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Interactive comment on "Ice layer formation in the snowpack due to preferential water flow: case study at an alpine site" *by* Louis Quéno et al.

Anonymous Referee #1

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This study provided very important data by field observation for water infiltration and ice layer formation using traditional snowpack observation, SnowMicroPen, and upper GPR. Considering water transport, thermal process, preferential flow, and the freezing process is important to study ice layer formation in the snow physics. Due to the difficulty of laboratory experiments for ice layer formation, the water transport model lacked validation data considering freezing. They are useful data to collaborate with laboratory experiments and 2D or 3D models. I would like to know whether authors have a plan to open these data. The implementation of ice reservoir parameterization is also interesting. And I impressed that the ice layer was reproduced well using a one-dimensional model. In my opinion, this paper is suitable to accept for The Cryosphere. I suggest several comments to make this paper more informative. But it is not necessary

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Discussion paper

requirement for acceptance. Please refer to comments to make this paper be better.

minor comment

Line 123-144 Section 2.2.2 is a new parameterization and main improvement part of the model. So a more detailed expression is necessary. I guess the ice in the matrix layer block (or transport with very low permeability) for water transport. But it is unclear whether the ice in the ice reservoir also affects hydraulic conductivity or not. Please add the description about the influence of ice in ice reservoir on water transport simulation.

Line 164-166 Is the SNOWPACK simulation reproduced this water front observed by upGPR, runoff and temperature profiles well?

Line 186-188 Fig.6 showed the mean SMP resistance. Can you explain the heterogeneity of SMP resistance other than layer 1 and 2 briefly?

Line 196-199 Confirmation of melt-freeze crust on buried surface hoar seems valuable observation result. Considering the theory, a capillary barrier forms on surface hoar due to low suction of surface hoar and froze later. Is it confirmed past study or observations? If so, please add the reference.

Fig 10-13 Please add a and b in the figure.

Line 247. I felt that the Fig. 12b is strange. In Fig. 10b, water ponds at 70-80cm height (on the freezing layer) on 11 February. On the other hand, despite the frozen layer was not shown in Fig 12a, water ponds at the same place. I guess that ice exists in the ice reservoir which was not shown in Fig. 12, and it affects this ponding. If my guess is correct, ice content in the ice reservoir had better be shown in some way. Also, can you describe the influence of the ice content in the ice reservoir on water percolation? In 2.2.2, formation of ice in ice reservoir is described. But influence of it on water transport should be also explained.

Line 325 (4 discussion): This study is attractive for researchers of water transport mechanisms using laboratory experiments and 2D or 3D models. Also, collaboration

with them enhances the value of this study in terms of cover some assumptions and make physical evidence. I expect the observation data will be opened. Also, during conducting this study, if the author came up with the idea that could be done by a laboratory experiment or a 2D or 3D model, suggesting ideas in discussion will be a good information.

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