

## ***Interactive comment on “Comparison of TRMM, MPEG and CFSR rainfall estimation with the ground observed data for the Lake Tana Basin, Ethiopia” by A. W. Worqlul et al.***

**Anonymous Referee #2**

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### General Comments

This study compares three satellite rainfall estimation methods, TRMM 3B42, MPEG, and CFSR, with rain gauge data over the Lake Tana Basin in Ethiopia during 2010. The authors find that MPEG, despite consistent underestimation, performed best, followed by CFSR and lastly TRMM 3B42.

The references are inadequate in several places. In particular, facts that have been known for decades are sometimes cited with a reference from 2012 or so.

The TRMM 3B42 algorithm (in the main text and Appendix A2) is referenced via a 2010

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paper that studied its performance in certain regions, instead of listing the appropriate citations:

Huffman, G.J., Adler, R.F., Bolvin, D.T., and Nelkin, E.J.: The TRMM Multi-satellite Precipitation Analysis (TMPA). Chapter 1 in *Satellite Applications for Surface Hydrology*, F. Hossain and M. Gebremichael, Eds., Springer Verlag, ISBN: 978-90-481-2914-0, 3-22, 2010.

Huffman, G.J., Adler, R.F., Bolvin, D.T., Gu, G., Nelkin, E.J., Bowman, K.P., Hong, Y., Stocker, E.F., and Wolff, D.B.: The TRMM Multi-satellite Precipitation Analysis: quasi-global, multi-year, combined-sensor precipitation estimates at fine scale. *J. Hydrometeorol.*, 8(1), 38-55, 2007.

The appropriate CFSR Version 2 reference, if this is the version used in this study, is:

Saha, S., and Coauthors: The NCEP Climate Forecast System Version 2. *J. Climate*, 27, 2185-2208, 2014; doi: <http://dx.doi.org/10.1175/JCLI-D-12-00823.1>.

The paper is generally well-written, but the English could be improved by review from a native speaker.

I reviewed the original manuscript without consulting the posted comments from and authors' reply to Reviewer 1, in order not to be influenced by their discussion. Additional comments after consulting that discussion will be listed at the end of the “Specific Comments” section and indicated as such.

### Specific Comments

1. TRMM is the name of the mission. The precipitation product is 3B42, also known as TMPA (TRMM Multi-satellite Precipitation Analysis). The title of this paper should cite it as either “TRMM 3B42”, as is done in the referenced Dinku (2011) and Ouma (2012) papers, or as “TMPA”, but certainly not just “TRMM”. If you do not wish to change the labeling in all the figures and the text, I suggest that when you first mention 3B42 in the Abstract and in the Introduction, you should specify “TRMM 3B42 (hereafter, simply

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“TRMM”).”

2. Because Fig. 4c shows that 3B42 is essentially unbiased overall, the last sentence of the abstract should mention this. I suggest replacing the last sentence with something like “The Bias indicated that 3B42 was, on average, unbiased, whereas MPEG consistently underestimated the observed rainfall, and CFSR often produced large overestimates.”

3. It would be helpful to state something about the quality of the gauge network. How well is it maintained? Is the data quality and availability roughly the same at all 38 stations?

4. In conjunction with Fig. 1, it would be especially helpful to depict or describe the differences in spatial resolution amongst the three satellite products, in particular in relation to the distribution of the gauges. How often do multiple gauges fall within the same grid box for each of the three products?

5. p. 8014, line 23 – there must be some source for this value; please provide it.

6. line 26: Sharma et al. (2012) may be one appropriate reference, but the point you are addressing has been well-known to the community for many years before this. After all, you cite WMO (1994) as a standard in mountainous regions. Therefore, there must be papers from 1994 or earlier that can be cited.

7. Similarly, nearly all of the citations in the paragraph spanning pages 8015-8016 are much too recent, as these facts have been known since the 1990's or even late 1980's.

8. p. 8021, line 1: It is inappropriate to cite a reference for the Bias calculation when none has been cited for R-Squared or RMSE. If citations are necessary, they should be mathematical reference works.

9. line 12: How is the increase 125 mm per 100 m elevation if the slope is 1.41?

