LADCO Winter 2018 Update

Zac Adelman
LADCO Executive Director

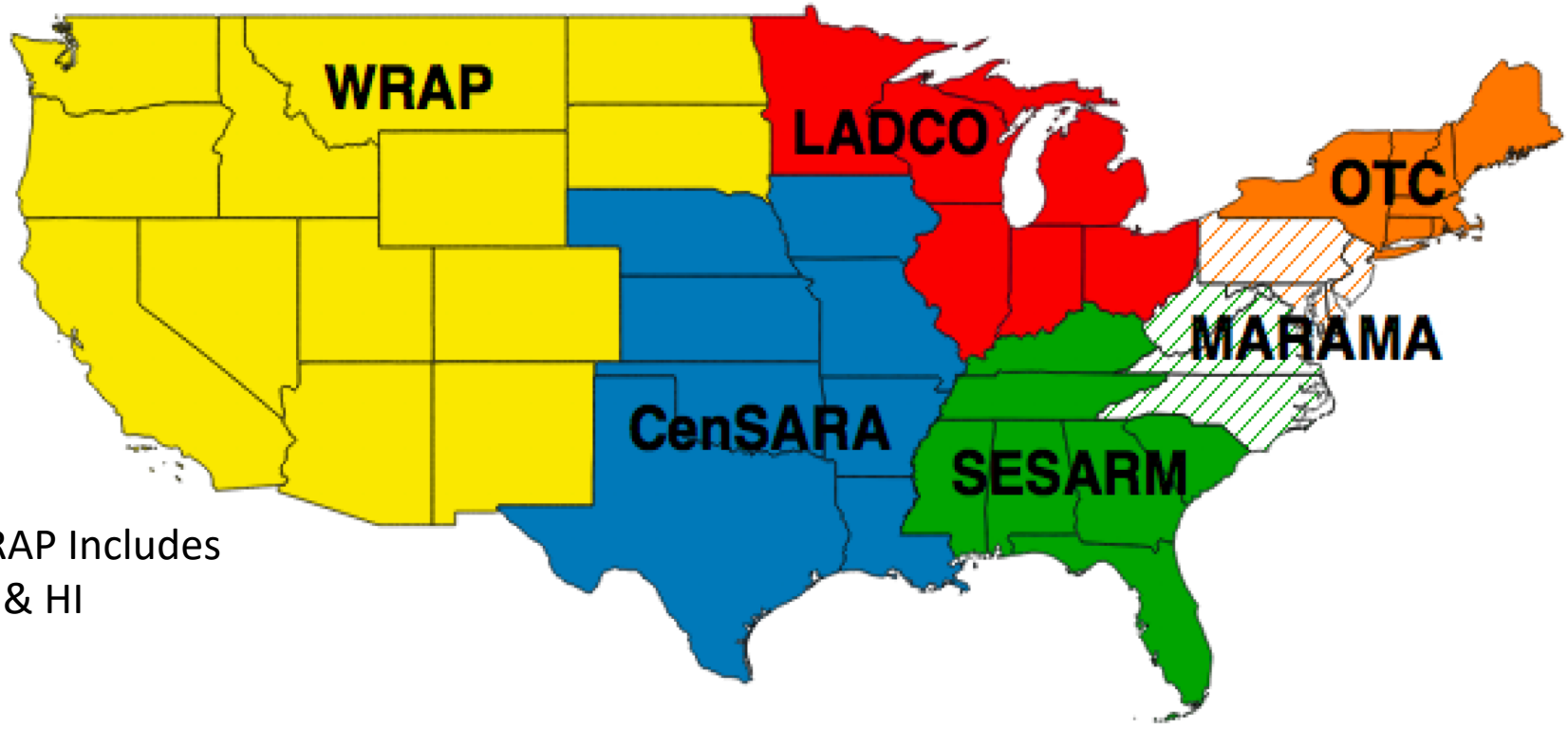
Presented to the Three Rivers Manufacturers Association

March 21, 2018


Isle Royale NP, MI


Boundary Waters Wilderness, MN

MJOs in 2018

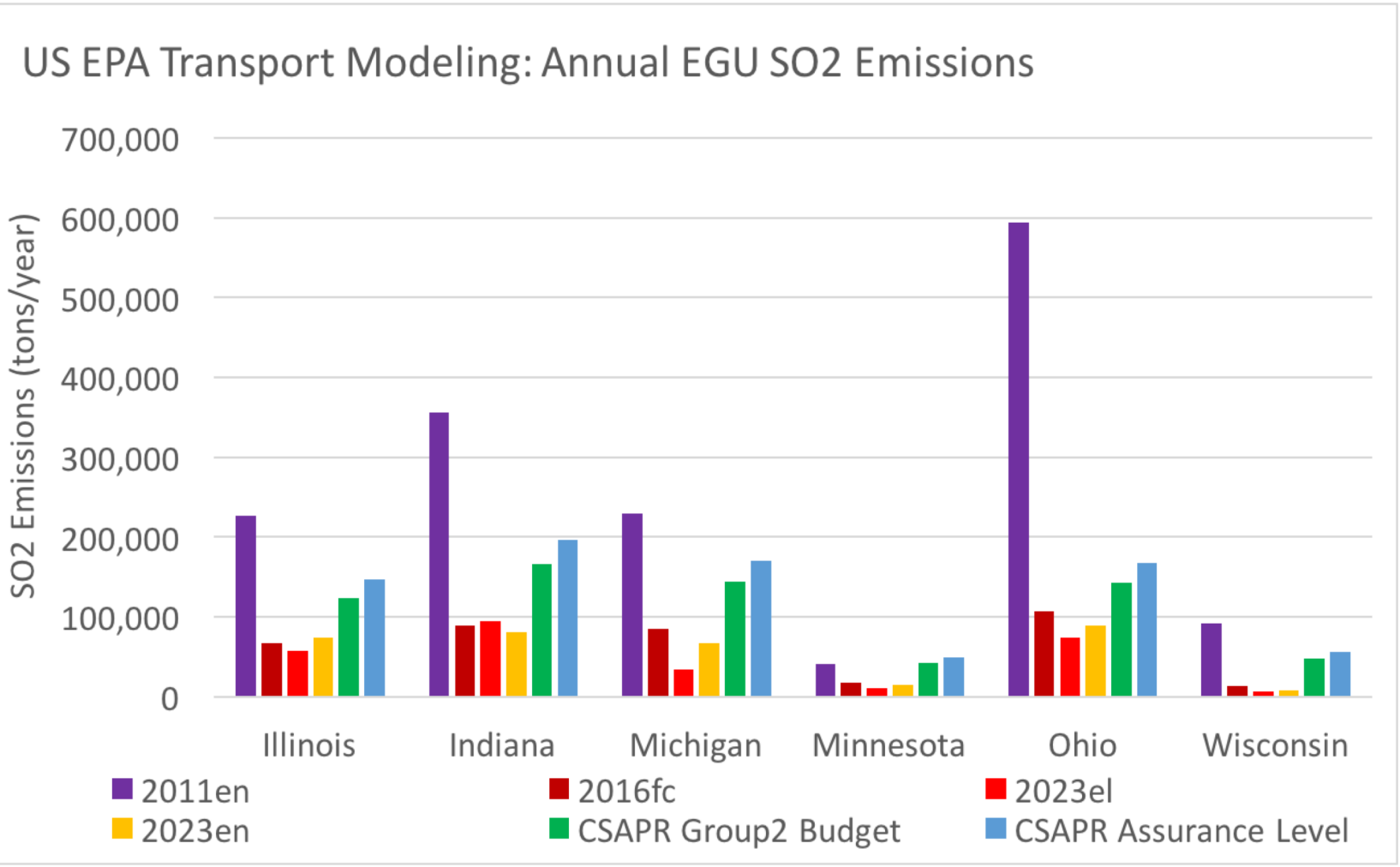


WRAP Includes
AK & HI

LADCO Background

- Formed in 1989 to bring Michigan, Indiana, Illinois, and Wisconsin together to address high ground level ozone in the region
  - Ohio joined in 2004; Minnesota joined in 2012
- Air pollution science, training, and planning support for the state (and tribal & local) air management agencies in the region
- Provides a forum to discuss regional air pollution issues
- Technical lead in the region for continental to urban-scale atmospheric modeling: meteorology, emissions, and chemistry-transport
- Current Events
  - New leadership as of September 2017
  - New modeling and business staff as of January 2018

How Have Energy Sector Changes Impacted LADCO Class I Areas?



