Identifying Census Tracts for PM2.5 Monitoring in the Joliet IL Area Using the CVI Tool and Local Data

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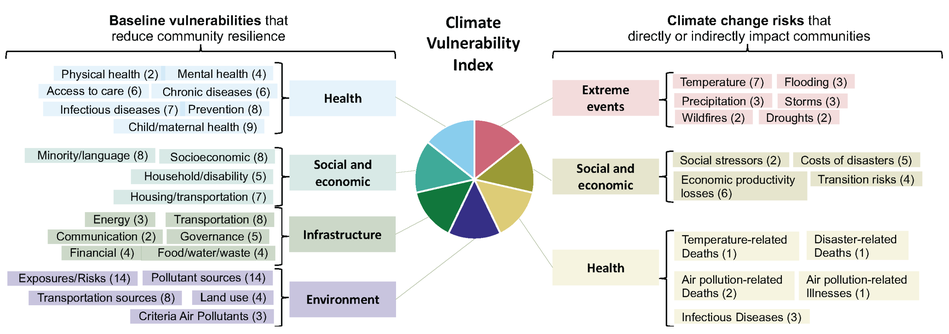
Background

The Joliet area in Will County, IL, is an urban area southwest of Chicago that has much heavy industry, refineries, natural gas-fired power plants, and increasing numbers of warehouses. This area is also located on a major transportation and shipping corridor with several interstate highways, several major rail lines, a ship canal, and an intermodal system that is the largest inland container port in North America. Among these are a number of environmental justice (EJ) communities with high social vulnerability and low socioeconomic status. Led by a community partner, Warehouse Workers for Justice (WWJ), we were engaged in a pilot air quality study of PM2.5 using PurpleAir sensors in the summer of 2021 in four communities in the Joliet area.[1] We found that these communities had elevated PM2.5 concentrations (moderate or above) on more than a third of days, with many other days falling just below the EPA threshold between good and moderate (but above the more stringent World Health Organization standards for PM2.5). This pilot study also included a truck counting and PM2.5 air quality monitoring using handheld AirBeam sensors by community volunteers at two locations along a busy truck route during 2 hour windows during AM and PM rush hours. Following this pilot study, WWJ, with Lewis as a sub-awardee, applied and was selected for an EPA ARP Enhanced Air Quality Monitoring Grant to expand PM2.5 air quality monitoring to as many as 20 sites in Joliet, Elwood, and the I&M Ship Canal Corridor (Bolingbrook, Crest Hill, Lockport, Romeoville, and unincorporated Fairmont) in Will County.

While EJScreen[2] was primarily used to identity priority census tracts for expanded air quality monitoring in preparing the grant and for the QAPP, we did a complementary study using the recently released Climate Vulnerability Index (CVI) tool and ground-truthed local warehouse data as a cross-check.

Census Tract Prioritization Using CVI

The Climate Vulnerability Index,[3] developed by the Environmental Defense Fund (EDF) and Texas A&M with input from stakeholders across the country, is a mapping tool that shows EJ disparities across the country and provides detailed information about specific vulnerabilities that make communities susceptible to climate threats. The CVI incorporates 184 data sets that include health, socioeconomic, environmental, infrastructure, and climate data to provide an overall vulnerability ranking of more than 70,000 census tracts as well as grouped (e.g. "Health" or "Infrastructure") rankings and individual input rankings. All data are available for download.

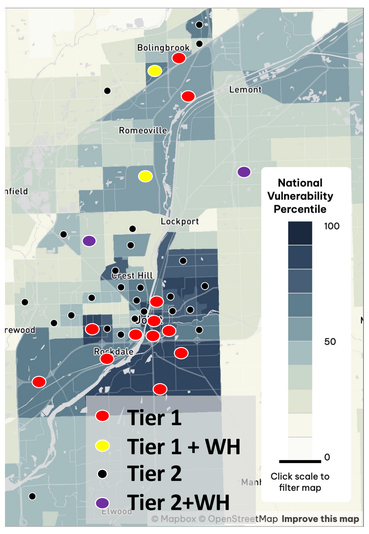


To prioritize census tracts of interest for PM2.5 monitoring we focused on a subset of 12 CVI data sets selected by taking local factors into account.

