Intensive field campaign at Mangshan near Beijing in autumn 2007: Overview and intercomparison of black carbon measurements

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We performed an intensive field campaign in Mangshan National Park (40^{o}15'N, 116^{o}17'E, 170m asl), located 40 km north of the city center of Beijing, China, in September/October 2007. During the campaign, we made (1) BC measurements using MAAP (multi-angle absorption photometer) and PSAP (particle soot absorption photometer), (2) continuous measurements of nitrate, sulfate, ammonium, and organics/aerosol using an AMS (aerosol mass spectrometer produced by Aerodyne), (3) chemical analysis (ECOC, water-soluble ions, metals) of aerosol particles collected on quartz filters using mini- and high-volume PM2.5 samplers, (4) molecular-specific organic aerosol analysis based on a TSP high-volume sampler, (5) determination of size distribution of aerosol particles using an optical particle counter, (6) measurements of optical properties (scattering and extinction coefficients) using an integrating nephelometer and MAX-DOAS. For gaseous species, we made O3 and CO monitoring, measurements of NO2 etc. by MAX-DOAS, and VOC measurements employing canister samplings.

During the campaign period, we observed polluted air masses (September 9-13, 15-17, 21-26, 29-October 1, 3-4) and unpolluted air masses (September 18-20, 26-28) alternately. The maximum hourly values reached 6.7 ug m^{-3} for EC(IMPROVE), 3.5 ppmv for CO, and 1.4x10^{-3} m^{-1} for scattering coefficient measured by nephelometer. Scattering coefficients were reconstructed in an empirical manner by summing the contributions from various chemical species, which were calculated by multiplying observed mass concentrations of each species with empirical mass scattering coefficient and humidity growth factor. The reconstructed coefficients were compared to the values directly measured by an integrating nephelometer.

In the black carbon comparison, we found MAAP recorded the highest values, next PSAP, and EC(IMPROVE) showed the lowest values. This order was similar to that found for Mount Tai in June 2006. However, the BC(MAAP)/EC(IMPROVE) ratio was higher for Mangshan (around 2). The reasons for the difference between BC and EC were studied using data sets for the two locations, including the possibilities (1) that optical instruments overestimated BC because of the increase in mass absorption cross section by lens effect induced by transparent material that coated BC and (2) that the thermal technique underestimated EC values.