

Thank you for providing us valuable suggestions and they do help improve the paper. According to the reviewers' comments, we revised the paper carefully and tried to give satisfactory answers to the reviewers' questions. The corresponding modifications are highlighted with red font in the revised paper.

The summaries of the revision for this paper are as follows:

First, the AVHRR GAC snow dataset have been updated with the final released version, which is based on based on the algorithm SCAMOD (Metsämäki et al. 2015). Furthermore, we extend the description of AVHRR GAC snow retrieval in the revised manuscript.

Second, more in-depth analysis was made regarding the performance of AVHRR GAC snow over different elevation regions (0-200, 200-500, 500-1500, 1500-2500, 2500-3500, 3500-4500, 4500-5500, >5500). Furthermore, the effect of landcover type, slope, aspect, and topographical variability were analyzed for different elevation regions.

Third, the structure of the manuscript has been improved. The accuracy of MODIS based on in situ sites was discussed along with AVHRR in Section 4.1. Furthermore, the comparison between AVHRR GAC and MODIS snow regarding the accuracy and temporal stability is also presented in this section. The comparison between AVHRR GAC snow and MODS snow regarding their absolute values as well as the comparison between AVHRR GAC snow and Landsat snow were presented in Section 4.2 (Comparison based on medium to high resolution data).

Fourth, based on the new results and analyses, more comprehensive conclusions were presented.

Fifth, some details, including figures and grammar, were improved.

For the specific comments for each reviewer, we have made detailed reply as following.

Reviewer3:

I spent a long time reading the first sections of the manuscript when I realized that this article should not have passed the Editor's initial screening. There are 16 figures but in fact most of the figures are multi-panel figures and I counted 72 individual graphs, some of them with multiple lines or symbols. That is too much information to analyze as a reviewer. The result section is a long description of these figures. I think that the authors should profoundly revise their manuscript to present a more concise assessment by cutting down some text and figures, and rework the design of the key figures.

Re: We completely agree with the reviewer, and we also admit that study is overloaded by figures and description of these. In the revised manuscript, the figures have been reworked substantially and a selection based on the main focus of the paper has been made. Since there is no need to show "gac raw" and "gac gap-filled" all the time, we put emphasis on the analysis of AVHRR GAC raw snow in the revised manuscript.

Furthermore, we would like to point out that the final AVHRR GAC snow data published and accessible for everyone is different from what we have previously employed in the paper. Our team have improved the retrieval algorithm, because there was a need to retrieve also snow on ground

with an identical procedure as for viewable snow. The final AVHRR GAC data dataset (openly accessible here <https://catalogue.ceda.ac.uk/uuid/5484dc1392bc43c1ace73ba38a22ac56>) in the whole time series was based on the algorithm SCAMOD (Metsämäki et al. 2015). Therefore, AVHRR GAC snow dataset have been updated with the final released version. Consequently, many results and conclusions have been reworked. In the revised manuscript, only case2 were adopted.

Since only the AVHRR GAC raw snow and the case 2 was focused, many figures (2, 11, 13, 14) have been either omitted or combined. There are in all 10 figures and 5 tables in the revised manuscript.

Beyond that issues I still think that the study is useful and important. I am not able to provide a more detailed review because that would cost me a couple of extra hours of work. However, there is an important point that cast doubt on a significant part of the study : About the Landsat data processing: "the 30 m FSC were resampled (nearest neighbor method) and projected to a geographic projection of 0.05° to identify FSC within a given AVHRR GAC pixel." If this is actually done as written it means that a *single* Landsat pixel of 30 m resolution was assigned to the 0.05° pixel (about 5 km resolution), i.e. the pixel that is the nearest to the center of the AVHRR pixel. The source code was not provided so I could not check. The Landsat pixels should be resampled to AVHRR resolution using the area-weighted average of contributing pixels.

Re: We would like to thank the reviewer for providing such a valuable comment. And we have changed the resampling method to area-weighted average of contributing pixels in the revised manuscript. This has been clarified in **Section 2.3.2** as "*These high-resolution data were then projected to a geographic projection and aggregated to AVHRR GAC pixel scale using the area-weighted average of contributing pixels to 'simulate' the reference FSC estimates at the AVHRR GAC pixel scale.*" in the revised manuscript.