Interactive comment on "Improving the rainfall rate estimation in the midstream of the Heihe River Basin using rain drop size distribution" by G. Zhao et al.

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The combination of polarimetric variables such as R (Z, Z_{DR}) and R (K_{DP}, Z, Z_{DR}) are superior to R(Z) because of the less sensitivity of Z_{DR} an K_{DP} to DSD variations. The differential phase (K_{DP}) can be used to correct the reflectivity factor for loss due to beam blockage by topography, attenuation, and anomalous propagations (Ryzhkov and Zrnic 1996; Ryzhkov et al. 2000). The lower sensitivity of $R(K_{DP}, Z, Z_{DR})$ and the higher sensitivity of $R(Z)$ to variations in DSD can be explained by the fact that the difference between the forward-scattering amplitudes at horizontal (H) and vertical (V) polarizations $f_H(D)$-$f_V(D)$ in

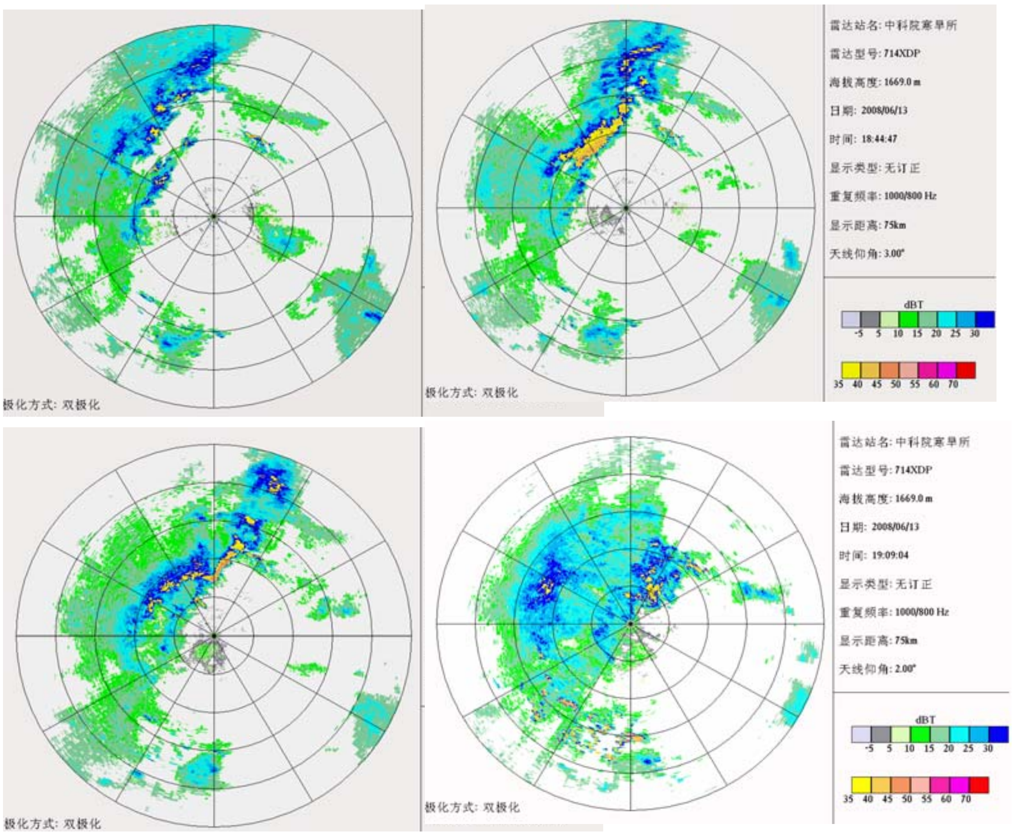

Fig. 1 The radar reflectivity of precipitation

the definition of K_{DP} is proportional to the 3^{rd} power of the diameter of a raindrop for the mono-disperse DSD model, while the reflectivity factor Z is proportional to the 6^{th} power of the diameter. There is an X-band polarimetric radar and several rain gauges available for testing these rainfall rate estimation. The attenuation has been corrected before we used the radar data. The follow table is given for testing. Fig.3 shows the radar reflectivity of precipitation。

