Modeling in the Midwest: Challenges and Policy Implications

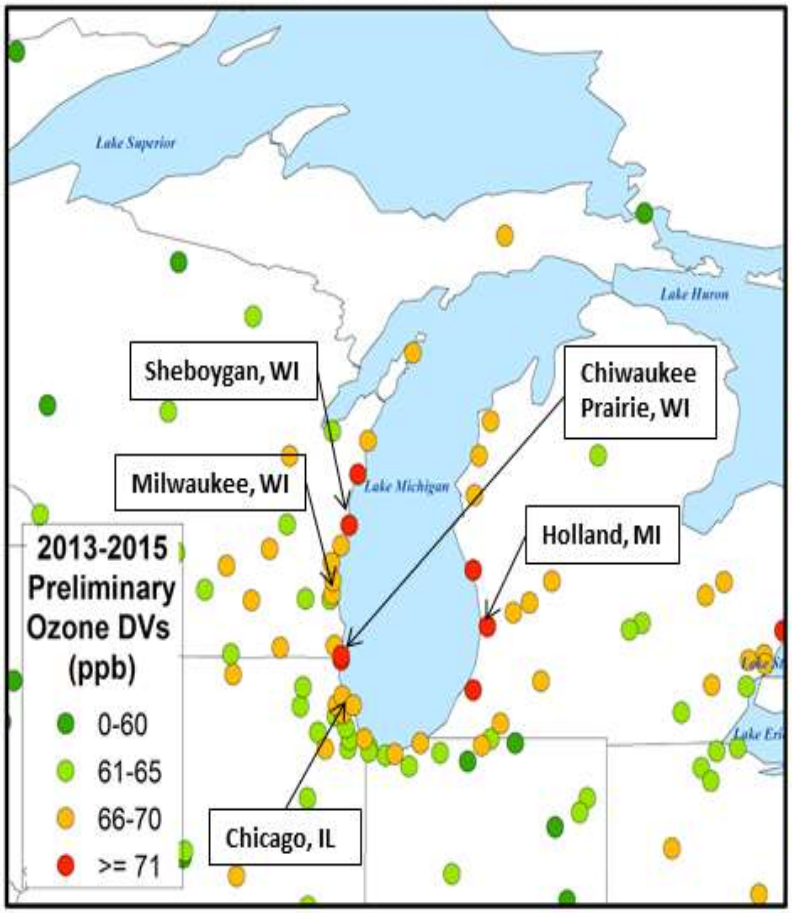
Rob Kaleel
Lake Michigan Air Directors Consortium
May 11, 2016

Regional Planning Organizations

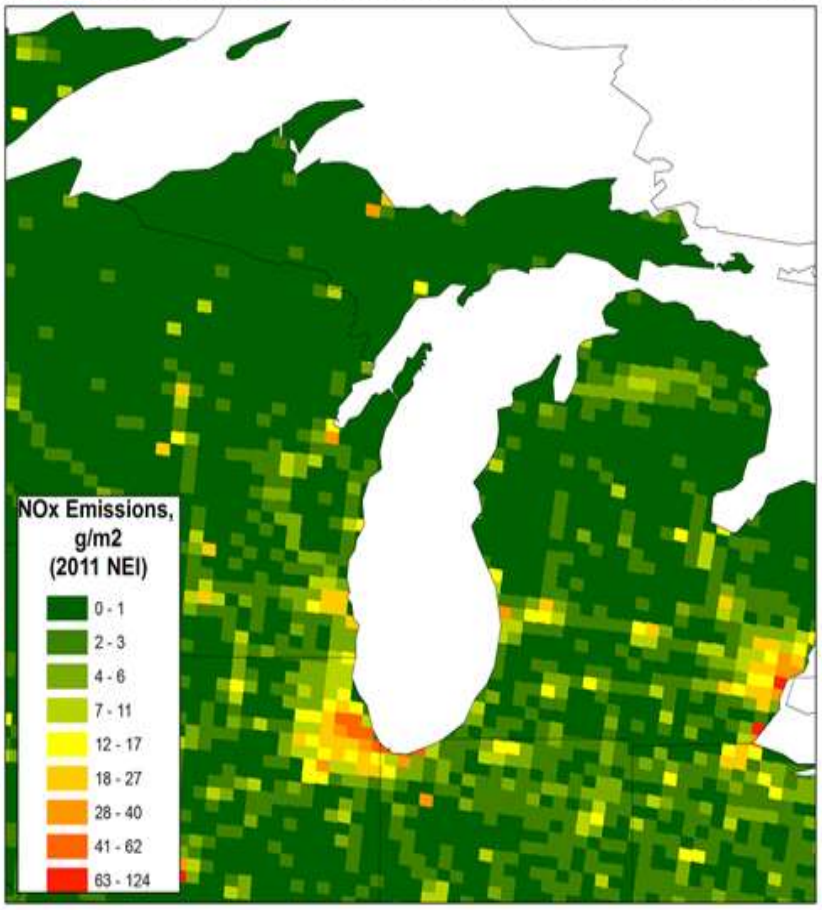
Overview

- Importance of Lake Breeze on Ozone Episode days
- Biogenic Emissions – BEIS and MEGAN
- Commercial Marine Vessels on the Great Lakes

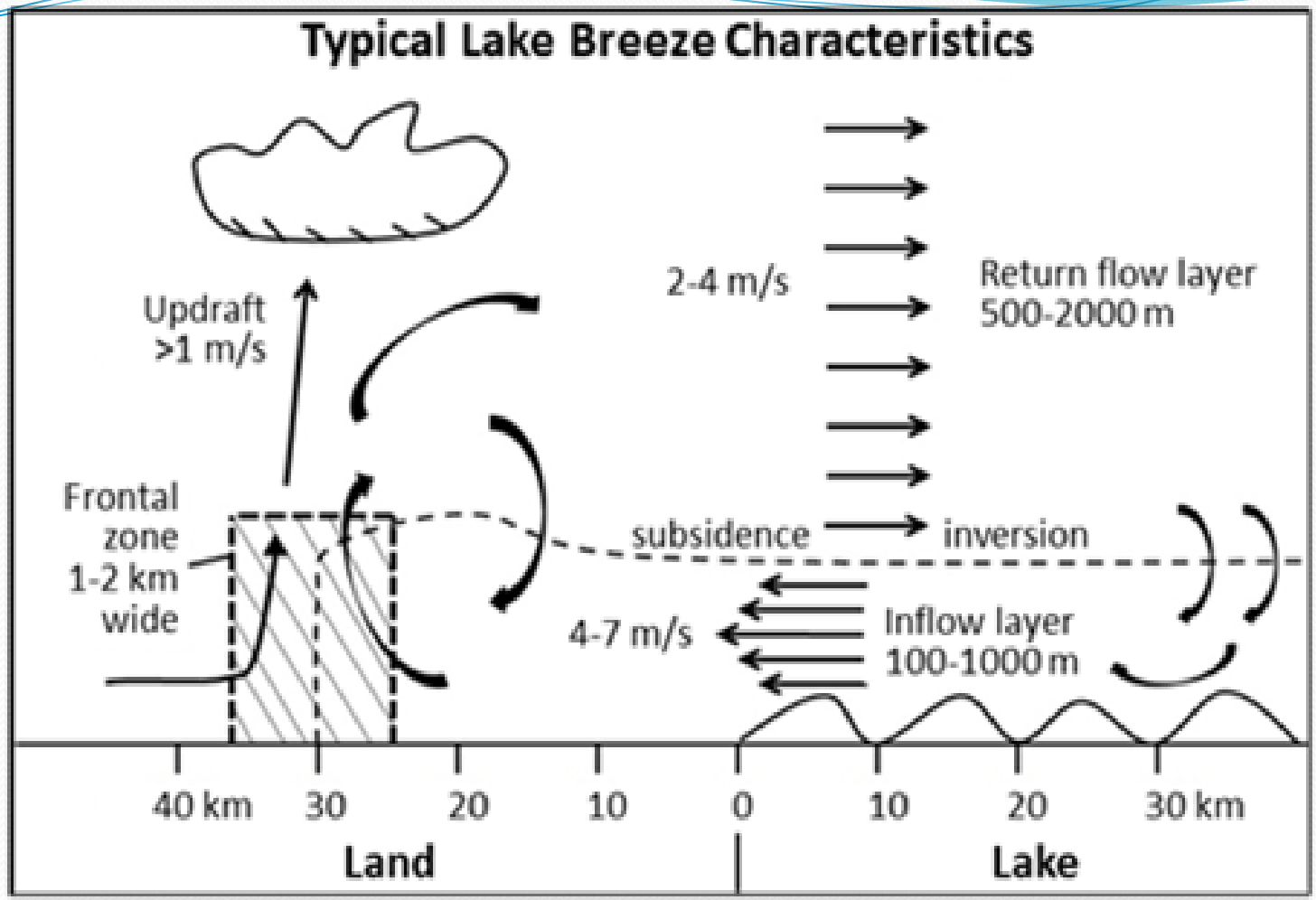
Highest Ozone Levels Occur at Shoreline Monitors



