Snow Microphysical Characteristics and Snowfall Estimation by Z-SR Relations Derived from 2D Video Disdrometers in East China

*Ranting Tao¹, Kun Zhao¹

¹. Nanjing University

During the East Asia winter monsoon season, the maximum snowfall intensity usually occurred in East China due to the abundant water vapor supplement in the specific region. This seems also imply that the snowfall microphysics in East China may differ a lot from that in the other climate regions.

In an effort to study the snow characteristics and quantify winter precipitation in East China, snow particle size distributions (PSDs) and the other microphysical characteristics (size, shape, density and fall velocity) in Nanjing (NJ), East China during the winter of 2015-2019 are investigated using the measurements of a 2D video disdrometer (2DVD) and a weighing precipitation gauge. Through the comparison against the results reported in previous literature, we found that the density and velocity of snow in this study are larger. The larger snow density accounts for the larger terminal velocity, after considering the influence of observation altitude and temperature. The snow PSDs are fitted to the gamma model and the interrelationships among the parameters of the model (shape parameter $\mu$, slope parameter $\Lambda$, and concentration parameter $N_0$) are explored. From the statistics, we found when snow rate (SR)>1.5, both $\mu$ and $\Lambda$ tend to converge but $N_0$ generally increases with SR. It indicates that the number concentration $N(D)$ of snow particles rises over the range of diameter with increasing SR. The fitted PSD parameters $\mu$ and $\Lambda$ from the PSDs show a strong correlation in individual snow cases, however, it is not easy to explore a uniform $\mu - \Lambda$ relationship for all different cases.

Then, the radar reflectivity factor ($Z_e$) and SR can be simulated based on the snow PSD measurements and snow density relation retrieved in NJ. Using the $Z_e - SR$ relationship derived from the snow dataset collected, the liquid equivalent snow rate is estimated from the reflectivity measurements of the S-band NJ radar in the snowfall event on 04 January 2018. The radar-based snow rates show fair agreement with the observed snow rates, with the mean accumulation error from eight gauges nearby less than 15%.

Keywords: snow, microphysics characteristics, snowfall estimation, disdrometer, S-band radar