Response to Referee #2

We wish to thank the Reviewer for his/her thorough review of our manuscript and for the useful comments that helped us improve the quality of the paper. The specific issues raised by this Referee are addressed in detail below:

The objectives are not quite clear. We all understand the emphasis on the model and the effects of sediment concentration, but what is it that you are particularly wanting the reader to learn from your research? The model and color figures are nice, but there must be some scientific objective that you tried to accomplish and want to share with the readers.

Response:

We thank the Reviewer for this comment. As we explained in the introduction of the original version of the manuscript:

"*The main objective of this investigation is to gain fundamental insights on the effects of high sediment concentrations on the propagation of floods in an Andean watershed."*

In the new version of the manuscript we have added additional comments, regarding the competing mechanisms that control the flood dynamics in mountain regions, namely the geomorphic characteristics of the channel, and the rheological effects of sediment concentration.

The conclusions are long and a bit vague. There should be a clear delineation of what can be concluded from this analysis. Also, the wishful thinking at the end of what you want to do in the future should be left out. There should be a greater emphasis on what has been done and what can clearly be demonstrated from your analysis. What can be achieved in the future should be left out for your next paper…

Response:

We have modified significantly the conclusions to consider this comment. In the new version of the manuscript the Conclusions are shorter and simplified. The main modifications include deleting all the comments referred to future work. We have summarized the paragraphs, simplifying the explanation of how we carried out this research, and most importantly, we have now highlighted the main findings of our research, justifying them with observations obtained from the analysis of our simulations.

The article is a bit long and there is quite a bit of excess verbiage (a good 10-15% can be trimmed out) that could be deleted without changing the technical content of your discussion. Also, once the paper is approved for publication, it seems better not to include the Appendix in this paper. This material can be useful to the reviewers at this stage of the review process, but will not be necessary in the final paper.

Response:

We have worked on reducing the size of the manuscript, eliminating repetitive content and reducing some paragraphs. We are open to eliminate the Appendix if the Reviewer and the Editor believe that it could make the paper more accessible to the readers.

The analysis of the effects of sediment concentration is interesting, but the results at a 60% concentration seem too fluid and flowing quite fast. Depending on the amount of clay and the type of clays, the flows at such a concentration can be very different than modeled. These hyper-concentrated flows may also resembling very slow moving mud flows. It may also be useful to indicate whether this is a concentration by weight or by volume. It does make a large difference at high concentrations.

Response:

We thank the Reviewer for this comment. We are aware that many factors control the complex dynamics of hyperconcentrated flows, which determine their rheological behavior and the velocity of the floods. (Julien and Leon, 2000).

The nature of the flow highly depends on the characteristics of the sediment particles, and specifically their size and composition. Slow moving flows typically occur in flows with high concentrations of silts and clays (fine sediment sizes). In these cases, the turbulent and dispersive stresses lose importance, and the yield and viscous stresses control the dynamics of the flow (Widjaja and Hsien-Heng Lee, 2013). Additionally, the cohesion between particles plays an important role on the flow resistance.

In the cases we are analyzing, however, the sediment is generated in a section of the Andes where the smallest fractions of sediment correspond to fine sand, and almost no clay is present. ***We are therefore considering particles with diameters that vary from 2 to 10 mm, which is considered very fine sand to medium size gravel*** *(Julien, 2010).*

In our simulations, the flow is a mixture of clastic material and a lubricating fluid and the main mechanisms for energy dissipation are collisions among particles (dispersive stresses) and turbulence at high flow velocities.

Finally, we would like to underscore that the quadratic rheological model used in this work considers all the stresses previously mentioned. Depending on the characteristics of the flow and sediment, and the terms representing each effect can take high or low values of the stresses.

As we explain in the new version of the manuscript, all the concentration values are expressed in terms of volumetric sediment concentration.