The impact of electrified and non-electrified clouds on the inter-seasonal characteristics of surface based precipitation

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Abstract

A multi-sensor analysis of the characteristics of electrified and non-electrified clouds along with their impact on the ground-based observation of raindrop size distribution (DSD) during the pre-monsoon and monsoon months of Indian Summer Monsoon over a heavy precipitation region of Western Ghat has been highlighted in the present paper. As the present region of study is instrumented with Ka-band Doppler Weather Radar, Microwave Radiometer and Joss-Waldvogel Disdrometer, hence an attempt has been made through this paper to address the result of investigation related to the characteristic pattern of clouds and precipitation associated with and without the lightning. The study initiated by analysing the morphology of vertical structure of clouds during various stages of a typical rainfall event which started initially with heavy precipitation, followed by lightning and finally ending with the precipitation accompanied by lightning. It was observed from the event that the initial heavy precipitation is basically due to the impact of the shallow convective cloud which is a natural phenomena of this region. The lightning is initiated in the presence of higher level clouds and finally when these higher level clouds joins the lower one, the precipitation accompanied with lightning begins.

The impact of these modulations of clouds over the surface based DSD for the inter-seasonal rainfall events had also been portrayed through this study. The analysis reveals that during the pre-monsoon (monsoon) months, raindrops of larger diameter dominate the rainfall evolving from the non-electrified (electrified) clouds compared to the rainfall evolving from the electrified (non-electrified) ones. This is basically due to the convective nature of pre-monsoon rainfall where strong updraft lifts the smaller drops aloft and thereby allowing the larger drops to precipitate locally. As lightning is associated with higher level clouds, the raindrops evolving from them experiences more collision, coalescence and break-up procedure with respect to the rainfall evolving from low/middle level clouds before reaching the ground. Thus, larger drops are visible for rainfall evolving from non-electrified clouds during pre-monsoon season. While for the monsoon months, as most of the rainfall originates from the deep clouds, the chances of drops to break-up/evaporate is comparatively less for the precipitation evolving from electrified clouds with charged droplets in comparison to the non-electrified ones. Hence, drops of larger diameter dominate the monsoon rainfall associated with lightning.