

Overarching suggestion

The inversion model gives a relatively simple physical-based foundation for evaluating the relationship between the acoustic source in the form of sediment impacts. To better be able to assess the model context and performance relative to other existing ones, I think that an introduction of the various models proposed thus far for the relationship between acoustic power and bedload flux should be needed (e.g., Thorne and Foden, 1988; Nasr et al., 2022). These models significantly differ from your inversion model in terms of the model derivation approaches and parameter space. E.g., the Nasr et al., (2022) model is derived using process-based bedload kinematic arguments, while the inversion model does not require such an in-detail perspective. I think you should make these points clear in your manuscript. Following your results and interpretations, you could also add a discussion about the different aspects in which the new inversion model is different than previously proposed models.

Line-by-line comments

Abstract: I think you should explain more about the model - what is unique about it? How is it different than the model proposed by Nasr et al., (2022)?

Line 14: 'measurements': are these measurements? Or data?

16: this sounds like you are supplying a full solution, are you?

19-21: grammar issues: (1) 'we tested the model using two field'... the field campaigns are not used to test the model, but the data are. (2) 'which measured the'... the field campaigns did not measure - the sensors measure...

22: define what the bedload profile is.

22-24: This is a little bit uninformative and ambiguous: it is unclear what a 'unique' curve is.

24: 'The inversion model shows..' - How does it show that? Perhaps the comparison of the model to data is essential for this interpretation?

27: 'Bedload...' do you mean bedload transport?

28: (1) the 'but' implies that you are contrasting the following sentence relative to the preceding one, are you? I don't think so. (2) I think that this sentence is constructed wrongly since it implies that in addition to some reasoning earlier, bedload is ALSO a consequence of morphology. However, earlier you did not supply such reasoning. Suggesting rephrasing the sentence.

29: 'velocity' - and also due to spatially heterogeneous micro-topography at the bed.

32: unclear. What is bed response?

35: high-resolution: spatial and/or temporal?

37: 'these techniques' - not all 'sensors' allow this, so you might want to relocate this sentence after the sentence introducing sensors that measure the energy that is emitted by signals...

41: grammar issues. Change 'consists in measuring directly' to 'another approach directly measures...'

48-49: This by itself can also be interpreted as increasing bedload flux (or changing turbulent structure/intensity) as a function of slope. Rephrase the sentence to make it clear.

52: with 'issue' you are implying a specific problem. If you meant it like this, please specify the problem. If you are referring to the general problem of formalizing an inversion model then state it explicitly.

53: for five gravel-bed rivers. (add 'rivers')

54-55: This sentence is misleading - the overestimation of data can suggest more views, not only that the finest grain sizes are not captured by the model.

60-63: Too lengthy and confusing. Split into two sentences.

65: 'this' - Do you mean the Geay et al., (2019) work? it is unclear.

73: you need to make it clear that the pressure fluctuations are occurring in a fluid media.

78-80: It might be a nuance, but I think it would be a result of a general physical model, isn't it? e.g., the Tsai et al., (2012) model for seismic noise contains the same properties.

98: what do you mean by source profile? Explain.

123: Define the variable h .

136: I am unclear if the attenuation coefficient is α_{λ} as defined in line 132, at which you referred to it as a dimensionless attenuation constant'. Clarify and use the same terms.

137: 'in the first place' - This part of the sentence is unclear. Do you mean 'to first order'?

143: 'with TL calibrated with' - Grammar. Rephrase.

146: what is global in that sense? Clarify.

149: delete 'Let's'.

149: 'in the space' - why not be more specific and state that the sources are located on the river bed? if you mean that particle-to-particle impacts are also considered then you need to address these explicitly.

152: 'surfacic acoustic sources' - What are these? Define.

160: Add an opening sentence giving a rationale for the paragraph. Currently, it is unclear where you are leading it without reading it through.

165: the notation of the Figure's colors belongs to the figure's caption. Not in the main text.

169: 'the vertical green lines...' - this also belongs to the fig's captions.

179: section 3.1: This section can be better communicated. The rationale is clear, but there are some structure and communication issues that make the following paragraphs hard to follow. Start with introducing the problem and Fig. 2 as you do. Describe the settings and why the example using a drift boat is relevant to acoustic measurements. Try to better communicate the variables, their meanings, and their relevance in the specific equations.

187: change 'For solving' to 'to solve'.

187: 'the acoustic measurements' - measurements are not a parameter. Do you mean data PSD? Clarify.

188: replace 'the' with 'a' before 'drift'.

190: the x direction is not specified in your text.

190: after 'PSD', add either 'data' or 'measurements'.

204: In Eq. (9b), explain the annotations of the attenuation variables. E.g., what does $A_{1,N}$ stand for?

Also - explain the rationale of Eq. 9b. To form an intuition of this model, give a short example of the algebraic calculation followed by specific outcomes of the matrix multiplication.

212-213: 'best fit of the measured...' that does not read well - rephrase.

223: add 'a' before 'minimization'

223: add a comma after 10b

227: 'instability' - how do you define stability in that case? does the solution diverges? explain.

227: what are slight variations? Explain.

234: 'close row values' - unclear, explain.

235: which coefficients?

236: $N = M$ - is there any method/wat to constrain the number of sources?

243-244: The sentence about bedload active channel distributions is unclear. Rephrase.

246: 'blue curve' - move to the figure's caption.

