



Supplement of

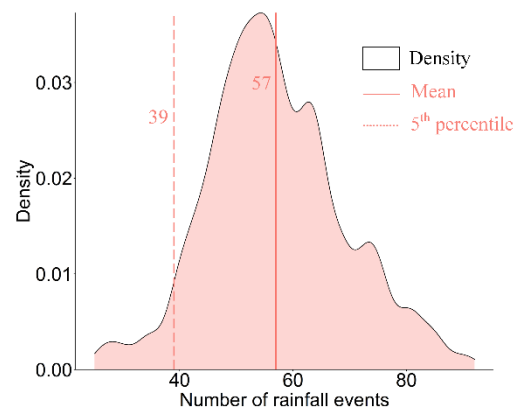
Quantifying unequal urban resilience to rainfall across China from location-aware big data

Jiale Qian et al.

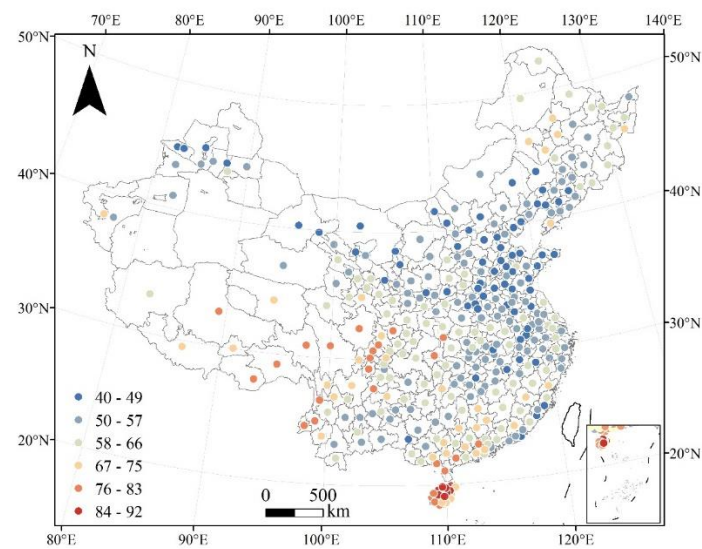
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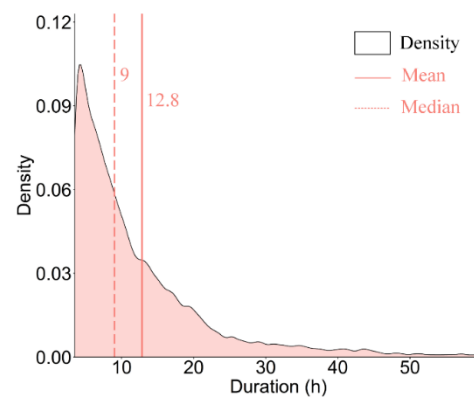
Sect. S1



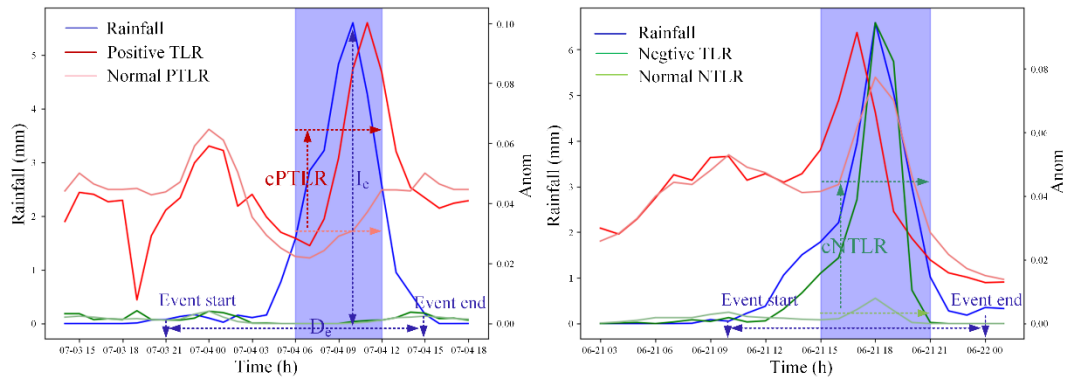
Figs. S1. The probability density function of the number of rainfall events for all cities.



