High-resolution datasets aid in assessing public health damages and environmental injustices from NO_2

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With thanks to…

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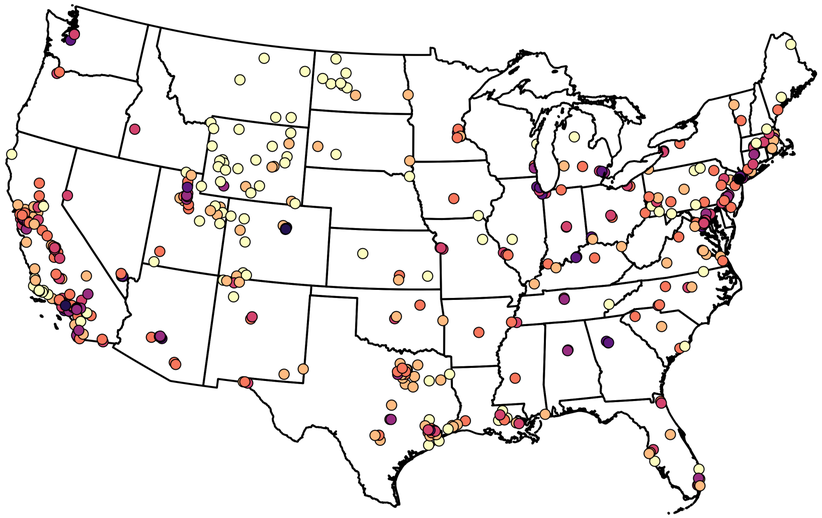
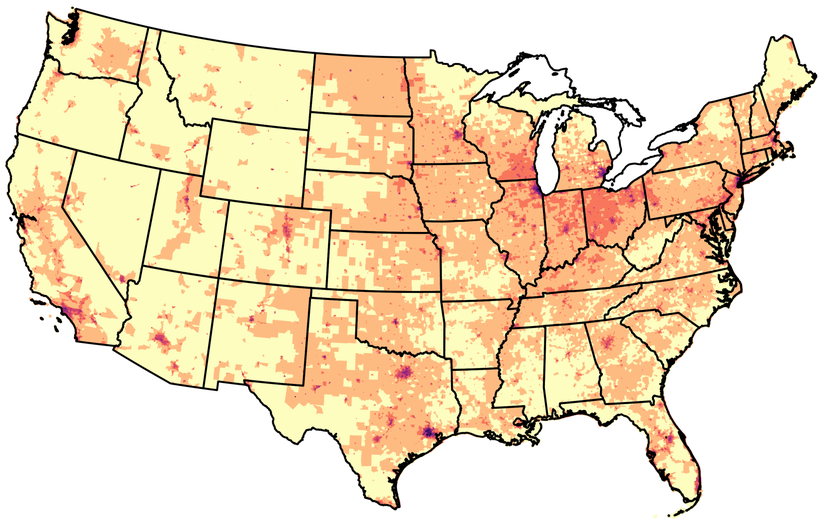
An arsenal of tools is available to aid in assessing gradients in population exposure to and health effects of NO_2

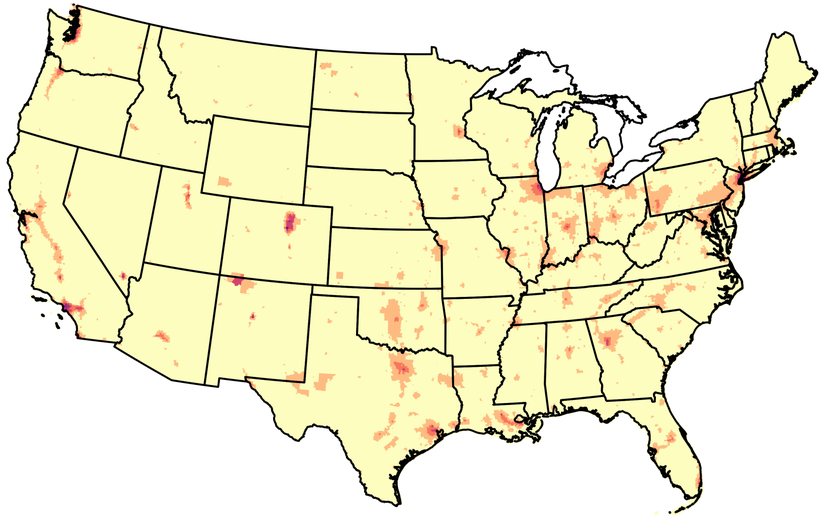
in-situ monitors (approx. 450 total)



