OASIS measurements of Aerosol Size Distributions

Conducted by:
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1. **Description of measurement.**

The NCAR "Particle Size Distribution" (PSD) instrument consists of three instruments that measure the size distribution of the ambient aerosol from 3 nm to 2 microns. A photo of the system is provided below. General specifications for the instrument DURING OASIS are as follows:

Size range: ~3.85 nm to 2 micron
Number of diameter bins: 75
Time resolution: 5 min

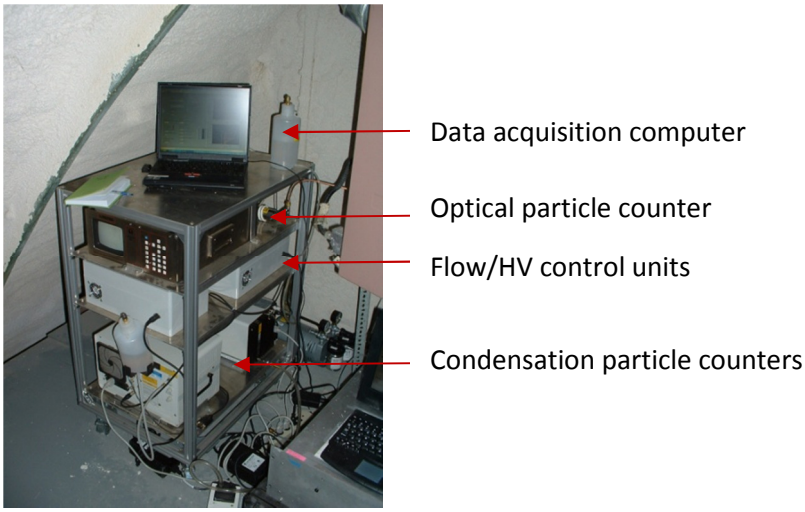

Figure 1: photograph of PSD instrument showing major components. DMAs are located on other side of rack.

Details of the instrument are as follows:

Nanometer Scanning Mobility Particle Sizer (Nano-SMPS): This employs a home-built bipolar neutralizer, a TSI model 3085 Differential Mobility Analyzer and a home-built high voltage and flow control system. An Ultrafine Condensation Particle Counter (UCPC, TSI model 3025a) is used to count size-selected particles. Size range is from ~3.85 nm to ~30 nm.

Standard Scanning Mobility Particle Sizer (SMPS): This is identical to the Nano-SMPS with the exception of using a "Long DMA," (TSI model 3081) and a standard CPC (TSI model 7620, modified to run at 1.2 lpm aerosol flow rate). Size range is from ~22 nm to ~225 nm.

Optical Particle Counter (OPC): The OPC is a Lasair model 1002 (PMS, Inc). Size range is 0.1 to 2 microns.

Sampling: Particles were sampled through a 320 cm long x 1.2 cm diameter Cu tube (see Figure 2 for an outside view of this sampling line). Particles were drawn into the sample line with an approximately laminar transport flow of 9.8 m s^{-1} (Re = 2500). Particle diffusion losses are calculated to be nominal over the size range for this study, but are also corrected in the analysis.

Figure 2: Outside view of sample line, which is shaped into a "gooseneck" at the top to reduce intrusion by blowing snow.

2. Data Analysis

Size distributions are represented by the "size distribution function," dN/dlogDp (ref: Seinfeld and Pandis, 1st Edition, Section 7.1), and are corrected for multiple charging, transmission efficiency, DMA transfer function, and particle counter sensitivity according to typical SMPS inversion procedures. Diameters were binned into 75 logarithmically-spaced bins from 3.85 to 1050 nm. During much of the campaign the OPC malfunctioned. During these periods we used 0.2 – 1 micron size distributions provided by the size distribution system built by the Leibnitz Inst. for Tropospheric Research for the CMDL site located nearby (http://www.esrl.noaa.gov/gmd/obop/brw/). In all cases when we compared our data in this 0.2 to 1 micron size range to the CMDL distributions the data agreed to within 10%, which is logical since particles in that size range don't vary along the spatial scales that separate the CMDL station from BASC. Thus we feel that the use of this data in this size range is justified.

The SMPS data are the average of the upward and downward scan of the voltage to the DMA, each of which took approximately 2.5 min for a total sample time of 5 min. We averaged the dN/dlogDp values for the diameter bins in which the nano-SMPS and SMPS instruments overlapped.

3. Data description

BRW_aerosol_size_distr.csv:
Column 1 contains the fractional day of year: The local time for the start of data acquisition, in units of fractional day of 2009 (e.g., 1 Jan 2009 at 00:00 equals “0”).

Row 1 contains the diameter (in nm) for the center of the diameter bin. There are 76 diameter bins.

Each column below Row 1 contains dNdlogDp1: the matrix of the particle size distribution, dN/dlogDp (in cm^{-3}) for each diameter bin and time.

BRW_aerosol_concentrations.csv:
Fractional day of year: The local time for the start of data acquisition, in units of fractional day of 2009 (e.g., 1 Jan 2009 at 00:00 equals “0”)

Total number concentration: the calculated total number concentration, calculated by taking the integral of the number distribution (units: cm^{-3}).

Total surface area concentration: the total aerosol surface area concentration, calculated by the number distribution and assuming particles have spherical symmetry (units: μm^2 cm^{-3}).

Total volume concentration: the total aerosol volume concentration, calculated by the number distribution and assuming particles have spherical symmetry (units: μm^3 cm^{-3}).

Fuchs surface area: $s_F = \pi(d/d_0)^{x(d)}$, where d_0 = 1 µm and *x(d)* varies between 1 and 2. The Fuchs surface represents the total particle surface area a diffusing molecule "sees"; for more details see Pandis S.N., Baltensperger U., Wolfenbarger J.K. and Seinfeld J.H.: 1991, J. Aerosol Sci. 22 417. (units: μm^3 cm^{-3})