Reply on RC1:

We thank the reviewer for the insightful comments and detailed suggestions on how to improve the manuscript. We found the comments to be very helpful and have incorporated them into the revised manuscript. In the following, the texts with blue font are the reviewer's original comments, the texts with normal font are authors' responses and the texts with italic font are authors' responses in the revised manuscript. Our detailed responses are as follows:

1) Please indicate the source or credit of the photo in Figure 1.

Response: We thank for the reviewer's comments. In the revised manuscript, we have indicated the sources of the photos as follows. Please refer to lines 8-17, page 3:
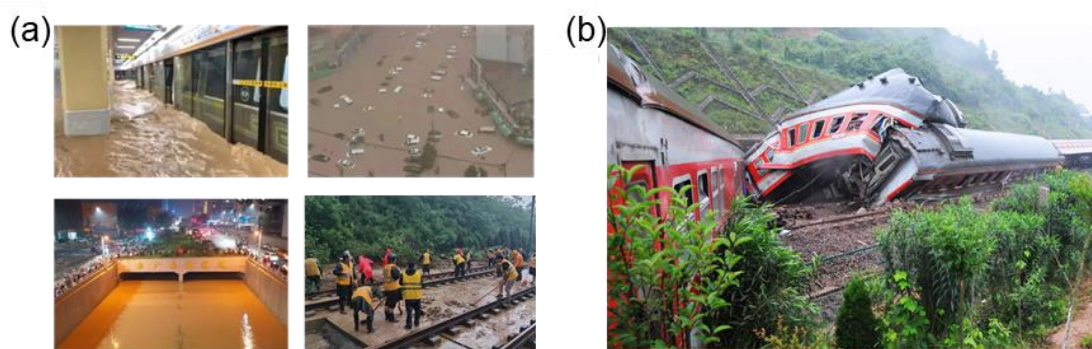
Fig. 1 (a) transportation infrastructure damaged by floods triggered by extreme precipitation at Zhengzhou (2021), the top left is from website (https://www.sohu.com/a/478600794_161795, last access: 25 March 2022), the top right is from website (https://chinadigitaltimes.net/chinese/668482.html, last access: 25 March 2022), the bottom left is from website (https://www.ettoday.net/news/20210802/2046308.htm, last access: 25 March 2022), and the bottom right is from website (http://m.thepaper.cn/baijiahao_13676454, last access: 25 March 2022); (b) Railroad damage by a debris flow triggered by extreme precipitation at Xiaogang (2010), which is from website (https://news.qq.com/a/20100524/000563_3.htm, last access: 25 March 2022)

Response: We thank the reviewer for the suggestion. 5-8 (Range of average unit costs (RMB million/per km of double track) column in Table 3) is the range of average unit costs for land acquisition and resettlement from the world bank report. We used the number to calculate the average unit costs for land acquisition and resettlement (Average unit costs (RMB million/per km of double track) column in Table 3). In the revised manuscript, we have deleted "Range of average unit costs (RMB million/per km of double track" column to make the list more clear. Please refer to line 1, page 10:

Table 3 Average unit costs (RMB million/per km of double track)

Element		Average unit costs (RMB million/per km of double track)	
Land acquisition and resettlement		6.5	
Civil Works	Embankment	42.5	25.5
	Bridges/viaducts		60.5
	Tunnels		59.5
Track (ballasted)		6	
Signalling and communications		3.5	
Electrification		4	

Response: We thank the reviewer for the suggestion. In the revised manuscript, we have unified them in Equation 1, Figure 4 and the corresponding text description. Please refer to lines 12-14, page 11 and lines 1-6, page 12:

The relationship between precipitation from news and M1-5d is given in Eq. (1) and derived using a least-squares fitting method, as presented in Fig. 4b, with R square 0.63. The constructed curve allows us to transform the precipitation in CN05.1($pre(M1-5d)$) to the local precipitation as far as possible.

