The Cryosphere Discuss., 7, C2645–C2647, 2013
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The Cryosphere
Discussions
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Interactive comment on "Limitations of using a thermal imager for snow pit temperatures" *by* M. Schirmer and B. Jamieson

Anonymous Referee #1

Received and published: 5 December 2013

General comments This paper obtained thermal images of exposed snow pit walls inside and outside of the cold laboratory with having the different air temperatures, focusing on the temperature profile near the crust layer. Faceting near the melt-freeze crusts is important for assessing snow metamorphism in relation to avalanche formation. The obtained thermal images indicate that the assimilation of the exposed pit wall to the air temperature could have a large impact on the interpretation of the pit wall temperature profile measured with a thermography camera when there is a large temperature difference between the pit wall and the air. The focusing point of this study is important for all readers who are interested in measuring snow pit temperature with the thermography. The results of this paper is still qualitative, however, provide good examples of errors in the thermal images caused by the temperature assimilation after the exposition of the pit wall to the readers. In this sense, the content of this paper is worthy of publication in TC after minor revision. My recommendation is that because much of the results and discussion is still qualitative (not quantitative), the authors should carefully explain their opinion about the causes of the warm/cold crusts. As the authors discussed in the text (4. Discussion section), while the proposed heterogeneous surface energy process due to the pit wall roughness can explain one aspect of mechanisms producing the warm/cold crusts found in the previous studies, the effect of possible internal snow temperature gradient on the warm/cold crusts phenomena cannot be eliminated completely by examining only the data presented in this study. In particular, the warm crust found by Shea et al. (2012c, Fig. 6) seems to be even warmer than before the cooling of the air temperature. That is, the finding of Shea et al. (2012c) contradicts the assimilation process of the pit wall to the air temperature proposed in this study. To eliminate the possibility proposed by Shea et al. (2012c) you should evaluate the effects of both surface energy process and internal snow gradient quantitatively. I think that the contradiction itself is considered to indicate the current limitation of using the thermal imager for this kind of study and thus the question should be open for discussion in future studies.

My specific comments are the followings:

Specific comments P5235, L17-18 The authors mentioned that “When integrating over the used camera’s spectrum, the grain type differences may be diminished.” However, a recently published paper (Hori et al., 2013, Applied Optics, 10/2013; 52(30):7243-55) estimated possible biases in measured temperatures with a FLIR thermal imager. Their results indicates that even if the emissivity effects are integrated over the camera’s spectrum the grain type differences are not necessarily diminished but remains depending also on the photographic (viewing) angles when measuring the surface of snow cover under clear sky conditions.

P5236, L17 (2.1.1 Snow pits section) In general, when explaining field observations, the place, date, and weather conditions (e.g., clear/cloudy, air temperature, windy or not) should be addressed to enable readers to interpret the measurement results cor-

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rectly.

P5237, L19 (3.1 Snow pits) The authors present only thermal image of snow pits in Fig.2 here. It will be helpful for readers to add a photograph (not thermal image) of the pit wall and/or describe the dimension (depth of concaves) of the shovel scours and the crust layer in the text in order to understand how much is the effect of the surface energy process on the heterogeneous temperature profile.

Technical comments P5235, L16 “deg. C” should be “deg.”

Interactive comment on The Cryosphere Discuss., 7, 5231, 2013.