Contributions of brown carbon and lensing effect to aerosol light absorption in the Nagoya urban area, Japan, during summer and winter

T. NAKAYAMA[1,*], Y. IKEDA[1], Y. SAWADA[1], Y. SETOGUCHI[2], S. OGAWA[2], K. KAWANA[2], M. MOCHIDA[2], AND Y. MATSUMI[1]

[1]Solar-Terrestrial Environment Laboratory and Graduate School of Science, Nagoya University, Nagoya 464-8601, Japan (*correspondance: nakayama@stelab.nagoya-u.ac.jp
[2]Graduate School of Environmental Studies, Nagoya University, Nagoya 464-8601, Japan

Observation

Observations were conducted during summer (August, 2011) and winter (January, 2012) in the Nagoya urban area, Japan. Absorption and scattering coefficients at 405 and 781 nm of PM1 particles were measured using the photoacoustic soot photometer (DMT, PASS-3), after passing through bypass line or one of the thermo-denuders (TD) maitained at 100 and 300°C (summer) or 300 and 400°C (winter).

Results and discussion

Passage through a TD maintained at 300 or 400°C resulted in evaporation of more than 70vol% of aerosol particles, which changed the optical properties. Comparison of absorption coefficients at 781 nm between aerosols that did and did not pass through the TD showed that an increase in black carbon (BC) light absorption due to the coating of non-refractory materials, that is lensing effect, was small (10%) during summer and negligible during winter. This result can be explained partly by assuming that a large portion of non-refractory materials were mixed externally with BC.

The fractions of light absorption by OM evaporated below 300(400)°C to total light absorption at 405 nm was negligible during the summer, but averaged 11(17)% during the winter. The backward trajectories suggest that the air masses mainly came from the southeast during the summer, but from the northwest during the winter. During the winter, combustion of biofuel such as wood was used for heating throughout northern China and Siberia. Although the use of biofuel is small in Japan, open burning of agricultural residue mainly in areas north of the observation site also may contribute to the OM observed in Nagoya. Therefore, the larger contribution of light-absorbing OM during the winter is likely due to the greater contribution of OM originating from biomass burning, including biofuel and agricultural residue burning, emitted in Japan, northern China, or Siberia, during the winter.