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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Using the nonlinear aquifer storage–discharge relationship to simulate the baseflow of glacier and snowmelt dominated basins in Northwest China" *by* R. Gan and Y. Luo

Anonymous Referee #2

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The paper addresses the issue of baseflow modelling in the SWAT model. In the standard version of SWAT, baseflow is represented by one linear reservoir, which does not always reproduce the recession phase very well. Therefore, the non-linear aquifer storage-discharge relationship (Wittenberg, 1999) was embedded in the SWAT model. Simulation results of this method were compared to those by the standard version of SWAT (using one linear storage) and those of an altered version of SWAT by Luo et al. (2012) using two linear storages. Also, simulated baseflow by the three model approaches were compared to results of a digital filter method. The approach presented in this paper is of interest for improving baseflow simulation in SWAT and similar mod-

els. In general, the methods used are valid and clearly outlined. The paper is well structured and concise. Nevertheless, I noticed some points that seem somewhat unclear to me still. To me it seems, that the terms "runoff", "flow / streamflow" and "discharge" are not clearly distinguished within the paper. In order to compare the simulation results of the different baseflow routines, it might be helpful to mention the time periods used for calibration and validation of the model explicitly. p. 5538, ll. 5,6,10: You are using Qb and not Q as in the Wittenberg (1999) paper, which somehow implies that you refer to baseflow. Then, in line 14 you only use Q (consistent with Wittenberg (1999)) – is there a difference between Qb and Q in your paper? p. 5540, ll. 6-7: It might be clearer to add "for the non-linear approach" to "the constants in Eq. (2)." Also, I would recommend using "coefficients/parameters" rather than "constants". p. 5540, ll. 7-9: To me, this sentence suggests that the simulation results in Luo et al. (2012) verify that the observation is correct, which does not seem logical.

p. 5540, l. 12: Adding "in Eq. (2)" would make the sentence clearer. In general, putting the sentence in ll. 13-14 before that in ll. 12-13 would be more logical.

p. 5540, ll. 13-19: As NSE is usually very high in catchments with a strong annual cycle (see for example Schaefli & Gupta 2007) and overestimates high-flow periods it may not be the best performance criterion to compare different approaches of baseflow simulation in a catchment with strong seasonality. It might help to consider quality criteria more applicable to the evaluation of low flow, like NSE with logarithmic discharge values or the Volume Efficiency suggested by Criss & Winston (2008).

p. 5540, ll. 10-12: "Generally, the nonlinear relation performs much better than the linear relation" – This is not visible from Fig. 2, Normalization of the figures or adding of meaningful criteria might help here.

pp. 5541-2, ll. 17 "which is sustained by outflow from groundwater" I wonder if this is the only case, or could it be also due to 1) water management in some way or 2) the methodology of discharge measurement?

pp. 5541-2, ll. 28-5. It might be useful to stress differences between the catchment used in your study and that used in the Partington et al. (2012) paper and maybe similarities to that used in the Cuen (2005) paper to be able to compare the results better. p. 5542, l. 7 – Not every reader will be familiar with this filter method. Could you please describe it in the methods part also?

p. 5543, ll. 1-3 –"There is a good agreement in the baseflow patterns of the SWAT and filter methods" – I do not agree with this statement. The overall seasonality is met, but magnitude of the baseflow and also the rising limb and the recession phase differ a lot between the approaches.

p. 5546, ll. 8-10 – This sentence implies that the parameters are calibrated without consideration of the observed streamflow data. Probably you wanted to stress, that the parameters are calibrated independently from one another (and not independently from the observed streamflow, which they are in fact calibrated against).

p. 5554, Table 5: To me the correlation matrix is still somewhat unclear, especially it is not mentioned which statistical test is used.

In general, the paragraphs under 3.2, 3.3 and 3.4 seem somewhat mixed, especially considering the description of observed streamflow.

While the variation of coefficient b is explained in detail in 3.5 and 4, the explanation for coefficient is still missing details in 3.5 and completely missing in the conclusion parts.

In the conclusion, the coefficients a and be should be described.

The tables and figures shown support the contents of the paper. Still, I also would like to add some minor remarks considering the figures: In figure 3, you used a dashed line in the actual plot, but a solid line in the legend. Also, perception of the plot would be easier if you used one colour for each model approach exclusively. In that case, you could also put all three models in one plot and add one plot for only one low-flow period, where the differences between two-linear and one-nonlinear could be shown

more in detail.

Proper credit is given to related work. But, some authors which are referred to in the bibliography are misspelt in the text: "Ferker" should be "Ferket" (p. 5536, l. 20, "Neistch" should be "Neitsch" (p. 5539, l. 2) "Morasi" should be "Moriasi" (p. 5539, l. 16, p. 5541, l.15)

For one reference you mixed the first and last name of the author in the bibliography: "Paolo, V." should be "Villani, P." (p. 5547, l. 28)

"Institute of Hydrology (1980)" is cited in the text (p. 5543, l. 13), but not mentioned in the bibliography

Overall, the language is fluent and precise. Not being a native speaker myself, I still would suggest some minor corrections regarding choice of words, grammar and punctuation:

p. 5537, l. 6: Replace ", Wittenberg" with ". Wittenberg".

p. 5537, l. 11: Replace "is relevant to" with "is related to" or better "is dependent on".

p. 5539, l. 5: Replace "is described in detailed" with "is described in detail".

p. 5539, l. 11: "as the period used" is redundant to "the low-flow period (. . .) was selected" and can be eliminated.

p. 5539, l. 16: Replace "and their ranking system" by "considering also the ranking system after Moriasi et al. (2007).

p. 5540, l. 20: Replace "Streamflow" with "streamflow".

p. 5541, l. 17: Replace "The observed streamflow eventually became nearly constant" with "During the summer months, streamflow is nearly constant".

p. 5542, l. 7: Replace "and filter method" with "and "the automatic digital filter technique" (Nathan and McMahon 1990).

p. 5542, l. 13: Replace “startes” with “starts”.

p. 5542, l. 26: Replace “The peak time” with “During the peak time” or “For the peak time”.

p. 5543, l. 20: Instead of “index” the plural “indexes/indices” should be used.

p. 5545, l. 5: Omit the comma.

p. 5545, ll. 18-19: Replace “was” with “is“ or restate the sentence.

p. 5545, l. 12: Replace “constant” with “coefficient” – as you explain the range of the parameter, it cannot be considered a constant.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 10, 5535, 2013.