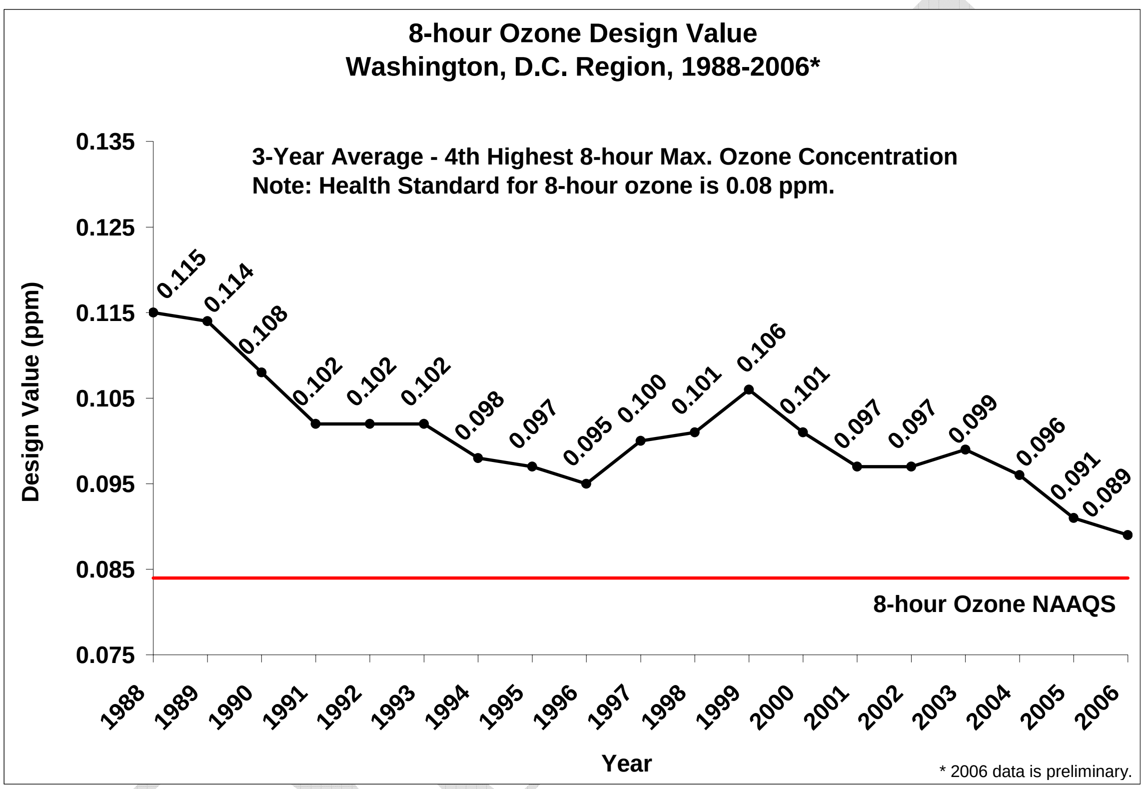
There were number of Weight of Evidence tests employed to test the potential of Washington region to attain the eight-hour standard in 2009. They were:

Details of each of these tests are being provided below.

Trend in 8-hour Ozone Design Value

Trend in the 8-hour ozone design values between 1988 and 2006 is shown in Figure 10-2. It is clear that the design value has significantly decreased during this period from 0.115 ppm in 1988 to 0.089 ppm in 2006.

