Kingston Air Quality Initiative at Bard College Reports After Four Years of Monitoring

KINGSTON, NY – The Center for the Environment Sciences and Humanities at Bard College is pleased to announce the findings of the Kingston Air Quality Initiative (KAQI) after four consecutive years of research and data collection.

KAQI began in January 2020 as a partnership between Bard's Community Sciences Lab and the City of Kingston Conservation Advisory Council's Air Quality Subcommittee. Since then, Kingston residents and Bard College students, staff, and faculty have facilitated both indoor and outdoor air quality monitoring projects throughout the Hudson Valley. Standing as the first air quality study of its kind in Kingston, KAQI's monitoring efforts focus on a regional assessment of air pollution as measured from the rooftop of the Andy Murphy Neighborhood Center on Broadway in Kingston.

KAQI's main monitoring efforts focus on a regional assessment of air pollution from fine particulate matter (PM2.5), made up of microscopic particles that are the products of combustion (burning), and released into the air through exhausts from oil burners, gas burners, automobiles, cooking, grilling, and both indoor and outdoor wood burning. PM 2.5 particles are so tiny, they stay suspended in the air for long periods of time, allowing them to travel long distances before depositing. When these particles are inhaled, they can enter the bloodstream through the lungs, creating or worsening health issues. The World Health Organization (WHO) states that "small particulate pollution has health impacts even at very low concentrations – indeed no threshold has been identified below which no damage to health is observed."

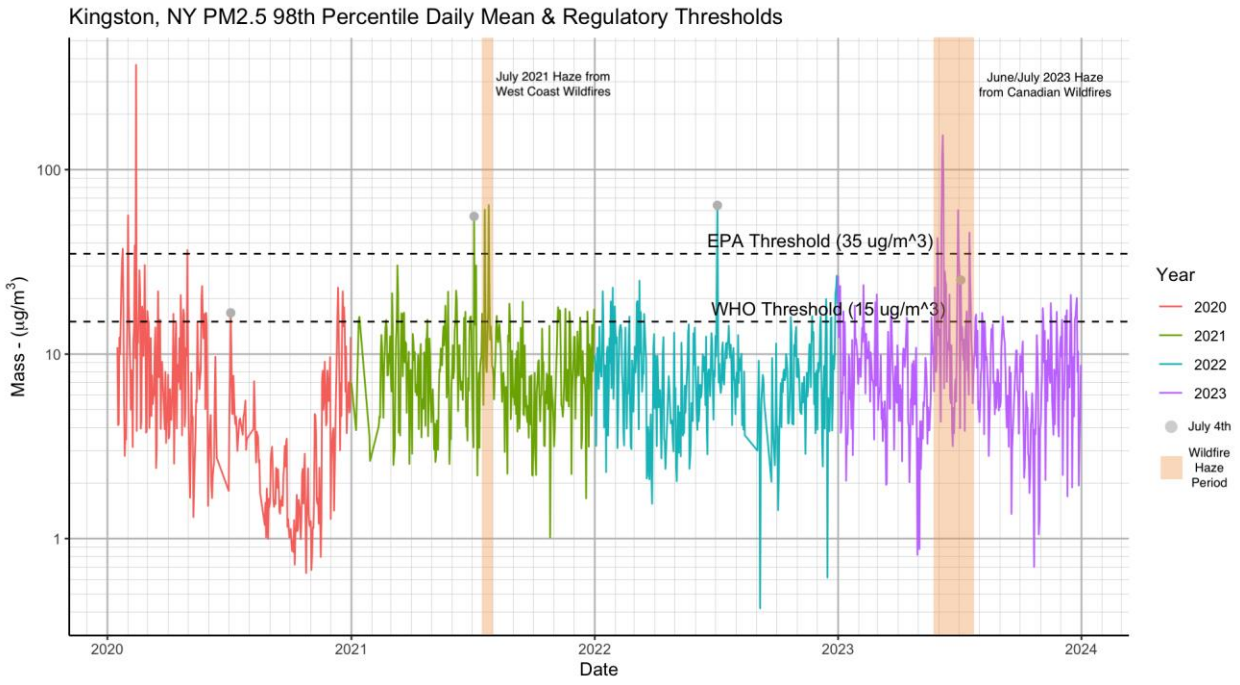

Figure 1. 98th percentile daily means from 2020-2023 on a $\log_{10}$ scale, with each year denoted by a different color line. These data can be directly compared to the EPA 24 hour threshold of 35 µg/m³, and are an underestimate of the

99th percentile calculation used by the WHO 24 hour threshold of 15 µg/m³, both of which are visualized by black dashed lines.Orange bars represent known haze periods when exterior wildfire smoke plumes traveled into the Hudson Valley.

