Evaluation of Methods for Measuring Carbonaceous Aerosol in Rainwater

Alexander Torres*, Tami Bond, and Christopher Lehmann
University of Illinois at Urbana-Champaign

Fuel combustion and other activities produce organic carbon (OC) and black carbon (BC) aerosols that are transported in the atmosphere and have adverse effects on visibility, climate change, and human health. Wet deposition is the main removal mechanism of carbon aerosols; hence, it dictates the atmospheric cycle and the lifetime, and the extent of the undesirable impacts. The study of wet removal of organic carbon and black carbon aerosols has been very limited. Challenges in this endeavor include the lack of a widely accepted method for their measurement, low levels of BC, and the susceptibility the samples to OC contamination and degradation. The goal of this research is to develop a sound analytical procedure to measure OC and BC in rain that can be incorporated into the NADP Monitoring. Different analytical techniques were tested to measure BC in precipitation, including: Thermal/Optical Analysis, Single Particle Soot Photometer (SP2), and UV/VIS Spectrophotometer. Water soluble OC was measured by Total Organic Carbon (TOC) Analysis and water insoluble OC was measured by Thermal/Optical Analysis. The evaluation was performed using laboratory standard solutions made by burning pine wood and aging with ozone, and rain samples collected by the National Atmospheric Deposition Program at Bondville (Champaign County), Illinois. Results indicated that filtration followed by thermal/optical analysis is only efficient (~90%) when a coagulant aid is added to the sample to increases particulate size and the collection efficiency of the quartz fiber filters. The UV/VIS spectrophotometer has proved to respond linearly at 550 nm-wavelength to BC particles in water; nevertheless, further evaluation of the interference of non BC particles is required. The SP2 analysis showed good reproducibility and sensitivity, despite its inherent losses (~33%) during the sample nebulizing. TOC Analysis is able to measure more than 95% of the total carbon (OC and BC).

*Corresponding author: (787) 515-7225; 337 Paddock DR W, Savoy IL 61874; torresn1@illinois.edu