Earth Surface Dynamics Discussions

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Comment on esurf-2021-72

Anonymous Referee #1

Referee comment on "Signal response of the Swiss plate geophone monitoring system impacted by bedload particles with different transport modes" by Zheng Chen et al., Earth Surf. Dynam. Discuss., https://doi.org/10.5194/esurf-2021-72-RC1, 2021

The paper describes large scale experiments with the Swiss Plate geophone. Different transport modes and impact angles of bedload particles were analysed based on video recordings and geophone data.

The paper is well written and encompasses a sound overview of research on indirect measurement methods. The experiments conducted are precise and the data analysis sound. The number of experiments is however somewhat limited as only one flow condition was analysed.

The aim of the paper is to investigate how the signal response of the Swiss plate impacted by particles changes with transport mode. Although this aim is adequate, the application of these findings are somewhat missing. The conclusions drawn miss how a continuous transport mode measurement might help to improve bed load data collection. Is future analysis of SPG data improved and does it help to better quantify the grain size distribution?

Why were saltation length and height or impact velocity not analysed? These are important parameters according to Sklar and Dietrich (2004) in order to estimate the impact velocity. Direct comparison to the recorded impact could have been made. Is it possible to analyse these from the video recordings?

The number of angles used in the impact experiments is very limited with 45 and 60° only (Table 2). The FEM comparison is not convincing as it does not give similar results. A wider range of experiments would have been useful, also given the fact that 60° impact angle is very high and most of the impacts are likely much lower (e.g. Auel et al. 2017b for supercritical flow).

Please find below line by line comments to further improve the manuscript.

Line by line comments

Line 80, 81. Please don't use three headings without text.

Line 87: Are MPA and JPM data used for further analysis in this paper?

Line 92: bedload sampled in the field. Where is this bedload from? Is there any relation to a real river. This should be mentioned here. Why D67 and D84? Please state their values here.

Line 107. Please indicate the discharge and the Froude number, the flow is supercritical.

Line 111: The video images in Fig 1b are distorted. Did you apply any correction?

Line 140: speed. The discussion is a little academic if the word*speed or velocity* should be used as speed is refers to a scalar and velocity to a vector. As you use the term velocity mostly throughout your paper (e.g. caption Fig 2 on the same topic), you should use it consistently.

Line 125: The chosen angles are rather steep compared to real particle impact angles as e.g. given in Auel et al. 2017b (not cited). Note that these angles are flat due to supercritical flow conditions. Your impact angles might be larger. Please elaborate if 45 and 60° are close to your observations.

Line 169: studies have shown.

Line 169: the probability of transport mode. The transport mode has no probability, saltation, rolling or suspension have a probability. Please rewrite.

Line 171: The choice of Teta_crit is quite crucial as you use it for plotting your results as a function of transport stage T and compare it with many other results taken from Auel et al 2017. Please elaborate in detail how you derived this value. You have a fixed bed. What

did Schneider and Shahmohammadi use in their studies? Auel et al. 2017 list a large variety of these values in their Table 3 and state: *most laboratory studies investigated motion of isolated particles moving on top of a bed of similar roughness size, for which θc = 0.008 to 0.01 were determined (Fenton and Abbott, 1977; Dancey et al.,2002).*

You also investigated isolated particles over a fixed bed of similar roughness size. Therefore, the choice of 0.03 is too high from my point of view. At least you should perform a sensitivity analysis of your results by varying teta_crit in order to check the effects on your results.

Line 157: you mention uniform flow conditions here. This should be mentioned in chapter 2.1.2 already, if the flow is uniform or gradually varied.

Line 176 ff. Chapter 2.3.2. It is not clear for what the description of the forces are used. Fig 4b and c are not explained at all. These forces have to be elaborated in more detail here and used also in the discussion section. See Auel et al 2017b for discussion on vertical and horizontal energy transfer. Else Fig 4 and the corresponding text should be deleted.

Line 184: please elaborate more what the vertical support force is? That is not entirely clear for me. Is this connected to the lift force? The lift force is caused by both the flow velocity gradient (Saffman force) and the spinning motion of the particle (Magnus force). Please elaborate more on that.

Line 252: I guess you mean VP,EST here instead of VP,CAL. Julien and Bounvilay analysed rolling particle velocities. You have mostly saltation in your experiments. Auel et al. 2017 found that particle velocity is only 8.5% lower than flow velocity for saltation in supercritical flows (hence rpw = 0.915). Finally which value for rpw did you chose for further analysis as 0.3 to 0.8 is a large variation.

Line 285: Fig 7. No need to do a semi log plot here, better use a regular Y axis.

Line 293, line 308, line 318, Fig 8b, Fig 9b, Fig. 10b. Please elaborate more on the difference between FEM and lab experiments. For me it looks like the results do not match at all. With the FEM I would expect the you reach results close to the still water experiments. How did you calibrate the FEM model?

Line 329 ff ;Discussion 4.1 should be improved to better understand how these results help to improve the geophone data analysis.

Line 330: Please explain what ri.j is good for? For what do you use or need this parameter?

Line 396. Explain the Hertz theory in a few words please.

Line 428: it should be noted here, that Auel et al 2017 did not differ between sliding and rolling. Both modes are included in their rolling mode.

Line 436: difference of estimation of rolling probability of Auel and you is not clear. Please rewrite, how do you obtain your value and what the difference to Auel is.

Line 445. … Auel et al. (2017) indicated that large particles have a high probability PRol. It is important to note that this is true for similar transport stages T (as T is dependent on friction velocity and particle size).

Line 446: Unclear. Please rephrase. Energy consumption of small particles is larger, that is why they saltate more? By energy consumption you mean energy transfer to the particle?

447: Proll decreases with large sizes? Please refer to the respective Figure in your results (12a?, In 12a, almost no variation of PR is visible for your saltation results). If Proll decreases, consequently Psal increases. Why should this be the effect of gravity? This result remains unclear. Please define how the 3 modes are related in your analysis (e.g. PRoll = (1-Psal), etc.)

448f: As transport stage T is a non-dimensional parameter, it should not play a role if your particles are larger.

451: note that Auel et al 2017 did not distinguish between rolling and sliding (see comment line 428).

454: The proposed line between sliding and rolling is interesting. Is this really a fit? Please state R^2.

455: I agree, that more flow conditions would be needed. Your variation in transport stage stems from different particle sizes but not flow (friction) velocities.

- The meaning of VP,Est is not clear for me. A variation between 30 and 80% is very large. What do you want to show with that?

467: Given that this is a double log plot, the data is not close to Auel et al. 2017. Your power function is 0.32 while it is 0.5 for Auel.

482 Conclusion.

Please indicate what would be the benefit of these statements for the geophone data analysis. Does your analysis help to indicate the transport mode with the SPG in the field? This would be the main result of your study. However, your discussion and conclusions do not really reveal if this is possible with your results.