MDE
MARYLAND DEPARTMENT OF THE ENVIRONMENT
1800 Washington Boulevard • Baltimore MD 21230
410-537-3000 • 1-800-633-6101 • www.mde.state.md.us

Martin O'Malley
Governor

Anthony G. Brown
Lieutenant Governor

Robert M. Summers, Ph.D.
Secretary

March 7, 2012

Mr. Shawn M. Garvin
Regional Administrator
USEPA Region III (3RA00)
1650 Arch Street
Philadelphia PA 19103-2029

Dear Mr. Garvin:

The purpose of this letter is to provide supporting documentation for Governor O'Malley's designation recommendations for Maryland. The Department is eager to work with you to achieve a final decision that we both find acceptable. Our primary concern is that the final EPA decision must address transport in a manner that provides Maryland with a reasonable chance of attaining the new standard by 2015 or 2018. EPA's preliminary response to Governor O'Malley's March 10, 2009 letter on air quality designations indicates an intention to continue designating small nonattainment areas based almost exclusively on county delineations or Metropolitan Statistical Areas, not even Combined Statistical Areas (CSAs). The Department believes this additional documentation and analysis may have a bearing on your final decision.

Governor O'Malley's December 1, 2011 letter provided updated recommendations on air quality designations for Maryland and included a more urgent request for EPA to consider establishing a large multi-state nonattainment area to better address the significant impact that transported air pollution has on Maryland's ability to attain the National Ambient Air Quality Standard (NAAQS).[1] EPA's response letter of December 9, 2012 vaguely suggests that other Clean Air Act (CAA) provisions would provide better relief from long-range transport. In justifying its position, EPA suggests that Maryland's recommendation for a large multi-state nonattainment area does not comport with a plain reading of the CAA § 107(d), authorizing nonattainment designations for "nearby" areas which contribute to a nonattainment area. To the contrary, today's science shows that an elevated reservoir of ozone forms daily and is trapped at about 2,000 feet above the Earth's surface by a nocturnal inversion. This elevated reservoir adds different background levels of ozone over a large geographic area. Maryland's 20 year ozone research program clearly shows through measured (not modeled) monitoring data, that ozone is being transported into Maryland from upwind states at levels often above the 75 ppb ozone standard. EPA's decision on the large nonattainment area seems tied to its

[1] Maryland currently has areas that are still not attaining the 0.08 ppm ozone standard. According to the Cross State Air Pollution Rule, this nonattainment is due in significant part to the interstate transport of ozone.

assertion that an upwind state, whose daily emissions are transported overnight and cause an ozone exceedance in Maryland the following morning, is not "nearby" within the context of § 107.

Despite the objections to the large nonattainment area EPA raises in its letter, EPA does not dispute that Maryland is significantly impacted by transport and that these states do in fact significantly contribute to Maryland's nonattainment problem. The large nonattainment area recommended by Governor O'Malley would be a fair and equitable way to clean the air while minimizing cost and maximizing economic recovery. Without a large multi-state nonattainment area, upwind areas are not incentivized to help achieve attainment in a downwind air as expeditiously as possible. To the contrary, they are incentivized to maintain current disparities in pollution controls, which provide them a competitive advantage through lowered industrial costs to upwind businesses and residents.

Absent the large multi-state nonattainment area to force a comprehensive SIP addressing nonattainment at each monitor in the area, subjecting everyone to the same potential sanctions for failure to attain in the timeframes mandated by the CAA, it seems clear that Maryland will not be able to meet the ozone NAAQS by the mandated deadlines. In the alternative, the Department finds substantial evidence that, at a minimum, the Baltimore-Washington consolidated statistical area should be designated as one nonattainment area rather than several, as EPA has recommended. EPA's recommendation to exclude Washington D.C. from the Baltimore nonattainment area is inconsistent with EPA's current interpretation of 'nearby' contributing areas, and would serve to only further isolate the Baltimore nonattainment area and reduce its ability to timely attain the ozone NAAQS. The designation of a single nonattainment area combining the Baltimore and Washington regions is clearly supported by EPA's 5 factor technical analysis that shows monitors in the Baltimore region consistently monitoring the same ozone levels as design value monitors in the Virginia area.

We want clean air for the citizens of Maryland. After a 30 year struggle, we feel we have empirical data, sound scientific evidence and a clear path to that goal. Success, however, will require EPA's help. We are anxious to work in partnership with EPA to attain the public health protection we all are working to achieve. We have major concerns that EPA's current policy on nonattainment boundaries will not allow Maryland to meet CAA public health protection deadlines. Equally important are our concerns over how EPA's decision may have a negative impact on Maryland's economic recovery efforts. As always, we are willing to work with EPA to find a collaborative solution to our problem.

Sincerely,

Robert M. Summers, Ph.D.
Secretary

Enclosure

MARYLAND DEPARTMENT OF THE ENVIRONMENT 120 DAY LETTER RESPONSE

The State of Maryland through the Department of the Environment submits this response to EPA's proposed ozone nonattainment designations for the 75 ppb ozone standard for Maryland, which were transmitted in Regional Administrator Garvin's December 9, 2011 letter and which EPA published notice on December 20, 2011 in 75 *Fed. Reg. 78872.* The Department supports the implementation of the 75 ppb ozone standard as quickly as possible but believes that the designation process should still afford Maryland an opportunity to negotiate regarding designations as intended under § 107 of the Clean Air Act (CAA). EPA's official proposal seems to indicate the designations are a fait accompli and further communications would not lead to any changes whatsoever. We hope that this is not the case.

The Department continues to pursue the recommendation from Governor O'Malley's March 10, 2009 letter for a large multi-state nonattainment area as the best option for Maryland designations. This document will provide further details explaining why a proper 5-factor (or 9 factor) analysis should result in such a designation. If EPA continues to designate smaller nonattainment areas, the Department does not understand why, at a minimum, EPA has failed to propose for designation the Baltimore Washington Combined Statistical Area (CSA) as a single nonattainment area using its nine (or five) factor analysis. The Department would like to discuss this as a second option. Further supporting documentation follows recommending that option also.

Preferred Option

The Department believes that EPA should designate areas as initially recommended by Governor O'Malley by letter dated March 10, 2009 and more recently by letter dated December 1, 2011. Expressly, EPA should designate a large multi-state ozone nonattainment area consisting of the following 16 states and the District of Columbia: Maryland, Delaware, New Jersey, New York, Pennsylvania, Virginia, West Virginia, Ohio, North Carolina, Tennessee, Missouri, Illinois, Indiana, Kentucky, Michigan and Wisconsin. These are the states that EPA has identified as significantly contributing to Maryland's ozone problem. A 5-factor analysis supporting such a designation is found in Appendix A.

EPA has raised three principal objections to the designation of a large nonattainment area: 1) it is "not in keeping with a plain reading of CAA § 107(d)" as it relates to contributions from "nearby areas; 2) the CAA offers other solutions to the transport problem and 3) large nonattainment areas are unworkable. Notably, these objections do not dispute that Maryland is significantly impacted by transport and that these states do in fact significantly contribute to Maryland's nonattainment problem.

Not in keeping with a plain reading of CAA § 107(d)

In a letter to Governor O'Malley dated December 9, 2011on the subject of ozone nonattainment area designations, EPA expressed its view that a large multi-state nonattainment area like the one suggested by Maryland, is "not in keeping with a plain reading of CAA § 107(d)" as it relates to contributions from "nearby areas." We disagree. The United States Court of Appeals for the District of Columbia Circuit, in its November 29, 2005 decision in Commonwealth of Pennsylvania v. EPA, did not find that Delaware's request for a large multi-state nonattainment area ranging from Virginia to Maine was prohibited by a plain reading of

the Clean Air Act. Rather, the court states that while Delaware's construction of "nearby" may well be sensible, it would defer to EPA's interpretation that the term "nearby" meant locally-based nonattainment areas within the context of § 107. The Court's deference to EPA's expert decision regarding the application of § 107 was again on display in that same case, where the court upheld EPA's designation of a multi-state nonattainment area consisting of portions of New Jersey, Pennsylvania and Delaware; an apparent expansion of EPA's limited interpretation of "nearby" previously applied in that case. In this regard, we question EPA's judgment and understanding of the science in rejecting the designation of a large multi-state nonattainment area comprised of states that significantly contribute to nonattainment in Maryland and other East Coast states.

EPA's assertion that larger nonattainment areas do not coincide with a plain reading of the CAA § 107 is called into question by recent policy decisions on air quality designations for Indian lands[1]. This policy memo refers to Indian tribal lands and adjacent state lands that are much larger than the state of Maryland. For example, the Navajo Nation is nearly the same size as the state of West Virginia[2], yet this policy memo uses the words "contributing to non-attainment in the adjacent area" when referring to tribal lands' emissions. Further, the State of Delaware's February 2, 2012 comment letter to EPA on the proposed designations for the 75 ppb ozone NAAQS, mentions that the word "nearby" must be interpreted as consistent with the scale of ozone transport[3]. The Delaware letter makes a valid observation that EPA's interpretation of the word "nearby" does not adequately address the impacts of transported ozone pollution on downwind states. Virginia, Pennsylvania and West Virginia are clearly nearby states.

The CAA offers other solutions to the transport problem

EPA generalized that the CAA has other solutions to the transport problem. We agree, Sections 110(a)(2)(D), § 126, and § 176 and 184 offer solutions to transported pollution, if implemented in a timely manner. However, these provisions have not eliminated the significant contribution to Maryland nonattainment because these provisions are seldom implemented, or are not adequately implemented to eliminate significant contribution in a timely manner. EPA should exercise its responsibility under § 110(a)(2)(D) to ensure that each upwind state has an approved State Implementation Plan (SIP) that promptly implements full compliance with § 110(a)(2)(D), or implement a Federal Implementation Plan (FIP) which satisfies that requirement. Yet, even as EPA proposes revocation of the 0.08 ppm ozone, not a single state has a fully approved § 110(a)(2)(D) SIP. State infrastructure and interstate transport SIPs to achieve the new 75 ppb NAAQS for ozone were due by March 20, 2011—nearly one year ago. EPA's September 22, 2011 guidance memo on designations for the 75 ppb standard acknowledges that "deadlines for some state submissions have already passed, including the infrastructure SIPs and interstate transport SIPs." The guidance also states that EPA does not intend to penalize states for late submittal of the SIPs. We understand the reasons for EPA's delay in the process and supported reconsideration of the ozone standard. The reconsideration issue has been resolved and we believe that EPA should move forward to fulfill all of its statutory obligations as quickly as reasonable and avoid further delay.

[1] 20 Dec 2011 EPA Memorandum, *Policy for Establishing Separate Air Quality Designations for Areas of Indian Country*

[2] http://en.wikipedia.org/wiki/Navajo_Nation

[3] State of Delaware, Department of Natural Resources and Environmental Control, Division of Air Quality, letter to EPA Air Docket dated February 2, 2012

Notwithstanding the need to promptly implement § 110(a)(2)(D) requirements, EPA's delayed implementation of this remedy leaves Maryland's recommendation for the large nonattainment area as the more immediate and timely solution.

Large nonattainment areas are unworkable

One of EPA's chief objections to large nonattainment areas is that they are unworkable because it would be too difficult to coordinate the air quality and transportation conformity processes between different states and metropolitan planning organizations (MPOs) within the large area. We believe that it would be very easy for areas in the large nonattainment area to follow the existing coordination process used in the Philadelphia-Wilmington-Trenton ozone nonattainment area and manage to successfully complete the appropriate CAA requirements and reach attainment. This process uses sub-regional coordination processes for both air quality planning and transportation conformity.

The Philadelphia-Wilmington-Trenton ozone nonattainment area that includes four states, two EPA regions, and at least two MPOs, is an example of a larger nonattainment area where the various jurisdictions have a positive record of working together to achieve good air quality. Each state submits a separate SIP selecting the reduction strategies it prefers. Photochemical modeling, inventories and attainment demonstrations are completed through an existing regional process that involves multiple states.

Sub regional mobile source emission budgets are utilized to keep MPOs and transportation planning regions intact. EPA Regions II and III have shown that this arrangement still permits sanctions to be levied against a particular state for failure to complete CAA requirements without harm to the other states involved. An example from the Philadelphia-Wilmington-Trenton ozone nonattainment area would be when sanctions were levied against New Jersey for a lapse in their enhanced inspection and maintenance program without consequence to any other state. While requiring a significant amounted coordination, the process in general has worked smoothly. Each state in the nonattainment area has achieved compliance with the ozone standard in effect at the time by the attainment deadlines. The important point is that each state would have remained designated as nonattainment if any of the other states could not achieve attainment. As such, all included states worked together to ensure attainment throughout the multi-state nonattainment area.

Maryland has participated in this process for over 20 years and believes that it could easily and seamlessly be implemented in a large nonattainment area to successfully comply with the requirements of the CAA while maintaining the existing CSA-based air quality and transportation conformity processes.

Benefits of large nonattainment areas

Twenty years of ozone research and air quality monitoring have clearly established the impact of ozone transport on air quality in Maryland. At Maryland's western and southern boundaries, we routinely use airplanes, balloons and mountaintop monitors to measure incoming ozone from upwind states at levels well above the current 75 ppb ozone standard. Our sources are already subject to pollution control requirements that are among the most stringent in the nation. Implementation of even the most robust additional local controls will not solve our air quality problems and bring us into attainment by the statutorily required deadlines. Recent modeling, included in Appendix C, shows that Maryland does not attain the

75 ppb standard when all "in-state" emissions are zeroed out. Establishment of a large multi-state ozone nonattainment area is an important step to address transport.

Maryland advocates for a large nonattainment area as a way to adequately address transport. As stated above, interstate transport has significantly affected Maryland for quite some time and we have invested considerable funds to provide valid scientific data to demonstrate this fact. A large nonattainment area will help Maryland in several ways. A nonattainment designation imposes a number of requirements on an area, including requirements for emission controls. At a minimum, it imposes a requirement to add state of the art controls on new sources instead of maintaining the advantage of allowing new sources into greenfield areas without controls. A number of new power plants have located just outside Maryland nonattainment areas to avoid this requirement. Enlarging the nonattainment area would prevent such occurrences, provide a more level economic playing field, and minimize additional upwind emissions.

A large nonattainment area also forces the entire area to remain designated as nonattainment until each monitor in the nonattainment area can comply with federal air quality standards. This ties the source of transported emissions to the affected monitor, and thus provides the incentive for each state in the nonattainment area to fulfill its 110(a)(2)(d) responsibilities promptly. EPA's policy of reviewing air quality data by beginning with the violating monitor and geographically ending the nonattainment area when monitors measuring attainment are found does not have much justification when one considers what is known about long range transport.

Under EPA's current designation proposal, the Baltimore Nonattainment Area would be the lone moderate nonattainment area on the East coast. We alone would be required to implement more controls at generally more than 4 to 8 times the cost of controls EPA plans to impose on states under the Cross-State Air Pollution Rule (CSAPR), a rule which only addresses the 0.08 ppm standard. Modeling for CSAPR indicates that 10 or more ppb of an average ozone concentration in Maryland comes from states contiguous to Maryland. Surely those "contiguous" areas should satisfy a plain reading of the word nearby under § 107. In addition, a large nonattainment area including "contiguous" states would have the practical effect of reducing emissions from more than just power plants. The 10 ppb transported into Maryland are not simply attributable to power plant emissions but to emissions from other sectors especially the mobile sector. A large nonattainment area would require each area in that designated nonattainment area to adopt controls for multiple sectors, a result which EPA indicates will be needed to achieve the 0.08 ppm ozone NAAQS in the CSAPR preamble.

Maryland has adopted a broad spectrum of controls, many of them statewide, in a quest for good air quality. These controls have come at great expense to its citizens. As noted above, Maryland's industrial sources are already subject to stringent air pollution control requirements and have been for many years. For example, Maryland's Healthy Air Act (HAA) is among the most stringent, if not the most stringent, coal-fired power plant control program in the East. Since 2008, Maryland utilities have invested almost $3 billion to clean Maryland's air. Maryland has adopted the California Car Program, and we continue to implement a centralized motor vehicle inspection and maintenance program. Maryland has worked closely with the other states that are part of the Ozone Transport Commission (OTC) and the EPA Regional

Offices who are members of the OTC technical committees, to identify and implement all potential additional control programs that can meaningfully reduce ozone concentrations. Over the past 30 years, we have adopted hundreds of air pollution regulations that reduce emissions from every feasible category ranging from power plants to perfume manufacturers. The average cost of ozone precursor pollution controls in Maryland is between $2,000 and $3,000 dollars per ton of pollution reduced. Some of our control efforts approach the $5,000 to $6,000 per ton range. These relatively expensive control programs improve ozone air quality by only a very small amount, and they place Maryland sources at a significant economic disadvantage in relation to their competitors in upwind states that are significantly contributing to nonattainment in Maryland, but are not subject to these kinds of controls. Widespread lower cost regional control programs are significantly more cost-effective and have been shown to drive very large reductions in ozone concentrations. Most recently, for example, the CSAPR used a $500 per ton ceiling to define required controls. Establishing larger multi-state nonattainment areas would help level the economic playing field by requiring lower-cost controls of the type already implemented in Maryland throughout the large nonattainment area.

In your December 9, 2012 letter and other EPA letters you imply that EPA's current efforts to address transport through rules like the CSAPR and other provisions of the CAA can be used to address transport and provide the promise of clean air in the timeframe mandated in the Act. Our science shows us that, with no uncertainty, it will be impossible for Maryland as well as other states to attain the 75 ppb standard on time. We believe the only way to achieve our public health protection goal is to establish the large nonattainment area we recommended as this will require all contributing areas to work as hard as Maryland to reduce emissions or face the penalties and sanctions that only apply to nonattainment areas under the CAA.

We are anxious to work in partnership with EPA to achieve our shared public health goals. We believe, however, that EPA's current policy on nonattainment boundaries will not allow Maryland to meet CAA public health protection deadlines. Equally important are our concerns over how EPA's approach may adversely impact on Maryland's economic recovery efforts. The small nonattainment area would drive Maryland to adopt minimally effective, extremely expensive control programs without insuring that the highly effective, much more cost-effective control programs in upwind, contributing states are required. This does not make environmental or economic sense.

Marginal Areas Unlikely to Attain By 2015 Due to Lack of Reductions

EPA has delivered many control programs, especially in sectors that the CAA prohibits states from regulating. These sectors include on and off road vehicles. States can expect continuing reductions from several of these regulations. EPA has announced intentions to propose additional tailpipe regulations, Tier 3, for light duty vehicles. These national rules are fair and very cost-effective and we encourage EPA to continue this practice. Due to their nature, some regulations unfortunately will not deliver sufficient reductions in the timeframes needed to reach attainment.

Maryland believes that EPA's proposed designations unduly penalize the Baltimore nonattainment area. EPA professes that marginal nonattainment areas will ease into attainment over the next 3 years. Attainment monitoring must begin in 2013. The following analysis of rules that might provide enforceable measures to achieve attainment shows that few emissions reductions will take place in this timeframe. Preliminary modeling shows that deep reductions

are needed to achieve the 75 ppb ozone standard. Even EPA's CSAPR modeling shows many areas fall short of attainment with the currently adopted suite of reduction strategies. This problem is compounded by the fact that areas classified as marginal nonattainment are not required to implement specific reduction measures under the CAA. Without ensuring emissions reductions from upwind areas by linking their attainment status to those areas to which they are significantly contributing, EPA is minimizing those same upwind reductions needed for downwind nonattainment areas to achieve the NAAQS.

The National Association of Clean Air Agencies (NACAA)[4], including Maryland, has developed a list of the top seven source categories for federal air pollution emissions controls. The list focuses on the source categories that are most important to control to help nonattainment areas with attainment of the national air quality standards. These seven categories represent 85% of the NO_x, 75% of the SO2 and 75% of the Hg left to regulate.

1. On-road vehicles
2. Electric generating units (EGUs)
3. Industrial, commercial & institutional (ICI) boilers
4. Cement kilns
5. Locomotive engines
6. Marine engines
7. Aircraft

EPA has promulgated a number of strong national regulations regarding these seven source categories, to try to improve air quality across the country. These programs control stationary and mobile sources nationwide. In doing so, they reduce not only in-state pollution but also pollution that crosses state borders and contributes to violations of national air quality standards in downwind areas. At the same time that these rules are highly beneficial, they fall short for the following reasons:

- Many measures do little or nothing in time for nonattainment areas to achieve clean data starting in 2013 for "marginal" areas and 2015 for "moderate" areas. Maryland fully supports these rules, but they simply provide reductions that are too late to help states with the 75 ppb ozone standard:
    - On-Road Vehicles (Tier 3)
    - EGUs, ICI Boilers and cement kilns (CSAPR II)
    - Locomotives Engines (small engine rule)
    - Marine Engines (small and large engine rules)
    - Aircraft (Tier 8 standard and nonroad rule regarding ground equipment).