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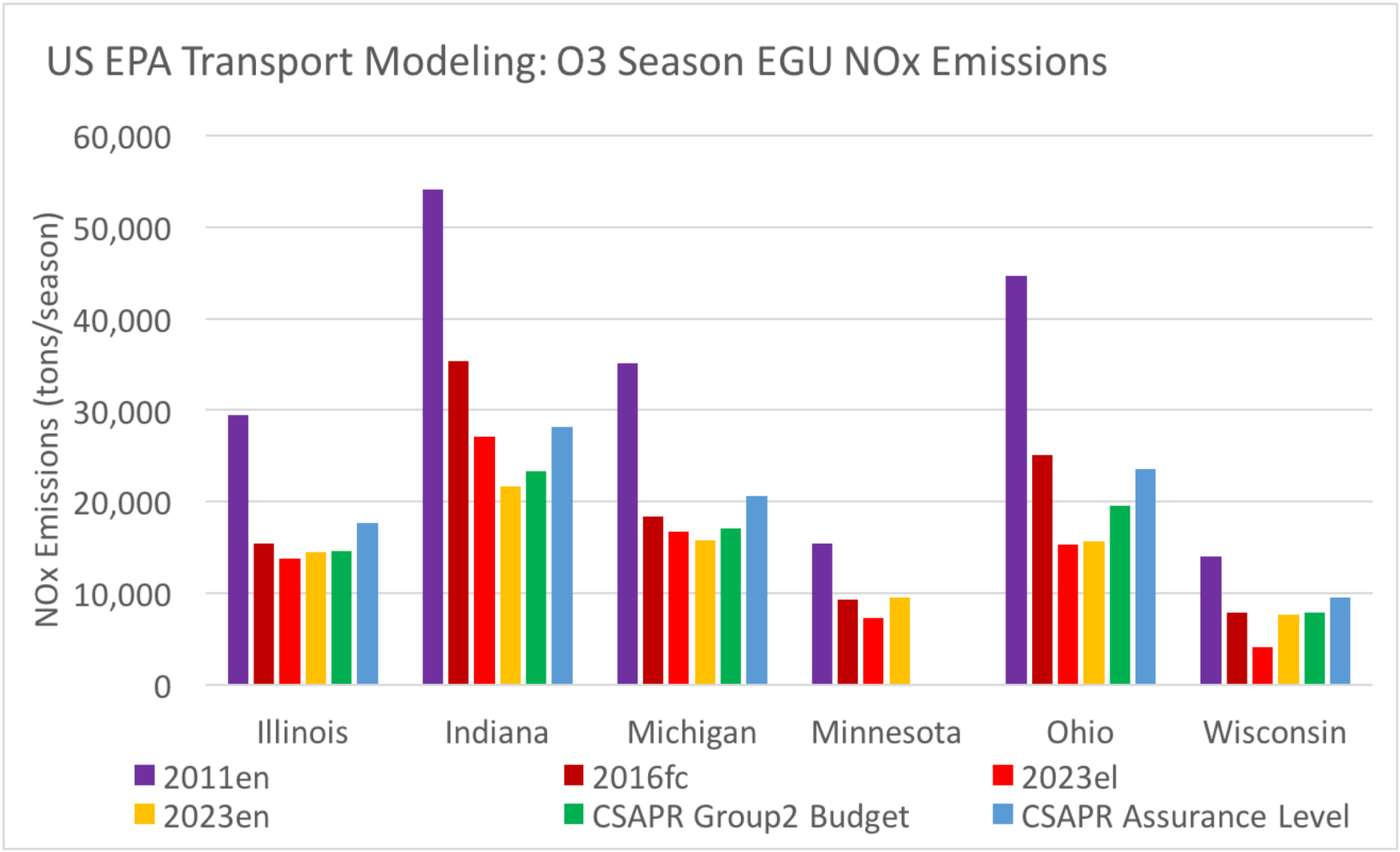

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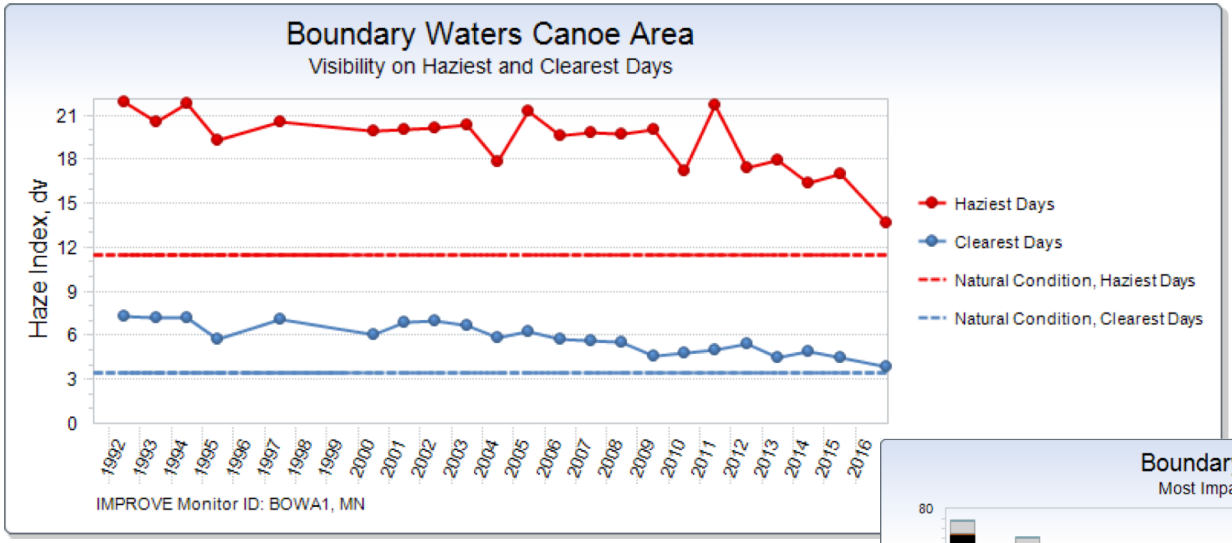

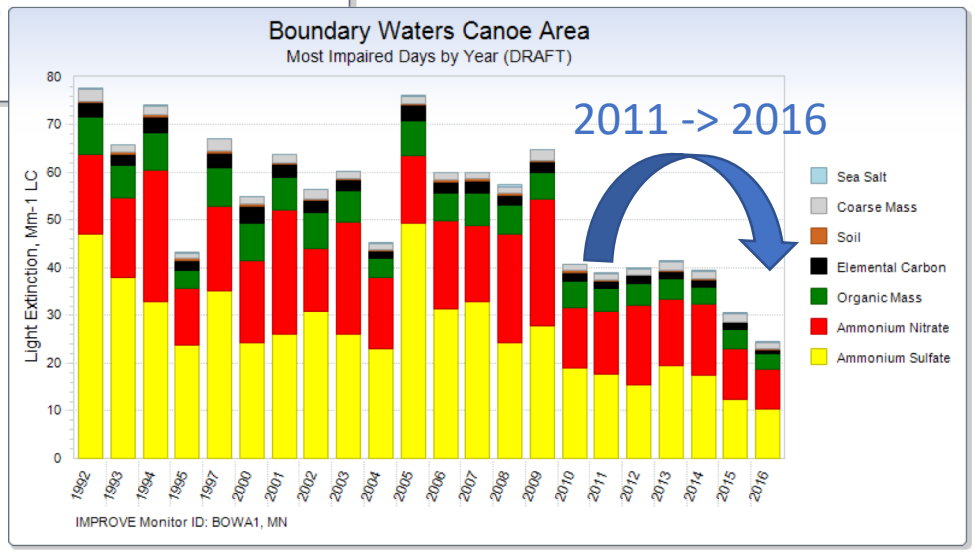

- Boundary Waters (MN) shows improvement in Most Impaired Days metric, starting around 2010
- 2011 to 2016 trend follows emissions
- Driven by NO_3 and SO_4

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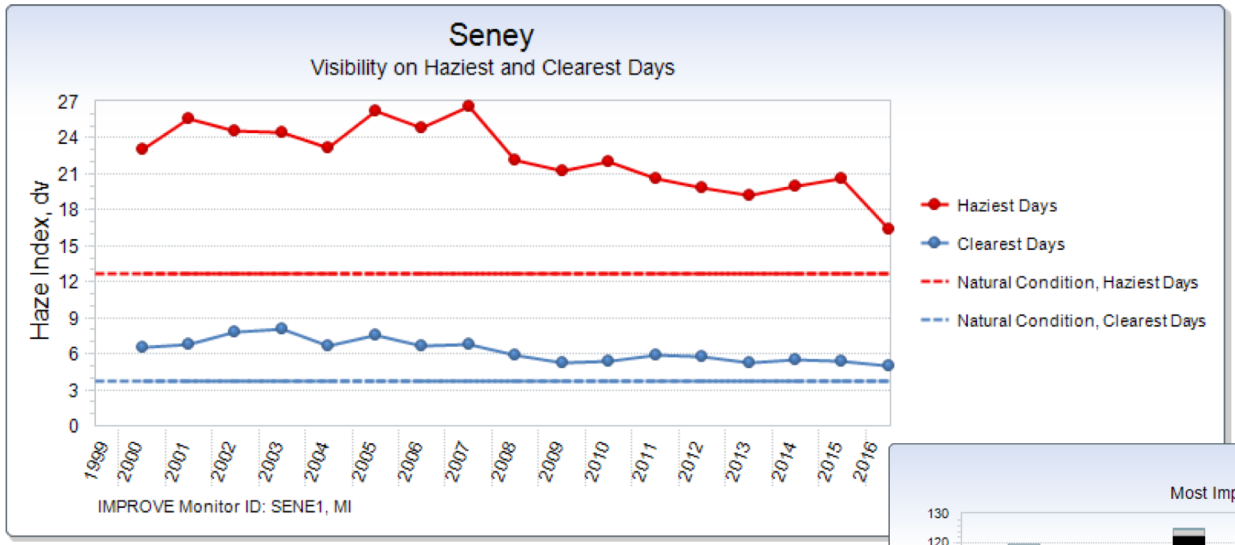
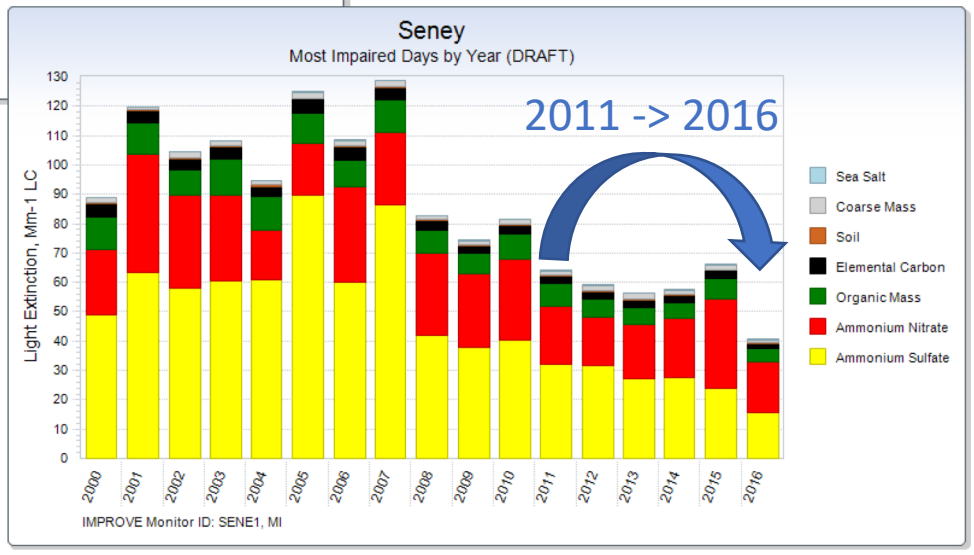
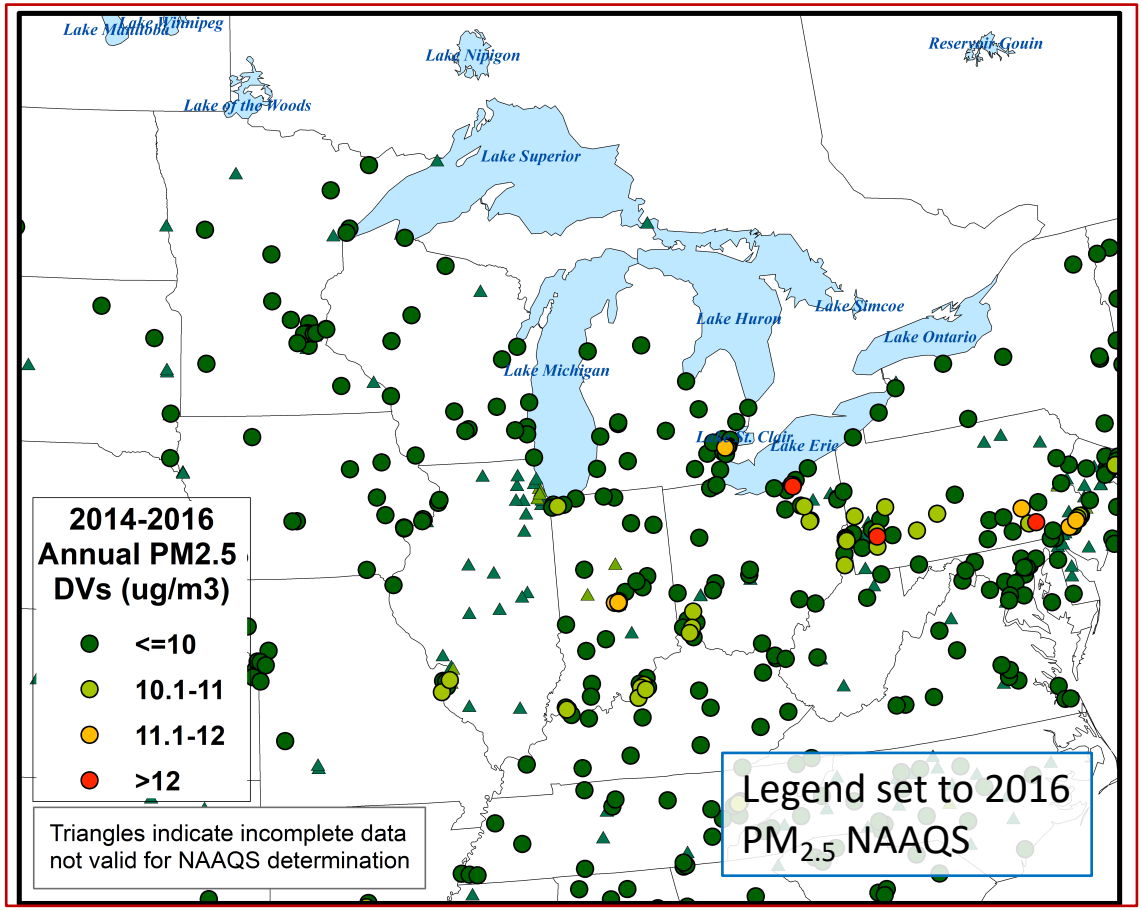




