O-27: THE WIND-INDUCED BIAS OF NON-CATCHING PRECIPITATION MEASUREMENT INSTRUMENTS

Enrico Chinchella, Università di Genova, Italy
Arianna Cauteruccio, Università di Genova, Italy
Luca G. Lanza, Università di Genova, Italy

Non-catching precipitation measurement instruments do not require a funnel to collect hydrometeors and measure the equivalent water flux but detect each of them individually in flight while crossing or impacting the sensing volume or surface. These instruments are being increasingly adopted by users since they provide precipitation microphysical properties (drops size and fall velocity) further to their integral features (rain amount and intensity) and require little maintenance.
Wind is a well-recognised source of environmental bias in precipitation measurements, affecting both catching and non-catching instruments. When immersed in a wind field, indeed, any precipitation measurement instrument behaves like a bluff-body, producing strong velocity gradients and turbulence near its sensing area or volume. These aerodynamic features may significantly divert the trajectories of the approaching hydrometeors away from the sensor.
In this work, we summarise the results of extensive research on the assessment of the wind-induced bias for liquid precipitation measurements using various non-catching instruments. A combination of Computational Fluid Dynamics (CFD) simulation and Lagrangian Particle Tracking (LPT) models is employed to investigate the accuracy of commonly adopted optical, acoustic, and light scattering sensors. Various combinations of wind speed and direction are considered since the instruments are usually not radially symmetric, and the rainfall intensity is also considered by assuming suitable relationships with the drop size distribution.
Results reveal that significant biases occur in the measurement of the microphysical properties of liquid precipitation when obtained in windy conditions. On the one side, drops are deflected by wind from their undisturbed trajectory and may fail to reach the sensing area of the instrument, while on the other side their fall velocity is modified, and they may reach the sensing area with a different velocity than the terminal one. The kinetic energy of individual drops is also affected by the wind, with a significant impact on measurements obtained from e.g., electro-acoustic disdrometers. The measurement biases on the microphysical properties propagate on the derived rainfall intensity and amount.
Although the drop size and velocity measurements are strongly biased in windy conditions, this bias can be quantified using the presented approach for any given instrument shape and measuring principle, and a few examples are given in this work for specific commercial instruments. Adjustment curves can be provided for the correction of the measured data, either in real time or within a suitable post-processing software.