PM2.5 National Ambient Air Quality Standard Health Exceedances on December 12, 2020

Exceedance Locations and Levels

On Saturday, December 12, 2020, there were two (2) exceedances in New Jersey of the National Ambient Air Quality Standard (NAAQS) for PM2.5 (24-hour average of 35 micrograms/cubic meter, ug/m3). See Table 1.

Table 1. New Jersey PM2.5 Concentrations on 12/12/2020

STATION	24-Hour Average (ug/m3)
Brigantine	5.7
Camden Spruce St	15.9
Columbia WMA	32.2
Elizabeth Lab	31.7
Flemington	24.8
Fort Lee Near Road	28.4
Jersey City Firehouse	25.3
Millville	6.7
Newark Firehouse	46.2
Rahway	39.5
Rider University	17.7
Rutgers University	25.4
Toms River	5.6
TOTAL EXCEEDANCES	2

From the out-of-state stations adjacent to New Jersey, there were two (2) exceedances of the PM2.5 NAAQS. See Table 2.

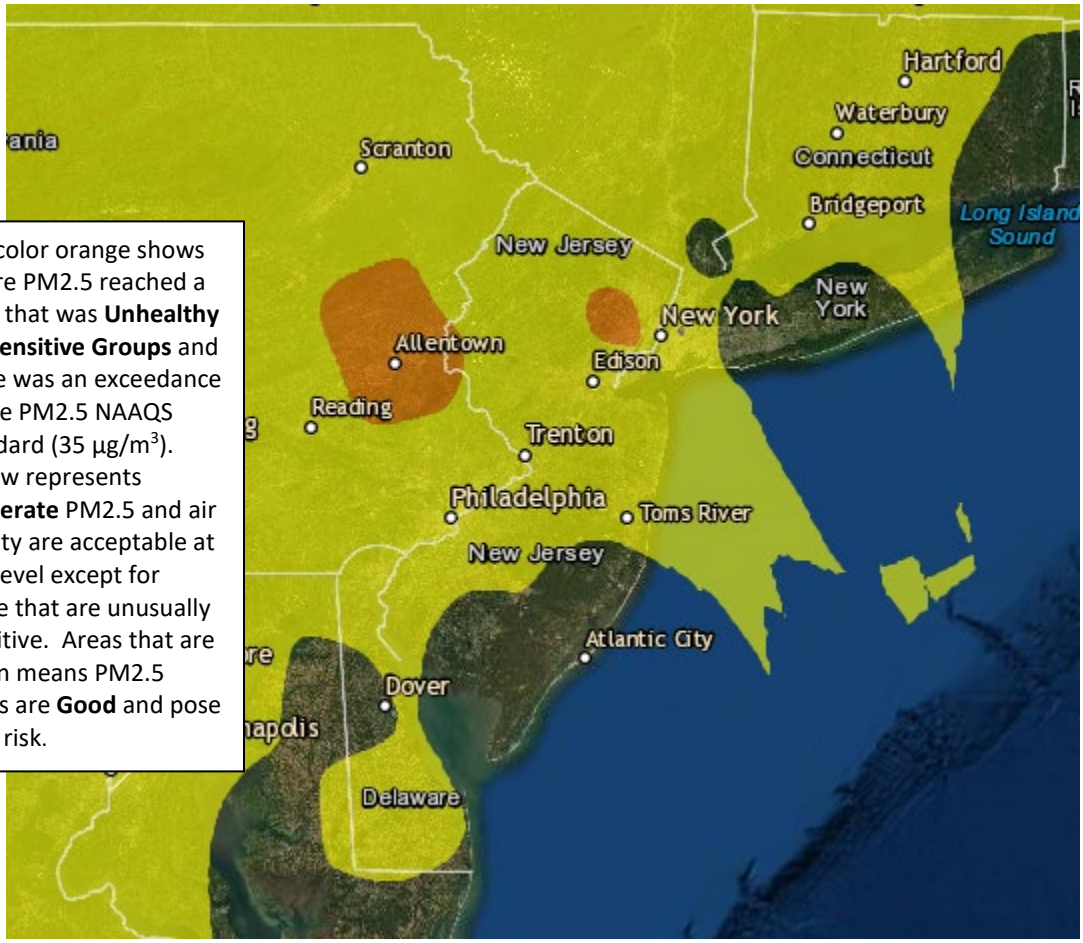
Table 2. PM2.5 Concentrations at Out-of-State Monitoring Stations Adjacent to New Jersey on 12/12/2020

