LADCO

Analysis of NO2 Concentrations Near Warehouse Facilities in the Chicago Region

Ethan Bledsoe, LADCO Summer Intern
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170,850
premature deaths per year are linked to NO2 exposure in the US
(Camilleri)

1.85 million
children worldwide develop asthma per year due to NO2 exposure
(Anenberg)

1,830
idling hours per year per truck
(Argonne)

Chicago Sun Times

Project Objectives

Analyzing NO2 and Wind Data

Plot wind and NO2 data around warehouse facilities

Correlate NO2 levels with wind patterns

Upwind & Downwind Analysis

Evaluate upwind and downwind of facilities

Estimate NO2 impact of facilities

Source Identification & Comparison

Identify high NO2 sources

Compare facility's impacts on NO2 levels

Data Collection

- EPA's GMAP vehicle
- Data collection dates: August 1, 2, 8, 12, 2023
- Measured parameters: NO2, ozone, meteorology
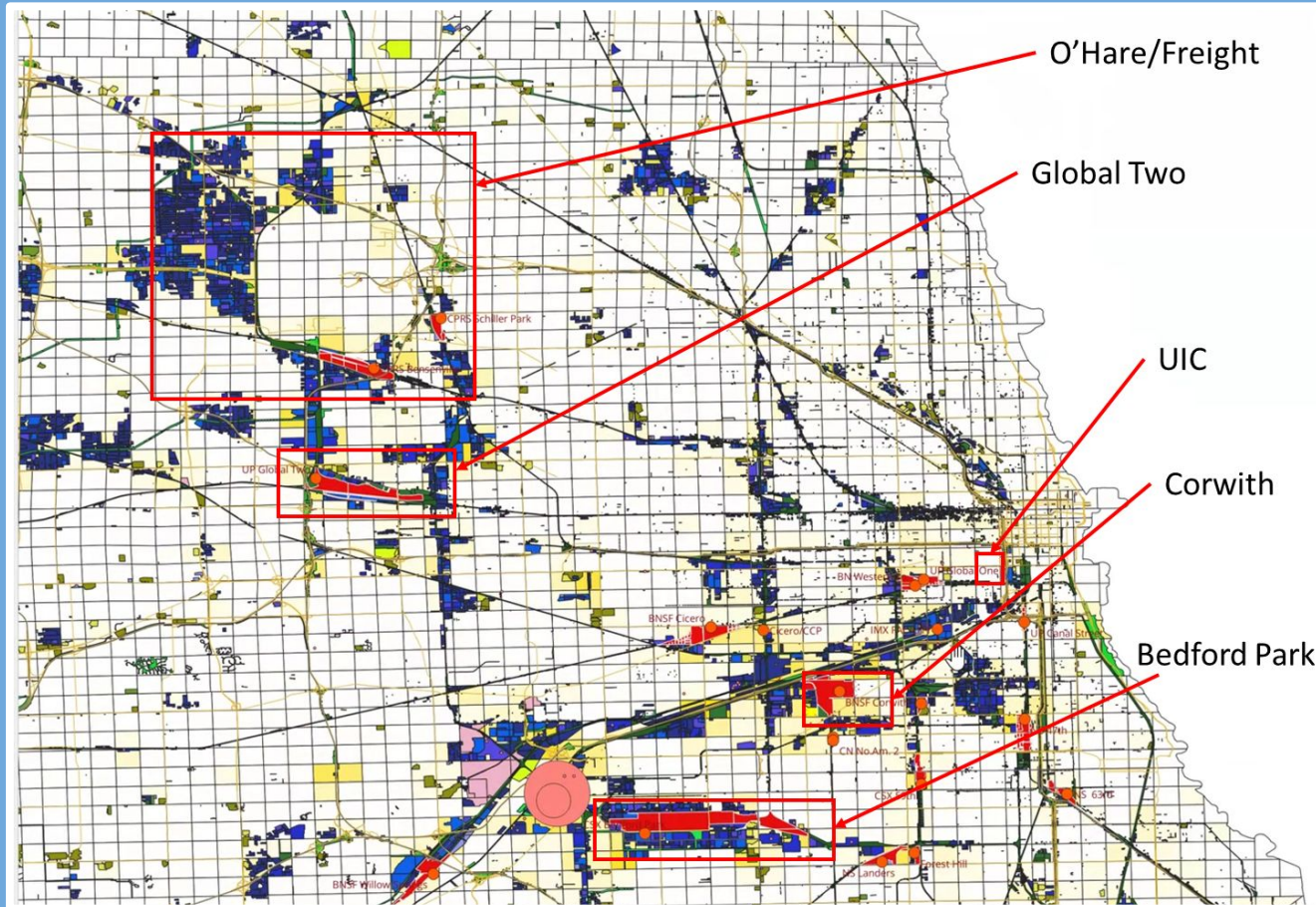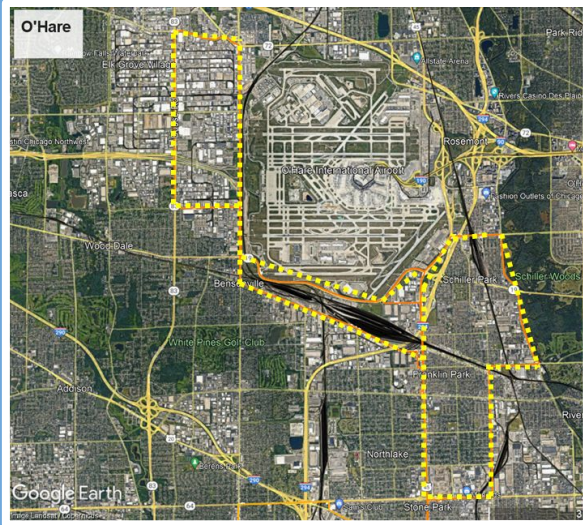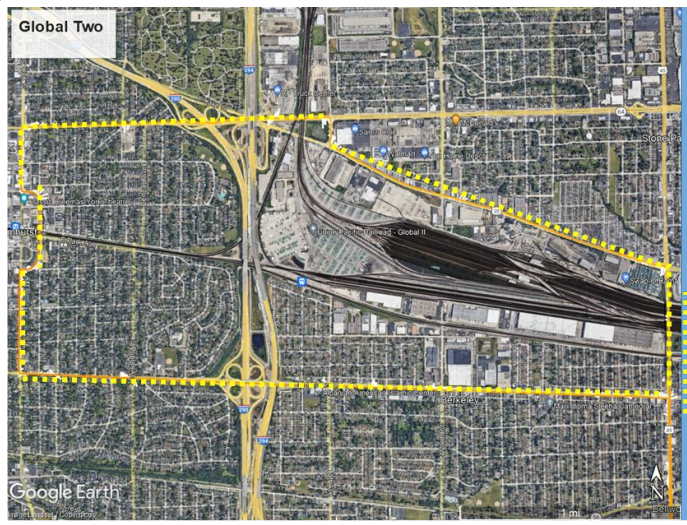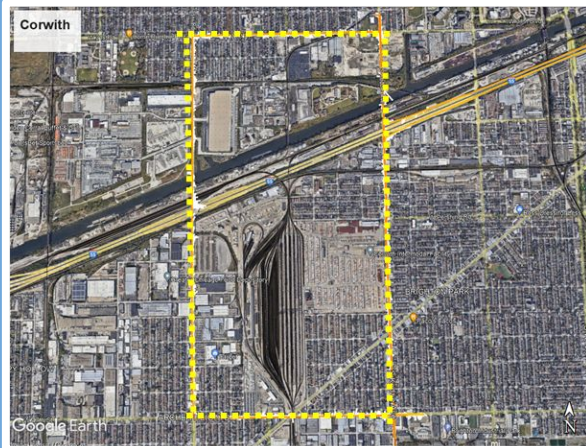- AGES+ campaign