- Seney (MI) shows improvement in Most Impaired Days metric, starting around 2008
- 2011 to 2016 trend follows emissions
- Driven by SO_4

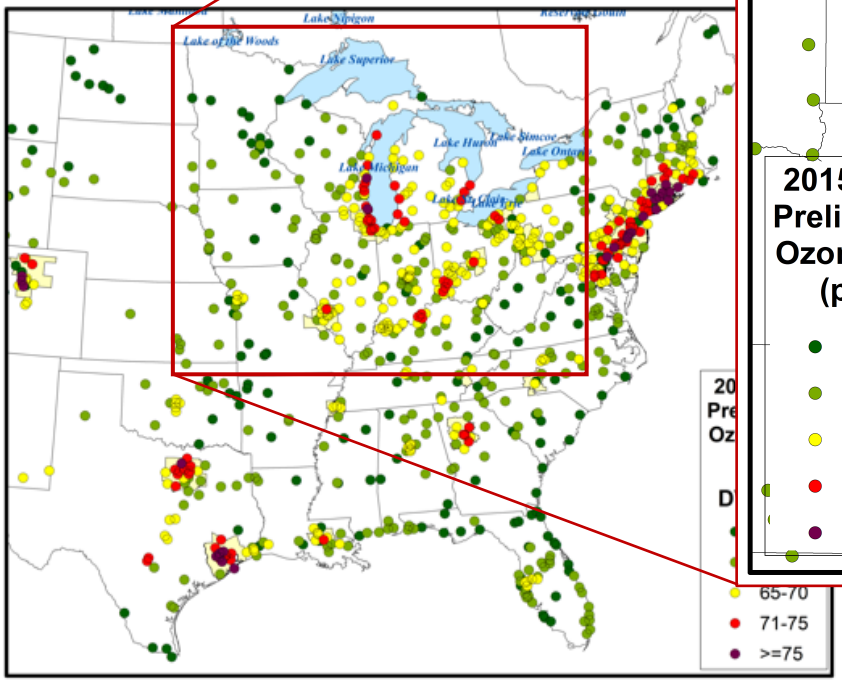
Recent $PM_{2.5}$ Design Values

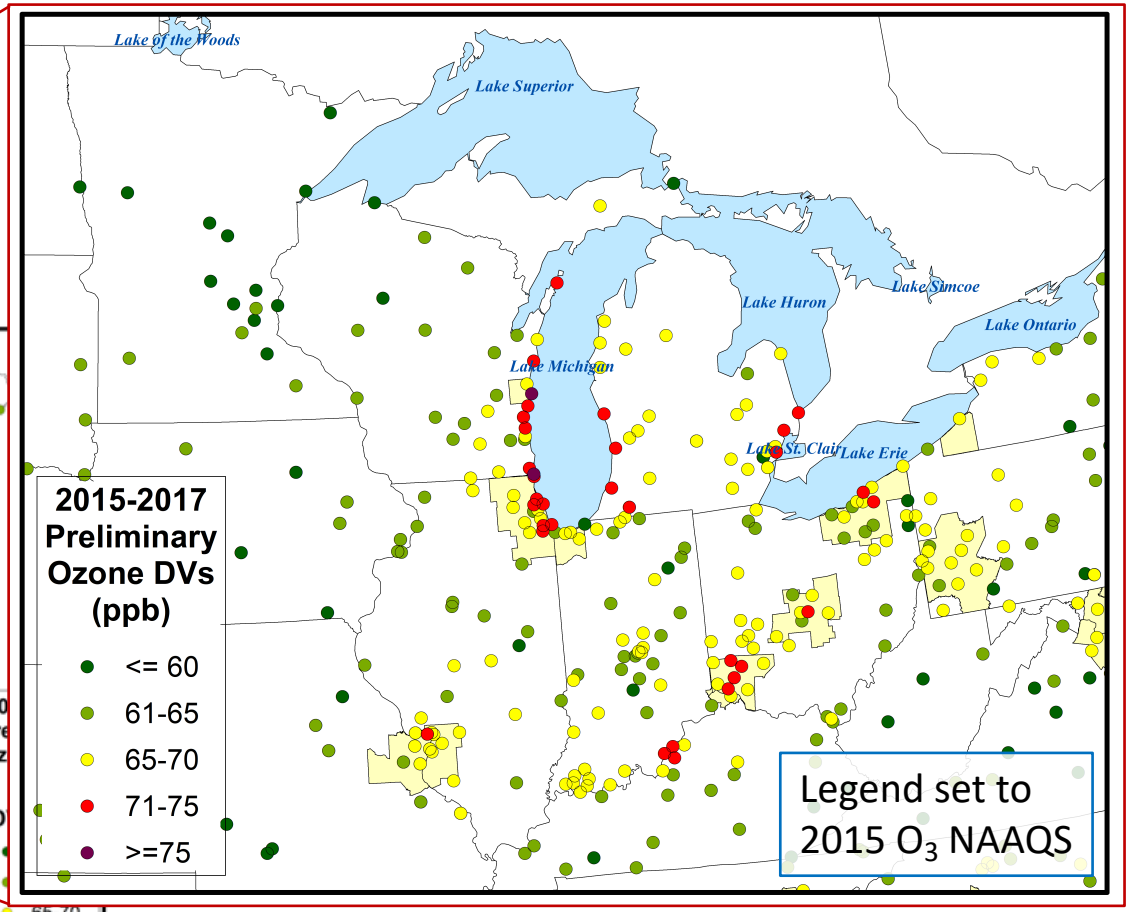
Annual $PM_{2.5}$ Design value = 3 year average of annual mean $PM_{2.5}$



Recent Ozone Design Values

O_3 Design value = 3 year average of annual 4th highest daily maximum 8-hour average O_3