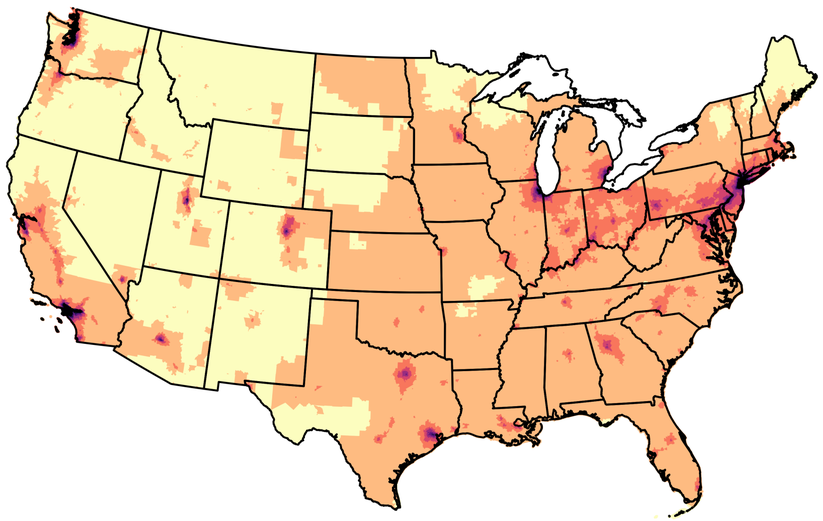
Statistical models (1 km²)



Geophysical models (12km²)

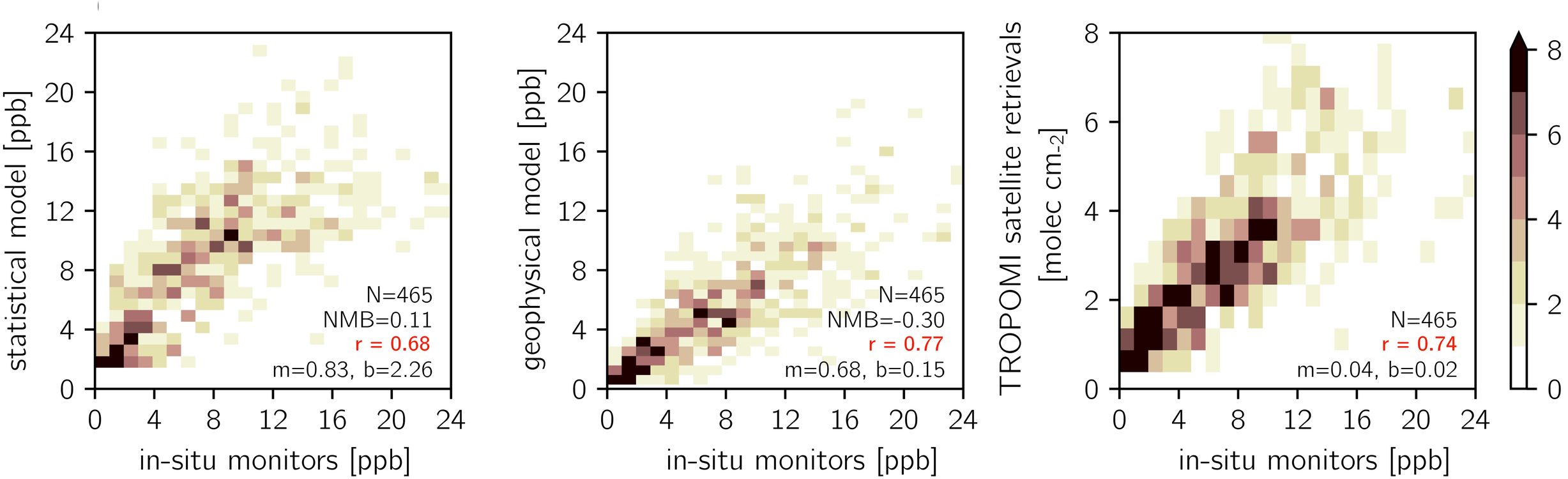


TROPOMI satellite retrievals (1 km²)



Source: Kerr et al. (in prep.)

