New Article on Pollution Sources Affecting Detroit Air Quality

"Apportionment of $PM_{2.5}$ Sources across Sites and Time Periods: An Application and Update for Detroit, Michigan" by Yang, Z.; Islam, M.K.; Xia, T.; Batterman, S. published in *Atmosphere,* on March 21, 2023

Background: Air pollution causes many harmful health effects, especially the tiny particles known as soot or particulate matter ($PM_{2.5}$) that penetrate deep into the lungs. $PM_{2.5}$ in the outdoor air is estimated to cause early deaths of 47,800 people in the US each year.[1] While exposure to air pollution is widespread, people of color are exposed to higher levels of $PM_{2.5}$.[2] The US Environmental Protection Agency (EPA) sets health-based outdoor air standards for $PM_{2.5}$. Recently, the EPA has proposed stronger standards to reduce disease and premature deaths.[3]

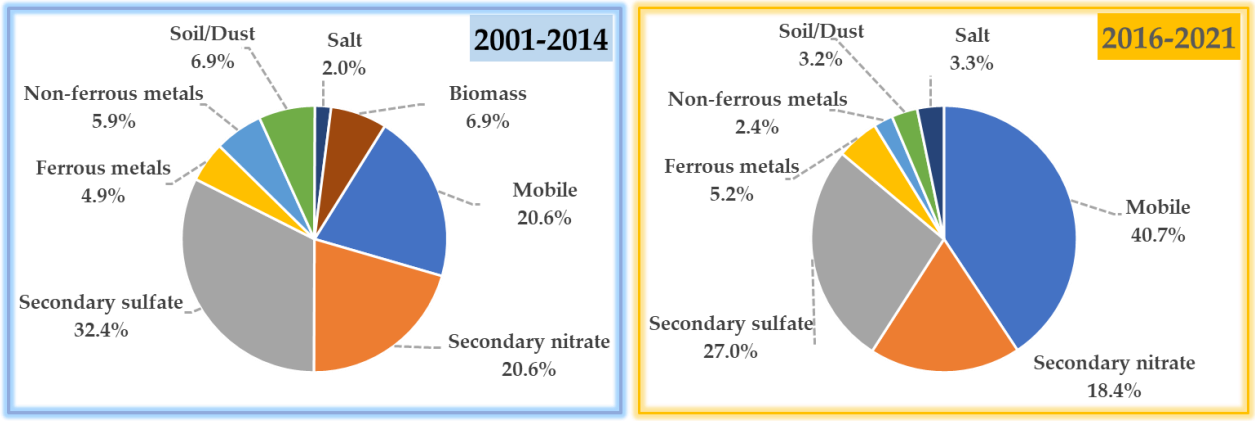
$PM_{2.5}$ levels in Detroit, as in many other urban and industrial areas, are below but near the current standards, and more stringent standards could force regulatory actions and controls to lower emissions in order to meet standards.[4] Identifying the sources of air pollutants is essential for developing effective controls, lowering exposures, improving health, and identifying disparities.

Summary: The purpose of this new study was to identify the major sources that contribute to $PM_{2.5}$ levels in Southwest Detroit, which currently has the highest levels of this pollutant in the state. Using a method called receptor modeling, the researchers used six years of measurements (2016-2021) collected at three monitoring sites. Receptor modeling is considered one of the best techniques to identify pollution sources.[5] The relatively long study period improves the accuracy and representativeness of results.

To show trends, the study contrasts results to older studies, including results using 2001-2014 previously analyzed by the same team at the University of Michigan. The study also analyzes effects of the pandemic shutdown. Some of the key results are:

- Exhaust emissions from trucks, cars, and construction equipment (together called "mobile sources") continue to grow in importance and are now the largest $PM_{2.5}$ source, responsible for over 40% of $PM_{2.5}$ in this area of the city, and even more in areas close to highways and large construction sites.
- Emissions from industrial sources burning coal and other fossil fuels, while still sizable, have been declining. This is shown by decreases in secondary sulfate and secondary nitrate. This reflects the recent shutting down of facilities like coal burning power plants in Michigan, Ohio, and elsewhere.
- There have been only modest changes in $PM_{2.5}$ emissions by Detroit industry, including metals production, processing, and manufacturing facilities. The diagrams below contrast old (left) and new (right) results for different types of sources, and show the growth in mobile sources (blue slice).

