

## ***Interactive comment on “Mapping the bathymetry of supraglacial lakes and streams on the Greenland Ice Sheet using field measurements and high resolution satellite images” by C. J. Legleiter et al.***

**G.S. Hamilton (Referee)**

gordon.hamilton@maine.edu

Received and published: 16 December 2013

This manuscript makes a nice addition to the literature on quantitative studies of supraglacial meltwater in Greenland. Remote sensing of melt pond bathymetry is a well-established method, based largely on radiative transfer theory developed for mapping coastal marine environments. This paper takes a slightly different approach by implementing a band ratioing technique developed for terrestrial rivers. The authors apply it to very high spatial resolution images of surface ponds and rivers in Greenland collected by the WorldView-2 satellite.

C2734

The paper is well written and easy to follow, and the results are promising. I have a couple of minor comments that should be addressed, but am otherwise looking forward to seeing this work published.

In my comments below, P1 = P4741, etc.

In applying the band ratio method to supraglacial melt ponds and streams, the authors make the assumption that radiative transfer processes are similar to gravel-bed rivers where the method was originally developed (see P10 L5). How safe is this assumption, given that the inherent optical properties of water play a large role in the transfer of light?

One of the curious results is that, although the band ratio method seems to work very well in general, the optimal combination of bands for extracting depth is variable from location to location, and maybe also from image to image. The authors attribute some of this variability to adjacency effects which seems reasonable. But how would one deal with those effects in practice?? I'd encourage the authors to provide a set of objective rules for selecting a priori which band combination should be ratioed for any given feature.

The figures are clear and appropriate, but I would have liked to have seen a figure comparing bathymetry as measured in the field and as extracted from WV2 imagery. A figure showing representative transects across a melt pond and a stream would be very instructive.

Other comments are as follows:

P2 L23: delete “the”

P3 L9: change “detained” to “retained”

P3 L15: passive voice, change “has become” to “is”

P4 L3-25: many of these issues were addressed in Sneed and Hamilton (2011).

C2735

P4 L19: passive voice, change “could” to “can”

P5 L5: two significant digits? Really??

P7 L5: what about the potential for shadowing as the boat carried out its surveys? Or is it unimportant because incoming radiance measurements were not co-located with the upwelling radiance measurements?

P8 L1: strictly speaking, you probably need to account for differences in solar zenith angle between the lake-shore and boat locations, although the differences will likely be insignificant on sub-km length scales.

P8 L21: one significant digit is probably fine.

P9 L19: delete comma.

P10 L5-20: did you collect any meltwater samples to quantify the IOP? Might be worth reading Sneed and Hamilton (2011) for some support to these ideas.

P14 L19: passive voice, change “could” to “can”

P14 L25: Rephrase. Earlier studies have already shown that spectrally-based methods are valuable for mapping supraglacial bathymetry.

P15 L4: no need for two significant digits.

P15 L13 and L15: “fairly” and “quite” are vague.

P18 L6: passive voice, change “could” to “can”

P18 L22: the ability to map bathymetry of supraglacial streams is very valuable, but keep in mind you need to measure current speed in order to convert to discharge flux.

P19 L6: many of these effects were investigated by Sneed and Hamilton (2011).

Reference: Sneed, W.A. and G.S. Hamilton. 2011. Validation of a method for determining the depth of glacial melt ponds using satellite imagery. *Annals of Glaciology*,

C2736

59, 15-22.

---

Interactive comment on The Cryosphere Discuss., 7, 4741, 2013.

C2737