STATE	STATION	24-Hour Average (ug/m3)
CT	Bridgeport	23.9
CT	Danbury	28.8
CT	New Haven - Criscuolo Park	23.0
CT	Waterbury	25.1
DE	KILLENS (Kent Co.)	No Data
DE	LUMS 2 (New Castle Co.)	19.2
DE	MLK (New Castle Co.)	20.9
DE	Rte 9 Del City	16.6

DE	SEAFORD (Sussex Co.)	13.6
MD	Fair Hill	13.0
NY	Bklyn - PS274	13.4
NY	CCNY	16.1
NY	Division Street	No Data
NY	Eisenhower Park	10.8
NY	Fresh Kills	21.1
NY	Holtsville	6.2
NY	Manhattan/IS143	16.9
NY	Maspeth	11.8
NY	Queens Near-road	13.3
NY	Queens	12.2
NY	White Plains	11.5
PA	Allentown	42.9
PA	Chester	23.4
PA	Freemansburg	41.8
PA	Marcus Hook	22.8
PA	New Garden	19.6
PA	Norristown	25.0
PA	FAB	No Data
PA	MON	19.7
PA	NEW	25.6
PA	RIT	23.4
PA	TOR	28.2
	TOTAL EXCEEDANCES	2

Figure 1 shows the widespread nature of this event with moderate PM2.5 levels noted in yellow throughout the region. Locally, the highest PM2.5 levels were noted over eastern portions of Pennsylvania and northern New Jersey reaching the Unhealthy for Sensitive Groups category (noted in orange).

Figure 1. PM2.5 Air Quality Index for December 12, 2020



The color orange shows where PM2.5 reached a level that was **Unhealthy for Sensitive Groups** and there was an exceedance of the PM2.5 NAAQS standard (35 µg/m^3). Yellow represents **Moderate** PM2.5 and air quality are acceptable at this level except for those that are unusually sensitive. Areas that are green means PM2.5 levels are **Good** and pose little risk.

Source: www.airnow.gov

For PM2.5 terminology definitions see NJDEP Air Quality Planning's Glossary and Acronyms webpage: http://nj.gov/dep/baqp/glossary.html

Weather

A broad area of high pressure, which dominated the weather pattern over the eastern half of the United States for several days, moved offshore early on Saturday, December 12, 2020. Meanwhile, a large low-pressure system over the Mid-West, slowly progressed northeastward during the day. This atmospheric setup allowed weather conditions, such as unseasonably warm temperatures, light and variable winds, and periods of fog or mist, to result in elevated levels of PM2.5 throughout much of the region. Additionally, limited atmospheric mixing allowed for emissions to accumulate near the surface, further supporting a regional increase in PM2.5 levels and, in turn, multiple NAAQS exceedances in various locations in eastern Pennsylvania and northern New Jersey.

Where Did the Air Pollution that Caused an Exceedance in PM2.5 Come From?

A favorable atmospheric setup with high pressure pushing offshore and an approaching area of low pressure allowed for a regional increase of fine particulate (PM2.5) levels on December 12th. Limited mixing heights, emissions from cars, trucks, and industry, as well as from emissions from wood-, coal-, and oil-burning heating devices, were able to accumulate close to the surface, leading to multiple NAAQS PM2.5 exceedances in portions of eastern Pennsylvania and northern New Jersey.

High PM2.5 events are typically associated with limited atmospheric mixing. The planetary boundary layer (PBL) can be considered the lowest point of the troposphere where atmospheric mixing occurs and is known to change along with the weather pattern. Under the complex weather pattern on December 12th, relatively low mixing heights were observed, trapping PM2.5 toward the surface, enhancing levels. Figure 2 shows the PBL heights over the region near mid-day on December 12th. As shown, significantly low mixing heights, above ground level (AGL), were observed near exceedance locations on this day.

