Assessment of modeled changes in air quality and deposition arising from hypothetical reductions in anthropogenic emissions over the eastern US

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Modeling System

- ***Air quality & deposition***: CMAQ v4.6, summer 2002
- ***Emissions***: SMOKE v2.1 (anthropogenic) & BEIS v3.12 (biogenic)
- ***Meteorology***: MM5 v3.6
- ***Modeling period***: July 10 – August 31 (discard July 10-13 for "spin-up")
- One base case and two hypothetical emissions reductions scenarios: (1) zero out all mobile source emissions, and (2) zero out all EGU & non-EGU point source emissions from US sources
- Focus on daily maximum O_3 and nitrate deposition

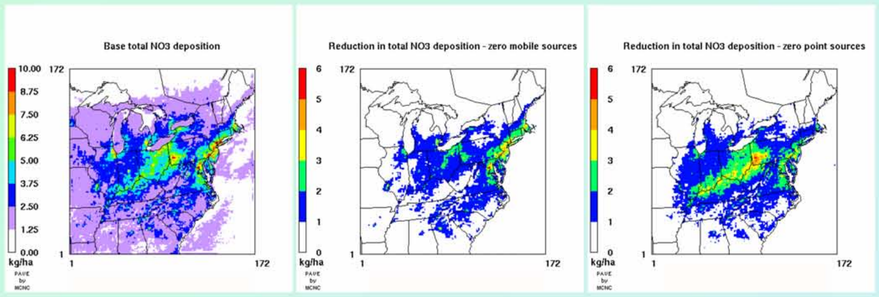
Total NOx emissions for each model scenario

Model scenario	NOx emissions, 10^{10} moles	% reduction from base case
Base	3.875	-
Zero out mobile sources	2.564	-33.8%
Zero out point sources	2.623	-32.3%

Analysis of model predictions

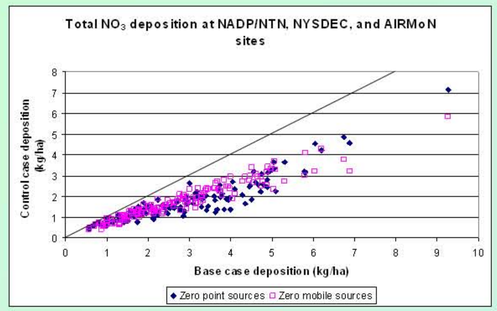
- Daily maximum 8-hour surface O_3 across the eastern US, plus an examination of hourly O_3 aloft corresponding to aircraft spirals made by the University of Maryland
- Total (wet + dry) NO_3 deposition across the eastern US, with a closer look at locations where wet deposition has been measured - NADP/NTN (130 sites), NYSDEC (19 sites), and AIRMoN (9 sites)

Nitrate deposition



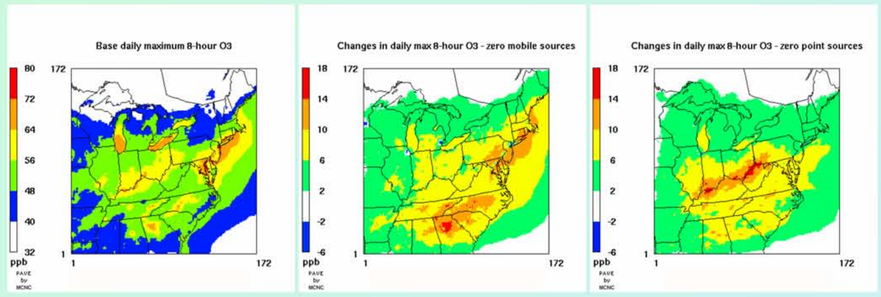
- Largest reductions resulting from removing mobile sources occur along the northeastern urban corridor
- Largest reductions resulting from removing point sources occur along the Ohio River Valley

Nitrate deposition (cont.)



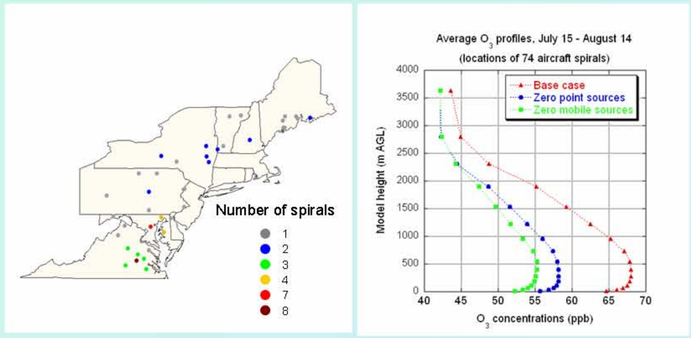
- Focus on modeled NO_3 deposition changes at 158 wet deposition sites, which for NADP/NTN and AIRMoN are located outside of core urban areas
- At 108 of these sites NO_3 deposition reductions were larger when point sources were removed
- At more urban sites (e.g. NTN site NJ99; NYSDEC sites in Bronx, Nassau, and Westchester counties), removing mobile sources had a larger effect on NO_3 deposition

Surface ozone concentrations



Reductions in daily maximum 8-hour O_3 concentrations are generally consistent with changes in NO_3 deposition in the northern part of the modeling domain. However, removing mobile sources had a substantial effect on O_3 reductions near Atlanta, eastern TN, and the Carolinas, which was not apparent in the NO_3 deposition.

Upper-air ozone concentrations



- The University of Maryland operated instrumented light aircraft over the northeastern US during summer 2002
- During this period, 74 vertical profiles of O_3 and other pollutants were obtained at generally rural or suburban locations
- At these locations, reductions in O_3 concentrations throughout the lower boundary layer were ~3-4 ppb larger when mobile sources were removed compared to when point sources were removed

Summary

- The spatial patterns in reductions in O_3 concentrations and NO_3 deposition are consistent with where emissions were removed
- Mobile source emission reductions had a larger effect on O_3 than NO_3 deposition in parts of the Southeast
- Mobile source emissions reductions appear to have a greater impact on both O_3 and NO_3 deposition in urban areas
- Point source emissions appear to have a greater impact on NO_3 deposition in places it has historically been monitored
- Effective air quality management may require different emission reduction strategies for different areas of the country, and for different pollutants

Acknowledgments The authors appreciate the efforts of Dr. Bruce Doddridge for insight into the aircraft data. The views expressed here do not necessarily reflect those of the New York State Department of Environmental Conservation. The authors appreciate the use of the NTN and AIRMoN data, available through the NADP website.