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Seasonal Variation of Rain and Cloud Microstructure at a Tropical Location

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Precipitation is a key element of the Earth's hydrology cycle and needs to be carefully monitored due to the rapid growth of satellite and terrestrial link based telecommunication services, using higher frequency band particularly above 10 GHz. The presence of raindrops which absorbs and scatters radio wave energy can produce degradation of the reliability and performance of the communication links. Thus, rain drop size distribution (DSD) is one of the most extensively used parameters for improved an accurate description of any rain event. Several DSD models, namely Lognormal, Gamma, Weibull, Marshall and Palmer are employed to characterize the DSD. Our present work employs three parameter Gamma distributions utilizing Method of Moments (MOM) technique to investigate the physical characteristics and microstructure of rain DSD in a tropical region based on three year long disdrometer observations. Characteristics of precipitation and clouds have been analysed in the present study over the tropical station Kolkata (22.57°N, 88.36°E), during the pre-monsoon (March, April and May), monsoon (June, July, August and September) and post-monsoon (October and November) months. Three year long measurements of the rain DSD have been made using a ground based impact type JW (Joss and Waldvogel) disdrometer located at the Institute of Radio Physics and Electronics of University of Calcutta during 2014-2016. Cloud microphysics is also observed during the same period as to investigate its role in determining rain microstructure. To depict the cloud microphysics of the above mentioned location, 1° X 1° cloud optical depth (COD) and cloud effective radius (CER) data are collected from Moderate Resolution Imaging Spectroradiometer (MODIS). Rain DSD analysis reveals that larger drops are more dominant in the pre-monsoon season compared to any other seasons (Monsoon and Post-monsoon) whereas comparatively smaller drops are more dominant in the monsoon season than the other seasons (pre-monsoon and post-monsoon) at same rain rate bins. This phenomenon occurs because of the pre-monsoon rain droplets are associated with well-built vertical updraft. Distinct variation of cloud effective radius (CER) value is noticed during different seasons of the year. A combined analysis of cloud drop size and rain drop size indicates that in the pre-monsoon months low CER values are associated with the dominance of large raindrops, and during the monsoon period large cloud droplets effect smaller rain drops to dominate the precipitation at the present location.