Effect of snowfall on changes in relative seismic velocity measured by ambient noise correlation

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Dear Editor, dear Referee,

Please would you find below a point-by-point response to the last review of our manuscript. Our contribution is highlighted in green, in response to the two remaining comments that we had to address. We hope that the whole process is complete before the final publication, and we thank you again for all the relevant comments on our work.

Best,

Antoine Guillemot

Minor revision : comments from referee

Dear Authors,

You have addressed all my questions and concerns from the first round of review – I sincerely thank you for that and find your manuscript much improved. I have some further minor comments:

Introduction

Some further elaboration is worthwhile. Readers need to understand why modelling snow is challenging, and why wet snow is even more so. Sayers 2021 models with diff. effective medium scheme the Vp and Vs dry snow using two phases: ice and air. If one were to model wet snowpack, one would further need to consider effects of partial saturation, another can of worms (for example O'Connell and Budiansky 1974 looked at partial saturation). In addition there would be critical conditions whereby snow would change its behaviour from grain-supported to fluid-supported. It is important to explain the complexity of snow in this regard, and the challenge it presents itself to theoretical models (as you mention in discussion the 3-phase model).

- To this end, we add these new sentences to the introduction about snow: "*Modelling snow acoustics is highly challenging, since acoustic phase velocities of this porous medium strongly depends on porosity, stiffness and density of the bulk frame. Recent studies address this dependency using rigid-frame and Biot's models, assuming pore space to be air-filled (Capelli et al., 2016; Sidler, 2015; Sayers, 2021). Furthermore, the presence of liquid water, and with it melting and refreezing of snow, deeply changes the behaviour of snowpack from grain- to fluid-supported, making wet snow modelling much more complex than in case of dry snow. Overall, partially saturated wet snow remains a critical challenge for modelling.*"

Line 103-113

Would benefit from a diagram, showing layers with properties A/B vs. layers with identity settled/fresh (which I understand from your description that they are different). Do I understand correctly that some of the HN48 has properties of A and some of B?
Line 263 increase in mass and also density?

- For the winter season, we compute the amount of new snow in the past 48 hours (HN48). If HN48 is positive, we model the snowpack with two layers (fresh snow and settled snow), with different density and temperature. According to your suggestion, we clarify this procedure by adding a diagram (Figure 2 in the article, Figure 1 here):

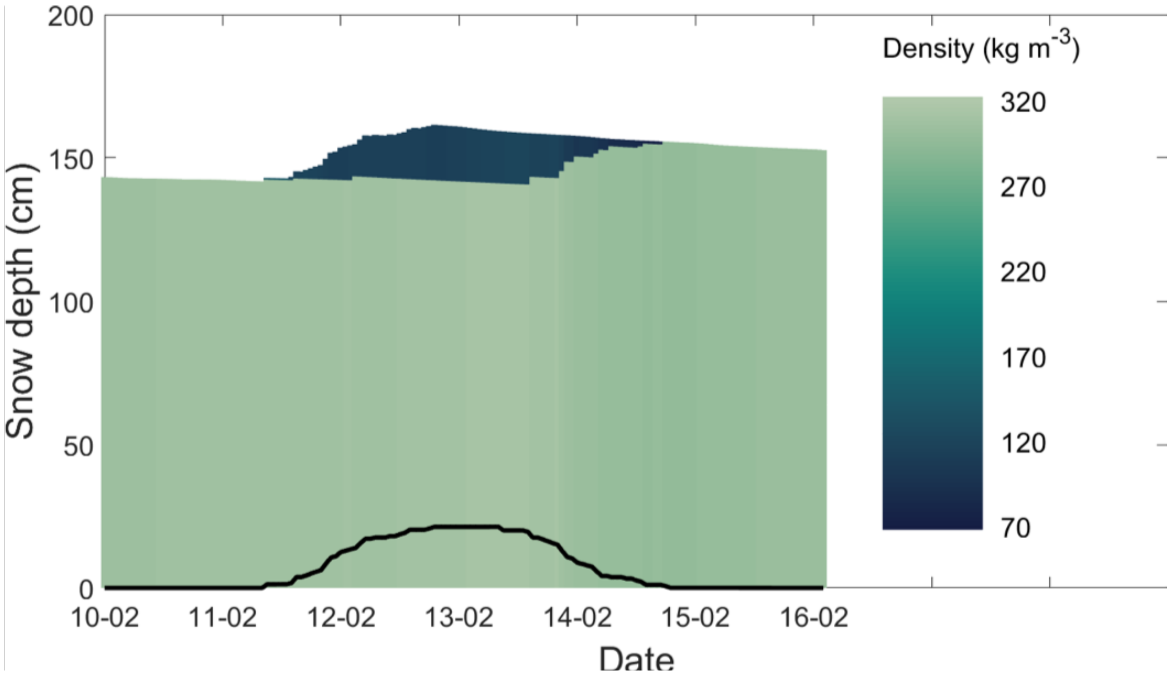

Figure 1: Evolution of snow density (colors) of the simplified snowpack consisting of two layers, during one snowfall event. When HN48 (black curve) was zero, both layers have the same density. For HN48 > 0, the upper layer consists of lower density snow (dark blue).

References

Capelli, A., Kapil, J. C., Reiweger, I., Or, D., and Schweizer, J.: Speed and attenuation of acoustic waves in snow: Laboratory experiments and modeling with Biot's theory, 125, 1–11, https://doi.org/10.1016/j.coldregions.2016.01.004, 2016.
Sayers, C. M.: Porosity dependence of elastic moduli of snow and firn, 1–9, https://doi.org/10.1017/jog.2021.25, 2021.
Sidler, R.: A porosity-based Biot model for acoustic waves in snow, 61, 789–798, https://doi.org/10.3189/2015JoG15J040, 2015.