

Dear Reviewers:

Thank you for your kind revisions and comments, in the revised version of the manuscript, we took into account all the comments of the reviewers and made the manuscript corrections as they suggested. In the revision submission, we provided two documents, one marked-up manuscript version (Xiaoyue_Zhou_REV.doc) showing the changes made, and the other final version of the manuscript (Xiaoyue_Zhou_DEF.doc). Thanks to the reviewers' kind suggestions. In the manuscript, the organizational structure of the paper is adjusted in detail, especially in the introduction part, which explains the advantages and disadvantages of seismological methods and traditional hydrological stations and remote sensing methods for monitoring river processes, and adds references for theoretical support, and describes the experimental settings in more detail, and draws a table of the placement of seismic instruments in the experimental process, which is composed of four experiments in four sections of a river, in order to explore the application of seismological methods in monitoring river processes. In this study, an empirical model was constructed based on the research results of previous scholars to invert the river flow, which opened up a good situation for us to explore the use of seismology to monitor the river process. In the REV file, corrections addressing the comments from Reviewer, are reported in red. All your suggestions are replied to as follows on a point-by-point basis.

Comments (checklist) by the reviewers:

General comments

The general structure of the manuscript is not satisfying. There is no clear cut between methodological considerations, manuscript results and result discussion, which are mixed up through sections 3 to 5. In general, the grounding of the manuscript into an appropriate literature context is insufficient, so is the mobilization of the literature to illustrate and support the argument, and to put the results into perspective in the Discussion. In many instances, the used references are irrelevant and/or erroneous with regards to the treated topic (e.g. reference to Aderhold et al., 2015 on l. 101-104, or to Bagnold et al., 1966 on l. 325). There are some articles in the bibliography that are not cited in the manuscript.

Response: Thank you for your kind revisions and comments. The overall structure of the manuscript has been reconstructed, and the introduction is reorganized, according to the importance of river monitoring and the key phenomena of river flow, followed by the advantages of using seismic methods to monitor river processes, the key research in the field of river seismology is briefly mentioned, and the specific research of scholars using seismic methods to monitor river processes is cited to provide theoretical support for the subsequent discussion, and finally the purpose of this study and the contribution of current research to the field of river seismology are introduced. This study consists of four experiments, four river sections are selected from the upstream to the lower reaches of the river, and each section is subjected to a 20-minute river process monitoring experiment, and an empirical model is constructed to invert the river flow according to the previous scholars' research, and whether it is feasible to use seismic methods to monitor the river process. In this paper, literature in the field of river seismology in recent years has been added to the manuscript, and the research results of scholars are used to provide theoretical support for this research. Corrections were made for incorrect citations of references in the manuscript. Thank you very much.

Specific comments

1. Introduction

l. 33-40: I do not find the first paragraph to be very efficient to justify the need for seismic studies of water discharge.

Response: Thank you for your suggestions. The first paragraph of the introduction begins with an opening statement to demonstrate the importance of monitoring river processes and to describe the advantages of using seismology to monitor river processes. More detailed have been presented in Line 34-36 in Section 1 "Introduction" in the Xiaoyue_Zhou_REV file. Thank you very much.

l.36: Please add a few references to illustrate your argument about remote sensing technology.

Response: Done. It has been presented in Line 42 in Section 1 "Introduction" in the Xiaoyue_Zhou_REV file. Thank you very much.

l.38-39: Cook and Dietze (2022) and Larose et al. (2015) have reviewed environmental seismology. They may not be the best references to illustrate your point about time-consuming and resource-intensive approach of hydrological stations. l. 87: Not convinced Viparelli et al. (2011) is an appropriate reference in this context.l.42-43: Turowski et al. (2011) have not used environmental seismology, but acoustic sensors. l. 46: Ricken man n et al. (2012) have used acoustic monitoring of bedload transport, not microseismic. l. 69: Gae u man (2014) is an off-topic reference.

Response: Thank you for your suggestions. References have been adjusted.

l. 41: Please define what you mean by "microseismic".

Response: Thank you for your suggestions. "microseismic" refers to seismic signal, which has been changed in the manuscript.

l. 57-69: The focus should remain on water depth/discharge seismic sensing, and not much on bedload transport sensing, since it is not something done in the frame of this manuscript.

