



Field investigation of an all-weather vibrating-wire precipitation gauge

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In recent years the Geonor vibrating-wire precipitation gauge has found increasing use in Scandinavia, Canada, and the United States to measure both liquid and solid precipitation. This paper is a summary of an ongoing field investigation of this gauge and is divided into two parts. The first part is a discussion of the various characteristics of the Geonor gauge that impact its capability to accurately measure precipitation. The most important characteristics are calibration stability, temperature sensitivity, and vibration due to wind. The second part is a comparison of time series of very high and very low precipitation events from the Geonor, a 2-dimensional video disdrometer (2dvd), and a tipping-bucket gauge. The unheated 3-wire Geonor gauge and the 2dvd are co-located in a pit 2 m by 4 m by 1.3 m deep covered by a grill and anti-splash fiber. Their orifices are at ground (grill) level. The tipping-bucket gauge is located 100 m from the pit. The measurement site is located in central Oklahoma and has good exposure in all directions.

Myriad analyses have been performed of 1-minute accumulations taken over more than a four-year period. The principal results of these analyses are as follows. (1) Periodic field verifications of factory calibrations show accumulation errors between approximately 0 and -0.1 mm/10 mm accumulation (or 0 and -1% error) over the range in possible accumulation from 0 to 600 mm. No systematic change in factory calibration with time is evident. (2) The natural frequency of vibration of each wire has a negative coefficient of variation with temperature that becomes more negative with increasing mass in the bucket. The average temperature sensitivity of the three wires is approximately -0.1 mm per 10C for 250 mm accumulation in the bucket. (3) The vibrational noise (Bernoulli effect or "wind pumping") observed in 1-minute accumulations and precipitation rates increases with increasing wind speed above about 4 m/s at a 2 m height, but is negligible below 4 m/s. (4) One-minute rain rates up to at

least 150 mm/h from the Geonor and 2dvd show reasonable correspondence. (5) Precipitation event totals less than 0.2 mm can be easily measured by the Geonor, but the effects of wetting of the intake cylinder, evaporation, and large ambient temperature changes with time on the measured accumulation must be taken into account to obtain an accurate estimate of the true precipitation amount. The overall conclusion is that the 3-wire Geonor vibrating-wire weighing-bucket gauge has the capability to reliably and accurately measure very small to very large precipitation rates and accumulations that are continuous in time.