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Interactive comment on "Winter speed-up of quiescent surge-type glaciers in Yukon, Canada" *by* T. Abe and M. Furuya

Anonymous Referee #3

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Review of: Winter speed-up of quiescent surge-type glaciers in Yukon, Canada Authors: T. Abe and M. Furuya

Article Summary:

The authors seek to better understand the mechanisms driving observed winter-time surge behavior through the examination of the spatio-temporal variability in velocity for several surge-type glaciers near the border of Alaska and Yukon. Results generally indicate propagation of winter-type speed up from upstream to downstream regions. Given the lack of observed surface melt production upstream, the authors conclude that stored melt water in basal crevasses under pressure as winter approaches accounts for observed behavior.

General Evaluation

The observations are compelling and well established based on conventional methods for features tracking from SAR imagery. The arguments establishing a theory on observed winter-time speed associated with surging behavior is circumstantial but compelling. I think the addition of (if available) time series of near surface air temperatures would be a solid addition to substantiate claims that winter-and fall conditions were not conducive for the production of surface melt (its likely they are correct), but an examination of both summer and winter air temps commensurate with the velocity measurement periods from 2007-2011 would be illuminating.

Specific Comments and Edits:

-Though understanding subglacial erosion rates is certainly a worthwhile endeavor, I am amiss at what the authors re attempting to accomplish in the paper. Is the overarching justification for this study to better understand mechanisms of surging behavior in glaciers with implications for surge-behavior on mass balance and mass contribution to sea level or is to better understand how surge behavior impacts basal erosion rates/till production and redistribution? Perhaps the authors are attempting to state how understanding surging behavior will have broader ramifications for understanding mass balance and sea level contributions in addition to improved understanding of such behavior on glacial geomorphology. If so, than the Introduction section should be restructured to make this clear. It currently does not read in such a way as to clearly articulate the significance of the research effort.

-might be worth adding either an Objectives section or to clearly state the research goals of the paper in a paragraph at the end of the Introduction section.

- I would recommend adding a Study Region Section in which I would provide details about the glaciers examined in the study, the glaciological context and historic behavior which is included in the Results section. A lot of that material should not be in that section. Section 3.2 looks like the beginning of such a section and the other sections

(3.1.1, 3.1.2) should be sub-section sf the Study Regions Section.

-page 2613, "..the dynamics of basal water.." what is meant here? Should be stated with greater clarity

-the Data and analysis section reads very poorly. The section should state early that measurements of surface velocity were assessed as derived from PALSAR data, then continue with detailed description of the methods to process the data as generally included.

-Should articulate why the analysis period was selected (December 2006-March 2011) in the Data/Analysis section.

-Define YGS before using in a sentence.

-RGB method as cited by (Yasuda and Furuya, 2013) should not only be defined (the acronym) but a summary of this methods should be detailed in the methods section, not mentioned in passing in the Results section. There is not mention of this method, what it is used for, how it is derived, and how it provides something important in accomplishing the intended research goals.

-not sure why you cited this statement, "..Moreover, in contrast to the upglacier propagation of summer speed-up (Zwally et al., 2002; Sundal et al., 2011; MacGregor et al., 2005), the higher-velocity region was observed to expand from upstream in fall to downstream in winter. . ." in the results section. I assume you are reporting results as findings from your analysis, not from the analysis of others. This kind of reference should not be made in the Results section of your paper. If your intent is to contextualize your results based on previous work than this kind of reference should be more clearly articulated in the Discussion section.

-again, I'm confused by such a reference, ".. Although we could not obtain quality summer velocity data for each year (Burgess et al., 2013),..". Why are you referencing other work when discussing your data and your analysis?

-you state in the Discussion section that, "Surface meltwater depletion from fall to winter. . ." is hit based on data analyzed in this paper (which I did not see) or based on previously published literature? This should be rectified.

-needs to be written clearly. . .its ambiguous what you are trying to say I this statement found in the2 Paragraph in the Discussion section, ". . .However, downglacier propagation of the winter speed-up will require such an efficient drainage system in the upstream that is usually found in the downstream closer to the terminus (Raymond et al., 1995). . ."

-page 2619, paragraph 2: ". . .Using the few ERS1/2 tandem radar interferometry data with the 1–3 day's observation interval, Lingle and Fatland <ADD CITATION DATE HERE>. . ." and then remove the citation at the end of the sentence.

-page 2619, paragraph 2: "Moreover, the detected bull's eye-like. . ." likely a better way to identify these features than use of such a colloquial statement. . .

-page 2619, paragraph 3: sentence is ambiguous, "We consider that our velocity TYPO<measuments>are complementary to the limited observations and revitalize the englacial water storage hypothesis. . ." revise.

-page 2619, paragraph 3: "vertical glacier surface motions"..what are you referring to here. . .did Lingle and Fatland (2003) measure verticle (i.e. vertical gradients in horizontal velocity), you're not referring to vertical displacement along the z-axis. This is confusing. . .IN fact this whole paragraph is confusing. I' not sure what "verticle motion" you are referring to as your measurements only are able to resolve btoh horizontal component of surface velocity and you did not present any evidence of such data beyond the resultant velocity magnitude (not even direction vectors are shown in figures). So I am confused by what you mean by vertical motion.

-Van der Veen, 1998 paper described criteria for formation and propagation of air and water-filled crevasses that form at the surface of a glacier. This is a different mechanism

than the formation and maintenance of basal crevasses.

-The last part of the discussion section (end of last paragraph) is rather speculative. The inference of a concave basal topography may be reasonable but is unsupported by evidence. The additional speculation of high geothermal heat fluxes without a knowledge of what the actual flux rates are is also quite speculative.

-It appears that the major argument in hits paper is that observed spatial and temporal variability in winter-time velocity for known surging glaciers is anecdotally explained by references to other work that has explained surging behavior through the injection of stored melt water in bottom crevasses. The argument purported here is circumstantial, yet compelling. An additional way to assist in establishing the foundation of the argument that is specific to the glaciers under analysis in this study would be for the authors to consider using the linear elastic fracture mechanics (LEFM) approach to determine the spatial distribution of conditions necessary for bottom crevasse to form as indicated in the works of van der Veen (1998a) and Nath and Vaughn, 2003. I'm not suggesting this as a necessary condition for publication as it might require a substantial amount of work but if feasible it might strengthen the argument established in this paper.

Recommendation:

I think the paper presents interesting findings. The argument to explain observations is anecdotal but plausible. The paper suffers from serious organizational and language problems which would require attention before the manuscript would be acceptable for publication. I recommend revising and resubmitting after major issues have been addressed.

Interactive comment on The Cryosphere Discuss., 8, 2611, 2014.