XVIII World Water Congress
International Water Resources Association (IWRA)

Evolution patterns of urban water consumption with the socio-economic development and its application in Changsha, China

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第18届 世界水资源大会 水与万物: 人与自然和谐共生

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Introduction

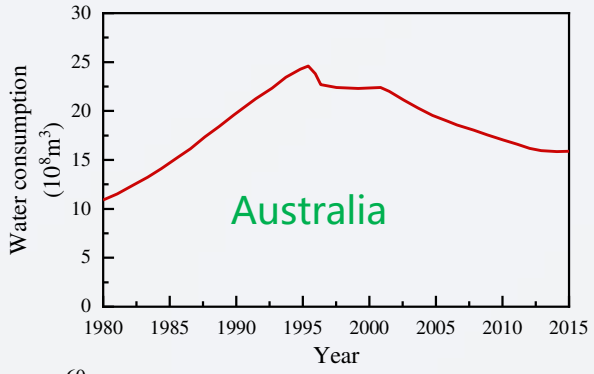
Urban socio-economic development

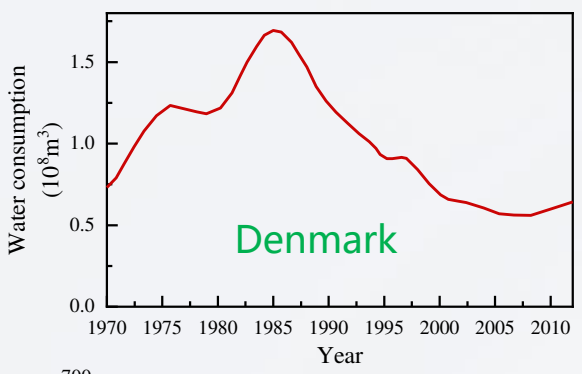
Industry

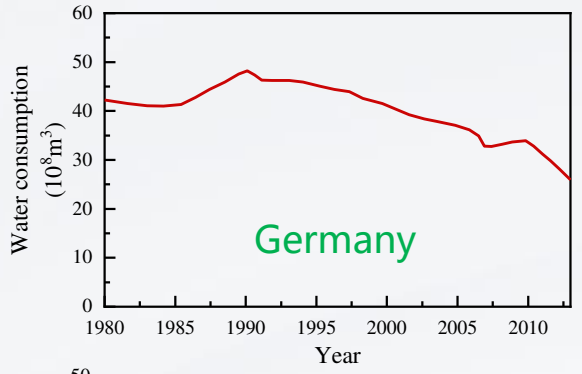
Population

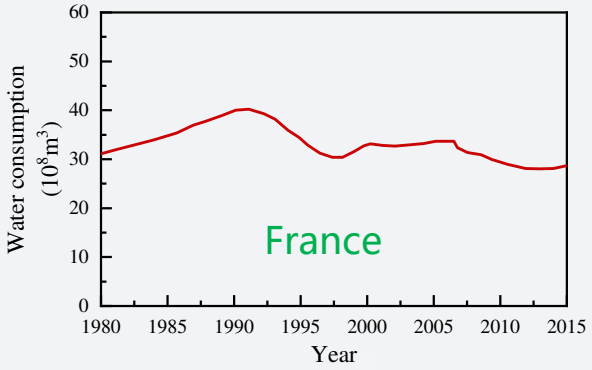
How is the correlation?