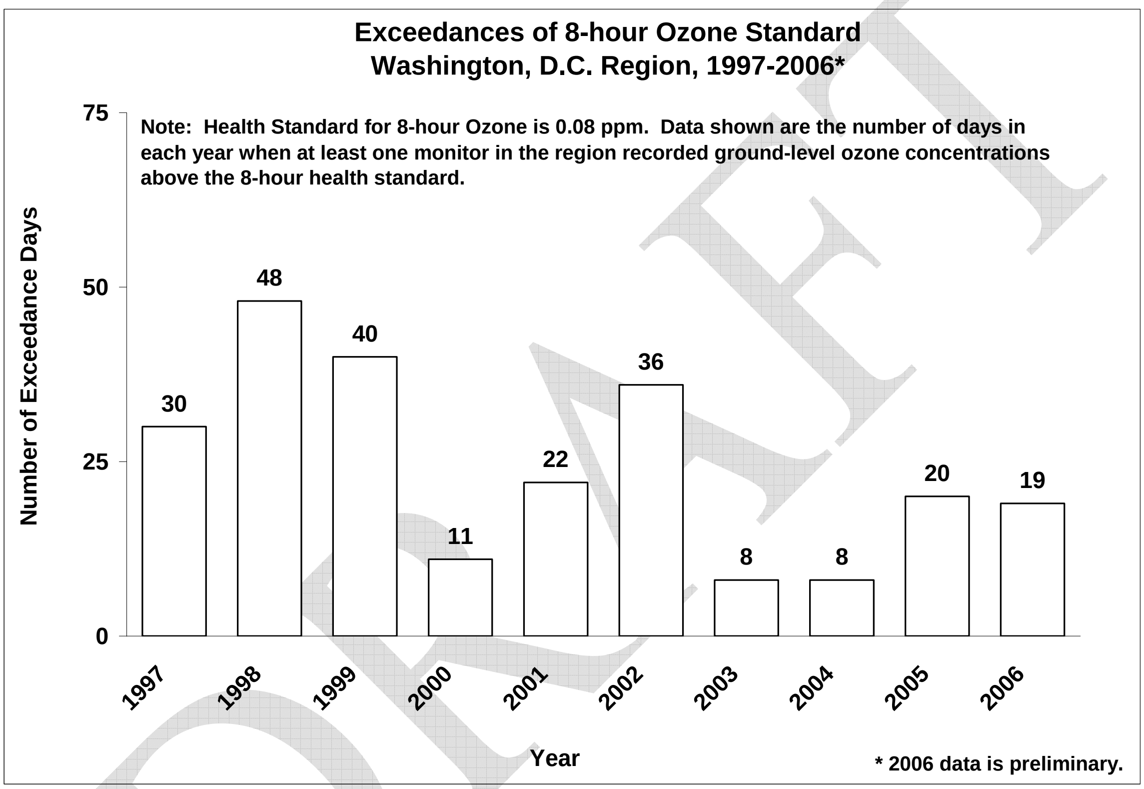
Figure 10-2: Trend in 8-Hour Ozone Design Value in the Washington, DC-MD-VA Nonattainment Area



Trend in Exceedance Count across All Monitors

The trend in the total number of exceedances at the monitor recording the highest number of exceedances between 1997 and 2006 is shown in Figure 10-3. Monitor exceedances occur whenever a monitor's 8-hour ozone concentration is greater than or equal to 0.08 ppm. Though the number of monitors in the Washington, DC-MD-VA 8-hour nonattainment area has actually increased by 20% (15 in 1997 to 18 in 2006), the number of exceedances decreased by 37% (30 in 1997 to 19 in 2006).

Figure 10-3: Trend in Monitored Exceedances across All Monitors in the Washington, DC-MD-VA Nonattainment Area

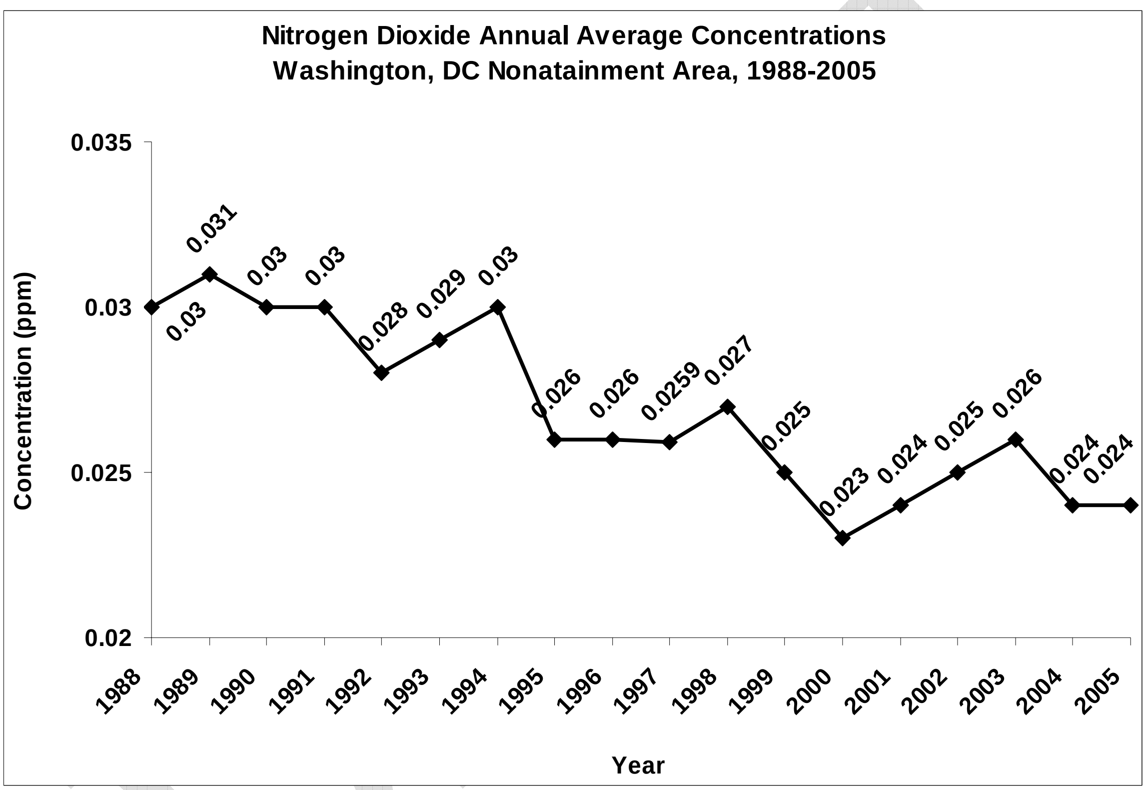


Trend in Nitrogen Dioxide Levels

The trend in nitrogen dioxide levels between 1988 and 2005 is shown in Figure 10-4. It is clear from the figure that the levels overall have been declining between 1988 and 2005. A significant