GMAP Truck

Fuoco & Haile

Circuits per Facility

	Number of circuits				
	Bedford Park	Corwith	UIC	Global Two	O'Hare
August 1	2	2	2	1	
August 2	2	2	2	1	
August 8	2	2	2		1
August 12	2	2	2		

Study Area Map

Warehouses (blue), intermodal facilities (red), and studied facilities (red boxes) (Janssen)

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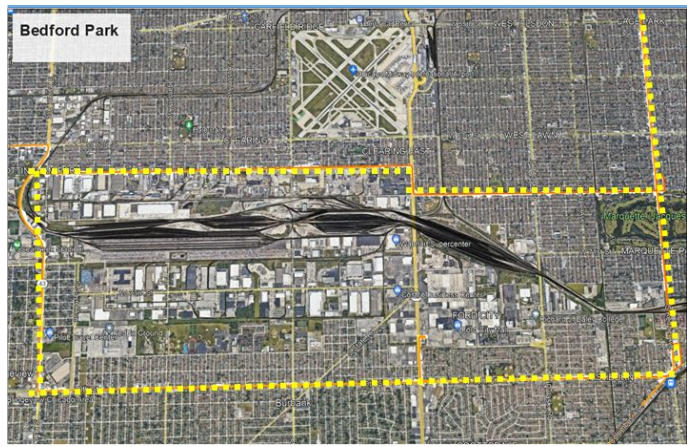
- GMAP route in yellow

Data Processing

Wind Averaging

Initial 1-second wind data too erratic

Calculated 1-minute average wind data

Geographic Data

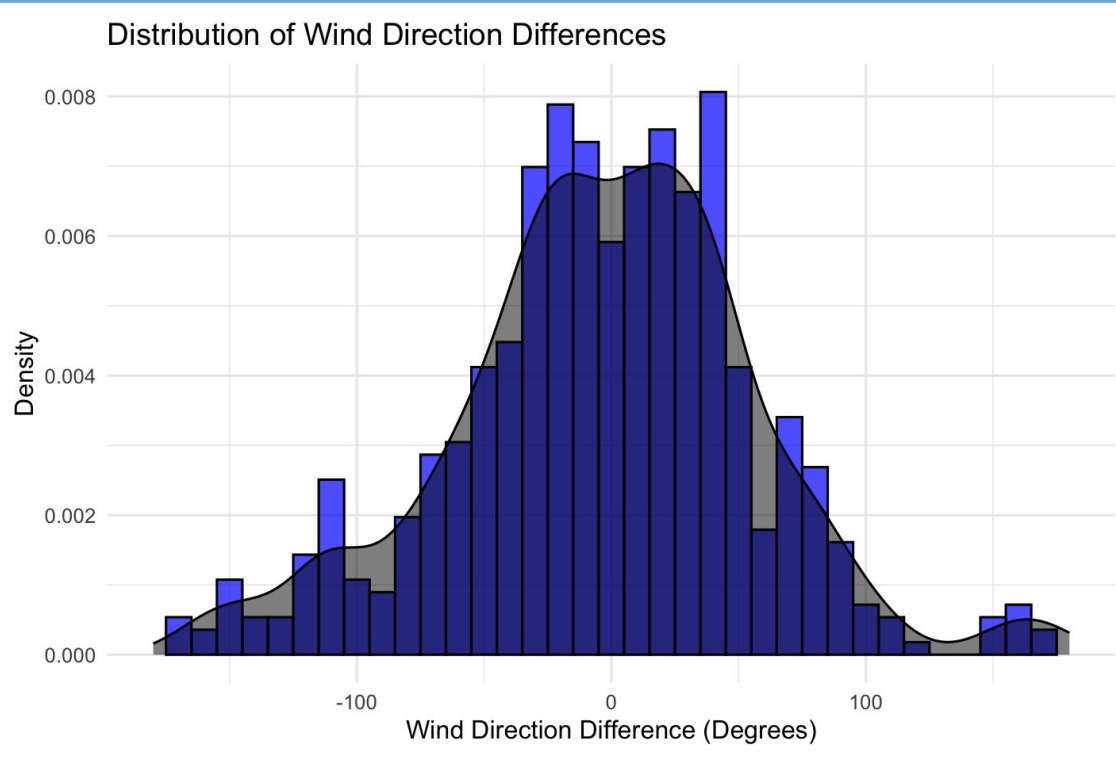Median values of latitude and longitude for each minute

