



Diurnal variations of rain-induced propagation and related atmospheric phenomena over a Tropical Location

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Characterization of diurnal precipitation features will help us to understand the mechanism of rain formation. The diurnal variation signifies the precipitation characteristics over a region and is governed by physical processes related to climatological features and atmospheric dynamics of that area [1]. It has been observed that the total accumulation as well as the hourly rainfall is quite significant at 19:30 IST for the monsoon period. This indicates that the intense rain events are most frequent around that period (19:30 IST) during monsoon. In pre-monsoon season, the major precipitation occurs during the evening through night (16:30-22:30 IST) and reaches maximum around 17:30 IST in the evening. The ku-band earth-space propagation effects are studied in respect of the diurnal variation of rain rate at the present location. The mean attenuation (dB/min) in monsoon period reaches its peak at about 19:30 IST. The exceedances, of rain attenuation greater than 6 dB, are more during the morning and afternoon (6-12 IST) spans in the monsoon. The period (0-6 IST) can be marked significant in view of radio communication with minimal necessary fade margin as the attenuation exceedances are minimum in this period. The mean attenuation considering the pre-monsoon months of 2006-2010 shows maximum value at 19:30 IST. It is also noted that 90% of the total pre-monsoon rain takes place within 16:30-22:30 IST. This particular criterion indicates the prevalence of convective events during the evening to late night period. The exceedance values of cross-polar enhancement show higher values mostly during morning hours (0-6 IST) in monsoon whereas in pre-monsoon occurrences are more in late evening and night. The standard deviation of scintillation follows the same pattern of precipitation but in a prior time slot as compared to precipitation. Fig. 1 shows that higher rain rate occurrences are dominant at early morning and late evening for monsoon period whereas lower rain rate occurrences presents all over the day. In regards to the time of occurrence, the pre-monsoon events are categorized as the afternoon and late evening rain events. These events are found to be associated with the distinct diurnal patterns of atmospheric parameters (CAPE and CIN, LWP and cloud depth). It has also been observed that lower and medium rain drops are mainly contributed to rainfall in monsoon season, whereas contributions of higher drops are significant in pre-monsoon. The observations of diurnal variations of rain and rain induced propagation impairments along with the variability of associated atmospheric parameters highlighted some of the unique features of tropical rain. The results also provide useful information of rain induced propagation characteristics which will help system designers to identify some time slots of the day during which satellite communication is possible with minimum fade margin.

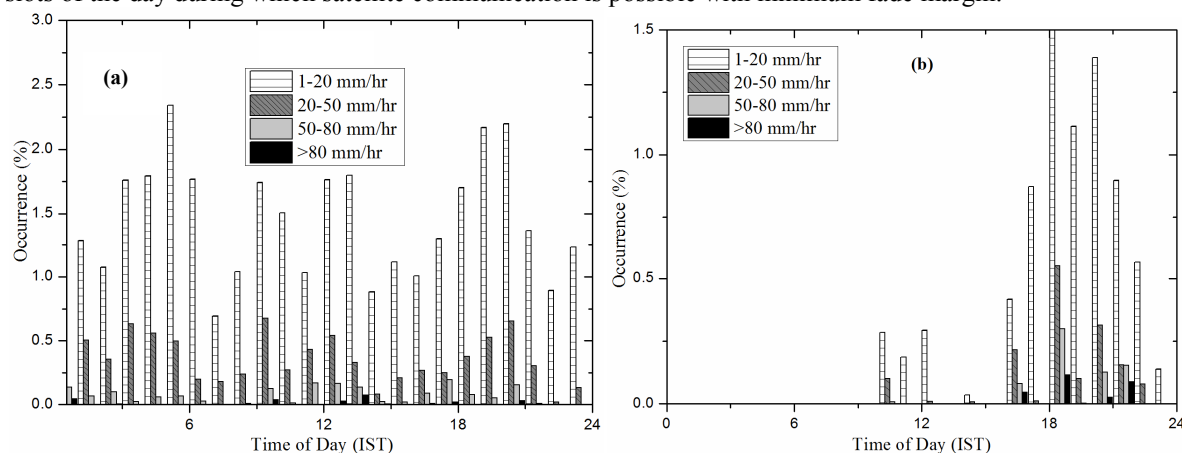


Fig. 1 Diurnal variation of rain occurrences (a) in monsoon, (b) in pre-monsoon, (c) mean CAPE for expected and delayed events of pre-monsoon, (d) MVD of drop size distribution for monsoon and premonsoon.