Seasonal Report

2018 Fine Particles ($PM_{2.5}$)

Department of the Environment

OVERVIEW

Similar to recent years, 2018 was once again another very clean year for fine particle ($PM_{2.5}$) pollution across the state of Maryland. $PM_{2.5}$, also known as fine particulates, is one of six pollutants which have a National Ambient Air Quality [Health] Standard (NAAQS) set by the Environmental Protection Agency (EPA). Exposure to high concentrations of $PM_{2.5}$ can cause adverse health effects. Due to its small size (*≤2.5µm in diameter*), it can penetrate deep into the lungs resulting in adverse cardiovascular effects. When the midnight to midnight daily 24-hour average $PM_{2.5}$ concentration exceeds 100 on the Air Quality Index (AQI) (*see bottom page)* it is deemed unhealthy for sensitive groups (USG) and is otherwise known as an "exceedance day". $PM_{2.5}$ is unlike surface ozone as it is not dependent on abundant sunshine and warm temperatures. This allows $PM_{2.5}$ to develop and exist year round. However, over the past decade or so the number of days when fine particle concentrations have reached or exceeded USG has substantially decreased. This is in large part due to the adoption of regulations to reduce emissions of SO_2 and NO_x. In fact, 2018 had ZERO days where the AQI exceeded the USG threshold of 100.

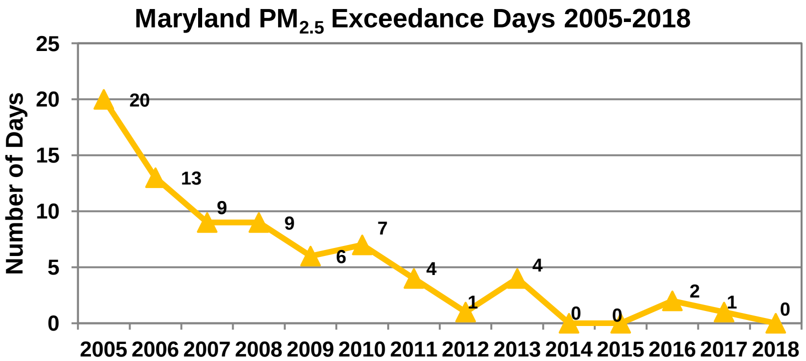

Figure 1: Annual number of days where the AQI surpassed 100 at any $PM_{2.5}$ monitor in Maryland, 2005-2018.

Cleanest Year On Record?

2018 marks the third year in Maryland's recorded history to have zero total $PM_{2.5}$ exceedances. The other two years being 2014 and 2015, with 2016 and 2017 having 2 and 1 respectively *(See Figure 1)*. Exceedance days are a valuable indicator that lets the public know how good or bad the air was during a particular year. However with the number of $PM_{2.5}$ exceedance days in Maryland being at all time lows in recent years, it is hard to judge which year is truly the "cleanest".

A good alternative is to look at the number of "haze days". The haze day term is used when the daily average $PM_{2.5}$ concentration exceeds 25 µg/m³ (78 AQI) versus the health based exceedance threshold of 35.4 µg/m³ (100 AQI). On these days, the air is perceptibly hazy *(See Figure 2).* As shown in Figure 3, there were only 3 days in 2018 where the haze criterion was met. This is the lowest number of days since $PM_{2.5}$ monitoring began back in 1999. While there may have been zero total exceedance days in 2014 and 2015, there were considerably more total haze days. This two year timeframe measured 33 total days above 25 µg/m³ with 14 and 19 days respectively for each year.