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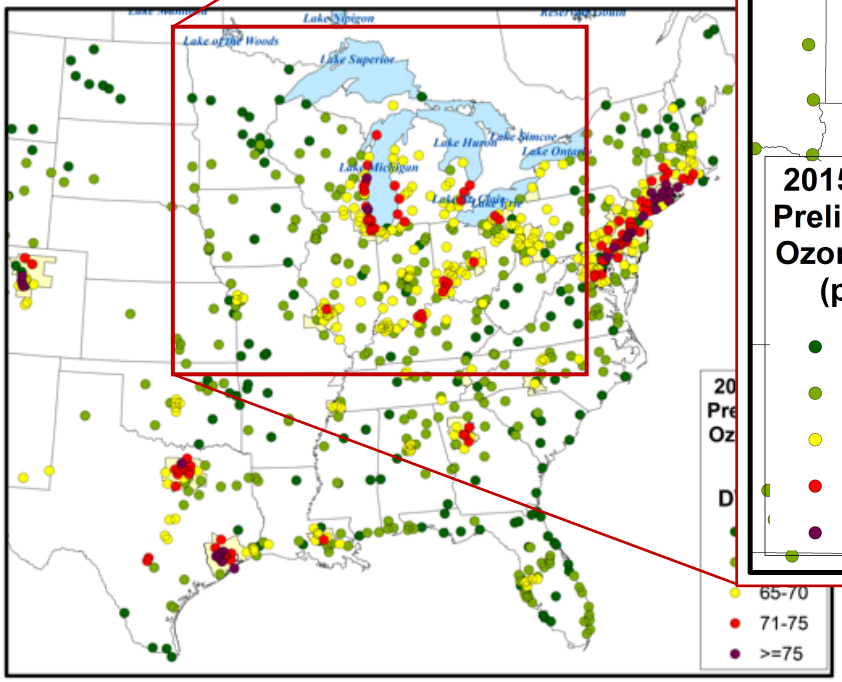
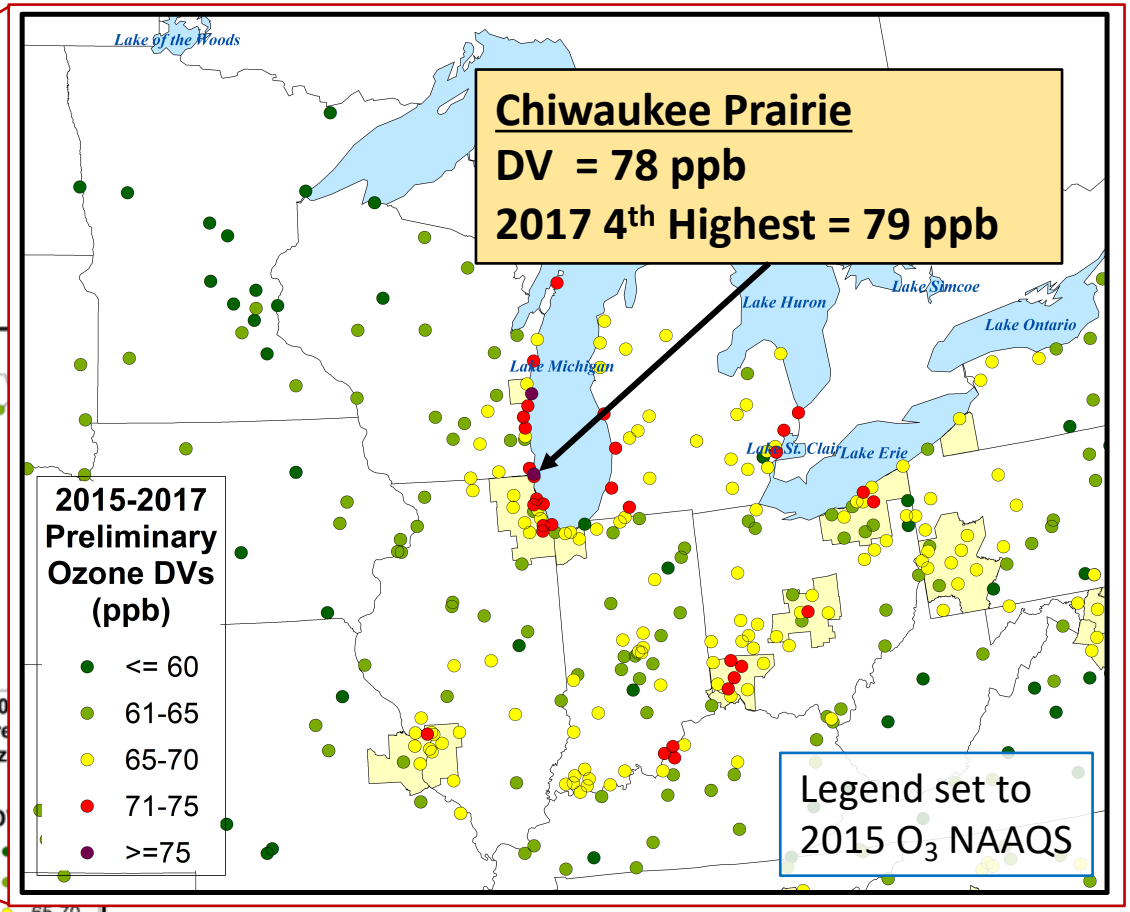
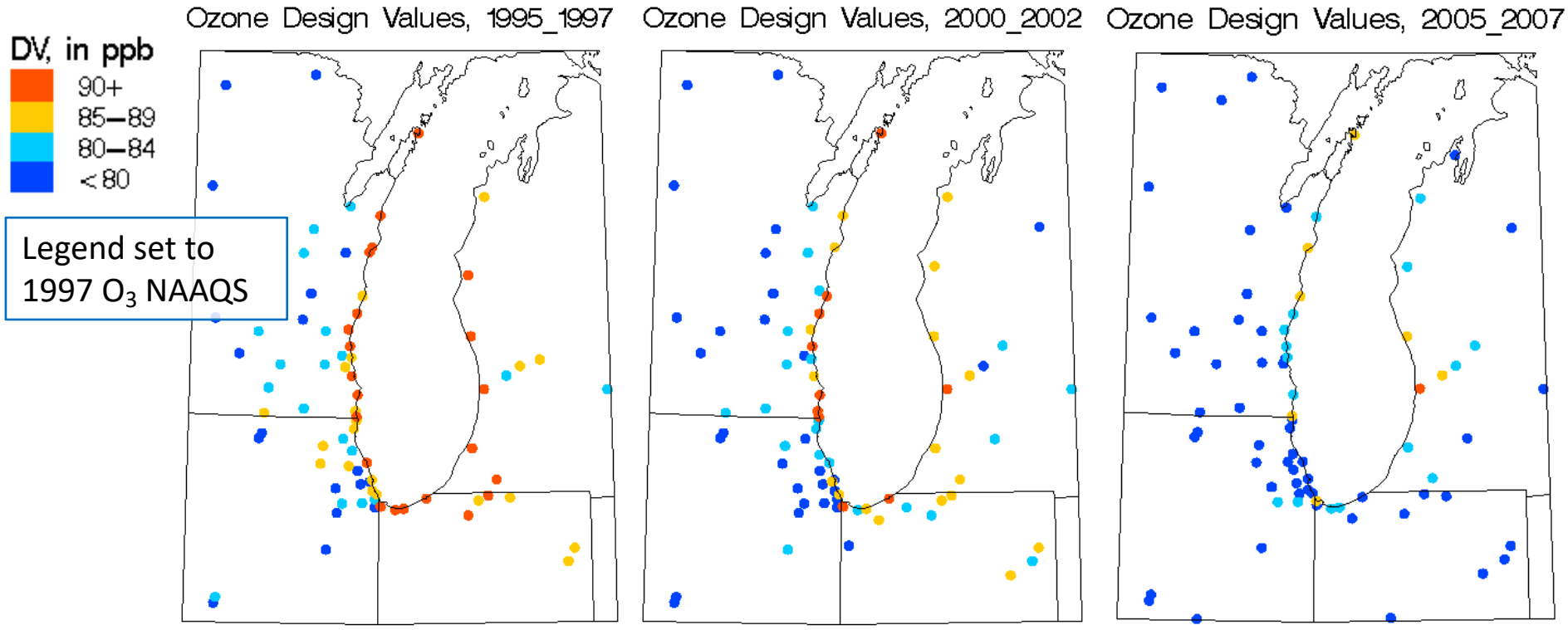




Lake Michigan Ozone Study

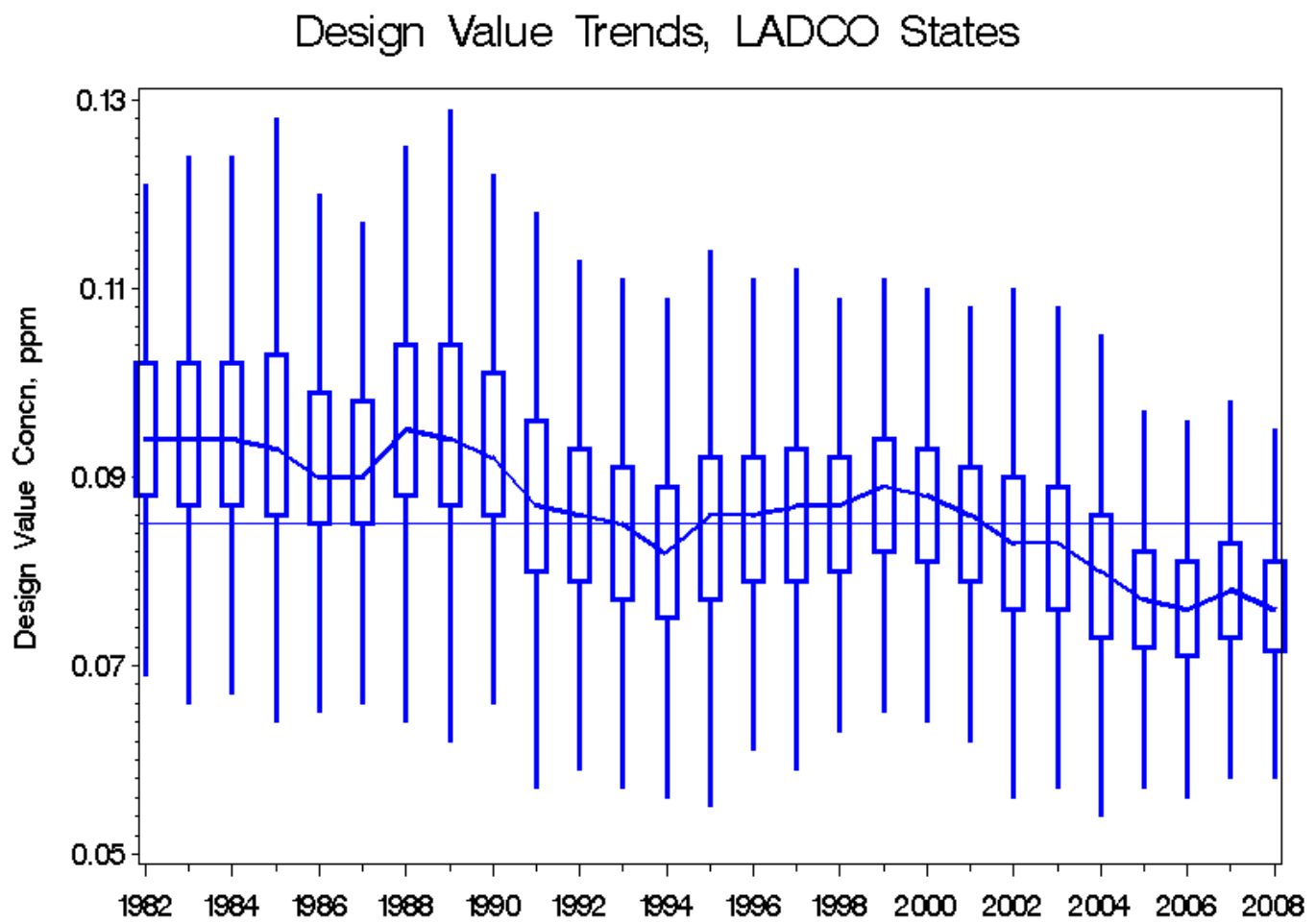
May – June 2017
Western Shore of Lake Michigan