(0.06 ppm) decrease is visible between the two years (1988-2005). The NAAQS for NOx (Annual Mean Concentration) is 0.053 ppm and therefore the region is well below the standard. As NOx is a very important factor in ozone formation, its decline over the years has been the one of the main reasons behind the reduction in ozone levels in the region.

Figure 10-4: Trend in Nitrogen Dioxide Annual Average Concentration in the Washington, DC-MD-VA Nonattainment Area

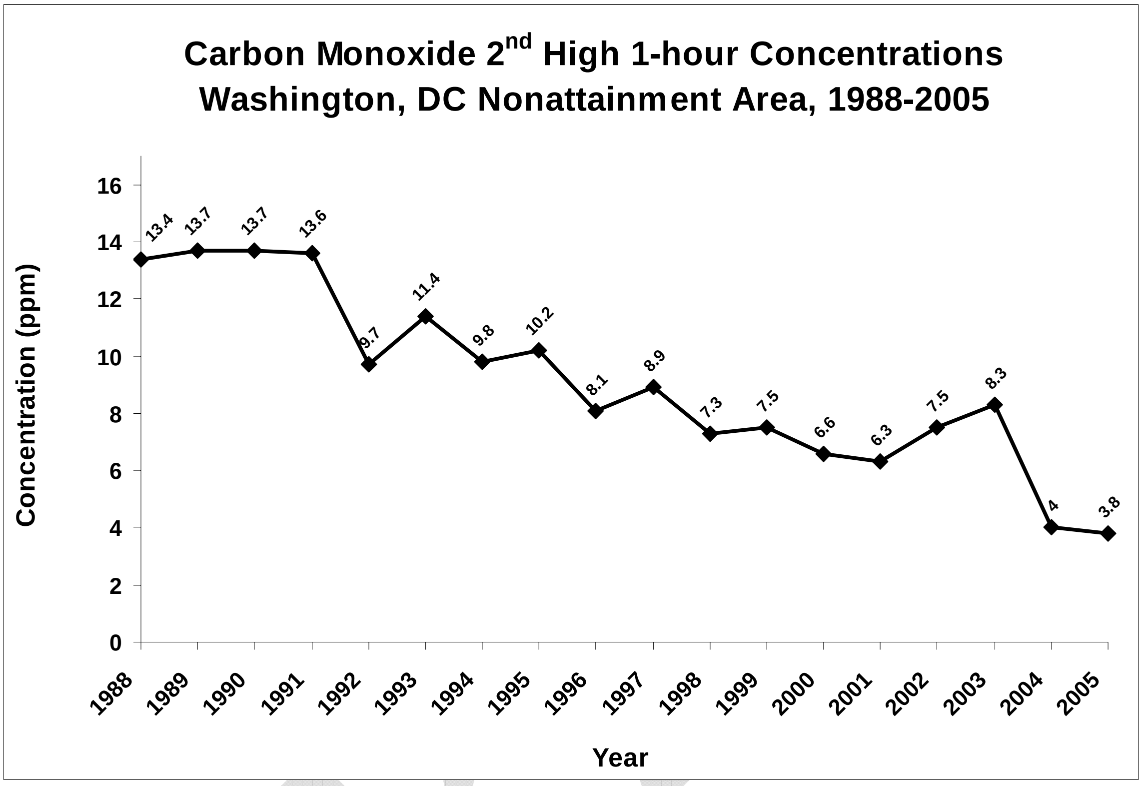


Trend in Carbon Monoxide Levels

The trend in Carbon monoxide levels between 1988 and 2006 is shown in Figure 10-5. It is clear from the figure that the levels have almost consistently been declining between 1988 and 2005.

A significant (approximately 10 ppm) decrease is visible between the two years (1988-2005).

Figure 10-5: Trend in 2nd High 1-Hour Carbon Monoxide Concentration in the Washington, DC-MD-VA Nonattainment Area



Trend in VOC and NOx Emissions

A comparison of VOC and NOx emissions in the years 2002, 2008, and 2009 is shown in Figures 5 and 6.

It is clear from Figure 10-6 that VOC emissions are projected to decrease between 2002 and 2009 for nonroad and onroad sources. Point source VOC emission will be increasing a little bit in 2008 and 2009, while area sources will go down in 2008 and then increase again in 2009 by a very small margin. However, total combined VOC emissions will decrease significantly in 2008 and 2009 from 2002 levels.