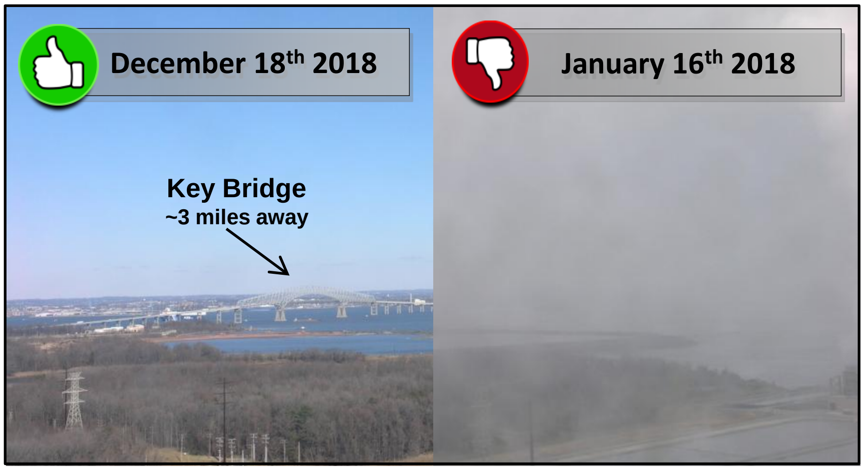

Figure 2: Side by side visual comparison of a Good air quality day, Dec 18th 2018 (Left) and a "Haze Day", Jan 16th 2018 (Right). Key Bridge location and approximate distance is noted on the left.

On the other side of the spectrum, looking at the total number of days where the air is "Good" in a given year can also give clues to how clean that year's air really was. Figure 4 shows the total number of days where the highest $PM_{2.5}$ concentration in the state remained at or below 12 µg/m³ (Good AQI). In 2018, there were a record number of Good AQI days with a total of 225 days. Again, comparing the other two years with zero exceedances, 2014 and 2015, both were considerably lower at 159 total days each.

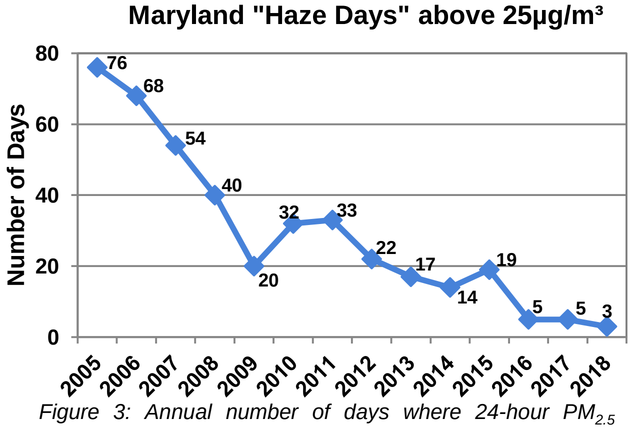

Figure 3: Annual number of days where 24-hour $PM_{2.5}$ concentration reached 25 µg/m³ or greater at any monitor in Maryland, 2005-2018.

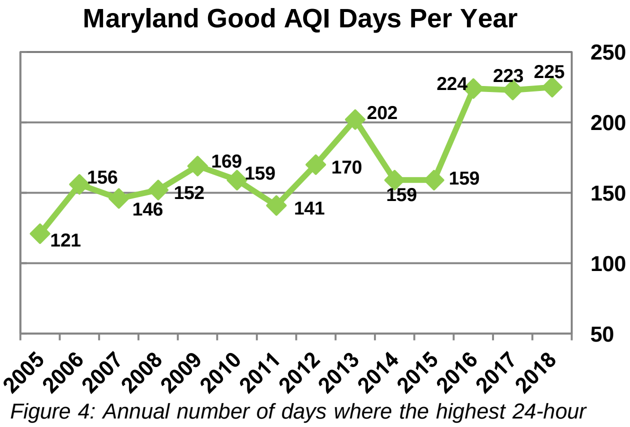

Figure 4: Annual number of days where the highest 24-hour average $PM_{2.5}$ monitor remained at or below an AQI of 50 (Good) in Maryland, 2005-2018.