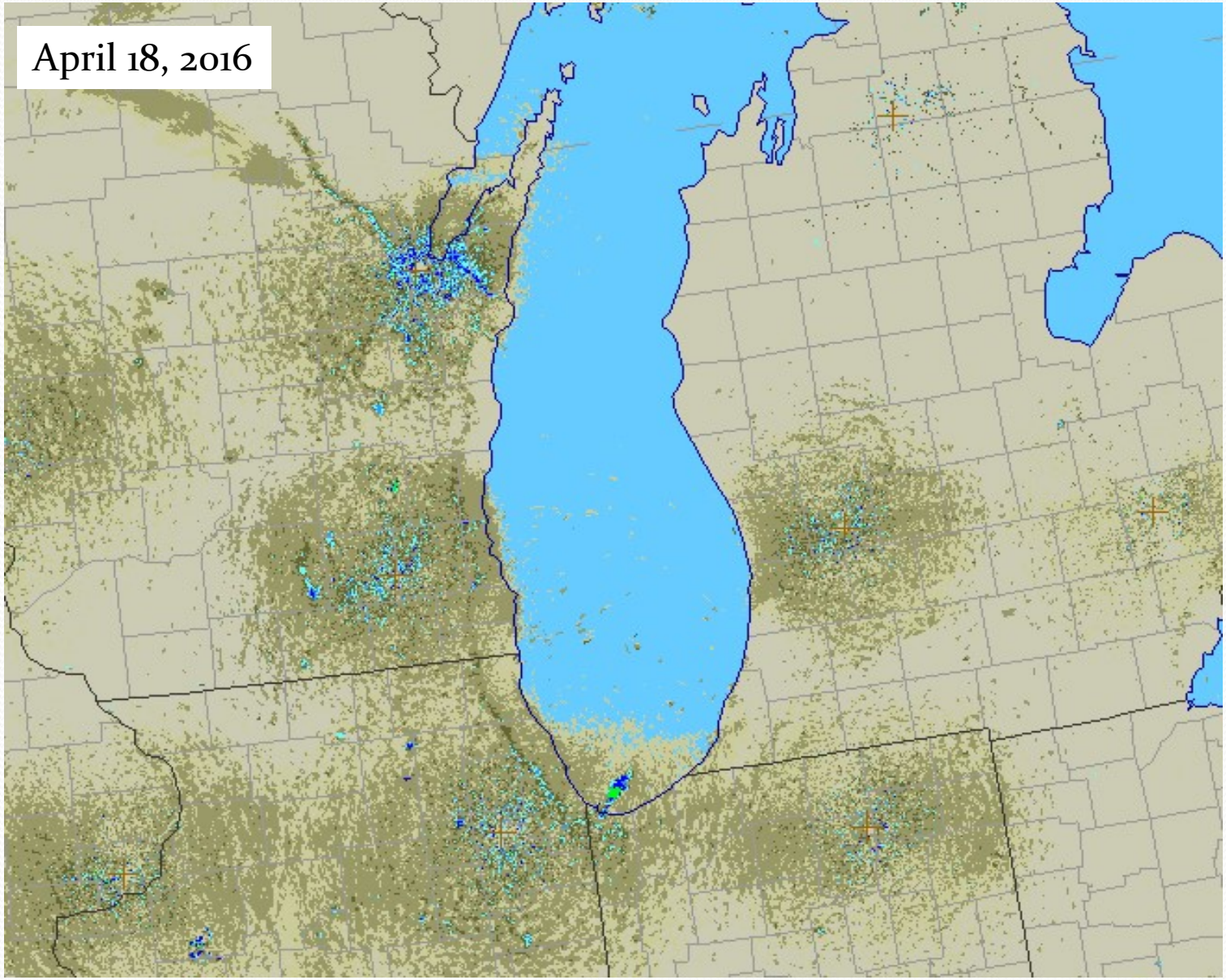
2013-2015 Ozone Design Values



NEI 2011 NO_x area emissions

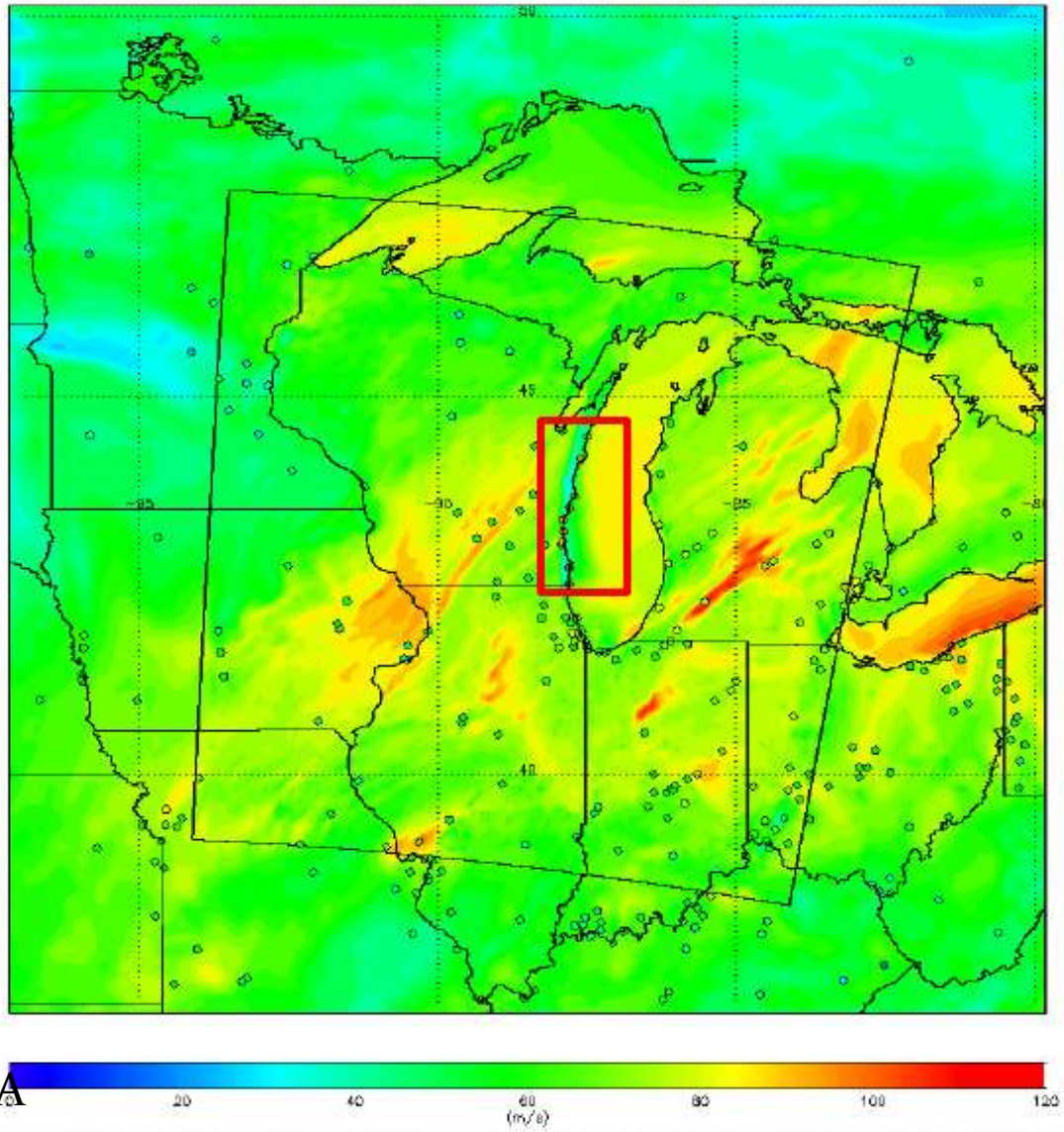


Conceptual model of land/lake breeze circulations responsible for enhanced ozone production along the shores of Lake Michigan (modified from Foley et al., 2011)


April 18, 2016

Current Modeling Does Not Reproduce Ozone Near Lake Michigan Shoreline

4km WRF-CHEM shows significant increase in surface O3 over Lake Michigan but actually shows lower surface O3 than 12km along Western Shore of Lake Michigan



