COMPARISONS BETWEEN 4-INCH PLASTIC AND 5-INCH COPPER RAINGAUGES

J. Finkelstein*

ABSTRACT

Comparisons between 4-inch plastic and 5-inch copper raingauges were made at the aerodromes at Kaitaia, Rotorua, Gisborne, Christchurch and Invercargill over a 15-month period in 1969–70. On the average the plastic raingauges recorded 2 percent more rain than the copper instruments, and the percentage difference was greatest for low daily rainfalls. This result was probably due to additional condensation in the plastic instrument.

INTRODUCTION

Until quite recently all raingauges used by the New Zealand Meteorological Service were made of copper. Plastic raingauges began to be commercially available in New Zealand in the 1950s, the first model being wedge-shaped. This raingauge (the Marquis 70) was tested by the Meteorological Service at Wellington in 1956 and was considered to be unsatisfactory. The most serious failing was poor calibration; other disadvantages were the open top allowing evaporation, the fact that the instrument needed to be exposed on a post, and the small orifice.

A later-model plastic raingauge (the Marquis 1000), which first became available in the 1960s, is much more similar to the standard copper raingauge, having a separate funnel and a separate inner can. Preliminary tests in 1966 indicated that this instrument gave values close to those from the standard copper raingauge, and it was thought likely that the plastic instruments could be used to supplement the copper gauges in the extensive network of official rainfall stations.

INSTALLATION

The Marquis 1000 raingauge is intended to be installed on a post. However, it is well known that the 'catch' of a raingauge decreases with height above ground, and in order to avoid this

* New Zealand Meteorological Service, Wellington.

source of error the Meteorological Service provides a standard peg to which the raingauge is to be attached. This peg is driven in until the raingauge is sitting on the ground; the rim is then at a height of 14 inches above the ground, only 2 inches higher than that of the standard copper instrument.

ADVANTAGES AND DISADVANTAGES

The obvious advantages of the plastic raingauge are its low cost and ready availability. Another advantage is the slight disturbance necessary to a lawn for installation compared with the digging in of a copper instrument with its splayed base. In addition, with heavy rain, emptying the plastic raingauge is much simpler than digging out the copper instrument.

Two disadvantages, however, have become evident. The first is that the funnel may be blown off rather easily in a strong wind. The second and more serious disadvantage is that condensation occurs readily in the gauge. It has been found that, on days when there has been no precipitation other than dew or frost, amounts of water as great as 0.8 mm may collect in the raingauge because of condensation. At Pleasant Flat, near Haast Pass, in June 1968 the total amount of condensation recorded in this way was 7.9 mm in 17 days. The total rainfall for the month was 211 mm.

Since plastic raingauges were first issued officially by the New Zealand Meteorological Service early in 1969, the following instruction has been issued to observers using either plastic or copper raingauges: "If the water measured is known to be the result of dew or melted frost the amount is *not* to be included in the monthly rainfall total, nor is the entry to be counted in reckoning the number of raindays." This instruction avoids 'spurious' raindays being recorded.

PROCEDURE FOR TESTING

In 1969 raingauge comparisons were commenced at the New Zealand Meteorological Service Branch Offices on the aerodromes at Kaitaia, Rotorua, Gisborne, Christchurch, and Invercargill. The comparisons ran for 15 months, from June 1969 to August 1970. At each station, daily readings were taken of a plastic raingauge situated near the standard copper instrument. At each of these stations a recording raingauge also operates, and hourly readings are taken of rainfall and wind.

RESULTS

The extreme values of the differences between monthly rainfall totals measured with the plastic gauge (P) and those measured with

the copper gauge (C) expressed as a percentage of C occurred at Invercargill. They were:

August 1970: P, 32.5 mm; C, 29.2 mm; Difference, +11%.
October 1969: P, 131.8 mm; C, 137.2 mm; Difference, −4%.

In Table 1 the average percentage departure for each of the five stations over the 15-month period is given, together with the average rainfall intensity, obtained by dividing the total rainfall over the period by the duration of rain, found from the recording raingauge. These data are plotted in Fig. 1. The correlation coefficient between the percentage difference and the rainfall intensity is −0.97.

TABLE 1 — Percentage differences between raingauges, and rainfall intensities for the period June 1969 to August 1970.

Station	*Mean percentage differences* $(P-C)/C\times 100$*	*Mean rainfall intensity, same period (mm/h)*
Kaitaia	+0.3	3.1
Rotorua	+1.9	2.4
Gisborne	+1.7	2.4
Christchurch	+4.3	1.3
Invercargill	+2.8	1.6

* P: plastic gauge. C: copper gauge.

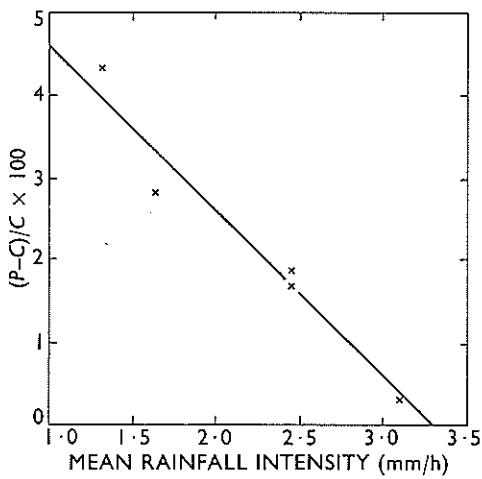

FIG. 1 — Percentage difference between rainfall from plastic (P) and copper (C) raingauges, and average rainfall intensity at five stations, for the period June 1969 to August 1970.

All daily falls of one inch (25.4 mm) or more were examined, there being 14 at Kaitaia, 17 at Rotorua, 11 at Gisborne, 1 at Christchurch, and 4 at Invercargill. For each of these falls the percentage difference $(P-C)/C \times 100$ was calculated, besides the average rainfall intensity and the average wind speed. The differences varied from -13% to $+8\%$. No relationship could be found between percentage difference and wind speed. The mean percentage difference for all these heavier falls was -0.3% for an average intensity of 7.4 mm/h. This may be compared with the difference for all stations combined for all falls of $+2.2\%$ with an average intensity of 2.0 mm/h.

All daily falls of 0.10 inch (2.5 mm) or less were also examined. For these the plastic gauge rainfall exceeded that of the copper by 48.8 mm in a total (copper gauge) for all these light falls of 467 mm, a difference of 10.2 percent. As the total difference for all falls between the rainfall from the two types of gauge amounted to 119 mm, 42 percent of the difference was to be found in these smaller falls which were only 8 percent of the total rainfall of 5995 mm.

CONCLUSIONS

(1) On the average, in New Zealand, the 4-inch plastic raingauge records 2 percent more than the 5-inch copper instrument.

(2) The average difference between the two instruments is negligible for daily rainfalls of an inch and over, and the highest percentage differences occur with lowest daily rainfalls.

(3) The difference is probably due mainly to additional condensation in the plastic raingauge.

(4) In low rainfall areas (less than about 700 mm per annum) the rainfall measured by a plastic raingauge will be on the average about 4 percent too high.