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## Reply on RC2

Jiale Qian et al.

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Author comment on "Quantifying unequal urban resilience to rainfall across China from location-aware big data" by Jiale Qian et al., Nat. Hazards Earth Syst. Sci. Discuss., <https://doi.org/10.5194/nhess-2022-167-AC2>, 2022

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1. The title is not accurate; it should be the resilience (or response) to rainfall not to rain.

Response: Thanks for your valuable suggestion. We have modified the title to Quantifying unequal urban resilience to rainfall across China from location-aware big data.

2. The Introduction section could be better organized to clarify the scientific question (or research gap) and aims of this study.

Response: Thanks for your valuable suggestion. We reorganized the research gap and the aims of this study to the Penultimate paragraph in section 1. Specific information is as follows: "However, previous resilience metric, which mainly forces on unique disaster event, is not suitable for the assessing in large scale. Two resilience metrics were introduced into this study from other fields. The sensitivity is a widely used tool for understanding resilience in different regions in many other weather events, such as heat wave and air pollution (Hong et al., 2021b; Wang et al., 2021). For example, Zheng et al. (2019) defined the links between the city-level happiness index calculated from the social media data and the daily local air quality metric as the perception sensitivity and explored its spatial variation. However, response sensitivity is not yet to be studied for rainstorm events through analysing the relation between the city-scale human activity response metric and rainstorm event index. Another index, rainfall threshold, is commonly used to study rainfall events that have resulted in landslides (Marra et al., 2016; Naidu et al., 2018). In this study, rainfall threshold, which is defined as the minimum rainfall index that corresponds to significant urban human activity response anomaly, is introduced to the study of the urban resilience. Two metrics can effectively depict the urban resilience in different focuses." Corresponding revision can be found on line 62~72 of page 3.

3. Urban resilience is very broad concept with many different elements and properties, mainly related to the capacity, sensitivity, flexibility of urban systems (including the community, infrastructure, institution, etc.). So, what does urban resilience mean in this study? How can it be related to human activities? Moreover, the rationality for using rainfall threshold and response sensitivity to describe urban resilience needs more justification.

Response: Thanks for your valuable suggestion. We give a full answer to this question in question 3. Corresponding revision can be found on line 62~72 of page 3.

4. I would suggest to add a discussion for the limitations of this study and the prospect for future study at the end of the manuscript.

Response: Thanks for your valuable suggestion. We add a discussion for the limitations of this study and the prospect for future study at the end of the manuscript. Specific information is as follows: "The study could be further studied. Rather than all the residents of a city, the Tencent location request dataset is generated by over one billion monthly active users. The Tencent dataset's aggregate geotagged human activities may underestimate the effects of rainstorms on infrequent users, particularly the elderly and children. To address this limitation and further investigate human responses to various weather events, our future studies would aim to integrate multisource geospatial datasets. Furthermore, identifying disaster types such as rainstorm, waterlogging, and flood from social media data and then analyzing regional response variation of large-scale human activity in different disasters can improve deep understanding of urban resilience". Corresponding revision can be found on line 340~347 of page 15.

5. It is not clear how the cities were classified to different types (e.g., HL, ML, HM, LL)?

Response: Thanks for your valuable suggestion. We add the classification method to the section 2.2.4. "Finally, we separately classified the rainfall threshold and response sensitivity indices of the 346 cities into three classes using the Jenks natural breaks classification method, which clusters data into different groups by seeking minimum variance within a class and maximum variance between classes (McDougall and Temple-Watts, 2012)." Corresponding revision can be found on line 172~175 of page 7.

6. There are several writing errors, such as "the method Qian et al. (Jiale et al., 2021) proposed" (Page 4), "Zou et al. (Zou et al., 2018) used" (Page 14).

Response: Thanks for your valuable suggestion. All issues about citation in the text have been corrected. Corresponding revision can be found on line 44 and 109 of page 2 and 5.

7. The supplementary Fig. 6 should be put in the manuscript rather than in the supplementary, as it appears for many times and is vital for the understanding of how rainfall time, peak intensity and duration affect human activities.

Response: Thanks for your valuable suggestion. We have put the supplementary Fig. 6 to the right position. Corresponding revision can be found on line 218 of page 9.