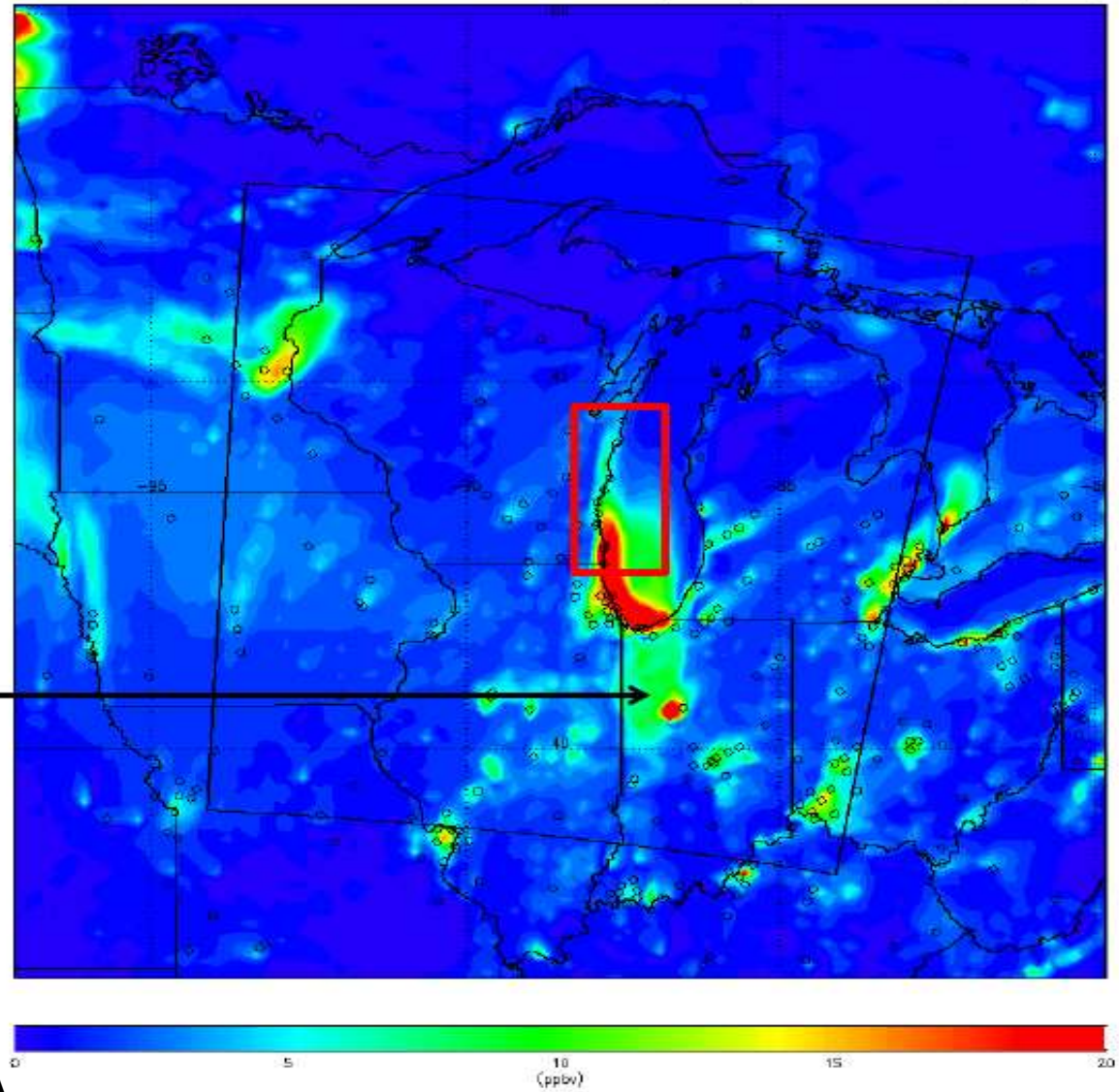
Source: Brad Pierce, NOAA

NOx Concentrations over Lake Michigan

WRF-CHEM 12km Surface NOx 22Z (5:00pm Central) July 17, 2011

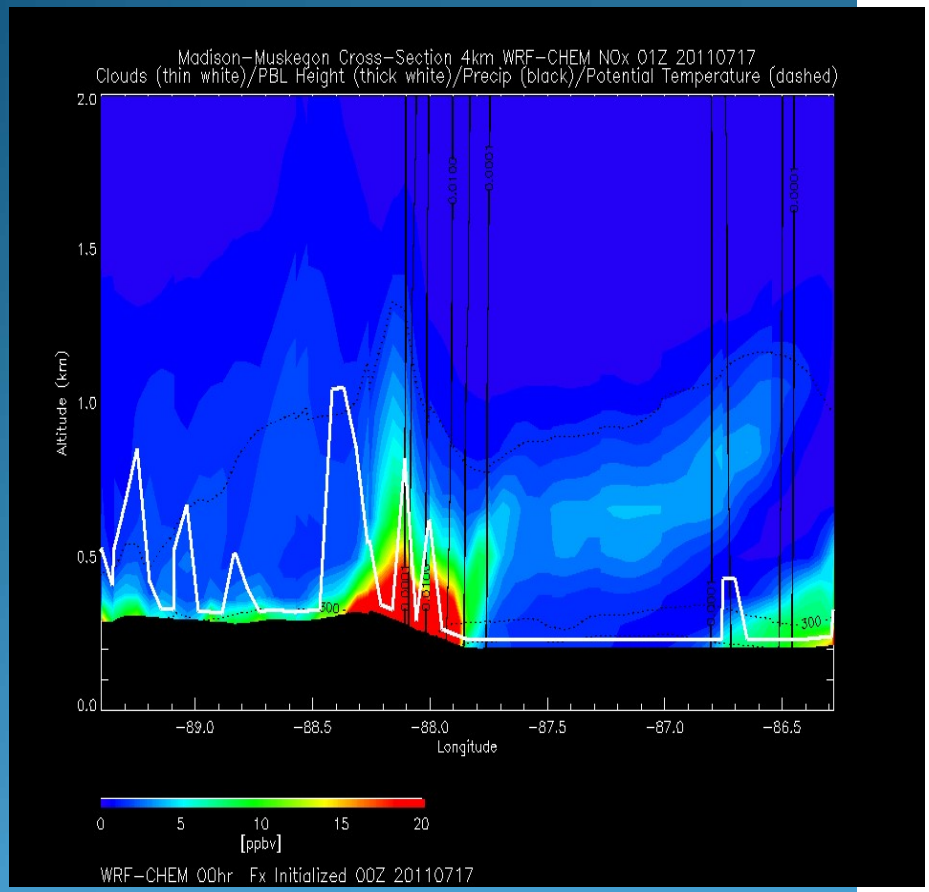
12km WRF-CHEM shows broad region of higher surface NOx over southern Lake Michigan and NW Indiana

