Evaluating Emissions and Anthropogenic Activities

Tracey Holloway, Monica Harkey, Xinran Wu, Cara Scalpone, Summer Acker, Chandler Wells, Brad Pierce, and many more!

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HAQAST

Proposed HAQAST Activities

2025-2029

- ❑ Evaluating NO_2 plumes using AERMOD and TEMPO
- ❑ Working with California counties and related stakeholders to evaluate emissions reductions from *Blue Whales Blue Skies*

2020-2025

- ☑ Working with the American Lung Association to applied satellite-derived $PM_{2.5}$ to health assessment
- ❑ Working with the Rocky Mountain Institute to assess NO_2 from building heating
- ☑ Constraining NOx emissions with satellite data

AERMOD – A widely used Regulatory Dispersion Model

- The American Meteorological Society (AMS)/ U.S. Environmental Protection Agency (EPA) Regulatory Model (AERMOD) is a steady-state, local-scale Gaussian plume model.
- It incorporates air dispersion based on planetary boundary layer turbulence structure and scaling concepts.
- AERMOD represents EPA's recommended model and is commonly used for permitting.

AERMOD Slides from Xinran Wu Ph.D. defense; work with Dr. Monica Harkey

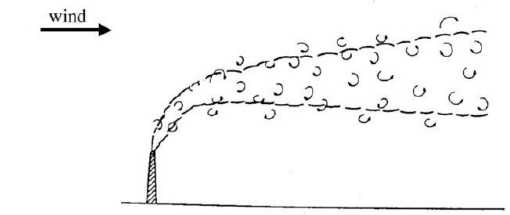
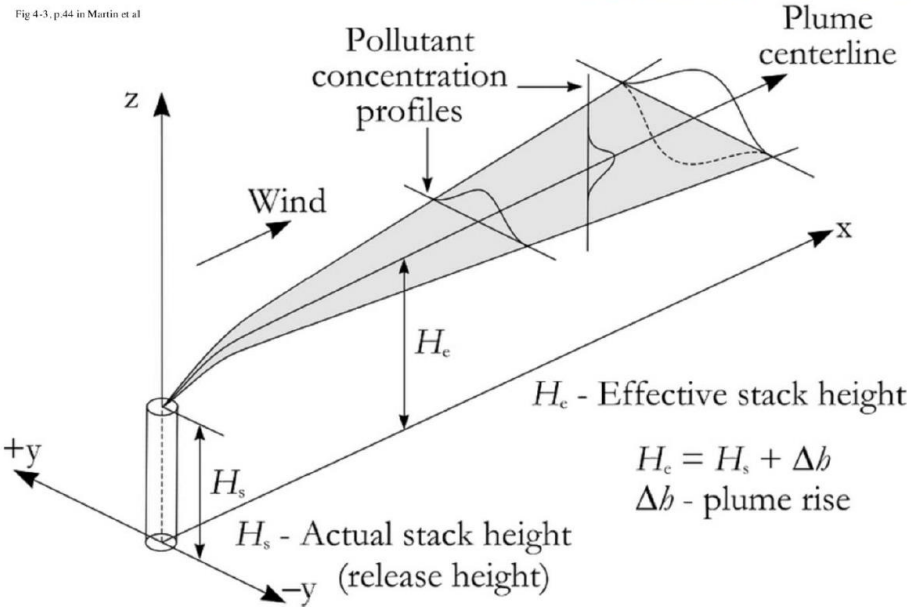
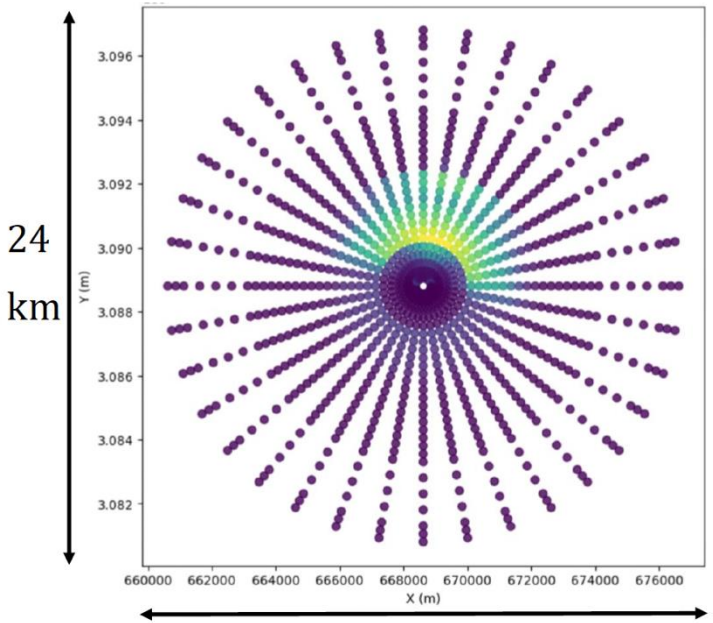


