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Spatiotemporal characteristics of extreme precipitation and their possible links to urban extent in China

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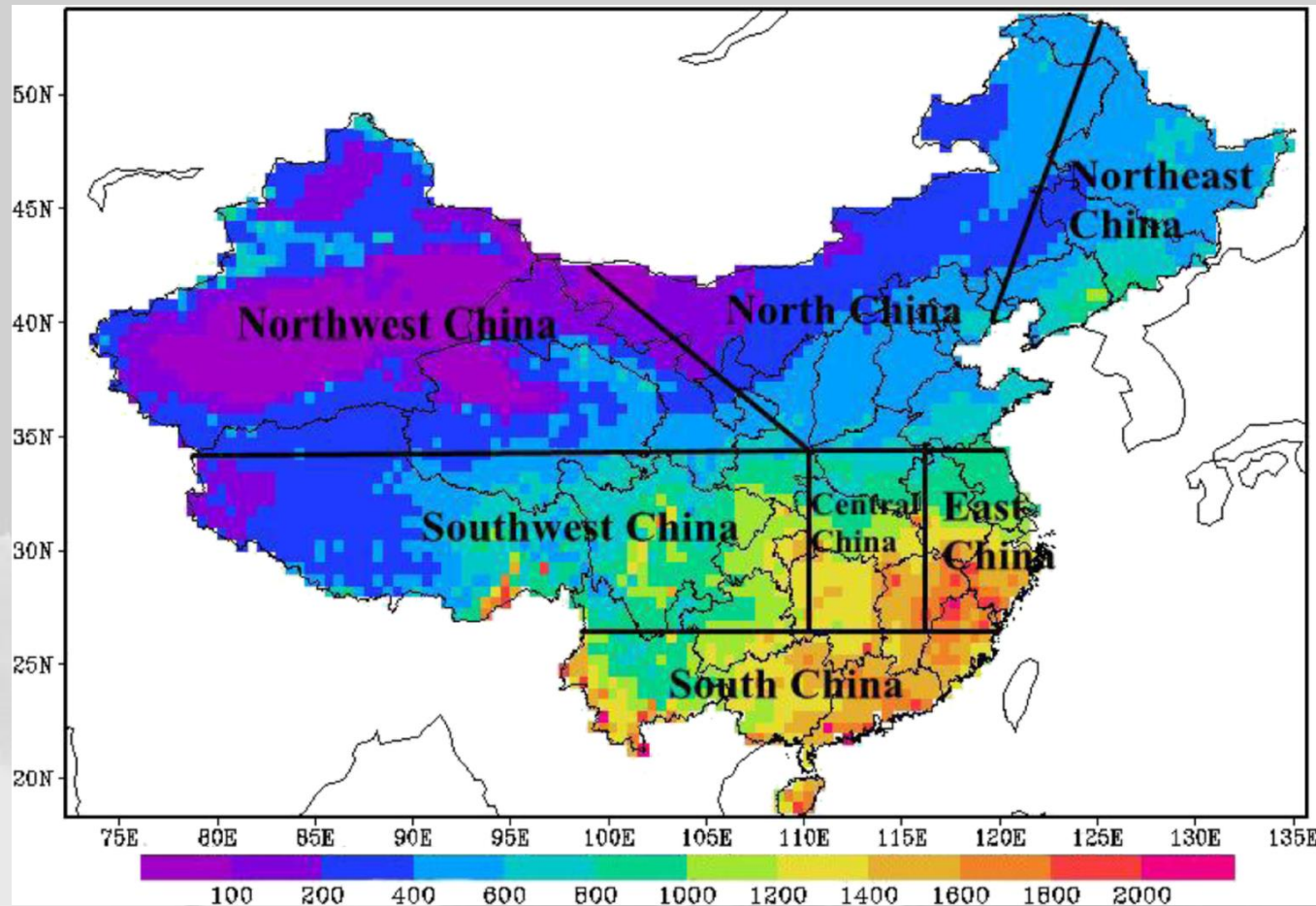


