

The Cryosphere Discuss., referee comment RC2
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Comment on tc-2021-46

Anonymous Referee #2

Referee comment on "Evaluation of snow extent time series derived from Advanced Very High Resolution Radiometer global area coverage data (1982–2018) in the Hindu Kush Himalayas" by Xiaodan Wu et al., The Cryosphere Discuss.,
<https://doi.org/10.5194/tc-2021-46-RC2>, 2021

- General comments

Extensive work has been done regarding a matter of the greatest importance. Being able to have an extensive temporal and spatial serie of snow cover over the Himalayan Hindukush region is a great challenge. But if most of the study shows interesting results, some key components are not considered enough, not discussed enough throughout the paper. What we see are good results hiding probable bad ones, the spatial weight of a "friendlier" topography to AVHRR GAC 4 km compensating on the large scale for the variability of the small and abrupt Himalayan range over the study area. Specifically, sections 2.2, 3.3, 4.2 and 4.3 raised questions, and a conclusion (section 5) that lacks the raised problem. There is a need to go more in depth in the results and discussion of this highly mountainous area, because what is presented does not show confidence into the use of the product over the Himalaya, and by extent over any high mountain range. Even though the rest of the results shows interesting work. This paper is not ready for publication.

- Specific comments

Section 2.2

There is a lack of basic informations about the product used, we should have more to get a better hold of it. Channels used to build the product, spatial resolution, ... Even though your work was not to build it, it would be of importance to have some basic informations about it. You describe MODIS and Landsat products more in depth than the product you actually want to validate.

I understand the advantage of using AVHRR GAC because of the temporal resolution and time serie, but I am not convinced the 4km spatial resolution to be an adequate choice for those regions with very high topographic variability. Studies generally tend to discard AVHRR for the specific purpose you try to use it for (snow cover in mountainous regions),

so you really need more justification to convince of the interest of such a low resolution product compared to the high topographic variability within a pixel. (an exemple here : *Sharma, V. et al (2014). Topographic controls on spatio-temporal snow cover distribution in Northwest Himalaya. International journal of remote sensing, 35(9), 3036-3056.*)

You use The fractional snow retrieval method by Salomonson and Appel (2006), at a different spatial resolution than the modis 500m product spatial resolution it was developed for. Both for AVHRR GAC at 4 km, and Landsat at 30 m. Were there any issues changing the scale of the spatial resolution for the application of this methodology ? would be interesting to discuss this matter

You don't discuss much topography... 0m to 8000m in the areas you use, gonna have a huge impact on SD , especially as viewed by satellites

Section 3.3

By resampling and projecting modis FSC 500m to AVHRR GAC 4km pixels in order to compare their absolute values, you clearly lose a lot of information in the highly variable topographic areas. But you don't discuss / show a comparative analysis of MODIS at 500m versus MODIS at 4 km to assess the accuracy of the resampled product. Might be of importance especially in the more mountainous areas.

Section 4.2

What your results are showing, essentially, is that using AVHRR in high mountainous areas with strong variations of slope, elevation, ... within a pixel, just doesn't work. RMSE values are over the roof (fig. 12), which is also quite explicit in fig. 10. You get overall good results for most of the study area, but not for the Himalayan range, and therefore cannot write that the results are good there as well.

You need a more specific analysis to show that your results are good enough, putting both of the Himalayan part of the tile and the further Tibetan highland part under the same "mountainous area" category doesn't make sense as their geographical characteristics aren't alike.

Section 5

Conclusion reflects the study, showing overall convincing results over the study area but lacking in depth work regarding the Himalayan range and the errors that go with. Work is in my opinion not complete if you want to include highly variable topographic areas in the spectrum of your validation.

- Technical corrections

Beware of the over use of logical connections at the beginning of your sentences. Makes the manuscript sometimes hard to read.

Section 4.3

Difficult to follow the discussion in a reader point of view, having to scroll back and forth to get to the plots. Would have been easier to read if the MODIS comparison was discussed along with the AVHRR, as a comparison to MODIS is one of the key point of your study to validate the AVHRR product