12km NOx high over NW Indiana due to low PBL

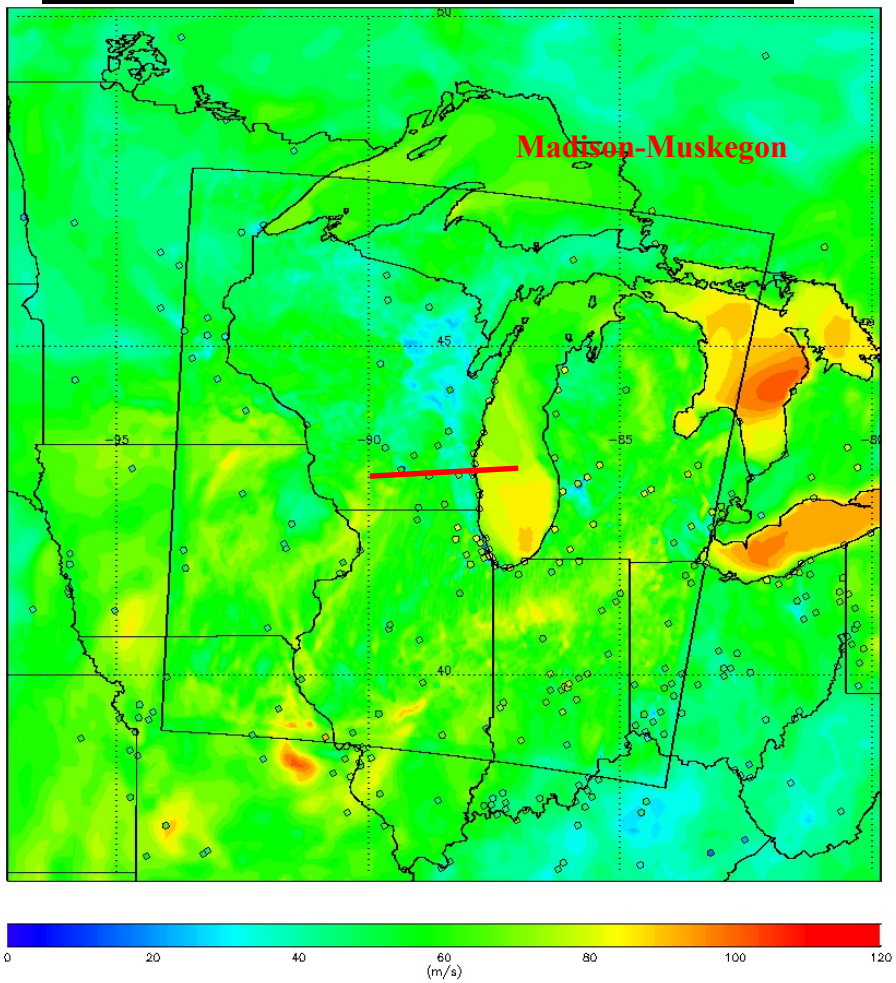


Source: Brad Pierce, NOAA

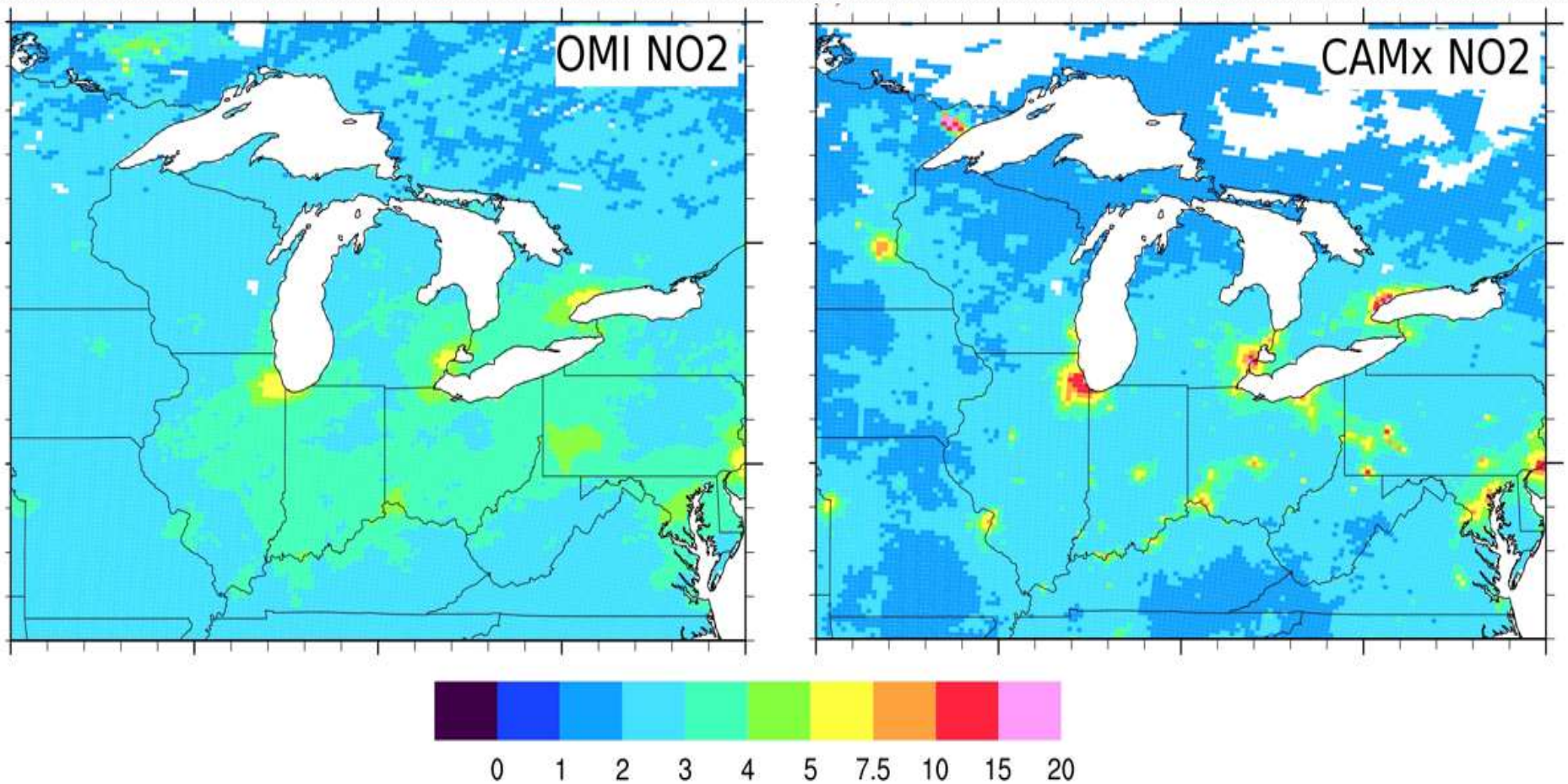
Too Much NOx?



12km/4km WRF-CHEM Surface O3
00Z 07/17 to 23Z 07/17, 2011



Comparison of 2011 NO_2 Concentrations Measured (NASA-OMI) and Modeled (CAMx)



Source: Monica Harkey, University of Wisconsin

White Paper: Lake Michigan Ozone Study 2017 (LMOS 2017)

Brad Pierce - NOAA NESDIS Center for Satellite Applications and Research (STAR), Cooperative Institute for Meteorological Satellite Studies, Madison, WI

Rob Kaleel and Donna Kenski - LADCO, Rosemont, IL

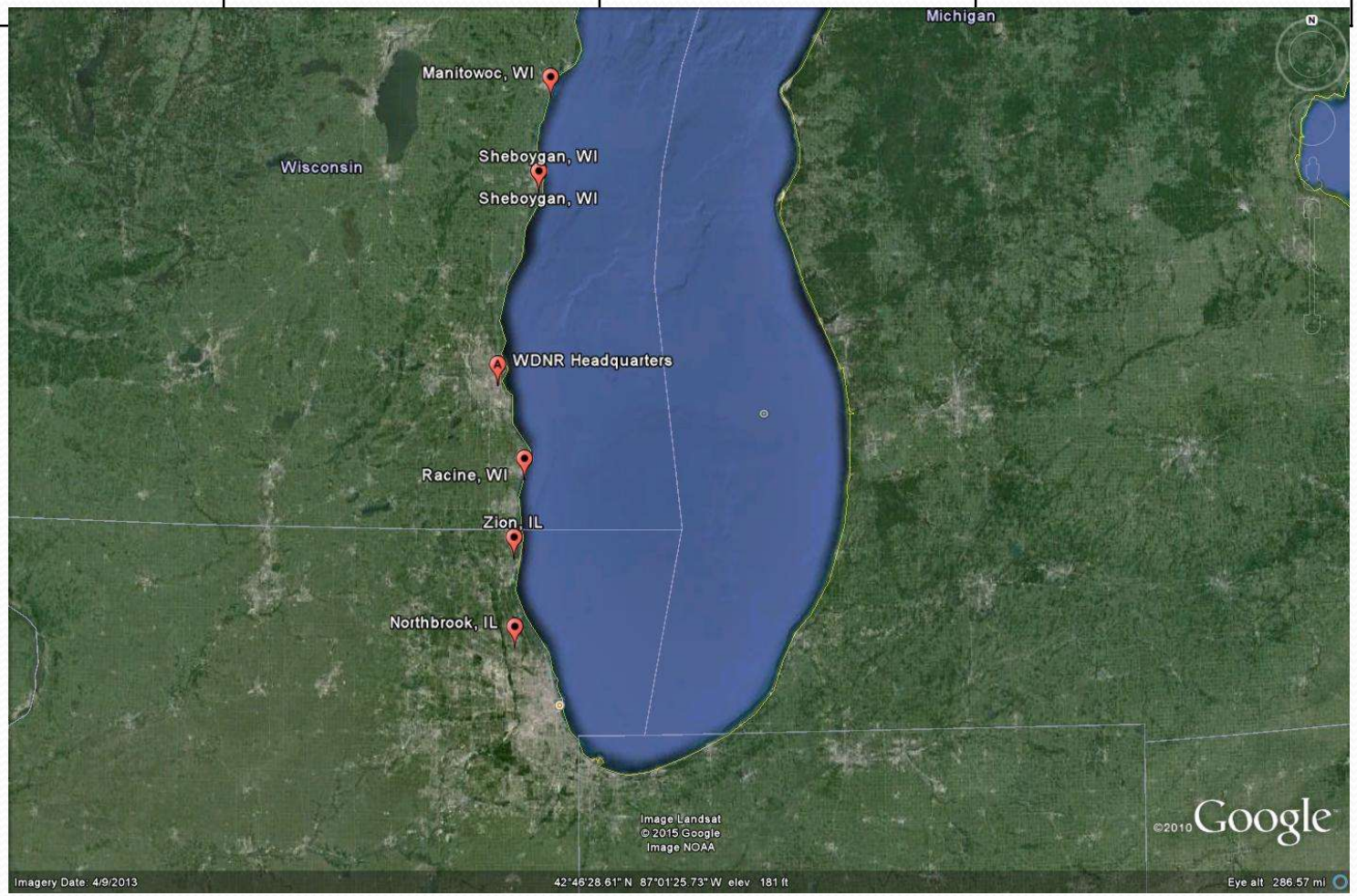
Angela Dickens - Wisconsin Department of Natural Resources, Madison, WI

