BNL-67284-AB

AIRCRAFT MEASUREMENTS OF PARTICLE SIZE DISTRIBUTIONS OVER THE 4-50,000 NM SIZE RANGE DURING THE NORTHEAST OXIDANT AND PARTICULATE STUDY

F. J. Brechtel, L. J. Nunnermacker, and S. R. Springston
Atmospheric Sciences Division, Environmental Sciences Department, Brookhaven National Laboratory, Upton, NY 11973-5000

March 2000

Annual Meeting of the American Association for Aerosol Research, St. Louis, MO, Nov. 6-10, 2000.

Ambient aerosol size distributions were measured during twenty research flights over Philadelphia using a new twin scanning electrical mobility spectrometer (TSEMS) system and two Particle Measurement Systems (PMS) optical particle counters. The TSEMS system measured dry size distributions over the 4-to-800 nm size range every 60 seconds using one nano-differential mobility analyzer (DMA) and one long-DMA, each with a TSI Model 3010 condensation particle counter (CPC). The temperature difference between the saturator and condenser of the CPC operated with the nano-DMA was increased to improve the CPC detection efficiency. Size distributions between 100 and 50,000 nm were measured at close to ambient relative humidity conditions once per second using PMS PCASP-100 and FSSP-100 probes located under the nose of the aircraft.

Results obtained during July and August of 1999 indicate that urban-influenced conditions were associated with total number concentrations of particles larger than 4 nm between 100,000 and 10,000,000 per cubic cm within one kilometer of the surface. The sub-2.5 micron total particle volume during these conditions varied between 5 and 30 microns cubed per cubic cm. Particles smaller than one-half micron typically comprised between 80 and 95% of the total sub-2.5 micron volume. Three distinct modes were often observed in the number size distributions. The smallest mode was observed less often and exhibited a geometric mean diameter smaller than 10 nm. An intermediate mode was observed between 10 and 30 nm, and a third mode at 100 nm. Evidence for recent new particle formation was found, as indicated by increased concentrations of particles in the 4-to-10 nm size range. Results from urban-influenced and background regional conditions will be compared to assess the impact of localized urban sources on ambient particulate loading. Periods corresponding to high concentrations of sub-10 nm particles will be investigated to determine whether the conditions for recent new particle formation can be elucidated.

Research by BNL investigators was performed under the auspices of the U.S. Department of Energy under Contract No. DE-AC02-98CH10886.