Response: Thank you for your suggestions. This paragraph has been rephrased.

l. 71-78: The paragraph goes in too many directions, without a clear structure, and lacks of appropriate scientific references.

Response: Thank you for your suggestions. The language of this paragraph has been reorganized and references have been added.

l.76-77: I am surprised that the turbulence model of Gimbert et al. (2014) to invert streamflow information from low frequency band seismic energy is not mentioned, described and further mobilized here, and throughout the manuscript.

Response: Done. The relevant content of this document has been cited and displayed in the manuscript.

2. Experiments

l. 91-97: Characteristics and statistics that are provided to describe the field site are not

backed up with references.

Response: Done. Added references to site feature descriptions.

I. 97-98: Can you provide some statistics on the discharge of the Jiuqu river (annual mean, variability, discharge during the experiments, etc.). Also, why is the discharge different between the different sections (e.g. tributary input?). If assuming mass conservation, the discharge is constant between the different sections, and it is its partitioning between width, depth and flow velocity that varies.

Response: Thank you for this suggestion. Data on the study of river flow have been added to the manuscript, and the specific changes are presented in the manuscript. The discharge different between the different sections may be due to the tributaries. The average annual precipitation in the study area was plotted.

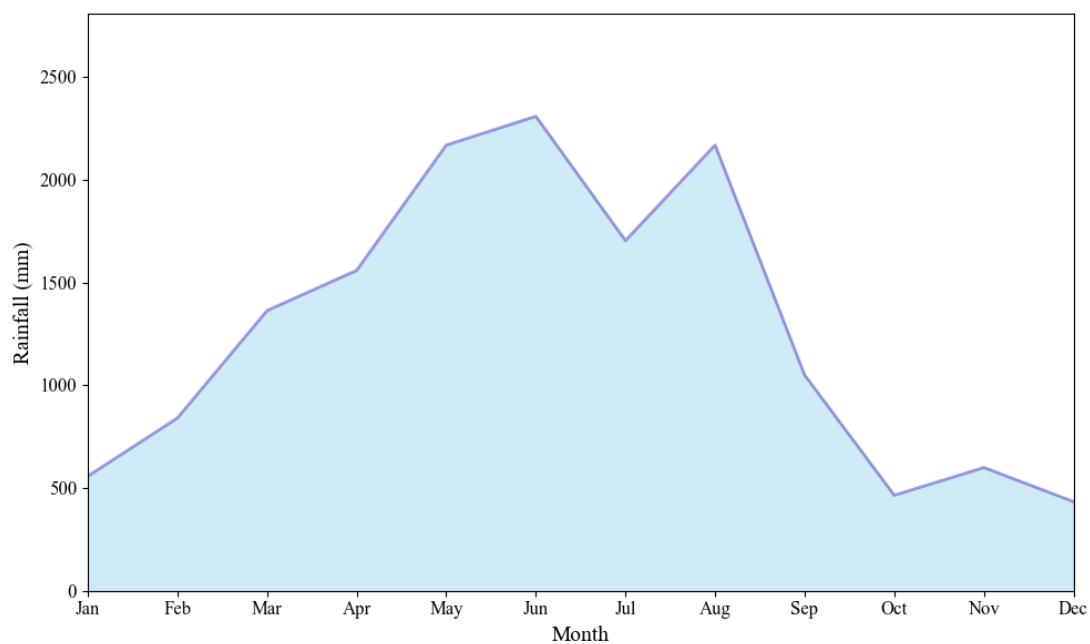


Figure 2. Monthly precipitation at the experiment site

I. 97-101: At line 97, it is mentioned that “four monitoring experiments were conducted at four sections (...)”. At lines 99-100, “we selected a curved section of the Jiuqu”. I do not understand the link between the initial four sections, and the following one section.

Response: Thanks. The specific description of the four river monitoring experiments on the Jiuqu River has been revised in the manuscript.

I. 101-104: the river studied in Aderhold et al. (2015) is in New Mexico! How do you transfer their local grain-size distribution measurements to the Jiuqu River, China?

Response: Thank you for your suggestions, the references are misplaced and have been revised in the manuscript of the text.

I. 105-107: Is this information about silt and sediment concentration needed with respect to streamflow seismic sensing? If it is, please justify its purpose in the text. If not, I would remove

it.

Response: Thanks. The sediment content has been removed.