Tim Bertram - University of Wisconsin-Madison, Department of Chemistry, Madison, WI

Charles Stanier - University of Iowa, Department of Chemical and Biochemical Engineering, Iowa City, IA

Analytical Approaches:

	Satellites	Airborne platforms	Ground-based
Type of measurement:	Remote sensing only	In situ & remote sensing	In situ & remote sensing
Spatial Coverage:	Excellent	Good	Limited
Temporal Coverage:	Limited	Good	Excellent



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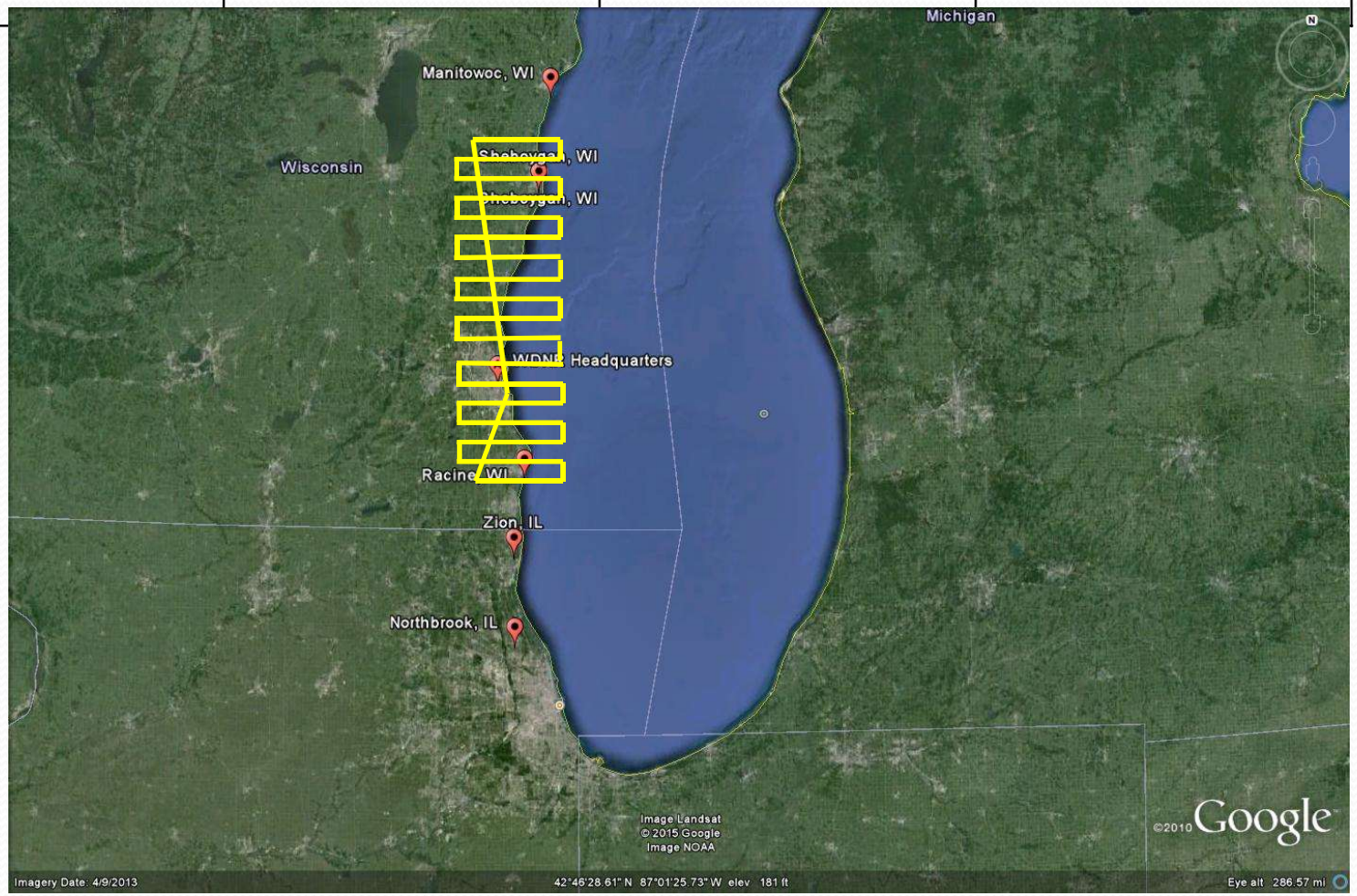

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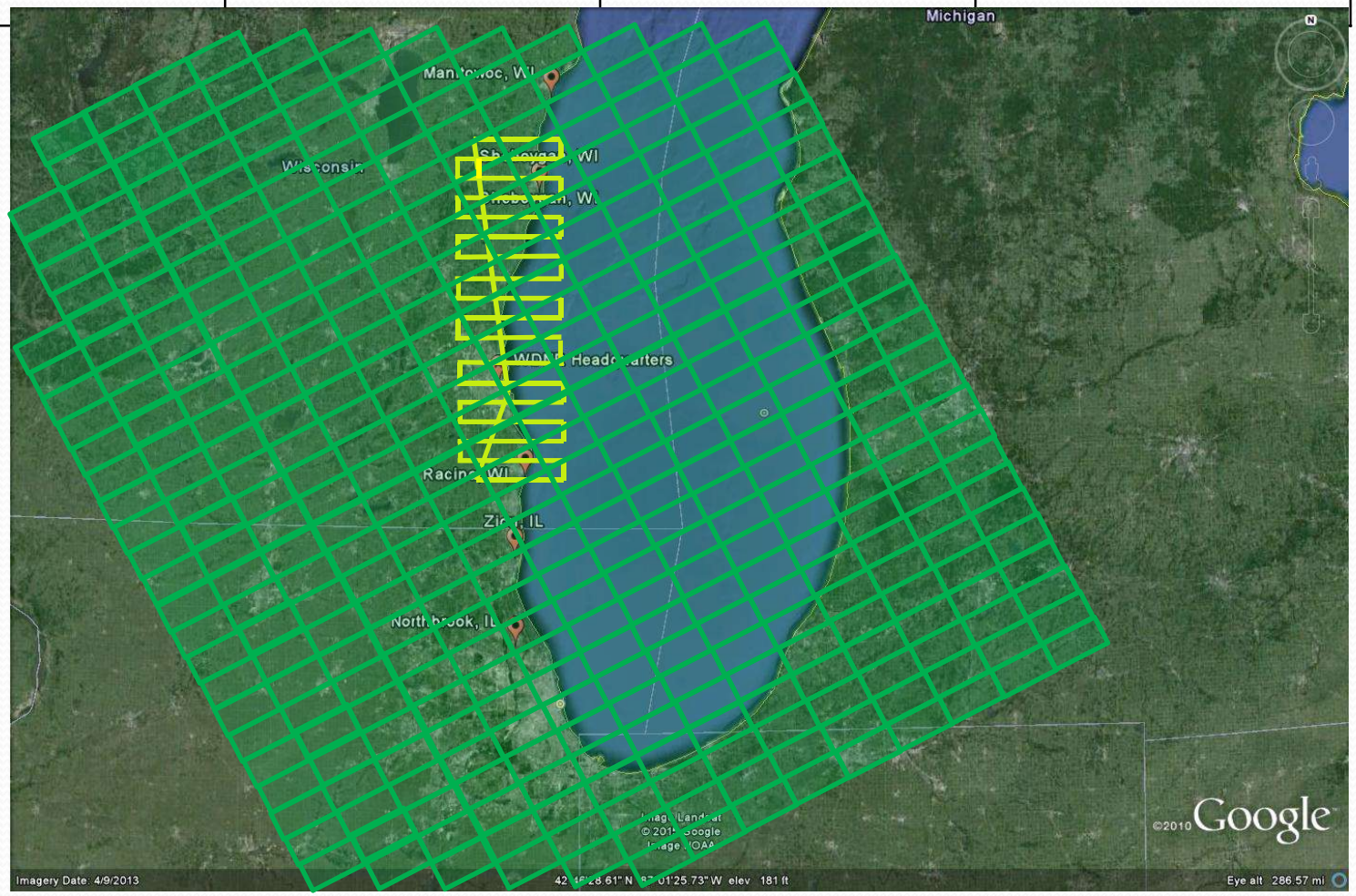
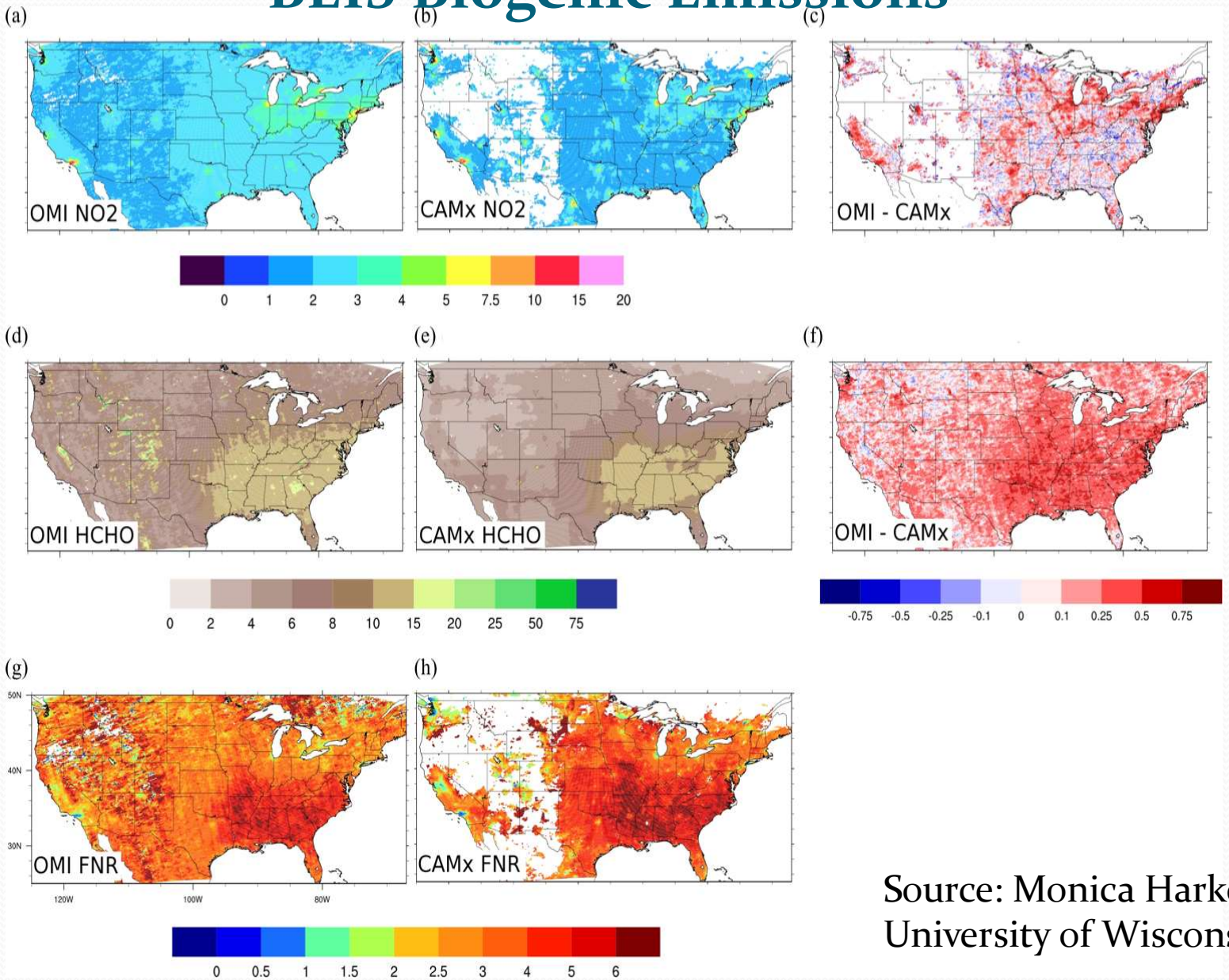


