Review of manuscript „Ablation from calving and surface melt at lake-terminating Bridge Glacier, British Columbia 1984-2013“ by M. Chernos, M. Koppes and R. D. Moore.

This paper reports on a summer season study of Bridge glacier in British Columbia in 2013. A comprehensive data set was collected and used to drive distributed energy balance model for the lower part of the glacier to estimate the surface melt and a simple model for the calving flux is applied with the measured velocity and estimated thickness of the lake terminating glacier to estimate the ablation due to calving, the frontal ablation, subarial or subaqueous is not considered. The study is limited becuase not enough data is available to estimate the total mass balance of the glacier, so the mass turnover for the season is not known.

General comments:

Confusing terminology, authors need to clarify in many places that they are not estimating the total ice loss, or the mass balance of the glacier, but only the summer surface melt below the ELA.

Weak error analysis is presented with a lot of handwaving, a rigorous sensitivity analysis on the mass balance gradient, zero elevation change assumption and the ELA estimates should be relatively simple to perform for the simple ablation model. Also, a sensitivity test for the constant albedo assumption in the DEBM could be done to assess the impact that assumption has on the results.

In the Discussion session is a comparison of the estimated ablation of Bridge glacier, due to calving and surface melt below ELA, to values from other glaciers that use the mass balance of the glaciers. This comparison can be misleading as the ablation and velocity of glaciers can be large even though the glaciers are in balance and not losing mass. It is therefore not clear what the current mass balance of Bridge glaciers is as we do not know the accumulation or snow melt in the modelled years.

Conclusions need rewriting, still a confusion of „total ice loss“ and „surface melt below ELA“. The final sentence is a very general statement that would apply for all glaciers in the world and therefore not clear why the extensive study of Bridge glacier is needed to come to this conclusion, suggest to rewrite the last sentence, see comment below.

Specific comments

Abstract: some clarifications are needed

Line 8 23% of what (missing in the text)

Line 11 clarify what kind of calving and surface melt estimates, calving estimates based on area change, velocity and floatation assumption and surface melt below ELA.

Line 12 „typically“ is very general, do you mean for the period 1984-2013? Then state that

Line 15-16 this is always the case for glaciers, I think authors want to make the point that calving ablation will have increasingly smaller contribution to the glacier total ablation, especially after the glacier has retreated out of the lake, suggest to make that clear in the last sentence of the abstract.

Introduction

Line 33, what do you mean by „climate stations“ suggest to use „climate change indicators“ or be precise and state that glaciers will respond to changes in temperature and precipitation and therefore will changes in their size give information about large scale climate change.

Line 34 „respond at least partially independent of climate on decadal timescales“ – not clear what authors want to state here, suggest to rewrite to clarify what they mean. Suggest something like the response is not only controlled by climate forcing.

Line 35 „this blurring“ not clear what authors mean, are you referring to other dynamical factors that can influence the retreat rate of lake terminating glaciers?

Line 38, „their inherent instability“ what do you mean here, in previous sentence authors talk about other forcing than climate on calving glaciers, but not inherent instability, what is that referring to, clarify

Line 55, move reference to the point they are referencing to, suggest to move the reference to after „calve“

Line 65 insert (DEBM) as it is only introduced in the abstract text, not the main body of text

Line 79 for what period is this snowline observation? Clarify

Line 86 m^2 do you mean m^3 for the size of the icebergs? Do you have estimates for their thickness?

Line 94 „significant predictor“ this statement needs a reference, how can you state this?

Line 96 Suggest to change the title of section to „Data“ as here the data is presented

Line 108 TLC is never written out, what does it stand for?

Line 111 and 113 suggest to replace „ground-truth“ with „evaluate“ or „assess“

Line 111 „from“ is two times in row

Line 117, reference for the instruments needed

Line 124 suggest to replace „calving flux“ with „calving front“

Line 127 suggest to add „on photographs taken by“ before „two time-lapse camera“ (you did not track the features from the cameras, did you?)

Line 149 what do you mean by „In order to impose the snowline elevation in the distributed energy balance model“? (here you could use DEBM as it is introduced in abstract and also in line 66 if introduced there) This wording is unclear. It seems like you want to state that you used the snow line elevations from Landsat images to validate the DEBM results, or do you use them to constrain the model?