Fig 4-3, p.44 in Martin et al

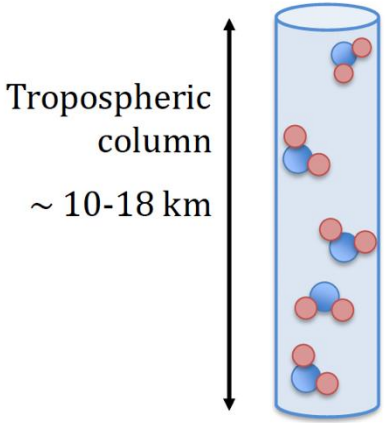


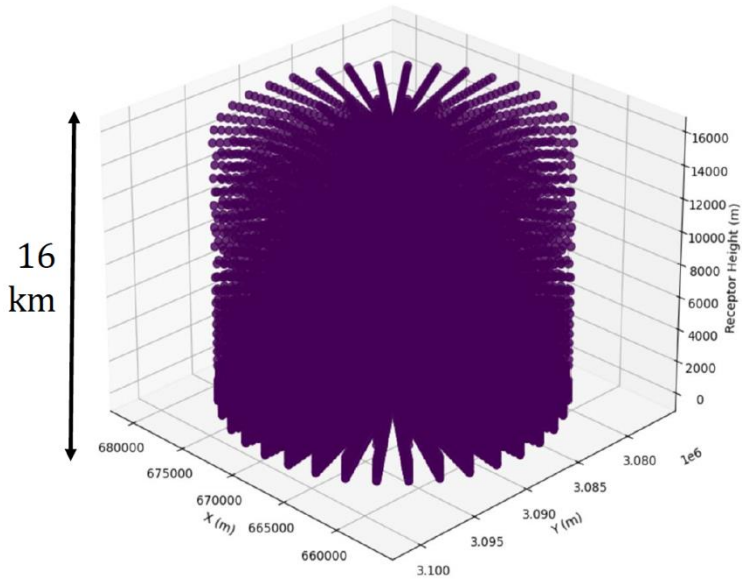
Schematic of a Gaussian plume model. Leelossy et al. (2014).

Horizontal & Vertical Modeling Setup



Horizontal receptors are set to be centered around the facility and extend with 12 km in 36 directions.

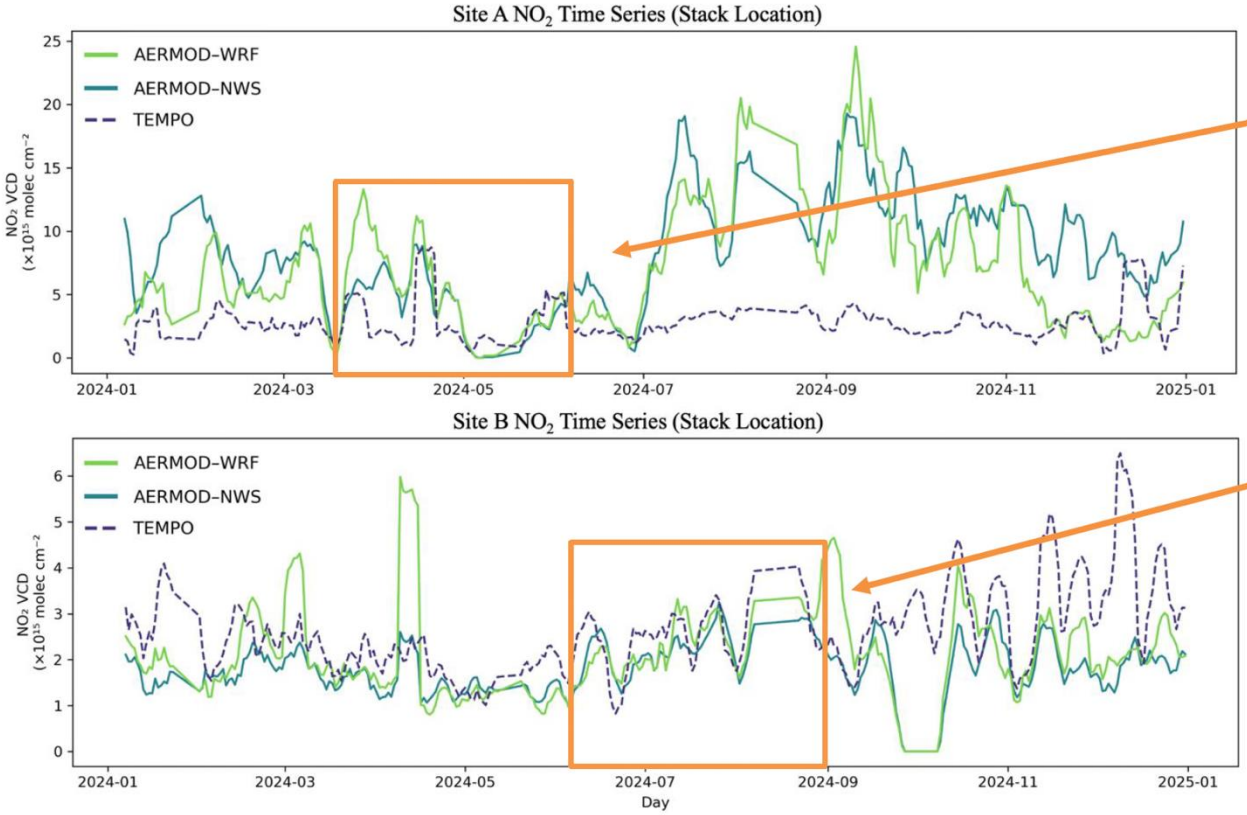




Vertical heights were limited to 15 km to capture the portion of the column most influenced by surface emissions.