- Some recently implemented regulations on the aforementioned categories offer few, if any, NO_x emission reductions. They miss an ozone precursor that is crucial to ozone emissions reductions:
    - EGUs (Mercury and Air Toxics Standards)
    - ICI Boilers (Maximum Achievable Control Technology)
    - Cement Kilns (New Source Performance Standards and MACT)

[4] Resolution 10-01 of the Ozone Transport Commission Calling on the US Environmental Protection Agency to Adopt and Implement Additional National Rules to Reduce Ozone Transport and Protect Public Health

- One key measure, in the works for more than a decade, was never designed to address the 75 ppb ozone standard, and, at this point, it is mired in the courts with its future completely uncertain:
    - EGUs (Cross-State Air Pollution Rule, and prior Clean Air Interstate Rule)

An easier approach to addressing the transport of pollution is to designate large, multi-state nonattainment areas. The benefits of this approach include the following:

- Upwind areas implement effective lower cost programs that have likely already been developed, tested, implemented, and refined in downwind areas.
- Upwind areas of concern are included in multi-state efforts to attain air quality standards in downwind areas that are not able to reach attainment on their own, thereby focusing limited resources where they are most needed.
- Upwind and downwind areas implement the same controls, creating equity for businesses in different locations and equity in their work.

In summary, while Maryland applauds EPA's great efforts on national rules, we urge EPA to designate large, multi-state nonattainment areas. Maryland will not be able to attain the 75 ppb ozone standard with the federal measures alone.

Below are details on the timing of federal measures pertaining to the top seven source categories.

1. On-road vehicles

We expect to see significant reductions from on-road vehicles if EPA, as expected, goes through with developing proposals for Tier 3 vehicle requirements and low sulfur fuel for on-road vehicles. A notice of proposed rulemaking (NPRM) for Tier 3 for light-duty vehicles is expected in approximately March 2012, with a final rule due in mid to late 2012. In the white paper, "*Cleaner Cars, Cleaner Fuel, Cleaner Air: The Need for and Benefits of Tier 3 Vehicle and Fuel Regulations*," October 31, 2011, NACAA estimates that the Tier 3/ low sulfur fuel regulations, including both the Tier 3 program and the low sulfur fuel program, will reduce NO_x emissions by 8 percent by 2017 nationally for on-road light duty vehicles and 29 percent by 2030, and it will reduce VOC levels 3 percent by 2017 and 26 percent by 2030.

NESCUM, in the presentation "Benefits and Costs of Tier 3 Low Sulfur Gasoline Program," Arthur Marin, CT DEEP SIPRAC Meeting, January 12, 2012, estimates higher emissions reductions benefits than NACAA and provides more detail on the proportion of NO_x and VOC emissions reductions from the Tier 3 portion of the rule compared with the low sulfur fuel portion of the rule. Specifically, the NESCAUM presentation indicates Tier 3 NO_x emissions reductions of 16 percent in 2017 and 59 percent in 2030, and VOC reductions at 4 percent in 2017 and 32 percent in 2030. NESCAUM estimates the low sulfur fuel NO_x emissions reductions at 25 percent, or 177,500 tons, if the Northeast and Mid-Atlantic States, the Midwest (eight states), and the Southeast (ten states) were included. NACAA indicates that these latter NO_x benefits, from reducing the sulfur in fuel would be immediate.

Maryland is glad to see EPA working to implement Tier 3 and low sulfur fuel, and urges EPA to propose and finalize this rule on schedule, in 2012. The low sulfur fuel's NO_x emissions reductions would be immediate, although the reductions from Tier 3 would be too late, 2017 and 2030, to help marginal areas show clean monitoring data starting in 2013 and moderate areas starting in 2015.

2. Electric generating units (EGUs)

EPA has been moving ahead with regional control programs such as the final Cross-State Air Pollution Rule, published in the Federal Register in August 2011. On December 30, 2011, however, the U.S. Court of Appeals issued a temporary stay of CSAPR and ordered EPA to continue to administer the Clean Air Interstate Rule (CAIR) during CSAPR's stay. CAIR is only in place temporarily until CSAPR is resolved and restored as CAIR's replacement rule. This makes the status of both CAIR and CSAPR very tentative. It also means that the implementation of CSAPR will be further delayed, resulting in additional delays in the control of emissions from sources upwind of Maryland and great difficulty in Maryland's efforts to achieve clean data starting in 2013 and 2015.

CSAPR II, the rule that was to follow CSAPR and provide additional NO_x reductions in accordance with states meeting the 75 ppb ozone standard is now also extremely uncertain. Prior to the court stay on CSAPR, CSAPR II had a suggested proposal date in the 2013 timeframe. In order to have clean monitoring data starting in 2015, if not 2013, in addition to nonattainment areas needing CSAPR implemented this year, nonattainment areas need CSAPR II proposed in 2012 and finalized in 2013.

Also, EPA has proposed national standards, particularly the EGU MACT known as the "Mercury and Air Toxics Standards" (MATS), published in the Federal Register on May 3, 2011. The final rule was released in unofficial copy on December 16, 2011 and is expected to be published in the Federal Register on February 16, 2012. While the EGU MACT is expected to result in substantial reductions in SO_2 from gas scrubbers installed to remove toxic air pollutants, particularly HCl and acid gases, SO_2 is not an ozone precursor, and the rule does not reduce emissions of the ozone precursor, NO_x. Nonattainment areas need additional NO_x reductions from EGUs across the country, by 2013 or 2015.

3. Industrial, commercial and institutional (ICI) boilers

The ICI Boilers MACT, "National Emission Standards for Hazardous Air Pollutants for Major Sources: Industrial, Commercial, and Institutional Boilers and Process Heaters" finalized on March 21, 2011, dramatically reduces SO_2 and toxic pollutants; however, it does not reduce NO_x emissions. As with the case of EGUs, we need additional NO_x reductions from ICI boilers. States have asked EPA to include this in CSAPR II, but as noted above, CSAPR II is, in effect, not even on the radar screen for EPA. In order to have clean monitoring data starting in 2013 or 2015, states urge EPA to propose CSAPR II in 2012 and finalize it in 2013. It is essential to include NO_x reductions from ICI boilers.

4. Cement kilns

On August 6, 2010, EPA issued amendments to the NSPS and MACT requirements for Portland Cement Plants. These rule revisions will provide small reductions in NO_x but significant reductions in VOCs and other pollutants. EPA estimates that when these programs are fully implemented in 2013, that VOCs (total hydrocarbons) will be reduced 83 percent and NO_x 5 percent. Overall, more NO_x reductions are needed from this source category. EPA agreed to consider including cement kiln NO_x reductions in CSAPR II, but as noted above, CSAPR II is, in effect, not even on the radar screen for EPA. In order to have clean monitoring data starting in 2013 or 2015, states need CSAPR II proposed in 2012 and finalized in 2013. It is essential to include NO_x reductions from cement kilns.

5. Locomotive engines

The 2008 rule, "Locomotive Engines and Marine Compression-Ignition Engines Less Than 30 Liters per Cylinder," provides dramatic reductions in NO_x and diesel PM emissions from newly built and remanufactured locomotive engines. Unfortunately, these emission reductions will occur too late to help nonattainment areas achieve clean monitoring data by 2013 or 2015.

As noted under "Marine engines," below, EPA estimates that by 2030, with fleet turnover, this rule, including both the locomotive and marine engine standards, will result in NO_x reductions of 80 percent, or 800,000 tons, and PM reductions of 90 percent, or 27,000 tons, from newly built engines that meet the Tier 4 standards in this rule compared with engines that do not (see 73 FR 37096). These same reductions are cited again below, under "marine engines."

The standards for remanufacturing of locomotive engines were scheduled to take effect as early as 2008, as soon as certified remanufacture systems were available, according to the EPA rule "Control of Emissions of Air Pollution From Locomotive Engines and Marine Compression-Ignition Engines Less Than 30 Liters per Cylinder; Republication," (73 FR 37096). Near-term, Tier 3, standards began to phase in starting in 2009, and the Tier 4 standards begin to take effect in 2015 for locomotives.

While these NO_x reductions are significant, they do not address the legacy fleet. These standards, going into effect in the 2008-2015 timeframe, will be slow to show an impact on NO_x emissions due to the low turnover of the existing fleet.

Another rule should have a slightly sooner impact on NO_x from engines in the existing fleet of locomotives: The Non-Road Diesel Rule finalized in May 2004, decreases sulfur levels in non-road diesel fuel that will help prevent damage to the emission-control systems and that will reduce NO_x and particulate matter from engines in the existing fleet of locomotives, while reducing engine maintenance cost. This rule was to reduce sulfur levels from about 3,000 parts per million (ppm) to 500 ppm in 2007 and is to reduce sulfur levels further, to 15 ppm, when fully implemented in 2012. This constitutes a reduction of sulfur in fuel of greater than 99 percent from the baseline value.

Overall, EPA projects that this rule will result in 738,000 tons of NO_x reductions and 129,000 tons of particulate matter reductions by 2030. EPA is not clear what proportion of these NO_x reductions are from the lower sulfur levels in the fuel. EPA analyses for this rule do not

address this question. Cleaner engine standards are also included in the rule, and while they are expected to substantially reduce NO_x, they are not applicable to the locomotive engines. Only the low sulfur fuel standard is applicable to locomotives.

Overall, it remains to be seen if the low sulfur fuel program in the Non-Road Diesel Rule may have some benefits for NO_x reductions in locomotives. If it does provide these benefits, though, the program's 2007-2012 implementation schedule means that the benefits would be seen by the time states need clean monitoring data, in 2013 or 2015.

6. Marine engines

The 2010 rule, "Control of Emissions from New Marine Compression-Ignition Engines at or Above 30 Liters per Cylinder," establishes two additional tiers of NO_x standards for newly built Category 3 (very large) marine diesel engines in the U.S.: Tier 2, which began in 2011 and is expected to result in a 15 to 25 percent reduction in NO_x compared with Tier 1 levels; and Tier 3, which will apply beginning in 2016.

The 2010 rule above also establishes emissions standards for VOCs and CO; provisions to allow for the production and sale of fuel containing 1,000 ppm sulfur for use in Category 3 marine vessels, which will also help reduce NO_x emissions; and an emissions control area (ECA) up to 200 nautical miles off U.S. coasts, which will reduce global levels of sulfur in fuel and thereby also reduce NO_x emissions. The 1,000 ppm sulfur in fuel standard will enter into force in January 2015.

In addition, in this rule, EPA is adopting engine and fuel standards from the international MARPOL Annex VI treaty. These standards will apply to both U.S. and foreign-flagged ships in U.S. ports and internal waters.

Overall, according to the EPA's "Regulatory Announcement: EPA Finalizes More Stringent Standards for Control of Emissions from New Marine Compression-Ignition Engines at or Above 30 Liters per Cylinder," EPA 420-F-09-068, dated December 2009," by 2030, when the above marine engine strategy included in the 2010 rule is fully implemented, it is expected to reduce NO_x emission rates by 80 percent, or 1.2 million tons, and PM emission rates by 85 percent, or 143,000 tons, "compared to the current limits applicable to these engines."

While these NO_x reductions are significant, they do not address the legacy fleet. These standards will be slow to show an impact on NO_x emissions due to the low turnover of the existing fleet. This is reflected in the expectation that the full NO_x emissions reductions of the marine engine strategy will not be realized until 2030. As a result, this rule will provide little if any assistance to states that need clean monitoring data starting in 2013 or 2015.

The 2008 rule regarding smaller engines, "Locomotive Engines and Marine Compression-Ignition Engines Less Than 30 Liters per Cylinder," also provides dramatic reductions in NO_x and diesel PM emissions from small and medium sized, Category 1 and 2, newly manufactured marine diesel engines and remanufactured large marine diesel engines. Unfortunately, these emission reductions will occur too late to help nonattainment areas achieve clean monitoring data starting in 2013 or 2015.

As noted under "Locomotive engines," above, EPA estimates that by 2030, this rule, including both the locomotive and marine engine standards, will result in NO_x reductions of 80 percent, or 800,000 tons, and PM reductions of 90 percent, or 27,000 tons, from newly built engines that meet the Tier 4 standards in this rule compared with engines that do not (see 73 FR 37096).

The standards for remanufacturing of marine engines were scheduled to take effect as early as 2008, as soon as certified remanufacture systems were available, according to the EPA rule "Control of Emissions of Air Pollution From Locomotive Engines and Marine Compression-Ignition Engines Less Than 30 Liters per Cylinder; Republication," (73 FR 37096). Near-term, Tier 3, standards began to phase in starting in 2009, and the Tier 4 standards begin to take effect in 2014 for marine diesel engines.

While these NO_x reductions are significant, they do not address the legacy fleet. These standards, going into effect in the 2008-2014 timeframe, will be slow to show an impact on NO_x emissions due to the low turnover of the existing fleet. As a result, this rule will provide little if any assistance to states that need clean monitoring data starting in 2013 or 2015.

Another rule should have a slightly sooner impact on NO_x from engines in the existing fleet of marine engines, same as with the locomotives: The Non-Road Diesel Rule finalized in May 2004, decreases sulfur levels in non-road diesel fuel, and in doing so, reduces NO_x and particulate matter from engines in the existing fleet of marine engines (particularly C-1 and C-2). This rule was to reduce sulfur levels from about 3,000 parts per million (ppm) to 500 ppm in 2007 and is to reduce sulfur levels further, to 15 ppm, when fully implemented in 2012. This constitutes a reduction of sulfur in fuel of greater than 99 percent from the baseline value.

Overall, EPA projects that this rule will result in 738,000 tons of NO_x reductions and 129,000 tons of particulate matter reductions by 2030. EPA is not clear what proportion of these NO_x reductions are from the lower sulfur levels in the fuel. EPA analyses for this rule do not address this question. Cleaner engine standards are also included in the rule, and while they are expected to substantially reduce NO_x, they are not applicable to the marine engines, as they were not applicable to locomotive engines, above. Only the lower sulfur fuel standard is applicable.

Overall, it remains to be seen if the low sulfur fuel program in the Non-Road Diesel Rule may have some benefits for NO_x reductions in marine engines. If it does provide these benefits, though, the program's 2007-2012 implementation schedule means that the benefits would be seen by the time states need clean monitoring data, in 2013 or 2015.

7. Aircraft

In 2005, EPA adopted a more stringent round of standards from the United Nations International Civil Aviation Organization (ICAO), for some gas turbine engines. In July 2011, EPA released a draft rule establishing more stringent Tier 6 and Tier 8 NO_x emissions

standards for newly-certified[5] and newly-manufactured aircraft engines, making their emissions consistent with ICAO 2010 NO_x standards. As of early February 2012, EPA expected to finalize this rule by the summer of 2012.

The Tier 6 NO_x standards for newly-certified gas turbine engines with rated thrusts of 89 kilonewtons (kN) or more vary from an 8 percent to a 12 percent reduction from Tier 4 standards. The Tier 6 NO_x standards for newly-certified gas turbine engines with rated thrusts greater than 26.7 kN and less than 89.0 kN vary from a 0 percent to a 12 percent reduction from Tier 4 levels, dependent on both the pressure ratio and rated thrust of the engine.

Tier 8 NO_x standards for newly-certified turbofan engines with rated thrusts of 89 N or more are considered 15 percent more stringent than the proposed Tier 6 NO_x standards at a pressure ratio of 30, the standard point of comparison. Tier 8 NO_x standards for newly-certified gas turbine engines with rated thrusts greater than 26.7 kN but less than 89.0 kN vary from a 5 percent to a 23 percent reduction from Tier 6 standards. EPA notes that since the effective date of the Tier 6 NO_x standard was January 1, 2008, and "nearly all in-production engines currently meet this standard," EPA focused their discussion in the rule (76 FR 45041) to engines that needed to comply with the Tier 8 NO_x standard.

Accordingly, EPA found that the landing and takeoff (LTO) NO_x reductions from Tier 8 would be approximately 5.5 percent worldwide in 2026 and 7 percent worldwide in 2036 relative to the baseline. In the U.S., this would be equivalent to approximately 5,200 tons in 2020 and 8,700 tons in 2030. Cumulative reductions from the implementation of Tier 8 in 2014 to 2030 are projected to be approximately 100,000 tons of NO_x [see 76 FR 45041 and related citations from various working and analysis groups of the ICAO Council's Committee on Aviation Environmental Protection (CAEP)].

With regard to newly manufactured engines,[6] only Tier 6 standards apply at this time, although EPA states that, depending upon ICAO actions, they may later consider requiring these engines to comply with Tier 8 standards (76 FR 45034).

Newly manufactured engines that were originally certified "prior to the effective date of the... rule may continue production without meeting the proposed Tier 6 standards through December 31, 2012. After that date, these engines must comply with the proposed Tier 6 standards" or cease production ("EPA Proposed NO_x Emission Standards for Aircraft Gas Turbine Engines," EPA, Office of Transportation and Air Quality, EPA-420-F-11-019, July 2011, page 1).

Overall, due to the long timeframe, 2014-2030, for implementation of Tier 8 and realization of the emissions reductions from Tier 8, the aircraft standards will not help nonattainment areas meet their 2013 and 2015 clean monitoring data needs. Maryland urges EPA to provide much more support toward nonattainment areas' attainment of the 75 ppb ozone standard.

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[5] [5] According to EPA (76 FR 45021), "the ICAO standards describe newly certified engines as '...engines of a type or model for which the date of manufacture of the first individual production model was after...' the effective date of the emission standards.

[6] "Newly manufactured engines" are "those that have been previously certified and manufactured in compliance with preexisting standards, and will continue to be produced after the effective date of a new applicable standard." (76 FR 45021)

Besides aircraft emissions standards, EPA has promulgated rules controlling emissions from airport equipment. EPA established and phased in emissions standards for new nonroad diesel engines, including certain aircraft ground support equipment, from 1994-2008. Tier I standards reduced NO_x emissions by 30 percent from engines greater than 37 kilowatts. Tier 2 emissions standards covered all engine sizes and further reduced NO_x, hydrocarbons, and PM. Tier 3 standards, for engines of 37-560 kW, further reduce nonroad diesel engine emissions by 60 percent for NO_x and 40 percent for PM, compared to Tier 1.

New nonroad spark ignition (SI) engines above 19 kW, which includes some airport equipment, have been required since 2007 to include optimized engines. These engines must include new diagnostic systems, in order to meet more stringent standards calling for a 90-percent reduction in NO_x, HC, and CO emissions. According to EPA's "Final Regulatory Support Document: Control of Emissions from Unregulated Nonroad Engines," EPA420-R-02-022, September 2002, the industrial spark-ignition nonroad engines greater than 19 kW covered in EPA's 2002 rule, "Control of Emissions From Nonroad Large Spark-Ignition Engines, and Recreational Engines (Marine and Land-Based)," are projected to achieve the following in 2020: VOC reductions of 89%, or 284,000 tons, and NO_x reductions of 91%, or 429,000 tons. Note that these projection emissions reductions include airport equipment as well as other nonroad large spark-ignition engines.

While these standards for airport equipment have already gone into effect and should start to help nonattainment areas in their efforts to achieve clean monitoring data starting in 2013 and 2015, the full benefits of this rule will not be realized until at least 2020. Nonattainment areas need additional support from EPA toward attainment of the 75 ppb ozone standard.

APPENDIX A
5 (9) – FACTOR ANALYSIS FOR THE 16 STATE NONATTAINMENT AREA

Since the 1990 Clean Air Act Amendments (CAAA) passed, EPA has used a 9 factor analysis to determine the boundaries of nonattainment areas. In the early 1990s this methodology supported the CAAA enlargement of nonattainment areas to have boundaries coincident with the boundaries of consolidated metropolitan statistical areas. It was also in keeping with the theory at that time that transport was short range, mostly from large metropolitan area to large metropolitan area. This theory formed the basis for creating the Northeast Ozone Transport Region.

During the Ozone Transport Assessment Group deliberations just before the turn of the century, scientific evidence came to light that long range transport had a similar if not larger affect on ozone levels in the east. EPA promulgated the NO_x SIP Call, the first long range transport rule, as a result of these findings. EPA utilized the same 9-factor methodology in designating areas for the 1997 0.08 ppm ozone standard in 2004. However, designations for the 1997 PM2.5 standard appeared to consider the sources of pollution more heavily in the designation process and, of late, SO2 and NO2 designations also seem to consider the nature of the pollutant more and adapt the designation process to the particular pollutant. Yet, despite a better understanding of the science of transport and its role in producing high ozone levels, EPA still employs the same 9 factor analysis, currently condensed into 5 factors. EPA evaluates the factors in the same way as before with no apparent consideration of long range transport or current scientific evidence. EPA has not been able to promulgate a regulation to control long range transport so that controls are in place to provide improved air quality prior to attainment deadlines. EPA has the discretion to modify the evaluation criteria for designating area boundaries to account for long range transport. The designation process should include such a factor in designating nonattainment areas now and in the future as it is the responsibility of a state to control significant pollution contribution to other areas.

Air quality data

EPA reviews the design values for ozone monitors to locate violating monitors. EPA then establishes nonattainment areas around those monitors expanding outward and geographically ending the nonattainment area when monitors measuring attainment are found. Certainly this technique is a good foundation but falls far short of examining other air quality data that should factor into designations, especially in light of what is known about long range transport.

Our 20 year ozone research program shows clearly that the number one contributor to Maryland's high ozone level is an elevated reservoir of high transported ozone that forms and collects in the middle of the night. This elevated reservoir is trapped at about 2000 feet above the earth's surface by a nocturnal inversion and can be pushed by elevated nighttime winds for hundreds of miles in a single night. Maryland has hard, measured (not modeled) data, from airplanes, balloons, mountaintop monitors, wind profilers and other measuring equipment that confirm the above conclusions. Our monitors show that as the nocturnal inversion begins to

break up, the aloft ozone, routinely measured at levels above 75 ppb, slowly mixes down to earth. The elevated reservoir is created by emissions from nearby, upwind states.

