Keystone-Conemaugh Projects, LLC
175 Cornell Road, Suite 1
Blairsville, PA 15717

November 22, 2019

Via Email Delivery - ozone@otcair.org
Ozone Transport Commission
800 Maine Avenue SW, Suite 200
Washington, DC 20024

Re: Keystone-Conemaugh Projects, LLC
Keystone and Conemaugh Generating Stations (KEY-CON)
Comments to the Ozone Transportation Commission (OTC) Proposed Recommendation for Establishing Daily Limits for Coal-Fired Electric Generating Units (EGUs) in Pennsylvania (PA)

Dear OTC:

Please find attached comments from KEY-CON and our air dispersion modeling contractor AECOM to the subject proposed recommendation. The Keystone and Conemaugh stations are located in western Pennsylvania and are among the facilities targeted in this proposed recommendation. Please recall that KEY-CON submitted comments in August 2019 to a document – a Clean Air Act Section 184(c) petition submitted by the Maryland Department of the Environment (MDE) - that proceeded and was used to generate the subject proposed recommendation. KEY-CON and AECOM are disappointed that the OTC elected to forego preparing a formal response to comments document (as is typically performed by state agencies and U.S. EPA for proposed rules and similar actions) as part of their approval to advance the petition and develop the subject proposed recommendation. Since that time, KEY-CON has developed additional information for consideration by the OTC and others.

This comments letter is organized as follows:

I. Background Information for KEY-CON – same as included in our August 2019 comments letter

II. Synopsis of KEY-CON's understanding of the OTC proposed recommendation – same as the first paragraph of the document entitled "OTC Recommendation for Establishing Daily Limits for Coal-Fired EGUs in Pennsylvania to Ensure that Existing Control Technologies are Optimized to Minimize Nitrogen Oxide Emissions Each Day of the Summer Ozone Season" – please see below.

> *The Ozone Transport Commission (OTC) recommends that the U.S. EPA require Pennsylvania to revise the Pennsylvania State Implementation Plan to include additional control measures which would establish daily nitrogen oxides (NOx) emission limits for all coal-fired EGUs with already installed Selective Catalytic Reduction (SCR) or Selective Non Catalytic Reduction (SNCR) control technology to ensure that these technologies are optimized to minimize NOx emissions each day of the ozone season.*

III. KEY-CON's request to the OTC

In response to our review of the proposed recommendation and supporting information, KEY-CON requests the OTC **to reject the proposed recommendation** for the following reasons:

(1) The alleged need for establishing daily limits as included in the proposed recommendation (and related Section 184(c) petition) is based largely on the results from a photochemical grid modeling effort completed by the University of Maryland (UMD) for the MDE. The modeling effort included a hypothetical set of "excess emissions" and "optimized emissions" for all targeted PA coal-fired EGUs. The modeling effort was designed such that either "excess emissions" or "optimized emissions" occurred simultaneously and continuously at the target EGUs during the entire month of July 2011 – each scenario was evaluated separately. MDE reported the resulting modeled increases in ozone due to these hypothetical "excess emissions." As part of our August 2019 comments letter, KEY-CON and AECOM noted that our review of the modeling effort showed that

(i) The ratios of non-optimized (i.e., excess) to optimized NOx emissions (as selected by MDE) for the KEY-CON units used in the modeling analysis were 2 to 4 times higher than the typical ratios that MDE determined in their 2017-2018 daily emissions analysis. Inflated ratios may also have been used for the other PA coal-fired EGUs as well. Therefore, the modeling results reported for these differences in NOx emissions for the PA coal-fired EGUs represent an extremely improbable outcome.

(ii) Even using these exaggerated NOx emission differences, ozone modeling results at three select MDE monitors for each day in July 2011 model run showed that the impacts of the "excess emissions" from the PA coal-fired EGUs are virtually undetectable.

KEY-CON and AECOM's review of the modeling effort earlier this year was somewhat limited because important modeling input data were not released for review by the MDE at that time. The modeling input data of interest were subsequently obtained in response to a recent Public Information Act (PIA) request to the MDE. This new information not only confirmed our earlier conclusion, but also allowed us to perform an updated and relevant analysis, which is summarized in AECOM's attached report entitled "Further Comments on MDE Analysis of the Impacts of PA Coal-Fired EGUs on Maryland Ozone NAAQS Compliance – Section 184 Request, November 22, 2019." AECOM's analysis showed the following:

The updated estimate of "excess emissions", totaled over the sources being considered, is <u>an order of magnitude lower</u> than the values assumed by the MDE in their photochemical grid modeling to determine the ozone benefit from their Section 184(c) petition. When the NOx emission difference is scaled to the more appropriate value based upon the latest three years of ozone season data, the ozone benefit for all states modeled outside of Pennsylvania by the MDE drops to below 1% of the NAAQS. As a result, the need for additional controls on the targeted Pennsylvania EGUs to support EPA's "Good Neighbor Provision" guidance is no longer present.

III. KEY-CON's request to the OTC (continued)

In response to our review of the proposed recommendation and supporting information, KEY-CON requests the OTC **to reject the proposed recommendation** for the following reasons:

(2) MDE's petition was silent on whether the claimed "excess emissions" impacted any of the MDE ozone monitors on days with measured exceedances of the NAAQS. As part of our August 2019 comments letter, trajectory analyses generated by AECOM using the HYSPLIT model show that of the total of 28 ozone exceedance days realized in the 2017 and 2018 ozone season, only 10 of the days involved back trajectories that were in the vicinity of KEY-CON, or about 36% of the cases. On those 10 select days, the backward trajectories also traversed either over large metropolitan areas in western Pennsylvania and Midwest states (Ohio, Indiana, Michigan, etc.) or over the Ohio River Valley. These large metropolitan areas and Ohio River Valley include significant sources of NOx emissions from mobile sources and other stationary sources.

Following the end of the 2019 ozone season, AECOM generated additional trajectory analyses using the HYSPLIT model for days in the 2019 ozone season with ozone exceedances (preliminary data, link: https://www.epa.gov/outdoor-air-quality-data/monitor-values-report) at either Maryland or Pennsylvania monitors. This review indicates that PA coal-fired EGUs were not upwind of the monitors on about half of the days examined. Over the 3-year period of 2017-2019, the PA EGUs were potentially contributing on less than half of the days involved in recorded 8-hour concentrations above the NAAQS in Maryland. Additional information related to this issue follows. The results for the 2019 trajectory analyses are presented in AECOM's attached report entitled "Further Comments on MDE Analysis of the Impacts of PA Coal-Fired EGUs on Maryland Ozone NAAQS Compliance – Section 184 Request, November 22, 2019."

III. KEY-CON’s request to the OTC (continued)

In response to our review of the proposed recommendation and supporting information, KEY-CON requests the OTC **to reject the proposed recommendation** for the following reasons:

(3) Importantly for MDE ambient air monitoring sites located near the Chesapeake Bay, which have historically recorded the highest number of ozone NAAQS exceedances over the MDE network, findings from studies recently published in peer-reviewed journals (e.g., Atmospheric Environment, Journal of the Air & Waste Management Association) report potential Chesapeake Bay sea breeze effects on elevated ozone readings at those select monitoring sites. Even with large-scale flow from the west and northwest, there are often localized sea breeze circulations that can bring air with locally elevated ozone onshore and result in exceedances of the ozone NAAQS that is largely affected by local stationary and mobile (watercraft and on-road and off-road vehicles) emission sources. AECOM investigated this potential effect, and their findings are summarized as follows:

Of the 7 days with Maryland ozone exceedances in 2019 featuring back trajectories passing over western Pennsylvania, 6 of these days involved monitors close to Chesapeake Bay. There was a low-level flow from Chesapeake Bay during the afternoon on all six days, as well as late morning on most of the days. The increased ozone concentrations that are found to be locally present over Chesapeake Bay likely influenced the monitor readings on those days, potentially contributing to or causing the NAAQS exceedances. Additional information related to this issue follows.

AECOM’s findings are presented in the attached report entitled “Chesapeake Bay Influences on Days with Regional Flow from Pennsylvania Toward Maryland Ozone Monitors, November 22, 2019.”

III. KEY-CON's request to the OTC (continued)

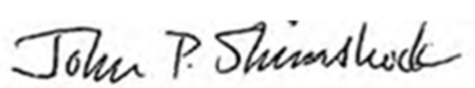
In response to our review of the proposed recommendation and supporting information, KEY-CON requests the OTC **to reject the proposed recommendation** for the following reasons:

(4) The previous comment noted the importance of local emission sources to MDE monitoring sites located near the Chesapeake Bay. KEY-CON and AECOM are aware of and concur with the OTC's recent efforts to better understand the influence on local air quality of peaking EGUs that are dispatched on high electric demand days (HEDD) – please refer to the following link: https://otcair.org/upload/Documents/Meeting%20Materials/OTC_SAS_Public_09212018.pdf).

As an example of the potential influence of select emission sources on local air quality, KEY-CON recently became aware of at least one peaking EGU (Westport Generating Station, link: https://www.exeloncorp.com/locations/power-plants/westport-generating-station) located in Baltimore City County, MD. This unit – a natural gas-fired simple-cycle combustion turbine, rated at 116 MW electrical generating capacity – is apparently licensed to operate by the MDE in an area with historic episodic ozone NAAQS exceedances without installed NOx emissions control devices (reported NOx emission rate = 0.381 lb/MMBtu, NOx mass emissions ≈ 600 lb/hr at full-load conditions, ozone season utilizations = 3.5%, 5.4% and 7.7% for 2017 through 2019, respectively, per data available on U.S. EPA Clean Air Markets Division webpage, link: https://ampd.epa.gov/ampd/). KEY-CON's review shows a high correlation between operations of the above-mentioned EGU and observed ozone NAAQS exceedances at monitoring sites located in the Baltimore-Columbia-Towson, MD and Philadelphia-Camden-Wilmington, PA-NJ-DE-MD core-based statistical areas (CBSAs) during the recent 2019 ozone season. This review is summarized in the following table. Time constraints prohibited KEY-CON from conducting a more detailed review of this and similar EGUs, but we encourage the MDE and OTC to continue with their above-mentioned HEDD efforts. Per PJM, the above-mentioned EGU is scheduled to deactivate on June 1, 2020 (link: https://www.pjm.com/planning/services-requests/gen-deactivations.aspx).

If you have any questions or concerns regarding these comments, then please contact me at (724) 235-4596 or jshimshock@keyconops.com.

Very truly yours,



John P. Shimshock
Environmental Specialist - Conemaugh Generating Station
Keystone-Conemaugh Projects, LLC

Attachments

Review of Westport Generating Station operations and nearby MDE ozone monitoring sites - 2019 ozone season

concentration > 0.070 (2015 ozone NAAQS)

Date	Westport Operating Hours	Daily Max 8-hour Ozone Concentration	Units	Site ID	Site Name	County	CBSA_NAME
6/26/2019	Westport CT dispatched, Hours 12-13	0.062	ppm	240259001	Aldino	Harford	Baltimore-Columbia-Towson, MD
		0.075	ppm	240251001	Edgewood	Harford	Baltimore-Columbia-Towson, MD
		0.071	ppm	240053001	Essex	Baltimore	Baltimore-Columbia-Towson, MD
		0.06	ppm	245100054	Furley	Baltimore (City)	Baltimore-Columbia-Towson, MD
		0.065	ppm	240031003	GLEN BURNIE	Anne Arundel	Baltimore-Columbia-Towson, MD
		0.06	ppm	240051007	Padonia	Baltimore	Baltimore-Columbia-Towson, MD
		0.06	ppm	240130001	South Carroll	Carroll	Baltimore-Columbia-Towson, MD
		0.067	ppm	240150003	Fair Hill Natural Resource Management Area	Cecil	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD
6/27/2019	Westport CT dispatched, Hours 13-17	0.066	ppm	240259001	Aldino	Harford	Baltimore-Columbia-Towson, MD
		0.08	ppm	240251001	Edgewood	Harford	Baltimore-Columbia-Towson, MD
		0.085	ppm	240053001	Essex	Baltimore	Baltimore-Columbia-Towson, MD
		0.076	ppm	245100054	Furley	Baltimore (City)	Baltimore-Columbia-Towson, MD
		0.077	ppm	240031003	GLEN BURNIE	Anne Arundel	Baltimore-Columbia-Towson, MD
		0.066	ppm	240051007	Padonia	Baltimore	Baltimore-Columbia-Towson, MD
		0.063	ppm	240130001	South Carroll	Carroll	Baltimore-Columbia-Towson, MD
		0.068	ppm	240150003	Fair Hill Natural Resource Management Area	Cecil	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD
6/28/2019	Westport CT dispatched, Hours 12-15	0.069	ppm	240259001	Aldino	Harford	Baltimore-Columbia-Towson, MD
		0.079	ppm	240251001	Edgewood	Harford	Baltimore-Columbia-Towson, MD
		0.082	ppm	240053001	Essex	Baltimore	Baltimore-Columbia-Towson, MD
		0.078	ppm	245100054	Furley	Baltimore (City)	Baltimore-Columbia-Towson, MD
		0.083	ppm	240031003	GLEN BURNIE	Anne Arundel	Baltimore-Columbia-Towson, MD
		0.075	ppm	240051007	Padonia	Baltimore	Baltimore-Columbia-Towson, MD
		0.065	ppm	240130001	South Carroll	Carroll	Baltimore-Columbia-Towson, MD
		0.072	ppm	240150003	Fair Hill Natural Resource Management Area	Cecil	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD
7/2/2019	Westport CT dispatched, Hours 9-18	0.074	ppm	240259001	Aldino	Harford	Baltimore-Columbia-Towson, MD
		0.079	ppm	240251001	Edgewood	Harford	Baltimore-Columbia-Towson, MD
		0.07	ppm	240053001	Essex	Baltimore	Baltimore-Columbia-Towson, MD
		0.063	ppm	245100054	Furley	Baltimore (City)	Baltimore-Columbia-Towson, MD
		0.074	ppm	240031003	GLEN BURNIE	Anne Arundel	Baltimore-Columbia-Towson, MD
		0.061	ppm	240051007	Padonia	Baltimore	Baltimore-Columbia-Towson, MD
		0.059	ppm	240130001	South Carroll	Carroll	Baltimore-Columbia-Towson, MD
		0.085	ppm	240150003	Fair Hill Natural Resource Management Area	Cecil	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD
7/16/2019	Westport CT dispatched, Hours None	0.077	ppm	240259001	Aldino	Harford	Baltimore-Columbia-Towson, MD
		0.073	ppm	240251001	Edgewood	Harford	Baltimore-Columbia-Towson, MD
		0.074	ppm	240053001	Essex	Baltimore	Baltimore-Columbia-Towson, MD
		0.077	ppm	245100054	Furley	Baltimore (City)	Baltimore-Columbia-Towson, MD
		0.076	ppm	240031003	GLEN BURNIE	Anne Arundel	Baltimore-Columbia-Towson, MD
		0.069	ppm	240051007	Padonia	Baltimore	Baltimore-Columbia-Towson, MD
		0.062	ppm	240130001	South Carroll	Carroll	Baltimore-Columbia-Towson, MD
		0.063	ppm	240150003	Fair Hill Natural Resource Management Area	Cecil	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD
7/19/2019	Westport CT dispatched, Hours 12-18	0.064	ppm	240259001	Aldino	Harford	Baltimore-Columbia-Towson, MD
		0.076	ppm	240251001	Edgewood	Harford	Baltimore-Columbia-Towson, MD
		0.064	ppm	240053001	Essex	Baltimore	Baltimore-Columbia-Towson, MD
		0.056	ppm	245100054	Furley	Baltimore (City)	Baltimore-Columbia-Towson, MD
		0.062	ppm	240031003	GLEN BURNIE	Anne Arundel	Baltimore-Columbia-Towson, MD
		0.051	ppm	240051007	Padonia	Baltimore	Baltimore-Columbia-Towson, MD
		0.05	ppm	240130001	South Carroll	Carroll	Baltimore-Columbia-Towson, MD
		0.062	ppm	240150003	Fair Hill Natural Resource Management Area	Cecil	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD
7/29/2019	Westport CT dispatched, Hours 10-21	0.069	ppm	240259001	Aldino	Harford	Baltimore-Columbia-Towson, MD
		0.077	ppm	240251001	Edgewood	Harford	Baltimore-Columbia-Towson, MD
		0.072	ppm	240053001	Essex	Baltimore	Baltimore-Columbia-Towson, MD
		0.065	ppm	245100054	Furley	Baltimore (City)	Baltimore-Columbia-Towson, MD
		0.067	ppm	240031003	GLEN BURNIE	Anne Arundel	Baltimore-Columbia-Towson, MD
		0.06	ppm	240051007	Padonia	Baltimore	Baltimore-Columbia-Towson, MD
		0.058	ppm	240130001	South Carroll	Carroll	Baltimore-Columbia-Towson, MD
		0.064	ppm	240150003	Fair Hill Natural Resource Management Area	Cecil	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD
7/30/2019	Westport CT dispatched, Hours 12-19	0.079	ppm	240259001	Aldino	Harford	Baltimore-Columbia-Towson, MD
		0.073	ppm	240251001	Edgewood	Harford	Baltimore-Columbia-Towson, MD
		0.074	ppm	240053001	Essex	Baltimore	Baltimore-Columbia-Towson, MD
		0.077	ppm	245100054	Furley	Baltimore (City)	Baltimore-Columbia-Towson, MD
		0.077	ppm	240031003	GLEN BURNIE	Anne Arundel	Baltimore-Columbia-Towson, MD
		0.068	ppm	240051007	Padonia	Baltimore	Baltimore-Columbia-Towson, MD
		0.056	ppm	240130001	South Carroll	Carroll	Baltimore-Columbia-Towson, MD
		0.062	ppm	240150003	Fair Hill Natural Resource Management Area	Cecil	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD
8/6/2019	Westport CT dispatched, Hours None	0.067	ppm	240259001	Aldino	Harford	Baltimore-Columbia-Towson, MD
		0.068	ppm	240251001	Edgewood	Harford	Baltimore-Columbia-Towson, MD
		0.07	ppm	240053001	Essex	Baltimore	Baltimore-Columbia-Towson, MD
		0.072	ppm	245100054	Furley	Baltimore (City)	Baltimore-Columbia-Towson, MD
		0.074	ppm	240031003	GLEN BURNIE	Anne Arundel	Baltimore-Columbia-Towson, MD
		0.074	ppm	240051007	Padonia	Baltimore	Baltimore-Columbia-Towson, MD
		0.061	ppm	240130001	South Carroll	Carroll	Baltimore-Columbia-Towson, MD
		0.057	ppm	240150003	Fair Hill Natural Resource Management Area	Cecil	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD

Review of Westport Generating Station operations and nearby MDE ozone monitoring sites - 2019 ozone season

concentration > 0.070 (2015 ozone NAAQS)

Date	Westport Operating Hours	Daily Max 8-hour Ozone Concentration	Units	Site ID	Site Name	County	CBSA_NAME
8/19/2019	Westport CT dispatched, Hours None	0.056	ppm	240259001	Aldino	Harford	Baltimore-Columbia-Towson, MD
		0.077	ppm	240251001	Edgewood	Harford	Baltimore-Columbia-Towson, MD
		0.062	ppm	240053001	Essex	Baltimore	Baltimore-Columbia-Towson, MD
		0.054	ppm	245100054	Furley	Baltimore (City)	Baltimore-Columbia-Towson, MD
		0.057	ppm	240031003	GLEN BURNIE	Anne Arundel	Baltimore-Columbia-Towson, MD
		0.053	ppm	240051007	Padonia	Baltimore	Baltimore-Columbia-Towson, MD
		0.052	ppm	240130001	South Carroll	Carroll	Baltimore-Columbia-Towson, MD
		0.054	ppm	240150003	Fair Hill Natural Resource Management Area	Cecil	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD
8/20/2019	Westport CT dispatched, Hours 10-17	0.066	ppm	240259001	Aldino	Harford	Baltimore-Columbia-Towson, MD
		0.062	ppm	240251001	Edgewood	Harford	Baltimore-Columbia-Towson, MD
		0.065	ppm	240053001	Essex	Baltimore	Baltimore-Columbia-Towson, MD
		0.062	ppm	245100054	Furley	Baltimore (City)	Baltimore-Columbia-Towson, MD
		0.065	ppm	240031003	GLEN BURNIE	Anne Arundel	Baltimore-Columbia-Towson, MD
		0.065	ppm	240051007	Padonia	Baltimore	Baltimore-Columbia-Towson, MD
		0.071	ppm	240130001	South Carroll	Carroll	Baltimore-Columbia-Towson, MD
		0.06	ppm	240150003	Fair Hill Natural Resource Management Area	Cecil	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD
9/11/2019	Westport CT dispatched, Hours 9-17	0.068	ppm	240259001	Aldino	Harford	Baltimore-Columbia-Towson, MD
		0.055	ppm	240251001	Edgewood	Harford	Baltimore-Columbia-Towson, MD
		0.056	ppm	240053001	Essex	Baltimore	Baltimore-Columbia-Towson, MD
		0.061	ppm	245100054	Furley	Baltimore (City)	Baltimore-Columbia-Towson, MD
		0.069	ppm	240031003	GLEN BURNIE	Anne Arundel	Baltimore-Columbia-Towson, MD
		0.061	ppm	240051007	Padonia	Baltimore	Baltimore-Columbia-Towson, MD
		0.06	ppm	240130001	South Carroll	Carroll	Baltimore-Columbia-Towson, MD
		0.072	ppm	240150003	Fair Hill Natural Resource Management Area	Cecil	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD
9/12/2019	Westport CT dispatched, Hours 10-19	0.055	ppm	240259001	Aldino	Harford	Baltimore-Columbia-Towson, MD
		0.05	ppm	240251001	Edgewood	Harford	Baltimore-Columbia-Towson, MD
		0.056	ppm	240053001	Essex	Baltimore	Baltimore-Columbia-Towson, MD
		0.054	ppm	245100054	Furley	Baltimore (City)	Baltimore-Columbia-Towson, MD
		0.056	ppm	240031003	GLEN BURNIE	Anne Arundel	Baltimore-Columbia-Towson, MD
		0.05	ppm	240051007	Padonia	Baltimore	Baltimore-Columbia-Towson, MD
		0.05	ppm	240130001	South Carroll	Carroll	Baltimore-Columbia-Towson, MD
		0.054	ppm	240150003	Fair Hill Natural Resource Management Area	Cecil	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD
9/16/2019	Westport CT dispatched, Hours 13-17	0.059	ppm	240259001	Aldino	Harford	Baltimore-Columbia-Towson, MD
		0.068	ppm	240251001	Edgewood	Harford	Baltimore-Columbia-Towson, MD
		0.077	ppm	240053001	Essex	Baltimore	Baltimore-Columbia-Towson, MD
		0.066	ppm	245100054	Furley	Baltimore (City)	Baltimore-Columbia-Towson, MD
		0.074	ppm	240031003	GLEN BURNIE	Anne Arundel	Baltimore-Columbia-Towson, MD
		0.051	ppm	240051007	Padonia	Baltimore	Baltimore-Columbia-Towson, MD
		0.052	ppm	240130001	South Carroll	Carroll	Baltimore-Columbia-Towson, MD
		0.057	ppm	240150003	Fair Hill Natural Resource Management Area	Cecil	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD

Chesapeake Bay Influences on Days with Regional Flow from Pennsylvania Toward Maryland Ozone Monitors

Robert Paine, David Heinold, and Adrienne Kieldsing (AECOM)

November 22, 2019

Introduction

On May 30, 2019, the Maryland Department of the Environment (MDE) provided a petition to the Ozone Transport Commission (OTC) under Section 184(c) of the Clean Air Act (CAA). This request asked OTC to develop and transmit to the administrator of the U.S. Environmental Protection Agency (EPA) recommendations for additional control measures to be applied for nitrogen oxide (NOx) emissions from Pennsylvania coal-fired electrical generating units (EGUs).

One issue that was not brought up by the MDE in their Section 184(c) petition was potential Chesapeake Bay sea breeze effects on elevated ozone readings at Maryland monitors in the vicinity of the Bay. Even with large-scale flow from the west and northwest, there are often localized sea breeze circulations that can bring air with locally elevated ozone onshore and result in exceedances of the ozone National Ambient Air Quality Standard (NAAQS) that is largely affected by local emission sources. The purpose of these additional remarks is to more fully describe this issue and how it may have an effect on ozone readings at Maryland monitors when there is regional flow that passes over Pennsylvania.

Locally High Ozone over Chesapeake Bay

There are unique aspects to Chesapeake Bay that can lead to locally higher ozone concentrations over the water, especially during daytime hours. These issues have been documented in technical papers[1,2] that include special observational studies. As stated by Dacic et al. (2019)[2], the "Chesapeake Bay airshed is rich with industrial and vehicular emission sources on both land and in the marine environment that can rapidly increase pollution levels in the presence of favorable meteorology (e.g., sunlight, stagnant air) and complex terrain and coastlines."

