



LADCO | LAKE MICHIGAN
AIR DIRECTORS CONSORTIUM

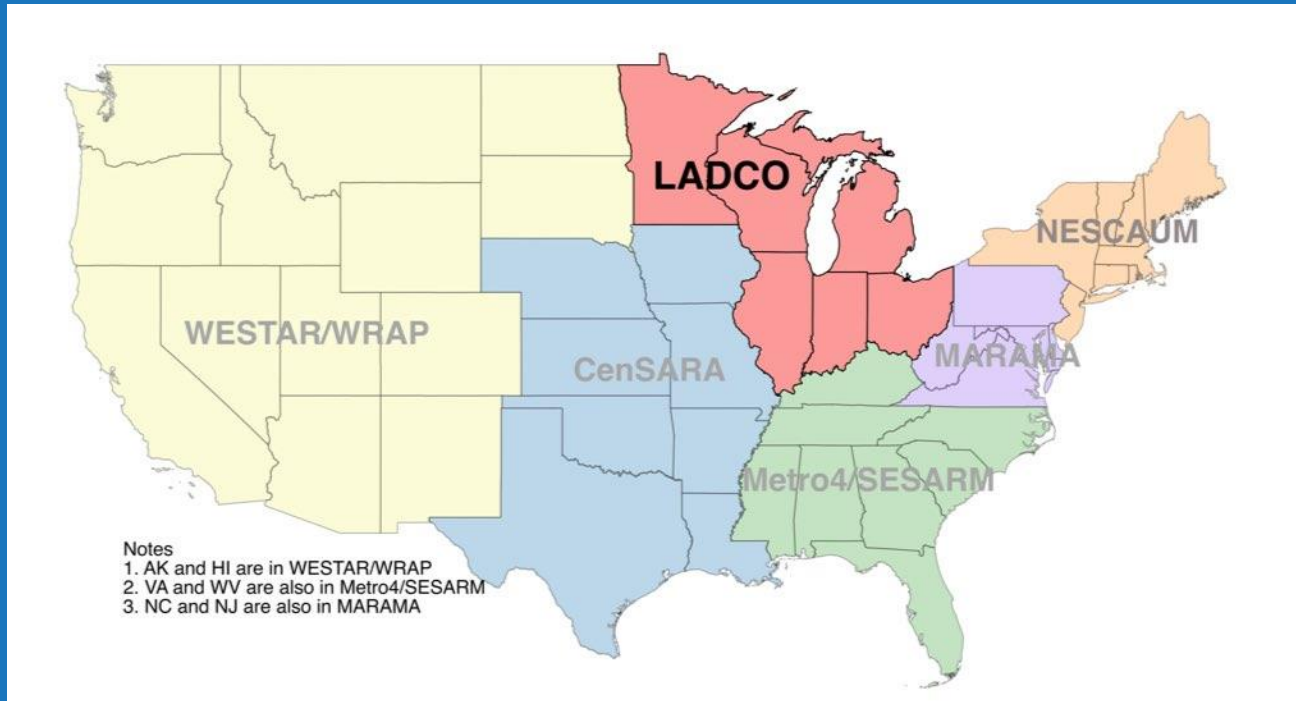
Evaluating Emissions using Satellite Data: LADCO Needs

Angie Dickens, Ph.D., Mark Janssen, &
Zac Adelman

HAQAST Madison
May 13, 2026

What is LADCO?

Lake Michigan Air Directors Consortium



- Formed in 1989 to bring the Great Lakes states together to address ozone pollution
- Governed by state air agency directors
- Scope
 - Forum for state agency planners
 - Air pollution emissions, modeling, and data science
 - Including some work with satellite data
 - Training

