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## Effects of tree shading and transpiration on building cooling energy use

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### Highlights

- Field measurements of urban microclimate and trees were conducted.
- Cooling effects of shading and transpiration of urban trees were simulated separately.
- Four scenarios of tree conditions were developed to demonstrate building energy load differences.
- Scientific-based suggestions for urban afforestation were proposed.

### Abstract:

Building cooling energy use is regarded as the hot topic of building research due to its increasing trend at a rate proportional to the total direct energy use in urban areas nowadays. Urban greening as an effective countermeasure in reducing building cooling load has been attracting close attention although there is a shortage of quantitative measures for applying the general idea to a specific site or building. This study addresses this problem. The cooling effect of trees around buildings and the influence of tree characteristics on building cooling load reduction was quantified using microclimate field measurements and sap flow rate of trees. By integrating approaches of field measurements of microclimate and tree characteristics into EnergyPlus simulation of building energy use, the cooling effects of trees due to both shading and transpiration on buildings were quantified and discussed. Four scenarios were developed based on different tree characteristics for quantifying the influence of trees on saving of

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