

# 1 Unshielded precipitation gauge collection efficiency with wind speed 2 and hydrometeor fall velocity.

3 **Authors' response:** Thank-you to John Kochendorfer and the anonymous reviewers for providing thoughtful reviews of the  
4 original and revised versions of this manuscript and greatly improving the quality of this paper. We have revised the paper to  
5 be more concise based on the reviewer suggestions. The list of all relevant changes and point-by-point reviewer responses are  
6 included below.

7

## 8 **List of all relevant changes with reference to tracked changes document:**

- 9 - Sections 3.1, 3.3, 6.1.1, 6.1.2, and 6.1.4.1 in the manuscript have been revised to present the key information related to the  
10 work more succinctly.
- 11 - Figs. 2 and 3 removed
- 12 - Ln. 8-10. Updated to introduce define HE1 and HE2 transfer function in abstract.
- 13 - Ln. 88. Spain added in list.
- 14 - Ln. 783. Corrected Ln. 775 reference to “slip”. “zero-slip” reference refers to the opportunity for future study with large  
15 shields using a zero-slip boundary condition at the earth’s surface.
- 16 - Ln. 319-323, Eq. 19, and ln. 334-336 removed.
- 17 - Figs. 5, 6, 7, 8 updated with “integral” replacing “overall”
- 18 - Updated CEm, Pun, and PDFAR with parenthesis in text and removed CE equation as it is introduced earlier.
- 19 - Updated equation formatting and parenthesis.
- 20 - Ln. 763. Changed, “and their paths shows,” to “and their paths show.”
- 21 - Ln. 931-934. Updated with the physical description of the CE differences: “The small differences in collection efficiency  
22 across different hydrometeor types with the same fall velocity are attributed to the varying contribution from higher fall  
23 velocity hydrometeors, with collection efficiencies approaching 1, in the mass-weighted distribution of hydrometeor fall  
24 velocities.”
- 25 - Ln. 1001. Changed “vertical” to “fall”

26 **Anonymous Referee #1 Comments:**

27 The revised manuscript is generally improved. However, the authors seemed to have merged directly Part 1 and 2 without  
28 adjusting the Part 1 content to present the key information succinctly. The information added from Part 1 (ex: section 3 and  
29 6.1) should probably be shorten to focus on the key information related to the goal of the study, which is about developing the  
30 transfer function that includes the fall speed and wind speed. In the discussion, the modeling and field measurements are  
31 separate and I think that some of it could be combined. Therefore, I think that the manuscript needs some minor revisions  
32 before publication. The revision is mainly on the organization of the manuscript.

33

34 **Authors' response:** Sections 3.1, 3.3, 6.1.1, 6.1.2, and 6.1.4.1 in the manuscript have been revised to present the key  
35 information related to the work more succinctly. Figs. 2 and 3 have been removed.

36

37

38 **J. Kochendorfer (Referee #2) Comments**

39 General comments: The revisions that have been made to this manuscript satisfy all of the comments I made on the last  
40 versions. With the exception of a few technical issues, the manuscript is ready for publication. I did not compare the last two  
41 papers to this one carefully, but I would hope that by combining them the total length might have decreased more. I will admit  
42 that I did not say this in my previous reviews however, so I understand if these suggestions are ignored. Perhaps Section 3.1  
43 can be shortened by focusing on the differences between this approach and past studies, using the appropriate references. I am  
44 not sure if all three of these figures are unique or new enough to merit inclusion. In general, as I see it, the main thing that is  
45 new in the modeling work is the derivation of a transfer function that includes fall velocity, so keeping this in mind, perhaps  
46 there are other modeling sections that can be shortened as well.

47

48 **Authors' response:** Sections 3.1, 3.3, 6.1.1, 6.1.2, and 6.1.4.1 in the manuscript have been revised to present the key  
49 information related to the work more succinctly. Figs. 2 and 3 have been removed.

50

51 Specific comments:

52 Abstract, ln. 9, 10, 16, 17... The reader hasn't been introduced to HE1 and HE2 yet. These need to be either defined in the  
53 abstract, or better yet, different, more generally understood terminology should be used.

54 **Authors' response:** Updated to introduce define HE1 and HE2 transfer function in abstract.

55

56 Ln. 85. Spain and Norway were omitted from the list of countries with measurement sites.

57 **Authors' response:** Included Spain and Norway in list.

58

59 Ln. 126. How can the ground be frictionless, and at the same time "no-slip" (ln. 775) or "zero-slip" (ln. 988)?

60 **Authors' response:** Corrected ln. 775 reference to "slip". "zero-slip" reference refers to the opportunity for future study with  
61 large shields using a zero-slip boundary condition at the earth's surface.

62

63 Ln 256. I still find the  $z^*$  and  $u^*$  terminology confusing, despite the fact that it has been used (once?) this way by Baghapour  
64 et al. (2017). Here is an example of a more common usage, from the AMS Glossary of terms:  
65 [https://glossary.ametsoc.org/wiki/Friction\\_velocity](https://glossary.ametsoc.org/wiki/Friction_velocity) Also it seems that the results here are basically the same as Baghapour et  
66 al. (2017), so the use of terminology that aids careful comparison may not really be necessary.

67 **Authors' response:** Figure and associated terminology removed.

68

69 Ln. 319 – 323, and Eq. 19. What purpose does the derivation of  $U_{wc}$  serve? I don't see how it contributes to the manuscript;  
70 I suggest removing this all together, unless I have missed something. The two sentences on ln. 334 – 335 would need to be  
71 removed as well.

72 **Authors' response:** Ln. 319-323, Eq. 19, and ln. 334-336 removed.

73  
74 In Figures 7, 8, 9, and 10 change “overall” on the Y-axis label to “integral.”

75 **Authors' response:** Updated

76  
77 Ln. 486 – 487. Put CEm, Pun, and PDFAR within parenthesis. Ln. 493. It isn't clear why “CE” is included in, “Collection  
78 efficiency transfer functions CE...”

79 **Authors' response:** Updated with CEm, Pun, and PDFAR in parenthesis. Reference to CE is removed as it is introduced  
80 earlier.

81  
82 Ln. 763. Change, “and their paths shows,” to “and their paths show.”

83 **Authors' response:** Updated

84  
85 Ln. 916 – 918. The “nonlinearity in the relationship...” is inadequate. A physical explanation of these CE differences would  
86 be preferable.

87 **Authors' response:** Updated with the physical description of the CE differences: “The small differences in collection  
88 efficiency across different hydrometeor types with the same fall velocity are attributed to the contribution from higher fall  
89 velocity hydrometeors less coupled to the local airflow, with collection efficiencies approaching 1, in the mass-weighted  
90 distribution of hydrometeor fall velocities.”

91  
92 Ln. 1001. Perhaps change, “vertical” to, “fall” for the sake of consistency in terminology

93 **Authors' response:** Updated