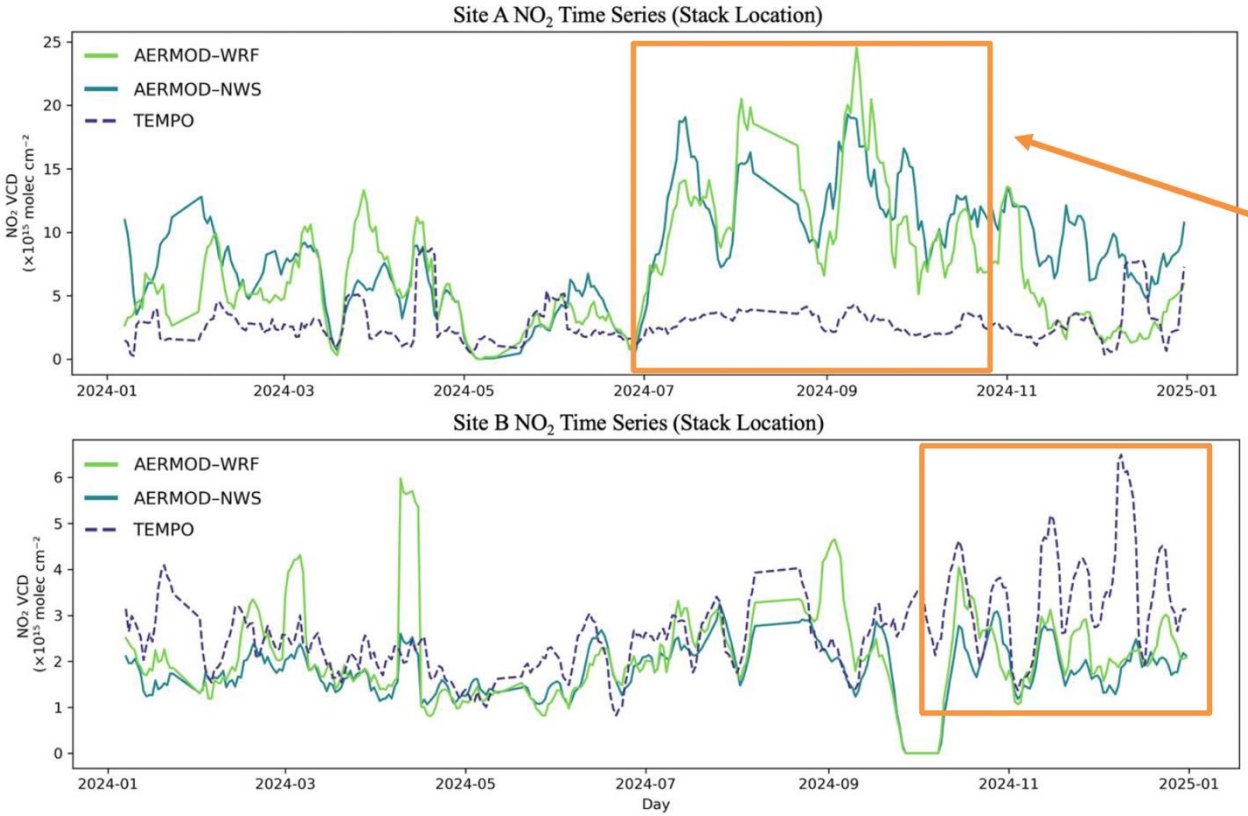
Satellite image, Shutterstock

Temporal Pattern – Annual Time Series of Stack Hourly NO_2



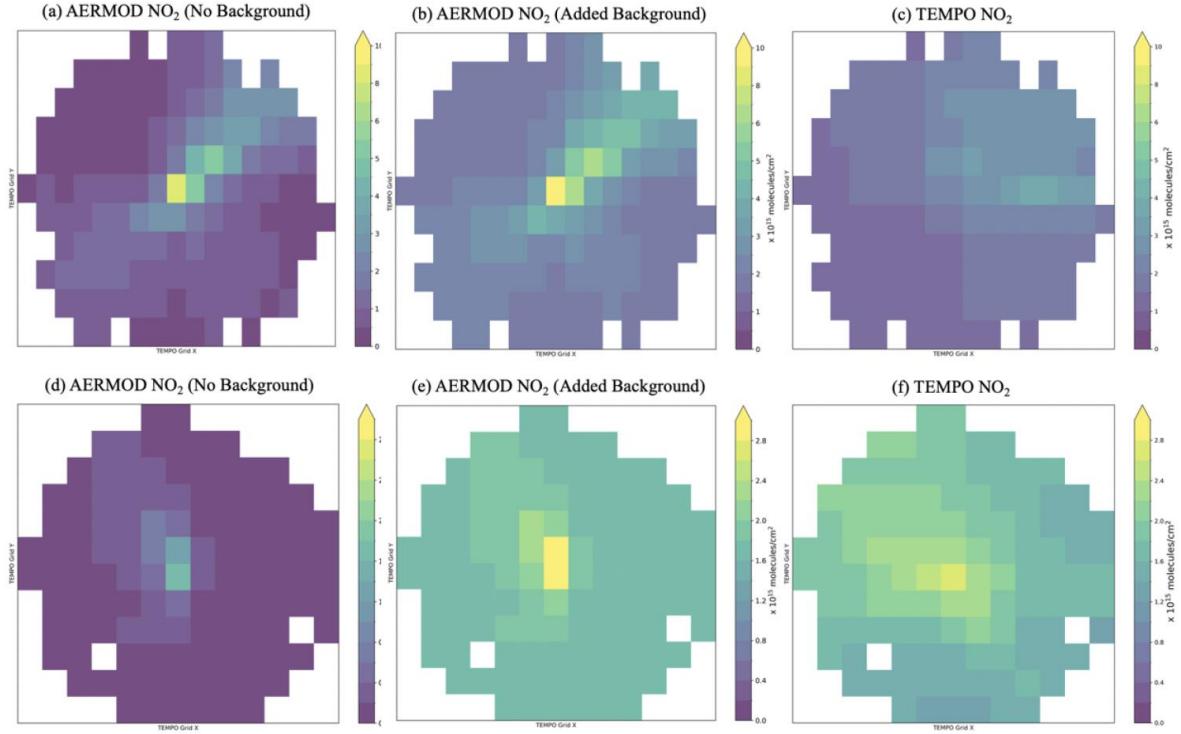
- AERMOD simulations generally capture the daily temporal variability observed by TEMPO.
- Agreement is stronger at Site B, where temporal patterns align more closely with TEMPO.

Temporal Pattern – Annual Time Series of Stack Hourly NO_2



