Dynamic Rain Gauge Calibration System

Introduction

A new dynamic rain gauge calibration system for tipping bucket rain gauges was developed for use at the SGP Calibration Facility in effort to mitigate underestimation of high precipitation rates. The goal is to provide field-corrected data to users, in addition to raw gauge output, resulting in reliable estimates of true precipitation rates despite gauge biases.

Methodology

Two calibrations are run: calibration of the pump, and calibration of the rain gauge. The pump calibration takes target (simulated) precipitation rates and measures actual pump output. The gauge calibration takes the same target precipitation rates from the pump calibration and measures actual gauge output. After both the pump and gauge calibrations are run for a series of target rates, the “real” (pump) and “actual” (gauge) rates are scatter-plotted (real vs. actual). A regression line is fit to the plotted data, and the equation of best-fit (2nd order polynomial, intercept at 0) is determined. The best-fit equation is then used to correct the data within the logger program when the corresponding rain gauge is installed.

Uncertainty

Scale: 0.1% of measurement; 0.1 g linearity; 0.1 g repeatability
CVO4: 0.13% of set voltage ±2.5 mV
Rain Gauge: 2% of measurement for 1-3”/hr rain;
3% of measurement for 0-6”/hr
Pump Controller: 1% of voltage; 1.5% linearity

Limitations

Rainfall rates above 120 mm/hr are not repeatable with the current design due to tube slippage and splashing. Also, the correction factors provided do not account for wind catchment errors. They only assume dependency on rainfall intensity.

The calibration procedures closely follow the recommendations by the WMO CIMO-XIV (2007), and the methods of Humphrey et al. (1997).