Outline

- **Spatial and temporal characteristics of extreme precipitation in China.**
- **How extreme precipitation has changed in China during last half century?**
- **Whether links exist between extreme precipitation and urban extent?**
- **What is the possible factors that regulate the correlation between urban extent and precipitation extreme?**



Mean annual precipitation(mm) in China (1961-2012)



Precipitation increases considerably from the northwest region to the southeast

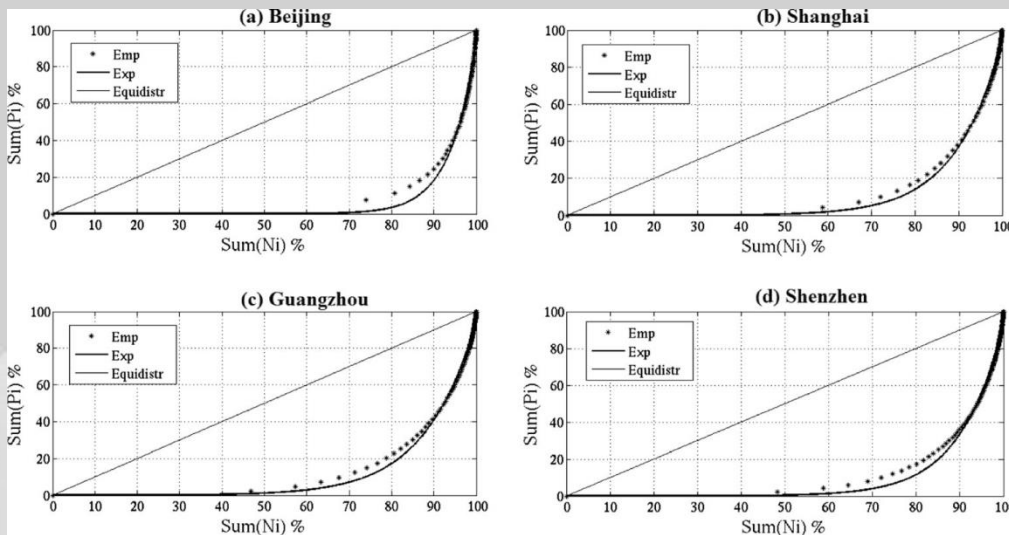
Lower than 100mm in northwest China

Higher than 2000mm in southeast



Precipitation extreme indices

- **CI** High CI value indicates that the precipitation was concentrated within a few rainy days during the year, and vice versa. (**daily scale**)

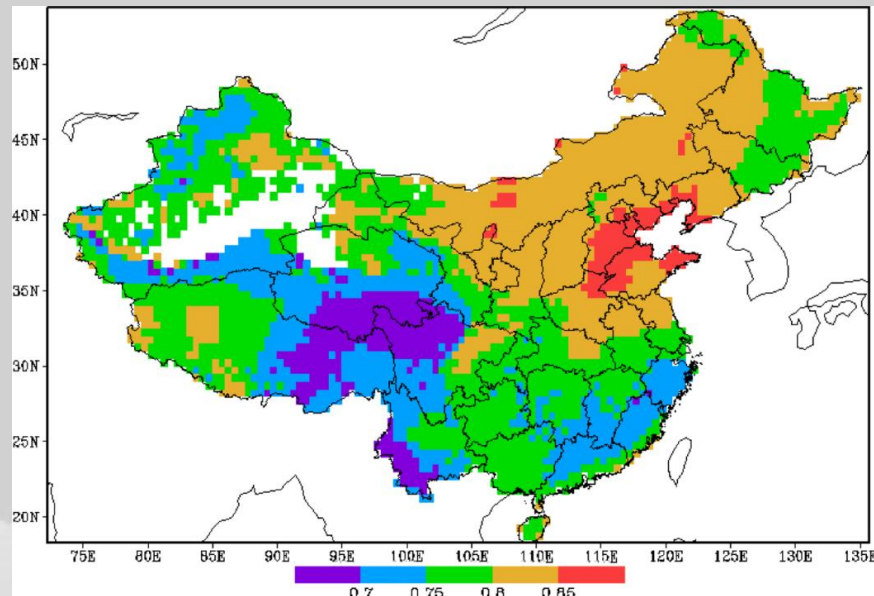


- **PCI**
$$PCI = 100 \times \frac{\sum_{i=1}^{12} p_i^2}{(\sum_{i=1}^{12} p_i)^2}$$
 precipitation concentration on (**monthly scale**)
where p_i is the rainfall amount of month i .