Biogenic Emissions
Comparison of BEIS and MEGAN

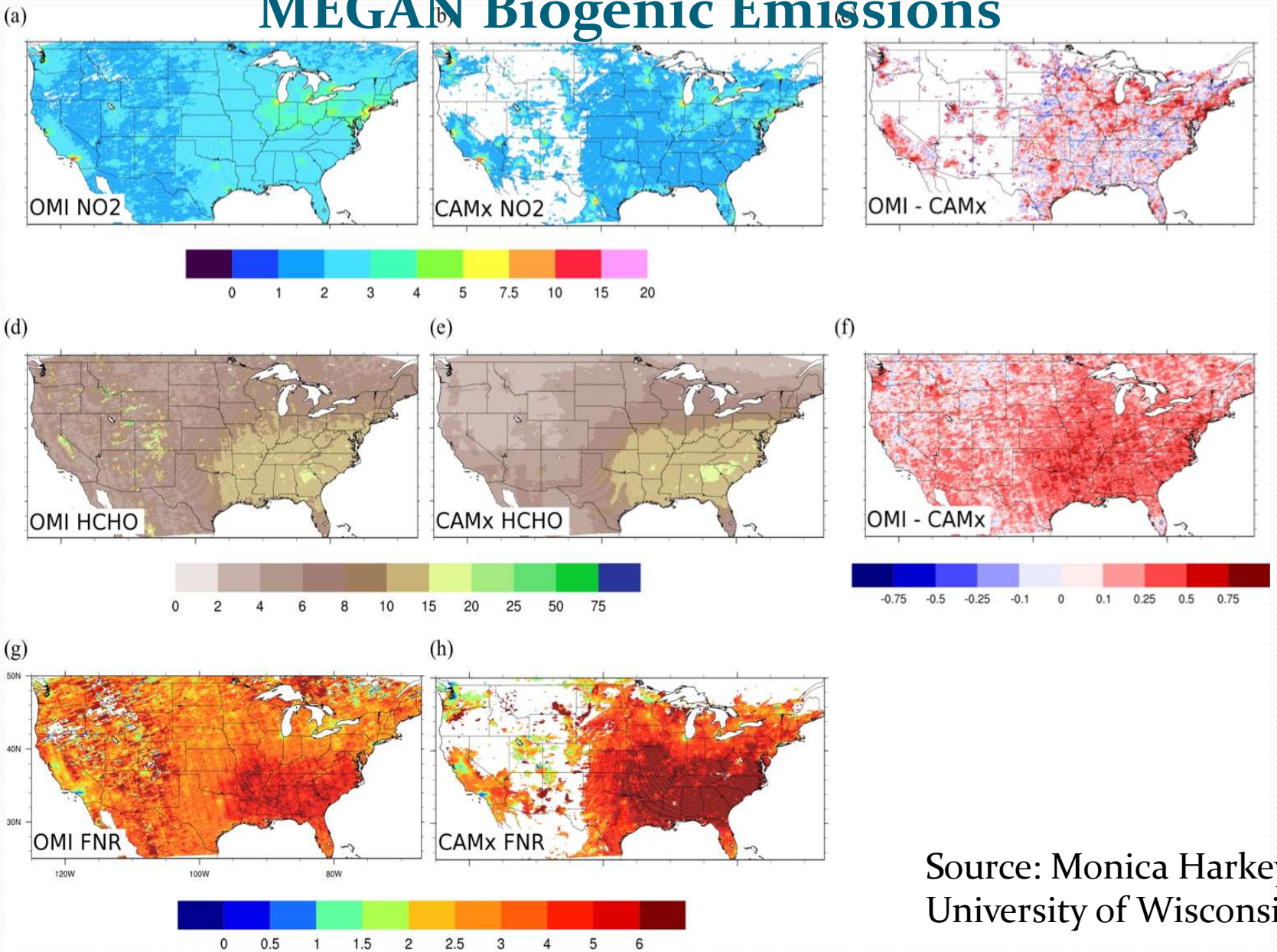
- EPA
  - BEIS V3.6.1 w/ prognostic PAR from WRF
- Rice University, Daniel Cohan
  - BEIS V3.14 w/ satellite PAR
  - MEGAN V2.10 w/ satellite PAR
- EPA and Rice BEIS results similar
  - EPA's BEIS not shown

