

## ***Interactive comment on “Derivation of a new continuous adjustment function for correcting wind-induced loss of solid precipitation: results of a Norwegian field study” by M. A. Wolff et al.***

**J. Kochendorfer (Referee)**

John.kochendorfer@noaa.gov

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General Comments:

“Derivation of a new continuous adjustment function for correcting wind-induced loss of solid precipitation: results of a Norwegian field study” is a well documented and thorough study of the underestimate of solid precipitation measurements caused by wind. The effects of wind on the amount of precipitation that falls into a gauge and the importance of wind shields are well documented and important issues. In the present manuscript the authors compare one of the most commonly-used (and therefore im-

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portant) standard methods of measuring solid precipitation to one the most accurate standards available. The experiment is sound, in that the standard used to measure precipitation is shielded from the wind with the widely accepted Double Fence, which was chosen as one of the standards for the ongoing WMO Solid Precipitation Intercomparison Experiment. In addition the wind speed, precipitation type, and air temperature measurements are all state of the art and carefully analyzed. The experiment is new and unique and useful because it focuses on automated measurements, it includes snowfall events that occur at much higher wind speeds than previously published, and it employs sophisticated statistical methods to objectively select the best method of accounting for the under-catch that occurs in a single-Alter shielded gauge. The results and the methods will be widely cited by researchers performing similar studies in different climates.

Specific Comments:

The writing needs improvement. The sections describing the statistical analysis and the results are well-structured and relatively free from grammatical errors, but the other sections need to be reviewed for errors in verb tense, sentence structure, and grammar. Specific suggestions are given below in the Technical Corrections portion of this comment, but they are not comprehensive. A complete review of the manuscript for such issues needs to be performed by the authors.

Although references are provided, more care and detail should be provided describing the wind speed and air temperature measurements. These measurements are central to the manuscript and merit description within the manuscript itself.

The chosen function (eq. 9) is quite complex, making it difficult to test on new datasets without employing sophisticated statistical tools. Are there simpler functions that also performed well? In the selection process was any consideration given to the number of parameters or the complexity of the function?

As the authors note themselves in Sec. 5.3, pg 10067, ln. 21-23, the function devel-

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oped in the manuscript must be inverted before being applied to actual precipitation data (eq. 11 and 12 are raised to the power of -1). With the stated goal of creating a function available to correct measured precipitation, why was the transfer function fit to catch efficiency (PM/PT) data, rather than the inverted correction factor (PT/PM) data? Are there any significant differences between the two approaches that might affect the form of the chosen function or the uncertainty of the correction?

In Sec. 5.3, pg 10067, ln. 23-26 the authors state that the results of the uncertainty analysis were unreliable. This is disappointing, especially considering the significant statistical expertise that is demonstrated in the manuscript. Could the uncertainty be better quantified (in mm and/or percent of hourly precipitation) by applying the correction to the actual PM data and comparing it to the standard PT results? I realize this may be beyond the scope of the current manuscript, but would a bootstrapping-type technique be appropriate for quantifying correction uncertainties using the available dataset?

In order to correct operational precipitation measurements, operational anemometers must be installed so that are unaffected by nearby obstructions to the wind (such as wind shields). This important point is clearly inferred from your work, but it should be stated explicitly.

Technical Corrections:

Many of the specific corrections below are offered as suggestions; better or more extensive changes used to correct the issues identified below would be welcome.

Pg. 10044, ln 8. "Precipitation data of automatic gauges" should be written as, "Automatic precipitation gauge data".

Pg. 10044, ln 14. "the model that is describing the data best" should be written as, "the model that best described the data."

Pg. 10044, ln 18. It isn't clear what is meant by "the chosen model uncertainty is

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slightly insufficient". Was the model used to describe uncertainty insufficient?

Pg. 10044, ln 19. Add, "because it is" between "usable" and "based".

Pg. 10044, ln 24. "data-tested validity" and "proved a stabilisation" are both awkward as written.

Pg. 10045, ln 2-3. Rewrite as, "In addition to rising global temperatures, climate models also predict significant changes to the hydrological cycle."

Pg. 10045, ln 3. "availability to water" should be written, "availability of water".

Pg. 10045, ln 16-17. The sentence, "Nevertheless, wind bias still remains..." is awkward as written.

