MARYLAND
Department of the Environment

Seasonal Report
2012 Ozone

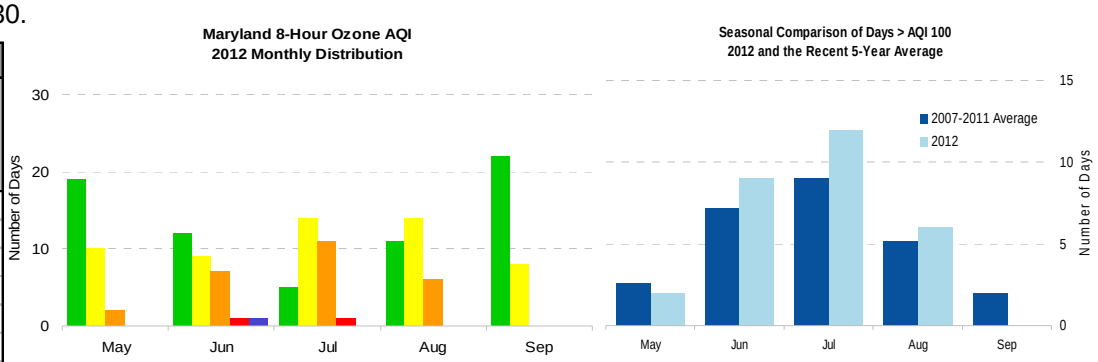
OVERVIEW

Surface ozone significantly increases between May and September, frequently becoming the lead pollutant for the Mid-Atlantic, and creating Maryland's "ozone season." Warm temperatures, intense sunlight and light winds during the ozone season increase surface ozone production. Ozone negatively impacts living tissue such as the human respiratory system. The Air Quality Index *(AQI, see legend at bottom)* was developed to easily evaluate air quality. AQI values in excess of 100 indicate the air quality is unhealthy. Days in which the maximum 8-hour average concentration exceeds AQI 100 are classified as exceedance days. The severity of an ozone season is measured by the total number of exceedance days.

The 2012 Maryland ozone season had two prolonged periods of weather conditions supportive of increased ozone production. As typical, most exceedance days occurred between June and August, but most of these days occurred within two continuous periods from late June through early July and late July to early August. Consequently, a higher than usual number of exceedance days occurred during these months (*see below*). For instance, 40% of July experienced USG or greater AQI. Outside of these three summer months, below average exceedance days were observed. At its close the 2012 season was slightly above the recent 5-year average of 27 days with the total exceedance days for 2012 at 30.

Maryland 2012 Ozone Exceedance Days

Date	No. of Monitors	Highest AQI Monitor	8-hr Average Ozone AQI
16-May	1	Piney Run	104
31-May	1	Calvert Co	111
9-Jun	2	Piney Run	114
10-Jun	15	Millington	135
19-Jun	2	Beltsville	109
20-Jun	13	Edgewood	135
21-Jun	15	Davidsonville	159
22-Jun	5	Horn Point	122
28-Jun	8	Millington	137
29-Jun	19	Blackwater NWR	201
30-Jun	2	Millington	119
1-Jul	3	Millington	119
3-Jul	5	Horn Point	132
4-Jul	6	Millington	116
5-Jul	14	Blackwater NWR	142
6-Jul	7	Beltsville	122
7-Jul	13	Millington	164
8-Jul	8	Blackwater NWR	142
17-Jul	14	Edgewood	150
18-Jul	5	Millington	127
19-Jul	8	Davidsonville	129
23-Jul	1	Fairhill	106
26-Jul	3	Fairhill	119
2-Aug	1	Padonia	104
3-Aug	1	Padonia	109
8-Aug	3	Padonia	119
9-Aug	1	Padonia	104
23-Aug	1	Beltsville	101
24-Aug	6	Fairhill	127
31-Aug	2	Millington	111



SEASONAL HIGHLIGHTS

Historically 2012 will be remembered as one of the hottest and driest on record in the continental United States. As a result of the extreme heat and arid conditions, a tremendous number of wild fires broke out across western states. Much of the smoke associated with these fires was blown towards eastern states and in one instance, smoke from a Colorado fire could be traced near the ground at Baltimore.

One of the most significant widespread wind storms in recent history took place in late June and helped mitigate an exceptionally poor air quality episode. On June 29, between approximately 9pm and midnight, a long-lived wind storm called a Derecho moved through Maryland. The storm helped clear out the most unhealthy air of the 2012 season but resulted in widespread property damage.

