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Hydrology and Earth System Sciences Discussions

Interactive comment on "The influence of precipitation and temperature input schemes on hydrological simulations of a snow and glacier melt dominated basin in Northwest China" *by* X. Ji and Y. Luo

B. Bookhagen

bodo@eri.ucsb.edu

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The authors describe the influence of different boundary conditions on the SWAT hydrological model with emphasis on a glaciated catchment. The authors rely on remote-sensing derived rainfall (TRMM3B43) that are re-calibrated and then used as model-input conditions. The authors describe different approaches to model temperature within the basin and propose a general approach in understanding the hydrologic regimes of alpine catchments.

The manuscript contains interesting points and touches upon important subjects; however, the authors do not provide a thorough investigation and there is plenty of room for improvement. I provide some below.

First and foremost, the manuscript needs a critical proofreading to check for English grammar and improper use of style. I have made some comments below, but stopped after the first 10 pages or so – this is clearly a job for a professional proof reader or the authors. Furthermore, the manuscript is on the lengthy side and several sections can be shortened and condensed without loosing much content. Contrary, there are several paragraphs and data explanation that should be extended to allow the reader to scientifically follow the manuscript.

Second, there exist some misconception in the use of remote-sensing data that should be remedied before the authors can successfully interpret their results. I list three key points here:

(1) The manuscript mixes rainfall and precipitation and I am uncertain if the authors are aware of the differences. Rainfall is liquid precipitation, whereas precipitation is rainfall and snowfall. The TRMM3B42 or 3B42 data product is most sensitive to rainfall (and not precipitation). Hence, the hydrologic budget based on TRMM 3B42 or 3B43 data only include a small fraction of snowfall. It is misleading to call this precipitation.

(2) Along the same lines, the authors provide a unique set of ground-control stations used for calibration. I doubt that these are precipitation measurement (even though they are listed as these in the Table). If these are precipitation measurements, how has the snowfall been converted to rainfall amounts? Through height measurement and some density estimation? Through melting snow? For this to be successful, the snow needs to be sampled right after the snowstorm, otherwise values may be influenced by sublimation, compaction, or other post-depositional processes. I emphasize the importance of this point, as a large fraction of annual precipitation appears as snow in this area. The authors should be more careful when using TRMM-derived products

and be aware of the limitations.

(3) Along the same lines, the authors use the ground-control stations to re-calibrate the TRMM data. They only show the re-calibrated elevation vs. rainfall datasets. It would be very instructive to show the uncalibrated data to give the interested reader the chance to judge the importance of the calibration. By how much have the TRMM3B43 data been adjusted? I note that the authors state that rainfall in mountain areas is underpredicted by TRMM data – I know of several studies that claim the opposite (TRMM 3B42-derived rainfall is higher in the mountains than actual measurements). This is complex terrain and there is no 'one-solution-fits-all' answer. In any case, the authors could show the station locations used for calibrating the data in Figure 2. I am even more puzzled by Figure 3 where the monthly linear fits are presented. What is the meteorological reasoning behind having 2 or 3 piecewise-linear fits vs. only one linear fit? I note that the source product (3-hr TRMM 3B42 data) are somewhat reliable in flat terrain, but certainly have issues in mountainous terrain.

Third, I have the following scientific comments that (hopefully) will provide food for thought.

(1) I am puzzled by the elevation vs. rainfall (or precipitation) approach. There certainly exists a relation between rainfall and elevation, but not for all elevation ranges (especially not for elevation above 3.5 or 4km). Orographic rainfall effects and limitations of water-vapour storage in colder (higher) airmasses prevent high rainfall rates at high elevation. Along the same lines, why are there negative relations in the elevation vs. precipitation plots? Is this an artifact of the relatively small numbers of calibration station (compared to the large catchment area) or is this part of an orographic rainfall effect? The rainfall vs. elevation transect do not display any uncertainties or linear-fit relations. This is crucial in evaluating the overall approach (they are not listed in any table either). Furthermore, the studied catchment has a high relief and likely has a steep rainfall gradient. I am wondering how many TRMM pixels are actually located in the catchment (with a 0.25degree cell-size, there are not too many in the catchment).

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Along these lines, Figure 1 needs a length scale!

(2) I note that the elevation-bin approach is tricky in a catchment with a steep rainfall gradient. Likely, the frontal high elevations receive much more rainfall than similar elevation farther inside the catchment (i.e., south of the mountain front). Why use a binning approach, if you use grid-based TRMM data?

(3) Regarding the hydrologic modeling approach, I would like to see a few more explanations about the SWAT model. What are the strength and weaknesses? No need to go into detail here, but there are some obvious limitations for steep, mountainous catchments (e.g., altitude binning).

(4) Why is the hydrologic model run and calibrated with mean monthly data? Why not use daily data? TRMM 3B42 provides a daily rainfall product as well.

(5) The evaporation measurements appear to be very high. I am puzzled by an evaporation rate of 950 mm/yr at 3550m. Is this really true? This is twice the precipitation (sigh) amount at the same altitude as given in Table 1. What is the source of water (or water vapor) to sustain these rates?

(6) The authors argue in their last paragraph in the Conclusion that 'this study provides a reference for hydrologic modeling in data-scarce basins'. Wouldn't it be more effective to use a well-monitored basin and see which and how many variables are necessary to understand the annual (or monthly) hydrologic budget? There are certainly equally-sized catchments in similar alpine settings with more gauge stations.

Wording comments: The word scheme is misleading and used in the wrong way. I suggest to replace or just it only in appropriate places. There is no 'model-warm up', it's called spin up. But I probably would refer to a 'initiation period' Spell out SWAT at first usage. I note that there are several place in the manuscript where the proper units are missing (e.g., page 823, line 7). Page 821, line 19: accurately. Page 815, line 9: a good linear Page 815, Line 13: single Page 816: Temperature data are not

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more or less noisy than rainfall. These are very different variables presenting different meteorological conditions.

Figures: Figure 1 needs length scale; increase width of polygon outlining MRB catchment. Figure 2 needs linear-fit information and statistics. Station location would help. Also, plotting the uncalibrated TRMM data would be very helpful and useful as well. Figure 3: You should use the same Y-axis scales for all figures. Plot slopes and fitting information in the graph. I emphasize that all rainfall vs. elevation figures use precipitation (mm) as Y axis. I urge the authors to think carefully if these are precipitation amounts or rainfall amounts. Also, the authors refer to a rate, so it should be mm/yr or mm/month. Figure 4: Units! Is this mean monthly temperature taken from 24-h measurements? Again, same Y axis would be helpful. Tables: Spell out all abbreviations (LPLAPS, SPLAPS, etc) Table 3 should contain fitting information (R2, RMS and uncertainty (1 or 2 sigma).

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 10, 807, 2013.