Dear Referee 2,

Thank you for reviewing our article. Your constructive comments will help to improve our manuscript significantly. Below you find the point-by-point replies to your comments.

General comments:

Abstract: in the abstract it is not completely clear what are your results and what is from literature. . . For ex. lines 6-8 is a result from your study? Then at line 8 there is a "We demonstrate. . ." and after a while again "We find (1) . . .". I would separate better what are your results concerning the different flow regimes that you list at lines 5-6.

>> To remedy this problem, we rewrote the abstract to clarify what are the methods (1) and what are the findings (2), line 6: We write: *"Using a numerical model that simulates both powder and wet snow avalanches, we study documented events with forest damage. First we show that in the powder regime, the blast of the cloud can produce large bending moments in the tree stem because of the impact area extending over the entire tree crown. We find that powder clouds with velocities over 20 m/s can break tree stems. Second we demonstrate that intermittent granular loadings are equivalent to low-density uniform dry snow loadings under the assumption of homogeneous particle distributions. The intermittent regime seldom controls tree breakage. Third we calculate quasi-static pressures of wet snow avalanches and show that they can be much higher than pressures calculated using dynamic pressure formulas. Wet snow pressure depends both on avalanche volume and terrain features upstream of the tree."*

p. 536, lines 22-23: forest destruction is known to be able to provide very important and precise information concerning avalanche frequency; in relation to the spatial extent of avalanche impact pressure the knowledge is not at the same level.. Actually this manuscript could help in this issue. I would specify this difference in knowledge.

>> Yes, this is our primary purpose for writing this article. According to the suggestion of the reviewer we modified two sentences: *"Forest destruction provides not only important information concerning the avalanche frequency but also the spatial extent of avalanche impact pressure. This information helps hazard engineers construct impact scenarios for different avalanche release conditions."*

p. 536, lines 24-26: I would specify that you are speaking of the protective role of forest along the avalanche track and not in the release areas. . .. The topics are completely different, therefore a specification is needed.

>> The reviewer is indeed very correct. This assumption is the basis of our work and obviously needs detailed clarification. Therefore we change this sentence to read as follows: *"More importantly, the capacity of mountain forests to decelerate and stop avalanches requires distinguishing between when the avalanche destroys the forest or when trees can withstand the avalanche impact pressure."*

p. 538, lines 14-16: This means that from field work you have already recognised the typical flow regime for the recorded avalanches? Which method did you use to define on field the different flow regimes? It was always so clear? I think it is an interesting information for the readers. . . why not putting, if you have them, 4 different pictures to show the 4 different flow regimes? If not, at least, say (in the methodological section) how you got this information, as it is crucial for the definition of the equation to be used for the bending stress computation. Another point here: as the result of the bending stress comes from simulated variables or parameters, it would be nice to have an idea of the uncertainty in the results. It is not necessary a sensitivity analysis, but an idea of the uncertainty in the result would be well accepted. This would belong to the discussion section.

>> One of the primary results of our recent research is how snow temperature controls avalanche flow regime. We added additional information concerning snow temperature when the avalanche released. The specifications of the documented avalanches are mentioned in sections 3.2 and 3.3. In the Täsch case we rely on measurements of a weather station. In Monbiel we refer to the paper of Sovilla et al. 2012 and Vera et al. 2015 where they describe the meteorological conditions prior to the event in detail. For the avalanches in Germany we have a detailed report from the Bavarian Avalanche Warning which describes the meteorological conditions leading to this avalanche circle in March 2009. We did not carry out field observations that document the temperature or snow granule size distribution as the flow regimes were clearly distinguishable from the documentation.

We will include a sentence in the discussion section stating that there is an uncertainty when using the results of the model simulations.

p. 543, line 22: What is hi? The height at which the granule i hit the tree?

>> Yes, we will clarify that with *"…, where hi is the impact height of a single granule."* following Equ. (11).

Section 3.4. This section is very different from the two previous ones. Can't you tell more about the damages? And it is strange that the title this section is Powder snow avalanches in Germany, but then in Fig. 8 you report the flowing core. . .. Can't you do the same as you did

for Section 3.3 (a powder avalanche)? If you do not have the same good data of the previous study case, simply tell it. . .. or highlight better which useful information you can gain from these additional case studies (as you already call them at page538, lines 19-21). The fact that the run-out distances were overestimated if not taking forest into account is an ancillary result for the main aim of the manuscript (forest damage).

>> Important remark. The reviewer is correct: we did not perform a field campaign for these cases. What we know is the extent of these avalanches from photographs out of a helicopter where the forest damage is clearly visible. We will include a sentence that almost all trees were broken. The outline of these avalanches was mapped by the Bavarian avalanche service. We will clarify this in the text. We know that these avalanches were powder snow avalanches from eye witnesses. We show that the dense flowing core could have been the cause of forest damage in the upper part of the avalanche tracks but probably not in the lower avalanche tracks. This assumption is based on our simulations and on the two case studies that we documented in detail before (section 3.1 and 3.2). We think that this supplementary result, that runout distances are overestimated when not taking forest into account is very important and has to be mentioned. This section is to demonstrate how forest damage can be implemented in avalanche modeling (see last sentence of section 3.1).

Pag. 555, line 11: where did you test on real data the formula for the intermittent regime? Maybe, it would be nice to have a table (in the result section 3.1) where you list the simulated avalanches with the different flow regimes. . . the reader would have in a glance an idea on the cases where you tested the different formulas to calculate the bending stress for the different flow regimes. Only at lines 7-16 it appears that no test on real cases were done. . ... of course it is a difficult task but, as you suggest this type of flow regime, it is necessary to be clear about what can be or cannot be done and what you could do in this paper.

>> We did not test the intermittent case on a real avalanche. As we prove theoretically that the dense flowing core exerts higher pressures than the intermittent case we do not calculate specific impact pressures from this layer. We will try to clarify which kinds of avalanches we simulated.

Fig. 6: I understood well that the pressure shown here is the one calculated from Vera et al. (2015)? It is not the result of equation 22 or 23?

>> Yes the pressure field is calculated with RAMMS by Vera et al. 2015. We use these values to prove that the dynamic impact pressures are not high enough to break trees. We calculated the pressure for the spruce denoted with the red cross with equations 22 and 23.