Influence of Fires on Air Quality During the SEAC4RS 2013 Campaign
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1. Motivation

Ground-level O₃ pollution is a serious public health and environmental concern in the U.S. I am interested in improving understanding of background O₃, a critical issue for setting the National Ambient Air Quality Standards (NAAQS). EPA is considering tightening the O₃ NAAQS, but it is unclear to what extent uncontrollable wildfires would hinder achievement of a lower NAAQS (Macdonald-Buller et al., 2011).

Addressing this issue is of critical importance for policy and presents a major scientific challenge to coupling atmospheric chemistry on global and regional scales.

Background O₃ is not directly measurable and thus must be calculated from a global chemical transport models (CTM). Current CTMs have difficulty capturing observed high background events (over 70ppb) due to a variety of limitations including modeling of wildfires. CTMs also show large differences in their representation of the impact of wildfires on the ozone background (Fiore et al., 2009) which is very problematic for air quality policy.

2. Fires Sampled During SEAC4RS

Plumes with high ΔO₂/ΔCO have enhanced PAN. PAN may be an important NOx reservoir for downwind O₃ production as well. Thus successful modeling of fire impacts on background ozone requires successful modeling of PAN.

3. Geos-Chem NOx-O₃-VOC Simulation

- Resolution = 0.25° x 0.3125° and 4°x5°
- Meteorology = GMAO GEOS-FP
- Emissions = NEI2008, FINN, MEGAN2.1
- Isoprene chemistry = Mao et al., 2013

Fire Injection
- Emit 40% of NOx as PAN and 20% as HNO3 (Alvarado et al., 2010).
- Inject 15% into 3-5km in the West to match SEAC4RS observations.
- For the rest of the northern midlatitudes, inject 15% into the first few km of the free troposphere.

Geos-Chem O₃ compares well with SEACIONS in the free troposphere.

4. Modeled Impact of Fires on Surface O₃

Geos-Chem predicts that during the SEAC4RS time period, ~4ppb of surface O₃ was due to fires in the West.

Geos-Chem overall underestimate surface ozone in the West which may be due to inadequate VOC and NOx emissions from either fires or anthropogenic sources.

5. Future Work

Free Tropospheric O₃ in the West:
- Improve modeling of near-source VOC chemistry from fires, and resultant ozone and PAN formation, in collaboration with Matt Alvarado using the ASP model.

Southeast U.S. Chemistry:
- Proper treatment of new isoprene oxidation products:
  - Wet and dry deposition
  - Aerosol uptake
  - Transport
- Incorporate the most recent studies on epoxides and isomerization to test uncertainties in these mechanisms.

6. Conclusions

O₃ chemistry in the southeast U.S. is sensitive to the products from isomerization and epoxides. The general problem of CTMs in overestimating O₃ in the southeast and underestimating O₃ in the West persists.

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