

Replies to the comments by Mojca Sraj

We would like to thank Mojca Sraj for her interest and for her comments on our manuscript.

Below, reviewer comments are in italic font and our replies are in normal font.

General comments

The paper investigates the reasons for failure of the conceptual hydrological model predicting changes in discharge as a response to observed increases in precipitation and air temperature for 156 catchments in Austria. The authors considered three groups of possible causes, namely data problems (precipitation, temperature), problems related to the model calibration (length of calibration period, objective function), and problems of the model structure (ET calculation method, vegetation changes). Hypotheses of the possible causes were evaluated using simulations with modifications of the baseline model. The paper is in the scope of the journal. It is well written and structured. The data seem to be of appropriate quality. References are up to date and appropriate. There are, however, some areas that require minor corrections for further improvement.

*1. Penman-Monteith method – Please, check the calculation and the equation for the net radiation at the crop surface (Eq. 4). Net radiation (R_n) is the difference between the incoming net shortwave radiation (R_{ns}) and the outgoing net longwave radiation (R_{nl}), and R_{ns} is derived from the balance between incoming and reflected global radiation (R_s) given by $(1 - \rho) * R_s$ (see Allen et al., 1998).*

Thank you very much for pointing this out. This will be corrected. The error only occurred in the manuscript (not in the calculations).

Specific comments

1. Page 1, line 21: I would suggest being more specific in defining the size of the impact. How much is "little"? Is it negligible?

We will add "(less than 5 mm yr⁻¹ per 35 yrs)" to be more specific.

2. Page 3, line 29: Using abbreviation Merz2011 for the reference is unconventional. I would suggest to use the usual way of citing, namely Merz et al. (2011). This issue should be corrected throughout the document.

Since Merz et al. (2011) is referred to very often, it seems a useful abbreviation and we will adjust this according to any guidance by the journal.

3. Page 7, line 16: Please, check equation 4. It does not seem ok to me.

See above.

4. Page 7, line 19: *Modified Eref calculated using a variable surface resistance based on changes in a satellite-based vegetation index should be marked as E2 (not E3) in order to be consistent with Table 3.*

Thank you for pointing this out. This will be changed.

5. Page 8, lines 9-10: *Abbreviations E1 and E2 should be explained when first mentioned. Furthermore, correct the numbering of E1, E2 and E3 to be consistent with Table 3.*

E0 and E1 are defined in Eq. 2 and Eq. 3. The numbering will be corrected to be consistent with Table 3.

6. Page 14, Table 3: *It would be useful for readers to include the exact years of the 5-year calibration period in the table or in the table caption. Is it the first 5 years of the considered data or any other? Is it the same for all model variants?*

Model calibration and the calibration periods are described in Section 2.3.3. We used seven 5 year calibration periods (based on hydrological years), during 1978–2012. As a modification, we also tested using a 25-year period as calibration period (1978–2002). We will change the header of the respective column in Table 3 from “Calibration period” to “Length of calibration periods”.

7. Page 15, lines 3-6: *Analyses of simulated changes in storage should be explained in more detail since they are mentioned only in this paragraph.*

We will add some more information on how we calculate changes in simulated storage and will extend this paragraph in the manuscript.

“For this, we analysed the sum of all simulated storages, i.e. soil moisture store, upper and lower zone subsurface store and snow water equivalent, and calculated trends of annually average values (based on hydrological years). Trends in simulated storage changes were, on average over all catchments, 8 ± 20 mm over 1978–2013. This shows that the overestimation of the discharge trend is not generated by an opposite trend in simulated storage. Of the simulated storage groundwater is the largest component. Small changes in simulated storage are in agreement with no consistent large scale groundwater changes in the observations (Blaschke et al., 2011; Neunteufel et al., 2017). “

8. Page 15, lines 13-16: *As seen from Fig. 4b, an increase in model performance loss with increasing distance of evaluation periods from the calibration period could be observed in almost all cases, regardless of the calibration period. Please, rewrite the sentence.*

Will be rewritten: “In many cases, model performance decreases with increasing distance between the calibration and the evaluation period, particularly for model evaluations in subperiod S1 and S2.”

9. *Page 20, Table 5: It would be useful for readers to add a corresponding model variant to each individual result.*

Good idea, will be added.

10. *Page 21, line 3: Please add which 5 years and 25 years were used for calibration of the mentioned model variants.*

Will be added.

11. *Page 21, line 21: It would be useful for readers to add a model variant in brackets.*

Will be added.

Technical corrections

1. *Page 15, line 18: It should be "is reversed".*

(Note, the comment apparently refers to page 14, line 18). Ok, can be changed.

2. *Page 15, line 14: Correct the structure of the sentence.*

See above, we will rewrite the sentence. "In many cases, model performance decreases with increasing distance between the calibration and the evaluation period, particularly for model evaluation in subperiod S1 and S2."

3. *Page 24, line 4: Bracket is missing at the end of the sentence.*

Thanks, will be corrected.