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Aerosol-cloud interactions as observed over Western Ghats, India

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Atmospheric aerosols have an important role in global climate and weather by scattering and absorbing incoming shortwave radiation and absorbing outgoing longwave radiation that influences the Earth's radiation budget. The aerosol indirect effect (AIE) on the cloud microphysical properties has been studied over a high altitude site, Mahabaleshwar (17.92° N, 73.66° E; 1380m a.m.s.l.), Maharashtra, India, using ground-based in-situ measurements during monsoon season (June - August) of 2017. The AIE was estimated using cloud droplets number concentration (AIE_n) and cloud droplet effective radius (AIE_s) at different fixed liquid water contents (LWC). The AIE was varying in the range 0.01 – 0.13 when LWC was varying from 0.04 – 0.26 gm^{-3} . The maximum values of AIE_n and AIE_s (0.125 and 0.119) were found at the lower LWC bin (0.06 - 0.07 gm^{-3}). The calculated values of AIE_n and AIE_s showed that the values of AIE_n were overestimated due to the dispersion effect. The maximum dispersion offset observed was 17.4% at LWC bin 0.16 – 0.17 gm^{-3} . After dispersion correction, the offset was reduced and AIE_n became close to AIEs. So dispersion correction is necessary for the correct estimation of AIE using cloud droplet number concentration (CDNC). For the first time in India, cloud droplets are classified into smaller and medium size droplets to study their relative dispersion and their contribution to the total dispersion of cloud droplet size distribution. The contribution of smaller and medium-size droplets on dispersion at a lower and higher LWC region was studied. In lower LWC (high AIE), the concentration of smaller size droplets are higher (71%) than medium size droplets, but medium size droplets are the major contributor (61%) of dispersion compared to the contribution by smaller size droplets. When LWC is higher (low AIE), the number concentration of smaller size droplets was reduced and the concentration of medium size droplets increased, compared to the case of lower LWC. However, the dispersion contribution by smaller size droplets was increased and the dispersion contribution by medium size droplets was reduced. An inverse relation between CDNC at a particular size class (small/medium) and their contribution to dispersion in CSD was observed.