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## ***Interactive comment on “Influence of supraglacial lakes and ice-sheet geometry on seasonal ice-flow variability” by I. Joughin et al.***

### **Anonymous Referee #1**

Received and published: 25 April 2013

This manuscript follows on from other InSAR-based observations of the Greenland Ice Sheet (e.g. Palmer and others, 2011) to discuss the complex spatio-temporal pattern of ice sheet speedup. I think the authors have a nice data set here, but I think that there could be more done to strengthen their arguments and/or lessen the importance of lakes in the manuscript.

The author makes the claim that speedup is concurrent with the period of lake drainage. I have had a really difficult time understanding Figures 3 and 4 because it is unclear to me what it means when a lake is coloured in (see notes re. Fig. 3 below). As such, it's difficult to know what the periodicity of lake drainage is. However, I don't think that there is enough data presented to definitively link lake drainage to the observed speedup for several reasons: 1) there are locations where lakes drain and no velocity response is

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observed (e.g. the very northern tip of the data set between June 12–June 23, 2009) and other locations where it appears that lakes drain after the speedup occurs. 2) speedup is shown as a snapshot in time on one particular day with no prior knowledge of the melt conditions on the previous days. Since speedup is known to be a function of variability in melt water input (Schoof, 2010), it is equally possible that melt had peaked prior to the observed speedup. Since there are numerous moulins in your study area that are connected via streams to lakes it is equally likely that meltwater flowing into moulins 'primes' the system thus allowing melt to be concurrent with speedup, without needing the water to be previously stored in lakes. Melt is well correlated with speedup on multiple time scales as seen in many GPS-based observations (e.g. Hoffman and others, 2011; Bartholomew and others, 2010 and 2011b). The authors discuss how their observed spatial variability makes point-based GPS observations difficult to interpret, but the downside of the approach used here is the temporal sampling used. How do the authors reconcile this? I suggest that the authors show sub-daily or daily melt estimates along side their GPS data and the analysis presented for a more thoughtful interpretation of their data in light of the GPS-based observations that have occurred previously.

I think the strength of this manuscript really lies in what is discussed on 1109 and 1110 and not the correlation of lakes and velocity change. The conclusions spend little time on lakes and more on the ideas developed in the latter part of the discussion. I think changing the title to reflect that the manuscript is about more than just lake drainage would be appropriate.

My other (more minor) concern is that the authors need to do a better job of referencing previous work. There is work on crevassing and moulin development by other authors as well as a large body of literature on overdeepenings and GPS applied to this problem that should be cited properly though the manuscript.

Specific issues:

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1103, 17: Zwally and others, 2002 is a bit outdated - especially after many numerous more recent publications on seasonal meltwater-induced acceleration.

1105, 6: meltwater drains into crevasses - aren't these then moulin also? or are you saying that meltwater fills crevasses and does not drain? Similarly on 1105, 29: what is the difference between large hydro-fractures that drain lakes and moulins? - Finally, what is the evidence that water is continually supplied to the bed for these fast-draining lakes?

1106, 16: This is confusing: did N. Lake drain on June 12 or between June 12 and Jun 23? How does the author know that the lake drainage was responsible for the observed speed up? I think the speedup is showing the difference between wintertime speeds and speeds on June 12 - so the speedup could have occurred at any time previously, correct?

1107, 10: when/how is the peak lake drainage identified?

1107, 23: "The observed relationship between surface melt production and ice-flow speed..." - from this manuscript? Where? From another study? Please cite. There is no data presented here indicating surface melt production.

Fig. 3: The caption mentions green and magenta outlines but you show those plus lakes that are infilled in green/magenta but with black outlines. This is confusing. Why are some (but not all) lakes coloured in? Also, the author points out that the maximum increase in surface speed occurs downstream of two major surface streams - however, other major surface streams see no similar acceleration. Is this worth pointing out?

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Interactive comment on The Cryosphere Discuss., 7, 1101, 2013.

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