THE WORST AIR QUALITY IN CHICAGO IN RECENT HISTORY: A LOOK AT THE 27-29 JUNE 2023 AIR QUALITY EVENT

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MOTIVATION FOR CROCUS

- Numerous studies pertaining to air quality in the Chicagoland area show unequal distribution of risk.
  - Hispanics and Blacks are disproportionally affected by poor air quality (King 2014), (Illgner & Lad 2022), (Esie et. al, 2022), (Cisernos et. al, 2017)
  - Poorer neighborhoods often have worse air quality and improper measurement equipment. More measurements are therefore needed. (Illgner & Lad 2022)
- This project emphasizes impacts from climate change and environmental justice on poorer neighborhoods.
  - Neighborhood-by-neighborhood emphasis is given in this project to help determine environmental justice impacts.
- Multiple sensors are to be placed throughout Chicago. Data from this study were collected from node deployed at Northeastern Illinois University (NEIU).

Figure 1 (Above): CROCUS sensor currently deployed at Northeastern Illinois University.

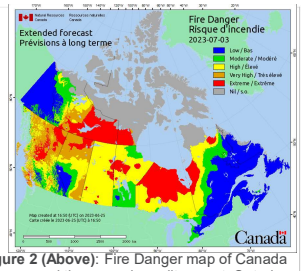

Figure 2 (Above): Fire Danger map of Canada from around the poor air quality event. Ontario and western Quebec remained under extreme fire risk. (Natural Resources Canada)

THE EVENT

On 27 June 2023, a plume of Canadian wildfire smoke came southward to the Chicagoland area, bringing with it dangerous levels of $PM_{2.5}$.

CAUSE OF EVENT: CANADIAN WILDFIRES

- Eastern Ontario and Quebec experienced their worst wildfire episode in recent history during the summer of 2023.
  - More hectares of land were burned in 2023 than any other year (NASA 2023).
  - During average year, 2.1 million hectares are burned. 18.4 million hectares this year (NASA 2023).
- Looking into the future, events like these are only expected to increase because of climate change (Paddison 2023).

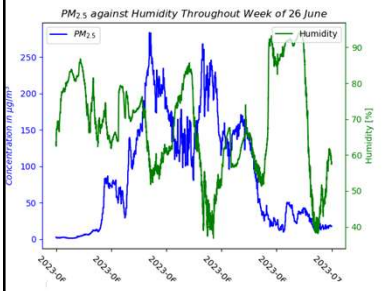

Figure 3 (Left): $PM_{2.5}$ against humidity. Large drops in humidity can be seen during peak $PM_{2.5}$ concentrations.

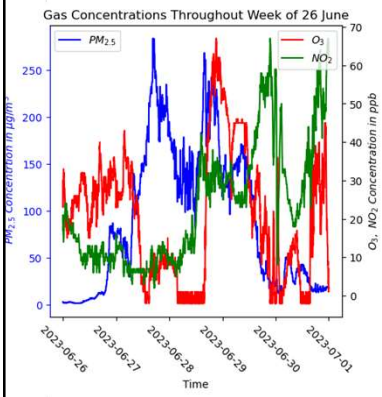

Figure 4 (Left): $PM_{2.5}$ displayed alongside O_3 and NO_2. During peak $PM_{2.5}$ concentrations, other gas concentrations are shown to be low.

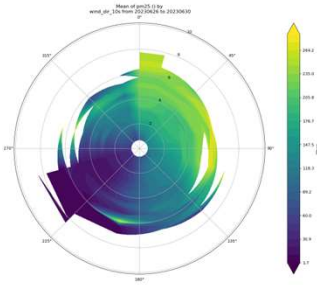

Figure 5 (Left): A windrose plot of $PM_{2.5}$ against wind speed and direction. High levels of $PM_{2.5}$ can be seen when winds come from the north and east, the direction of the wildfires.

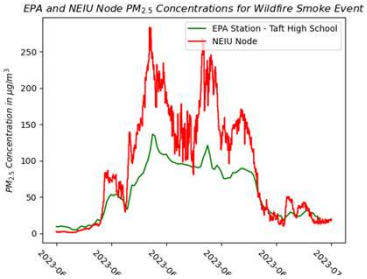

Figure 6 (Left): NEIU sensor displayed against an EPA station data from 3 miles away. NEIU sensor is shown to be much more sensitive than EPA station.

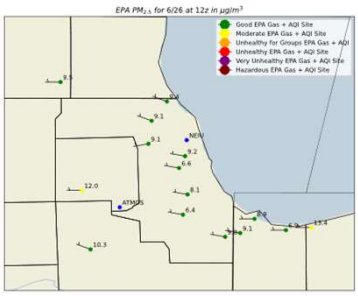

Figure 7 (Left): Chicagoland area EPA $PM_{2.5}$ data from 7am CDT on 26 June, before the smoke plume moved in. Winds can be seen coming from the west.

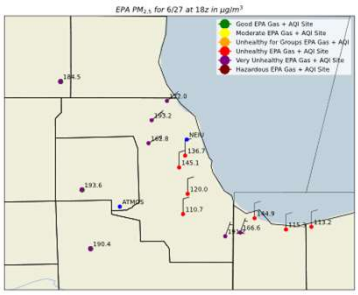

Figure 8 (Left): Chicagoland area EPA $PM_{2.5}$ data from 1pm CDT on 27 June, after the smoke plume had moved in. Winds are from the north, with highest concentrations displaying easterly wind component.

IMPACT

- Dangerous levels of $PM_{2.5}$ can cause serious health risks:
  - Cardiovascular System (Hamanaka & Mutlu 2018)
  - Central Nervous System (Hamanaka & Mutlu 2018)
  - Obesity and Diabetes (Hamanaka & Mutlu 2018)
- Not all neighborhoods had the same amount of $PM_{2.5}$.
- Not all neighborhoods handle increased amounts of $PM_{2.5}$ in the same way.
  - Important to take socioenvironmental factors into account.

FUTURE DIRECTIONS

- More nodes are to be deployed to gather more data – up to 21 throughout Chicagoland area.
  - CROCUS nodes are much more sensitive to little changes, necessary for analysis.
- Important to consider all socioeconomic factors
  - Talk to people on the south side to see how they responded/reacted to poor air quality event
  - Might not have proper ventilation, enhancing effects.
- Not just air quality! Sensors can also be used for other climate impacts like flooding.
  - Chatham on the south side of Chicago floods much more often than Evanston, for example.
- Now have the tools and notebooks to perform analyses like these in the future.

Cisneros R. et. al, Journal of Environmental and Public Health, 2017; Esie P. et. al, American Journal of Public Health, 2022, 112, 1765-1773; Hamanaka R. & Mutlu, G. Front Endocrinol, 2018, 9; Illgner T. & Lad N. Front Public Health, 2022, 10; King, K. Population and Environment, 2013, 37, 1-21; NASA, 2023. Paddison, L. CNN, 2023.

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To see more information about CROCUS and the code used to make the plots seen here, scan this link!

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