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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Comparing CFSR and conventional weather data for discharge and sediment loss modelling with SWAT in small catchments in the Ethiopian Highlands" *by* V. Roth and T. Lemann

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In this manuscript, the authors are interested in comparing locally observed weather data with simulated (CFSR) data for use in the SWAT hydrological model in small watersheds (<5km2). They assert that this exercise will indicate whether CFSR data are useful in other data scarce regions. From SWAT outputs, they compare uncalibrated results for discharge and sediment. They parameterize SWAT using a detailed (2m resolution) DEM and soils, though land use was adapted from generic land use maps

to a similar resolution using field observations. Observed versus Simulated weather and SWAT Model performance were evaluated using methods recommended by Moriasi et al. (2007). The authors conclude that "no adequate discharge and/or sediment modelling was possible with CFSR data".

This is an interesting discussion that adds to our knowledge of challenges faced in data-scarce regions. It is an important discussion, though ultimately this paper doesn't suggest a solution other than we should all be better off to collect high quality, high resolution data. Unfortunately, such luxuries of adequate high quality data are rare.

Section 1

Lines 16 – 17: I would refer you to:

Fuka, D. R., Walter, M. T., MacAlister, C., Degaetano, A. T., Steenhuis, T. S., & Easton, Z. M. (2014). Using the Climate Forecast System Reanalysis as weather input data for watershed models. Hydrological Processes, 28(22), 5613-5623

Worqlul, A. W., Maathuis, B., Adem, A. A., Demissie, S. S., Langan, S., and Steenhuis, T. S.: Comparison of rainfall estimations by TRMM 3B42, MPEG and CFSR with ground-observed data for the Lake Tana basin in Ethiopia, Hydrol. Earth Syst. Sci., 18, 4871-4881, doi:10.5194/hess-18-4871-2014, 2014.

In addition, currently under review in this same journal:

Worqlul, A. W., Collick, A. S., Tilahun, S. A., Langan, S., Rientjes, T. H. M., and Steenhuis, T. S.: Comparing TRMM 3B42, CFSR and ground-based rainfall estimates as input for hydrological models, in data scarce regions: the Upper Blue Nile Basin, Ethiopia, Hydrol. Earth Syst. Sci. Discuss., 12, 2081-2112, doi:10.5194/hessd-12-2081-2015, 2015.

Section 2

Consider more regionally appropriate terminology for rainy seasons: short rains are

belg season and long rains are kremt season. It is important to discuss that the belg in particular is quite erratic in Ethiopia with respect to its timing and volume of rainfall as well. You get at this a bit in Section 3.1, but it would be advisable to bring this up in your study area description with pertinent references as to why this important.

Regarding HRUs: water is not routed between HRUs. Water is routed using the methods you describe between sub-basins. At the HRU level, the water balance is calculated but this is all then summed at the sub-basin level and not routed, which you imply in the way your discussion reads going from HRUs to routing without clarifying.

Is there a citation for the 2m DEM used? It would be good to know how this DEM was developed as well as information regarding its accuracy and performance for hydrological applications.

You discuss land use map, but nothing regarding land management practices. Did you modify SWAT for this in the database? You need information on management practices to adequately represent plant growth otherwise this will impact both discharge and sediment. And, what of livestock? In many of these areas overgrazing is an issue and certainty influences sediment and erosion. Also, gullying is a problem. How did you approach this challenge and the large amounts of sediment delivered in this way?

What about curve numbers? How did you handle the monsoonal climate and issues with soil water content? This has been shown to be a challenge that must be addressed when modeling in such areas (c.f. look up work on SWAT-WB from Easton et al.).

"The sub-basin sizes were fixed at 2000 ha." Is this a typographical error? Or, is there an error in how the study site sizes were reported. Perhaps stick to similar units throughout (either km2 or ha, but not mixed).

To generate weather, you used the SWAT weather generator but also indicate that the local weather had numerous gaps. How did you address this in developing the underlying statistics for the weather generator? For example, how many missing days

were there for the different variables? For variables that you may not have data, how did you develop statistics?

