POSTER 04

Quantitative Precipitation Estimation obtained by 0.1mm Tipping Bucket Raingauge

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I. Introduction

Rain is a major component of the weather data such as temperature and provides suitable conditions for many type of ecosystems as well as water for crop irrigation. Rainfall is measured using rain gauges. As the tipping bucket rain gauge, one of precipitation sensors for measurement in Korea, commonly has 0.5 mm resolution, the measurement with 0.1 mm resolution is also necessary for the prediction of disease and pest in agriculture. However, if the rain falls heavily, the water overflowing from the bucket may cause the error of –1%, –3% and 5% in case of the rainfall rate upto 10 mm, 20 mm and 30 mm per hour, respectively (Campbell Scientific. Inc. TE525MM Tipping bucket rain gauge manual). Therefore, it should be calibrated the measurement error to obtain accurate measurement of precipitation. This study aims at estimating the quantitative precipitation with the instrument of resolution 0.1 mm tipping bucket rain gauge (TE525MM) calibrated with determined by the regression between the measurement of 0.5 mm rain gauge and 0.1 mm rain gauge, which helps to reduce the measurement errors that inevitably occur during heavy rain.

II. Materials and Methods

The precipitation measured by 0.1 mm tipping bucket rain gage (TE525MM) using CR10X rogger manufactured by Campbell Scientific Inc. in Yangpyeong-gun in Gyeonggi province since July 2006. The TE525 is an adaptation of the standard National Weather Service tipping bucket rain gage. Output is a switch closure for each bucket tip. The other specification of the instrument shows in Table 1.

III. Results and Discussion

A regression equation is used to find out what relationship between 0.5 mm tipping bucket

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rain gauge and 0.1 mm tipping bucket rain gauge measured for six days (11 July 2006 ~ 16 July 2006) in Yangpyeong to calibrate the measurement error when the instrument of 0.1 mm resolution used. The equation is as follows (R^2 = 0.9925, Fig. 1) :

$$y = 1.1613x - 0.1102 \qquad (1)$$

The measurement error caused by overflowing from the bucket calibrated with the equation when the precipitation measured hourly by the 0.1 mm tipping bucket rain gauge. A scatter diagram in Fig. 2 shows that the calibrated values are more reliable than 0.1 mm resolution measurement (R^2 = 0.997, Fig. 2). Fig. 3 shows two instruments of measuring precipitation used in this study.

Table 1. The specification of the instrument for measuring precipitation

	TE525	**TE525WS**	**TE525MM**
Sensor Type	tipping bucket/potted magnetic momentary contact reed sitch		
Switch Ratings	30 Vdc at 2 A; 115Vac at 1A; closure time: 135ms; bounce settleing time: 0.75ms		
Bucket Material	white powder coated spun aluminum		
Funnel Collector Material	gold anodized spun aluminum		
Screen Material	gold anodized spun aluminum		
Locking Snap Ring Material	stainless steel		
Operating Temperature	0° to +50°C (30° to 125°F)		
Resolution	1 tip		
Accuracy	1.0% up to 2 in/hour (50 mm/hr)		
Rainfall per Tip	0.01 in (0.254 mm)		
Volume per Tip	4.73 ml/tip	8.24 ml/tip	4.73 ml/tip
Knife Edge Funnel Collector Diameter	15.4 cm (6.1 in)	20.3 cm (8 in)	24.5 cm (9.7 in)

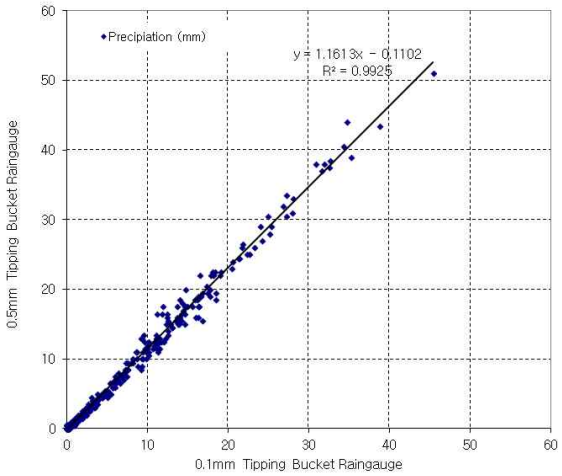

Fig. 1. The scatter diagram shows a relationship between 0.5 mm tipping bucket rain gauge and 0.1 mm tipping bucket rain gauge.

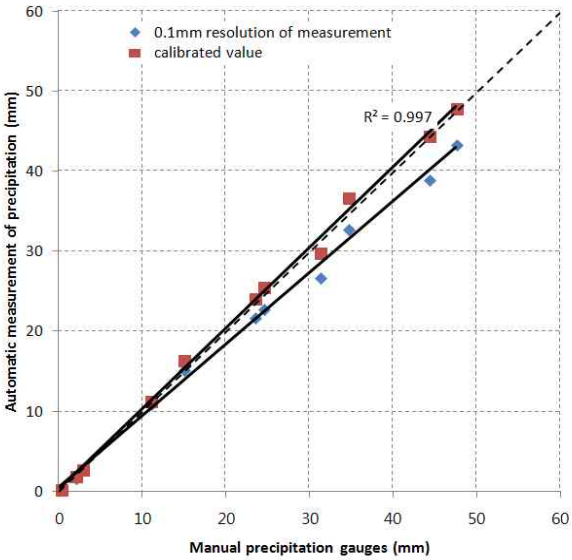

Fig. 2. The scatter diagram shows a relationship between automatic measurement of precipitation and manual precipitation gauge.

Fig. 3. The automatic measurement of precipitation (0.1 mm tipping Bucket Rain gauge, left) and manual precipitation gauge(right).

References

Campbell Scientific, Inc. 2010: *Manual TE525 Tipping Bucket Rain Gage*, Campbell Scientific, Inc.