Getting the Timing Right

Diurnal Biases and Decision Support

Jen Kaiser, Talat Odman, Yongtao Hu, and Ted Russell | Georgia Tech

HAQAST

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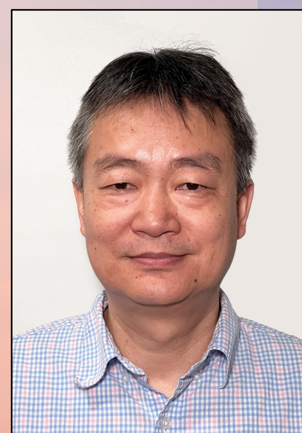

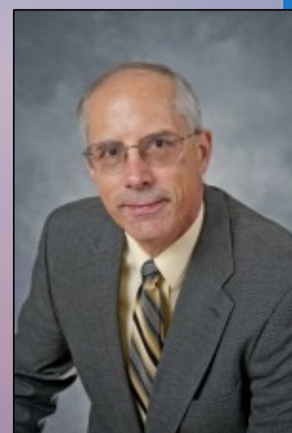

HAQAST 2025 Project Goals:

1. Quantify and correct **diurnal biases** in sectorized emissions
2. Provide accurate estimates of the **time sensitivity of sectorized source contributions** on population-level exposure
3. Provide related products for improved **decision-making** in air quality and environmental health management.

Partner Organizations:

- Georgia Department of Natural Resources (**GaDNR**) – Byeong Kim
- Lake Michigan Air Directors Consortium (**LADCO**) – Zach Adelman
- South Coast Air Quality Management District (**SCAQMD**) – Sang-Mi Lee
- We're eager to grow this list!

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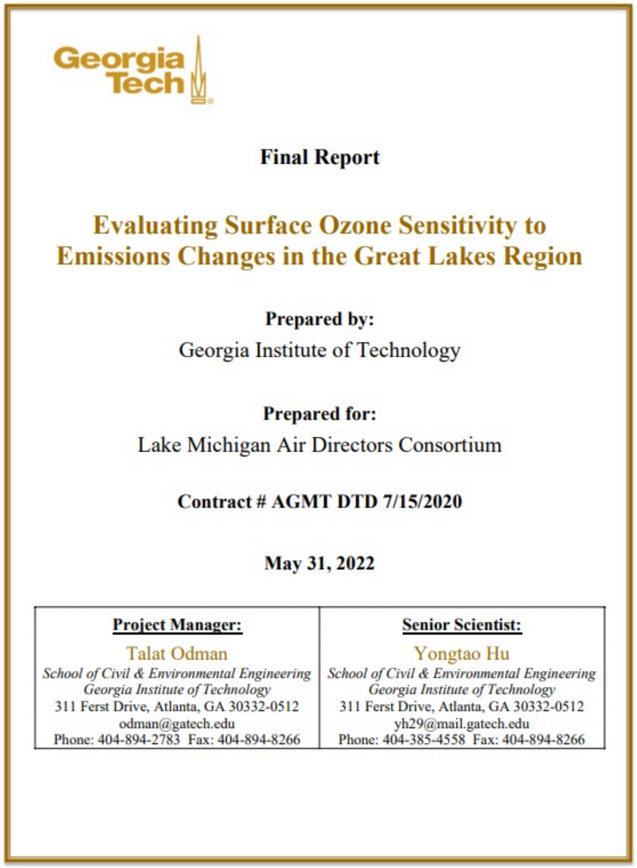
Building on prior work with LADCO



Georgia Tech

Final Report

Evaluating Surface Ozone Sensitivity to Emissions Changes in the Great Lakes Region

