

# Brief Communication : Monitoring active layer dynamic using a lightweight nimble Ground-Penetrating Radar system. A laboratory analog test case. Answer to reviewers

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Dear reviewer RC2,

Thanks for your review and your useful comments. Overall we edited consequently the paper in terms of presentation and rephrased most of the results. We added additional materials to answer one of your concern. Please find below our answers to your comments .

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*[...]However, only one experimental dataset has been collected which shows some interesting features from the freezing and thawing cycles, but there is no indication of repeatability and sensitivity of experimental parameters. The numerical model is really too simplified and basic to be of much value. It would have been interesting and much more inciteful to include the GPR antenna and dispersive effects from the water (particularly during freezing/thawing) in the numerical model.*

10 We performed 9 experiments in total, involving each time, the freezing and warming cycle of the cold chamber/room, the partial or full saturation of the *approx* 400 kg of dry sand and its correct compaction. The freezing and thawing phase is taking about 10 days with the thermal equilibrium of the chamber and the bottom freezing procedure with the cryostat. We have a total of 6 good experiments, defined here as non perturbed with power supply failure, leakage and container breaking because of the temperature. We insist once again that the aim of the paper is to present the capability of the system to monitor changes  
15 in permafrost table height and/or thawed layer movement. This is why we privileged describing and showing one experiment only, keeping the message short (only 4 pages for a brief communication) and simple. In order to illustrate our answer to your very good comment we added : L.106-107 "We present in detail the results of one experiment while 4 others are available in supplementary materials."

Concerning the numerical modeling, we re-explained it and added 2 other figures to strengthen the message. However we agree  
20 with you in the sense that the modeling is very rough, once again aimed to understand which reflection is coming from where. This is especially difficult to understand the difference between B and C reflection origin and our "simple" modeling allows us to give a first hypothesis. The next step would be to model entirely the thermo-hydrodynamical process and then couple it

with GPR-codes. This is out of the scope of this study since, once again we target a paper on the prototype proof of concept.  
We added 2 sentences :

25 L 137-138 "We use this simple modeling to interpret the experimental radargram.";

L. 160-163 "The modeling presented in this study is very simple, but was aimed in understanding from where the reflections observed in the experimental radargram where coming from. A coupled thermo-hydro-EM modeling is currently in development in order to fully simulate the physical phenomena and use the M-GPR data to infer SFCs."

30 *[...]The presentation of the manuscript needs to be improved - there is a lack of consistency of style across the figures and the text contains grammatical errors. The features of the measured GPR data (Figure 3c) could be better highlighted and described in the text.*

We answered these issues with our RC1 comments. We redesigned all the figures and re-explained in details Figures 2 and 3. We homogenized the fonts and swiped part for clarity. We do hope it will suit you better.

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Thanks for your relevant comments,

Best regards

Emmanuel Léger