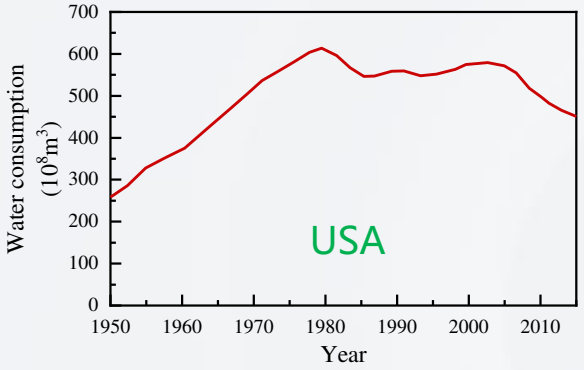
Urban water consumption

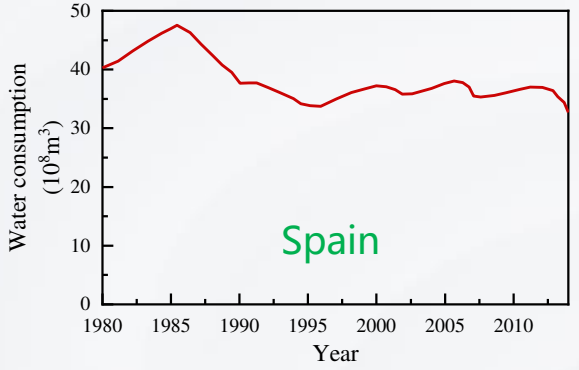








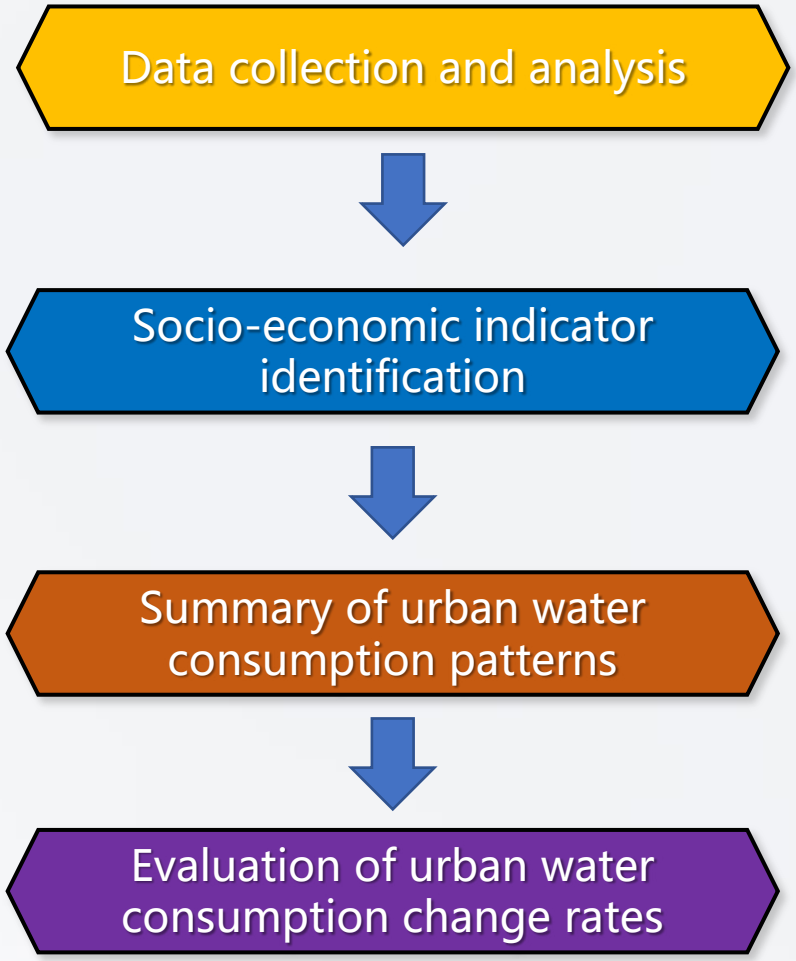




- The water consumption showed a trend of rising first and then stable or declining
- How are urban water consumption evolution? Are there the similar patterns?

(Zhao, Y et.l., 2021. The law of growth: Prediction of peak water consumption in china. Journal of Hydraulic Engineering. 52 (2), 129-141).