CAMx-OMI Comparison Using BEIS Biogenic Emissions



Source: Monica Harkey, University of Wisconsin

CAMx-OMI Comparison Using MEGAN Biogenic Emissions



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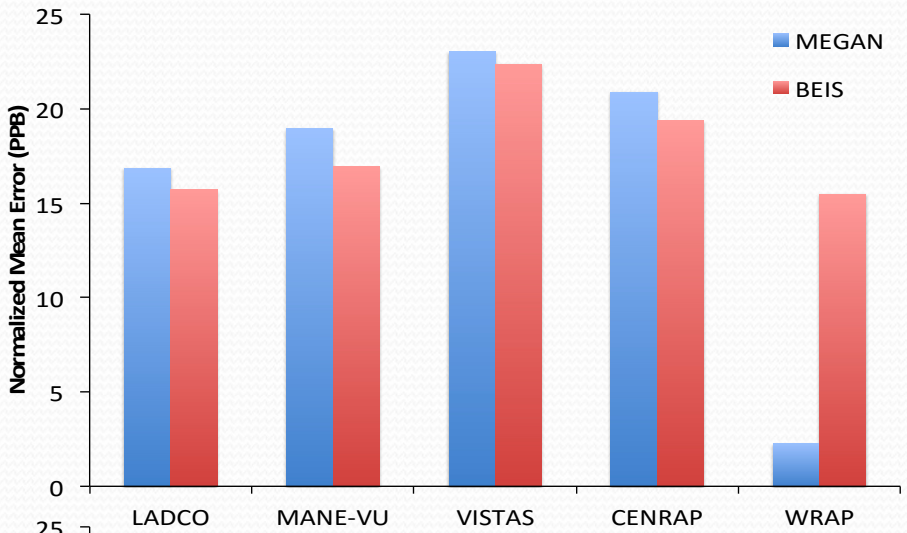
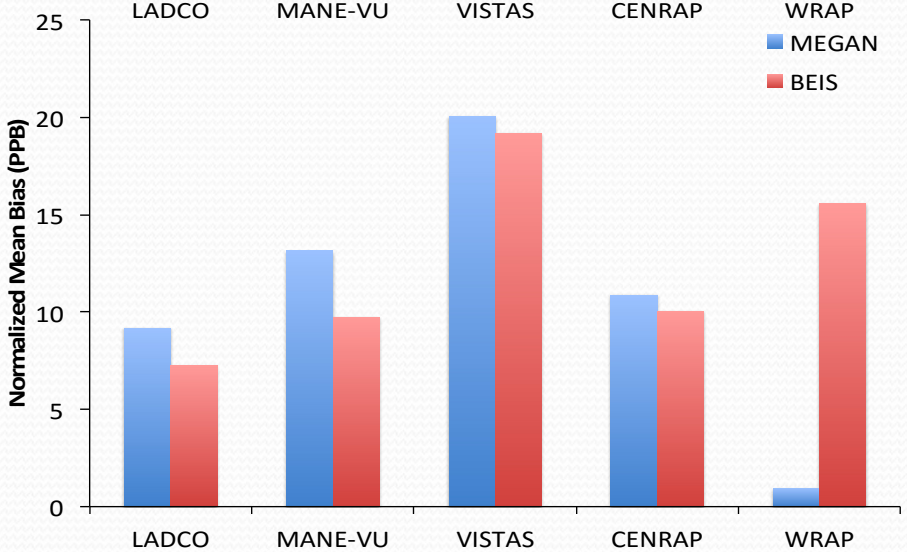
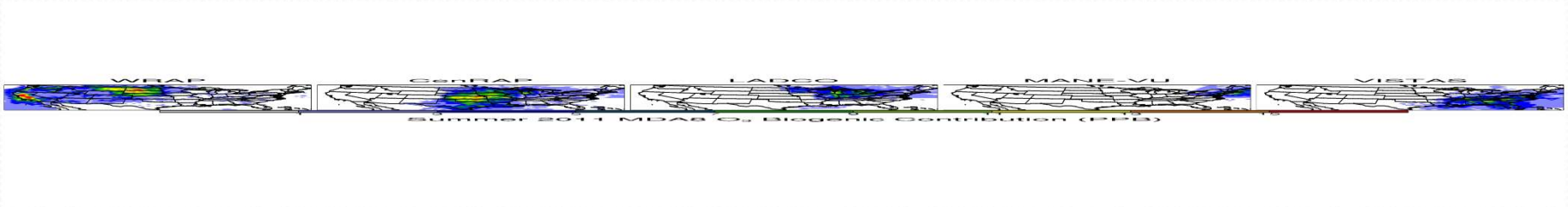
MDA8 O_3 CAMx Model Performance

