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Interactive comment on "Characterising spatio-temporal variability in seasonal snow cover at a regional scale from MODIS data: The Clutha Catchment, New Zealand" *by* Todd A. N. Redpath et al.

Markus Hrachowitz (Referee)

m.hrachowitz@tudelft.nl

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The manuscript "Characterising spatio-temporal variability in seasonal snow cover at a regional scale from MODIS data" by Redpath et al. provides a timely and detailed analysis of snow duration and snow covered area in a part of the world where quantitative knowledge on these variables is scarce. The manuscript will thus be of interest to many in the community. The paper is organized in a logical way, well-written and the analysis is based on sound methods. Overall I really enjoyed reading this paper and besides a few small notes, I do only have three major questions for and comments to

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Discussion paper

the authors:

(1) At the end of the introduction it remains somewhat vague what the actual objective of the paper is. The term “snow cover climatology” is very vague and can be interpreted in a wide range of ways. I am not even sure if the analysis provided in this manuscript show a robust enough link to “snow cover climatology”. In addition, it remains unclear what the actual research question is and which specific research hypotheses are tested in this manuscript. To help the reader to better appreciate this work, I would thus strongly encourage the authors to (a) be more specific in their terminology and (b) explicitly formulate a set of research questions and the related research hypotheses.

(2) I am not sure if the use of the Coefficient of Variation (CV; Eq.1; section 4.3) is the most informative way to illustrate the spatial differences in annual snow cover fluctuations. As it is the ratio of the standard deviation over the mean, it will be strongly controlled by the mean. Thus, for example low elevations with short SCD will inherently show a bias towards higher CV than higher elevations. This is exactly what can be seen in figure 4b. I think the standard deviation would be much more informative to show here, because in the end it is all about the absolute change in snow covered days – in a region with only 5 snow covered days per year a standard deviation of say 2 days will result in a high CV – but in that region snow is rather irrelevant anyway. In contrast, in a region with 150 snow covered days the same standard deviation of 2 days will result in a much lower CV.

(3) It is not entirely clear why in section 3.3.3 suddenly the regional snowline elevation technique by Krajci et al. (2014) is used. This method is a spatial cloud filter. As I understand, here, clouds are filtered using a temporal filter (section 3.2.1). thus, for each pixel on each day, a binary value of snow yes/no is then available. In conjunction with a DEM, then also the elevation with snow in is known at that location – thus no need for further filtering. Please clarify this.

Minor points:

Section 2: please add a bit more information about the region, such as elevation range, mean annual and mean winter precipitation as well as temperatures or % glacier area

p.4, l.5: not sure what is meant by “water management is not a new concept. . .” – please rephrase.

p.4, l.32: as far as I know is the effective resolution of MODIS currently estimated at ∼2000m, due to factors such as topographic gradients. If I am not mistaken, the information content of the 500m product is already rather limited. Not sure if further downscaling is really warranted here. Please double-check!

p.5, l.6: please be more specific! How much higher are these resolutions?

p.5, l.10-11: please be specific! What does “rigorous” mean here? How do they do it?

p.5, l.23: what is meant by “data cube”?

p.5, l.24, figure 2: flow chart is nice, but please specify what the lighting symbols stand for. Potential problems?

p.5, l.32: what is meant by “erosion” here?

p.6, l.3-7: what are the largest gaps filled here? one day? One week? One month? Which length of gap would be considered unacceptable? Why?

p.7, l.3: not sure if “epoch” is a suitable term here. please rephrase.

p.8, l.15: on basis of what were the individual mountain ranges defined?

p.11, l.5: what do you exactly mean by “the typical snow cover climatology. . .”? please try to be more specific and rephrase that.

p.11, l.7, figure 4: the 120-days line is not really well-visible in the figure. Please also adjust the contrast in the color scheme in figure 4a – right now it looks as if essentially all the region has a SCD of ∼90 days.

p.11, l.10: should read as “. . .elevation of 615m. On average,. . .”

p.11, l.11: should this perennial snow cover than not be defined as a glacier?

p.11, l.13: "...appears" sounds very speculative here. why not directly linking it to and highlighting the position of these locations in figure 6?!

p.17, l.32-33: what is meant by "positive" and "negative" variance?

p.19, l.18-32: the reference Gao et al. (2017) would fit nicely here.

References: Gao, H., Ding, Y., Zhao, Q., Hrachowitz, M., & Savenije, H. H. (2017). The importance of aspect for modelling the hydrological response in a glacier catchment in Central Asia. Hydrological processes, 31(16), 2842-2859.

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