A Comment on "The N_0 Jump of Raindrop Spectra"

FRANCIS J. MERCERET

National Hurricane Research Lab., NOAA, Coral Gables, Fla. 33124

30 July 1974

In his recent paper, Waldvogel (1974) points out a systematic variation in the intercept of the exponential size distribution of raindrops as computed from liquid water content and radar reflectivity values based on raindrop spectrometer measurements. His data indicate a similar variation in the coefficient of the Z-R relation which he does not mention.

When the coefficient A in the Z-R relation $Z=AR^B$ is considered as a function of the intercept N_0 of the exponential spectrum

$$N(D)=N_0e^{-\lambda D},$$

the data of Waldvogel are closely represented by a function of the form

$$A=C_1N_0^{-\frac{1}{2}}$$

as shown in Fig. 1. This is unexpected, since if λ is related to the rainfall rate by a formula such as that of Marshall and Palmer (1948), i.e.,

$$\lambda=41R^{-0.21},$$

then

$$Z=\int_0^\infty D^6N(D)dD$$

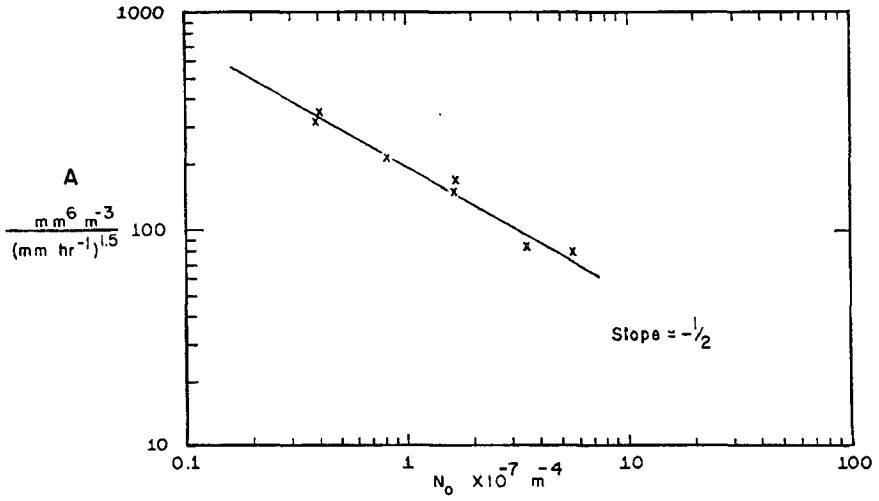

FIG. 1. A as a function of N_0 from the data of Waldvogel (1974).

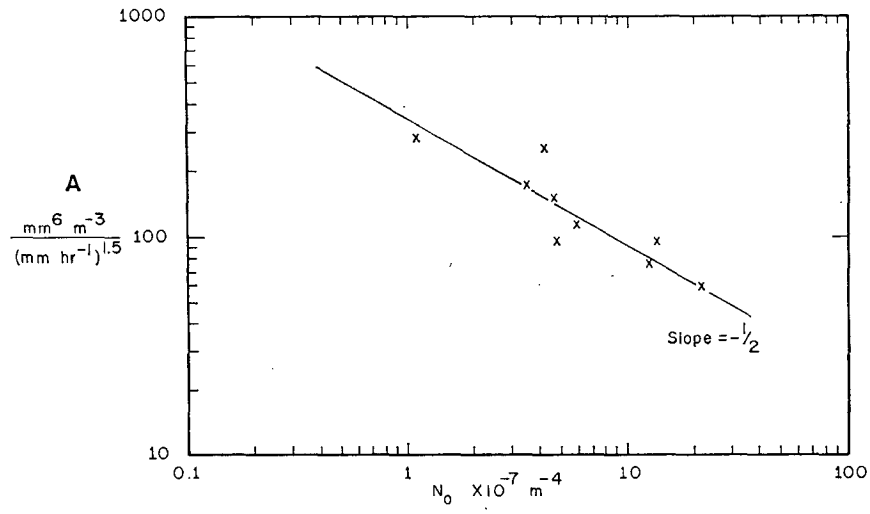

FIG. 2. A as a function of N_0 from National Hurricane Research Laboratory data (unpublished).

becomes proportional to $N_0R^{1.47}$—quite a different relationship.

Our airborne foil impactor data from tropical storm Felice (1970) and hurricanes Ginger (1971) and Ellen (1973) give nearly identical results for N_0 computed from liquid water content and volume mean droplet diameter calculated from the foil spectra, as shown in Fig. 2. Such a coincidence is unlikely unless the phenomenon is real.

Since our spectra correlate very well with the exponential form [see Merceret (1973) for example, showing correlation coefficients averaging greater than 0.9 in tropical storm Felice], it may be that the discrepancy lies in the manner of computing N_0. Our work (Merceret, 1973) shows that the relation

$$\lambda = aR^b$$

is valid only when N_0 is constrained to the classical value and the slope λ obtained by least squares from the number-size histogram obtained from the raw measurements. When N_0 is allowed to "float," λ may not be related to R in a manner independent of N_0, and the observed dependence of A on N_0 may be compatible with an exponential distribution computed as Waldvogel and the author have done in the work discussed here.

REFERENCES

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