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Variability of raindrop size distribution over Sumatra and its effect on the Z–R relationship

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A systematic and intensive analysis is performed on 2 years (2006-2007) of two-dimensional video distrometer (2DVD) data to re-investigate the variability of raindrop size distributions (DSDs) over Sumatra and their impact on the radar reflectivity (Z) to rainfall rate (R) conversion. Linear regression on log-transformed values both R over Z (LREG1) and Z over R (LREG2), minimizing the root mean square difference (RMSD), and probability matching method (PMM) are used to calculate the coefficient A and exponent b of the $Z - R$ relationship. The sequential intensity filtering technique (SIFT) and sorting and averaging based on two parameters (SATP) are used to minimizes the effect of the spurious variability on 2DVD data. From a whole dataset, the $Z - R$ relationship before (and after) the filtering procedure are $Z = 155R^{1.54}$ ($153R^{1.55}$), $Z = 166R^{1.40}$ ($191R^{1.40}$), $Z = 158R^{1.47}$ ($171R^{1.47}$), $Z = 204R^{1.41}$ ($314R^{1.31}$), for LREG1, LREG2, PMM, RMSD respectively. It is found that SATP (SIFT) increase (decrease) the coefficient A, in comparison with the values estimated from non-filtered data. During 2006-2007, we analyzed 385 rain events. Of 385 $Z - R$ relations, the diurnal variation is observed, consistent with previous results. A-coefficients during 00-06, 06-12, 12-18 and 18-24 local time (LT) are in an interval of 98-249 (86 % of the values < 200), 93-220 (99 % of the values < 200), 98-283 (87 % of the values < 200) and 88-301 (89 % of the values < 200), respectively. Other scales (seasonal, intraseasonal, rain type, time average, rainfall rate threshold) of the DSD variability and their effect on rainfall intensity R estimation from radar reflectivity Z are explored in terms of bias and random errors. In addition, we also discussed the effect of binning procedure of 2DVD data on the $Z - R$ relation. Physical processes leading to the formation of DSDs are then classified according to the vertical structure of radar data as measured by a 1.3GHz wind profiler collocated with the distrometer. Besides $Z - R$ analysis, relationship for rainfall estimation using polarimetric radar measurements at frequencies 3, 5 and 10 GHz, by using real drop shape from 2DVD measurement, will be also presented.