

Dear Editor Rebecca Hodge,

We appreciate your valuable comments on this manuscript. All the comments are helpful to further improve the manuscript. Some revisions have been made and highlighted (in red) in the revised manuscript based on these comments.

The following are point-by-point responses to the comments and suggestions, that we hope will meet with your approval. In our responses, the line number citations refer to the revised version of the manuscript.

Comments from Editor

- **Comment 1:** Thanks for undertaking a thorough review of your paper, and for clearly addressing all the reviewers' comments. I have some minor suggestions for places where I think that the paper would benefit from additional clarification (listed below). I recommend the paper for publication subject to these minor revisions.

Comments by line numbers (in the tracked changes version of the text).

Response: Thanks for your valuable comments on our manuscript. The responses to your comments are presented as follows.

- **Comment 2:** Abstract: The abstract does not mention the use of the FEM, which should be included.

Response: Agreed. We added the following sentence in the abstract (L12-13):

“The finite element method (FEM) was utilized to construct a numerical model of the SPG system and to simulate the signals triggered by a quartz sphere hitting the plate center with impact angles ranging from 0° to 90°.”

- **Comment 3:** 66: Not all readers will be familiar with the finite element method, so explain briefly what it is.

Response: Agreed. We added the following statements to explain the finite element method:

“The dynamic response of the SPG system that corresponds to the recorded signal can be fully described by the partial differential equations (PDEs) based on elastoplastic mechanics, and these PDEs can be numerically solved by the FEM formulations resulting in a system of algebraic equations.”

See lines 69-71 in the revised manuscript.

- **Comment 4:** 300: Without referring back to your definitions, the differences between 'real', 'apparent' and 'effective' impacts aren't obvious to me. I can't think of better terms though. Maybe remind the reader of your definitions here. I'm not sure that 'effective' is the right term for the sum of real and apparent impacts. How about 'total recorded' impacts? Or given that the term is only used in a couple of places, just use 'real and apparent impacts'?

Response: Thanks for this valuable suggestion. The packets triggered by bedload particles impacting on the SPG plate above the considered geophone sensor are being classified as “real”. The packets triggered by bedload impacts on a neighboring plate or on the concrete bed of the flume are classified as “apparent”. We think the term “total recorded impacts” is an accurate way to describe the sum of real and apparent impacts. This has been revised accordingly in the manuscript (L303-306, 308, 312).

- **Comment 5:** Figure 6: Explain in the caption how transport mode was determined for these data. It might also help to recap the difference between real/apparent/effective impacts.

Response: Some related statements have been added in the figure caption (L311-316).
- **Comment 6:** Table 5: It's not clear to me why you've included the 25th and 75th percentiles, but not the median or mean.

Response: Here we just want to show the range or variability of these parameters.
- **Comment 7:** 373: What is a non-effective impact?

Response: A non-effective impact here means a particle impact that does not trigger any signal packets. In other words, an impact that cannot be detected by our system. To make these sentences more clear, we rephrased them as follows, avoiding the term non-effective impact (L377-380):
 "The ratio $r_{i,j}^{Packet,V_F}$ is close to one for two reasons. First, in the video analysis, we considered only the signal packets that were generated by particle impacts on the SPG plates. Second, given that impacts of such small particles are generally too weak to generate apparent packets, the number of detected packets can be expected to be close to the number of impacts on the SPG plates. A possible explanation for $r_{i,j}^{Packet,V_F} < 1$ could therefore be the limited visibility during the video analysis due to flow turbulence, resulting in an underestimation of the number of impacts on the SPG plates."
- **Comment 8:** 489: I don't follow the sentence that starts: 'Auel et al...'. Please rephrase.

Response: In Auel et al. (2017a), the definition of the probability for the rolling mode is stated as follows:
"The probability P_R is defined as the distance covered by a particle in rolling motion divided by its total covered distance given by the sum of rolling and saltation motion averaged over n particle travels."
 With regard to this definition, we know that P_R is defined as a ratio of two travelled distances. One (numerator) is the travelled distance covered by a rolling particle. The other (denominator) is given by the travelled distance covered by both saltation and rolling modes (or say all transport modes because Auel et al. did not distinguish the rolling and sliding modes) that is averaged over the numbers of particles.
 Hence, we rephrased the statement as follows (L494-495):
 "Auel et al. (2017a) defined the probability for the rolling mode as the ratio of the travelled distance covered by a rolling particle to the overall travelled distances determined by the sum of all transport modes that are averaged over numbers of particles."
- **Comment 9:** Figure 12: What is the pink zone in panel b? Is this the red shaded area referred to in line 518? It needs to be included in the legend and/or caption.

Response: It is the red shaded area with 75% transparency, so it may look a little pink. This area indicates variabilities of the particle velocity $V_p^{Est,*}$ estimated from the flow velocity, ranging from 30% to 80% as suggested by Julien and Bounvilay (2013).
 We have added a sentence in the figure caption of Fig. 12b in the revised manuscript (L536-537).

Additional clarifications

In addition to the above comments, all spelling and grammatical errors have been checked and corrected in the manuscript.

We look forward to hearing from you in due time regarding our submission and to respond to any further questions and comments you may have.

Sincerely,

The authors of manuscript esurf-2021-72.