

## ***Interactive comment on “Glaciers and Climate of the Upper Susitna Basin, Alaska” by Andrew Bliss et al.***

### **Anonymous Referee #1**

Received and published: 25 June 2019

General comments: This paper presents a dataset in the Upper Susitna Basin in Alaska and contains the data itself, the data collection and data processing of meteorological, glacier mass balance, snow cover and soil measurements. Data collection in this region is hard and this data can be great value for model validation or calibration in this region, however, I think not in the way it is framed now by focussing on implications for the dam (that is not there) and climate change (data is too limited).

I think the dataset presentation can be more thorough and better structured than is presented now. I miss at various places context of statements and the naming of the different stations can be structured better, such that it is clear to the reader which data you are referring to. I specified this in the specific comments below.

I suggest major comments, predominantly since I think the focus of this paper should

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be on the data and not too strongly framed to dam-implication work and/or climate change work, since this work does not address that.

Specific comments: The introduction does not focus on the relevant subjects. You present solely a measurement dataset and you focus in the introduction on climate change and (modelled) river runoff, which you did not do in the paper. Please restructure the introduction, remove this information or at least shift focus to the data. You could include more information about previous field works/data sets in this region?

In general: update the captions of figures, such that those are complete. In Figure 1 I miss for example explanation of the subpanels. Also update the figure labels and text inside the figures such that those are readable (mainly Figure1) and resolution is high enough (also for the tables).

P1L16: You did not raise any questions yet. Please rephrase. P1L16: Your introduction is focused on climate change and river runoff, however I do not think 1 data set is sufficient to solve that. I would focus more on fundamental understanding rather than climate change. Please shift the focus of the importance of the data or even present it only as a dataset.

P2L1-4: in the paper itself you do not make the link to water runoff or the dam so I find this information misleading. P2L5: state 127 glaciers instead of 'more than 120'. Be specific P2L9-10 similar as stated above, you do not make this link to dam operations and environmental resources. Or looked at river discharge. P2L11-14: So you do not include modelling (as stated in P2L3)?

Section 2. Study area: A lot of unnecessary information. Please exclude some information or make more clear why you discuss this information. Connect the information to your paper and rewrite to a smoother story. P2L19-21 "modern glaciers. . . Ice sheet" Surging Permafrost

P2L19: why Kienholz reference needed? P2L24: "few"=how many glaciers? P2L28:

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change “ninety-three” → 93 P2L28: “127 glaciers”: numbers are not congruent (“more than 120 glaciers” in L5, “Most glaciers (in total 127)” in L23). If the area contains 127 glaciers please change in L5 to “more than 120 glaciers” to “127 glaciers”, remove in L23 “(in total 127)”. P2L29: how did you estimate this volume? Explain in text. P2L30: why do you use these scaling coefficients? Please explain how you got those or insert reference. P2L31. Place ‘.’ After m a.s.l.. P2L33: change point into comma or insert ‘and’

Page 3: Figure1: Combine Figure 1 and 2 by shading/colouring the permafrost areas >50% in Figure 1. For reader it is not clear why permafrost is so important. P3L1: Why is debris cover relevant? P3L1-2 please rephrase and combine L1 and 2 P3L5: include Östrom reference. P3L6: Do you exactly study the same area? P3L10: “History of surging”, are they still defined as surging glaciers or long time stable already??

P4L1-8: why is surging relevant? Mass balance not that different than non-surging glaciers. P4L9: this line suggests that glacierized parts have vegetation and human development. Please rephrase. P4L9-15: why is permafrost relevant?

Page 5 Figure 2: Do not understand the importance of this figure, maybe only the two upper permafrost colors needed? Then combine with Figure 1.

Page 5 Figure 3: put all photos next to each other or make panel a and d bigger such that they are similar height as b+c.

P6L4: do you refer to figure three, or do you mean you installed three AWS? Are those the ‘station type AWS” in Table A1? Not clear for reader that energy balance weather stations are ‘AWS’ and that simple AWS is ‘HOBO’ in table A1. P6L6: “floated” is not appropriate here. P6L25: “The station records...surface elevation changes”, put earlier in section (for example at the end of P6L4.

Page 7: Figure 4: caption “(i) outgoing longwave radiation” use abbreviation LW as defined before.

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Page 8: Table 1: It is not clear to me whether the “energy balance weather stations” are the ones indicated by “AWS” or “HOBO” in Table A1? Please use consistent naming for all stations throughout paper. P8L1-2 : what do you want to show with correlation coefficients in Table 2? P8L4: “variable”, you indicate only the range of the data in Table 2. Please provide also the standard deviation of the values in Table 2 and refer to the standard deviations in the text. P8L7: “more than 4 degrees Celcius lower”: please rephrase to “temperatures by a minimal bias of 4 degrees” or similar. P8L8: connect the sentences by adding “when” P8L6-10: structure is missing, please rephrase P8L11-13: please provide numbers instead of only calling it ‘higher’, ‘greater availability’, ‘less variability’ etc.

