

## **Author's response to Associate Editor Decision on "Reconstruction of three-dimensional rockfall trajectories using remote sensing and rock-based accelerometers and gyroscopes"**

Dear Michael Krautblatter, dear Niels Hovius.

We thank for the in detail treatment of our manuscript and the positive conception of our submission. We are grateful for the meaningful hints to improve final submission and have augmented the manuscript according to the proposal:

Please find below the response on your remaining suggestions:

*(i) Introduction: In ESurf, there should also be a more prominent statement highlighting the scientific importance of such data next to the engineering practice. The reach of disc shaped particles with a better rotation of particles has been postulated since the pioneering work of Anders Rapp in the 1960s; many scientific papers have speculated on energy transformation of particles during the impact with the ground and scaled it with particle size, surface material, vegetation etc. and introduced an assumed constant "restitution coefficient". Your data provides very good evidence to reject the existence of such a constant restitution coefficient and you mention it in the conclusion. However, there should be a small paragraph in the Introduction better explaining the scientific debate mentioned above to prepare the wider ESurf readership to be able to follow your assumptions.*

We prominently extended the introductory part (Introduction, paragraph 1) by with a small introductory paragraph (and corresponding references) to position our current research in front of the longstanding – and controversial - discussion on restitution coefficients in rockfall science. The revised introductory paragraph and phrasings are marked in blue in the attachment.

*(ii) Starting from the state of the art of "restitution coefficients", it would make sense to provide ratios of ingoing and outgoing kinetic and rotational energies at the impact rather than absolute values to underline the different types of impact. For example in Table 2, I would add a final column at the right with the ratio of  $E_{kin b} / E_{kin e}$  as well as  $E_{rot b} / E_{rot e}$  such as 0.39/1.03 (first line). These two ratios are the crucial outcome in terms of how much kinetic and rotational energy is proportionally lost (or even gained as in the case of rotational energy) and it is much better readable than the non-normalised absolute values. The ratios are a conciser and better normalised information and you also use them implicitly in the text to explain near-perfect elastical rebounds (p17 l2) and so on. I would also suggest using them in the conclusion/abstract to highlight the differences between the alternative types of ground contacts.*

We very much like this idea and eagerly adopted it to the table. However, the ratios have to be calculated from the respective end velocities of a jump and the consecutive start velocity of its succeeding jump. Since the table rows consist of parameter of interest of individual airborne phases, we added new lines corresponding to the respective impacts between these jumps. The rations differ thus slightly from the upper example. The revised caption of Table 2 is marked in blue in the attachment. The additional information arising from those ratios is also discussed in the corresponding sections in the manuscript (p11, l24 ff, p13, l17ff). We also enriched the conclusion with a concluding remark on the restitution coefficient discussion (p14, l14ff).

*(iii) In the conclusion, rather than indicating that these experiments can be transferred to other settings (obviously), I suggest to include a sentence what type of information future experiments could add - other types of contact, greater variation of grain sizes, impact on structures...*

We added a paragraph in the conclusion highlighting further experimental ideas treating greater variety of grain sizes, inclusion of mitigation structures etc. (p14 |21ff).

*(iv) In the attached pdf you find ca. 80 smaller remarks on spelling, readability, clarity etc.*

The manuscript has been amended according to the remarks. Thank you very much!

We would like to thank the Associate Editor Michael Krautblatter for his valuable time in evaluating our manuscript and strongly believe that the publication was enhanced by the made changes.

On behalf of the authors, yours sincerely,

Andrin Caviezel