Prepared by:
Georgia Institute of Technology

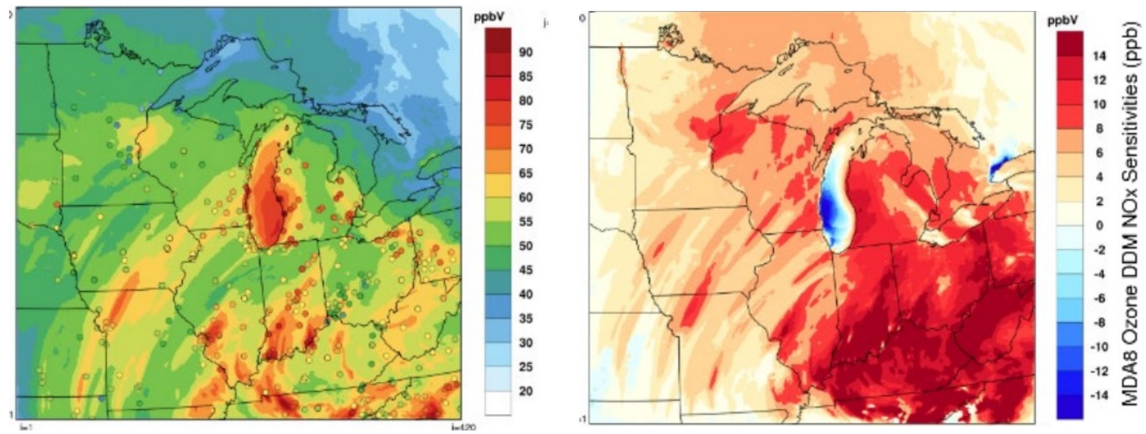
Prepared for:
Lake Michigan Air Directors Consortium

Contract # AGMT DTD 7/15/2020

May 31, 2022

Project Manager:	Senior Scientist:
Talat Odman *School of Civil & Environmental Engineering* *Georgia Institute of Technology* 311 Ferst Drive, Atlanta, GA 30332-0512 odman@gatech.edu Phone: 404-894-2783 Fax: 404-894-8266	Yongtao Hu *School of Civil & Environmental Engineering* *Georgia Institute of Technology* 311 Ferst Drive, Atlanta, GA 30332-0512 yh29@mail.gatech.edu Phone: 404-385-4558 Fax: 404-894-8266

June 10, 2016 CAMx modeled MDA8 O3 concentrations and NOx sensitivity



- CAMx-DDM was used to simulate the sensitivity of ozone formation to precursor emission reductions from different sectors at different times of the day.
- Need to refine method, address modern issues, utilize next-generation observations

DDM approach provides sensitivity of MDA8 ozone to sector, time, and species (VOC or NOx)

Evaluate either NOx or VOC sensitivity

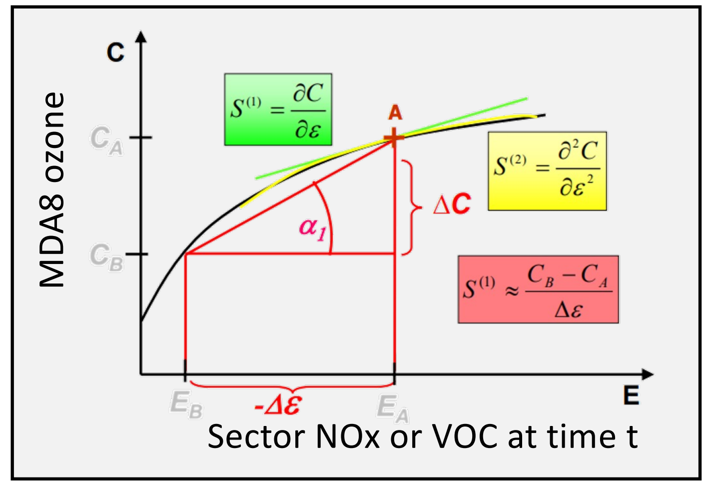
Anthropogenic NOx sectors:
- Onroad gasoline
- Onroad diesel
- Nonroad
- EGU point-source
- Non EGU-point source

Anthropogenic VOC sectors:
- Onroad gasoline
- Onroad diesel
- Nonroad
- Volatile chemical products (VCPs)
- Other non-point VCPs
- Non EGU-point source

Choose Timing

Time	(EDT)
Early AM	6-9
Late AM	10-12
Early PM	13-15
Late PM	16-19
Evening	20-22
Night	23-5