Table 1 The reliability of the rainfall estimators

Rain gauge	Z_H(dBZ)	Z_{DR}(dB)	K_{DP}(degkm^{-1})	$R(Z)$/Err	$R(Z,Z_{DR})$/Err	$R(Z,Z_{DR},K_{DP})$ /Err	R_{gauge}
NO.03	29	0.8	1.2	1.9/17%	2.1/8%	2.0/13%	2.3
NO.05	35	1.4	0.3	4.1/46%	4.9/75%	2.0/28%	2.8
NO.11	35	1.9	1.4	4.1/2%	4.2/5%	4.5/12%	4.0
NO.12	31	1.0	0.3	2.5/21%	2.8/12%	3.8/18%	3.2
NO.14	38	2.0	2.2	6.1/39%	6.3/43%	4.7/7%	4.4
NO.19	35	1.3	2.9	4.1/29%	5.1/12%	5.9/2%	5.8
NO.26	23	1.3	0.6	0.7/75%	0.38/5%	0.31/22%	0.4
NO.29	35	4.6	1.6	4.5/26%	5.3/13%	6.0/1%	6.1

The OTT Parsivel has not be applied in other areas in China, but Zhang(1989) got the rain drop size distribution data in Piliang and got a conclusion that the relationship between the R and Z was $R=a\times z^b$, but our conclusion was $R=a\times 10^{b\times Z}$. It revealed that the Characteristic of rain drop size distribution in this area is different from the area of Qinghai-Tibet Plateau.

Fig. 2 shows the DSD for a precipitation of stratiform rainfall cloud, the number of data is 236. Fig. 3 shows the DSD for a convective rainfall cloud, the number of data is 285. Fig. 3 shows that the size distribution for convective rain is broader than that for stratiform. Similar to Steinerde(1987)’ conclusion, there is a multi-peak structure. Most peaks appear in the D < 3 mm region for convective rainfall cloud.

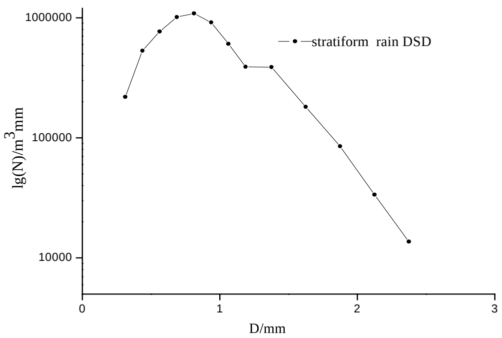

Fig. 2 DSD for the stratiform rainfall cloud

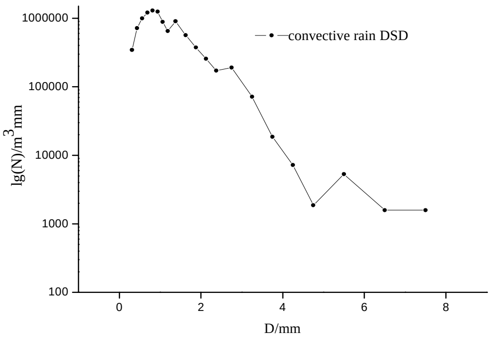

Fig. 3 DSD for the convective rainfall cloud

Fig.1 is not the average values for raindrop diameter. Table.1 shows the terminal velocity of the rain drop with different diameters. There the terminal velocity and rain drop diameters are got from PASIVEL directly. Because PASIVEL got the terminal velocity are rang of diameter, In Table 1 and Figure 1, one point contained lots of raindrop diameters.

I agree with your conclusion that “ 4 types estimator” better instead of “4 relationships of rain-rate and radar parameters”

References

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