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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Evaluating quality of data collected by volunteers for first level inspection of hydraulic structures in mountain catchments" *by* V. J. Cortes Arevalo et al.

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Dear Editor,

We would like to thank the Reviewers for their valuable comments and suggestions to enhance the scientific quality of our contribution. We deeply appreciate their enthusiastic comments to the manuscript.

Reviews refer first to the representativeness of volunteers. Then, to the choices for the inspection of hydraulic structures, according to the type of hazards we are dealing with. Therefore, their recommendations address both dimensions of the research to improve

clarity to the reader and widen our contribution.

In the following, we have addressed the reviewers' comments according to the sections of the paper. We will wait for communication of the editor before uploading a new version of the manuscript. We also thank Reviewers for the technical corrections: the ultimate manuscript will be amended accordingly.

Kind regards on behalf of all authors,

V. J. Cortes Arevalo

Authors' comments (AC) to review from reviewer 1 (R1) and reviewer 2 (R2).

General comments:
As suggested by R2, we will add a sub-section at the beginning of the methods to address participants' groups. Then, we will streamline the methods by including tables to characterize participants and to synthesize the rating scales. Regarding the paper length, we have balanced the requests of further explanations (R1) with the synthesis requirements (R2). Therefore, the paper length may eventually be only slightly shortened, but with an increase on the overall quality.

In this document, we distinguished reference to additional tables or sub-sections with (*). We used some additional references to support our explanations that are listed accordingly to the response.

Title:

R1 on p.C1156: *"I would propose changing the title to improve its clarity..."*

AC: We appreciate the suggestions by adjusting the title from "Evaluating quality of data" to *"Evaluating data quality"*.

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Abstract:

R1 on p.C1156: *"kind and number of volunteers used in the first sentence and to mention more precisely where the inspections were undertaken ..."*

AC: This information will be briefly mentioned in the abstract. Further details on location will be provided in section 2.

Introduction:

R1 on p.C1156: *"...reason for using citizen based-approaches/volunteers..."*

AC: A more detailed explanation on the opportunities for citizen-based approaches will be added after lines 10-12 on p. 3579.

R1 on p.C1156: *"...the type and frequency of hazards involved; and their destruction concerning hydraulic structures..."* **R1 on p.C1156-1157:** *"...In the same paragraph (p. 3580, 2nd paragraph)..., It would be logical to mention the inverse as well, influence of sediment and other processes on the security of hydraulic structures." "...obstruction and erosion of bridges and culverts is mentioned. Here other forms of obstruction apart from sediments should be mentioned, such as logs, vegetation etc. The different forms of obstruction should ideally be introduced earlier on in the paper"*

As well as:

R2 on p.C1215: *"on p.3580, lines 10-21. This paragraph could be shortened ...For instance, the sentence "Therefore . . . dams" (lines 16-17) could be deleted."*
AC: We split the paragraph starting with line 10 on p.3580. Therefore, we will rearrange in one-paragraph lines 12-16 on p. 3580. That is to include comments of R1 while avoiding repetitions in the arguments (R2). Further details on the different forms

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of obstruction will be added while describing the form (i.e. section 2.1).

R1 on p.C1156: *"On p. 3580, 2nd paragraph - describe in one or two sentences what type of citizen volunteer groups and how many volunteers are involved, how representative they are for different target groups. Also explain why and under which circumstances the groups are selected (remoteness, difficulty in logistics?)"*
AC: We will follow the suggestion by putting in one-paragraph lines 10-11 and 18-21 on p. 3580 as well as adding a clarification on the type and number of volunteers.

2. Methods:

R1 on p.C1157: *"Explain who the volunteers were. Why were no local inhabitants such as farmers, fishers, local citizens, mountain guides etc. implied?"... "In the third paragraph (on p.3582), it is indicated that photos were taken by some volunteers. This should be indicated in the methodology earlier on. Why was systematic photography not used as part of the methodology by all volunteers?"*
AC: We agree with R1 on the need to clarify the target groups at first (lines 6-15 on p. 3581). Therefore, we will add one paragraph for each step of the methodology. The first one for participants groups by answering to R1. The second one to introduce better the rating scales in the inspection form. Thus, we will move into that introductory paragraph the lines 3-6 on p. 3583, where we will also specify about the use of photo record (R1). Finally, we will introduce the data-collection exercise with little adjustments to the original text.