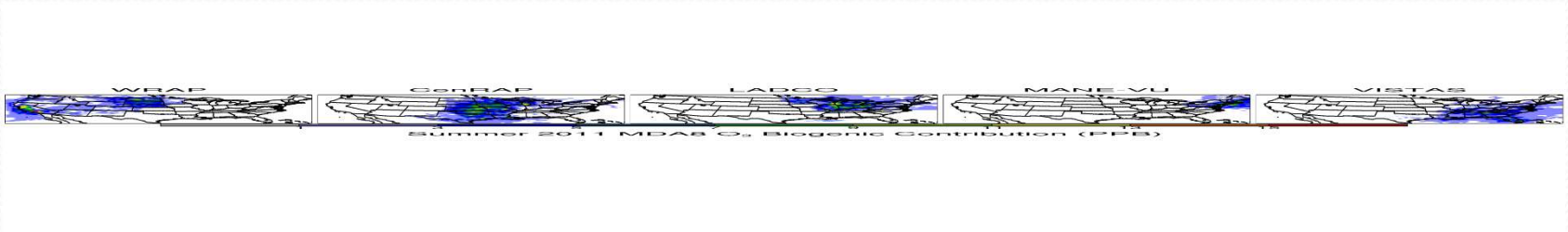




BEIS and MEGAN
Contribution of Biogenic Emissions to MDA8 O_3

BEIS

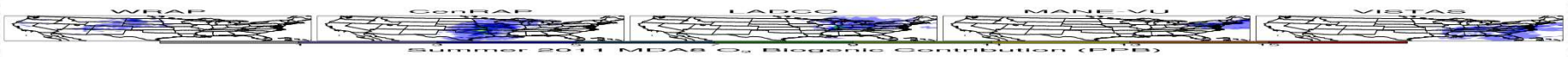


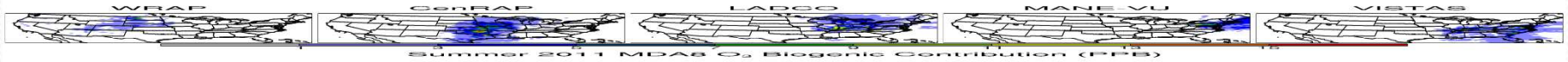


MEGAN

BEIS and MEGAN Biogenic Emissions EGU Contributions to MDA8 O_3

BEIS

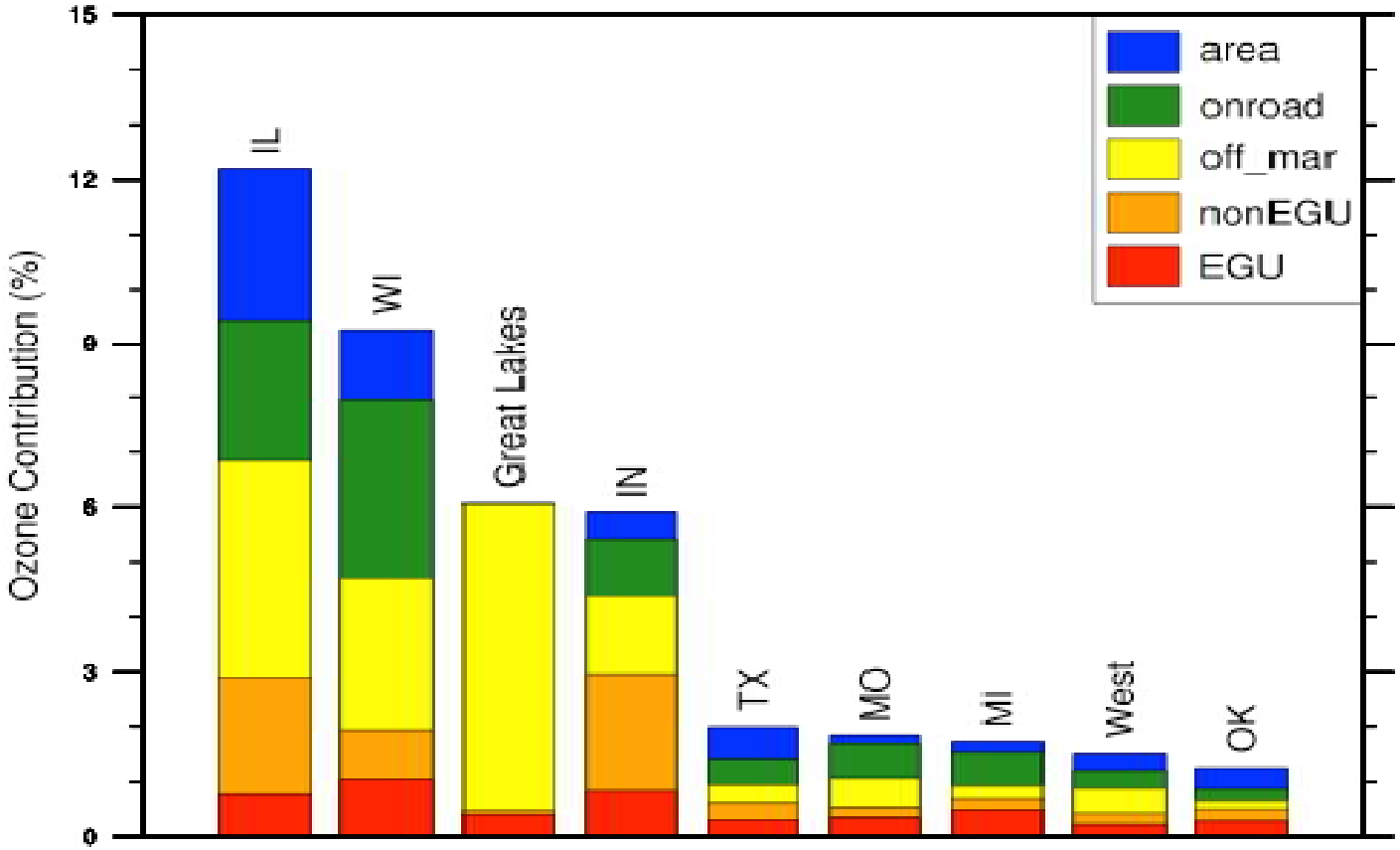




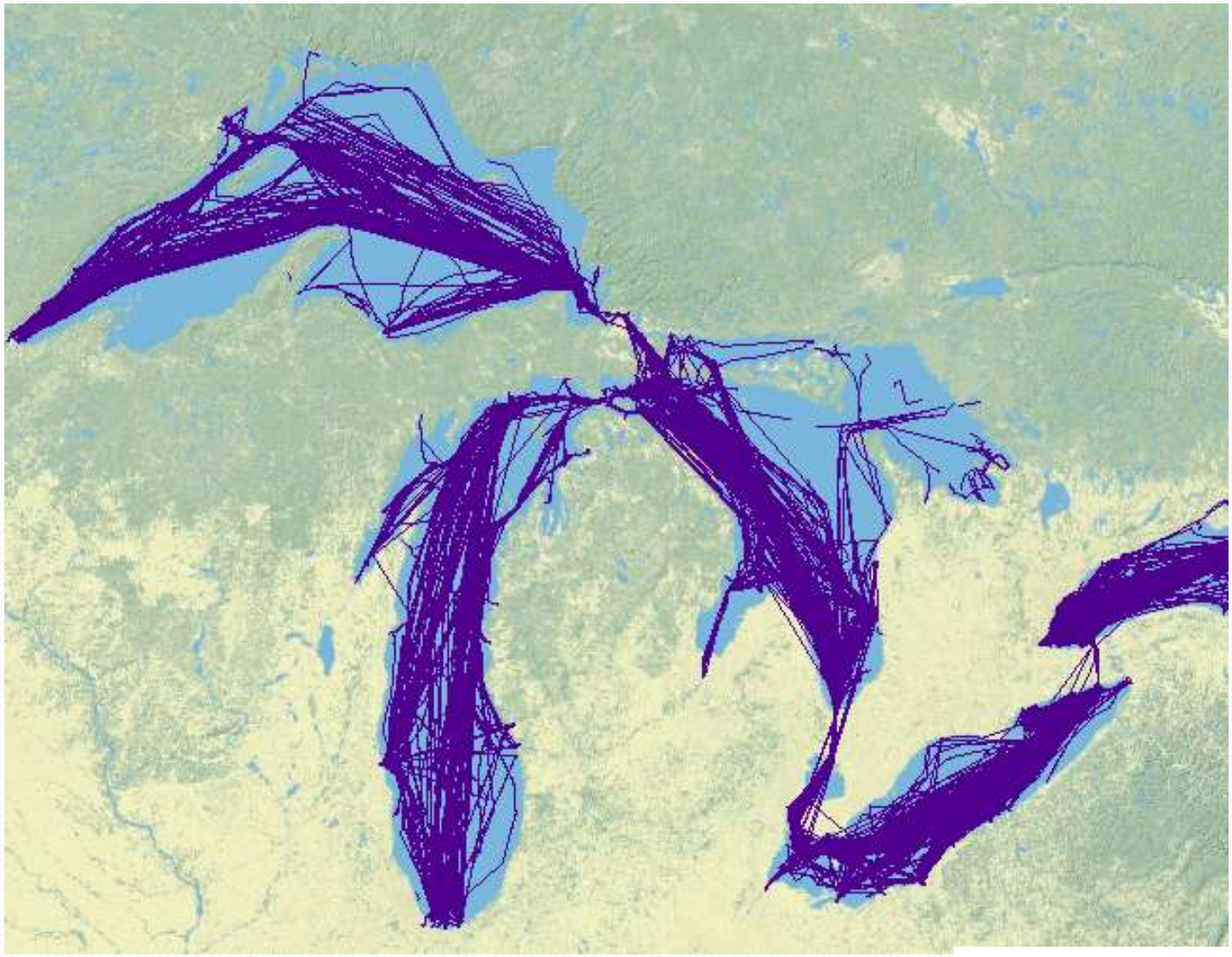
MEGAN

Contribution of Commercial Marine Vessels to Ozone Concentrations In the Great Lakes Region

Source Attribution for Sheboygan, WI (Monitor ID: 551170006)

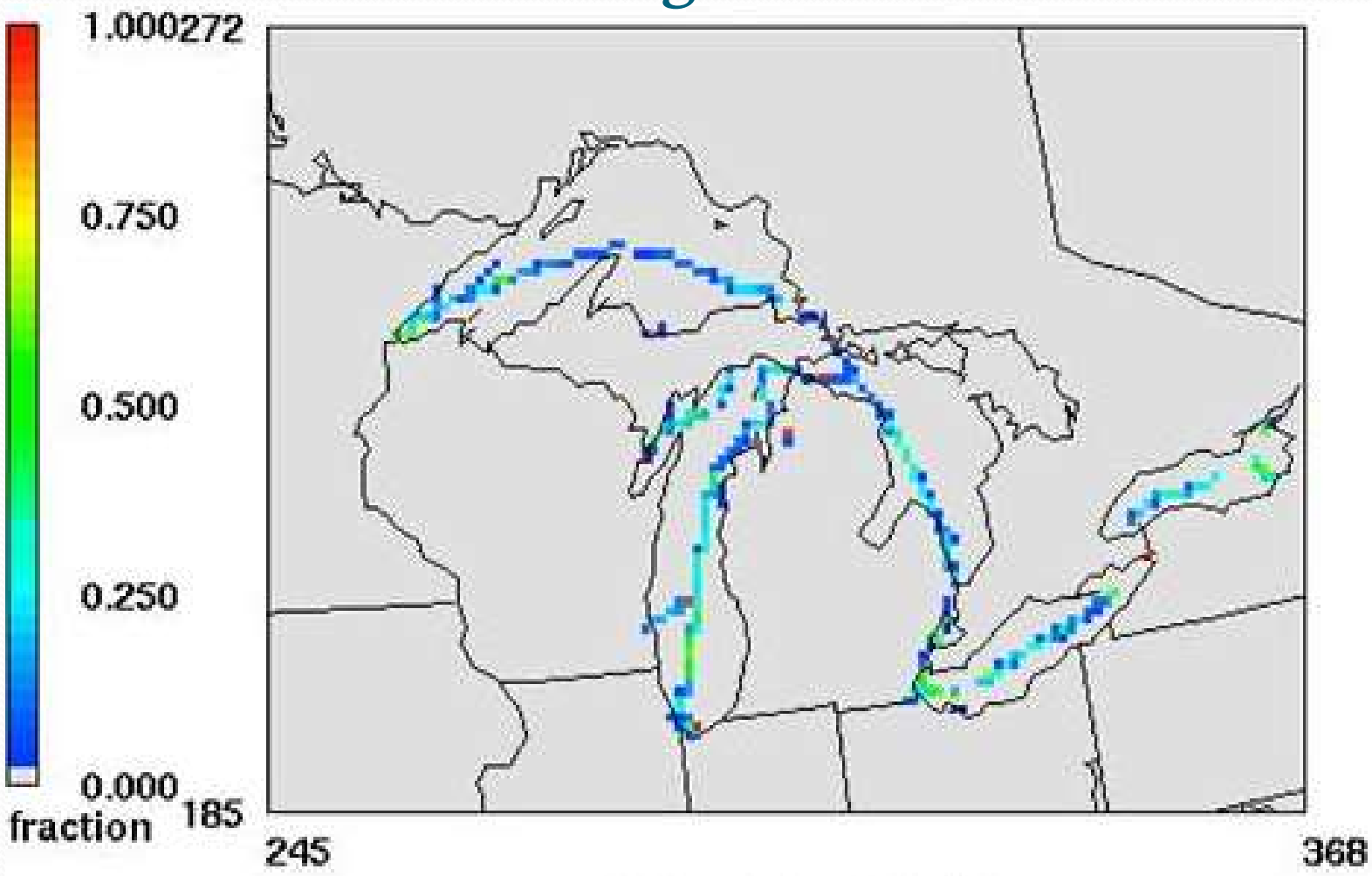


Commercial Marine Vessel Tracks in the Great Lakes



ENERCON

Spatial Allocation of Emissions from Commercial Marine Vessels in EPA's 2011 Modeling Platform



Questions?

Rob Kaleel – LADCO

kaleel@ladco.org

847-720-7880