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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Linking local vulnerability assessments to climatic hazard losses for river basin management" *by* H.-C. Hung et al.

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Replies to the interactive comment on "Linking local vulnerability assessments to climatic hazard losses for river basin management" Anonymous Referee #1

The authors would like to sincerely acknowledge the anonymous referee for providing us very valuable suggestions and comments. In particular, the referee's suggestions are really helpful for improving our article's conceptual framework, language and overall quality. We summarize the replies and relevant ways of dealing with each comment or suggestion as follows.

1. This paper deals with the losses and damages of a typhoon and relates these to

a composite vulnerability index. The underlying datasets and the statistical work is of relevance for the scientific community. However, there are significant lacks in - The conceptual frame for the work - A critical view of the approach followed and of the results achieved. *Replies: To improve the expression of our conceptual frame, the authors will rewrite the section 2 (Vulnerability and disaster impacts) of the revised manuscript to elaborate more on the process and basis of building our conceptual framework. Moreover, in the section 3 (Methods and data), we will also increase a paragraph and a conceptual figure (Figure 1) to help explain our basic concept and the stepwise procedure of analyses. In the manuscript, it really needs more discussions about the approaches followed and the findings achieved. Thus, in section 2, the authors will add more sentences to explain their vulnerability concept and the approaches followed, as well as to describe more on the linkages between vulnerability and disaster losses. In addition, in the section 4.4 (Policy implications) and section 5 (Conclusions), we will reinforce the explanations about our findings and the limitations in our approaches.

2. In addition, the text has to be significantly improved regarding the English language. I have given a number of proposed corrections in the first half of the text (See below). *Replies: We really appreciate all the help the referee give us. It is greatly helpful for us to improve our writing and to clarify some basic concepts in our manuscript. To improve the language problem in this manuscript, besides the referee's suggestions (please see the attached rudimentary revised manuscript), we will reorganize the whole manuscript, including the word choice, grammar, sentence usage and structure. Finally, the revised manuscript will also have a thorough edit for making the content more intelligible and more suitable for publication.

3. I would encourage the authors to review their paper thoroughly and particularly regarding the various concepts of vulnerability. I would also like to ask them to take the constraints of their methodologies into consideration when discussing their results. *Replies: In the revised manuscript, the authors will reinforce the discussions about various concepts of vulnerability. This could help the authors elaborate the process of

developing their conceptual vulnerability framework. On the other hand, we will also increase the discussions about the constraints of our methodologies in explaining the findings of our case study.

4. The concept of vulnerability and the implication that the conceptual approach has on the study is not clear: - At the end of chapter 2.1 the authors state that it is necessary to integrate the vulnerability concepts of the disaster community and of the IPCC. The proposed formular (1) however does reflect only the IPCC concept. If the authors start to discuss these conceptual issues they need to be much more sharpened in their explanation of the differences of the various approaches and why and how they would like to integrate approaches. *Replies: Indeed, in the manuscript, the explanations about the process of our conceptual vulnerability framework was not very clear. In the revised manuscript, the authors will reinforce the explanation about how we conceptualize vulnerability. We will focus more on the descriptions of how we combine the IPCC concept and risk-hazard approach (particularly, UNISDR concept) to generate the formula (1) and formula (2). Especially, the formula (2) is built based on the risk-hazard approach that allows us to link the concept of vulnerability to hazard losses. In addition, we will also strengthen our discussions on why and how we assess vulnerability and examine its relations with hazard losses using an integrated approach. We argue this issue are mainly based on the requirements of integrated river basin management.

5. The two approaches for investigating the relationships between vulnerability and disaster losses in chap 2.2 are not described clearly enough. *Replies: In the section (chapter) 2.2 (Vulnerability and disaster losses) and 3.1 (Linking vulnerability factors and climatic disaster losses) of the revised manuscript, the authors will increase more explanations about the relationship between risk-hazard and IPCC approaches to vulnerability and disaster losses. In the section 2.2, we classify existing studies into two types. One type of approach focuses on combining existing hazard loss theories (such as risk-hazard, PAR, PSR theory or MCDA) with computer-aid simulation and GIS-based analysis to predict disaster losses, while another type of approach empha-

sizes on applying existing or surveyed databases to characterize the distributions of disaster damages. In the section 3.1 (Linking vulnerability factors and climatic disaster losses), we will further add a conceptual framework to link above mentioned two types of approaches, as well as to explain how we apply this framework to develop our methodology and analytical procedure.

6. The methodology for the selection of indicators is not transparent. There is a lack of clarity in the concept reflected in the description of the indicators in chapters. 3.1.X. For example, coping is mentioned as part of both sensitivity and adaptive capacity. *Replies: In the original manuscript, it really lacks clarification of the methodology of our indicator selection. Thus, in the revised manuscript, the authors will further provide more explanations about the basis and process of indicator selection. In reality, the procedure of indicator selection are stemmed from our conceptual vulnerability framework, as well as from a summarizing review of the literature and the contextual characteristics of the river basin management. Moreover, we will reorganize the classification of the indicators in order to more conform with their characteristics.

7. A critical reflection on the selection of a limited number of indicators is missing. *Replies: Indeed, the authors should discuss the constrictions of the selection of a limited number of indicators to assess vulnerability and to examine its relations to disaster losses. In the revised manuscript, the authors will discuss more on the limitations of their studies, while they describe the implications and applications of their findings to supporting the process of policy-making.

