BREAKOUT SESSIONS II: OPTICAL PROPERTIES

22 people attended this session

BREAKOUT SESSIONS II: OPTICAL PROPERTIES

Sub-title of our Session: ***What is the present status of calculating aerosol optical properties including fn(RH) from size distributed composition and where should the effort be focused?***

Overarching target of the field of aerosol optical properties (as stated by Steve): To calculate from measured size distribution and composition, the optical properties i.e. extinction coefficient, single scattering albedo, phase function or asymmetric parameters, as a function of wavelength and as a function of RH.

Clearly these are MODELING issues but they cannot be separated from Measurements.

Section I <u>Modeling</u> **Section II <u>Measurements</u>.**

Our topic overlaps with the break out session on Organic Aerosols: Barbara Finlayeson Pitts' summary included points:

- If data are wrong models will be wrong.
- Photochemistry and chemistry are not in models
- Optical properties of SOA are needed.

Overlap with modeling session summary by Jerome Fast:

- Emission of OA from biomass burning.
- Hydroscopicity of OA
- Mixing state in models; how important is it?

Questions for process topical groups from Ashley and Steve:

1. What are the major uncertainties in understanding of aerosol optical properties related to climate forcing?

2. How is our current portfolio of ASP projects addressing these uncertainties? (Are there changes in direction DOE should consider?)

3. Who else (outside ASP) is addressing this problem?

4. Are there any areas where improved coordination within our ASP project portfolio (or with others) would be beneficial? Might explicitly address ARM activities here.

MODELING: With known and reasonable uncertainty from measured size distribution and composition of the aerosol, where are we relative to the target (as stated by Steve)

1. What important aspects of optical properties are currently left out of the models? What needs to be done next?
2. Are we data poor? Model poor? Related to section 1; are there measurement issues in the optics, in the size distribution, in composition?
3. What is the present status of calculating aerosol optical properties including f(RH) from size distributed composition? Where should effort be focused?
4. Related to models, what calculational accuracy is required to meaningfully predict optical properties from known (measured) size and composition?

To calculate from measured size distribution and composition, the optical properties i.e. extinction coefficient, single scattering albedo, phase function or asymmetric parameters, as a function of wavelength and as a function of RH.

MODELING: With known and reasonable uncertainty from measured size distribution and composition of the aerosol, where are we relative to the target (as stated by Steve)

NOT VERY FAR; TOO MUCH UNCERTAINTY IN KEY ASPECTS

1. What important aspects of optical properties are currently left out of the models? What needs to be done next?
2. Are we data poor? Model poor? Related to section 1; are there measurement issues in the optics, in the size distribution, in composition?
3. What is the present status of calculating aerosol optical properties including f(RH) from size distributed composition? Where should effort be focused?
4. Related to models, what calculational accuracy is required to meaningfully predict optical properties from known (measured) size and composition?

1. What important aspects of optical properties are currently left out of the models? What needs to be done next?

- f(RH) is parameterized in models, however its effect on optical properties appears not to have been constrained (no closure)
- Wavelength dependencies not adequately addressed.
  - -Specially in the UV (SOA)
- Morphological dependence not included as well as chemistry and cloud processing.
  - -Some of this due to lack of experimental data

2. Are we data poor? Model poor? Are there measurement issues in the optics, in the size distribution, in composition?

- More data poor than model poor. New data needed as will be discussed.
- Radiative modeling framework exists

BUT

- *In situ* closure is limited
- Sensitivity analysis of radiative models is needed

3. What is the present status of calculating aerosol optical properties including f(RH) from size distributed composition? Where should effort be focused?

- Radiative transfer calculation framework exists
- Field observation of size resolved composition are becoming available
- f(RH) dependencies

  -Done for sizes-growth factors

  -Possible for scattering

  -Missing for single particle composition

  -Missing for absorption

  -Missing for morphology
- Missing for angular dependence scatter
- Sampling misses big particles (>8 microns)

4. Related to models, what calculational accuracy is required to meaningfully predict optical properties from known (measured) size and composition?

- Need to perform meaningful sensitivity analysis
  - Enough field data exists to initiate this
  - Much more data is needed to reach closure

MEASUREMENTS: *Are the following known with adequate accuracy? At this point is more work needed in these areas?*

YES and specific gaps are identified.

1. Black Carbon (BC): Specific absorption (SA) and Single scattering albedo (SSA). Effect of coatings, morphology and RH.
2. Organic Carbon (OC including SOA HULIS) and BC from biomass burning; Optical properties as a function of RH.
3. Inter-comparison of instruments measuring optical properties (absorption and scattering).
4. Effect of aging (atmospheric processing) on optical properties of (BC, POA and SOA).
5. Dependence of optical properties on SOA composition.
6. Effect on optical properties of aerosol (internal) mixing state.
7. Instruments and techniques needed to measure scattering angle

Path Forward

- Plan laboratory experiments on RH, morphological and coating dependencies of optical properties of carbonaceous aerosols (soot, biomass burn, SOAs).

- Several ASP groups are planning such studies.

- Closer coordination amongst modeling, laboratory and field groups is essential
  - e.g. We have enough field and laboratory data to begin sensitivity studies and attempt preliminary optical closure calculations (f(RH), size resolved composition)