



耶鲁大学-南京信息工程大学大气环境中心

Yale-NUIST Center on Atmospheric Environment

The effect of urbanization level on air and surface temperature

---A Case Study of Fuzhou and Zhangzhou

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Outline

- Background
- Objective
- Method
- Results and Discussion
- Conclusions
- Next Work



Background

Urbanization has brought a series of environmental problems and changed the local microclimate. The sustainable development of the city, the protection of the ecological environment and so on are subject to different levels of urbanization.

In addition to natural factors, urbanization and land use and other human factors is an important factor affecting the temperature changes. The changes in temperature and surface temperature are the main indicators for understanding urbanization.



Objective

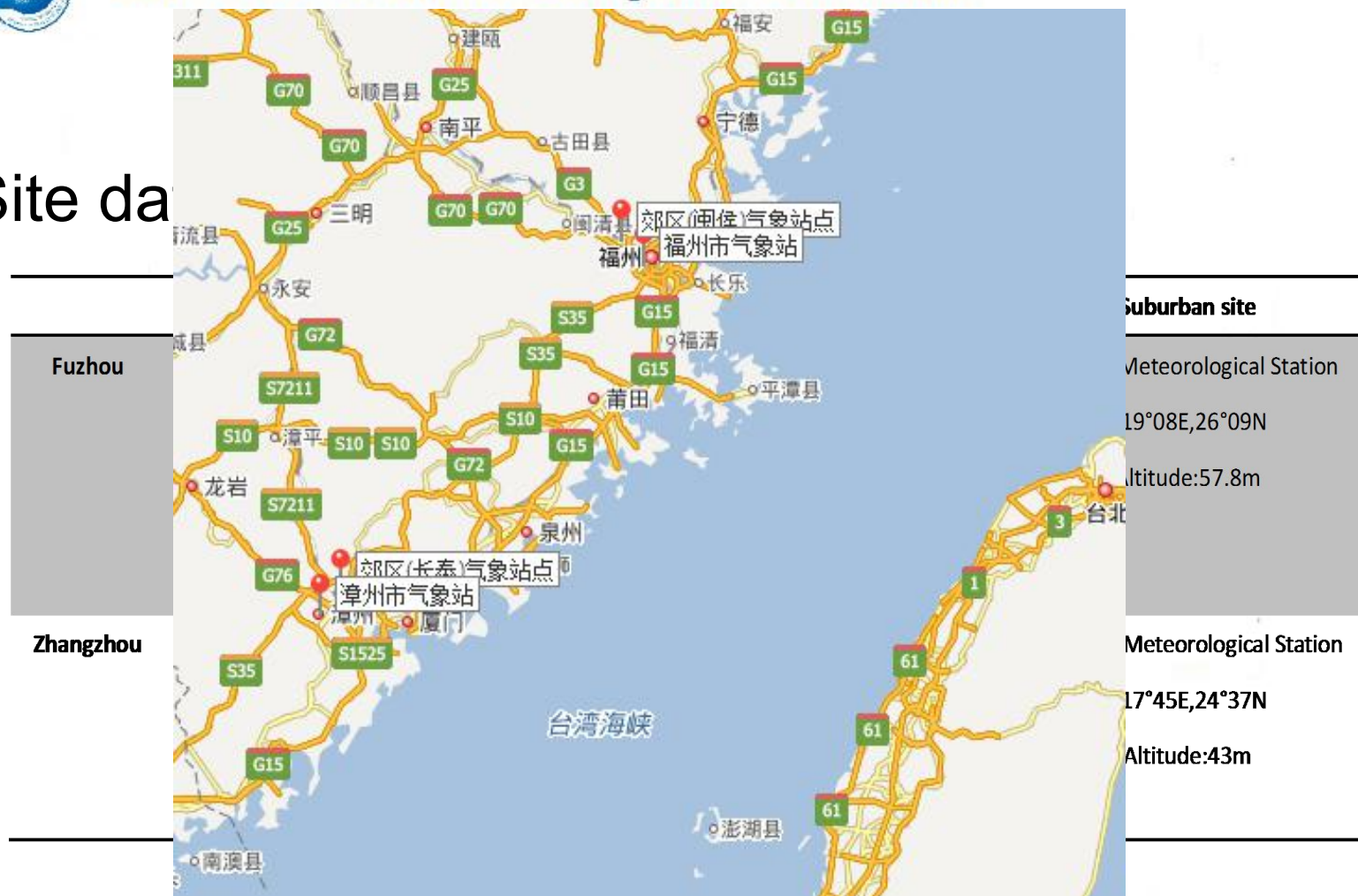
- Analyze the difference of different urbanization level to air temperature.
- To explore the response trend of urban and suburban temperature in different urbanization process.