8. A discussion of the problems when using statistical methods when only limited damage and loss data is available is entirely missing. *Replies: In the revised manuscript, the authors will enhance the discussions about the restrictions of using limited typhoon damage and loss data to examine the relationships between vulnerability and disaster losses. In particular, the findings are based on a single hazard event approach, which would limit their applications in other hazardous events. Thus, our study focuses more on developing a conceptual framework and methodology of examining the relationships

between vulnerability and hazard losses. These related discussions will be reinforced in the descriptions of our findings and their implications.

9. A description of the typhoon event itself is missing. *Replies: The authors will give a brief description about Typhoon Morakot. This typhoon, a Category 1 typhoon, hit southern Taiwan during 8–12 August 2009. It was the most severely damaged typhoon in Taiwan in the past 50 years. This typhoon caused torrential rainfall that resulted in widespread flooding and thousands of landslides. Typhoon Morakot killed nearly 700 people and left thousands of people either displaced or homeless. The estimated total amount of economic losses was approximately US$ 0.6 billion. These descriptions about Typhoon Morakot will be added in the revised manuscript.

10. It is not clear for which spatial extend the regression analysis has been carried out. For example, what was the spatial resolution of rainfall data? How did the authors deal with the fact that the data is available in different formats (point, raster etc). *Replies: The data unit used in our regression analyses is a village. This spatial resolution of data is also available for extending to various formats, such as point, raster, etc. But in practice, the survey values of various data could contain different scales and units. It still needs some processes of data processing to fit the requirements of regression analysis. For example, we used an average annual rainfall value (the past ten years) surveyed by the nearest rainfall station (set up by the Central Weather Bureau, Taiwan) as the rainfall data for each village. In the revised manuscript, we will also increase the related discussions about the potential of extending our methodology to other areas and other formats of data.

11. The MCDA has not been described in detail, what is it exactly and which role does it play? *Replies: In the manuscript, it is really rarely described in detail about the role of the MCDA. To improve the descriptions, in the revised manuscript, we will add an explanation about how we develop the conceptual framework of vulnerability and apply this framework to assess integrated vulnerability over the three case study river basins using an MCDA procedure.

12. The discussion needs to consider the problem to look at hazard and vulnerability factors separately. The authors state that “villages with higher elevations, in upper streams and more proximity to rivers tended to suffer more disaster casualties and losses due to their higher exposure to typhoon impacts”. Unclear remains what the difference is between exposure and typhoon impacts (are impacts = damage?). Then they conclude, “However, constraints associated with local government adaptation efforts in the river basins reflect a range of challenges in relation to how the integrated RBM adaptation efforts have structured. The efforts to facilitate adaptation should largely target the mitigation of vulnerability and risk.” – these types of conclusions need to be explained further. *Replies: Many thanks for the referee’s valuable suggestions. Indeed, in the manuscript, there is a bit confusing in the distinction between the terms of “exposure” and “hazard impacts”. In our study, we consider the disaster risk/loss as a function of hazard and vulnerability. In a long-term scale, disaster risk requires the consideration of uncertainties in both hazard and vulnerability factors due to ambiguities in the possible changing of the future hazard and vulnerability factors over time. However, in a short-term or single hazard event scale, it is a deterministic approach, which the focus is on a single disaster loss that could vary with different hazard intensities, impacts and vulnerability factors. In our study, we applied a single hazard event approach. We also consider “exposure” as a factor of vulnerability, which refers to the presence of areas, system or assets in places and settings that could be adversely affected. The term “hazard impacts” involves the hazard intensities and their effects on the areas, which could include the hazard damages and its physical influences (e.g., flooding, landslides) on the areas. The distinction between the concepts of these two terms is really not clear in the manuscript. We will clarify these differences by increasing more explanations about the concepts of these two terms in the revised manuscript. Furthermore, in the conclusions, we will rewrite, reorganize and increase more sentences in the section 4.4 (Policy implications) in order to more clarify the related discussions about the policy implications of our findings.

Please also note the supplement to this comment:
http://www.nat-hazards-earth-syst-sci-discuss.net/nhess-2016-114/nhess-2016-114-AC1-supplement.pdf

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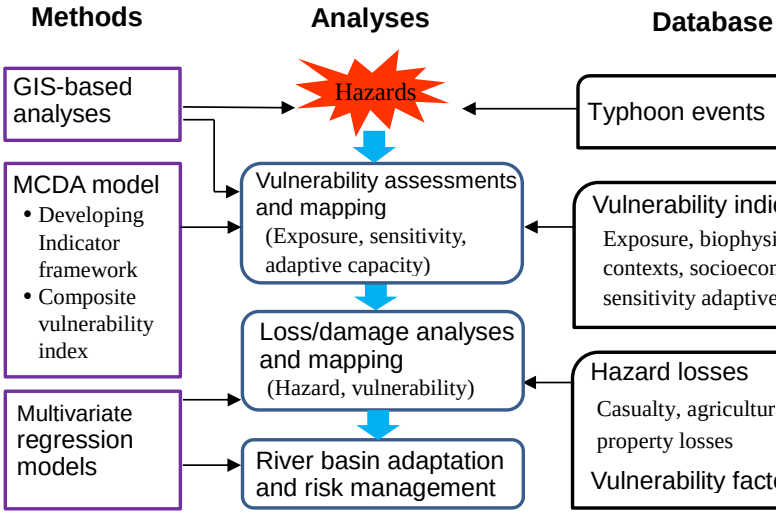

Figure 1. Stepwise procedure and framework of analysis