Summary of RS-HDMR sensitivity analyses of modeled ozone and hydrogen oxides for six NASA field campaigns

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Motivation

- Sensitivity and uncertainty analyses are useful to determine certainty in modeled results and attribute sources of error.
- Ozone, OH, and HO\textsubscript{2} are well studied and important
  - Determine lifetimes of VOCs and other trace gas species
  - NASA field campaigns are ideal
  - Many in-situ trace gas measurements for comparison
  - We use a global sensitivity analysis method
    - Simultaneous perturbations of dozens of inputs
    - Nonlinear interactions are taken into account

Methods

- Pre-Screen (Morris Method)
  - Determine ~50 factors
- Create Uncertainty Distributions
- Sample and Perturb
- Sensitivity Analysis

Campaigns studied

- ARCTAS-B (2008)
- ARCTAS-A (2008)
- INTEX-B Houston (2006)
- TRACE-P (2001)
- PEM-Tropics B (1999)

Summary

- General agreement between model and measurements when uncertainties in both are taken into account
- Uncertainties similar between campaigns
  - Ozone: 15-20\% for N. America, 25-30\% for Pacific
  - OH: 25-40\%
  - HO\textsubscript{2}: 20-40\%
- Emissions represent the majority of the uncertainty
  - Lightning NO\textsubscript{x}, isoprene, surface NO\textsubscript{x}, and CO
- Photolysis and kinetics can also be large sources of uncertainty
  - Upwards of 30-40\%
  - Noteworthy because of low uncertainties in rates
    - $k_{NO2+OH}$, $j_{NO2}$, $j_{O3}$
- HO\textsubscript{2} aerosol uptake is the dominant source of HO\textsubscript{2} uncertainty for many regions and of OH uncertainty in some regions
  - Can represent upwards of 50-75\% of total uncertainty
  - Relatively small differences with aerosol uptake producing H\textsubscript{2}O\textsubscript{2} or H\textsubscript{2}O
  - Generally better agreement with lower aerosol uptake rates (currently 0.2)
- A few factors show up repeatedly
  - Local NO\textsubscript{x} sources, lightning NO\textsubscript{x}, isoprene, CO, $k_{NO2+OH}$, $j_{NO2}$, $j_{O3}$, gamma HO\textsubscript{2}

Current and future work

- Finish examining N. American campaigns
- Examine Pacific campaigns
- Examine sensitivities for other outputs
  - Lots of possibilities
  - Ensemble was created for oxidants though
- Work on making model ensemble available for others to examine

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