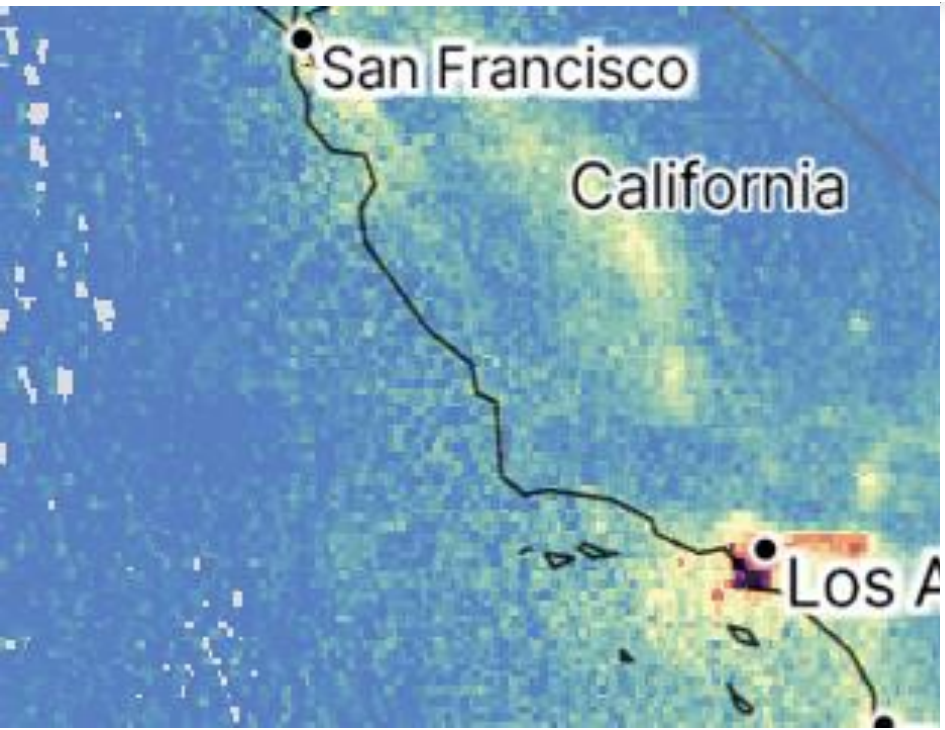
- But discrepancies in peak magnitudes exist, particularly at Site A.

Spatial Pattern – Annual-averaged NO_2 on TEMPO Grid



- AERMOD results (no background added) only show localized plume effects, which may not be apple-to-apple comparable to TEMPO.
- Adding the TEMPO-derived background makes AERMOD pattern more closely match the overall magnitude of TEMPO NO_2.