Some of the factors that lead to increased ozone concentrations over the waters of Chesapeake Bay relative to the adjacent land areas are:

- Convective mixing heights are suppressed over the water, leading to reduced dilution.
- During the spring and summer, when Bay water is cooler than the air over the land, the cooler water inhibits development of low level cumulus clouds during late morning and

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[1] Joel Dreessen, Daniel Orozco, James Boyle, Jay Szymborski, Pius Lee, Adrian Flores and Ricardo K. Sakai, 2019. Observed ozone over the Chesapeake Bay land-water interface: The Hart-Miller Island Pilot Project, Journal of the Air & Waste Management Association, 69:11, 1312-1330, DOI: 10.1080/10962247.2019.1668497

[2] Natasha Dacic, John T.Sullivan, K. Emma Knowland, Glenn M.Wolfe, Luke D.Oman, Timothy A.Berkoff, and Guillaume P.Gronoff, 2019. Evaluation of NASA's high-resolution global composition simulations: Understanding a pollution event in the Chesapeake Bay during the summer 2017 OWLETS campaign. ***Atm. Env.*** (in press; online as of November 16, 2019).

afternoon hours. These clouds may cover most of the sky over land, while the sky over the Bay will be completely clear. This leads to additional photochemical activity over the water, creating additional ozone.

- Localized emissions from marine activities as well as the major metropolitan areas (e.g., Baltimore) can stagnate over the Bay in the morning on fair weather days, form ozone with strong sunlight, light winds, and reduced convective mixing.
- Deposition of ozone onto vegetation, which occurs over land, is not present over water, and this effect acts to further increase concentrations over the Bay.

Another Look at Maryland Ozone Exceedance Days in 2019

To determine the likelihood for emissions from Pennsylvania EGUs to contribute to ozone concentrations at Maryland monitors, we conducted back-trajectory analyses using the Hybrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT) model[3] for days in 2019 for which there were 8-hour ozone concentrations at any Maryland monitor above the 70 ppb NAAQS.

In 2019, there were 14 different days with ozone peak 8-hour averages above the level of the NAAQS at one or more Maryland monitors, with 7 days involving back trajectories passing over western Pennsylvania near the Conemaugh and Keystone Generating Stations. Of those monitors that could have been affected by trajectories from western Pennsylvania, most are close to Chesapeake Bay (Edgewood, Essex, Glen Burnie, Fair Hill, and Horn Point), and could have also been influenced by low-level transport of elevated ozone levels from Chesapeake Bay, even though the upper-level regional flow was from the west or northwest. It is possible to review wind patterns from multiple weather stations along the Bay shoreline using Weather Underground's "Wundermap®" system to determine if bay breezes occurred on days for which regional flow from the Pennsylvania EGUs was potentially occurring.

Of the 7 days with Maryland ozone exceedances in 2019 featuring back trajectories passing over western Pennsylvania, 6 of these days involved monitors close to Chesapeake Bay (see Figure 1). The figure shows the applicable ozone monitors as well as local weather stations near each one. The weather stations are not government-operated stations, but rather private stations that report data to Weather Underground. Although the weather data from these stations is not necessarily certified for use in dispersion modeling, the stations are strategically located and provide a useful indication of the presence of a bay breeze on specific days of interest. Plots of the winds measured at each station on the days of interest are provided in Appendix A.

A review of applicable weather stations in the "Wundermap" area of the Weather Underground web site provides the following results for the 5 days involved.

- June 26, 2019 (Edgewood monitor had the highest ozone concentration): a bay breeze was detected starting in the early afternoon hours
- June 27, 2019 (Essex monitor had the highest ozone concentration): a bay breeze was detected starting in the late morning hours
- June 28, 2019 (Glen Burnie monitor had the highest ozone concentration): a bay breeze was initiated in the late morning hours

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[3] National Oceanic and Atmospheric Administration (NOAA) Air Resources Laboratory: https://www.ready.noaa.gov/HYSPLIT.php.

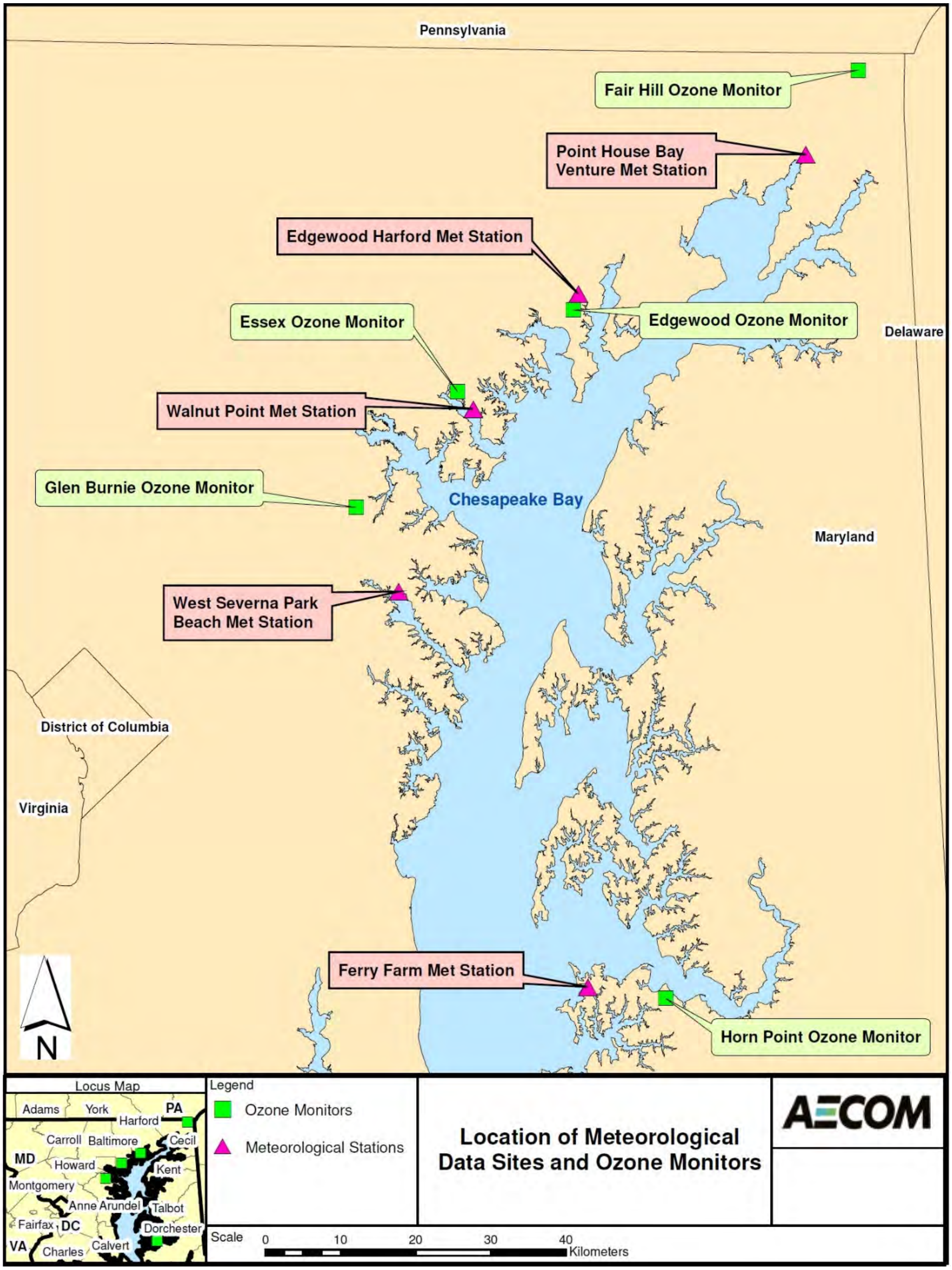
- July 2, 2019 (Fair Hill monitor had the highest ozone concentration): a bay breeze was initiated in the late morning hours
- July 19, 2019 (Edgewood monitor had the highest ozone concentration): a bay breeze was initiated in the late morning hours
- September 12, 2019 (Horn Point monitor had the highest ozone concentration): a sustained bay breeze from the southwest was initiated in the mid-morning hours.

For each of these cases, the bay breeze persisted through the whole afternoon.

Conclusions

For several days that we examined involving Maryland ozone monitors near Chesapeake Bay that had an ozone NAAQS exceedance reported in 2019, there was a low-level flow from Chesapeake Bay during the afternoon (on all six days, as well as by late morning on most of the days). The increased ozone concentrations that are found to be locally present over Chesapeake Bay likely influenced the monitor readings on those days, potentially contributing to or causing the NAAQS exceedances.

Figure 1: Locations of Maryland Ozone Monitors Near Chesapeake Bay and Nearby Weather Stations



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Appendix A: Weather Station Data Plots for 6 Identified High Ozone Days in 2019

Figure A-1: Edgewood Harford Station (KMDEDGEW1) Weather Data for June 26, 2019

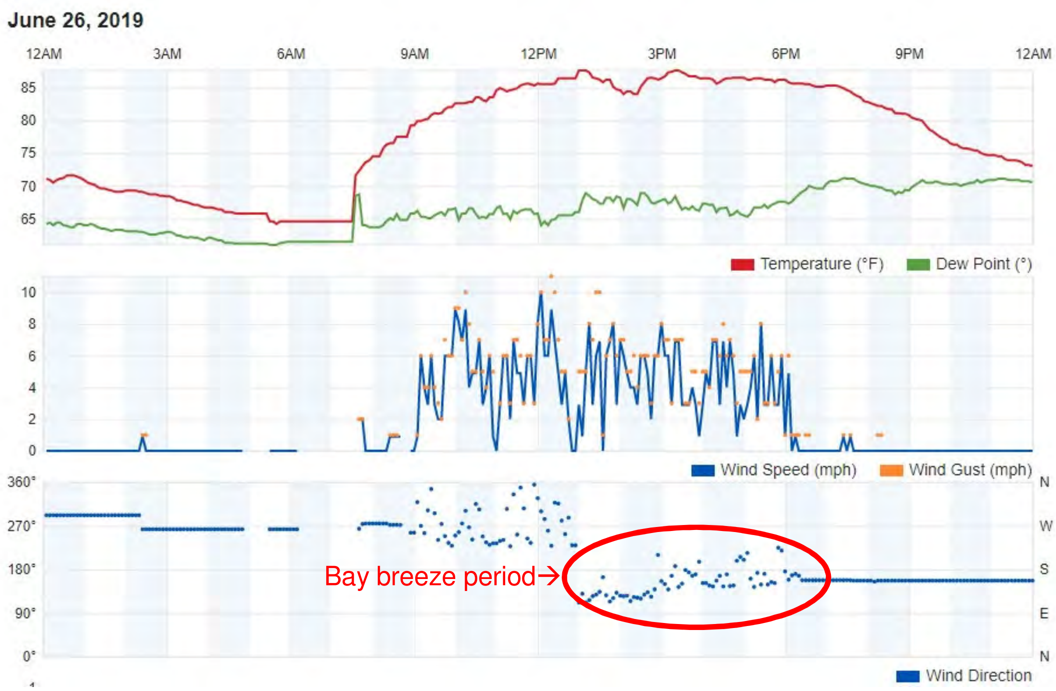

Figure A-2: Walnut Point Station (KMESSEX13) Weather Data for June 27, 2019

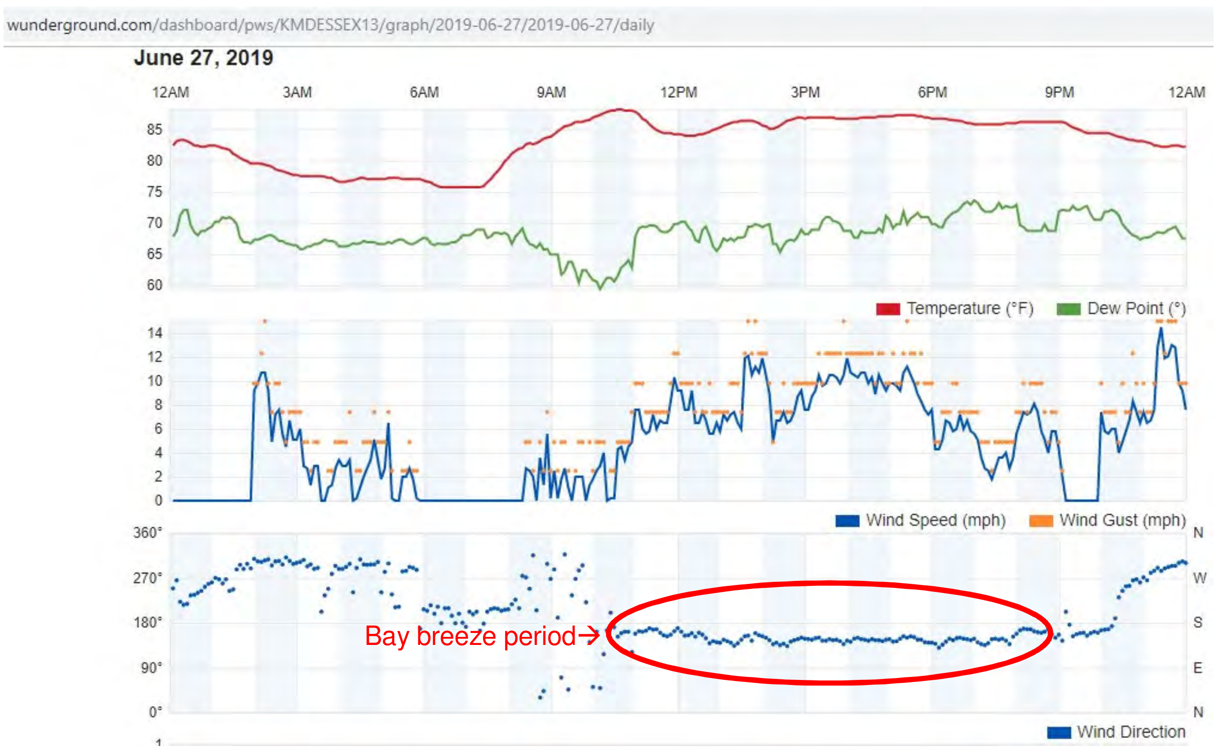

Figure A-3: West u Park Beach Station (KMDSERVS2) Weather Data for June 28, 2019

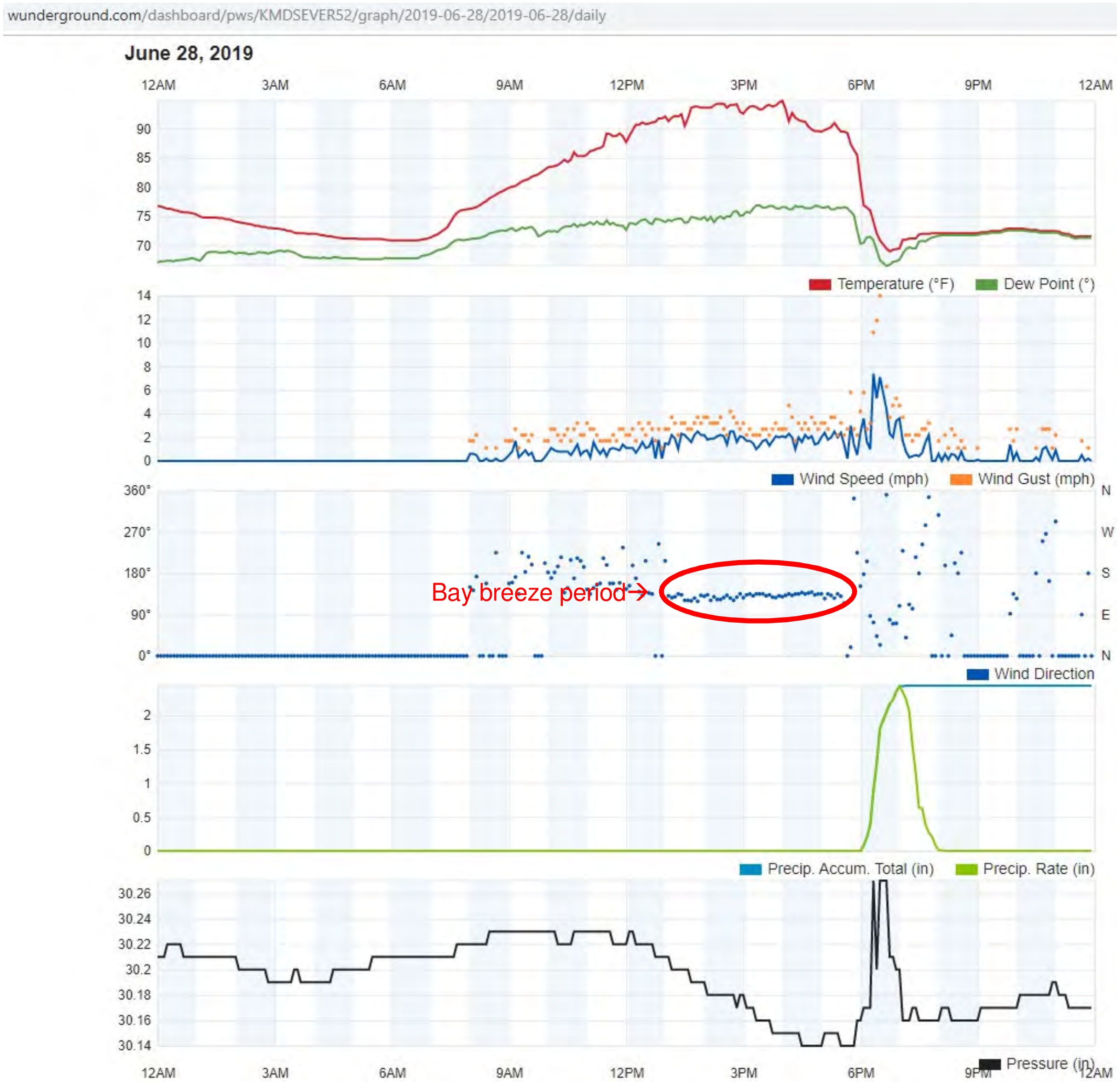

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Figure A-4: Point House Bay (KMDNORTH41) Weather Data for July 2, 2019

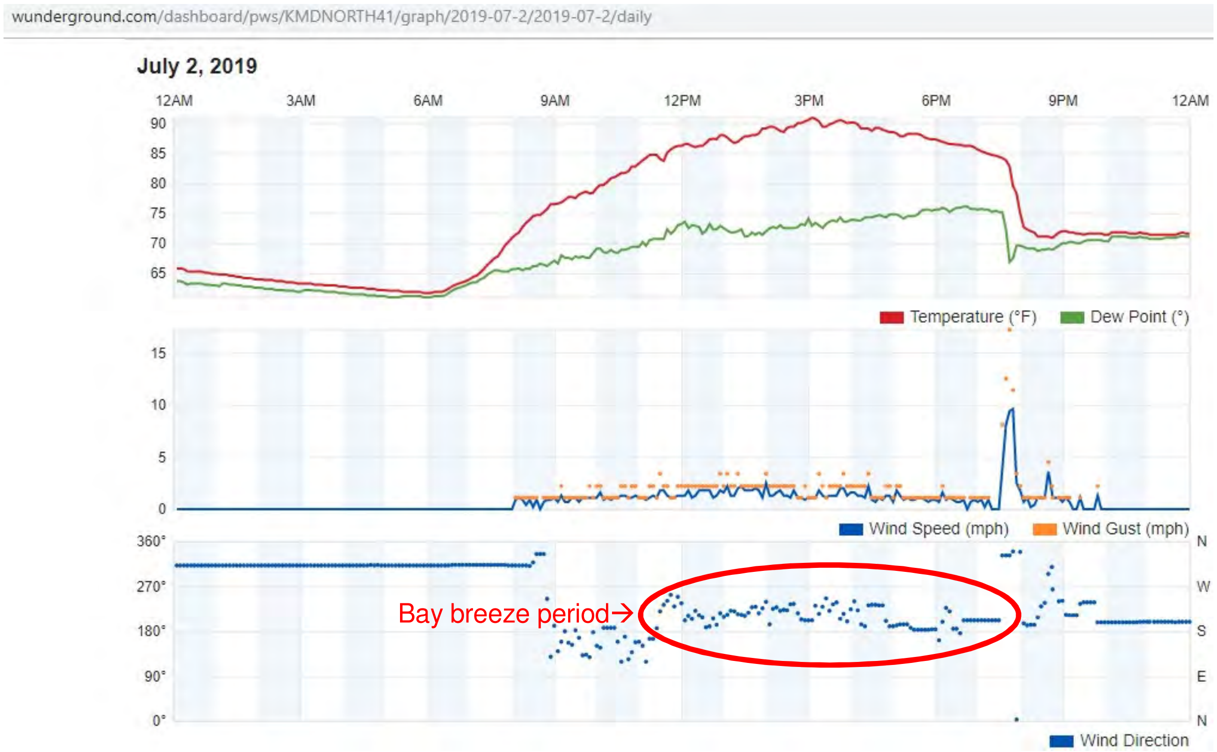

Figure A-5: Edgewood Harford Station (KMDEDGEW1) Weather Data for July 19, 2019

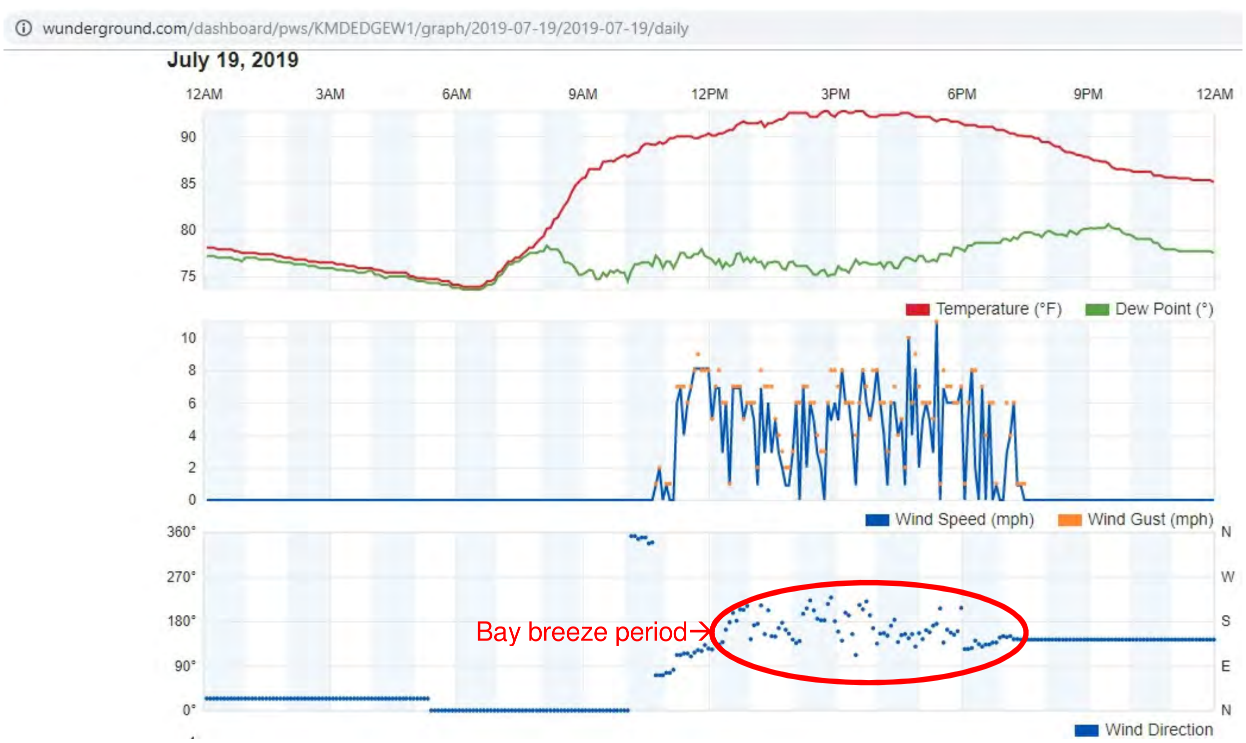

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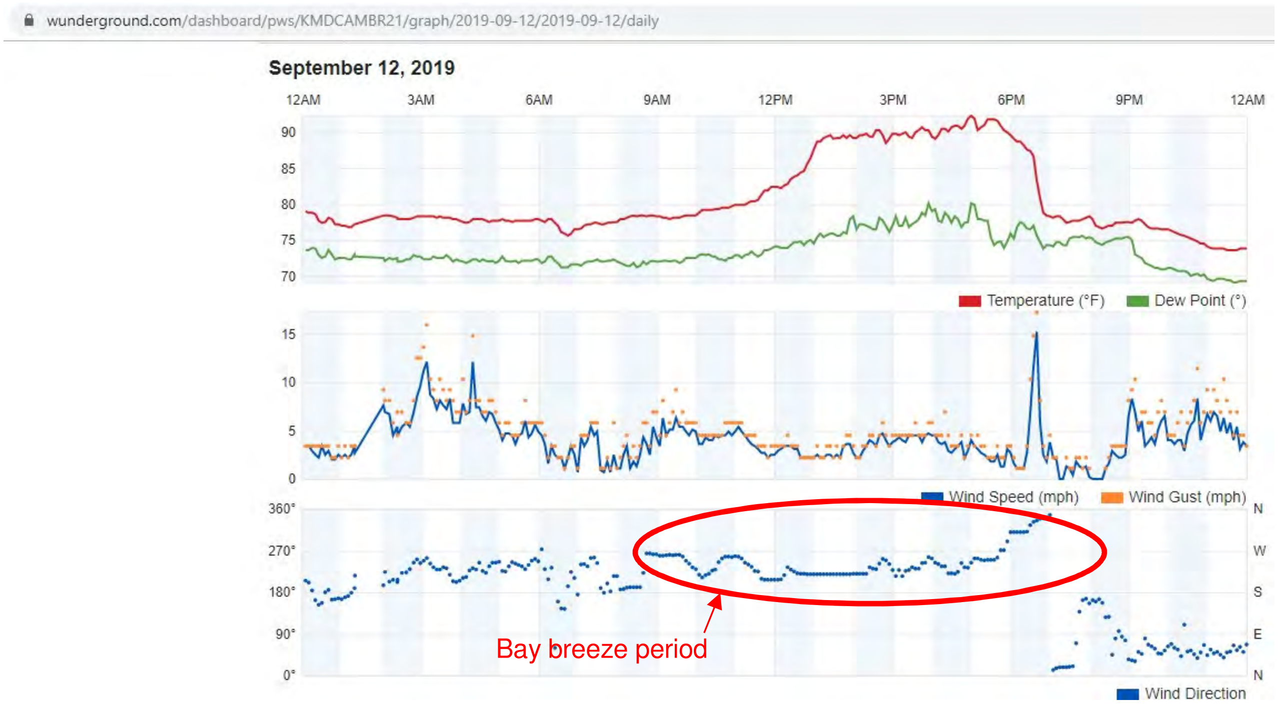
Figure A-6: Ferry Farm (KMDCAMBR21) Weather Data for September 12, 2019



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Further Comments on MDE Analysis of the Impacts of PA Coal-Fired EGUs on Maryland Ozone NAAQS Compliance – Section 184 Request

Robert Paine, David Heinold, and Adrienne Kieldsing (AECOM)

November 22, 2019

Introduction

On May 30, 2019, the Maryland Department of the Environment (MDE) provided a petition to the Ozone Transport Commission (OTC) under Section 184(c) of the Clean Air Act (CAA). This request asked OTC to develop and transmit to the administrator of the U.S. Environmental Protection Agency (EPA) recommendations for additional control measures to be applied for nitrogen oxide (NOx) emissions from Pennsylvania coal-fired electrical generating units (EGUs). In its submittal to the OTC, the MDE conducted a sensitivity modeling analysis of what it considered "excess emissions" of NOx from Pennsylvania coal-fired EGUs in 2017 and 2018 after implementation of Pennsylvania's Reasonably Available Control Technology (RACT) II Rule and the Cross-State Air Pollution Rule (CSAPR) Update (Phase II).