We also have empirical evidence of emissions transported by the nocturnal low level jet (NLLJ). This is a strong southwest wind along eastern side of the Appalachian Mountains that runs very close to the ground. It begins at sundown and can last until dawn. It can start as far south as North Carolina and can reach as far north as New Jersey, Massachusetts, and Connecticut. Given an average speed of 30 mph, a NLLJ that runs for 7 hours carries gases and particulates 210 miles. Data collected simultaneously from wind profilers and ozonesondes has revealed that ozone is transported via the low level jet. Lidar data reveals similar transport for particulate matter.

This air quality data is more difficult to find and evaluate but does lend proof those areas of influence should be included in the areas of nonattainment they affect. EPA claims one natural reading of Section 107 is that an area must be designated nonattainment if it "contributes to nonattainment" in a "nearby area" at the time EPA promulgates the final designations pursuant to section 107. The areas Maryland recommended for inclusion in a nonattainment area with Maryland do contribute to our nonattainment at this time.

Emissions and emissions-related data

Once an independent factor, EPA now combines emissions related data with the emissions factor. EPA interprets emissions-related data to include actual and estimated emissions of VOC and NO_x from sources, such as the data available in the latest National Emissions Inventory available, and to include the latest information and trends for Vehicle Miles Traveled (VMT) and commuting, and population characteristics and trends of the area (growth factors). Population, VMT and commuting patterns and growth factors were once independent factors.
Traffic and commuting patterns- location of non point source emissions

Controlling transported pollution is very important in attaining the ozone NAAQS to downwind states such as Maryland. In some areas of Maryland we need controls in place beginning in 2012 to meet 2015 attainment deadlines for the 75 ppb ozone NAAQS. In other areas such as the Baltimore serious nonattainment area, additional transport reductions are needed immediately to prevent this area from becoming classified as severe by the end of 2014. Judgments regarding air quality compliance with the 0.08 ppm standard are on-going. EPA modeling from the CSAPR shows that 5-10 ppb of Baltimore's design value are attributable to transport. Subtracting 10 ppb from Baltimore's current design value of 92 ppb would allow Baltimore to attain the 0.08 ppm standard and be at the same starting point, nonattainment for the 75 ppb standard only, as other states in the eastern U.S.

Transport becomes central to attainment in more and more states with every lowering of the NAAQS. Specifically, with every decrease in the NAAQS, the proportion of the NAAQS represented by transported pollution in these states increases. Meteorologists and atmospheric chemistry researchers at Howard University, the University of Maryland, and other institutions have documented the impact that meteorology and air transport processes such as the nocturnal low level jet (NLLJ) and the elevated ozone reservoir have on local emissions levels.

Local measures in Maryland have been all but exhausted. Maryland fully agrees that in the past many local emission reductions were necessary. Maryland developed and implemented

necessary regulations with the involvement of our state's industry leaders. These regulations have resulted in large reductions in Maryland emissions. For example, Maryland has implemented the state's Healthy Air Act, which is reducing NO_x levels from electric generating units (EGUs) by approximately 75% from 2002 levels, in addition to significant reductions in SO_2 and mercury. Emissions from mobile sources, including onroad, nonroad, marine, air, and rail, also continue to contribute significantly to NO_x and VOC emissions levels, but the setting of mobile emissions standards is outside the authority of most states to regulate. Very deep, additional regional reductions of NO_x will be needed for Maryland to attain the new ozone standard.

Many of the states Maryland proposed including in the large nonattainment area meet the criteria EPA says it uses to include a nearby area in a nonattainment designation. NO_x emissions for these states are quadruple the NO_x emissions from Maryland. Some of these sources are controlled but many are not and modeling shows they have an effect on Maryland's air quality. Emissions per capita in these states are greater than emissions per capita in Maryland. Many of these states export power into Maryland and other states and do so in a regulated environment where control costs are passed on to the consumer. Not including them in the nonattainment area is a direct disadvantage to Maryland sources which are deregulated and operate in a merchant situation. This encourages growth in emissions in these states as most plants are not yet operating at maximum capacity.

State	**Population (2010 census)**	**2010 NO_x lbs (EPA CAMD)**	**2010 Per Capita NO_x Emissions (lbs/per person)**
MD	5,773,552.00	37144200	6.43
PA	12,702,379.00	250972400	19.76
VA	8,001,024.00	66169600	8.27
WV	1,852,994.00	102785600	55.47
IN	6,483,402.00	241848000	37.30
KY	4,339,367.00	183648600	42.32
NY	19,378,102.00	47421800	2.45
NC	9,535,483.00	99222400	10.41
TN	6,346,105.00	61979200	9.77
MI	9,883,640.00	152260000	15.41

There is no doubt that Maryland is highly urbanized containing a large city and half the suburbs of the nation's capital. Its small geographic size accentuates that density. Many of the states we requested as part of the large nonattainment area are much larger in square miles and though they have major cities, their population density is diluted with the additional geographic area. These cities are experiencing growth just as Maryland is, yet they are not required to offset the growth in emissions that accompanies growth in population the way Maryland will be as the lone moderate nonattainment area in the east.

Growth in emissions includes growth in VMT, growth in area sources and growth in nonroad sources as well as growth in point sources and EGU capacity. Most, if not all, of these areas

will do infrastructure planning with no mobile source emissions budget-only the build/no build test which supports growth in mobile source emissions. The large geographic areas of these states encourage growth in VMT. Maryland has taken numerous steps to both reduce emissions through technological measures and to encourage reductions in VMT. We are currently waiting to implement our Clean Cars program and are implementing aspirational conformity goals. These are difficult steps to take when they are not echoed in surrounding states and they do little to improve air quality in your own state.

Meteorology

The next factor is Meteorology, which includes weather and transport patterns. The EPA uses 30-year average summer surface-level wind directions to help identify ozone nonattainment boundaries.

a. *Local Transport*

MDE agrees with the EPA finding that the meteorological data does not provide a basis for separating the Baltimore and Washington, DC nonattainment areas. In fact, "[s]everal Maryland counties in the current Washington DC-MD-VA nonattainment area are most frequently upwind of and most proximate to a violating monitor in the current Baltimore nonattainment area."

b. *Regional Transport*

However, climatological surface wind direction only tells part of the meteorological story. Surface wind roses do not represent the three-dimensional flow of air in the atmosphere. Transport patterns based solely on surface wind speed and direction ignores aloft winds and regular vertical mixing such as occurs in the daily cycle of the planetary boundary layer (PBL). Objective, hierarchical clusters based on three-dimensional wind fields provide a more realistic representation of the origins of air during ozone exceedance days (see, e.g., Hains et al., 2008 and Taubman et al., 2006).

Chemical lifetimes are longer and transport faster in the lower free troposphere than at the surface and, as a result, ozone and ozone precursors are commonly carried hundreds of miles from their sources. Following transport, air in the lower free troposphere mixes down to the surface as the nocturnal inversion breaks down due to solar heating in the mornings of ozone exceedance days. The relevant mixing layer for pollutants can vary in depth during a 24-hour period from less than 100 m at night to more than 1,000 m on a warm and sunny day.

Due to interstate transport, Maryland's ozone is essentially a regional rather than a local problem. Frequently, during the morning hours of an ozone exceedance day, a large reservoir of ozone that has been transported into Maryland from other states via the stronger winds above the boundary layer sits over Maryland and the Mid-Atlantic area waiting to mix down (see Figure 3-1). Based on ozone data collected at mountain top monitoring stations (aircraft and ozonesondes too), ozone levels in the reservoir can routinely reach 60 to 100 ppb during the late night and early morning hours. In contrast during the morning hours, ozone levels at the surface are very low. Normally, around 10:00 or 11:00 AM, the nocturnal inversion breaks down and ozone in the reservoir mixes down to the surface and significantly degrades air quality. Since the air that mixes down has ozone levels at or near the 8-hour ozone NAAQS, no amount of local controls will help prevent an ozone exceedance day from occurring.

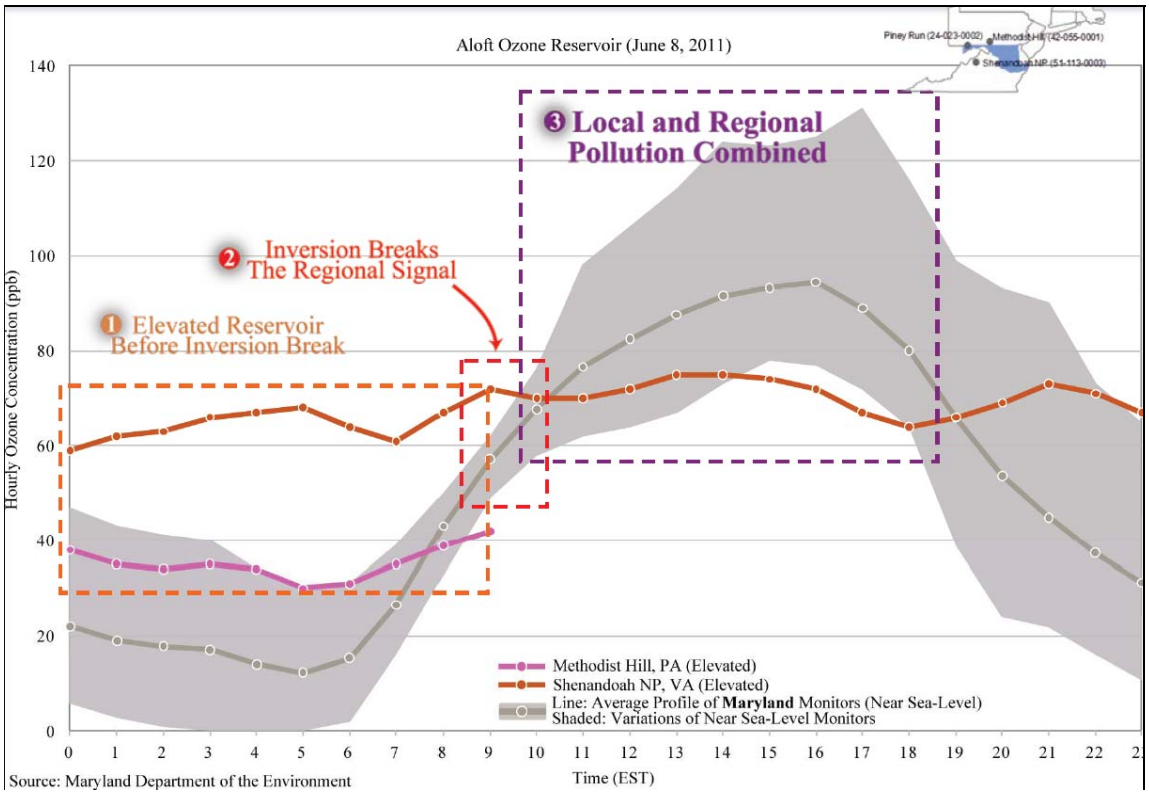

Figure 3-1. Timing of the mixing down of the aloft ozone reservoir from mountain top measurements on June 8, 2011, from MDE.

c. *Scientific Evidence*

There is an extensive body of scientific findings proving that regional transport plays a significant role in urban high ozone episodes in Maryland. During the summer ozone season, scientists from the University of Maryland College Park (UMD), Howard University (HU), University of Maryland Baltimore County (UMBC) and others have used aircraft, ozonesondes, and remote sensing techniques to show that both ozone and its precursors are transported from nearby upwind states into Maryland.

More than 15 years of aircraft measurements by the UMD, have proven that aloft air coming into Maryland contains ozone concentrations between 60 – 100 ppb as the result of sources in the nearby states; including Ohio, West Virginia, Pennsylvania, and Virginia. Each of these states contributes substantially to Maryland's air quality problems. *Taubman et al*. (2006) compared measured ozone profiles upwind and downwind of the Baltimore area, and determined that when the greatest cluster trajectory density lay over the Ohio River Valley (~59% of the profiles), transport accounted for 69–82% of the afternoon boundary layer ozone in Maryland. Under stagnant conditions (~27% of the profiles), transport accounted for 58% of the afternoon boundary layer ozone in Maryland.

Based on aircraft measurements made during a nine year period (1996-2004) by scientists at the UMD, morning ozone profiles show the highest aloft median ozone concentrations of about 70 ppb at approximately 1,000 meters above the surface (see Figure 3-2). Once the nocturnal boundary layer breaks down this ozone (plus ozone precursors) are poised to mix to the surface and cause Maryland to experience another ozone exceedance day.

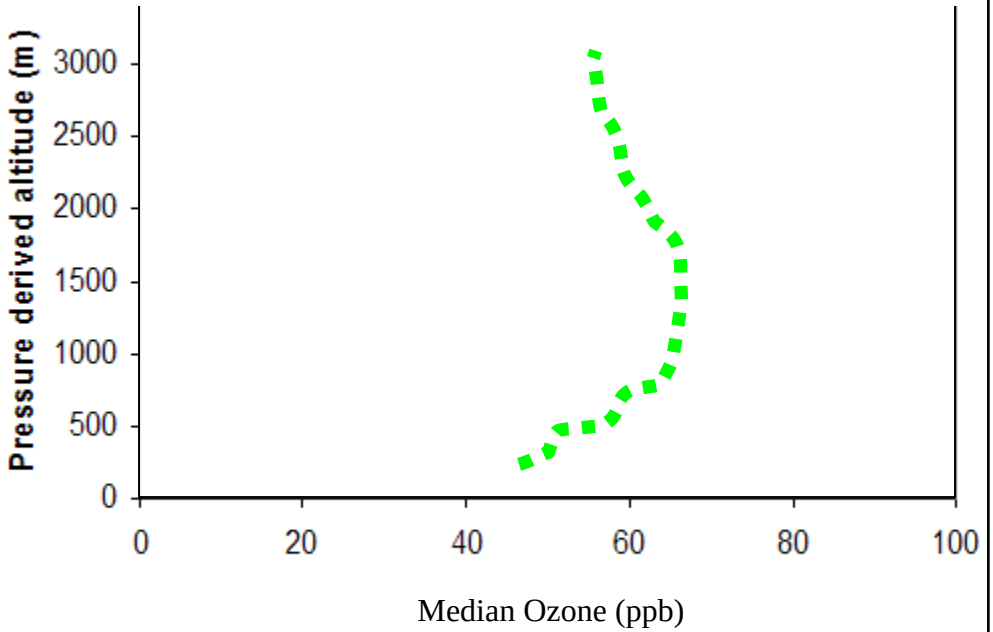

Figure 3-2. UMD Aircraft Data - All Morning Ozone Profiles (1996 -2004)

During a flight that took place on July 21, 2011, UMD scientists flew a vertical profile over rural Luray, VA at 11 AM. Aircraft measurements made during this morning flight, showed that approximately 80 ppb of ozone was aloft waiting to mix down to the surface (see Figure 3-3). 24-hour back trajectories showed that winds on this day were from the Ohio/West Virginia region.

Ozone concentrations well above the 75 ppb NAAQS have been measured repeatedly over the western (climatologically upwind) boundaries of Maryland. These consistently high concentrations of ozone and ozone precursors along with wind patterns (based on back trajectories) make a compelling case that ozone is being transported into Maryland from areas outside the State.

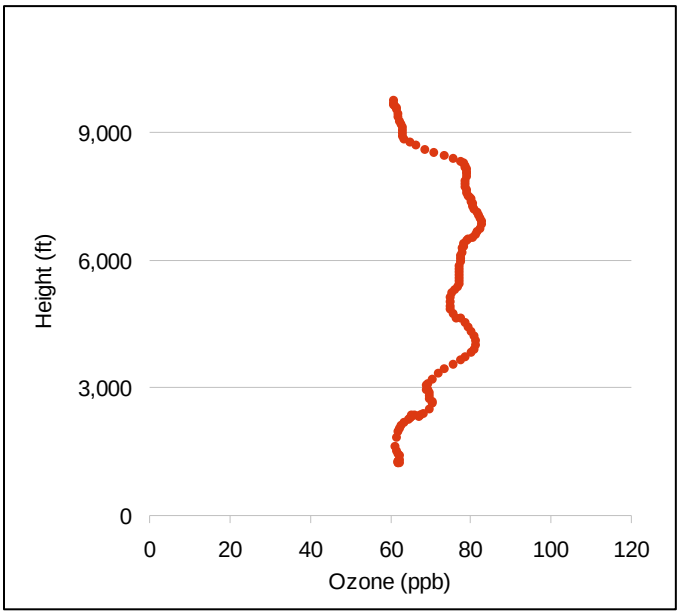

Figure 3-3. Vertical Profile of Ozone at Luray, VA on July 21, 2011 at 11 AM

MDE started contracting with HU in 2005 to launch ozonesondes during the late night and early morning hours in an effort to measure ozone concentrations in the aloft ozone reservoir and within the nocturnal low level jet (NLLJ).

Figure 3-4 shows 10:30 p.m. and 2:30 a.m. ozonesonde launches on July 12th and 13th, 2008 at Beltsville, Maryland. During the 10:30 p.m. launch the highest ozone concentration of approximately 80 ppb was measured at about 600 m, and during the 2:30 a.m. launch approximately 95 ppb was measured at about 800 m. Both launches captured high ozone concentrations being transported from the south to the north within the NLLJ. These high ozone concentrations within the NLLJ are already well above the 75 ppb NAAQS and have been measured repeatedly by ozonesondes launched from Beltsville, MD. These consistently high concentrations of ozone (and ozone precursors) measured within NLLJ (based on ozonesondes and wind profiler measurements) make a compelling case that ozone is being transported into Maryland from areas outside the State.

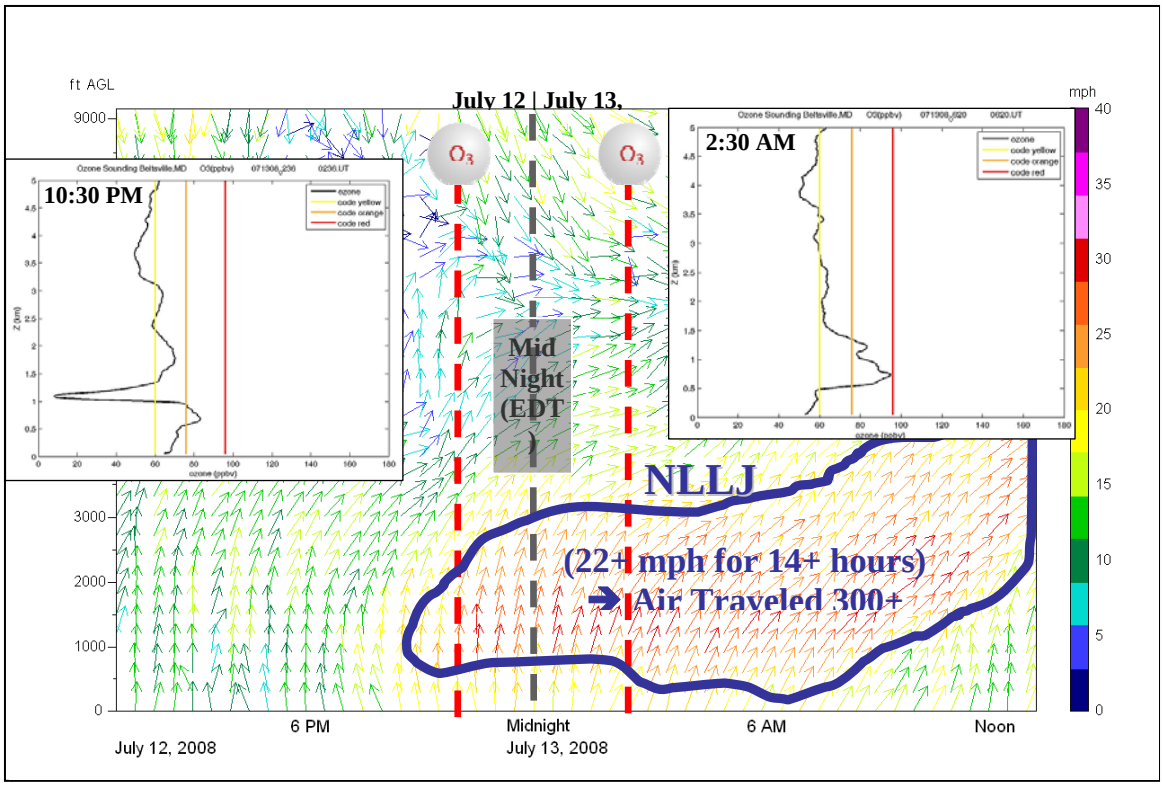

Figure 3-4. Ozone profiles from Howard University ozonesondes launched at 10:30 p.m. and 2:30 a.m. during a NLLJ event on July 12-13, 2008.

MDE started contracting with UMBC scientists in 2002 to make aloft measurements using LIDAR (Lidar Detection And Ranging) technology. The LIDAR is used to measure vertical profiles of atmospheric particles concentrations in a time series. Based on Figure 3-5, there is a high concentration of aerosols aloft in the early morning hours. At around 10:00 a.m. the nocturnal inversion breaks down and these particulates mix down to the surface and increase the concentrations of ground level pollutants. This data supports similar dynamics that allow ozone and ozone precursors to mix down to the surface and combined with local pollutants.

