Comments to the revised study by Bakken-French et al.

The revised ms has greatly improved compared to the first version. The now annotated photos guide the reader much better through the observations, the methods are clearer described and the study appears to be more focussed. However, from the response of the authors to my comments and the unchanged results, I conclude that it was not sufficiently clear what I criticised. The authors arrived at their very high area loss rates for the 2000-2023 period because they changed the definition of a glacier, largely by introducing the vaguely described term 'active ice'. For this, they use (qualitative) geomorphological characteristics of advancing glaciers (L141/2) to define where a glacier terminus is rather than (quantitative) information about glacier flow. As the listed characteristics do not apply to retreating or down-wasting glaciers, they looked at the wrong place for the terminus. How they identified it in the field (when being in the middle of a debris-covered glacier) remains a bit mysterious. They write about repeat photography and that they took ice margins (mapped from multiple Sentinel-2 images) to the field (L122-126), but they neither show the outlines derived from this mapping nor describe how they have determined the region of stagnation without flow fields. Anyway, also stagnant ice has to be included.

The authors state their approach of glacier extent mapping is consistent with prior methods (L117), but it is not. As the authors did not provide glacier outlines for 2023 or 2004, I had to use the 2015/16 outlines from Fountain et al. (2023) for a comparison (Figure 1). This revealed that the authors removed the polygons marked as 'buried ice' by Fountain et al. (2023) for Coe and Eliot glacier although these regions were also included in the study by Lillquist and Walker (2006). This decision (to not say manipulation) resulted in a strong area loss for Coe and Eliot. Also images available in the internet* show the terminus of Eliot at a different place (close to its 2004 position). For Coe one can clearly see the real terminus (marked by a darker frontal part) on the image in Fig. 1B (a bit below the 2004 outline).

For the massive shrinkage of Ladd Glacier the situation is more difficult, as the authors largely followed the interpretation by Fountain et al. (2023), who decided to ignore the debris-covered parts and divided Ladd into five pieces. In fact, these pieces are all still connected and its 2023 extent is not very different from 2004. This might be difficult to see in other images, but in my previous comments I have asked the authors to use the very high-resolution image from the ESRI Basemap for interpretation. This also would have helped to get more realistic extents for Sandy Glacier. For its northern part and terminus region the 2023 extent is still very similar to 2015/16, so their shrinkage here is overestimated. The region with strong area loss since 2004 in its south-western part has indeed little ice left, but the ridge still has a few small glaciers. These have to be included for a correct calculation of area changes. This also applies to Zigzag, where the ice patch marked with a 2 in Fig. 3A and B has to be included; that the ice is probably stagnant does not matter when calculating area changes.

Hence, the strong area loss and retreat of several glaciers reported by the authors for the past 20 years are strongly overestimated for at least three of the larger glaciers, leading to wrong conclusions. In fact, several of the glaciers (Ladd, Coe, Eliot) have barely changed their extents since 2004 when following the interpretation of earlier studies. In the case the authors would like to correct their datasets and report the real area/length changes (please note that providing glacier outlines for review is mandatory), I have a few more comments below. In its current form the results are misleading and should better not be published.

* http://www.mounthoodnationalpark.org/MHNPArticles/210731_Eliot_Branch_Erosion.jpg

