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Interactive comment on "Wintertime storage of water in buried supraglacial lakes across the Greenland Ice Sheet" *by* L. S. Koenig et al.

Anonymous Referee #1

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Review for "Wintertime storage of water in buried supraglacial lakes. . ."

This paper presents new airborne radar observations of buried supraglacial lakes in Greenland. An adequate description of suitable methods is provided. The observed wintertime storage of water is described as a 'hydrologic pathway', but the justification for this definition is not provided. It seems to me that these are a sub-category of supraglacial lakes – presumably they are lakes in the accumulation zone that do not drain during the melt season, and then freeze over and insulated by further snow fall. Once they are frozen over, they are no longer a local topographic minimum, and free-water at the surface is less likely to drain into them. It would have been more revealing, and would have better played to the strengths of the data presented, if this paper had discussed the possible formation mechanisms (and associated feedbacks)

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of these buried lakes in more detail. The authors attempts to characterise the spatial and temporal distribution of these lakes are limited by 'sampling' restrictions imposed by the data acquisition methods, but more could be done to describe the spatial distribution. More could be done to explore the variations in apparent spatial density of buried lakes in relation to the flightline density. The authors could have explored surface temperatures and accumulation in the years leading up to the radar observations using regional climate model output, to explore the relationship between where these lakes form, and the regional climate forcing (and variability).

The paper discusses the possible impact on ice dynamics of these buried lakes, but does not present a coherent discussion of the mechanisms. The authors estimate the total volume of water contained in these buried supraglacial lakes, but do not fully explore this significance of this estimated volume. For instance, in each region of the GrIS, how does this compare with the estimated volume of water contained in subaerial supraglacial lakes? Other questions are raised: Do individual buried lakes contain sufficient water to propagate fractures to through the local ice thickness? If not, what is the shortfall? If so, why haven't they already drained? How do the locations correspond to areas of crevassing and/or known moulins? It seems to be that the most important implication of the existence of these buried lakes is that they are capable of delivering water to the subglacial hydrological system at times when it is not efficient at draining water to the margin, and therefore can 'pressurise' the system and alter ice dynamics. Presumably the most likely time for this to happen would be at the start of the following melt season, when a small amount of meltwater added to the buried reservoir is sufficient to cause it to drain to the bed, supplying 'pulse' of water to a system that has not yet evolved into a channelized system efficient at draining water to the ice margin. Again, a more focused discussion of these issues is warranted, with reference to the existing literature.

In general, the figures and tables are poorly presented and are not currently of the standard expected for TC. Figure 1: I find this schematic confusing – it appears to

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be a combination of cross-sectional and perspective views. I suggest removing the perspective view component for clarity. Figure 2: Interesting to see the radargrams, though the axis labels are illegible – increase the size and perhaps arrange as 2 x 2 plot. Figure 3: Perhaps quantify the correspondence between the detected buried lakes and observed supraglacial lakes in the caption Figure 4: Not sure inclusion of this figure is justified. Suggest remove or else focus on the region of interest and discuss in greater depth in main text. Figure 5: Interesting figure, but the flightline location should be indicated more clearly on the roght panels. Also, can you quantify the 'lighter blue/darker blue/more turquoise' in the image caption? Presumably you have the RGB values from the DMS? Figures 6 and 7: Poor use of space. This would be much improved if you could combined these figures using a combination of shapes and colour. Also, as there are large portions where no buried lakes are detected, it may be more useful to 'zoom in' on areas where the highest density of lakes are detected. Could this apparent higher density be due to higher flightline density? Figure 8: No scale or location information. May be improved with annotations. I'm not convinced inclusion of this figure is warranted. Figure 9: No scale or location information. Location of flightline on DMS image should be shown more clearly Fireu 10: inefficient use of space. Axis labels are illegible – enlarge. It is not clear what this figure is showing – requires clarification and more detailed explanation in the caption and main text. Table 1: I think this table says more about the survey characteristics than the distribution of buried lakes. May be useful to express # lakes deteceted per 1000 flightline km? Also, it would be interesting to tabulate the number of lakes detected in each region of the GrIS. Perhaps include appendix containing tabulated information for each individual lake detected (location, depth, year detected etc). Table 2: Not convinced this is required. Easily summarised in main text.

I am happy to provide detailed specific comments once the manuscript has been revised as recommended.

Interactive comment on The Cryosphere Discuss., 8, 3999, 2014.