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Geoscientific Instrumentation Methods and Data Systems
Discussions

# *Interactive comment on* "An instrumented sample holder for time-lapse micro-tomography measurements of snow under advective airflow" *by* P. P. Ebner et al.

**Anonymous Referee #3**

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Comments on "An intrumented sample holder for time-lapse micro-tomography measurements of snow under advective airflow" from P. Ebner et. al.

The authors present the design and development of a special purpose sample holder that allows tomographic imaging of snow exposed to air flow through the pore space. The benefit of such a device is the possibility of repeated controlled laboratory experiments that can yield quantitative data, as opposed to field work with many uncertainties. The availability of such a device promises quantitative evaluation of the interaction between snow metamorphism and air transport, and thus is a valuable contribution to-



wards an understanding of snow-atmosphere interactions.

The article is well organized and well written. In general, the concept of the setup could be introduced more clearly, because for readers unfamiliar with the Scanco device, the situation is hard to imagine. A simple sketch with a disk of snow and intended flow configuration would do the job. Introduction of a coordinate system would be beneficial; after all, the authors refer to the z-direction on several occasions (e.g. "z-stage" page 356, derivative w.r.t. z on page 360, ...) A coordinate system would also help to describe the orientation of the slices in Fig. 5. A crucial piece of information is missing in the description of the sample holder: The dimensions of the sample. In Section 2.1, general numbers are given: "up to 50 mm diameters and 140mm height". Looking at Figure 2, the height of the sample in the proposed setup is probably around 30mm.

Regarding the results of the CFD simulations, I would like see some more discussion. In Fig. 3, the scale is logarithmic (spanning 5 orders of magnitude) and hence one cannot estimate the typical fluctuations inside the sample chamber. How strong does the flow vary across the slice depicted in the lower part? What is the FOV of the CT in relation to the sample holder? Is the flow within the FOV constant enough to deduce quantitative conclusions from the CT images? For a detailled (quantitative) interpretation of the CT images, an inhomogeneous flow field should be taken into account.

Throughout the paper, the authors claim to be able to establish a controlled temperature gradient by heating the incoming air flow. Without any calculations or thermal simulations, it is hard to believe that there will be a significant and well defined temperature gradient in the snow. A typical flow rate of 2l/min corresponds to a delivered heating power of about 43mW for every degree that the air is warmer than the sample. (rough estimate with typical values for c_p and rho of dry air) With this heating power, the air plug-in (connected to the base frame!) will be heated, as well as the snow sample and the aluminum conductor. Hard to tell what the temperature field inside the sample will look like, but I expect an inhomogeneous distribution with bent isothermes.

With the CFD simulation already set up, would it be possible to investigate the thermal effects of a warmer air stream? To this end, an FEM model of a snow sample whould have to be included, which would of course yield a huge computational model. For the future, I think this would be worth the effort.

In the experimental setup, section 2.1, I am missing a summary of the imaging parameters. While later in the text the voxel size is mentioned to be 18 um, the tube energy, number of projections, and reconstruction algorithm are not mentioned. The size of the field of view (FOV) would also be very interesting. These are important parameters for repeating such an experiment.

In section 2.2, the authors say that they used POM "to save weight and to ensure good thermal decoupling from the environment". How can this be justified? What's the density of POM, and what would be the alternatives? Why does POM provide good thermal decoupling? And what are the X-ray properties?

page 360, equation 5: many people recognize this phenomenon under the name "Kelvin effect"

In Fig. 5, the reader should be informed that the bright phase in the segmented images corresponds to ice, and the dark phase corresponds to air. Similarly for the raw images, which are proportional to the absorption coefficient of the material. The 3D-renderings are too dense, the authors should consider to zoom in such that the reader can distinguish a few details. The caption should also mention that the samples were exposed to convective flow.

In conclusion, I think this sample holder is able to yield new insight into recrystallization processes during snow metamorphism and the interaction with convective air flow. I recommend the paper for publication in GI after responding to the comments.

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