Interstate Transport Modeling for the 2015 Ozone Standard in the Midwest and the Northeast

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Motivation

In support of "Good Neighbor" State Implementation Plans (CSAPR, 2011; CSAPR Update, 2016) for meeting the 2015 ozone (O_3) National Ambient Air Quality Standard (NAAQS), LADCO used the Comprehensive Air Quality Model with Extensions (CAMx version 6.4) to assess the impacts of interstate transport on surface level O_3 concentrations in the Midwest and Northeast U.S.

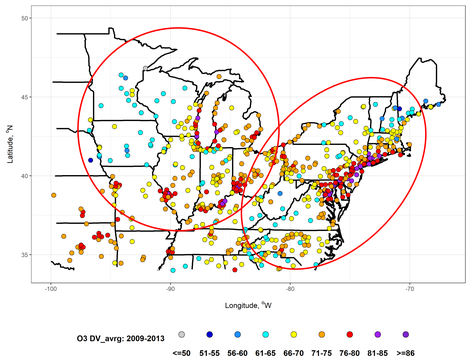


Figure 1. *Base Year (Average of 2009-2023) O_3 Design Values. O_3 concentrations are higher in urban cores such as St. Louis and southern Indiana. Shoreline monitors near Lake Michigan and Mid-Atlantic coast are in violation of 2015 O_3 NAAQS (as shown by orange, red, purple dots)*

Model Configuration

- LADCO's 2023 O_3 air quality and interstate transport forecast is based on the CAMx modeling platform released by U.S. EPA in October 2017 (US EPA, 2017)
- The 2023 emissions data are based on the U.S. EPA 2011v6.3 ("EN") emissions modeling platform (US EPA, 2017b) except for EGU emissions.
- EGU emissions are estimated using the ERTAC EGU 2.7 Tool (http://www.marama.org) with 2011 CEM data and state-reported updates for EGUs emissions as of May 2017.

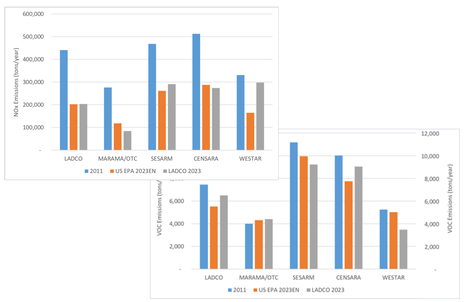
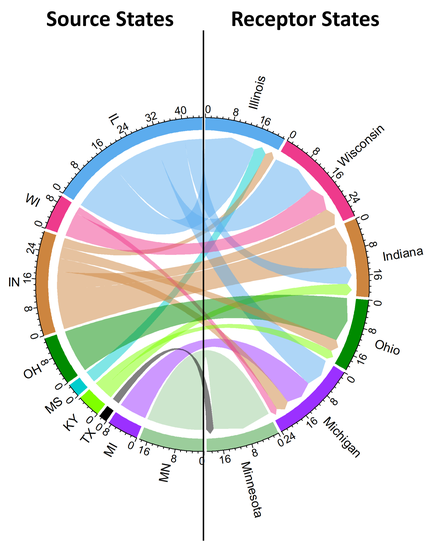


Figure 2. *NOx and VOC emissions estimated by the ERTAC EGU v2.7 Tool for the Base (2011) and Future (2023) years*

- Applied the CAMx with APCA configuration over 12x12km domain covering the contiguous U.S. for May-Sep of 2011.
- Estimated O_3 Design Values in 2023 (DV_{2023}) at monitors using the Software for Modeled Attainment Test Community Edition Version 1.2 by following the U.S. EPA Draft Guidance for Attainment Demonstration Modeling (US EPA, 2014b).

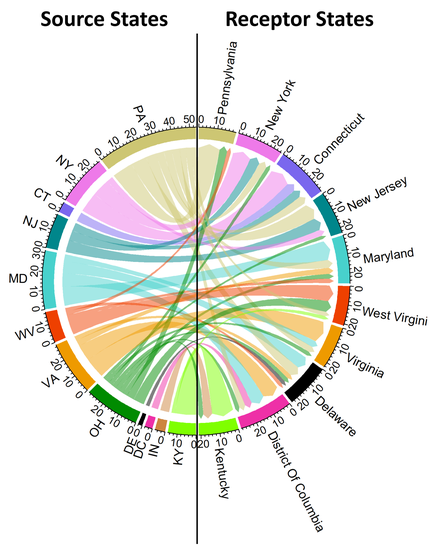
Interstate O3 Contributions in the Midwest and Northeast



a) State average contributions to O_3 DV_{2023} in the Midwest

Key Messages:

- Home state is the biggest contributor for its own O_3 design value, except for Wisconsin and Michigan where IL is dominant contributor.
- O_3 precursors from the south central U.S. contributed to design values in the LADCO states (e.g., TX contributes to MN).



