

Interactive comment on “Simulating the regional water balance through hydrological model based on TRMM satellite rainfall data” by D. Li et al.

Anonymous Referee #2

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Simulating the Regional Water Balance through Hydrological Model Based on TRMM Satellite Rainfall Data D. Li, X. Ding, and J. Wu

OVERALL COMMENTS This paper aims to evaluate the performance of TRMM rainfall data for driving hydrological modelling using the SWAT model in the Tiaoxi catchment in China. The topic is suitable to the journal thematic areas and could potentially complement previous HESS papers. However, the manuscript lacks a clear explanation of the substantial contribution to scientific progress being made. Moreover, the manuscript falls short on scientific and presentation quality. The ideas, data, and methods are not new as acknowledged by some references cited by the authors. Additionally, it is not clear what novel contribution (other than a different catchment) is made with this manuscript compared to the Li et al. 2012 paper by the same authors. At the same

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time, many previous studies that have implemented TRMM based approaches for simulating the water balance are neglected in the review of background literature (see suggested additional references). Further, the methods section does not explain the model calibration in sufficient detail, there is no discussions section, and the conclusions are not directly stemming from the work presented in the manuscript. The quality of the presentation is poor (see detailed suggestions with regard to tables and figures) and the manuscript needs an overall and thorough revision for use of English grammar and language before re-submission can be considered.

DETAILED COMMENTS

Page 2497 Title: Consider rephrasing the title to include the name of the model and perhaps even the catchment where the work is carried out; it could be misleading that this manuscript brings in new ideas and concept that would be applicable to hydrological modeling globally, which is clearly not the case.

Page 2498 Abstract: See below for suggested amendments to the abstract L4: Replace ‘could increase’ with ‘is higher’ or similar; replace ‘gauge is’ with ‘gauges are’ or similar. L5: Replace ‘would be’ with ‘provide’ or similar. L5-6: Delete ‘and the foreseeable future’ – satellites do not operate in the future. L7: Abstracts briefly summarise outcomes rather than stating objectives – consider rephrasing accordingly; also, (a) and (b) are objectives and corresponding outcomes, from which conclusions with regards to (c) can be drawn, i.e. (c) is not really an objective of this work. L10: What is meant here by ‘reasonable’? L11: Write histogram in plural form to fit with the meaning of the sentence or replace ‘histogram’ with ‘frequency distributions’; What is meant here by ‘satisfactory’? L13-16: This is nothing new, it has been done at least about 5-10 years ago (see suggested additional references at the end of this document). L18: Delete ‘widely accepted as’. L19: Add comma after ‘sense’. L20: Consider using serial comma, i.e. add comma after ‘ecological’ and before ‘and’. L23-25: The sentence is structured in an awkward way – it is not because hydrological models are simplified representations of natural hydrological process that they models are founded in phys-

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ical theory. Not all models are the same either. Consider avoiding such generic and unclear statements, or revise to clarify the intended meaning. L25: Consider revising the term 'predictions' as there is no hydrograph prediction element in the study presented in this manuscript. L26: What is meant by 'precisions' here? Please clarify. Also, replace 'inputting' with 'input'.

Page 2499 L1: Delete 'In general,' and capitalise the next word. L2: Replace 'calculated' with 'calculating'. L3: Insert comma after 'polygons'; Delete 'believed'. L7: It is not clear to explain sparse gauge networks with 'economic or terrain limitations'. This is a generic and unclear statement that is not substantiated with any information on the relative density of existing gauge networks worldwide. There are many practical (political instability, economic issues, staffing resource barriers, etc.) and physical (terrain, proximity to roads, etc.) issues that can explain a sparse gauge network. Also, spatially sparse networks are only one side of the story. What about temporally continuous records? L9-20: The discussion of radar and blending methods is not clearly introduced and statements are poorly justified. On line 15, consider replacing 'quite a lot of' with 'many'. L21-22: The structure of this sentence is slightly awkward, consider re-phrasing for clarity. L24: Replace '+' with 'and'? L28: Replace 'Recently, many' with 'Recent'; Add 'multiple' before 'satellite'. L29: What is substantially different and novel in this manuscript (other than the different catchment) from the Li et al. 2012 article? Also, see list of suggested additional references.

