RESPONSE TO REVIEW #1

We highly appreciate time and effort the reviewers put into studying and reviewing our manuscript, thank you for initiating this exchange! After carefully reading and discussing the remarks, we have thoroughly revised and improved the manuscript accordingly. Please find our responses (blue) and revised text blocks (*blue, italic*) below the quoted reviewer comments (**black, bold**). Please note that, in the meantime, we had the invaluable opportunity to visit the study site in person and subsequently incorporated newly gathered ground truth data in the numerical modelling scheme. Moreover, we included a few minor changes that might not refer directly to specific reviewer comments, but are meant to enhance the readability and hence understanding of our approach and findings according to a native speaker.

General Comments

This paper compares the effectiveness of two adaptation strategies: (1) a large-scale flood protection scheme as currently constructed in HCMC and (2) the widespread installation of small-scale rainwater detention as envisioned in the framework of the Chinese Sponge City Program (SPM). As authors claimed, it is important to explore and evaluate potential options of hazard mitigation as flood risk is becoming a major challenge for many cities in low elevation coastal zones. The topic of this study is valuable. But the quality and innovation of the current manuscript are not satisfactory. In any case, I have a few recommendations that I believe will help the authors to clarify their contribution and improve the readability of the manuscript.

We are very happy that the reviewer acknowledges our motivation and the intended value of the presented topic. This statement confirms our original idea to present and disseminate our simple, but generic approach to explore and evaluate hazard mitigation option to alleviate urban flood risks in low elevation coastal zones and our specific findings from HCMC to a wider audience. We are in line with the reviewer’s perspective that flood exposure studies and tailor-made adaptation measures become gradually more important, especially to flood-prone communities in emerging economies and developing countries. To improve the quality and innovation of the current manuscript, we have addressed and diligently integrated the reviewer’s queries and recommendations. The provided comments, indeed, helped us a lot to clarify the objectives and current limitations of our contribution and improved the readability and quality of the manuscript. Details about the specific revisions undertaken can be found below.

Specific points are:

1. **Most of the figures in the manuscript are very poor in quality and hard to meet the standard for this journal, such as Figs. 2, not clear enough. Generally, some of the figures are too small.**

   This feedback is very helpful as it seems that illustrations originally saved in 600 dpi resolution were compressed and therefore blurred during PDF conversion. We will make sure that all figures will be provided in original quality in the revised manuscript. Based on this comment, we also revisited mentioned Fig. 2 and decided to simplify some of the depicted model in- and outputs for a more intuitive perception of the illustrated workflow.

2. **How to simulate the small-scale rainwater detention in the HEC-RAS model? What is the limitation or uncertainty?**

   We are happy that the reviewer pointed out this lack of clarity. Following the previous comment, we tried to improve the readability of figures including our illustration of the attenuated hyetograph (Fig. 2 c right), which allows us to simulate small-scale rainwater detention by means of a parametrization. We hope that, accordingly, the explanations given in section 2 Material and Methods (ll. 207-216) should now give a sufficient explanation of the rationale behind this way of implementation. Instead, we revised section 4 Discussions and Conclusions (ll. 309-318) adding further discussion of the limitations/uncertainties inherent to this approach. The paragraph now reads as follows:

   "Additional limitations arise from the parametrization of rainwater detention in the form of an attenuated hyetograph (cf. section 2 Material and Methods) (…) The estimation of the roofed area from satellite imagery and corresponding detention capacities entails additional uncertainties with respect to the assumed runoff attenuation. In reality, the actual shape of this hyetograph depends on a multitude of factors including technical details about the individual solutions (how much storage volume per unit) as well as the degree of implementation (how many units per area). Nevertheless, the presented approach is sufficiently descriptive for a conceptual juxtaposition of the effects and performance of the two mitigation strategies under consideration and demonstrates the general working principle despite the underlying simplifications: (…)"

3. **I am not convinced by the model setup given limited information, more information for the validity of flood simulation by HEC-RAS should be described in the paper.**

This comment addresses a concern, which has already been much-discussed within our group before submission. In the current version of the manuscript, explanations regarding the numerical setup were deliberately kept short to be readily accessible for non-experts in the field of hydraulics and water resources. The same group of authors currently aims to publish, in parallel, the more detailed aspects of the flood simulation in a separate manuscript submitted by Hoballah Jalloul et al. (in review) in the same Special Issue of NHESS. This second manuscript not only addresses all specificities about the acquisition and processing of input data and the calibration/validation of the model, but also elaborates on the general validity and performance of open-access data in any numerical flood risk analyses. The methodology is meant to enhance understanding and build capacities to create sound adaptation strategies. In order to keep the focus and objectives of our work as distinct as possible, we decided to separate the two studies and consequently reduced methodological details in the current manuscript to a minimum. Nevertheless, we added an explicit in-text reference here to improve the balance between both publications. This allows readers with a modelling background to follow up on the methodology, while maintaining a risk management perspective within this study. The description of the model setup (referring to Fig. 2 b) has been revised and now reads as follows:

"For a more detailed explanation regarding the processing of input data as well as the calibration/validation of the employed model, please be referred to the independent publication by Hoballah Jalloul et al. (in review), which discusses the general validity of open-access data in numerical analyses more profoundly."