Ensured consistency

Circuit Segmentation

Divided into AM and PM circuits

AM circuit covered Global Two or O'Hare

Wind Comparison

Distribution of Wind Direction Differences

GMAP wind data with NWS Midway data

1-minute wind direction differences

Most differences within ±40 degrees

Median difference: 1.48 degrees

IQR: -34.17 to 37.13 degrees

Bedford Park
Mean concentration: 22.94 ppb,
SD: 14.98 ppb

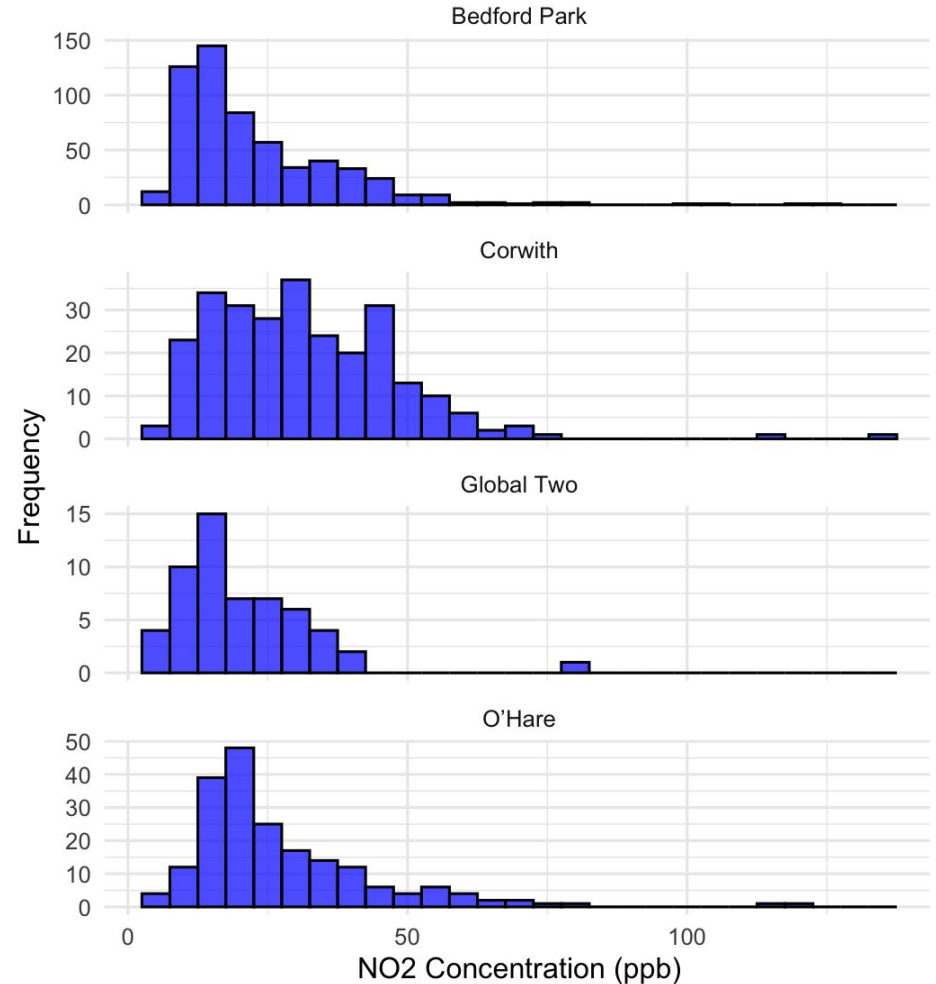**Corwith**
Mean concentration: 31.44 ppb,
SD: 16.70 ppb

Global Two
Mean concentration: 20.28 ppb,
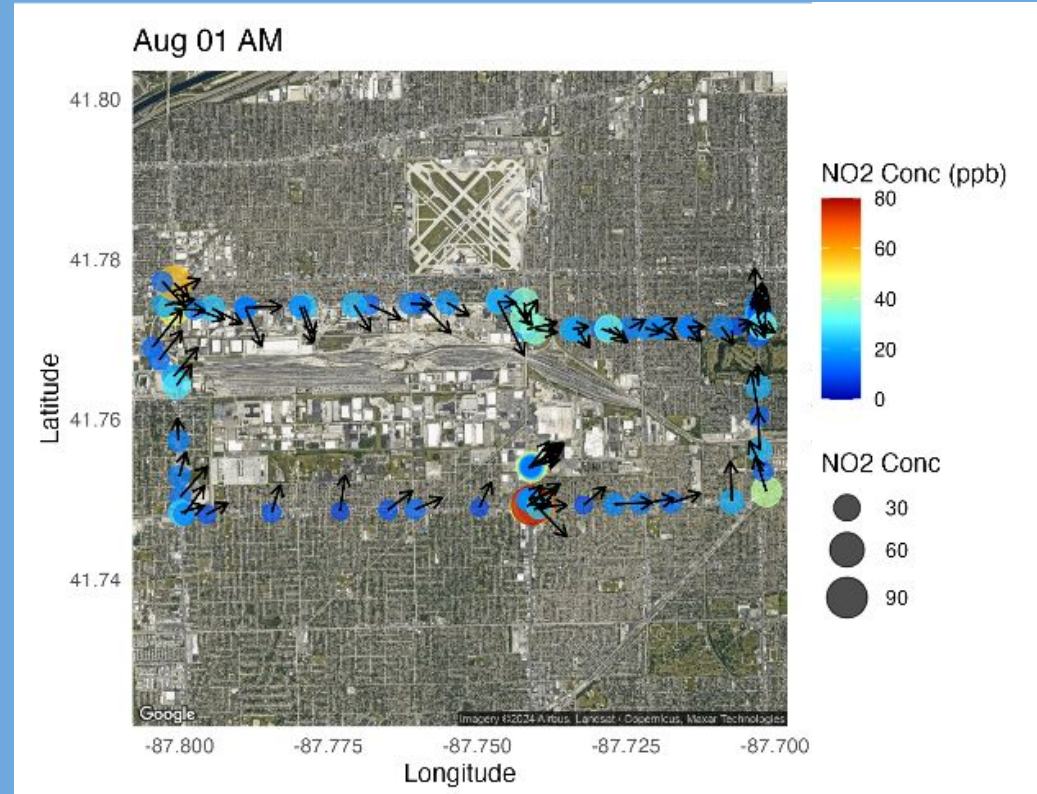SD: 12.19 ppb