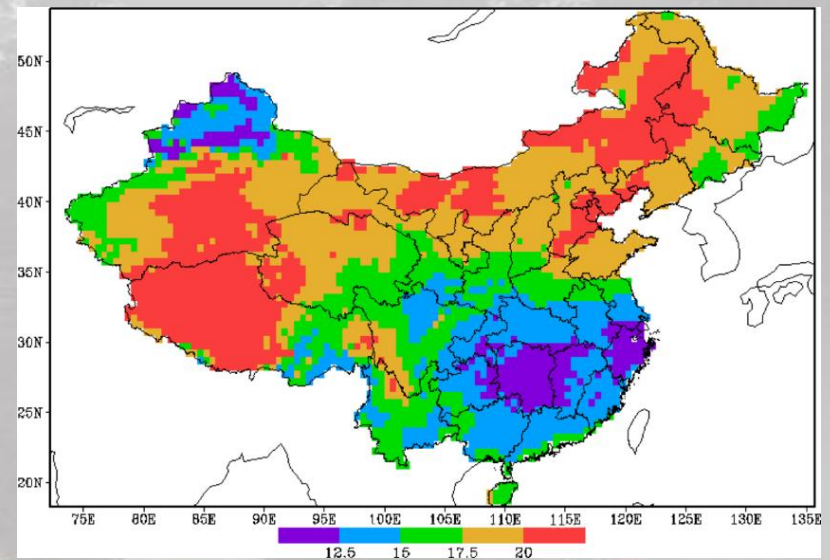


Spatial pattern of extreme precipitation

Spatial distribution of annual CI (1961–2012)

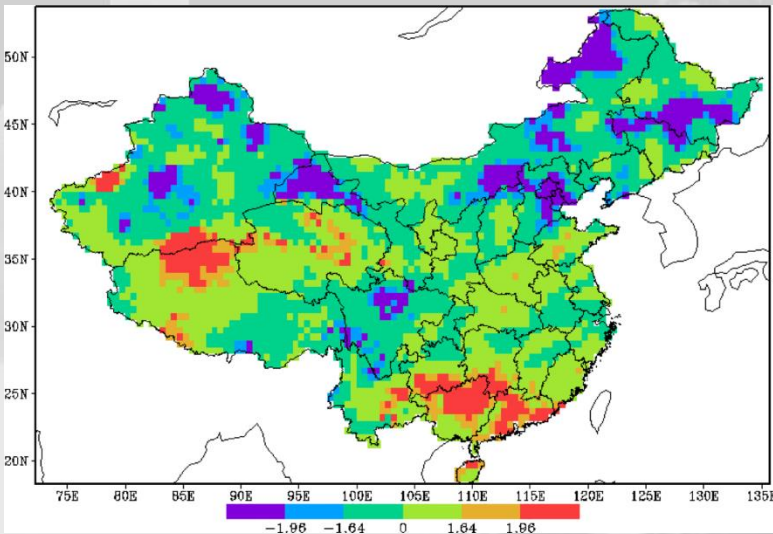
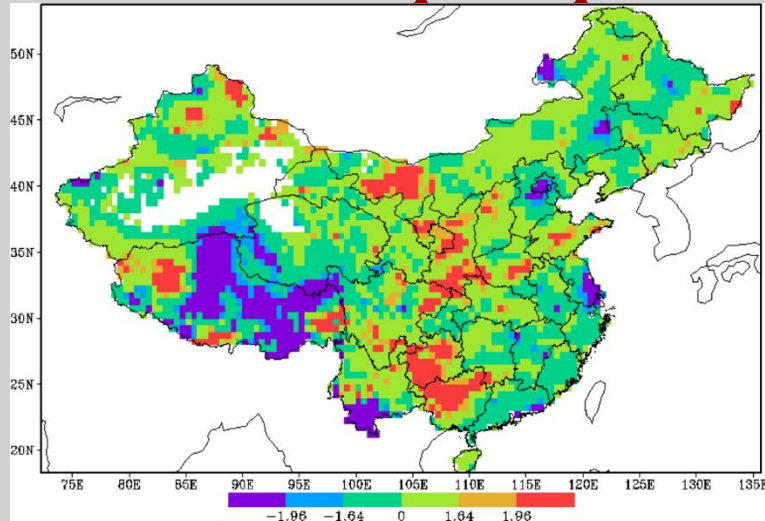