I. 119: Location of the seismic sensor is not clear.

Response: Thanks. The location of the seismic sensor is described in detail below. "In this study, four field monitoring experiments were conducted at four sections of the Jiuqu River with different discharge. Flowmeters and seismic stations were installed on the riverbank to measure the flow velocity and seismic ambient noise in each segment. Four seismic monitoring devices were utilized for this study. The station deployment protocol was as follows: During each experiment, the S3 (Station 3) unit was consistently deployed near roadsides with frequent human activity. The remaining three sensors were distributed in different hydrological environments - one installed in the river channel, another along the riverbank, and a third positioned approximately 50 meters offshore for ambient environmental noise comparison monitoring. (Note: The offshore deployment was omitted during the fourth experiment due to site constraints.). Each experiment lasted for 20 minutes. Therefore, in all four experiments, the S3 (Station 3) was placed about 1 meter from the riverbank, near the road. This configuration aimed to record seismic signals generated by river activities while minimizing interference from human activities. The flow velocity was continuously measured at a sampling frequency of once per minute."

I.119-122: I would say this information is not needed.

Response: Done. This sentence has been deleted.

I. 123-124: Phrasing not clear enough with respect to which of the two types is sensitive to high-frequency (...). Please rephrase. I.125-132: I am not convinced the content of this paragraph is of first relevance with regards to the focus of this manuscript.

Response: Done. The description of the instrument in these two manuscripts has been modified, and the specific changes are shown in the manuscripts.

I. 142-143: why isolating the sensors from the ground if seismic waves travelling in the ground are aimed to be measured?

Response: Thank you for this suggestion. This is the leveling bracket for the seismic instrument, and the seismograph needs to be used after leveling.

Figure 3: I am struggling to follow between the four test sites in Figure 1, and the four seismic stations in Figure 3. Please clarify how many seismometers were used in each site, where there were located, what distance to the stream, what were the potential sources of external noise, etc. Perhaps a summary table would be helpful for this purpose.

Response: Thank you for your suggestion. A table summarizing the location distribution and number of individual instruments is as follows:

Table1. List of the seismic stations used in this study and of their features in terms of sample rate, distance from the river and distance from the road.

Name	Experiment	Sample Rate (Hz)	Distance from the River (m)	Distance from the Road (m)
S3	1	200	50	1
S4	1	200	0.1	50

S5	1	200	1.5	50
S2	2	200	0.1	50
S3	2	200	100	1
S4	2	200	1.5	100
S5	2	200	3	100
S2	3	200	1.5	100
S3	3	200	100	1
S4	3	200	0.1	100
S5	3	200	3	100
S2	4	200	1.5	100
S3	4	200	100	1
S4	4	200	0.1	100
S5	4	200	3	100

I. 158: Is an ‘experiment’ the same thing than a ‘test’. Please use the same word to refer to the same step, to easen the reading.

Response: Thank you for your suggestions, the two have been reconciled in the manuscript.

I. 163-169: This paragraph may belong to the ‘Result’ section.

Response: Done. This section has been moved to the results section.

I. 182: Unclear what is meant by ‘appropriate devices’. Please be more specific, with argument illustrated by references.

Response: Done. I changed ‘appropriate devices’ to ‘flowmeters’.

3. Seismic ambient noise

I. 220: It is not clear if there should be the ‘Results’ section starting here, or whether we are still in the methodology description.

Response: Thanks. Adjust the order of paragraphs in the manuscript.

I. 223: Reference to back up your statement.

Response: Done. References have been cited.

I.224-225: Not clear what “flow configuration of the river” means in this context. Please be more specific.

Response: Thank you for this suggestion. “flow configuration of the river” refers to the shape and manifold of the river.

I. 228-231: In this paragraph, I would really specify what process can be distinguished (again, focusing on streamflow) in which frequency band, with referencing to the appropriate literature.

Response: Done. Specific frequency bands have been added to the manuscript and relevant references have been cited.

l.241-246: This paragraph may belong to the ‘Results’ section.

Response: Done. Adjustments were made to the paragraph distribution in the manuscript.

l.262: It is still not clear to me whether the different Tests are used to investigate the same thing at different sites, or whether different experiments are conducted at each site.

Response: Thanks. Each experiment is described, and this study consists of four experiments in these four river sections.

l. 272-276: Comparison of the ‘Results’ with the literature belongs to the Discussion section I think.