After four years of comprehensive monitoring in Kingston, we continue to uncover valuable insights into our air quality and its connection to our daily activities and decisions as citizens. 2023 stands out from the past 4 years – after three years of decreasing daily average levels of pm2.5 from 2020-2022, we saw an increase in 2023 (*figure 2*). Annual mean pm2.5 was higher in 2023 than any other year on record. Some of this increase is directly attributable to the wildfire smoke we experienced from Canada in June 2023, which may be a new reality for the Hudson Valley as fires continue to ravage Canadian forests.

One consistent observation over the past four years is the seasonal trend of higher particulate concentration in the winter and summer months, likely attributable to combustion (wood for heating & recreation, other fuels for heating) (*figure 1*). Despite improvements in vehicular and industrial emissions, we are overall seeing consistently higher pollution levels. This trend underscores the ongoing need for more aggressive sustainable heating practices and transportation solutions to combat air pollution in Kingston.

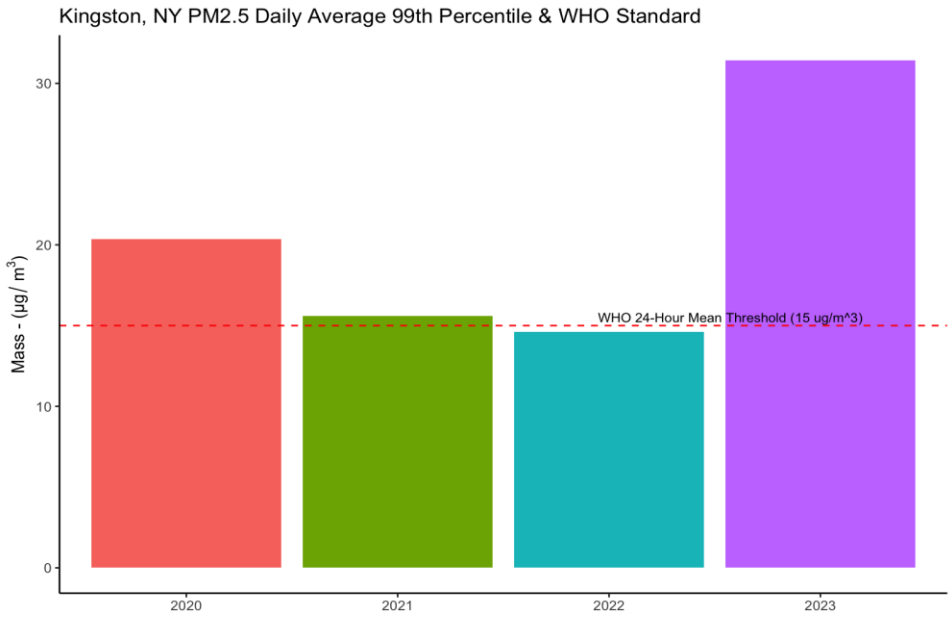

Figure 2. Kingston PM2.5 annual average of 99th percentile daily average values. These numbers represent the average of the highest 1% of daily average PM2.5 numbers seen over an entire year. The higher value for 2023 is an indication of very poor air quality on our worst air quality days.

Another critical factor and ongoing research subject is the occurrence of atmospheric inversions and their implications for ground-level air pollution in Kingston. These events, characterized by temperature increases with altitude, inhibit vertical mixing and trap pollutants at ground level. Given Kingston's geographical location in the Hudson Valley, where air circulation is restricted, awareness of these events is crucial for informed decision-making to mitigate air pollution. To assist with this, we have developed a new inversion dashboard tool, providing real-time updates

every 12 hours on potential atmospheric inversion days (*figure 3*). This tool empowers individuals to assess how their actions, such as wood burning or car usage, may impact ground-level air pollution on any given day. By utilizing this tool, residents can proactively choose cleaner alternatives during inversion events, contributing to improved air quality in Kingston.

