Seasonal Report

2018 Ozone

MARYLAND
Department of the Environment

OVERVIEW

2018 was a very clean year across the state of Maryland for ozone pollution and continued the trend of cleaner air. Surface ozone is a secondary air pollutant and is created through the interaction between NO_x and volatile organic compounds (VOCs) in the presence of sunlight. It is typically worst between April and September as more direct sunlight, warm temperatures, and a weakening of surface winds provide a more suitable ozone formation environment. Unlike stratospheric ozone, which is up high and protects us from harmful ultraviolet (UV) radiation emitted by the sun, surface ozone can lead to numerous adverse health effects such as reduced lung function, inflammation of airways, chest tightness and shortness of breath. Surface ozone concentrations have been monitored across Maryland since 1980 and MDE has issued air quality forecasts to help inform the public of the next day's predicted ozone levels since the 1990's.

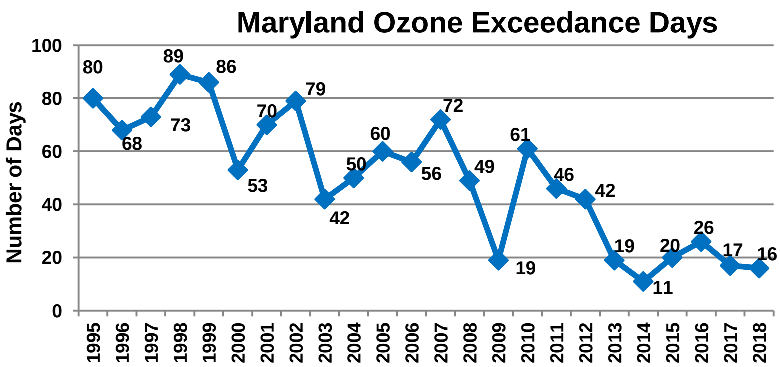

Figure 1: Total number of Maryland ozone exceedance days using the EPA 2015 70 ppb standard, 1995 – 2018.

The EPA - National Ambient Air Quality Standards (NAAQS) are health based thresholds for six criteria pollutants, including ozone. When the daily 8-hour average ozone concentration exceeds 70 parts per billion (ppb), or 100 on the Air Quality Index (AQI) (*see bottom of page),* it is deemed unhealthy for sensitive groups (USG). When a day meets this criteria it's called an exceedance day and it can be a valuable indicator of the ozone season's severity. The 2018 ozone season experienced 16 exceedance days (see Figure 1), the second fewest in Maryland's recorded history.

SEASONAL HIGHLIGHTS & QUICK STATS

Maryland Apr-Sep Average Daily Temperature:
Above normal (21st Warmest) – Warmest on record: 2010
Days at or above 90°F at BWI: 39 (on average BWI has 31 days)
Maryland Apr-Sep Precipitation: Wettest on record (1st Wettest)
Mid-Atlantic Basin Apr-Sep Temperatures: Above normal (28th Warmest)
Mid-Atlantic Basin Apr-Sep Precipitation: Well above normal (2nd Wettest)

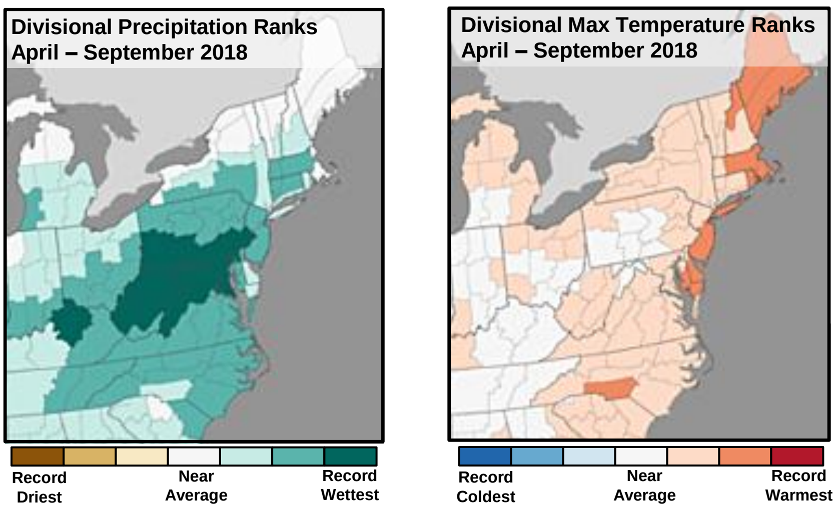

Figure 2: April – September 2018 divisional precipitation ranks (left) and maximum temperature ranks (right). Source: NOAA/NCDC Climate Division.

