

Light extinction by fine atmospheric particles in the White Mountains region of New Hampshire and its relationship to air mass transport

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Chemical, optical, and physical measurements of fine aerosols (aerodynamic diameter $\leq 2.5 \mu\text{m}$) have been performed at a mountaintop location adjacent to the White Mountain National Forest in northern NH, USA. A 1-month long sampling campaign was conducted at Cranmore Mountain during spring 2000. We report on the apportionment of light extinction by fine aerosols into its major chemical components, and relationships between variations in aerosol parameters and changes in air mass origin. Filter-based, 24-h integrated samples were collected and analyzed for major inorganic ions, as well as organic (OC), elemental (EC), and total carbon. Light scattering and light absorption coefficients were measured at 5-min intervals using an integrating nephelometer and a light absorption photometer. Fine particle number density was measured with a condensation particle counter. Air mass origins and transport patterns were investigated through the use of 3-day backward trajectories and a synoptic climate classification system. Two distinct transport regimes were observed: (1) flow from the north/northeast (N/NE) occurred during 9 out of 18 sample-days; and (2) flow from the west/southwest (W/SW) occurred 8 out of 18 sample-days. All measured and derived aerosol and meteorological parameters were separated into two categories based on these different flow scenarios. During W/SW flow, higher values of aerosol chemical concentration, absorption and scattering coefficients, number density, and haziness were observed compared to N/NE flow. The highest level of haziness was associated with the climate classification Frontal Atlantic Return, which brought polluted air into the region from the mid-Atlantic corridor. Fine particle mass scattering efficiencies of $(\text{NH}_4)_2\text{SO}_4$ and OC were $5.35 \pm 0.42 \text{ m}^2 \text{ g}^{-1}$ and $1.56 \pm 0.40 \text{ m}^2 \text{ g}^{-1}$, respectively, when transport was out of the N/NE. When transport was from the W/SW the values were $4.94 \pm 0.68 \text{ m}^2 \text{ g}^{-1}$ for $(\text{NH}_4)_2\text{SO}_4$ and $2.18 \pm 0.91 \text{ m}^2 \text{ g}^{-1}$ for OC. EC mass absorption efficiency when transport was from the N/NE was $9.66 \pm 1.06 \text{ m}^2 \text{ g}^{-1}$ and $10.80 \pm 1.76 \text{ m}^2 \text{ g}^{-1}$ when transport was from the W/SW. Results from this work can be used to predict visual air quality in the White Mountain National Forest based on a forecasted synoptic climate classification and its associated visibility.