Interactive comment on "Performance of post-processing algorithms for rainfall intensity measurements of tipping-bucket rain gauges" by M. Stagnaro et al. (Reply to Referee #4).

Matteo Colli[1,2], Mattia Stagnaro[1,2], Luca G. Lanza[1,2], and P.W. Chan[3]

[1]University of Genova, Department of Civil, Chemical and Environmental Engineering, Via Montallegro 1, 16145 Genova, Italy
[2]WMO/CIMO Lead Centre "Benedetto Castelli" on Precipitation Intensity, Italy
[3]Hong Kong Observatory, 134A Nathan Road, Honk Kong, China

Correspondence to: Mattia Stagnaro (Mattia.Stagnaro@unige.it)

We would like to thank referee #4 for his/her comments since they allowed us to improve the quality of the manuscript. Below we report the referee comments in bold and our answer. A revised version of the manuscript, containing the reviewer's suggestion, is provided in the supplement of a separate comment.

In particular, the characteristics of the errors, as summarized by the relatively large observed biases and variabilities relative to the reference measurements, merits some discussion.

We tried to summarize the discussion about the characteristics of both the bias and the variability of the observed RI output in the "Results" section of the manuscript. In particular, the descriptions of Fig. 5 and 6 precisely aim at providing the requested discussion. The same is true for the descriptions provided in the text with reference to Fig. 7 and 8. Consider also that the reference is here provided by a high-resolution optical gauge, but this has associated inaccuracies as well - which are totally unknown.

One of the referees has commented on the need for a site description which should include the spatial layout/separation distances/mounting heights of the gauges etc that might influence the characteristics of the errors.

The site description of the field test site have been added to the revised version of the paper following the suggestion of referees #1 and #3.

Given that the TBRGs are stated in the paper to have been subjected to laboratory calibration/ correction of the intensity data using a correction curve, it does not seem that the errors observed in relation to the reference raingauge can be attributed to "instrumental mechanical errors", given that the correction curve is supposed to account largely for these effects.

We added some statements in the discussion of the results (section 5) in order to stress that the variability of the errors after correcting for calibration are only partially attributable to the remaining calibration uncertainty, as commented by the Reviewer. We stated that there are other factors that contribute to the measurements accuracy such as the RI calculation method adopted (inter-tip vs. simple count) and environmental factors (e.g. the wind-induced and wetting effects).

Small scale rainfall variability across the measurement site must make a contribution to the observed variability.

The OSK reference is distant approximately 5.8 and 2.1 m from the SL3 and LGO rain gauges respectively. All the three rain gauges are installed on the ground in the test field site of the Hong Kong Observatory and they are placed far from relevant obstacles. Due to this configuration, it is possible to assume that the impact of rainfall spatial variability is negligible.

In relation to the consistent underestimation observed, which should be largely removed by the correction curve, was a volumetric check gauge run alongside the two TBRGs and the reference gauge to check on the total volumes from each over the period of the experiment?

The reviewer is correct to propose a volumetric check of the TBRGs to investigate the observed underestimation; however, data from co-located totalizer gauges were not available during the campaign. The objective of the study was not to assess the best performing gauge, nor to achieve the most accurate measurements in absolute terms, but rather to compare two different algorithms for RI retrieval. In this view, a residual bias between the two TBRGs and the reference is not expected to affect the results, which are mainly based on variability analysis (standard deviations).