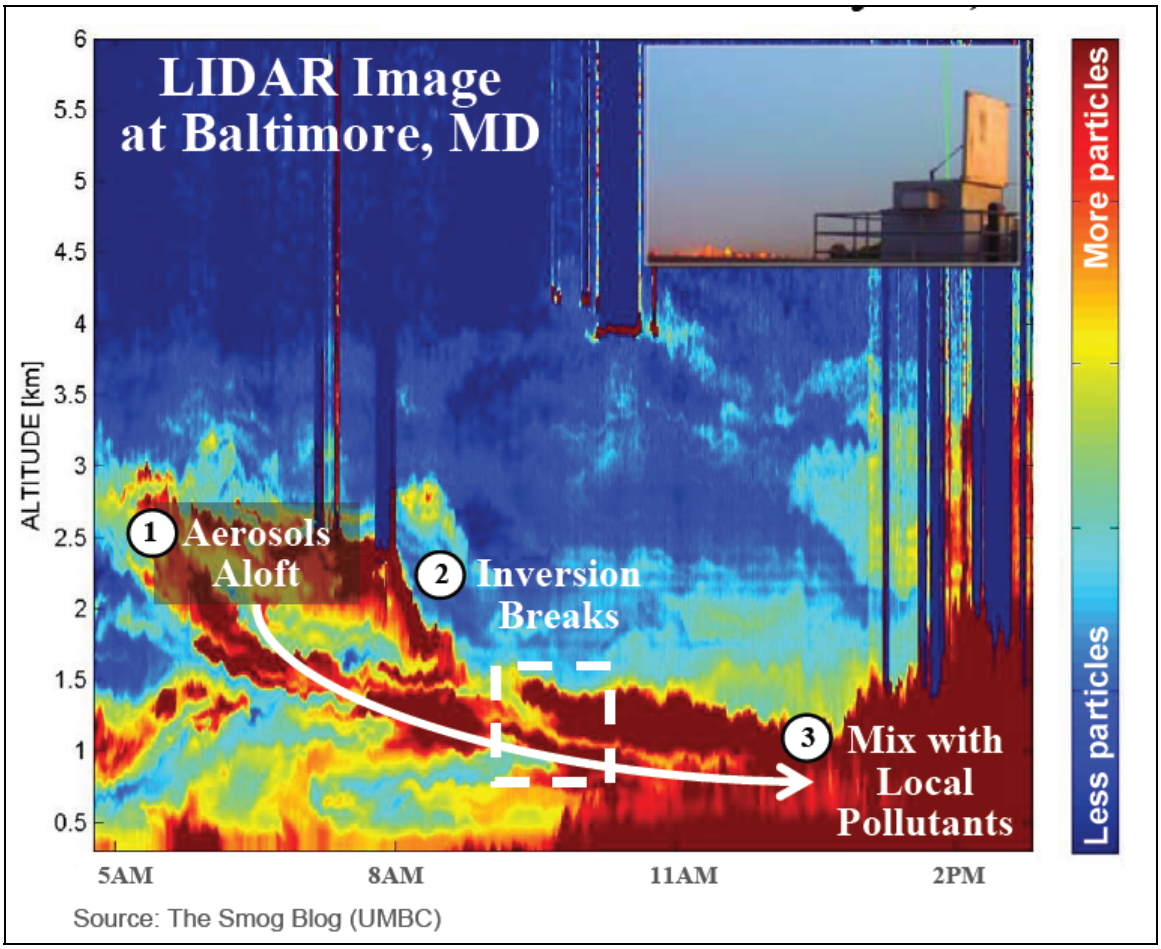

Figure 3-5. Particle profile time series from UMBC Lidar in Baltimore, MD on July 28, 2007.

In July 2011, NASA led a major air quality field campaign over Maryland. The project is called DISCOVER-AQ, which stands for Deriving Information on Surface conditions from Column and Vertically Resolved Observations Relevant to Air Quality. Among the core objectives of this campaign were to measure pollutant altitude profiles to better correlate those concentrations with surface values, as well as to determine the origins of tropospheric ozone and PM over the Baltimore-Washington area. Preliminary results of the DISCOVER-AQ campaign, exhibited in dozens of presentations at the 2011 American Geophysical Union Fall Meeting, indicate substantial concentrations of ozone and ozone precursors are transported into the Maryland area via the free troposphere and then mix down to the surface.

The success of regional NO_x controls in reducing ozone in Maryland is also well-documented. The implementation of significant local controls from 1997 to 2003 in Maryland was able to reduce ozone by about 1 ppb/year. Under the NO_x SIP Call, 75% of the EGU controls were put in place from 2003 to 2007. From 2003 to 2008, Maryland ozone was reduced by 2 ppb/year — double the rate under local controls alone.

d. *The "Meteorologically-Challenged" State*
Maryland is a meteorologically-challenged state due to its geography, topography and location, as discussed in more detail in the geography section. It is located west of the Ohio River

Valley, which has a large concentration of power plants. The Chesapeake Bay breeze stops ozone and its precursors from being blown out to sea and instead funnels dirty air along the I-95 corridor. The Appalachian Mountains are responsible for both the "leeside trough" and "nocturnal low level jet" that speed the transport of pollution toward Maryland.

e. *Significant Contributions from Other States*

New scientific analysis from the UMD determined the most common transport routes for Maryland ozone exceedance days. Using back trajectories, this research identified five meteorological regimes associated high ozone days (see Figure 3-6). The largest cluster is westerly transport through Ohio and Pennsylvania. The second largest cluster is northwest transport through Pennsylvania. The third largest cluster is southwest transport from Virginia and West Virginia. Two smaller local clusters were also identified: recirculation and stagnation.

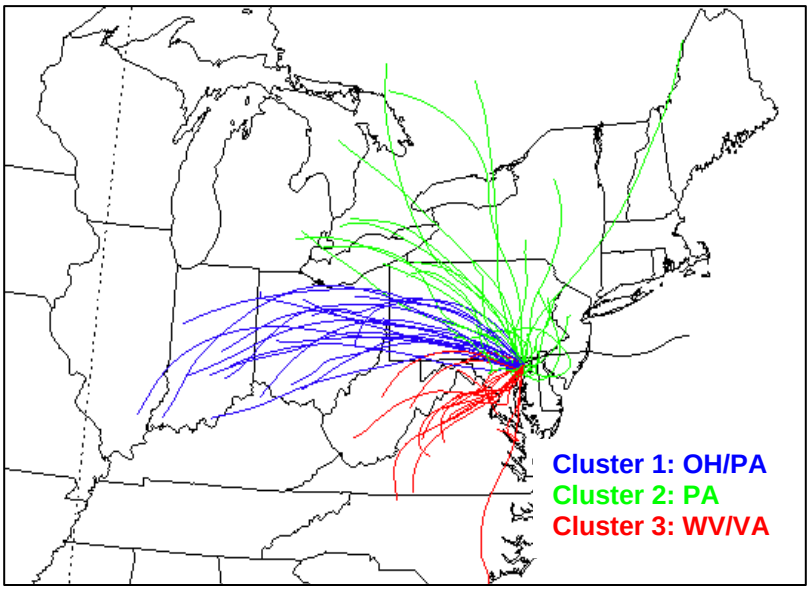

Figure 3-6. HYSPLIT 48 hr back-trajectory (1000 m)

Only approximately one-third of Maryland's air pollution is from local anthropogenic sources. Approximately half is from interstate transport. This data comes from the EPA's modeling for the Cross-State Air Pollution Rule (CSAPR), also known as the Transport Rule. Table 3-1 summarizes the contributions in ppb (percentages) of projected 2012 ozone design values for the 15 Maryland monitors included in the source apportionment modeling runs with CAMx. (Note that the four states with the largest contributions match the four states identified in the UMD cluster analysis shown in Figure 3-6.)

Table 3-1: Contribution to 2012 Ozone Design Values[±]

State	Maximum Contribution ppb (%)	Average Contribution ppb (%)	Range (ppb)
Biogenic / BC	21 (29%)	18 (24%)	15 – 21
Maryland	35 (43%)	27 (35%)	17 – 35
Virginia	14 (19%)	9 (12%)	6 – 14
Pennsylvania	8 (11%)	6 (7%)	3 – 8
Ohio	5 (8%)	3 (5%)	1 – 5
West Virginia	5 (7%)	3 (4%)	1 – 5
Other OTR	5 (6%)	2 (3%)	1 – 5
Other Outside OTR	13 (17%)	8 (11%)	4 – 13

[±]calculations based on final Transport Rule (aka CSAPR) modeling data from Average and maximum design values by monitoring site for 8-hour ozone, annual PM2.5, and 24-hour PM2.5 for the 2003-2007 base period, the 2012 base case, and the 2014 base and CSAPR control scenario. (Excel 354 KB) and Contributions of 8-hour ozone, annual PM2.5, and 24-hour PM2.5 from each state to each monitoring site. (Excel 1.38 MB) downloaded from http://www.epa.gov/airtransport/techinfo.html on 8-2-11

While the CSAPR modeling used an 85 ppb standard, the release of the contribution modeling results along with the established 1% significant contribution threshold allows states like Maryland to identify significant contributors under the 75 ppb standard. These states, in order of the magnitude of their contribution to Maryland, are: Virginia, Pennsylvania, Ohio, West Virginia, Kentucky, Indiana, Michigan, New York, North Carolina, Tennessee, Illinois, and New Jersey (See Figure 3-6).

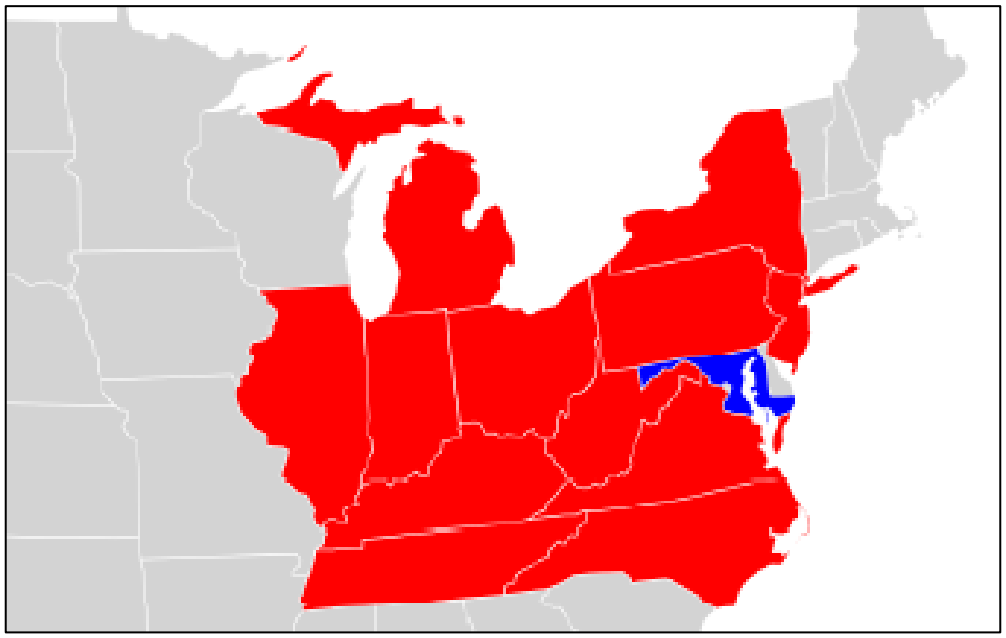

Figure 3-6. Significant Contributors to Maryland using a 75 ppb Ozone NAAQS, prepared by NESCAUM from EPA CSAPR modeling results.

The EPA analysis for ozone nonattainment area boundaries and CSAPR both have the goal of identifying "linkages" and "significant contributions" to an area's ozone problem. For consistency, the EPA should use the same standard as laid out in CSAPR federal regulations, which have gone through the public comment process, should have priority over the interpretation of ozone nonattainment area boundary criteria, which only appear in EPA memoranda to the states. In addition, the CSAPR approach to identifying meteorology-based linkages is consistent with the science of ozone formation and more importantly transport. Therefore, the meteorology factor supports an ozone nonattainment area boundary of a large multistate area.

f. *Resources*

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Geography/topography (mountain ranges or other air basin boundaries)

The next factor is geography and topography including mountain ranges or other air basin boundaries.

a. No Intrastate Barriers

MDE agrees with the EPA conclusion that the Washington-Baltimore-Northern Virginia CSA generally does not have any barriers appreciably limiting air pollution within its air shed. The Appalachian Mountains are a barrier to surface transport but not to aloft transport of ozone and ozone precursors.

b. Chesapeake Bay Breeze

There is an important air basin boundary not addressed by the EPA analysis: the Chesapeake Bay. The "bay breeze" plays a significant role in preventing pollution from blowing out to sea and channeling it back toward Washington, DC, and Baltimore.

As show in Figure 4-1, the air over the Bay remains cooler during the day than the land, creating a breeze that flows from the east. As ozone is usually blown in from the west, the breeze creates a "wall" that allows the pollution to build up on the west side of the Bay, where Washington, DC, and Baltimore (and the Edgewood monitor) are located (Landry 2011). This barrier also channels pollution in a northeast direction, up toward Pennsylvania, New Jersey, and New York.

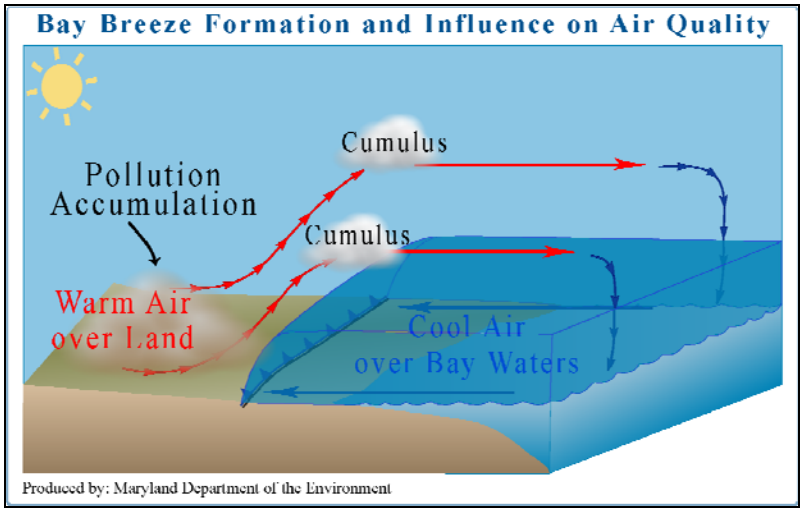

Figure 4-1: Chesapeake Bay Breeze as an Air Basin Barrier, from MDE

c. Leeside Trough

The position of the Appalachian Mountains enables formation of a meteorological phenomenon called a “leeside trough.” According to the *American Meteorological Association Glossary* (2010), a leeside trough is “a pressure trough formed on the lee side [opposite the wind] of a mountain range in situations where the wind is blowing with a substantial component across the mountain ridge; often seen on United States weather maps east of the Rocky Mountains, and sometimes east of the Appalachians." This shift in pressure along the trough (the orange dashed line in Figure 4-2) results in westerly to northwesterly flow on the left side and southerly flow on the right side. Since the leeside trough usually develops over Maryland, this phenomenon results in pollutants from the Ohio River Valley and Western PA veering (or turning northward) into Maryland and at the same time allows ozone and ozone precursors to be transported from Virginia and North Carolina into Maryland too.

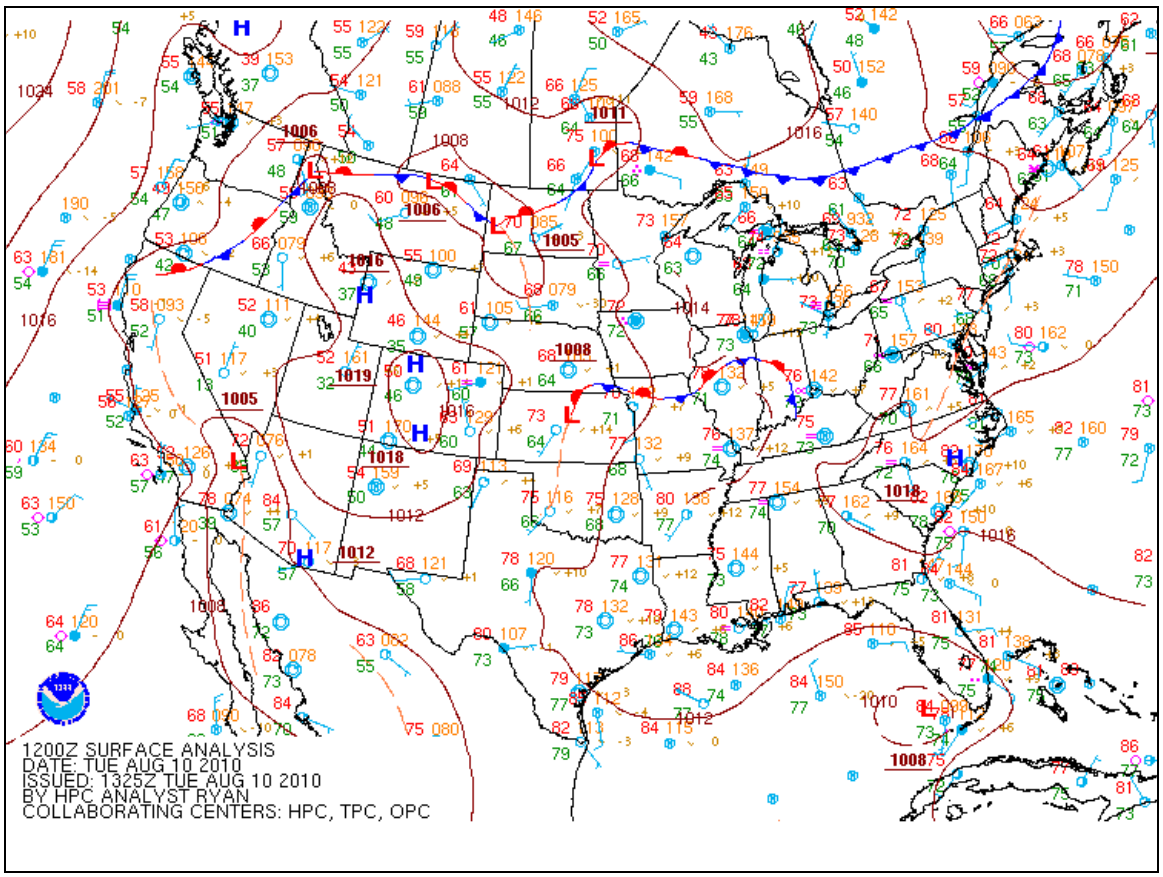

Figure 4-2. August 10, 2010 12z Surface Analysis from the Hydrometeorological Prediction Center (HPC)

On August 10, 2010 a lee side trough formed over Maryland and the result was an ozone exceedance day, which included pockets of unhealthy air quality (refer to Figure 4-3).

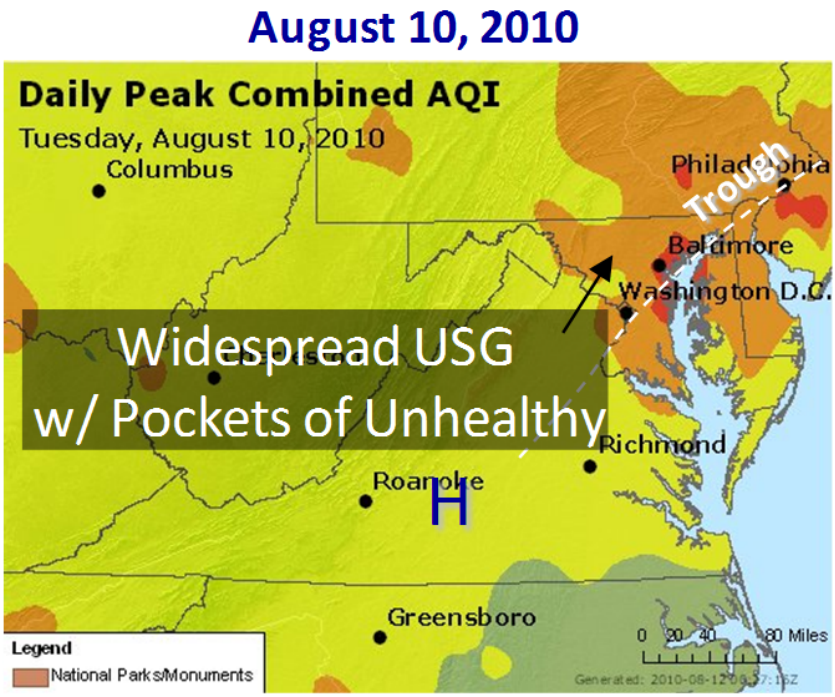

Figure 4-3. August 10, 2010 EPA AQI Map

d. Nocturnal Low Level Jet

Another meteorological phenomenon that results from the location of the Appalachian Mountains to the west and the Atlantic Ocean to the east is the nocturnal low level jet (NLLJ). The NNLJ is a fast moving stream of air that is typically observed between the Appalachian Mountains and the Atlantic Ocean during the late night and early morning hours. This fast moving stream of air can reach speeds of 40 mph and stretches from NC to MD to NJ to MA (refer to Figure 4-4).

In an effort to measure ozone concentrations in the NLLJ, MDE started contracting with the scientists at HU in 2005 to launch ozonesondes during the late night and early morning hours (see the factor 3 Meteorology section). Based on these ozonesonde measurements, ozone in excess of 90 ppb has been measured on several occasions within the NLLJ (refer to Figure 4-5).