Just starting: Evaluating Vessel Speed Reduction Impacts on Air Quality

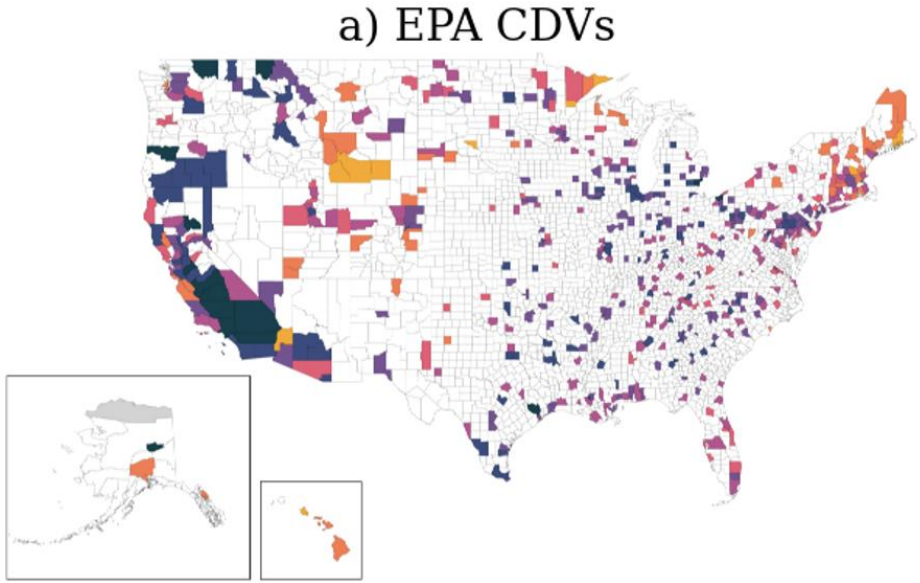


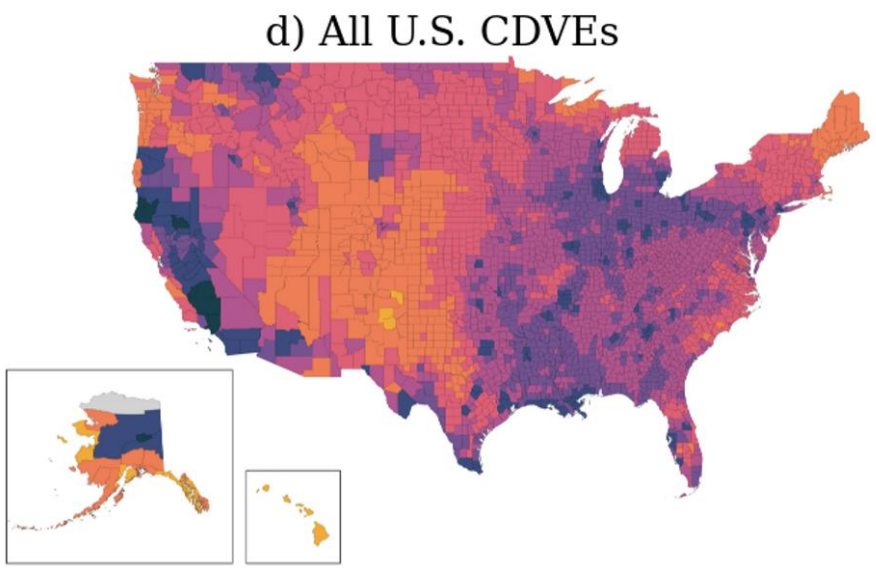
Illustrative data from TEMPO

Something in the Air Reports

A series of reports highlighting the promising potential of satellite data to complement and enhance the United States' existing air quality monitoring network.

As a nation, we make great strides cleaning up air pollution—but not all communities benefit equally.





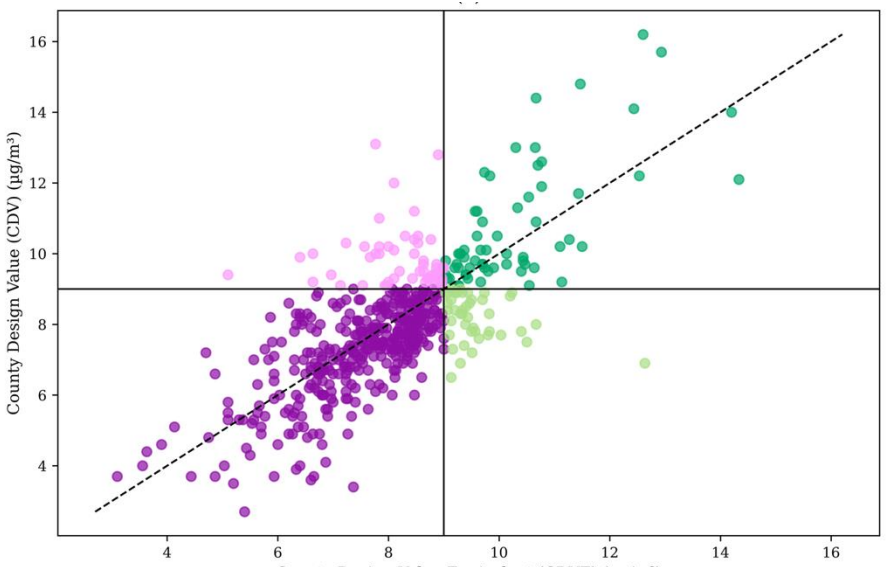
County Design Value (CDV) – highest 3-year annual $PM_{2.5}$ monitor in county