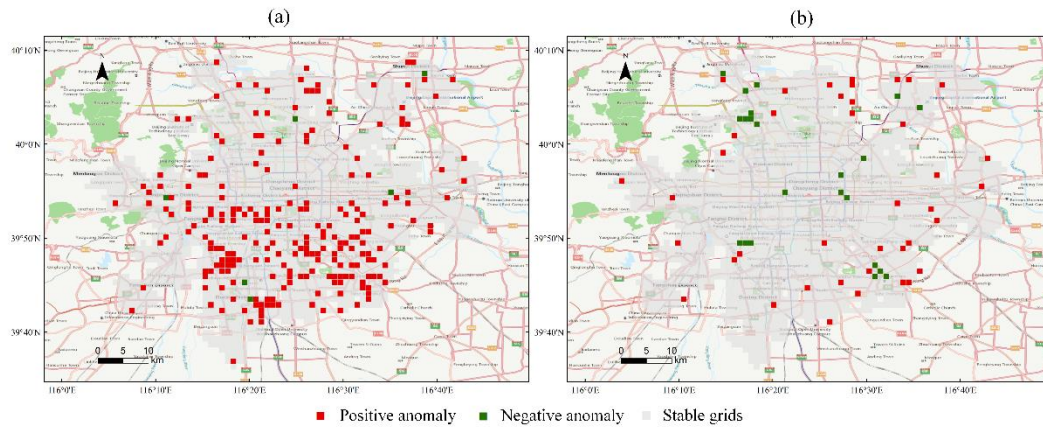
Figs. S2. The number of rainfall events by city.



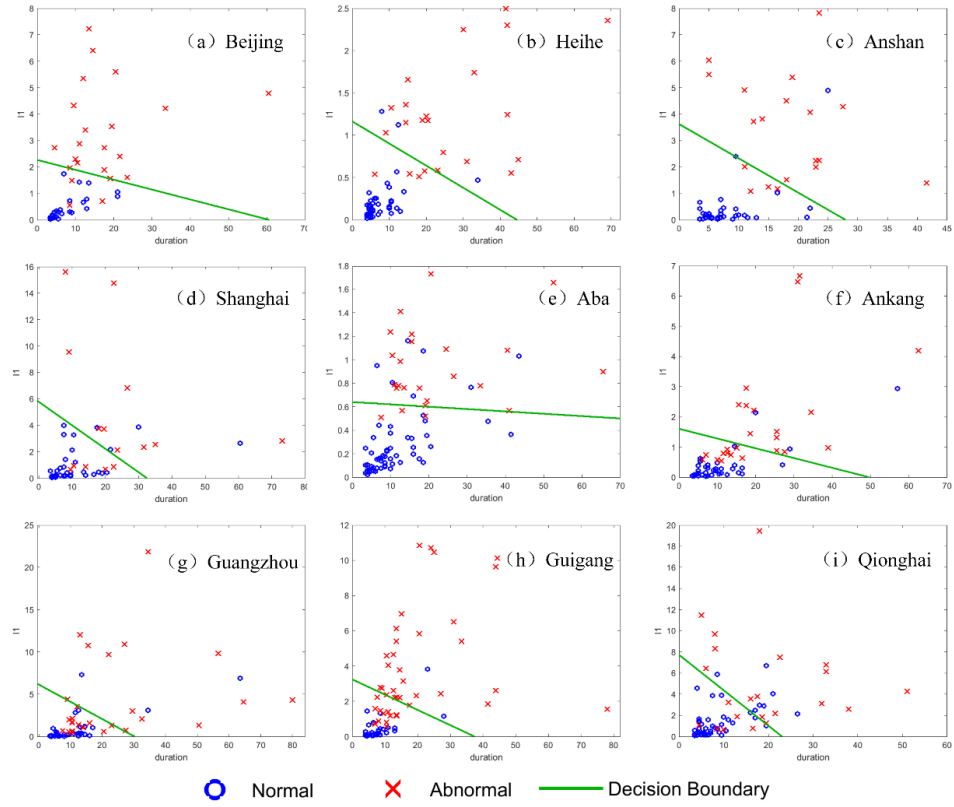
Figs. S3. The rainfall duration probability density function for all rainfall events.