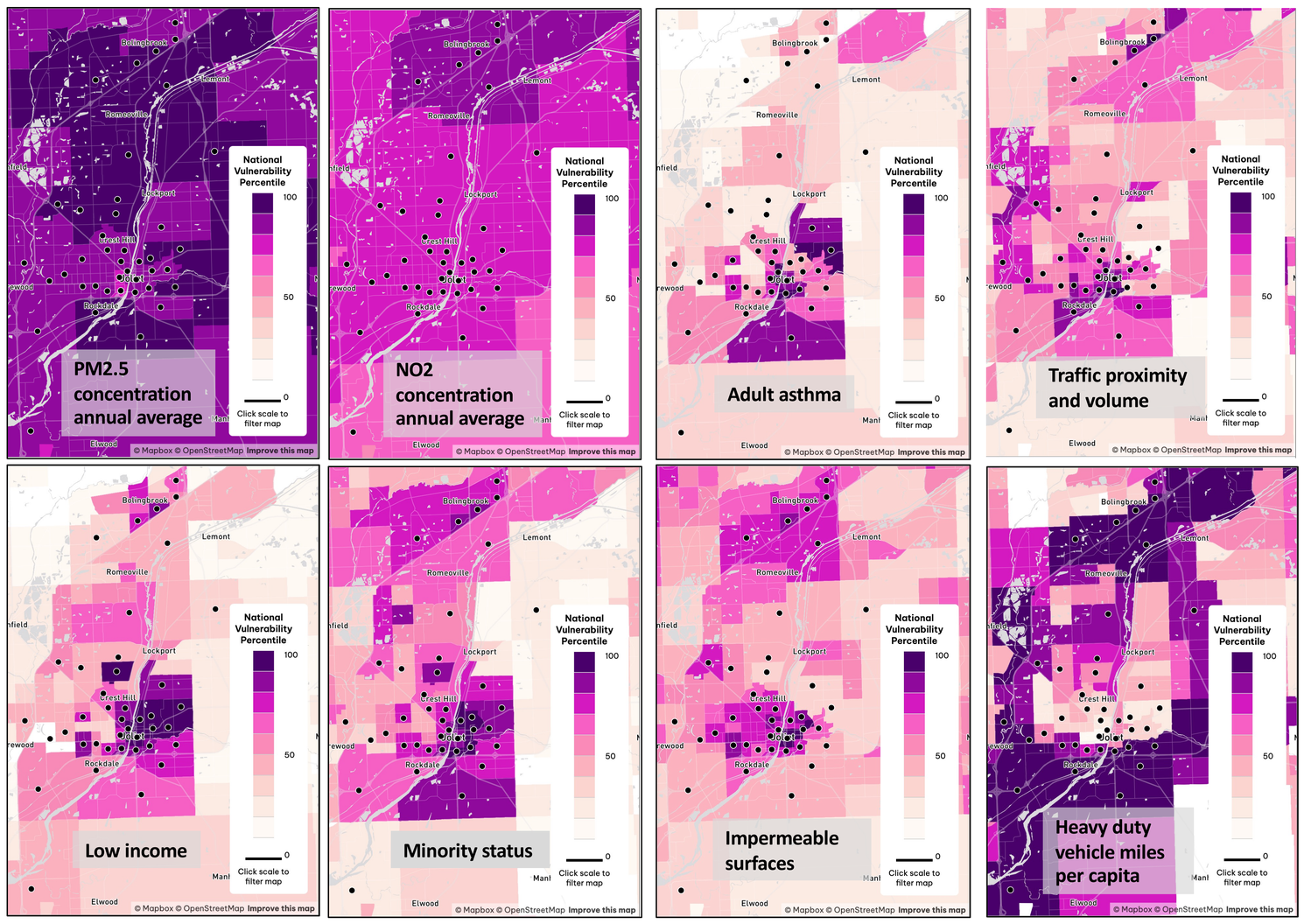
- *Health:* Adult asthma*
- *Social & Economic:* Low income, Minority status
- *Transportation and other pollution sources:* Truck vehicle miles traveled per capita, Heavy duty vehicle miles traveled per capita*, Traffic proximity and volume*, Rail crossings, Chemical manufacturers, Metal recyclers
- *Environmental:* Annual PM2.5 concentration*, Annual NO2 concentration, Impermeable surfaces

The census tract scores, which are national vulnerability percentile rankings, were averaged, with starred items in the list given double weight, for all 151 census tracts in Will County. The top 12, all of which are in Joliet and the Canal Corridor, were prioritized as Tier 1 census tracts. The next 36 census tracts were grouped as Tier 2 based on their scores, but nine of these census tracts were omitted since they are not in the expanded PM2.5 monitoring area within the county.

