Modeling in the Midwest: Challenges and Policy Implications

Rob Kaleel
Lake Michigan Air Directors Consortium
May 11, 2016
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\textsubscript{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)
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

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

Madison-Muskegon

Too Much NOx?
Comparison of 2011 NO2 Concentrations Measured (NASA-OMI) and Modeled (CAMx)

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:

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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

Source: Monica Harkey, University of Wisconsin
MDA8 O₃ CAMx Model Performance

Normalized Mean Error (PPB)

Normalized Mean Bias (PPB)
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
Commercial Marine Vessel Tracks in the Great Lakes
Spatial Allocation of Emissions from Commercial Marine Vessels in EPA’s 2011 Modeling Platform
Questions?

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