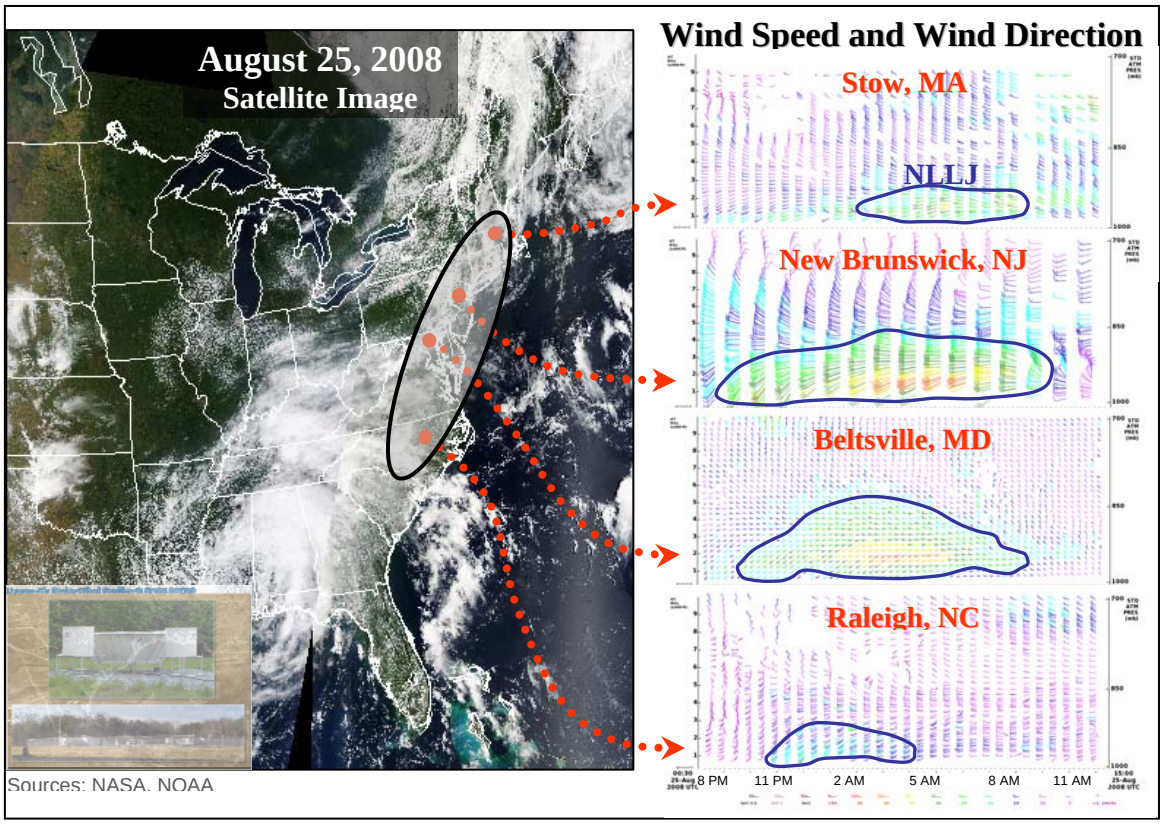

Figure 4-4. Extent of the Nocturnal Low Level Jet

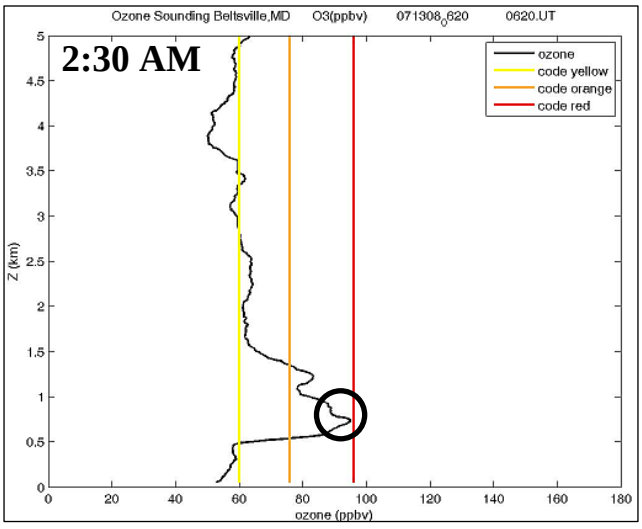

Figure 4-5. Ozone Concentrations With in the Nocturnal Low Level Jet

e. *True Air Shed Size?*

The "air shed" that is relevant to the ozone nonattainment area boundary is the same as the "air shed" for the Chesapeake Bay, since both seek to delineate sources of nitrogen oxides (NO_x) that contribute to federally-regulated pollution (Dennis 1997).

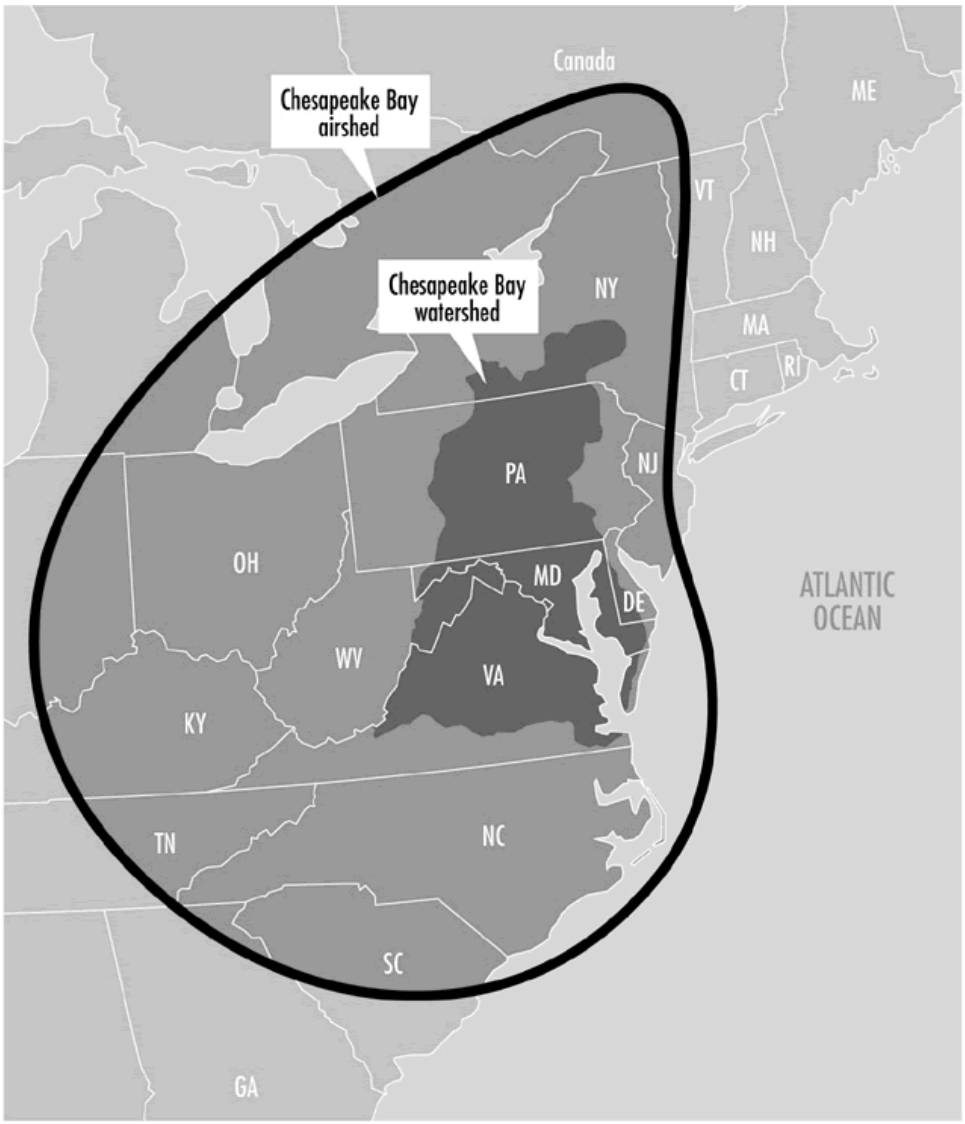

Figure 4-6: States in the Chesapeake Bay Air Shed, from Chesapeake Bay Foundation, http://www.cbf.org/page.aspx?pid=577, retrieved 2/1/12

As shown in Figure 4-6, the Chesapeake Bay air shed includes Maryland, Delaware, Virginia, Pennsylvania, West Virginia, North Carolina, Ohio, most of New York, New Jersey, Kentucky and South Carolina, and parts of Indiana, Tennessee, Michigan, and Vermont. Therefore, the geography factor supports a large multistate nonattainment area boundary.

d. *Resources*

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Jurisdictional boundaries

The proposed large nonattainment area has clearly defined legal boundaries within the nonattainment area. The air quality planning functions, transportation planning functions and enforcement functions can work as described earlier for the Philadelphia region, with the additional of more sub regions.

APPENDIX B
5 (9) – FACTOR ANALYSIS FOR BALTIMORE-WASHINGTON CSA NONATTAINMENT AREA

Since the 1990 Clean Air Act Amendments (CAAA) passed, EPA has used a 9 factor analysis to determine the boundaries of nonattainment areas (currently condensed into 5 factors). In the early 1990s this methodology supported the CAAA enlargement of nonattainment areas to have boundaries coincident with the boundaries of consolidated metropolitan statistical areas. It was also in keeping with the theory at that time that transport was short range, mostly from large metropolitan area to large metropolitan area. This theory formed the basis for creating the Northeast Ozone Transport Region.

The 1990 Census was the first census to combine the Baltimore and Washington metropolitan statistical areas into a consolidated metropolitan statistical area. The publication of the census findings was too late to create a combined nonattainment area for Baltimore and Washington, DC under the one hour ozone standard. As designations progressed for the 1997 eight hour ozone standard, both Baltimore and Washington, DC were designated and classified as moderate subjecting them to the same requirements. EPA's proposed designations for the 2008 eight hour ozone standard classify Baltimore as moderate and Washington, DC as marginal, creating a significant disparity in the requirements each area must meet.

MDE has investigated the Edgewood monitor responsible for the moderate classification proposed for the Baltimore nonattainment area. The monitor is directly influenced by emissions from the Washington, DC area. We believe that this influence will increase if the Washington region is classified as marginal and maintained as a separate nonattainment area from the Baltimore region. The two metropolitan areas are separated by less than 30 miles from center to center. We believe that EPA should designate the Combined Statistical Area (CSA) as one nonattainment area and classify the area as appropriate. The following analysis supports this recommendation. The area would probably retain the sub regional boundaries now in place but the area as a whole would be classified uniformly.

Summary of the 5-Factor Analysis

1. Air Quality Data

EPA carefully examines the air quality data for each county in the combined statistical area to determine whether the county contains a violating monitor. If it does EPA looks at contiguous counties for cause or contribution. In proposing to separate Baltimore and Washington, DC, EPA did not look at the CSA as a whole. Throughout almost the entire CSA, monitoring data is relatively uniform with the exception of fringe outer counties and the Edgewood monitor. EPA actually comments that the Anne Arundel County monitor tracks well with values at the Virginia design value monitor. This is because the overall air quality of the CSA is fairly uniform and emissions from the region as a whole generate ozone uniformly throughout the region. This is an indication that the Baltimore region is affected strongly and mostly by sources to the south and west, which includes the Washington, DC area. EPA states in analyses from other states that this is typical of the northeastern United States, since most of peak ozone design values

are found north and east of the centers of major urban areas. We believe this uniformity demonstrates that the two regions should be designated as one nonattainment area. In support of this belief, Maryland has micro scale modeling that shows the influence of the Chesapeake Bay and the bay breeze effect on the transported emissions from the Washington, DC region which helps explain the abnormally high readings at the Edgewood monitor.

2. Emissions and Emissions-Related Data

Emissions throughout the CSA are fairly uniform. EPA has used 2008 emissions data which excludes the reductions from the Maryland Healthy Air Act. Most of the counties with exceptionally high NO_x emissions contain power plants which supply most of the power for the Washington DC area. If EPA used current data that captures the reductions made by the Healthy Air Act the Maryland NO_x data would be lower as shown in Table 8 revised from EPA's analysis. Additionally, three quarters of the 495 Beltway which serves the CSA lies within Maryland. The NO_x emissions from traffic on this portion of the beltway are attributed to Maryland even though Virginia commuters regularly utilize this highway. Table 8 shows that mobile emissions are the dominant factor in the Washington region. Growth factors in Virginia far outpace growth factors for counties in Maryland implying additional non-point source emissions in the region.

3. Meteorology

Through research, MDE has found the existence of a localized phenomena referred to as the Chesapeake Bay breeze. The Chesapeake Bay breeze is caused by the sharp gradient between land and water temperatures which causes the air over the warmer land to rise and be replaced at the surface by cooler air from atop the Bay waters. This sharp gradient effectively creates a microclimate akin to a mini-cold front that inhibits pollution transport across the Chesapeake Bay, and instead transports pollution towards the western side of the bay where the Edgewood monitor is located. Scientists from the University of Maryland College Park (UMD) have performed high resolution (0.5 km domain) WRF (meteorological) and CMAQ (photochemical) modeling that illustrates how early morning stagnation over the Chesapeake Bay allows high pollution concentrations at the bay breeze convergence zone to buildup and then be lofted and transported downwind. The high resolution photochemical modeling shows that pollution transported from the Baltimore and Washington, DC regions is directed northwestward towards the Edgewood monitor. This high resolution CMAQ modeling generates ozone concentrations that are closer to the observed concentrations.

4. Geography

The topography and geography of the Baltimore and Washington, DC regions are similar. As stated in the meteorology section, the Chesapeake Bay is a barrier to the east of both regions. Monitors on the eastern shore of Maryland are attaining the standard in the absence of other urban areas. However, the western shore of the Bay is influenced by the Chesapeake Bay breeze which effectively creates a microclimate akin to a mini-cold front that inhibits pollution transport across the Chesapeake Bay, and instead transports pollution towards the western side of the bay where the Edgewood monitor is located and concentrates emissions along its edge.

5. Jurisdictional Boundaries

The CSA has county boundaries even though it crosses state lines. It would have within it three or more functional sub regions currently performing both air quality and transportation planning. While it may be possible to exclude some of the outer ring counties, the fact that

these counties are included as part of the CSA indicates their forming ties to the core urban area.

Air quality data

EPA reviews the design values for ozone monitors to locate violating monitors. EPA then establishes nonattainment areas around those monitors expanding outward and geographically ending the nonattainment area when monitors measuring attainment are found. The inclusion of the Baltimore and Washington, DC regions in a single nonattainment area is consistent with this technique.

Plotting the design values for each county on a map shows that most of the Baltimore and Washington, DC region have similar design values with few exceptions. The exceptions are Baltimore City, one of the two monitors in Harford County, and the outer ring counties in Virginia and Maryland. It seems rather arbitrary to separate the two areas based on Metropolitan Statistical Area (MSA) boundaries.

EPA actually comments that the Anne Arundel County monitor tracks well with values at the Virginia design value monitor. This is because the overall air quality of the CSA is fairly uniform and emissions from the region as a whole generate ozone uniformly throughout the region. This is an indication that the Baltimore region is affected strongly and mostly by sources to the south and west, which includes the Washington DC area. EPA states in analyses from other states that this is typical of the northeastern United States, since most of the peak ozone design values are found north and east of the centers of major urban areas. We believe this uniformity demonstrates that the two regions should be designated as one nonattainment area.

In support of this belief, Maryland has micro scale modeling that shows the influence of the Chesapeake Bay on the transported emissions from the Washington, DC region and explains the abnormally high readings at the Edgewood monitor (further discussed in the meteorology section). The other monitor in Harford County tracks well with other design values in the region, most of which are within a couple percent of the standard.

We have empirical evidence of emissions transported by the nocturnal low level jet (NLLJ). This is a strong southwest wind along eastern side of the Appalachian Mountains that runs very close to the ground. It begins at sundown and can last until dawn. It can start as far south as North Carolina and can reach as far north as New Jersey, Massachusetts, and Connecticut. Given an average speed of 30 mph, a NLLJ that runs for 7 hours carries gases and particulates 210 miles. Data collected simultaneously from wind profilers and ozonesondes has revealed that ozone is transported via the low level jet. Lidar data reveals similar transport for particulate matter.

Emissions and emissions-related data

Once an independent factor, EPA now combines emissions related data with the emissions factor. EPA interprets emissions-related data to include actual and estimated emissions of VOC and NO_x from sources, including data available in the latest National Emissions Inventory, the latest information and trends for Vehicle Miles Traveled (VMT) and commuting, and population characteristics and trends of the area (growth factors). Population, VMT and commuting

patterns, and growth factors were once independent factors. Traffic and commuting patterns indicate the location of non point source emissions.

Transport becomes central to attainment in more and more states with every lowering of the NAAQS. In Maryland's case, this includes transport from nearby areas, such as the other half of the CSA. Estimates of the time needed to form ozone correspond with the time it takes emissions from the Washington, DC region to travel over the Baltimore region.

Emissions throughout the CSA are fairly uniform. In making its proposed designations, EPA has used 2008 emissions data, which excludes the reductions from the Maryland Healthy Air Act. Most of Maryland's counties with exceptionally high NO_x emissions contain power plants. If EPA used current data that captures the reductions made by the Healthy Air Act the Maryland NO_x data would be lower as shown in the revision to Table 8 from EPA's 5-factor analysis for Maryland. Maryland's actual emission rates for the Baltimore region versus its real world monitoring data support the conclusion that the Baltimore region is significantly impacted from transported emissions, including those from the Washington, DC region.

Despite the substantial reductions in point source emissions from the Healthy Air Act, NO_x emissions remain high for the Maryland counties in the Washington CSA. This is because emissions in the Washington metropolitan area are predominantly from mobile sources. Three quarters of the 495 Beltway which serves the CSA lies within Maryland. The NO_x emissions from traffic on this portion of the beltway are attributed to Maryland even though Virginia commuters regularly utilize this highway. Growth factors in Virginia far outpace growth factors for counties in Maryland implying growth in additional non-point source emissions in the region.

EPA's Table 8[7] is reproduced here, reflecting the reductions produced by the Healthy Air Act. These reductions help equalize emissions in between the Baltimore and Washington DC regions. Power plants in Maryland are the major suppliers of electricity to the Baltimore and Washington DC regions. Table 8 shows emissions of NO_x and VOC given in tons per year (tpy) for violating and potentially contributing counties in the current Baltimore MD and Washington DC-MD-VA nonattainment areas and other portions of the Washington-Baltimore-NV CSA.

Table 8.
Total 2008 NO_x and VOC Emissions with 2012 Healthy Air Act Caps Applied

County/City	State Recommended Nonattainment?	NO_x (tpy)	VOC (tpy)
Current Baltimore MD Nonattainment Area:			
Anne Arundel County Co., MD	Yes	22,110	14,423
Baltimore City, MD	Yes	18,621	11,397

[7] MARYLAND Area Designations for the 2008 Ozone National Ambient Air Quality Standards, pp 33-35.

Table 8.
Total 2008 NO_x and VOC Emissions with 2012 Healthy Air Act Caps Applied

County/City	State Recommended Nonattainment?	NO_x (tpy)	VOC (tpy)
Carroll County, MD	Yes	6,617	3,948
Harford County, MD	Yes	5,854	6,396
Howard County, MD	Yes	9,219	7,848
Baltimore County, MD	Yes	25,736	16,807
Baltimore Subtotal:		**88,157**	**60,819**

County/City	State Recommended Nonattainment?	NO_x (tpy)	VOC (tpy)
Current Washington DC-MD-VA Nonattainment Area:			
District of Columbia, DC	Yes	11,332	11,362
Calvert County, MD	Yes	2,797	2,406
Charles County, MD	Yes	5,823	3,939
Frederick County, MD	Yes	9,389	6,460
Montgomery County, MD	Yes	18,415	20,426
Prince George's County, MD	Yes	19,793	18,882
Arlington County, VA	Yes	5,264	4,329
Fairfax County, VA	Yes	21,403	25,603
Loudoun County, VA	Yes	6,948	7,331
Prince William County, VA	Yes	7,698	8,603
Alexandria City, VA	Yes	3,349	2,625
Fairfax City, VA	Yes	326	794
Falls Church City, VA	Yes	138	324
Manassas City, VA	Yes	553	1,020
Manassas Park City, VA	Yes	92	285
Washington DC-MD-VA Subtotal:		113,321	114,389
Fredericksburg, VA Area:			
Spotsylvania County, VA	No	3,539	4,226
Stafford County, VA	No	3,377	3,516
Fredericksburg City, VA	No	859	1,007
Fredericksburg, VA Subtotal:		**7,775**	**8,749**
Frederick County, VA Area:			

Table 8.
Total 2008 NO_x and VOC Emissions with 2012 Healthy Air Act Caps Applied

County/City	State Recommended Nonattainment?	NO_x (tpy)	VOC (tpy)
Frederick County, VA	No	2,838	4,714
Winchester City, VA	No	508	1,006
Frederick Co., VA Area Subtotal:		**3,346**	**5,720**
Other counties:			
Queen Anne's County, MD	No	2,725	2,402
St. Mary's County, MD	No	3,475	4,038
Clarke County, VA	No	941	949
Culpeper County, VA	No	1,726	2,109
Fauquier County, VA	No	3,383	3,389
Warren County, VA	No	1,463	1,773
Hampshire County, WV	No	734	2,078
Jefferson County, WV	No	1,566	1,481
All other counties subtotal:		**16,013**	**18,219**
CSA Total:		**228,612**	**207,896**

Growth rates are not uniform throughout the CSA. Growth rates indicate growth in emissions including growth in VMT, growth in area sources, growth in point sources, and growth in nonroad sources. The higher growth rates in some Virginia counties will result in additional emissions impacts to the Baltimore region due to transport. The impacts of this growth would be shared if EPA designated the CSA as one nonattainment area.

