Review of An assessment of the disequilibrium of Alaskan Glaciers
By Otto et al.

SUMMARY
This study investigates the state of disequlibrium of ~5600 glaciers in Alaska using a well-published "model"/equation that links mass-balance anomalies and retreat in terms of length. The analyses focus on how different response times and the shape of the climate forcing affect the state of disequilibrium. Overall, they find the glaciers are in a state of severe disequilibrium and thus a lot of retreat is already inevitable in the future.

Overall, the study is highly relevant and provides new knowledge about the state of Alaskan glaciers, thereby making it suitable for The Cryosphere. However, there are considerable areas of the manuscript that could be revised to improve readability and more clearly convey these findings. Specifically, the method descriptions were fairly hard to follow, even though the concept itself is fairly "straightforward" (i.e., there's a model that can determine the state of disequilibrium and this is stated with the f_eq metric). In fact, the "straightforwardness" of the analysis is one of the most eloquent pieces of the analysis; hence, if the methods and readability can be improved, I think it will reach a much larger audience and the key points will come across much better. I thus recommend major revisions.

MAJOR COMMENTS
Section 2 is a bit hard to read, which seems to be due to the structure of the section. For example, the first sentence refers to Figure 1, which ultimately took me to read Figure 1; however, without any context, it was very hard to understand. Another issue with this section is that Figure 1 is technically a result; however, there's no information about the model and methods given yet – that all comes later. It thus feels very confusing and forced me to read it twice in order to understand, i.e., understand the methods first, and then understand this theoretical result. It also seems to provide remarkably detailed justification related to not focusing on natural interannual climate variability without any context. If you want to keep this theoretical case (i.e., results) as a way of describing the concept within this section, I would at a minimum recommend that you restructure the section so that the text is logical to follow in a single read. I would further recommend that you focus on the key elements, and provide detailed justification as relevant later on.

Section 2 and 3 – check on formatting requirements, but it's a bit odd to see equations that are written in both equations as well as equations written in lines (e.g., L96, 97, 105, L158, etc.).

The heavy use of variables in place of actual text reduces readability. Even something as simple as writing out tau as "glacier's response time" or just "response time" or H as characteristic thickness could greatly improve accessibility and readability of the manuscript and only add one word. This is also likely part of the reason Section 2 is challenging to read.

Can Figures 3, 5, 6, 7 be merged together? This would be nice to able to see the differences. Also, it's interesting that the regional data is provided in Figure 2; however, these regional differences aren't really included within the analysis. It could be interesting to see Figures 3, 5,

6, 7 with these regional colors included within the pdfs. I recognize this would not enable the area-weighted and count pdfs to be done, so there's some discretion as to the important narrative to show. Maybe there could be a Figure 3, 5, 6, 7 pdf with just the counts in the supplement/appendix?

There are many parts where it seems like results are provided in the methods and methods are provided in the results. See specific comments below, but these really break up the flow of the text.

Discussion: I was surprised not to see any comparison to prior values of the state of disequilibrium or committed mass losses? It seems like referencing these studies, especially those in Alaska (e.g., Davies et al. 2024, *Nature Communications*) is needed at a minimum. I suppose that this model can only do length changes and not mass change. This may be an important distinction that should be highlighted in the discussion?

The glacier-wide climatic mass balance is the response of the glacier to the climate. The equilibrium state is thus the geometry that is needed to support a given climatic mass balance gradient.

LINE COMMENTS

L32 – consider replacing the "-" with "as" to make it easier to read.

L42 – This sentence feels out of place as it's a result but stated as a "for example" in the introduction. I don't think it's needed and distracts more than helps.

L55-56 – consider rephrasing. The "…, and for three different assumed …" doesn't make sense.

L70 – this sentence describing the equilibrium length, if I understand this correctly, then this is the length if you were to hold the temperature anomaly at any given point and allow the model to run until it reaches it's equilibrium length? If so, some mention of the timescales being different (i.e., it's a seemingly infinite timescale) is important to note here; otherwise, it looks like the glacier retreats that length immediately which does not make sense.

L70/71 – length anomaly should specify what the anomaly is calculated with respect to, i.e., the initial length.

L71 – consider replacing the ":" with "as" to make it easier to read.

L74 – why use years at all? The use of years implies it's associated with a specific time period. If it's intentional, i.e., that it reflects the change in temperature from pre-industrial, then this should be stated along with the justification. At the same time, I suspect that this would become exceptionally tricky here given Arctic amplification; hence, you have variable increasing temperatures for different areas, so the justification should make it very clear (and explicit) as to how it's being selected.

L78 – I don't know if this level of detail is necessary as the concept is fairly straightforward, but for my own curiosity, what happens for overshoot scenarios? I assume the current text is assuming only scenarios of consistently increasing temperatures?

L80 – regarding "increase their rate of change until it matches that of the warming trend", how is that possible given they're completely different units (e.g., m/yr versus degC/yr)?

L80 – "and so asymptote to as" doesn't make sense. This reads as though asymptote is a verb. If I understand what's being implied it's referring only to the orange line? The current sentence reads quite general so I was very confused since the 75-year response time example certainly has not reached its new equilibrium in this example.

