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Comment on hess-2021-310

Juraj Parajka (Referee)

Referee comment on "Development and parameter estimation of snowmelt models using spatial snow-cover observations from MODIS" by Dhiraj Raj Gyawali and András Bárdossy, Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2021-310-RC1, 2021

General comments

This study presents an approach for calibrating different degree-day snowmelt approaches by using MODIS snow cover data. The second aim is to examine different degree-day variants for snowmelt simulations and calibrate/validate them using satellite snow cover data. The approach is tested in two regions (Baden-Württemberg in Germany and Switzerland). The results indicate a slight increase in overall NSE runoff performance and a better NSE performance during the winter period.

I read with interest the manuscript because we did numerous similar experiments in the past (and recently). I have to say that the manuscript presents some interesting and novel experiments, but as a whole, it is not ready for publication in its current form. The main reasons for such assessment are:

- The Introduction section needs to be improved. In its current form, it is not specifically presenting which approaches are already available, what the research gaps are and how this research goes beyond existing studies? There are numerous studies (for example, please see some references below, and references cited in these studies) investigating and comparing different degree-day snowmelt models and studies investigating calibration of conceptual hydrologic models (their snow part) to MODIS snow cover data. The introduction needs to clearly present the research done so far and to formulate what the novel scientific contribution of this study is. In my opinion, a comparison of existing degree-day models is not novel. Nor a general use of MODIS snow cover data in hydrological modelling. Still, I think the study presents some interesting approaches which can be turned into novel research objectives, such as how many and which MODIS images are needed for robust calibration of conceptual snowmelt models.
- The structure of the document/story is not easy to understand, and the clarity of the presentation can be improved. If the study's main aim is to propose some novel

approach/method, then I would suggest presenting it first and describing the study region and data later. This will allow the reader to understand the novelty and eventually to apply the general approach to other regions/models. I would also suggest presenting a general strategy at the beginning clearly. This will create a storyline and improves the clarity of the presentation. In its current form, there are many subsections and the order reads more like a summary of all technical works done but does not present clearly what the novel scientific contribution/research hypothesis is.

- The study needs to be more focused on the novel contribution. I'm not sure how the interpolation and its cross-validation contributes to the novel scientific findings in the field of using satellite data form model calibration? Perhaps the crossvalidation can be presented only in a supplement. The more interesting point is to analyse which MODIS images are needed for robust model calibration. I do not understand why not use all available images, particularly for model validation? How sensitive are presented results to the selection of dates of MODIS images? There should be a more detailed analysis and evaluation for supporting the results and interpretations made. It is also not clear why not to use the concept of the HBV for simulation of snowmelt accumulation and melt. Why is it needed to separate the degree-day part and then link it back with the hydrological modules instead of using it together (i.e. to calibrate only the snow module first and then apply the complete model)?
- The discussion of the results is not comprehensive. It will be interesting to link the findings with similar studies calibrating the hydrologic models by using MODIS or comparing different variants of degree-day models.

I believe the manuscript presents an interesting topic and can be an interesting contribution, but it needs a very substantial revision and extension.

Specific comments

Which MODIS version is applied?

Kriging. Was the spatial correlation model (semi-variogram) fitted separately for each day?

Radiation based model: how was the Linke coefficient estimated. Does it vary seasonally?

Cross-validation of interpolation. Leave-one –out crossvalidation is typically used to

camper different interpolation methods. Were the residuals smaller than obtained by some other interpolation method? How do the resulting maps compare with existing gridded (precipitation, air temperature) products provided by MeteoSwiss or DWD?

References:

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