Page 2500 L5-7: TRMM tends to underestimate rainfall and not only over high elevations, but also due to missing localized convective storms that deliver high-intensity rainfall with over a footprint smaller than the 0.25x0.25 TRMM grid resolution (see list of suggested additional references). L7-9: Avoid using 'fewer' as the number of studies on a given topic does not provide an indication of the significant level of scientific contributions. L8-10: This statement is unsubstantiated (see list of suggested additional references). L11: Replace 'evaluate' with 'evaluating'. L11-13: How are these objectives different from each other? L14-15: Avoid repetition of 'brief' twice in the

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same sentence. L16-17: What is meant by the 'processes the hydrological simulation' here? L17: What two types of rainfall? Did you mean two model forcing data sets – one from gauges and the other from TRMM? L17-18: The statement 'describes the water balance of the watershed' is vague. L21-22: This sentence reads as if China "is a part of southern catchment of Taihu... ", consider re-phrasing to clarify the intended meaning. L22: Consider replacing 'at' with 'between' and hyphens with 'and'. L24-25: Single digit numbers might have to be spelled out. L26: Suggest deleting 'whole'.

Page 2501 L4-5: Remove double quotation marks around names of stations. L10-12: Move this information to the caption of the respective figure. L12-14: Move this information to the caption of the respective figure. L15-17: Considering putting this information in the legend of the respective figure. L19: Consider adding an indication that Tables S1 and S2 are provided in the supplementary material to the article. L20: With regard to the section starting on this page/line, insert information on the current Version of TRMM data that are being used in the study – Version 7?

Page 2502 L2: Insert the relevant reference at the end of this sentence. L13: The section starting on this page/line does not provide information on the model calibration. Some of this is discussed in the results section, however, not sufficiently detailed. L20: Replace 'files' with 'inputs'. L21: What is the source of the 30 x 30 m DEM raster data? L26: Insert comma after '(RMSE)'.

Page 2503 L2: The Willmott and Matsuura (2005) paper discusses the use of MAE over RMSE. Thus, it appears to provide poor justification for the authors' choice to use NRMSE and CC. Moreover, there is no explanation of the reasons for having chosen the rest of the performance metrics being used. L4-6: Move this sentence to section 3.2.4 on the next page.

Page 2504 L6: Insert comma after '(FAR)'.

Page 2505 L4: Replace 'It' with 'FAR' and insert comma after '0'. L5: Insert 'to' after 'and' and before '1'. L12: Suggest re-formatting the numbering of section 3.3.4 to 3.4

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as it deals with the performance of hydrological modeling rather than the correspondence between gauge observations and satellite estimates of rainfall. L15: Suggest inserting 'follows' before ':' at the end of the line.

Page 2506 L10: Consider re-phrasing the first two sentences into one starting with, for example, 'Table 1 shows the statistics for areal average. . .'. L14: Spell out acronyms on first occurrence. L14-15: The meaning of this sentence is not clear. L18: Insert 's' at the end of 'distribution'.

Page 2507 17-19: Is it necessary to expand these acronyms for the second time? L20: Move together with previous paragraph. Also, is this an average of all months in the time period of interest? Please clarify. L21-24: It is not clear what methods were used to process the data here. Please consider clarifying. L28-29: This is hardly a new finding to the rainfall monitoring community. Moreover, hydrological modeling still requires daily (and even sub-daily) temporal resolutions.

Page 2508 L1: It would be better to refer to the gauge and TRMM based model forcing datasets in a clear way rather than 'the two data sets'. L3-4: Does the 'average' here refer to average rainfall values over the time period of interest for the nearest TRMM pixel? If so, this sentence needs to be re-phrased to avoid ambiguity. L8: Above it was stated that TRMM has 'reasonable performance at monthly scales' and here that it 'tends to underestimate the monthly rainfall'. Could the authors clarify their findings and provide a relevant interpretation. L13: See comment on the same page, L1 above. More importantly, the section starting on this line describes the model calibration and parameterized model runs, which belongs to the methods section and needs a lot more detailed explanation of how the model is calibrated and what scenarios are being run with specific calculations of the various performance metrics.

