Air Quality Trends Update

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LADCO Data Scientist

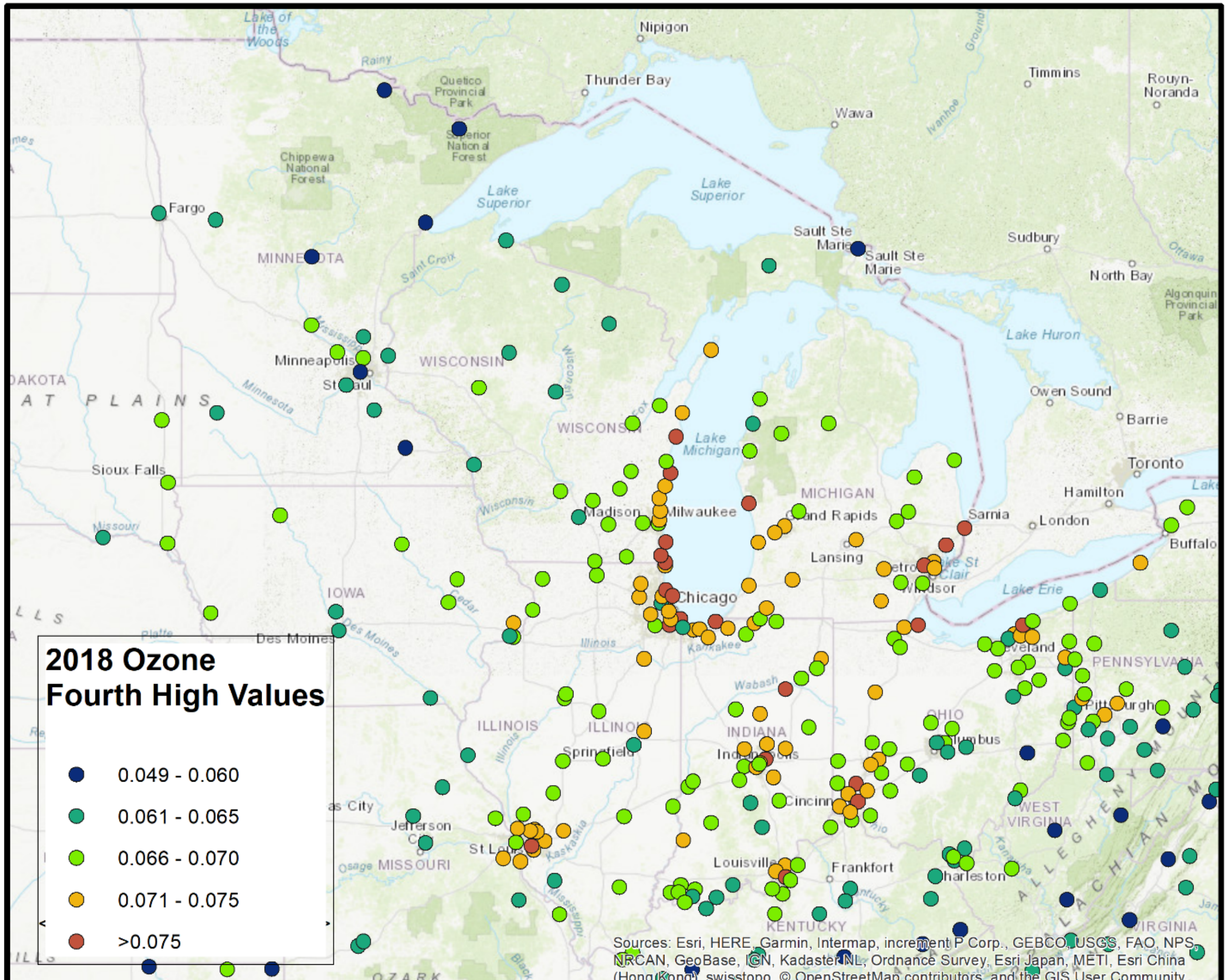
April 15, 2019

LADCO | LAKE MICHIGAN AIR DIRECTORS CONSORTIUM

5 Updates

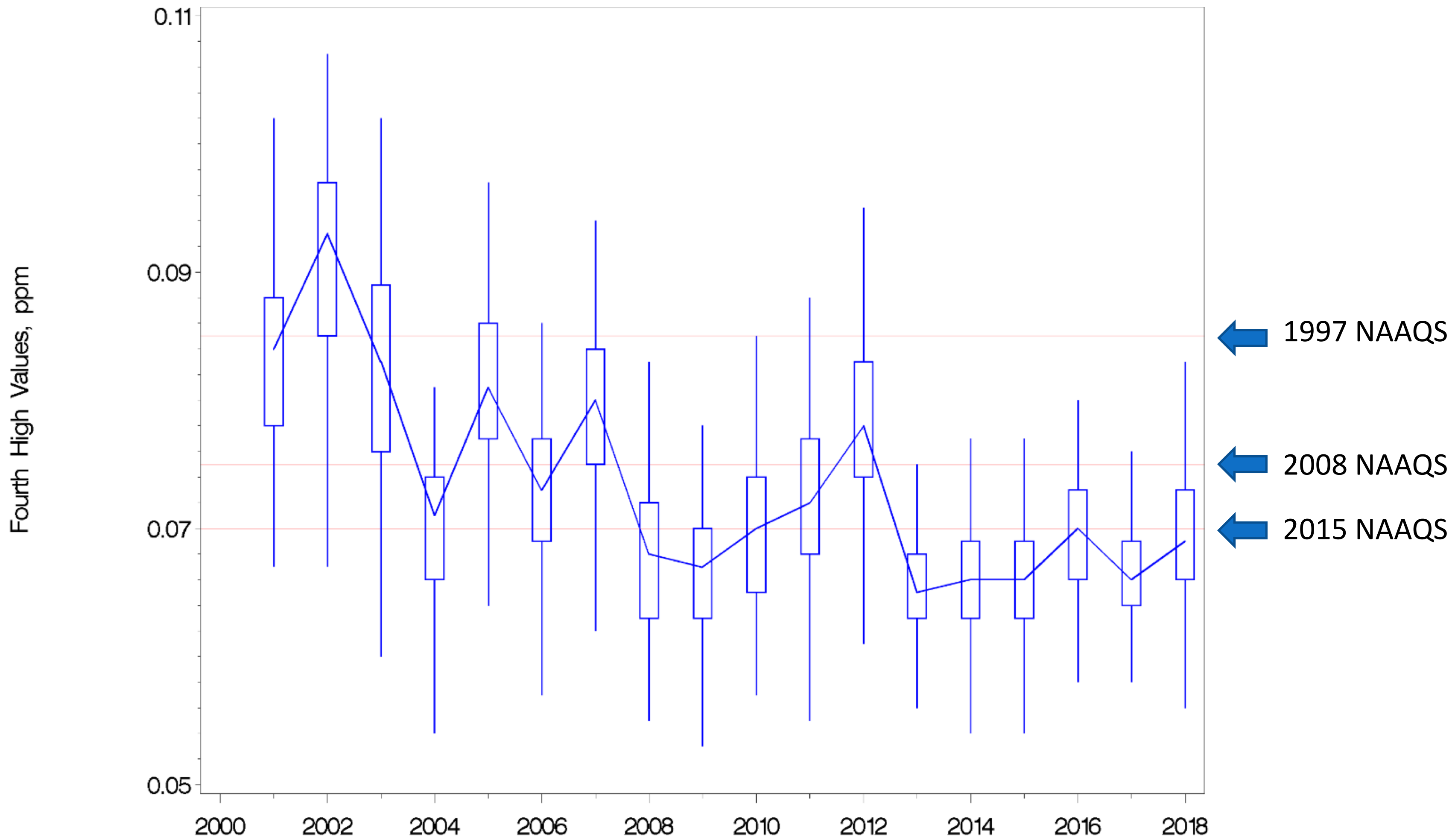
- Ozone
- PM2.5
- Regional Haze
- Mercury
- 2015 Network Assessment

Ozone: 2018 Fourth High Values



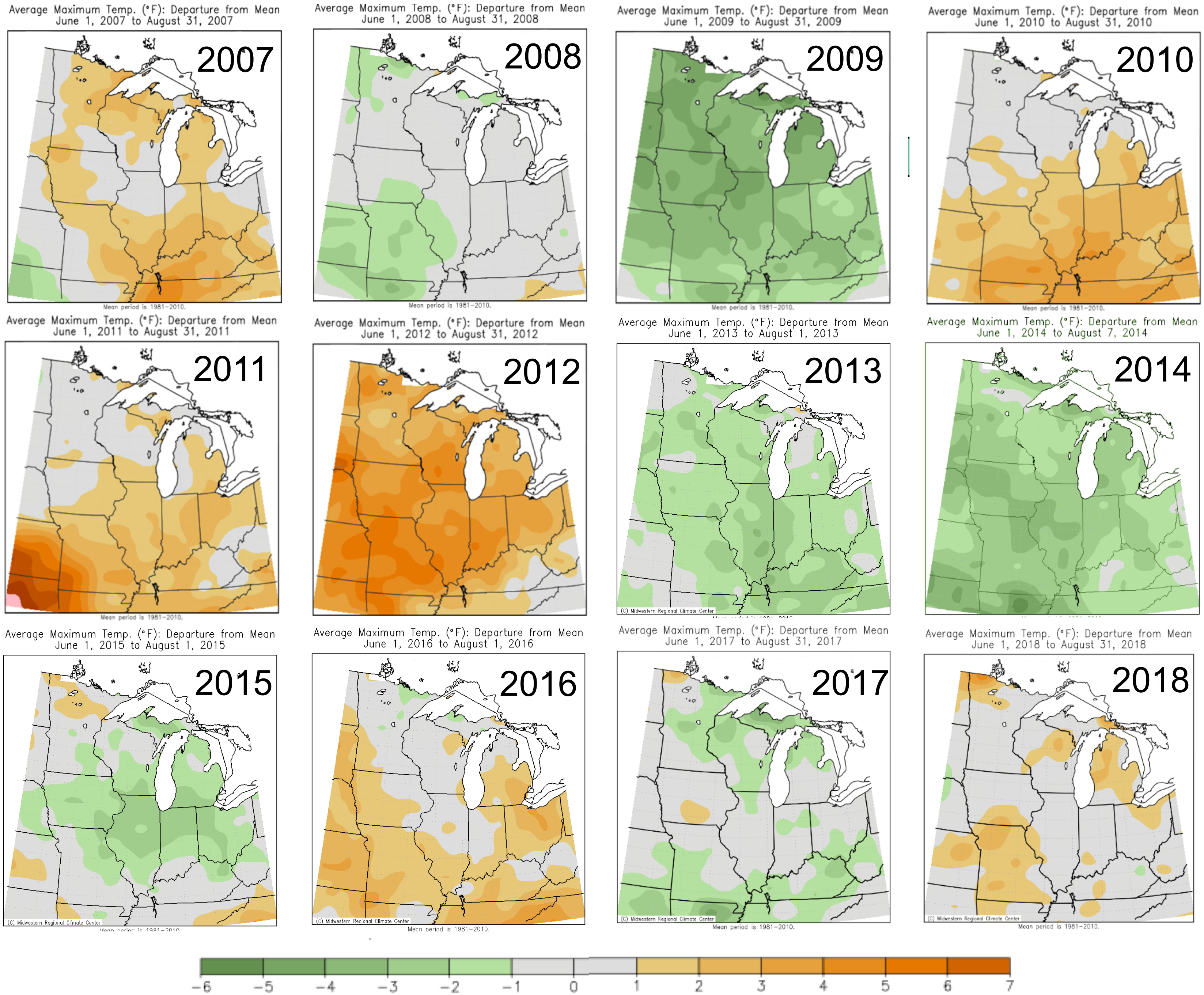
4th High value of daily 8-hour maximum ozone; these values are averaged over 3 years to derive the design value, which is the metric that is compared to the NAAQS and determines attainment or nonattainment.

