Geophysical Research Abstracts
Vol. 12, EGU2010-7284, 2010
EGU General Assembly 2010

On Correcting for Undercatch of Tipping-Bucket Rain Gauges

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In a presentation at the EGU General Assembly 2009, three examples of high rain rate events were shown in which undercatch from tipping-bucket gauges was a serious problem. The magnitude of undercatch was determined by comparing rain event totals from two MetOne tipping-bucket gauges with 30.5 cm (12 in) collection diameters with those from a Geonor T-200B vibrating-wire weighing gauge with a 16 cm (6.3 in) collection diameter. The Geonor gauge, used as the reference gauge, and one tipping-bucket gauge are located in a pit such that their collection orifices are positioned about 1 cm above the surrounding anti-splash material at ground level. Thus the measured rainfall accumulations from the gauges in the pit should be minimally affected by wind speed. The other tipping-bucket gauge is located 105 m from the two gauges in the pit and is enclosed by an Alter-type slatted wind screen. Its collection orifice is positioned 1 m above ground level.
In this presentation we show the results of correcting the one-minute rain rates observed from the two tipping-bucket gauges for undercatch due to the finite time increment required for the bucket to tip from one side to the other. We applied these corrections to the data from the same and additional rain events to obtain improved estimates of the event totals for comparison with the Geonor totals. The corrected rain rates are based on dynamic rain gauge calibrations performed in a laboratory in which each tipping-bucket gauge is exposed to five known rain rates ranging from 19.9 mm/h to 175.2 mm/h. A quadratic relation between the observed rain rate and the known rain rate for each gauge was found to provide a very good fit (R-squared > 0.9999). The quadratic relation was inverted and applied to the observed one-minute rain rates in the field to yield estimates of the actual rain rates from which the improved estimates were obtained.
We recognize that application of the correction procedure assumes multiple tips in each minute are uniformly distributed in time over the course of the minute. This is highly unlikely and we show the consequent errors for various sample distributions of times-of-tip during a given minute.
High wind speed also results in undercatch by the aboveground tipping-bucket gauge. As time permits, we will show its apparent undercatch due to wind speed after correcting for the undercatch discussed above. The rainfall observed by the Geonor again serves as the reference.