Figure 10-7 shows that NOx emissions are projected to decrease between 2002 and 2009 for nonroad and onroad sources. Area source NOx emission will be increasing a little bit in 2008 and 2009, while point source NOx emission will increase slightly in 2008 and then decrease by almost 50 percent in 2009. However, total combined NOx emissions will decrease significantly in 2008 and 2009 from 2002 levels.

Figure 10-6: VOC Emissions in the Washington, DC-MD-VA Nonattainment Area

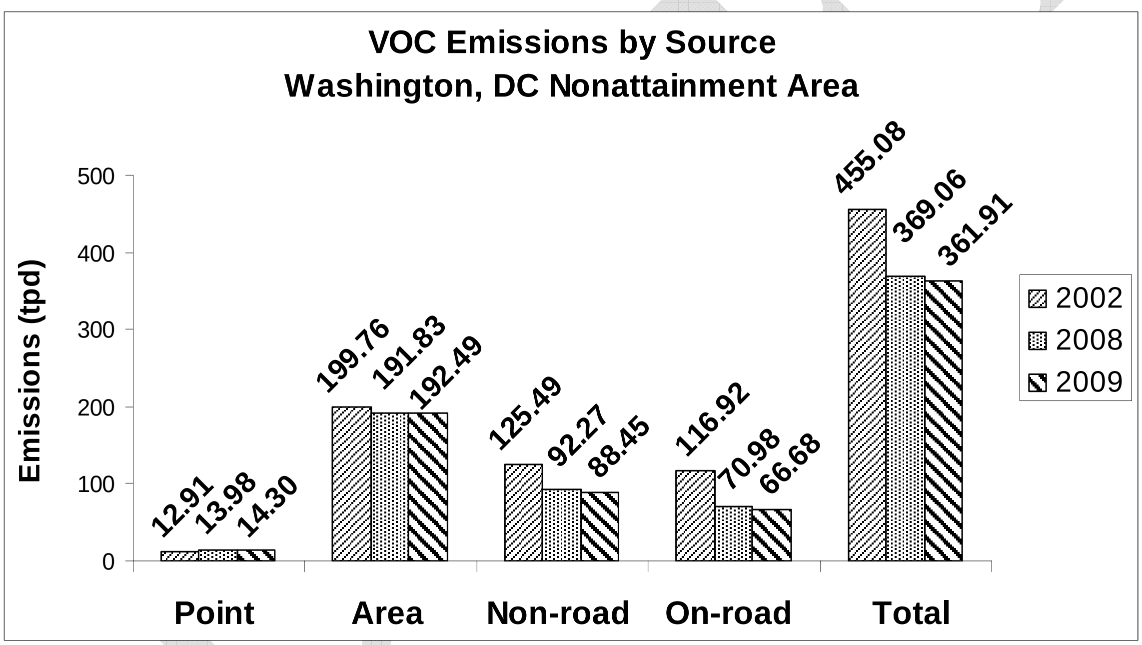
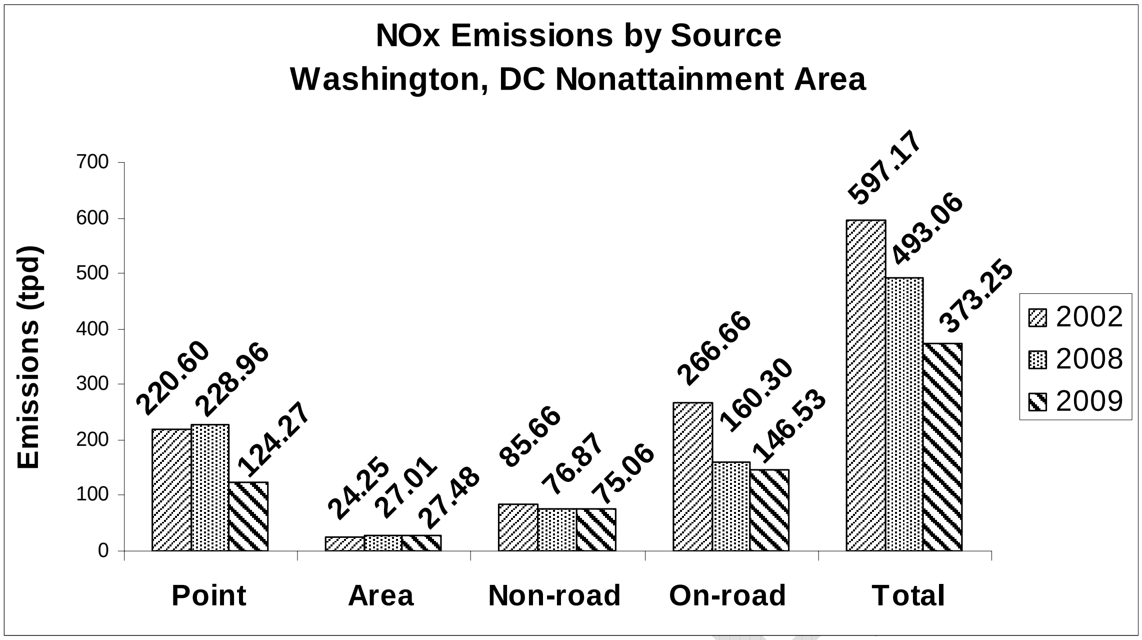