Page 2509 L3: Are the authors suddenly interested in evaluating SWAT as a model? L4-5: It is unusual that the authors do not question and explain the possible modeling errors (some of which naturally may arise from the calibrations, which are not

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explained in sufficient detail). This carries over to the remainder of the manuscript: if the correspondence between gauge observations and TRMM estimates of rainfall improves when values are aggregated from daily to monthly time steps, why is the discrepancy between the simulated water balance components so much poorer with the TRMM based model runs? It is striking that the authors provide little explanation on this matter and fail to discuss the implications this has for hydrological modeling. L11: It is not really easy to observe this – please consider providing a quantitative measure of the correspondence between simulated and observed hydrographs. L16: Replace comma after 'area' with full stop. L17: Certainly, TRMM data might be better than no data; however, see comment on the same page L4-5 above and an additional question with regard to the TRMM data: can the authors confirm or reject that the gauge observations used in the study are not part of the gauge-based adjustment in TRMM 3B42? L22: It appears odd that the authors are now concerned with 'testing the validity of the rainfall data' and it is not clear how the SWAT model helps in this? The model itself is not perfect and error-free at all, there is an error propagation element in process based modelling that is not discussed at all. L26: This is a description of the model rather than a result and it should be re-phrased to something along the lines of 'The SWAT model partitions precipitation into. . .'

Page 2510 L4: Replace 'case' with 'scenario'. L1-11: The section starting on the previous page and ending in these lines is a very poor discussion of results. The model parameters are different between different scenarios / model runs and it is not clear which are the parameters that drive the rainfall partitioning process at the soil surface and how that affects the results from model simulations using the gauge and TRMM rainfall datasets. Which parameter in SWAT drives the runoff partitioning and which one drives the base flow rate? L13-25: The conclusions section is weak as the authors need to go back to the structure of the study and work out what scenarios and model runs need to be done to understand the role of the most important rainfall components in hydrological modeling, namely rainfall occurrence, rainfall rate, and accumulated rainfall totals, including through extreme (high-intensity) rainfall events. The role of this

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information in hydrological modeling can then be suitably discussed through the SWAT model calibration and parameterization. L22: Conclusions are weakly corroborated and ignore background literature that might help the authors explain their findings (see suggested additional references for some relevant papers).

Page 2511 L5-13: It is odd to include reference in a conclusions section, as it should be limited to the direct outcomes of the study carried out here and not statements about the way forward in the field cited from other sources.

Page 2515 Consider revising Table 1 caption: for example, replace 'statistical indexes' with 'statistics'; explain if all TRMM grid cells have been averaged spatially across the catchment, or if the values for the nearest grid cell are averaged over the time period of interest. Also, spell out acronyms, use consistent notations for units, and replace 'Gauging' with 'Gauges'.

Page 2516 There is little information in the text of the manuscript to explain the sensitivity analysis carried out in order to derive optimal calibration parameters.

Page 2517 Add 'model' after 'SWAT' in the table caption, spell out acronyms, and consider replacing 'First' and 'Second' with '1)' and '2)' or similar.

Page 2518 Add 'SWAT water balance' before 'model' in the table caption. Consider adding hyphens in empty table cells.

Page 2519 Presumably this is elevation in metres above mean sea level? The figure caption would be a suitable place to add information on the elevation data source.

Page 2520 It would be useful to include information on the percentage cover of each land cover class in the legend of this figure, as well as information on the data source.

Page 2521 See comment above with regard to Figure 2. Also, consider referring in the figure caption to the supplementary tables S1 and S2.

Page 2522 This appears to be a slightly confusing way to present information on differ-

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ent rainfall classes and their contributions to the total rainfall in different years. The word occurrence in the legend seems unnecessary, if it is just referring to rainfall amount at the gauge and at the TRMM pixel.

Page 2523 Acronyms need to be spelled out, possibly in the figure caption. Is this an average of all months in the time period of interest? Are there non-negligible seasonal differences?

Page 2524 It is not clear why scatterplots are not based on daily rainfall as the daily data are used to drive the SWAT model.

Page 2525 This figure would potentially carry more information if observed and simulated discharge values are presented as average values for months from January to December, or even better, if the discharge data are available at the daily time step, as average values for days in the year from 1 to 355/356.

Suggested Additional References with DOIs

Gu et al. 2010 – doi: 10.3882/j.issn.1674-2370.2010.04.005

Harris et al. 2007 – doi: 10.3390/s7123416

Kneis et al. 2014 – doi: 10.5194/hess-18-2493-2014

Tarnavsky et al. 2012 – doi: 10.1080/02626667.2011.637498

Tarnavsky et al. 2013 – doi: 10.3390/rs5126691

Tobin and Bennett – doi: 10.1175/2010JHM1206.1

Zhao et al. 2015: doi 10.1007/s11442-015-1161-3

Zulkafli et al. 2013 – doi: 10.1175/JHM-D-13-094.1

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