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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Effectiveness of low impact development for urban inundation risk mitigation under different scenarios: a case study in Shenzhen, China" *by* Jiansheng Wu et al.

Anonymous Referee #2

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Review: Effectiveness of low impact development for urban inundation risk mitigation under different scenarios: a case study in Shenzhen, China

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In this study a pipe drainage model (SWMM) coupled to a surface flow model is used to run test scenarios with different measures (green roofs and permeable pavements)

to mitigate inundation in a city after heavy rainfall. For this purpose, a test area of about 37 km^2 in a city in China is used. Different percentages of green roof area and permeable pavement are considered to compare maximal inundation depth, inundation area and inundation time between the different scenarios. It is concluded that both measures help to mitigate inundation. The gain is high if 25 percent of roofs are green and 25 percent of the pavement are permeable (compared to zero), while the change is not that much more when the percentage is increased further. It is also concluded that combines measures are more helpful than one measure alone with a higher percentage.

The topic is very interesting and relevant and it is in the focus of NHESS. The abstract of the manuscript is very motivating. However, the manuscript falls a bit short of what is announced. One expects that one learns about the coupling strategy of the two models. However, this part is not convincing (outlined below) and should be tuned down. The case studies with this model are sound. However, the study is somewhat superficial. There is hardly any discussion about the findings. For this reason, it is not clear how far these results are representative for other urban areas and if they could be transferred to other sites. Also, there is no discussion about limits of the study. Not much is learned about the processes that cause the effects that are described. This makes it also difficult to estimate if the results are transferrable or specific for the test case.

- Page 3, lines 16-18, 'However, we find that few researchs use....': I do not think that this is right. Dynamic models have maybe not been used much to test the measures for mitigation by permeable pavement and green roofs, but such coupled models (1d pipe drainage network model and 2d surface flow model) exist and are used for urban flood management (just a few arbitrarily chosen examples: R. Loewe, C. Ulrich, N.Sto. Domingo, O. Mark, A. Deletic and K. Arnbjerg-Nielsen (2017): Assessment of urban pluvial flood risk and efficiency of adaptation options through simulations - A new generation of urban planning tools. Journal

of Hydrology 550, 355-367. B. Russo, D. Sunyer, M. Velasco and S. Djordjevic (2015): Analysis of extreme flooding events through a calibrated 1d/2d coupled model: the case of Barcelona (Spain). Journal of Hydroinformatics 17(3), 473-490. M. J. Burns, J. E. Schubert, T. D. Fletcher and B. F. Sanders (2015): Testing the impact of at-source stormwater management on urban flooding through a coupling of network and overland flow models. WIREs Water 2. 291-300).

- 2.2 Data, part 4: What were the criteria for removing nodes and pipelines? A reduction from 4502 to 597 pipelines and from 1175 to 653 nodes seems a bit more that deleting some redundant and incorrect data. How was it tested that the data were redundant?
- 2.4 Coupling the SWMM/IFMS Urban models: As written above, I think that one does not learn much about the coupling. Also, Figure 4 does not help in this respect. One just learns that the models were coupled. But how were they coupled? Is inflow and outflow from and to manholes possible? What were the criteria for inflow and outflow? What was the spatial resolution of the geometry of a street? What timesteps were chosen for coupling? Either more discussion about the coupling is needed, which means that one also need to know more about the numerical schemes used for the two different models, or it does not make sense to have a section for this part.
- Page 5, lines 18-20: This sentence is unclear. Also: What is innovative about the coupling?
- Page 5, line 26: Why was a geostatistical method (Kriging) used for interpolation? I do not see the connection to geostatistics for a digital elevation model in a city.
- Page6, top: Please explain why green roofs should not be possible in a dense construction land.

- Modeling part (Section 2): Please explain how green roofs and permeable pavements are realized in the model. I assume that a storage for a roof area is assigned (or an existing one is increased) and that there is a soil compartment which gets a connection to the paved area if the pavement is permeable. As this is the key process that is here investigated, I think it is necessary to outline these things (and it is not enough to refer to the manuals of the models).
- Page 7, top: Please explain why the classification in hazard levels is made. What can be learned from the classification? It is written that the changes of inundation level are different for the different classes. But what does one make out of this fact? More discussion about consequences would be useful.
- Page 7, line 4: Please name scenarios 1 to 4.
- Figure 6: What is meant by percentage GR and PP? Both with the same percentage?
- Page 7, lines 14-18: I do not see where this conclusion comes from. Is this concluded from the numbers in Table 4? What is here meant by performance? Reduction of maximum inundation? This paragraph needs clarification.
- Page 7, lines 28-31: Again it is not clear where these numbers come from. I do not find it in the Figures. In Figure 6, the single 100 percent cases are not shown.
- Page 8, line 11: This needs explanation. Why is it difficult to mitigate? Is the reason the topography? I think that such a statement needs to be more specific.
- Page 8, lines 12-13: How can one see in these figures that the infrastructure is not perfect? And what infrastructure is here meant and how does it influence the inundation? Also: How can one see from these figures that the LID practices are not perfect? In which sense are they not perfect?

- Page 8, lines 13-15: I could not follow the reasoning. Why does the mitigation of short-time inundation areas lead to an increase in the average inundation time with LID measures? Is here something meant along the lines: If a storage due to green roofs helps to keep water back, leading to less inundation depth, the storage will at the same time lead to a longer inundation time (it holds the water back, but releases it eventually)? I am just guessing and I think this needs a better explanation.
- Section 4.1, Comparison of permeable pavement and green roofs: What is the reasoning of the different effects? This should be explained based on the mitigation mechanisms. The last sentence sounds a bit strong. I do not think that one test case can use as a proof, if no general reasoning is given for the different performances.
- Page 8, line 29: I would be a bit more careful with the word 'comprehensively'. The paper shows one case study. I do not think that this is a comprehensive exploration of inundation mitigation in an urban watershed.
- Page 9, lines 10-14: As before, I do not see the point about infrastructure. How is poor infrastructure reflected in the model? If not at all: How can one draw any conclusions about this point from a modeling study that does not capture this effect? If yes: What exactly is meant by poor infrastructure and how is this realized in the model?
- Page 22-23: Maybe this sentence is only not formulated well. But I do not see how from this study one could see anything about landscape patterns ('we find that the...' sounds as if it is a conclusion from this study). The landscape patterns are not discussed, so one cannot conclude about this point. For this reason, I can also not see how 'this provides a new perspective'. Or is here simply meant that this point should be studied in the future? In this case the sentences need to be reformulated.

- Conclusions: I think it should be mentioned that the findings in this study apply to the one test case considered. It is not clear if the results are more general and could be transferred to other sites. In particular: Numbers can certainly not be transferred.