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004 EPA STAR Graduate Fellowship Conference *Next Generation Scientists—Next Opportunities*

Cloud Condensation Nuclei (CCN) Properties of Ambient Aerosol

Environmental Issues

louds and Climate Change

- The Earth's climate is the result of a delicate balance between incoming and outgoing radiation.
- Small changes in the Earth's cloudiness can lead to changes in the overall energy balance on the globe, which can affect climate.

erosols, Clouds, and the Indirect Effect

- Clouds form by water condensing on small particles suspended in the air (aerosols). Particles upon which cloud droplets form are called cloud condensation nuclei (CCN).
- Human emissions are increasing levels of aerosols in the atmosphere. The extent and mechanism of this impact are some of the key problems in the science of climate.
- Aerosol particles alter cloud properties and, therefore, have an indirect radiative forcing on climate.

*Images from terra.nasa.gov

w particle number centration = fewer, larger lets formed
re visible radiation reaches Earth's surface.
wer cloud albedo (reflectivity)

- High particle number concentration = more, smaller droplets formed
- More visible radiation reflected back to space
- Higher cloud albedo (reflectivity); cools Earth's surface

Scientific Approach

• Instrument Development

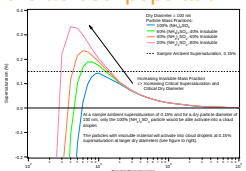
- Designed and built one-column and three-column CCN counters (CCNCs), based on previous Caltech CCNCs

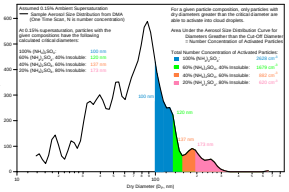
•Field Campaigns

- Field campaigns allow the integration of data from many different instruments at the same time.
- Large CCN data sets are obtained during field missions by deploying a CCNC on an airplane and sampling at various locations and altitudes.

• Aerosol/CCN Closure Studies

- Compares CCN concentration observed by the CCNC to that predicted from the aerosol size distribution measured by a Differential Mobility Analyzer (DMA).
- Can be complicated by chemistry and other properties of the aerosol population.



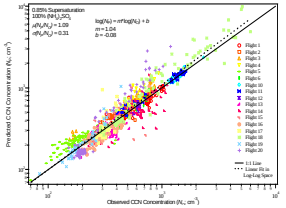


•Theoretical Development

- Modify existing CCN activity theory to include more complicated parameters, such as chemical effects, that are discovered to be important in the activation process from field campaign data analysis.

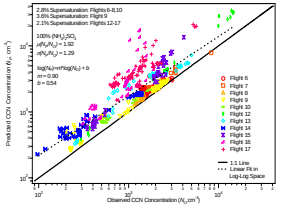
Aerosol/CCN Closures

• CRYSTAL-FACE (July 2002)



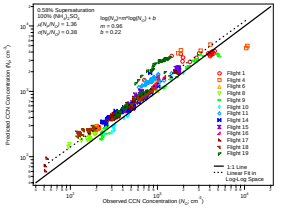
- Key West, FL: Marine Conditions
- Closure was successful, probably due to simple chemistry, mostly $(NH_4)_2SO_4$, of ambient particles.
- Important activation properties in theory: aerosol size distribution
- *VanReken et al. (2004)*

•ARM Aerosol IOP (May 2003)



- Lamont, OK: Continental Conditions
- Closure complicated by continental character of ambient aerosol – increased insoluble material, possibly organic, and external mixing
- Important activation properties in theory: insoluble material and mixing state of the aerosol population

•CSTRIPE (July 2003)



- Marina, CA: Marine and Continental Conditions
- Closure line shifted due to mixed (marine and continental) character of sampled aerosol populations
- Important activation properties in theory: insoluble material and mixing state of the aerosol population

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