The Cryosphere Discuss., 5, C270–C273, 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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The volume of water stored in surface lakes and ponds on the Greenland Ice Sheet is important for glaciological and climatological reasons. Several recent studies have proposed remote sensing algorithms for extracting water depths (and hence volumes) from multispectral satellite imagery, but these theoretical formulations have not as yet been thoroughly validated with field observations. The current paper seeks to fill this void by describing measurements of water optical properties and lake depth obtained at a site on the ice sheet margin in west Greenland, which are then compared with depths ex-

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Interactive Discussion

Discussion Paper

tracted from nearly-contemporaneous satellite images. Results show that theoretically-derived algorithms generally perform quite well. This is a useful manuscript which describes an innovative method for in situ observations of lake properties and provides new insights into radiative-transfer modeling of supraglacial water depths. I recommend that it be accepted for publication once a few technical and editorial issues are addressed (see below).

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 imagery (sensor types, acquisition dates, etc.).

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.

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 field-of-view. Was this done?

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 ($\sim$780-820 nm).

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 & Fry (1997, Appl. Opt.).

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

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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 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. 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?

The writing needs tidied up in places. A few suggestions are noted below:

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: insert a space after A_d

P482 Line 9: “...to satellite METHODS for the estimates...”

P482 Line 21: “Solving Eq. (1)...”

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% reflective?

P484 Line 10: “...WERE collected up to 1050 nm...”

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P484 Line 13 (and elsewhere): Landsat should be lower-case.

P485 Line 9: reverse word order, "...iterative fitting..."

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 figure a lot more easily understood than the lat/lon lines alone.

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