How LADCO Uses Emissions Inventories

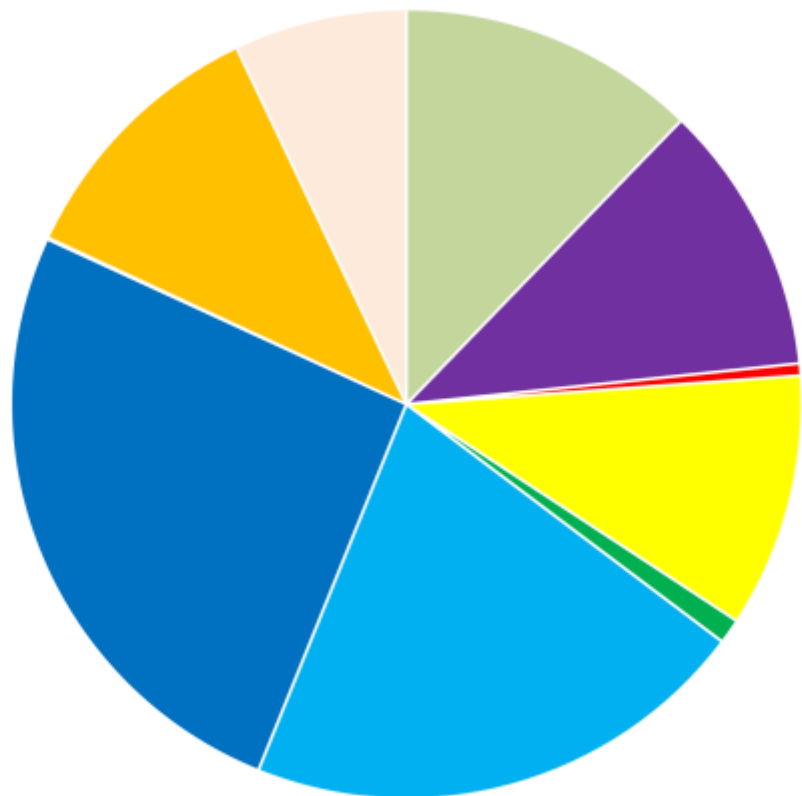
- To understand what sources contribute to pollution and how much
 - Helps inform development of emissions control strategies and programs
 - Can result in regulations targeting emissions from particular sectors or sources
- To understand the impacts of different emissions control programs
 - What will be most effective; what won't
- Inputs to photochemical models
 - We do the regulatory modeling for our member states
 - Used to evaluate the air quality impacts of control strategies and to meet different Clean Air Act requirements

We do a lot of work validating emissions!

→ Still highly uncertain and could use more verification

Need #1: Satellite Validation of Inventories

2022 NOX Emissions Tons In LADCO States



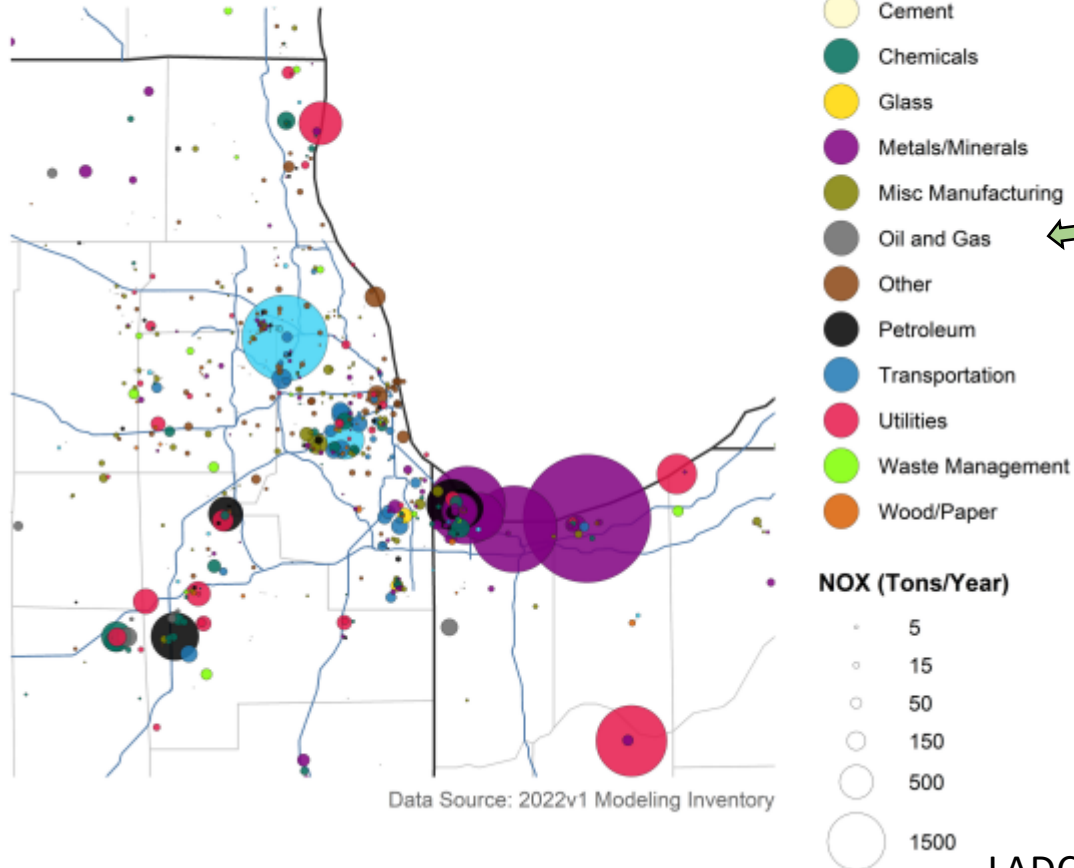
Questions:

- What are the relative distributions of different emissions sources?
- Can we distinguish between:
 - Onroad vs nonroad mobile sources?
 - EGUs vs industrial point sources?
 - Anthropogenic vs natural (biogenic & fires) emissions sources?
- Where are our inventories right? Where are they under- or over-estimating sources?

Need #1: Satellite Validation of Inventories

2022 Point Source NOX Emissions

Chicago



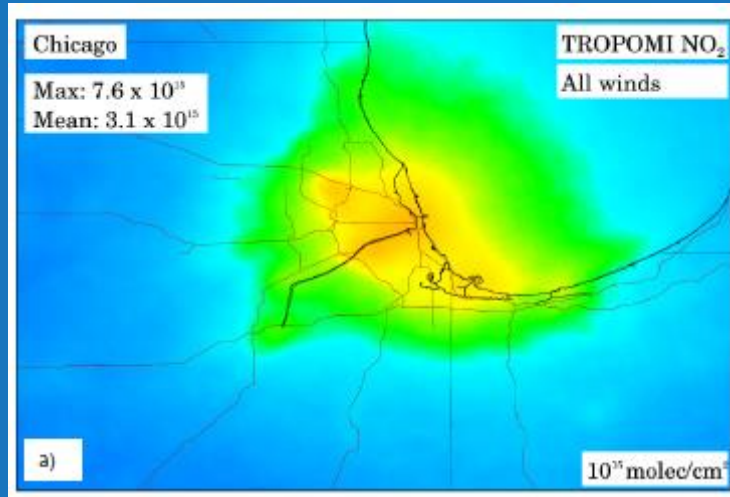
- Spatial and temporal resolution of NO₂ from TEMPO could help
 - Spatial:
 - Combine with high-resolution land use data?
 - Compare satellite with inventory maps
 - Is there fine enough resolution in the satellite to see patterns?
 - Temporal:
 - Use natural experiments (time of day, weekdays/weekends, holidays, etc.)
 - Expect different sectors to have different patterns
 - Spatial & Temporal
 - Compare diurnal patterns in satellite with expected emissions patterns and locations

How to Make Your Science Useful for an Inventory Modeler

- Provide enough information to inform a specific aspect of the inventory
 - Not useful: “The NO_x inventory is 2 times too low” (not enough specificity)
 - Sector-specific
 - “Onroad gasoline VOC is 30% too low”
 - Temporalization
 - “NO_x in Chicago is 20% higher in August than in May”
 - Chemical Speciation
 - “Isoprene, Ethylene, and Acetaldehyde make up 25% of the midday VOC in rural sites in Michigan”
 - Spatial Allocation
 - “VOC emissions in Nashville are three times those in rural Tennessee”
- Talk with an inventory developer

