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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Improving SWAT model performance in the Upper Blue Nile River Basin using meteorological data integration and catchment scaling" *by* Erwin Isaac Polanco et al.

Anonymous Referee #2

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Improving SWAT model performance in the Upper Blue Nile River Basin using meteorological data integration and catchment scaling

BY Polanco et al.

General comments

The paper presents the effect of different weather datasets under different sub basin discretization on the SWAT Model performance. The authors go further step and proposed a new performance indicator, SWAT Error Index (SEI). The topic of the paper and the problem setting are certainly interesting for many readers of the journal, however, I have some concerns about the validity of the methods and results presented

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in the paper. The paper is also far repetitive and is not well structured and difficult to understand. Furthermore, the paper tries to address many things (i.e. different number of sub basin discretization (30, 87), comparing three data sets (Ground data, CSFR, the integration of both), three evapotranspiration estimation (ET) methods (Hargreaves method, Penman-Monteith, and MOD16 ET) and lacks focus. The main concerns are outlined below:

(i) The tile of the paper should match its content. I think catchment scaling is not the right word to use and need to be replaced. (ii) Methodologically, it is not clear how the integration of the two dataset was carried out. (iii) Given the amount of hydrological studies carried out in the basin, it is not clear why the authors compared their results against Cherie (2013) only. Interpretation of results and discussion with pervious work in the region is mostly lacking. (iv) The study claim that sub basin discretization have significant impact on the water balance. On the contrary, the authors compared their water balance result against Cherie (2013), which used different number of sub basin discretization. The water balance result presented in Table 1 by Cherie (2013) also for the Eldiem station, comparing it with the Kiessie water balance as was done in P13, L28 is misleading. (v) It also difficult to assess the validity of the newly proposed performance measure, The SEI index proposed in this study is not different from calibrating a model against a weighted root mean square error using two different data set, in this case discharge and ET. The problem though, the normalization of the root mean square error introduced to derive SEI. As it can be seen in Figures 4-7 the range (maximum – minim) of discharge is much higher than the range of ET data presented in Figures 8 and 9. Since the range of ET is smaller compared to discharge the contribution of ET for the overall SEI is expected to be higher for the same root mean square error in discharge simulation. Hence, the index is more biased. (vi) The MOD16 ET used to calculate SEI is not appropriate, because it does not represent observed ET and cannot be used as a target. (vii) Conclusion mainly focus on the summary of the work. (viii) Uncertainties and sources of uncertainties in the presented method should be clearly communicated.

Abstract

The abstract gives more emphasis on the general methodology. It must also describe what problem the authors are trying to solve or research gap.

P1 L21-22: “the calibration was done. . . soils properties”. It is not clear how you do the calibration. You can clarify it here or delete this sentence.

P1 L30: “Nash Sutcliffe Efficiency (NS)”. Not Nash Sutcliff

P1 L32: “Based on the parameterization”, what you mean parameterization here?

P1 32-33: it is not clear how study conclude that the integrated model represent the land use and soil conditions? In terms of land use and soil the integrated and ground based models, I assume they are not different.

Introduction

The introduction lacks a good introductory overview of the issues discussed in the paper. Please add a discussion on the impact of sub basin discretization on the hydrological simulation? Supporting your reasoning why you want to do it.

P1, L 14 citation should be Wang and Sun (2016) not Wang et al. (2016).

P 2, L 9, the reference should be Setegn et al. 2008. Not (Shimelis, 2008)

P3 L4-5: “problems concerning the evapotranspiration and the water balance of the catchment are not discussed in details? What type of problem? Is it the performance of the model or the method to calculate or what?

Material and Methods

The method used to integrate the two dataset (ground and CFSR) is not clear. On P8 L25-27: it was mentioned that data the missing weather station data were filled by using data from adjacent CFSR stations. This ground based data were again compared with CFSR, which seems in appropriate.

P3, L 29-30, please include location map of the major basin listed here.

P 3, L 37-38, Present spatial soil map.

P4 L3-7: This paragraph seems unnecessary.

P5-7, section 2.3, can be shortened and presented more concisely.

P5, L 9 should be Tekleab et al. (2011) and also P 7, L 24.

P6, L11 citation has to be (Hargreaves and Samani, 1982).

P6, L11 (Hargreaves et al., 19985) is missing from the reference list.

P 7, L31, should be evaporation of a given day.

P 7, L 31, obtained from, not . . . obtained for.

P8 L25-27: it is stated that "The missing weather variables for each of the 42 stations, were completed using weather data of its nearest CFSR." This makes it unclear as to the purpose of the comparison that was done afterwards. This has to be discussed.

P9-10 section 2.6.1. Again, this section is very long and repetitive of what is in literature. You can make it short, clear and direct of the most important thing you want to say. Provide reference for the rest, example for SUFI-2.

P 9, L 40 use Qm and Qs rather than x and y.

P9, L33 (Table 2) Do you use the same calibrated parameter for two different discretization setups and for the three datasets?

P 10, L12, should be (Abbaspour, 2015) not (Abbaspour et al. 2015).