Ozone: Region-wide Fourth High Trends



Trends for a subset of monitors with data for at least 16 of 18 years shown.

Average Maximum Temperature Departure from Mean, Jun-Aug



Source: cli-MATE, Midwestern Regional Climate Center. Illinois State Water Survey, Prairie Research Institute, University of Illinois at Urbana-Champaign. http://mrcc.illinois.edu/CLIMATE

Ozone: 2018 Design Values

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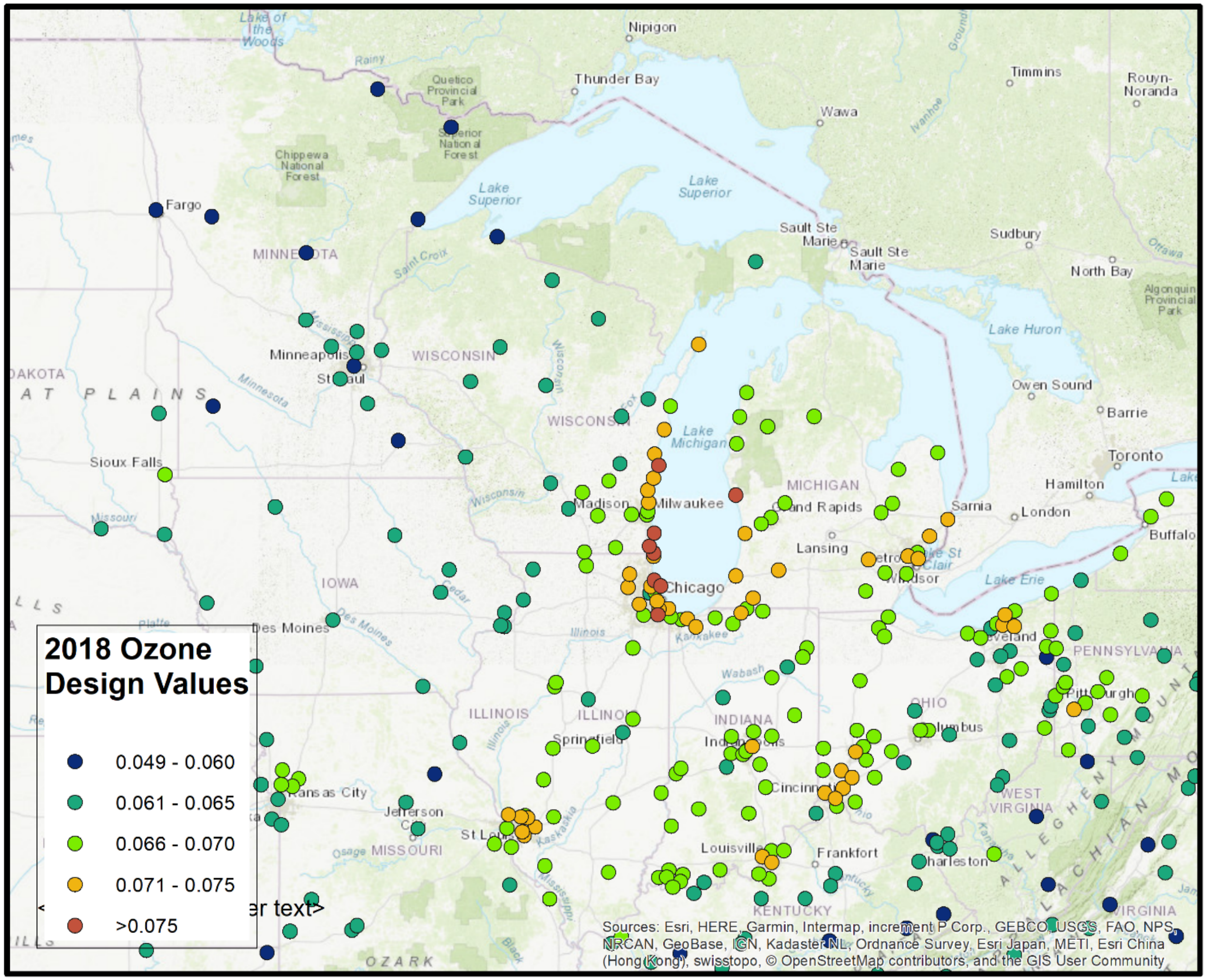
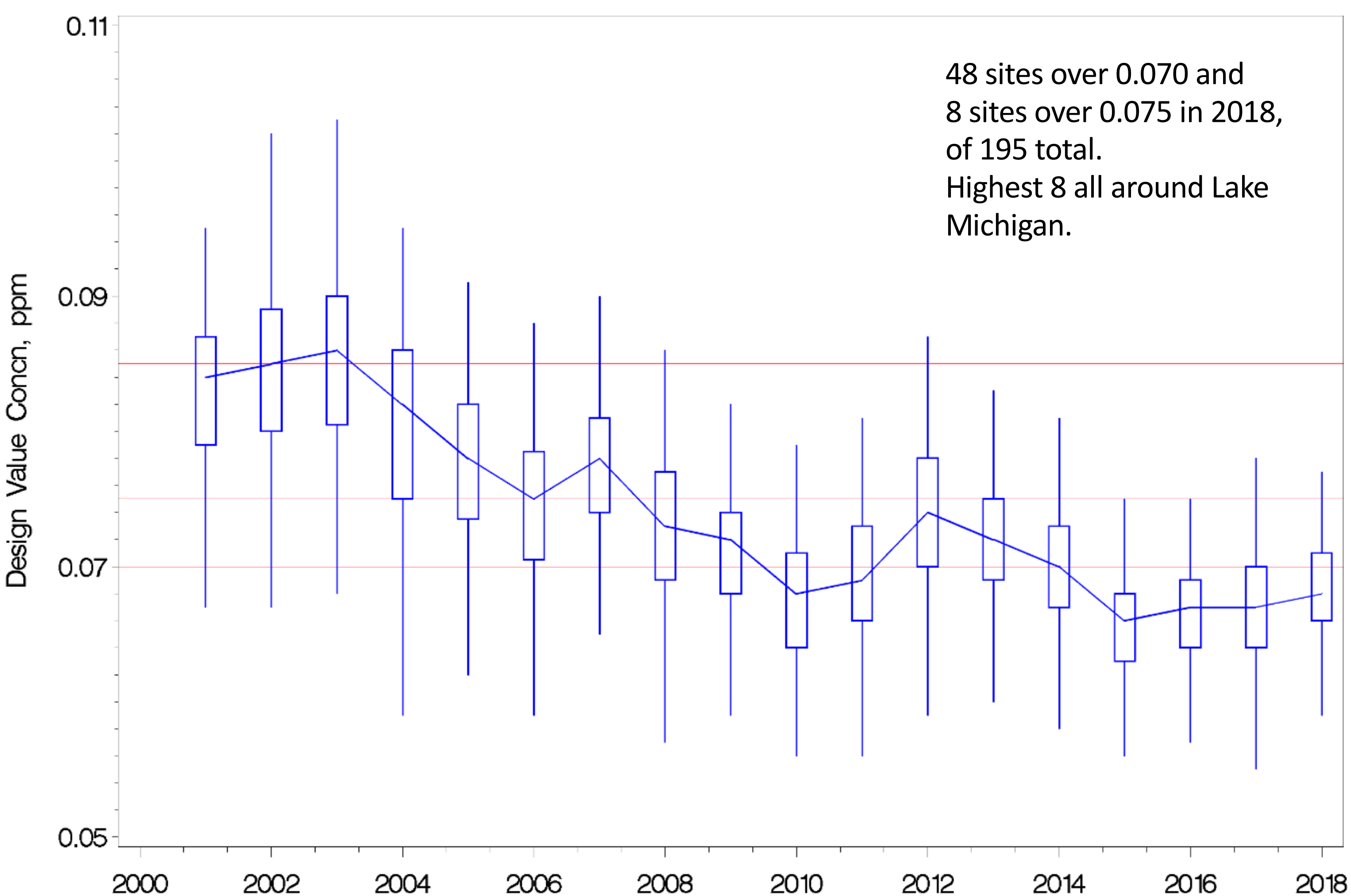
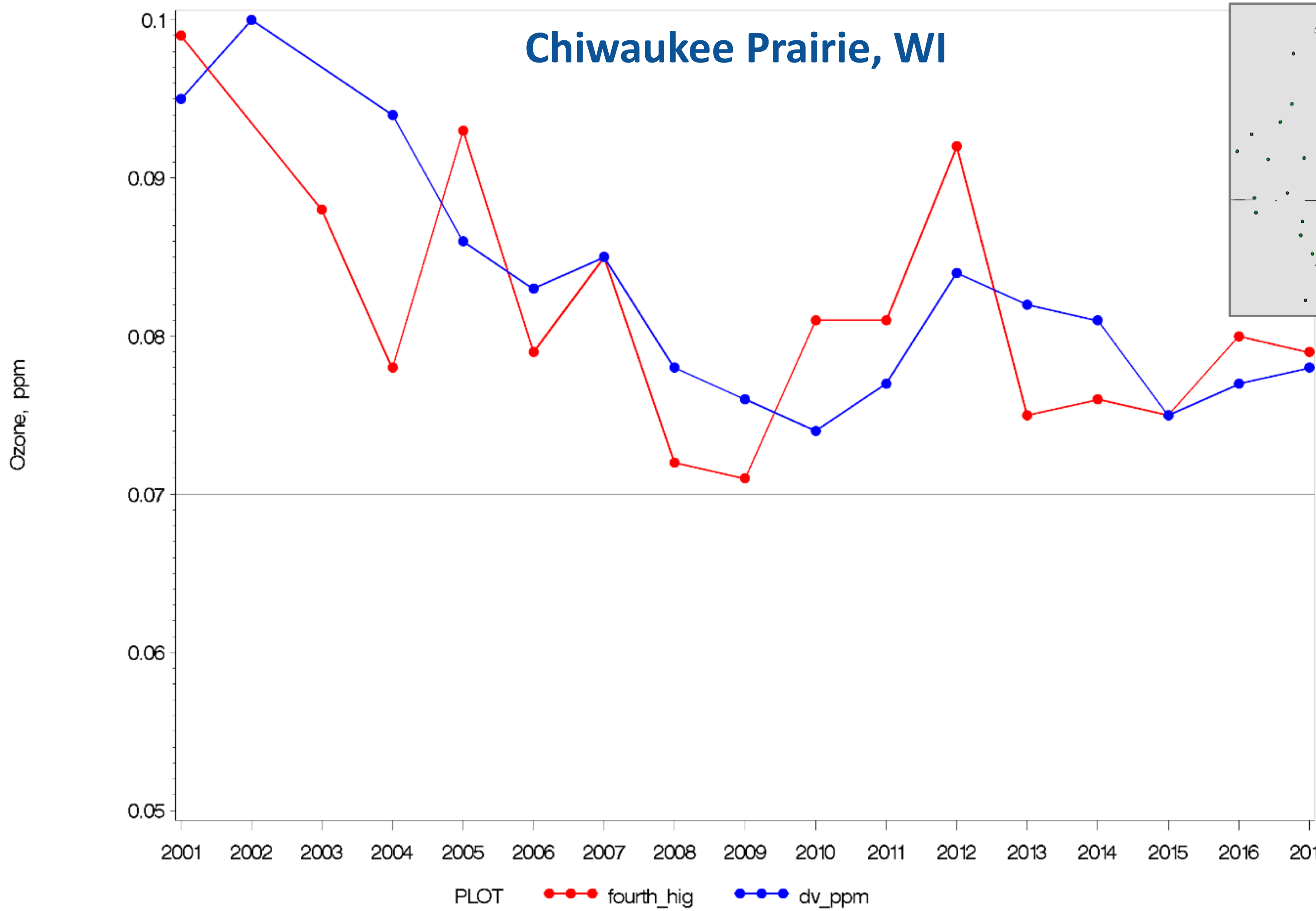


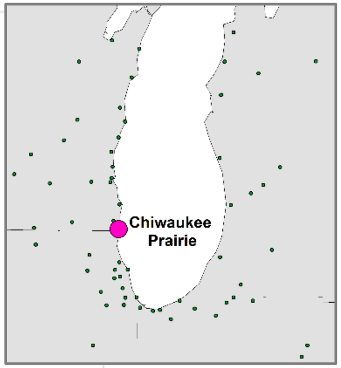
Ozone: Region-wide Design Value Trends



Trends for a subset of monitors with data for at least 16 of 18 years shown.