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

*Unhealthy for Sensitive Groups

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FEATURED EPISODE: November 19th-20th California Wildfire Smoke

Several large fires broke out across California beginning in early November. Dry conditions along with gusty winds allowed these fires to rapidly expand. Two of the largest fires during this time frame were the “Woolsey” fire and the “Camp” fire. These two fires alone burned over 250,000 acres of land. In fact the Camp fire burned more than 10,000 structures, becoming the deadliest and most destructive fire in California history. Enormous plumes of smoke billowed from these two fires. Given the density and sheer volume of these plumes, the smoke emitted by these fires was able to travel across the country.

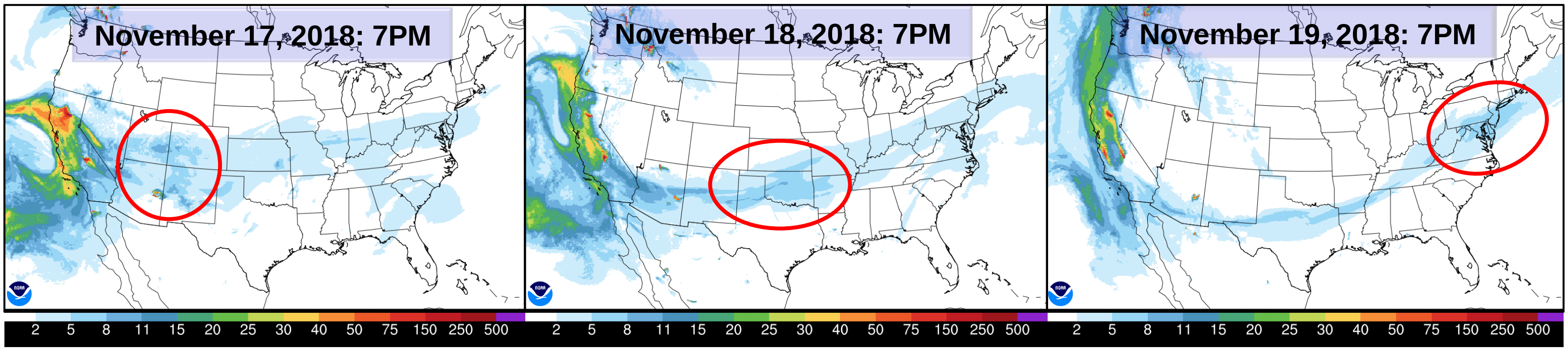

Figure 5: High Resolution Rapid Refresh (HRRR) Model Vertically Integrated Smoke (mg/m²) across the continental U.S. Valid times are Nov 17th, 2018 7:00pm EST (left), Nov18th, 2018 7:00pm EST (middle) and Nov 19th, 2018 7:00pm EST (right). Red circles indicate the location of densest smoke as it traversed west to east.

Beginning November 16th, while the fires were near peak strength, a west-east wind pattern across the continental U.S. developed in the low to mid-levels of the atmosphere. Winds at this height are crucial to the transport of these smoke plumes. With a steady westerly wind, the wildfire smoke was able to push east towards the Central Plains and remain cohesive. The High Resolution Rapid Refresh (HRRR)-Smoke model (*Figure 5)* clearly shows the diffuse smoke as it treks across the entire continental U.S. By November 19th, the densest part of the smoke plume from the California fires were being felt across the state. $PM_{2.5}$ concentrations across the region peaked during the early afternoon hours of the 19th (*Figure 6).* In addition, black carbon (a good tracer for wildfire smoke) measured several orders of magnitude higher than what is typically observed during this same timeframe. These concentrations remained fairly high until the early morning hours of the 20th. It was at this time the smoke plume pushed to the south and eventually dissipated/exited the region.