https://cesh.shinyapps.io/New-York-Daily-Inversions/

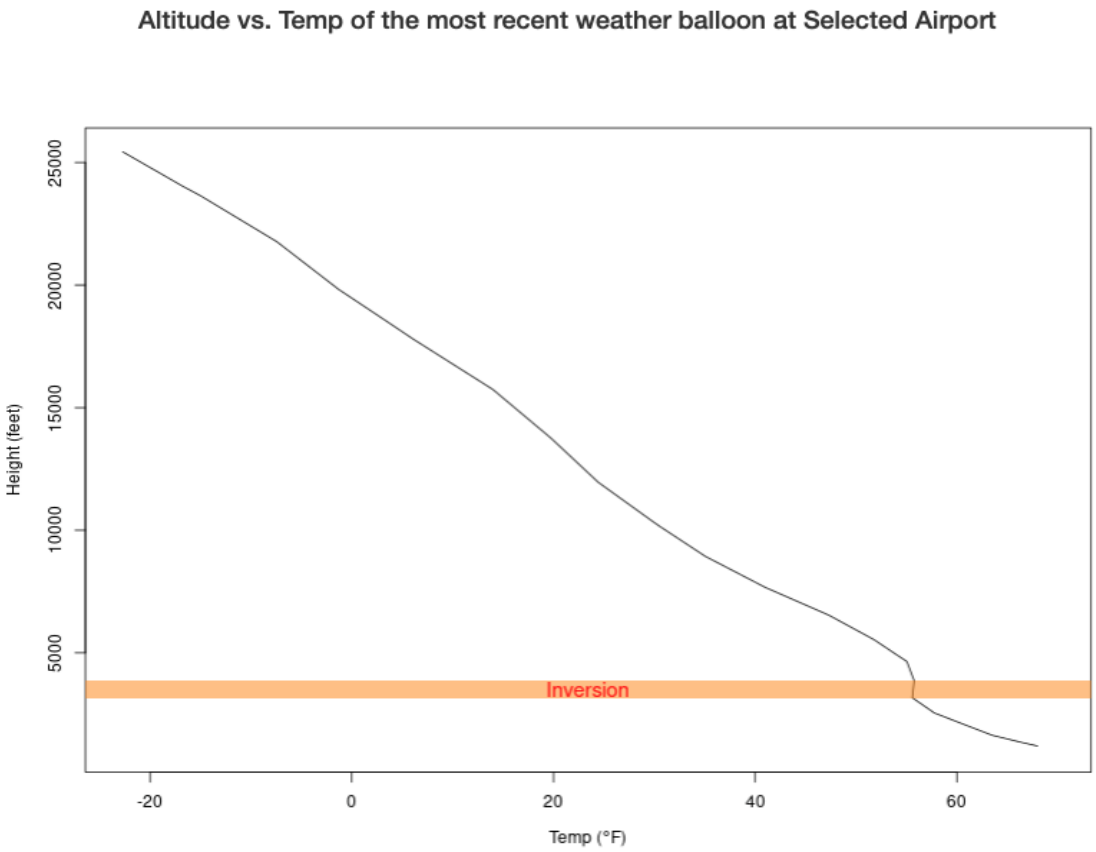

Figure 3. Screenshot of CESH's new inversion visualization tool, available at https://cesh.shinyapps.io/New-York-Daily-Inversions/. The tool can be used to identify potential atmospheric inversion conditions at 8 different regions across New York state. Height (altitude in feet) is shown on the left axis, and temperature on the bottom. A potential inversion is highlighted by the tool on this example from May 1, 2024 in Albany, NY.

As we continue to research the complexities of air quality management, it's essential for Kingston residents to stay informed and engaged. By adopting sustainable practices, supporting clean energy initiatives, and advocating for policies that prioritize air quality, we can work together to create a healthier environment for all. More detail about KAQI's findings can be found at the Center for Environmental Sciences and Humanities website: https://cesh.bard.edu/kingston-air-quality-initiative-kaqi/ and the City of Kingston website: https://kingston-ny.gov/

Bard's Center for Environmental Sciences and Humanities, through the Community Sciences Lab, is excited to announce that the success of KAQI has led to the recent establishment of a regional air quality station (replicating Kingston's station) in partnership with the Poughkeepsie

Library, and a future station to be installed in Newburgh in partnership with Mount Saint Mary College. We also look forward to further research using our ever-expanding network of hyper-local air quality monitors, called Purple Airs, that are a collaboration between Bard College, SUNY-Albany, and the EPA. Libraries across the Hudson Valley have joined our Hudson Valley Library Air Quality Network, and we encourage more to join us. These neighborhood-scale monitors will allow us to gather insights closer to ground level and at a much higher resolution in order to more accurately assess air pollution and its effects on people on a neighborhood level. We hope to develop this new dataset and analysis for our next monitoring report.