Citizens were involved in the form of Civil Protection volunteers due to safety and related responsibility issues. In addition, we chose to widen the range of participants to students for assumed differences in preliminary knowledge to fill the form. Civil Protection volunteers in the study area offered opportunities to collect useful information about the functional status of the structures, due to their level of involvement

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and hazard experience. However, we could also specify in the discussion potential target groups for further research. The instrument could be tested in other study area to evaluate opportunities for decision-making. In addition, it could be adapted for other target groups who are not aware/involved on management activities (e.g. last-year high school students). That could be an alternative approach to enhance their awareness towards hydrometoerological hazards and mitigation actions.

R1 on p.1157: *"What was the level of knowledge of the volunteers on the type of work they were doing? Did some already have similar training?..."* **R1 on p.C1157-1158:** *"In the third paragraph (lines 17-26 on p.3584), explain how the participants were chosen. Self-application or selected? What was their age group? Experience? Were they indigenous or from outside? Why were only students and actors from Civil Protection taken? From which university were the students from? All from the same? In which year of study were they?"*

As well as:

R2 on p.C1215: *"Section 2, p. 3581, lines 6-15. There is some confusion between the different groups of actors described. Please, clarify the profile or requisites imposed to be "selected" as citizen-volunteer. Degree of studies? Are all of them from Civil Protection, geosciences and social sciences students? Previous knowledge on the matter?."*
R2 on p.1215-1216: *"Please, add more information about their age, sex and provenance distribution. Write here the total number of volunteers and technicians that participate in the exercise. How were distributed in the Control and Learning Groups (number and criteria)? What is the relationship between this distribution and this explained in page 3584, lines 17-26? I would recommend join this information and starting section 2 with the presentation of the "sample" of volunteers and technicians, criteria, statistics, distribution in different groups,.. Perhaps a table could be useful to synthetize all this kind of information..."*
AC: Following the recommendation of R2, a sub-section 2.1.* Participants' groups will

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be added. We will support the added text by two tables (1*. distribution of participants and A1*. their characteristics). To introduce Table 1*, we will move up lines 17-26 on p.3584 into sub-section 2.1*.
Then, Table A1* will summarize characteristics of participants according to the distribution presented in Table 1*. To introduce Table A1*, we will rearranged into the same sub-section lines 8-13 on p.3584. Thus, Table A1* will summarize aspects such as age, level of education, risk experience, gender, time in location and preliminary knowledge on the matter. Traditionally, citizen-volunteers of Civil Protection received minimum training that includes formative, informative and safety procedures (Protezione Civille della Regione FVG, 2009). Instead, students have preliminary knowledge on the matter according to their background studies and own experience.

Cited references: Protezione Civille della Regione FVG: Formazione, Formazione Campus Virtuale [online] Available from: http://www.protezionecivile.fvg.it/ProtCiv/default.aspx/81-formazione.htm (Accessed 7 July 2014).

2.1 Design of the inspection forms:

R1 on p.C1157: *"In the second paragraph on p. 3582, it is stated that parameter A focusses on water flow and erosion. Please mention in more detail what kind of erosion or obstruction...been considered in the forms?"*
AC: We agree with R1 to specify about obstructions to inspect in the form. Thus, we made a separated paragraph from lines 3-6 on p.3582 to detail on that aspect.

Cited references: Remaître, A., Malet, J.-P. and Maquaire, O.: Morphology and sedimentology of a complex debris flow in a clay-shale basin, Earth Surf. Process. Landf., 30, 339–348, doi:10.1002/esp.1161, 2005.