Ozone: Trends at Key Monitors





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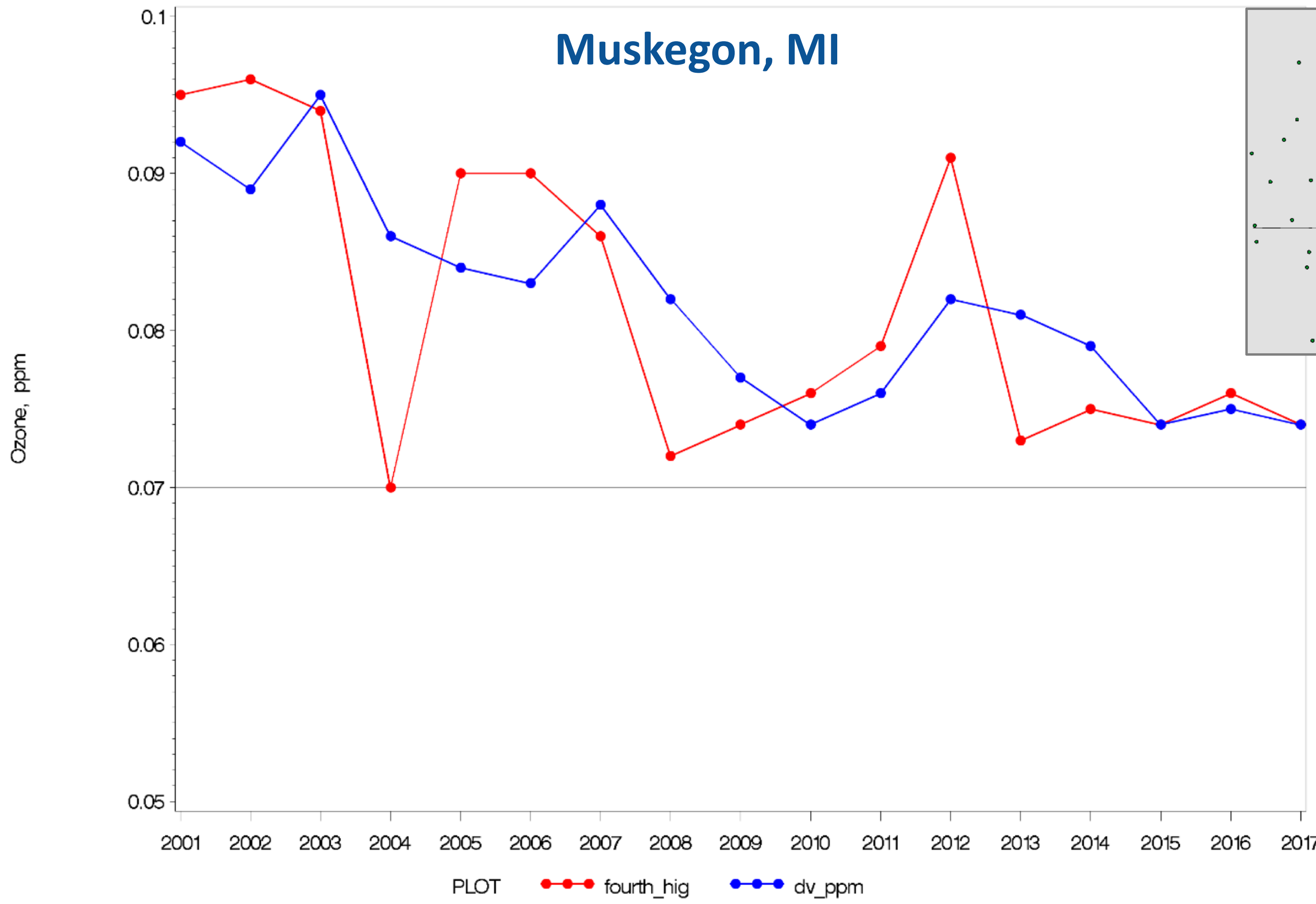

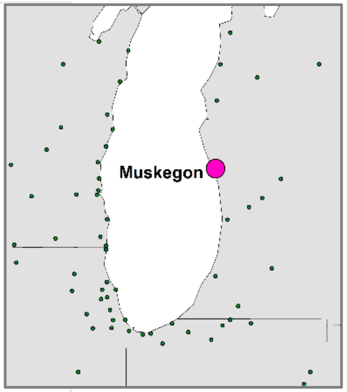

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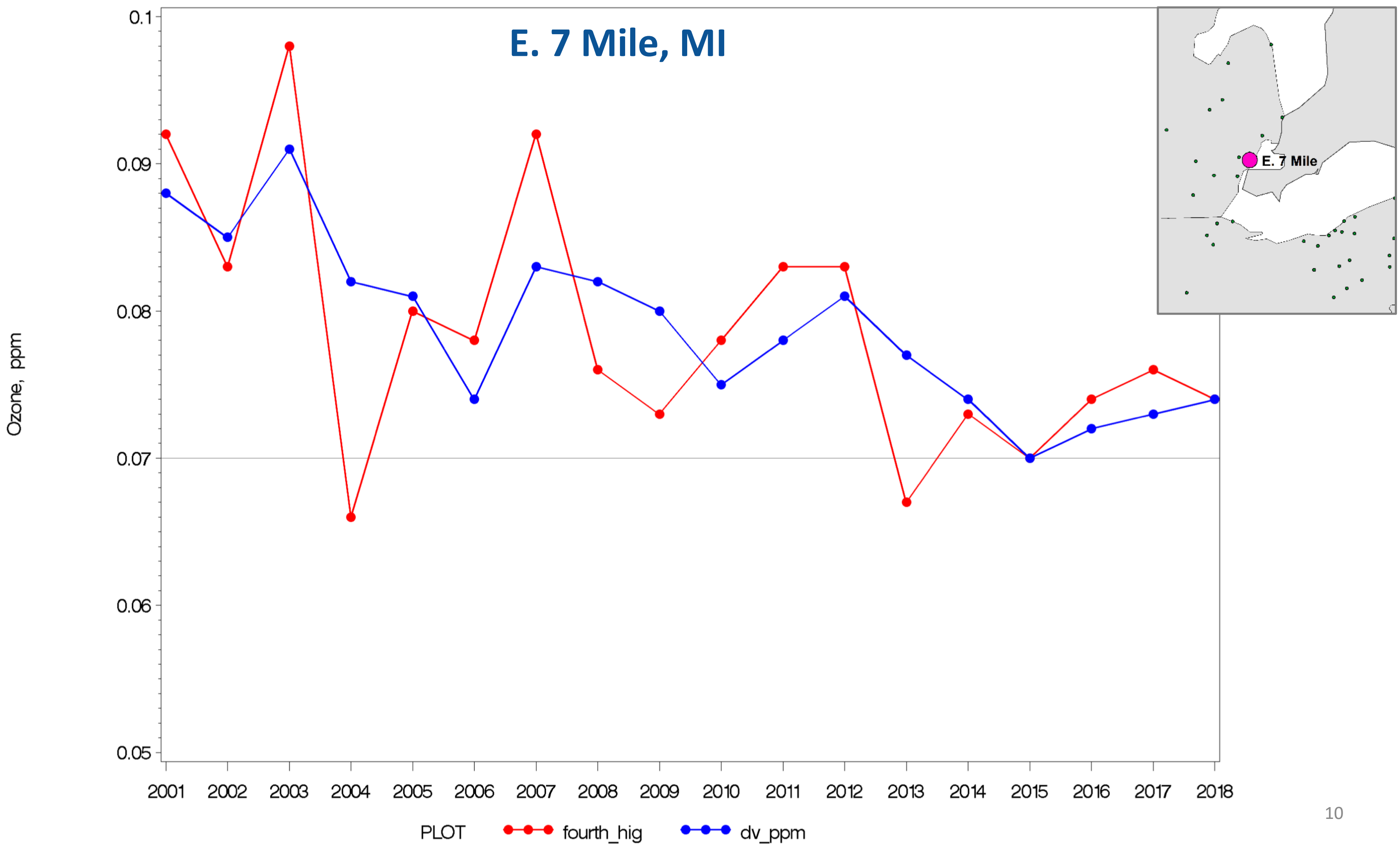
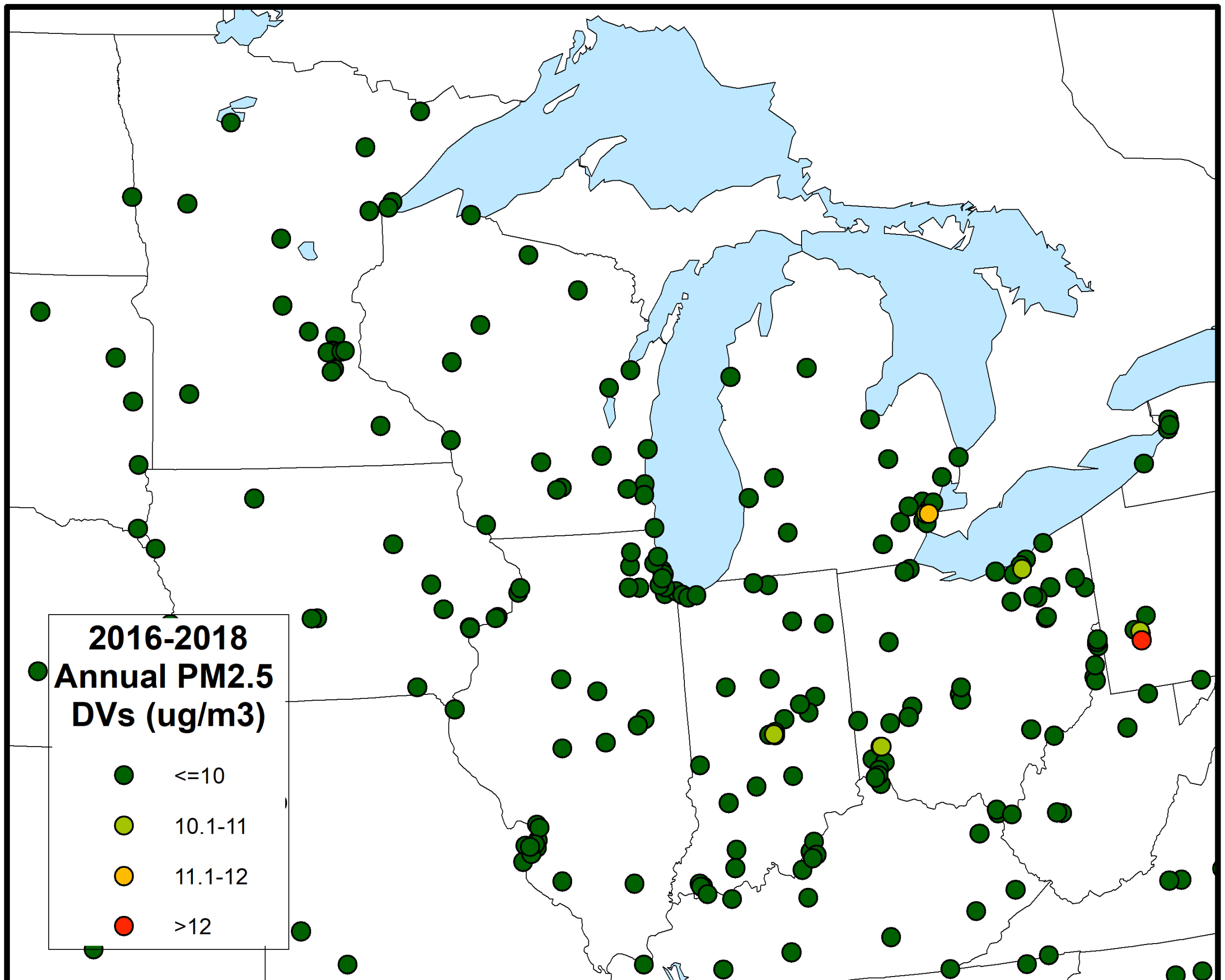


PM2.5: Annual Design Values



Two PM2.5 NAAQS: Annual and Daily.