L80 – this also assumes that the glacier is large enough, i.e., there's enough mass loss (or length change remaining) to enable this.

L81 – choose a different word than "spun up" as this implies initialization conditions of a model, which is not the case here.

L90 – "circumventing uncertainty in some inputs" is clearly model specific. I would state this as other readers may be interested in applying these metrics to other models (for example) and thus this might not apply. Note: see major comment as we still don't have any knowledge of "some inputs" yet, so this is also confusing to read.

L102 – can you add the context as to which metric (length, time scale, mass) this "estimate" refers to?

L106 – "… within 5% of the asymptotic limit (e.g., Fig 1c, orange line)" – this is wonderfully clear! This type of statement following the description of the method is very valuable and I'd encourage it to be earlier.

L107-108 – This reads as an important result, but in a conceptual/methods section. Suggest moving to the results section.

L109 – is this different than the "climate trend" described by L105? If different, specify this.

Equation 4 – why is there a box around this?

Figure 1 – can you show the initial length on one of these figures? It'd be nice to see the raw metric as opposed to only the anomalies/metrics.

L118 – "retreat" not "retreats", no?

L119-120 – again, it would be useful to show the metrics (and potentially state the differences) instead of only stating the differences here.

L137 – What about debris-covered glaciers? I assume their retreat behavior would complicate this?

L139 – This would read better deleting or changing "Lastly" since it refers to the last two.

Figure 2 caption – I assume the color-coding in Figure 1b and 1c refers to the subregions. It'd be good to explicitly state this.

Figure 2 – Why not use something different besides circles for the long-term mass balance records to avoid confusion?

Figure 2 – I assume you're aggregating these areas based on the center lat/lon? It looks like a regular grid of some sort. Would be good to state the resolution of this grid.

L154-157 – perhaps good reason to add a CDF (even if it's just the total) to these two plots as well as a right-hand side axis.

L157 – delete "simple". It's a glacier count. This implies glacier area is complex somehow?

Section 4.1 – Shouldn't this be "Characteristic thickness"?

Figure 3 – change "the method outlined in the main text". If you want to highlight this, state (see Section X) or something similar.

L209 – I assume you're referring to Order 2 RGI regions? If so, state this.

Figure 4 – Is there a reason that you include the accumulation areas (i.e., > 0 m/yr) when the methods state you're only using the ablation area data? Does it change the numbers you get at all?

L233 – no need to repeat the caption. Recommend re-writing such that you just state what the b_t values are and then refer to Figure 5a,b in parentheses.

L250 – Figure 6 shows … is just repeating the caption.

L251 and others – I don't think you need to state (and 90% range) every time. Only at first use.

L264 – can you give the areas or just a broad definition here of how "small" is used? < 10 km2 for example?

L299-314 – this is all methods.

Figure 8 – suggest using different colors to avoid confusion with the same colors being area-weighted vs. count in Figures 3, 5, etc.

L319 – remove "see text for details" as that's obvious. Refer to a section if essential.

L329 – Recommend not using highly unique acronyms like "ETCW" and "GWI" as they greatly impede readability. If writing three to four words is deemed too large, then come up with a new name to refer to them as that's meaningful.

L336 – The shape of the warming is important compared to the linear shape; however, the "ETCW" and "GWI" shapes provide relatively consistent values. This seems worth mentioning earlier (noted it's in L341-342) since it currently reads that they're all highly different until you get there.

L336 – Building on the impact of the shape, I would recommend analyzing this relative to the linear f_eq, i.e., reporting the differences on a per glacier basis. This would make it a lot easier to grasp the statements like L338-340. L330-334 report the 90% range, which is highlighting the glacier variability, but ultimately this whole paragraph is about the differences on a per-glacier scale.

L343-345 – I don't see where this statement is supported?

L349 – check formatting.

Figure 9 – This looks highly smooth. I assume some function was fit through the data? Please state this in the caption.

L356 – what information is not available? This is quite vague.

L356-359 – is this not methods?

L350-367 – prior to this section, there are a lot of values provided. Then in this section, there are no values to actually accompany the uncertainty estimates. Instead the uncertainty is just qualitatively described and not shown. Can one provide some values? Maybe for some of these different examples?

369-375 – Like my prior comment, the interesting thing here is the difference by glacier, not the actual values. Consider changing the way this is provided. For example, are all glaciers 0.08 higher or is it highly variable? Is there not a figure that shows this that can be referenced as well?

L380 – suggest pulling out a few important numbers from the table here to make this more quantitative. Again, it'd be interesting to know the differences, not the values for all of them (see prior comments).

L389-392 – Are these statements supported anywhere? Figure 9 does not seem to show this.

L406-411 – Consider rephrasing. It's a bit odd to state that more detailed numerical modeling can address a problem but then state that you don't expect it to be any different. In that case, there's not really a point in having a more detailed numerical model.

L445 – "other uncertainties in the setting" – provide some examples. Otherwise, highly vague.

L458 – "It seems important" consider making this line stronger. Awareness of how much retreat is already baked into the future evolution of glaciers is important for policy makers, resource managers, and the general public to know to _____. Perhaps that _____ is preserve the glaciers that remain? Reduce our greenhouse gas emissions?