Evolution of the Mixing States of Aerosols Campaign (EMSAC)

Carl Berkowitz (PI), Will Shaw, Larry Berg, Dan Cziczo,
Jerome Fast, Connor Flynn*, Mikhail Ovtchinnikov, Beat Schmid,
Rahul Zaveri, Alla Zelenyuk
Pacific Northwest National Laboratory, Richland, WA

*presenter

Rich Ferrare, Chris Hostetler
NASA Langley Research Center, VA

Phil Russell
NASA Ames Research Center

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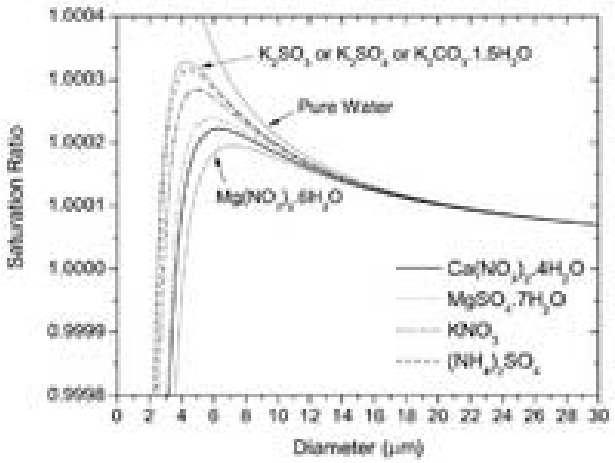
How valid are the mixing assumptions in models?

- Are particles externally mixed (e.g. global models) or internally mixed (e.g., detailed process models). When? Where?

- The mixing state of particles affects their optical and activation properties through
  - Complex refractive index = f(composition)
  - Critical supersaturation = f(composition)

- There is a large element of uncertainty in the descriptions of the mixing state of particles
  - Paucity of observations
  - Complexity of added emissions



Kohler curves showing range in SS for various compositions.

From Kelly, Chuang, and Wexler. 2006. "Influence of dust composition on cloud droplet formation." Atmospheric Environment 41(14): 2904-2916, doi:10.1016/j.atmosenv.2006.12.008

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Proposed Campaign

- Overview:
  - "…summertime field campaign in 2011 to investigate the evolution of the mixing state of aerosols and the consequences of this evolution on the direct and indirect effects of aerosols off the east coast of the continental U.S."
- Goal:
  - "to provide key measurements of aerosol composition, size and optical properties (both local and columnar) needed to evaluate existing models and to aid in the development of new models suited to study both direct and indirect effects of aerosols on climate."

The COVE site (from http://cove.larc.nasa.gov). Aircraft would sample east from Langley, VA.

Why East Coast?

- Key Advantage: relatively simple emissions encountered once a parcel of air moves away from land and over the ocean.

- Much useful information about mixing state of particles emanating from Mexico City:
  - much of this work had to take into account the addition of emissions encountered by these particles as they were transported to the downwind measuring sites
  - emissions along transport pathways complicated analysis of the composition and other physical properties of the particles being studied.

- Many past campaigns on east coast (e.g., NEAQS, TARFOX)
  - We know something about this area but
  - We propose to carry out model evaluations **on particle mixing states and radiative state of atmosphere**

What's New?

- Unique measurements to address mixing state/radiative properties including:
  - observations of optical depth (including slab-AOD) with *in situ* aerosol characterization to measure mixing states, all from a single platform
  - profile and columnar observations of key aerosol properties and an extensive set of surface based measurements at the CERES site.
- Also
  - measurements focused over a more limited geographical area so as to develop a set of key measurements within a common region.
  - Would contrast observations within marine boundary layer/CERES and aloft/aircraft.

Key Platforms

- **G-1 aircraft:** instrumentation to provide
  - aerosol mixing state (SPLAT II) – *Alla Zelenyuk*
  - column and layer measurements of aerosol properties of optical depth, single scattering albedo, and size distribution (4STAR) – *Beat Schmid and Connor Flynn*
  - CCN spectrum, 3-λ scattering, absorption, aerosol and droplet size spectra.

- **NASA aircraft:** instrumentation to provide (*Chris Hostetler and Rich Ferrare)*
  - aerosol backscatter, extinction (High Spectral Resolution LIDAR)
  - aerosol effective radius, surface and volume concentrations, refractive index, single scattering albedo (the Research Scanning Polarimeter).

- **The CERES Ocean Validation Experiment (COVE)** site at Chesapeake Lighthouse, located in the Atlantic Ocean, 25 km east of Virginia Beach.

For more information:

- see ASP Webpage:

  http://www.asp.bnl.gov/prospective_field_projects

- "EMSAC_ConceptPaperBerkowitz.pdf"

- Contact:
  - Carl.Berkowitz@pnl.gov, (509) 372-6183
  - Will.Shaw@pnl.gov , (509) 372-6140
  - Chris.A.Hostetler@nasa.gov, (757) 864-5373)

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