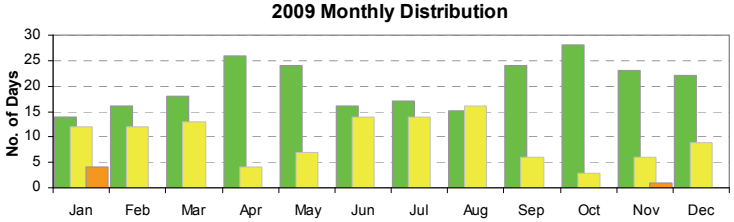
FINE PARTICLES ($PM_{2.5}$)

2009 January – December

During 2009, fine particle pollution, or $PM_{2.5}$, caused air quality to reach Unhealthy for Sensitive Groups on a total of five days. This means that the Air Quality Index[1] (AQI, see color bar below) was greater than 100, and labeled an exceedance day. Five[2] exceedance days are well below normal when compared with the five-year average of 15 exceedance days per year (2004-2008). Determining the number of $PM_{2.5}$ exceedance days per year is one way to assess Maryland's air quality.

Fine particles are active throughout the year, however, the Mid-Atlantic region generally experiences a higher number of exceedance days during the summer months as a result of the higher temperatures. These higher temperatures often allow fine particle precursors such as sulfur dioxide (SO_2) and nitrogen oxides (NO_x) to chemically react at a faster rate, leading to higher fine particle concentrations. In addition, there is a noticeable decrease in visibility during high $PM_{2.5}$ AQI days. The Haze Cam images to the right show the Baltimore City area demonstrating this. A Good AQI day is shown on May 18th. The city is clearly visible about 10 miles away from the camera location. On February 2nd, a different story is shown as visibility was obscured by haze due to fine particle levels reaching into the Moderate AQI range.

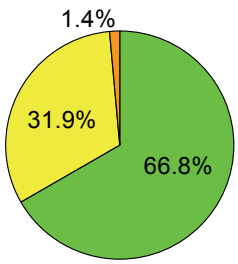
Maryland 24-hour Average $PM_{2.5}$ AQI
2009 Monthly Distribution



SEASONAL HIGHLIGHTS

In 2009, Good AQI days accounted for just over 66% of all days and Moderate days ranked next at 31.9%, as shown in the pie chart to the right. A very small 1.4% represented Unhealthy for Sensitive Groups (USG) days. Overall, $PM_{2.5}$ AQI values did not seem to vary a great deal by month. The monthly AQI trends are shown in the chart, "Maryland 24-hour Average $PM_{2.5}$ AQI 2009 Monthly Distribution." January was by far the worst month with four USG days. These USG days were observed on January 19th, 23rd, 26th, and 27th. Of the four, January 19th had the highest AQI value of 115 at the Essex air monitoring site. All 2009 exceedance days are listed in the table on pg. 2. This table lists the number of air monitoring sites that reported AQI levels exceeding 100, the name of the site reporting the highest AQI value, and that site's corresponding AQI value. The air monitoring sites for fine particles are displayed in the map above the table.

Maryland 24-hour Average $PM_{2.5}$ AQI
2009 Total



The months of February and March had similar ratios of Moderate and Good days where Good days occurred about 60% of the time and Moderate days occurred roughly 40% of the time. During April and May, Good days vastly outnumbered Moderate days as Good days accounted for approximately 90% of the days in each month. During the summer months of June, July, and August, it was a nearly 50/50 split between Good and Moderate days. However, August was the only month of the year where Moderate days surpassed *(continued on pg. 1)*

Air Quality Index (AQI)

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

[1] AQI based on the 2006 24-hr proposed $PM_{2.5}$ thresholds
[2] $PM_{2.5}$ data are preliminary

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1800 Washington Boulevard | Baltimore, MD 21230
410-537-3000 | 1-800-633-6101
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FINE PARTICLES ($PM_{2.5}$)

