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Interactive comment on "Unshielded Precipitation Gauge Collection Efficiency with Wind Speed and Hydrometeor Fall Velocity. Part II: Experimental Results" *by* Jeffery Hoover et al.

Anonymous Referee #1

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This manuscript shows that the RMSE of the collection efficiency can be significantly reduced if the fall speed derived from the Precipitation Occurrence Sensor System (POSS) is used. The paper is well written and shows new findings as the POSS can be used to improve the adjustment of solid precipitation. Nevertheless, I think that the text could be more concise for clarity and key information are missing. They are listed below. I recommend major revisions.

Major comments:

1. Introduction:

i) A few references are missing. 1) Colli et al. (2020) should be added to the paragraph

discussing methods to improve the adjustment of solid precipitation. Colli et al. (2020) showed that the precipitation intensity improvements the adjustment of solid precipitation at given wind speed. 2) Chubb et al. (2015) also proposed that the precipitation rate as could be used to adjust solid precipitation measurements.

Colli, M., Stagnaro, M., Lanza, L. G., Rasmussen, R. and Thériault, J. M. (2020). Adjustments for wind-induced undercatch in snowfall measurements based on precipitation intensity, Journal of hydrometeorology, 21, 1039-1050.

Chubb, T., Manton, M. J., Siems, S. T., Peace, A. D., & Bilish, S. P. (2015). Estimation of Wind-Induced Losses from a Precipitation Gauge Network in the Australian Snowy Mountains, Journal of Hydrometeorology, 16(6), 2619-2638.

ii) What is the goal of the study? A summary of the methodology is given in the last few paragraphs but it never stated the goal clearly.

2. The methodology section is incomplete. i) a description of the CFD simulations is missing. The relevant information from Part 1 should be added to the methodology of this manuscript. ii) A description of the method used to develop the transfer functions, in particular, the fall speed threshold values given in Section 3.1 should be added.

3. Section 3.1: How are the air temperature and fall speed threshold values determined in the study? In Table 2, the fall speed values for the precipitation type categories overlap. For example, snow events could also be mixed events if the temperature is < 0.5°C and the precipitation falls at < 2.32 m/s. It should be clarified in the text.

4. Why not using the temperature thresholds used in Kochendorfer et al. 2017b, which are -2°C to +2°C, to discriminate the precipitation types? Those are the threshold commonly used in the literature.

Minor comments:

1. Lines 81-83: Change hydrometeor type for "type of solid precipitation" or "type of snow" because the study was done for solid precipitation. Add "fall speed" to the

sentence because that is a key parameter of the study. The revised sentence could be: "Theriault et al. (2012) demonstrated similar trends for snowfall, with collection efficiencies varying significantly with the type of solid precipitation, fall speed and size distribution."

2. Lines 171-173: The transfer function uses the accumulated precipitation while the CFD simulations uses the precipitation intensity. Clarify this possible inconsistency.

3. Equation 3: Could you explain why this equation is relevant? If not, remove it.

4. Lines 287-292: Why using 1.93 m/s as a threshold? It should be explained.

5. Lines 296-301: Why using 2.81 m/s as a threshold? It should be explained.

6. Figure 4: Did you try using boxplots instead of a scatter plot to show the collection efficiency? It could give an idea of the scatter in the collection efficiency with wind speed.

7. Tables 3 to 9 could be put in an Appendix since that it is showing additional information. One could also do barplots instead of Tables.

8. Lines 477-479: The sentence: "While automatic . . . this work" seemed out of place. It may be better in the conclusion?

9. Line 505: The sentence: "The HE1 transfer function showed good results for snow, supporting its use for unshielded gauge.". I agree but Figure 3b (as an example) still shows lots of scatter in the collection efficiency for fall speeds associated with snow/solid precipitation ($\sim$1-2 m/s). Add a short discussion?

10. Lines 537-539: This sentence is not quite right and I think that it is an important point. The references from Kienzle (2008) and Harder and Pomeroy (2013) should be after the word "instructive" because they developed a method to diagnose the precipitation phase at the surface when the information aloft is not available. Theriault et al. (2012) suggested to use surface temperature but did not develop a method to diagnose

the type/phase of precipitation. At the end of the sentence, the authors should refer to a paper that state the importance of the atmospheric conditions aloft to determine the type/phase of precipitation at the surface such as for example Stewart et al. (2015).

Stewart, R. E., J. M. Theriault, and W. Henson, 2015: On the characteristics of and processes producing winter precipitation types near 0°C. Bull. Amer. Meteor. Soc., 96, 623–639, doi:10.1175/BAMS-D-14-00032.1.

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