The same large scale weather pattern that brought excessive heat and drought to much of the country altered the usual spatial distribution of Maryland ozone. For instance, in a typical year the Edgewood, MD ozone monitor most frequently observes the highest ozone in the state. In 2012, however, Edgewood observed high levels of ozone (of at least USG) half as often as previous years and observed the highest ozone in the state only two days despite 2012 experiencing an above average number of exceedance days.

WEATHER & AIR QUALITY

The summer of 2012 was dominated by a very large and intense dome of hot and dry air across the central United States. Many locations across the United States reached all-time record highs and Maryland experienced the tenth warmest summer on record. The Maryland 2012 summer season (May-September) experienced 44 days with temperatures of 90°F or above, nearly double the average of 24 days. Warm temperatures are conducive to ozone production and likely accounts for the prolonged poor air episodes between June and August. Despite the warmth, the number of exceedance days in 2012 was only slightly above the recent 5-year average and similar to 2011, which, for comparison, experienced 40 days at or above 90°F.

Southerly and southwesterly surface winds typically dominate Maryland summers. The influence of the hot dome of air over the central United States changed that in 2012. Upper level winds in the atmosphere became more northwesterly and surface winds oscillated between the southwest and northwest as well. While this apparently did not significantly alter storm patterns in 2012, the variation in average wind had a dramatic effect on Maryland air quality by varying the observed geographical ozone distribution. Ozone patterns were variable and far from typical. For instance, northwesterly winds pushed *(continued on next page)*

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 2008 8-hour ozone NAAQS

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MDE

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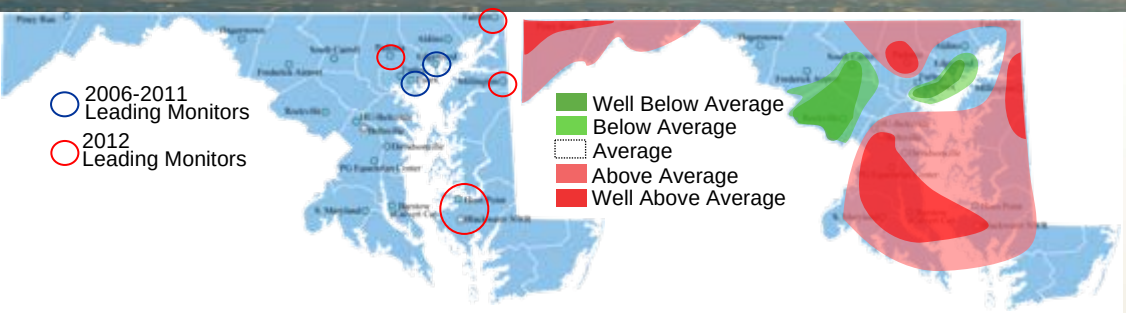
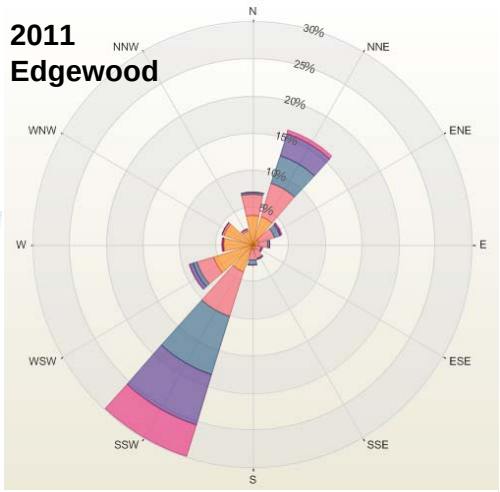
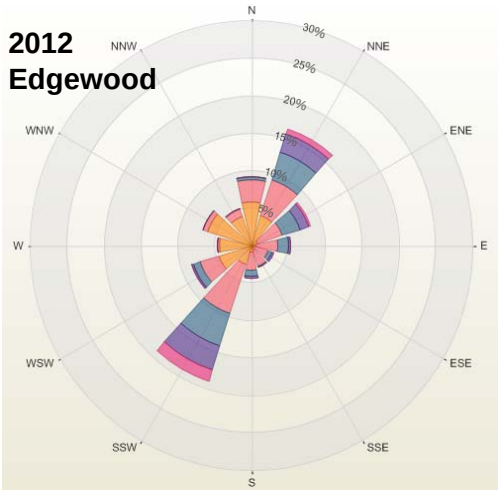