O'Hare
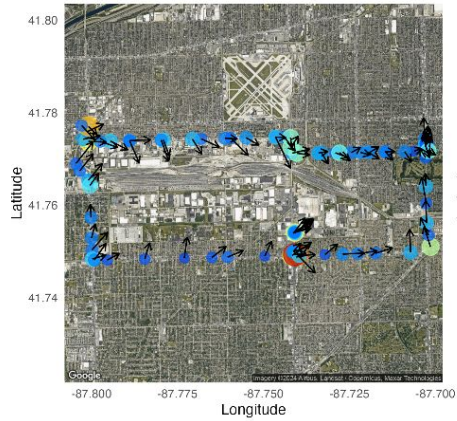Mean concentration: 27.54 ppb,
SD: 17.01 ppb

Bedford Park

- Midway Airport
- Residential areas
- Generally westerly winds
- High points in the NW and bottom-center
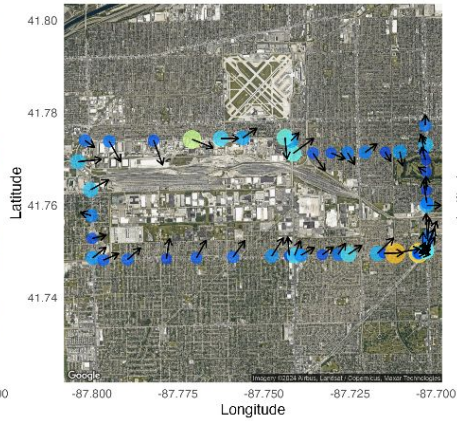- Notice the bottom right corner

Dots represent NO2 observations with color size scale. Arrows represent wind direction and speed.
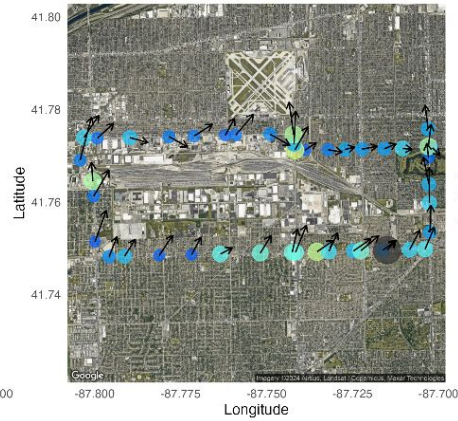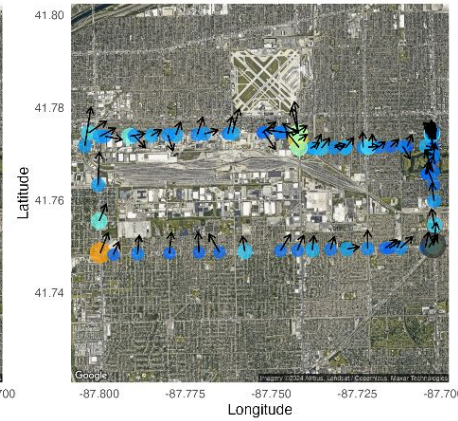
Bedford Park
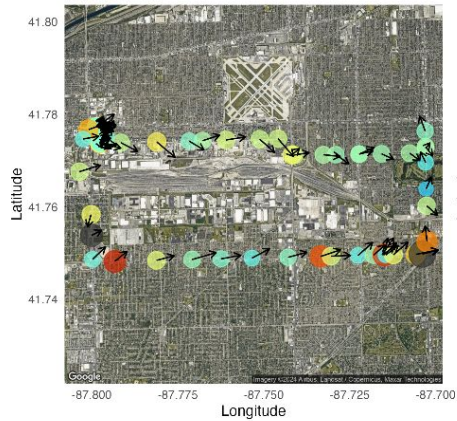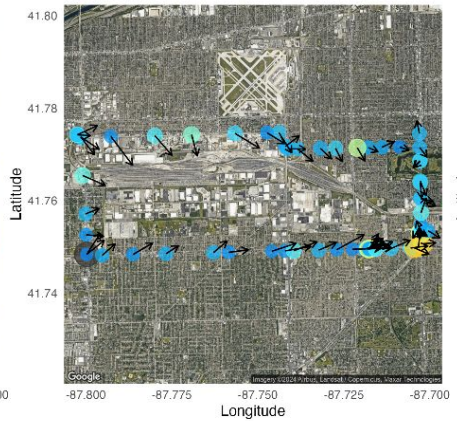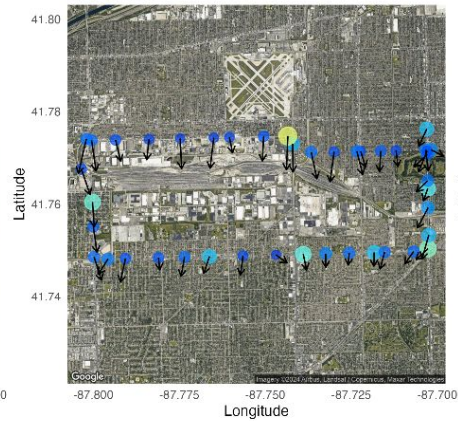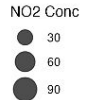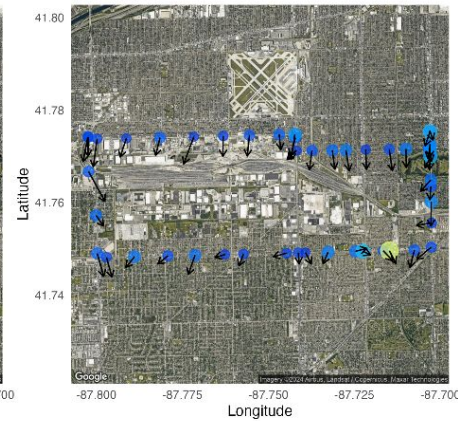
Bedford Park Close Up

