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Assessment of regional radiative implications of aerosols over South Asia

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Quantitative assessment of aerosol radiation interaction (direct) over south Asia with the Indian sub continent in focus, has been carried out, using a synergy of data from a dense network of ground based observatories and chemical transport model simulations. Direct radiative effects (DRE) of the composite aerosols as well as the constituent species were estimated for each season, and the effects of radiative coupling between scattering and absorbing species have been delineated and quantified for an external mixture. Sensitivity of the coupling to the composite aerosol loading, change in composition, and surface reflectance are examined using radiative transfer model simulations.

The composite aerosols over the Indian region has a strong seasonality in its composition and spatial distribution; with a strong anthropogenic BC dominance (with more than 50% contribution to the atmospheric forcing) during winter over the central and northern Indian plains, changing over to natural aerosol dominance with more than 50% contribution coming from dust in spring. Assessment of aerosol induced diabatic heating of aerosols, estimated for the entire region following the above considerations for different seasons, showed values as high as $\sim$1 K day-1 over eastern India during spring time. The radiative forcing at the top of the atmosphere due to BC and organic carbon is comparable in magnitude with opposite sign. Hence carbonaceous aerosols have negligible effect on the radiation balance at the top of the atmosphere over the Indian region. The systematic gradients in aerosol loading and radiative forcing across the latitude over the Indian region revealed the importance aerosol warming on regional climate and monsoon during spring and winter.