Maryland 2018 Ozone Exceedance Days				
Date	Day	No. of Monitors	Highest AQI Monitor	8-Hr Average Ozone AQI
1-May	Tue	9	Edgewood & Fair Hill	112
2-May	Wed	7	Fair Hill	115
3-May	Thur	1	Aldino	101
4-May	Fri	1	Glen Burnie	101
1-Jun	Fri	1	Glen Burnie	101
17-Jun	Sun	1	Padonia	112
18-Jun	Mon	4	Beltsville	150
30-Jun	Sat	7	Beltsville	133
2-Jul	Mon	1	Furley	112
3-Jul	Tue	2	Beltsville & Furley	105
9-Jul	Mon	8	HU-Beltsville	166
10-Jul	Tue	12	Horn Point	151
16-Jul	Mon	5	HU-Beltsville & Beltsville	108
10-Aug	Fri	3	Essex & PG EQ Center	108
27-Aug	Mon	1	Edgewood	112
27-Sep	Thur	2	Fair Hill & Glen Burnie	105

Table 1: 2018 Maryland ozone exceedance days. Day of week is noted along with highest monitor and its color coded 8-hr AQI value.

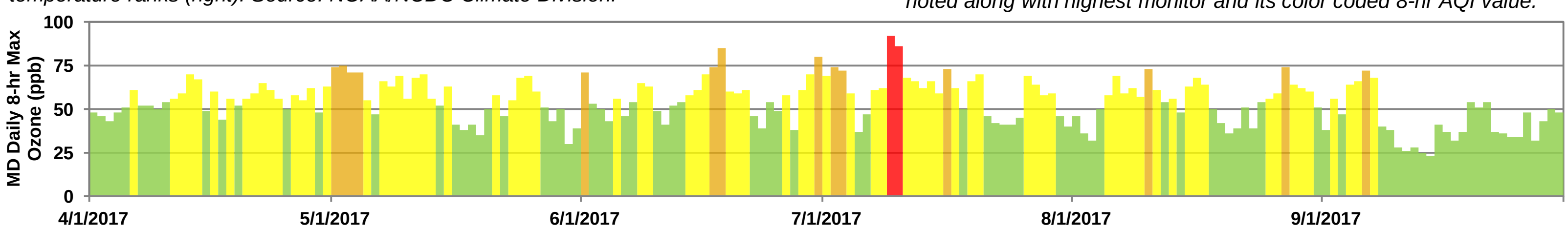

Figure 3: Maximum daily 8-hour ozone concentration (ppb) in Maryland from April 1 – September 30, 2018. Bars are color coded by AQI.

AQI					
0-50 Good	51-100 Moderate	101-150 USG*	151-200 Unhealthy	201-300 Very Unhealthy	301-500 Hazardous

*Unhealthy for Sensitive Groups
Based on 2015 8-hour ozone NAAQS

MARYLAND DEPARTMENT OF THE ENVIRONMENT
1800 Washington Boulevard | Baltimore, MD 21230
410-537-3000 | 1-800-633-6101
Larry Hogan, *Governor* | Boyd Rutherford, *Lt. Governor* | Ben Grumbles, *Secretary*

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Agricultural Burning and Ozone

In recent years there have been an anonymously high amount of early season (April/May) ozone exceedance days despite the overall decrease in seasonal totals. Over the past three years (2016-2018) Maryland has experienced between 18% and 25% of its total exceedance days during the months of April and May. Temperatures during this period are typically not supportive of high ozone concentrations. The average high temperatures for Baltimore during the months of April and May are 64.5°F and 73.9°F respectively. Temperatures can certainly climb much higher than that during this time frame, but the frequency of hot (90°) days is low. So what is contributing to these early season ozone exceedance days?

First, in order for ozone to be created there needs to be an interaction between NO_x and volatile organic compounds (VOCs). Smoke from controlled burning is a well known contributor of both of these ozone precursors. Agricultural burning is a common practice in the southeast, mid-west and central plains of the U.S. during the spring months. Individually these fires and their emissions are very small. However, if you sum up hundreds or even thousands of these fires it can lead to deterioration of the regional air mass and given the right meteorological conditions can aid in contributing to ozone exceedance days.