Maryland has taken numerous steps to both reduce emissions through technological measures and to encourage reductions in VMT. We are currently waiting to implement our Clean Cars program and are implementing aspirational conformity goals. These are difficult steps to take when they provide greater air quality benefits to downwind states than to Maryland, particularly where similar programs are not implemented in surrounding states.

Meteorology

The next factor, meteorology, includes weather and transport patterns. The EPA uses 30-year average summer surface-level wind directions to help identify ozone nonattainment boundaries.

a. *Local Transport*

MDE agrees with the EPA finding that meteorological data does not provide a basis for separating the Baltimore and Washington, DC nonattainment areas. In fact, "[s]everal Maryland counties in the current Washington DC-MD-VA nonattainment area are most

frequently upwind of and most proximate to a violating monitor in the current Baltimore nonattainment area.[8]"

In addition, MDE has found the existence of a localized phenomena referred to as the Chesapeake Bay breeze and based on research conducted by the University of Maryland College Park (UMD), have determined that the bay breeze acts to adversely affect the Edgewood monitor causing it to report ozone concentrations that are consistently a bit higher than other area ozone monitors.

The Chesapeake Bay breeze is caused by the sharp gradient between land and water temperatures which causes the air over the warmer land to rise and be replaced at the surface by cooler air from atop the Bay waters. This sharp gradient effectively creates a microclimate akin to a mini-cold front that inhibits pollution transport across the Chesapeake Bay, and instead transports pollution towards the western side of the bay where the Edgewood monitor is located. Refer to Figure 3-2 for a schematic of the bay breeze.

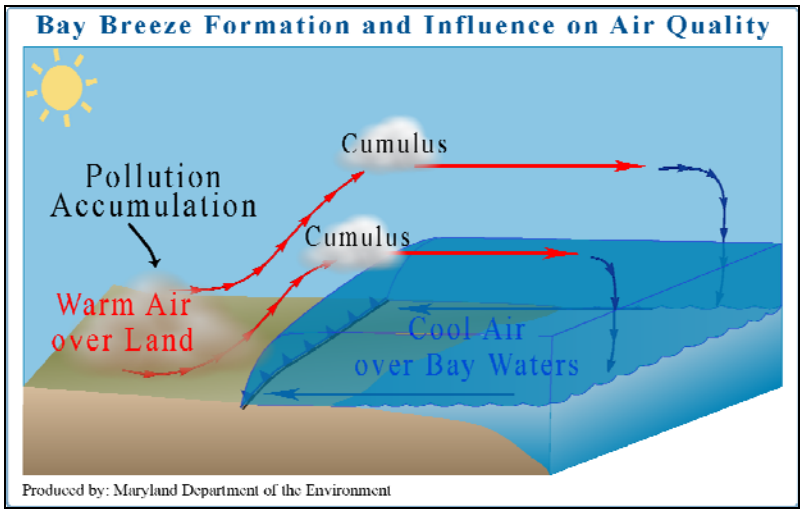

Figure 3-2: Chesapeake Bay Breeze as an Air Basin Barrier, from MDE

Scientists from the UMD have performed high resolution (0.5 km domain) WRF (meteorological) and CMAQ (photochemical) modeling in an effort to learn how the bay breeze dynamics work and if pollution from the Washington area is transported towards the Edgewood monitor. This high resolution meteorological modeling shows westerly winds transport ozone and ozone precursors from the Washington region to over the bay starting in the early morning hours (7 AM). Refer to Figure 3-3 for these meteorological modeling results. Later in the morning, at around 9 AM (EST) meteorological modeling shows winds over the bay become northerly and stagnation in the northern end of the Chesapeake Bay causes pollutants to accumulate. Refer to Figure 3-4 for these meteorological modeling results. High resolution CMAQ modeling illustrates how early morning stagnation over the Chesapeake Bay

[8] MARYLAND Area Designations for the 2008 Ozone National Ambient Air Quality Standards, p.59.

allows high pollution concentrations at the bay breeze convergence zone to buildup and then be lofted and transported downwind towards the Edgewood monitor. Based on the comparison of monitored data and modeled data it can be seen that this high resolution CMAQ modeling generates ozone concentrations that are closer to the observed concentrations. Refer to Figure 3-5 for the CMAQ modeling results.

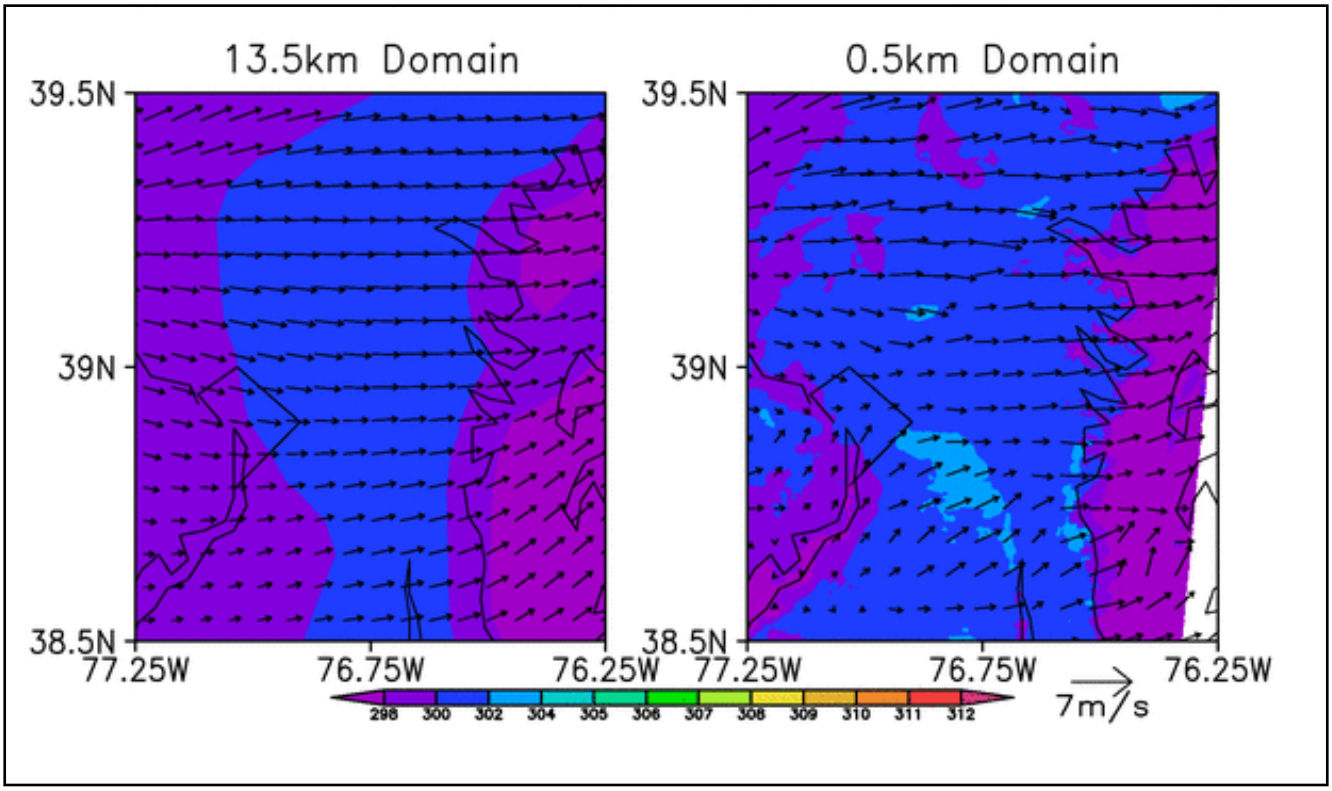

Figure 3-3 WRF-UCM Temperature and 10-meter Wind Speed at 7 AM on July 9, 2007 (Loughner, High Resolution WRF-UCM and CMAQ Modeling, UMD-MDE RAMMPP Quarterly Meeting, April 25, 2011)

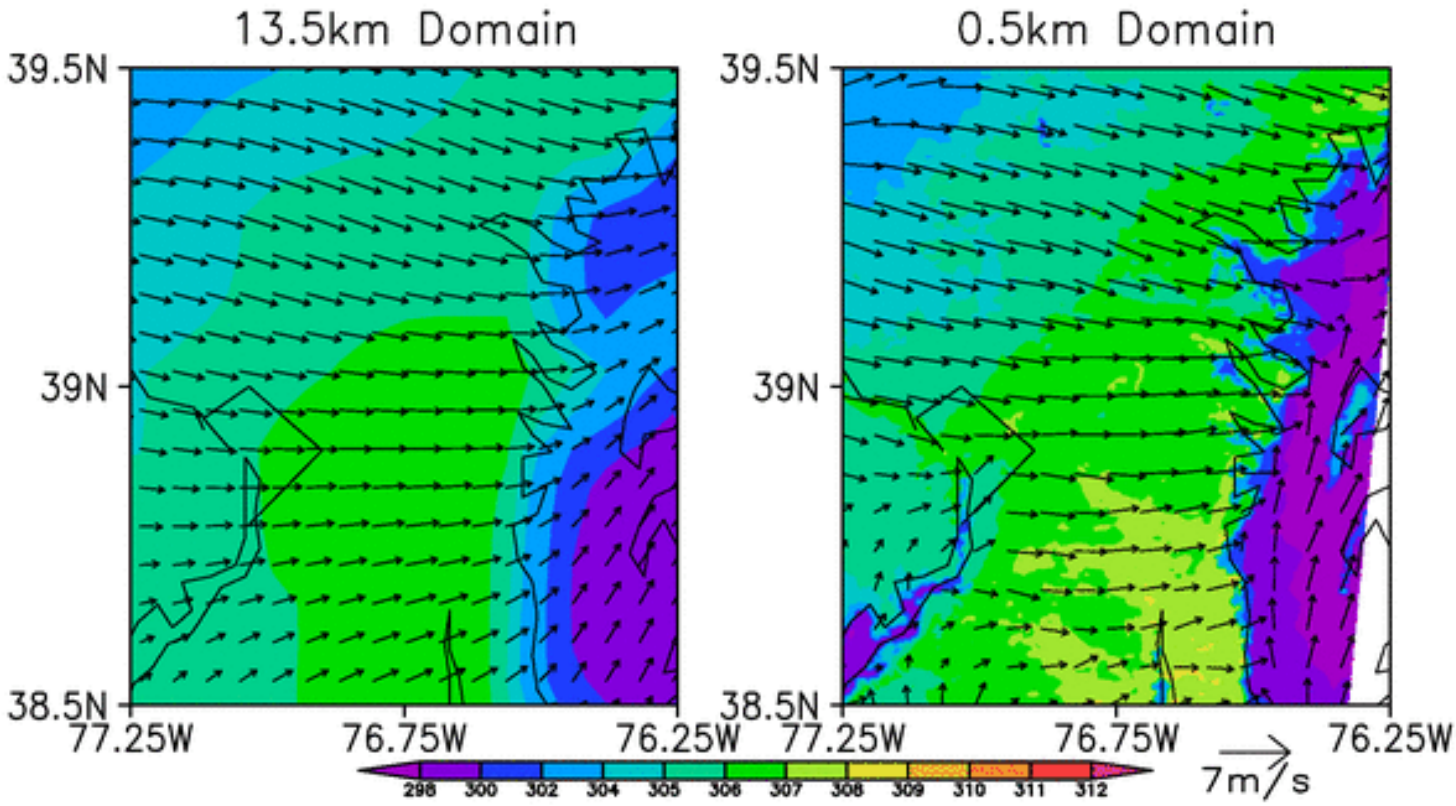

Figure 3-4 WRF-UCM Temperature and 10-meter Wind Speed at 9 AM on July 9, 2007 (Loughner, High Resolution WRF-UCM and CMAQ Modeling, UMD-MDE RAMMPP Quarterly Meeting, April 25, 2011)

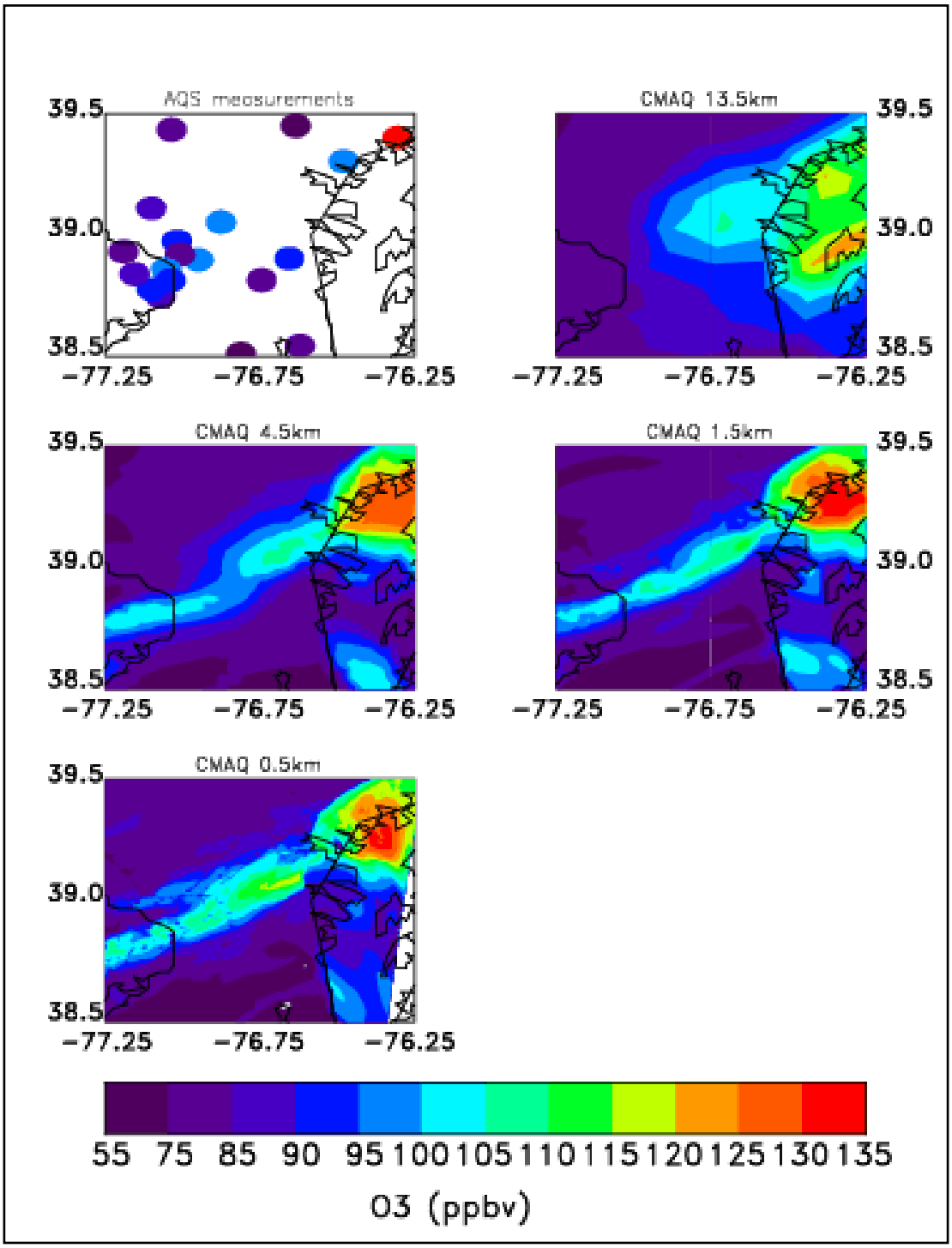

Figure 3-5 Ozone Concentrations at 2 PM on July 9, 2007 (Loughner, High Resolution WRF-UCM and CMAQ Modeling, UMD-MDE RAMMPP Quarterly Meeting, April 25, 2011)

Based on the high resolution modeling completed by the UMD and that the largest source of NO_x emissions (post Maryland's Healthy Air Act (HAA)) in the region are from mobile sources; where the split between the Baltimore and Washington areas is approximately 40%

and 60%, respectively. It can be concluded, that Edgewood always having a bit higher ozone concentration is directly linked to Washington area mobile NO_x emissions.

b. *Regional Transport*
However, climatological surface wind direction only tells part of the meteorological story. Surface wind roses do not represent the three-dimensional flow of air in the atmosphere. Transport patterns based solely on surface wind speed and direction ignores aloft winds and regular vertical mixing such as occurs in the daily cycle of the planetary boundary layer (PBL). Objective, hierarchical clusters based on three-dimensional wind fields provide a more realistic representation of the origins of air during ozone exceedance days (see, e.g., Hains et al., 2008 and Taubman et al., 2006).

c. *Scientific Evidence*
There is an extensive body of scientific findings proving that regional transport plays a significant role in urban high ozone episodes in Maryland. During the summer ozone season, scientists from UMD, Howard University (HU), University of Maryland Baltimore County (UMBC) and others have used aircraft, ozonesondes, and remote sensing techniques to show that both ozone and its precursors are transported from nearby upwind states into Maryland.

More than 15 years of aircraft measurements by the UMD, have proven that aloft air coming into Maryland contains ozone concentrations between 60 – 100 ppb as the result of sources in the nearby states; including Ohio, West Virginia, Pennsylvania, and Virginia. Each of these states contributes substantially to Maryland's air quality problems. *Taubman et al*. (2006) compared measured ozone profiles upwind and downwind of the Baltimore area, and determined that when the greatest cluster trajectory density lay over the Ohio River Valley (~59% of the profiles), transport accounted for 69–82% of the afternoon boundary layer ozone in Maryland. Under stagnant conditions (~27% of the profiles), transport accounted for 58% of the afternoon boundary layer ozone in Maryland.

During a flight that took place on July 21, 2011, UMD scientists flew a vertical profile over rural Luray, VA at 11 AM. Aircraft measurements made during this morning flight, showed that approximately 80 ppb of ozone was aloft waiting to mix down to the surface (see Figure 3-6). 24-hour back trajectories showed that winds on this day were from the Ohio/West Virginia region.

Ozone concentrations well above the 75 ppb NAAQS have been measured repeatedly over the western (climatologically upwind) boundaries of Maryland. These consistently high concentrations of ozone and ozone precursors along with wind patterns (based on back trajectories) make a compelling case that ozone is being transported into Maryland from areas outside the State.

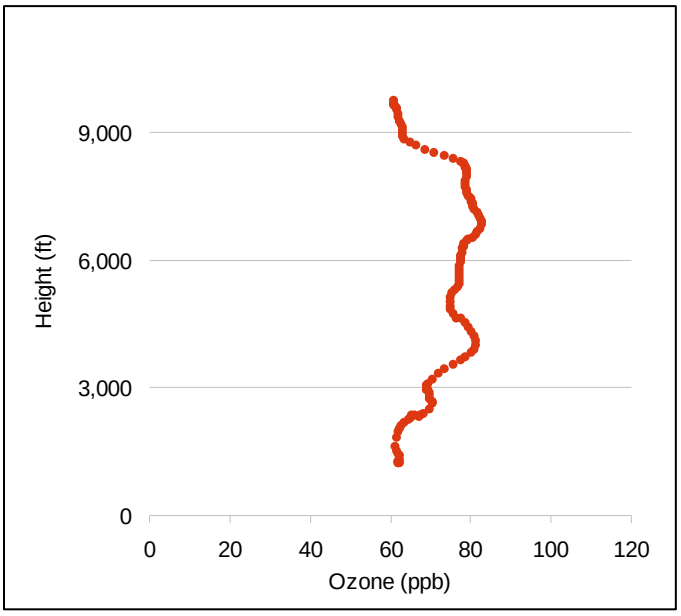

Figure 3-6. Vertical Profile of Ozone at Luray, VA on July 21, 2011 at 11 AM

MDE started contracting with HU in 2005 to launch ozonesondes during the late night and early morning hours in an effort to measure ozone concentrations in the aloft ozone reservoir and within the nocturnal low level jet (NLLJ).

Figure 3-7 shows 10:30 p.m. and 2:30 a.m. ozonesonde launches on July 12th and 13th, 2008 at Beltsville, Maryland. During the 10:30 p.m. launch the highest ozone concentration of approximately 80 ppb was measured at about 600 m, and during the 2:30 a.m. launch approximately 95 ppb was measured at about 800 m. Both launches captured high ozone concentrations being transported from the south to the north within the NLLJ. These high ozone concentrations within the NLLJ are already well above the 75 ppb NAAQS and have been measured repeatedly by ozonesondes launched from Beltsville, MD. These consistently high concentrations of ozone (and ozone precursors) measured within NLLJ (based on ozonesondes and wind profiler measurements) make a compelling case that ozone is being transported into Maryland from areas outside the State.

