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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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The manuscript compares locally measured rainfall data (WLRC data) with simulated rainfall data (CFSR data) for 3 small watersheds (1-5 km2) in the Ethiopian Highlands. The authors compare the rainfall data over a period of 30 years. Then they compare SWAT simulated discharge and sediment export from these 3 watersheds obtained with each precipitation data set. Parameterization of the model is based on very detailed and site specific topographic and soil data for each watershed. Annually changing land

use patterns were represented by a site specific generic land use map.

For two watersheds (Andit Tid and Anjeni), the results of the SWAT model for discharge are either acceptable or right on the border of being acceptable (Table B1). Given the absence of calibration of the model, I believe this is sufficient to compare with discharge obtained with the simulated CFSR rainfall data. For the last watershed (Maybar) and for all sediment simulations, SWAT simulations are not satisfactory with the measured rainfall data (Table B2). Consequently, comparison of results obtained with CFSR and WLRC data are inconclusive.

The reason for the poor performance with sediment simulation might be in inaccuracies with management data. Sediment simulation is very sensitive to tillage operations or to over-grazing. The authors mention that "land use is dominated by smallholder rain-fed farming-systems with grain-oriented production, ox-plough farming, and uncontrolled grazing practices." How were these represented? For small watersheds of that size, would the quantity and timing of plough operations have an impact on simulation results?

The authors then continue the analysis by aggregating more and looking at mean monthly results (Table 5 and 6, and figures 4 to 6). Analyses of mean monthly results with performance measures such as NSE, r2, and RSR are questionable because there are only 12 data points and these points have expected seasonal variation. At the minimum, there is no justification to apply the performance criteria proposed by Moriasi et al., which were defined for the comparison of measured and simulated time series. Mean monthly values can be calculated, plotted, and discussed as done in section 3.2. However, performance measures threshold values have no validity.

An alternative might have been to consider annual runoff and sediment export, for which it would have been justified to apply performance criteria for NSE, r2, or RSR. I would like to point to a relevant paper, which I found by searching for papers on global weather data: Tamrakar and Alfredsen (2013) Satellite-based precipitation esti-



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mation for hydropower development. Hydro-Nepal J of Water Energy and Environment 11/2013; 12:52-58. DOI: 10.3126/hn.v12i0.9033.

Overall, given the poor simulation results with sediment with either data set, I would suggest to remove these results for the paper and concentrate on the discharge. The story would be much stronger. The conclusions would be similar because with poor discharge, there is really no hope of obtaining meaningful sediment results.

Generally, I find it difficult to decide for myself if the simulation results are satisfactory or not. It would be nice to present the results for each micro-watershed in the same order each time, whether in the text, in the tables, or in the figures. Similarly, the format of tables that have similar information should be similar. For example, it would help the reader to have the same order of performance measures in tables B1 and B2. Why are tables A1 through B2 not cited directly in the text? Are they supplementary material? I think they are quite critical to the understanding and interpretation of the results and should not be relegated to supplementary material. Finally, figures 4, 5, and 6 should be introduced in increasing order, e.g., introduce figure 4 before figure 5. These figures are also difficult to read because of the superposition of colors in the bar charts.

Specific comments: I don't see anything in the manuscript that supports the last statement of the abstract: "and might be better adapted to larger watersheds than the ones used in this study". Please remove.

How can tons of sediment be converted to millimetres? Doing so would require an assumption on the density of the sediment. Is it what was done? What is the assumption? Furthermore, I don't see the necessity of converting a mass to a depth. What does it bring? Why not using tons per hectare, a common unit used to evaluate sediment loss from an area?

In section 2.1.1, the authors mention that SWAT divides the catchment into HRU. Technically, SWAT does not do this. The HRU delineation can be done with the ArcSWAT interface but it could also be done with different tools.



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Again in this section (2.1.1), the authors state that SWAT predicts individual HRU hydrology using the water balance equation. That is not technically true. Each component of the water cycle, i.e., runoff, ET, aquifer recharge, and subsurface flow, is calculated individually. The water balance equation can be used to validate these calculations.

In section 2.2, please detail how the surveys were conducted. Were those from interviews, observations? If references are available, give them. What is the size of the individual holdings? Describe the process of generating a generic land use map from the 2008 and 2010 land use maps.

In section 2.3, how are the one-litre samples collected? Are they grab samples? flow proportioned samples? What is the protocol?

In section 2.4, is the sub-basin size really fixed to 2000 ha? What does that mean for micro watersheds that range from 100 to 500 ha? There must be a mistake somewhere.

Section 2.4, line 21: "During the dry season and outside rainfall events the monitored rivers are sediment free". Really no sediment at all? It would be very difficult to visually distinguish a low sediment concentration (up to 100 mg/l) from no sediment at all. The assumption of no sediment might be justified on the basis that the concentrations are low and the transport is insignificant compared to what rainfall events transport. But it is probably not sediment free.

Section 2.5, line 20: NSE is not always the best objective function for reflecting overall fit. In particular, it is not very indicative of performance when measured data have low variance. When there is high variance, NSE is biased toward high values. I am not contesting its use here, only that it is presented as the best.

Section 3.2: A graph of simulated and measured daily or monthly discharge values would greatly help.

Technical comments: The word "data" is plural. Correct usage is: "data are available",



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or “where they are available”. Please correct throughout the paper.

Page 2115, line 4 “modelled rainfall data”: there is a contradiction between modelled and data.

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