Satellite view of Bedford Park highlighting St. Rita of Cascia High School (yellow box), adjacent to H&M International Transportation Intermodal facility. Red lines are the GMAP route.
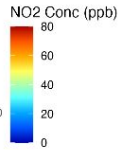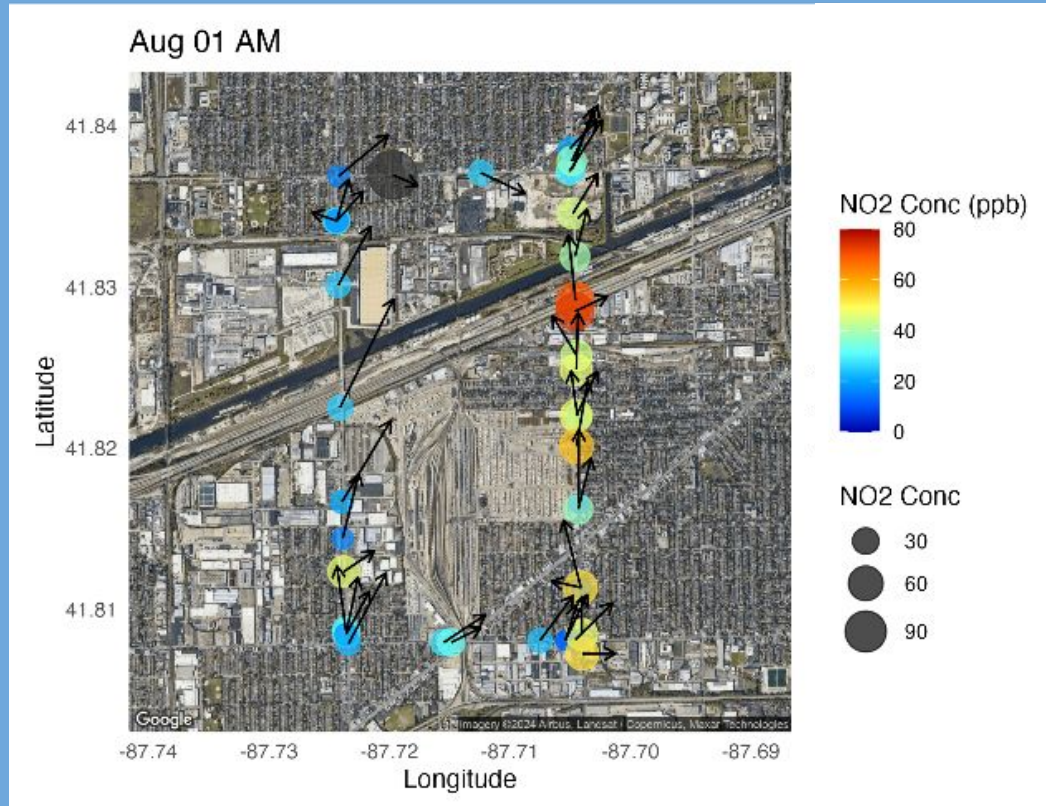
Corwith

- Residential areas
- Generally north-easterly winds
- Gray point in top left
- High point near the highway

Dots represent NO2 observations with color size scale. Arrows represent wind direction and speed.