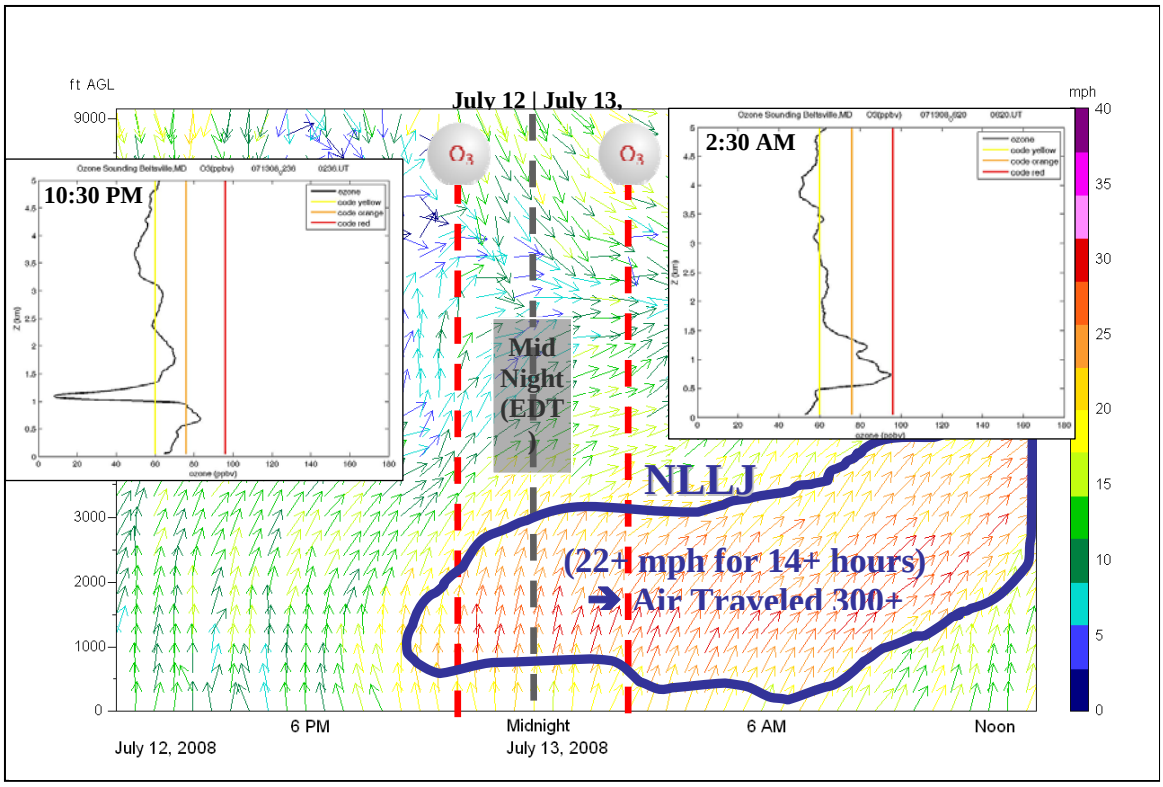

Figure 3-7. Ozone profiles from Howard University ozonesondes launched at 10:30 p.m. and 2:30 a.m. during a NLLJ event on July 12-13, 2008.

In July 2011, NASA led a major air quality field campaign over Maryland. The project is called DISCOVER-AQ, which stands for Deriving Information on Surface conditions from Column and Vertically Resolved Observations Relevant to Air Quality. Among the core objectives of this campaign were to measure pollutant altitude profiles to better correlate those concentrations with surface values, as well as to determine the origins of tropospheric ozone and PM over the Baltimore-Washington area. Preliminary results of the DISCOVER-AQ campaign, exhibited in dozens of presentations at the 2011 American Geophysical Union Fall Meeting, indicate substantial concentrations of ozone and ozone precursors are transported into the Maryland area via the free troposphere and then mix down to the surface.

The success of regional NO_x controls in reducing ozone in Maryland is also well-documented. The implementation of significant local controls from 1997 to 2003 in Maryland was able to reduce ozone by about 1 ppb/year. Under the NO_x SIP Call, 75% of the EGU controls were put in place from 2003 to 2007. From 2003 to 2008, Maryland ozone was reduced by 2 ppb/year — double the rate under local controls alone.

d. *The "Meteorologically-Challenged" State*

Maryland is a meteorologically-challenged state due to its geography, topography and location, as discussed in more detail in the geography section. It is located west of the Ohio River Valley, which has a large concentration of power plants. The Chesapeake Bay breeze stops ozone and its precursors from being blown out to sea and instead funnels dirty air along the I-

95 corridor. The Appalachian Mountains are responsible for both the “leeside trough” and “nocturnal low level jet” that speed the transport of pollution toward Maryland.

e. *Significant Contributions from Other States*
New scientific analysis from the UMD determined the most common transport routes for Maryland ozone exceedance days. Using back trajectories, this research identified five meteorological regimes associated high ozone days (see Figure 3-8). The largest cluster is westerly transport through Ohio and Pennsylvania. The second largest cluster is northwest transport through Pennsylvania. The third largest cluster is southwest transport from Virginia and West Virginia. Two smaller local clusters were also identified: recirculation and stagnation.

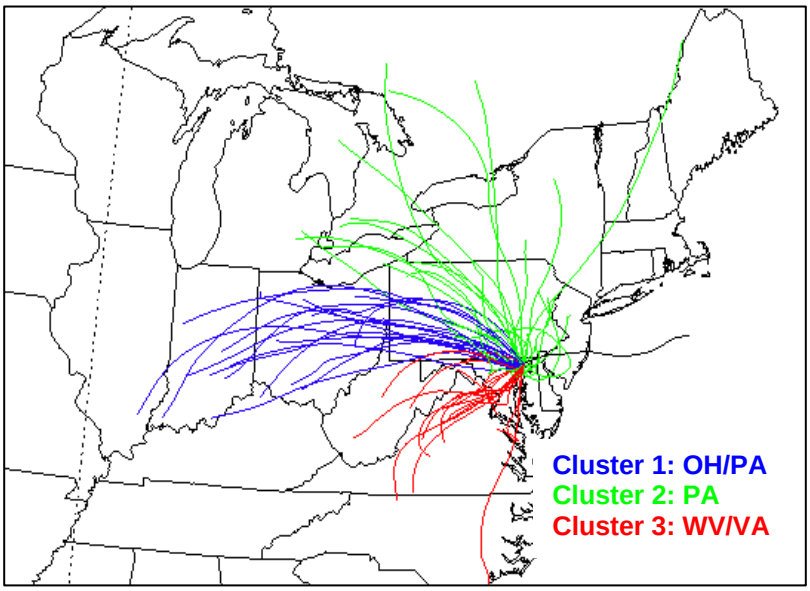

Figure 3-8. HYSPLIT 48 hr back-trajectory (1000 m)

Only approximately one-third of Maryland’s air pollution is from local anthropogenic sources. Approximately half is from interstate transport. This data comes from the EPA’s modeling for the Cross-State Air Pollution Rule (CSAPR), also known as the Transport Rule. Table 3-1 summarizes the contributions in ppb (percentages) of projected 2012 ozone design values for the 15 Maryland monitors included in the source apportionment modeling runs with CAMx. (Note that the four states with the largest contributions match the four states identified in the UMD cluster analysis shown in Figure 3-8.)

Table 3-1: Contribution to 2012 Ozone Design Values[±]

State	Maximum Contribution ppb (%)	Average Contribution ppb (%)	Range (ppb)
Biogenic / BC	21 (29%)	18 (24%)	15 – 21
Maryland	35 (43%)	27 (35%)	17 – 35
Virginia	14 (19%)	9 (12%)	6 – 14
Pennsylvania	8 (11%)	6 (7%)	3 – 8
Ohio	5 (8%)	3 (5%)	1 – 5
West Virginia	5 (7%)	3 (4%)	1 – 5
Other OTR	5 (6%)	2 (3%)	1 – 5
Other Outside OTR	13 (17%)	8 (11%)	4 – 13

[±]calculations based on final Transport Rule (aka CSAPR) modeling data from Average and maximum design values by monitoring site for 8-hour ozone, annual PM2.5, and 24-hour PM2.5 for the 2003-2007 base period, the 2012 base case, and the 2014 base and CSAPR control scenario. (Excel 354 KB) and Contributions of 8-hour ozone, annual PM2.5, and 24-hour PM2.5 from each state to each monitoring site. (Excel 1.38 MB) downloaded from http://www.epa.gov/airtransport/techinfo.html on 8-2-11

f. *Resources*

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Geography/topography (mountain ranges or other air basin boundaries)

The next factor is geography and topography, including mountain ranges or other air basin boundaries.

a. No Intrastate Barriers

MDE agrees with the EPA conclusion that the Washington-Baltimore-Northern Virginia CSA generally does not have any barriers appreciably limiting air pollution within its air shed. The Appalachian Mountains are a barrier to surface transport but not to aloft transport of ozone and ozone precursors.

b. Chesapeake Bay Breeze

As discussed previously in the meteorology section, the Chesapeake Bay is an important air basin boundary not addressed by the EPA analysis. The Chesapeake Bay "breeze" plays a significant role in preventing pollution from blowing out to sea and channeling it back toward the Baltimore area, and more specially Edgewood.

c. Leeside Trough

The position of the Appalachian Mountains enables formation of a meteorological phenomenon called a "leeside trough." According to the *American Meteorological Association Glossary* (2010), a leeside trough is "a pressure trough formed on the lee side [opposite the wind] of a mountain range in situations where the wind is blowing with a substantial component across the mountain ridge; often seen on United States weather maps east of the Rocky Mountains, and sometimes east of the Appalachians." This shift in pressure along the trough (the orange dashed line in Figure 4-1) results in westerly to northwesterly flow on the left side and southerly flow on the right side. Since the leeside trough usually develops over Maryland, this phenomenon results in pollutants from the Ohio River Valley and Western

Pennsylvania, veering (or turning northward) into Maryland and at the same time allows ozone and ozone precursors to be transported from Virginia and North Carolina into Maryland.

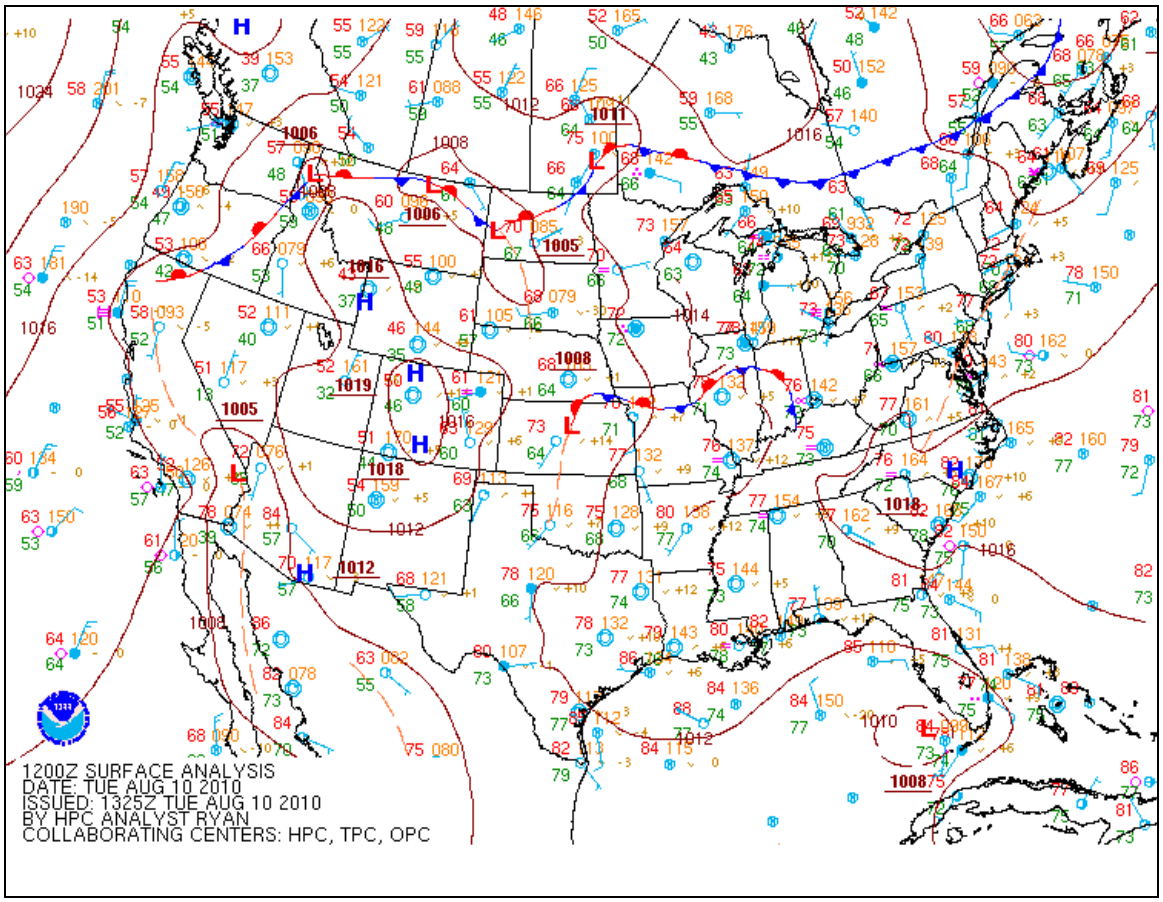

Figure 4-1. August 10, 2010 12z Surface Analysis from the Hydrometeorological Prediction Center (HPC)

On August 10, 2010 a lee side trough formed over Maryland and the result was an ozone exceedance day, which included pockets of unhealthy air quality (refer to Figure 4-2).

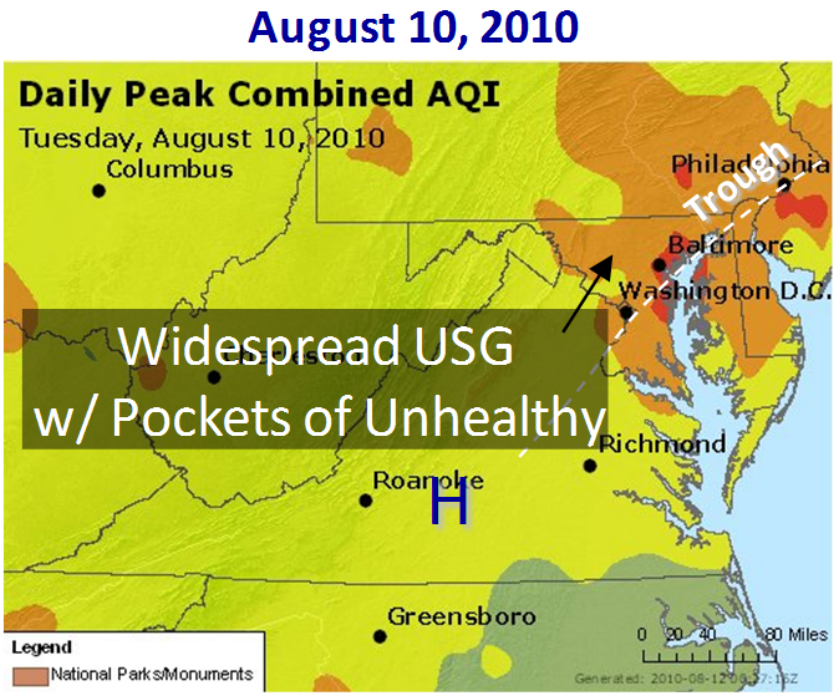

Figure 4-2. August 10, 2010 EPA AQI Map

d. Nocturnal Low Level Jet

Another meteorological phenomenon that results from the location of the Appalachian Mountains to the west and the Atlantic Ocean to the east is the nocturnal low level jet (NLLJ). The NNLJ is a fast moving stream of air that is typically observed between the Appalachian Mountains and the Atlantic Ocean during the late night and early morning hours. This fast moving stream of air can reach speeds of 40 mph and stretches from NC to MD to NJ to MA (refer to Figure 4-3).

In an effort to measure ozone concentrations in the NLLJ, MDE started contracting with the scientists at HU in 2005 to launch ozonesondes during the late night and early morning hours (see the factor 3 Meteorology section). Based on these ozonesonde measurements, ozone in excess of 90 ppb has been measured on several occasions within the NLLJ (refer to Figure 4-4).

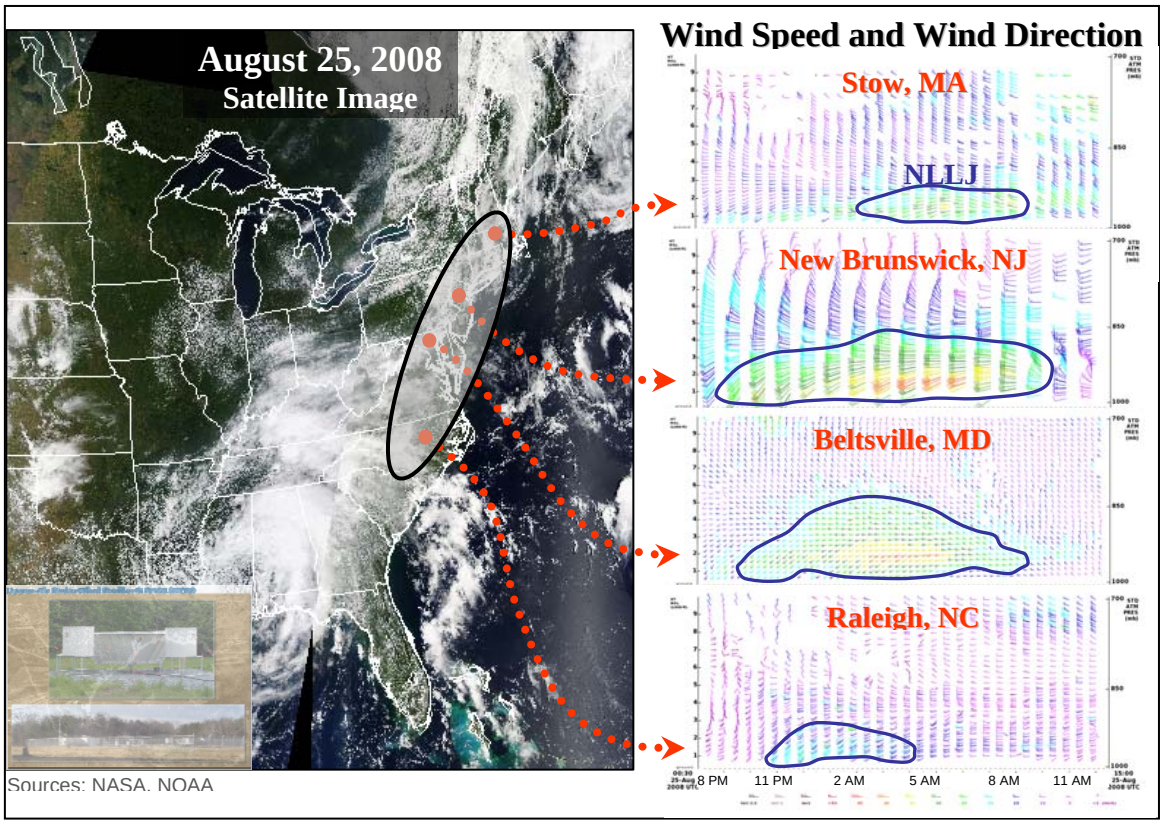

Figure 4-3. Extent of the Nocturnal Low Level Jet

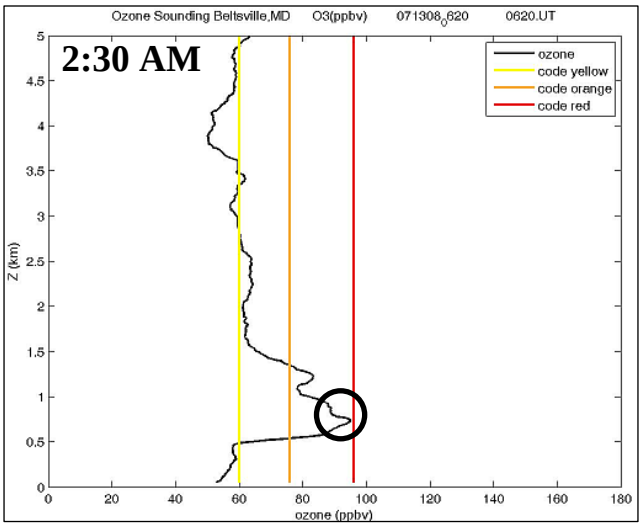

Figure 4-4. Ozone Concentrations With in the Nocturnal Low Level Jet

e. *True Air Shed Size?*

The "air shed" that is relevant to the ozone nonattainment area boundary is the same as the "air shed" for the Chesapeake Bay, since both seek to delineate sources of nitrogen oxides (NO_x) that contribute to federally-regulated pollution (Dennis 1997).