Julie L. Noble, Sustainability Coordinator, City of Kingston:
"As a compact urban city, with a large percentage of our community living in either Disadvantaged Communities designated areas and/or Potential Environmental Justice Areas, we are acutely aware of the localized impacts of air pollution on our community members and quality of life. The partnership we have had with Bard has been tremendously positive for us, providing sound, local data that we have been able to share, in real time, with our residents, to help them stay safe, plan accordingly, and make better choices for their own health and for the health of our environment."

Lorraine Farina, member of the Hudson Valley Air Quality Coalition (https://hvaq.wordpress.com/) :
"While it is recognized by the WHO that there is no safe level of exposure for anyone to PM 2.5, as a founding member of HVAQ (Hudson Valley Air Quality Coalition), I have personally suffered, and know other members who suffer, the negative health effects of woodsmoke pollution in their own neighborhoods in Kingston. Respiratory and cardiac effects are not limited to times when there are Canadian wildfires in our area. The concept of "home" equates to safety and security for most people, but when people cannot protect themselves from woodsmoke invading their homes, there is a feeling of defenselessness. While we have no control over woodsmoke pollution (and the attendant PM 2.5) coming from afar, we have the power to enact and enforce policies that address locally-produced woodsmoke pollution to protect our health and also mitigate climate change here in our own community, where we live and breathe."

Eli Dueker, Associate Professor of Environmental Studies and Biology, Director of the Bard Center for Environmental Sciences and Humanities (www.cesh.bard.edu): "This unprecedented partnership with the city of Kingston is a model for Hudson Valley cities building resiliency in the face of climate change. By monitoring of our own air quality, we, as a community, can together make decisions about the air we breathe. As last year's Canadian wildfire smoke reminded us, we cannot take clean air for granted. The air we breathe relates directly to our health, and it is important that we as a community ensure that everyone has access to clean, healthy air. Each of us can contribute to this effort, by making decisions about what we contribute to the air, including respecting city laws related to outdoor woodburning in city limits, decreasing indoor woodburning (particularly during inversion events), biking and walking more, and participating in city-led efforts to move to sustainable (and less polluting) energy sources and further climate-proof our city."

The Center for the Environment Sciences and Humanities at Bard College, in collaboration with KAQI, has been working on a handful of air quality related projects centralized around community needs and concerns. These include:

- Developing a publicly-accessible atmospheric inversion monitoring system for the Kingston area.
- Neighborhood-level air quality monitoring, through the fast-developing Hudson Valley Library Air Quality Network. Using outdoor real-time air quality monitoring devices stationed at public libraries, air quality data is free and accessible online. We are always looking for new locations throughout the Hudson Valley to add to the network and provide more localized data for residents. If any libraries are interested, please reach out to csl@bard.edu.
- In partnership with SUNY-Albany, conducting indoor and outdoor air quality monitoring in homes with woodsmoke, mold and structurally-related air quality challenges.

For more information or ways to get involved, please visit https://kingston-ny.gov/airquality or https://cesh.bard.edu/kingston-air-quality-initiative-kaqi/.
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About Bard College
Founded in 1860, Bard College is a four-year, residential college of the liberal arts and sciences located 90 miles north of New York City. With the addition of the Montgomery Place estate, Bard's campus consists of nearly 1,000 parklike acres in the Hudson River Valley. It offers bachelor of arts, bachelor of science, and bachelor of music degrees, with majors in more than 40 academic programs; graduate degrees in 13 programs; eight early colleges; and numerous dual-degree programs nationally and internationally. Building on its 163-year history as a competitive and innovative undergraduate institution, Bard College has expanded its mission as a private institution acting in the public interest across the country and around the world to meet broader student needs and increase access to liberal arts education. The undergraduate program at our main campus in upstate New York has a reputation for scholarly excellence, a focus on the arts, and civic engagement. Bard is committed to enriching culture, public life, and democratic discourse by training tomorrow's thought leaders. For more information about Bard College, visit bard.edu.

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