The MDE asserted in its petition that "despite significant progress in reducing long term average nitrogen oxides (NOx) emissions from coal-fired EGUs, Pennsylvania (PA) rules still allow excess emissions on a daily basis." MDE indicated in its petition to the OTC that reducing excess emissions on a daily basis is critical to attaining and maintaining the 2015 ozone National Ambient Air Quality Standard (NAAQS).

In response to comments received in August 2019 to the petition, in October 2019 the OTC crafted a proposed recommendation that is currently available for public comment. A summary of the recommendation is as follows:

> *The Ozone Transport Commission (OTC) recommends that the U.S. EPA require Pennsylvania to revise the Pennsylvania State Implementation Plan to include additional control measures which would establish daily nitrogen oxides (NOx) emission limits for all coal-fired EGUs with already installed Selective Catalytic Reduction (SCR) or Selective Non Catalytic Reduction (SNCR) control technology to ensure that these technologies are optimized to minimize NOx emissions each day of the ozone.* season.

The support for the petition and subsequent proposed recommendation is based on MDE's analysis that estimated the daily "excess emissions" from targeted PA coal-fired plants. The MDE did not, however, correlate the claimed excess emissions to days with high 8-hour ozone concentrations as measured at Maryland ozone monitors. In a related analysis, MDE commissioned the University of Maryland (UMD) to conduct photochemical grid modeling for a hypothetical set of excess emissions for all targeted PA coal-fired plants, as if excess emissions occurred <u>simultaneously and continuously</u> during the entire month of July 2011. MDE reported the resulting modeled increases in ozone due to these hypothetical excess emissions. These findings were submitted in support of MDE's request to the OTC to request additional controls on PA coal-fired EGU NOx emissions.

The discussion below presents our comments on two areas of the analysis that relate to the technical merits of the MDE-provided information that was used in support of their petition: 1) aspects of the sensitivity modeling, and 2) frequency of high ozone days with back trajectories passing over the targeted Pennsylvania EGUs.

Issue #1: Review of CAMx Runs Showing the Impact of PA Coal-Fired EGU Emissions on Maryland Ozone Levels in July 2011

The MDE CAMx model sensitivity analysis for ozone used two hypothetical sets of NO_x emissions, one set representing emissions from PA coal-fired EGUs operating at "optimal" emission control rates and the other set representing "non-optimal" NOx emission control rates. In both scenarios, all other sources were set to presumed constant 2023 emission rates. The stated purpose of the ozone sensitivity analysis was to simulate the effect of having all PA coal-fired EGUs operating at their "optimal" NOx emission rate at all times on reducing ozone concentrations in Maryland and elsewhere for July 2011, a month with a large number of days with ozone excursions above the NAAQS concentration level. The availability of a 2011 CAMx modeling platform made selection of this limited period a reasonable sensitivity modeling approach.

The CAMx modeling scenarios were run using the UMD Science Framework (i.e., emissions of NOx from mobile sources had been reduced by 50%). The "Scenario 5r" was the base case scenario and consisted of the GAMMA 2023 inventory (included on the books (OTB) and on the way (OTW)), ERTAC EGU 2.7 2023 without CSAPR and un-optimized EGUs.

In their documentation for the Section 184 petition, MDE did not provide a listing of the actual emission rates for the PA coal-fired EGUs nor did they provide the ERTAC 2.7 reference case emission rates. This omission made it difficult to determine the emissions that were used in the modeling for these EGUs for the "optimized" vs. "non-optimized" cases, although this information was ultimately provided in response to a recent Public Information Act (PIA) request to the MDE. The key point derived from this information is the very large difference in the modeled NOx tons for the two cases: about 49,981 tons in July 2011 for the non-optimized case vs. only 10,999 tons for the optimized case.

Table 1: MDE CAMx Modeled Emission Rates for PA EGUs with Optimized and Non-Optimized NOx Emissions

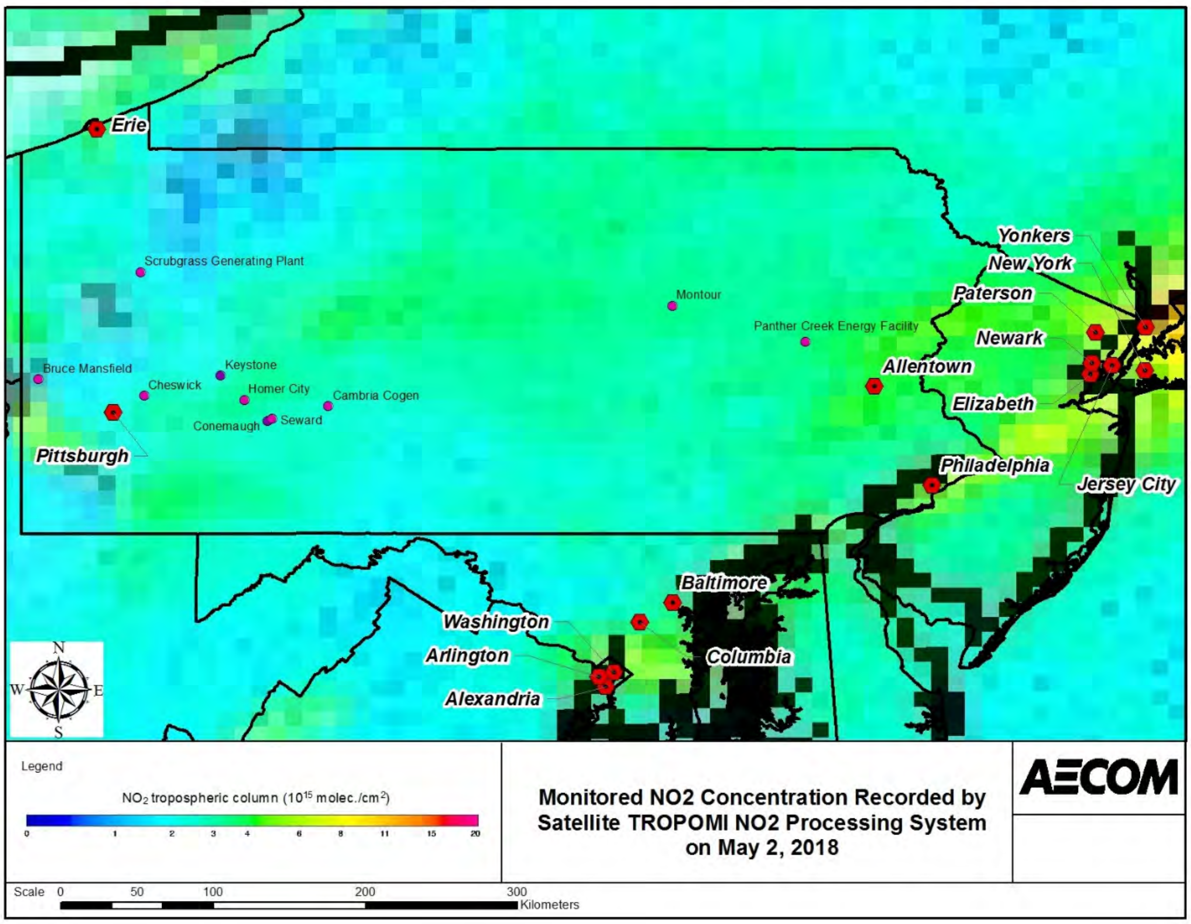
Facility	Sum of 2023 With Optimized SCR/SNCR in PA OS NOx Mass (Tons)	Sum of 2023 With Non-Optimized SCR/SNCR in PA OS NOx Mass (Tons)
Bruce Mansfield	2938.51	9691.34
Cambria Cogen	204.71	482.84
Cheswick	624.52	2937.54
Conemaugh	1934.93	5617.67
Homer City	2018.46	10122.30
Keystone	1255.90	10544.54
Montour	988.29	8996.93
Panther Creek Energy Facility	195.49	248.56
Scrubgrass Generating Plant	149.31	341.52
Seward	688.90	997.53
Grand Total	**10999.04**	**49980.75**

A large portion (80-90%) of the total emissions listed in Table 1 comes from an area in western Pennsylvania that includes all of the plants listed in Table 1 except for Montour and Panther Creek. The locations of the plants listed in Table 1 are shown in Figure 1, which also includes a map of the total NO_2

atmospheric loading for May 2, 2018 obtained from the satellite-based Tropospheric Monitoring Instrument (TROPOMI).

MDE's review of emissions data that led to MDE's determination of optimized and non-optimized emissions included years of operation going back to 2005, which involve periods that are not representative of current operations. In addition, the assumption that non-optimized emissions occur constantly is not in any way representative of typical EGU operations. Thus, the results of the sensitivity modeling greatly inflate the difference in ozone concentrations between the two emission cases.

Figure 1: TROPOMI Image for May 2, 2018 Overlaid on Base Map with PA Coal-Fired EGUs and Major Cities Indicated



Additional issues with MDE's analysis were stated in comments submitted by Conemaugh and Keystone in August 2019 regarding the MDE 184(c) petition and are summarized below.

1. Performing the emissions rate comparison without a thorough understanding of the historical context (e.g., applicable or expected future regulations, age of the emissions control device, fuel quality, etc.) will yield misleading or erroneous conclusions.

2. Many of the NOx emission control devices, especially the SCRs, were installed to take advantage of economic drivers related to market-based trading programs established to

incentivize investment in emissions controls and yield the low-cost solution to regional emissions reduction goals, and not to comply with state or federal NOx regulations.

3. In many cases, the year of the highest ozone season-average NOx emission rate preceded 2017, which was the first year of the PA RACT Rule and CSAPR Phase II regulations. Importantly, there is no applicable requirement to operate units in accordance with "*past best practices*" – this is not a Clean Air Act term or requirement.

It is reasonable to expect that periods of elevated NOx emissions, for example due to SCR operational malfunctions or curtailed demand that may lower exhaust temperatures below those needed to allow for SCR operation (i.e., ammonia injection with consequential NOx emission reduction), are independent of high electrical demand associated with high ozone periods. Therefore, a more up-to-date, representative, and reasonably unbiased assessment of the difference in NOx emissions in MDE's terminology between optimized and non-optimized emissions can be based on a review of actual NOx emissions from the EGUs listed in Table 1 for the ozone season months in 2017-2019.

This analysis was conducted with the following procedure:

- Any facility that is currently deactivated (as approved by PJM, the regional electric grid operator) was omitted from the analysis (Bruce Mansfield and Cambria Cogen).
- The total actual heat input for the operational facilities was computed for the 3-year ozone season period.
- The optimized NOx emissions were computed by taking the average heat input rate over the 3-year ozone season months multiplied by the MDE-assumed NOx emission rates. This estimate includes periods of operation that cannot be sustained without operational damage (e.g., for Keystone in the year 2005, as outlined in the August 2019 comments letter), so the optimized emissions are biased on the low side.
- The non-optimized NOx emissions were computed by taking the actual NOx emissions for the 3-year ozone season period. Since these periods include some hours with no SCR operation due to exhaust temperatures below the safe operational threshold, the emissions overstate the SCR-related emissions and therefore the difference between non-optimized and optimized operation of the SCR equipment.
- The difference in total NOx tons for the ozone season (averaged over the 2017-2019 period) was compared to the difference shown in Table 1 (49,981 tons – 10,999 tons = 38,982 tons).
- Since the MDE-modeled ozone benefit is associated with the difference between the NOx emissions between the non-optimized and optimized cases as listed in Table 1, the difference between the recomputed difference between non-optimized and optimized NOx emissions for 2017-2019 was used to scale the MDE-modeled ozone benefit to provide a more reasonable indication of this benefit.
- The scaling procedure is approximate (there is not sufficient time in the comment period to rerun the modeling), but has precedent in EPA's current guidance[1] for modeling secondary modeled impacts for permitting of new sources.

The resulting NOx emissions computation for the 2017-2019 ozone season period is provided in Table 2. For the active EGUs at issue, the difference between the non-optimized and the optimized NOx emissions for an ozone season is about 8,202 tons – 4,652 tons, or 3,550 tons. This difference is over

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[1] See, for example EPA's "Guidance on the Development of Modeled Emission Rates for Precursors (MERPs) as a Tier 1 Demonstration Tool for Ozone and PM2.s under the PSD Permitting Program", page 53; available at https://www3.epa.gov/ttn/scram/guidance/guide/EPA-454_R-19-003.pdf.

an order of magnitude less than the difference MDE modeled in their sensitivity study, and it indicates that the results of the MDE sensitivity study were highly inflated.

The next step in the analysis is to scale the results of the MDE sensitivity modeling to estimate a more realistic ozone benefit from requiring daily optimized NOx emission limits for the targeted Pennsylvania EGUs. The scaling factor is 3,550 tons / 38,982 tons, or 0.091. This scaling factor can then be applied to the peak ozone benefit reported by MDE in their petition among the states that they modeled. The results are shown in Table 3.

It is noteworthy that all of the scaled ozone benefit concentration values are below EPA's 2018 guidance[2] for the ozone Significant Impact Level of 1 ppb. The peak scaled ozone benefit in Maryland and all states outside of Pennsylvania is below 0.7 ppb, which is 1% of the ozone NAAQS. EPA has determined[3] through its "Good Neighbor Provision" guidance that an upwind state can interfere with maintenance of a NAAQS if it produces more than 1% of NAAQS concentration in at least one downwind state. In this case, no downwind state has an impact of at least 1% of the ozone NAAQS.

[2] Available at https://www.epa.gov/nsr/significant-impact-levels-ozone-and-fine-particles.

[3] See https://www.epa.gov/sites/production/files/2015-11/documents/goodneighborprovision2008naaqs.pdf.

Table 2: 2017-2019 Ozone Season NOx Emissions Used for Estimates of Optimized and Non-Optimized Emissions

Facility and Unit	Actual Total NOx (tons)	Annualized Actual Total NOx (tons)	Actual Total Heat Input (MMBtu)	Actual 3-yr Avg NOx Rate (lb/MMBtu)	MDE Optimized NOx Rate (lb/MMBtu)	3-yr Total Optimized NOx (tons)	3-yr Avg Optimized NOx (tons)
Cheswick							
1	1416.1	472.0	16815769.2	0.168	0.0793	666.7	222.2
Conemaugh							
1	2977.1	992.4	66003297.4	0.090	0.0720	2376.1	792.0
2	3581.6	1193.9	73128092.5	0.098	0.0744	2720.4	906.8
Homer City							
1	2308.2	769.4	29987949.8	0.154	0.0660	989.6	329.9
2	1820.3	606.8	22562439.5	0.161	0.0820	925.1	308.4
3	1237.1	412.4	24352999.1	0.102	0.0870	1059.4	353.1
Keystone							
1	4111.0	1370.3	78794387.5	0.104	0.0442	1741.4	580.5
2	3376.0	1125.3	70514094.2	0.096	0.0433	1526.6	508.9
Montour, LLC							
1	1112.4	370.8	17686281.3	0.126	0.0440	389.1	129.7
2	856.7	285.6	12409697.9	0.138	0.0472	292.9	97.6
Panther Creek Energy Facility							
1	19.3	6.4	352805.6	0.109	0.1050	18.5	6.2
2	23.9	8.0	408155.4	0.117	0.1020	20.8	6.9
Scrubgrass Generating Plant							
1	230.8	76.9	3752314.1	0.123	0.0548	102.8	34.3
2	242.2	80.7	3457770.4	0.140	0.0790	136.6	45.5
Seward							
1	639.8	213.3	12963885.4	0.099	0.0740	479.7	159.9
2	654.2	218.1	13658584.4	0.096	0.0745	508.8	169.6
sum	24606.7	8202.2	446848523.9			13954.4	4651.5

Table 3: Scaled Ozone Benefits From MDE Results Using Overstated NOx Emission Differences

State	MDE Maximum Ozone Benefit from SCR/SNCR (ppb)	Scaled Ozone Benefit Based on 2017-2019 Emissions Data (ppb)
PA	10.70	0.97
MD	7.00	0.64
NJ	5.80	0.53
DC	4.50	0.41
NY	4.20	0.38
VA	4.00	0.36
DE	3.20	0.29
CT	2.10	0.19
RI	1.20	0.11

Issue #2: Review of Back Trajectories for Maryland Ozone Exceedance Days in 2019

To determine the likelihood for emissions from Pennsylvania EGUs (specifically, the Conemaugh and Keystone Generating Stations), we had previously conducted back-trajectory analyses using the Hybrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT) model[4] for days in 2017 and 2018 for which there were 8-hour ozone concentrations at any Maryland monitor above the 70 ppb NAAQS. These results were included with the comments submitted by Conemaugh and Keystone in August 2019 on the MDE petition. The analysis has now been updated with HYSPLIT modeling for high ozone days in 2019 (preliminary data) for monitors in Maryland and Pennsylvania.

The features of the HYSPLIT model were discussed[5] at the 9th Modeling Conference of the Environmental Protection Agency (EPA) as a useful tool for back-trajectory analyses of plume transport. HYSPLIT is also being used by the Western Regional Air Partnership[6] for determining source regions of regional haze. As noted in the Stein et al. (2015) journal article[7], the HYSPLIT model, developed by NOAA's Air Resources Laboratory, is one of the most widely used models for atmospheric trajectory and dispersion calculations.

AECOM used HYSPLIT's default modeling approach for computing back trajectories. The trajectories were designed to end at the location of the peak monitoring site for each day analyzed. The computed trajectories were designed to start at the monitor site at the default height of 500 meters above ground level and going backwards in time for a 72-hour period. Trajectories were computed for arrival at the monitoring site for 4 times each day, separated by 6 hours: 2 A.M. local time (06 UTC), 8 A.M. local time (12 UTC), 2 P.M. local time (18 UTC), and at 8 P.M. local time (00 UTC the next day). The North American Mesoscale Forecast System (NAM[8]) 12 km resolution meteorological dataset which covers the continental United States from 2007 to the present was used within HYSPLIT to compute the back trajectories for 2019. The Eta Data Assimilation System (EDAS) 40-km meteorological dataset, which had been used for the previously completed 2017-2018 HYSPLIT analyses, has been discontinued as of December 2018, thus necessitating the use of the NAM meteorological dataset for the 2019 HYSPLIT analysis. HYSPLIT was run with the default vertical motion option which uses modeled vertical velocity. The default settings that were used in the running the HYSPLIT model are shown in Figure 3.

In 2019, there was a total of 17 different days with ozone peak 8-hour averages above the level of the NAAQS at one or more Maryland or Pennsylvania monitors. Figures showing the four 6-hour HYSPLIT figures for the exceedance days involving Maryland monitors are presented in Appendix A and figures showing the 6-hour HYSPLIT figures for the Pennsylvania monitors are presented in Appendix B.

Our analysis of the HYSPLIT back trajectories for 2019 is summarized in Table 3 for Maryland monitors and in Table 4 for Pennsylvania monitors. Of the total of 14 days involved for Maryland monitors, 7 of the days involved had back trajectories that might have passed through the vicinity of the Conemaugh and

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[4] National Oceanic and Atmospheric Administration (NOAA) Air Resources Laboratory: https://www.ready.noaa.gov/HYSPLIT.php.

[5] https://www3.epa.gov/scram001/9thmodconf/draxler.pdf.

[6] See the presentation at https://www.wrapair2.org/RHPWG.aspx associated with the WRAP Regional Haze Planning Workgroup Control Measures Subcommittee.

[7] Stein, A. F., R. Draxler, G. Rolph, B. Stunder, M. Cohen, and F. Ngan, 2015. NOAA's HYSPLIT Atmospheric Transport and Dispersion Modeling System. *Bulletin of the American Meteorological Society*, vol. 96, issue 12, pp. 2059-2077. https://journals.ametsoc.org/doi/full/10.1175/BAMS-D-14-00110.1.

[8] https://ready.arl.noaa.gov/data/archives/nam12/README.TXT.

Keystone Generating Stations. For the high ozone days for Pennsylvania monitors, less than half (4 out of 9) of the days had back trajectories that passed close to the Conemaugh and Keystone stations. Therefore, on about half of the high ozone days in 2019, these Pennsylvania coal-fired EGUs played no role in the high ozone concentrations being monitored at the Maryland and Pennsylvania monitors. It should be noted that for the days when the back trajectories passed over Conemaugh and Keystone, they also passed over urban areas that likely contributed ozone precursor emissions. In a separate technical paper, we provide a discussion about the role of localized onshore flow from Chesapeake Bay and how it may influence ozone readings at Maryland monitors near the bay.