Spatial distribution of annual PCI

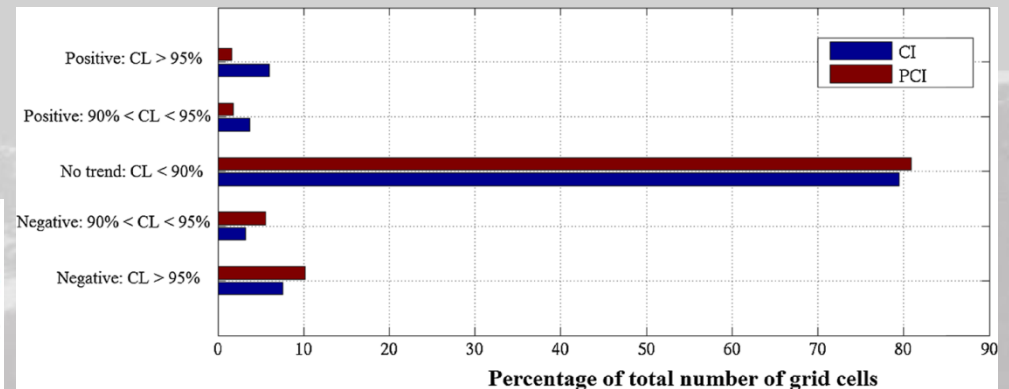




Time trend of precipitation extreme in the last half century



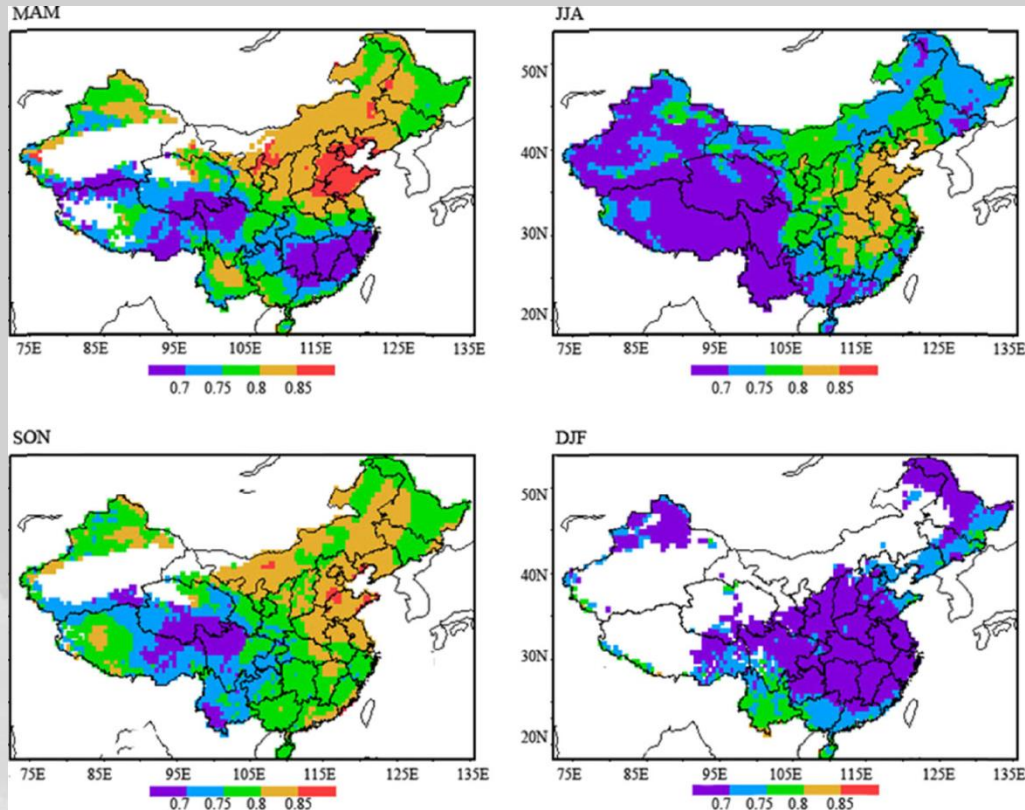
It can be seen that an increasing trend spreads from southern to northern China.



