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Comment on hess-2021-500

Anonymous Referee #1

Referee comment on "Synopsis of the uncertainties introduced by bias-adjusted climate forcings in regional glacier surface mass balance evolution studies - A case study using a CORDEX chain envelope in western Norway" by Yongmei Gong et al., Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2021-500-RC1, 2022

Review of High-resolution modeling of glacier mass balance and surface runoff in western Norway driven by bias-corrected climate forcing by Gong and Rogozhina submitted to HESS-2021-500

This work utilizes a snow model driven by different sets of climatic data to calculate the runoff from 18 glaciated catchments distributed over southern Norway. The motivation of their study is to improve the knowledge of future change in runoff from glacierized basins and have a better downstream societal preparedness to such changes. In general this is a ambitious effort to bring in the large amount of gridded weather/climate data that exists today to build a model that can serve as a tool to assess past changes, and possible also to predict changes into the future. As the authors state improved knowledge of the runoff from glaciated catchments in southern Norway is a prioritized question. This manuscript deals with the present /past tempus, and I suspect the authors will aim for the predictive power of the suggested methodology in future contributions.

I got three **major questions** that lingered during the full path of reading the manuscript:

1. I am not sure how they actually modelled the surface mass balance of the glaciers. As I read the methodology presented in section 2 it seems to me that SMB is not explained here as (glacial) Surface Mass Balance, but it seems more to be described as the Snow Mass Balance. From section 2 onwards to the final sections this was what I interpreted this work to be. I kept forgetting that SMB was glacial mass balance, and I had to hop back the introduction to remind myself what this study was about. The methodology is a very clear description of how the snow balance is treated, but it seems like a subsection of how the glacier surface mass balance, or the climatic mass balance (van Pelt et al, 2019) was calculated. A clarification of this would be a necessary addition to the manuscript. There are some physics in addition to the snow model described in section 2, that usually is applied when calculating the CMB of glaciers (Hock, 2005). I would recommend to expand section 2 with new a sub-section that describe the physics used to calculate the CMB and

reference the used methodology. Another possible reference may be to look into Huss et al (2008): Modelling runoff from highly glacierized alpine drainage basins in a changing climate. Hydrol. Process., 22(19), 3888–3902 (doi: 10.1002/ hyp.7055).

2. Another question is how useful the CORDEX data was in this study. The comparison of the NORA10 and the different CORDEX datasets was interesting, showing NORA10 seem to beat the CORDEX data on most of the parameters tested for. I am not sure how meaningful the continued use of CORDEX is after seeing the results in Figure 3, with their large RSMEs. Or is the use of CORDEX in interest for driving the model in future scenario mode? If not the CORDEX output is well argued to be important here, the space and number of figures can be substantially shortened.

3. A third issue is the validation of the model output with the seNorge data in section 3.1. As I understand the seNorge data is model data, and is calibrated with, or have assimilated observational data in the model input. Although I would guess the hindcasted NORA10 as well as the CORDEX data, both of the products from HIRLAM, may use assimilated observational data in the hindcast mode. With this I see a question with validating modelled data from NORA/CORDEX (yi, ...yi+x), with modelled data from seNorge (x). Maybe the observational data in seNorge has a larger weight than in they have in the NORA10/CORDEX simulations, but that needs to be stated. One way to manage this is to use the observational data, or the nodes in seNorge that are anchored to observational data to manage a cross correlation check. That is, using only the pixels / nodes where seNorge has observations, and where the observation bias should be weighted highest in the seNorge output. Although I think it is now possible to download the observational data from the seNorge webpage, if the raw data of the observations is wanted for a correlation test.

Minor comments

Li 111. Precipitation **into** (?) our model.
Li 276. Is Table S1 provided?
Section 4.1./Fig. 10. I do not follow the discussion with reference to the correlation matrix in Figure 10, probably because I am not sure what this matrix show. Is all melt from SMB calculated as runoff? What about (temporal) storage, evapotranspiration etc? The two lowest arrays roffw and roffa should they not be same as SMB runoff? I guess a few lines of text describing this figure would help to motivate this part of the results.
Li 410. Maybe add the reference here again of where you got the data of glacier cover, to repeat this to the reader, or call the delineation you refer to in section 2 as glacier cover.
Li 484. Bondhuselv**a** ?

Comments of Figures and Tables.

Figure 1. Please add lines for each zoom-in picture that join the frames of the area in the bigger map.
Figure 1. Would it be possible to make the hydrography clearer in the zoom-in maps? You could add a blue streamline following the hydrography pointed out in each of the zoom-out maps, and number them to follow the legend of the streams. That would make the zoom-out maps more clear, and will make it easier to navigate in them.
Figure 1. The upper right zoom-out. Grå should be Gråsː
Figure 4. Perhaps name the panels a-d. As now it is hard to follow the caption as what of

the matrices are linked to what part of the description in the caption.
Figure 4. Do the two matrices in b) indicate reverse signs of the SMB between observed and some of the modelled data? That would be remarkable. I am not sure what these matrices show. Make this clearer, or it may be a source of confusion on the reader side.
Figure 5. The left side panels in this figure should me made with more contrast, and perhaps larger. As now it is hard to see what they contain.
Figure 10. See comments above on Section 4.1.
Figure 11. Make it clearer in the captions that the 18 different catchments are ordered with respect to the glacier cover, and add their number 1 to 18 in at least one of the point distributions to make it more transparent where each of the catchments are representing which point.