Using the measured Particle Size Distribution to assess the wind-induced bias of catching-type raingauges

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Abstract

Wind-induced biases that affect catching-type precipitation gauges have been largely studied in the literature and dedicated experimental campaigns in the field were carried out to quantify this bias for both liquid and solid precipitation (including the recent WMO intercomparison on solid precipitation – SPICE). Experimental results show a large variability of the Collection Efficiency (CE) curves that depend on the precipitation type, intensity and the Particle Size Distribution (PSD) (see e.g. Colli et al. 2020). This was confirmed by recent studies using Computational Fluid Dynamic simulations to assess the airflow pattern around the gauge body and particle tracking models to simulate the particle trajectories when approaching the collector and calculating the Catch Ratio (CR) associated with various drop size - wind speed combinations (see e.g. Colli et al 2016, Cauteruccio and Lanza 2020).

In the present study, the CR values derived from the work of Cauteruccio and Lanza (2020) for a catching-type cylindrical gauge as a function of the drop size were fitted with an inverse second-order polynomial. The parameters of such curves were themselves expressed as a function of the wind speed. This formulation was adopted to calculate the CE of a catching-type cylindrical gauge based on contemporary wind and PSD measurements. These were obtained at the field test site of the Hong Kong International Airport using six co-located anemometers and a two-dimensional video disdrometer (2DVD), at one-minute resolution. The obtained CE was used to correct the rainfall intensity measured by three catching-type cylindrical gauges, located at the same site, and was compared with the ratio between the raw data measured by the three cylindrical gauges and the 2DVD rainfall intensity measurements. Results show the improvement due to the correction and suggest that the 2DVD is subject to some wind-induced bias as well.

References:

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