Response: Done. This paragraph has been placed in the discussion section.

l. 283: Please be consistent and specific with the naming. What are locations 1, 2 and 3? According to l. 256-270, location 1 should instead be Test 1, S4; location 2 should be Test 2, S2, etc. I agree this does not read well, so I think there is a general rework to do to rename all the experiments and sensor location in a clearer way.

Response: Done. The interpretation of the numbers of the individual instruments is specified in the table 1.

l. 293-297: Mainly repetitions from l. 221-227.

Response: Thank you for your suggestions, this part has been removed from the manuscript.

l.298-299: Those considerations should come earlier in the manuscript. The reference to Boano et al. (2011) is irrelevant (i.e. the paper is about hyporheic exchange, not sediment transport).

Response: Thank you for your suggestion. This sentence was removed from the manuscript after careful consideration.

l.317-328: Again, I would say those considerations belong to the Discussion.

Response: Thank you for this suggestion. It has been moved to the discussion section, which is presented in the manuscript.

l. 325: Why do you mention human activities here? Reference to Bagnold (1966) is inappropriate in this context. Not convinced the reference to Turowski and Bloem (2016) is neither relevant in this context.

Response: Thank you for your questions. Human activity is mentioned because this high-frequency band noise can be caused by human activity. The references have been revised.

l.331-339: Please specify in the Figure 10 caption for which Test and sensor location the different diagrams relate to.

Response: Done. In the title of Figure 10, different plots have been added in relation to which test and sensor position is relevant.

4. Seismic interpretation and river discharge calculation

l.342-364: This is pure methodological description, and it should appear much earlier in the manuscript. You have already presented many result figures containing PSDs.

Response: Thank you for this suggestion. This passage has been moved to the methodology section in the manuscript.

l.378-381: I do not find the matching that clear. You may want to use a metric like a correlation to support your observation more quantitatively. The variations in discharge are very small, probably much smaller than the precision you get with the hydraulic estimate of discharge, so I am not convinced those results are robust enough. In addition, I guess your were walking into the river to do the velocity measurements, and this may have also been recorded in the seismic signal. Figure 11: Why is it needed to present the results for every 3 components of the seismic sensor?

Response: Thank you for your suggestions. The three components of this instrument that monitors river processes are all related to river flow, which is more convincing.

5. Results and Discussion

l. 397-403: Again, not clear from which experiment, test, location, section, etc. we are talking about.

Response: Thank you for your suggestions. The specific description of the experiment has been modified in detail in the Methods section.

l. 403-404: Not clear to me.

Response: Thank you for your suggestions, this sentence has been modified to read as follows: 'The total energy of the seismic waveforms generated by multiple sources is the sum of the energies in the river processes.'

l. 466-472: In general, it looks like you are proposing an empirical model (and not a physical one as argued in the title) that requires calibration to predict discharge, while a physical model of turbulence has already been developed (Gimbert et al., 2014) and tested in multiple instances (e.g. Dietze et al., 2019), so I am not convinced by the usefulness of the proposed model.

Response: Thanks. This study is a preliminary exploration of the use of seismic methods to monitor river processes, and an empirical model is proposed, which is an application of the physical model proposed by previous scholars.

6. Conclusion

l. 487-503: The organization of the argument in this paragraph is very fuzzy.

Response: Thank you for your suggestion. The last paragraph of the conclusion is rephrased and is shown in the manuscript.

7. References

l. 516: Burtin et al. (2008) not cited in the manuscript, while it definitely should. l. 536: Foulds et al. (2014) not cited in the manuscript. Technical corrections

Response: Thank you for your suggestions, the issue of these two references has been revised in the

literature.

I. 176: “precision” instead of ‘accuracy’ I think.

Response: Thank you for your suggestions, 'accuracy' has been changed to 'precision' in the manuscript.

I. 510-586: in multiple instances (e.g. Schmandt et al., 2013), I saw that there are missing spaces between words in the references. Please check and correct throughout.

Response: Thank you for your suggestions, the absence of spaces between words in the references has been revised.

I. 563: Reference not sorted in alphabetic order.

Response: Done, the references in the manuscript have been revised to be in alphabetical order.

I.275: Tsai et al. (2012), and not Tasi. I. 568: Tsai et al. (2012) cited twice in the bibliography.

Response: Done, it has been revised in the manuscript.

References

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