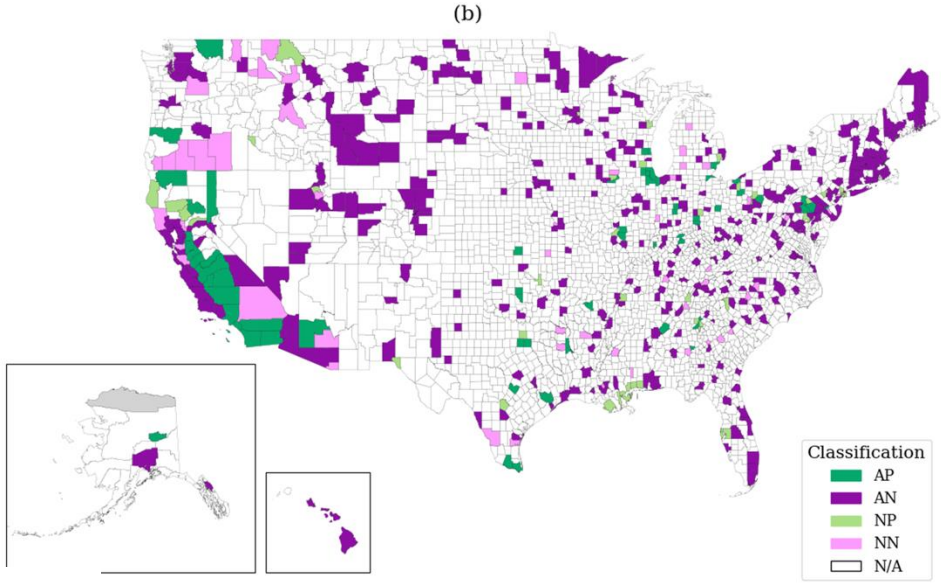
CDV-Equivalent (CDV-E) – highest 90th percentile satellite-derived $PM_{2.5}$ grid in county

< 4 µg/m³ | 4 - 6 µg/m³ | 6 - 7 µg/m³ | 7 - 8 µg/m³ | 8 - 9 µg/m³ | 9 - 12 µg/m³ | > 12 µg/m³ | N/A

Applying Satellite-Derived $PM_{2.5}$ Data to Policy-Relevant Air Quality Metrics

Tracey Holloway[1,2*], Summer Acker[1], Lizzy Kysela[1,2], Colleen Heck[1,2], Aaron van Donkelaar[3], Randall V. Martin[3], Kevin Stewart[4], Katherine Pruitt[4]



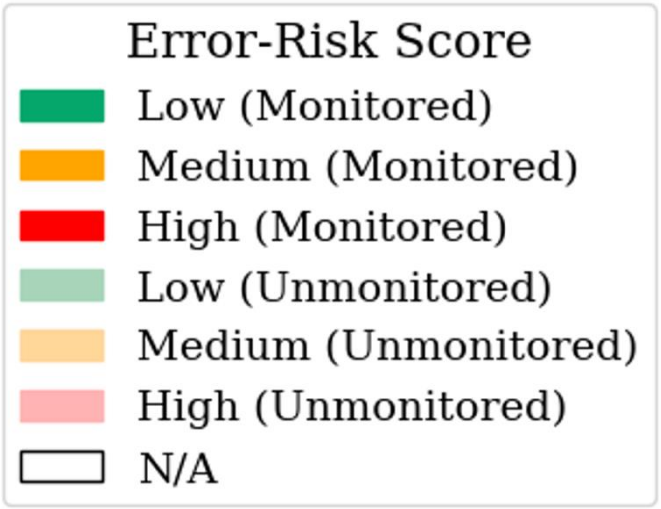


AP AN NP NN

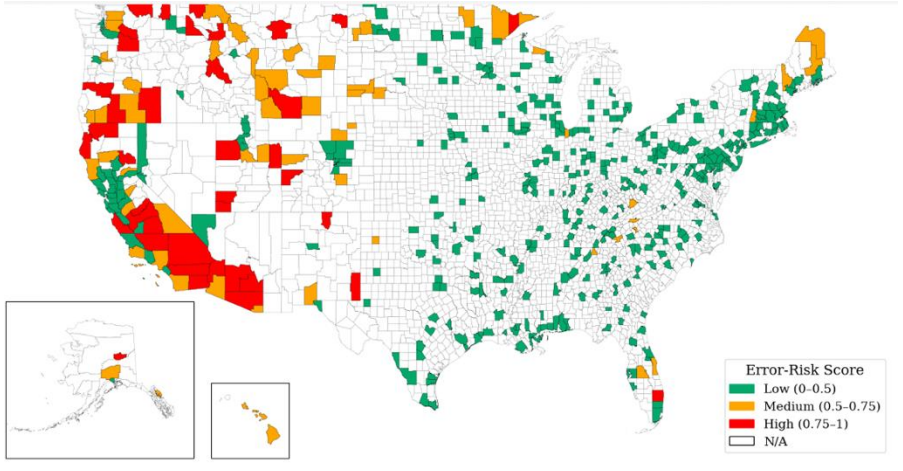
manuscript submitted to *GeoHealth*

Comparison of policy-relevant air quality metrics calculated with sparse in situ monitoring and contiguous satellite-derived data