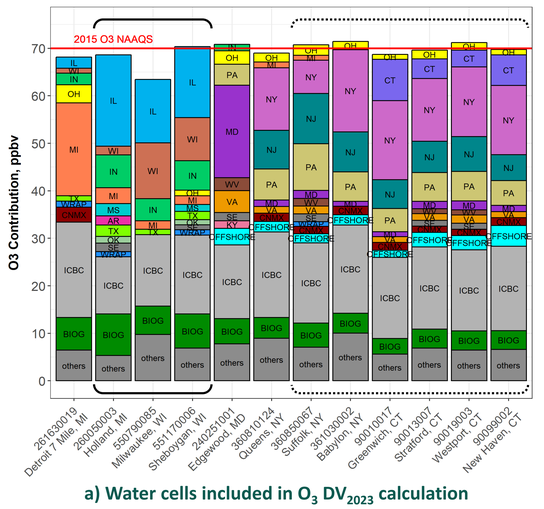
b) State average contributions to O_3 DV_{2023} in the Northeast

Key Messages:

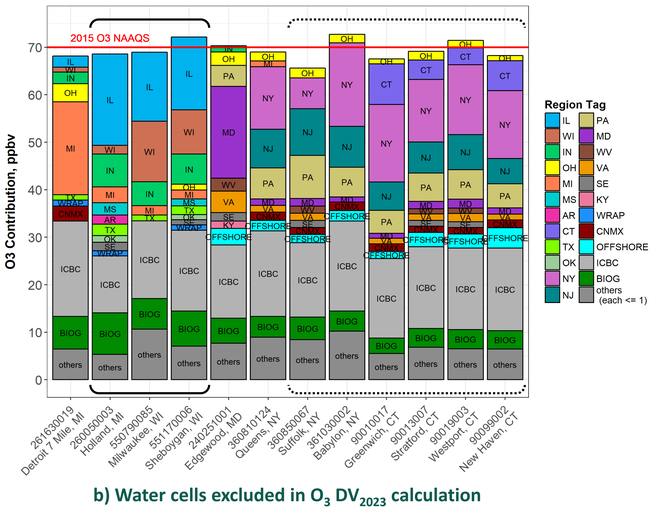
- PA, MD, NY, VA, OH are the largest contributors to O_3 design values in the Northeast.
- For the shoreline and smaller states (CT, NJ, DE, and DC), upwind states are the biggest contributors depending on dominant air flows in O_3 season.

Figure 3. *Statewide average contributions to O_3 DV_{2023} in the Midwest (a) and Northeast (b). Plots show receptor states with >2 ppb contribution from upwind states, and exclude ICBC, BIOG, CNMX, SE, OFFSHORE, OTC, and WRAP source region tags.*

O3 Contributions at Selected Monitors & Impacts of Water Cells on Design Values



a) Water cells included in O_3 DV_{2023} calculation



b) Water cells excluded in O_3 DV_{2023} calculation

Figure 4. *Source region contributions to O_3 DV_{2023} at key monitoring sites in the Midwest and Northeast. The O_3 DV_{2023} were calculated using the maximum of the modeled MD8hO3 values in the 3x3 grid cells surrounding a monitor where water cells are included (a) and excluded (b). Only the source regions with contributions >= 1.0 ppbv are explicitly shown in these plots, all source regions with contributions <1.0 ppbv are grouped into the "others" category.*

Vertical solid and dashed braces enclose shoreline monitors in the LADCO region and the Mid-Atlantic region, respectively. The impact of including/ excluding water cells in the attainment test calculation at particular monitor can be seen by comparing monitor specific cumulative bars of each plots for that monitor.

Key Messages:

- Initial and Boundary Conditions (ICBC) and Biogenic (BIOG) together accounts about 22 ppbv (~32%) of the O_3 DV_{2023} at individual sites. Canada/Mexico (CNMX) sources have the largest contribution (3.14 ppbv or 5%) on O_3 DV_{2023} at the Detroit, MI and about 0.79-1.76 ppbv (~2%) contributions at sites in the Northeast. Offshore sources, primarily commercial marine vessels contribute as much as 3.48 ppbv (4%) of the DV_{2023} at sites in the Northeast.
- Inland home state is the biggest contributor to its O_3 DV_{2023}. Emissions sector tagged APCA modeling shows that onroad (17%), non-road (15%), EGU point (9%), non-EGU point (8%), and nonpoint (8%) are the top 5 emissions sectors contributing to the O_3 DV_{2023} (results are not shown).
- In general, excluding water cells in the attainment test calculation results in higher DV_{2023} at lakeshore monitors in the LADCO region, lower DV_{2023} in the Mid-Atlantic region.