Regarding sediment: While I can completely understand that you may only have sediment data after rainfall events, it is a bit of a jump to then state there is no sediment during the dry season or outside rainfall events. First of all, flows will continue to move sediment after and event and secondly, there will still be some sediment movement in a river during such times. Low, perhaps but not entirely absent. And, if you only collect during rainfall events, how can you know this one way or another? Also, wouldn't there be some data collection up to some point after a rainfall event? Also, this is about data collection and not model set-up and so it should be moved into a section on sediment data perhaps. I might suggest you reorganize this section along lines of:

2.1 Study area

2.2 Data

2.2.1 Spatial data

2.2.2 Hydrometric data

2.2.3 Sediment data

2.3 Hydrologic model

2.3.1 SWAT model setup

2.4 Model evaluation

Section 3

Again, it is important to indicate the completeness of local data and any issues regarding accuracy (if known).

One thing you might want to consider discussing in your "Model evaluation" section is how the various goodness-of-fit measures are susceptible to outliers or extreme

values and how you are addressing this. I say this due to the variable nature of climate in East Africa. Maybe in section 3.1, you can show basic summary statistics with information on observed data regarding missing days and times of year when such data are missing? You say that MAE and MSE were also computed. Where are they? This needs to stand out more among your results to paint a clearer picture. Again, in themselves they do not tell us much, but you are trying to paint a bigger picture here of challenges faced.

Looking at uncalibrated results in Tables 5 and 6, it is unclear to me how you can jump to the conclusion that the model performs poorly. This is especially true for discharge at Andit Tid and Anjeni, which are near acceptable. From this, it can be stated that the WLRC data produce a better simulated result than CSFR for an uncalibrated model. For Maybar, no similar such conclusions can be drawn for discharge. In regard to sediment, similarly, for both Andit Tid and Anjeni the CFSR and WLRC produce adequate uncalibrated results, but neither performs well at Maybar. Overall, I don't find the discussion on sediment to add much to this paper. Sediment delivery in the Upper Blue Nile is a serious challenge and perhaps your work can add to a separate and more complete discussion on this particular challenge in modelling the region.

Section 4

I think it is hasty to make the following statements:

"Our results clearly show that no adequate discharge and/or sediment loss modelling was possible with the CFSR data"

"Thus, contrary to Dile and Srinivasan (2014), this study suggests that CFSR data may not be applicable for small-scale modelling in data-scarce regions. . ."

My concerns with these specific statements are that 1) you did achieve adequate (uncalibrated) results using CFSR in some instances and 2) you make a jump to the conclusion that this therefore implies the data are inadequate in data-scarce regions gen-

erally. You have not given us other examples of using these data in other data-scarce regions (either your own research or citations to other works). Also, due to the unique challenges posed by the high variability of East African climate, why would this then apply to all other data-scarce regions? By this comment I do intend to say that CFSR data are ideal or even adequate, but the evidence for such statements is thin in the paper at this point and so would need more. You state that "there is no substitute for high quality conventional weather data." I doubt many would argue with argue on this point; however, in remote data-scarce regions of the developing world we rarely have such data available. Even in this work you indicate that the data sets you were using have gaps, suggesting issues and challenges but then there are no details about the data sets.

It is good to point out at least a bit that you can achieve good results with models for the wrong reasons and at various spatial and temporal scales. This should really be a stronger component of the work and perhaps have a great spatial assessment. And, just because this happens (right results for the wrong reasons), it doesn't necessarily follow that the data or models should be abandoned but rather an exploration of where there may be systematic errors in the data that can be improved upon or a discussion on when and where data are more or less applicable. In this study, spatial scale is quite small and so therefore errors will be more pronounced, especially given that rainfall and its distribution are always a concern. And at such small scales, a greater consideration should be given to driving processes and ensuring those are adequately represented in the model.

Technical comments

As noted above, consider how you refer to seasons (e.g., belg and kremt).

A datum is but data are . . . please be mindful of noun-verb agreement.

"and/or" This convention has no place in English writing from a truth value perspective. "Or" is sufficient because in a statement where it is used, if one or both parts may be

true, then the statement is true. “And” statements, on the other hand, are more restrictive, and are true only when both parts of a statement are true. However, this scenario is also covered under the use of the term ”or”. As such, the “and/or” convention is extraneous and unnecessary.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 12, 2113, 2015.