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Impact of urban heat island and global warming on multi-energy complementarity optimization of buildings: application to typical office buildings in Hangzhou, China

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Main Research Focus

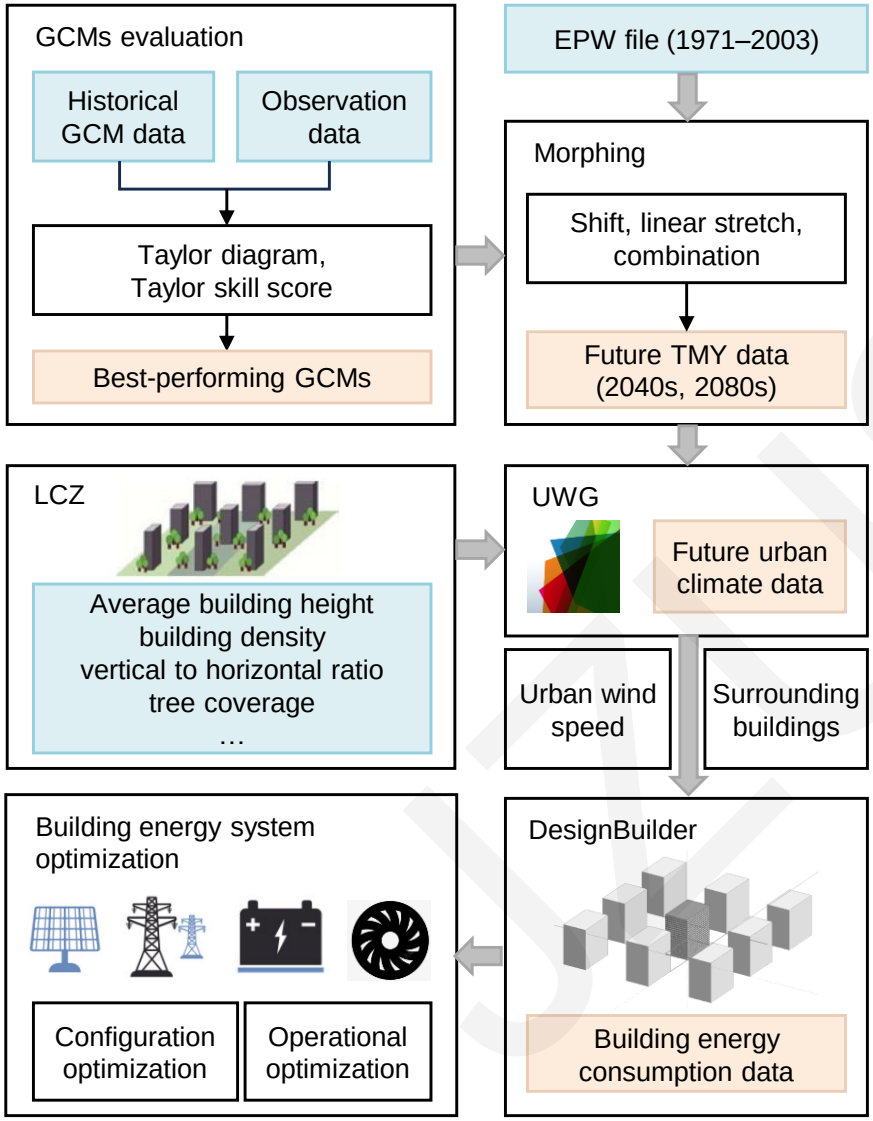

Fig. 1. Research framework.

1. Evaluate general circulation models (GCMs).
2. Use the Urban Weather Generator (UWG) to account for the urban heat island (UHI).
3. Calculate urban wind speeds to derive annual urban microclimate data.
4. Combine the generated meteorological data with a typical building model to generate annual energy consumption data.
5. Optimize the building energy systems.

Evaluation of GCMs

- **The applicability of the same GCM varies across different cities, and the optimal models differ from city to city**