Background on LMOS



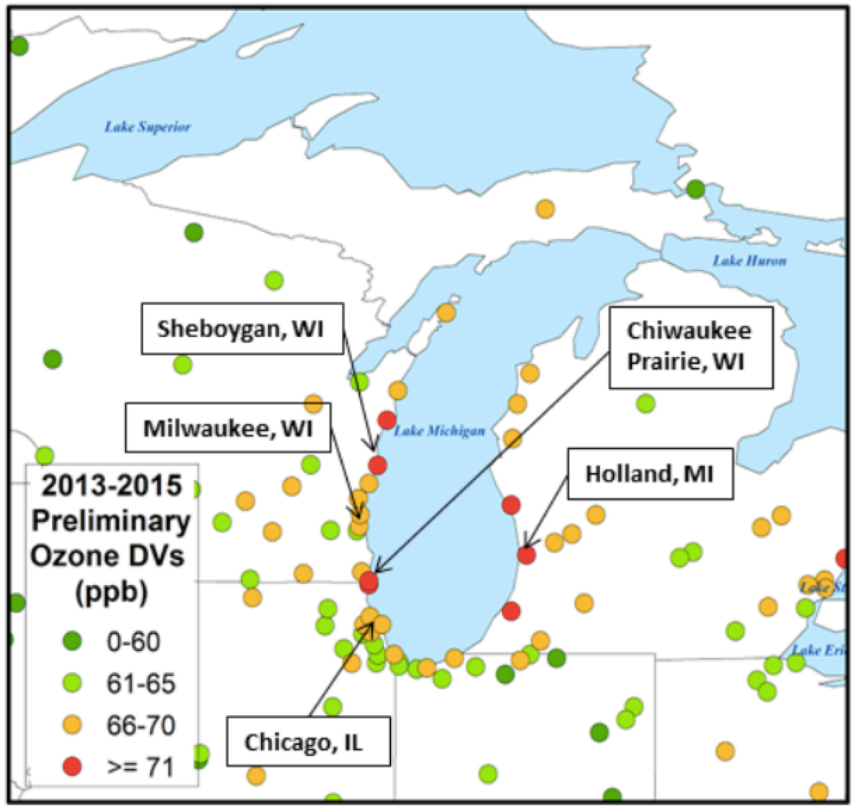
Ground level ozone concentrations in the region have improved significantly since the mid-90s.

Background on LMOS

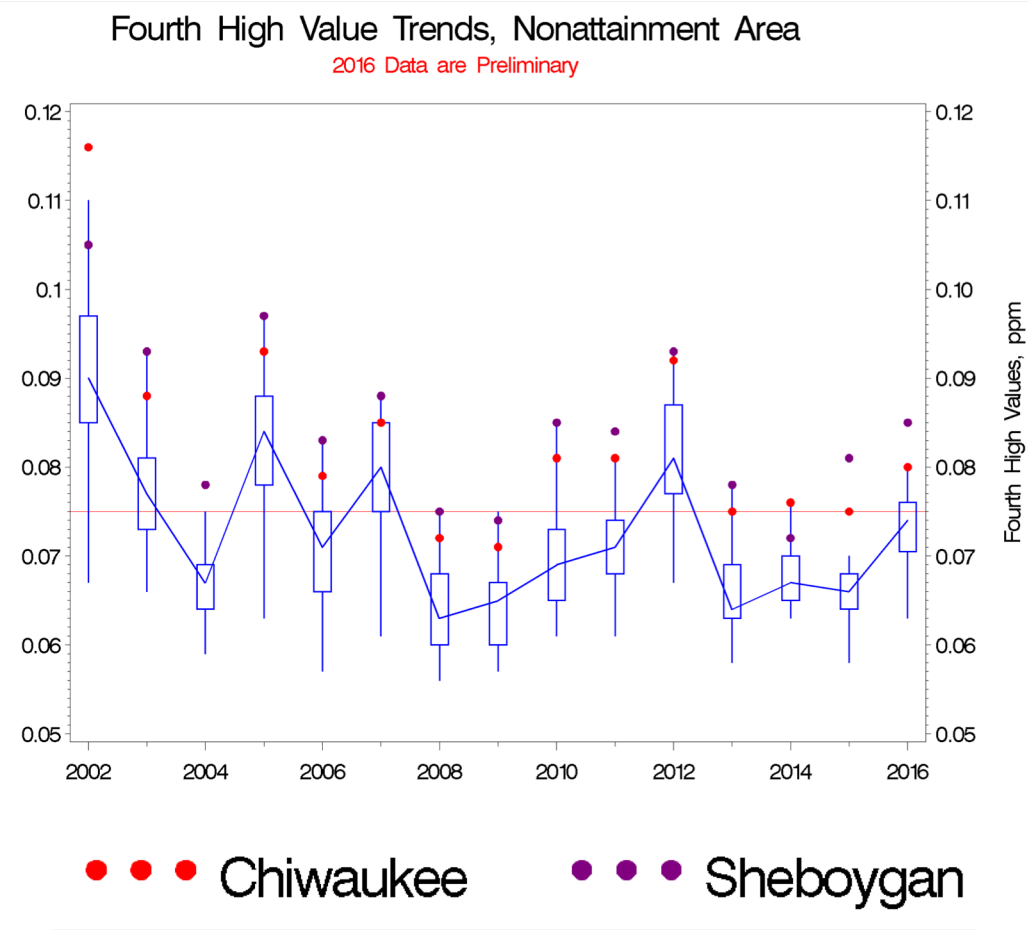


Design value plotted by end year of 3-year period. 2008 data are preliminary.

Persistent High O_3 at Coastal Sites



Legend set to 2015 O_3 NAAQS



We Know…

- NO_x + VOCS + sunlight → O_3

Credit: T. Holloway, U. Wisconsin

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- NO_x + VOCS + sunlight → O_3

But not the ratio of NOx to VOCs across the region → key to policy design

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- NO_x + VOCS + sunlight → O_3
- Ozone precursors from IL, IN, MI, WI (& more!) "cook up" over Lake Michigan

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But we don't know how much is attributable to each state under changing conditions

Credit: T. Holloway, U. Wisconsin

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- Ozone values at the monitors

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But not over water bodies, or away from the monitors on land

Credit: T. Holloway, U. Wisconsin

We Know…

- NO_x + VOCS + sunlight → O_3
- Ozone precursors from IL, IN, MI, WI (& more!) "cook up" over Lake Michigan
- Ozone values at the monitors
- What the models tell us about lake breeze & chemistry

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- Ozone precursors from IL, IN, MI, WI (& more!) "cook up" over Lake Michigan
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- What the models tell us about lake breeze & chemistry

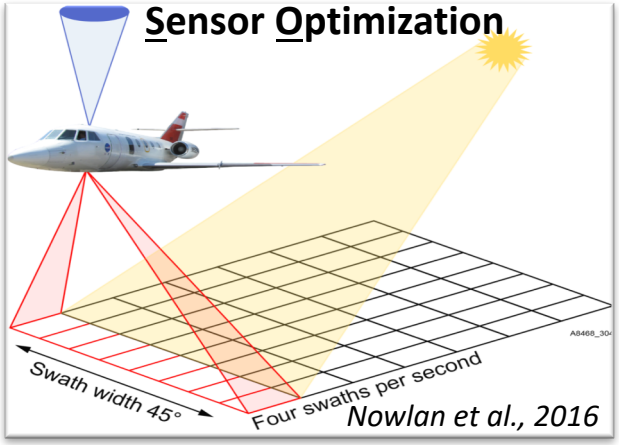
But the models may not resolve, include, or correctly capture key processes

Credit: T. Holloway, U. Wisconsin

Motivations for LMOS

- Persistent high O_3 at some coastal sites
- Planning needs of the LADCO states require further clarity on regional O_3 production
- Last field campaign: summer 1991
- Need for a new study: New instruments/satellites and scarce aloft and over-lake observations

