The link between the drop scale, high resolution measurements and precipitation estimates at the catchment scale

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Abstract:

In-situ liquid precipitation measurements are the essential source of information about the rainfall process, its spatiotemporal variability, and the expected frequency of intense events. Other sources are remote sensors or the measurement of hydrologically connected variables, such as the water flow in rivers or evaporation, but all these only provide indirect estimates of precipitation. Notwithstanding the advantage of allowing areal estimates, they still require accompanying in-situ measurements for calibration or validation purposes.

The accuracy of in-situ precipitation measurements, though understated in most research studies and hydrological applications, is imperative to substantiate both scientific achievements and decision making. Unfortunately, due to budgetary shortages and other priorities, the managers of monitoring networks rarely address accuracy and traceability issues to a significant extent, and measurements are performed at a much lower level of accuracy than the current scientific knowledge and technological development would actually permit.

The neglected precipitation measurement biases propagate through the applications or the modelling chain and their awareness is often rapidly lost, together with the reliability of the obtained results. The comparability and homogeneity of precipitation estimates and their hydrological consequences between different studies is also questionable.

High-resolution measurements, even down to the scale of the single drop, are the way to achieve better knowledge of the precipitation process and to raise the confidence of users in the accuracy of their basic source of information. In this work, based on the most recent results in precipitation measurement studies, we aim at demonstrating that the accuracy of catchment scale rainfall and snowfall estimates rely on the interpretation of high-resolution raw data from traditional sensors and on the knowledge of the drop size distribution and other microphysical parameters of the rainfall process. Drop scale measurements must be accurate as well, and this is still an open issue for the currently available disdrometers.