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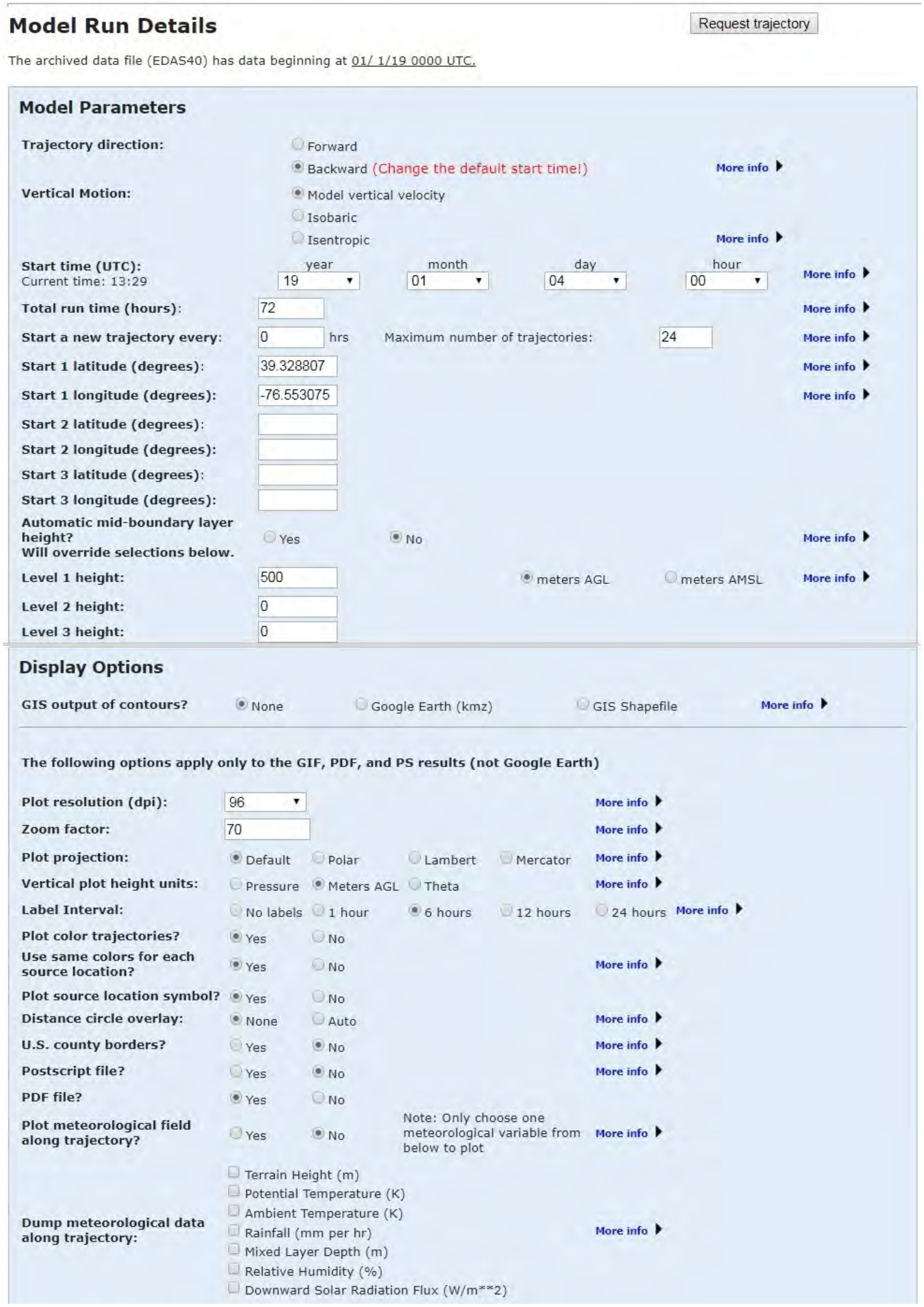
Figure 3: HYSPLIT Model Run Example



Model Run Details

Request trajectory

The archived data file (EDAS40) has data beginning at 01/ 1/19 0000 UTC.

Model Parameters

Trajectory direction:	○ Forward ◉ Backward (Change the default start time!)				More info
Vertical Motion:	◉ Model vertical velocity ○ Isobaric ○ Isentropic				More info
Start time (UTC): Current time: 13:29	year 19	month 01	day 04	hour 00	More info
Total run time (hours):	72				More info
Start a new trajectory every:	0 hrs	Maximum number of trajectories:	24		More info
Start 1 latitude (degrees):	39.328807				More info
Start 1 longitude (degrees):	-76.553075				More info
Start 2 latitude (degrees):					
Start 2 longitude (degrees):					
Start 3 latitude (degrees):					
Start 3 longitude (degrees):					
Automatic mid-boundary layer height? Will override selections below.	○ Yes	◉ No			More info
Level 1 height:	500	◉ meters AGL	○ meters AMSL		More info
Level 2 height:	0				
Level 3 height:	0				

Display Options

GIS output of contours?	◉ None	○ Google Earth (kmz)	○ GIS Shapefile	More info

The following options apply only to the GIF, PDF, and PS results (not Google Earth)

Plot resolution (dpi):	96					More info
Zoom factor:	70					More info
Plot projection:	◉ Default	○ Polar	○ Lambert	○ Mercator		More info
Vertical plot height units:	○ Pressure	◉ Meters AGL	○ Theta			More info
Label Interval:	○ No labels	○ 1 hour	◉ 6 hours	○ 12 hours	○ 24 hours	More info
Plot color trajectories?	◉ Yes	○ No				
Use same colors for each source location?	◉ Yes	○ No				More info
Plot source location symbol?	◉ Yes	○ No				
Distance circle overlay:	◉ None	○ Auto				More info
U.S. county borders?	○ Yes	◉ No				More info
Postscript file?	○ Yes	◉ No				More info
PDF file?	◉ Yes	○ No				
Plot meteorological field along trajectory?	○ Yes	◉ No	Note: Only choose one meteorological variable from below to plot			More info
Dump meteorological data along trajectory:	☐ Terrain Height (m) ☐ Potential Temperature (K) ☐ Ambient Temperature (K) ☐ Rainfall (mm per hr) ☐ Mixed Layer Depth (m) ☐ Relative Humidity (%) ☐ Downward Solar Radiation Flux (W/m**2)					More info

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Table 3: Analysis of HYSPLIT Back Trajectories for Eleven 2019 High Ozone Days for Maryland Monitors

Date of Exceedance	Maximum 8-hour Ozone Concentration For Maryland Monitors (ppm)	Site Name	Notes on Back Trajectories for Conemaugh and Keystone Involvement
6/26/2019	0.075	Edgewood	**Some back trajectories pass over/close to Conemaugh and Keystone.**
6/27/2019	0.085	Essex	**Some back trajectories pass over/close to Conemaugh and Keystone.**
6/28/2019	0.083	GLEN BURNIE	**Some back trajectories pass over/close to Conemaugh and Keystone.**
7/2/2019	0.085	Fair Hill	**Some back trajectories pass over/close to Conemaugh and Keystone.**
7/16/2019	0.077	Aldino	No back trajectory passes in the vicinity of Conemaugh or Keystone.
7/19/2019	0.076	Edgewood	**Some back trajectories pass over/close to Conemaugh and Keystone.**
7/29/2019	0.077	Edgewood	Back trajectories generally pass through southern PA or northern VA.
7/30/2019	0.079	Aldino	Back trajectories are generally from the south.
8/6/2019	0.077	HU-Beltsville	Back trajectories are generally from the south.
8/19/2019	0.077	Edgewood	Back trajectories are generally from the south.
8/20/2019	0.074	Frederick Airport	**Some back trajectories pass over/close to Conemaugh and Keystone.**
9/11/2019	0.075	Beltsville	Back trajectories are generally from the south.
9/12/2019	0.078	Horn Point	**Some back trajectories pass over/close to Conemaugh and Keystone.**
9/16/2019	0.077	Essex	No back trajectory passes in the vicinity of Conemaugh or Keystone.

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Table 4: Analysis of HYSPLIT Back Trajectories for Nine 2019 High Ozone Days for Pennsylvania Monitors

Date of Exceedance	Maximum 8-hour Ozone Concentration For Pennsylvania Monitors (ppm)	Site Name	Notes on Back Trajectories for Conemaugh and Keystone Involvement
6/27/2019	0.075	Lancaster County - on a Trailer	**Some back trajectories pass over/close to Conemaugh and Keystone.**
6/28/2019	0.081	Reading Airport	**Some back trajectories pass over/close to Conemaugh and Keystone.**
7/2/2019	0.078	Delaware County - on a Trailer	**Some back trajectories pass over/close to Conemaugh and Keystone.**
7/10/2019	0.072	North East Airport (NEA)	No back trajectory passes in the vicinity of Conemaugh or Keystone.
7/16/2019	0.082	North East Airport (NEA)	No back trajectory passes in the vicinity of Conemaugh or Keystone.
7/19/2019	0.072	North East Waste (NEW)	**Some back trajectories pass close to Conemaugh and Keystone.**
7/27/2019	0.078	North East Waste (NEW)	No back trajectory passes in the vicinity of Conemaugh or Keystone.
7/30/2019	0.071	North East Airport (NEA)	Back trajectories are generally from the south.
8/5/2019	0.072	Delaware County - on a Trailer	No back trajectory passes in the vicinity of Conemaugh or Keystone.

Conclusions

The MDE asserted in its petition that "despite significant progress in reducing long term average NOx emissions from coal-fired EGUs, PA rules still allow excess emissions on a daily basis." MDE indicated in its petition to the OTC that reducing excess emissions on a daily basis is critical to attaining and maintaining the 2015 ozone NAAQS. Key arguments made by the MDE include the following:

- Based upon historical operation of each EGU, an "optimal" NOx emission rate has been arbitrarily computed by MDE, based upon identifying the lowest historic average ozone season NOx emission rate and then taking the highest day's emission rate for that year. From the optimal emission rate, daily "excess" NOx emissions were calculated by MDE
- CAMx sensitivity modeling commissioned by MDE with a hypothetical reduction in the PA coal-fired EGU NOx emission rates has resulted in estimates of the ozone concentration reductions that would occur if the NOx emissions from the PA coal-fired EGUs were optimized at all times.

We find several limitations to MDE's analysis, as noted below.

- The optimized emission rates are not sustainable in some cases. In the Keystone example, the injection of too much ammonia resulted in a best year's NOx emission rate at the expense of damage to the air preheater equipment due to ammonium bisulfate fouling. This emission rate could not be sustained. The lack of consideration by MDE of operational considerations for SCR operation makes their entire analysis too simplistic.
- MDE's estimate of non-optimized NOx emissions from the targeted Pennsylvania EGUs was highly inflated, especially because MDE assumed non-optimal emissions at all times from all plants in their modeling. We have generated a much more representative estimate of the "excess emissions" of NOx from the active targeted EGUs using data from the latest three years (2017-2019).
- The updated estimate of "excess emissions", totaled over the EGUs being considered, is an order of magnitude lower than the values assumed by the MDE in their CAMx modeling to determine the ozone benefit from their 184(c) petition. When the NOx emission difference is scaled to the more appropriate value based upon the latest three years of ozone season data, the ozone benefit for all states modeled outside of Pennsylvania by the MDE drops to below 1% of the NAAQS. As a result, the need for additional controls on the targeted Pennsylvania EGUs to support EPA's "Good Neighbor Provision" guidance is no longer present.
- A previous examination using the HYSPLIT back trajectory model of high ozone days in 2017 and 2018 that resulted in NAAQS exceedances at Maryland monitors indicates that the Conemaugh and Keystone stations were not upwind of the monitors on the majority of the days. They were only potentially contributing on 36% of these days, and urban area influences were also evident on those days.
- An updated HYSPLIT review of days in the 2019 ozone season with ozone exceedances at either Maryland or Pennsylvania monitors was conducted. This review indicates that Conemaugh and Keystone stations were not upwind of the monitors on about half of the days examined. Over the 3-year period of 2017-2018, these PA EGUs were potentially contributing on less than half of the days involved in recorded 8-hour concentrations above the NAAQS in Maryland. On those days, urban area influences were also likely present, as well as effects from elevated concentrations of ozone present over Chesapeake Bay (described further in a separate paper).

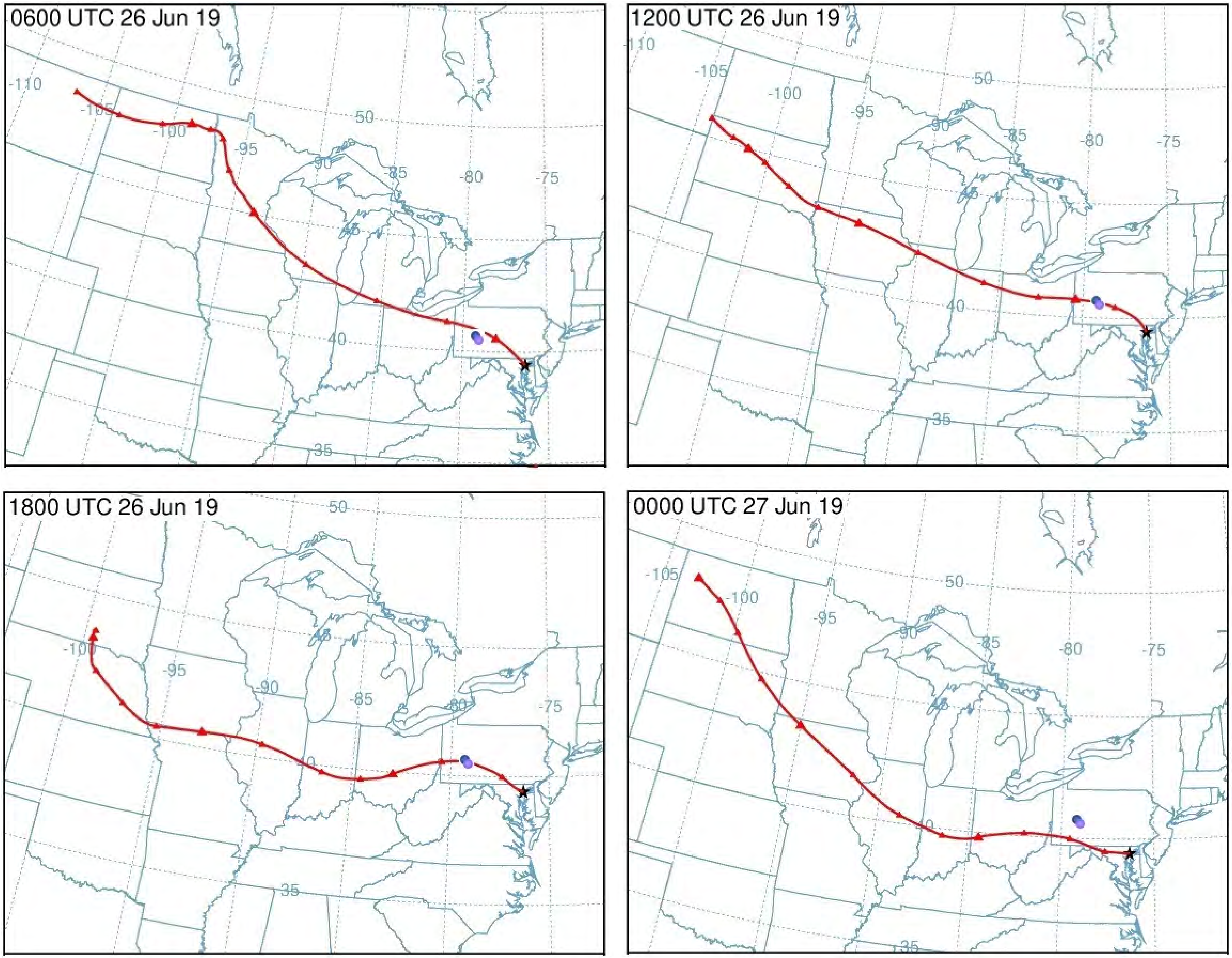
We conclude that the MDE's technical analysis is insufficient to support its petition as well as the recent OTC proposed recommendation related to the need for daily NOx emission limits for selected PA coal-fired EGUs.

Appendix A: HYSPLIT Back-Trajectory Plots for Days of Ozone Exceedances in 2019 for Maryland Monitors

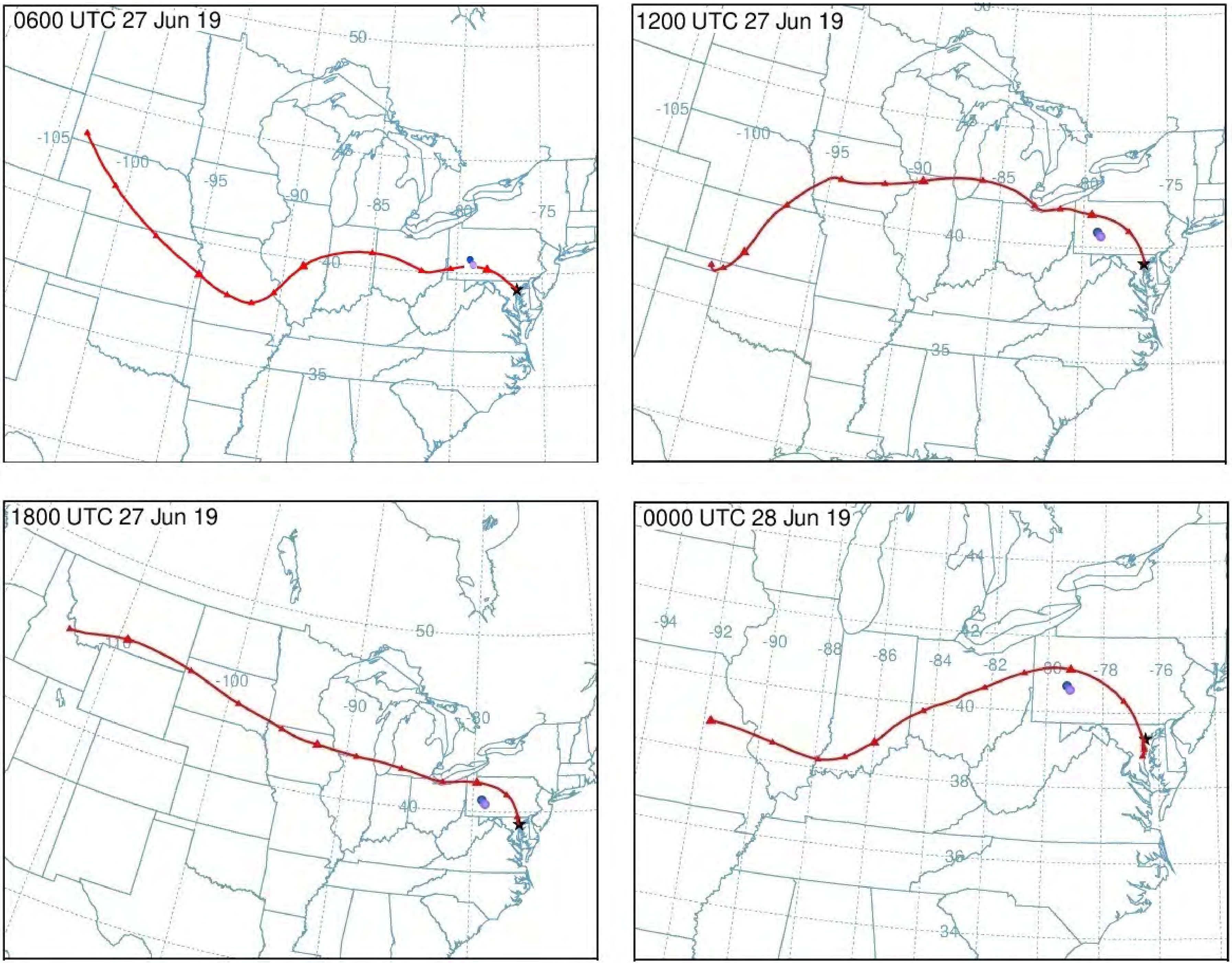
Dates Included are:

- 6/26/2019
- 6/27/2019
- 6/28/2019
- 7/2/2019
- 7/16/2019
- 7/19/2019
- 7/29/2019
- 7/30/2019
- 8/6/2019
- 8/19/2019
- 8/20/2019
- 9/11/2019
- 9/12/2019
- 9/16/2019

