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Towards an Improved Understanding of the Influence of Raingauge Design, Slope and Aspect on Rainfall Measurements: A Cross-Calibration Study

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High altitude raingauges, such as those situated in Cathedral Peak and Jonkershoek, are a vital part of the raingauge network in South Africa. The tipping-bucket raingauge, has generally replaced the historical manual raingauges, such as the popular Snowdon raingauge, in rainfall monitoring networks worldwide. The accuracy of rainfall volumes captured by current tipping-bucket raingauges is a popular debate in hydrology and meteorology. With the re-establishment of the Cathedral Peak research catchments and the upgrade of the Jonkershoek research catchments, Texas high-intensity and Davis tipping-bucket raingauges replaced the historical Snowdon raingauges. There are several differences between the raingauges, such as measuring mechanism, shielding and angle of inclination, which could influence the measurement of rainfall. As the Snowdon raingauges were used with Nipher shields historically in the Cathedral Peak research catchments, the meteorological station at Cathedral Peak provided the perfect site to conduct a comparison between the Snowdon and Texas tipping-bucket raingauges, as well as to test the influence of shielding. An objective of the study was to ensure the compatibility of the historical and current rainfall records of the Cathedral Peak and Jonkershoek research catchments through a cross-calibration study. Beyond this, the influence of altitude, aspect and slope on rainfall measurements was considered. A further objective was to improve the understanding of the influence of a shield and gauge design on rainfall measurement accuracy. Eleven raingauge sites at Cathedral Peak and eight sites at Jonkershoek were included in the study. Concurrent monitoring of the historical and tipping-bucket gauges was undertaken for 27 months in Cathedral Peak and 10 months in Jonkershoek. Over this period, a general trend emerged across both catchments. The historical and current raingauges recorded similar rainfall volumes, with the historical raingauge generally recording more with the recorded difference never exceeding 12.1% in Jonkershoek and 13.5% in Cathedral Peak. Statistically the differences between the current raingauge and the historical raingauge were not significant, and no confident trend was identified for slope and aspect. At the meteorological station, a ground level raingauge was used as a reference raingauge to compare to the above ground raingauges. After 20 months of observation, the comparison between the Snowdon raingauge and the Texas raingauge showed that there was little difference between the gauges, with the Snowdon raingauge recording 0.7 % more rainfall, and both raingauges recording around 8 % less rainfall than the ground level raingauge. The shielded Texas raingauge recorded the least amount of rainfall, recording 12 % less than the ground level raingauge at a monthly time scale. The study concluded that the difference between the current and historical raingauges at the two specific sites considered is not significant enough to warrant the use of correction factors. The upgrade of equipment should pose no significant problem to change detection and the homogeneity of the rainfall record at these two-important high altitude monitoring sites. The difference found between the shielded and unshielded raingauges, was greatest for high intensity, low wind speed events.