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- Site data





- Site basis

According to the previous method, establish a comprehensive indicator of the degree of urbanization:

$$Y=f(y_1,y_2,y_3,y_4)=\lg(y_1*y_2*y_3*y_4)$$

Among them, y_1 , y_2 , y_3 , y_4 are the population, built area, electricity consumption, the GDP.

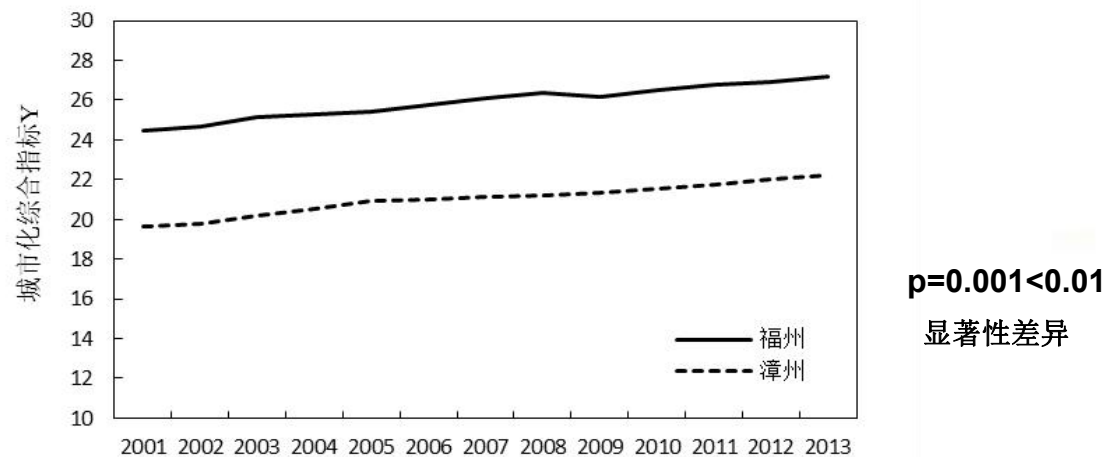


Figure 1. 2001-2013 Fuzhou and Zhangzhou urbanization process



- Data

1. Urban and suburban 2m air temperature data (1961-2013)
2. NCEP/NCAR R1 reanalysis data (Monthly average temperature/2m, $2.5^{\circ} \times 2.5^{\circ}$)
3. MODIS: Aqua land surface temperature product (MYD11A1, daily, 500m)



- Method

1. OMR(observation minus reanalysis).The OMR value is the difference between the temperature anomaly of the observed data and the temperature anomaly of the reanalysis data. which is

$$\text{OMR}(\Delta T_{\text{OR}})=T_{\text{o}}-T_{\text{R}}$$

2. The following indicators were used to quantitatively evaluate the impact of urbanization on trends in temperature:

Impact of Urbanization: $\Delta T=T_{\text{u}}-T_{\text{r}}$;

Contribution of Urbanization to Changes in Temperature:

$$E_{\text{u}}=(\Delta T_{\text{ur}})/(|T_{\text{u}}|)=(T_{\text{u}}-T_{\text{r}})/(|T_{\text{u}}|)$$



