

Interactive comment on “Influence of stress, temperature and crystal habit on isothermal densification and specific surface area decrease of new snow” by S. Schleef et al.

Anonymous Referee #2

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This paper is an experimental survey of new snow densification tracking microstructural parameters using a X-ray micro CT scanner. Both natural and laboratory derived samples are considered each with relatively low initial density. Various overburden normal stresses and a few different temperatures are considered as the microstructural evolution is temporally tracked with CT images. Overall the paper does a reasonable job at addressing the relationships between SSA and densification to normal compressive stress and temperature through time. The crystal habit results were not motivating and seem to be an afterthought when unexplained behavior was observed as the only possible remaining explanation. The linear relationships, as noted by authors, would likely become ore logarithmic for higher densities and different time scales. Sample storage

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before the tests (at -60 deg C) raised several questions that were not addressed in the paper. On an editorial note, there is a striking lack of commas used in the paper. Additionally, in section 2 the writing transitioned from third person to first person. This reviewer prefers third person but it is only a preference. The paper should be consistent one way or the other. Detailed comments: -1, line 20: Fails to address crystal habit which may be important for SSA and albedo, comment appropriate? Since crystal habit is part of the study, should address in pervious work. Not all work is corrected to optical equivalent grain radius. - 1, line 5-20: What is the clearly stated hypothesis of the project? Overburden stress and tenmperture. . .to SSA and densification. Good ideas here, lead the reader to a clear hypothesis that your experiments will attempt to prove. - 1, line 10: Define microstructural parameters, which is a very open ended description. - 2, line 10-11: Do you feel this is a correct statement for dendritic forms? Theoretically, dendritic decomposition is still at play? -2, line 16-17: Stress values are not weight. - 2: I would like more discussion on storage and how samples were verified to be unsettled and limited metamorphism during storage. This is important since sieving took place before storage. Were they reexamined before testing? A little more explanation on storage and transition to testing would be helpful. - 2, line 25: How long did it take to bring samples from storage temperature to test temperature? Was that during testing periods? - 2, line 30: confusing wording, a height is not a volume. Maybe clarify sample dimensions and volume here. -3.1, line 3: It is not clear what “high variability of their initial characteristics” is referring too. Please clarify specifically what is meant here. - 3.1, line 4: this is the first use of “nature-identical”. Without substantiation this is an overreach in terminology. Laboratory derived samples are fine, but how is identical to natural snow justified? The authors even noted crystal habit consistency differences between their natural and lab samples. 3.1: the discussion of what is evident in figures 1 and 2 is sparse. There is some great trend data that will be used in discussion but could be pointed out here. Explain for the reader what in the figure(s) is important vs letting the reader decide. The trends are based on temperature and stress, but crystal habit is not mentioned. Again, consider what crystal habit is adding to the paper and

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either remove it or find a way to strengthen supporting influence. 3.2, line 11-12: I am not sure “the apparent variability” is an accurate description. Increases and decreases look similar but different initial conditions result in shifted results. I believe empirical fits would show similar slopes even if logarithmic or power law based. To me, that is a strength in the data that the trends are consistent. 3.2, line 18: Any possibility that storage may be at play here? 3.3, line 4: Sample is 14, not 9? 3.3.1: Why was 0, 133 Pa chosen? Any specific reason? 3.3.1, line 17-18: Could settlement during storage already have happened and not observed here? 3.3.2, line 22: use sigma instead of p to be consistent with table 1. 3.4: this section is not motivating to me. The evident that crystal habit is playing a significant role in settlement is not really shown clearly. It seems that since it is the only remaining parameter looked at, it is assumed to be the culprit when other parameters are eliminated. Can a stronger case be made? Eqn(4): What does this say about storage times and temperatures? Eqn(8): Euler characteristic doesn’t seem to be a strong influence here, should that be discussed more? Is it adding to the understanding of densification? 4: No crystal habit section? This again leads me to believe this is a weaker (currently) part of the paper. Consider ways to strengthen the connection or consider removing it. Table 1: “nature-identical” Fig 4: Test day may not be first settlement, storage needs to be clearly addressed. Fig 6: Labels on Y axis is not correct. The numerator is a rate, $\Delta\phi/\Delta t$, not just $\Delta\phi$. Fig 10: labels on both axis are not correct. Each should have a time rate in the numerator, not just $\Delta\phi$.

Interactive comment on The Cryosphere Discuss., 8, 1795, 2014.