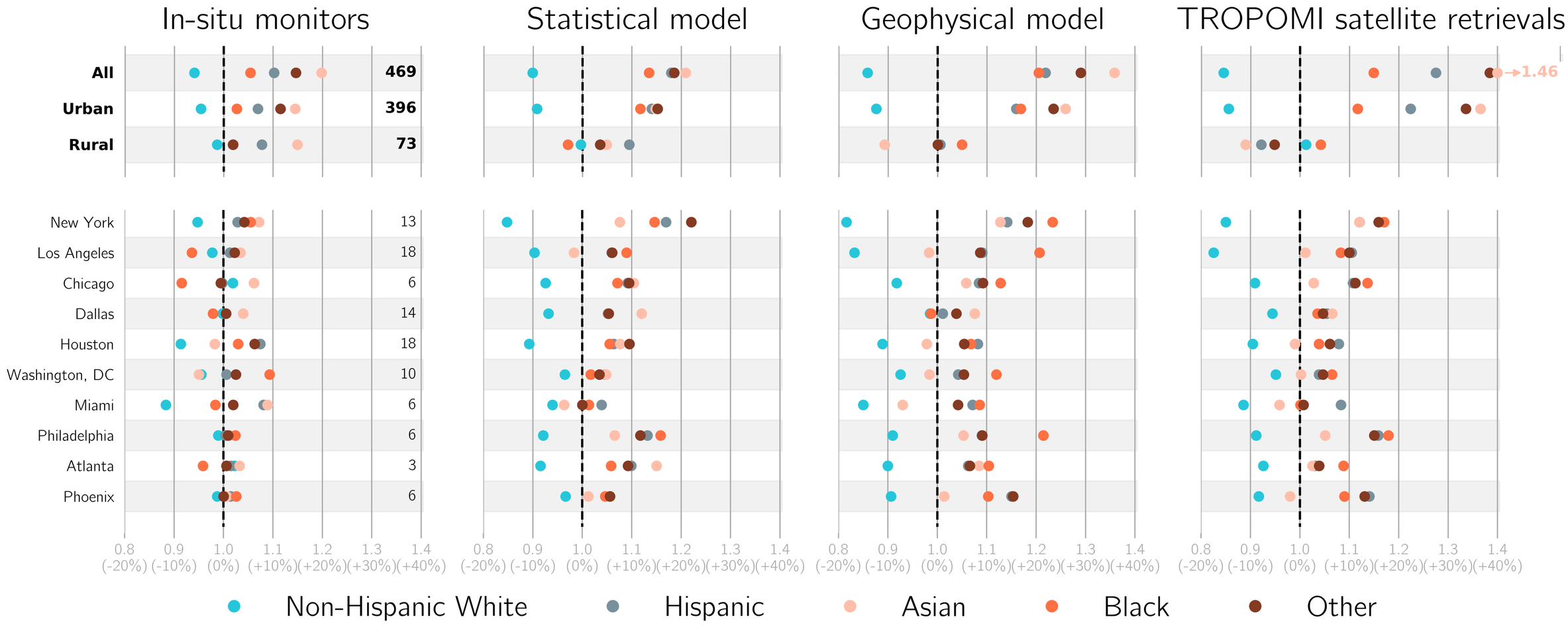
Spatially-complete model and satellite datasets capture observed concentrations while filling gaps over unmonitored regions



Despite statistical and geophysical models estimating surface-level NO_2 and TROPOMI empirically measuring tropospheric NO_2 columnar densities, these datasets have a high degree of agreement with in-situ monitors ($r \approx 0.7$).

Source: Kerr et al. (in prep.)