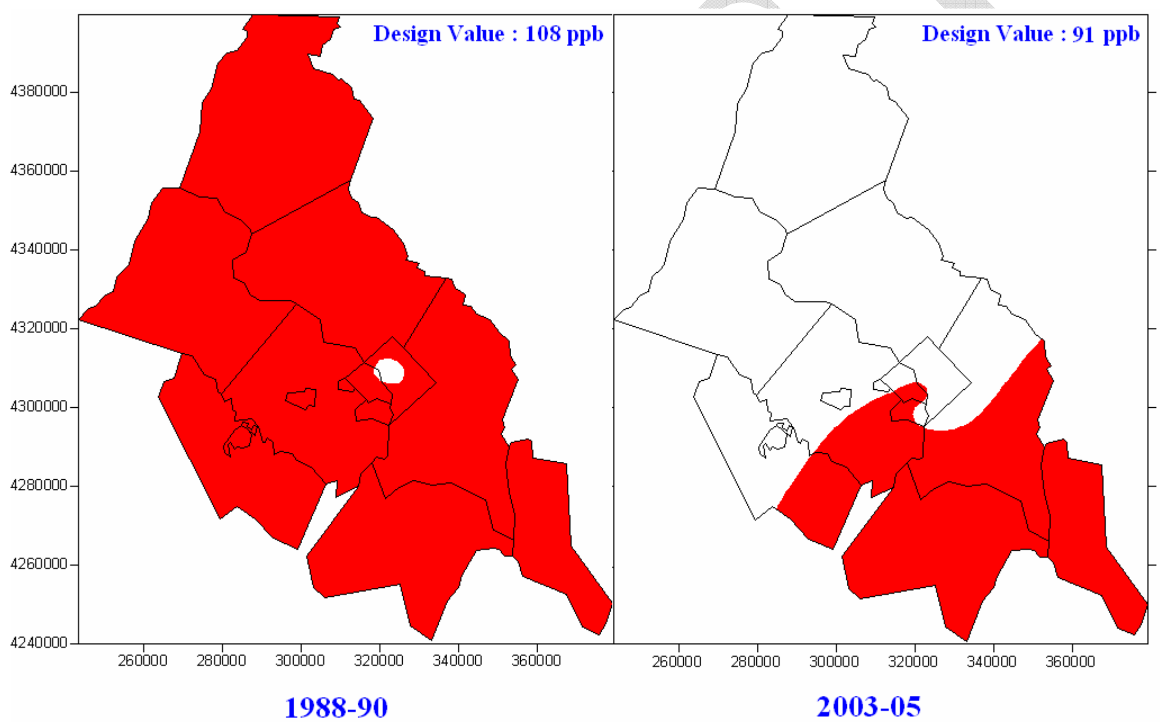
Figure 10-7: NOx Emissions in the Washington, DC-MD-VA Nonattainment Area



Spatial Extent of NAAQS Violations

The Washington, DC-MD-VA nonattainment area's geographical extent of violation has been decreasing in size since 1990. Figure 7 shows a decrease in the spatial extent of the nonattainment zone within the Washington, DC-MD-VA nonattainment region between 1990 and 2005. The actual nonattainment geographical area exceeding 8-hour ozone design value of 84 ppbv has been shown in red color in the figure. It is clear that almost entire Washington, DC metropolitan region was in nonattainment during 1988-1990. The 2003-2005 data show that the geographical extent of this area has reduced in size to portions of the District of Columbia, the city of Alexandria, and Arlington, Fairfax, Prince Williams, Charles, Calvert, and Prince George's counties. Ozone levels observed in these areas are not only the product of local emissions but are also impacted a great deal by the transport of ozone and its precursors from upwind areas. Not only the nonattainment zone in 2005 has been reduced to about 40% in size compared to 1990, but also the design value has also been reduced by about 16% from 108 ppb to 91 ppb.

Figure 10-8. Comparison of Nonattainment Zones within Washington, DC-MD-VA Nonattainment Area (1990 – 2005)



Trend in 8-Hour Ozone Exceedance Days and High Temperature Days

Ozone concentrations are quite dependent on meteorological conditions especially temperature. High temperatures help drive ozone production. Correlations can be made between ozone concentrations and meteorological variables such as the number of 90ºF days. Hot dry summers can produce long periods of elevated ozone concentrations while ozone production can be limited during cool and wet summers.

