Reply to Reviewer 2

*We thank Reviewer 2 for their review. Each comment is addressed below with the reviewer's comment in normal black text and our response in italicized blue text.*

This paper presents neutron radiography results of snow/soil interface fitting it with a 1D model. The paper is very well written and clearly structured.

My main concern is heterogeneity: the sample is highly heterogeneous and so is the fluid flow (e.g., Fig. 9), yet the methods adopted essentially neglect this intrinsic heterogeneity.

*We do ignore the heterogeneity for the 1D profiles and quantification of the hydraulic properties, but extensively discuss these limitations in the manuscript. However, we do show aspects of this heterogeneity in Figures 9 to 11. We agree that 2D quantification is a necessary next step and believe this will be more beneficial in future experiments where issues such as premature melting are mitigated.*

The adoption of radiography (over neutron tomography) for example, could be questioned.

*In principle, tomography would be better. However, at NEUTRA, the flux is too low to perform tomography to allow us to capture the dynamics in these experiments. Additionally, regardless of the flux, the sample would have been limited to a column of about 1 cm in diameter, which would have limited the size of the sample dramatically. Tomography experiments at a higher flux source would be very interesting to perform.*

Even neglecting the third dimension, the fitting curves appear rather far from the experiments (e.g., Fig. A8/9/10) both in terms of local fluctuations and overall trend (this could also explain some of the convergence issues).

*We agree that there are deviations, particularly in the fits of hydraulic conductivity ($K_s$) and this is a necessary topic of future research. Based on suggestions by Reviewer 1 and the Editor, we will add information about the quality of the fits to the manuscript to quantify this in addition to the errors in the fit parameters provided in Table 1.*

Much of the discussion is focused on the mismatch between the fitted parameters and literature predictions but this discussion could appear a bit stretched once accounting for this simplification.

*As discussed above, we are well aware of the limitations of the assumptions made here and discuss these in detail. However, we think that the comparison to literature is still valid (and important) given that the literature values also have their own limitations. For example, the van Genuchten parameters determined by Yamaguchi et al. (2012) were determined at a much lower spatial resolution (2 cm height, 5 cm diameter), so averaging across the entire sample seems appropriate for comparison. Similarly, the hydraulic conductivity experiments by Katsushima et al. (2013) also used larger samples. As such, we intend to leave the discussion as is and allow the reader to interpret the discussion given the limitations we outline throughout.*

In the 2D analysis you make the hypotheses that the snow does not move but playing the videos in the supplementary materials they all move by a significant amount downwards with a slight turn.

*This is indeed true. However, the analyses in Figures 9, 10, and 11 are meant to demonstrate that we can quantify 2D effects and to show that they are important to consider in the future. For the 1D analyses, the movement should not affect the results more than the assumption of a single density for the entire snowpack.*

Specific and minor notes:
= Section 2.4 appears scientifically correct and clear, but it follows mostly a well-established approach and could conceivably be moved to an Appendix.

*We think this section is important to provide an overview of the method for those less familiar with it.*

= The review in the introduction is paraphs a bit broad compared to the actual topic of the work and could conceivably be refocused. Also, it does not mention if a similar experimental approach has been adopted before.

*We are not sure what the reviewer means here exactly. We feel the introduction is very focused on describing water flow in snow and we provide an overview of the experiments and modelling approaches which have been used to date.*

= Why deduce the density from CT and not gravimetric measures?

*We chose to use the density obtained from the µCT scans because we used these measurements for the SSA. We also measured the density with a 100 $cm^3$ density cutter and it provided similar values.*

= “weak capillary forces of a high porosity layer of a vegetation layer” perhaps rephrase to avoid repetition?

*Good point – we will rephrase.*