Author response to Referee #3 comments

Manuscript hess-2017-106, "Using isotopes to constrain water flux and age estimates in snow-influenced catchments using the STARR (Spatially distributed Tracer-Aided Rainfall-Runoff) model" by Ala-aho, P. et al.

We are grateful for the remarks by Referee #3 on our manuscript. We have addressed the comments providing suggestions for corrections and clarification as requested. We hereby provide our point by point responses how the comments by ref #3 will be addressed in the revised manuscript.

Sincerely,

Pertti Ala-aho

Referee #3 comments

The article developed a calculation scheme to describe the spatially and temporally variable isotope fractionation processes in seasonal snowpacks, and the calculation scheme was linked to the STARR model to simulate the stream flows, isotope ratios and snow pack dynamics in three long term experimental catchments.

GENERAL COMMENTS:

1. The spatially distributed water age was simulated as shown in Fig.9. Does the spatially distributed water age is estimated by averaging the water age of surface water, soil stored water and groundwater stored water in each computing unit? The water age of incoming precipitation is taken as 1, which means the water age of stored water in the catchment should be larger than 1. Why the calculated water age is less than 1, even equal to 0, in many places of the three catchments?

Thank you for the comment, we realise that the legend in Fig. 9 can cause confusion. The age of 0, pointed out by the referee, indicated by the dark blue colour, means water with age between 0-0.5 years. The legend in Fig. 9 will be changed to make the "age bins" more obvious.

SPECIFIC COMMENTS:

1. L18P1, P4 It is better to specify how long does the "exceptionally long" mean?

To give better context to your claim for "exceptionally long datasets" we will rephrase this to highlight that the datasets are exceptional in the context of Northern catchments, rather than specifying data record lengths (which vary for each catchment and observation):

"In the context of Northern catchments the sites have exceptionally long and rich datasets of hydrometric data and - most importantly - stable water isotopes for both rain and snow conditions."

The observation period for the hydrometric data and the stable water isotopes date should also be given in the "Study sites" section for better understanding the simulation process and calibration results.

Thank you for the suggestion, however we respectfully suggest to leave the data description in its own section. We find that merging the site and data description would lead to a more fragment structure, and make the comparison between sites in section "2.2 Model input and test data" more difficult.

2.L24P1, The geology setting is only briefly described for the Bogus Creek, but not given for the other two study sites in the article. How to make a conclusion that the geology is an important factor causing contrasting water age distribution among the three catchments?

A fair comment, we will remove the term geology and refer only to soil characteristics

3. L8P2, The meaning of abbreviation of "STARR" has been given in L2P2.

Thank you for pointing this out, repetition will be removed.

4. L12P2, The literature "Ala-aho et al., in review" has been cited several times in the article. It's better to give a specific published journal or publishing house etc. of the literature.

It is very likely that the paper will be soon in press (it is accepted subject to revision) if it is not accepted before the HESS paper is published the citation will be changed to:

Ala-aho, P., Tetzlaff, D., McNamara, J. P., Laudon, H., Kormos, P. and Soulsby, C.: Modelling the isotopic evolution of snowpack and snowmelt: testing a spatially distributed parsimonious approach, accepted in Water Resour. Res., subject to revisions, in review.

5. L25P2, The sentence seems written in Latin.

This text will be removed

6. L26P5, The meaning of DCEW should be given here.

DCEW will be defined at its first occurrence

7. L33P5-L5P6, The meteorological date from stations in the neighboring catchments are used for the Krycklan and Bruntland Burn catchments. It's better to describe the distance of the stations from the study sites, or give the latitude and longitude coordinates of the stations for better judging the reliability of the inputted meteorological data in the model.

Distances between meteorological stations and the catchment outlets will be added to the text

8. L31P8, What does the "kg" means? Hydraulic conductivity?

The sentence will be rephrased to make the meaning of k_g clear:

"For the groundwater one parameter (k_g), which linearly relates the groundwater storage to groundwater outflow (Q_{gw}), was calibrated."