Figure 2. Regional Planetary Boundary Layer Height on December 12th (mAGL)

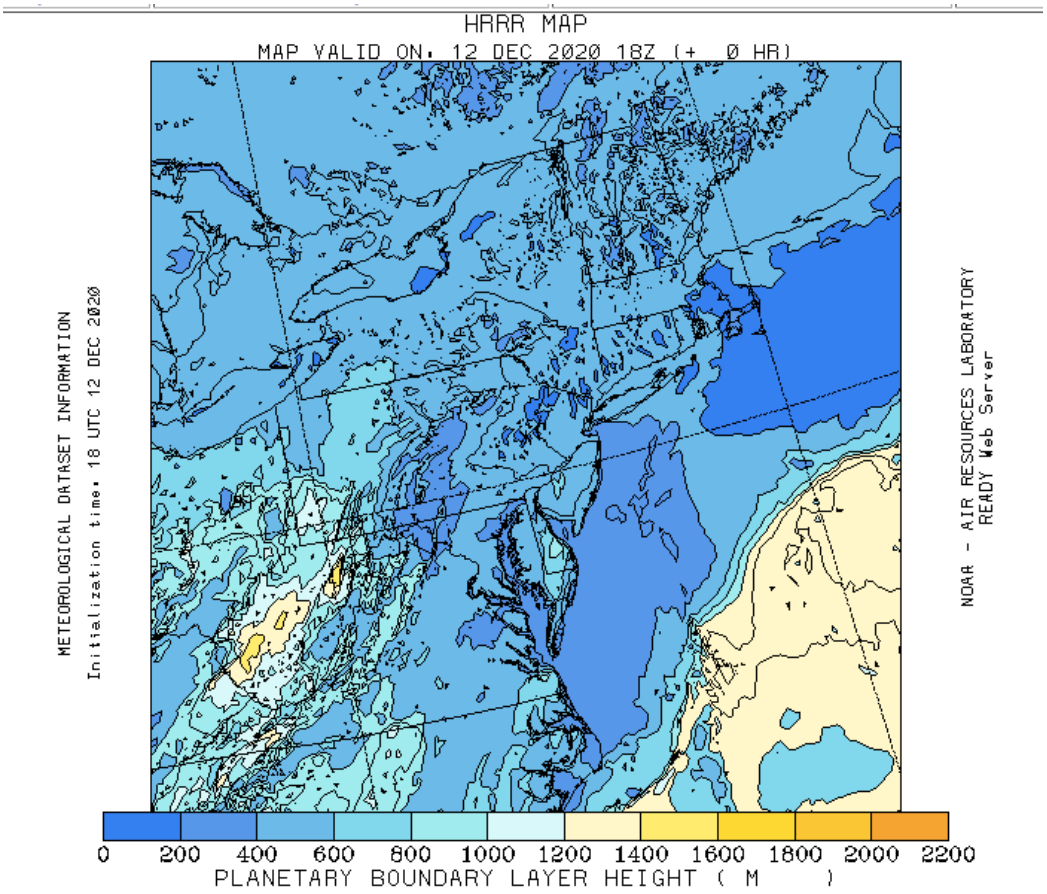


Figure 3 below shows surface level back trajectories for the monitored exceedances on December 12, 2020. This figure illustrates where surface winds came from during the 48 hours preceding the high PM2.5 event. With the low mixing heights and limited vertical mixing on this day, surface wind back trajectories will help provide the best visual of PM2.5 transport. Four (4) monitoring stations in the region with 24-hr PM2.5 NAAQS exceedances were used to run back trajectories. The selected sites and the 24-hr average PM2.5 level recorded are listed in Table 3 below:

Table 3. Monitoring Stations in New Jersey and Adjacent States with a 24-hr PM2.5 NAAQS Exceedance that were Selected to Run 48-hr Back Trajectories

STATE	STATION	24-Hour Average ($\mu g/m^3$)
PA	Allentown	42.9
PA	Freemansburg	41.8
NJ	Newark Firehouse	46.2
NJ	Rahway	39.5

Backward trajectories from Saturday, December 12th show that a stagnant air mass with very light winds and limited atmospheric ventilation was in place for several days leading to localized transport and recirculation within the region. At the surface, air traveled slowly during the 48hrs preceding this high PM event, allowing the air to become increasingly polluted throughout transport, which led to multiple exceedances.