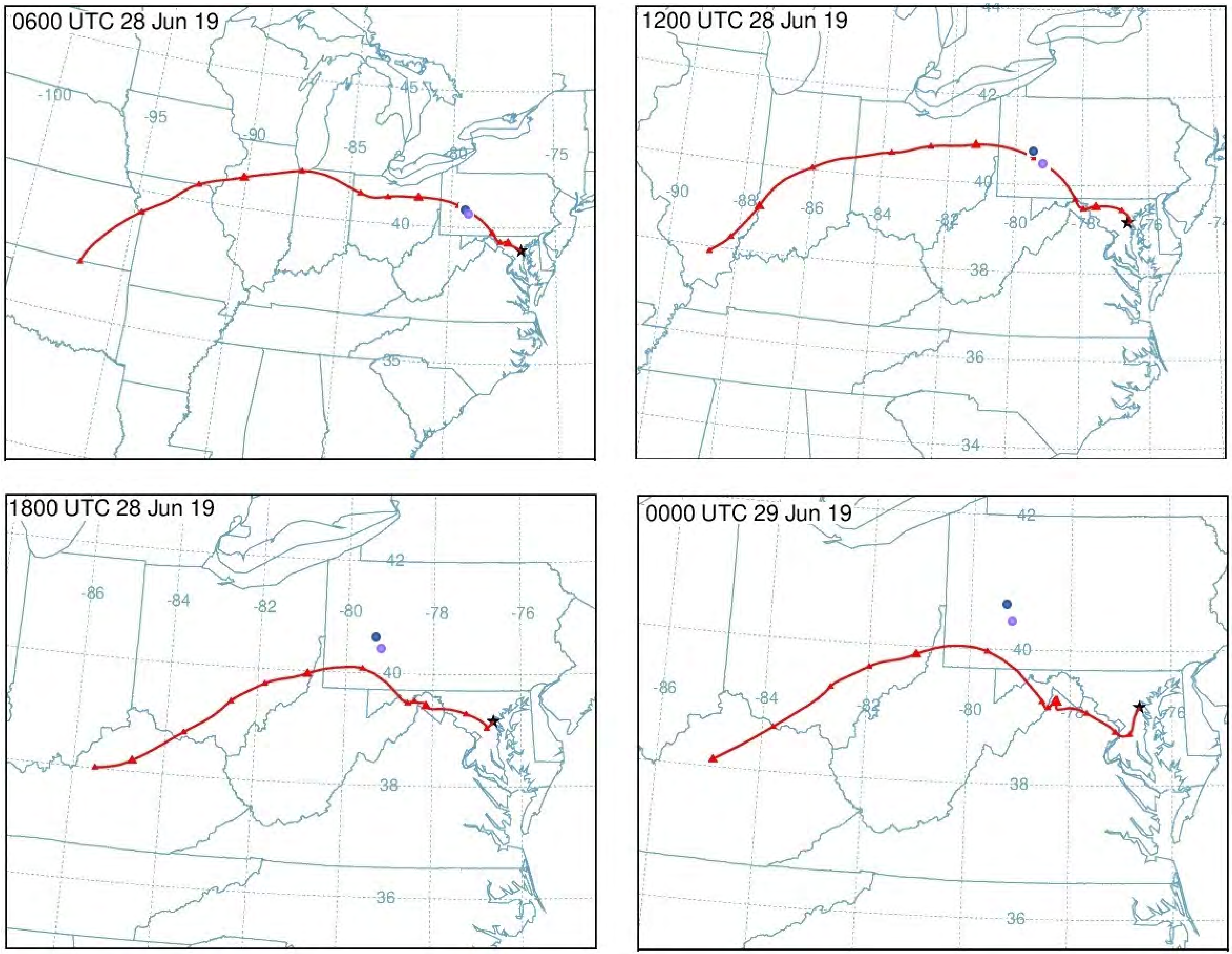
June 26, 2019 – Edgewood Monitor



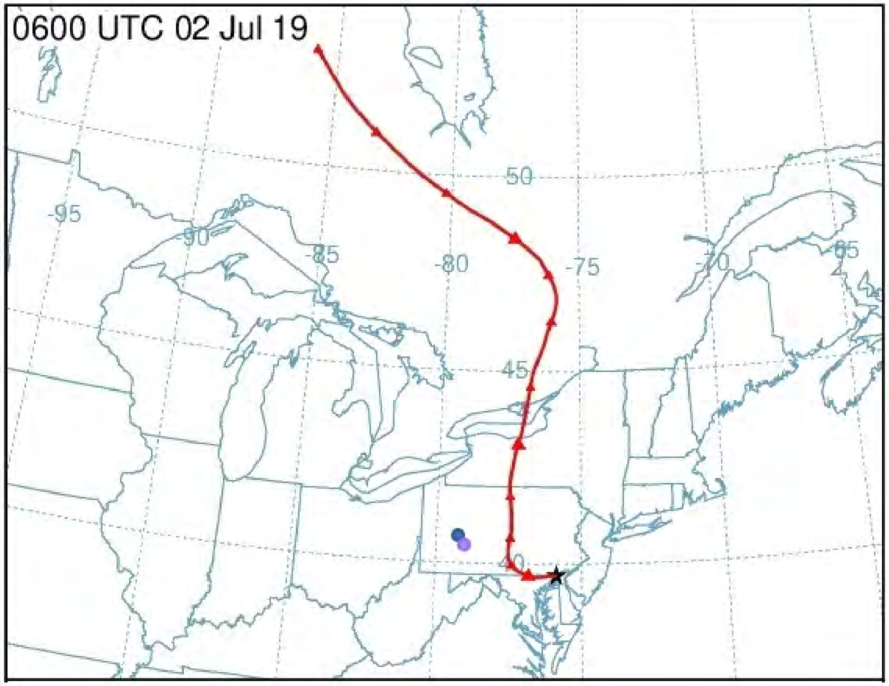
June 27, 2019 – Essex Monitor

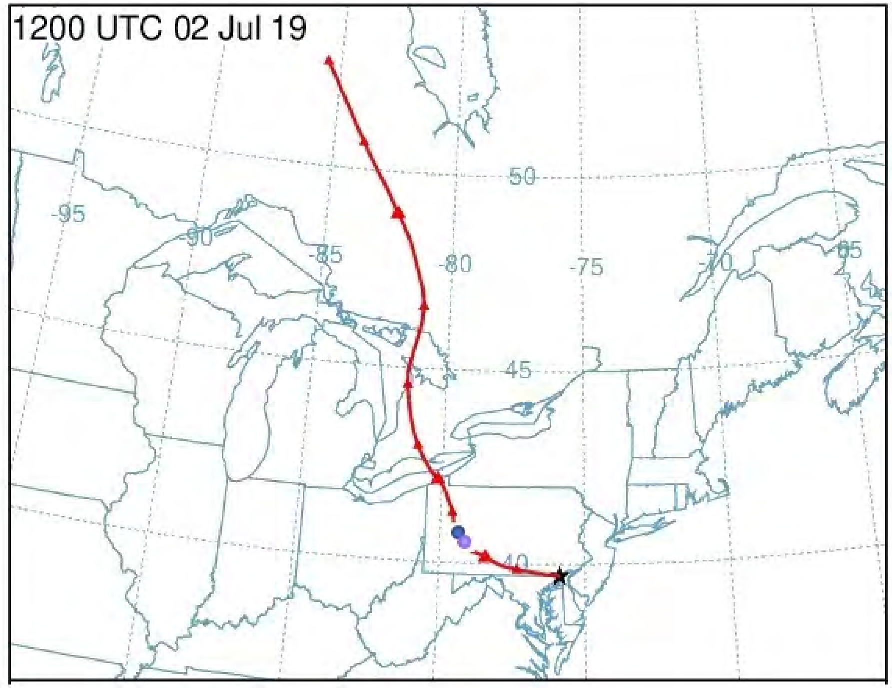


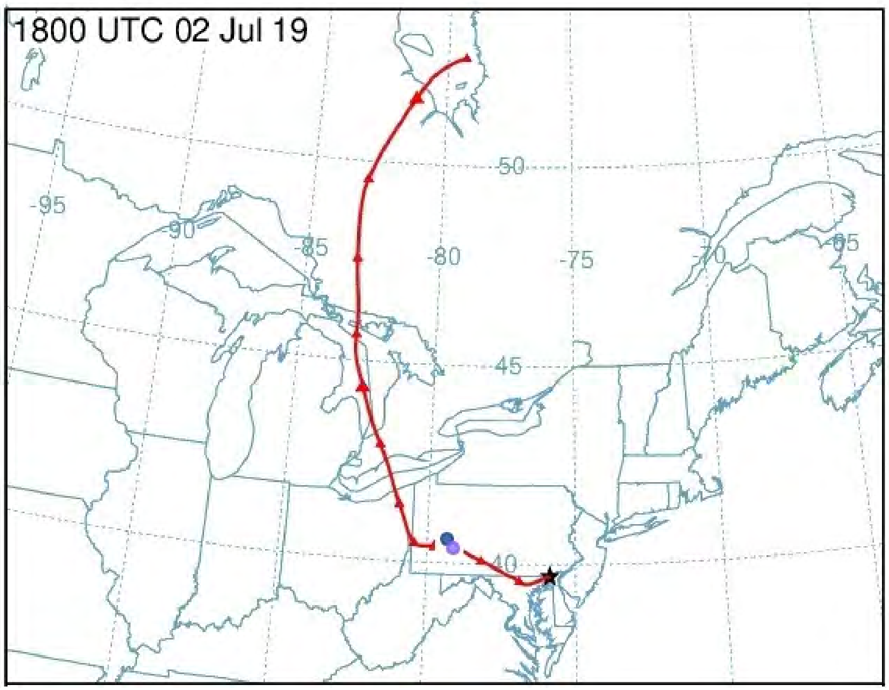
June 28, 2019 – Glen Burnie Monitor

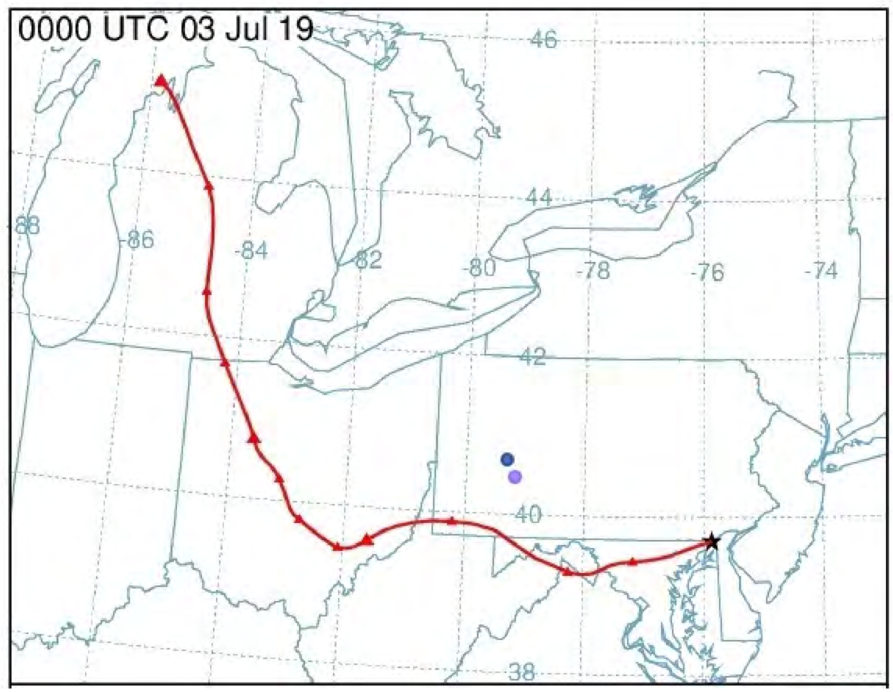


July 2, 2019 – Fair Hill Monitor

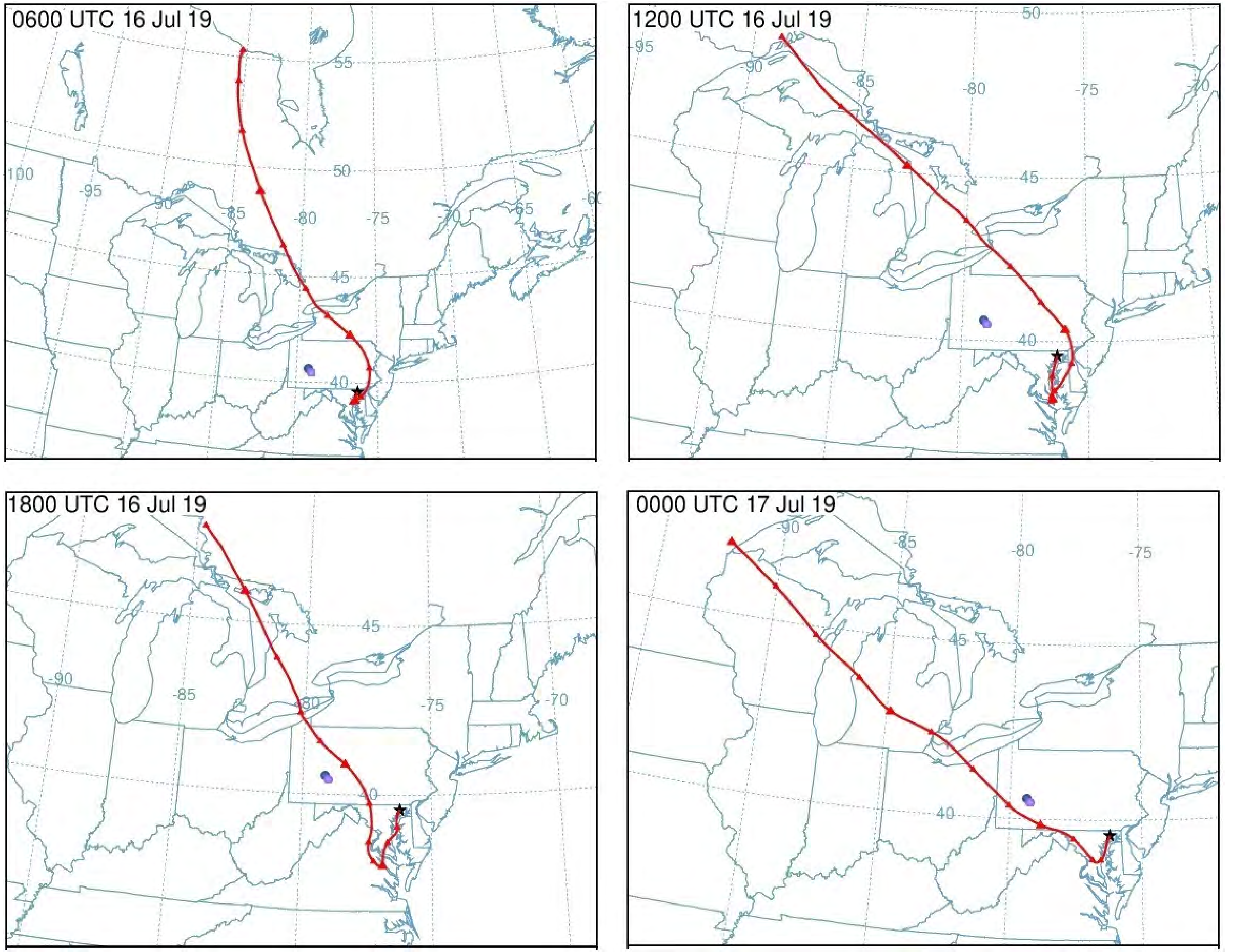




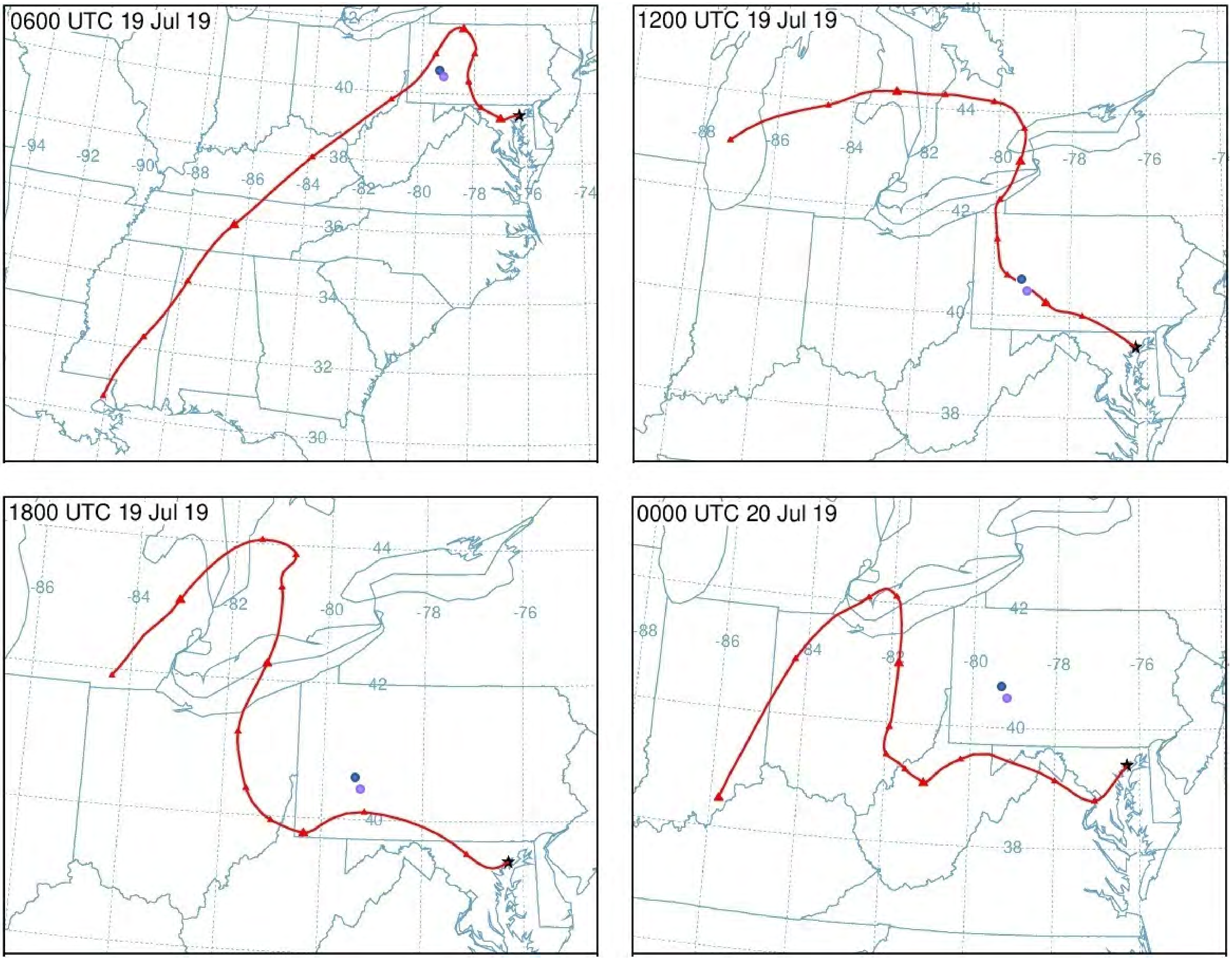




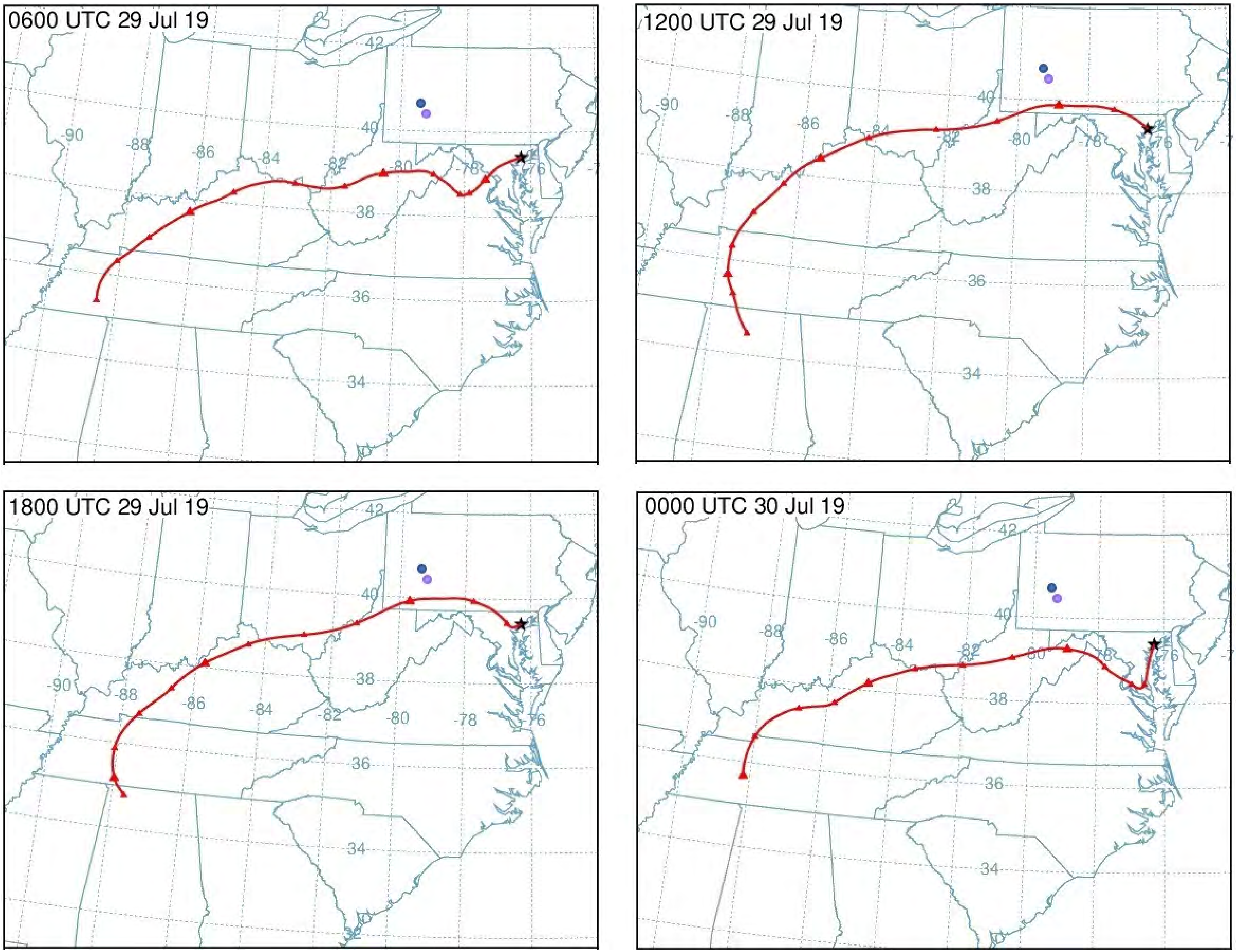
July 16, 2019 – Aldino Monitor



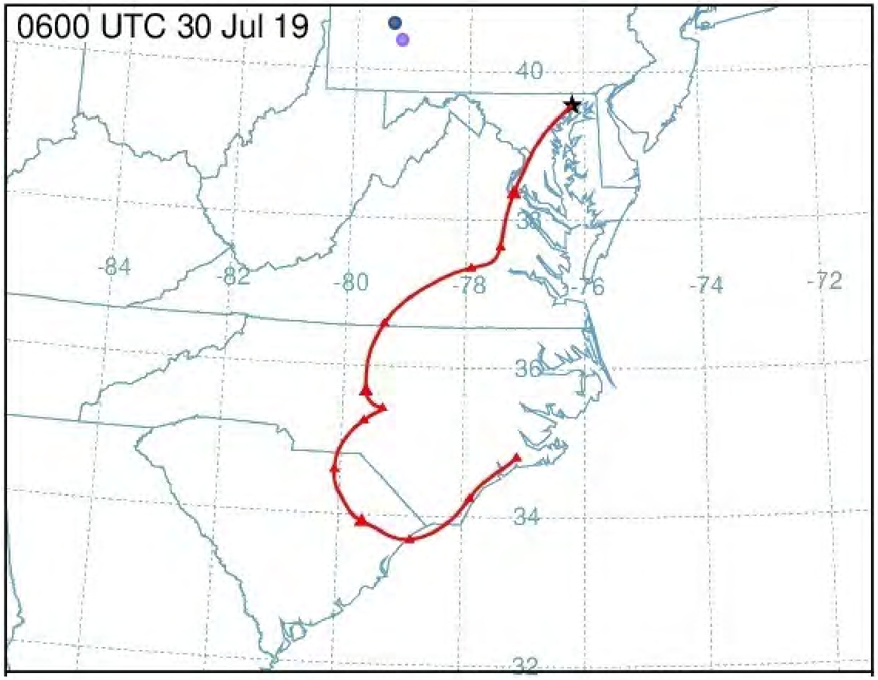
July 19, 2019 – Edgewood Monitor

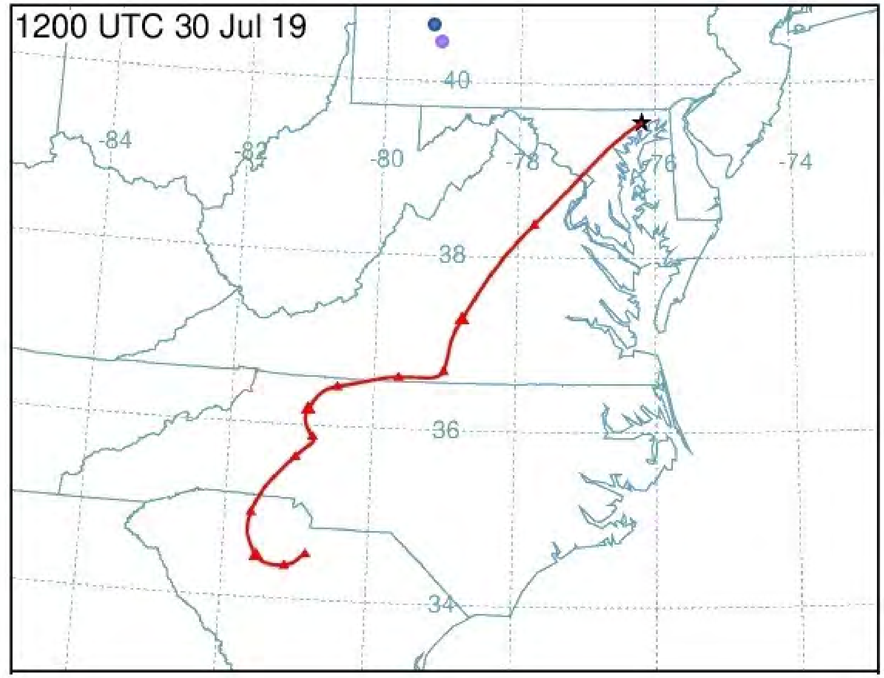


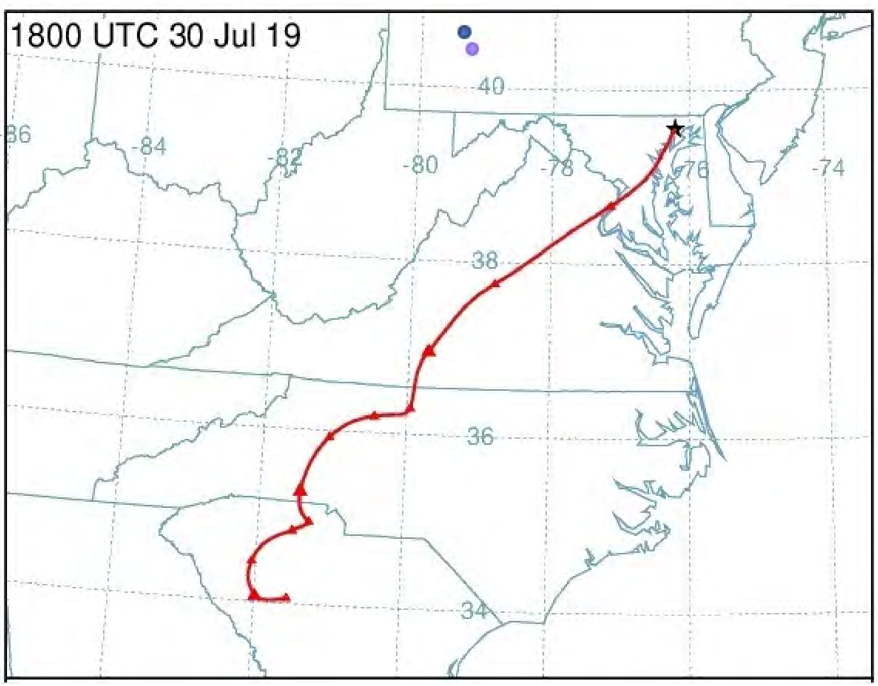