An increasing trend spreads across southern China and the Qinghai-Tibet Plateau

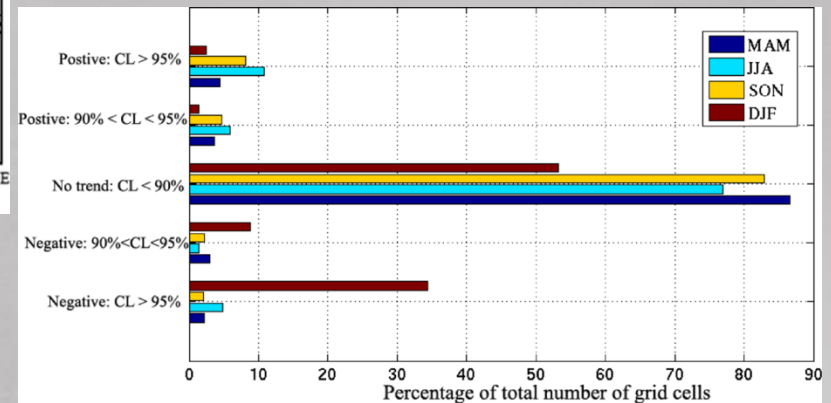


Spatial distribution of seasonal CI



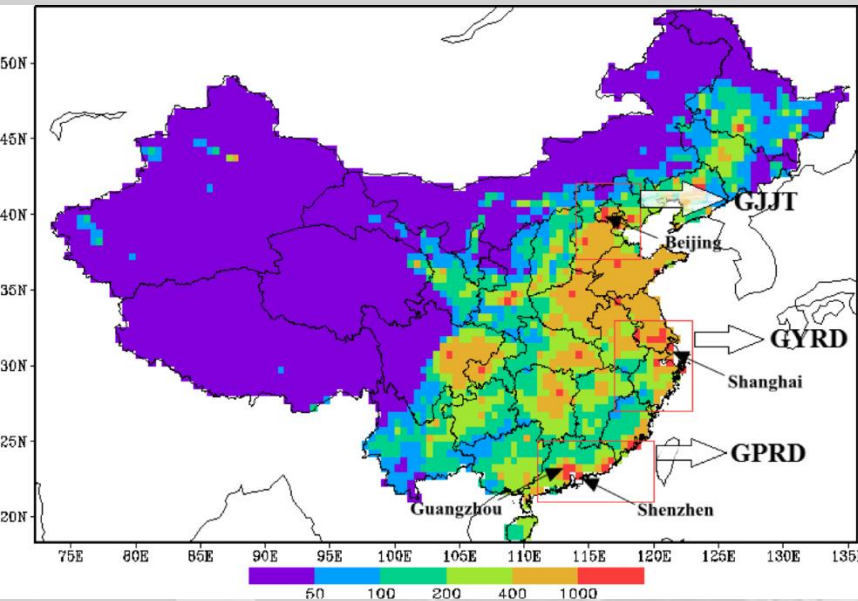
A northeast-southwest contrast is found in spring and autumn, whereas an east-west contrast is very evident in summer.

