Black Carbon Aerosols: Radiative Forcing and Climate Impact

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Black carbon (BC), among the carbonaceous aerosols, is gaining considerable significance because of its ability to influence air quality and climate on local, regional and global scales. Black carbon aerosols are produced as primary particles from incomplete combustion processes such as fossil fuel and biomass burning, and hence most of the BC in the atmosphere originates from man-made activities. The radiative and climate impacts of BC are increasingly recognized as BC can absorb sunlight, heat the air and contribute to global warming, unlike the other aerosol types (e.g., sulfate) which produce cooling. Both absorbing (BC) and scattering (sulfate) aerosols cool the surface by reducing the incoming solar radiation and cause solar dimming. The solar dimming is a global phenomenon even though the aerosol sources are local, due to diverse geographic locations of aerosol sources, abundances of aerosols, their continuous emissions, and long-range transport. The sulfate aerosols are hygroscopic and perfect scatterers in the shortwave, while in the longwave sulfate aerosols act as absorbers. BC is hydrophobic and is the largest absorber of the radiation in the atmosphere both in shortwave and longwave. The presentation will focus on the monthly mean variations in aerosol physical and optical properties over an urban region, and the resultant radiative effects with an emphasis on the black carbon aerosol owing to its crucial role in regional and global climate impacts. The climate implications in terms of the heating rates (K/day) for different scenarios of BC mass concentrations and zero BC conditions will be presented and discussed.