Methodology



Collect historical data on the water consumption and socio-economy of developed cities. And analysis the evolution trend

Identify the main socio-economic indicators influencing urban water consumption through **correlation analysis.**

Identify the thresholds of socio-economic indicators for dividing urban water consumption stages through **statistical analysis**

Evaluating according to data of developed cities with similar water resources conditions and socio-economic development trends

Result

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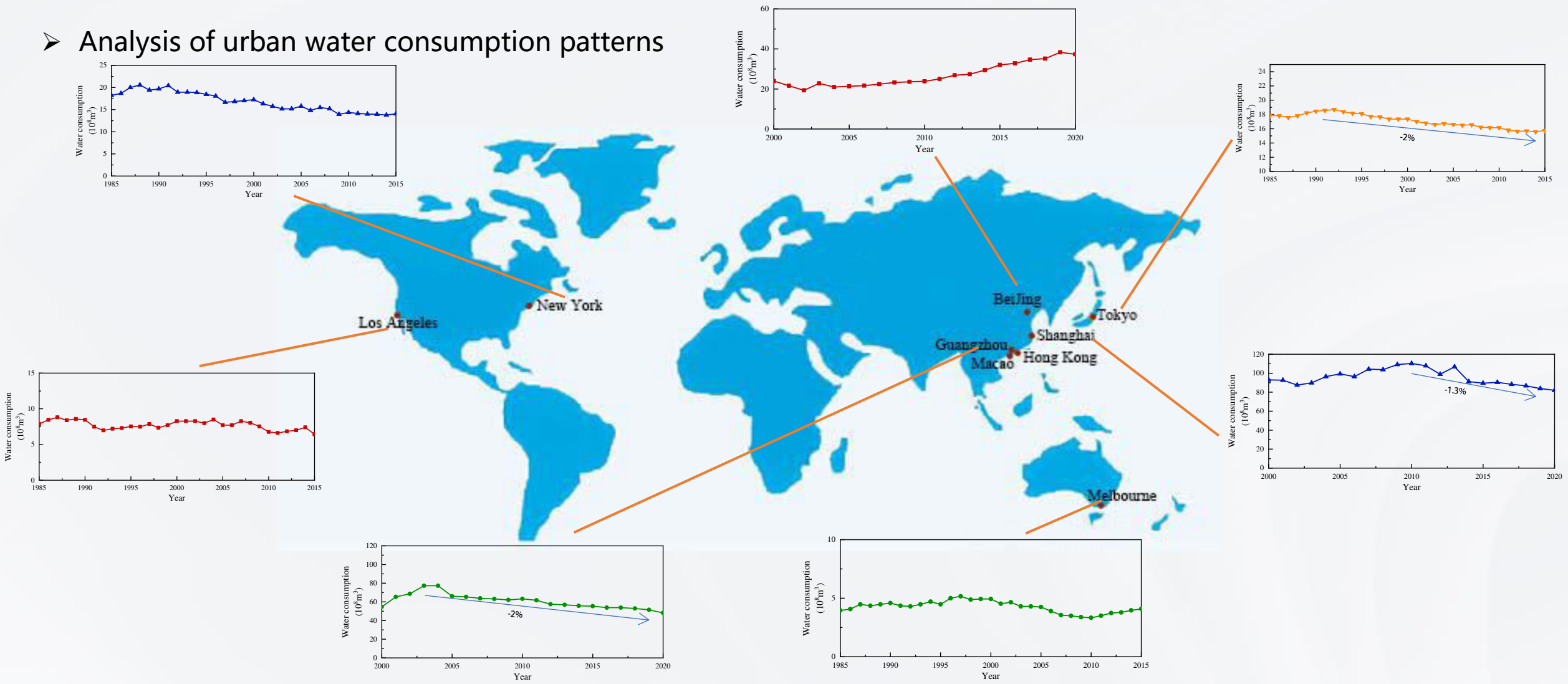
- Analysis of urban water consumption patterns



