Geophysical Research Abstracts
Vol. 12, EGU2010-15576, 2010
EGU General Assembly 2010

A statistical comparison of electronic weighing and tipping-bucket precipitation gauging for snowfall

M. Savina, B. Schäppi, P. Molnar, P. Burlando, and B. Sevruk
Institute of Environmental Engineering, ETH Zurich, 8093 Zurich, Switzerland (savina@ifu.baug.ethz.ch)

Rainfall and snowfall measurements are basic inputs for watershed modelling, natural hazard assessment, and generally for the evaluation of hydrological response. Although distributed radar precipitation fields are becoming routinely used in hydrological analyses, point observations remain fundamental as control points and best estimates of precipitation at the ground level. However, the problem with point precipitation measurements using common can-type gauges is that they are unreliable. Besides the observational, calibrating and construction errors, there are systematic errors consisting mainly of wind-induced errors, wetting and evaporation losses, all of which affect the accuracy of the measurement at the event scale.

In this paper we evaluate the performance of two widely used measurement systems - the tipping-bucket and a modern electronic weighing system - with a special focus on snowfall and the errors (differences) caused by heating and the tipping mechanism. Data for the study were collected at the MeteoSwiss weather station field in Zermatt (Swiss Alps) in the winter 2009/2010. Our data demonstrate i) a delay of the tipping bucket gauge in recording the beginning of an event due to melting snow and filling of the first tip; ii) a general loss of water in the tipping bucket gauge due to higher evaporation loss because of a larger heated area; and iii) the effect of smoothening of the high resolution precipitation intensity by the different measurement mechanisms.

Most notably, the tipping bucket gauge produced a total water loss of about 20% compared to the weighing gauge and showed a substantial delay (on the order of 20-30 min) in identifying the beginning of snowfall events, which also led to a disagreement in the duration of the events. We decomposed the delay into a delay due to the time needed to melt the first snow and direct the water to the outlet of the funnel ($\sim$10 min) and the time needed to fill the first tip ($\sim$20 min). The delay is an important factor if accurate event timing is required. Our results show that merging precipitation observations measured by different gauges (measurement systems) must take into account and correct not only for differences in the total rainfall depth, but also in the onset and timing of recorded events, especially if the data are to be used for the validation of radar precipitation fields.