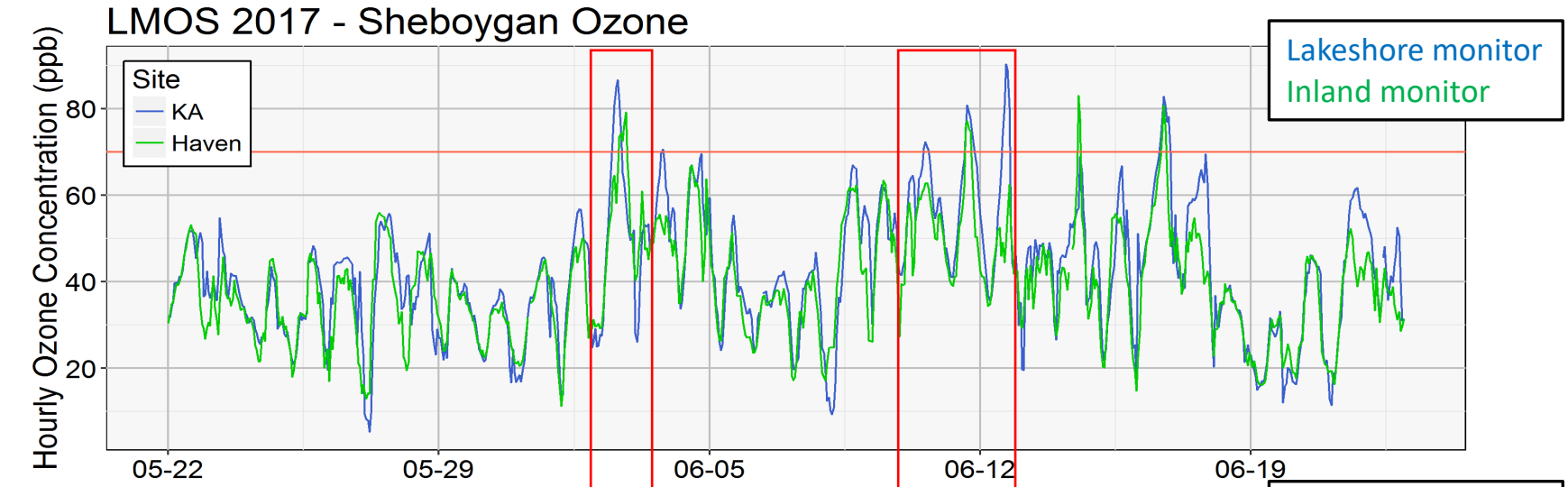
Geostationary Trace gas and Aerosol Sensor Optimization

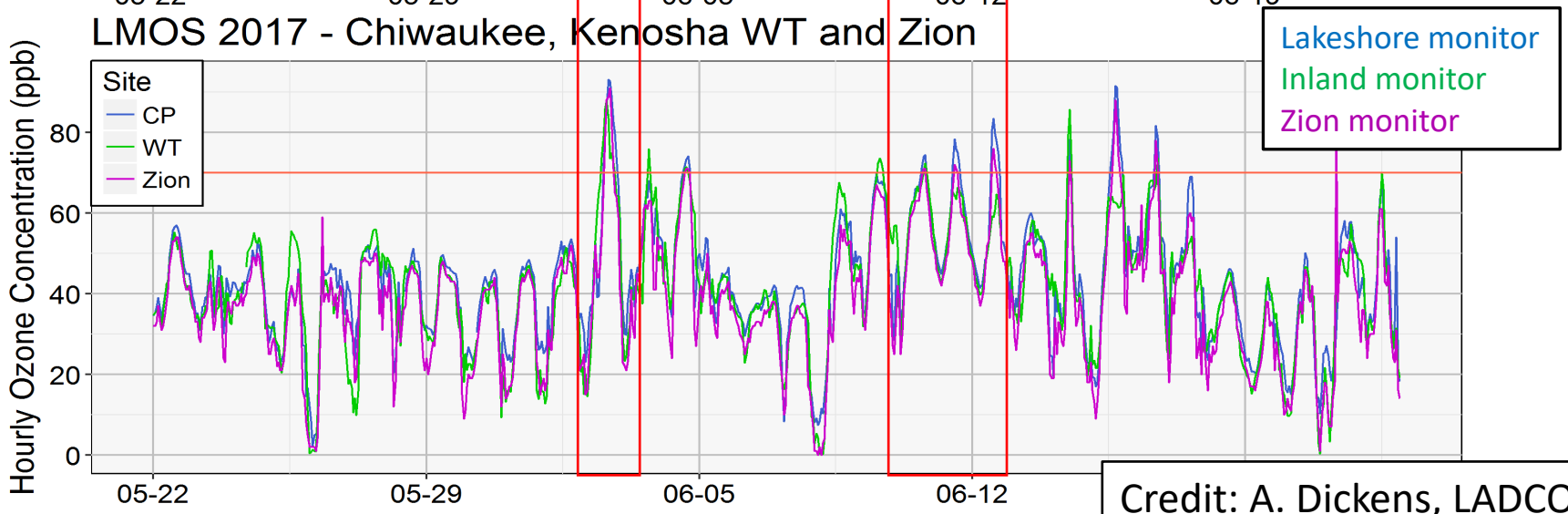


LMOS Objectives

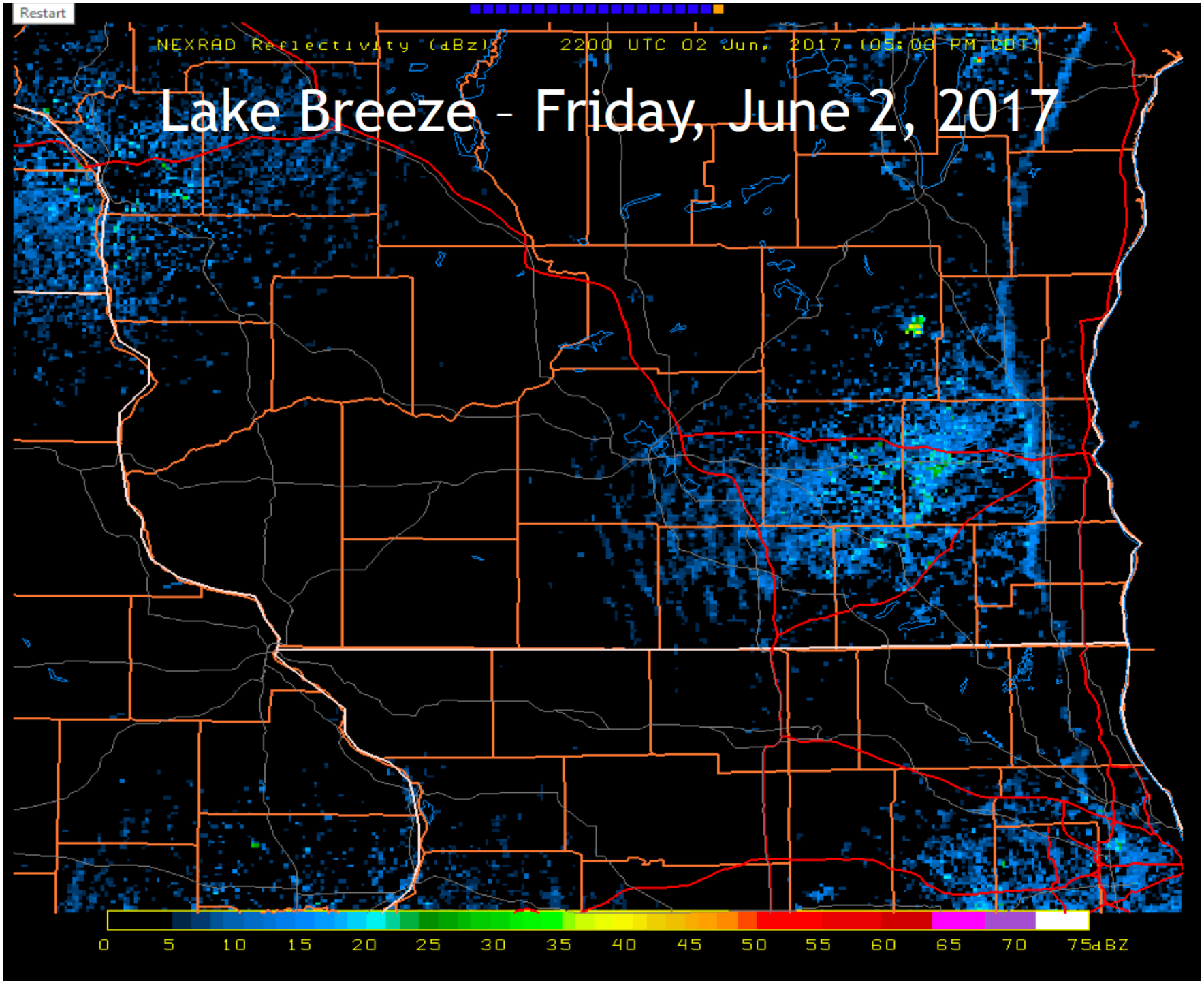
- Measure the concentrations of O_3-relevant compounds
- Quantify the relative contribution of inter- and intra-state NO_x and VOC emissions and emissions sources on O_3 production rates along Lake Michigan
- Evaluate and improve meteorological and chemical transport model skill
- Study link between lake breeze circulations and O_3
- Analyze the causes of concentration differences between coastal and inland sites with observations and model data
- Develop best practices for O_3 planning modeling

1st Law of Measurement Campaigns?