Trends of seasonal precipitation CI at various confidence levels





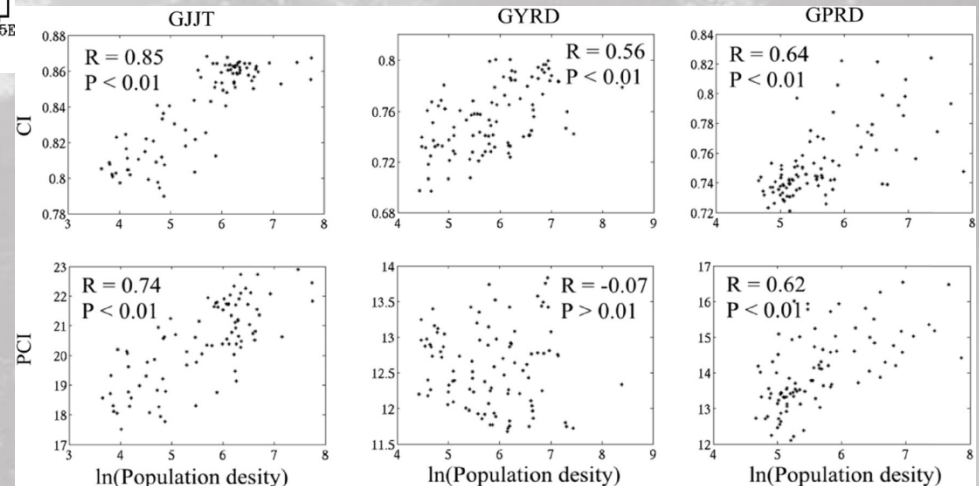
Population density (persons/km²) for 2000 over China



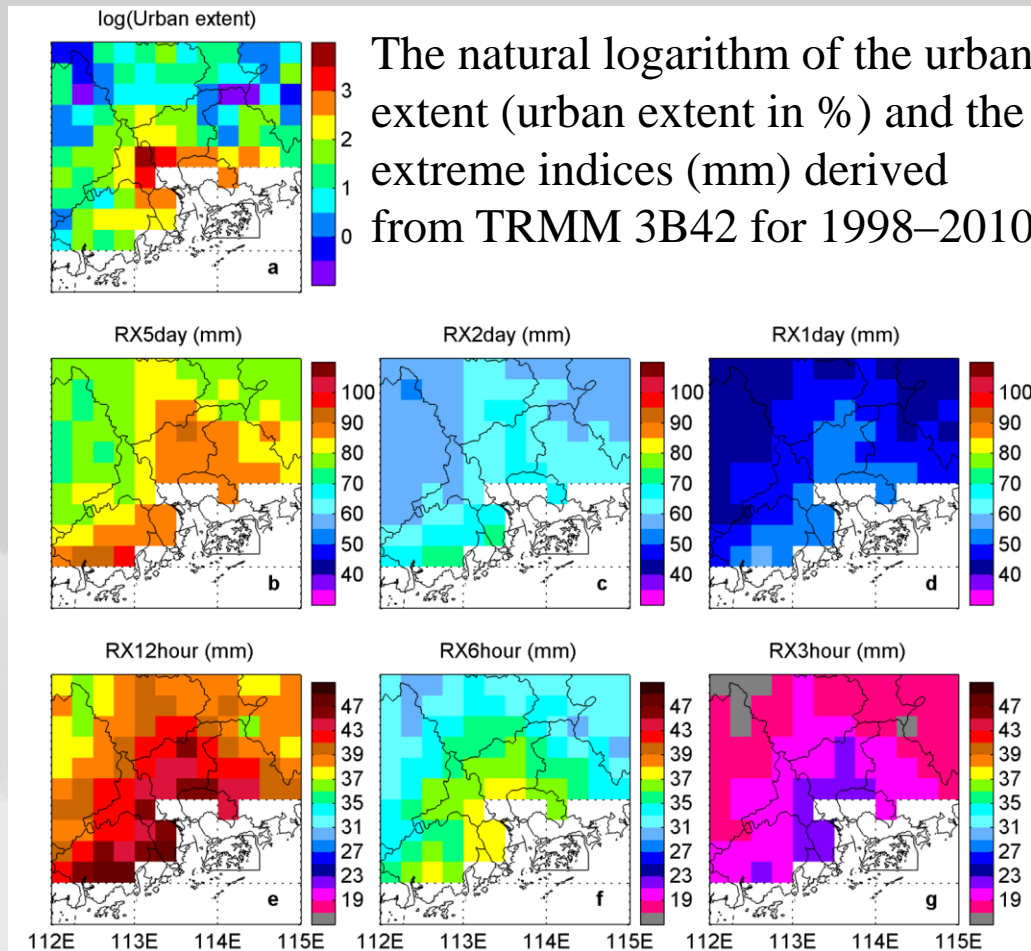
The scatter plot of the natural logarithm of population density for 2000 versus CI (PCI) (1961-2012)

