Dear Ryan and co-authors, Dear Harry,

Please find below my review on the article "Surface mass balance modelling of the Juneau Icefield highlights the potential for rapid ice loss by the mid-21st century".

## Summary

The authors use the COSIPY energy and mass balance model to improve the surface energy balance (SEB) on the Juneau Icefield. The model is used to simulate historical and future mass changes. COSIPY is driven with dynamically downscaled historical and the RCP8.5 climate scenario and calibrated using long-term in-situ observations. Mean mass changes over the period 2031-2060 are finally compared to the historical period 1981-2010. The authors conclude that the simulated mass loss is largely caused by reduced snow precipitation leading to plateau-wide glacier thinning.

## General comment

Although the work does not substantially change our scientific understanding of the Juneau Icefield, it supports and strengthen previous findings. The utilization of numerical energy and mass balance models represents a significant step toward consolidating existing knowledge. The aim of the work is clearly formulated, and the methodology is well chosen to improve the surface mass balance estimates on the Juneau Icefield. The findings are well supported with figures and illustrations and appropriately discussed in relation to previous studies. In summary, the authors present their results and conclusions in a clear, concise, and well-structured way.

However, there are a few important aspects that should be considered before the article can be published:

**(1) Uncertainties** play an important role in the analysis of climate scenarios. Nowadays, the inclusion of uncertainty estimates is considered good scientific practice. Determining these uncertainties is not always easy and the determination is subjective. The important aspect of uncertainties is something that has been completely neglected in this study. The results are based on only two models and one scenario (RCP8.5). If the entire CMIP5 ensemble were considered, the uncertainties in the SMB estimates would certainly be correspondingly large. In addition to the ensembles, model uncertainties from COSIPY should also be considered. It is difficult to make specific recommendations for dealing with these uncertainties. However, you should include as many CMIP5 members as possible in your study (Lader et al. (2020) certainly included several more ensemble members) and determine the uncertainties of the COSIPY model parameters using, for example, Monte Carlo runs. At the end, an uncertainty range should be given for all SMB simulations.

**(2) Drivers of change across the Juneau Icefield.** The increase in the equilibrium line altitude (ELA) into the higher regions of the plateau and the ice-elevation feedback are mentioned as key mechanisms that accelerate the melting of the plateau. So far, the discussion has been very vague, and there is a lack of reliable facts. It would be highly interesting to quantify the effect of the ice-elevation feedback and determine its impact on the surface mass balance (SMB) trend. The same applies to the ice-albedo feedback, which is equally exciting. To quantify the contribution of these feedback mechanisms, further simulations need to be conducted, where the digital elevation model (DEM) is updated annually in the model. I can only encourage you to quantify these feedbacks, as this would greatly increase the importance and visibility of your work in the scientific community. Honestly, I would put the focus of this paper on the feedbacks rather than writing another "mass balance of" paper.

**(3) The potential response of glaciers across the Juneau Icefield**
The analysis of the potential response of glaciers could be further improved. As correctly mentioned, factors such as size, setting, etc., play a role. Fundamentally, glacier dynamics should be considered to account for the influence of mass changes on glacier length. Only by doing so, one can make a reliable statement regarding the response of glaciers. One approach could be to drive the OGGM model using the mass balance simulations from COSIPY. That is indeed a somewhat greater effort, but only in this way can one assess or quantify the effect of changes in the climate signal on the outlet glaciers.

## Specific comments

### Input data to COSIPY

P5L150: It would be good to mention briefly why the two models rank in the top five of all CMIP5 models for Alaska.

P5L155: It is comprehensible that only the RCP8.5 scenario was used here due to the available simulations of Lader et al. (2020). However, I do not share the opinion that the choice of scenarios is irrelevant for the selected period. As can be seen from the previous paragraph, the two models have very different climate sensitivities, which is especially noticeable in more extreme scenarios. When interpreting the RCP8.5 model results, the different climate sensitivities of the models must be considered. It would be also nice to see what the differences between RCP8.5 and RCP3.7 are in this region.

P5L172: Bias corrections usually assume that the biases at the quantiles do not change over time (stationarity).  Thus, the correction itself leads to further errors in the time series, or does it not?

### Model optimisation

P6L189: Why were only 100 random samples generated for parameter optimization? Typically, several hundred or thousand parameter combinations are used.

### Historical simulations of SMB from climate models (1980-2010)

P8L256: What do you mean exactly with statistically similar?

**Future SMB of the Juneau Icefield (2031-2060, RCP8.5)**

P9L285: Why do the two SMB time series show a very similar trend even though the climate trends and climate sensitivities are so different?

P9L287: How would the result change to that of Hock et al. (2019) if the change in glacier hypsometry were considered? Wouldn't the results of the two studies then be further apart?

P11L322: Why has this physical logic reversed, and snowfall no longer reduces ablation? Is there an explanation for this?