Summer Acker[1*], Tracey Holloway[1,2], Kevin Stewart[4], Aaron van Donkelaar[3], Randall V. Martin[3]



CDV and CDVE are more likely to be **non-aligned** in counties with deserts, mountains, and non-urban land use



b) All Counties

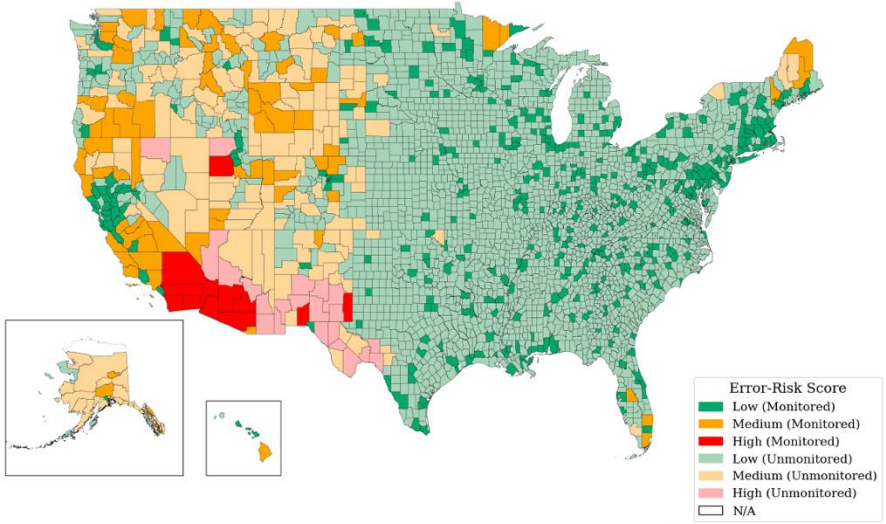
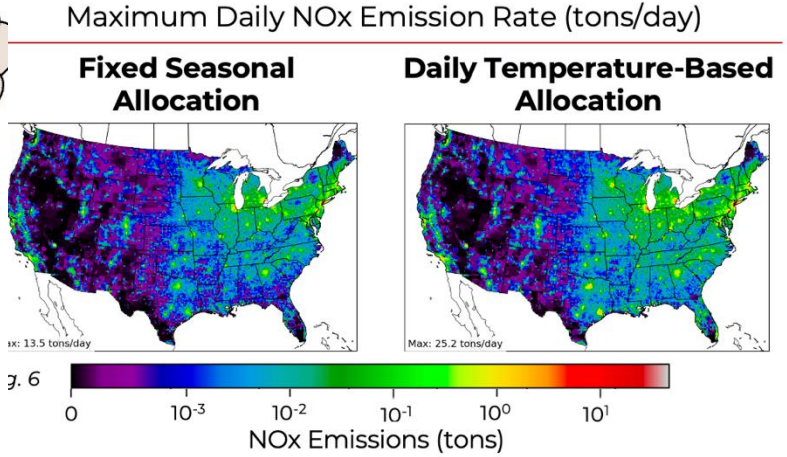



Fig. 1
NOx


Maximum Daily NOx Emission Rate (tons/day)
Fixed Seasonal Allocation
Daily Temperature-Based Allocation
Max: 25.2 tons/day
0
10-3
10-2
10-1
100
101
NOx Emissions (tons)

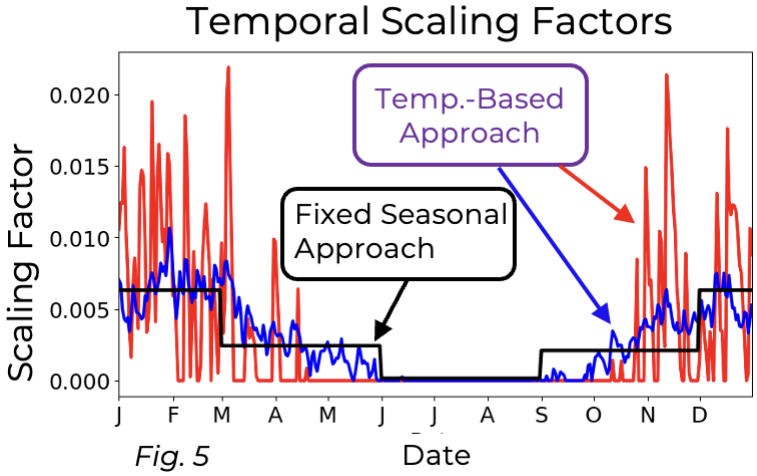

Temporal Scaling Factors
Temp.-Based Approach
Fixed Seasonal Approach
Scaling Factor
0.020
0.015
0.010
0.005
0.000
J F M A M J J A S O N D
Date