July 29, 2019 – Edgewood Monitor

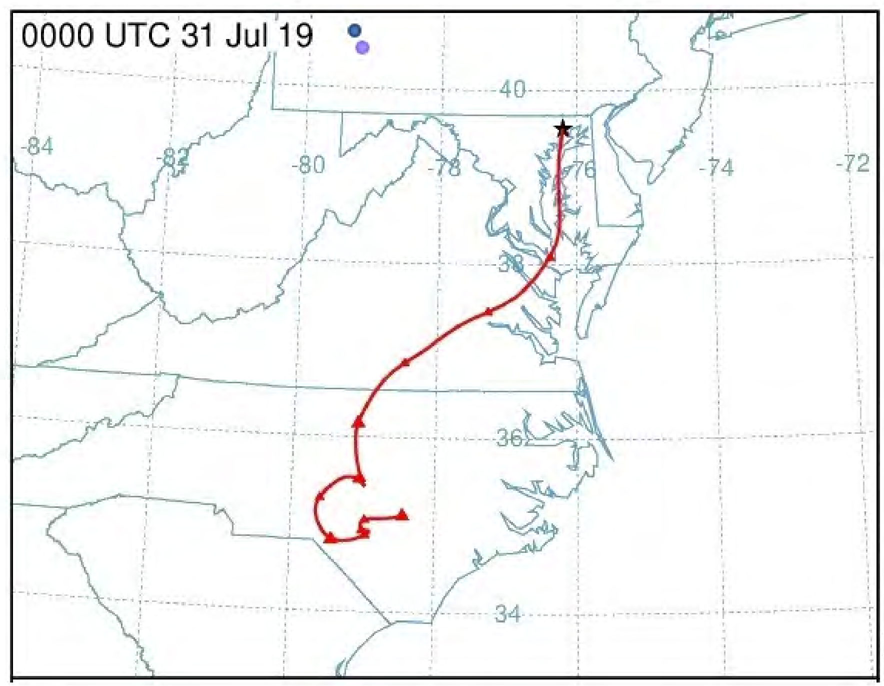


July 30, 2019 – Aldino Monitor

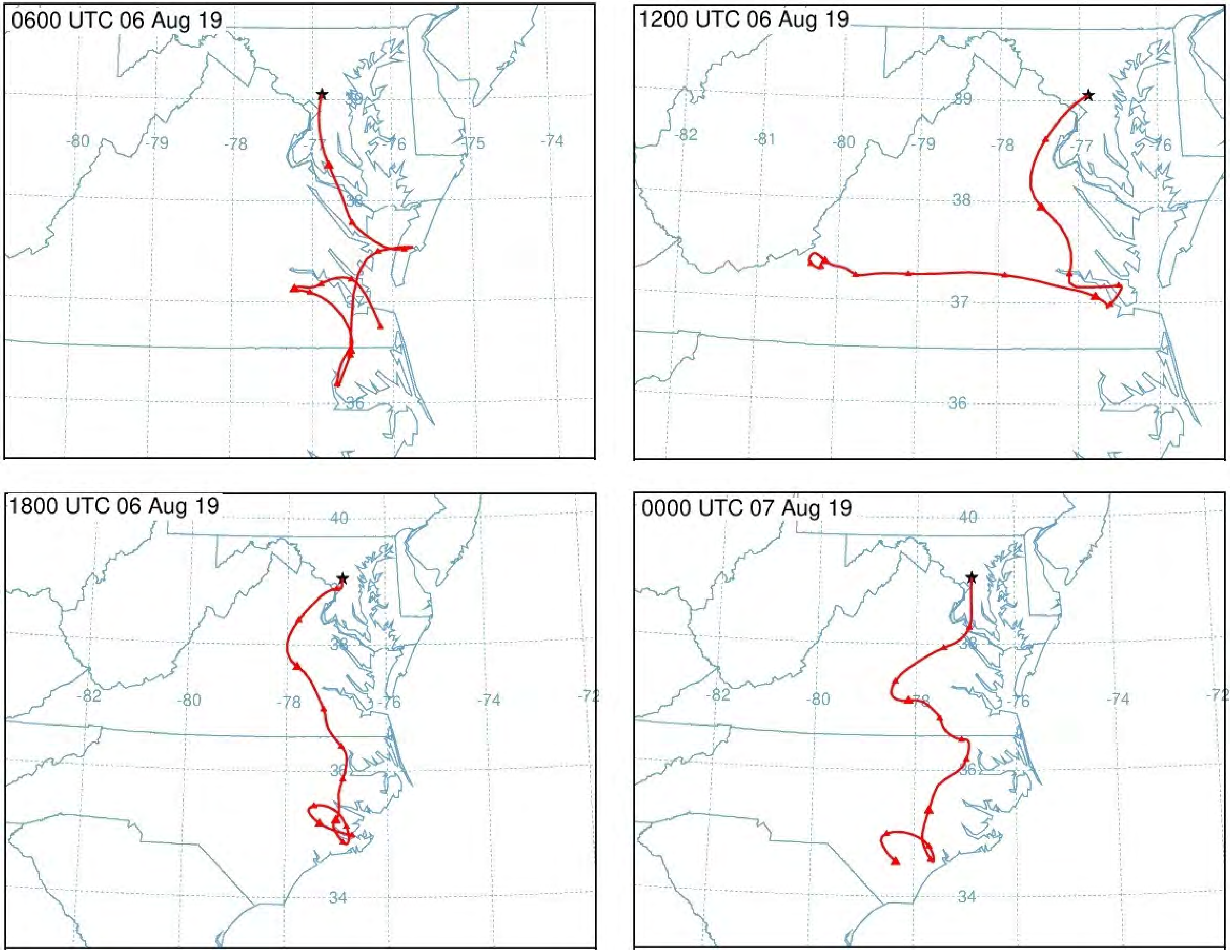




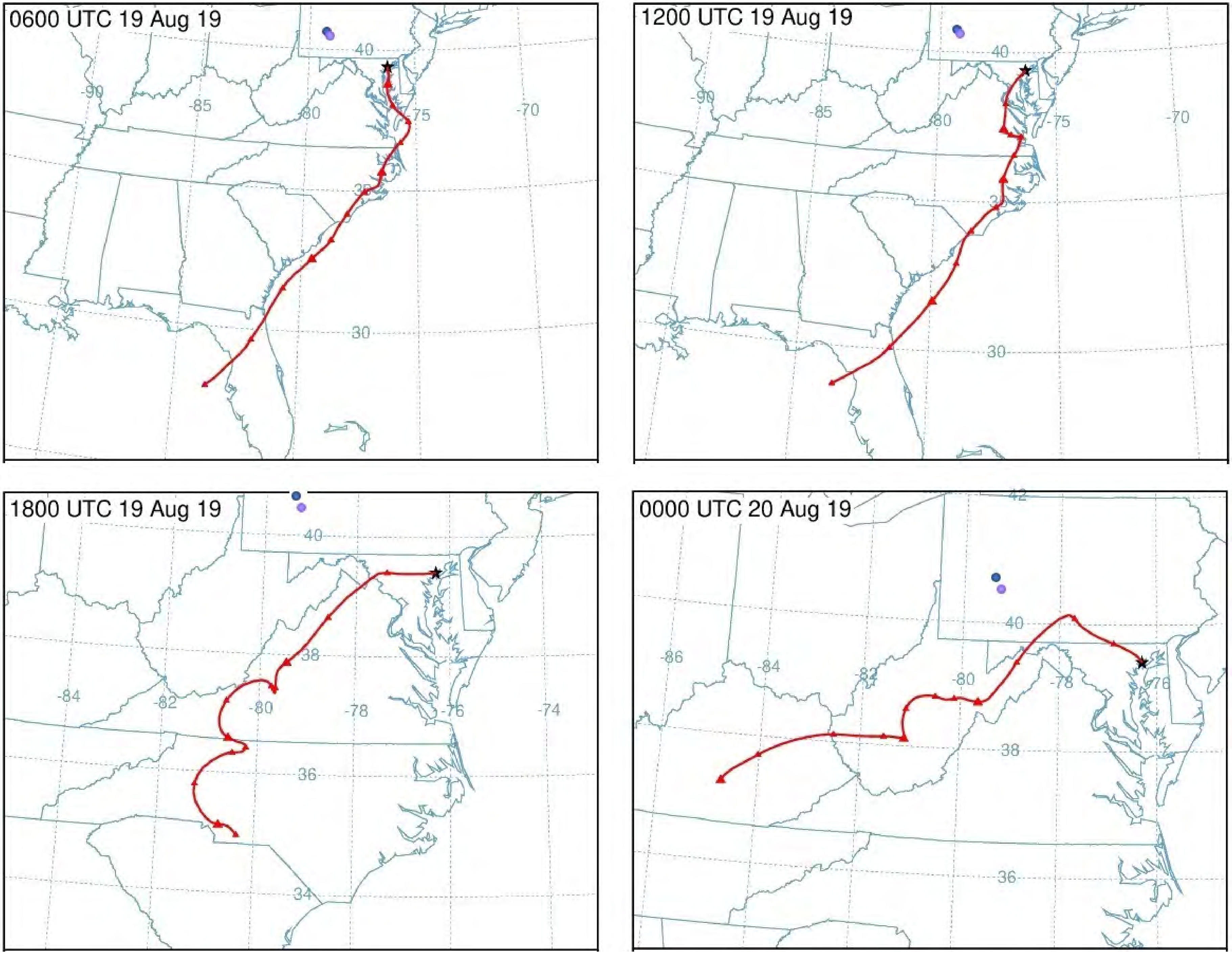




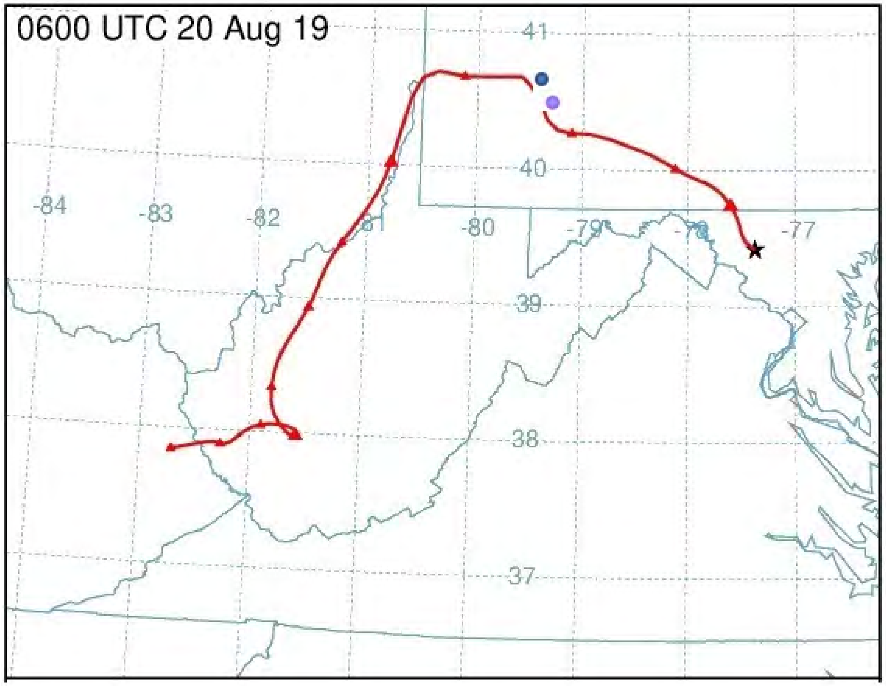
August 6, 2019 – HU-Beltsville Monitor

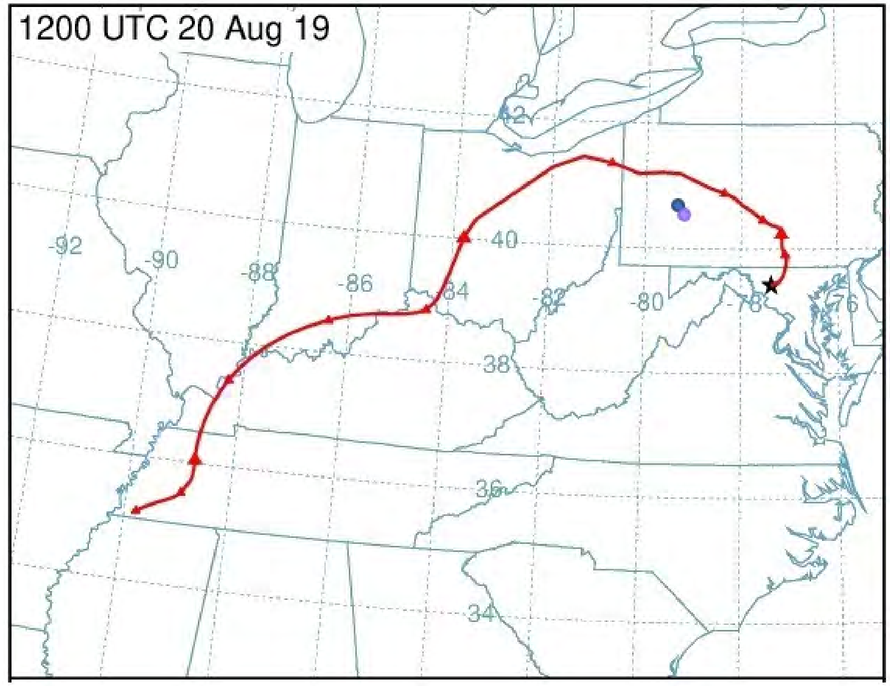


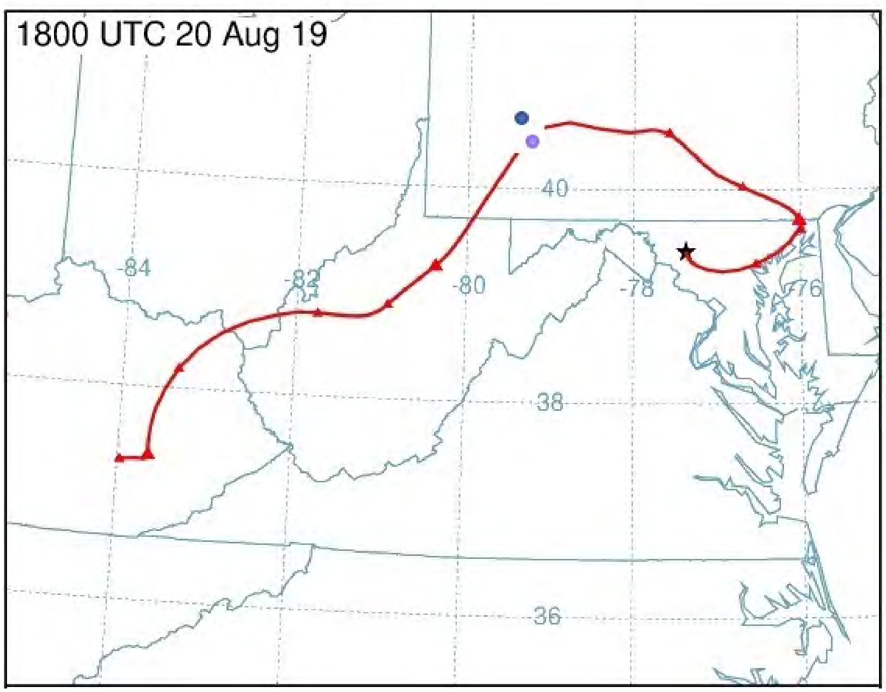
August 19, 2019 – Edgewood Monitor

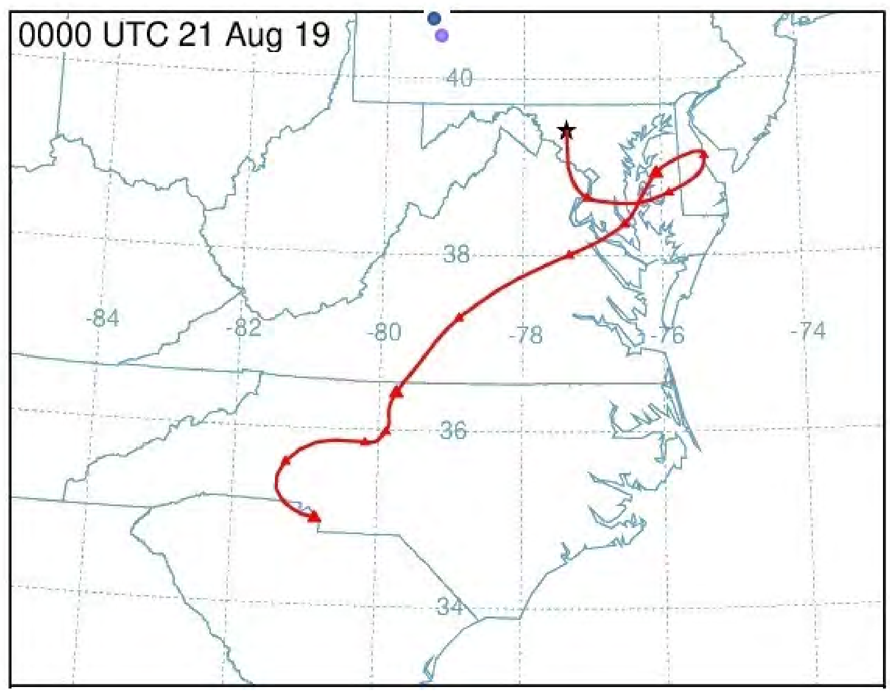


August 20, 2019 – Frederick Airport Monitor

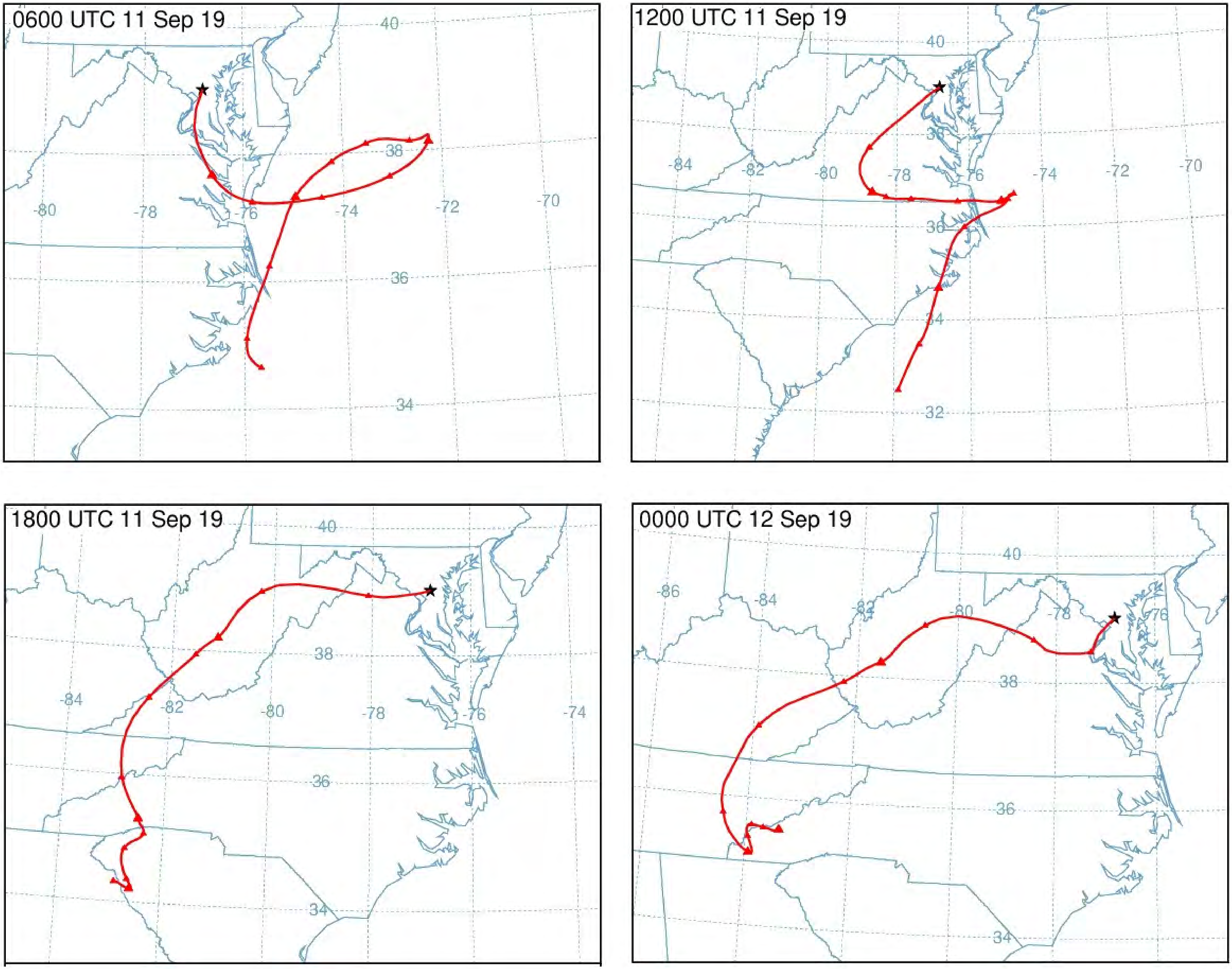




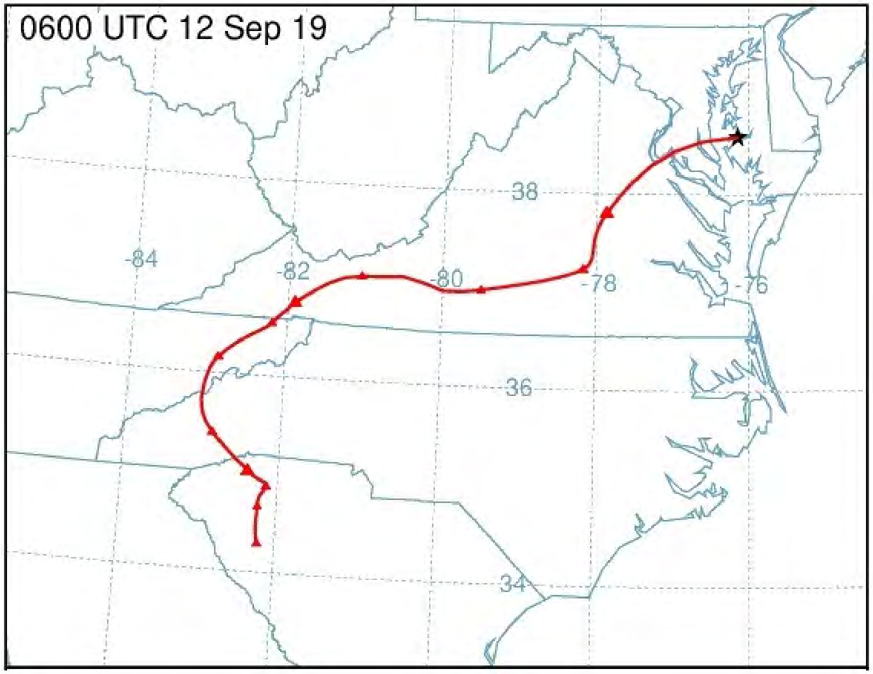


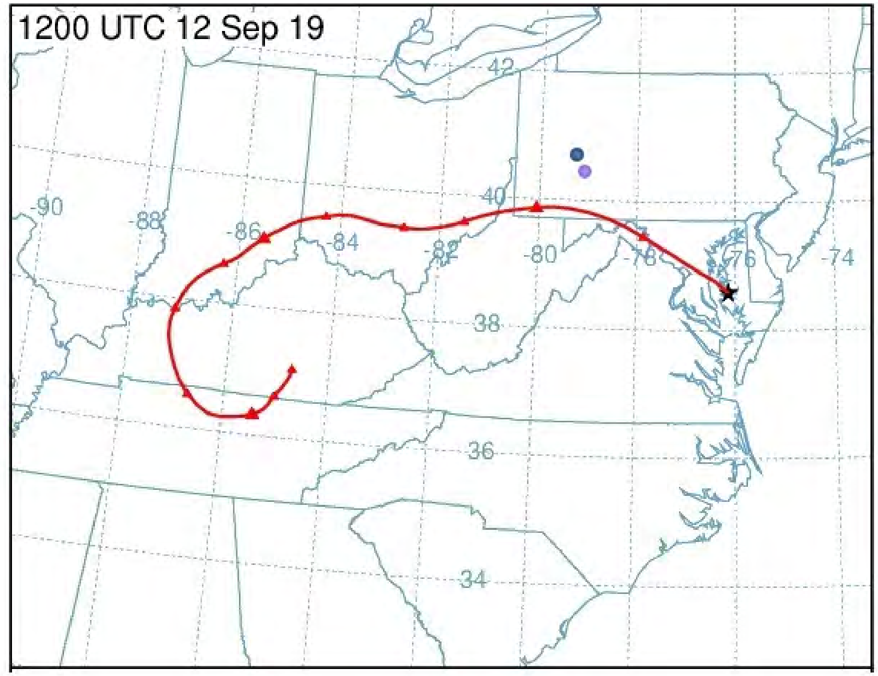


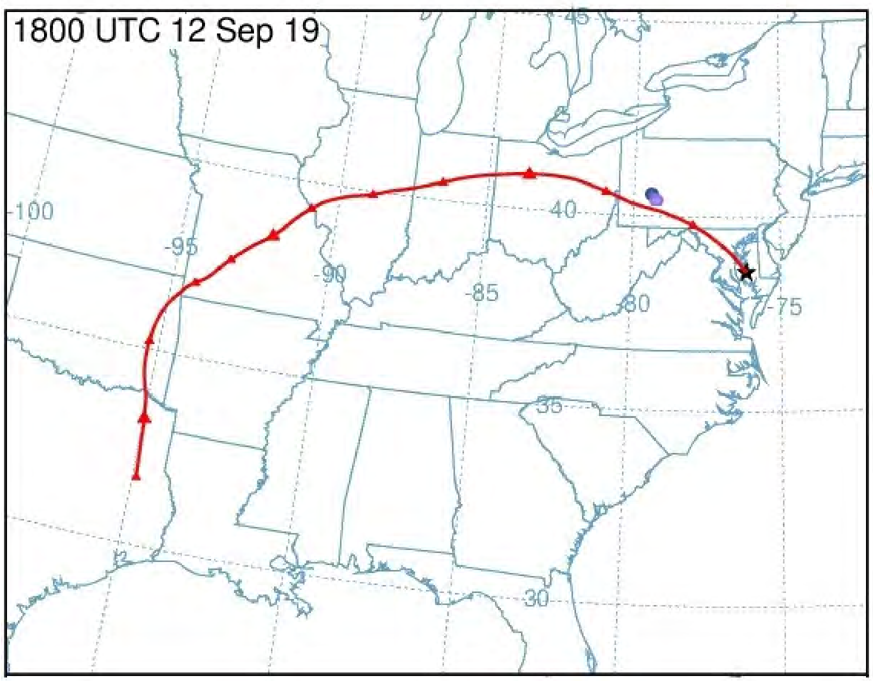
