Geophysical Research Abstracts
Vol. 16, EGU2014-16644, 2014
EGU General Assembly 2014

Optical closure study on light-absorbing aerosols

Andreas Petzold (1), Ulrich Bundke (1), Andrew Freedman (2), Timothy B. Onasch (2), Paola Massoli (2), Elizabeth Andrews (3), and Anna G. Hallar (4)

(1) Forschungszentrum Jülich, Institute of Energy and Climate Research 8: Troposphere, Germany, (2) Aerodyne Research, Inc., Billerica, MA 01821-3976, USA, (3) NOAA/ESRL Global Monitoring Division, Boulder, CO 80305, USA, (4) Storm Peak Laboratory, Division of Atmospheric Sciences, DRI, Steamboat Springs, CO 80488, USA

The in situ measurement of atmospheric aerosol optical properties is an important component of quantifying climate change. In particular, the in-situ measurement of the aerosol single-scattering albedo (SSA), which is the ratio of aerosol scattering to aerosol extinction, is identified as a key challenge in atmospheric sciences and climate change research. Ideally, the complete set of aerosol optical properties is measured through optical closure studies which simultaneous measure aerosol extinction, scattering and absorption coefficients. The recent development of new optical instruments have made real-time in situ optical closure studies attainable, however, many of these instruments are state-of-the-art but not practical for routine monitoring.

In our studies we deployed a suit of well-established and recently developed instruments including the cavity attenuated phase shift (CAPS) method for aerosol light extinction, multi-angle absorption photometer (MAAP) and particle soot absorption photometer (PSAP) for aerosol light absorption, and an integrating nephelometer (NEPH) for aerosol light scattering measurements. From these directly measured optical properties we calculated light absorption from extinction minus scattering (difference method), light extinction from scattering plus absorption, and aerosol single-scattering albedo from combinations CAPS + MAAP, NEPH + PSAP, NEPH + MAAP, CAPS + NEPH. Closure studies were conducted for laboratory-generated aerosols composed of various mixtures of black carbon (Regal 400R pigment black, Cabot Corp.) and ammonium sulphate, urban aerosol (Billerica, MA), and background aerosol (Storm Peak Lab.).

Key questions addressed in our closure studies are: (1) how well can we measure aerosol light absorption by various methods, and (2) how well can we measure the aerosol single-scattering albedo by various instrument combinations? In particular we investigated (3) whether the combination of a CAPS and NEPH provides a reasonable approach for determining aerosol absorption using the difference method, and (4) whether this comparison provides any indication that the PSAP and/or MAAP measurements of absorption have artifacts by organic condensation as suggested in the literature.

The results presented here contribute to the ongoing efforts of assessing measurement methods suitable for the monitoring of aerosol optical properties.