The Cryosphere Discuss.,
doi:10.5194/tc-2015-217-RC2, 2016

The Cryosphere Discussions
Open Access

Interactive comment on "Sensitivity of snow density and specific surface area measured by microtomography to different image processing algorithms" *by* P. Hagenmuller et al.

Anonymous Referee #2

Received and published: 29 March 2016

The content of the paper is suitable for publication in The Cryosphere. I believe the approach is generally sound and conclusions relevant. However, there are a few areas that would benefit from additional clarification. In particular, the surface energy concept applied to the CT analysis, in my opinion, needs some additional explanation. I have attached an annotated pdf copy of the paper with my comments and suggestions.

Please also note the supplement to this comment:
http://www.the-cryosphere-discuss.net/tc-2015-217/tc-2015-217-RC2-supplement.pdf

Interactive comment on The Cryosphere Discuss., doi:10.5194/tc-2015-217, 2016.

The Cryosphere Discuss., doi:10.5194/tc-2015-217, 2016
Manuscript under review for journal The Cryosphere
Published: 25 January 2016

The Cryosphere Discussions

Sensitivity of snow density and specific surface area measured by microtomography to different image processing algorithms

Pascal Hagenmuller[1,2], Margret Matzl[3], Guillaume Chambon[2], and Martin Schneebeli[3]
[1]Météo-France - CNRS, CNRM-GAME, UMR 3589, CEN, 38400 Saint Martin d'Hères, France
[2]Irstea, UR ETGR Erosion torrentielle, neige et avalanches, 38402 Saint Martin d'Hères, France
[3]WSL Institute for Snow and Avalanche Research SLF, Fluelastrasse 11, 7260 Davos Dorf, Switzerland
Correspondence to: Pascal Hagenmuller (pascal.hagenmuller@meteo.fr)

Abstract. Microtomography can measure the X-ray attenuation coefficient in a 3D volume of snow with a spatial resolution of a few microns. In order to extract quantitative characteristics of the microstructure, such as the specific surface area (SSA), from these data, the grayscale image first needs to be segmented into a binary image of ice and air. Different numerical algorithms can then be used to compute the surface area of the binary image. In this paper, we report on the effect of commonly used segmentation and surface area computation techniques on the evaluation of density and specific surface area. The evaluation is based on a set of 38 X-ray tomographies of different snow samples without impregnation, scanned with an effective voxel size of 10 and 18 μm. We found that different surface area computation methods can induce relative variations up to 5% in the density and SSA values. Regarding segmentation, similar results were obtained with sequential and energy-based approaches provided the associated parameters are correctly chosen. The voxel size also appears to affect the values of density and SSA, but because images with the higher resolution also show the higher noise level, it was not possible to draw a definitive conclusion on this effect of resolution. Finally, practical recommendations concerning the processing of X-ray tomographic images of snow are provided.

1-1
1-3

1 Introduction

The specific surface area (SSA) of snow is defined as the area S of the ice-air interface per unit mass M, i.e. $SSA = S/M$ expressed in $m^2\ kg^{-1}$. This quantity is essential for the modelling of the physical and chemical properties of snow because it is an indicator of potential exchanges with the

1

Fig. 1.