Annual set to protect from chronic exposure; average of all measurements over the year.

Daily set to protect from acute health effects (cardiovascular, pulmonary events); 98th %ile measurement

PM2.5: Daily (98th%ile) Design Values

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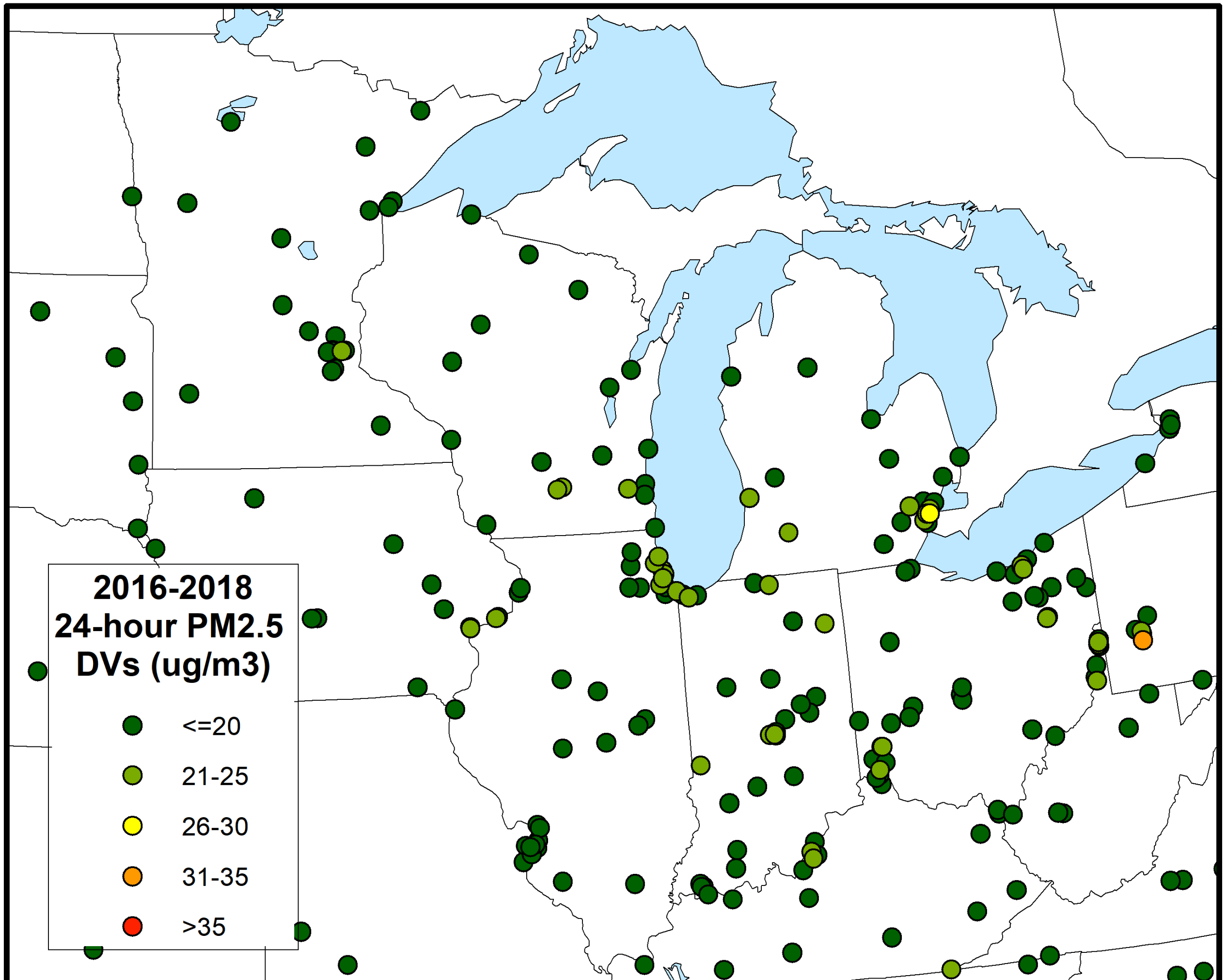

PM$_{2.5}$: Region-wide DV Trends

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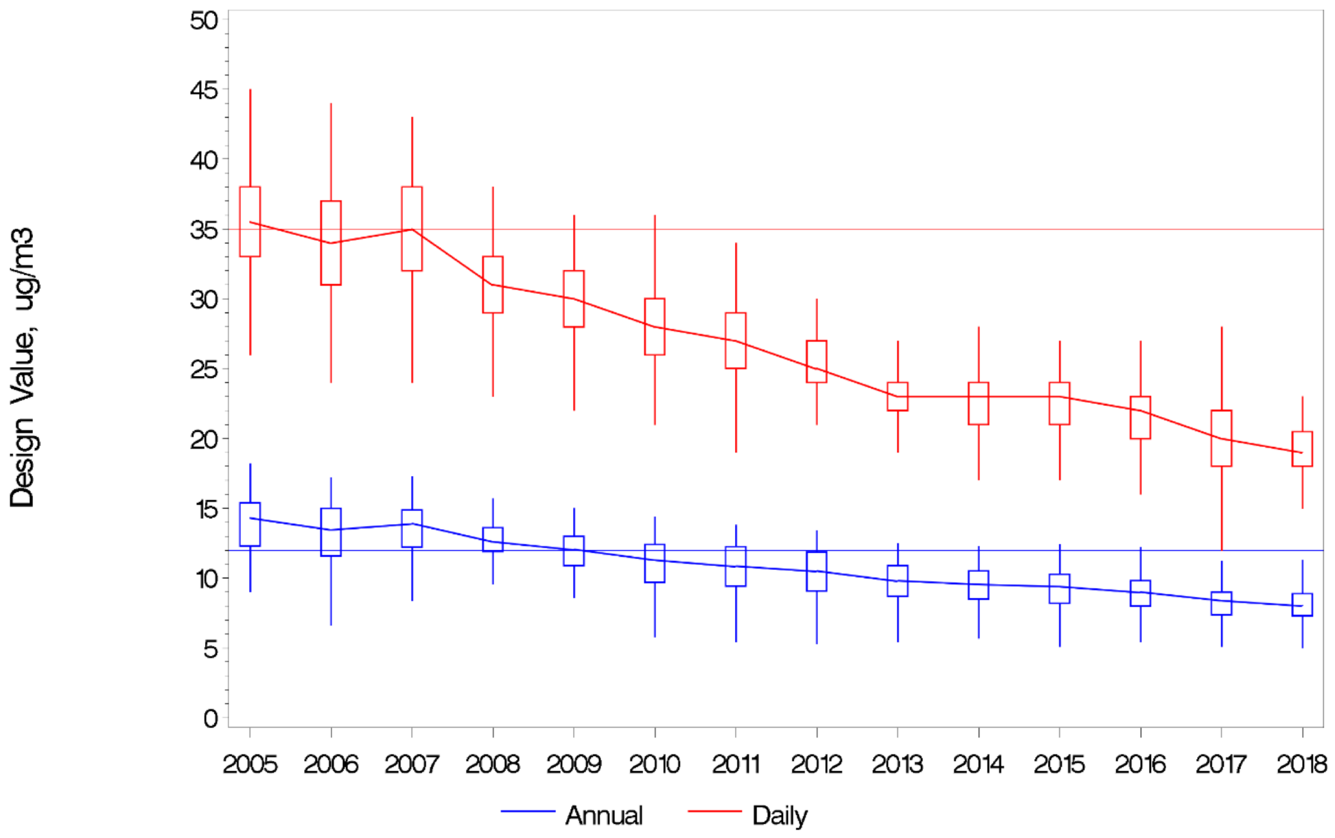
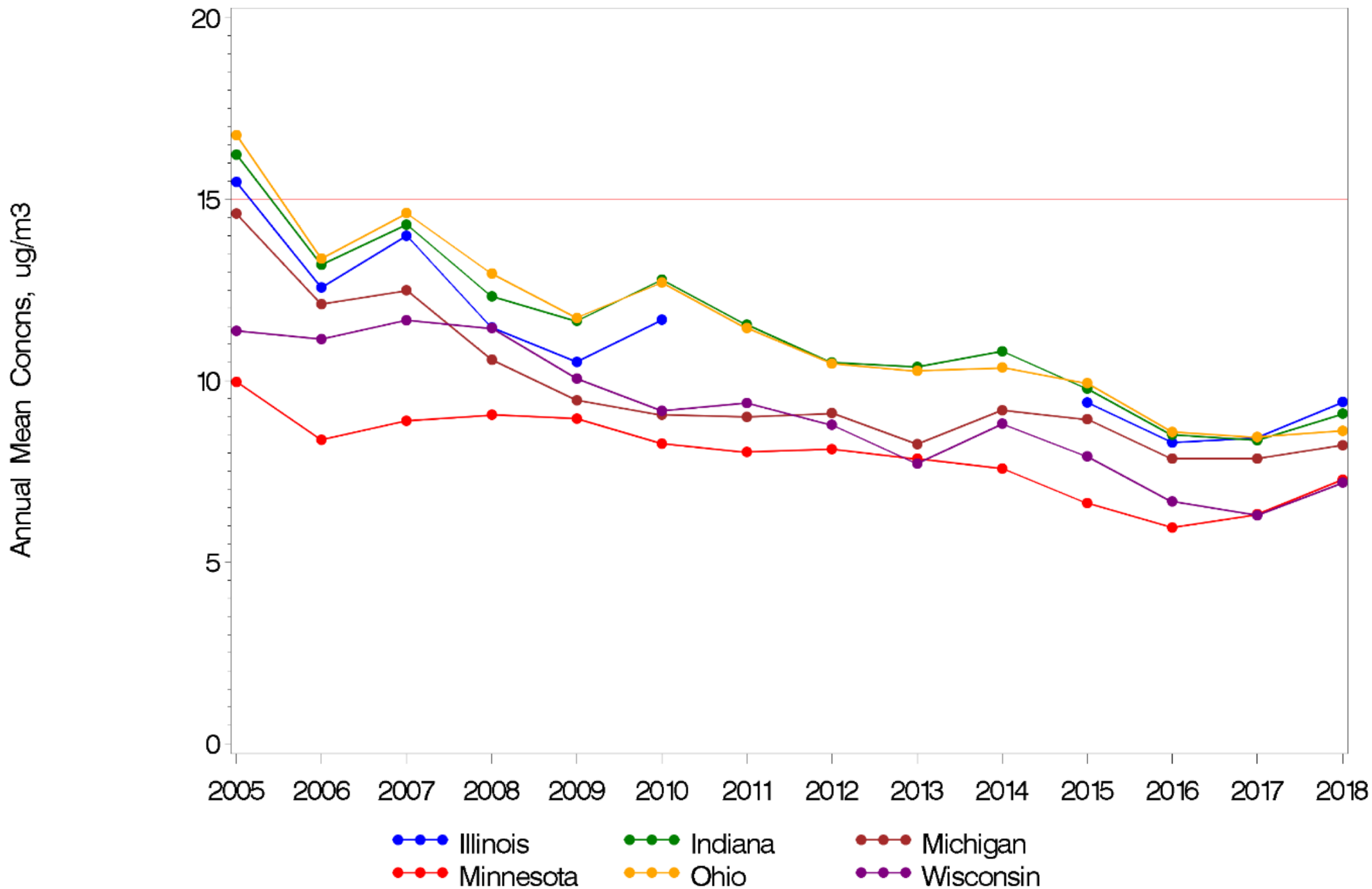


Only monitors with 11 or more years of complete data, not including IL
Design value plotted by end year of 3–year period.

