Aerosol Processes Working Group

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GEOS-Chem AEROSOL SIMULATION

- Sulfate-nitrate-ammonium (SNA)
  - Sulfate and nitrate on SS
- OC/BC: anthropogenic & BB (hydrophillic & hydrophobic)
  - SOA: biogenic (BVOC incl. isoprene)
  - SOA: anthropogenic (aromatic): when in standard code?
  - SOA: glyoxal uptake (in the pipeline v8-02-01)
  - SOA: ocean BVOC?
  - PBAP (not mature)
- Dust: 4 size bins
- Sea-salt: 2 size bins
- *Sectional Model*

What aspects or properties of atmospheric aerosols should be represented? Major interests, applications or problems to solve?

- Size distributions, composition, and mixing information for more robust online calculation of:
  - Total number and mass concentrations for health effect assessment
  - CCN and indirect radiative forcing
  - Optical depth and direct radiative forcing
  - Visibility and air quality
  - Deposition
  - Heterogeneous chemistry

PROBLEMS OR ISSUES

- Ammonium nitrate underestimates in the Western US → pathological? Related to thermodynamics? Resolution?
- Wet deposition parameterization: old/obsolete? (calculated as a fraction of the gridbox), also any need to revisit aging assumptions? "don't fix it if it's not broken?"
- SOA: ongoing
- Sulfate: do we have a real problem with too much SO_2 oxidation? Need to investigate oxidation pathways

ON-GOING ACTIVITIES

- Sectional models: complete development, implementation in standard code, exploration!
- CMU likely to work on SOA volatility basis set in GEOS-Chem in the future
- Caltech also thinking about organic aerosol schemes
- CSU continuing PBAP work
- Much on-going work using current SNA/carbonaceous scheme for AQ and climate → validation of schemes and emissions

PRIORITIES & PLANS

- IN THE PIPELINE
  - Glyoxal SOA (v8-02-01)
  - Aromatic SOA (soon)

- LOW PRIORITY
  - Clean up deposition code (size resolved dust/SS for all)
  - BC/OC emissions (new Bond)
  - 1 year benchmarks: observational datasets for aerosol benchmarking (IMPROVE, EMEP, TRACE-P, Dalhousie PM2.5, EPA supersites, AERONET?…)
  - Oceanic SOA precursors
  - Fungal spores OA (could be in the pipeline shortly)

PRIORITIES & PLANS

- HIGH PRIORITY
  - Size resolved model implementation (TOMAS & APM) seen as a priority for applications: heterogeneous chemistry, Br, CCN
    - CMU and Albany groups will finalize code, evaluate, clean up and speak with GEOS-Chem support team about implementation in standard code (target: next 6-12 months)
  - Aerosol optics
    - adjust size parameters , eg. Sulfate too wide, organics too small r_{eff} (Easan Drury)
    - BC density=1.8
    - adding coarse mode organics
    - Dust refractive index updates (Randall Martin)

    → dataset: Mie code at 10 nm intervals with above recommendations (+others?)
  - ISOROPIA II → pH/H_2O prediction for dust/SNA interactions, others
    - Need to engage Nenes in implementation

Two different sectional particle microphysics models will be available to the community.

1. TOMAS

2. APM

APM model plan:

1. Ready in the standard version (v8-02-01 or later version) for release in ~ 6-12 months
2. Types of aerosols considered:

   (1)Sulfate (plus uptaken nitrate, ammonium, SOAs): 40 bins
   (2)Sea salt (plus coated secondary species): 20 bins
   (3) Dust (plus coated secondary species): 15 bins
   (4) hydrophobic BC (plus coated secondary species): 20 bins
   (5) hydrophilic BC (plus coated secondary species): 20 bins
   (6) hydrophobic OC (plus coated secondary species): 20 bins
   (7) hydrophilic OC (plus coated secondary species): 20 bins

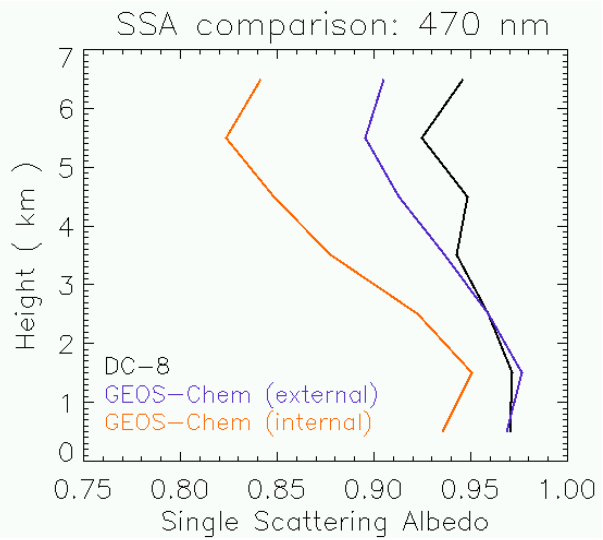
   Total number of tracers: 54 + 73 + 95 = 222, estimated computing cost – triple compared to original version (54 tracers).

   You can turn off the APM model and run the model as the original 54 tracers code with a simple switch.

   You can change the number of bins for each type of aerosols without much difficulty.

3. Will provide benchmark

ISSUES WITH OPTICS & AODs (Easan Drury)



- externally mixed aerosols more closely match measured SSAs than assuming all aerosol is internally mixed
- GADS size distrubutions are too wide (sig=2.0 or 2.2 instead of sig=1.6) (Drury comparisons with DC8 obs and Dubovik comparisons with AERONET)
  - AODs would be underestimated
  - Backscatter would be overestimated, with negative forcing overestimated (eg. By 20% for sulfate)