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Interactive comment on "Oscillatory subglacial drainage in the absence of surface melt" *by* C. Schoof et al.

Anonymous Referee #2

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This is a fascinating paper. It presents a detailed and complex data set which is very well summarised. The set of borehole data at sites A1-A3 shows very clearly a set of well correlated (and hydrologically connected) boreholes which reveal very interesting pressure perturbations as the drainage system closes down at the end of the melt-season. The conceptual explanation and modelling undertaken to explain these intriguing observations, and those of the doublets, is very convincingly presented. How significant the results are with respect to glacier-hydrology and ice dynamics depends on how representative are the results from the few presented boreholes and in particular, their possible impact on ice motion (which is discussed briefly and tantalisingly in the last line of the conclusion). The paper is very clearly written and draws on and compares the findings well with a lot of the earlier borehole literature. Overall, this is a very nice study and I look forward to seeing further developments in this work (such as

the noted paper in preparation).

There are a few areas in the text, as outlined below, that would benefit from more discussion or require clarification:

P5617, L14-17. From the world-view imagery (or field observations), are there any moulins draining in to the glacier upstream of the study area? This is worth adding/discussing given your summary of the surface hydrology? It is also relevant to your subsequent discussion – you say (p5625, l29) that "Due to the absence of moulins in or above the study area" but are you sure there are no moulins above the study area that could be driving your diurnal cycles rather than from drainage through crevasses and narrow cracks? After all, the glacier is polythermal (and presumably pretty cold in the upper layers given Nov, Dec, Jan temps) so water will likely find it hard to get to the bed through narrow cracks as it will refreeze.

P5627, l4 – this ongoing flow could be groundwater but why also do you not mention melt generated from geothermal heat and frictional heat (basal sliding) which will presumably provide a pretty constant flux throughout the year as it does at other glaciers? This issue crops up in other places (e.g. p5627, l26; p5636, l13-14) and needs clarifying.

P5628, l14 – with reference to water stored in "other smaller water pockets", why not mention subglacial cavities as an obvious possibility (linking to Kamb's theoretical work or the mapping of exposed proglacial bedrock that reveals large cavities (e.g. work of Hallet and others at Blackfoot Glacier or Sharp and others at Tsanfleuron); especially as you then go on to mention linked-cavity drainage systems on l19 of the same page.

P5633, l11-13 Given your estimates of mL, it would be interesting to know what upstream contributing area would be required to deliver these sorts of volumes of water purely from geothermal and frictional melt (in other words – do these volumes make sense for the upstream catchment area that you have derived from your Shreve style analyses (Fig. 2)?

The borehole water pressure results would seem to suggest that the subglacial channel is closer to boreholes A1-3 than A4-5 while the Shreve reconstructions put them closer to ∼A5. Does varying f ever move the predicted channel west to align more closely with boreholes A1-3?

You drilled 76 boreholes in the upper ablation area but present results from just three which really show clear instabilities in water pressure during the winter period. It would be very useful to know whether these are in fact rather odd/atypical events (which are nevertheless interesting) or whether the behaviour is actually rather characteristic of a lot of your sites as the winter drainage system develops.

Figures

Fig 1. The map in Figure 1a really needs to be bigger – it is too small to see anything at normal size. Some labelled contours would also help put the glacier morphology into context.

Fig 2. Delete the second "the" in the 4th line of Fig 2 caption and add "TO straddle" or "likely straddles" in line 6.

Fig 2/3. Bit odd using UTM in one and Lat/long in the other - is there a reason for this?

Fig 3. The vertical dotted lines need to be darker to be visible.

Fig 3. Use lines across the top of the plot to delimit your four phases as described in the text (as opposed to just simply having the numbers).

Fig 4 and 5. Add that it is also a time series of air temp.

Minor points and typos/edits

P5617, L24. Give (expected) instrument error range when stating that the transducers "generally conformed to factory calibration"

P5619, L13-14. It would be useful here to simply state that f=0 is the equivalent to the

routing of flow at atmospheric pressure

P5620. Give the date of the Phases in brackets after each time the phase is first mentioned to aid clarity

P5621, l22 – grammar awkward – replace the second "continued" with ongoing.

P5622, l2 – delete "also"

P5623, l17 – until ∼mid (not late) September i.e. 18 sept for diurnal cycles

P5626, l1 – crevasses spelling

P5628, l20 – channel-liKe

P5635, l7 – conduitS

P5637, 2 - delete comma after both

Interactive comment on The Cryosphere Discuss., 7, 5613, 2013.