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The Cryosphere Discussions



# *Interactive comment on* "Some fundamentals of handheld snow surface thermography" *by* C. Shea and B. Jamieson

**C. Shea and B. Jamieson**

cashea@ucalgary.ca

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**Note:** The text of the original comment is in *italics*; answers follow each portion.

*This is an interesting paper that makes a significant contribution by introducing the fundamentals of handheld thermography to our field. The paper is clear and well organized, and brings up some important points to consider such as the effect of the observer on the snowpack temperature.*

Thank you.

*I only have a few minor comments.*

*On line 17 in Section 2 the authors state (and later show) that portions of the snow* *surface can re-equalize with the ambient air within minutes. However, Figure 1 shows a strong delineation between the cold bed surface and the surrounding snow of just 2.5 deg C still exists 5 minutes after the avalanche. Would the authors like to postulate why these temperature changes in the field appear to be slower than those they measured in some other parts of the paper?*

The greatest heating observed in the paper was that on the areas 1 m away from the observer, and those areas experienced approximately 1 deg C warming per ten minutes operator exposure (Section 6.4). Indeed, in regards to the avalanche photo, the snow surface and bed surface temperature difference had been reduced to 0.3 C approximately 20 minutes after that photo was taken.

So, working backwards, the difference right after the avalanche may have been around 3.0 degrees of difference, and it had indeed warmed during the five elapsed minutes, not to mention the unknown effect of any frictional heat from the slide.

These numbers are so close to the observed heating rate noted in Section 6.4 that it is difficult to say how much speed difference there was.

*I encourage the authors to expand (with perhaps only a sentence or two) on the debate regarding the location of the maximum daytime temperature in the snowpack (Section 6.1, line 6). It seems that it would depend on the individual situation that day. For example, you might expect quite a different result if you were comparing a cloudy day with warm air advection over a cold snowpack with a clear day with incoming solar radiation and outgoing longwave.*

Yes, this is a great suggestion. We will re-phrase the first sentence to indicate that we were discussing specifically situations with direct incoming solar (shortwave) radiation and adequate longwave escape.

It seems that sometimes with significant shortwave a sun crust appears on the very surface, indicating the greatest warming occurred there; other times as the citations in the manuscript state, the greatest temperature occurs slightly below the surface.

*The Figure numbers are off in sections 7.1 (line 5, should be Figure 5 rather than Figure 8) and section 7.2 (line 10, should be Figures 6 and 7 instead of Figure 8).*

Good catch. Thank you.

*In section 7.1, lines 16 and 17, the authors report on heat penetration into the snowpit wall, but do not give a time for that penetration. How much time did it take for the heat to penetrate those 10 to 18 cm into the pit wall?*

Very approximately, 30 minutes. This will be added to Section 7.1

*Finally, I would also encourage the authors to expand on Section 7.3 with some additional discussion of applications and various research problems that could be pursued with this technology. Their Figure 8 brings to mind many possibilities, such as a careful quantitative investigation of temperature gradients around bushes to better explain the formation of faceted crystals around buried bushes.*

As the other reviewer comment also requested additional applications, Section 8 will be somewhat expanded to include additional applications, including:
- Tomography and crystal metamorphosis
- Surface radiation balance
- Wind pumping
- Effect of vegetation
- Detection of buried heat – bushes, (lack of) application for rescue, etc
- Downscaling of satellite imagery

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Interactive comment on The Cryosphere Discuss., 4, 1467, 2010.