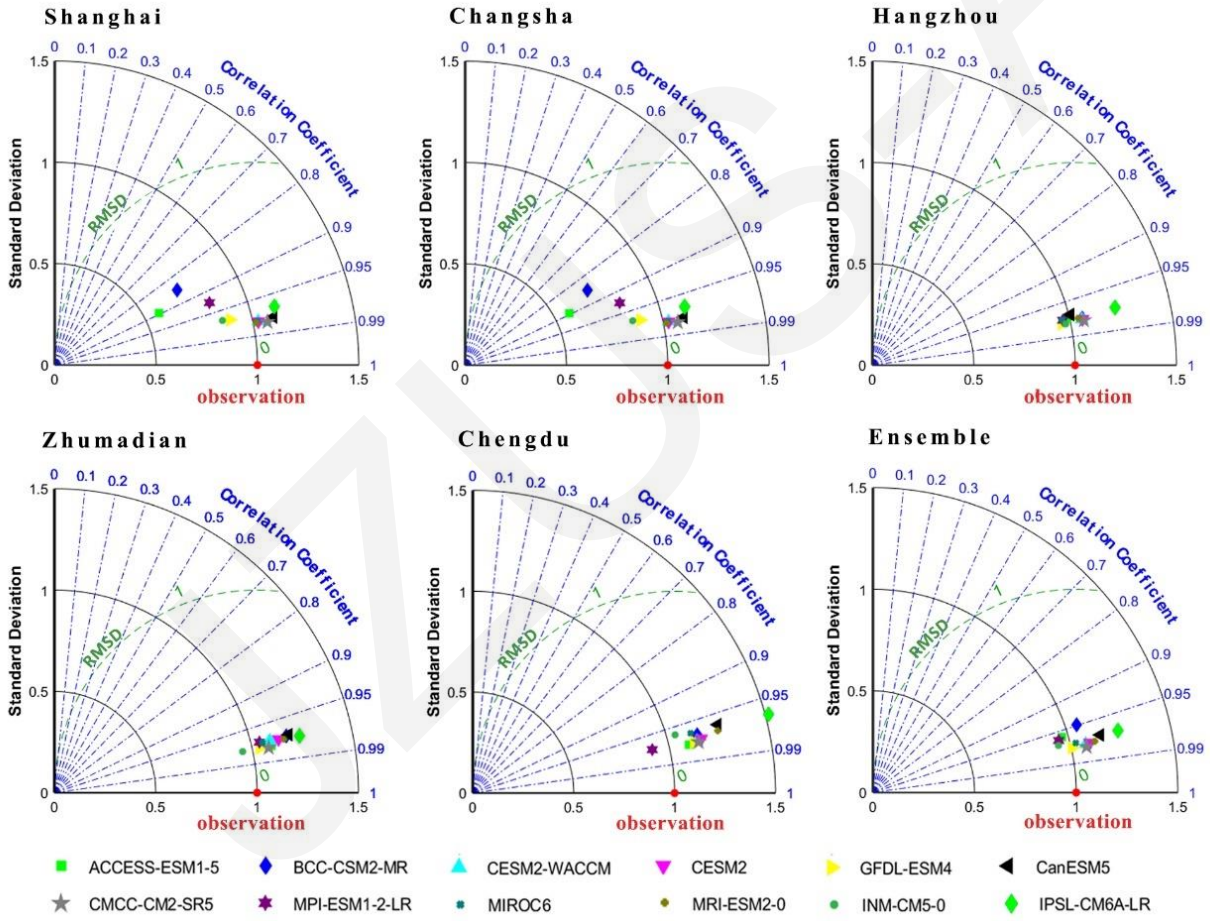

Fig. 2 Air temperature applicability evaluation

Future Building Energy Consumption

- **Energy consumption for cooling in office buildings has increased, while energy consumption for heating has decreased**