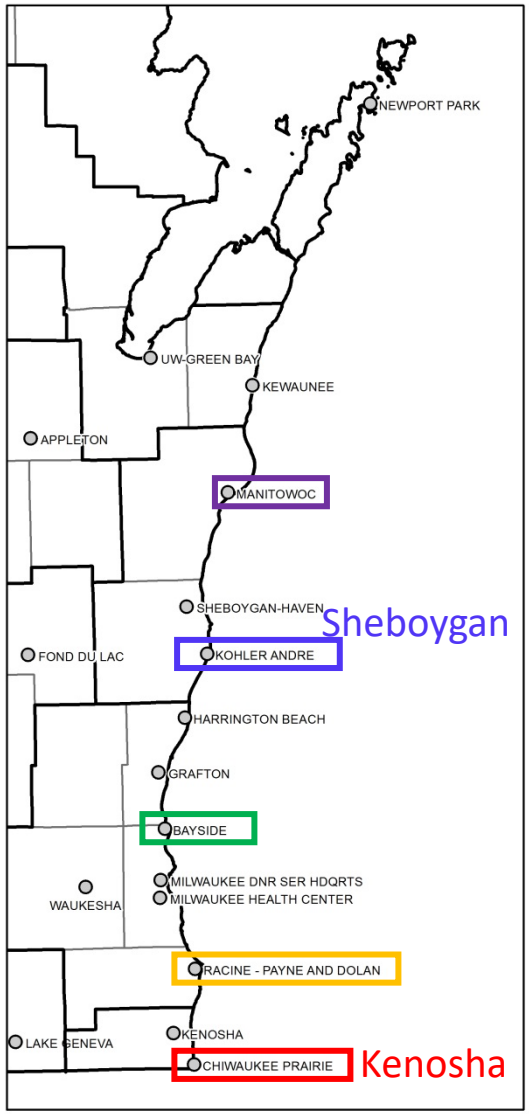


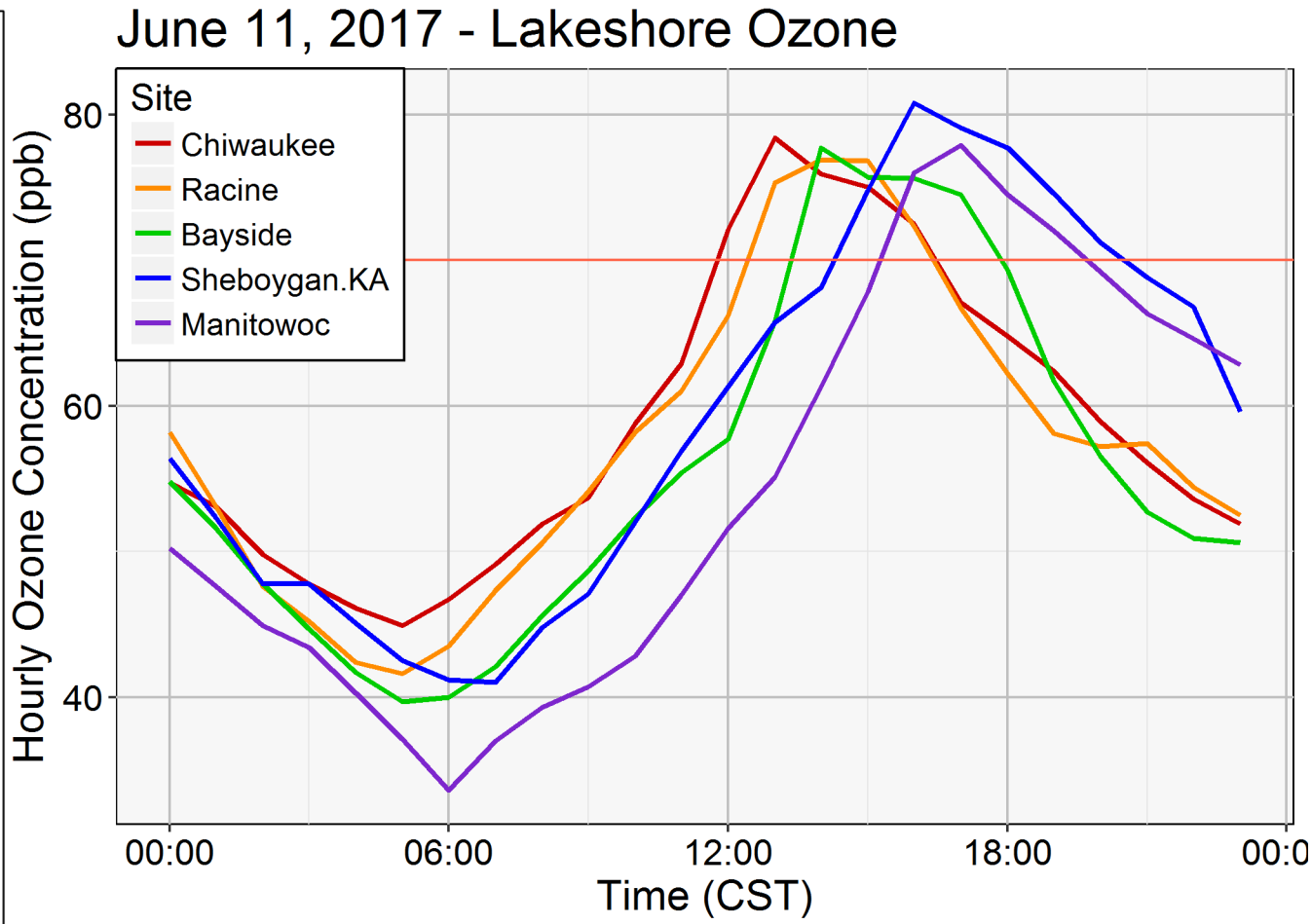


Credit: A. Dickens, LADCO


Restart
NEXRAD Reflectivity (dBz)
2200 UTC 02 Jun 2017 (05:00 PM CDT)
Lake Breeze - Friday, June 2, 2017
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75dBZ

