

Overview from Reviewer #2

The paper presents results from tests on the adequacy of (mostly already existing) transfer functions for precipitation gauges. It directly builds on the paper by Kochendorfer et al. 2017, recently published in HESS.

The topic discussed by the Authors is of scientific relevance and timely, and its scope is within the objectives of HESS. The manuscript presents novel findings that may be useful to inform the selection of proper instrumentation for measuring (solid) precipitation. Results and conclusions are clearly outlined; however, I believe the overall presentation should be substantially restructured to better convey the manuscript's findings. Specifically, I think that, in its current form, the manuscript lacks important pieces of information and an overall picture that would enhance its comprehension.

Authors' response: Thank you. We agree with this evaluation and will restructure the manuscript based on the reviewer's suggestions.

In the following, I report a few suggestions for improvement.

General comments:

1. A short introduction should be provided on the reasons why new precipitation gauges are needed, what are the criticalities in measuring precipitation, what we expect the improvements from using alternative measurement systems would be. I understand that many of these aspects were already outlined by the Authors in Kochendorfer et al. 2017; herein, the Authors should focus on measurement equipment alternative to traditional systems. Alternative precipitation gauging systems are blossoming in the hydrological community, and their promise/limitations may be reported to better support the scope of the paper and expand the bibliography.

Authors' response: The Introduction will be augmented with a description of why new precipitation gauges are needed, and areas where the authors see the potential for improvements. By 'alternative' precipitation measurement systems, we assume that Reviewer #2 means non-catchment types of gauges, which include the hotplate and optical devices such as the present weather sensors, present weather detectors, disdrometers, and optical rain gauges. Some of these types of gauges were included in WMO-SPICE, and the results will be detailed in the forthcoming project report. A detailed discussion of these gauges is beyond the scope of the present manuscript, which focusses on weighing gauges ('traditional' systems).

2. The role of wind in the underestimation of precipitation should be better highlighted through key citations.

Authors' response: This is a good suggestion; we will add more citations describing the effects of wind on gauge catch efficiency.

3. Why were these specific gauging systems selected? I think that the description of gauges can be improved by providing further details on how they work, what their features contribute to, and

what we should be expecting in terms of performance and limitations. I also suggest that Figure 2 is improved and key features are highlighted for each of the gauges.

Authors' response: All of the weighing precipitation gauges tested in WMO-SPICE have been included in the manuscript. Many of the gauges were provided by the manufacturers that chose to participate in WMO-SPICE, and others were provided (and selected) by site hosts for their own national and scientific interests. Such an explanation will be added to the manuscript. Some description of the individual gauges was provided in the appropriate Results sections, but these will be expanded and moved to the Methods section. This may also help with the restructuring of the manuscript.

Figure 2 was included to provide readers with visual examples of field installations, and to help familiarize readers with the different types of gauges and windshields discussed in the manuscript. Such images can also be used to visually assess the effects of wind on the different types of gauges and shields. These examples provide valuable context for the interpretation of results and discussion regarding wind effects on different gauge/shield combinations. The technical features of the gauges will be described in a new table, added to the revised manuscript. However visual depictions of the specific transducers for each gauge type, and of other gauge elements such as heaters and buckets, are not critical to the interpretation of results, and will not be included.

4. The Discussion and Conclusions should clearly state what research findings are and recommend best practice for measuring solid precipitation. I suggest the Authors include a Table in the "Synthesis" section where each gauge is coupled with the recommended transfer functions and comments are provided on eventual limitations.

Authors' response: This is an excellent suggestion. We will modify and restructure the manuscript, which will have a larger Synthesis Section, and a smaller Section describing the results of the individual gauges. A Table will be added clearly documenting the recommended transfer functions for each gauge and shield.

Specific comments:

1. Abstract: I think the Abstract should be simplified (it is not necessary to list the names of all gauges) and the paper objectives and results clearly outlined.

Authors' response: We will remove the list of gauges and further simplify the Abstract by focusing on the general objectives and results.

2. Introduction: I believe including a synthesis Table on previous experiments would help the reader to frame the work within previous studies. I also recommend the Authors expand the last paragraph by (i) justifying the selection of specific gauges; (ii) clearly stating hypotheses; (iii) and identifying key objectives.

Authors' response: These are good suggestions. The Introduction will be expanded to describe in greater detail how the present work relies upon and supports previous studies. Clarification of

the inclusion of all available WMO-SPICE weighing gauges will be included. Hypothesis and key objectives will also be described.

3. Methods: Many parameters/terms were not properly defined. I believe the Authors should devote a paragraph to re-state what catch efficiency is, what are key variables influencing the response of the gauges, and to report previously developed transfer functions. Please also clarify the data structure (sentence on Page 4 line 31 is out of the blue).

Authors' response: Thank you. The Introduction will be expanded to more thoroughly introduce the reader to new terminology, precipitation gauge undercatch, and transfer functions. The Methods section will be augmented with definitions of key terms, measurements, and the data structure.

4. Results and Discussion: Since many of the tested gauges had a similar behavior, I do not think separate sections and Figures 4 to 12 are necessary. I suggest the Authors consolidate results in a Table. I would also move the transfer function coefficients in the Supplementary Material.

Authors' response: These are good suggestions. We will develop a more succinct way to present the main results, and can move the transfer function coefficients to the Supplementary Material.

5. I think the presentation quality of the paper is sufficient; however, the number of references could be extended. I also suggest the Authors double check the English for minor typos. I herein list some of them:

Authors' response: Thank you. We will double check for minor typos and add more references to the Introduction.

- Page 3 line 9: "consisted of a either a"

Authors' response: This will be corrected.

- Page 10 line 6: "This result are"

Authors' response: This will be corrected.

- Page 11 line 6: "measurements are attributed"

Authors' response: This will be corrected.

- Page 13 line 17: "3-dimensional" (please clarify what this means)

Authors' response: Thank you. By '3-dimensional' we meant as a function of both wind speed and air temperature. The term will be removed, as it is unnecessary.

- Page 15 line 4: This sentence is unclear, please elaborate.

Authors' response: The following sentence clarifies: “At higher wind speeds, where such measurements require doubling or even tripling, the uncertainty in the measurements was also doubled or tripled, accordingly.” But the sentence is indeed confusing, and will be rewritten.

I also suggest the Authors pay special attention in defining all acronyms

Authors' response: The manuscript will be reviewed carefully to ensure that all acronyms have been defined properly.