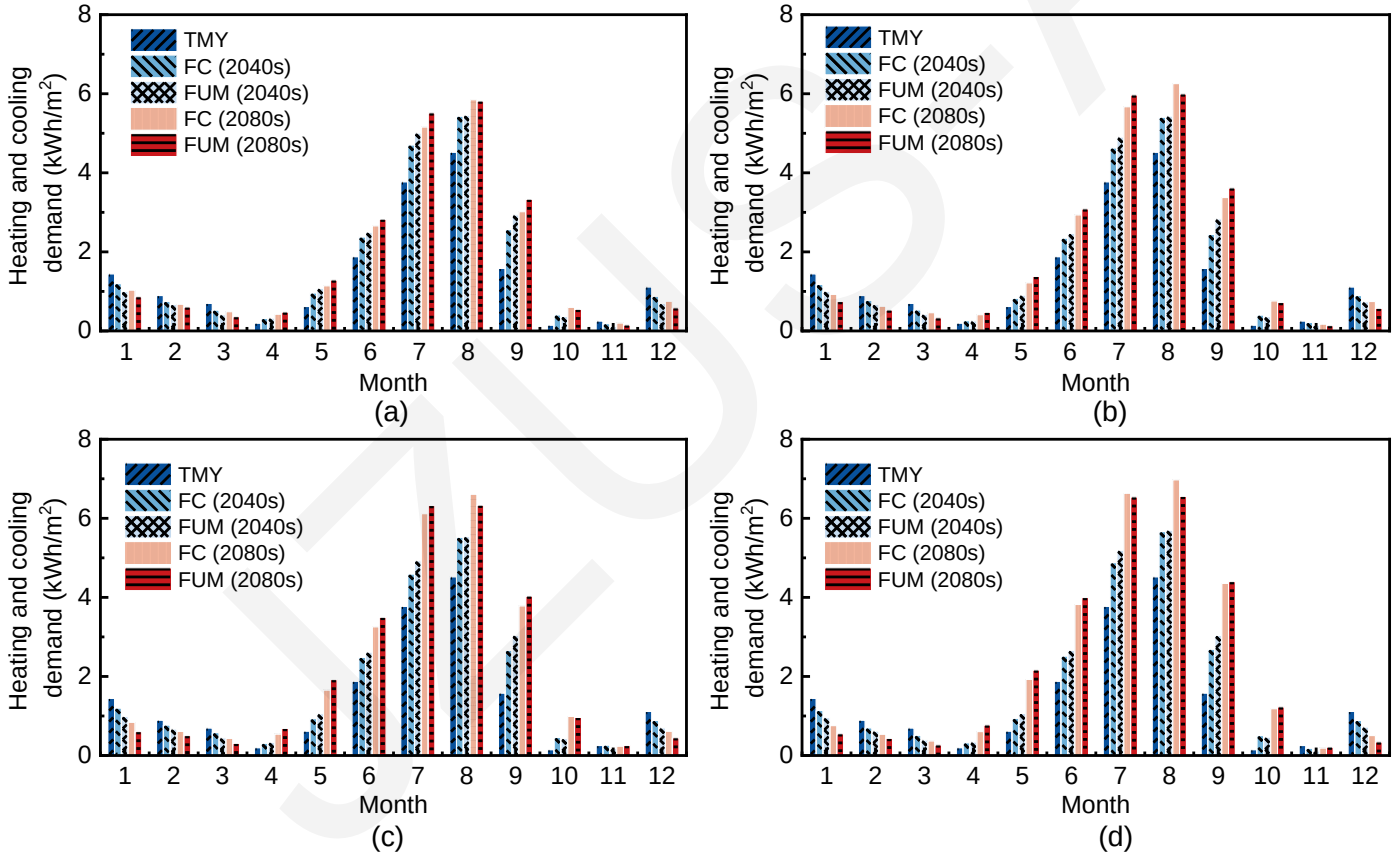

Fig. 3 Monthly changes in cooling and heating demand per unit area under different paths: (a) SSP126; (b) SSP245; (c) SSP370; (d) SSP585

Future Building Energy Systems

■ Net present value (NPV) magnifies changes in building energy consumption

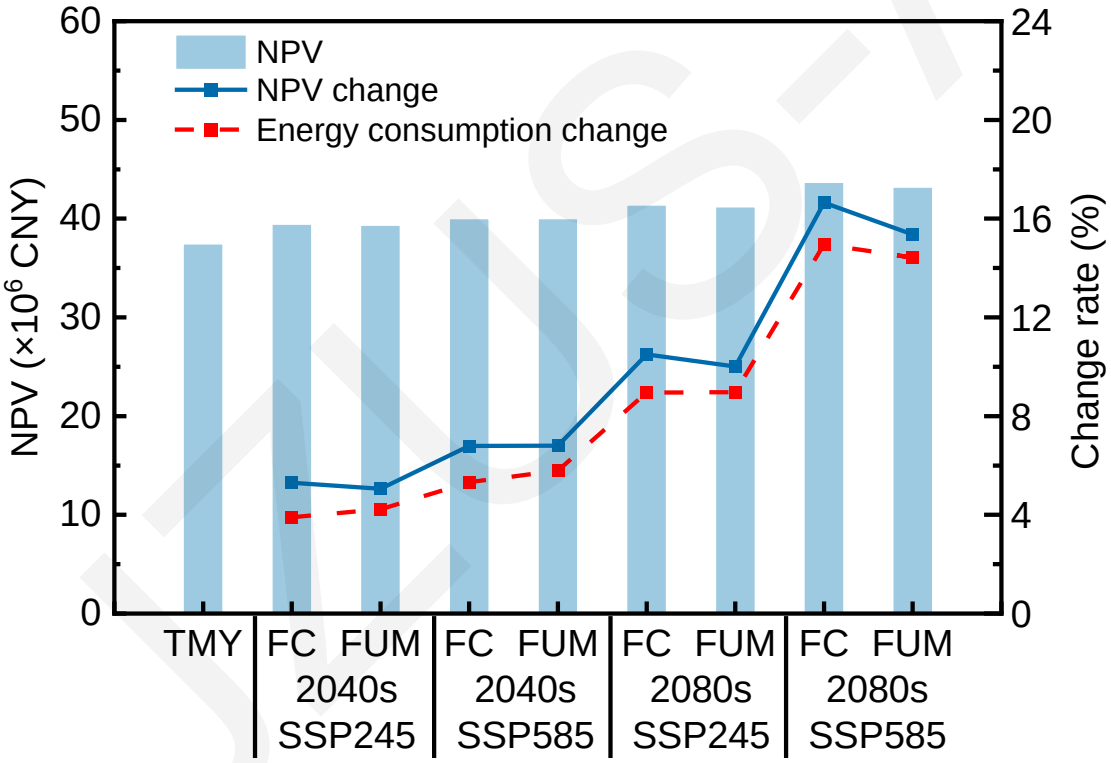

Fig. 4 Trends in NPV and energy consumption

Conclusions

- **Future climate change will lead to a 28.9%–103.0% increase in cooling demand, a 19.7%–52.6% decrease in heating demand, and a 3.9%–15.0% increase in total energy consumption for a typical office building in Hangzhou, China.**

- **Under future climate and urban microclimate scenarios, the NPV of optimal system configurations is estimated to be 5.05%–16.65% higher than that under historical climate conditions.**