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Hydrology and Earth System Sciences
Discussions

Interactive comment on "The Quantification and Correction of Wind-Induced Precipitation Measurement Errors" *by* J. Kochendorfer et al.

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GENERAL COMMENTS:

"The Quantification and Correction of Wind-Induced Precipitation Measurement Errors" is an important paper on the field related to addressing the quality issues of precipitation measurements using auto gauges. The paper includes observations from two sites Marshall (US) and Haukeliseter (Norway). The paper presents two transfer function models: a sigmoidal and a simplified exponential sigmoidal model, the simplified model is first published in this paper. The two models are compared using RMSE and bias statistics, the results were very similar. The paper describes the recommended / possible use of the transfer function for correcting wind related precipitation measurement errors. The comparison of different gauge / shield combination at Marshall (US)

site identifies the efficiency of different shields. The discussion on the effect using gage height versus 10 meter wind speed in the correction procedure is also important in future applications.

As of possibilities for improvements, the site descriptions should be more consistent and coordinated. The use of minimum 0.25 mm threshold is acceptable, but debatable (can be lowered, as low as 0.1 mm). For the Norwegian site further description of pre-processing method would help the understanding of the results. The time period used for the analysis is missing from the description part. The individual gauge and the combined series analysis suggested to be separated into individual tables. For the individual gauge transfer function development the US-SA and NOR-SA analysis can also be added. This additional result can also be compared with the modified coefficients using the merged ALL-SA dataset. The use of "universal" transfer function is a bit ambitious and misleading in this paper, since beside the US gauges, only one additional gauge was added to the analysis representing somewhat different climate.

SPECIFIC COMMENTS:

ABSTRACT

- It is well written. I would only argue on the use of the words "remove" in the bias analysis. In 7 out of the 8 SA verification cases (3 cases at gage height and 4 cases at 10 m wind speed) the biases was reduced (or decreased) and not removed.

CHAPTER 1

- Line 4 and 9: If possible, add more recent references here

- Line 11: Add Mekis and Vincent, 2011 reference (see at the end)

- Correct the reference: Goodison et al, 1998 (see at the end)

- Line 28: "various measuring sites" should not be used here since in the paper only two sites are included (representing two climate types only)

CHAPTER 2

The title “Methods” of this chapter is incorrect, misleading. It includes data (metadata) of the sites, applied gauges beside the methodology.

CHAPTER 2.1

- Add a small map with site locations

- Level of details in describing the two sites should be consistent, coordinated and synchronized: MARSHALL: Add reference gauge description; add any reference where this site is already described in details and HAUKELISETER: Add typical snow regime

- Line 12-14 sentence: Add reference to this statement

CHAPTER 2.2

- Consider adding a figure: The descriptions and all the technical details is a bit “dry” using numbers only, the comparison of the shields (for an outsider) would be easier with a sketch of the shield types

- Identify the sites (US and/or NOR) where the given shields were installed and used in this chapter (will correspond later to tables).

CHAPTER 2.3

- Line 25: Use the same notations U4.5 vs Ugh

- Identify the air temperature and wind instruments for the NOR site as well (similarly to 2.3.1), please include more details

CHAPTER 2.4

- Figure 2 reference is missing, it is probably belong to here

CHAPTER 2.5.1

- The period used for transfer function development is completely missing from the

paper (it is mentioned as “several years” in the introduction) – please include here (or somewhere in chapter 2).

- For NOR the short summary of the method from Wolff (2015) paper would be beneficial, help the understanding. Important to know how was the 3-wire input used, or any further sensor was included (wetness sensor, PWD or any other overlapping observation).

CHAPTER 2.5.2

- The use of 0.25 mm lower limit for the standard (reference) gauge is debatable based on Figure 3, the SE minimum value is around 0.1 mm.

CHAPTER 2.5.3

- Figure 4: SA data points should be better identified (period of observation, number of measurements by sites)

CHAPTER 2.6.1

- Is there any NOR pair to be included?

CHAPTER 3.2

- Table 2 and 3 are hard to read, lines are broken, difficult to find the related numbers

- The TF function development results and the validation is confused in Table 2-3. From Table 2 & 3 the US SA and NOR SA fitted values are missing, that should be part of these tables. Separate (or last line) should be used the verification values – RMSE and bias values computed from the SA-ALL coefficients. It would also add the possibility to compare the RMSE and Bias before/after values.

- Line 14: decreased the bias, not removed; it is especially true for the NOR site

- Line 25-26: easier to follow from the table, if % values are not rounded

- Lines 31-32: goes back to my original point – the algorithm at the NOR site used to

create the output from the 3 wires in missing from section 2.5.1. The difference can be due to different pre-processing algorithms as well.

- P13: Line 9: US SA N = 1156 (not 843).

- P13: Gauge height and 10 m TF analysis should be separated (in lines 6-12 the values refer to Table 2, then suddenly the conclusion is for both Table 2 and 3).

- P13 / line 15-16: Wind speed observations were available from several gauges (from 2.3.1 first paragraph), so independent gauge height wind speed measurements could have been used. Next sentence is meaningless, since the gauge height and 10m wind input are dependent (derived from each other).

- P14 / lines 1-6: Small variations are not as important as bringing the total closer to reality (in the context of the water budget) – this can be further highlighted.

CHAPTER 4.1

- Line 9-10: this statement is in contrast with the fact, that for this study the US gauge-height wind speed was derived from 10 m; in spite of the fact, that it was available at 1.5, 2 and 3 meters. The use of 10 m wind for the combined dataset is understandable, but not necessary for the individual analysis. Additional study including different wind sources could have been completed for the US installations.

CHAPTER 4.2

- As I mentioned earlier, this “universal” transfer function is not universal enough to justify the use of this word here, since the analysis representing only two different climates.

- The discussion of the site-specific analysis perhaps can be replaced by the more general climate-specific analysis.

CHAPTER 5

- Line 19: The end of the sentence was not clear, a suggestion to improve: “and for various gauge/shield combinations”

- Line 21: Verb missing at the end: Wolff et al. (2015) is presented.

REFERENCES:

- Line 16: Precipitation

- Please correct the reference: Goodison, B.E., P.Y.T. Louie, D. Yang (1998): WMO Solid Precipitation Measurement Intercomparison – Final Report. Instruments and Observing Methods Report No. 67, WMO/TD-No. 872, World Meteorological Organization, 212 p.

- Nitu et al, 2016: it was a presentation – can’t be referenced.

- Add: Mekis, E. and L.A. Vincent, 2011: An overview of the second generation adjusted daily precipitation dataset for trend analysis in Canada. Atmosphere-Ocean, 49(2), 163-177.

OTHER:

- Figures should be numbered following the appearance – Figure 1 only referenced toward the end of the paper

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