248: 'above each....' this is unclear given that you are dealing with a 3D domain. State explicitly that the above is in the vertical dimension.

248: 'simulated PSD' - You need to differentiate between 'simulated' and 'measured' - in Eq. (7) the variable P is the measured acoustic power. Here it is simulated using Eq. (7). Make the differences between an actual measurement and a simulation clearer.

251-251: move figure descriptions to the caption.

251: 'random coefficients' - this is vague. You need to give the reader the possibility to reproduce your results. What you could do is, in the supplementary material, explain in a few

sentences in what way you introduced such noise. I also encourage you to consider the sources of such noises (however, it may be better to discuss this in the discussion).

263: the imposed one is not inverted - rephrase the sentence.

269: 'that is unit\scale, ...' – the sentence is unclear, rephrase.

274: How do you define 'good'? I would argue that $VE_{cv} = 0$ is good. Hence, isn't it comparative?

280: Figure 3 caption - I think that the figure should be independent, to some extent, from the text. Thus, make sure that just by looking at the figure + reading its caption, the reader is able to understand the context and the results. Specifically: 1. I don't understand what the titles (VE_{cv}) stand for. Clarify .2 .You need to better communicate the different curves. It is a relatively complicated figure with lots of details. Extend the caption to explain the different curves (red; blue; black); 3 .What is the difference between the red curves: specifically, what is the difference between SGN with\without noise?

283: 'This first experiment' – beginning with this statement makes the readers ask themselves whether they've missed anything. In other words - context is missing. Add a sentence or two between titles 4 and 4.1 explaining what you are about to do in the following Section 4.

301-302: 'at a distance of' - unclear. Explain the location such that it is better understood.

309: define the directions of x and y in space relative to the river dimensions.

314: I am unclear about what is 'drift n' – rephrase.

321: remind the readers what is the source of the coefficient

323: 'third-octave band' – why?

326-327: 'The ratio between...' - Unclear. Rephrase sentence.

329: Figure 5b plots bedload flux rather than acoustic power. Do you mean 4b?

337: I am unclear about what is 'ex' in the parentheses.

338: 'Figure 5c' – you actually mean 4c.

338-339: move the color descriptions to the figure's caption.

341: 'lab-measured spectrum' – unclear.

342-343: I don't understand what you did here and what the point is. Clarify.

343: 'Figure 5b' – it is actually 4b.

345: 'good performance' - Again - I am unclear on how you define 'good' performance. Mentioning the spherical model association kind of makes me want to compare the performance to a different model (E.g., the cylindrical model). I understand that this is probably beyond the scope of your study, thus you need to carefully consider your phrasing here.

Figure 4 captions: the dashed red line cannot be spotted in the figure.

Additionally, you mention the mean inversed spectrum, in the red line, but I am unclear on how to recognize it.

350: replace 'The experiment' with 'An experiment'.

352: 'Two SGN and bedload flux...' - What is the difference between the two? I think you want to say here that bedload produces SGN, right?

358-359: 'similarly to the active test'... I think this sentence is redundant.

361: Fig. 6a does not show what you mean. You have a problem with figure numbering(?).

370: 'For solving the inversion problem' - be more specific and clear with your aims.

373-374: How are they estimated? Explain.

382: 'left part of the river section' - in the text, add the specific location on the x-axis.

384: 'a qualitative analysis' - unclear, what do you mean by that?

385: 'heard' - Do you mean that you are listening to the files? Clarify.

389-390: explain this interpretation.

Figure 5: in panel b, delete the zero before 2021.

395: Replace the first 'The' with 'A'.

405: Given that you are using the measured profile to conduct the inversion, I don't understand the rationale behind comparing also the measured acoustic profile.

409: Change 'The Values' to 'The values'.

410: better than what?

416: Remind the reader what 'window' stand for.

417-418: move the color and point descriptions to the figure's caption.

420: RMA is not defined. Please do.

420: This is a judgment\subjective statement. Replace with stating the reasoning for using such regression method and omit the 'recommended'.

428-429: Vague. Clarify and reference specific figures.

437: add 'the' after 'in'

440: I think you should also mention the sound generated by rainfall impacting the water surface, as well as the turbulence fluctuations near the boundaries (bed and air).

445: 'qs = f(P)' - spell out the relationship using text.

446: Separate 'as' from 'predicted' (they are attached to each other).

446: The citation of Nasr et al., lacks the associated year of publication.

453: how do you reason such a reduction of the effects by the inversion model?

454: I am unclear on how you interpret the different transport conditions. You need to be more explicit in this argument - do you mean the difference between 2018 and 20121? Do you mean the different conditions along the cross-section? Or both? Clarify.

455: I am unclear on how you separate noises from various sources following the inversion. Elaborate.

456: omit 'in this context'.

459: Slope: I think this is a great contribution made by your study which should be emphasized in the main text. You could elaborate a little bit here on the process, and present the empirical equations you derived. Also, state how Geay et al., (2019) obtained/calculated channel slope so that this is reproducible by others in the future.

462-463: move 'red' and 'black' to the figure's caption.

471: omit 'in the first place'.

476: 'most important' – that's judgment statement.

477: You have extra parentheses before the citation of Geay et al. (2018). Remove.

478: 'naïve' - judgment. Remove.

480: add 'the' before 'results'.

482: replace 'out of' with 'beyond'.

499: 'ss' is misspelled. You probably mean 'as'.