Overall Climate Vulnerability from CVI Tool



Selected CVI Data Used



Eight of the twelve CVI factors used to determine priority census tracts. The overlayed dots represent Tier 1 and Tier 2 census tracts with local warehouse information included.

Incorporating Warehouse Data

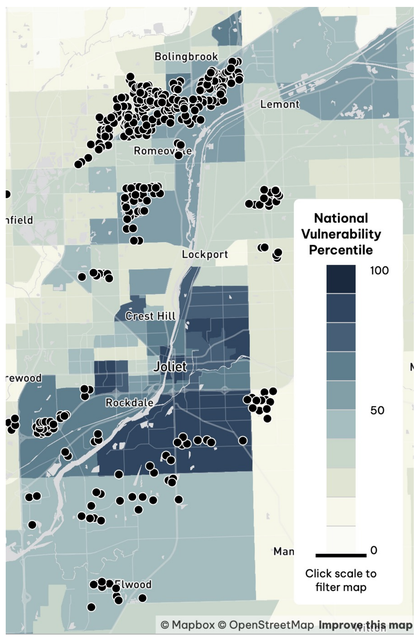
The number of warehouses in Will County is increasing rapidly, which increases truck traffic and reduces green space. This is an important local factor to consider for Joliet and the Canal Corridor. We used satellite images from Google Maps and ground truthing to collect data on warehouses in Will County. We grouped the warehouses in each census tract by estimated size into five size categories and calculated a weighted warehouse count (WC):

$$WC = \sum_{i=1}^{5} w_i c_i$$

where c_i is the number of warehouses in a size category and w_i is the weighting factor for that category.

We then defined the data set Weighted Warehouse Count per Area ($WC/Tract\ Area$) for each census tract, ranked the census tracts in Joliet and the Canal Corridor, and averaged this data set with the 12 CVI data sets.

When accounting for warehouses, two Tier 2 census tracts moved into Tier 1, and two census tracts that initially fell outside Tier 2 moved into Tier 2.

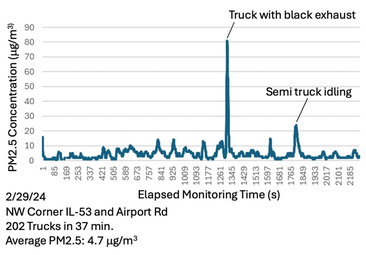


Warehouses overlayed on the Overall Climate Vulnerability map

	Estimated Size	Weighting Factor (w)
Small	<100,000 sq. ft.	0.5
Medium	100,000 – 250,000 sq. ft.	1.75
Large	250,000 – 500,000 sq. ft.	3.75
Extra-Large	500,000 – 1,000,000 sq. ft.	7.5
Extra-Extra-Large	>1,000,000 sq. ft.	15

Future Work

- Incorporating more localized data with the CVI data to provide communities with the information they need to advocate for funding and/or changes they would like to see in their communities to mitigate the risks from climate change.
  - Local truck counting and idling data
  - Mobile air quality and heat monitoring
  - Data from stationary air quality sensors



- Using more granular remote sensing air quality data from TEMPO
  - TEMPO's resolution would allow for the area covered by city of Joliet alone to be divided into 16 pixels.

Acknowledgements

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[1] M. Lisle, Y. Kalmyka, and J. Kozminski, (2022) *For Good Jobs and Clean Air: How a Just Transition to Zero Emission Vehicles Can Transform Warehousing.* Warehouse Workers for Justice Report. https://www.ww4j.org/uploads/7/0/0/6/70064813/wwj report good jobs clean air.pdf
[2] U.S. Environmental Protection Agency, (2024) *EJScreen: Environmental Justice Screening and Mapping Tool*. https://www.epa.gov/ejscreen
[3] Environmental Defense Fund (2024). *The US Climate Vulnerability Index*. https://climatevulnerabilityindex.org/