Estimation of rain and DSD variables using the Johnson-SB distribution

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Numerous fields of atmospheric and hydrological sciences require the parameterization of the raindrop size distribution (DSD) to estimate quantitatively the rainfall rate or as input in cloud modeling and numerical weather prediction. The three-parameter Gamma distribution is currently used for most of the atmospheric applications, from the radar meteorology to the atmospheric physics to model natural DSD. This study aims to investigate the capability of the Johnson-SB distribution (JSB) in estimating rain and DSD parameters and in modeling the DSD shape. To achieve this goal, rainfall rate (R), radar reflectivity (Z) and mean mass diameter (Dmass) estimated by JSB are compared with those estimated by a three-parameter Gamma distribution. A large dataset consisting of more than 155,000 one-minute DSD, from six field campaigns of Ground Validation (GV) program of the NASA/JAXA Global Precipitation Measurement mission (GPM), is available to test the performance of both JSB and Gamma distribution.

The JSB and Gamma are compared calculating the correlation coefficient, bias, root mean square error (RMSE) and fractional standard error (FSE) between the estimated and measured parameters. Furthermore, the estimated (by both JSB and Gamma) and measured DSDs are compared to appreciate the goodness in following the natural DSD.