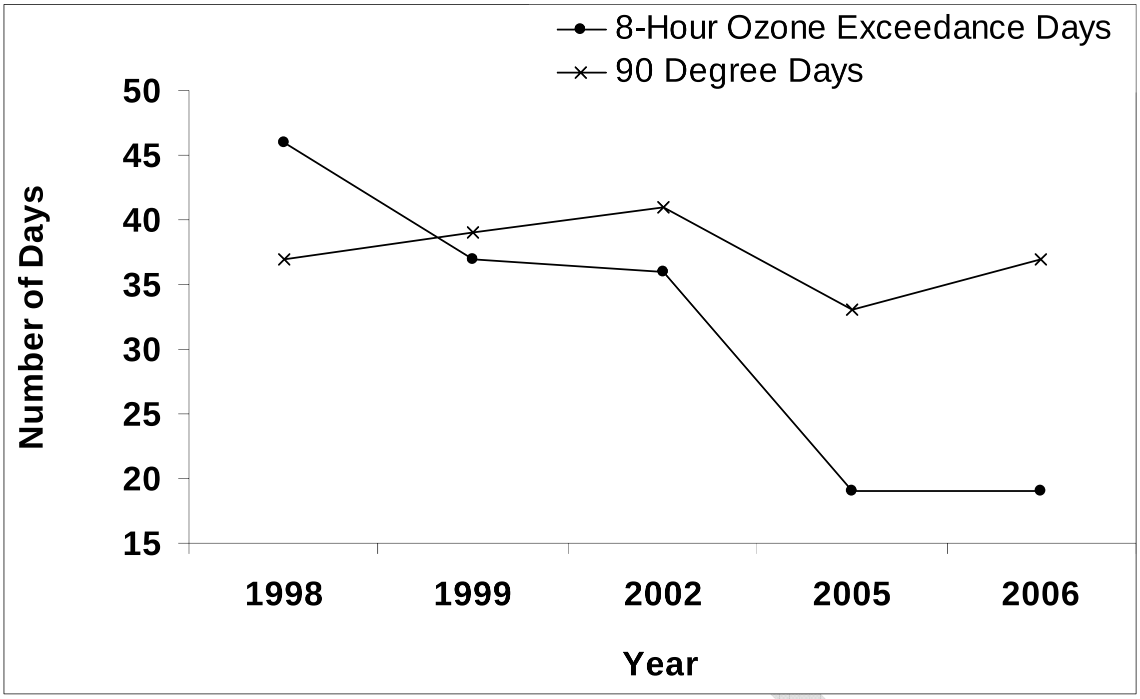
Temperature data from the Dulles International Airport were reviewed during years considered warmer than normal to determine any trends between 8-hour ozone values and high temperature days. The years analyzed were 1998, 2002, 2005, and 2006. During these years, there were more than 30 days when temperatures equaled or exceeded 90ºF. Table 10-2 lists the number of 8-hour ozone exceedance days and the days with temperatures ≥ 90ºF in each of the four years mentioned above in the Washington, DC-MD-VA nonattainment area. In comparing these years to 1998, there has been a decline of 25% (2002), 58% (2005) and 60% (2006) in the number of 8-hour ozone exceedance days.

Table 10-2: Temperature and 8-Hour Ozone Exceedances in the Washington, DC-MD-VA Ozone Nonattainment Area

Year	8-Hour Ozone Exceedance Days	Days with Max. Temp ≥ 90ºF
1998	48	37
2002	36	41
2005	20	33
2006	19	37

Trend in the number of 8-hour ozone exceedance days and the number of days with maximum temperature ≥ 90ºF is shown in Figure 10-9. A close look at the Figure 10-9 reveals the number of ozone exceedance days on decline since 1998 even though the number of high temperature days has remained high and at more or less the same level in the four analysis years. The reason behind fewer ozone exceedance days after 1998 can be attributed to lower emission levels. While during 1998 temperatures below 90ºF were able to cause an exceedance, beginning 1999 exceedances occurred only when temperature reached more than 90ºF due to lower emission levels. Thus it is clear that the emission levels have been decreasing over the years and since 1999 it has been reduced to such a level that it now required the temperature to be more than 90ºF in order to exceed. A number of federal control measures such as, Acid Rain Program (Phase 1 – 1996 & Phase 2 – 2000) and NOx SIP Call (2004) were implemented during 1996-2004 to control emissions level. Also a wide range of local and regional control measures were implemented by Maryland, Virginia, and the District of Columbia beginning 1996, full benefits of which began in 1998. Emissions reductions from all the above mentioned measures combined resulted in the decrease in the number of ozone exceedance days since 1998.