R2 on p.C1216: *"Section 2.1, p. 3582. Lines 26-27. It would be more interesting having an example of these four questions than the present example of A1, A2, A3*

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and A4."

AC: We thanks R1 for the suggestion. Thus, we modified lines 26-27 on p. 3582 by adding some examples of questions. Then, we emphasize in the text that the inspection forms adopted are available as supplementary material to the manuscript.

R2 on p.C1216: *"Section 2.1, p. 3583. Lines 5-9. You speak about rating scales in different parts of the text and sections. You speak about 3-5, 2 or 5 classes, but it is not clear. To aid the reader it would be more useful to introduce here all the different classes in a table, and refer to them along the text. . .Section 3, p. 3585. Please, move paragraphs 1, 2 and 3 (until line 18) to section 2.1 where you introduce the rating scales."*

AC: We thank R2 for the suggestion of an additional table for this sub-section. Therefore, Table 3* will summarize the rating classes, their criteria, ordinal scores meaning and evaluation classes, with reference to questions in the forms. The evaluation classes refer to the aggregation of rating classes according to the given range in precision for the scales used in the form. Next to the original text (lines 6-7 on p.3583), we rearranged lines 6-18 on p.3583 for introducing Table 3* to the reader.

After this insertion, there will be seven tables in the main text and one in the appendixes. Therefore, numbering will be updated accordingly.

2.2 Data collection exercise:

R1 on p.C1157: *"Please specify in more detail where the study was carried out, mentioning in which altitudinal range the structures were inspected within the mountain catchment, the size of the catchment area, the nearest bigger town or city, approx...It would be useful to mention the frequency and damage potential of the natural hazards affecting the hydraulic structures..."*

AC: We agree with R1 to detail on the study area. That is nearest city, river basin, what kind of altitude range, last major hydro-meteorological event, etc. Thus, we will

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rearrange the title of this sub-section to Study area and data collection exercise. We will start a new paragraph with lines 19-20 on p. 3583. In addition, we will explain in a separated paragraph the hydraulic structures in place, as related in the inventory for the Fella basin. That consideration highlights the structures up to Pontebba location that are within the hazardous areas defined by basin authorities.

Cited references:

Borga, M., Boscolo, P., Zanon, F. and Sangati, M.: Hydrometeorological Analysis of the 29 August 2003 Flash Flood in the Eastern Italian Alps, J. Hydrometeorol., 8, 1049–1067, doi:10.1175/JHM593.1, 2007.

Calligaris, C. and Zini, L.: Debris Flow Phenomena: A Short Overview?, in Earth Sciences, pp. 72–90, InTech. [online] Available from: http://www.intechopen.com/books/earth-sciences/debris-flow-phenomena-a-short-overview- (Accessed 30 June 2014), 2012.

Autoritâ di bacino dei fiumi dell'Alto Adriatico: Progetto di Piano Stralcio per l'Assetto Idrogeologico del bacino idrogeografico del fiume Fella., PAI - FELLA [online] Available from: http://pai.adbve.it/PAI_Fella/index_fella.html (Accessed 7 July 2014), 2012.

R2 on p.1216: *"Section 2.2, p.3584. Lines 5-26. Please, reduce and move these paragraphs referred to participants to the first subsection of section 2, as I have pointed before. Please, clarify the numerical distribution."..."Table 2 should be moved here and the title of the table should be changed (it refers more to participants than data collection)."..."Before explaining the evaluation on the quality, you should introduce a short explanation about the methodology followed by the different groups to complete the experiment. As far as I understand pre-test means that volunteers fill the inspection forms looking at a poster. When you explain in the text that there are an inside and an outside experiment, you could clarify these aspects. How many field works have made*

any volunteer? One for structure? All the groups have analyzed all the selected structures? Some of this information is in table 2, but some questions should be clarified in the text (i.e. three optional dates? Is the Test outside and pre-test inside?"

