Interactive comment on “Estimating supraglacial lake depth in western Greenland using Landsat 8 and comparison with other multispectral methods” by A. Pope et al.

G.S. Hamilton (Referee)
gordon.hamilton@maine.edu

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This manuscript adds to the growing literature on remote sensing of surface water in Greenland by examining the performance of several different methods for extracting lake depths (and hence volumes) from optical satellite images, with a particular focus on Landsat-8 data. Existing methods fall into two broad categories: physically-based models or empirically-derived coefficients. Both methods, on their own, seem to produce sensible depth estimates but until now there has not been a rigorous comparison of their performance when applied to the same images. Moreover, many of the remotely-sensed depth estimates have not been well-validated with independent observations. This paper addresses both these issues, and helps advance our understanding of how to quantify surface water on ice sheets from spaceborne observations. The material is definitely appropriate for the journal and the manuscript is reasonably well-written, so I recommend it be published pending some fairly minor changes.

The science is fundamentally sound and the interpretations are mostly valid. My major comment on the manuscript is that it is way too long and tends to lose focus in a few places. It works best as a thorough examination of the factors which produce the most realistic depth estimates. The glaciological results/discussion are interesting but they sit uneasily with the rest of the manuscript. My suggestion is to delete the description of results from P3271/L10 through P3272/L20 (by all means retain a 1-2 sentence summary), and the discussion between P3275/L17 through P3276/L17. This material would benefit from a more developed treatment in a separate paper.

I have a few additional comments that I hope are useful to the authors.

P3259 L3: delete sentence “Supraglacial lakes...”
P3259 L21: replace “glacial” with “ice sheet’s”
P3260 L4: material in the intro paragraph could be synthesized a bit better (e.g., don’t need two descriptions of positive feedback mechanisms)
P3260 L10: Sneed and Hamilton (2007) is more appropriate than our 2011 paper
P3260 L17: why not say "WorldView series", rather than just WV-2
P3261 L21: clarify if the spectral and bathymetric data are from the same lake; as written it’s not clear
P3262 L12: actually the requirement for having optically-deep water in the same image as supraglacial lakes is not absolute. See our discussion in Sneed and Hamilton (2011) in which we show that R_inf can be characterized for a particular sensor and then applied to other images lacking optically-deep water.
“lake bed surfaces” is an odd term. Do you mean “lake bed” or “lake surface”?

“The parameter g…”

Delete “As the spatially closest…bottom albedo,”

What “assumption”?

Delete “In an application of a form of” and replace with “We use spectral mixing analysis to…”

My recollection of Legleiter is that the coefficients for supraglacial water might also vary depending on location.

Delete “based”

Delete “In situ concurrent and bathymetric”

“is examined in 2013 as it as” and shorten to “is an area with throughout summer 2013”

Write out all numbers smaller 11.

“farther” should be “farther” (distance)

Reorder sentence so “in 2014” at the very end.

“based” should come after the material in parentheses.

Using DEMs to validate remotely-sensed lake depths is not an entirely novel idea. See Georgiou et al. (2009; Ann. Glaciol.) for an earlier example from Greenland.

“LiDAR” should be “LiDAR” to be consistent with elsewhere in the paragraph.

Either cite the “preliminary studies” or delete.

“as” should be “because”

I think you mean “blunders” rather than “errors”

After these steps, > 250,000 pixels (30 m) from six days in 2013 and….

Not clear if it is 250,000 pixels for each six-day period, or in total.

“The results (Table 1)…are shown in Figure 2.”

“success” is subjective term. How about “performance”?

“RSME of 3.10 m” (and elsewhere where you quote paired RSME estimates)

Paragraph mixes sensors (OLI, ETM+) and spacecraft (Landsat 7) in a way that could confuse readers. Stick with a consistent descriptor.

“Our analysis shows that supraglacial lake depth retrievals using Landsat-8 are as good as or better than Landsat-7 retrievals.”

“day” should be lower case.

“estimated” is better than “returned”

Delete “We investigate which method…”

Is it really necessary to have a subsection (4.3) describing the DEM comparisons? Seems a bit odd to include it for the NW glaciers but not for the Jakobshavn area.

No superlative needed, delete “very”

Not immediately clear why “ice flow” would lead to inconsistent depth estimates between images and DEMs. Delete or explain.

“fairly” is a bit vague

Tell readers over what surface area the reported water volume occurs.
The sentence “A histogram...” seems a bit unnecessary. Shorten it to refer readers to Fig. 6a for the frequency distributions of lake depths.

suggest rewriting to “…shallow lake pixels is consistent with the observed lakes having low surface slopes at their edges.”

Delete the first paragraph.

awkward introduction of a work in progress. Either discuss it in detail as part of this manuscript, or delete the mention of it.

suggest rewriting to “…may, with better parameters, produce results consistent with the physically-based...”

suggest shortening “g values” to simply “g”

missing units (-0.1 +/- 1.7 m)

“probably leading to significantly overestimated lake depths” seems a bit speculative. And how did you estimate the ~30% difference?

find a better word than “believed”

paragraph starts to lose focus with the discussion of hydrofracturing. Suggest deleting this stuff and shortening the preceding summary of earlier work.

We concluded the same thing in our 2007 paper (Sneed and Hamilton).

delete “discussed in the previous paragraphs”

what are the “updated lab-based g values”??

Delete the next few paragraphs (as far as P3276 L17). They are too much of a digression and detract from the main message of the paper.

We also showed that radiative transfer models (in our case, HYDROLIGHT) can be used to validate remotely-sensed lake depth estimates in Sneed and Hamilton (2011).

“varies” should be “variability”

delete “on to”

the sentence “However, because much...” runs on and is awkwardly constructed. Shorten and rewrite.

delete “in the discussion”

Interactive comment on The Cryosphere Discuss., 9, 3257, 2015.