

Interactive comment on “Boundary conditions of an active West Antarctic subglacial lake: implications for storage of water beneath the ice sheet” by M. J. Siegert et al.

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We are very grateful to the online review of our work by Sasha Carter. We share his opinion that debate on the glaciology of ‘active’ subglacial lakes, offered by The Cryosphere Discussion, is important and constructive. We’re pleased that Sasha found the work interesting and believes it contributes to our evolving understanding of the subglacial hydrologic system.

Sasha had 6 main issues that require our attention, and a series of other relatively minor comments. While we will wait until all referees’ comments are received before we formally detail how changes have been made to the paper, here we provide an

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initial response to Sasha’s 6 main issues.

A. Sasha recommends highlighting the importance of surface elevation changes by indicating the required bed elevation change that would result in the same effect, under hydrostatic equilibrium conditions. We agree, and it is of course easy to implement. Sasha also recommends comparing our surface elevation errors with the satellite data. This has already been done in Figure 6, however. We feel there is no need to introduce further comparison, as it would add little more to the paper.

B. Sasha comments that there should be more RES data than is apparent in Figure 1b. He is right, and the data lines are available in Ross et al. 2012 (Nature Geoscience) and in the UK Polar Data Centre. We chose restrict the transects to only those over the lake, to make the diagram clearer. We are open minded as to whether the additional RES lines need to be included in Figure 3, given the topography has already been published. We don’t think it is a major issue, however.

C. A good point is made about survey design and the lack of ICESat track re-flights. To confirm, we did not re-fly any ICESat tracks. At the time of the survey planning, in 2009, our priority was to obtain topographic and potential fields data for other research purposes. The lake was chosen as a target because it was scientifically interesting and was located close enough to the field station for several passes; thus providing the data for this paper. With hindsight we agree it would have been useful to have re-flown an ICESat line, for the reasons stated by Sasha. Unfortunately, the centre of the lake provided in Smith et al. (2009), which the survey was based around, does not coincide with the ICESat tracks; an issue we only found out about after the survey was completed and this paper’s analysis undertaken. This issue is a consequence of the lake only having two ICESat tracks to originally define it. We will check to see whether we work out the absolute elevation at the cross-overs between our RES lines and the ICESat lines, as Sasha suggests. We agree it would be useful to show this, if it can be done effectively.

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D. Concerning the ice dynamics associated with the lake location and its draining, Sasha provides some papers that may be of use to us. Indeed we are aware of most of them. The work by Evatt in understanding that lakes can self-seal upon losing water is certainly useful, and we shall mention this work more carefully in the revision. However, we have evidence for very little water – if the RES data are to be believed – making Evatt's explanation difficult to reconcile with the data available. Again, we will mention this. Importantly, the paper of Sergienko and Hulbe provides a useful assessment that we should make more of. In it, they indicate that lakes may form downstream of sticky spots. While there are difference between ours and their lake situations (Whillans' lakes lie on a fairly flat bed, which potentially encourages freeze-on downstream of sticky spots, whereas in our lake situation the ice thickens downstream of a major obstacle, preventing basal freezing by super cooling and, perhaps, further encouraging water build-up) we think their work may help in understanding the glaciological situation in which lake Institute E2 is found, and we will therefore mention it in the revision.

E. Sasha presents an assessment of flowrates into Institute E2. We don't disagree with his assessment, but don't see what needs to change in the paper. In fact, we are pleased that he was able to get so much out of our work, which rather suggests that the paper is sufficiently detailed. We are planning a wider subglacial hydrology paper of the entire Institute Ice Stream catchement in due course, which may take into account the issues that Sasha eludes to. We do not think changes are needed in this paper, however.

F. We note the 'ICESat' issues, and will change the paper accordingly.

Interactive comment on The Cryosphere Discuss., 7, 2979, 2013.