As well as:

R1 on p.C1157: *"...how many check dams and bridges are present and time taken for a full inspection programme (number of hours/days/structures visited)? ... Also, mention how often and with which spatial representation the volunteers were asked to carry out the inspections. Were repeat inspections carried out?""*
R1 for Figures on p.C1158: *Please redo Fig.1 adding a clearer and larger overview map with nearby cities and rivers and some heights in m."*

AC: We recognize the importance to separate participants distribution from the data collection exercise. Thus, we will bring up lines 17-26 on p. 3584 as part of the new sub-section 2.1* Participants groups. As referred by R2, some of the information in the Table 2 should be also detailed in the text for better clarity to the reader in the next sections. Therefore, we will precise the methodological aspects into lines 5-16 on p.3584.

Thanks to R1 for the comment about the duration of full inspection program. It was deleted while formatting the table. Therefore, it will be adjusted accordingly to include the total time per activity in hours. In addition, its title will be adjusted to Description of activities in the data collection exercise. Figure 1 already illustrates the spatial distribution of the structures between learning and testing session. The overview map will be enlarged as required by R1.

3. Evaluation on the data quality collected by volunteers

R2 on C1216-C1217:*"Section 3, p.3586. What is "mode-off"? Lines 15-24 are difficult to understand and you speak again about rating scales but they seem to be different*

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from these explained previously. I insist in joining the criteria for rating scales and scores. Why there is not score 3?"

AC: As referred before, we will summarize rating classes and scores within new Table 3*. That is in the section where we explained the inspection form. Therefore, by referring to that table we will adjust the lines 15-24 on p.3587. Mode-off is a range in precision given by aggregating the extreme scores of the rating classes. Score 3 is not aggregated as it corresponds to medium conditions.

3.1 and 3.2 Functional status of bridge and check dams for A and B parameters

R1 on p.C1158: *"On p. 3591, 2nd paragraph, discuss the differences in the origin of the volunteers in more detail (local or not)? Familiar with mountain terrain or not? Familiar with natural hazards or not?)"*

As well as:

R2 on p.C1158: *"Section 3.1 and 3.2, p. 3587-3588-3589. It is not necessary to do this detailed description. You could reduce considerably this part."* R2 on p.C1217: *"p. 3589, line 16. If the Learning Group is composed by technicians and volunteers, why you say that LG were more precise than volunteer groups? If you are comparing T with V, please, use the same kind of nomenclature, and the same for the following sentence."*

AC: We agree with R1 by addressing this aspect on the discussion (lines 6-15 on p.3593). Following the suggestion of R2, we will remove possible repetitions in the results sub-sections. We will also verified the nomenclature in the text to avoid misunderstandings.

4. Performance and feedback of participants

R2 on p. C1217: *"Section 4, p. 3590, l. 25-28. This information should be moved to*

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the first part of section 2...The last paragraph of section 4 that refers to Table 5, should be moved to the discussion".

AC: As referred before we will move up these paragraphs to the participants subsection*. We agree with R2 to rearrange the referred paragraph next to the lines 5-12 on p. 3594 in the discussion.

5. Discussion

R2 on p.C1217: *"Section 5, p. 3591-3594. It is too long and the most important aspects disappear between other non-relevant comments. There are some paragraphs (i.e. p. 3592, lines 5-12) that only provide a resume of the work explained in the previous sections and they are not necessary. The last paragraph of section 4 that refers to Table 5, should be moved to the discussion."*.

AC: We agree with R2 to remove parts that only provide a resume of the work.

R1 on p.C1158: *"p. 3592 3rd paragraph. With relation to volunteer's awareness of the water-sediment processes, the colour / sediment concentration of the flow could also be observed to give an indication of whether the hazards is still ongoing and endangering the structure...P; 3592 Last paragraph. Concerning the photo record, was a more systematic documentation with coordinates envisaged?"*.

AC: R1 highlighted the stream conditions during the inspection. To improve its clarity to the reader, we will adjust lines 6-12 on p.3592. Beyond the parameters for functional status, we considered in the form a section for the inspection conditions. Thus, section III in Table 1 serves to compare between inspection campaigns carried out at different periods. Additional aspects can still be referred as a comment or in the photo record. Participants expressed difficulties to relate sequentially the photo record in the form.