Pie charts showing sources contributing to $PM_{2.5}$ levels in Detroit, in percent, over 2001-2014 and 2016-2021.[6]



(continued)

- $PM_{2.5}$ levels ranged from about 8 to 11 micrograms per cubic meter ($\mu g/m^3$) during the 2016-2021 study period. The current EPA standard is 12 $\mu g/m^3$. For perspective, EPA lists 737 US monitoring sites that have sufficient data over the study period. Levels in Detroit are among the worst 5% of sites across the nation. If California is excluded, which is not really comparable to Michigan, Detroit ranks in the top 1 to 2% of polluted sites.[7]
- $PM_{2.5}$ levels did not change significantly during the COVID-19 pandemic, other than some short-lived decreases in early 2020.

Study implications: The good news from is that a large share of $PM_{2.5}$ pollution is from local sources, including on- and off-road traffic and local industry, that can be controlled. These emissions can be reduced by improving emission controls, retiring older and highly polluting trucks and construction equipment, converting to electric vehicles, and reducing traffic using transit and combining trips. Additionally, enforcing anti-idling ordinances, using traffic measures like synchronized signaling, and lowering speed limits are helpful.

The bad news is that truck traffic and industrial sources are broadly distributed across the area, and truck traffic will likely increase given the many new warehouses, the new international bridge, and the widespread use of highways, arterials and surface streets by heavy duty vehicles.

$PM_{2.5}$ exposures and impacts can be reduced by reducing emissions (as noted above), designating and enforcing trucking routes, using buffers to separate pollution sources from residents, constructing sound walls, and by using dense vegetative cover, tree canopies, and indoor filters to trap some of the $PM_{2.5}$.

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The article can be accessed for free at https://www.mdpi.com/2073-4433/14/3/592 and the pdf file can be downloaded at https://www.mdpi.com/2073-4433/14/3/592/pdf

Additional information on air quality in Detroit can be found at https://caphedetroit.sph.umich.edu/

For further information, please contact Stuart Batterman at stuartb@umich.edu

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References

[1] Health Effects Institute. 2020. State of Global Air 2020. Data source: Global Burden of Disease Study 2019. IHME, 2020. https://www.stateofglobalair.org/. Accessed March 17, 2023.

[2] Christopher W. Tessum et. al., "PM2.5 polluters disproportionately and systemically affect people of color in the United States," *Science Advances*, April 28, 2021.

[3] National Ambient Air Quality Standards (NAAQS) for PM," Environmental Protection Agency, Accessed January 31, 2023.

[4] $PM_{2.5}$ levels in Detroit are below the current standard of 12.0 $\mu g/m^3$. However, if EPA lowers the standard to 9 or 10 $\mu g/m^3$, which appears likely, then Detroit will exceed air quality standards (called non-attainment) and mitigation plans and actions will be required to reduce $PM_{2.5}$ pollution.

[5] We used an EPA-developed tool called Positive Matrix Factorization or PMF for analysis and data collected at Dearborn, Allen Park and Southwest High School monitoring sites operated by the Michigan Department of Environment, Great Lakes and Energy. The data include 1393 samples collected at these three sites that were analyzed for chemical elements, ions, elemental and organic carbon, and other parameters.

[6] 2001-2014 analysis is from Milando, C.; Huang, L.; Batterman, S. Trends in $PM_{2.5}$ emissions, concentrations and apportionments in Detroit and Chicago. *Atmospheric Environment*. 2016, 129, 197–209. https://doi.org/10.1016/j.atmosenv.2016.01.012. This older analysis uses a similar approach and data from Allen Park. Results for the new analysis shown as the average across three sites (one of which is Allen Park).

[7] Because $PM_{2.5}$ levels change from year to year, the analysis is based on long term (multiyear) averages of $PM_{2.5}$, which help reduce these fluctuations. Only sites with at least 75% of the data in each year are used. Also, because the analysis combines $PM_{2.5}$ measurements that use several techniques, results may be slightly biased. Excluding California leaves 672 sites.