Acknowledgements

We acknowledge the access to data and software, and technical support provided by the U.S. EPA Office of Air Quality Planning and Standards staff to LADCO during this project. LADCO also acknowledges the contributions from our member state air agency staff.

Summary and Key Findings

Using the CAMx APCA modeling, LADCO identified monitors with potential air quality problems in 2023 and estimated contributions of 32 source regions (Figure 5) to the monitors. We explored the impacts of including or excluding water cells in the calculation of future design values.

LADCO's final Technical Support Document for our member state 2015 O_3 "Good Neighbor" SIPs is available on www.ladco.org.

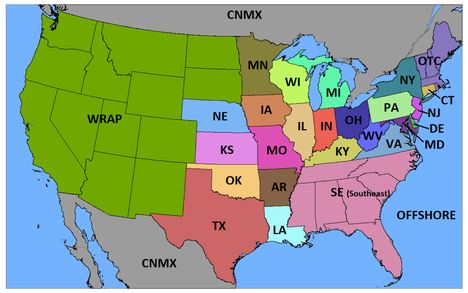


Figure 5. *CAMx APCA source regions used in LADCO 2023 simulation*

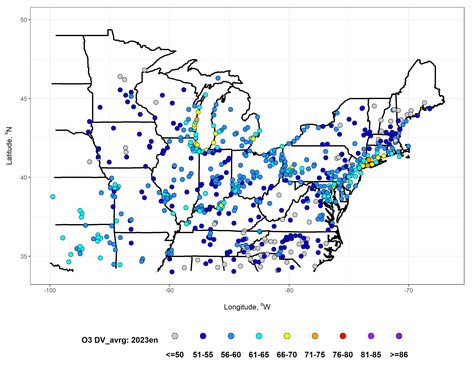


Figure 6. *Estimated O_3 DV_{2023} in the Midwest and Northeast*

If EGU emissions reductions take place as projected by ERTACv2.7 along with the EPA's emission projections for other sources, monitors in the Midwest and the Northeast could attain the 2015 O_3 NAAQS by 2023 (Figure 6). A few sites by the Lake Michigan and Connecticut shorelines are projected to be at or near maintenance status of the standard.

Inland home states are the biggest contributors to their own O_3 concentrations. For shoreline states, WI, MI, CT, NJ, DE, and DC, upwind states are the biggest contributors depending on dominant air circulation in the O_3 season. Mobile (32%), point (17%), and nonpoint (8%) sources appear to be the key contributing emissions sectors to future O_3 design values.

Excluding water cells from the attainment test resulted in higher DV_{2023} for the lakeshore monitors in the LADCO region, but lower DV_{2023} for the Connecticut shoreline monitors.

Key References

1. Cross State Air Pollution Rule (CSAPR) Update, 81 Fed. Reg. § 74,504 (final rule Oct. 26, 2016)(to be codified at 40 C.F.R. pts. 52, 78, 97).
2. Ramboll-Environ. 2016. User's Guide: Comprehensive Air Quality Model with Extensions version 6.40. Novato, CA.
3. US EPA. 2018. Memorandum: Information on the Interstate Transport State Implementation Plan Submissions for the 2015 Ozone National Ambient Air Quality Standards under Clean Air Act Section 110(a)(2)(D)(i)(I), Research Triangle Park, NC. https://www.epa.gov/sites/production/files/2018-03/documents/transport_memo_03_27_18_1.pdf
4. US EPA. 2017. Memorandum: Supplemental Information on the Interstate Transport SIP Submissions for the 2008 Ozone NAAQS under Clean Air Act Section 110(a)(2)(D)(i)(I), Research Triangle Park, NC. https://www.epa.gov/sites/production/files/2017-10/documents/final_2008_o3_naaqs_transport_memo_10-27-17b.pdf.
5. US EPA. 2017b. Technical Support Document: Additional Updates to Emissions Inventories for the Version 6.3 Emissions Modeling Platform for the Year 2023. Research Triangle Park, NC. https://www.epa.gov/sites/production/files/2017-11/documents/2011v6.3_2023en_update_emismod_tsd_oct2017.pdf