Collection and Characterization of Organic Matter in NADP Wet and Dry Deposition

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Organic matter in the atmosphere significantly affects visibility, human respiratory health, and climate change. Dissolved organic matter (DOM) is predominantly organic carbon and, among other functions, supplies energy to support the food web. Recent findings suggest that atmospheric deposition influences the quality of DOM in alpine lakes on a global scale. Here, we evaluate the quantity and quality of DOM in wet and dry deposition and of total particulate matter (PM) in dry deposition at the Niwot Ridge Long Term Ecological Research Station (Colorado, USA), and nearby alpine and subalpine ecosystems. Atmospheric wet deposition collectors located at NADP CO02 (3520 m a.s.l.), CO90 (3022 m a.s.l.), and CO94 (2524 m a.s.l.) were analyzed, as were wet and dry collectors at the Soddie site (3345 m a.s.l.).

Wet deposition was found to be a seasonally variable source of dissolved organic carbon (DOC), depositing on average 6 kg C/ha/yr or roughly 1500 kg C to the Green Lake 4 watershed at Niwot Ridge. This wet deposition of DOC was equivalent to over 80% of the carbon yield from the watershed. For dry deposition, which is often subject to sample loss in windy alpine environments, we developed a new marble insert procedure. In tests with known dust loading, we found that PM recovery was comparable to controls with no insert. Current efforts are aimed at quantifying the total PM deposition and its organic fraction. Thus far, our measurements of PM loading in dry deposition from collectors with inserts have shown that PM loading is highly variable, ranging from 100 to >230 g/ha/d in June and July, 2011. Estimates of particle numbers (> 4 μm) using a FlowCAM echoed this variability, showing that 104 to 105 particles/d were found in summer dry and wet deposition, and identified large numbers of pollen and other bioaerosols. Characterization of DOM in wet and dry deposition by fluorescence and absorbance spectroscopy showed that DOM chemical character and optical properties varied widely. In summer months, high concentrations of amino acid-like fluorescence suggest the deposition of bioaerosols and more biologically labile organic compounds. High spectral slope ratios (>2) further suggest that DOM in atmospheric deposition undergoes intense photobleaching, which may enhance bioavailability.

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