

Response to RC2 comments (<https://doi.org/10.5194/egusphere-2026-2108-RC2>)

General comments.

The manuscript presents results from numerical estimates regarding the effects of rain gauge shapes on the rainfall measurements as wind intensity increases. The subject of the manuscript covers an important problem in the precipitation measurements performed during high windy intervals. Nonetheless, the paper shows only numerical outcomes but not any comparison between the proposed design and other rain gauges during natural events. By this, I suggest that the title should be changed to indicate that the conclusions are based on numerical simulations.

The title was modified as suggested by the reviewer.

Specific comments.

Section 2.1

Figure 1 caption. The symbols of the angles must be changed (to greek letters) to match what is indicated in the figure.

Done.

Section 3.

Here are presented the results from the performed simulations but no contrast (discussion) with respect to previous studies. So, the section should be renamed as “Results”.

Done.

Section 3.1

Lines 234 and 235. Change the symbols corresponding to the angles for the Greek letter (tetha) of Figure 1a.

Done.

Section 3.2

Lines 266 and 267. The indicated panels do not correspond to the beta angles indicated. The panel 4a has a beta value of 45 degrees. Please modify the text.

Done.

Please explain the reason for the overestimation for drops with $D > 1$ mm of the six cases with respect to the SBS-500 gauge.

Overestimation in the cases indicated by the reviewer is due to an aerodynamic effect already shown in existing literature (Cauteruccio et al. 2020). For specific combinations of wind speed and drop size, the aerodynamic disturbance can divert a small fraction of drop trajectories upwind of the collector inside of it. Meanwhile the aerodynamic disturbance cannot divert an

equal or larger number of trajectories outside the collector downwind, due to the presence of strong downdraft and lower horizontal flow velocity. This results in some limited overestimation that is strongly dependent on the specific combination of drop size and flow velocity. A more detailed explanation has now been included in the text.

Cauteruccio, A., & Lanza, L. G. (2020). *Parameterization of the collection efficiency of a cylindrical catching-type rain gauge based on rainfall intensity*. *Water*, 12(12), 3431. <https://doi.org/10.3390/w12123431>

Section 4

Lines 326-330. Explain the reason by these results are not presented in Section 3.

In section 3, several design solutions are compared under a specific wind condition to evaluate the optimal configuration. In section 4, instead, performance is quantified only for the proposed design extending the analysis to cover a wide range of environmental conditions. This difference was clarified at the end of the introduction section.

Lines 347-354. How do the authors estimate the number of collected drops? Testik and Pei (2017), Bolek and Testik (2022), and Testik and Bolek (2023) have shown that during windy episodes (horizontal wind < 10 m/s), raindrops can get considerable horizontal speeds. Are those results considered in your estimates? The effect on the falling behavior of raindrops should be larger when wind speed has larger values, especially when wind speed is greater than the raindrop terminal velocity, which should be reflected on the CR values of Figure 9.

To determine if a drop was collected, its impact point inside the computational domain was determined. If the trajectory ends on the external surface of the gauge or on a domain boundary (or did not reach any surface when the simulation stops) it is considered “uncollected”. Only drop trajectories that terminates on the internal collector surface are considered as “collected”. This explanation has now been included in the text to improve clarity.

The effect reported by the reviewer is clearly visible in the simulation, with smallest drops having an almost horizontal trajectory when wind is strong. Under the hypothesis of uniform wind speed, the fall angle can be obtained simply by the vector combination of drop terminal velocity and wind speed. For this reason, in our simulation each drop is inserted in the domain with an initial vertical velocity equal to its terminal velocity and a horizontal velocity equal to the undisturbed wind speed. Drop velocity can then change when it approaches regions of the domains where air velocity is affected by the presence of the gauge.

This is well documented in Figure 9, where a reduction of CR with increasing wind speed is evident and is more severe for small drop diameters (meaning drops that tend to have an almost horizontal trajectory) and less severe for larger drops (that tend to have a more sloped trajectory under the same wind speed). This indicates that the effect cited by the reviewer is indeed reflected into the CR values (and in Figure 9) and it increases with increasing the wind speed (as expected and in accordance with the cited literature).

Conclusions

Lines 472-474. There is not any result in the manuscript that supports such conclusion. So, the residual is eliminated completely or how much is reduced?

Optimising the rim design reduces the impact of wind on the efficiency of the gauge collection, thereby minimising the wind-induced bias in precipitation measurements. However, it cannot eliminate undercatch completely, since the gauge cannot be made fully transparent to the wind. A residual bias remains, which is quantified in the manuscript for the proposed rim design using calculated CRs as a site-independent factor. By introducing a suitable particle size distribution, the collection efficiency (CE) of the proposed rim design can be calculated for any local climatology. From the CE definition, adjustment curves can be derived and applied to the raw data to eliminate residual bias. This approach is fully supported in the manuscript, as it is derived solely from the calculated CRs.

For the adjustment to be effective, detailed, high-resolution information is required regarding both the wind speed at the collector's height and the actual particle size distribution. Insufficiently precise information about these two variables may affect the efficacy of the adjustment and prevent the bias from being eliminated completely.

We have slightly modified the text to better explain this concept.