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Influence of semi-volatile aerosol on physical and optical properties of aerosol in Kathmandu valley

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A field study was conducted in the urban atmosphere of Kathmandu valley to study the influence of the semi-volatile aerosol fraction on physical and optical properties of aerosols. The study was carried out during the 2015 pre-monsoon period. Experimental setup consisted of air from an ambient air inlet being split to two sets of identical sampling instruments. The first instrument received the ambient sample directly, while the second instrument received the air sample through a thermodenuder (TDD). Four sets of experiments were conducted to understand aerosol number, size distribution, scattering and absorption properties using Condensation Particle Counter (CPC), Scanning Mobility Particle Sizer (SMPS), Aethalometer (AE33) and Nephelometer. The influence of semi-volatile aerosols was calculated from the fraction of particles evaporated in the TDD at set temparetures: room temperature, 50°C, 100°C, 150°C, 200°C, 250°C and 300°C. Results show that, with increasing temperature, the evaporated fraction of semi-volatile aerosol also increased. At room temperature the fraction of semi-volatile aerosols was 12% while at 300°C it was as high as to 49%. Aerosol size distribution analysis shows that with an increase in TDD temperature from 50°C to 300°C, peak mobility diameter of particles shifted from around 60nm to 40nm. However we found little change in effective diameter of aerosol size distribution with increase in set TDD temperature. The change in size of aerosols due to loss of semi-volatile component has a stronger influence (∼70%) in higher size bins when compared to at lower size bins (∼20%). Studies using the AE33 showed that absorption by black carbon (BC) is amplified due to influence of semi-volatile aerosols by upto 37% at 880nm wavelength. Similarly nephelometer measurements showed that upto 71% of total scattering was found to be contributed by semi-volatile aerosol fraction. The scattering Angstrom Exponent (SAE) of semi-volatile aerosol fraction was found to be more sensitive at lower temperatures (<100°C) than at higher temperatures. However Absorption Angstrom Exponent (AAE) of semi-volatile aerosol fraction did not show any significant temperature dependence. Finally our study results show that the semi-volatile fraction of aerosols contributes 40 to 80% of the physical and optical properties of ambient aerosol over Kathmandu valley.