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Results and Discussion

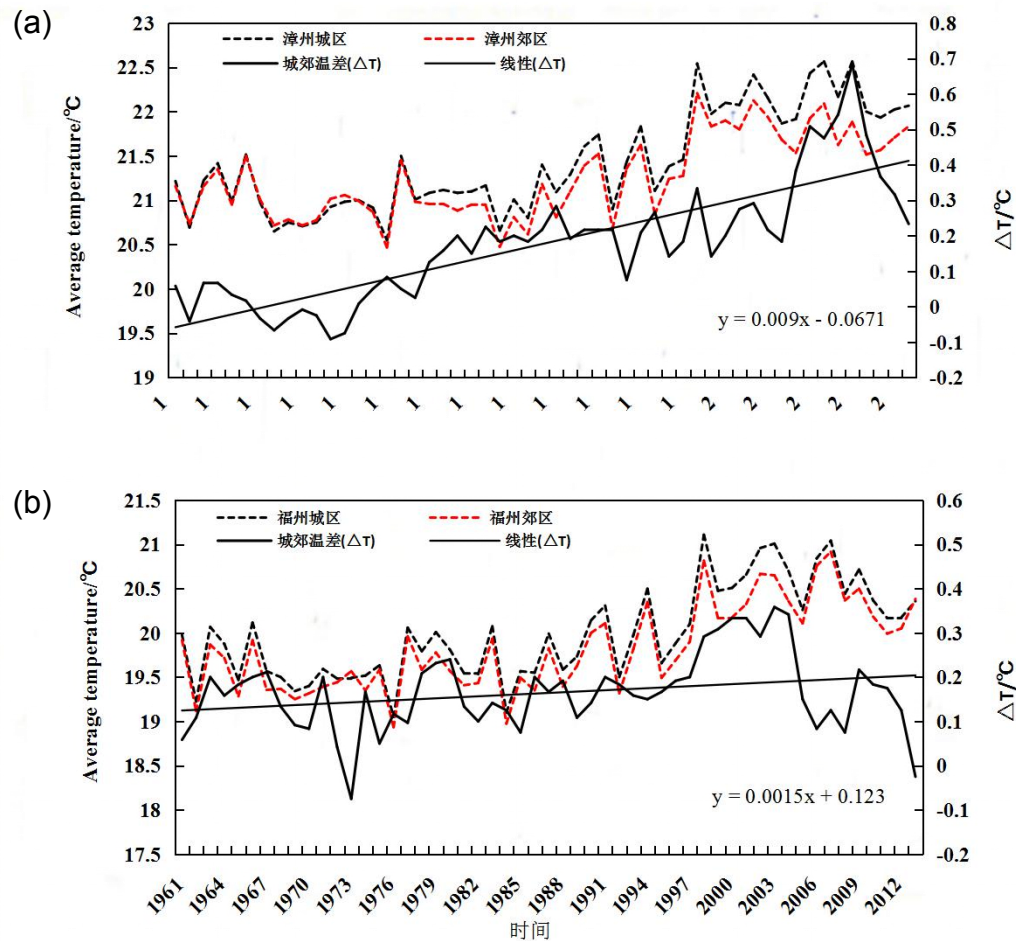


Figure 2. The Change of Mean Temperature and Temperature Difference in Urban and Suburban of Fuzhou and Zhangzhou in 1961-2013

