Author comment to Reviewer #1

Manuscript no. hess-2014-268, “Estimation of temporal and spatial variations in groundwater recharge in unconfined sand aquifers using Scots pine inventories” By Ala-aho, P. et al.

Thank you for the several positive comments regarding our manuscript. All the comments and suggestions are valuable and highly appreciated. We have carefully addressed the reviewers’ comments and suggestions in order to make changes in the manuscript. We hereby provide our point by point responses how each of the reviewer’s comments will be addressed in the manuscript.

Sincerely,
Pertti Ala-aho

Detailed response to reviewer #1 comments:

The paper seems excessively long. I recommend reducing the text, such as in the Discussion section.

We appreciate this comment to improve the readability of the paper and will shorten the manuscript in following ways:

- Results of the water flow at different depths (Fig. 7) and related discussion will be removed from the manuscript. We reconsidered that this result is not essential for the paper and can be removed in order improve the focus of the paper.
- The comparison of measured stream baseflow to different simulated recharge will be simplified (Table 3).
- Materials and methods will be shortened by removing example of the spatial distribution of model results (page 12 lines 11-23) and not explaining the technicalities (page 14, 20-26).
- In materials and methods section, equations for different evaporation components could be presented as additional material / annex if this in line with the journal formatting.
- some sections of the discussion will be removed (e.g. page 28 lines 2-6 and lines 10-16) or reorganized.

Throughout the paper, please change the word "depth" to "thickness" in reference to the thickness of the unsaturated zone. The unsaturated zone is the region between land surface and the water table and thus is not a "depth".

This is a good specification, and will be addressed throughout the manuscript

Page 18: Not simulating the water table "for computational efficiency" is not a valid justification in my opinion. I recommend that the water table be included in the model to accurately simulate hydrologic processes such as ET.

An important comment to ensure models ability to produce realistic ET rates. Presence of water table is acknowledged in the simulations indirectly for cells where the interpolated water table is less than one meter from the ground surface. This is done with the water balance approach described in the paper (page 18). When the simulations were performed with water table fixed at 1m, the annual average ET rates were 5,4%, 2,3 % and 6,5 % higher for LAI values of 0.5, 1.5 and 3 than without the water table, respectively. For deeper water table configuration (2m) the increase in ET was trivial for LAI values of 0.5 and 1.5, and 3,5 % higher for LAI values of 3. We assume that for deeper water table configuration the water table influence on ET would be insignificant.

Therefore we assume that neglecting the water table influence below depth of 1m can produce minor overestimation in areas where the water table is in the region on 1-2 m from ground surface with high LAI values. However we argue that in aquifer scale the impacts will be minimal, because 8% of model surface is within this groundwater table configuration (Fig. 2), and model cells with high LAI are not very common (Fig. 2). This justification will be more clearly incorporated in the manuscript and the text on page 18 better organized to convey the point.

Page 20, last paragraph: I don't agree that the land surface is a reasonable representation of the water table "in the transition zone between recharge and discharge areas". Please modify accordingly.

This concept of groundwater table being close to land surface in the recharge-discharge area transition zone is obtained from the work of Rossi (2014). This is better explained with a cross-section which will replace Fig. 3. The cross-section shows the water table sloping towards the discharge zone which demonstrates the assumption of GW-table near ground surface. We assume similar water table configuration around the aquifer.

Page 23: In comparing the model recharge estimates to that from the baseflow method I recommend that the authors acknowledge that streamflow estimates are (at best) accurate to within 5% based on USGS data. Modify the text accordingly in relation to this qualifier.

A valid notification, and the uncertainty related to baseflow determination will be included in the revised manuscript.

References:

Rossi, P.M.: Integrated management of groundwater and dependent ecosystems in a Finnish esker. PhD thesis, University of Oulu, Finland. Available: http://jultika.oulu.fi/Record/isbn978-952-62-0478-9. 2014.