Sources of Atmospheric Fine Particles and Mercury in New Jersey

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What was the purpose of the study?

The main goal of this study was to identify the major sources of fine particulate ($PM_{2.5}$) and mercury (Hg) air pollution in New Jersey and to investigate whether there were changes in their contributions over time. This study had the following objectives:

- To assess statistically the $PM_{2.5}$ and mercury data from a sampling site in Brigantine, NJ
- To determine sources of the fine particulate and mercury air pollution in NJ
- To investigate changes in the pollutant concentrations, emitted by these sources, over the long period of time
- To study seasonal changes of these concentrations
- To evaluate EPA's Positive Matrix Factorization (PMF 5.0) model for the combined mercury and $PM_{2.5}$ data set

The results of the study are useful for better emissions control strategies and an improvement of the air quality and human health in New Jersey.

What was the general approach to the study (methods)?

Sampling of airborne fine particles in Brigantine, New Jersey was conducted by NJDEP between September of 1991 and January of 2020 as a part of the Interagency Monitoring of PROtected Visual Environments (IMPROVE) network, a consortium of EPA and Federal land management agencies (Federal Land Manager Environmental Database, 2023). The samples were analyzed by different methods to determine chemical composition of the particulate matter. NJDEP also performed continuous measurements of mercury at the site. The combined mercury and chemical composition particulate data from Brigantine were used to study the air pollution in New Jersey.

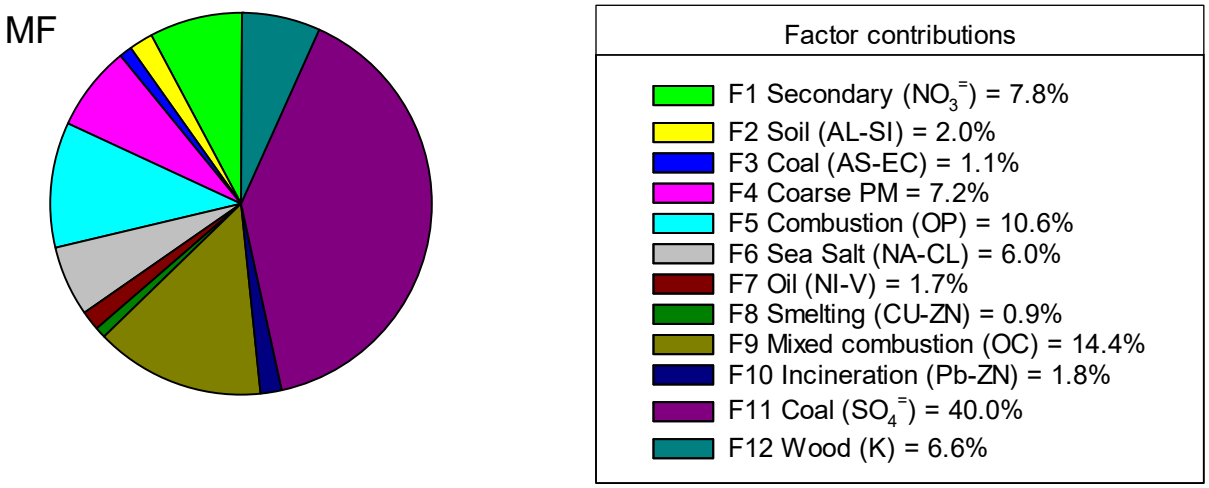
An advanced statistical method, Positive Matrix Factorization (PMF), was used as a tool for the study of combined mercury and chemical composition particulate data set from Brigantine, New Jersey. The PMF model can be used to analyze many different types of environmental data (e.g.,

soil, water, air, etc.) to determine source types and contributions. In this project, the PMF model was used to identify air pollution sources. The PMF 5.0 software was provided by EPA (EPA, 2014).

Overall, what did the studies show?

Statistical analyses of the data were performed, and the full discussion of the results are presented in the full report. Twelve sources of air pollution have been identified by PMF, such as coal and oil combustion, incineration/metal production, wood combustion, soil, sea salt emissions, etc. Time series for the three determined sources – F7 (Oil Combustion, V-Ni), F10 (Incineration/Metal Production, Pb-Zn), and F11 (Coal Combustion, $SO_4^{=}$) - showed negative trends.

The figure below represents identified source contributions to the total particulate fine mass. Midwestern coal combustion (F11) was identified as a major source for $PM_{2.5}$ in New Jersey as 40% of the total fine mass was contributed by this source. About 65% of total fine mass ($PM_{2.5}$) in Brigantine were the emissions from this source F11 and organic carbon combustion sources F5 and F9.



See Figure 12 in the report for similar graphics showing the source contributions for mercury. The main source of gaseous elemental mercury was coal combustion. Time series for some of these sources, related to mercury emissions, showed a negative trend, while others exhibited no trend.

Overall, the use of the EPA PMF receptor model was an effective approach for identification and quantification of the air pollution sources.

How will DEP use the data?

The results of the investigation are useful for understanding the mechanisms of transport and transformation of atmospheric pollution and could lead to improvement of the emission control strategies.

Please review the full report for more detailed information at https://dspace.njstatelib.org/handle/10929/112000

Who to contact with further questions.

For more information on this report, feel free to contact Alexander Polissar (Alexander.Polissar@dep.nj.gov).

References:

EPA, 2014. Positive Matrix Factorization Model for Environmental Data Analyses. https://www.epa.gov/air-research/positive-matrix-factorization-model-environmental-data-analyses

EPA, 2023. Mercury Air Releases Trends. https://www.epa.gov/trinationalanalysis/mercury-air-releases-trend
Federal Land Manager Environmental Database, 2023. https://views.cira.colostate.edu/fed/QueryWizard/Default.aspx

Kim, E., Hopke, P.K, 2004. Improving source identification of fine particles in a rural northeastern U.S. area utilizing temperature-resolved carbon fractions. Journal of Geophysical Research 109, D09204.

Song, X.-H., Polissar, A.V., Hopke P.K., 2001. Sources of fine particle composition in the northeastern US, Atmospheric Environment 35, 5277-5286.