Sector-specific NOx or VOC impacts at a given monitor, on a given day

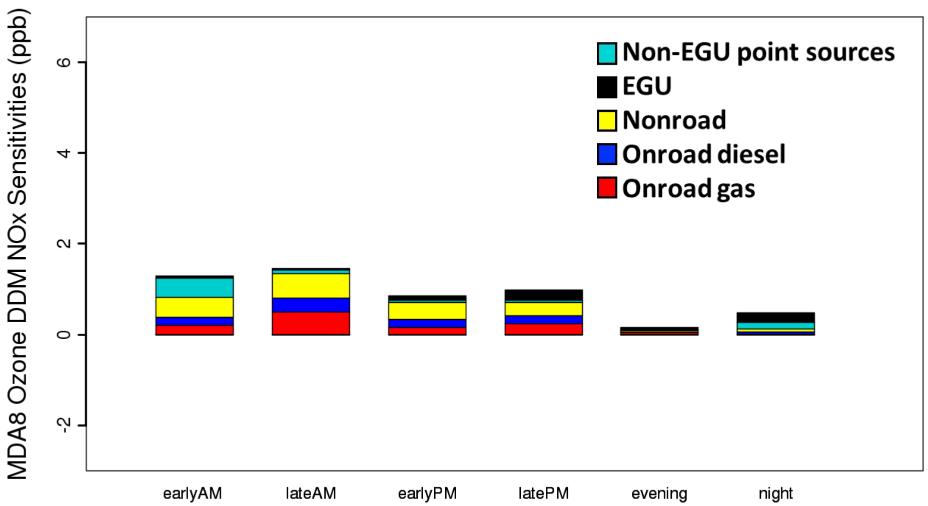


12 runs (2 DDM setups x 6 times)
66 sectorized, timed sensitivities

Example results: NOx sensitivity

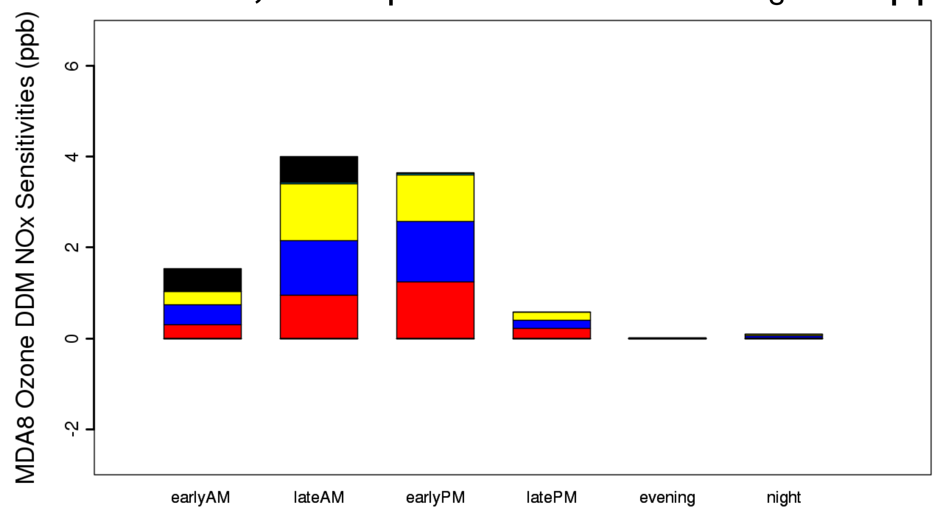
Chicago (Water Plant)

June 19, 2016 |Observed MDA8 O_3 = 74 ppb



St. Louis (West Alton)