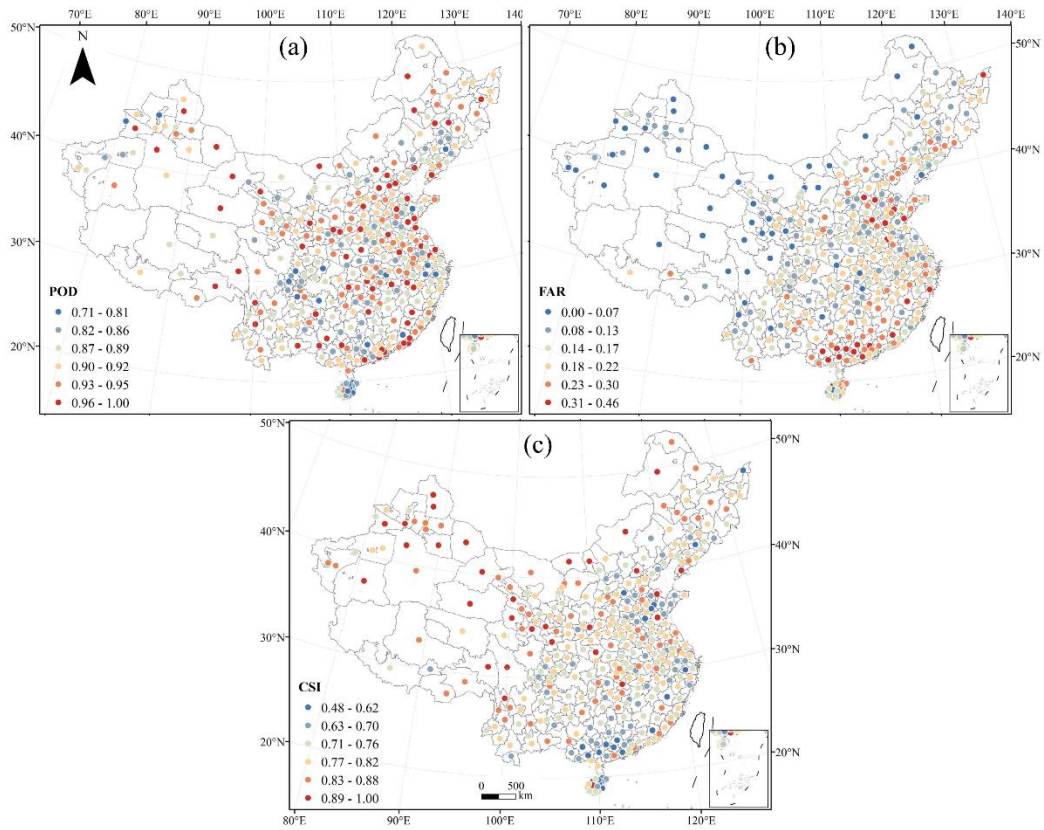
Figs. S4. Definitions of the variables of rainfall and human activity anomalies used in this study, as exemplified by Beijing and Zhuhai city.



Figs. S5. The stable grids with positive, negative, and no anomalies in Beijing when it is raining at 10:00 am on July 04, 2017 (a) and not raining at 10:00 am on June 18, 2017 (b).