Spatially-complete model and satellite datasets lead to consistent findings regarding NO_2 inequality unlike in-situ monitors



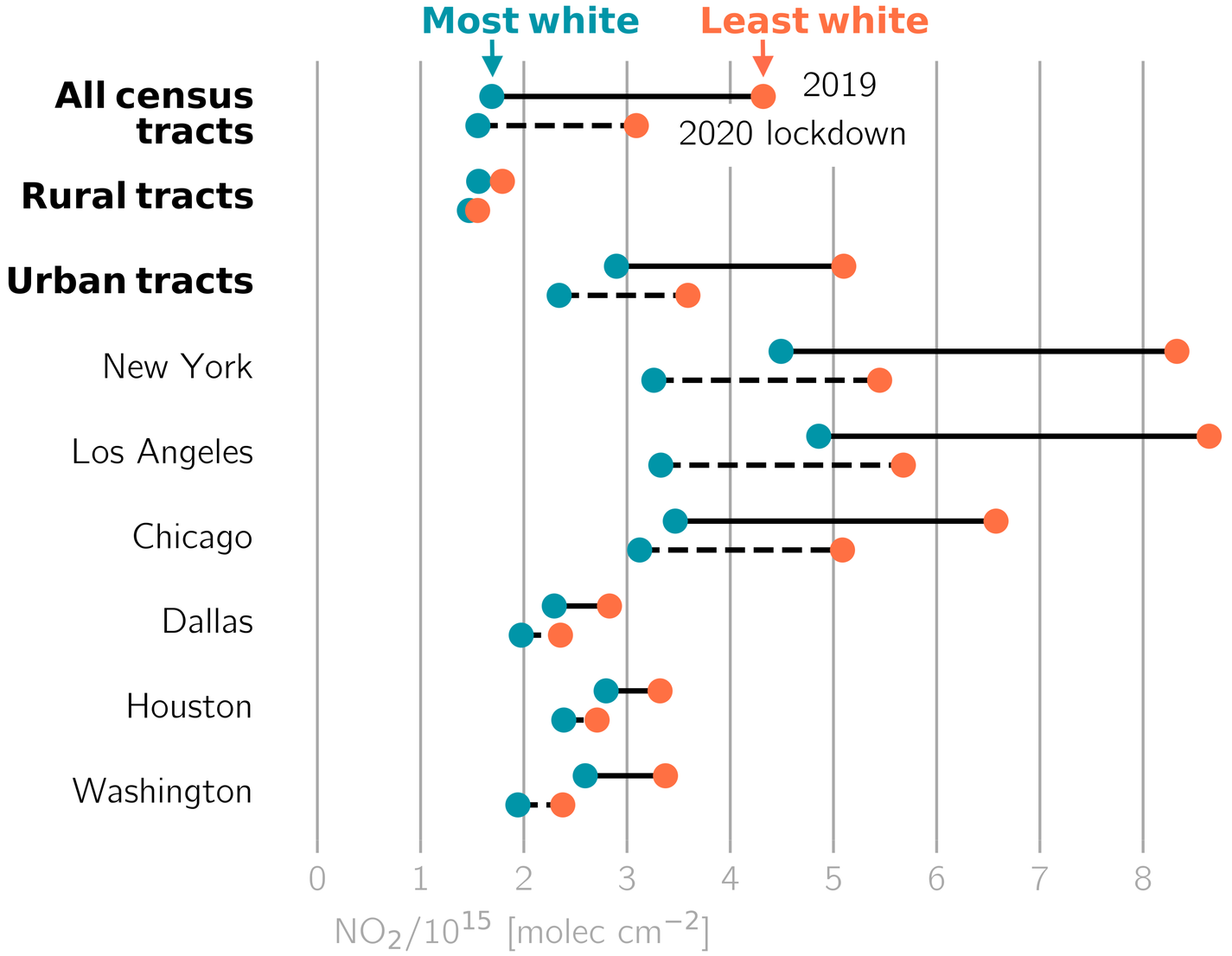
Model and satellite datasets consistently show that the non-Hispanic White population experiences lower NO_2 than the population-weighted average and other population subgroups (by ~ 5-20%).

Source: Kerr et al. (in prep.)