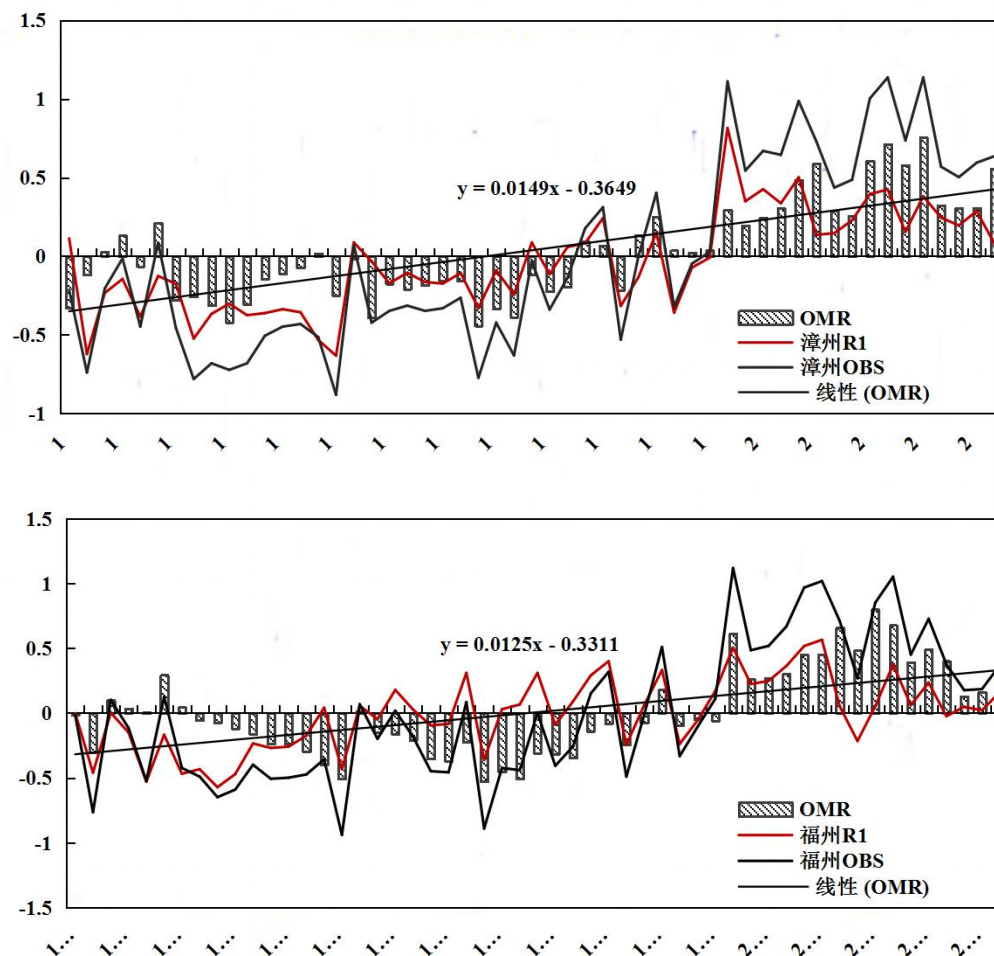


Figure 3. Observational, R1 and OMR time series of temperature anomalies in Fuzhou and Zhangzhou during 1961-2013

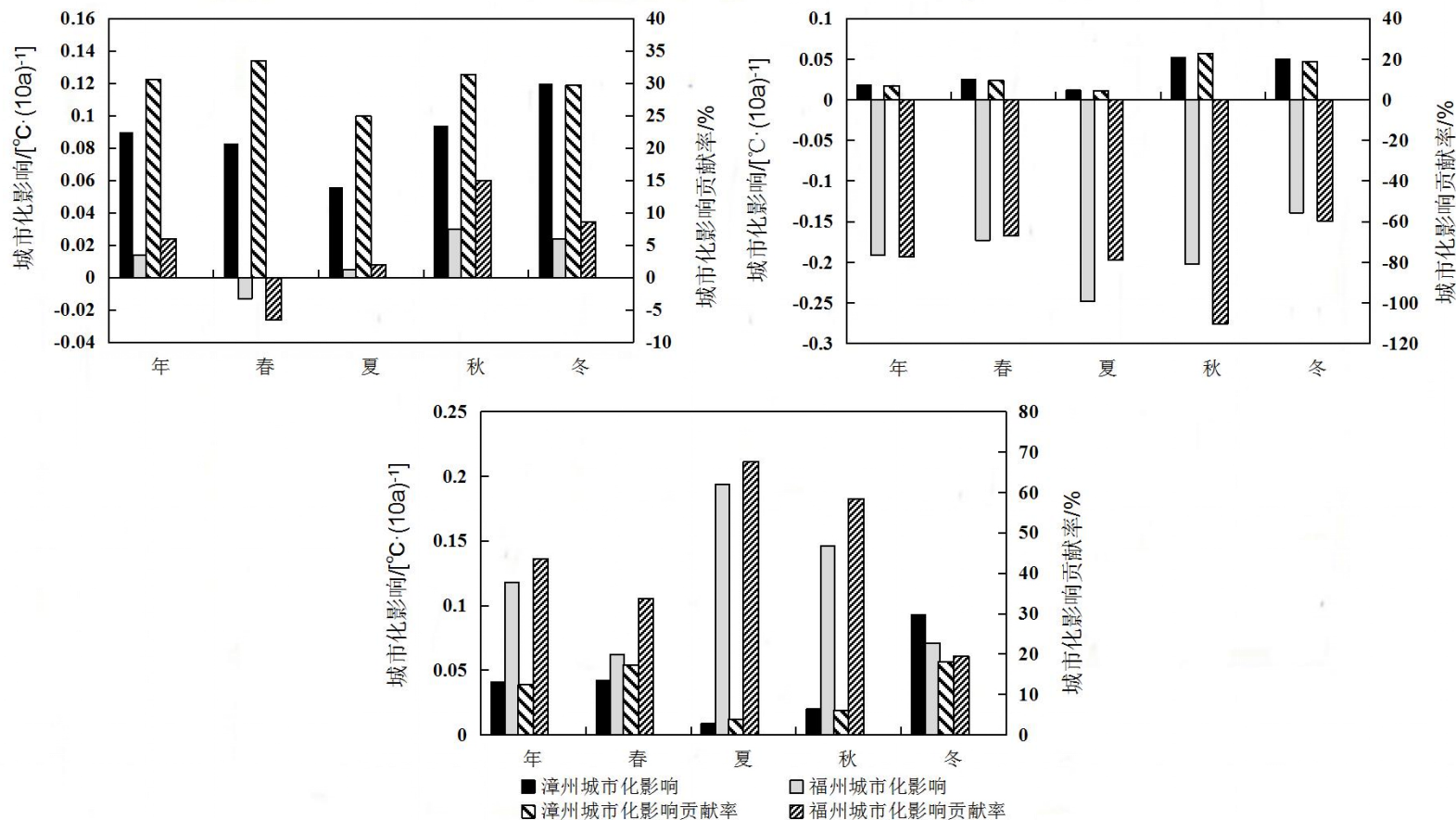


Figure 4. Zhangzhou and Fuzhou average temperature (a), maximum temperature (b) and minimum temperature (c) of urbanization and urbanization impact contribution rate during 1961-2013

