This paper used a bias correction and downscaling method to estimate snow cover fraction from regional climate models. The method and results are difficult to follow. Comments and questions are below.

Thank you for the review and constructive feedback.

We can elaborate more and better on the methods and results in a revised version. As the other referee has also pointed out that the methods are difficult to follow, we shall enhance readability and provide additional figures and schemas to make the procedure easier to understand.

1. Figure 1, the outline of the small study area is not clear. Please also give the description of the small study area. In Figure c and d, which data source does the snow cover duration come from?

We can improve Figure 1 in a revised version. The snow cover duration is from MODIS, based on the same data used in the downscaling procedure. We can clarify this in the caption.

2. L95-100 belong to “Study Area”, rather than “Data”.

We can add a separate section titled “Study Area”.

3. Section 2.1 “Observed snow cover fraction from remote sensing”, in addition to pointing to referenced paper (Matiu et al., 20201), state how you obtained the daily cloud-free snow cover maps?

The cloud-free maps were obtained by a series of temporal and spatial filters.

1. We applied a mean filter over a square of size 299 pixels centered on each pixel, where a snow pixel was reclassified as clouds, if the neighborhood contained more cloud than snow pixels, and a cloud pixel was reclassified as snow, if the neighbourhood contained more snow than cloud pixels. This was performed to improve accuracy at cloud borders or within clouds, where misclassifications sometimes occurred. This step was only performed for April to October, where this issue was mostly prevalent.
2. Then, we applied a conservative temporal filter, which is based on the persistence of snow. A cloud pixel was reclassified as snow, if it was snow one or two days before, as well as snow one or two days after. The same for land pixels.
3. Afterwards, a spatial filter was applied based on snow and land lines, which exploits the elevational dependence of snow cover. For any given day, all cloud pixels above the average elevation of all snow pixels were reclassified snow, and all cloud pixels below the average elevation of all land pixels were reclassifed as land. This step was

not applied if the image had more than 50% clouds (-> snow and land lines not representative), the ratio of snow to land pixels was less than 0.05 (-> too little snow for snow line to be representative), and not in the summer months June to September (-> too little snow)

4. Finally, a greedy temporal filter was applied that replaced any cloud pixel with the next available observation (land or snow) from either forward or backward in time. Most values were filled after a few days, but we set a maximum of ten days as the threshold to look for cloudfree observations.

We can provide a summary of these steps in a revised version.

4. Change “2.1 Snow cover fraction from regional climate models” to “2.2 Snow cover fraction from regional climate models”.

Thanks for spotting this error.

5. L155-157, please provide more detailed information for the conversion from snow water equivalent to snow cover fraction. Snow cover fraction is a ratio, how did you use the threshold of 5 mm to get the snow cover fraction.

We used the 5mm threshold to create a binary value for each pixel/grid cell and each day. This binary value was then either snow or snow-free. Snow cover fraction was then calculated either along space, time, or spacetime by calculating the ratio of pixels with snow divided by all pixels.

6. L162ï¼Œwhy use 19 GCM-RCM for RCP8.5 and 3 GCM-RCM for RCP2.6?

This imbalance between RCP8.5 and RCP2.6 scenarios results from the fact that more RCP8.5 simulations are available than for any other scenarios. We also tried to take only the common GCM-RCM pairs, but found that results for the mean were similar, and more GCM-RCMs give a better estimate of the modelling spread. So, we decided to keep the maximum available number. We can elaborate on this further in a revised manuscript, and also make the hint to the little number of scenarios for RCP2.6 more prominent.

7. L169-170, the full name of DC, QM, QDM have provided in the Introduction section, here just use DC, QM, QDM.

Fine.

8. How did you validate the estimated snow cover fraction?

We intended to use the comparison between the physical-based AMUNDSEN model and the statistical-based downscaling as a kind of two-way validation for both approaches. Since these are projected changes, we have no real validation data set, but can only perform comparison betweens approaches and models. For example, the comparison between raw, bias corrected, and downscaled estimates from RCMs as well as AMUNDSEN can give some hints on the differences and agreements. But without a true validation data set, there is little else possible.

On the other hand, we validated the downscaling procedure internally, by applying it to the upscaled snow cover fraction from MODIS (L249ff). We can provide more information on this in a revised manuscript.

Otherwise, the general capability of RCM to reproduce snow cover fraction can be validated for the past. Such an evaluation/validation has been performed previously in Matiu et al. 2020b, mentioned in the introduction, (https://doi.org/10.3390/atmos11010046) using most of the GCM-RCMs in this study and the similar MODIS observation. We can provide more information on this previous validation in a revised version.