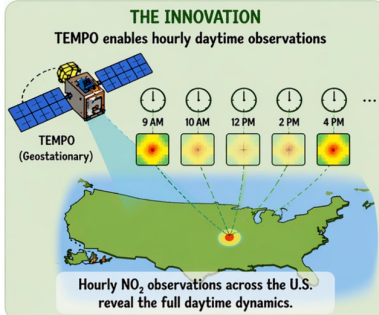
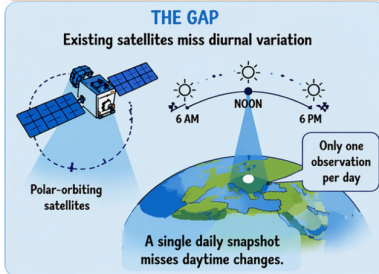
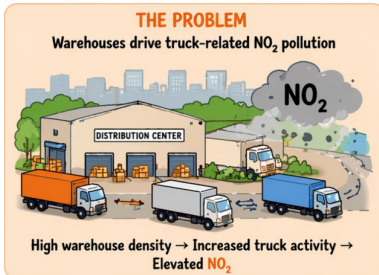


Living Next to Warehouses: Daily NO₂ Pollution Patterns around Warehouses Revealed by Satellite

Lulu Chen¹ (lulu.chen1@gwu.edu), Daniel L. Goldberg¹, Susan C. Anenberg¹, M. Omar Nawaz², Gaige H. Kerr¹

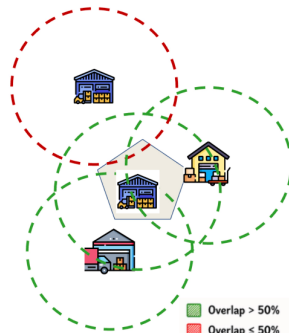
¹Department of Environmental and Occupational Health, GWU; ²School of Earth and Environmental Sciences, Cardiff University

Introduction



*Illustration generated with assistance from ChatGPT (OpenAI) and refined by the authors.

Characterizing “Warehouse Density”



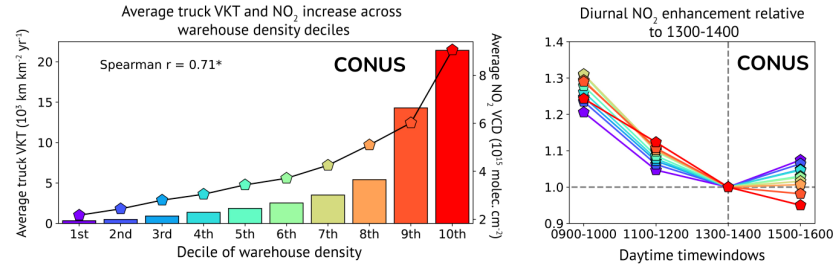
Creating a 7 km buffer around each warehouse

In each census tract, identifying intersecting warehouse buffers

Defining “warehouse density” as number of warehouse buffers that overlap at least 50% of the census tract area.

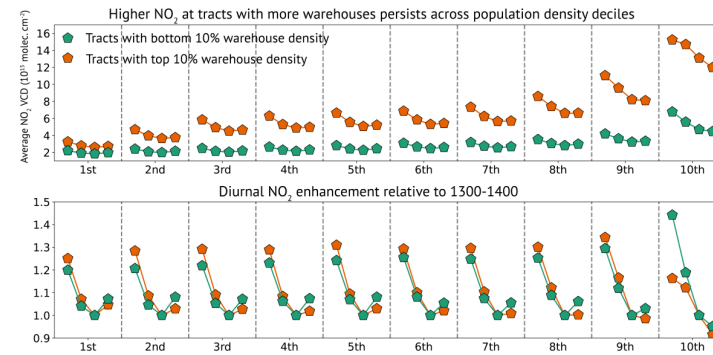
In this example, warehouse density for this tract is 3.

Warehousing Activities Lead to Higher NO₂ Levels and Distinct NO₂ Daytime Variation



TEMPO VCD: Aug 2023-July 2024
VKT: Vehicles Kilometers Travelled
In tracts with **higher warehouse density**:

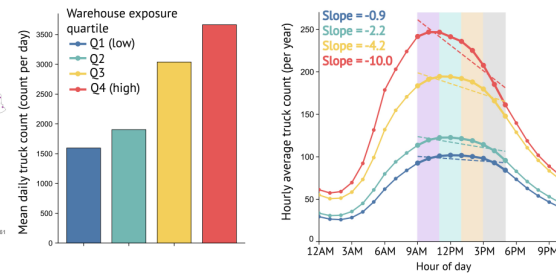
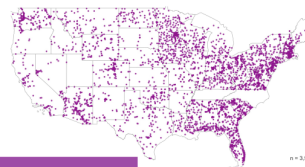
- Higher NO₂ daytime pollution.
- Morning enhancement.
- Absence of afternoon recovery.



- We stratified all CONUS tracts into 10 deciles based on **population density**.
- In each decile, we further identified the **top 10%** and **bottom 10%** of tracts based on **warehouse density**.
- Across all deciles, **tracts with higher warehouse density**:
 - consistently exhibit higher NO₂;
 - have different NO₂ daytime variation.

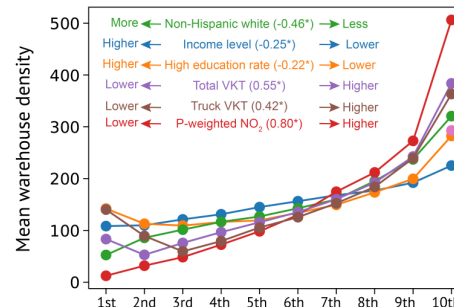
Truck Activity Explains Elevated and Diurnally Declining NO₂ Near Warehouses

TMAS stations monitor traffic 24/7 and classify vehicle types (n=3961)



Higher NO₂ near warehouses is driven by **increased truck activity**, which **declines throughout the day**—more sharply in warehouse-dense areas.

Higher Warehouse Density in Socioeconomically Disadvantaged Communities



Tracts with **higher warehouse density** tend to have:

- Less non-Hispanic White residents;
- Lower median household income;
- Less people with university degree or higher education;
- Higher total VKT and truck VKT;
- Higher population-weighted NO₂.