Automated Solid Precipitation Measurement

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Goals

To improve liquid and solid precipitation measurements in support of the NOAA-led effort to modernize and automate the United States Climate Reference Network (USCRN) and the Regional United States Climate Reference Network (RUSCRN).

Issue

Under-catch in windy and snowy conditions and snow accumulation on the precipitation gauge can cause large precipitation measurement errors . These errors can be minimized through proper wind shielding and inlet heating. Accumulated blowing snow, the size of the wind shield, wind shield maintenance, power requirements and the price, reliability, accuracy, and redundancy of the gauge are some of the factors considered in our search for the 'ideal' precipitation gauge and wind shield.

Figure 1. Air flow over a precipitation gauge within the Atmospheric Turbulence and Diffusion Division wind tunnel.

Approaches

ARL installed replicates of three different types of weighing gauge, one type of tipping-bucket gauge, and three types of wind shield at the winter precipitation testbed in Marshall, CO. ARL is evaluating the variability between like measurements to estimate the significance of errors due to shield and sensor type.

Figure 2. Aerial photo of the Marshall, CO winter precipitation testbed.

Accomplishments

•The testbed will be included in the upcoming World Meteorological Organization study of automated precipitation measurements.

•Results from the past three years of near-continuous operation at the testbed were recently submitted to the Bulletin of the American Meteorological Society for publication.

• In conjunction with Belfort Instruments, a new double Alter shield has been designed that demonstrates significant improvement over the standard double Alter shield.

•Improved solid precipitation measurement methodologies.

•Development of transfer functions for correcting solid precipitation measurement errors.

•Quantification of the magnitude of solid precipitation measurement errors and variability using different wind shield/gauge combinations.

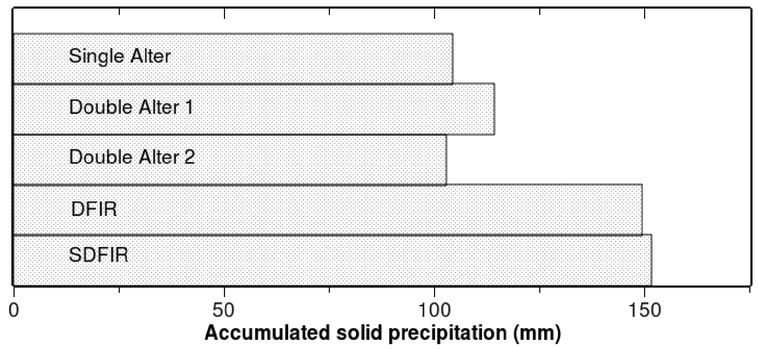

Figure 3. Accumulated solid precipitation from the winter of 2009/2010 as measured by Geonor T-200B weighing gauges within different wind shields. A standard single Alter, two standard double Alters (Double Alter 1 and Double Alter 2), the Double Fence Intercomparison Reference (DFIR), and the small DFIR (SDFIR) are shown.

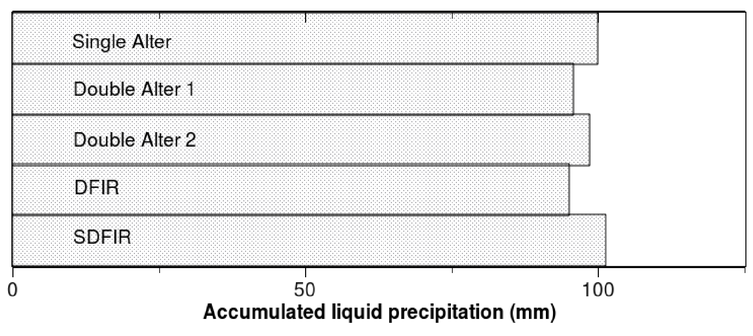

Figure 4. Same as Fig. 3, but for accumulated liquid precipitation from the summer of 2009.

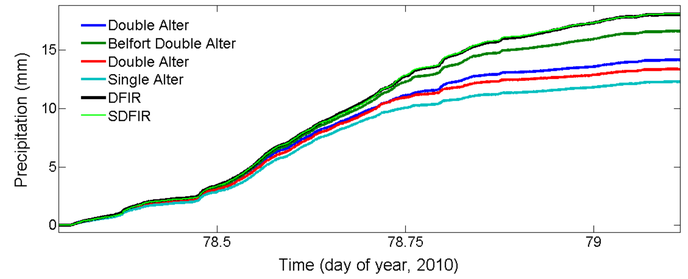

Figure 5. Solid precipitation accumulation from within different types of wind shields.

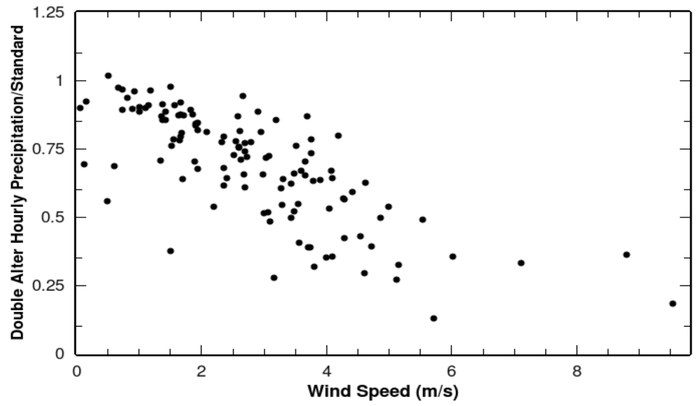

Figure 6. Hourly ratios of the accumulated precipitation within a double Alter shield to the standard (S)DFIR precipitation measurements as a function of wind speed.

Collaborators and Partners

Future Direction

•ARL will continue operation of the Marshall, CO testbed to provide needed additional wintertime data for the fundamental precipitation measurement systems under review.

• ARL will install selected precipitation gauge/wind shield combinations at a few operating USCRN sites to support the development of more robust transfer functions.

• ARL will participate in the World Meteorological Organization automated precipitation measurement study.