Pg. 10045, ln 22. "An outcome" should be written, "One outcome".

Pg. 10045, ln 23. "DFIR" should be in parentheses. Also "the reference for which snow measurements should be compared to" could be written more clearly as, "the reference snow measurement".

Pg. 10045, ln 24-25. "measurements configurations for solid precipitation" should be written, "solid precipitation measurement configurations".

Pg. 10046, ln 3. Remove the word, "highly".

Pg. 10046, ln 8-9. The phrases, "tremendous effect" and, "their order of magnitude" should be replaced with more specific and descriptive language.

Pg. 10046, ln 13. "falls a larger fraction" is awkward as written.

Pg. 10046, ln 16. "is in the magnitude of" should be rewritten, "is of a similar magnitude as".

Pg. 10046, ln 25. "only a few focuses on" should be rewritten as, "only a few focus on".

Pg. 10046, ln 27. "This problem is also given focus" should be rewritten as, "This

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problem is also given attention”.

Pg. 10047, ln 1. “From 2008 to 2009, performance of...” should be rewritten as, “From 2008 to 2009, the performance of...”

Pg. 10047, ln 12-15. The entire sentence beginning with “Here, several countries participate...” is awkward as written.

Pg. 10047, ln 18. “in the need of accurate” should be rewritten as, “in need of accurate”.

Pg. 10047, ln 21. The “the” in front of “changes” should be deleted.

Pg. 10047, ln 21-22. Delete, “Furthermore”.

Pg. 10047, ln 28. “are used” should be, “were used”.

Pg. 10047, ln 29. “the model describing the data best” should be rewritten as, “the model best describing the data.”

Pg. 10048, ln 5. “not as common.” should be rewritten, “less common”.

Pg. 10048, ln 6-7. “settings” isn’t correct grammar. Also “chapters” are usually used in books rather than scientific papers. The whole sentence could be shortened and rewritten, “The measurement site and its climate are described in Section Two.”

Pg. 10048, ln 7-8. “done in advance” should be rewritten, “performed in advance”.

Pg. 10048, ln 8. Delete, “qualitative and quantitative”.

Pg. 10048, ln 19 -20. “The tops” should be called “The mountaintops”, or “The mountains”. Rewrite as, “The mountaintops to the east are ca. 1250 m a.s.l at a distance of...”

Pg. 10048, ln 20-21. Rewrite “towards South and West...” as “towards the south and the west, with the mountains 4 km and 3 km away, respectively”.

Pg. 10048, ln 22. “Precipitation sensors were mounted...” rather than, “Precipitation

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sensors are mounted...”.

Pg. 10048, ln 26. Replace, “construction which” with, “construction that”.

Pg. 10049, ln 1. “minimizes wind influence on the...” should be rewritten, “minimizes the influence of the wind on the...”

Pg. 10049, ln 4. “The combination of DF and automated...” should be rewritten as, “The combination of the DF and the automated...”

Pg. 10049, ln 6. Delete, “currently”.

Pg. 10049, ln 12. Begin this sentence with, “The Haukeliseter”, rather than, “Haukeliseter”.

Pg. 10049, ln 13. “very usual” is awkward as written.

Pg. 10049, ln 16. Delete, “estimated”.

Pg. 10049, ln 26. “starting early” should be rewritten as, “starting in early”.

Pg. 10050, ln 3. “upgrading works” is awkward as written.

Pg. 10050, ln 5-6. Rewrite, “were March and April rather warm” as, “March and April were rather warm”.

Pg. 10050, ln 6. Rewrite, “above normal” as, “above the normal”.

Pg. 10050, ln 9. Rewrite, “with exception of” as, “with the exception of”.

Pg. 10050, ln 12. Was March 2010 really the warmest month ever recorded, or was it the warmest March ever recorded? I would expect July or August to be the warmest month.

Pg. 10050, ln 16. Replace, “was registered” with, “occurred”.

Pg. 10051, ln 3. Replace, “comparable” with, “reproducible”, or explain what is meant by “comparable” - ie. comparable to what?

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Pg. 10051, ln 10. Rewrite, "8 of 10" as "8 out of 10".

Pg. 10051, ln 22. Rewrite, "thus determining dependencies" as, "thus determined dependencies".

