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Dynamic performance of a weighing rain gauge under laboratory simulated time-varying reference rainfall rates

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Recent calibration experiences of rain intensity gauges based on the weighing measuring principle have been based on laboratory tests performed under constant reference flow rate conditions (Lanza et al., 2005). The 2007-2009 intercomparison campaign in the field, promoted by WMO (the World Meteorological Organization) and involving several instruments characterized by various measuring principles, was largely based on such kind of calibration tests applied to the whole set of catching type gauges (Lanza and Stagi, 2009). Although the Weighing Gauges (WG) do provide better performance than more traditional Tipping Bucket Rain gauges (TBR) under continuous and constant reference intensity, dynamic effects seem to affect the accuracy of WG measurements under real world – time varying rainfall conditions (Vuerich et al., 2009). The most relevant is due to the response time of the acquisition system and the derived systematic delay of the instrument in assessing the exact weight of the bin containing cumulated precipitation. This delay assumes a relevant role in case high resolution rain intensity time series are sought from the instrument, as is the case of many hydrologic and meteo-climatic applications.
Investigation of the time constant parameter T of a modern weighing gauge manufactured by OTT is here addressed as the first objective of the present work. Experimental tests are conducted in the laboratory using this instrument, since it demonstrated very good performance under previous constant flow rate calibration efforts. Three different laboratory test conditions are applied: first an intermittent flow rate corresponding to a given reference rainfall intensity is used to evaluate T based on the hypothesis of a first-order type of dynamic behaviour. Then a squared incremental and decremental hyetograph is applied to assess the dynamic behaviour under varying rain intensity conditions. Finally the simulation of real rain events recorded at the local meteo station is performed. Tests are carried out after preliminary development and validation of a suitable rainfall simulator for the generation of one-minute step variable reference intensities; the generator is characterized by a sufficiently short time constant with respect to the expected weighing gauge behaviour in order to ensure effective comparison of the measured/reference intensity at very high resolution in time. The results of this phase are presented in terms of deviations between the actual and the measured rainfall rates at the scale of one minute.
The outcome of this work aims to foster the implementation of a suitable correction algorithm for weighing gauge dynamic measurements, based on the experimental results. The comparison between dynamically corrected and traditionally calibrated series is expected to provide substantial improvement in the accuracy of the measurements at any range of rainfall rate.

References

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