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Interactive comment on "Surge dynamics on Bering Glacier, Alaska, in 2008–2011" *by* E. W. Burgess et al.

M. Pelto

mauri.pelto@nichols.edu

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Burgess et al (2012) have derived and analyzed a very detailed data set that identifies changes in velocity, surface elevation and driving stress for the Bering Glacier through its most recent surging cycle. This is a valuable data set looking at the surge cycle on a complex glacier system. The surge cycle has been more commonly documented on simpler and smaller glacier systems. The paper has considerable potential to expand our understanding of the propagation of changes in velocity during a surge phase, and the associated changes in surface elevation and driving stress. This potential is limited at present by four significant issues: 1) A poor introduction. 2) The need for additional figures and enhanced figure clarity. 3) The lack of sufficient discussion of the potential role of basal water pressure between the introduction and conclusion. 4) The lack of

detailed description of the 2011 second surge phase mentioned in the abstract, though Figure 3 depicts this.

1182-17: A sentence on the termination in 2011 and the velocity reduction is important in the abstact.

1182-21: The start of the introduction needs a much better description of the Alaska surge cycle. Below is some suggested changes with additions in quotes. "In Alaska the surge events usually begin and end abruptly and the quiescent phase of the surging glacier cycle is significantly longer than the surge phase of the cycle". Surge events are associated with high basal water pressures that reduce the amount of basal shear stress a glacier bed can support, thus allowing the glacier to slide rapidly on its bed surface. "Typical accelerations are 10-100 times the quiescent phase velocities". Driving stress is dependent on glacier thickness (h) and very sensitive to glacier surface slope angle

1183-1: In terms of clarity it would be helpful to explain surge dynamics in terms of the surge phases consistently. "Quiescent phase features a steepening glacier profile due to restricted outflow from the active thickening, reservoir zone and the depleted receiving zone. The zones are separated by the trigger zone. During the surge phase the glacier profile is reduced as mass is redistributed from the reservoir zone to the receiving zone nearer the terminus." This reduces the glacier slope angle and reduces the driving stress. "The termination phase follows with sudden deceleration leading to thinning again of the receiving zone. As the cycle begins again, the driving stress can increase again though thickening of the upglacier area, thinning of the terminus reach and steepening of the glacier slope." Variegated Glacier, AK, for example, had quiescent flow speeds slower than steady state along most of its length, causing steepening and increased driving stress across most of the glacier until the surge initiated in 1982 (Raymond, 1987; Raymond and Harrison, 1988). During quiescent phase, as a glacier undergoes changes in geometry, flow velocities adjust in response to the changes in stress regimes. "Flow velocities are consistently reduced in the receiving zone. In the reservoir zone" it is not uncommon for surging glaciers to have small acceleration events during quiescent phases.

1183-26: What were the pre or post surge velocities at same locations?

1184-16: Basal water pressure is never mentioned again in the paper. It deserves a bit more attention in terms of its potential to reinforce changes in driving stress observed, or in terms of its potential to alter the surge velocities expected simply from driving stresses. Is there any portion of the observed changes that can be better explained with consideration of basal water pressure? I recognize that the data obtained is not necessarily specific to basal water pressure, so solid conclusions could be difficult. 1194-7 is one place this is warranted, but is should be discussed before the conclusion as appropriate.

1184-11: More important to note that east is upglacier and west downglacier of the transition point. The transition point can be considered the trigger point or dynamic balance line. Most surges are initiated from a point where longitudinal stresses at a transition from high to low drag.

1184-17: The introduction just ends before it is finished. What is the goal of this paper is not mentioned or even the time span to be examine or how this surge may relate to another or what data was collected by any researcher in the decade before the surge.

1191-19: Quantify thickness changes and resulting slope change.

1191-24: Drew down what portion of accumulation zone and by how much?

1191-27: instead of accumulation zone which is much larger than the area indicated here not this as the reservoir zone.

1192-1: It is important to specify this as the transition in longitudinal stress that indicates this as the trigger zone.

1192-5: The area where driving stresses increased most must be defined in this para-

graph. The area is simply referred to as “it” afterwards in paragraph. It is important to make it clear where this location was in 2008 versus the second stage of the surge phase in 2010-11. From Figure 2 it seems to be further downglacier.

1192-27: This discussion is not finished. In the abstract a 2011 second phase acceleration is mentioned, but is not further discussed in terms of the specifics of where this occurred or the more specific time period.

1194-22: This may not be the correct location to address the question of the two stage surge, but is this typical for the Bering system? If so does this simply reflect the size of the system or is this observed commonly on smaller surge glaciers too?

Figure 1 It would be quite useful to provide identical diagrams indicating the different spatial distribution of velocity during two the various surge phases and the quiescent phase.

Figure 3: Indicate the km reach of this closeup image.

Figure 4: Indicates a much steadier buildup in velocity than Figure 2, and the typical rapid end to the surge phase.

Figure 5: This is an incredibly valuable figure that at the moment is too busy to gain full value. The most features are the changes in elevation change rates from the blue, green and red intervals to the orange line 1995-2007 intervals in contrast to what follows. The change from the 2003-2007 interval to the 2009 interval in elevation change indicates the whole redistribution that can be much better highlighted by increasing figure size and focusing just on those two intervals in a separate figure. Thick and thin lines are hard to distinguish no reason to combine the two and have two y-axis.

Interactive comment on The Cryosphere Discuss., 6, 1181, 2012.