$$pre(news) = 1.87 * pre(\text{M1} - 5\text{d}) + 27.35 \qquad (1)$$
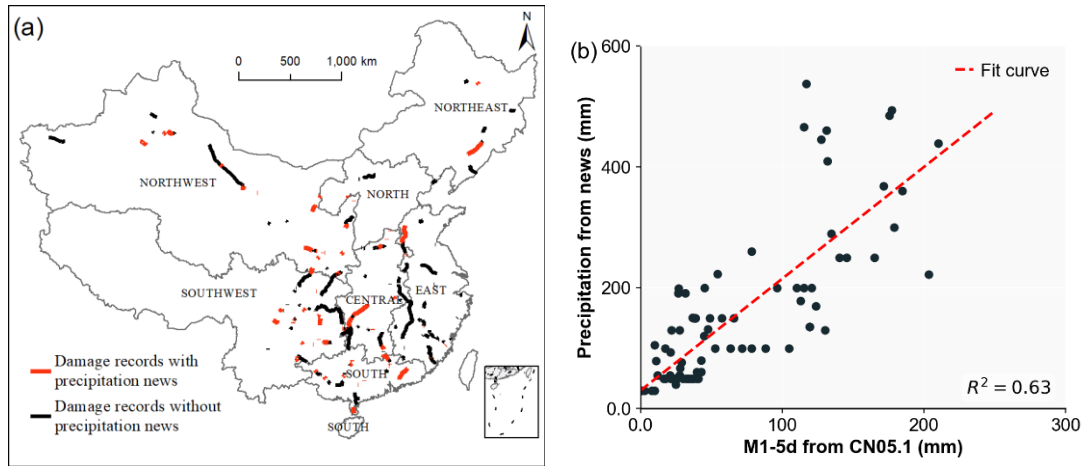
Fig. 4 The precipitation information (a) the spatial distribution of precipitation extracted from news and CN05.1 (b) the relationship between precipitation extracted from news and M1-5d extracted from CN05.1.

4) I did not see clearly or understand the part about the moving average method. I am especially curious about how to use the moving average method to get multiple values under the same rainfall intensity in Figure 5. Finally, the statistics get the highest, lowest and average value.

Response: In this part, the "moving average method" is a method that is applied by adding up all the damage ratios of points for a specific precipitation intensity range and dividing it by the total number of points. To make it clear, in the revised manuscript, we have added an example in Table A2 to illustrate the method and how to calculate the highest, lowest and average value in lines 8-14, page 15 as follows:

To eliminate the noise and significant changes in the damage ratio, a moving average method is used to smooth the damage ratio in each precipitation intensity range. We add up all the damage ratios of points for a specific precipitation intensity range and divide it by the total number of points. In this study, we use the criteria for classifying the precipitation intensity issued by the China Meteorological Administrator (2008), which is presented in Table 5, to apply the moving average method. An example to illustrate the moving average method is presented in Appendix Table A2.

Table A2 An example to illustrate the moving average method. There are 3 damaged

records among Light rain (0.1-9.9), the damage ratio range is 0.0065-0.2145 for record 1, 0.0015-0.0495 for record 2 and 0.0009-0.0297 for record 3. After using the moving average method, the lowest value is 0.002967, the average and highest value is 0.050433 and 0.0979, respectively. The precipitation intensity by using the moving average is 5mm.

	Precipitation intensity	*Total precipitation, in 24 h/mm*	*Damage ratio range of records*	*Damage ratio by using the moving average method*	*Precipitation intensity by using the moving average method, in 24 h/mm*
Lowest value	*Light rain*	*0.1-9.9*	*Record 1: 0.0065-0.2145* *Record 2: 0.0015-0.0495* *Record 3: 0.0009-0.0297*	$\frac{0.0065+0.0015+0.0009}{3}$ $= 0.002967$	5
Average value				$(\frac{0.0065+0.2145}{2}+\frac{0.0015+0.0495}{2}+\frac{0.0009+0.0297}{2})/3$ $= 0.050433$	
Highest value				$\frac{0.2145+0.0495+0.0297}{3}$ $= 0.0979$	

5) Reading through the full text, this article does a risk assessment of the railway. I suggest replacing the transportation with railway.

Response: We thank for the reviewer's comments. In the revised manuscript, we have changed the title into " How to use empirical data to improve railway infrastructure risk assessment"