The Cryosphere Discuss., 5, C472–C476, 2011
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The Cryosphere Discussions

Interactive comment on "In-situ multispectral and bathymetric measurements over a supraglacial lake in western Greenland using a remotely controlled watercraft" *by* M. Tedesco and N. Steiner

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Comment: P480 Line 10 onwards The abstract does not fully describe the contents of the paper. For example, more detail could be added about the depth extraction from satellite imager y (sensor types, acquisition dates, etc.).

Response: We extended the abstract by stating more clearly the scope of the paper and by adding more information about the methodology and the specific sensors and

dates.

C: P480 Line 19 onwards Several approaches for estimating lake depth are mentioned, but not all methods are similar even though they all use satellite imagery. It would be very useful to spend a few sentences summarizing the main points of each method, as well as their respective advantages/disadvantages.

R: We expanded the description of the approaches as requested by the reviewer.

C: P483 Line 25 onwards the methods description could use a bit more detail. For example, what was the frequency of the sonar equipment? Was it a single- or dual-frequency instrument? What is the reported depth uncertainty? When deploying spectral radiometers, care must be taken to ensure the boat does not cast a shadow across the instrumental ïňĄeld-of-view. Was this done?

R: We introduced the technical parameters of the sonar equipment and discussed the shadowing problem, as requested.

C: P484 Lines 9-14 The choice of 450-650 nm as your top range of bands is a bit curious because other studies (e.g., Sneed and Hamilton, 2007; Sneed and Hamilton, 2011) have chosen VNIR3/Landsat ETM+ band 4/MODIS band 2 precisely because of their sensitivity to shallow water at those higher wavelengths (∼780-820 nm).

R: Since this study is more interested in assessing lake depth retrieval (rather than lake detection) we have decided to focus on wavelengths below 650 nm. Near-infrared (NIR) is, with no doubt, more sensitive to the presence of water but lake depth

retrieval using NIR is limited by strong absorption by water. We also note that, as a consequence of such absorption, in-situ spectral measurements in that band for lake depth above a few tens of centimeters were characterized by an extremely low signal/noise ratio (e.g., comparable to the dark current measurement) and were, therefore, excluded from our analysis.

C: P484 Line 26 K_d from Smith Baker (1981) is okay but, strictly speaking, I think it refers to "pure sea water". For "pure water", see Pope Fr y (1997, Appl. Opt.).

R: We compared the absorption in the two citations and found negligible differences between the results with the two different data sets. However, technically speaking the reviewer is correct. Thanks for pointing that out.

C: P486 Line 3 what exactly was derived from the analysis of daily WV2 images? Changes in lake depth? If so, how?

R: We used WV2 data in this study only to generate a high resolution image that we then used to overlay the in-situ lake depth measurements made by the boat. We are currently comparing WV and Quikbird derived reflectance values with those measured on ground to study the possibility of retrieving lake depth at high spatial resolution from commercial satellites.

C: P486 Line 25 onwards The decision to use the MOD09 data product is problematic because it is actually a composite for any given day, i.e., the one-day granule is made up of different orbits that have different viewing angles, different solar angles, etc. We have done tests of our own and have been unable to get derived depths/volumes from the MOD09 product to come anywhere near those from ASTER images acquired on

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the same day, for reasons that we ascribe to the composite nature of the MODIS product. Also, it seems an odd choice to downsample band 2 (250 m resolution) to match band 4 (500 m resolution) given that band 4 could have been upsampled with relatively little extra effort.

R: We acknowledge the fact that the MOD009 product is made from different images and that this is a source of uncertainty. We introduced a small section describing potential sources of uncertainty in the case of the MOD09 product.

C:The authors note that MOD09 is an atmospherically-corrected product, but I did not see any mention of the companion Landsat images also being atmospherically-corrected. Were they? And if not, why not?

R: Initially, we presented LANDSAT results without atmospheric correction. The reasoning behind this choice was driven by the absence of information regarding the vertical profile of atmospheric parameters for such a correction. We decided after the reviewer's suggestion to perform an atmospheric correction (using a tool in ENVI) so that the LANDSAT results could be consistent with those from MODIS. Following this, we re-calculated and re-plotted all quantities affected by the introduction of an atmospheric correction on the LANDSAT data.

P480 Line 11: "shallow waters", no hyphen
P481 Line 1: long and awkward opening sentence. How about splitting it up?
P481 Line 23: "...suggest that the DOMINANT uncertainty derives from the selection of A_d." P481 Line 28: inser t a space after A_d
P482 Line 9: "...to satellite METHODS for the estimates..."
P482 Line 21: "Solving Eq. (1)..."

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P483 Line 11: “A commercially-AVAILABLE...”
P483 Line 25: “...sun was at zenith...”, no the
P484 Line 7: not clear what you mean by 99%. Do you mean the material is 99% reïňĆective?
P484 Line 10: “...WERE collected up to 1050 nm...”
P484 Line 13 (and elsewhere): Landsat should be lower-case.
P485 Line 9: reverse word order, “...iterative ïňĄtting...”
P488 Line 11: by “factor” do you really mean “bias”? Delete “...and what are the causes.”
P489 Line 5: by “atmospherically transported material”, do you mean cryoconite? If so, use the commonly-used glaciological term.
P490 Line 24: “...IN WHICH depth estimations...”
P495 Figure 2: could really do with a inset showing location in Greenland, and also a scale bar. Makes the ïňĄgure a lot more easily understood than the lat/lon lines alone.

R: All suggestions above were accepted. We made corrections or inserted text following reviewer's requests.

Interactive comment on The Cryosphere Discuss., 5, 479, 2011.