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The Cryosphere Discussions

Interactive comment on "Vapor flux and recrystallization during dry snow metamorphism under a steady temperature gradient as observed by time-lapse micro-tomography" *by* B. R. Pinzer et al.

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We thank E. H. Bair for his constructive critique of our paper.

In his referee comment RC C629, Dr. Bair provides many useful suggestions for improving the language of our manuscript. We will incorporate these suggestions into the manuscript. We would like to emphasize that TC is now routinely offering a final language editing service of which we will benefit.

Below we provide our response to comments which are not concerning style and lan-

guage:

1) p. 630, remark about the term STGM The introduction of the term "Steady temperature gradient metamorphism" was motivated by the fact that the effect of a non-steady, and especially a sign-changing temperature gradient metamorphism causes a differnt morphology of the snow grains. We refer to the paper by Pinzer and Schneebeli (2009), Geophysical Research Letters, 36, L23503, doi:10.1029/2009GL039618. However, we agree that the wording is a bit awkward, and will follow the suggestion of the reviewer.

2) p. 634, in comment on p 1683 l 17 and p 1684 l 11-12: SNOW DENSITY The snow density is measured for each tomogram in terms of 'ice-voxel-density', by counting the ice voxels and dividing by the total number of voxels. The values are given in Table 1 in the column termed 'n'. This value is the average over all measurements (49 scans for Series 1, 84 for Series 2, and 64 for Series 3). The temporal evolution shows no trend for Series 1 and 3, while for Series 2 there is a slight tendency towards lower densities at the end. During the 28 days of the experiment, the density decreased by about seven percent. This change in density could be explained by natural (spatial) density fluctuations which can occur on a length scale of several mm in snow. In our metamorphism experiment, vapor moved from the lower (warmer) side into the field of view (FOV), and left the FOV on the upper, colder side. The 'apparent movement' of the structure will lead to the appearance of new ice structures at the upper edge of the FOV, with geometrical properties determined by the structures just above the FOV. This would imply a 'movement' of a zone of lower density into the FOV. To indicate the temporal evolution of the density, we will add a column to table 1 with the relative fluctuations, which are between 0.2 and 3.5 percent. In addition, we will add the complete graph of density vs. time in the supplementary material, as well as a graph of SSA vs. time. We added these figures in this answer.

3) p. 645, in comment on Eq. 4: APPROXIMATION The approximation is made to simplify the expression; by doing this, we naturally obtain an easy link between vapor flux and apparent structure movement. The reason why this has to be done at all is the

simplicity of the model, which does not include vapor exchange between arbitrary particles and non-spherical particles. Nevertheless, we think that the model is instructive to explain the principle. A posteriori, when a complete turnover is shown by experiment, the equivalence between structure movement and vapor flux is obvious.

4) p. 637, in comment on p 1695 l 23: CONTRADICTORY STATEMENTS The reviewer pointed out that in the introduction we say "More precisely, temperature gradients in an alpine snow pack can be sustained for extended periods, especially near the ground." while on p 1695 we say "In a natural snow cover, a constant temperature gradient over three weeks is not very common." We think there's no contradiction, because the first sentence refers to a large temperature gradient can be found over a longer period, while the second sentence refers to fluctuations. As this sentence is confusing, we will modify the first sentence accordingly, e.g. "More precisely, large temperature gradients in an alpine snow pack can be sustained for extended periods, especially near the ground. In this regime, fluctuations are often small compared to the magnitude of the gradient, and therefore we focus on this steady-temperature-gradient metamorphism (STGM) in the following, thus neglecting complicated daily variations of the gradient which occur especially near the surface."

5) With respect to the figures, we agree that the suggestions of the reviewer will improve understanding and we will modify the figures in the revised paper accordingly.

Interactive comment on The Cryosphere Discuss., 6, 1673, 2012.