BNL-94802-2011-AB

ENHANCED DETECTION OF 1 NM CONDENSATION NUCLEI USING DIETHYLENE GLYCOL AND BUTANOL CONDENSATION PARTICLE COUNTERS

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For presentation at
The Second Science Team Meeting of the
Atmospheric System Research (ASR) Program,
San Antonio, TX
March 28-April 1, 2011

Environmental Sciences Department/Atmospheric Sciences Division
Brookhaven National Laboratory

U.S. Department of Energy
Office of Science

ABSTRACT

Atmospheric aerosols influence climate and climate change on local to global scales by affecting the atmospheric radiation balance directly through scattering and absorbing incoming solar radiation and indirectly as cloud condensation nuclei. New particle formation (NPF) by photochemical reactions of gas-phase precursors greatly increases the number concentrations of atmospheric aerosols, and therefore their impact on climate. Although methods for measuring sizes and concentrations of newly formed particles of diameter greater than 3 nm are well established [*Stolzenburg and McMurry*, 1991], measurements of nanoparticles and neutral molecular clusters smaller than this are needed to constrain nucleation rates and to better understand nucleation mechanisms. A diethylene glycol-based ultrafine condensation particle counter (DEG-UCPC) has recently been developed for sub-2 nm detection, enabling the measurement of laboratory generated aerosol standards with a detection efficiency of 2% at 1.19 nm [*Iida et al.*, 2008; *Jiang et al.*, 2010]. By increasing the flow rate and operating temperature difference in the DEG-UCPC, this detection efficiency has been increased to over 20% at the same particle size. Similar operating modifications to a commercial butanol-based CPC (TSI 3025A) have increased the detection efficiency of 1.68 nm particles from less than 1% to over 35%. Laboratory characterization of CPC detection efficiency as a function of particle size, charge, and composition will be presented for both instruments. Based on these results, a viable solution for long-term sub-2 nm aerosol measurement through modification of existing instrumentation will also be presented.

References

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