The Cryosphere
Discussions

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Interactive comment on "Pore morphology of polar firn around closure revealed by X-ray tomography" *by* Alexis Burr et al.

J. Freitag (Referee)

johannes.freitag@awi.de

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General comments

The paper of Alexis Burr et al. deals with the important issue of pore close-off in polar firn. It presents direct measurements of the pore network on small firn samples retrieved at two cold and dry Antarctic sites using X-ray microcomputer tomography. The authors calculated pore structure related parameters from the volume images and performed a comprehensive investigation of different errors associated with CT-applications. They found different tortuous pore networks at different locations, and suggest an alternative parameter, the connectivity index, for the prediction of close-off depth and critical density in CT-applications instead of using closed to total porosity

ratios.

The paper is well written, precise and thoroughly in great detail and comes to important conclusions. In my opinion, it is suitable to be published in the journal The Cryosphere. Nevertheless, I would suggest some minor revisions. A shortening of the manuscript would increase the clarity of the main conclusions/results. I am wondering if on can skip some of the figures (4 or 8ef or 9bcd?)

Specific comments

(section 3 and 4): I am wondering if you can discriminate between the resolution and sample size effect on closed porosity calculations? Did you perform measurements like M60, M30, M12, L12 or L30, L60 in your notation, meaning: different resolution, same volume?

(section 4.1): I missed the discussion related to the layered character of polar firn: density variations in vertical direction are much higher than in horizontal direction. The layering is a result of different deposition conditions/densification. What is the effect of sample selection (on the very small scale) on density? Could this explain some of your differences? What do you mean with representative density? Representative for a certain layer? Or only for the sample itself? The layered character of firn density imposes huge fluctuation in almost all properties when the data are plotted against depth. Therefore, I would not expect a smooth curve in Paramter(depth)-plots

(Section4.3): It would be very instructive for the reader to learn about the connectivity index (CI). What is the index meaning? It is in some sense related to the open porosity (ignoring all cut and isolated pores) and therefore a kind of compliment to the closed porosity? And, in my view, I would think that CI is size dependent, at least for already separated pore clusters. That is quite easy to understand if you consider separated bubbles: here the bubble size (or the largest bubble) would be counted for CI. Fine grained – small bubble ice would have a smaller CI than coarse grained structures with in average larger bubbles...

(related to CI) What is the reason for CI giving no information about LID but closeoff-depth? Any ideas?

(Section 5) " Fig. 7b shows that all points fall approximately on a master curve. This supports the idea that the close-off arises on first approximation at a particular density." This is a quite interesting observation and you should highlight this (repeat it in the conclusions!) although it is probably hard to bring it into the context of the introduction of the connectivity index. In this figure you compare really firn from totally different temperature regimes. Mega dunes, WAIS and your very cold sites on the East Antarctic Plateau! What is your opinion about this result? Is the coherence of all the closed porosity ratios on one master curve only the result of inaccurate estimations? It would be great to calculate the CI for all the sites! Could you do this?

FIGURES:

Figure 9a: missing "z" before "direction" in legend 9a Figure 9b,B: missing "t" in "throats" in axis label

UNITS:

Unit of density should be written as kgm-3 instead of kg.m-3

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