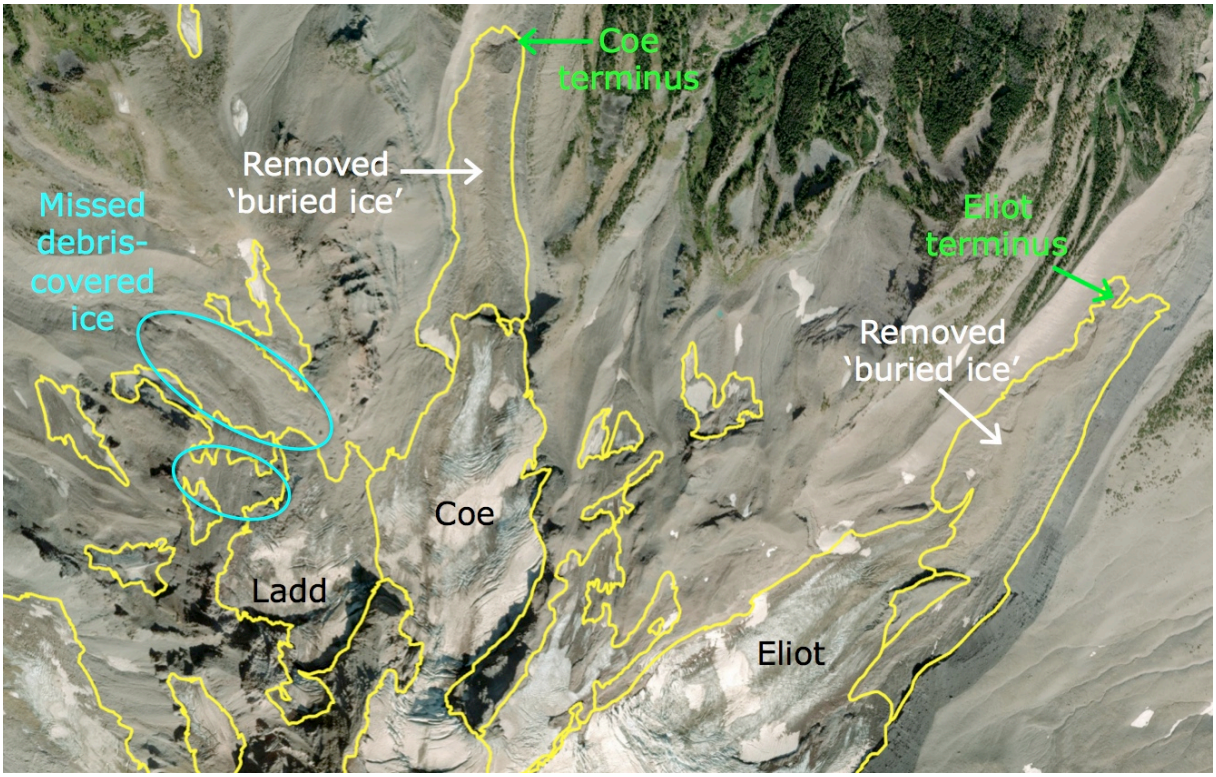

Figure 1: Overlay of glacier outlines (yellow) from Fountain et al. (2023) on a WolrdView 3 image from Sep 2023 available from the ESRI Basemap (World Imagery layer). White arrows point to the polygons that were removed by the authors although the (debris-covered) ice is connected to the main glacier and the real termini are well visible. The cyan circles to the left for Ladd Glacier indicate regions that have been removed from the glacier by Fountain et al. (2023) although the ice is still there and connects the five pieces. This new interpretation results in a strong but wrong area loss from 2004 to 2015/16.

Public interest in glacier changes

As these days any reported glacier changes are of high interest for a large public and critically assessed by 'sceptics', the results presented must be as solid, reproducible and correct as possible. This is not the case here and the wrong assignment of glacier boundaries result in a rather dramatic shrinkage for several glaciers. I would thus not publish the study as it is now and recommend re-working the outlines using the available very high-resolution satellite image. Ladd and Newton Clark Glacier will grow a bit compared to 2015/16, but Zigzag, Eliot and Coe will become comparable to this and earlier extents, allowing calculating consistent change rates from 2004 to 2023. As a note, the authors refer to the year 2004 in Fig. 1B, to 2003 in Table 1 and to 2000 in Table 2. The different dates need to be clarified.