Qinghai-Tibet Plateau is generally **<50 persons/km²**

coastal areas is as high as **1000 persons/km²**



Urban extent versus extreme precipitation

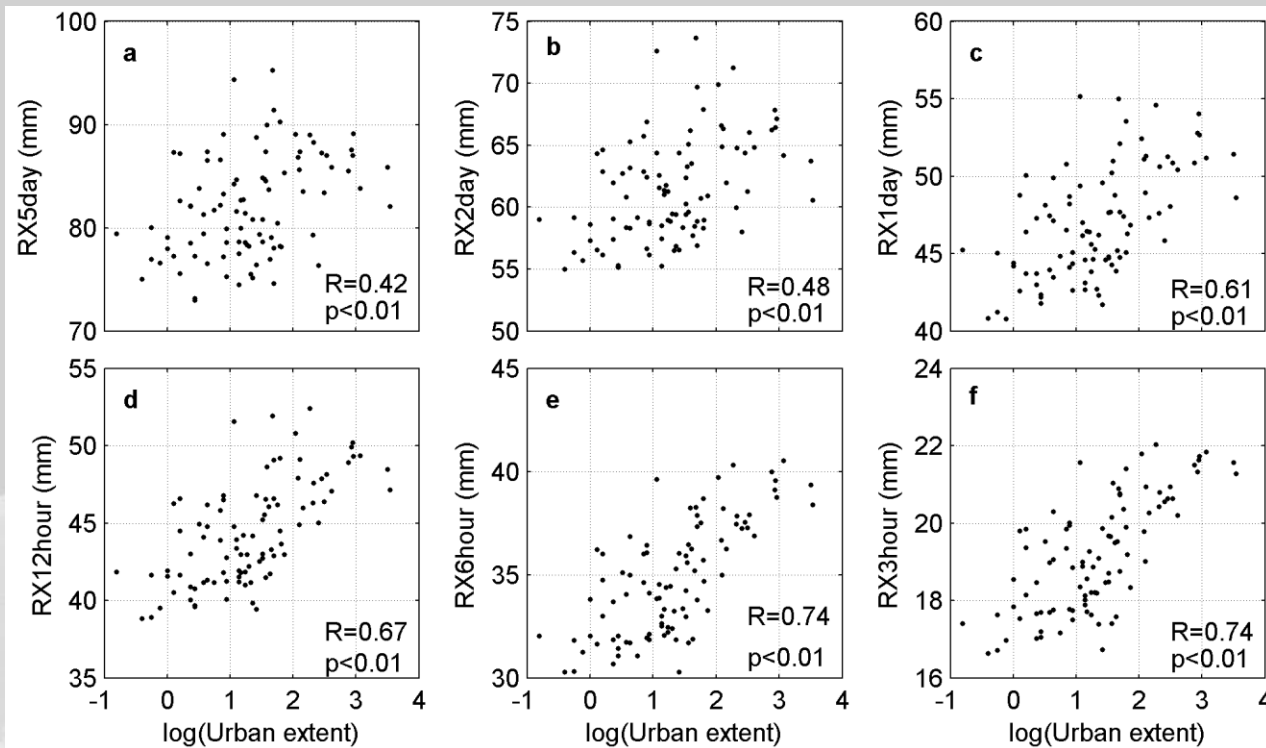


Larger values of extreme indices are found in the cities of Guangzhou, Foshan, Dongguan, Zhongshan and southern Jiangmen

highly urbanized areas experienced larger amount of **strong precipitation** than surrounding nonurban areas



