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An extensive study on Rain DSD over tropical stations in Peninsular India using a J-W Disdrometer

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ABSTRACT

Rain drop size distribution (DSD) was studied using a Joss-Waldvogel type Disdrometer installed at four tropical stations, Thiruvananthapuram (Lat: 8.29 N, Long: 76.59 E), Kochi (9.58 N, 76.17 E), Munnar (10.08 N, 77.07 E) and Sriharikota (13.58 N, 80.29 E). Thiruvananthapuram is on the west coast at the tip of peninsular India. Kochi is an important commercial city in Kerala situated on the western coast on the shores of the state's largest estuary. Munnar is a beautiful hill station about 130 km east of Kochi on the Western Ghats in South India (at about 1500 m amsl) and Sriharikota is on the eastern coast. Thiruvananthapuram, Kochi and Sriharikota experience rainfall intensities greater than 100 mm/hr while the rainfall intensity in Mannar is rarely close to 100 mm/hr.

The entire data were divided into periods of different rainfall intensity. The intensity ranges used were from $<$ 0.01 mm/hr to $>$100 mm/hr with boundaries of 0.02, 0.05, 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50 and 100 mm/hr. The mean DSD for each intensity range was computed. The DSD values were fitted with the log-normal distribution function of the form

$$N(D) = (a_0/D) \exp(-0.5((\ln(D) - a_1)/a_2)^2)$$

Three physically significant parameters, namely, total number of drops (N_T), geometric mean diameter (D_g) and standard geometric deviation (σ), were derived from the fit parameters. We found that N_T increases gradually with rainfall intensity at Thiruvananthapuram, Kochi and Sriharikota for all intensities. But at Munnar, it increases

with intensity up to 1 mm/hr and then decreases at higher intensities. We fitted the values with the expression $N_T = aR^b$ as suggested by Verma and Jha (*Raindrop size distribution model for Indian climate*, Indian J. Radio Spa Phys, vol. 25, 15-21, 1996). The fit was good for the stations other than Munnar. The geometric mean diameter values were also fitted with a similar expression. We found that, at Thiruvananthapuram, Kochi and Sriharikota, D_g increases with rainfall intensity. But at Munnar, D_g remains more or less constant for intensities up to about 1 mm/hr and then increases exponentially. The standard geometric deviation did not show any significant dependence on rainfall intensity.

The characteristics of rainfall in terms of the three parameters for coastal stations on the west coast, i.e., Thiruvananthapuram and Kochi, are similar. But the characteristic at Sriharikota, a station on the east coast, is different from that at Kochi and Thiruvananthapuram. At Sriharikota, N_T increases faster with rainfall intensity than at Kochi. In fact, for any given rainfall intensity, N_T is higher at Sriharikota than at Kochi. D_g increases with rainfall intensity at both the places. But for any given intensity, the D_g at Kochi is higher than that at Sriharikota. Thus, for a given intensity of rainfall, there are less number of drops at Kochi than at Sriharikota, and the drops are generally larger in size. In other words, rainfall at Sriharikota is made up of more number of smaller drops compared to Kochi.