Regional Aerosol Characterization over Eastern Peninsular India: Known and Unknown

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Intensive efforts towards a comprehensive characterization of atmospheric aerosols over eastern India led to the understanding of certain processes that determine the optical state of the atmospheric with respect to the physical properties of the atmospheric aerosols. Extensive measurements were made for the past one decade over certain locations in the region on the aerosol spectral optical depths, near surface aerosol mass size distributions, number density size distribution, surface BC mass concentration, aerosol scattering coefficient and aerosol vertical profiles. Investigation of aerosol properties reveals that while the aerosol temporal variability at different locations depends on the seasonal variability in the processes that generate and transport different aerosol species to a specific observing location thereby complicating the evaluation of the aerosol climatology valid for a region, there still remains some uncertainty in quantifying the optical state of the atmosphere at a given time. Systematic measurements of AOD, aerosol size distribution and size index 'α over a regional extent in the north eastern part of the peninsular India during the Indian ISRO-GBP land campaign-I and comprehensive measurements including the aerosol vertical profiles using a Micro Pulse LIDAR system at IIT campus, Kharagpur located under the vent in the out flow regions from the Indian sub-continent indicate probable aerosol transport from north Indian polluted regions to peninsular India via Bay of Bengal. The north Indian region is characterized by persistent haze during local winter. The study also revealed a considerable decrease in estimated single scattering albedo and large positive atmospheric forcing during hazy sky days. This enhancement in heating up of lower atmosphere can further strengthen low level inversions during winter months restricting aerosols to be trapped near the earth's surface which process may become a cyclic phenomenon and there is possibility for accumulation of more and more aerosols at the surface layer leading to extended haze episodes. Aerosol back scatter profiles obtained from the region also show certain high altitude aerosol layers during the local summer, with the prevailing meteorology not indicating any possible local entrainment of aerosol leading to the formation of elevated layers due to boundary layer dynamics. The study shows that the possible origin of the layers could be from Arabia in 60% of the cases

which could have significant fraction of dust while it is from Indian sub-continent during the rest of the events. The inferred aerosol single scattering albedo over the region was in the range of 0.7 and 0.9 showing a distinct seasonal variation with most probable value of 0.85 during post monsoon and winter months. Relative variation of column and surface angstrom size index derived respectively from aerosol optical depth spectra and surface measurements with the SSA indicate that the *in-situ* measured SSA is applicable to column integrated estimation during winter and monsoon months while such applicability is limited during summer months due to the possibility of aerosol transport. However, there are several unknowns in composition of the multiphase atmospheric aerosol system over the region to be able to sufficiently provide a prognostic analysis of the future radiative forcing and climate response.