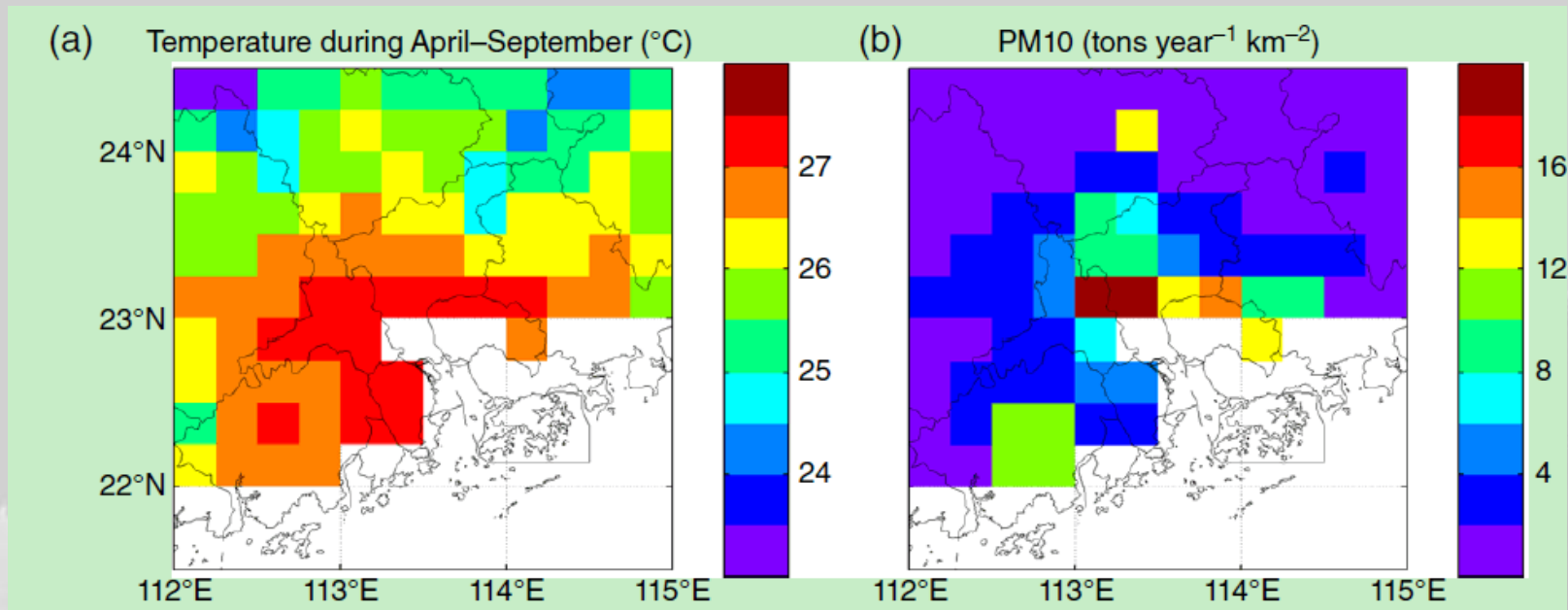
Quantitative link between urban extent and extreme precipitation



All temporal scales are positively correlated with urban extent

The correlation coefficient between urban extent and the indices monotonically increase as the temporal scale decreases

Possible reasons behind the links



The mean surface temperature during the wet season (April–September) based on the data set of 1998–2007, and annual PM10 based on the data set of 1998–2008.



Summary

- The spatial distributions of the 52-year averages of PCI and CI are different. A northwest–southeast contrast for PCI and a northeast–southwest contrast for CI are very evident.
- In summer and autumn, the fraction of areas with a significant increasing trend is approximately 15 %, In winter, a substantial fraction (35 %) of China experiences a decreasing trend in CI.
- The correlation analysis reveals that extreme precipitation is positively correlated with urban extent, and correlation coefficient increases with the decrease in the temporal scale of the extreme indices.
- The possible factors that regulate the correlation between urban extent and precipitation extreme could be urban heat island effect (through thermodynamic and dynamic mechanisms) and aerosol concentrations.



References

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Thanks!