Typical Regional Ozone Event



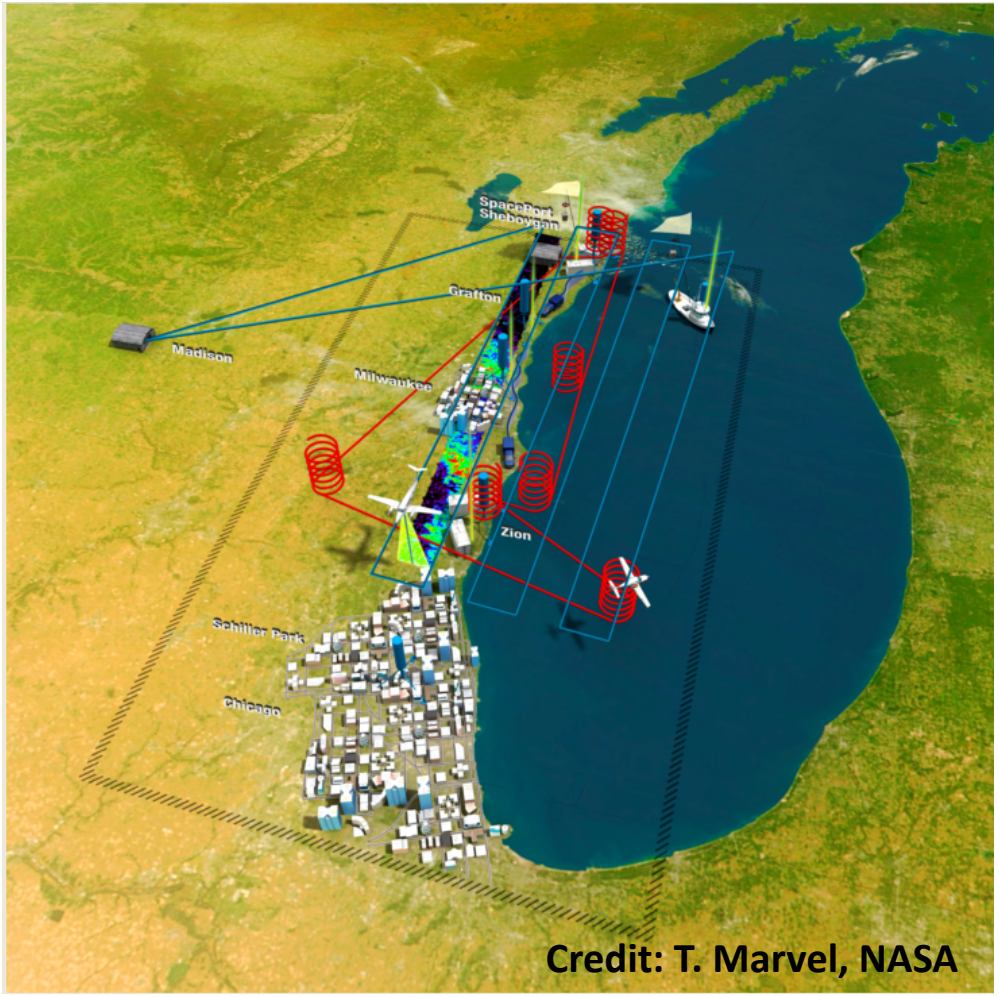


- Ozone peaks first at southern monitors
- Ozone plume moves northward

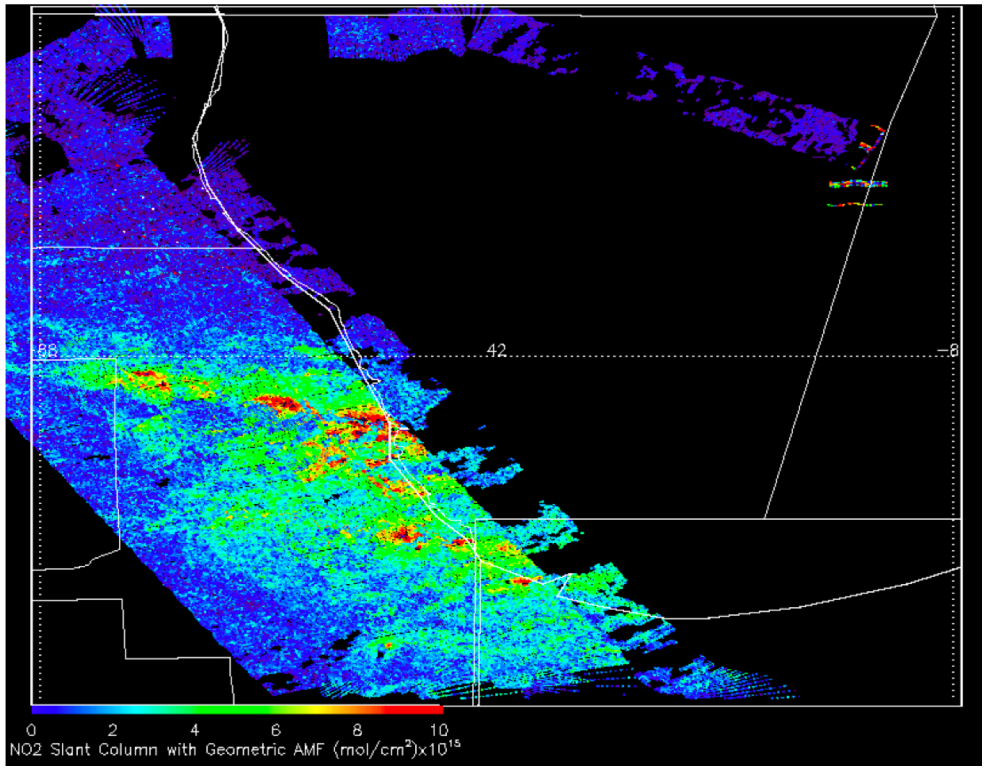
Credit: A. Dickens, LADCO

LMOS Study Design

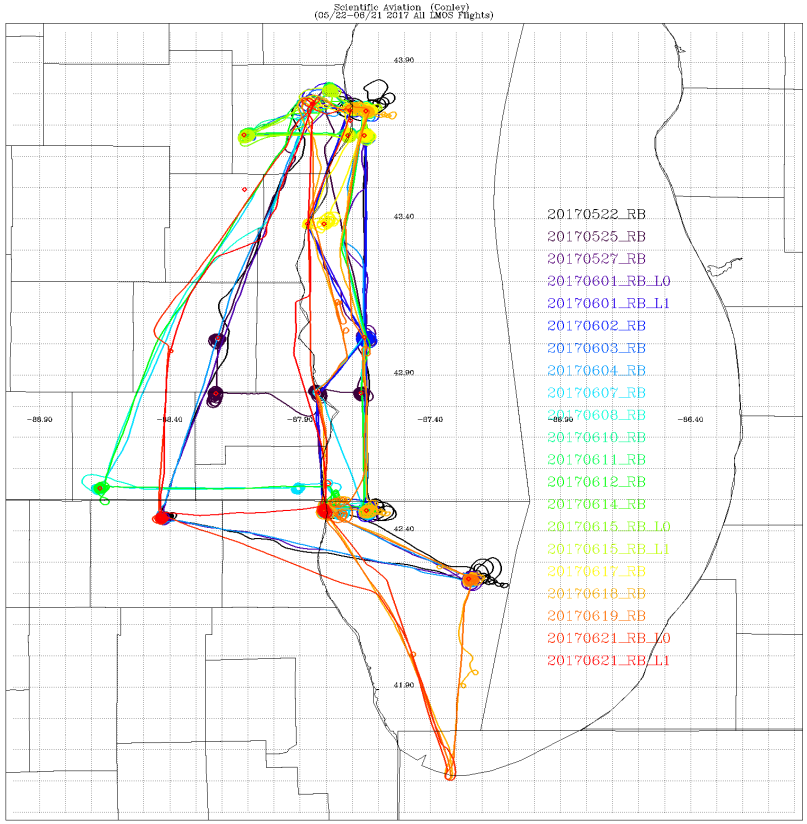
- Observations
  - Aircraft
  - Ship
  - Mobile on-shore
  - Zion, IL Supersite
  - Sheboygan, WI Ground Site
- Forecasts
  - WI DNR
  - NOAA NESDIS
  - U. Iowa
  - NWS



LMOS Airborne Platforms



NASA GeoTASO
NO2 Column Mapping Over Chicago
June 19, 2017



Scientific Aviation Measurement
Flight Paths

Next Steps

- Internal synthesis report detailing the measurements, modeling, and data collected during LMOS (early 2018)
- Meteorology & photochemical modeling best practices for modeling ozone in the region (early 2018)
- Explore a long-list of scientific questions with LMOS data (2018 and beyond)
- Synthesis paper in the peer-reviewed literature (summer 2018)
- Merge datasets for public release (fall/winter 2018)
- Technical papers in the peer-reviewed literature (2019)

LMOS Investigators

- M. Christiansen, C. Stanier, G. Carmichael, E. Stone (University of Iowa)
- T. Bertram (University of Wisconsin)
- D. Millet (University of Minnesota)
- P. Cleary (University of Wisconsin - Eau Claire)
- A. Czarnetzki (University of Northern Iowa)
- B. Pierce (NOAA/NESDIS)
- J. Szykman, R. Long, M. Fuoco (U.S. Environmental Protection Agency)
- A. Dickens, (Wisconsin Dept. of Natural Resources)
- R. Kaleel, D. Kenski (LADCO)
- J. Al-Saadi, L. Judd (NASA Langley Research Center)
- S. Janz, M. Kowalewski (NASA Goddard Space Flight Center)
- S. Conley (Scientific Aviation, Inc)
- N. Abuhassan (GSFC/UMBC)
- S. Shaw (Electric Power Research Institute)

LMOS Funding

- NSF AGS-1712909, NSF 1712828, NSF 1713001
- NOAA/NESDIS GOES-R Program Office
- Electric Power Research Institute (EPRI)
- Lake Michigan Air Directors Consortium (LADCO)
- Significant personnel and equipment contributions from USEPA, NASA, EPA Region V, and LADCO member states

National Inventory Collaborative

- A new multi-purpose emissions modeling platform (EMP) based on the 2014 National Emissions Inventory version 2 (2014NEIv2) is needed
  - State Implementation Plans, federal analyses
- Regional organizations and states asked to be more involved in the development of national EMPs
  - Need for broader input into the methods used, especially for "projections" of emissions to future years
- For the first time, EPA, states, and MJOs are engaging in collaborative EMP development
  - The 2016 base year was selected via a collaborative process
  - Process and timing are evolving
  - **Participation in the EMP collaborative is voluntary**

Organizational Structure

- **Coordination co-leads**: Zac Adelman (LADCO) and Alison Eyth (EPA OAQPS)
  - Developed process and communication structures, facilitate discussions, help resolve issues, documentation requirements, coordinate distribution of data to stakeholders
- **Coordination committee**: regional, state, EPA leaders
  - Define processes, resolve issues, co-lead workgroups
  - Includes overall and WG co-leads plus MJO directors
- **Sector-specific Workgroups**: one regional/state staff and one EPA staff (where possible)
  - Focus on preparing emissions estimates for 2016 and future years, plus improve how the emissions sectors are modeled
  - Include participants from EPA/states/locals/regions

Workgroup Overview

Workgroup	Co-leads	Members
Biogenics	Jeff Vukovich (OAQPS), Doug Boyer (TCEQ)	10
Fires	Jeff Vukovich (OAQPS(, Tom Moore (WESTAR)	30+
Oil and gas (point+nonpoint)	Tom Moore (WESTAR), Jeff Vukovich	30+
Nonpoint (dust, RWC, ag, other)	Caroline Farkas (OAQPS), Chris Swab (OR)	30+
Non-EGU point (includes aircraft)	Caroline Farkas (OAQPS), Tammy Manning (NC)	30+
EGUs	Julie McDill (MARAMA), Serpil Kayin (OAP)	30+
Onroad	Julie McDill (MARAMA), Alison Eyth (OAQPS)	30+
Marine	Mark Janssen (LADCO), Michael Aldridge (OTAQ)	20+
Rail	Mark Janssen (LADCO), EPA OAQPS EIAG	30+
Nonroad	Sarah Roberts (OTAQ), Joe Jakuta (OTC)	30+
Meteorology	Chris Misenis (OAQPS)	15
International	Alison Eyth (email only)	10

2016 EMP Schedule

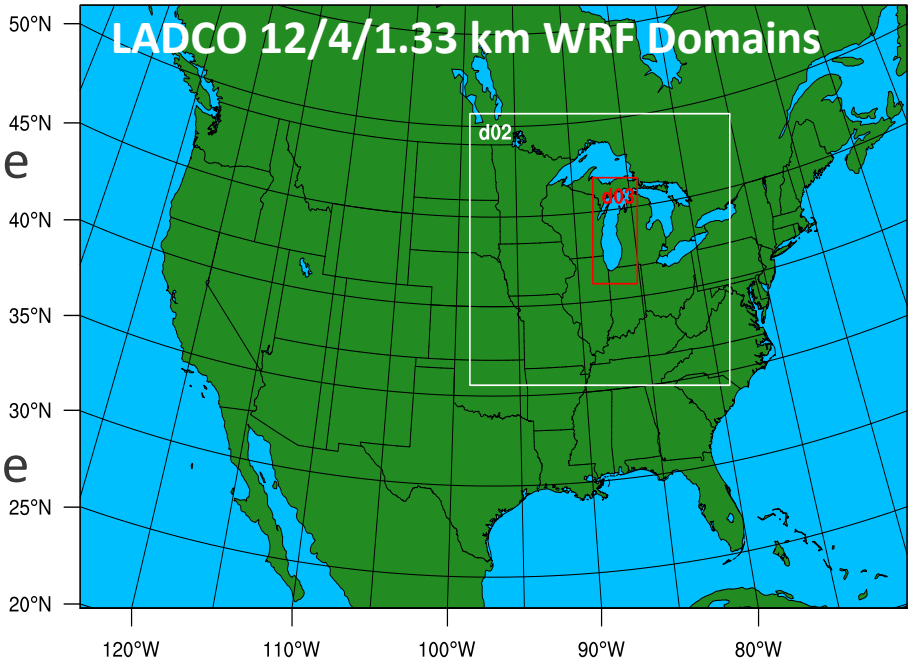
- Several versions of 2016 platform will be developed
  - **Alpha**: *preliminary* version with 2014 NEIv2 scaled for most and 2016 emissions for some sectors for initial testing of 2016 model runs (March, 2018)
  - **Beta**: *improved and/or new* version of actual 2016 emissions for most sectors and preliminary projected emissions to 2023 and 2028 (Summer-Fall, 2018)
    - Exact timing of beta 2016 and projections is uncertain
  - **V1.0**: *fully updated* 2016 emissions and complete projected emissions for 2023 and 2028 (Winter, 2019)
- Schedule overlaps with 2017 NEI Development
  - **Prioritize the 2017 NEI over the 2016 platform**, as needed
  - Any missing data for 2016 will be filled in based on 2014 NEI data and nationally consistent methods

Regulatory Issues @ LADCO

- 2015 O_3 NAAQS
  - Final designations in April
  - Likely marginal status for all violating LADCO monitors
  - iSIPs (including ”Good Neighbor” SIPs) due October 2018
  - Marginal NAA SIPs due October 2019
  - Attainment demonstration (SIP) not required for marginal
- 2008 O_3 NAAQS
  - Chicago bump up from moderate to serious status this summer
- Regional Haze
  - Round 2 SIPs due June 2021

Technical Analyses @ LADCO

- Regional Photochemical Modeling
  - 2023 CAMx Source Apportionment for 2015 O3 NAAQS Transport
  - 2016 WRF/CAMx/CMAQ modeling for O3 and Regional Haze
- Emissions Modeling
  - Inventory Collaborative
  - Analysis/improvement of mobile sources: onroad, offroad, rail, marine
- Meteorology Modeling
  - WRF optimization for high ozone conditions



Questions and Contact

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