

Interactive comment on “On the uncertainties associated with using gridded rainfall data as a proxy for observed” by C. R. Tozer et al.

Anonymous Referee #1

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GENERAL COMMENTS AND RECOMMENDATION

The manuscript focuses on the analysis of 3 gridded rainfall datasets over Southern Australia at monthly and yearly scales since 1900. The 3 datasets are obtained by interpolation of rain gauge observations (whose distribution and coverage changed with time) using different techniques. The analysis is carried out in terms of rainfall accumulations in the period 1900–2008, and in terms of the hydrological response of the Finiss basin (193 km²) in the period 1970–2002. The first analysis focuses on the comparison among the 3 rainfall datasets and against the observations of the rain gauges used for generating the data sets.

The paper is well written and clear, and the richness of the analyzed datasets makes

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this kind of analysis an interesting contribution that deserves publication.

However, some of the results would need more in-depth analysis and reflection. Therefore, major revisions are needed before I can recommend the paper for publication to Hydrology and Earth System Sciences.

MAJOR COMMENTS

1) In my opinion the discussion on the 3 rainfall datasets needs some more in-depth analysis. Among others, the authors could consider/comment on the following topics:

+Almost no information is provided about the spatial and temporal distribution of precipitation amounts within the analysis domain. For instance, the reader may be interested in the comparing the maps of Figure 4 with the maps of average yearly rainfall amounts from the 3 products.

+How do the authors interpret the systematic differences between datasets (“biases”) found in section 4.1? Do the methodologies used to generate the 3 datasets explain these results? Are these differences significant at gauge locations? Would the authors expect the “unexplained microscale variance term” used in AWAP produce systematic differences with gauge measurements?

+What is the time-variability of the obtained results? Given the time extent of the 3 rainfall datasets, I encourage the authors to compare the 3 datasets for different periods. It would be of certain interest to relate the differences in gridded rainfall for different periods with the evolution of gauge density and distribution.

+How was the “random location in SA” selected? A more systematic analysis would be necessary in order to generalize any conclusion obtained from the analysis relative to Figure 5. Similarly as for previous comment, this analysis would benefit from information on the gridded rainfall amounts.

+The hydrological model is calibrated using the observations of a single rain gauge. What would be the effect of calibrating the hydrological model with the gridded rainfall

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datasets on the hydrological simulations?

+In Figure 8 it seems that in the period 1996-2009 the use of AWAP rainfall inputs produces better flow simulations than using gauged rainfall (which was used for model calibration in the period 1970-1986). In particular, the use of gauge measurements systematically overestimates observed runoff. How do the authors explain such a behavior? Flow simulations with BOM and SILO rainfall inputs should also be included in Figure 8.

2) As reported by the authors (page 8404, last paragraph), the SILO dataset is based on an exact interpolation technique. This implies that the SILO dataset exactly reproduces the observed rainfall values at rain gauge locations. This is responsible for the very good agreement between SILO datasets and rain gauge observations presented in Tables 2, 3 and 4 and Figures 6 and 7. Although the authors state such an extent in several parts of the paper (for example in page 8413, lines 21-25: “SILO is a much better fit to the gauged data but this is to be expected as the method used to develop the SILO database involves a step that directly fits the gridded data to the gauged observation.”), little discussion is made beyond the good correspondence between SILO and gauge measurements (for instance in Sections 4.2.1 or 4.2.3). For instance, further discussion on how the authors explain the differences between the 3 gridded datasets could be interesting for the reader.

If possible, I suggest comparison against an independent reference (e.g. rain gauge records not used to produce the gridded datasets). This would allow the authors to assess how the 3 gridded datasets reproduce independent observations. Otherwise, the lack of an independent reference limits the interest of the comparison between gridded datasets and rain gauges records.

Otherwise, given that “in reality, assessing the fit of the AWAP and BOM datasets to a gauged point location is not a fair comparison. . .” I would suggest balancing the paper by enhancing the material and discussion on the comparison of section 4.1 and on

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the time variability and significance of the results, which would make the paper more interesting (see also major comment 1 and minor comment 8).

3) The paper states that “the intention here is to quantify the differences between various gridded data sources, and how they each compare with observed point data, such that these differences can be considered and accounted for in (...) studies that utilize gridded data”. However, very little is said about the representativeness of point observations to estimate mean areal rainfall (which is, in many cases, the variable of interest) and on how this representativeness relates to the spatial variability of the rainfall field. This is especially relevant in the discussion of the results obtained with the hydrological model in the Finiss basin (193 km²) presented in section 5.