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Corwith
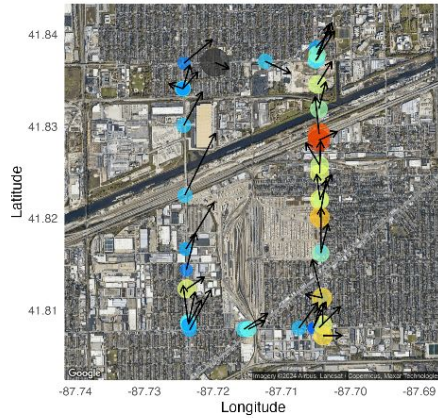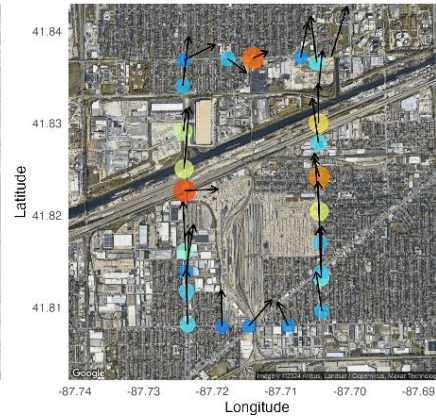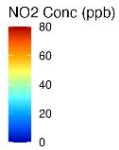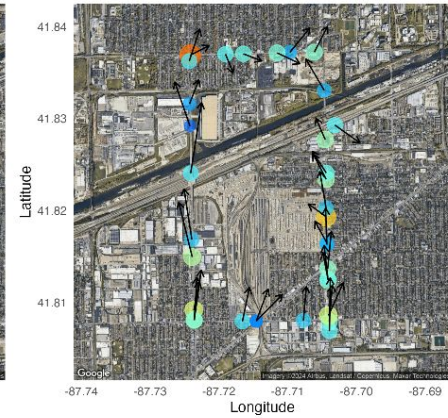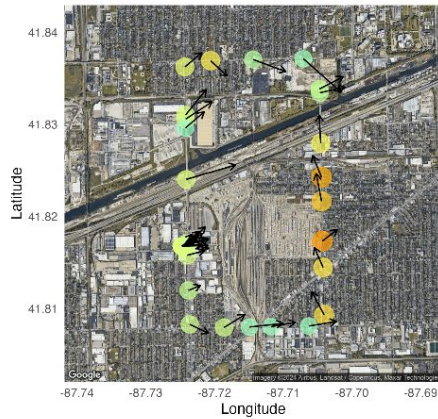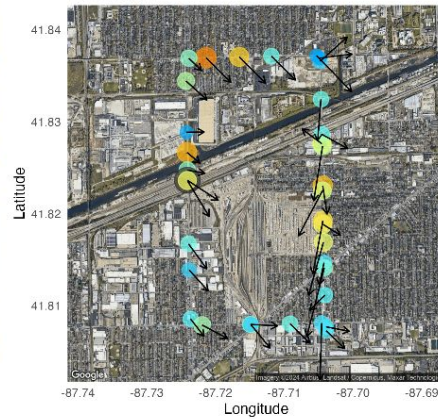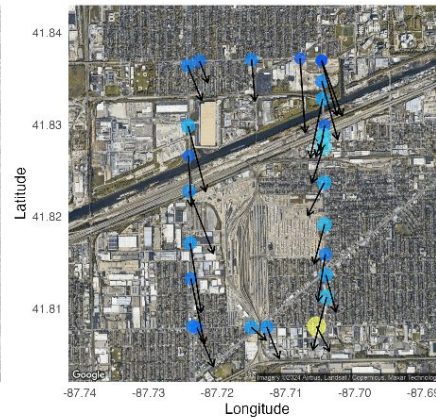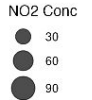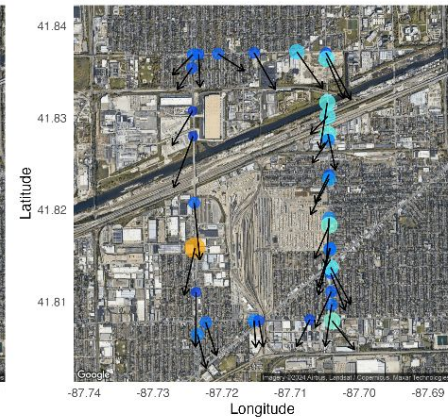
Global Two
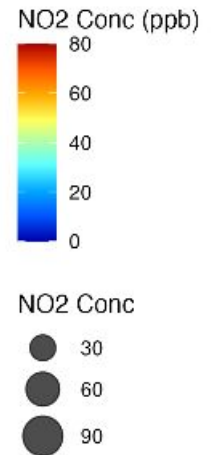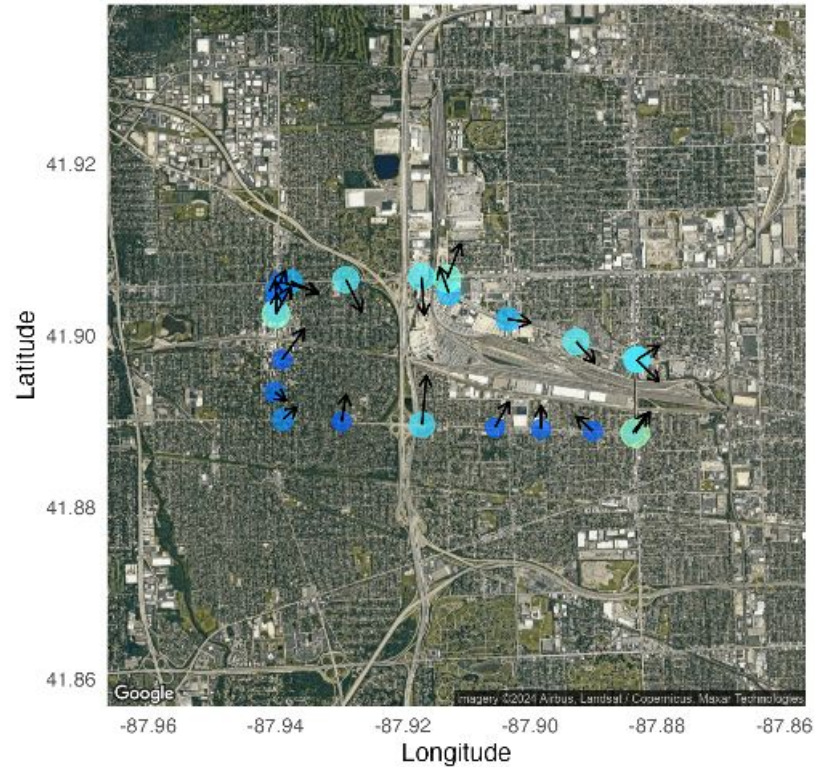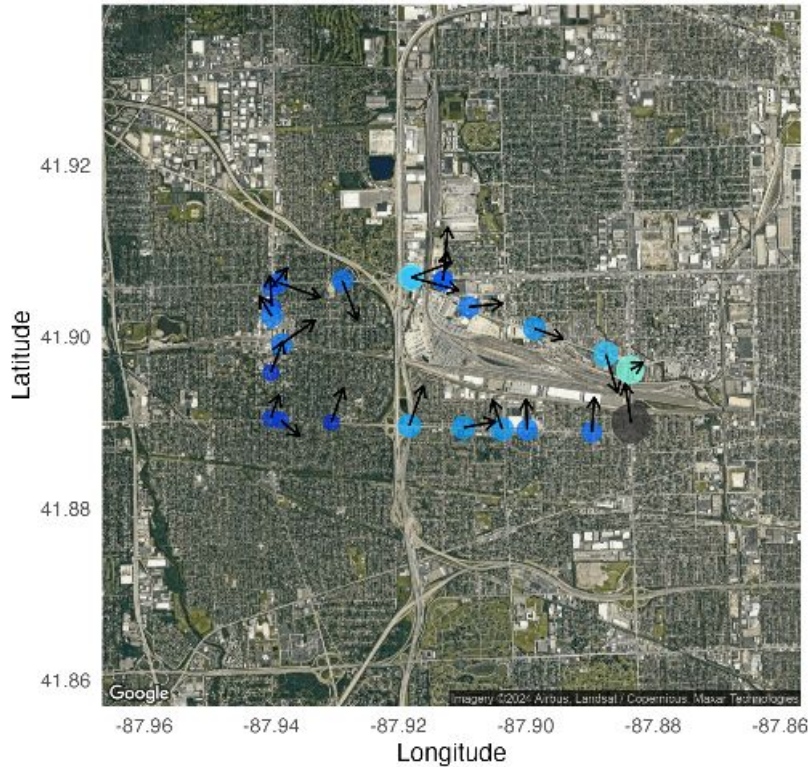
O'Hare

