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Comment on nhess-2021-289

Anonymous Referee #2

Referee comment on "Detrainment and braking of snow avalanches interacting with forests" by Louis Védrine et al., Nat. Hazards Earth Syst. Sci. Discuss., https://doi.org/10.5194/nhess-2021-289-RC2, 2021

This manuscript discussed the snow avalanche protection efficiency of the forests with applying the 3D MPM combined with the modified cam Clay model. This approach developed by the authors' group looks very powerful and promising to break through various aspects of snow avalanches from its initiation to dynamics. In actual, 3D MPM provides overwhelming useful information comparing to the previous depth averaged model. Further, once the model has been established it can be applicable under the various conditions. Taking into conceivable factors, the deduced relations in this study will be quite useful for the practical applications, I believe. Although it is out of scope here, I hope the authors proceed the research on the other aspect as well: how the forest stabilizes the snowpack and prevent from the snow avalanche release.

All the methodologies and discussions are well organized and carefully described. So, I believe this article is worth publishing. However, I am glad if the authors can clarify and improve some of the points listed below before the publication.

Line 47: K is used for not only the detrainment coefficient but the material bulk modulus in eq. (5).

Please check fonts of variables. They are not always unified in the text, the figure and figure captions: italic or vertical, such as spacing of trees "e".

Line 102: "CFL" means Courant-Friedrichs-Lewy Condition? Since it is not so common

outside the numerical simulation field, the brief explanation is preferable, if you dare to use.

Line 121: M=0.8 snow, defined as warm shear regime, agreed well with the field observations. On the other hand, Case 3 of M=1.2 is also set as the warmer case in Table 2. So, the Case 2 of M=0.8 snow correspond to the snow which is dry but the temperature is close to zero? I am curious whether you have got the information of snow properties by Feistl et al.? Are these reasonably agree with the physical parameters given in this study? In this study snow properties are designated with snow friction coefficient: M, the tension compression ratio:β , the hardening factor ζ, and initial consolidation pressure $p^0_{ini.}$ Although the general features of snow defined with these parameters are explained briefly, it will be glad if the authors clarify the relations more specifically with the snow properties we usually observe in the field.

Further, do you have any idea how you can validate that the model is also appliable for the dry snow?

Table 2: The hardening factor ζ is set the same for both dry and wet snow. Is this reasonable?

Figure 2: No snow depositions are found in (b) after the rectangular domain. Does it mean all the snow went through?

Table 2: Density of Case 1 which is explained as cold "dense" regime is still 200 kg/m^3?

It is the same as other two warmer cases? I do have an impression that the density of the dry avalanche is usually lighter than the wet one. In particular, densities of granules and blocks in Case 3 are still 200 kg/m^3? I wonder densities described here perhaps show bulk densities including air and snow?

Line 185: Although it does not matter much, I am a bit worried that authors use the word "impact" frequently. Since this article deals with the avalanche impact on the forest in actual, I prefer rewording such as "action", "affect" and "influence" to avoid the misleading.

Figure 6: Eq. 3.5 and 3.4 in the figure must be Eq. 8 and 9.

Is it just a coincidence that Case 1 maximum and Case 2 final agrees quite well? Further, please specify the reason why Case 3 is not shown here.

Figure 8: Again, here why case 1 is not introduced?

Figure 9: Please explain physically why the detrainment mass is proportional to the third power of the forest density.

Table 3: According to Figure 8, the relation between the detrainment mass and tree diameter for Case 2 and Case 3 are obviously different even though the front velocities are almost the same (11.2 m/s and 10 m/s). Thus, I do not understand the reason why you can use the same p3 and p4 for all three types of snow as shown in Table 3. Further, although no results are not introduced in 4.2.2, I am wondering the snow type does not give any effect on the forest density consequence.

Line 273: Please explain why the detrainment energy, when the avalanche reaches the bottom of the valley, is similar between the random and the regular staggered arrangements, in spite of the fact that the final stopped mass with both arrangements are largely different.

Line 281: Random arrangements is the most effective to stop the avalanche. I am curious how you suggest to people in charge who take care of and manage the forest? Do you say the forest should leave as it is without artificial maintenance? Foresting should be done randomly?