June 10, 2016 |Observed MDA8 O_3 = 72 ppb

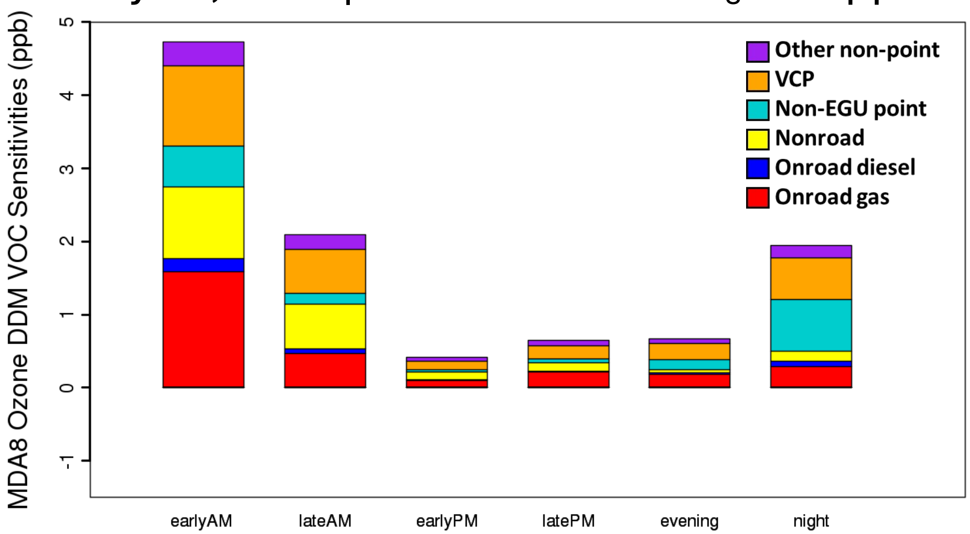


- Larger responses in St. Louis, more time-dependent
- Late AM, early PM non-road and onroad could be targeted to achieve benefits across region
- Non-EGU early AM NOx has localized impact in Chicago

Example results: VOC sensitivity

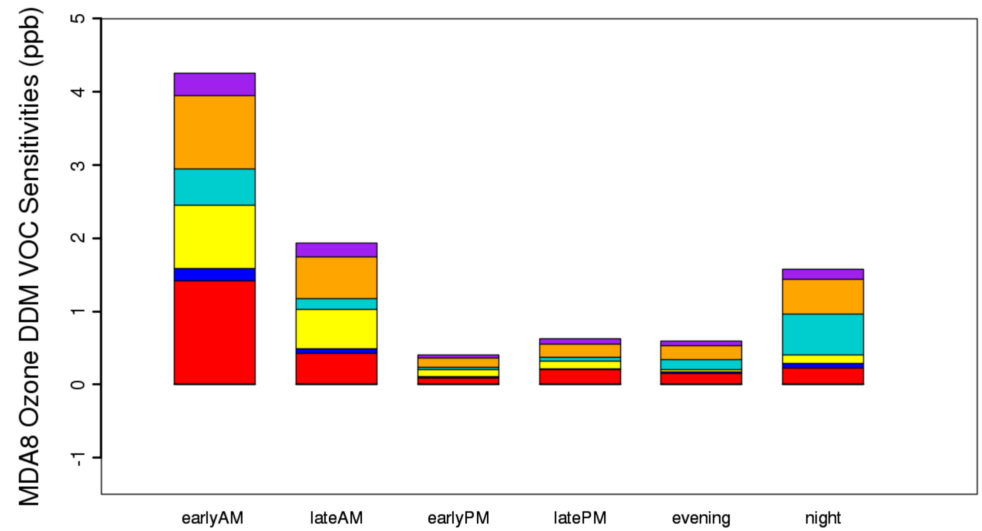
Milwaukee (Harrington Beach Park)

July 20, 2016 |Observed MDA8 O_3 = 80 ppb



Sheboygan County (Kohler Andrae)

July 20, 2016 |Observed MDA8 O_3 = 85 ppb



- Similar responses across the region (sites are close, same day), larger gains in Milwaukee
- Importance of VCPs persists throughout the day
- In general, early/late AM emissions are most impactful for MDA8.