- Separated into West, Central, and East
- Inconsistent wind data
- High point on West
- Plane to truck intermodal facility
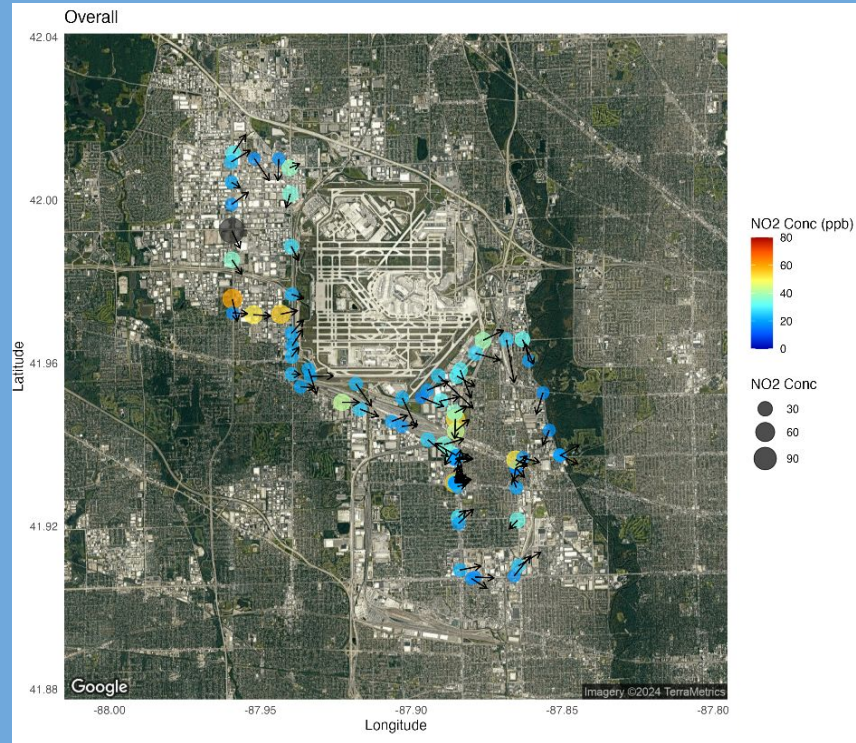
August 8 - AM Circuit

Dots represent NO2 observations with color size scale. Arrows represent wind direction and speed.
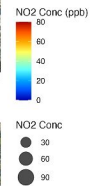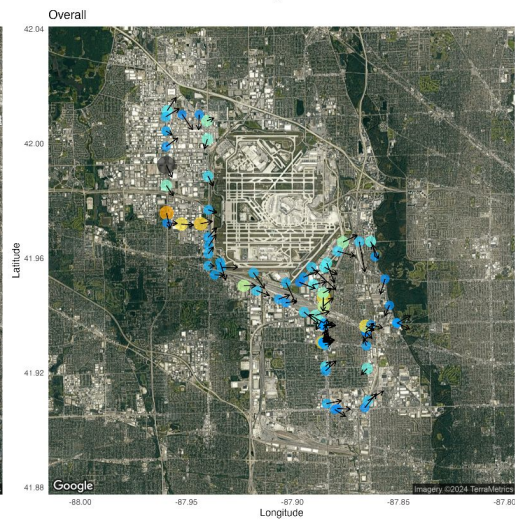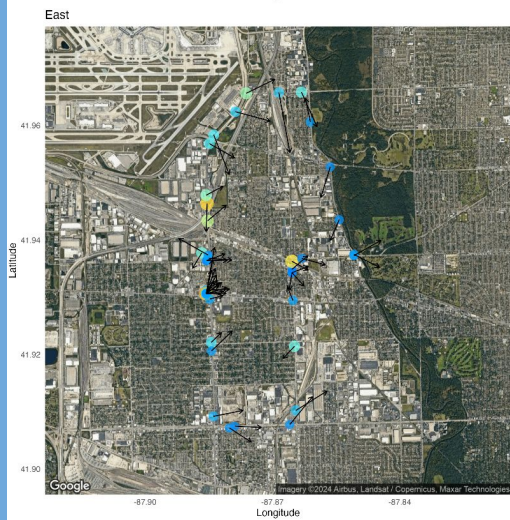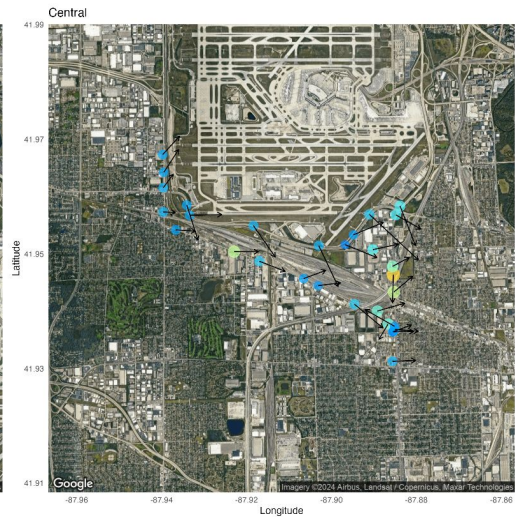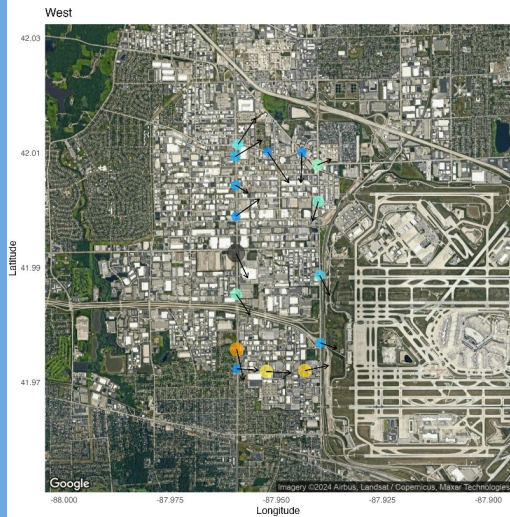
O'Hare