WEATHER & AIR QUALITY *(cont.)*

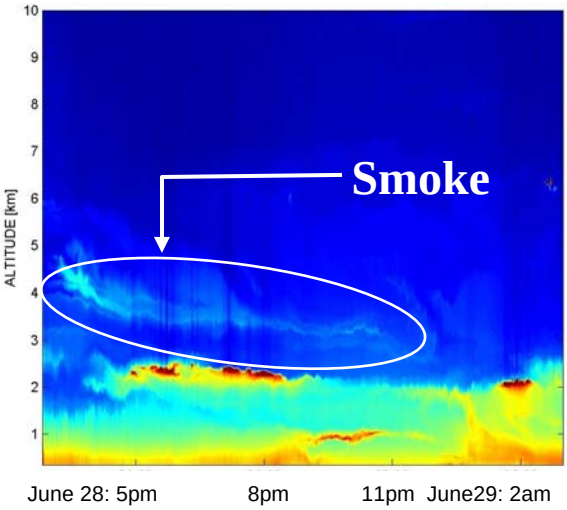
(continued from previous page) pollution towards southern Maryland instead of towards the typically troubled Edgewood area *(see figures above)*. The 2012 ozone season had fewer Unhealthy days compared to 2011 *(see 2011 seasonal ozone report)*. In general, varying wind patterns caused relatively weak and widely varied ozone events.

The Horn Point/Blackwater NWR, Padonia, Millington, and Fairhill ozone monitors *(red circles on map)* observed the highest ozone concentrations most frequently in 2012. The distribution of ozone was quite dissimilar from the recent five year average (2006-2011) in which Edgewood and Essex led all Maryland monitors (*see blue circles*). The right-hand map above shows the departure of 2012 from the recent five year average (2006-2011), with green areas below normal and red areas above. A distinct decrease in exceedance days exists north of Washington D.C. and northeast of Baltimore along the Chesapeake Bay. Significant increases were found southeast of the DC metro[1]. Wind direction at Edgewood during the 2012 summer months varied, with a pronounced decrease in southwest wind frequency compared to the more typical 2011 summer *(see wind roses)*.

2012 was a dramatic example of the impact weather patterns have on pollution. Record warmth across the United States altered Maryland summertime wind conditions. Instead of a semi-steady southwest summer wind concentrating pollution near Edgewood, northwest winds developed more frequently increasing ozone production in southeastern Maryland. Light and varying winds at other times during the summer resulted in scattered ozone hotspots like Padonia. In the end, the weather pattern that caused record warmth across the United states resulted in a greater frequency of ozone days in non-typical locations.

FEATURED EPISODE: June 29, 2012

Wild fires in states such as Colorado and Utah burned for several days. Smoke from these fires blew to the east coast and were seen by UMBC's Light Detection And Ranging (Lidar) system *(pictured right)*, a instrument that can detect small particles in the atmosphere and show the time-evolution of their concentration. Though difficult to assess if this smoke directly influenced surface air quality, the Lidar showed smoke descended towards the surface the night of June 28. On June 29 the worst air quality of the 2012 season occurred as the leading monitor, Blackwater NWR, reached 201 AQI.



All twenty monitors exceeded USG ozone levels on June 29. Widespread poor air quality resulted in hazy conditions. A front just north of Maryland helped concentrate pollutants. The front also helped develop a large, long-lived and damaging wind storm called a derecho that moved through Maryland on the night of June 29, producing widespread damage. Though June 30 was also an exceedance day, the highest monitor was 82 AQI less than the previous day, showing that the derecho helped to mitigate an ongoing and severe air quality episode in Maryland.

Top left: Map of Maryland ozone monitors. Circles show leading monitors in the recent 5-years (2006-2011 average, blue) and 2012 (red); Top middle: Same as top left except categorically rated as above average, average, or below average based on percent change of 2012 exceedances from 2006-2011 average. Darker shades are areas that are more than 50% different than normal[1]. Top right: Wind rose at Edgewood, MD from June 2011 through August 2011. The length/size of pie slices show the frequency of wind from a particular direction. Bottom right: Same as top right except for 2012. Left: Lidar image showing a layer of smoke (circled) descending towards the surface. Lidar uses visible light to detect very small particles in the atmosphere. Brighter/warmer colors in the image show high concentrations of particles. Time moves left to right.

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

Source: UMBC

[1] Horn Point was excluded from this analysis because only one year of data was available, Blackwater NWR had three years of available data

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