

Interactive comment on “Topographic control of snow distribution in an alpine watershed of western Canada inferred from spatially-filtered MODIS snow products” by J. Tong et al.

J. Tong et al.

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Thank you for the constructive comments submitted on our manuscript. We have adjusted the text accordingly and provide below responses to the comments as well as details on the revisions performed in the manuscript. All the figures in this response are available at: <http://nhg.unbc.ca/HESS>

Response to Referee #3:

Specific comments: 1. Please clarify briefly the role of daily snow cover maps MOD10A1 in your study. The use of MOD10A1 is mentioned on page 2351, line 12, but without more detailed information.

Response: In this paper, the MOD10A1 are only used to calculate the daily cloud coverage to compare with the MOD10A2 and SF products. The SF method is only applied to the MOD10A2 product (See lines: 24-29). A SF is used to reduce cloud coverage in Moderate Resolution Imaging Spectroradiometer (MODIS) 8-day maximum snow cover extent products (MOD10A2) from 2000-2007, which are obtained from MODIS daily snow cover extent products (MOD10A1), to assess the topographic control on snow cover fraction (SCF) and snow cover duration (SCD) in the Quesnel River Basin (QRB) of British Columbia, Canada (See lines: 151-153). However, about 20% cloud coverage remains during winter such that the SF is adopted to decrease the cloud coverage and improve the accuracy of snow mapping of MOD10A2 in the QRB.

2. "Seeming" accuracy - does it make practical sense to use the numbers in tenth or hundredths considering the existing uncertainties? For example, 0.63 days, 0.89 days, 1.04 days practically mean 1 day and the difference is only "mathematical". The DEM used in the study DEM has resolution of 1 km. Documentation on the DEM states the following: "...Vertical accuracy varies by source materials used in GLOBE. Values may range from 10 meters to 250 meters (and in rare cases, to over 500 meters in elevation)..." Therefore, calculation of standard deviations of SCDs for 10 m elevation band gives only more numbers for the statistics and Fig 7; the accuracy is just apparent. I think it would be fairer to work with 100 m elevation bands. The accuracy of spatial filter was validated using only 3 ground-based observations. I assume there were no more ground-based observations available. But then again, does it make practical sense to say that the accuracy is, e.g. 82.72% (hundredths of percents)? The numbers should correspond to uncertainties. It was found out that at altitudes below 1000 m a.s.l., about 2.5% of snow cover is indicated in summer which is not realistic. This is perhaps (the least) uncertainty which should be kept in mind.

Response: We agree that too much precision was implied and accordingly have changed the significant figures reported in the paper to an accuracy of tenths. We still use the 10 m bands to calculate the standard deviations of SCDs to improve the

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spatial resolution of the results. As Fig. 7 indicates, the trends in snow cover duration and the standard deviation of snow cover duration with elevation are consistent and not "noisy" indicating that the use of 10m bands is acceptable to show these trends. Larger elevation bands could have been used, but would have shown the same trend and have masked this variability. Figure 7 (in this response) shows the trends in 100 m bands, indicating the same trends as Fig. 7 in the paper. Some of the standard deviation is likely due to inaccuracy in the DEM, as the reviewer notes.

3. Page 2355, line 19. The authors say that "...;the north-facing areas have always the lowest SCF from September to March."; Fig. 5 shows that it should perhaps be south-facing areas (in September, October, November and March for slopes between 5 and 15 degrees and in September, October and March for slopes above 15 degrees).

Response: See lines: 250-252. In areas with slopes above 50, the north-facing or south-facing areas always have the lowest SCF from September to March.

4. Could you explain why the standard deviations of snow cover duration above 2000 m a.s.l. decrease in the onset season?

Response: This arises owing to perennial snow above 2000 m a.s.l. In this circumstance the standard deviation of snow cover duration at the onset of the snow season will therefore be lower compared to that at lower elevations.

Technical comments: 1. Readability of figures. It would be good to change color scale for elevations in Fig. 1 (less classes, higher contrasts among classes). Otherwise the elevations are not much recognizable even in color version (the black and white version would be unreadable at all). Figs 3 and especially Figs. 5 and 7 would benefit from longer y-axes, Fig. 6 could be bigger. Please think about using more contrasting symbols in Fig. 7.

Response: The figures are modified according to these comments.

2. The paper is subjectively sometimes not easily readable due to many abbreviations.

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Abbreviations such as SCE, SCD, SCF, SF can be useful. However, perhaps it would be good to use full names for the terms which are not so frequent in the paper, e.g. standard deviation.

Response: We have eliminated unnecessary acronyms in the revised paper.

3. Page 2360, line 15; publication Hall and Riggs, 2007 is not mentioned in the main text of the paper.

Response: See lines: 140-141: Even though the accuracy of the MODIS snow cover maps is about 90% in cloud-free pixels (Déry et al. 2005, Zhou et al. 2005, Hall and Riggs, 2007),

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