PM2.5: Individual State Annual Mean Trends



Trends for monitors with at least 11 years of data, except IL

Regional Haze: Visibility Differences

What causes haze?

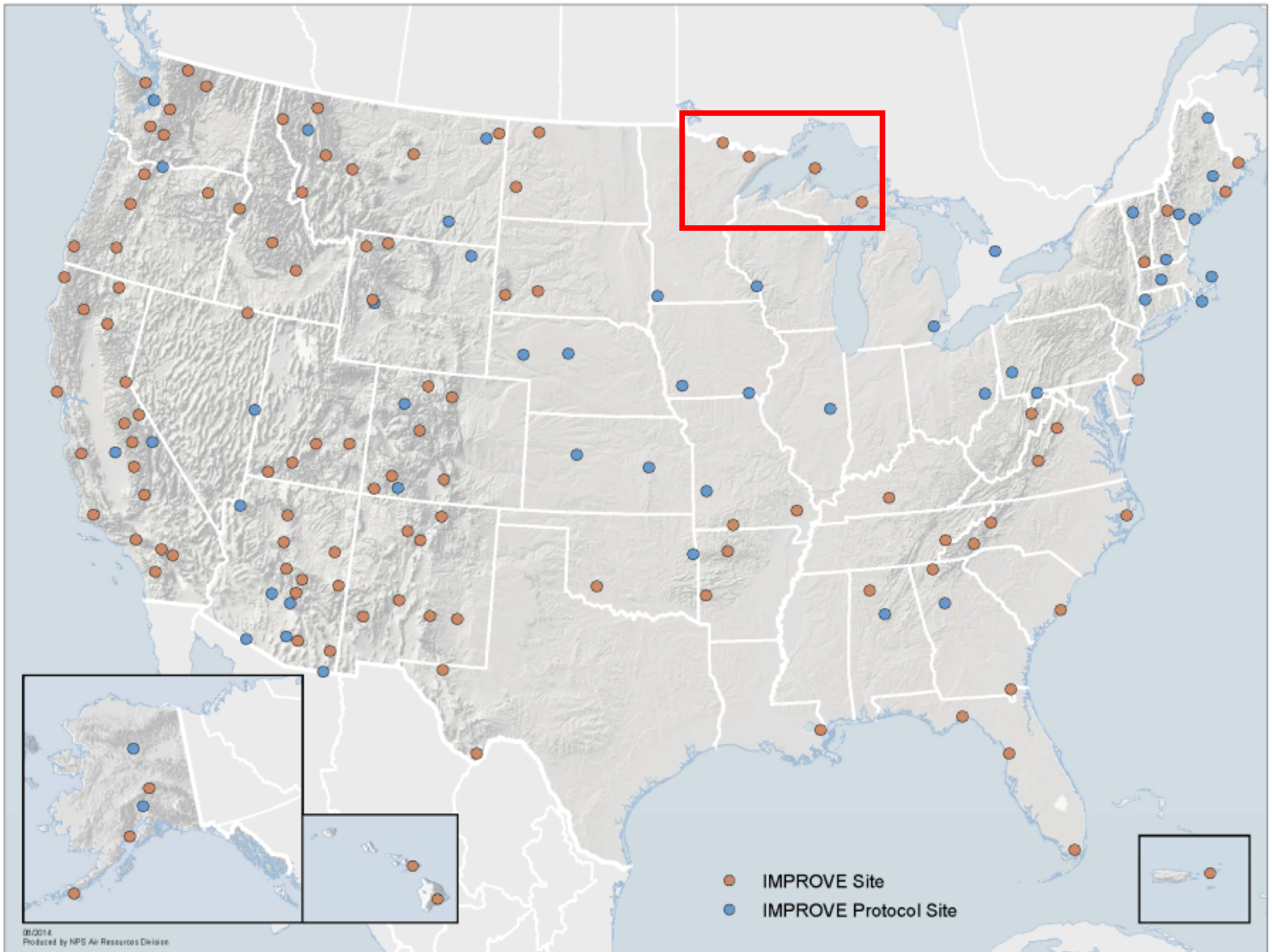
-Particles in the atmosphere scatter light.

-Natural and anthropogenic sources: wildfires, agriculture, coal combustion contribute to light extinction and visibility impairment.

-Like ozone and PM2.5, meteorology plays a role.

Source: http://vista.cira.colostate.edu/Datawarehouse/IMPROVE/Data/Photos/VOYA/html/IMG0015.htm

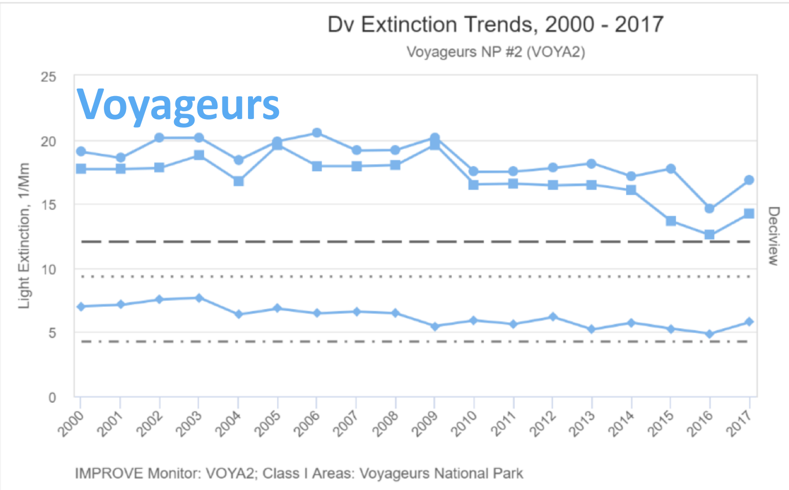
Regional Haze: Improving Visibility in Class 1 Areas

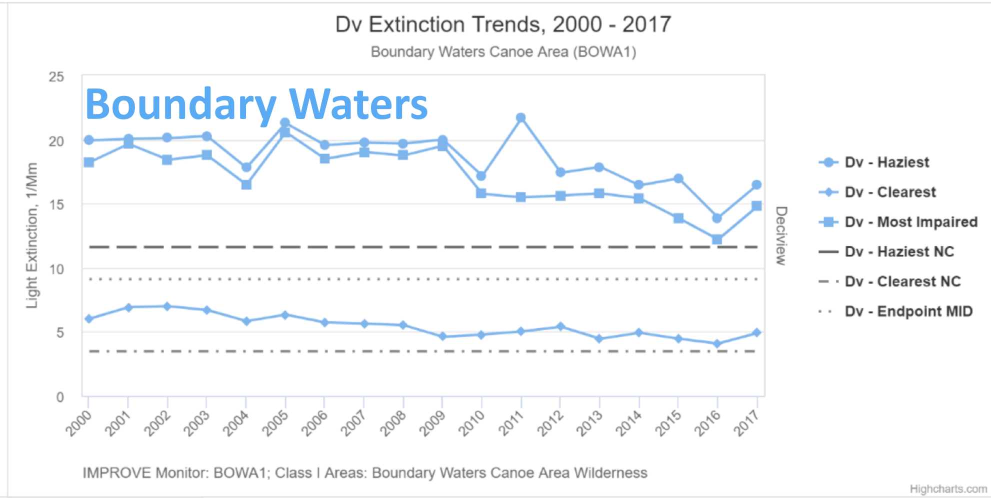


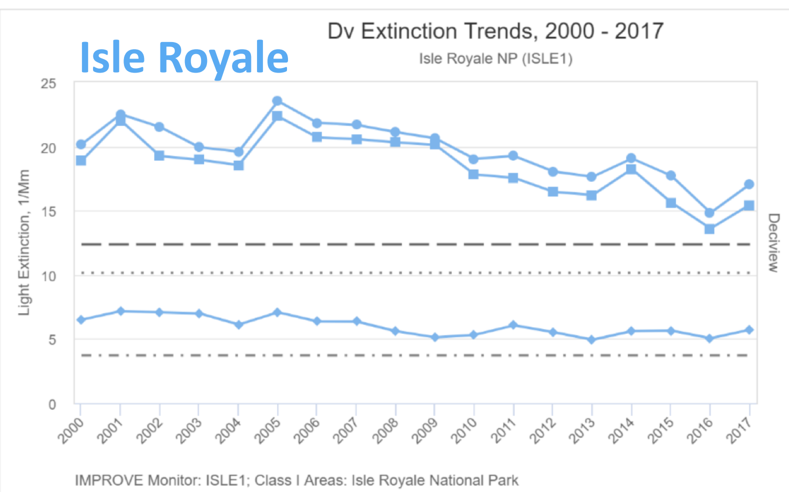
Regional Haze Rule of 1999 requires protection of visibility in 156 Class 1 Areas (national parks and wilderness areas).
Goal is to reach natural visibility conditions by 2064.

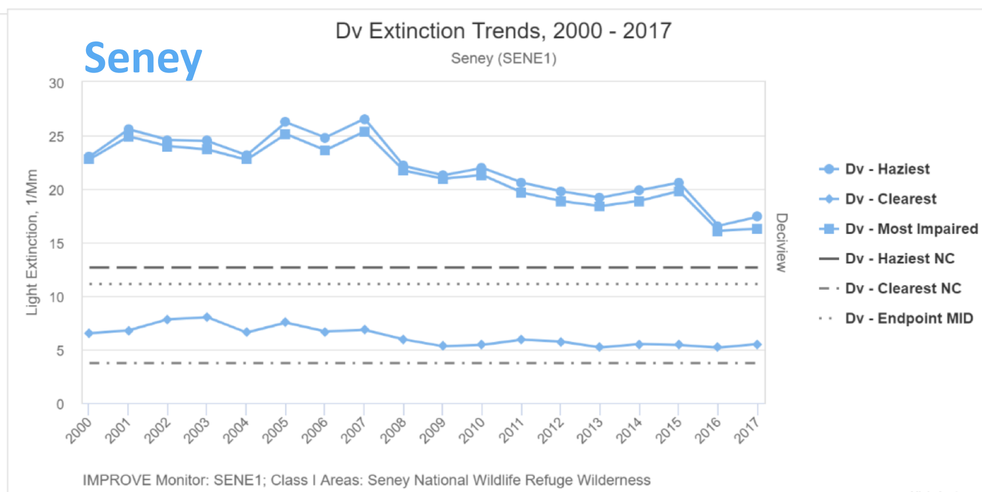
Source: http://vista.cira.colostate.edu/Improve/improve-program/