Figs. S6. The binary classification results of the cities in Northern(a-c), Midwestern(d-f), and Southern(g-i) China.



Figs. S7. The POD, FAR, and CSI of rainfall threshold detection based on the binary classifiers.

Sect. S2

Tabs. S1. Rainfall indices uses in this study

| Rainfall indices | Description |
|---------------------|---|
| Peak intensity (1h) | Hourly peak rainfall intensity |
| Peak intensity (6h) | Six-hour-window peak rainfall intensity |
| Cumulative rainfall | Cumulative rainfall during a rainfall event |
| Duration | The time period a rainfall event lasts |
| Peak hour | The time of peak intensity(1h) |

Tabs. S2. Correlations between the 3-hour rainfall threshold and explanatory variables

| Urban indices | Coefficients | Kendall | Pearson | Spearman |
|--------------------------|--------------|---------|---------|----------|
| Annual rainfall | 0.40*** | 0.22*** | 0.40*** | 0.31*** |
| Population density | 0.21** | 0.27*** | 0.40*** | 0.40*** |
| Gross domestic product | 0.20* | 0.25*** | 0.40*** | 0.37*** |
| Area of paved roads | -0.16* | -0.05 | -0.17* | -0.07 |
| Green coverage rate | 0.17 | 0.21** | 0.27** | 0.31** |
| Drainage network density | 0.09 | 0.17* | 0.20* | 0.24* |

***p<0.001;**p<0.01;*p<0.05. $R^2=0.40$.

Tabs. S3. Correlations between the 6-hour rainfall threshold and the explanatory variables

| Urban indices | Coefficients | Kendall | Pearson | Spearman |
|--------------------------|--------------|---------|---------|----------|
| Annual rainfall | 0.43*** | 0.24*** | 0.42*** | 0.33*** |
| Population density | 0.21** | 0.26*** | 0.39*** | 0.38*** |
| Gross domestic product | 0.20* | 0.24*** | 0.39*** | 0.36*** |
| Area of paved roads | -0.17* | -0.06 | -0.19* | -0.09 |
| Green coverage rate | 0.16 | 0.20** | 0.26** | 0.30** |
| Drainage network density | 0.10 | 0.17* | 0.20* | 0.24* |

***p<0.001;**p<0.01;*p<0.05. $R^2=0.42$

Tabs. S4. Correlations between the 12-hour rainfall threshold and the explanatory variables

| Urban indices | Coefficients | Kendall | Pearson | Spearman |
|--------------------------|--------------|---------|---------|----------|
| Annual rainfall | 0.50*** | 0.35*** | 0.49*** | 0.50*** |
| Population density | 0.19* | 0.19*** | 0.31** | 0.27** |
| Gross domestic product | 0.13 | 0.15* | 0.29** | 0.22* |
| Area of paved roads | -0.17* | -0.12 | -0.23* | -0.17 |
| Green coverage rate | 0.07 | 0.12 | 0.17 | 0.19 |
| Drainage network density | 0.10 | 0.14* | 0.18 | 0.20* |

***p<0.001;**p<0.01;*p<0.05. $R^2=0.38$.

Tab. S5. Correlations between the response sensitivity and the explanatory variables

| Urban indice | Coefficients | Kendall | Pearson | Spearman |
|-----------------------------|--------------|----------|----------|----------|
| Annual rainfall | -0.37*** | -0.22*** | -0.35*** | -0.33*** |
| Population density | -0.19* | -0.23*** | -0.34*** | -0.33*** |
| Gross domestic product | -0.17 | -0.23*** | -0.34*** | -0.38*** |
| Area of paved roads | 0.05 | 0.03 | 0.05 | 0.06 |
| Green coverage rate | -0.05 | -0.18** | -0.20* | -0.26** |
| Drainage network density | -0.20* | -0.18** | -0.29** | -0.27** |

***p<0.001;**p<0.01;*p<0.05. $R^2=0.31$