

## ***Interactive comment on “Further summer speedup of Jakobshavn Isbræ” by I. Joughin and B. E. Smith***

### **Anonymous Referee #3**

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This is a nice brief paper which adds some rather spectacular (and disturbing) data to the longer term records of ice motion near the calving front of Jakobshavn Isbrae. While the paper could go into a lot more detail in its analysis, the main point of the article (given that it is a short communication) is to get the results in to the public domain. There are no major problems with the paper although it would be good to see a more involved discussion with respect to the predicted retreat scenarios; this discussion is not very detailed and seems to give little attention to a whole gamut of processes which might affect the retreat history over the coming decades – this point is discussed further under the ‘Main Points’.

#### **Main points**

The speed comparisons need amending. Given the issues associated with speed-  
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up of sites as the thinning terminus retreats towards them, the comparison of e.g. M6 velocities between 2012 and 1992 (286% speed-up) is not very informative. A comparison between the velocity values from 1km behind the terminus between 2012 and 1992 would be more useful (and presumably not as extreme as the 286% speed-up quoted).

Explanations of the summer velocity variations. You state that “For example, analysis of data from 2009 indicates that the forces associated with the terminus depth variation and height above flotation account for most of Jakobshavn Isbræ’s seasonal flow variation (Joughin et al., 2012). Such results are consistent with the large summer speedups in 2012 and 2013 when the terminus appears to have reached the bottom of an overdeepened basin (Fig. 3), which occurred after the terminus retreated more than a kilometer farther inland than previous summers.” However, what is therefore the explanation for peak velocities occurring in late summer in 2011, ‘12 and ‘13’ while the peaks were earlier (about end-June) in 2009 and 2010 – during all this period, the terminus was on a reverse slope so the explanation that has been given should result in the same temporal acceleration to peak velocity each summer. What has changed between the earlier and later summers?

Issue re gridding artefact. The suggestion that “the high spot might be a gridding artifact” seems rather odd. Whatever gridding was used, it should only give a ‘high spot’ relative to the lower elevations either side IF there was a high point somewhere within that part of the survey. If this is the case and the high point doesn’t in fact exist, then this is a data error (perhaps because it is very hard to sound (Li, 2009)) but this is not a gridding error/artefact.

The rather bleak doomsday scenario for retreat and acceleration would benefit from a caveat. You state in the introduction that the previous initial speed-up was “likely in response to increased basal melting (Holland et al., 2008; Motyka et al., 2011) and to weakened ice mélange in the fjord (Amundson et al., 2010; Joughin et al., 2008).” Does your retreat scenario assume that weakened ice mélange and increased basal

melting can now be assumed as inevitable in decades to come? If not, and given the complexity of tidewater glacier dynamics, then you should at least add something about other processes that might slow (or indeed increase) the rate of flow and retreat. At the moment, the discussion seems overly simplistic in simply saying that accelerating retreat is inevitable. In addition, since the thrust of the retreat argument is really based on the reverse bedslope marine instability theory, it would be good to reference some early work that has alluded to the concept (e.g. Weertman, 1974). Furthermore, given that you say the bed topography is very hard to sound (and thus the bed data are presumably poor?), how confident are you that there aren't a lot of potential pinning points inland of your transect or to either side of the transect?

Minor issues

P5462, L18 – over the last decade and A half

P5462, L23 – suggest adding actual velocity behavior to clarify text: 'the glaciers speed has varied seasonally SLOWING as its terminus advanced in winter and ACCELERATING DURING retreat in summer'

P5462, L24 – "This seasonal variation of the terminus.." – best to say variation in what I,e, velocity and position.

P5464, L5 – M23 and M43 locations not shown

P5464, L23 - as it moves increasingLY close

P5465, L3 - relative to the 1992 PEAK?

P5465, L3 - The statement 'While terminus position has often been correlated with terminus retreat' is meaningless as written and needs amending (with rates perhaps) to give the correct context.

P5466, L11 – "While the high spot above the basin" is very imprecise. Could say "While the high spot behind the basin at km 12.5 (Fig. 3)..." (or whatever the correct distance

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is)

P5466, L16 – amend to make point clearer "(~1300m below sea level and ~15km upglacier from its current position (Fig. 3)).

"Once past the high spot" – again, very imprecise. Do you mean the one at ~12.5km or the higher one at ~17km – this could be expressed more clearly

Figures

Fig. 1. The orange and purple labels are almost impossible to see. Keep the circles coloured but make the lettering black or white (and larger if necessary) so they are legible

Fig 3 – indicate the time period recorded by the terminus position in the caption (as the annual cycles over ~4 years around kms 7-12 are clear but not sure how long the rapid 8 km retreat took hence it needs clearer labelling (presumably from 2009 given top plot but it would help to state start and end of that multi-colour time series))

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Interactive comment on The Cryosphere Discuss., 7, 5461, 2013.

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