Satellite data provide near real-time insights to changes in NO_2 that cannot be captured with emissions inventories

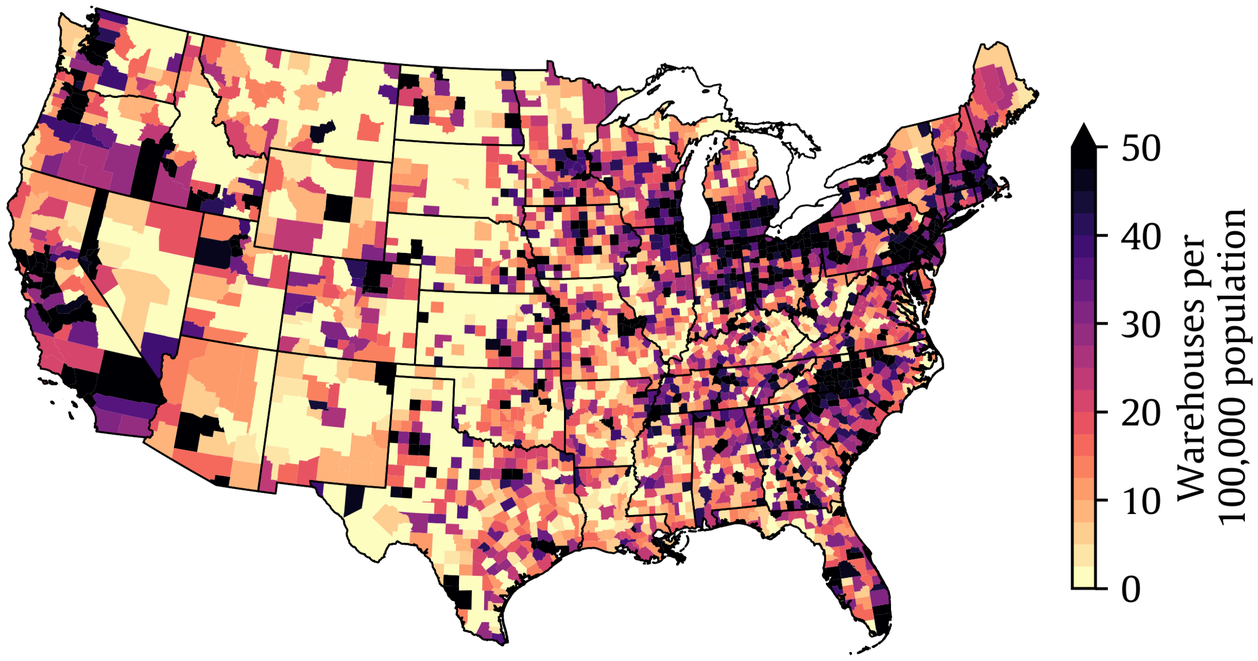
- The COVID-19 pandemic provided an opportunity to understand the extent of NO_2 disparities using satellite data (TROPOMI) and showed that the pandemic reduced, but did not eliminate, NO_2 disparities in the United States.

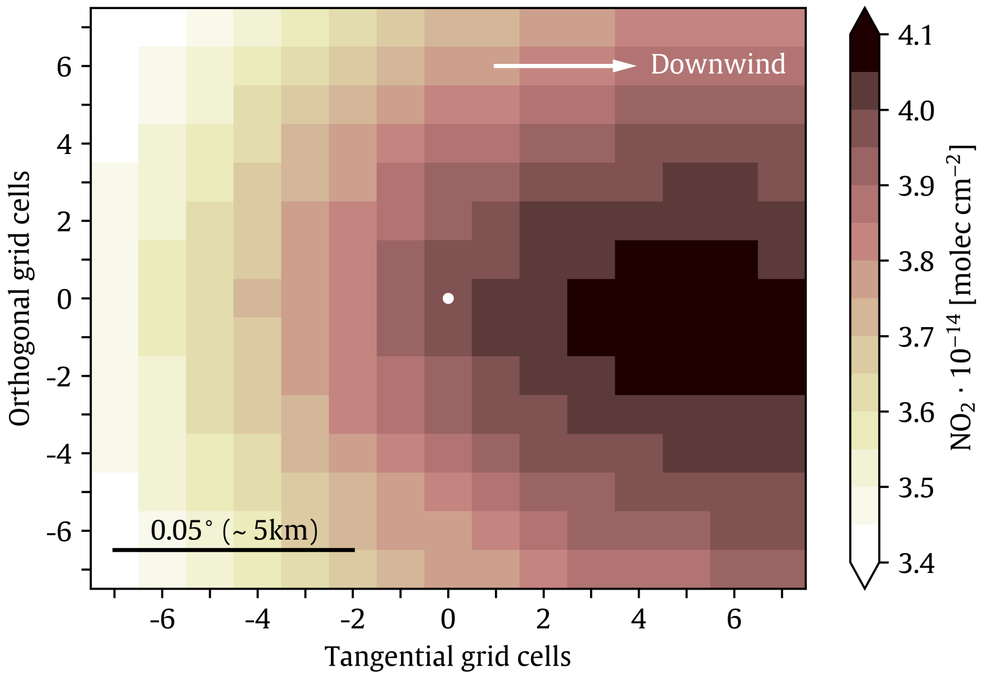
- In many urban areas, the least white communities experienced higher NO_2 levels during the pandemic than the most white communities experienced prior to the pandemic.