Regional Haze: Trends



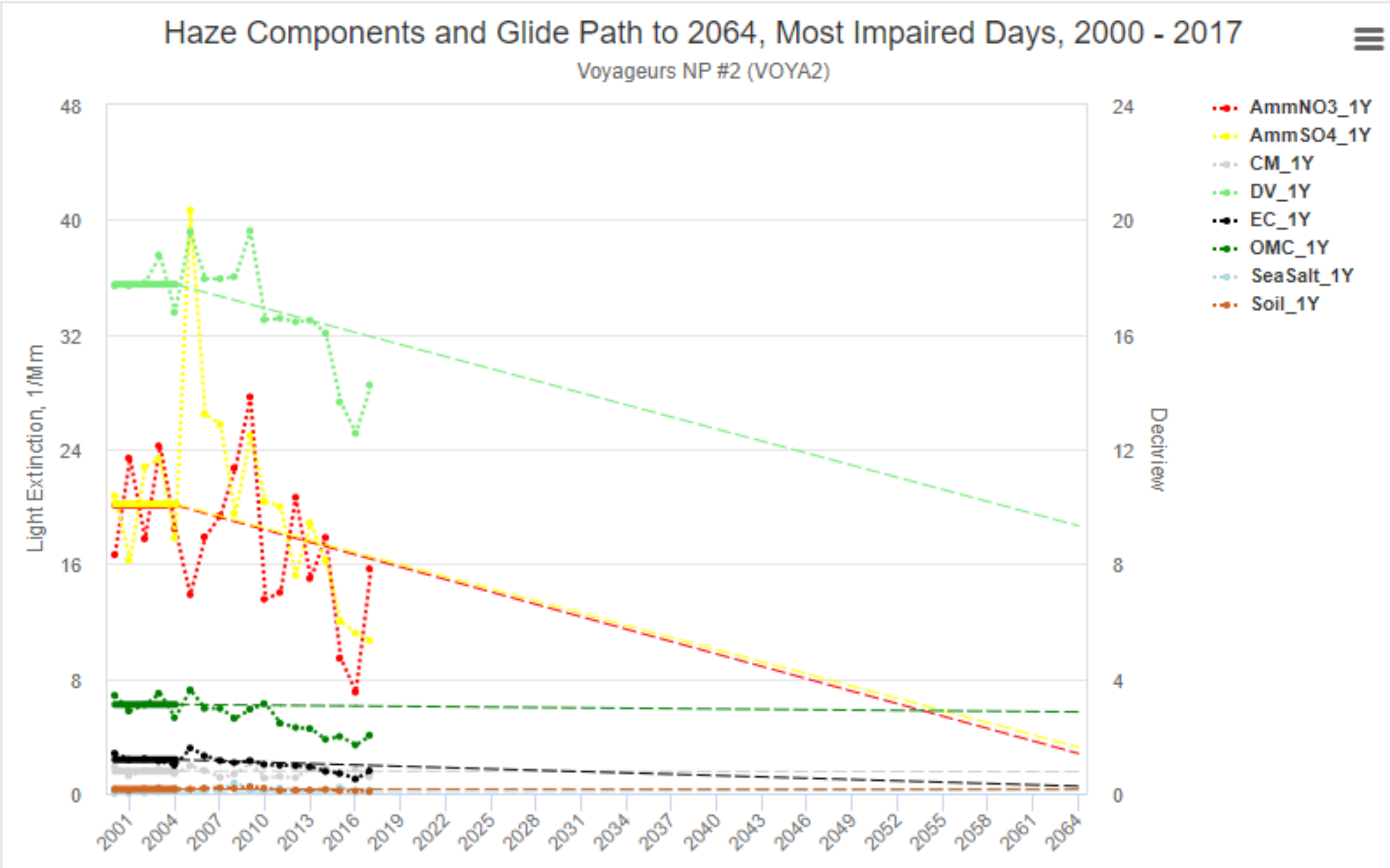






Source:http://views.cira.colostate.edu/tssv2/HazeAnalysis/

Regional Haze: Glide Paths



Source:http://views.cira.colostate.edu/tssv2/HazeAnalysis/

Regional Changes in CEM Emissions: 2000-2018

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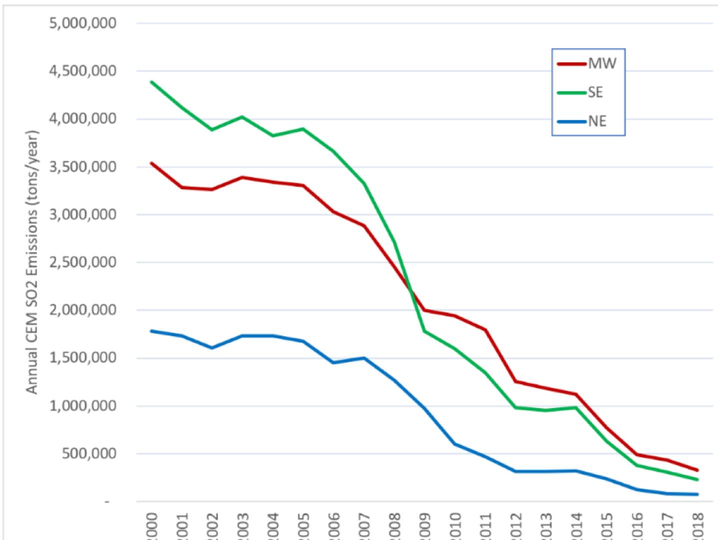
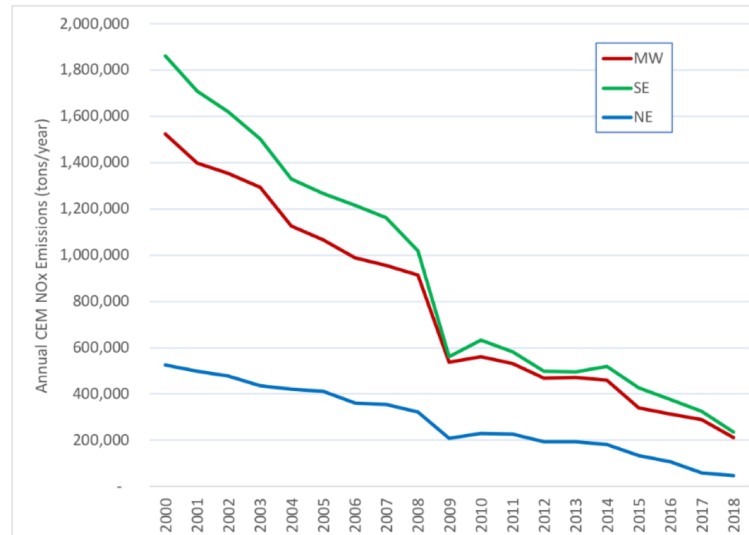
Annual Total

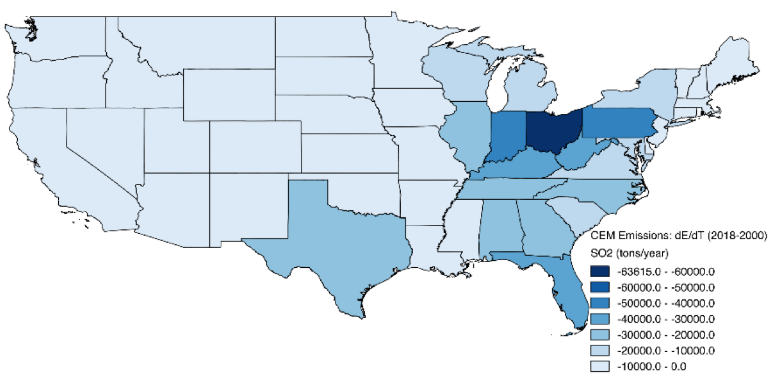
SO_2 Emissions

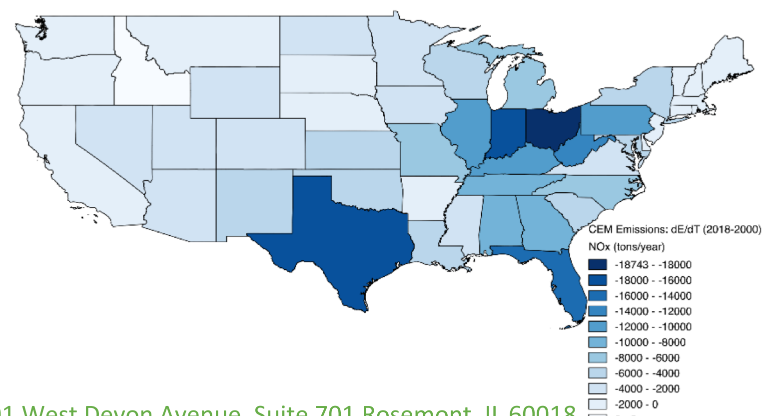


NO_x Emissions

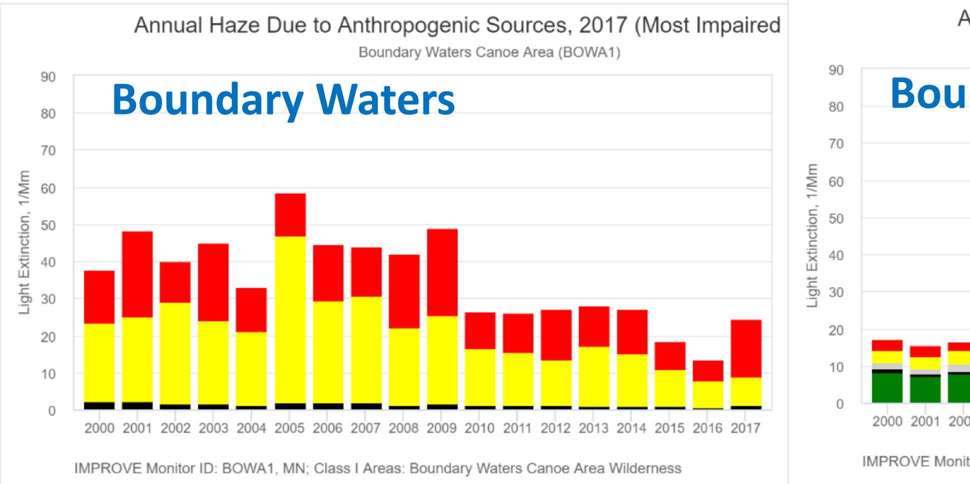


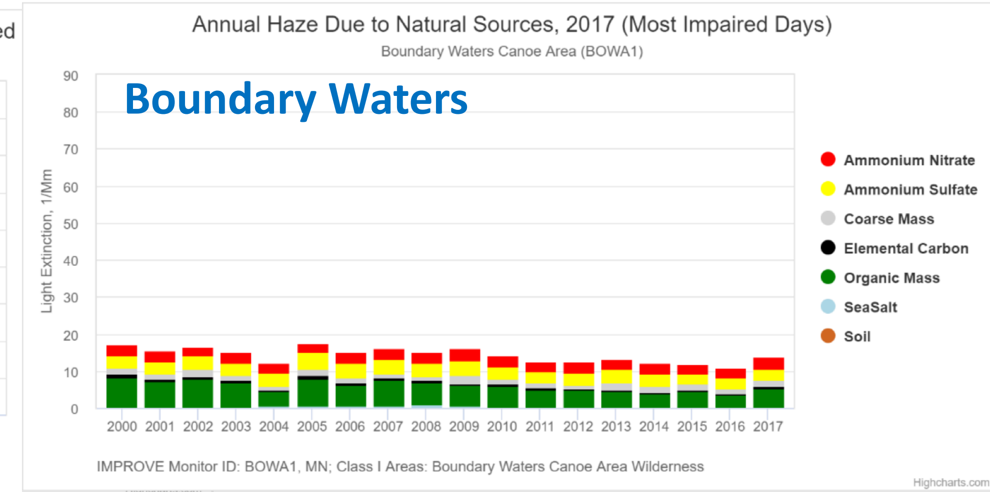
dE/dT (2000-2018)

