Anonymous Referee #2

We thank Referee #2 for his/her time and effort and helpful and constructive comments. The original comments of the reviewers are in blue. Our replies are in black.

I assess the study to have a high potential to contribute to the ski climate literature by focusing on (1) historical data, (2) climate variability, and (3) compensation potential of snowmaking for adaptive capacities. I believe the manuscript is good for publication but it could discuss some of my suggestions along with some minor points to be corrected below:

>>>> We thank Referee 2 for the positive and helpful comments. We went through the comments in detail and complemented and refined the manuscript accordingly.

- The authors intuitively claim that "there is more literature regarding future projections than past observed impacts." Can this be quantified, e.g. based on the Steiger review? It should also be noted that most of those future projections studies do bear (yet most often implicitly) past observations/reanalyses at least at some of point of their modellings (e.g. validation, calibration, bias correction etc).

>>>> It is correct that several studies addressing future climate change impacts use past climate in the process (for adjustment/bias correction or evaluation of the modelling systems), however we maintain that studies addressing past trends in snow cover reliability are quite rare, as noted by Reviewer #1 Bruno Abegg. We also note that studies addressing the relationship between past snow cover conditions and the performance of the ski tourism industry in the past, while based on past observations, do not provide information about potential trends in snow cover reliability. In this sense, several of the studies referred to as “Climate sensitivity assessments” in the Steiger et al. (2019) review do not provide information about snow cover reliability trends. The classification of scientific studies in Steiger et al. (2019) cannot directly be used to perform such an analysis, although we note that a few studies only (most of them quoted in our discussion article) have explicitly analyzed trends in snow cover reliability, which is consistent with our statement. However, for better clarity, we have rephrased the first sentence of the abstract to : “*Snow reliability is a key climatic impact-driver for the ski tourism industry, although there are only few studies addressing past changes in snow reliability in ski resorts accounting for snow management practices (grooming and snowmaking, in particular).*”

- I am not sure if the focus should be on the "developed" countries in the introduction especially now that we have China at the forefront of installing snowmaking systems and even promising an entire Olympic based on this technic.

>>>> We agree here and changed the sentence to:
"*Ski tourism is a major socio-economic component of mountainous regions for many countries around the world (Vanat, 2020).*"

- "Based on interviews with ski resort managers and ski tourists, several studies": Which "several" studies? You add a couple more in section 4.4, but is there any more to make them "several"?

>>>> We added references to studies based on interviews of ski tourism stakeholders and tourists:

Morrison, C., & Pickering, C. M. (2013) *Perceptions of climate change impacts, adaptation and limits to adaptation in the Australian Alps : The ski-tourism industry and key stakeholders*. Journal of Sustainable Tourism, 21(2), 173-191
Bicknell, S., & McManus, P. (2006) *The Canary in the Coalmine : Australian Ski Resorts and their Response to Climate Change*. Geographical Research, 44(4), 386-400.

- How do you justify the 25 cm (compared to the more commonly used 30 cm) threshold in your modelling? Is it field informed maybe for this particular case of the Savoie?

>>>> In fact, our analysis is based on a threshold in terms of snow mass (snow water equivalent) of 100 kg m^{-2}, which indeed corresponds to 25 cm of snow with a density of 400 kg m^{-3} - but this number is only provided as an indication of what 100 kg m^{-2} corresponds to. Our focus on snow mass, rather than snow depth, alleviates the influence on snow grooming on the snow depth (through compaction), and provides a fairer comparison between simulations with and without snow grooming. However, as we focus here on relative changes in snow cover reliability indices across the time periods considered, the sensitivity of our results to the exact threshold value used here is low, and very similar results would be obtained using a slightly different threshold (e.g. 100 or 120 kg m^{-2} snow water equivalent).

- Please run a grammer check for Fig. 1.

>>>> We have thoroughly checked the wording in Fig. 1

- Lastly I would like to suggest two papers for your consideration as they may support your departure and enrich the discussions: Firstly, in a Swiss case, Gonseth (2013, Climatic Change) concludes that "an increase in the snowmaking percentage coverage from 30 % of the total length of ski runs to 50 % could counteract a 42 % increase in the natural snow conditions' variability" - a point to add to your discussions of snowmaking's added value to adaptive capacities. Secondly, in terms of a historical approach to climate variability, you can compare your innovative Q20 method and results to Mayer

et al. (2018, Sustainabiltiy) study which uses the ARCH/GARCH model to determine a significantly volatile historical visitation pattern, attributable to weather/climate variability, in the case of an Austrian glacier ski area.

>>>> We added the reference recommended of Gonseth's study (2013) in the discussion part since it mentions the snow reliability gains with snowmaking but also the diminishing returns to snowmaking investments. See below,

"*Our results are consistent with Gonseth (2013) who highlighted snow reliability gains with snowmaking. However this study stressed diminishing returns to snowmaking investments, similarly to Falk and Vanat (2016). Gonseth (2013) also pointed out snow reliability gains expected with snowmaking remained based on a dual assumption of economic and technical feasibility under future meteorological conditions.*"

>>>> We also added a reference to Mayer et al. (2018) in the discussion part. This study illustrates the importance of weather indices (e.g. thermal comfort index) to analyze the impact of climate conditions on the ski tourism industry. See below,

"Snow reliability index and its derivatives remain one indicator among others to analyze the effect of climate conditions on the operation of the ski tourism industry. For instance, Mayer et al. (2018) illustrated that thermal comfort index could have a more significant effect on ski demand than snow depth. Several microclimatic characteristics may influence both the operation and visitation of the ski resorts."

Beyond the changes described below in response to the comments, and changes in response to the feedback from Reviewer #1 Bruno Abegg, note that we have performed some further updates to the manuscript in order to improve. In particular, we have extended the time period covered by the study from the winter 1960-1961 to the winter 2018-2019. Figures 8, 9 and 10 have been improved by sorting the ski resorts the other way around (higher elevation resorts are at the top, not at the bottom).