Field vs. remote sensing

In my view consistent measurements of glacier length changes is best done in the field, whereas mapping of glacier extent and area changes is the domain of (orthorectified) aerial or satellite imagery acquired under the best possible snow conditions. To obtain meaningful results, the spatial resolution of the imagery used for this should be higher towards smaller glaciers. The 15 m panchromatic band of Landsat is likely the upper resolution limit for the comparably small glaciers of Mt. Hood, mapping with 10 m Sentinel-2 as performed by the au-

thors is certainly more accurate. For this region the authors have also a 0.3 m resolution image with near-perfect snow conditions. Combined with their knowledge about the topography of Mt. Hood and its glaciers, very accurate outlines can be generated based on subtle changes of contrast and/or colour, often also for debris-covered glaciers. I would argue that this is nearly impossible in the field when being on the glacier in a sea of rocks. When including the 'stagnant ice', the 2023 termini for Coe and Eliot will be close to the orange circles in Fig. S1B. As a note, the images displayed in Figures S6 to S8 for Eliot, Coe and Ladd do not show their termini, but regions higher up. So they are of limited use to illustrate changes of the terminus.

Comparison with other sources
In Table 1 the authors compare their glacier extents to those from 1981 by Driedger and Kennard (1986) and in Table 2 to year 2000 areas from Jackson and Fountain (2007). But in the latter study the areas are listed for the year 2004 rather than 2000 and for the 1981 extents the authors authors do not show the mapped extents. I assume the authors have these as they provide areas for 1981 with two decimals instead of one. It could then be shown that the interpretation of glacier entities is consistent and related outlines should be added to Fig. 1B. For consistent area changes, all parts belonging to the largest glacier extent need to be included.

Comments by other reviewers
In several cases the authors replied that the other reviewers have not mentioned my comment as an issue. Whereas I agree that this is a possibility to ignore a requested change, I think in this case an 'outside' view could still be worth considering as the other reviewers might have worked along the same guidance documents. It is also the right of the authors to say study xyz has been peer-reviewed and published, so the results presented there should be correct, but sometimes this is not the case and different views remain. When it comes to mapping glacier extents this is likely more usual than agreement. In short, I added my comments also because the other reviewers did not notice the issues.

Relation to climate
I would strongly recommend removing the climatic interpretation (Figure 6 and Table 3). The sample is too small, each glacier has a different response time, some glaciers did flow over or now end at steep rock cliffs (creating dead ice) and glaciers are debris-covered to a variable extent. All this creates non-linear responses of variable magnitude that should not be compared to some fixed mean values of the climatic history. Of course, glaciers retreat and shrink when it is getting warmer, but that's it. In this region I assume that also precipitation amounts could have an impact on glacier length changes, as these seem to correlate well with small advances of several glaciers. However, due to the backward temporal averaging of the time series this is difficult to say.

Please note that the 920 m retreat of Ladd Glacier between 1984 and 1989 reported by Lillquist and Walker (2006) is also suspicious. The authors of that study have likely decided to interpret the lower part of the glacier in 1989 as dead ice (they write 'ice-cored ground and lateral moraine') and have assigned a new terminus. While this can be required for some glaciers, such jumps in the time series disqualifies it for the statistical analysis performed here (as it relates to a much longer evolution that has little relation to the change in a specific year).

Apart from some further small remarks, I do not further comment on details of the ms, as I expect substantial changes to the text should the authors decide to get the glacier extents corrected and resubmit the study.

Small comments

I still found 8 times the word glaciated instead of glacierized.

L398: That all data are available from the figures and tables presented in the text is not true. The key dataset (the glacier outlines from different points in time) where all analysis is based on are not provided. This is mandatory for a proper review of such a detailed study of individual glaciers.

Fig. 3E shows lots of seasonal snow cover. The image should not be used for a visual comparison of glacier extents.

Figs. 4 and 5: The plots need axis bars and tick marks also on the opposite site of the graph.

Fig. 6: Instead of 'Normalized length' (which is hard to imagine) one could also work with length changes. Please also provide the length changes for all glaciers in a table. Now most of them are spread in the glacier descriptions of the supplemental material. Please also use different symbols when using green and red lines in the same plot (maybe replace the green with blue).