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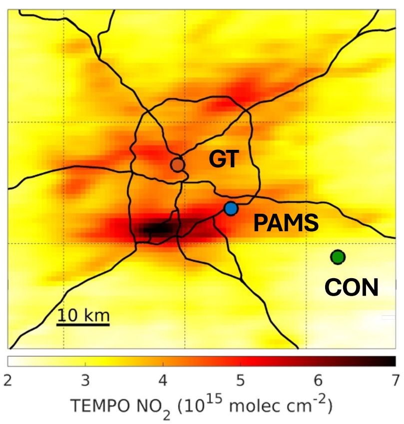
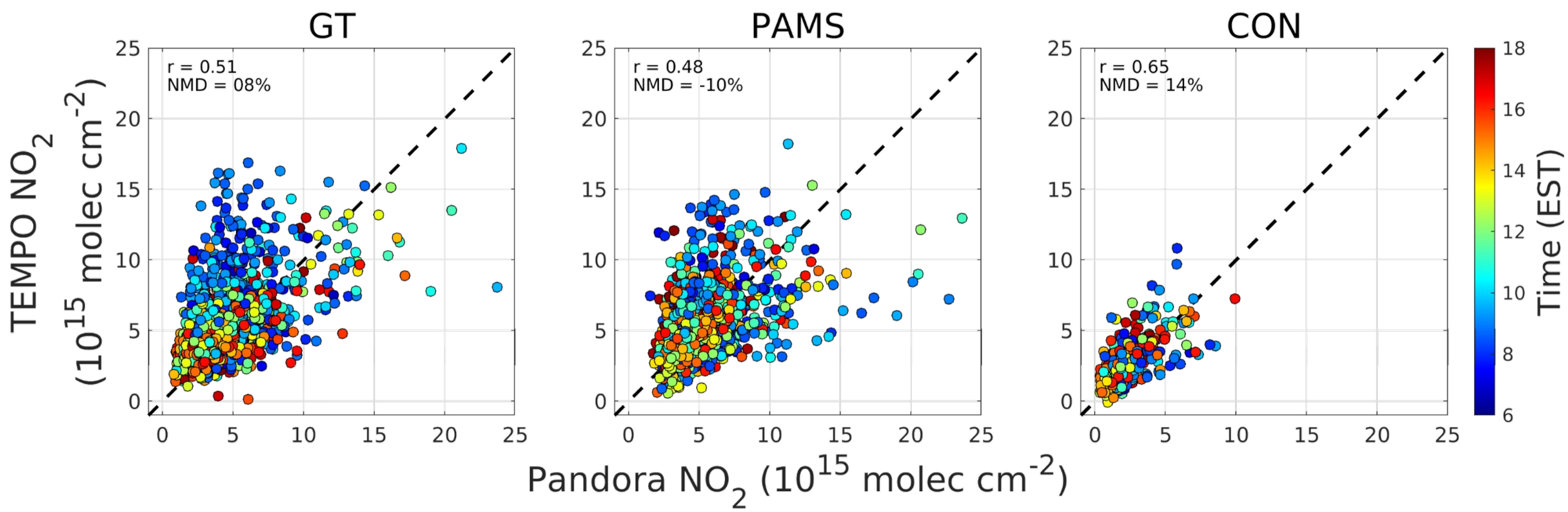
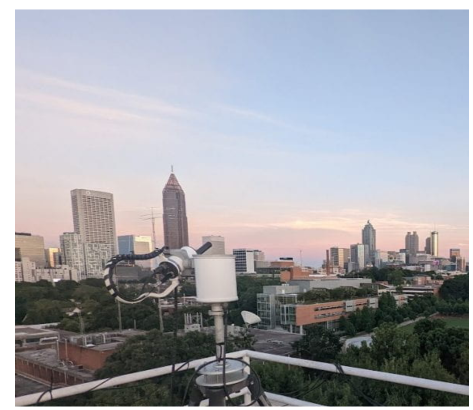
TEMPO gives us diel observations: Are they correct?

