Modeling of Optical Characteristics of Urban Aerosols: External and Internal Mixing

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Atmospheric aerosols can influence the incoming solar radiation and outgoing terrestrial radiation and thus affect the earth-atmosphere radiation budget. Aerosols are the largest source of uncertainty in models for the prediction of climate change [1]. Most of the radiative transfer models treat external mixture of aerosols with the assumption that there is no physical or chemical interaction among the different aerosol species. Generally, aerosol radiative forcing estimated by assuming external mixture of aerosols provide the lower bound (more cooling) while homogeneous internal mixing provide the upper bound of forcing [2]. However, the third type of mixing, core-shell mixing, results the forcing value in between the value of external and internal mixing [2]. Model results for mixing of elemental carbon shows that the forcing by core-shell mixing state is 50% higher than external mixing and 40% lower than homogeneous internally mixed aerosols [3]. Thus the assumption of mixing state of aerosols provides uncertainty in model estimation of aerosol radiative forcing. The present study will address the differences in the aerosol optical characteristics with the change in mixing state of different aerosol species during different seasons over an urban location Ahmedabad (23.03^{o}N, 72.55^{o}E, 55m amsl). In the present work, aerosol optical properties such as aerosol optical depth and single scattering albedo are simulated by assuming different mixing states (external, homogeneous internal, and core-shell mixing) of different aerosol species for urban environment. For external mixing, aerosol optical properties are estimated by the theory of Mie scattering of spherical particles using Optical Properties of Aerosols and Clouds (OPAC) model [4]. The optical properties of homogeneous internally mixed aerosols are estimated by Maxwell-Garnett mixing rule. Different types of mixing scenarios are used to estimate the optical properties of aerosols over Ahmedabad during different seasons and aerosol radiative forcing are estimated by radiative transfer model. Detailed results on optical features of aerosols for different mixing states and radiative forcing will be presented and discussed.

References

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