Upwind & Downwind Analysis
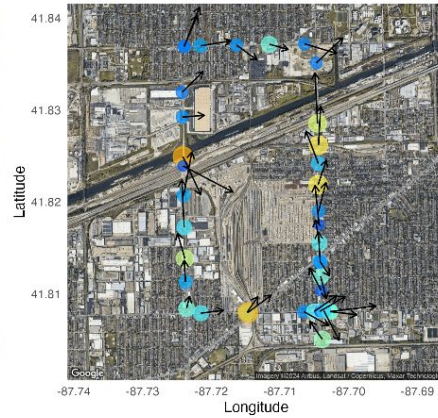
- Classify North, South, East, and West ends
- Average wind direction
- Identify upwind/ downwind sides using wind direction
- Calculate NO2 concentration averages of sides differences

Schematic illustration
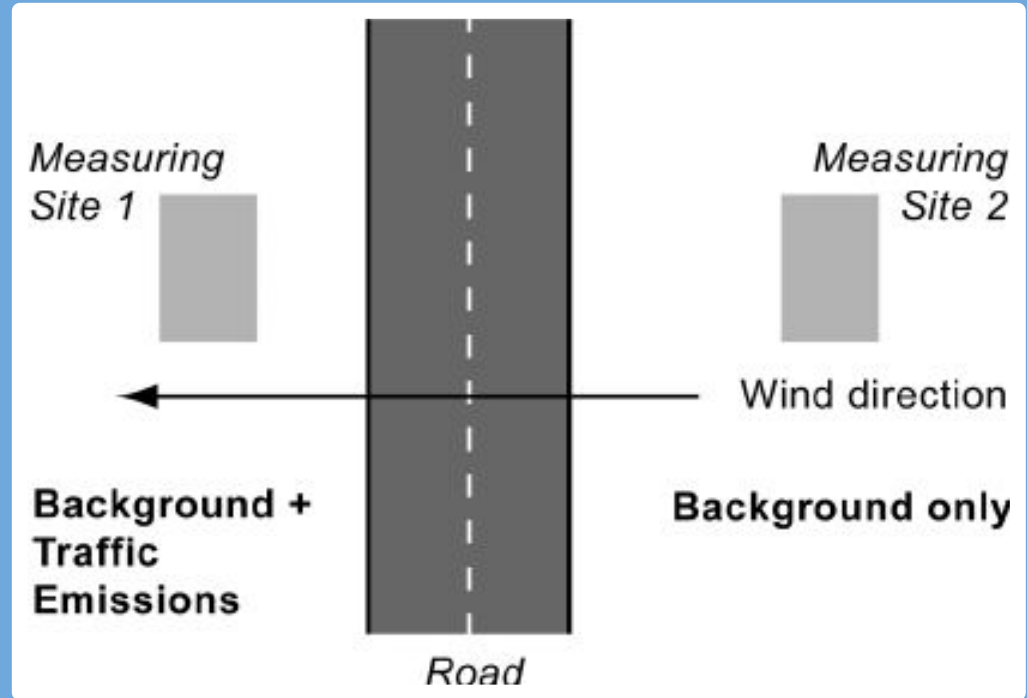
Infographic of upwind/downwind comparison from Mats Gustafsson

Upwind vs. Downwind NO2 Concentrations by Facility

Facility	Circuit	Upwind (ppb)	Down-wind (ppb)	Δ (Downwind - Upwind)
Bedford Park	AM	27.52	24.37	-3.15
Bedford Park	PM	20.16	21.30	1.14
Corwith	AM	28.94	36.33	7.39
Corwith	PM	29.76	28.79	-0.97
Global Two	AM	17.56	21.65	4.09
O'Hare West	AM	37.65	34.90	-2.75
O'Hare East	AM	21.68	25.84	4.16

Positive Δ indicates NO2 from facility

Negative Δ suggests other influences

Conclusion

- Consistent hot spots: highways, next to warehouses, and intersections
- Corwith yard consistently added NO2 to downwind air in the mornings
- Future study recommendations
  - Fewer facilities, more data collection at each facility
  - Incorporate airborne and satellite mapping (AGES+)

Caveats

- High variability in data, especially in some facilities
- Limited data on certain circuits (Global Two, O'Hare)
- Kerr et al.'s peak NO2 findings

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