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The Cryosphere Discussions

Interactive comment on "A model for French-press experiments of dry snow compaction" *by* Colin R. Meyer et al.

Vincent Verjans

v.verjans@lancaster.ac.uk

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This study provides an insightful perspective on the densification of snow. The theoretical model is clearly explained. The model agrees well with laboratory experiments for snow samples in the density range of 150 to 325 kg mˆ-3. This is even more notable given that the parameters were set at their standard values (thus not calibrated against other data) and kept constant for the different experiments.

Interestingly, the authors point out the transition to a different compaction regime for the higher density samples. From a firn modelling perspective, it is important to separate the different stages of densification. Plastic compaction seem to describe accurately the densification in the low density ranges. Additional processes cause the compaction

rates to deviate from the theoretical predictions at higher densities. In order to reach physically based firn densification models, the community needs to (1) identify the different compaction regimes and (2) use the physically accurate governing processes for each regime. This study undoubtedly contributes to a better understanding of the early compaction.

Further research will be required to constrain the physics prevailing in other regimes and at the transitions between the different regimes. Also, the question of scaling will need to be addressed. Does such model-observations agreements can still hold for field samples of firn and snow which are more heterogeneous in their intrinsic properties.

I think that the following typos need to be corrected: Equation (18): changing x to z. On the line above Equation (19): the authors refer to the "top of the sample" whereas they give the boundary condition for the bottom of the sample. Equation (32): I think that the (rho_a - rho_i) term should be on the numerator and not on the denominator. Equation (33): I am not sure whether the authors forgot the (rho_a - rho_i) term or if it is implicitly included in the effective pressure term (in which case the authors should explicitly mention this for the sake of clarity).

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