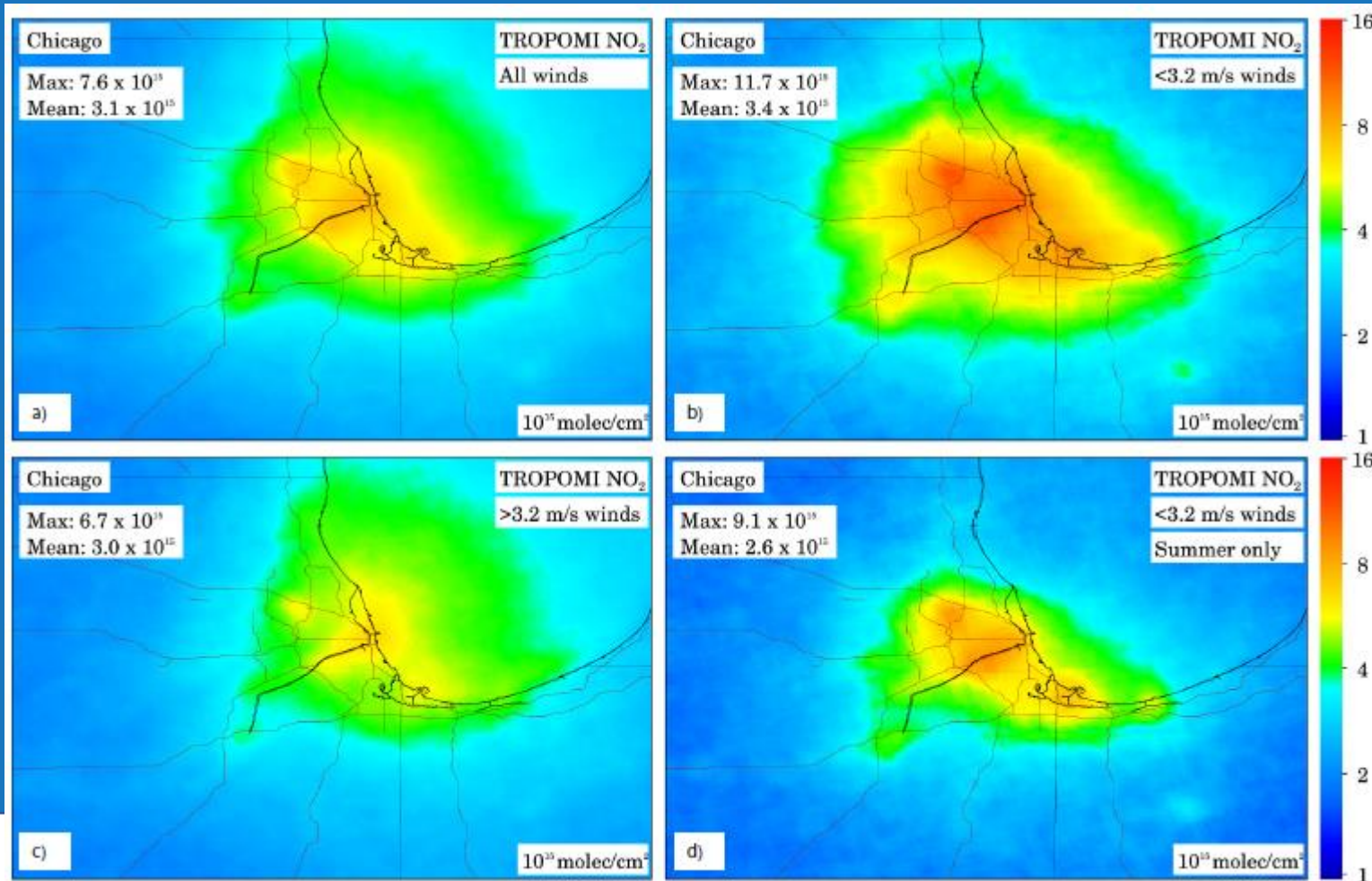
Useful!

Need #2: More Selective Oversampling



- Most oversampled maps:
 - Average periods with winds going in all directions, smearing out the emissions signals
 - Large blobs of high concentration
 - Hard/impossible to distinguish individual sources

Need #2: More Selective Oversampling



- Oversampling based on meteorological patterns could provide finer-grained emissions information
 - Winds speeds
 - Low ws smears signal less
 - Wind directions
 - Synoptic weather types
 - High- vs low-ozone days
 - High- vs low-winter nitrate days
- Make a tool to allow the user to select which days/times to combine for oversampling?



Questions?

dickens@ladco.org