September 11, 2019 – Beltsville Monitor

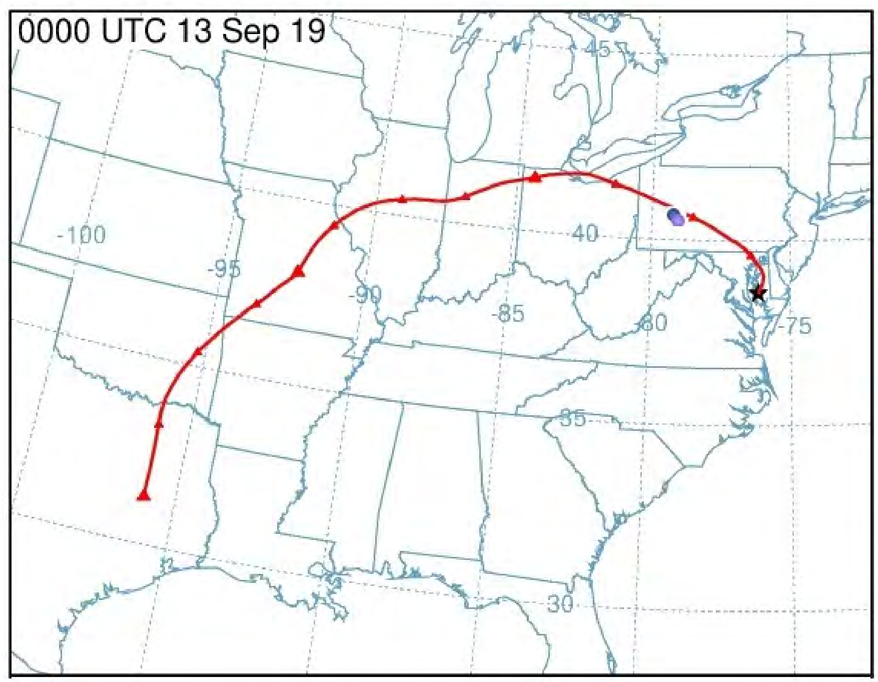


September 12, 2019 – Horn Point Monitor

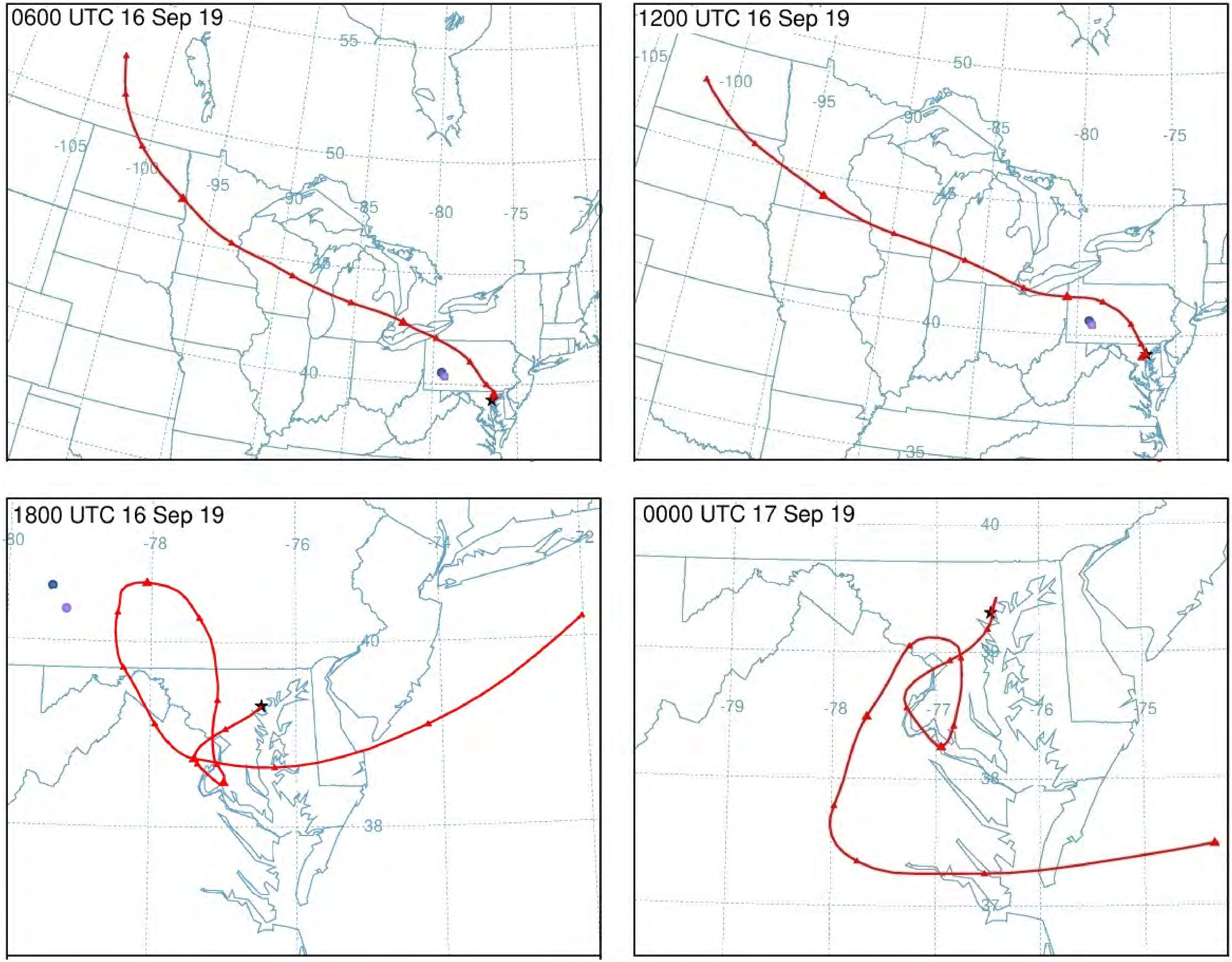








September 16, 2019 – Essex Monitor

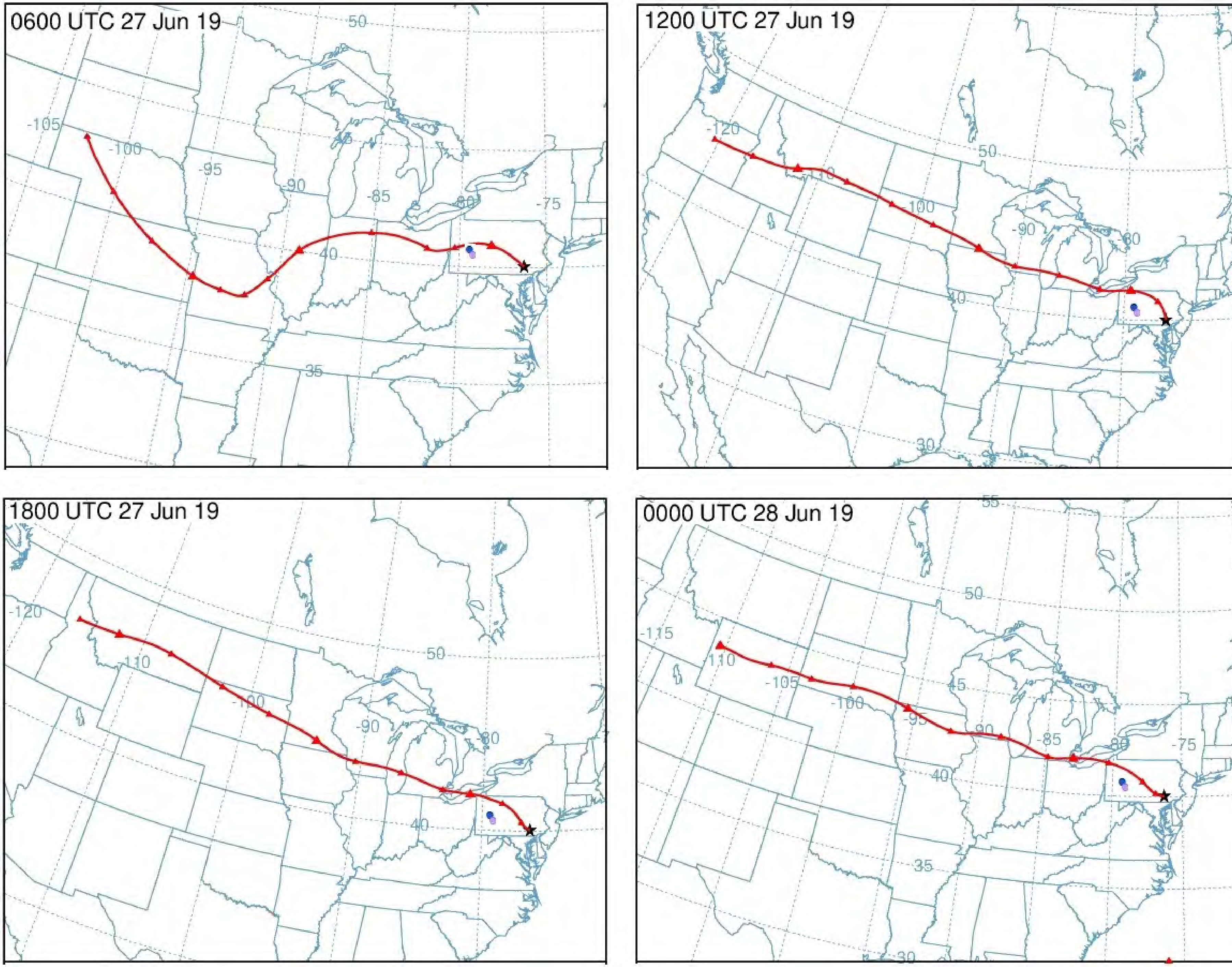


Appendix B: HYSPLIT Back-Trajectory Plots for Days of Ozone Exceedances in 2019 for Pennsylvania Monitors

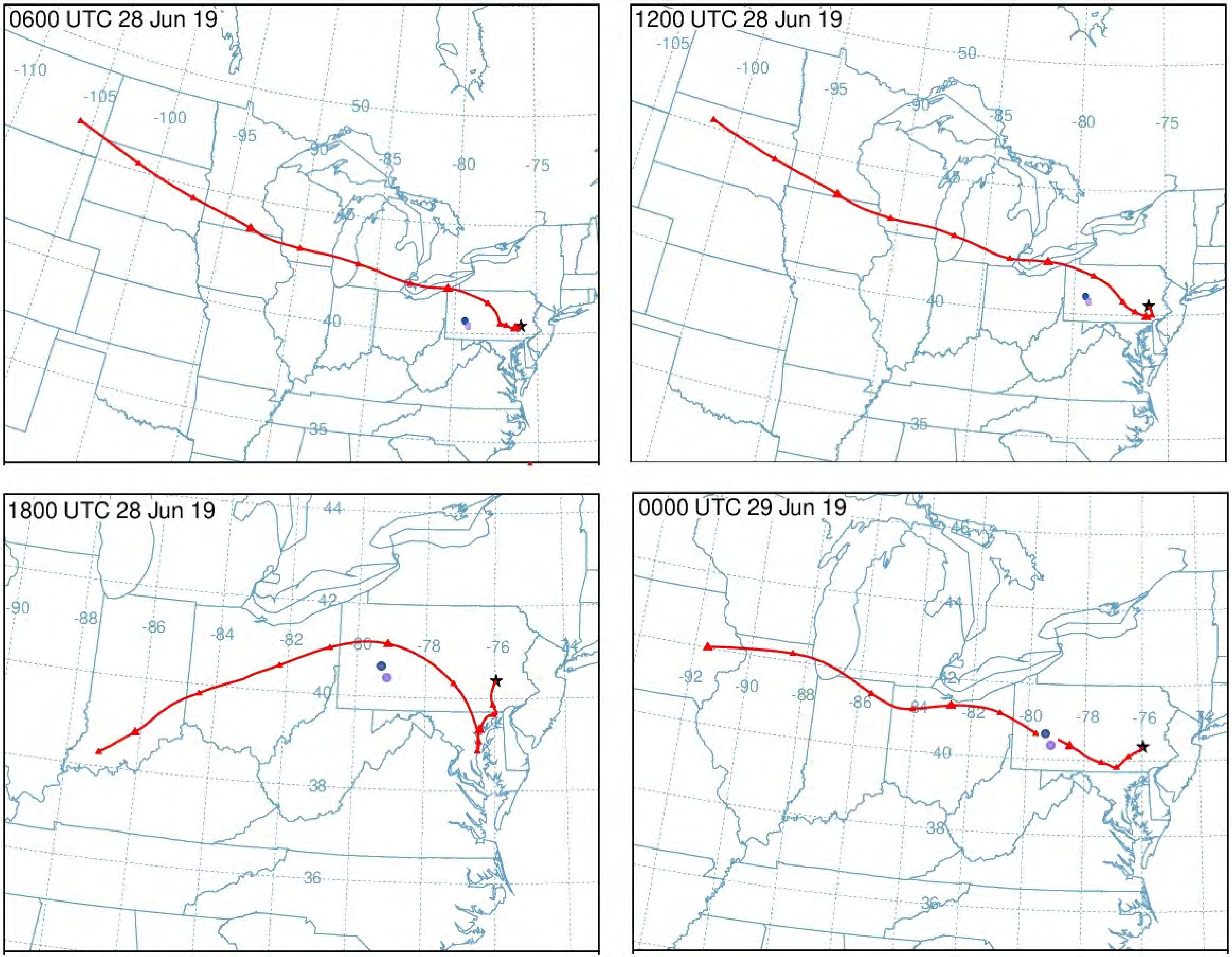
Dates Included are:

- 6/27/2019
- 6/28/2019
- 7/2/2019
- 7/10/2019
- 7/16/2019
- 7/19/2019
- 7/27/2019
- 7/30/2019
- 8/5/2019

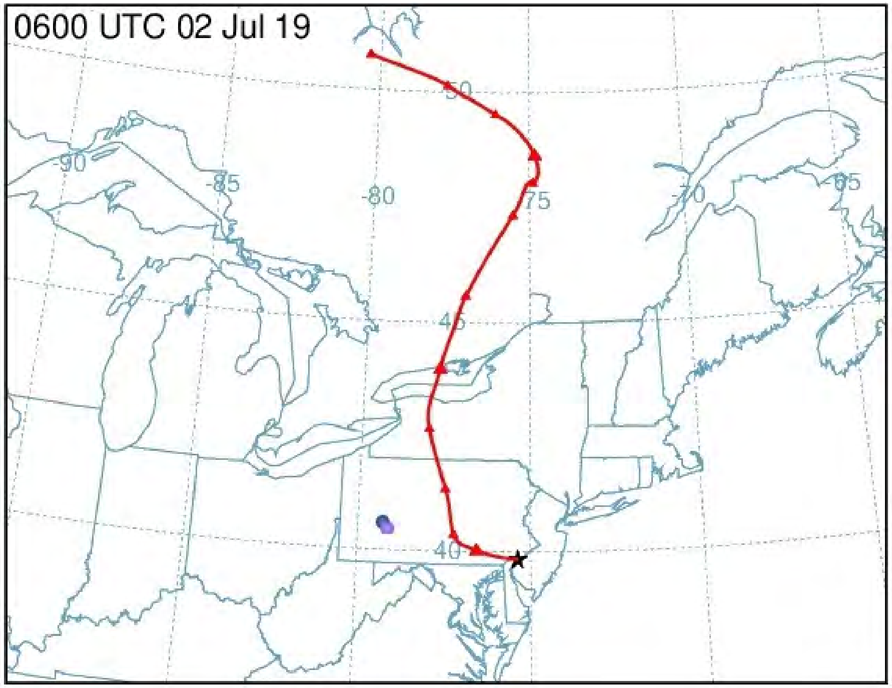
June 27, 2019 – Lancaster County Monitor – On Corner Of A Trailer