The latter aspect addresses the second comment of R1. Therefore, we will move

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up to this segment lines 13-25 on p.3594 for further elaboration. Mobile applications could be exploited for an embedded glossary, systematic tag and documentation with coordinates. However, the GPS covering signal of mobile devices is especially limited in mountain catchments. Therefore, a known ID of the structure is still relevant.

R1 on p.C1158-1159: *"Table 1 Do the forms include a category on the visible damage on the check dams and bridges? Are the participants asked to do any remarks. on local sediment sources causing obstruction such as small landslides on the slopes and river banks? Do the volunteers differentiate between sediment and vegetation? Same For Table 2. Table 4 Do the volunteers estimate the sediment size causing the obstruction? Do they estimate the relation between the size of the sediment/ tree trunk and the size of the check dam or the free surface below the bridge? Do they differentiate between loose and consolidated obstructions (mobilisable or not, endangering the structure more or less?)."*

AC: We recognize the reviewers' questions for more detailed information. However, a trade-off exists; increasing the complexity of the inspections can decrease the data quality. We will replace the text in lines 28-29 and 1-5 in p.3592 and 3593, respectively. Visual inspections are subjected to various sources of biases, both for volunteers and technicians. Thus, it was useful to combine rating scales with scores while providing a range in precision. Surveys procedures should remain as simple as possible. Photo and videos could support on the need for detailed descriptions. Iterative design and testing is still required to improve the consistency and robustness of the methods and data.

Cited references:

Dirksen, J., Clemens, F. H. L. R., Korving, H., Cherqui, F., Le Gauffre, P., Ertl, T., Plihal, H., Müller, K. and Snaterse, C. T. M.: The consistency of visual sewer inspection data, Struct. Infrastruct. Eng., 9(3), 214–228, doi:10.1080/15732479.2010.541265, 2013.

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R1 on p.C1158: *"First paragraph, p.; 391. It would be useful to have a wider statistical representation in future. It is mentioned that regional database could be updated in future. Expand on this. How could the database be improved? Higher spatial and temporal frequency of inspections?"* **R1 on p.C1158:***"p. 3596, 2nd paragraph. Explain why the exercise was not foreseen as a more perennial task, including the long-term experience of local citizens."*

AC: We agree with Reviewers that the methods could be used as starting point. Therefore, we agree with R1 to extend on aspects for future research at the end of the discussion section after lines 5-17 on p.3594.

To make a perennial activity from this pilot, some methodological aspects should be improved before widening the statistical representation. First, improvements on the inspection procedures should be separately tested with technicians. Thus, we could validate the iterative design within the reference group. It is important to define with technicians the procedures for using the volunteers' inspections in decision-making, or simply for their later examination. Then, replication exercises could be carried out on a separate day for each participants' group. This would facilitate participants' involvement in smaller groups and limit their interaction during the inspection tests. The poster set-up could still be used with mixed teams of participants to support the knowledge exchange during the learning session. Despite the type of activity, participants should have feedback on the quality evaluation after every inspection campaign or training activity. It may contribute to update survey procedures and to improve the data quality. Finally, we strongly believe that mobile applications could offer great advantages as compared to printed forms.

5. References

R1 on p.3596: *"References you could also refer to work done by CIMA, Savona on*

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linking civil protection with natural hazard emergency plans and early warning".

AC: We appreciate the suggestion of the Reviewer. We will acknowledge in the introduction (lines 10-12 on p.3579) examples of data collection approaches such as this one for flood damage assessment.

Cited references:

Molinari, D., Menoni, S., Aronica, G. T., Ballio, F., Berni, N., Pandolfo, C., Stelluti, M. and Minucci, G.: Ex post damage assessment: an Italian experience, Nat. Hazards Earth Syst. Sci., 14(4), 901–916, doi:10.5194/nhess-14-901-2014, 2014.

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