P9 Table 2: daily correlations? Add standard deviations to the means to indicate the variability. You can remove the range, since that does not add more information than the standard deviation

P10L9: Incoming longwave radiation is also influenced by the surroundings, especially in complex terrain. Insert “mainly”→“which depends mainly on the effective..” P10L12: high correlations means meteorology is affected by larger scale forcings rather than micrometeorology. You could add discussion about that. P10L23: change “Figure 5” to “Figure 5C”. and add ABC in Figure 5 P10L25: not necessary melt when  $T > 0$  degrees, the surface energy balance should be positive. P10L30: What about the influence of precipitation. P10L31: rephrase “in the ice rather than the snowpack” to “the layer consists of ice instead of snow” or similar

P11 Figure 5: explain the reversed patten of ice temperature (red lines) with depth in the text. At 21 April lines are ordered from light to dark lines with depth, while in June this pattern is reversed. With other words explain why the temperature gradient reverses. the lightest lines (Ice2.5m) are not clearly visible and Ice3m not present at all. Please make those lines more clear.

P12 Figure6: the reversed temperature gradient is here not visible why (not)? Go

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more in depth in the data (general comment) P12L4: “simple weather stations”? Why is station type in Table A1 than indicated by “HOBO glacier”? please make naming consistent throughout the paper.

P13L7: which of the two sensors are more trustworthy? And why the comparison? Please explain in text. P13L9-11: I think these argumentations do not match: The HOBO sensor is slower than the Campbell, but coefficient of 1, and then conclusion is that there is a lack of consistent pattern. I do not follow this, please explain and rephrase P13L20: add some explanation/conclusion. I miss in this whole section why you do the comparison between the sensors and eventually the physical interpretation or conclusion from your statements.

P14L1-2: did more people had this problem? Is it a random tip that can also occur during dry periods (since this can not be filtered out)? Or is the tip sometimes ‘stuck’? P14L4: or conclusion is the HOBO has a sensor problem. P14L16: is this katabatic flow measured or a assumption it develops?

P15 Figure 7: include the colours in the caption

P16-P17: Section 3.3 I do not think this section is a great addition to your purpose of the paper and not supported by any in depth discussion, please remove.

P18 Figure 11: is this the same transect measured every week at same location? What do you mean with “plotted relative to a reference station”? Does this mean steepness in line is varying in time? Please explain in caption. Mention in caption what upper stations in winter are not operating/measurement problems.

P19 figure 12: Add coloured lines for each of the dots to show whether the gradients change in time/how sensitive they are. Add the resolution of the glacier inventory in the caption. Insert in caption how the mass balance in computed (from the “HOBOglacier” station in Table A1?

P19L1-2: or the measurements are not representative for the whole region. P19L4-

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end: the linear interpolation is done with all data such that no division is made between years (1 average value for all glaciers and all times?)? If so this is a very simplified method and I am not convinced in the numbers you present. For example P is highly spatially variable, as you also state in P20L14-15.

P20 Section 4.2 Very limited, please expand or consider removing or merging this section. P20L17: I do not follow this, you did not do any model simulation of snow accumulation, or this is not mentioned. P21L2-3 please rephrase. Absolute difference at 2000 and 1000m or did you do some averaging? P21L4: how do you know surface roughness is responsible? Please add explanation or supporting material for this statement. P21L6-8 I am not convinced

P22L9: again, why the roughness of the ice surface? P22L16: add explanation why data become noisier. Why does ice give more noise signal? P22L20: you assumed constant density? What are the implications of this assumption?

P24 Table 6: increase fontsize Section 5.2: please remove, I do not think is Section is of additional value P24L11: "though we did not do a detailed texture analysis", But still you know it matches with the STATSGO soil map? I am not convinced.

P25 Section 6.2 Explain the uncertainties and effect by the disturbance of the disturbed soil on the measurements.

P27L11-13: why is this relevant, please remove. P27L25: How do you relate this to the dam? No runoff analysis is done. P27L27: this is only a minor section and for me not strong part of your paper and now you present the climate change numbers as one of your main conclusions.

P28 Figure 18: air temperature is gray colour? P28L6: not new conclusion, snow amounts are generally higher at high elevations P28L7: you did not measure the soil and your conclusion is that these match with the mapped soil descriptions. Please remove this statement out of your conclusions and preferably also out of the text

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Conclusion in general: please do not focus on climate change and dam implications, but give conclusions about the data you found in the field. What did you find and why is it special?

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