

The Cryosphere Discuss., referee comment RC1  
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## Comment on tc-2021-46

Anonymous Referee #1

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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.,  
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### General Comments:

Interesting concept to build a long-term snow cover data product from AVHRR GAC. There are many challenges to creating and validating an AVHRR GAC snow cover dataset over the Hindu Kush Himalaya (HKH) region for the period 1982-2013. Description of, and explanation of how the AVHRR GAC snow cover dataset was created are insufficient. There are significant problems regarding how the snow cover dataset was created, and with how the satellite validation datasets were processed and analyzed. A map of the snow cover dataset is not presented. A AVHRR GAC snow map must be shown in support of evaluation/analysis. The quality/accuracy of the snow cover dataset cannot be evaluated. The conclusions are not substantiated by the analysis presented. The manuscript is not suitable for publication.

### Specific Comments:

Line 44: The GCOS does recommend area covered by snow cover as an essential climate variable daily at 1 km or higher resolution. The GAC resolution is much lower than recommended. The lower resolution needs to be discussed relevant to GCOS observation requirements.

Discussion is also lacking on explaining the relevance of coarse GAC resolution product in the HKH region, especially when higher resolution snow cover data sources are available.

Section 2.2: I do not understand how you created a AVHRR GAC snow extent. I read the FCDR product user guide. I downloaded and looked at the FCDR data products. There is no snow cover extent dataset in any of the products. There is no AVHRR channel reflectance data in those products that could be used to calculate NDSI.

The fractional snow method of Salomonson and Appel (2006) is based on a using Landsat TM data at 30 m to estimate the fractional amount of snow in a MODIS 500 m pixels. That relationship is not directly applicable to GAC data at  $1 \times 5 \text{ km}^2$  resolution. Please explain why you applied this regression to GAC data to estimate FSC.

NDSI cannot be calculated from AVHRR data until 1998 when with NOAA-15 Channel 3A at 1.6  $\mu\text{m}$  was added to AVHRR. Before then there was no shortwave infrared channel covering 1.6  $\mu\text{m}$ . It is not possible to calculate NDSI from AVHRR data prior to 1998. But your dataset record is 1982-2013. How can it possibly be consistent across major design changes in the AVHRR?

The calculation of NDSI from AVHRR GAC is not explicitly given. Without explanation of how NDSI was calculated the entirety of the validation discuss and results is doubtful.

Section 2.3.2: The estimate of FSC for TM/ETM data is flawed. Salomonson and Appel (2006) did not derive the FSC regression to estimate TM/ETM FSC, they derived a FSC estimate for MODIS data based on the higher spatial resolution TM/ETM data. That regression is not appropriate to estimate FSC in TM/ETM data.

No AVHRR GAC snow map is shown! No snow maps are shown! The research describes building an AVHRR GAC snow cover map, but none is shown. Visual evidence of the snow maps must be presented.

Line 145: It is unclear how the 30 m FSC data was used to identify FSC in a GAC pixel. Were many 30 m FSC pixels mapped into a GAC pixel then was some spatial averaging or binning of observations done to estimate FSC in a GAC pixel? A clear explanation of sampling and estimate of FSC in GAC pixel is needed.

Line 248: How were MOD10A1 data resampled and reprojected to a GAC pixel? Many MOD10A1 pixels can be covered by a GAC pixel. What method was used to resample? Was there any averaging or compositing observations to GAC pixel done?

Because of the great amount of uncertainty regarding how the AVHRR GAC snow cover dataset was created and uncertainty of processing the validation datasets, only a cursory review of the methods and results was done.

The conclusion that this AVHRR GAC dataset has consistent performance across the whole suite of AVHRR sensors is not substantiated.