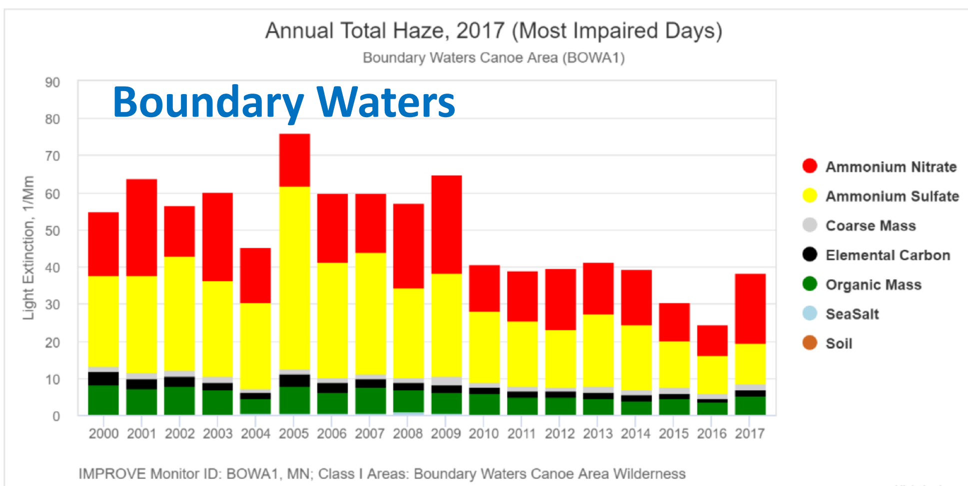




Regional Haze: Anthropogenic vs Natural

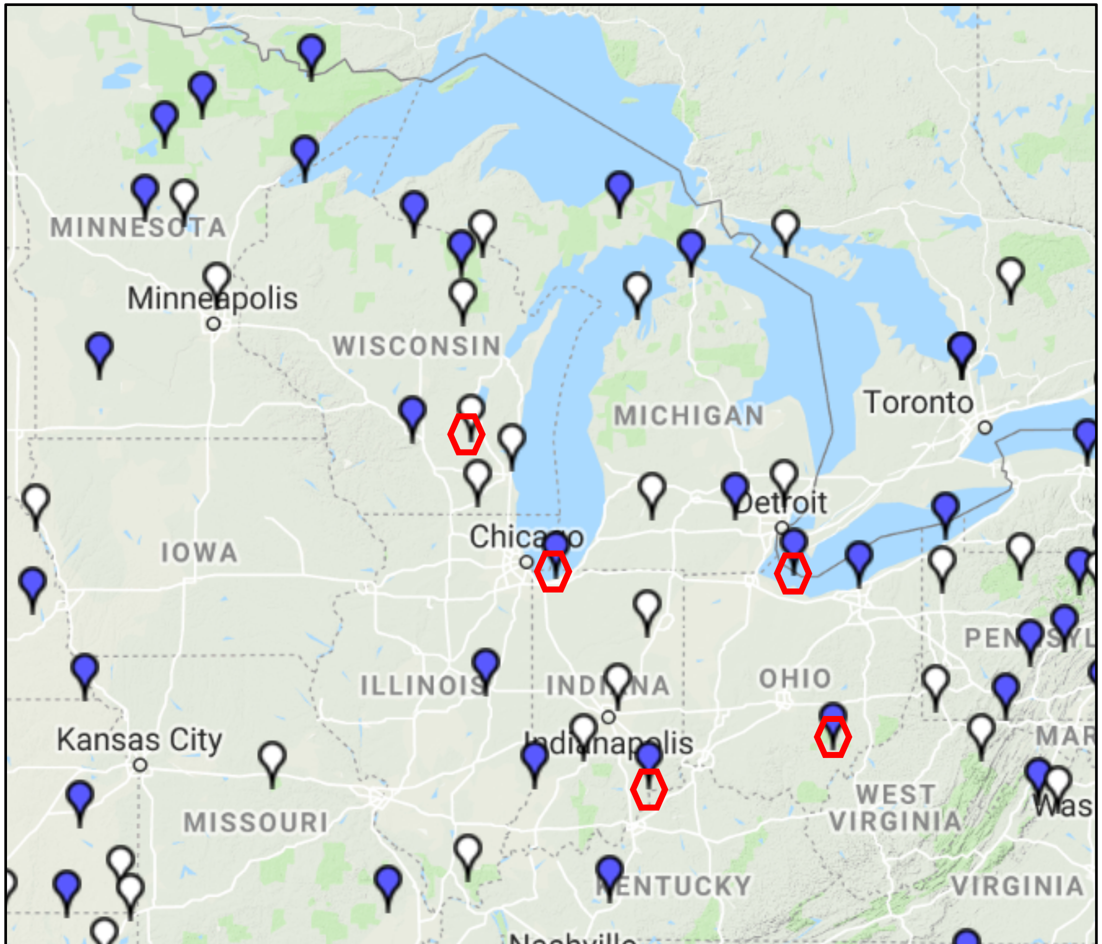






Source:http://views.cira.colostate.edu/tssv2/HazeAnalysis/

Mercury



Source: NADP

--Why mercury? Toxic, persistent, accumulates in environment, transforms in environment to extremely toxic forms

--Shrinking network: all white markers are shutdown sites

--Measured in precipitation (blue markers) and atmosphere (red markers)

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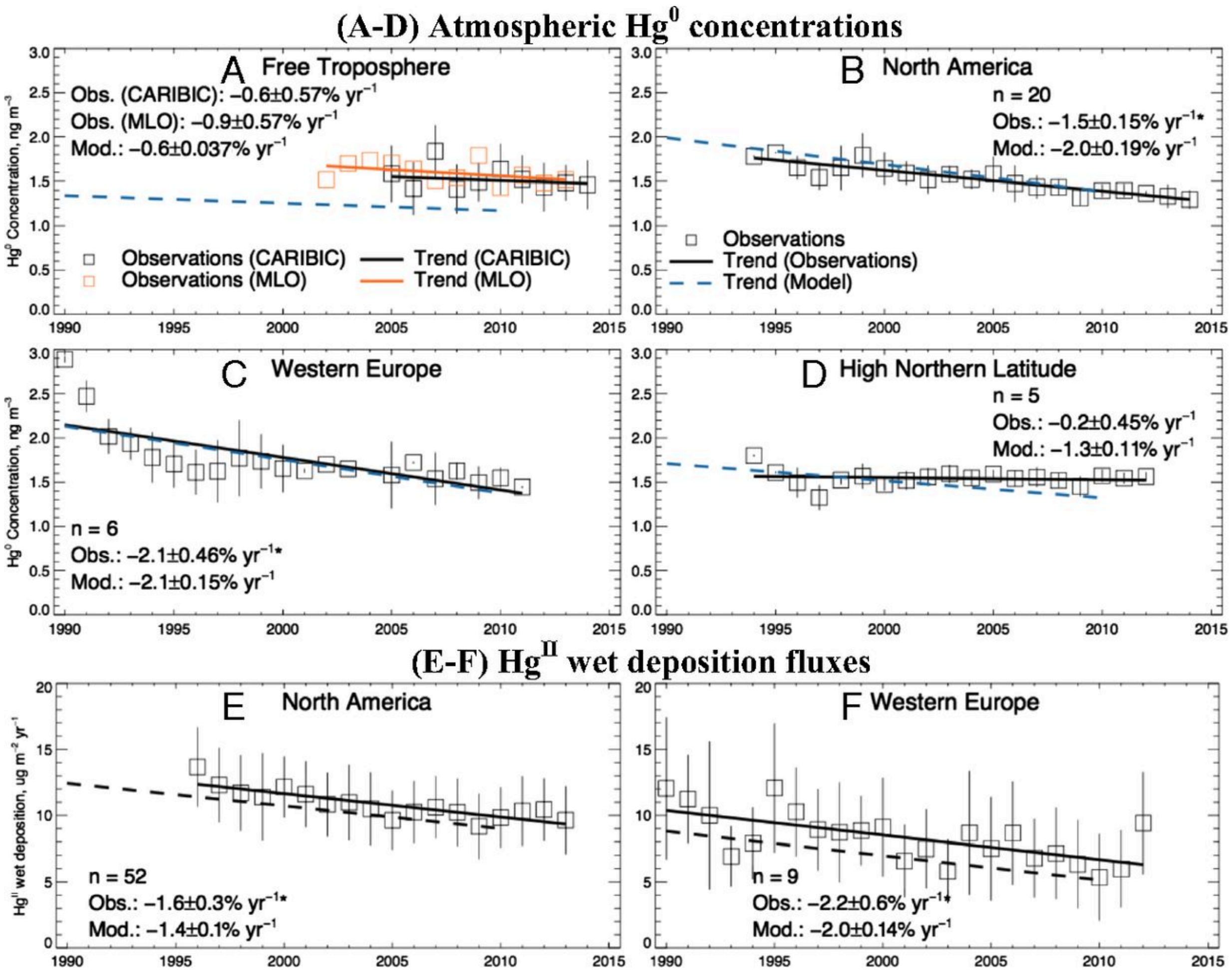
Mercury Trends



Source: Zhang, Y., et al; **Observed decrease in atmospheric mercury explained by global decline in anthropogenic emissions,** PNAS January 19, 2016. 113 (3) 526-531