Methodology

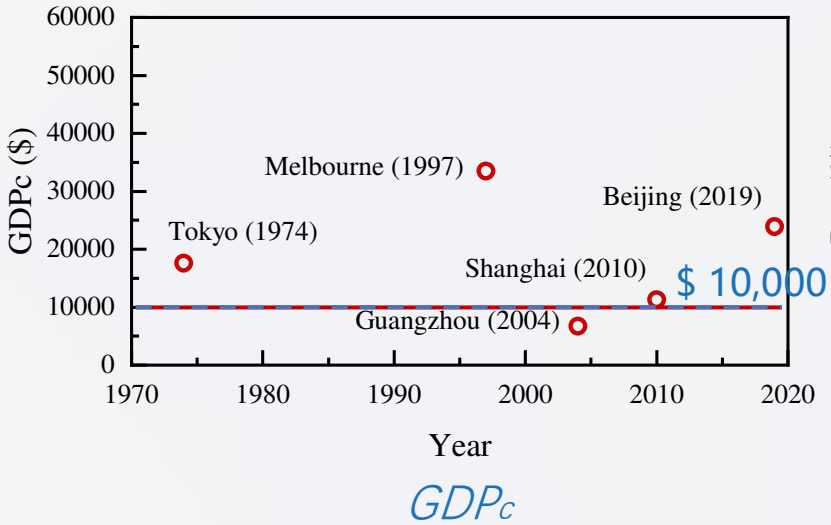
Through correlations analysis, three factors:

- ***GDPc***: GDP per captia
- ***Ru***: Urbanization rate
- ***Rtg***: Ratio of the tertiary industry to GDP

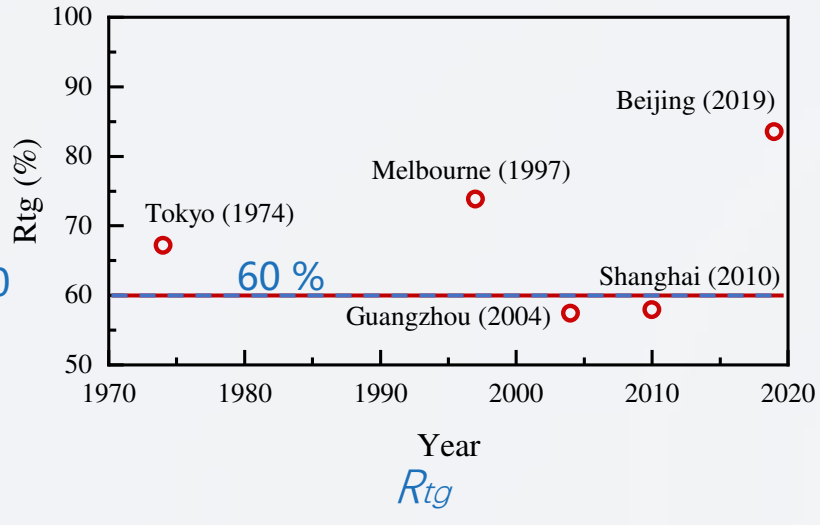
are identified as the main socio-economic indicator influencing urban water consumption evolution.

Result

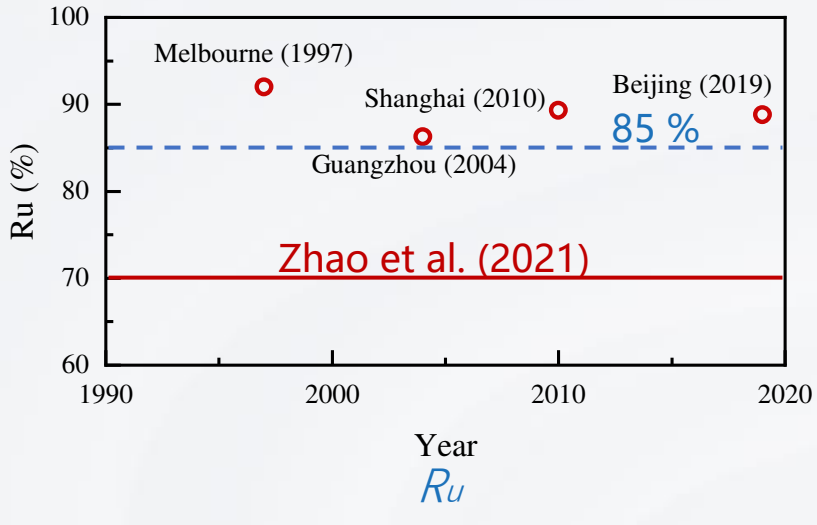
➢ Analysis of urban water consumption patterns