MINOR COMMENTS

- 1) Abstract: Should contain a description of the main findings and conclusions of the paper.
- 2) Caption of Fig. 1. Please, add that the “Random ungauged point” is marked with a green dot. Also, a more visible symbol could help the reader to find the location of such a point in the map.
- 3) Reference to Figure 3 appears in the text before Figure 2. Please, change the numeration.
- 4) Page 8406, line 5: “. . . the gridded datasets are intended to represent the same observed (or real) situation. . .”. Given that observations also suffer from errors, something like “the gridded datasets are intended to represent the real situation” would be more strictly correct.
- 5) Page 8407, lines 17-22 and elsewhere in the text. Perhaps something like “grid cell” or “grid unit” would be more appropriated than “grid” to describe one element of the grid.
- 6) Page 8408, line 18: The notation BOM/AWAP and SILO/AWAP may be confusing.

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- 7) Figure 4. How do the areas with smaller differences between rainfall datasets match the spatial distribution of rain gauges?
- 8) Figure 4. The mean annual rainfall (at least for the AWAP product) in the domain would be useful for the reader. Also, how systematic are the results of Fig. 4? It would be interesting to add some Figures with the percentiles (e.g. 15% and 85%) of the relative differences in yearly rainfall to quantify the variability of the errors.
- 9) Section 4.1: the use of the term “error” implicitly assumes that AWAP is more trustable than SILO and BOM. Instead, I would suggest using the term “difference”.
- 10) All throughout the text: I suggest emphasizing on the time accumulation windows (monthly vs yearly) for which the analyses are made. For instance, in the last paragraph of page 8408 and figure 5, it should be specified what the results are presented for yearly accumulation products (which is only specified in the title of the y-axis of Figure 5).
- 11) Similarly as for Figure 4 (see comment 8), the time series of yearly accumulated rainfall in Figure 5 would be useful for the reader. Also, Information about the measured average yearly accumulation is necessary in Table 2.
- 12) The discussion on the large RMSE values at the gauge at the highest location is rather speculative. Perhaps further justification should be provided.
- 13) Page 8409, lines 24-25: “Figure 2 shows the location of the four SA grids investigated in the annual rainfall extremes assessment and the stations within each grid”. This sentence may need some rephrasing.
- 14) Section 4.2.2: How do the techniques to produce 3 gridded datasets tackle the presence of multiple rain gauges in a grid cell? The discussion in this section should consider this.
- 15) Page 8410, lines 1-9 and Figure 6. The term “events” may be confusing when it refers to yearly accumulations.

16) All Figure and Table captions should be more descriptive of all the elements in the Figures and Tables.

17) Page 8410, line 17-20. NSE results show “that SILO is a better match to gauge data compared to AWAP and BOM (a result consistent with the RMSE analysis)...”. It is assumed that the authors refer to the results presented in section 4.2.1 for annual accumulations. This should be made explicit in the text. Otherwise, it could be confusing given that the NSE is biunivocally related with the RMSE ($NSE=1-RMSE^2/\sigma^2$, where σ^2 is the variance of the reference).

18) Section 4.2.4 analyzes the number of zero monthly rainfall values for the different gridded products and compares them with observations. The minimum monthly accumulation detectable with the rain gauges should be reported. Also, is there any threshold applied to gridded rainfall data to distinguish rain from no-rain? I strongly suggest adding the values of gridded rainfall matching the cumulative probability of observed zero accumulations for the different gridded products (that is, for the first row of Table 4, the monthly rainfall for BOM, SILO and AWAP in station 16031 that is not exceeded for 162 months out of the total number of records in this station). This would allow better interpretation of the results.

19) The SIMHYD model was calibrated in the Finiss River catchment (193 km²) with monthly records of rainfall and flows. Further description of the model and its calibration is necessary in the paper beyond the provided references. In particular, the type of model, rainfall inputs (aggregated or distributed) or number of parameters should be reported. Also, the fact that the records of a single rain gauge were used for the calibration of the model should be stated more clearly.

20) Page 8413, line 17: “The results of this study have shown that the SILO, AWAP and BOM gridded datasets are not an exact match to gauged rainfall”. According to the results presented in Tables 2-4 and Figures 6 and 7 SILO datasets match the observations of rain gauges used in the production of SILO remarkably well. Further

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support to that statement should thus be provided.

TECHNICAL COMMENTS

1) Page 8410 line 24: “. . .yet during summer BOM tends to record higher NSE values compared to AWAP”. The text could be modified to something like “. . . yet during summer higher NSE values are obtained for BOM products”.

2) Page 8414, lines 14-15: “Although the focus is of Fawcett et al. (2010) was on western Tasmania. . .” should be “Although the focus of Fawcett et al. (2010) was on western Tasmania. . .”.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 8, 8399, 2011.

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