P11, L23 should be Ruhoff et al. (2013).

P11, L36 should be Setegn et al. (2009), without a.

P11, L25 should be cited as Sun et al.(2007) not Sun Z. et al. (2007).

P11, L35 should be cited as Tibebe and Bewket (2011), without et al.

P12, L18, independent verification of the proposed SEI is critical.

P 12, L 18 using MOD16ET in equation 10 for SEI is not appropriate because it is not an observed data.

P12, L 34-35, what is the basis of assigning 0.7 and 0.3 for the weights (W1 and W2)? The authors need to discuss the uncertainties associated to these weights and other issues associated with SEI.

P13, L 11 use appropriate reference (Cherie, 2013).

Results and discussion

The number of sub basin discretization determines how input data is averaged out or topographic parameters are distributed. It is clear from Table 3 that the catchment discretization affect the amount of precipitation input in the catchment. It is because in SWAT, each sub basin take the data from the nearest available station. However, say if you have only one weather station for the whole watershed, discretization really do not matter. Given the scarce data in the basin I would like to see the optimal number of sub-basin discretization rather than comparing two sub basin discretizations.

The SWAT model was applied for the whole Upper Blue Nile River Basin and calibrated using Eldiem gauging station at the border, however, looking at Figure 1 most of the ground stations are located upstream of Keissie river gauging station. Therefore, it is not surprising to see some improvement in the model performance due to additional information gained from CFSR station located where there is no ground weather stations. Given lack of weather station data that cover the whole basin it seems in appropriate to use the result from this station to compare the two datasets.

Furthermore, there is no much improvement in the Nash Sutcliffe Efficiency (NSE) between using the ground data or the integrated data for the Keissie where both weather station and CFSR data coverage is relatively good (Figure 6 and Figure 7, Table 4).

Surprisingly, in Figure 7 the NSE model calibrated using ground based data is slightly higher than the integrated. This makes it questionable about the extra advantage obtained from using CFSR, which is supported by Roth and Lemann (2016), page 2, Line 33.

It is also difficult to tell the validity of the SEI proposed in this study without testing it where a good dataset is available or with results from past studies. The other issue is that the weight assigned to the index are subjective.

On page 11 line 26 the authors claim that although the MOD16 underestimate ET comparison of the SWAT models with satellite ET data could help to more accurately identify the level of the reliability and SEI, but this is contradicting. If it is not good enough how it can be used as reference?

P 13, L14, annual precipitation in the UBNRB is estimated to be approximately 1300 mm/year, provide reference and also the data period where the analysis was made.

P13, L28, the study claim that . . .. . . the calibration of Kessie were good for models using the ground and integrated dataset in statistics as well as in terms of water balance. I understand the authors compared their results in Table 3 with results from previous study by Cherie (2013) presented in Table1. I think this is a bit misleading, because, the water balance calculated by Cherie (2013) is the whole Upper Blue Nile using the Eldiem station not for Kessie. The sub-basin discretisation used in Cherie (2013) is not the same as this study.

P14 L18-19: “However, the SWAT models was calibrated under Hargreaves evapotranspiration method”. So why don’t you just calibrate it with the Penman Monteth method? Why you choose Hargreaves method?

P14 L15 – 40: This is a repetition of what is already in the methodology.

P15 L11 it is not clear for which station is SEI is presented in Table 5.

P15 L13 For instance, the values in the tables (Refer the Table number explicitly)

Conclusions

The conclusion of the paper is not strong. It read as a summary of what has been done than what has been found and its implication.

Tables and Figures

Table 1: citation has to be (Cherie, 2013).

Table 5: SWAT Error Index results for the UBNRB, for which station? Eldiem or Kessie?

Figure 1: Ground stations data lower half of the catchment does not exist?

Figure 2: Given that the ground stations are concentrated in the upper catchment, how reliable is that the rainfall distribution obtained from SWAT and presented in Figure 2 (Right)?

Figure 3: The x- axis, it is difficult to read and the time of analysis is not the same for all graphs. Suggest to assign different label for each Figure say (a, b, c...), in that way it is easier to refer the Figures in the text.

Figure 8 and 9: be consistent in the use of the legend. You used MODIS here instead of MOD16 used in the text. The unit in the y-axis can also be written as mm/month.

Reference

P17,L17 should be cited as: Cherie N. Z. 2013 Downscaling and Modelling the Effects of Climate Change and Hydrology and Water Resources in the Upper Blue Nile River Basin, Ethiopia, PhD Thesis University of Kassel, Germany

P19, L28 should be cited as : Setegn, S.G., Srinivasan, R., Dargahi, B., 2008. Hydrological modelling in the Lake Tana Basin, Ethiopia using SWAT model. The Open Hydrology Journal, 2(1).

P19, L 35-37 Sun, Z., Wang, Q., Ouyang, Z., Watanabe, M., Matsushita, B., Fukushima, T., 2007. Evaluation of MOD16 algorithm using MODIS and ground ob-

servational data in winter wheat field in North China Plain. Hydrological processes, 21(9): 1196-1206.

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