

General comments

This paper conducted cold chamber experiments for continuous observation of snow metamorphism under the strong temperature gradient approximately 100 K/m and clarified the heterogeneous grain growth. As the authors say, there have been several previous studies in which snow layer was continuously observed in a low-temperature chamber using X-ray CT, but the novelty of this paper lies in the experiment that the vertical structure of the approximately 10 cm snow layer was observed precisely and continuously. By applying a strong temperature gradient to a thick snow layer, the different regimes of crystal growth within a single snow layer were achieved. The authors also mentioned a decrease in the density at the bottom of the snow layer, and the formation of hard depth hoar. These results will provide fundamental data for snow transformation modeling and snow stability prediction.

Specific comments

1. The authors mention that different regimes of crystal growth were observed depending on the temperature range. Figure 11 shows in the height direction for each temperature zone, but the columns and plates are very difficult to see from the 2D image. Photographs of the particles or a 3D surface rendering would be appreciated.

2. Sturm and Johnson (1991) reported that the depth hoar near the bottom of the natural snowpack in Alaska has a C-axis that is oriented almost horizontally in some places and is growing horizontally. (same figure of Fig. 2 of Sturm and Benson (1997)).

In this range of prismatic growth, did the prismatic face of the snow with the C-axis oriented horizontally grow vertically and the horizontal basal growth was not observed?

3. The experiment with large temperature gradients at very low temperatures is similar to that of Kamata and Sato (2007). However, Kamata and Sato's experiment lasted 5.5 days, whereas the authors observed for about a month. The authors would mention what differences they found over a longer period of time, although there is a description of a large change in the initial period.

4. The differences in temperature ranges appearing in the long vertical samples lead to interesting results. However, since the number of experiments was only two, it is hoped to increase the number of experiments to obtain a data set in future work. Kamata and Sato also have a few experiments, so these experiments will provide valuable data.

Technical corrections

Line 77

“Those evolution” is “Those evolutions”

Line 306

“can not explained” is “can not explain”

Line 590

“Yosida: “ is “Yosida, Z.”