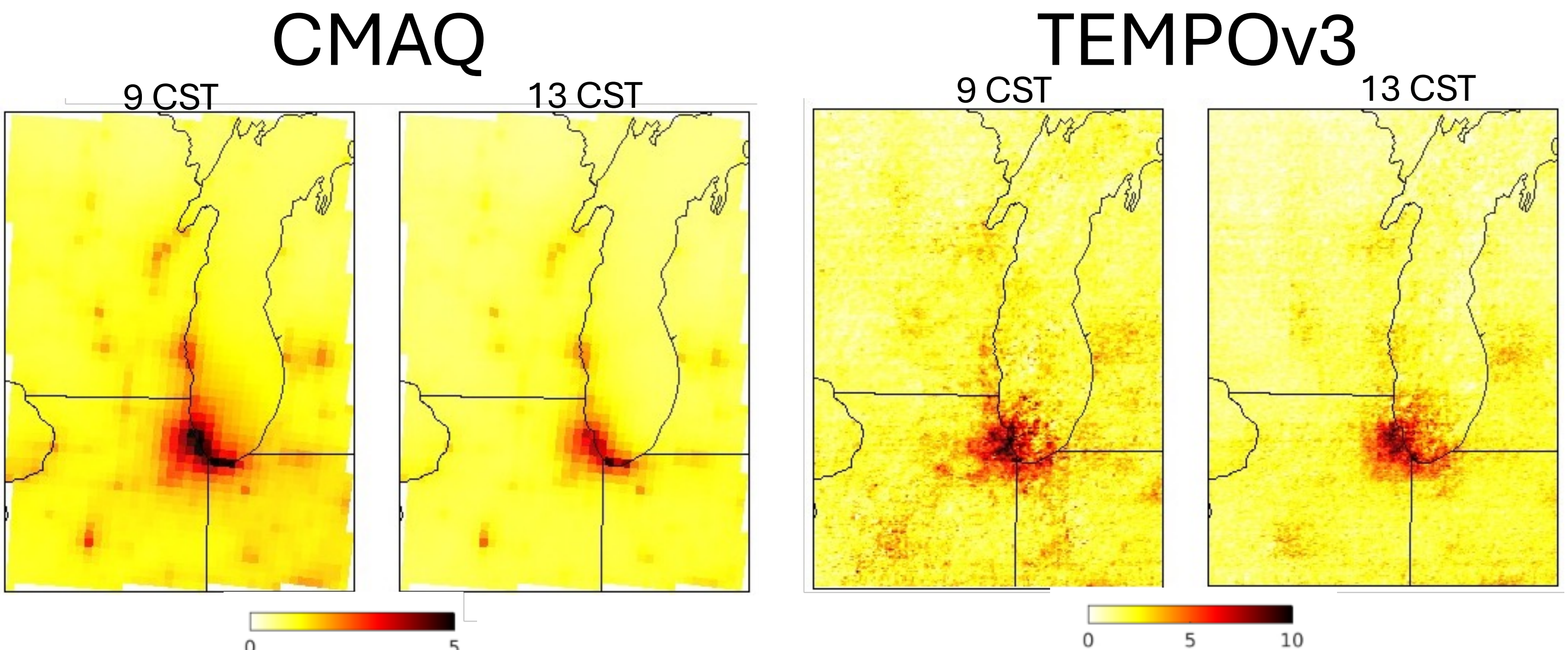




- Mid-day values look quite good across all sites!
- Morning values show some significant biases.
- We expect TEMPOv4 to correct some of these.
- City-specific validation key.



Model evaluation using TEMPO (very preliminary!)



Avg JJA 2024 NO_2 VCD (10^{15} molec cm^{-2})

- CMAQ and TEMPO mid-day NO_2 VCDs have similar spatial patterns
- Spatial patterns in AM differ; wait until TEMPO v4 to evaluate
- Magnitude difference point to potential need to adjust emissions

Take-aways and next steps

- CMAQ-DDM allows us to ask “emissions of what, from which sector, when” with reduced computational cost.
- TEMPO and other observations build confidence in model results.
- Work will expand to multiple regions and include estimates of exposure and health impacts.
- Stake-holder input drives the work — What is practical? What sectors?