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Investigation of aerosol effects on rain drop size distribution

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Recently it is being increasingly realized that aerosols play an important role in the present climate change processes by perturbing the Earth's radiation budget directly through interacting with the incoming solar and outgoing terrestrial radiations and indirectly by altering cloud lifetime and precipitation. However, 'complete' understanding of all possible interactions between various mechanisms of these tiny particles with different atmospheric processes is lacking. The present study demonstrates the aerosol effects on rain drop size distribution and the consequent effects on climate change. Simultaneous observations of ground-based impact type disdrometer and Lower Atmosphere Wind Profiler (LAWP) radar were carried out to observe rain drop size distribution change during the premonsoon season at Gadanki (13.5˚N, 79.2˚E), a tropical station in India. After two months drought condition the first precipitation occurred on 21st May 2011. Disdrometer observations show that this initial rain was relatively weak with peak rain rate of about 5 mm/hr for ten minutes duration and the mean raindrop diameter was about 1 mm. However, initial few minutes rain could not reach the ground, as noticed from LAWP observations. This could be due to either advection (meaning that it might reach ground at downwind locations) or strong evaporation. The relatively small raindrops and low precipitation flux indicate that the initial rain might experience strong evaporation while falling to the ground, and this strong evaporation could be due to either a dry below-cloud air or small rain drops to begin with. The space borne observations from MODIS-Aqua and OMI-Aura suggest that there is high loading of dust aerosols and CALIPSO observations identify a dust layer present in between 2 to 6 km as well as boundary layer absorbing aerosols. The high aerosol loading may cause not only significant changes in cloud microphysical properties and thus resulting in smaller raindrops but also warming of the atmosphere, both of which can intensify the evaporation of the falling rain drop. This study applied observation and model simulation to determine which process is the most likely reason for light rain with smaller droplet sizes during premonsoon season in the Indian subtropical region.