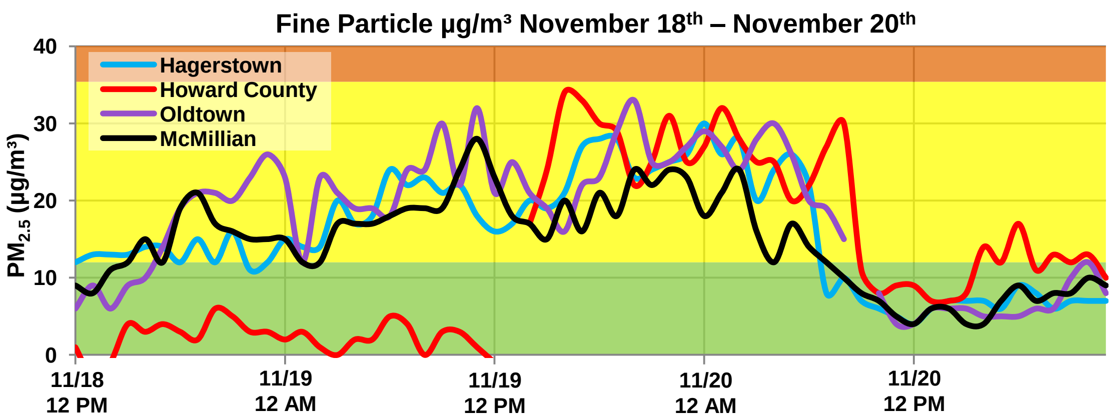

Figure 6: $PM_{2.5}$ concentrations (µg/m³) for several Maryland monitors between the timeframe of November18th – November 20th 2018. Horizontal coloring matches with appropriate AQI ranges.

Despite the diffuse smoke clearly observed across the region, there were no $PM_{2.5}$ exceedance days recorded across the state during this time period. The highest 24-hour $PM_{2.5}$ concentration in the state was 23.04 µg/m³ on November 19th at both the Oldtown and Rockville monitors. Thankfully these values are still far below the USG threshold of 35.4 µg/m³. On the other hand local communities in California had 24-hour $PM_{2.5}$ concentrations in excess of 400 µg/m³! Even though Maryland didn’t have an exceedance day, it’s impressive that the Maryland area was impacted by wild fires that were over 2,300 miles away. This was a great example of how Maryland’s air quality isn’t just affected by local emissions but also by regional and even national emissions.

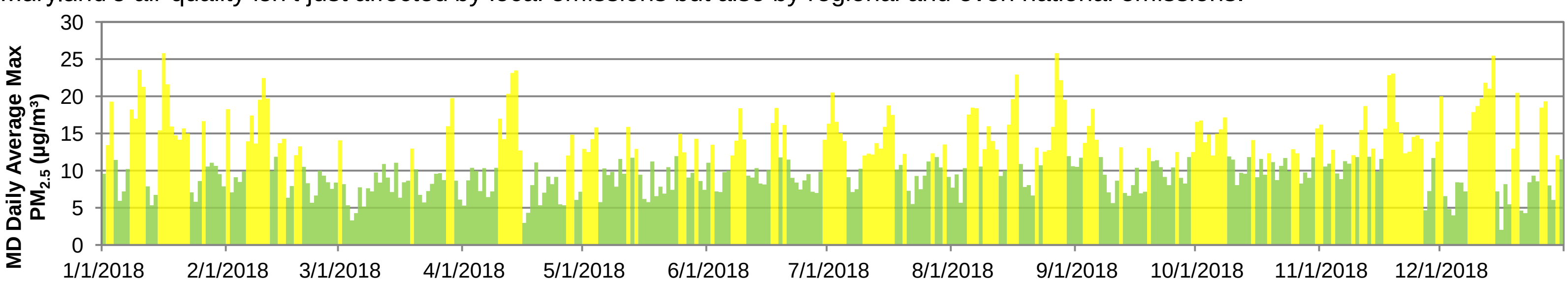

Figure 7: Average maximum daily 24-hour $PM_{2.5}$ (µg/m³) in Maryland from January 1 – December 31, 2018. Bars are color coded by AQI.

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

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