Line 156 what do you mean by „digital artifacts in the data“ explain better

Line 161 suggest to replace „total ice loss during the summer“ „surface ablation below the ELA“ see comment above about terminology

Lines 177, 180 confusion, (K) is not in the equation, suggest to add (K) after shortwave in line 177

Line 188 suggest to add „computed“ after „integrals are“

Line 191 „is not expected“ how do you know this? You could make a quick sensitivity test by applying variable albedo in your model (within the range you would expect the albedo to vary) and assess how large impact it has on the results, this way you could quantify the impact this assumption has on the resulting melt volume.

Line 201 the skyview factor needs more explanation or reference to where it is defined and what values it can have.

Line 202 This is strange, first you state because of heterogenity it is not measured and then that a constant value is assumed. Again, this assumption can be tested by applying variable values for the albedo and assess the sensitivity of the results.

Line 223 add „radiation“ after „longwave“

Line 231 and 234 be consistent in variable names, use either c_a or c_{air}

Line 252 add reference for the chosen lapse rate

Line 257 suggest to replace „differential“ with „difference“

Lines 265-267 not clear if authors are describing observations or assumptions in the model here

Line 267 „show no significant change“ are these observations made on the glacier? From where?

Line 279 „Since we found no significant elevational or east-west precipitation gradient“ how did you look for that? Are there available observations to assess the validity of this assumption?

Figure 4 caption. Are you assuming that the inflection point and the grounding line is the same location? (I cannot see grounding line marked on the photo)

Figure 5 caption. Not clear what „(arrows to scale)“ means, there are no scaling arrows, or indication in the legend what the size of the arrows is in terms of magnitude.

Line 304. Here „annual surface melt rates“ are estimated, but „ice loss“ in line 161, what is the difference? Need some clarification and consistency in the terms.

Lines 311-314 this sentence is not clear „underestimates“ suggest to write „gives lower estimated ablation than the DEBM results. Suggest to replace „mass balance gradient from the DEBM“ with

something like „the results of the DEBM give the possibility to evaluate a mass balance gradient that can be used to estimate the gradient in the previous years“

Lines 315-316 „are considered in Equation 14“ not clear what you mean by this sentence, needs clarification or rewording, suggest something like „Areas that the ice had calved from in 2013 are estimated in equation 14 by assuming an elevation of 1400 m a.s.l. for all points.“

Line 318 What to you mean by „climatic indicator“ suggest to used „climatic variables“ or rename section to something like „retreat compared to climate variables“

Lines 321 and 324 suggest to replace „punctuated“ by some other word, not clear what you mean here

Line 323 from figure 7e it seems like that retreat accelerates after 2004, not 2009, is that correct?

Line 326 „does not fully follow regional climatic trends“ - not clear what authors mean here, what is a regional climatic trend? Do you mean variability in precipitation and temperature measured in one location?

Line 328 suggest to replace „from“ with „in“ and replace 7a with 7b in parenthesis

Line 330 „it appears that retreat was decoupled from climate“ what do you mean by this statement? Clarify

Line 330 „it remains unclear... „ – are you not estimating this in the paper? Figure 11? Why is this sentence here?

Figure 8 caption suggest to add „location of“ in front of ablation stakes

Lines 344 and 345 suggest to replace „ice loss“ with ablation or surface melt to be consistent with for example Figure 8

Lines 346-347 not clear what the observation uncertainty is, is seems like authors estimate the observation uncertainty by how well the model fits the observations, is that true? If not, then the sentence needs rewording.

Figure 9 it is not clearly stated how the error bars in figure 9 are obtained, neither for the observations nor the model

Line 350 „ may have been errors in measurements“ it seems strange to suggest that observations have larger errors than the stated uncertainty (the error bar in figure 9) when the model does not agree with them, suggest to rewrite this sentence.

Line 359 suggest to replace „comparing“ with „adding“

Line 375-378 this sentence is unclear, suggest to turn the sentence around, by first discussing the variability in the „glacier ice loss“ (suggest to replace that with ablation or summer melt, to be consistent with previous text) which is due to the variability in the ELA, as a result of equation 14

Line 377 „surface melt“ suggest to replace with ablation or summer melt – be consistent, also in figure caption 11 „ice loss from calving“ and „surface melt“ do you mean ablation by calving and ice melt below ELA?