Fig. 5

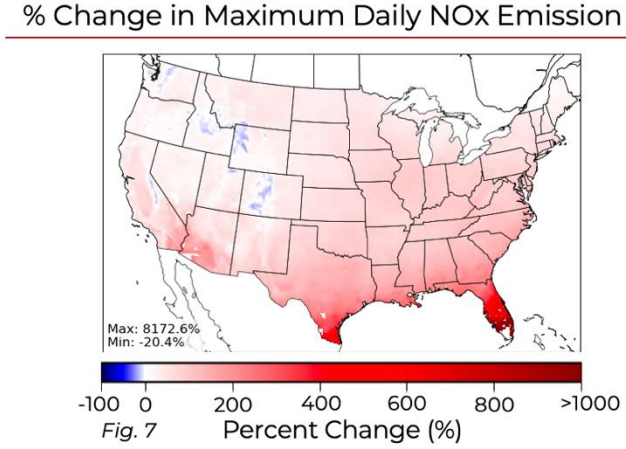
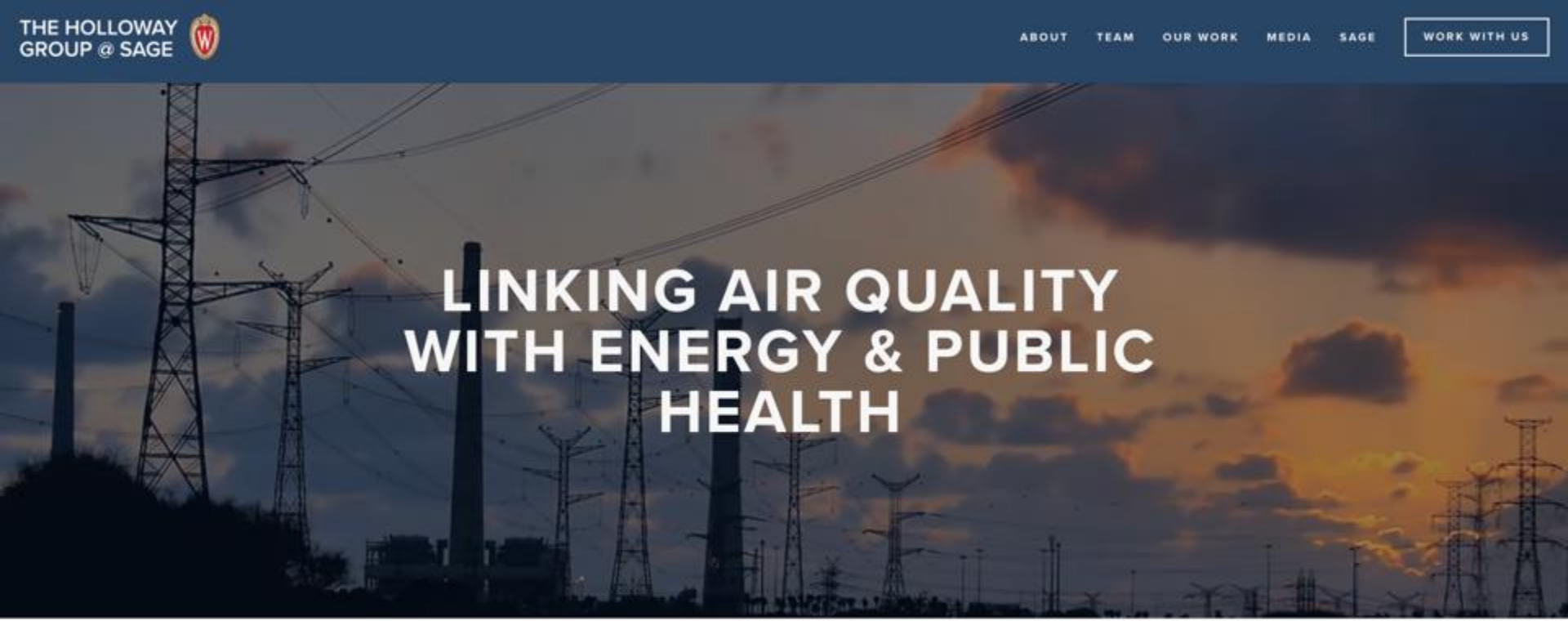

% Change in Maximum Daily NOx Emission Rate
Max: 8172.6%
Min: -20.4%
-100 0 200 400 600 800 >1000
Percent Change (%)

Fig. 7



The Holloway Group Advances Air Quality Research To Inform Science And Policy. We Partner With Organizations To Ensure The Relevance Of Our Work To Real-World Needs.

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