4. **What is "Flood Severity Index (NFSI) ", how is it measured?**

Similar to the previous comment, we acknowledge the lack of clarity with regard to the Normalized Flood Severity Index (NFSI) as a consequence of our attempt to balance the readability for non-experts in the field by simplifying technical terms. We also understand that readers should get all information that are relevant to understand the implications arising from the definition of this variable and its significance for risk assessment. Accordingly, we added the following mathematical definition of the NFSI to this manuscript:

"For a given pair of coordinates, the NFSI is calculated as the product of these two conventional flood intensity proxies divided by the product of the 95 % percentiles of the same proxies as follows:

$$NFSI(x,y)(\%) = \frac{z_{max}(x,y) * DoT(x,y)}{z_{95\%}(x,y) * DoT_{95\%}(x,y)} * 100 \quad (1)$$

where $z_{max}(x,y)$ *refers to the maximum simulated flood depth at coordinates x and y and* $DoT(x,y)$ *refers to the inundation duration over the pre-defined threshold at the same coordinates. As a qualified first estimate, this easy-to-apply index emphasizes those areas, which are exposed to significant flooding over a significant time and, thus, are expected to experience the most severe damage across a given study area."*

For further details, an in-text reference should now direct the interested reader to the companion paper by Hoballah Jalloul et al. (in review), which further elaborates on the methodological details:

"A detailed explanation of the rationale behind the NFSI and its validation can be found in an independent publication by Hoballah Jalloul et al., (in review)."

5. Drainage capacity should be considered for the flood simulation.

The reviewer addresses an important limitation, here. We generally agree that a direct implementation of this detail would be highly desirable, as it could add further credibility to the numerical setup and robustness to subsequent calculations. However, there are hardly any public information about the local drainage as we tried to acknowledge in section 2 Material and Methods (ll. 158-161). As a conservative estimate and in view of the given spatial resolution, we assumed the drainage system to be entirely inactive or malfunctioning throughout all simulations. The same rationale may explain, why other studies have abandoned the idea of implementing the HCMC drainage system in comparable studies (e.g. Scussolini et al. 2017). Last but not least, one could argue that the drainage capacity would be identical for all three considered adaptation cases and any drainage-related reduction of runoff volumes should hence be cancelled out in the subsequent comparison as we discuss in section 4 Discussions and Conclusions (ll. 320-324). To emphasize the applicability of these assumptions and underline our chosen conservative approach, we have revised our methodological explanations as follows:

"As there is hardly any public information about the quality and condition of the existing drainage system in HCMC – except that its capacity is regularly overloaded during extreme events – all rainfall is assumed to become gradient-controlled surface runoff as is a common conservative estimate (e.g. Scussolini et al., 2017)."

6. **In Table 1, Flood depth (dmax) is the average for all the raster cells? This seems very simple. More analysis should be done for different cells, especially considering the spatial distribution.**

   It is correct that the original results section only presents mean values of flood depth (d_{max}) and flood duration ($T_{d>10cm}$) for all the raster cells and we have to admit that this poses the risk of losing information, especially regarding the spatial distribution of these flood proxies. Accordingly, we offer incorporating visualizations of the spatial distribution of flood depth and duration, corresponding to the NFSI in Figure 3, for all adaptation strategies in the Supplemental Material. Moreover, we have prepared an additional figure showing the relative frequency of maximum inundation depths and duration, which illustrates the hydraulic effectiveness of the discussed adaptation options in greater detail.

7. **Spatial distribution of Flood Severity (NFSI) for different cells?**

   We understand this question to be directly related to the previous comment, suggesting that insights from the numerical simulations might be lost if results are solely presented in terms of overall mean values (Table 2). Although we generally share this concern and complemented our results section accordingly, we believe that Figure 3 already comprises much of the available (spatial) information about flood severity. In its current version, the illustration gives a comprehensive overview of how the assessed adaptation options would reduce the Normalized Flood Severity Index (NFSI), and thus inherently also maximum flood depth and duration, across the model domain. Corresponding to our previous response, we can offer to provide spatial data about the absolute NFSI as Supplemental Material. However, if our interpretation of this comment was incorrect, we would be grateful for additional remarks to further improve our study.

8. **This study only considers three scenarios of the mitigation scenarios, I think more analysis considering different sponge city measures would be very interesting. You will want to discuss this.**

   We fully agree that it would be a valuable objective to simulate different technical solutions that put the Sponge City concept into practice. However, our conceptual approach and, more specifically, the implementation of rainwater detention in the form of an attenuated hyetograph partly rules out this kind of investigations. Although a comparison of solutions is generally possible on an analytical basis – investigating what measure would theoretically cause which attenuation – their parametrized implementation in the model would still be very similar. Given that the main goal of this study was to compare the working principles of classic flood protection and decentralized rainwater detention, the suggested parameter study (regarding different attenuated hyetographs) would go beyond juxtaposing these two general concepts of flood adaptation. Corresponding to the reviewer's remark, we added the following paragraph in section 4 Discussions and Conclusions (ll. 326-332 and 336-342):

"Even if a comparison of different technical solutions for this type of climate adaptation is generally possible on an analytical basis – investigating what rainwater detention measure would theoretically cause which attenuation – their parametrized implementation in the model would nearly be identical as is their general working principle. As a consequence, also the experienced flooding would be very similar in its pattern of depth and duration for all realizations of the Sponge City concept. (…) Nevertheless, the presented approach is sufficiently descriptive for a conceptual juxtaposition of the effects and performance of the two mitigation strategies under consideration and demonstrates the general working principle despite the underlying simplifications: The large-scale pumping stations comprised in the classic protection scheme reduce flood volumes along the inner-city canals and thus represent a line or even point sink within the numerical model; the implementation of the Sponge City concept, in contrast, is characterized by spatially uniform runoff attenuation, which translates to an area sink for flood volumes across the whole model domain. The aim of this study was to compare the working principles behind these two, seemingly adverse adaptation options, which is thoroughly accomplished by the employed conceptual approach."