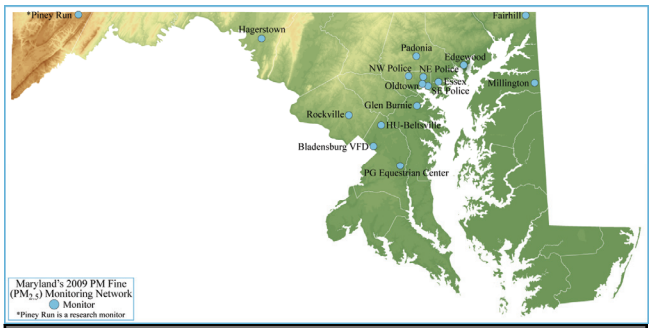
2009 January – December

SEASONAL HIGHLIGHTS

(continued from pg. 1) Good days. September through December showed much better fine particle conditions with Good days representing the majority of these months. The last exceedance day of the year was observed on November 9th at the Oldtown air monitoring site with an AQI value of 105.

WEATHER & AIR QUALITY

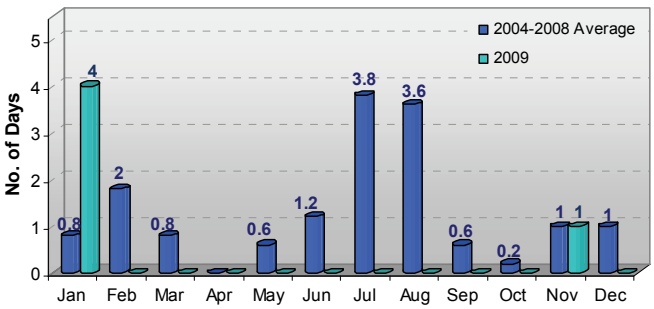
The annual temperature and precipitation conditions across the U.S. were generally similar to climatological normals. Overall in 2009, nearly all locations along the East Coast experienced temperatures that either closely matched average conditions or were one to two degrees divergent of them. The Midwestern states showed relatively cooler conditions throughout the year, though by a margin of one to two degrees again. Annual precipitation trends for 2009 showed the Southeast region generally experienced above average precipitation, which is contradictory to the summer months where below average precipitation occurred (pg. 3). This increase in annual precipitation was mirrored by other regions including the Mid-Atlantic, Midwest, and New England.



Maryland's 2009 $PM_{2.5}$ Exceedance Days

Date	No. of Monitors	Monitor with Highest AQI	24-hour Average $PM_{2.5}$ AQI
19-Jan	4	Essex	115
23-Jan	1	Essex	102
26-Jan	1	Essex	105
27-Jan	2	Essex	107
9-Nov	1	Oldtown	105

Seasonal Comparison of Exceedance Days



Weather conditions such as temperature and precipitation can easily influence $PM_{2.5}$ pollution. Some influence can be seen by comparing monthly weather to the number of exceedance days per month. The chart "Seasonal Comparison of Exceedance Days" to the left shows that nearly three additional exceedance days were experienced in the month of January than the five-year average. Except for January and November, all other months experienced consistently healthy levels of air quality which indicates air quality was much better than normal.

$PM_{2.5}$ has commonly been observed to be more active during the summer season in the Mid-Atlantic region. The 2009 season had very different results. Approximately eight exceedance days are usually experienced during June to August. However, there were no exceedance days observed during this period. This may be due to a difference in wind flow pattern. On poor air quality days in the summer months, wind flow from the southwest is experienced often and can transport pollutants from several states away toward the Mid-Atlantic and locations north. This southwesterly wind flow was much less common in the summer of 2009. Instead, northwesterly wind flow occurred more frequently. This change in wind flow was observed many times by our radar wind profiler that measures vertical profiles of wind direction and wind speed. Northwesterly wind *(continued on pg. 3)*

Air Quality Index (AQI)