Low level (10 m) back trajectories followed different transport pathways during the 48 hours of transport preceding this event (Figure 3). Trajectories influencing the Pennsylvania monitors originated in southeastern Pennsylvania and traveled slowly around the Philadelphia suburbs before migrating slightly northward. At this time during the last 24 hours of transport, air recirculated and remained nearly stationary during these final hours before arriving at the destinations of Freemansburg and Allentown, PA. Meanwhile, trajectories influencing the New Jersey monitors originated in Maryland and southern Delaware and traveled northward along the coast into Long Island and the greater NYC metropolitan area. Here, air slowed to a crawl, allowing the air to become increasingly polluted in the NYC metropolitan area before it was transported just southwest of the city into New Jersey. Both sets of trajectories traveled very slowly along the ground level during their path and passed through areas where moderate PM2.5 levels were recorded the previous day. Also, air traveling at ground level during this event likely picked up emissions from cars, trucks, and industrial facilities. In addition to these sources, air traveling along the ground may have also picked up emissions from wood-, coal-, and oil-burning equipment, which are all common sources of PM2.5.

Figure 4 shows national PM2.5 concentrations observed on December 11, 2020, the day prior to this high PM2.5 event. As shown in the figure, widespread moderate, and isolated USG air quality were observed throughout much of the eastern United States. This widespread plume of elevated PM2.5 concentrations extended from Florida to northern New England and into portions of the Mid-West. In addition, the trajectories suggest that transport from New York City and recirculation in southeastern Pennsylvania, in combination with favorable weather conditions mentioned above, enhanced levels of PM2.5 leading to a widespread regional event.