Source: Kerr et al. (2021)

Satellite data provide near real-time insights to changes in NO_2 that cannot be captured with emissions inventories



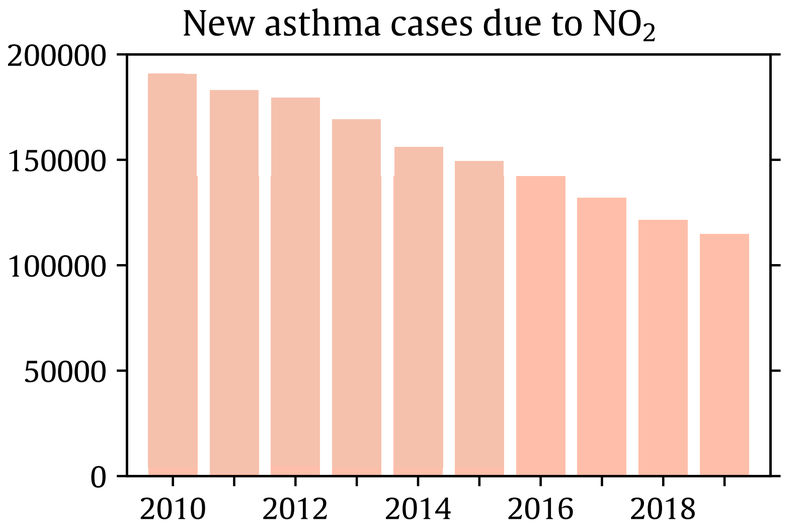


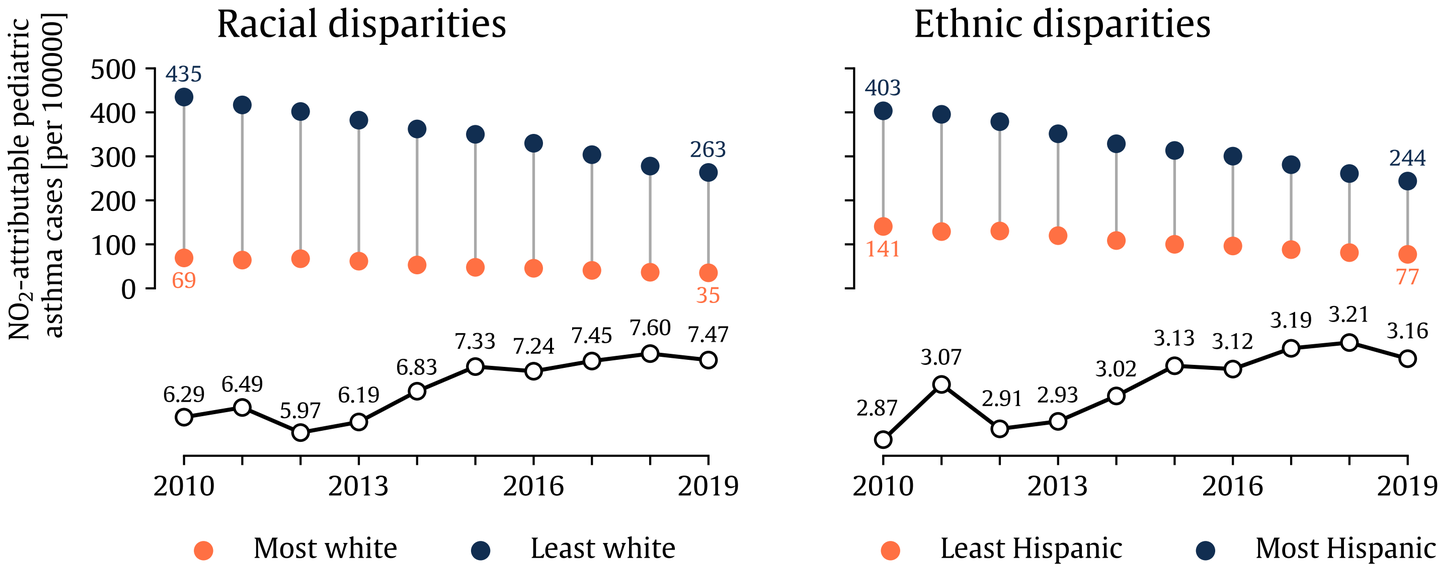
(Left) There is a growing number of disparately-sited warehouses in the U.S.; (right) we used satellite data (TROPOMI) to assess NO_2 pollution near warehouses and found a ~20% increase slightly downwind compared with cleaner, upwind regions.