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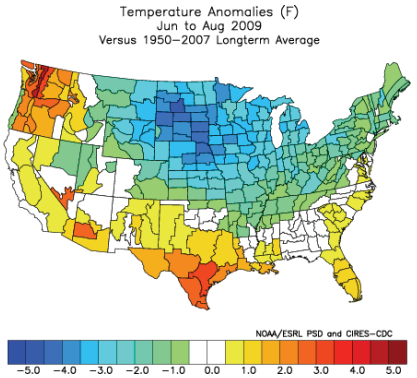
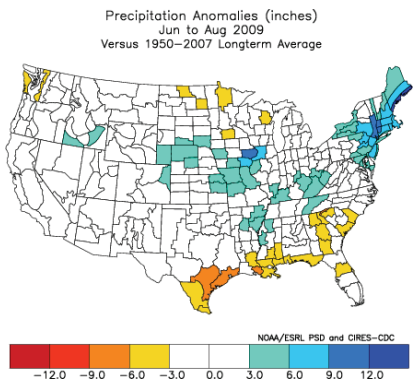
FINE PARTICLES ($PM_{2.5}$)

2009 January – December

WEATHER & AIR QUALITY

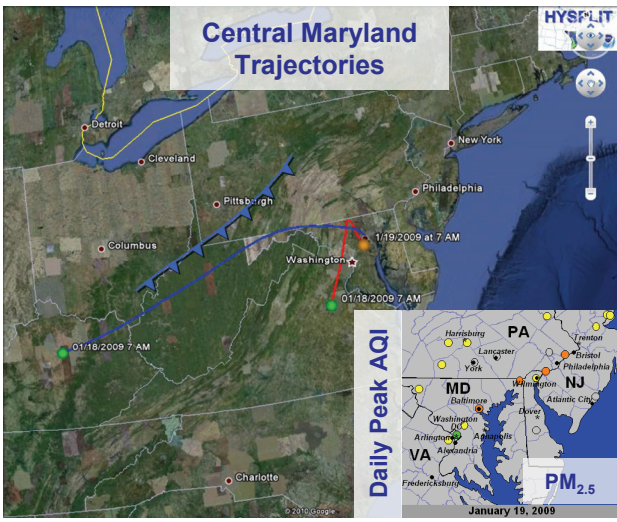
(continued from pg. 2) flow would point to the eastern Midwest and southern Pennsylvania as upwind regions from the Mid-Atlantic. Usually, these regions generate pollution that can also be transported toward Maryland, but temperature and precipitation anomalies help illustrate the large decrease in exceedance days. Anomalies of temperature and precipitation during June to August are shown in the U.S. maps (pg. 3) as compared with the climatological average of 1950-2007. These anomalies show that temperatures were significantly lower than normal, or colder, in the Midwestern states. Below normal temperatures would most likely mean less $PM_{2.5}$ precursors emitted in the Midwest, potentially due to a decrease in electrical demand resulting from reduced use of air conditioning as well as the affects from the economic recession. This, in turn, led to less pollution transported toward the Mid-Atlantic. Local $PM_{2.5}$ concentrations can also cause air quality to reach the USG or greater AQI range, but the 2009 summer did not appear to have the right meteorological conditions such as air stagnation for this type of exceedance day to occur.





FEATURED EVENT: January 19, 2009

On January 19th, $PM_{2.5}$ air quality conditions reached USG AQI values. Several factors contributed this USG occurrence. During the morning hours, a weak high pressure system centered over the Mid-Atlantic region induced very light southwesterly winds which reduced dispersion and allowed local $PM_{2.5}$ to accumulate. In addition, a morning temperature inversion formed. This led to a cap of the vertical mixing layer keeping pollutants close to the surface. In the image to the right are two 24-hour back trajectories that represent the path two air parcels took at different vertical levels into Maryland. The red trajectory (initiated at 10 m above ground level, or AGL) shows that the air over Maryland on January 19th came from northern Virginia, a short distance away. The blue trajectory (500 m AGL) showed air aloft came from the central Kentucky where air quality was Good on the previous day.



Later in the day with temperatures near freezing, a cold front (shown at 7 AM in the image) became stationary over Maryland further restricting any ventilation of the area. The combination of these weather conditions enhanced local and regional $PM_{2.5}$ concentrations. Four locations in the state observed USG AQI values. The Essex air monitoring site reported the highest AQI value at 115.

MORE INFORMATION

Visit www.mde.state.md.us/air for current air quality conditions and forecasts, or call the air quality hotline at 410-537-3247.

References: AIRNow, NOAA ARL READY HYSPLIT Trajectory Model, NOAA ESRL PSD Climate Analysis Branch

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