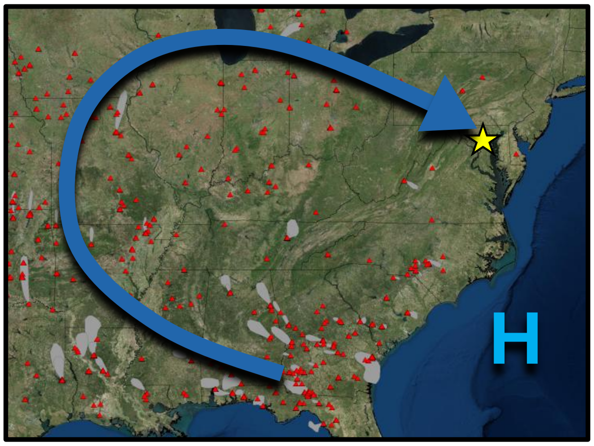

Figure 4: Hazard Mapping System (HMS) analyzed fire and smoke product for April 30 2018. Red Triangles signify fires, grey shading is smoke plumes. Approximate location of high pressure system noted (H) along with general surface air path (blue arrow). Location of BWI is yellow star.

The May 1-4 ozone exceedance days across Maryland were directly tied to agricultural burning across the southeast and mid-west states. Figure 4 shows the Hazard Mapping System (HMS) fire and smoke product for April 30 leading up to the multi-day poor air quality event. Numerous small fires were analyzed to Maryland's south and west. With high pressure off the Atlantic coast, winds were able to bring this "dirtied" air mass into the state. Nine of Maryland's ozone monitors (45%) surpassed the 70ppb standard on May 1 despite a daytime high only reaching 80°F at BWI airport. This dirtied air, aided by local contributions and favorable meteorology, persisted for several days and led to the four consecutive ozone exceedance days.

OWLETS-2 The Chesapeake Bay Air Quality Study

The Ozone Water-Land Environmental Transition Study (OWLETS-2) was an intensive collaborative effort during the summer of 2018 to study air quality in and around the northern Chesapeake Bay. Participating in the study was the Maryland Department of the Environment (MDE), scientists from NASA, NOAA, and several local universities.

Recent and significant decreases in pollutant emissions have decreased the frequency and severity of local high ozone events, however, ozone continues to exceed EPA standards in Maryland. One goal of the OWLETS-2 campaign was to learn where the emissions that impact Bay ozone production come from. The Baltimore area itself is a mix of several sources of ozone producing pollution, such as cars, trucks, power plants and industry emissions. The study in essence strived to answer a couple of questions: "What are the primary emissions sources influencing the production of ozone over the Bay, and how is ozone affected by the land water interface?"

Air quality measurement instrumentation was deployed at various locations in and around the Bay from June 6 – July 6, 2018 (*Figure 5*). The MDE air monitoring network provided a foundation for surface ozone measurements. Surface and aloft pollutant measurements were taken by an assortment of instrumentation. Aloft measurements included ozone lidars, ozonesondes, tethered balloons, aircraft, satellites, wind lidars (wind cube), radiometers, and ceilometers (*Figure 6*). Additional surface measurements included fine particles, CO, NO_x, NO_y, Mercury (Hg), SO_2, and VOCs. OWLETS-2 provided a much needed and unique opportunity to take a combination of air quality measurements over and around the Chesapeake Bay. These air pollution and meteorological measurements will be used to better understand why air quality models have such difficulty predicting ozone concentrations within areas in and surrounding the Bay and other large bodies of water.

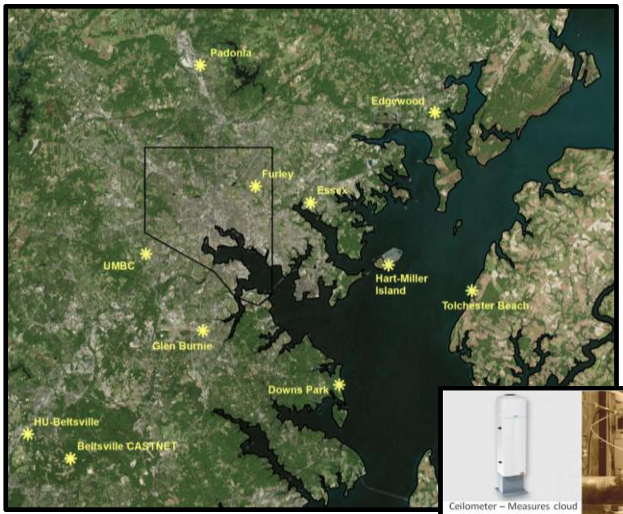

Figure 5 (Top): Locations of various instrumentation in and around Baltimore/Chesapeake Bay during the OWLETS-2 campaign.
Figure 6 (Right): Sample of the various observation platforms used during OWLETS-2.

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