GDPc



Rtg



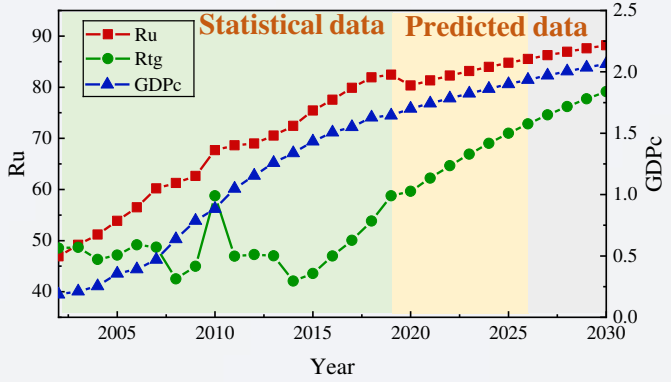
Ru

When urban water consumption reachs the peak value:

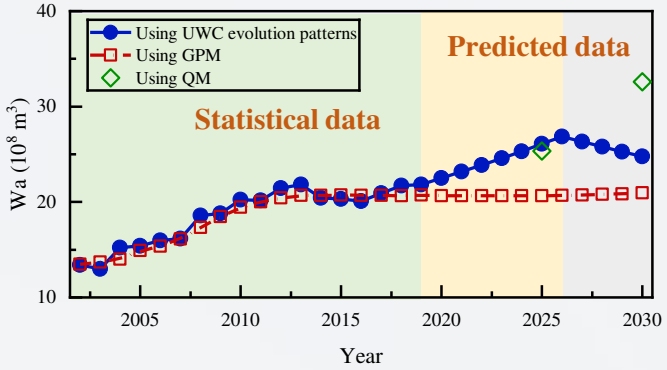
- *GDPc* ≥ 10,000 $, (state: *GDPc* ≥ 10,000 $)
- *Rtg* ≥ 60 %, (state: *Rtg* ≥ 60 %)
- *Ru* ≥ 85 %, (state: *Ru* ≥ 70 %)
- Same or higher than those of a state as indicated by Zhao et al. (2021).

Result

➢ Case study (Changsha City, China)



Socio-economic prediction of Changsha



Comparison between the statistical and predicted annual total water consumptions of Changsha

- The socio-economic indicators of Changsha is predicted based on the trend analysis.
- The socio-economic indicators of Changsha are predicted to exceed the thresholds in about 2026.
- The peak value of urban water consumption in Changsha may be about **$2.686 \times 10^9 m^3$** in **2026**.

Methods	Urban water consumption ($10^9 m^3$)	
	2025	2030
Socio-economic indicators	2.608	2.478
Genetic programming (GPM)	2.067	2.095
Quota method (QM)	2.535	3.261

Conclusion

Main conclusions

- Generally, the urban water consumption of a city shows an increasing trend first and then tends to decrease or keep stable.
- The socio-economic indexes (GDPc, Ru, and Rtg) of a city are generally about or above $ 10,000, 85 %, and 60 %, respectively when water consumption trend changing.

Some perspectives

- Driving factors: climate changes, industrial structure
- Prediction: comprehensive prediction framework of urban water consumption

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Thanks for your listening!

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