PRELIMINARY RESULTS: DO NOT QUOTE OR CITE

Source: Kerr et al. (in prep.)

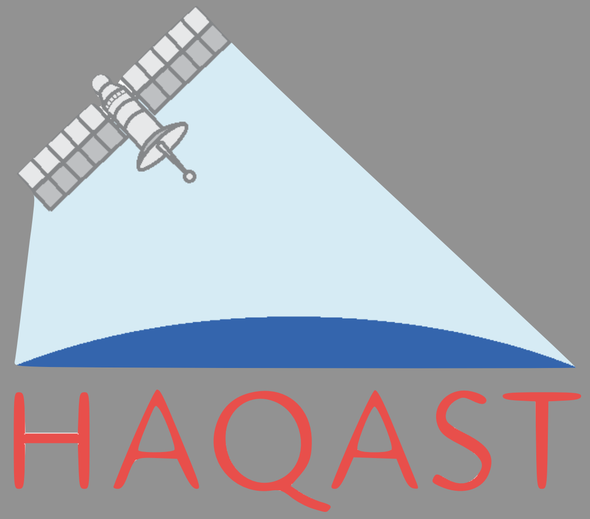
Statistical and geophysical models enable health impact and environmental justice assessments





(Left) Despite long-term decreases in NO_2, we estimated that approximately 115,000 new cases of pediatric asthma might be attributable to NO_2 in 2019; (right) relative disparities in attributable pediatric asthma rates have increased during the 2010s.

Source: Kerr et al. (under review)



The NASA Health and Air Quality Applied Sciences Team supported a team of scientists and stakeholders who were interested in expanding the use of satellite data for environmental justice applications.

+ Engaged over 160 people in monthly calls (54% were from various academic institutions, 27% from governmental organizations, and 19% from non-profits, industries, and think tanks).

+ Integrated satellite-derived data on NO_2, $PM_{2.5}$, and O_3 into different environmental justice screening and mapping tools, including the Environmental Defense Fund's new Climate Vulnerability Index.

+ Prepared tutorials to assist stakeholders in integrating satellite data for environmental justice applications; see www.haqast.org/ej/

Different types of spatially-complete datasets contribute unique insights in understanding NO_2 and associated injustices:

- **Statistical models: highest resolution; appropriate for health impact assessments**
- **Satellite retrievals: high resolution; most empirical dataset; capable of capturing emerging NO_x sources and changes**
- **Geophysical models: lowest resolution; strengths in simulating source contributions to NO_x and mitigation scenarios.**

However, in-situ observations have carried the most weight in policy discussions and should be augmented by these spatially-complete datasets to ensure that no segments of the American population are omitted from air quality assessments due to sparse and uneven monitor coverage.

References:
Kerr, G. H., Goldberg, D. L., & Anenberg, S. C. (2021). COVID-19 pandemic reveals persistent disparities in nitrogen dioxide pollution. Proc. Natl. Acad. Sci. U.S.A., 118(30): e2022409118. https://doi.org/10.1073/pnas.2022409118.
Kerr, G. H., Martin, R. V., van Donkelaar, A., Brauer, M., Bukart, K., Wozniak, S., Goldberg, D. L., & Anenberg, S. C. (under review). Increasing disparities in air pollution health burdens in the United States. https://www.authorea.com/doi/full/10.1002/essoar.10512159.1.