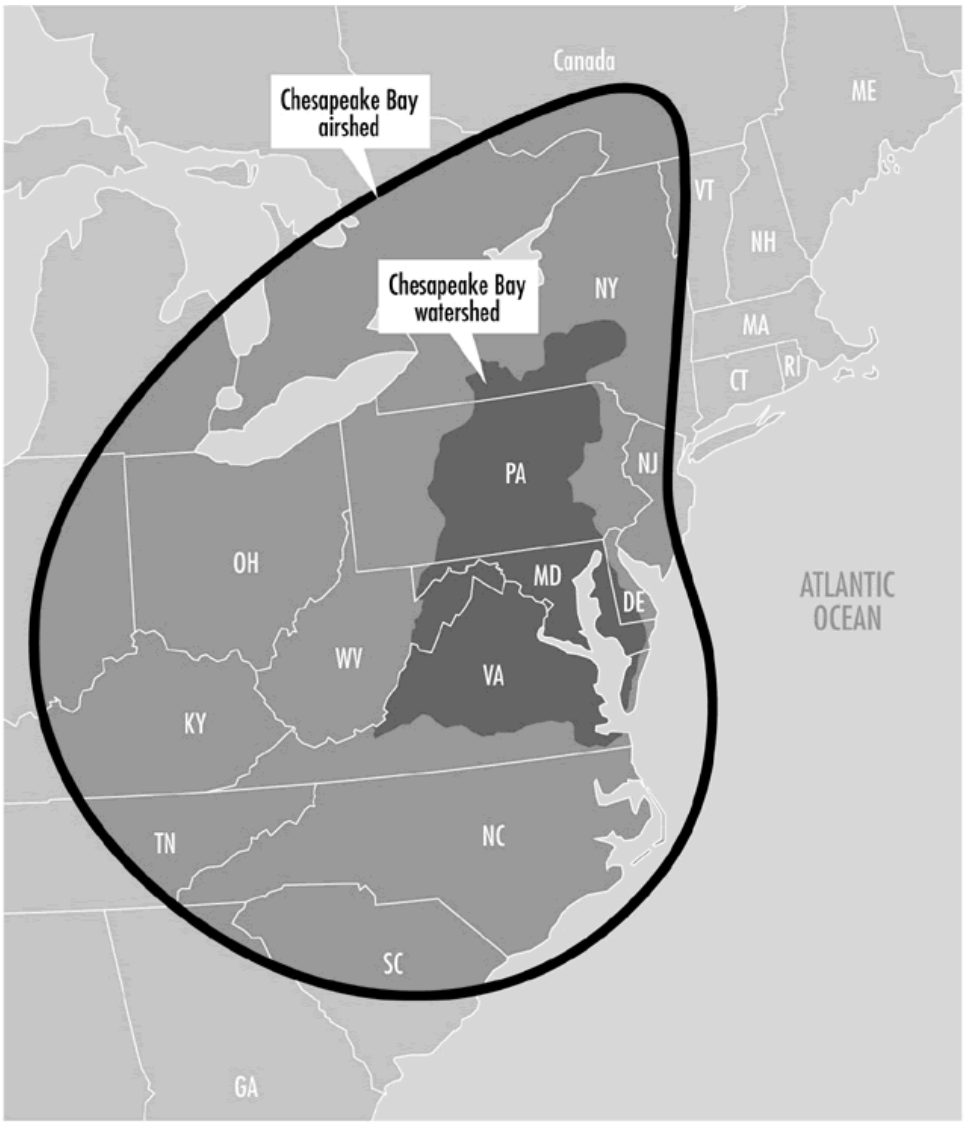

Figure 4-5: States in the Chesapeake Bay Air Shed, from Chesapeake Bay Foundation, http://www.cbf.org/page.aspx?pid=577, retrieved 2/1/12

As shown in Figure 4-5, the Chesapeake Bay air shed includes Maryland, Delaware, Virginia, Pennsylvania, West Virginia, North Carolina, Ohio, most of New York, New Jersey, Kentucky and South Carolina, and parts of Indiana, Tennessee, Michigan, and Vermont. Therefore, the geography factor supports a nonattainment area at least as large as the entire CSA.

d. *Resources*

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Jurisdictional boundaries

The CSA has county boundaries even though it crosses state lines. A nonattainment designation corresponding with the CSA would have three or more functional sub regions currently performing both air quality and transportation planning. While it may be possible to exclude some of the outer ring counties, the fact that these counties are included as part of the CSA indicates their forming ties to the core urban area.

APPENDIX C
ZERO OUT MODELING RUNS

Modeling Analysis Results

In effort to determine the regional effect on Maryland's local air quality, a series of zero-out (only anthropogenic emissions were zeroed out) CMAQ modeling runs were completed by modelers at the University of Maryland College Park (UMD).

The base case modeling used a MARAMA Version 2 2007 emissions inventory and the time period, July 25 – August 17, 2007 was utilized for this modeling analysis. This particular time period was chosen due to both local and transport driven events being account for. The end of July dates were used for model spin up, so this analysis focused on the days in August.

Baltimore Zero-Out Modeling Analysis

The Baltimore zero-out modeling analysis was conducted to determine, if all emissions in the Baltimore Nonattainment Area (NAA) (Baltimore, Carroll, Howard, Anne Arundel, Harford Counties and Baltimore City) were zeroed out, would all areas in Maryland demonstrate compliance with the 8-hour ozone 75 ppb NAAQS during both local pollution and transport driven events?

After comparing Baltimore NAA no emissions scenarios with those of the base case during local pollution event days it was determined that certain specific areas in Maryland saw a decrease in ozone, but there were still areas of Maryland which exceeded the 8-hour ozone 75 ppb NAAQS. Refer to Figure 1.

After comparing Baltimore NAA no emissions scenarios with those of the base case during regional pollution event days it was once again determined that certain specific areas in Maryland saw a decrease in ozone, but there were still areas of Maryland which exceeded the 8-hour ozone 75 ppb NAAQS. Refer to Figure 2.

Maryland Zero-Out Modeling Analysis

This modeling analysis was conducted to determine if all emissions in Maryland were zeroed out, would all areas in Maryland demonstrate compliance with the 8-hour ozone 75 ppb NAAQS during both local pollution and transport driven events?

After comparing Maryland no emissions scenarios with those of the base case during local pollution event days it was determined that certain specific areas in Maryland saw a decrease in ozone, but there were still areas of Maryland which exceeded the 8-hour ozone 75 ppb NAAQS. Refer to Figure 3.

After comparing Maryland no emissions scenarios with those of the base case during regional pollution event days it was once again determined that certain specific areas in Maryland saw a

decrease in ozone, but there were still areas of Maryland which exceeded the 8-hour ozone 75 ppb NAAQS. Refer to Figure 4.

Conclusion

Based on this modeling analysis, even if there were no sources of emissions in either the Baltimore NAA or all of Maryland, the State would still not be able to demonstrate compliance with the 8-hour ozone 75 ppb NAAQS.

This modeling analysis clearly demonstrates keeping Maryland as a small nonattainment area will force Maryland to adopt minimally effective and extremely expensive control programs that will not help Maryland attain the 8-hour ozone 75 ppb NAAQS. A better course of action would be for other states that contribute to Maryland's nonattainment problem to implement much more cost-effective control programs that would help slash their pollutant contribution to Maryland and help the State demonstrate compliance with the 8-hour ozone 75 ppb NAAQS. This particular approach makes more environmental and economic sense.

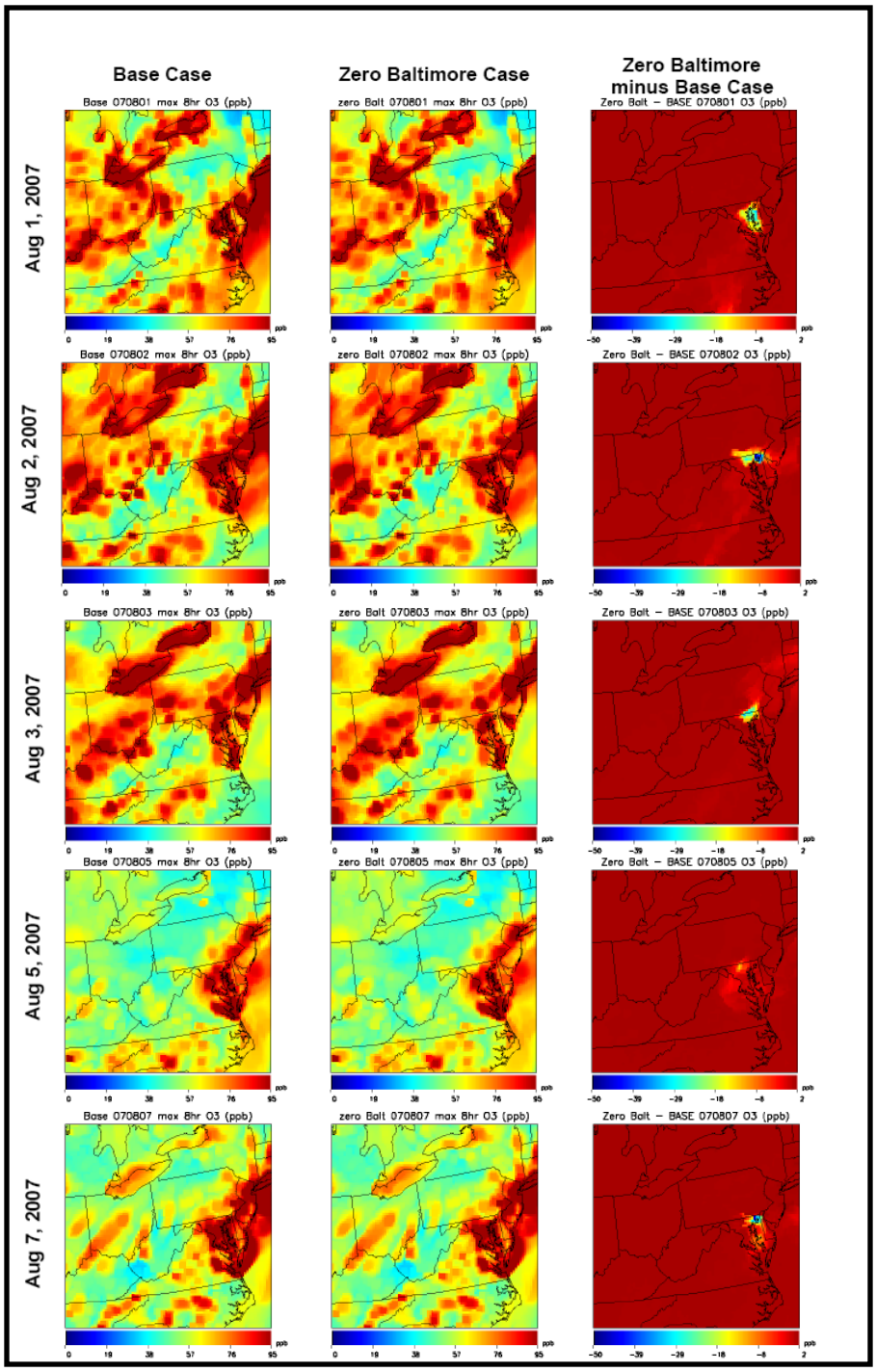

Figure 1. Baltimore NAA Zero-Out Runs - Local Pollutant Events

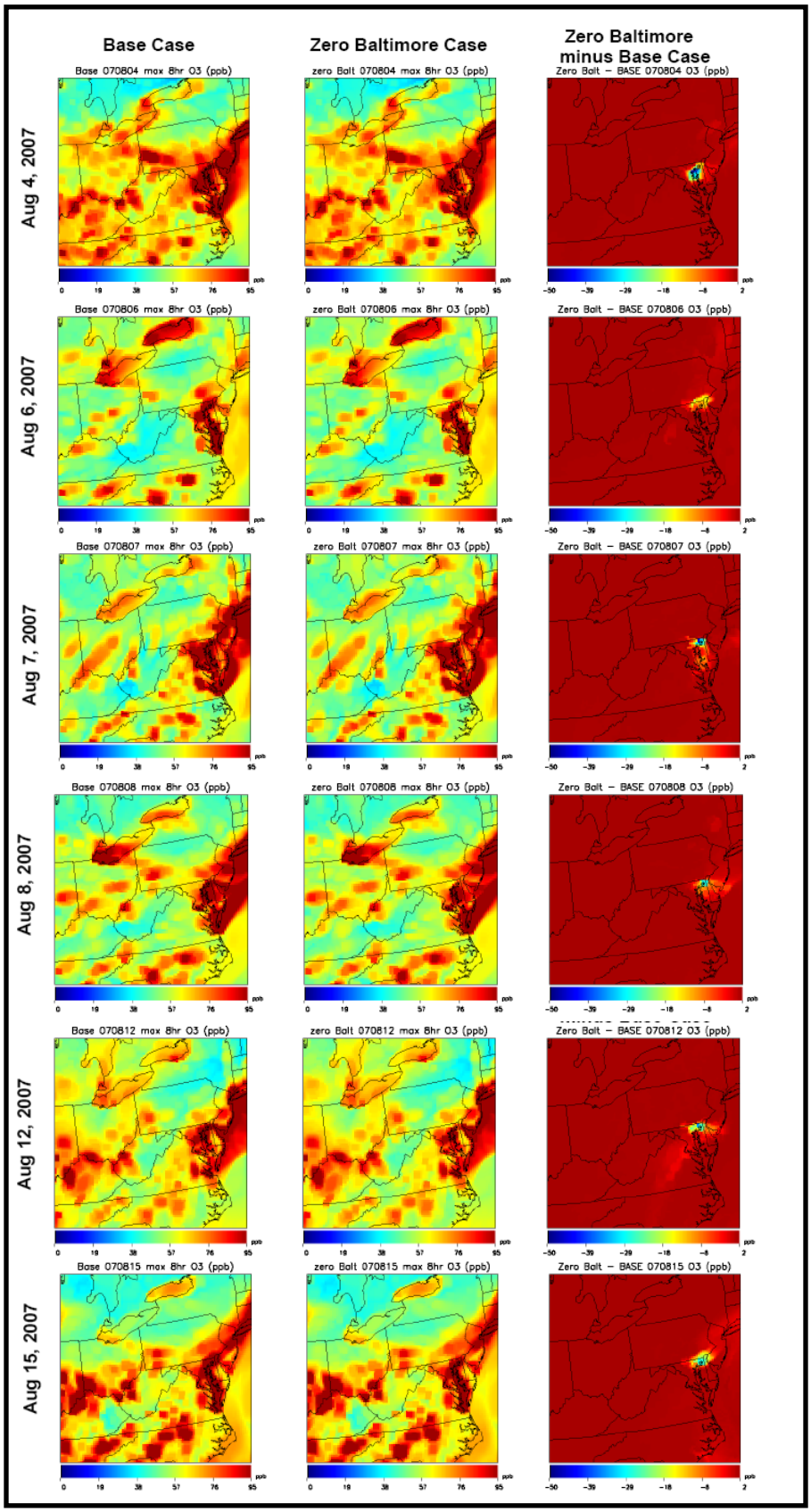

Figure 2. Baltimore NAA Zero-Out Runs - Regional Pollutant Events

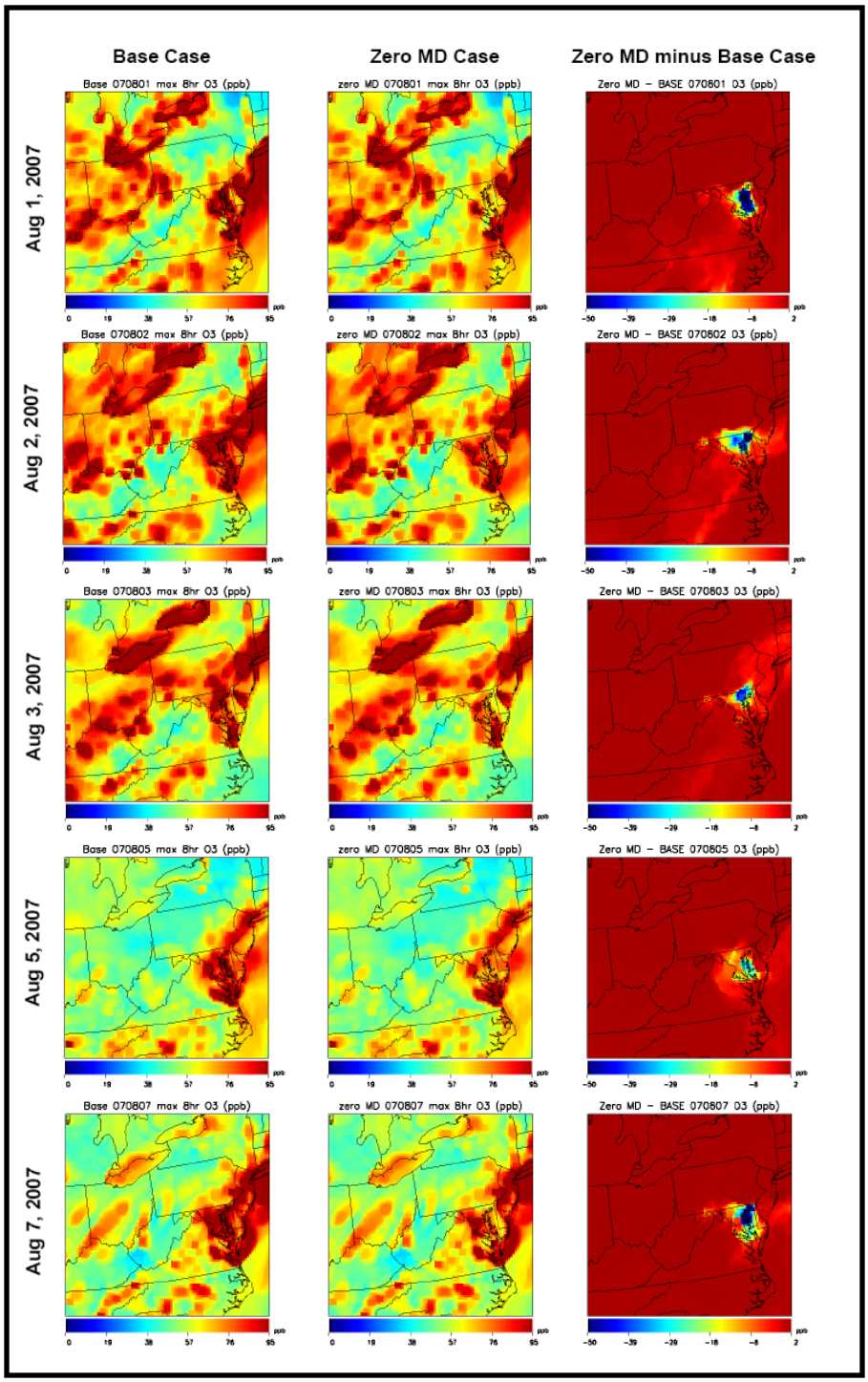

Figure 3. Maryland Zero-Out Runs - Local Pollutant Events

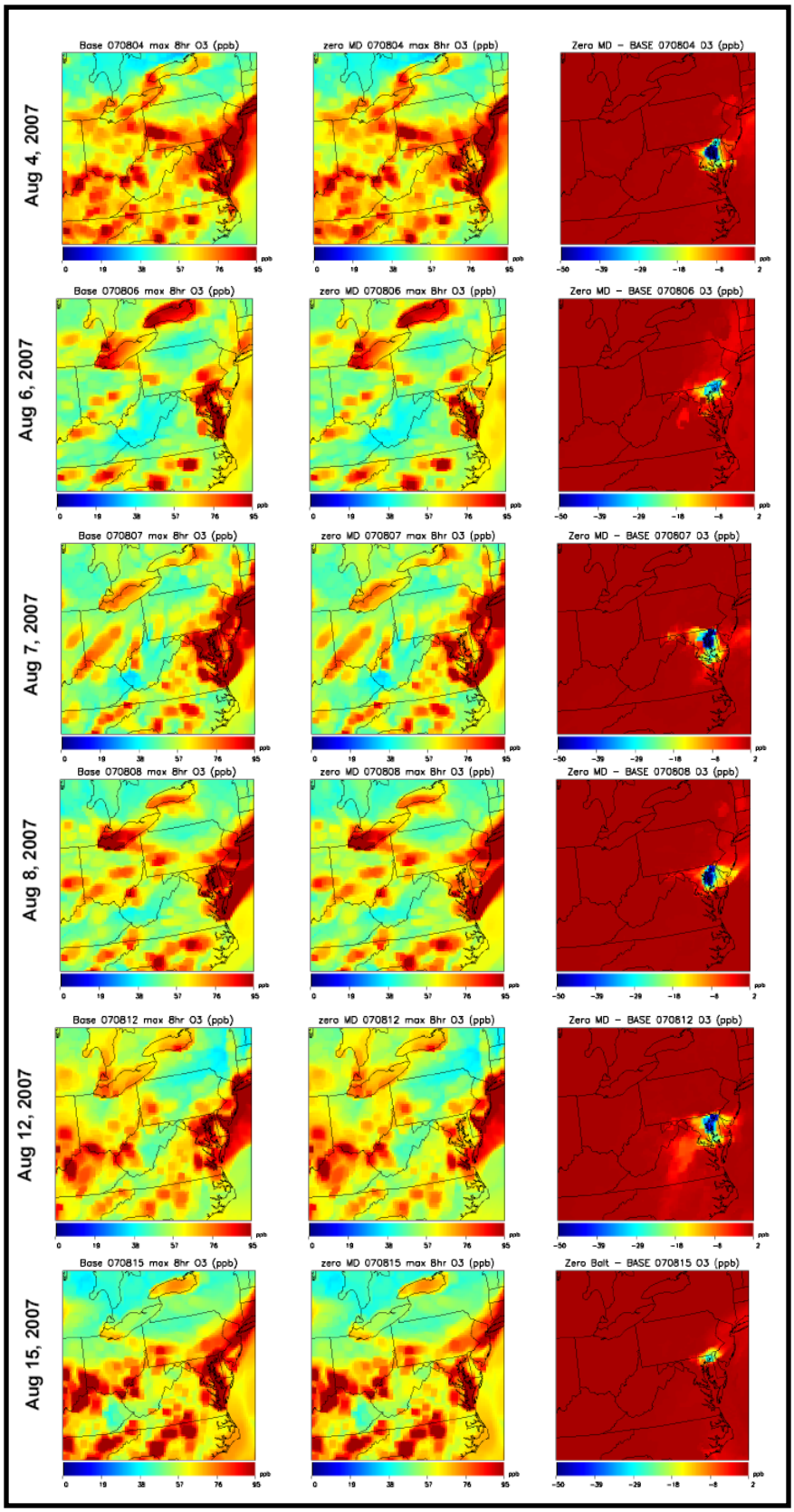

Figure 4. Maryland Zero-Out Runs - Regional Pollutant Events