Line 385 strange to state that the highest calving flux occur between 2003 and 2006 when there are higher values in 2008 and 2010, suggest to rewrite sentence

Line 387 suggest to replace „period of stability“ with „low calving rates“

Line 387-388 „surface ablation rates decrease“ it is not clear from the figure that this is true, only year 2010 has lower surface melt - again be consistent, figure states surface melt, surface ablation is used in the text and it is not clear that only ice ablation below the ELA is discussed.

Lines 392-394 this is a strange statement and not rigorous error analysis, why do you expect differences to be smaller than calculated error (how is the error calculated?) the melt model is very simple linear regression using the height of the ELA, what about making a sensitivity analysis on the assumed mass balance gradient?

Line 394 „summer balance“ do you mean surface melt below ELA?

Line 405 „summer balance“ see comment above

Line 406 it would be in order to do a sensitivity analysis on the elevation change and assess this effect, by changing the elevation by a reasonable value for this period, then the authors would not have to be guessing, or assuming „a minor effect on modelling results“. A sensitivity analysis on the mass balance gradient should be included, see comment above.

Line 423 Turnover depends much on the overall mass balance of the glacier, it can have large velocities due to high preciptation and therefore not clear what is compared to what here.

Line 428 suggest to replace „driving“ with „important“

Line 444 suggest to replace „trend“ with „amount of“

Line 459 „calving and surface melt losses“ be consistent with other places in paper, suggest „ablation due to calving and surface melting below ELA“

Line 459-460 „climate is the driving factor affecting the long-term health“ suggest to replace with something like „controlling the mass balance“

Line 461 „calving fluxes in most systems“ -what do you mean, not clear, suggest to rewrite

Line 463, 470, 473, 481, 500 not clear that calving rate is now „retreat due to calving“ suggest to clarify this, before the model was computing calving flux, m^3/year, but here retreat due to calving m/y is discussed.

Line 465 suggest to replace „ice loss“ with retreat and „calving losses“ with „calving ablation“

Line 467 replace „glacier‘s future health“ with „mass balance of the glacier“

Line 471 „falls in the middle of a continuum of magnitude and frequency of calving...“ - this sentence does not make any sense, glacier does not fall into anything - and a continuum is meaningless in this sentence, do you mean „observations of magnitude and frequency“? suggest to rewrite

Line 479 suggest to add the time of this observation, 2013, right?

Line 483, this need better explanation for the paper to be self contained, what is used in the revised relationship, how is this calving rate computed?

Line 485 „falls along the linear spectrum of calving and water depth“ does not make sense, rewrite or delet, figure 12 does not give useful information as there is no data, only the lines that have been interpreted, without the data this figure is based on, it is useless and I suggest to omit this discussion.

Figure 12 suggest to omit, without the data this figure is useless

Line 491 how much larger is the lake (areawise), is the depth of 300 significant for this comparison? It is confusing to compare area and depth in the same sentence.

Line 507 in this paper the „total loss“ has not been estimated, only the ablation below ELA using a simple parameterisation based on the height of ELA and mass balance gradient, and calving ablation, based on simple models and observations of velocity and thickness of the glacier. It is therefore not comparable to the numbers for the other glaciers that present the net mass balance of the glaciers.

Line 511 replace „total ice loss“ with „ablation below ELA“

Line 511 „different stages in a relatively uniform ‚life cycle‘“ is not clear and needs to be reworded, not sure what authors mean here, lake calving glaciers do not have „life cycle“.

Line 514-517 This statement is strange, as what has been observed is that the calving rate is larger when the water depth is increased, it is therefore no temporal trend that can be applied to other glaciers across the globe, it is very localised and dependent on the lake bathymetry.

Line 524 replace „total ice loss“ with „surface ablation below ELA“ in two places add the year

Line 531 replace „total ice loss“ with „ablation due to calving and surface melt below ELA“ – or be consistent with above. Also, add which period is being discussed here.

Line 533 isn‘t the glacier almost out of the lake? Is that not the reason for reduced importance of calving for the mass balance of the glacier?

Line 536-537 This is very general statement and not clear why „therefore“ is needed, the mass balance of all glaciers in the world is controlled by ablation – and accumulation, actually the balance between the two, with additional calving ablation, where applicable. Perhaps the final sentence of the paper should be something about reducing importance of calving ablation as the glaciers is retreating to shallower water, or even out of the lake.