Pg. 10052, ln 2. Replace, "are performed by" with, "were recorded with". Also describe the location and make/model of the sensors in more detail.

Pg. 10052, ln 4-5. "directly installed to the precipitation gauges." should be more descriptive and better written.

Pg. 10052, ln 6-7. Delete, "close by" and rewrite, "the met sensors" as, "the anemometers mounted near the shield".

Pg. 10052, ln 9. Delete, "further", and add, "the" before, "gauge-height".

Pg. 10052, ln 11. "featuring" is no the right word here.

Pg. 10053, ln 1. Replace, "are showing" with, "showed".

Pg. 10053, ln 3. Rewrite, "the installations are..." as, "the installations were...".

Pg. 10054, ln 11. Replace, "are still suggesting" with, "still suggest".

Pg. 10054, ln 12. "a larger possibility for rain" is awkward as written.

Pg. 10055, ln 1. Replace, "The data are reporting..." with, "The data include...".

Pg. 10055, ln 10. Replace, "are these data" with, "these data are".

Pg. 10055, ln 16. Delete "precipitation" in, "Based on the observed precipitation intensity".

Pg. 10055, ln 18-19. Delete, "in the presented winter precipitation data set".

Pg. 10056, ln 2. Rewrite, "The literature on mechanistic..." as, "The literature on the mechanistic...".

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Pg. 10056, ln 4. Rewrite, "The most used" as, "The most commonly used..." or restructure the sentence to begin with, "Forland et al. (1996) created the most widely used..."

Pg. 10057, ln 3. "That let expect that intensity" is awkward as written.

Pg. 10057, ln 15. Replace, "(iv) what data is" with, "(iv) the data that is".

Pg. 10059, ln 21. "opens up the possibility for a lot of" is awkward as written.

Pg. 10063, ln 17-18. Rewrite, "describes the actual catch ratio can be evaluated with a closer look on the residuals" with, "described the actual catch ratio was evaluated by analyzing the residuals".

Pg. 10063, ln 21-22. Rewrite, "the covariates wind speed and temperature" as, "the wind speed and temperature covariates".

Pg. 10063, ln 23. Rewrite, "dependent of the" with, "dependent on the".

Pg. 10064, ln 7. Replace, "affected" with, "compromised".

Pg. 10064, ln 8. Replace, "after key parameters which", with "using key parameters that".

Pg. 10064, ln 11-12. The sentence beginning with, "Only wind speed..." is awkward as written.

Pg. 10064, ln 14. "It was refrained from" is awkward as written.

Pg. 10064, ln 19. Replace "exists" with, "exist". The word, "data" is plural.

Pg. 10064, ln 22-25. Awkward as written. Replace "huge" with a more descriptive word. Rewrite "Wind speeds" as "Event average wind speeds". "That allowed for the first time to derive" is not grammatically correct. "data-tested validity" is awkward as writtten. "let expect that extrapolation" is awkward as written.

Pg. 10065, ln 7. "used wind data" is awkward as written.

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Pg. 10065, ln 18. "thus going along with huge" is awkward as written.

Pg. 10065, ln 25. "showed to be far less" is awkward as written.

Pg. 10065, ln 26. "A natural variety" is awkward as written.

Pg. 10065, ln 28. "is not correcting" is grammatically incorrect.

Pg. 10066, ln 13. "happen not necessarily" is awkward as written.

Pg. 10066, ln 16-18. "The question if the results are transferable" and "a broad variety" are awkward as written. Also "thus providing data" should be written, "thus provided data".

Pg. 10066, ln 23. "at very different climates" should be written, "in very different climates".

Pg. 10067, ln 16-17. "but uncertainty analysis" should be written, "but it does indicate that the uncertainty analysis". Also "Heavy tailed characteristics" should be written, "Heavily-tailed residual distributions".

Pg. 10067, ln 19-20. The entire sentence beginning with, "Though symmetry about zero still seems to be the case and systematics bias" is awkward and grammatically incorrect as written.

Pg. 10068, ln 22. Are the results truly "less ambiguous" at near-freezing temperatures, or are they more ambiguous? Explain. "ambiguous" might not be the right word.

Pg. 10069, ln 1. "which describes the model best..." can be rewritten as, "that best describes the observations".

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