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Atmospheric Measurement Techniques Discussions

Interactive comment on "Evaporation from weighing precipitation gauges: impacts on automated gauge measurements and quality assurance methods" *by* R. D. Leeper and J. Kochendorfer

Anonymous Referee #1

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The discussion paper by Leeper and Kochendorfer discusses the impact of evaporation from an accumulating precipitation gauge on the estimation of sub-hourly precipitation amounts. They use a pair of Geonor T-200B precipitation gauges co-located at a relatively warm and dry site, one with evaporation suppressant as a control and the other without. The gauge without suppressant, called evap, obviously experiences substantial evaporation during the dry periods of the study period while the gauge with suppressant, called nonEvap, has negligible evaporation. The authors then test two algorithms used to derive precipitation amounts for 29 events and compare the estimates

from the evap gauge to the control nonEvap gauge. Results showed that one algorithm (referred to as pairwise) produced 5% more precipitation than the second algorithm (referred to as wAvg) when compared to the control. The pairwise algorithm also resulted in higher precipitation estimates in the control gauge. The main take home point of this paper is that the choice of processing algorithm to produce precipitation amounts from the raw Geonor bucket weights has a substantial impact on the final precipitation estimates and that this choice is more significant when no evaporation suppressant is used.

The information presented in the paper is useful, especially if the user needs to make decisions between suppressant and non-suppressant and between the pairwise and wAvg algorithms. Although not overly extensive or novel, the analysis seems to be scientifically relevant and mostly scientifically sound. However, it is the opinion of this reviewer that the information is not well presented and requires some re-working. This reviewer has several lingering questions that should be addressed. These are:

1)The QA method evaluation is really the focus of this paper yet the description of these methods, especially the algorithms, are quite vague, somewhat confusing, and largely left to a reference of another submitted manuscript. a) Starting on page 12856 line 12, you note that the 1-minute data were "aggregated" into 5-minute values but this sentence is confusing and doesn't explain how this was done. Was it an average of the 1-minute data or a re-sample? b) You need to provide at least one paragraph explanation for each of the two algorithms, instead of the 4 sentences on page 12856.

2)On page 12858, you speculate that the increase in bucket weight in the evap gauge during low vpd and surface wind to possible condensation inside the gauge. This doesn't show up in the nonEvap gauge so I assume that you are inferring that this moisture is derived from evaporation of the liquid in the bucket. Can you comment on the impact of this on (false) precip estimates as a product of either of the algorithms? You could look at low vpd/wind speed periods to confirm your statements, or at least suggest that this could be done. Also on page 12858 lines 6-8, you comment that

wind has less of an impact on the depth change in the evap gauge but I clearly see a decrease in depth with increasing wind in Fig 4d. You should revise this statement.

3)On page 12858 lines 13-22, you attribute the amplified diurnal trend in the evap gauge to the occurrence of evaporation. I don't think this is the case. I'm wondering if this has more to do with the inherent noise in the sensors rather than an evaporation/condensation signal. The difference between hour 1 and hour 24 is more important I would think. Similarly, you make a comment on page 12859 lines 5-7 attributing the variability in sign to spatial variability in precipitation but could this also be a result of signal noise and the processing technique?

4)On page 12860, lines 23-24, you note that evaporative biases shift the timing and impact the intensity of precipitation events. Can you comment on why this happens, assuming that it is a product of the algorithm?

5)In your conclusion, page 12861 lines 8-16, you basically suggest that evaporative suppressants are not required if you use the correct algorithm. I can understand this may be the case for measuring liquid precipitation events BUT many of the past studies that you cite in earlier sections have focussed on solid precipitation, and with solid precipitation measurement, you require an antifreeze solution that usually contains methanol to inhibit stratification and freezing. Without an evaporative suppressant, this will not work. Be careful with your broad recommendations without caveats. Also, your statement in lines 17-19 is a bit misleading since you are suggesting that scientists using the data will not have to correct the data sets for evaporation. . .but that's because the algorithm has already provided this adjustment. Maybe state this in a different way.

6)In Table 1, the pairwise algorithm not only results in less precipitation in the evap gauge, but also in the control (nonEvap) gauge. This isn't really addressed in the paper but perhaps it should be.

There are some specific changes that I would request to improve the presentation quality of this paper. These are:

Abstract: 1)Abstract has some wording and formatting issues that confuse the reader. The sentence from lines 12-14 is confusing. Try "Two Geonor gauges were collocated with one gauge using an evaporative suppressant (referred to as nonEvap) and the other with no suppressant (referred to as evap) so that...". Also, you use "suppressant" often but you don't describe what the suppressant is. 2)Suggest changing the names of the gauges to "Geonor-Evap" and "Geonor-NonEvap" might add to the readability of the paper. I found that the interjection of "evap" into sentences when referring to the gauge was confusing when talking about evaporation at the same time (are you referring to the gauge or to what's happening to the gauge?). Maybe it's just me. 3)The way that you interjected the numbers in lines 17-20 impacted the readability of the sentence. 4)Line 21 should be ". . .design affect gauge evaporation rates, computational methods can. . ." and Line 22 should be "It is hoped that this study. . ."

Introduction: 1)Page 12854, line 6: ". . .can bias observations even when taken at subhourly. . ." 2)Page 12854, lines 13-16: The sentence "Addition analysis. . ." has several issues to correct and should be re-worded for clarity.

Methodology: 1)Page 12855, lines 10-12: The Geonor and Tretyakov are not really similar. Instead of saying this, why don't you simply describe the Geonor gauge. 2)Page 12855, line 13 and onward: you refer to "gauge depth". What you are actually referring to is bucket weight which is translated by the logger into precipitation depth. Perhaps either call it bucket weight or explain why you call it "gauge depth". 3)Page 12855, line 12: why don't you reference the gauge sensitivity from the Geonor manual? 4)Page 12855, line 24: change "evaporation biases" to "biases as a result of evaporation". 5)Page 12856, lines 1-10: lots of detail in the instrument descriptions that can be omitted.

Results: 1)Page 12857, line 17: "gauge" should be plural. 2)Page 12859, line 17: where does 0.2mm come from and why? Conclusions: 1)Page 12860, line 2: ". . .was extensive when no suppressant is used." 3)Page 12860, line 9-10: ". . .which likely challenges QA processes that distinguish between. . ." 4)Page 12860, lines 18-21: The

sentence starting with “However. . .” is confusing and could be stated in a better way. Re-word. 5)Page 12861, line 8: You can probably omit “National trends” as the data is likely used for much more than this. 6)Page 12861, line15: Should “wildness” be wilderness? 7)Page 12861, lines 19-23: The sentence beginning with “It is hoped. . .” is a bit confusing and should be reworded or made more concise.

Figure 6: You have been using red and blue for evap and nonEvap and then used red and blue again for Pairwise and wAvg. How about changing the colours on this graph to something other than red and blue? Same applies for Figure 7.

Interactive comment on Atmos. Meas. Tech. Discuss., 7, 12851, 2014.