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Editorial

Measurement and Modeling of the Precipitation Particle Size Distribution

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Precipitation plays a vital role within the Earth system. Precipitation consists of a collection of liquid or solid water particles, which are referred to as hydrometeors, that begin within a cloud [1]. When these hydrometeors grow too heavy to continue being suspended by vertical motions in the cloud, they fall towards the ground in the form of rain, snow/ice or a mixture and ultimately replenish the oceans and lakes, either directly or indirectly via surface hydrological processes such as runoff and discharge. Hence, understanding how hydrometeors are distributed within the atmosphere and near the ground enables a more accurate depiction of a principle component of the water cycle. It also enables a more accurate depiction of precipitation's erosive effects on the soil important for modeling runoff and on human-made structures important for defining building standards and codes [2–4].

The scientific measurement of raindrop size evolved from using flour or filter paper to an electro-mechanical device named the disdrometer (drop size and distribution meter) [5–7]. Disdrometers are the primary instrument used for measuring characteristics of individual hydrometeors, such as raindrops and snowflakes. Although there are several basic types, optical disdrometers have become the most widely used [8]. Optical disdrometers and array probes have been used both on the ground and mounted on aircraft to measure hydrometeor characteristics near the ground and within clouds [9,10]. They operate off the principal that the amount of light obstructed from a photodiode array by a particle is proportional to the particle's size. Most ground-based optical disdrometers are also capable of measuring the fall velocity of particles, which provides information about the precipitation intensity and particle type. The two-dimensional video disdrometer [11] is one type of optical disdrometer that also provides a measure of particle orientation and shape, which is helpful for ascertaining the particle type and needed for electromagnetic scattering simulations used in remote sensing applications such as weather radar-based quantitative precipitation estimation. However, caution must be exercised when using particle size distribution measurements since each disdrometer has its own inherent sampling uncertainties [12,13].

Measuring and depicting the distribution of frozen or melting hydrometeors is more problematic than it is for liquid hydrometeors. The sizes of individual ice particles and snowflakes are often represented with a spherical diameter and often fully enclosing the observed particle, but unlike raindrops, their mass is not equally distributed within that shape. This complexity has necessitated a parameterization of their mass distribution, often as a function of the measured maximum (or median) diameter, but the diversity of ice habits and their shapes have given rise to a multitude of mass–dimension relationships [14–16]. Furthermore, snowflakes can be highly variable in space and time relative to raindrops. The characteristics of snow falling to the ground can change from one day to another and can even change within a continuous precipitation event [17]. Therefore, disdrometers are generally used to observe the bulk characteristics of snowflakes and other ice hydrometeors. Some high-definition cameras being employed in disdrometer systems can achieve enough detail to obtain robust estimates of the snowflake density [18], which is needed for developing snowfall estimation algorithms that can be applied to remote sensing measurements that cover a much larger area.

In situ measurements of the precipitation particle size distribution (PSD) have provided essential information for developing and validating microphysical processes represented within cloud-resolving and mesoscale weather models [19,20]. Precipitation size is often parameterized in these models using either an exponential or a gamma distribution, which require either two or three parameters that are often determined from disdrometer measurements. However, these statistical models are not universally applicable for all precipitation events, and hence the quest continues to find a more robust means for representing the precipitation PSD.

This Special Issue of *Atmosphere* entitled "Measurement and Modeling of the Precipitation Particle Size Distribution" consists of eleven papers reporting original research in the area of precipitation science. They touch on some of the aforementioned PSD topics, ranging from in situ observations of individual raindrops [21–23] and snowflakes [17,18] to estimation of the PSD using satellite-based radar [24–26] as well as the nuances of modeling the PSD of precipitation [16,27].

Conflicts of Interest: The authors declare no conflict of interest.

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