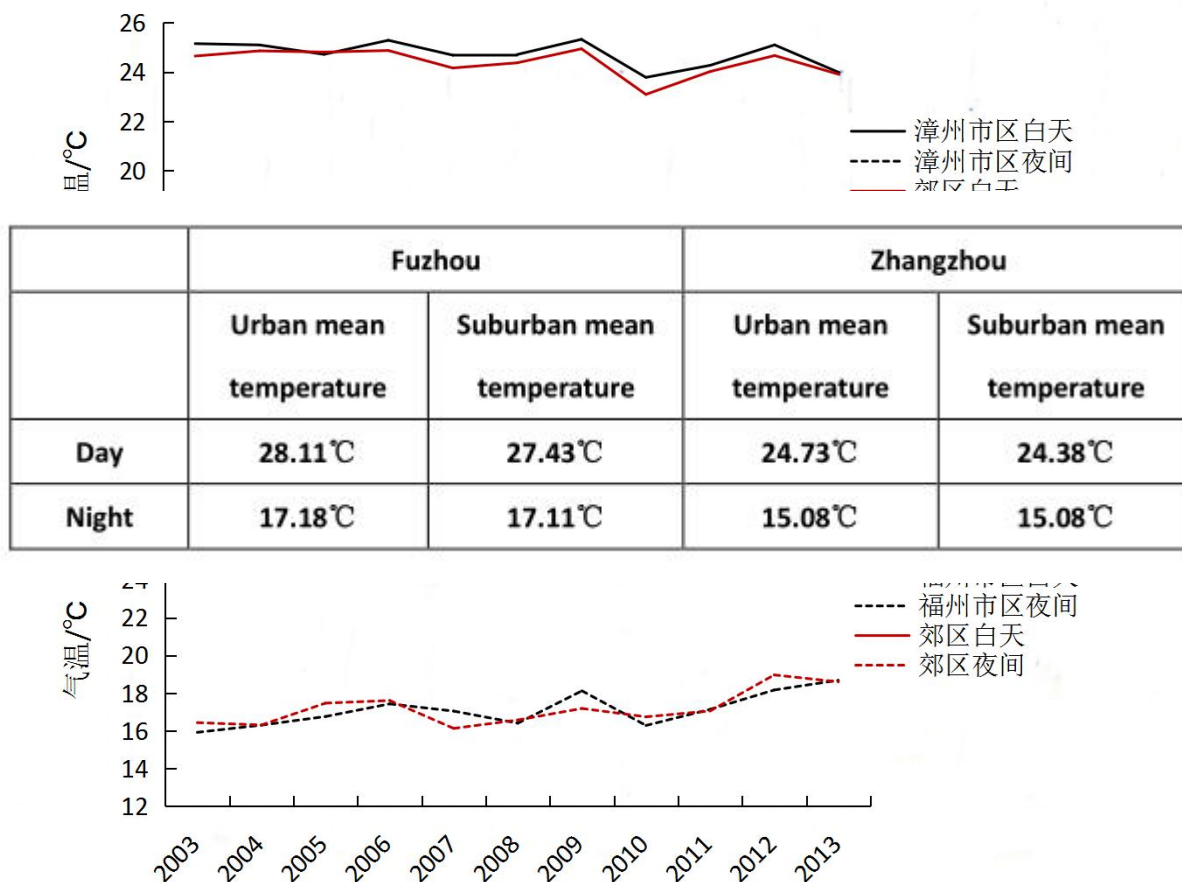


Figure 5. Aqua land surface temperature change in Fuzhou and Zhangzhou during 2003-2013



Conclusions

- The mean annual temperature in Zhangzhou is 20.43°C , and the mean annual temperature in Fuzhou is about 21.99°C . The mean annual surface temperature in Zhangzhou is 21.27°C , and the mean annual surface temperature in Fuzhou is 23.72°C . The higher the level of urbanization, the greater the influence of urbanization on the temperature and surface temperature.
- The effects of urbanization on the average temperature, minimum temperature and maximum temperature are different.



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Next Work

- Analysis of remote sensing data (Terra).
- Biochemical factors are used as an indicator of the degree of urbanization development.



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Thank you !