10. lines 13-15: How did you stratify the data points into categories, particularly for

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the stations that fall in between the two best-fit lines? It would be very helpful to depict the sites on a map similar to Fig. 1, but plotted as rectangles and circles, in order to see whether each group of stations is clustered together geographically or in some spatially-coherent pattern. This could potentially support or disprove your contention that one cluster is convective only and the other is convective+orographic. Actually, you do this for the convective points in Fig. 6, much later in the paper.

11. p. 8022, line 1: I do not see Yismala station depicted in Fig. 4. Perhaps this is the missing station (see Technical Comments for Fig. 4)?

12. p. 8023, lines 13-14: The number of stations specified within each watershed does not appear to correspond with Fig. 6. Perhaps I am misunderstanding, but for example, the Thiessen polygon for Gilgel Abbay watershed in Fig. 6 shows no stations within the blue boundary.

13. p. 8023-24: It would be helpful to include a figure similar to Fig. 7, but for Bias. Values of Bias within +/-5% for two of the four basins for CFSR and within +/-10% for 3B42 for three of the four basins seem like excellent results, yet your text de-emphasizes this in favor of proposing scaling factors for the consistently-underestimating MPEG.

14. p. 8024, lines 23-24: words like “inconsistent” and “not consistent” make it sound like both the CFSR and 3B42 do a bad job with respect to Bias ratio, when in fact it is better to have such results (as long as the values do not deviate too far from 1.0) than to have a consistent (i.e., systematic) underestimation, as MPEG does.

15. p. 8025, lines 6-7: this conclusion seems unnecessarily harsh given that 3B42 was unbiased overall (Fig. 4c), whereas MPEG consistently produced underestimates, and CFSR often produced large, sometimes more than a factor of two, overestimates.

16. Appendix A2, line 2: GPM was launched in February 2014.

Technical Comments

1. Abstract, line 14: TRMM is misspelled.

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2. p. 8015, line 1: Replace “Though” with “However”.
3. line 6: (WMO, 1994) is cited but not listed in the References.
4. line 7: “gauge” is misspelled. [...now I see this was addressed in response to reviewer 1.]
5. p. 8016, line 14: the meaning is not clear.
6. lines 2024: the meaning is not clear.
7. p. 8017, lines 7-10 should be deleted (redundant).
8. p. 8018, lines 4-6 should be deleted (redundant).
9. p. 8019, lines 8-9 can be deleted, because this is obvious.
10. p. 8021, line 10: I suggest replacing “trends” with “relationships”, since trends suggests a pattern over time.
11. p. 8022, line 3: swap the order to say “Shembekit and Gassay”.
12. lines 25-27 should be deleted (redundant).
13. p. 8023, top paragraph (from Section 3.1): I understand what you are saying about the influence of orography, but the English needs some cleaning up, especially for the last sentence. Also, the references listed are fine but should again be supplemented by older references that have found similar results.
14. p. 8023, line 12: Replace “there” with “their”.
15. line 16: Fig. 7, not Fig. 9 (which doesn't exist).
16. p. 8024, lines 5-7: The meaning is not clear.
17. Appendix A1, line 20: presumably you mean SSMIS rather than SSM/I?
18. Appendix A2, line 28: this should be SSMIS rather than SSM/I. MHS (Microwave

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Humidity Sounder) should also be listed.

19. Fig. 1: It would be helpful to have latitude/longitude labels and/or some indication of the distance in km covered by the area depicted. Of the 50 or so stations shown, can the 38 stations actually used in the study be highlighted?
20. Fig. 3 needs an additional sentence in the caption describing the right panel. [...now I see this was addressed in response to reviewer 1.]
21. Figs. 4 (a-c): I count 37 station names along the x-axis, not 38 (missing Yismala?). Also, “average” is misspelled in Fig. 4c. The captions are redundant. 4a can end “average R-square value”; 4b can end “Root Mean Square Error”; 4c can end “values” or “values of Bias”. These captions should state that monthly values during 2010 were used.
22. Fig. 5: Please retain the color scheme from Fig. 4. It is confusing to use the same three colors, but switch their assignments. It would also be helpful to use the same color scheme in Fig. 7, if possible.

FROM RESPONSE TO REVIEWER 1:

1. New Fig. 5: “Rainfall” is misspelled in all 3 labels.
2. 3B42RT is the near-real-time version of TRMM 3B42. Its latency is roughly 7 hours. Is this adequate for operations in Ethiopia?
3. p. 8016, line 5: should be “utilize” instead of “utilizes”.

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 11, 8013, 2014.

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