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Discussions

Interactive comment on "Complexity and performance of temperature-based snow routines for runoff modelling in mountainous areas in Central Europe" *by* Marc Girons Lopez et al.

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General comments

This work analizes the performance of different snow routines based on the degree-day method in the framework of the HBV hydrological model. For this, runoff together with other snow-related variables are simulated in a large number of basins in Alpine areas in Central Europe and then compared to different sets of observations. The routines include different modifications for the snow routine components in HBV. Despite the significant variability found among cases, the results identified an exponential snowmelt function as the best modification in terms of model performance, followed by

the adoption of a seasonal degree-day factor; other processes, like refreezing, added little benefit to the model pointing out that complexity itself is not an advantage without careful model design. The work addresses an interesting topic for areas where physical modelling approaches demand larger data sets than the available observations, and it is very clearly presented. Despite the conclusions cannot be directly extrapolated to other snow regions in the world, the number of study cases cover a large area in Central Europe, where snow processes condition the hydrological response in many rivers.

I have some observations that can be assessed by the Authors to emphasize the applicability of the results and the scope of the study; some minor comments are also included.

1. The work includes all the different snow routines in the HBV model, and no other hydrological model is assessed. I suggest making it clear in the title that the assessment is done on the HBV performance, since ". . . for runoff modelling in mountainous areas in Central Europe", since it may lead to expect a wider scope of models. Additionally, some comments addressing whether the level of improvement or not obtained from each routine is affected by the model choice. At least, some reference to similar models should be included and some justification of what conclusions would be expected to be shared from simulations by other hydrological models.

2. A second issue is related to the spatial resolution of the input data, and potential scale effects. Gridded weather data in the Swiss cases, 1-km2 of gridded SWE, and 25-m cell size of the DEM, whereas point observations from stations and a 5-m DEM are used in the Czech catchments. Could you provide some assessment on these potential scale effects, and whether the source of weather data had an influence or not on the results? I also wonder whether using mean SWE values over each elevation zone, and point SWE measures, depending on the cases, could affect the results and comparison. Also, do you think that the results are scale-dependent of the cell size of the DEM used in the HBV model?

3. In the introduction, I miss some inclusions, like the importance of sublimation from the snow under certain conditions (not only in dry areas like we reported in Sierra Nevada-Spain, but also during the summer in the Alps and other regions, see Herrero and Polo, 2016), the existence of experimental catchments in the world devoted to snow processes research (see for example a recent Special Issue in Earth System Science Data on “Hydrometeorological data from mountain and alpine research catchments”), or the use of remote sensing sources to provide data to monitor snowpacks and snowmelt (many examples can be found, e.g. Dietz et al. 2012). Lines 55-60 should also address the limitations of degree-day approaches, and when they, although simple, are not an option.

4. I am curious about the performance of each routine regarding the snow cover distribution. Did you check also their ability to capture this by testing against some satellite images? This is very interesting in terms of model performance to identify the sources of improvement or not.

5. Since only four of the case studies were above 2000 m a.s.l. (only one above 2500 m), I think that some comment on how the results could change or not in higher elevation sites would shed light on their further applicability, especially in catchments where snowmelt is a higher fraction of runoff.

6. I fully agree with selecting just some examples to conduct the presentation of results. I think, however, that including more than just one catchment, and year, would add value to your results. You could suggest another one from a lower altitudinal range, coming from the Swiss area, so that the impact of the spatial scale effects could, if needed, also be discussed. It would be very nice being able to see selected results from all the cases, I would suggest their inclusion as supplement.

Other comments: 7. The gridded data of SWE in the Swiss cases were derived from a temperature-index model. Could this bias the performance of the routines?

8. Lines 259-260. Please, could you assess whether this decision could affect the

results or not.

9. Figure 4. Please, could you show also some validation results for this example case and year.

10. Lines 410-412. Any comment on why these different behaviours are found?

11. Lines 425-427. Reading this, I would conclude that runoff data/simulations are somehow limiting the model performance’s improvement (see also your comments in lines 482-484, and in lines 496-499. Additionally, this content should be reflected in conclusions (lines 565-567), to be more specific.

12. I would suggest including some quantitative result in the conclusions, but I leave it up to the Authors.

I hope that these comments help the Authors to address further their results and can contribute to the final version of the manuscript.

References:

Dietz et al., 2012. International Journal of Remote SensingÂă33(13):4094-4134 https://doi.org/10.1080/01431161.2011.640964

Herrero and Polo, 2016. The Cryosphere, 10, 2981–2998, 2016 https://doi.org/10.5194/tc-10-2981-2016

Special Issue in Earth System Science Data on “Hydrometeorological data from mountain and alpine research catchments” https://www.earth-syst-sci-data.net/special_issue871.html

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