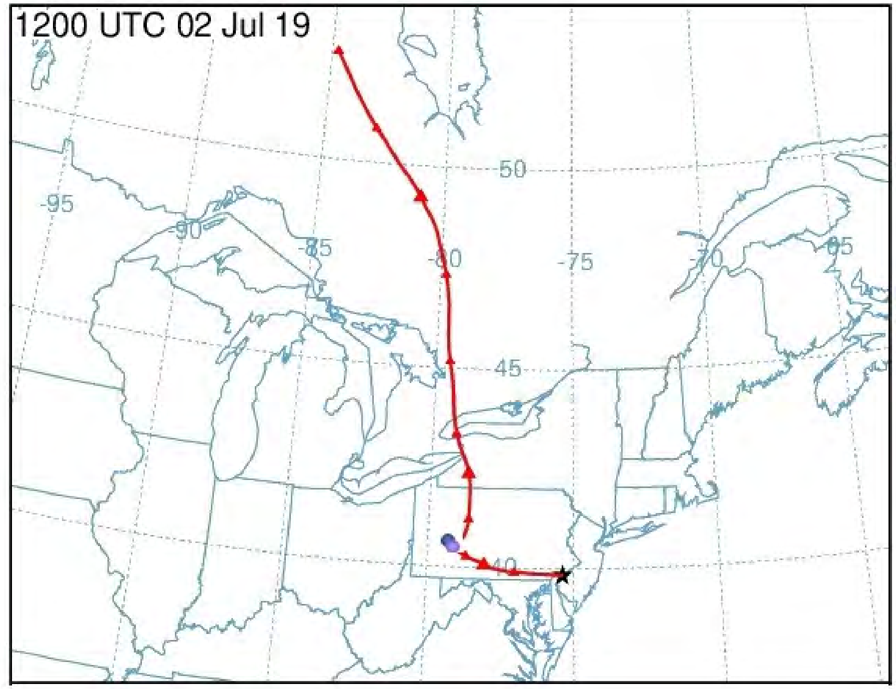


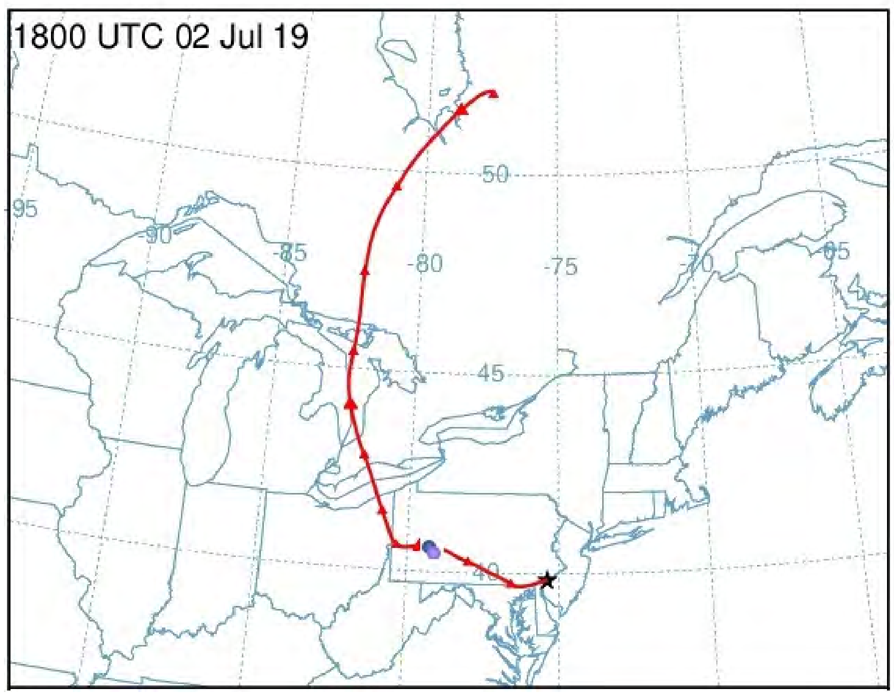
June 28, 2019 – Reading Airport Monitor

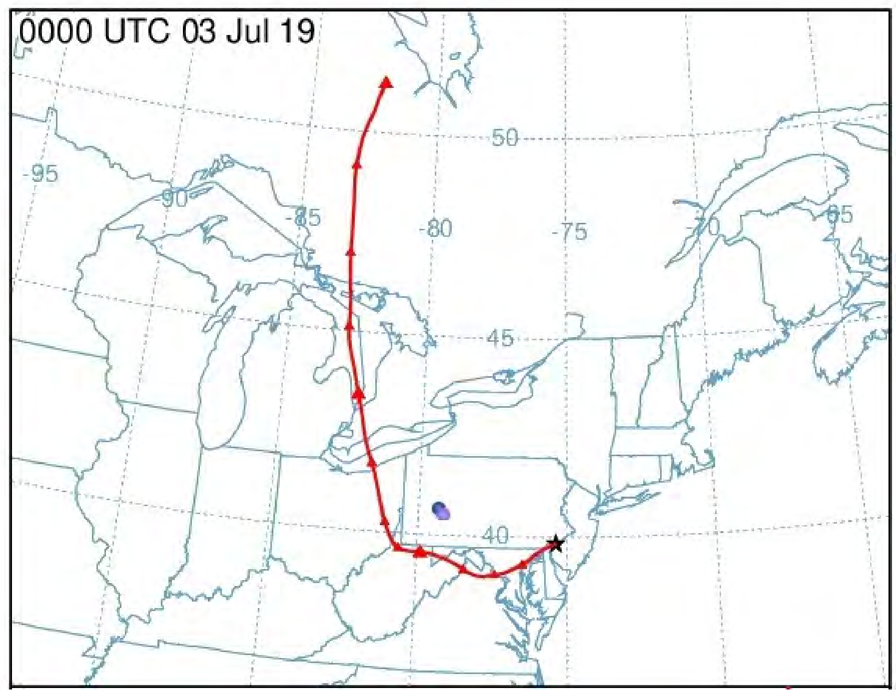


July 2, 2019 – Delaware County Monitor – On Corner Of A Trailer

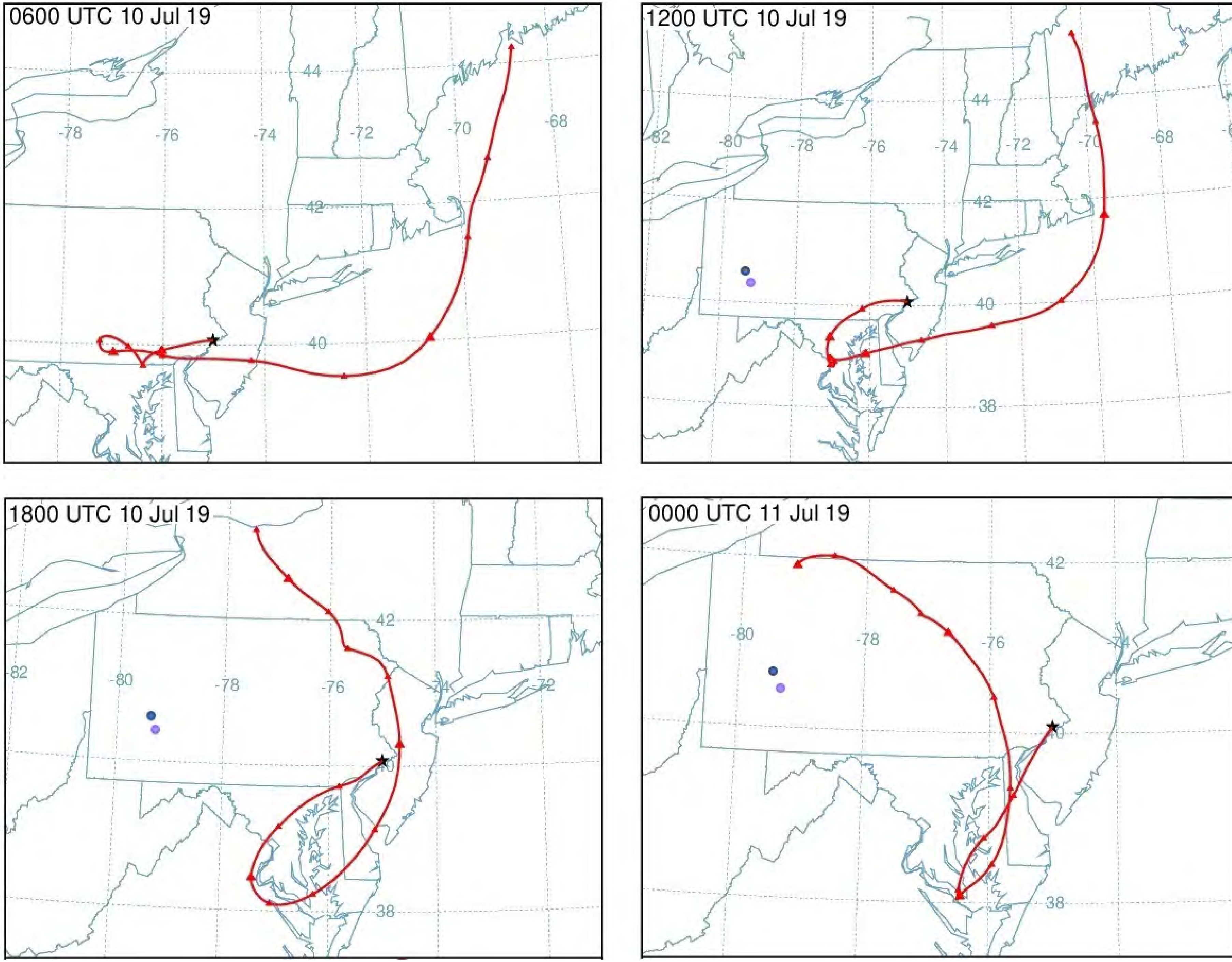




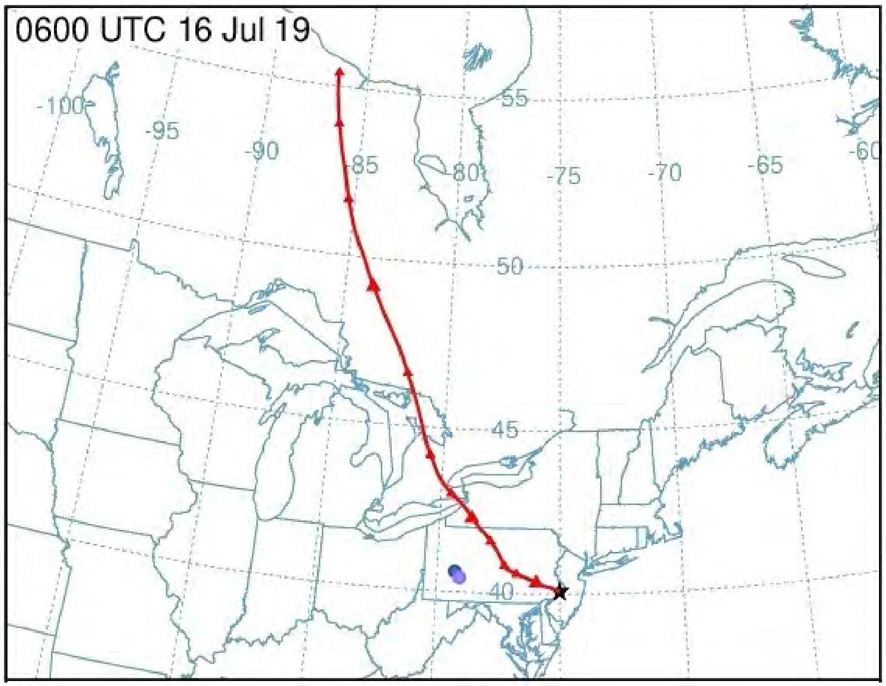


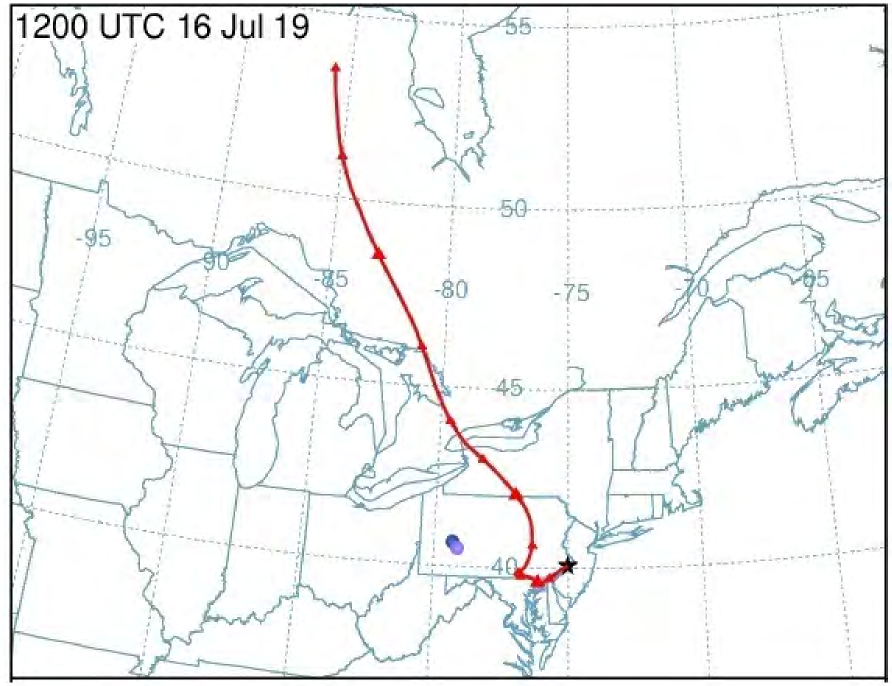


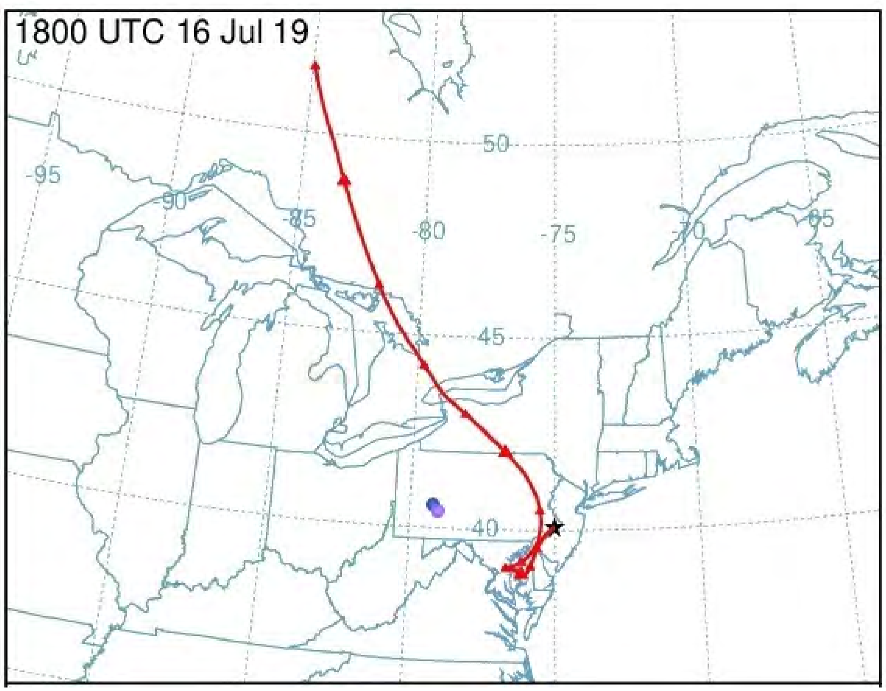
July 10, 2019 – North East Airport (NEA) Monitor

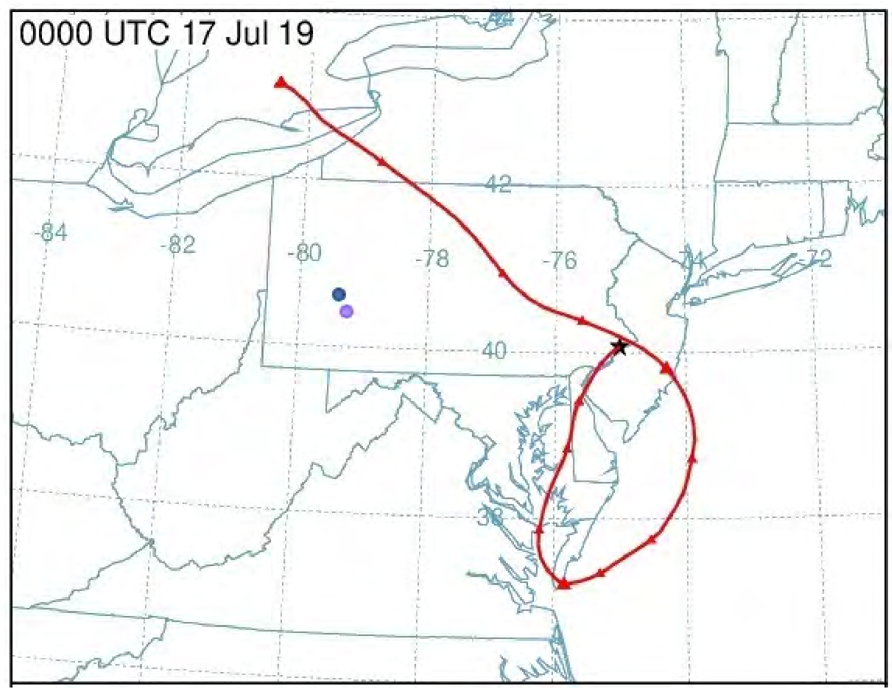


July 16, 2019 – North East Airport (NEA) Monitor

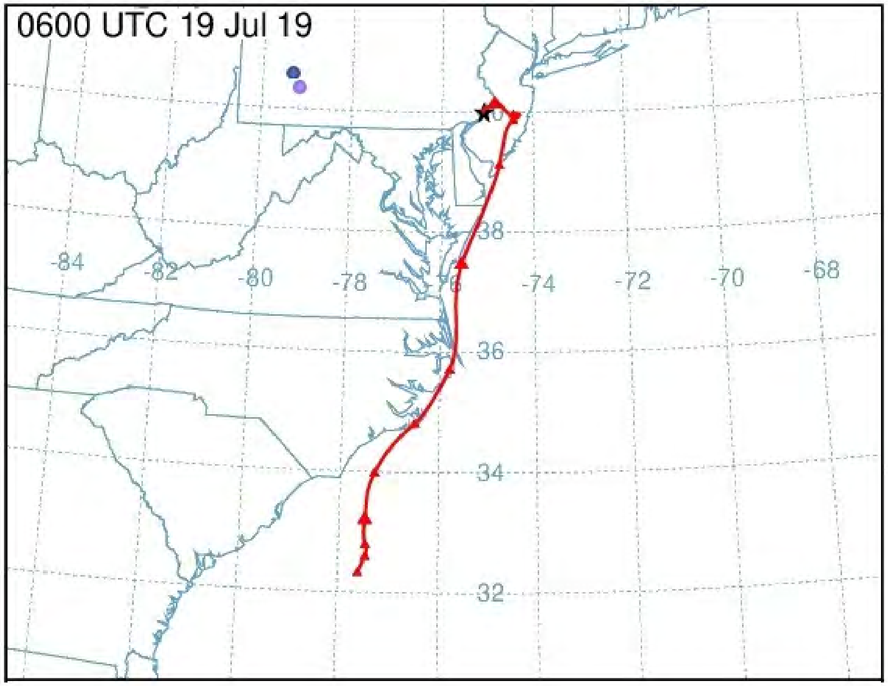


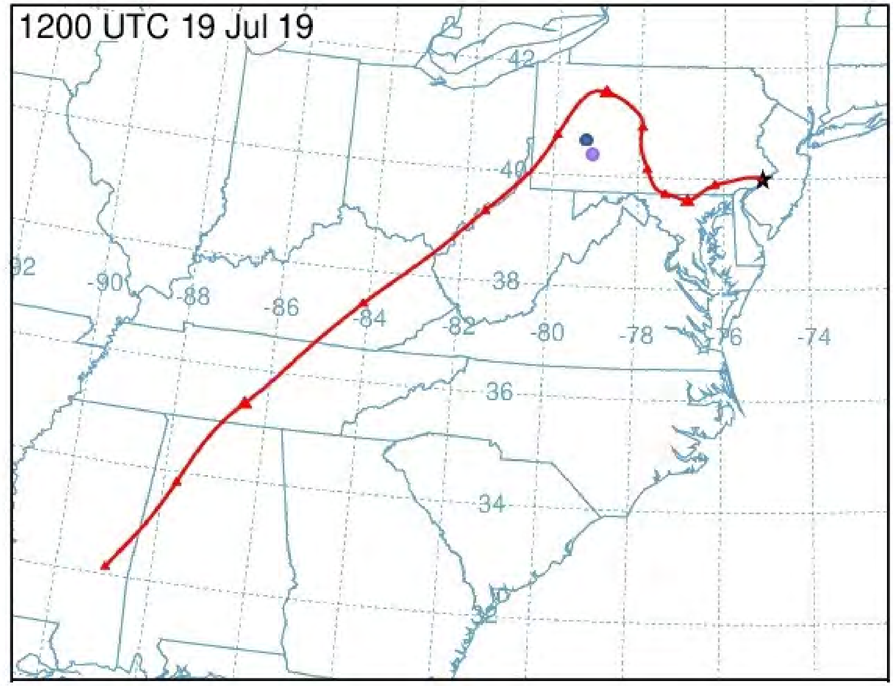


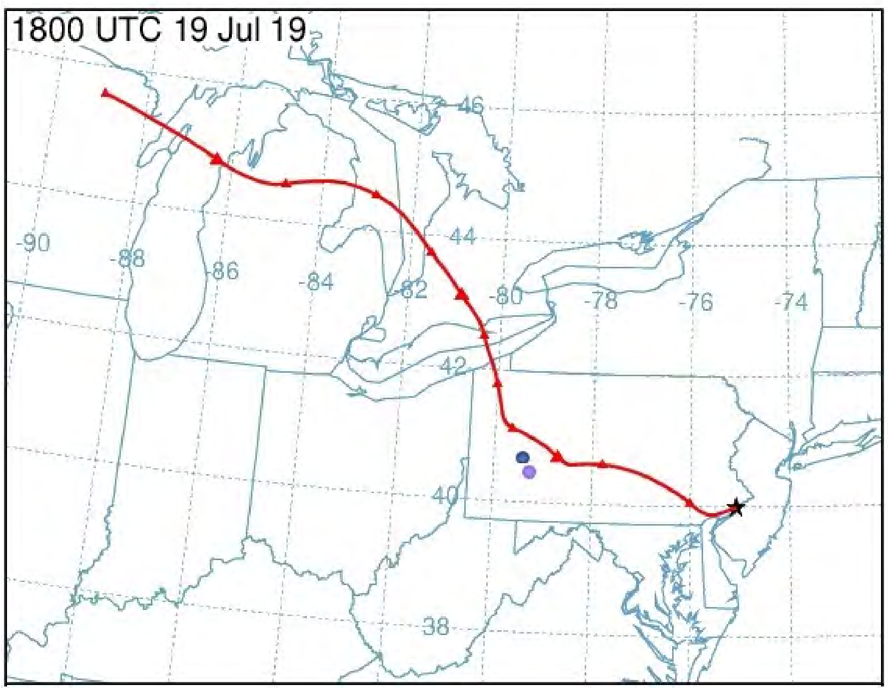


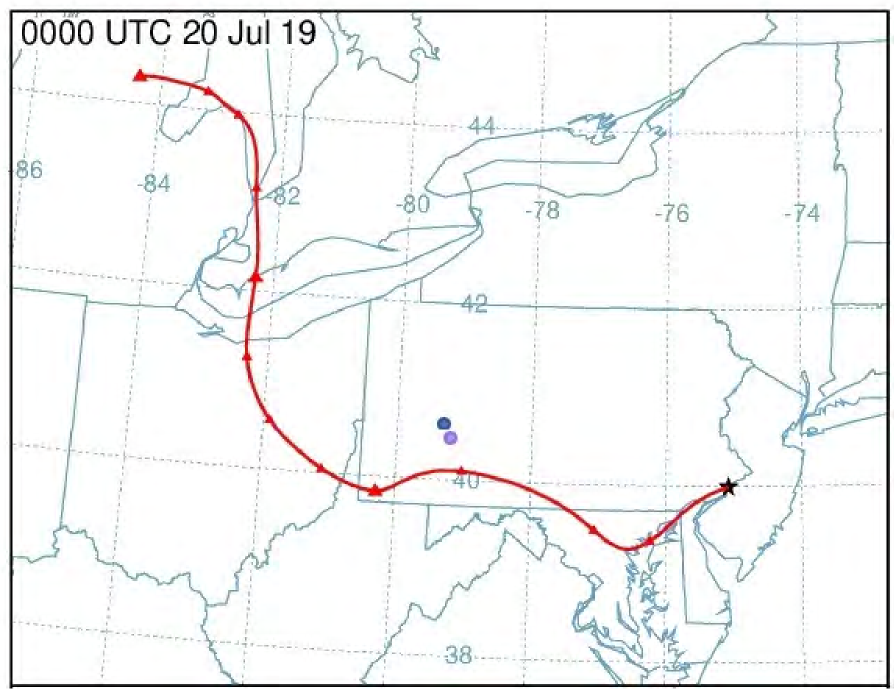


July 19, 2019 – North East Waste (NEW) Monitor

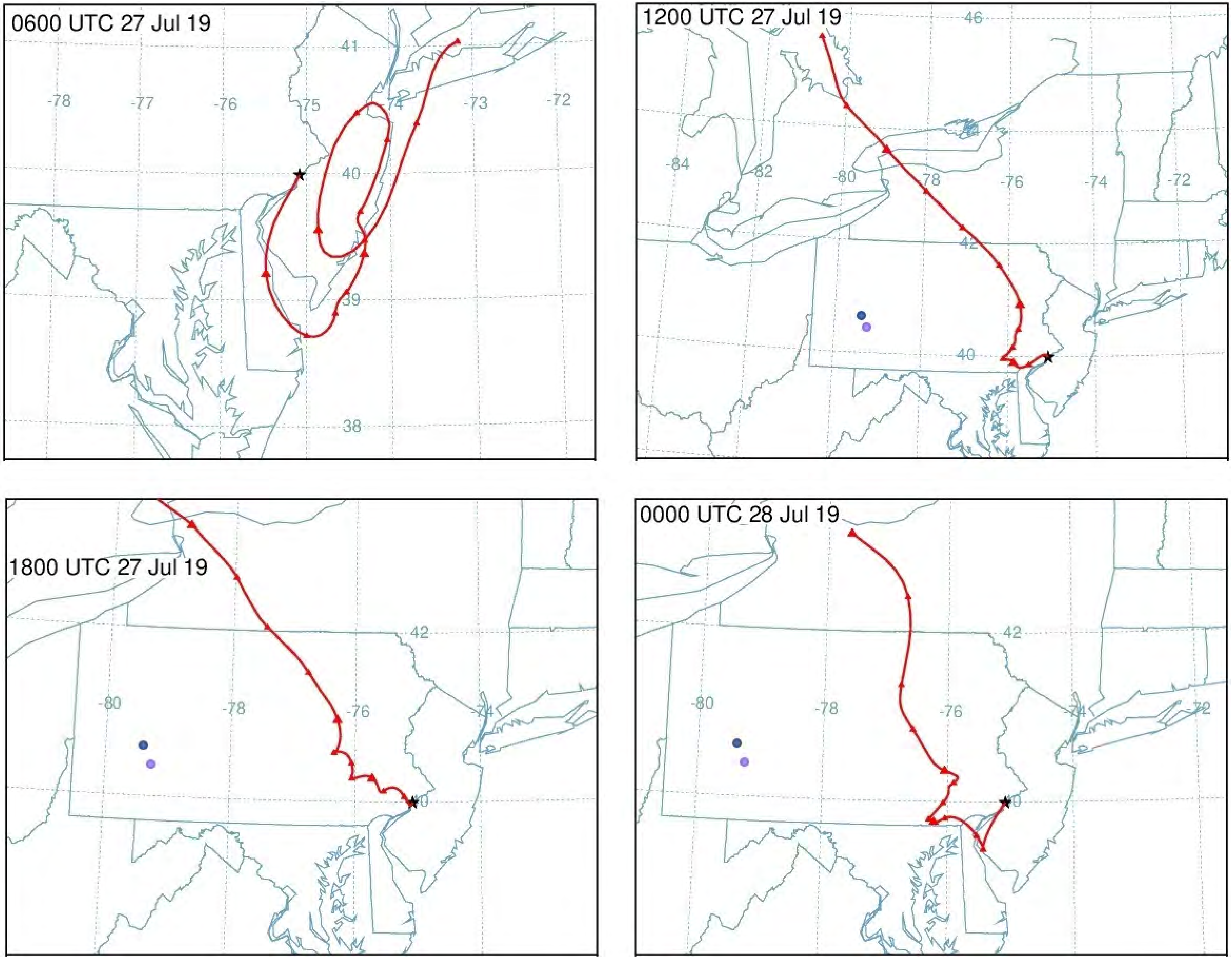




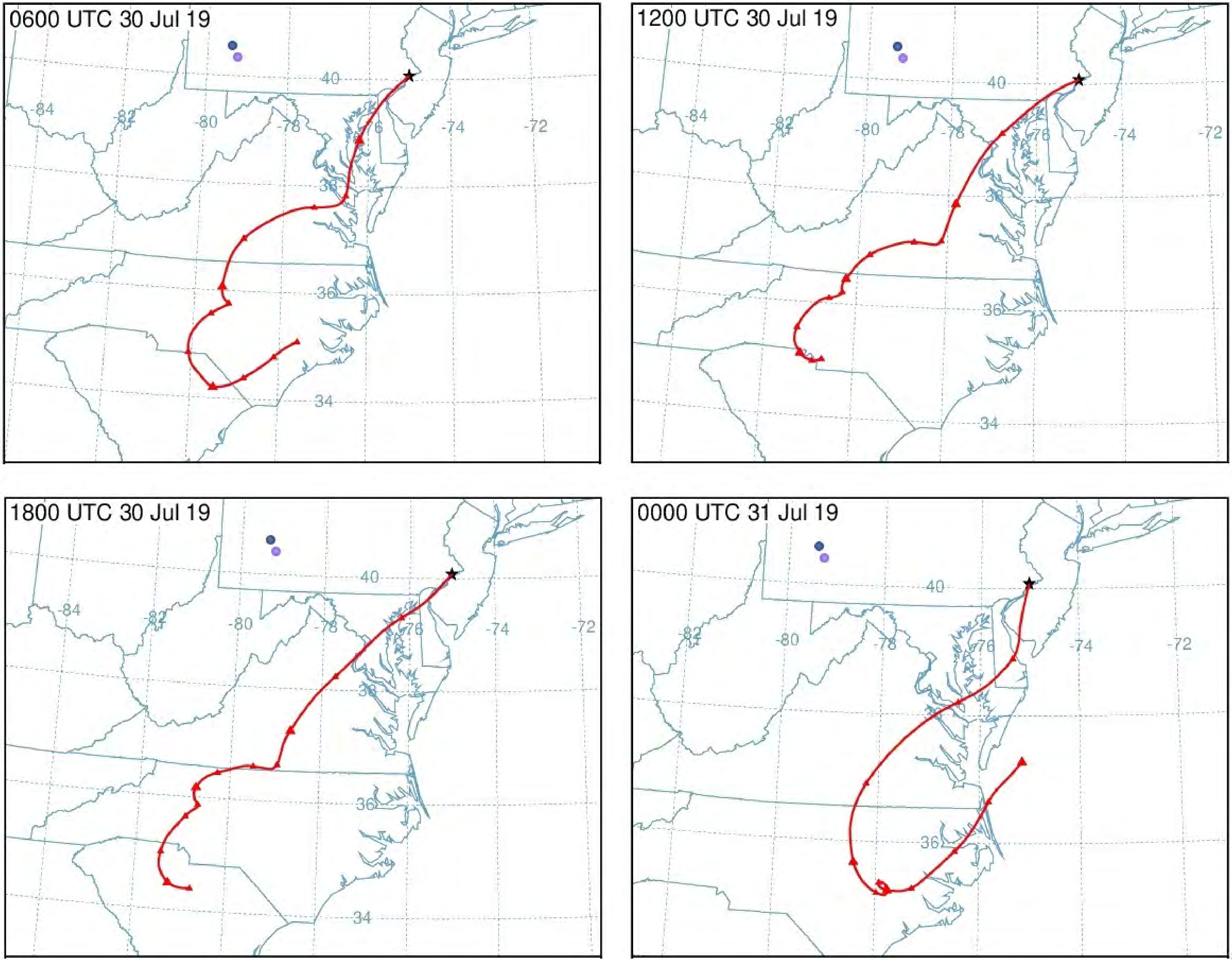




July 27, 2019 – North East Waste (NEW) Monitor



July 30, 2019 – North East Airport (NEA) Monitor



August 5, 2019 – Delaware County Monitor – On Corner Of A Trailer