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Hydrology and Earth System Sciences Discussions

Interactive comment on "Impacts of ditch cleaning on hydrological processes in a drained peatland forest" *by* H. Koivusalo et al.

Anonymous Referee #1

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Ditch cleaning is a highly relevant topic in forestry and forest hydrology, which, at present, receives increased attention in Scandinavia and other regions where ditching was used to enhance forest productivity. This study is based on extensive field data and combines it with hydrological modeling, which distinguishes it from many purely theoretical thought experiments. However, plot scale observations, such as water table depths, are often extremely difficult to model with hydrological models that often operate at larger scales and that rely on simplifying assumptions.

A major criticism concerns the model performance because only 5 of 39 sites, including sites used for calibration, achieve Nash-Sutcliff efficiencies higher than 0.5 for water table predictions. In such a case, the model should be rejected for all sites where it fails and it should not be considered to be more representative after scaling it up to

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the catchment scale. Generally, it would be better if the model was only be applied in cases where it performs satisfactorily. In all other cases, especially at the catchment scale, experimental measurements should be given considerably more weight than the FEMMA simulation results. This could be done, for example, by a more thorough flow analysis of the C3 and C4 catchments before and after the cleaning.

Major comments are:

(1) Inferences based on mathematical modeling can only be made in cases where the model can reproduce the reality satisfyingly well. Rejecting ones own model can be painful, but it is not a shame but rather a virtue to use it only in cases where one can trust in it. Since the model seems to work for at least 5 sites, it could be used for plot scale studies.

(2) This study is based on a wealth of experimental data and could benefit a lot if more weight was given to these observations; particularly in cases where the model fails.

(3) The effectiveness of ditch cleaning is evaluated by considering the soil structure and hydraulic conductivity as well as the LAI of the local forest stand. However, no mention is made regarding the effect of ditch spacing although it varies between 28 -43m. Ditch spacing is a key parameter for the design of drainage systems and its importance is also reflected in Hoogoudt's equation (particularly when calculating the water table depth half-way between two ditches where the ditch-spacing parameter is taken to the power of two). How applicable are the conclusions drawn in situations with different ditch spacing? Perhaps this could be evaluated by a sensitivity analysis using the calibrated FEMMA model?

(4) Effects of ditch cleaning on hydrological processes are only presented as changes in total annual flows or volumes. I think that a closer look on seasonal effects (e.g. temporal distribution or timing of discharge at the catchment scale; at the plot scale: changes in soil temperature or water level or transpiration rates e.g. at the beginning of the growth season) could add a lot more value to this study.

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(5) A lot of effort has been spend on snow modeling. In practice there seems (to me) that there is no (direct) link between snow dynamics and ditch cleaning other than through (indirect) effects related to biomass growth. In this study, "the effect of ditch cleaning on the growth of forest biomass is neglected under the five-year study period". However, the fact that simulated canopy and snow processes are not affected by ditch cleaning during is presented as a result. This is somewhat misleading because it is a direct consequence of the model assumptions and not a result.

Minor comments are:

(a) No mention is made on how the model was calibrated. Were the model parameters adjusted manually or automatically based e.g. on a genetic algorithm/ Monte Carlo simulations or on a hill climbing technique?

(b) On-site measurements were not used, because "they deteriorate the performance of the snow model". It sounds a bit strange to select input data based on its effect on the model performance, especially if in-situ measured forcing data is replaced with interpolated data. This requires a better argumentation.

(c) "Deficiencies in the snow simulations are one of the most important factors affecting the model performance." When looking on the Figures 11b) and 11c) it seems that the model also fails to reproduce the observed hydrograph during late autumn when there should be no snow. Generally, the modeled recession appears much slower than the observed recession. Again, this can hardly be related to short-comings in the simulation of snow.

(d) It is well known that the conductivity and specific yield vary considerably in the upper layer (acrotelm) of a mire. It is unclear how well this can be represented using Hoogoudt's equation. The authors mentioned that Hoogoudt's equation can account for different conductivities, but only "above and below a ditch depth". How can this be solved in cases where most of the variations of hydraulic conductivity and specific yield occur in the region above the bottom of the ditch? Could this be a reason for the

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previously described recession problem?

(e) The snow model used in this study seems to be a physically-based energy balance model, which probably involves a lot of parameters. However, a simple degree-day model could be sufficient, especially because ditch cleaning apparently doesn't affect snow dynamic.

Based on the above comments I cannot recommend the paper for publication in HESS as it is now. However, considering the relevance of the topic as well as the extensive amount of available field data, this study could potentially provide a valuable contribution in HESS after major revisions. In my opinion, the field data has received so far too little attention. A possible solution could consist of using a numerical experiment at the plot scale to study the sensitivities of selected parameters relevant for biomass-growth to ditch cleaning while, at larger scales, a more thorough analysis of the experimental data could be provided.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 5, 147, 2008.