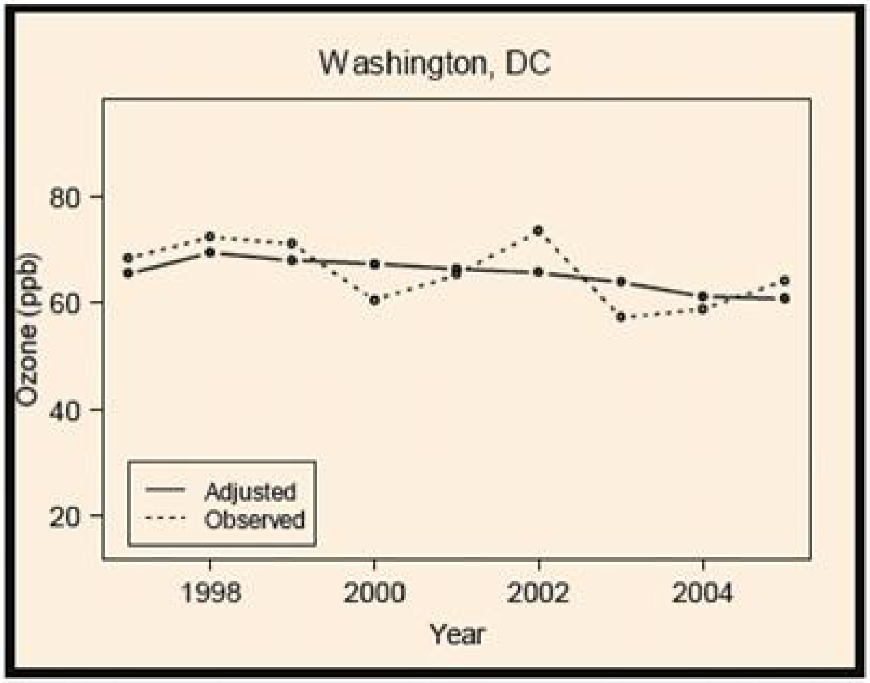
Figure 10-9: 8-Hour Ozone Exceedance Days and High Temperature Days (≥ 90ºF) in the Washington, DC-MD-VA Nonattainment Area

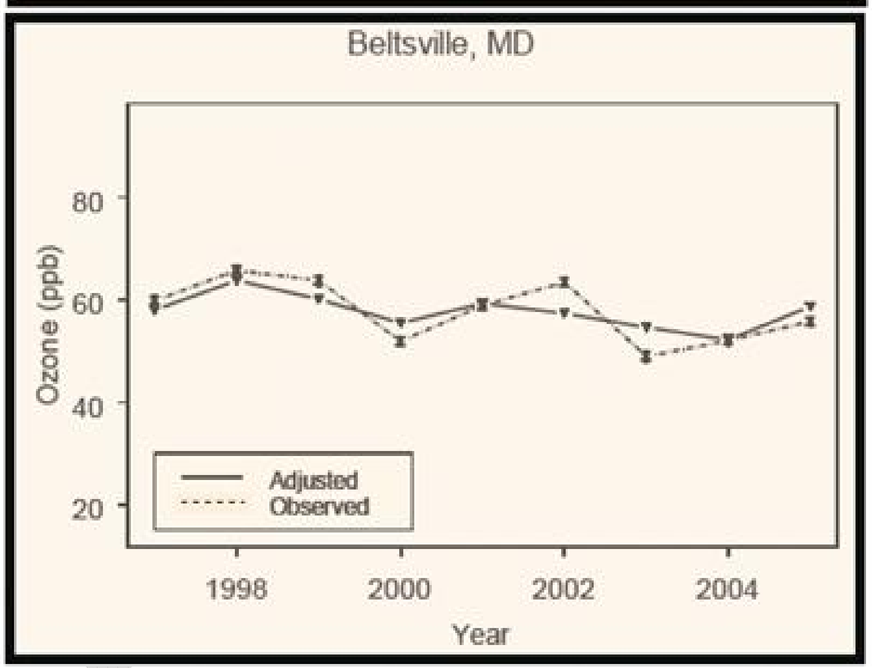


Trend in Meteorology Adjusted Ozone Levels

Cox and Chu (EPA)[1] developed an advanced statistical technique, which allows the effects of meteorology (temperature, humidity, etc.) to be separated from the 8-hour ozone levels. EPA applied this technique at a number of monitors across the country to develop meteorology adjusted 8-hour daily maximum ozone levels and compared them to the observed 8-hour daily maximum ozone levels. This analysis was published in the EPA's ozone trend report titled *"Weather Makes a Difference: 8-hour Ozone Trends for 1997-2005"* in August 2006 and is available at http://www.epa.gov/air/airtrends/weather.html. EPA performed this analysis for Washington, DC and Beltsville (Maryland) in Washington, DC-MD-VA ozone non-attainment area. Figure 9 shows the results for these two sites. It is quite clear from the two figures that a consistently declining trend is observed in ozone levels in response to consistently declining VOC and NOx emissions levels once the effect of meteorology has been removed. With emissions further projected to decline in 2009, ozone levels will also decline in the attainment year.

Figure 9. Meteorology Adjusted Ozone Season Average
8-Hour Daily Maximum Ozone Trend (1997-2005)





[1] Cox, William M. and Shao-Hang Chu. (1996). "Assessment of Interannual Ozone Variation in Urban Areas from a Climatological Perspective.", *Atmospheric Environment*, 30.14, 2615-2625.

10.8 Additional Weight of Evidence: Voluntary Action Campaigns

10.8.1 Clean Air Partners

Clean Air Partners is a bi-regional public-private partnership in the Baltimore Washington region created to develop and implement voluntary action programs to reduce emissions on the days when ozone levels are expected to be high.