Mercury: Tracking Air Mass Origins with Back Trajectories

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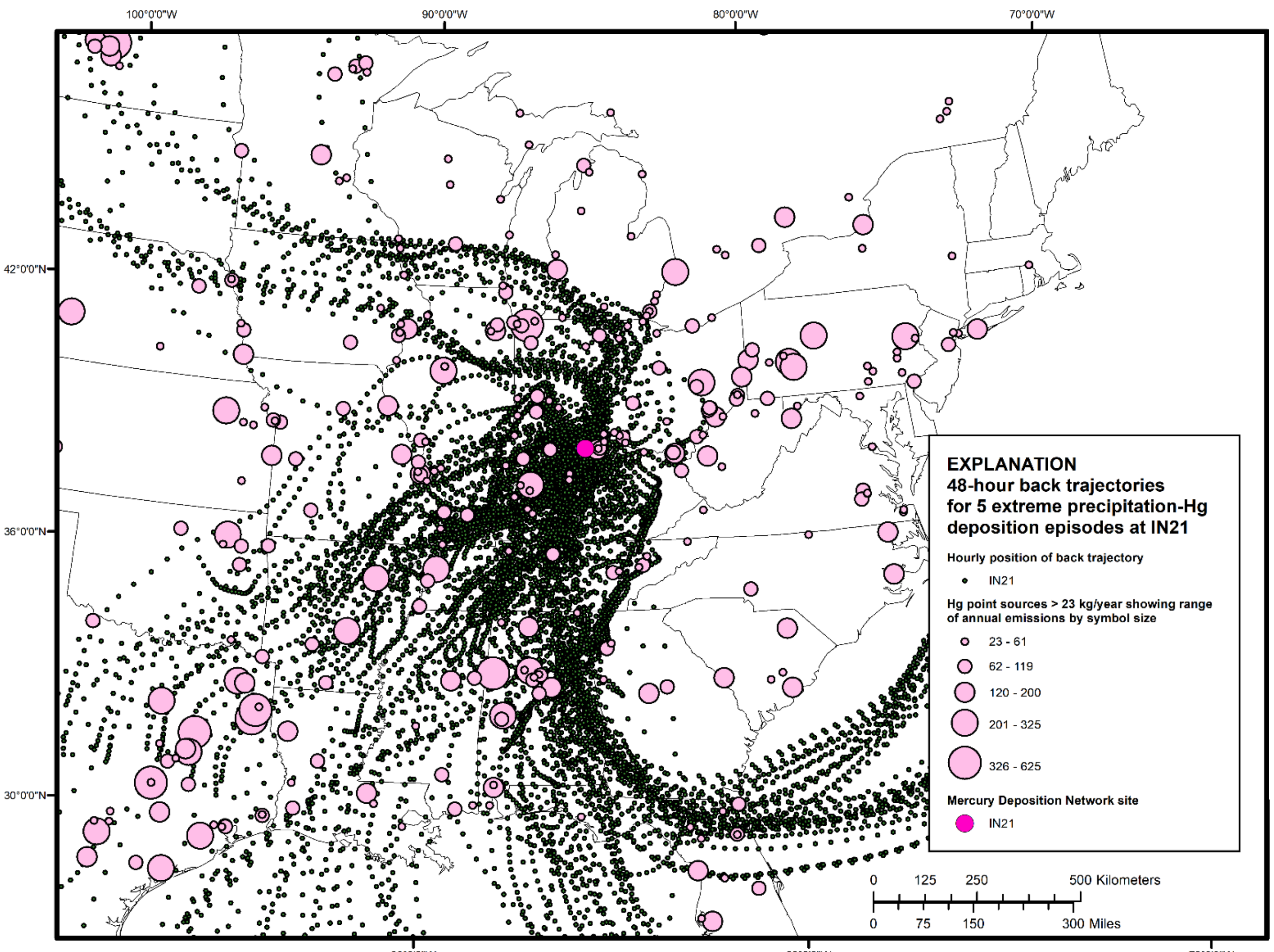
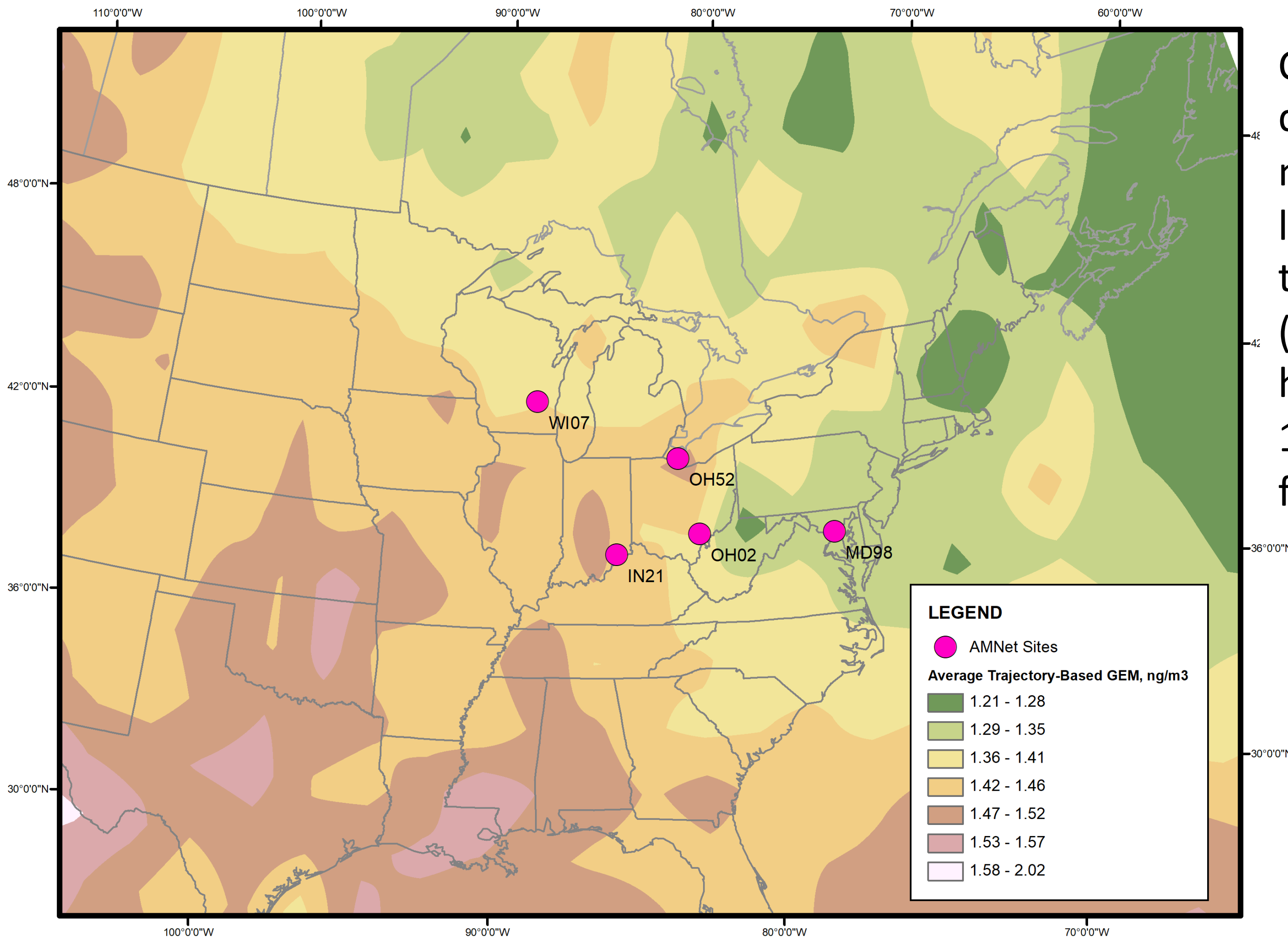


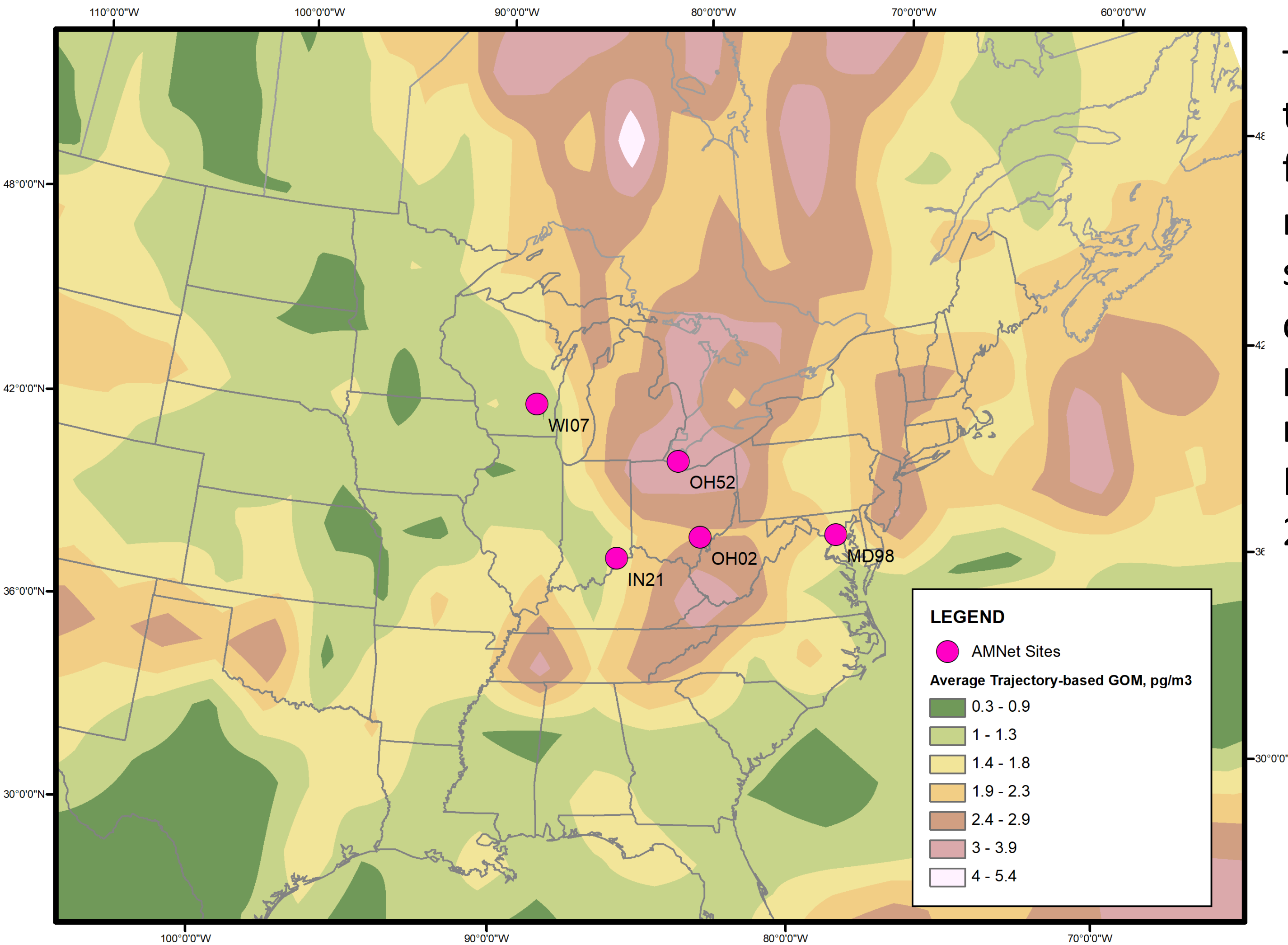
These trajectories represent 5 extreme events over 10 years at Clifty Falls. Each dotted line shows the path of an air mass as it traveled toward CF before the rain event, and the sources of mercury it passed over or near.

Mercury: Gaseous Elemental



Continuous gas data allows a more detailed look at air mass trajectories (samples every 2 hours, versus 1/week). Data from 2016-17.

Mercury: Gaseous Oxidized



Trajectories for the reactive form of mercury (GOM) show a very different pattern of air mass origin. Data from 2016-17.

5-Year Network Assessment

- State submittals due to EPA July 1, 2020
- No new guidance from EPA
- For 2010 and 2015 assessments, R5 states used a regional approach, focused on O3 and PM2.5.
- Purpose: to determine
  - "if the network meets the monitoring objectives defined in appendix D,
  - whether new sites are needed,
  - whether existing sites are no longer needed and can be terminated, and
  - whether new technologies are appropriate for incorporation into the ambient air monitoring network."

5-Year Network Assessment

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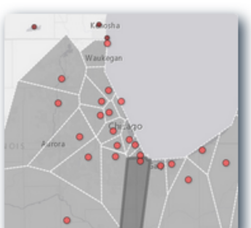
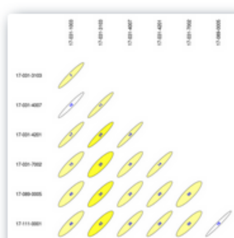
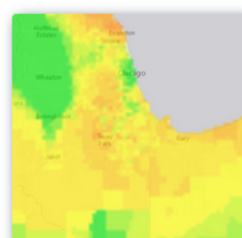
- Planning has begun for the 2020 assessment: R5 and LADCO directors approved a regional approach again.
- 2015 team had outstanding support from IDEM and MPCA for RShiny development
- On-line tools developed for 2015 assessment are being updated by OAQPS and they plan to release them early this summer.
- First tasks for workgroup will be deciding format and scope for this review: online GIS approach or RShinyApp or something new? May expand the number of pollutants examined and the tools we use.



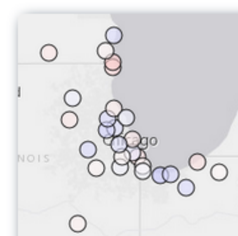
Area Served



Correlations



Exceedence



Removal Bias

Questions and Contact

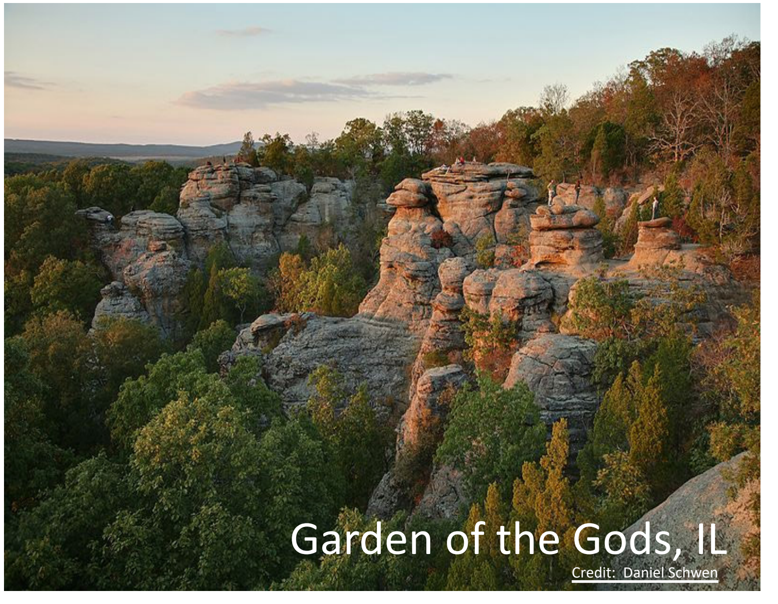
Donna Kenski, PhD

Data Scientist

kenski@ladco.org

Sleeping Bear Dunes, MI

Credit: NPS



Garden of the Gods, IL

Credit: Daniel Schwen

Mercury: Particulate