Figure 3. 48-hour Back Trajectories for December 12, 2020 at 10 meters

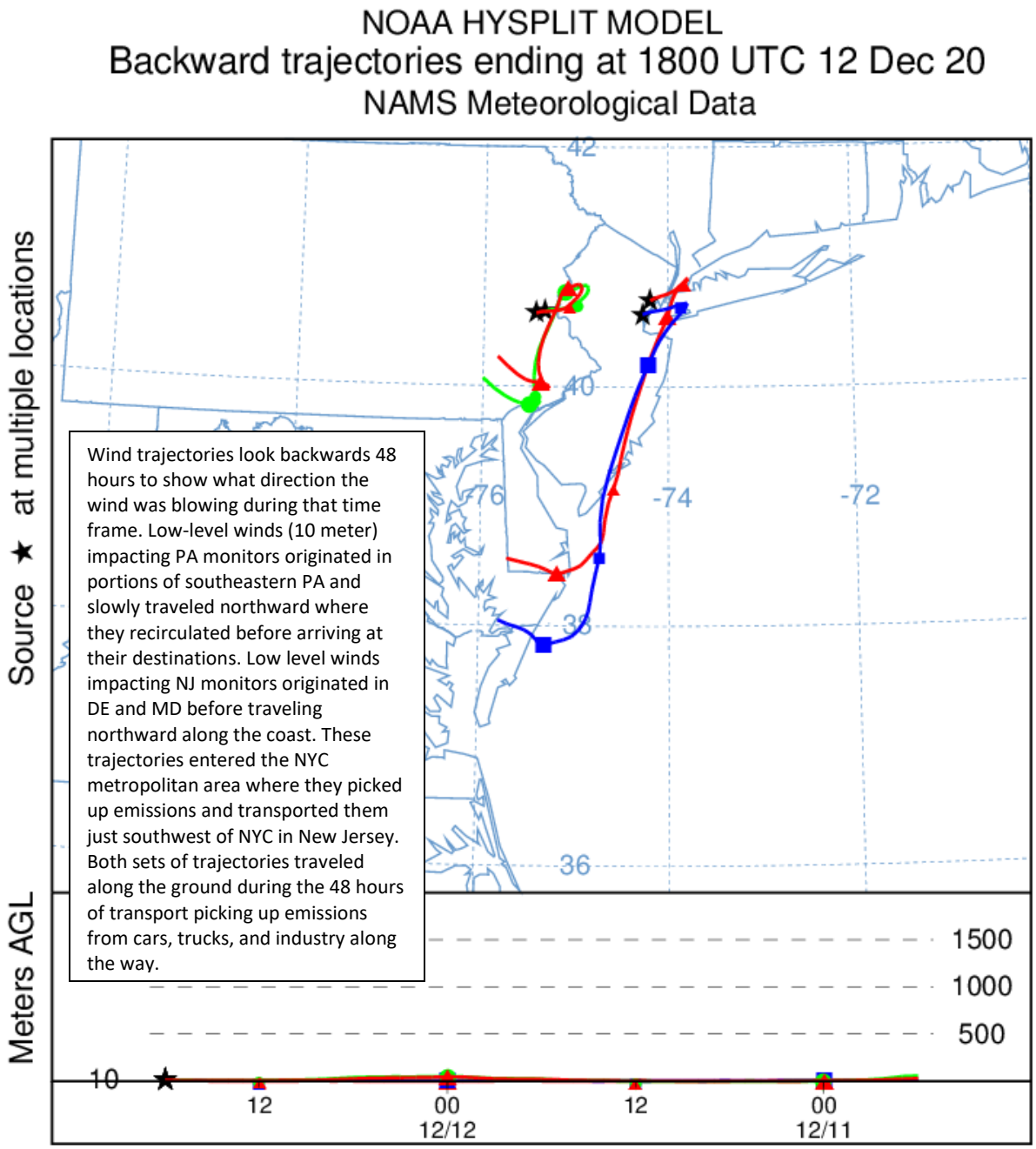
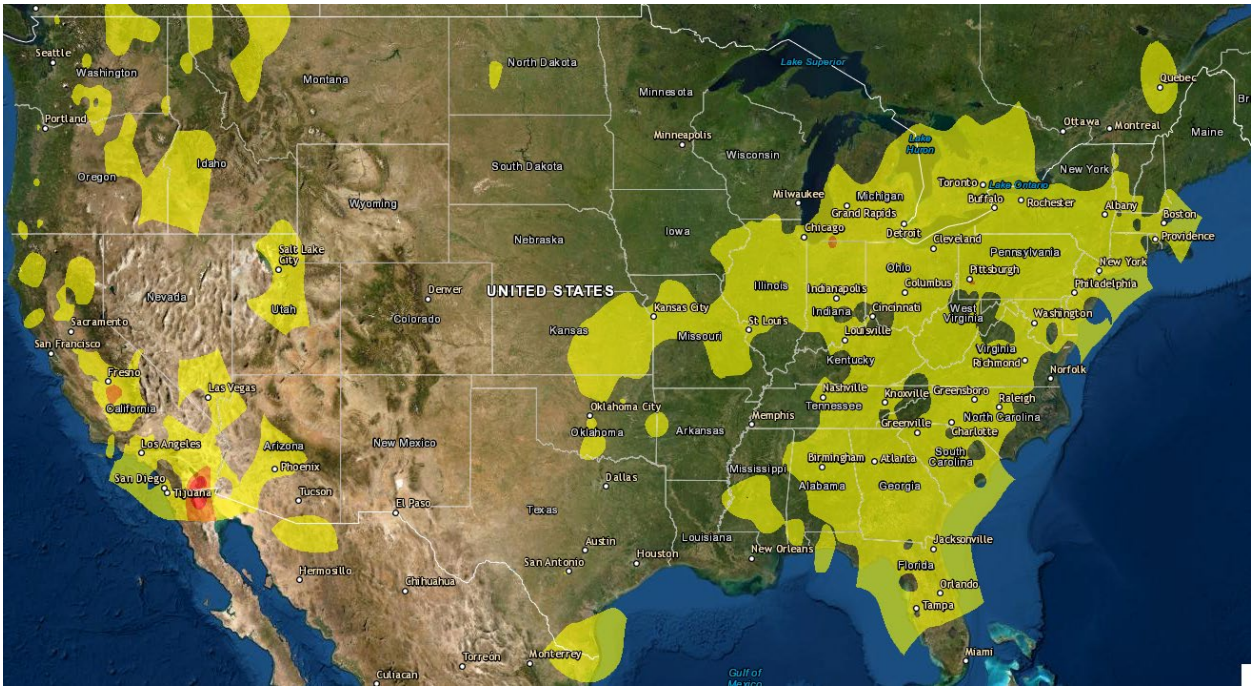


Figure 4. National PM2.5 Air Quality Index for December 11, 2020



Find Out About Air Quality Every Day

The "What's Your Air Quality Today?" page at http://www.nj.gov/dep/cleanairnj/ tells you how to sign up to receive notifications and find out when your local air has reached unhealthy ozone levels.