The partnership was created in 1994 by the Metropolitan Washington Air Quality Committee (MWAQC), the Transportation Planning Board of the National Capitol Region (TPB) and the Baltimore Metropolitan Council (BMC). The partnership, originally known as ENDZONE Partners, has conducted an air quality public education campaign in the Washington and Baltimore metropolitan areas since 1995. The purposes of the campaign are to raise public awareness of air quality issues and to promote voluntary actions to improve air quality. The campaign is funded by public funds from Maryland, Virginia, the District of Columbia, and receives staff support from the state air management agencies. In 1997 the partnership formed a new formal public-private partnership, hired a Managing Director, and in 1999 changed its name to Clean Air Partners.

Clean Air Partners runs a campaign throughout the ozone season, May to September, to educate the public about the effects of ground-level ozone and what people can do to improve air quality. Daily forecasts of ozone pollution are distributed widely by fax and email to the media and Ozone Action Days participants. The air quality forecast is color-coded for ease of communication, following EPA's regulation for the Air Quality Index for ozone. The Ozone Action Days participants include 500 businesses and government agencies, which encourage clean commute options on Ozone Action Days.

During the ozone season, in addition to communicating daily with television and radio meteorologists in the regions, Clean Air Partners places radio and television ads to advise about the health risks and to promote less polluting behaviors on Ozone Actions Days. The ad messages target four categories for behavior modification: use of aerosol consumer products, use of cars and other light duty vehicles, use of lawn and garden equipment, and use of paints.

10.8.1.1 Evaluation of Voluntary Action Campaign

Clean Air Partners conducts surveys to determine the effectiveness and reach of its message. Two types of surveys are conducted, an "end of season" survey and an "episodic survey," taken on the evening of a forecasted Code Red Day. Surveys have been conducted by the partnership since 1995.

The end-of-season survey, conducted seven times since 1995, is to estimate the potential for behavior change and to help target the right messages. Episodic surveys began in the summer of 1999. The objective of the episodic survey is to determine if the Clean Air Partners' message is being heard and if the potential for behavior change is being realized. During each summer, multiple surveys have been conducted, except for 2000 when no survey was conducted.

A recent study looking at trends in results of surveys taken over eight years indicates that the episodic survey, conducted on the evening of a forecasted Code Red Day, provides the most reliable measure of behavior in response to the campaign.

10.8.1.2 Trends in Survey Results

Data from the two types of surveys indicate that general knowledge levels about air quality and its measurement systems increased substantially in both metropolitan areas during the five years, 1996-2001. Knowledge that Code Red indicates unhealthy air when activity should be limited increased significantly during the period. Over 90% surveyed knew that today was a “Code Red/Bad Air Day,” in 2002, and 67% said the phrase Code Red means “air is unhealthy.”

Over the period, 1996-2001, the end-of-season survey results for the Washington metropolitan region show the percentage of residents willing to act grew from 35% to 44% in 2001. The percentage of people reporting changing their behavior or limiting someone else’s (child) was 66% in 2001, an increase from 40% in 1996. In Washington, seventeen percent of all respondents said they took action to reduce air pollution.

Results:

- Increase in knowledge about ground-level ozone and color-code rating system
- Steady increase in “willingness to act” from 35% in 1996 to 44% in 2001.
- Behavior change in response to bad air days is common

Avoidance of health risk is most common reason for behavior change (66%); second reason is to reduce emissions (17%).[1]

10.8.1.3 Other Voluntary Actions

In addition to participating in Clean Air Partners programs, the local governments and state agencies in the Washington region have taken a coordinated, proactive approach to reducing emissions attributable to their organizations on an episodic basis. These actions reduce VOC and NOx emissions from a variety of source sectors. Shutdowns of county waste-to-energy facilities reduce stationary source emissions. State agencies and county governments ban refueling of non-emergency fleet vehicles and application of traffic paint and pesticides, eliminating area source emissions. Many of these organizations also ban operation of lawn and garden equipment to reduce non-road emissions. Mobile emissions are reduced through liberal leave policies and support for teleworking on Code Red Days. Though the benefits of these episodic programs are not reflected in the region’s 2005 controlled inventory, the programs are an important part of the region’s attainment strategy and provide additional evidence that the region will attain the ozone standard in 2005.

10.9 Overall Conclusion

Based on the results from the July 1991 modeling, EPA’s Tier 2 modeling, comparison of projected controlled 2005 and modeled attainment inventory, and the two Weight of Evidence tests; there is evidence that the Washington region will attain the 1-hour ozone standard in the year 2005.

References:

1. "An Analysis of Air Pollution-Related Knowledge, Attitudes, and Behaviors Across Time: The End of Season and Episodic Surveys," Fox, J. Clifford and Mousumi Sarkar, Virginia Commonwealth University, December 2002, prepared for Clean Air Partners.