



**World Forum on
Urban Forests**
Mantova 2018

Session: PS_3.4:
Changing Benefits

Ecosystem services from urban green spaces - a quantitative study to compare the species differences at micro-scale

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A century of urbanized world

Built environment is distinctive

Climate change strengthens this distinctiveness



Source: OUPblog – Oxford University Press



Micro-scale studies in Munich



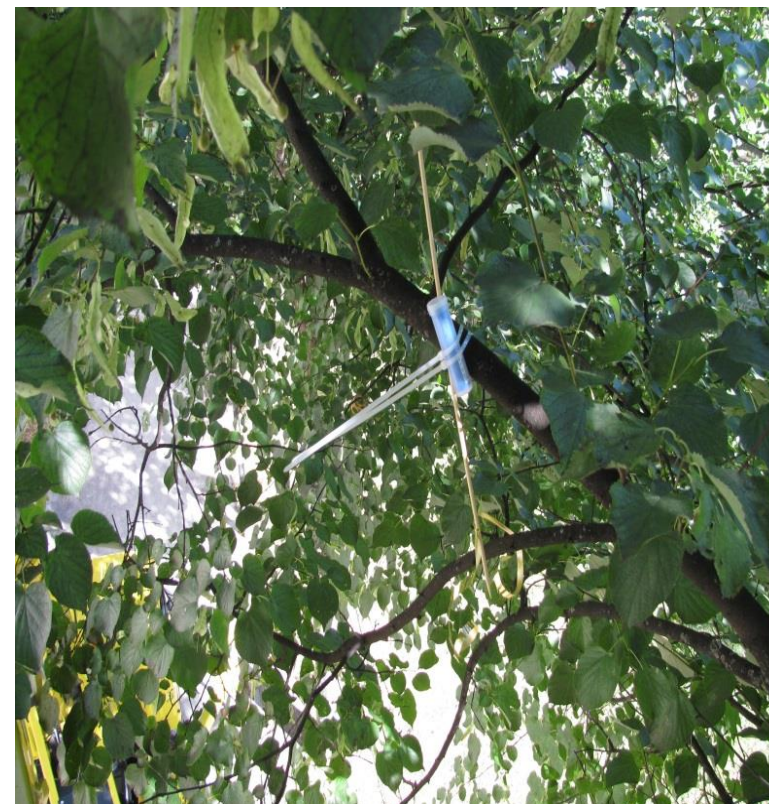


Techniques used





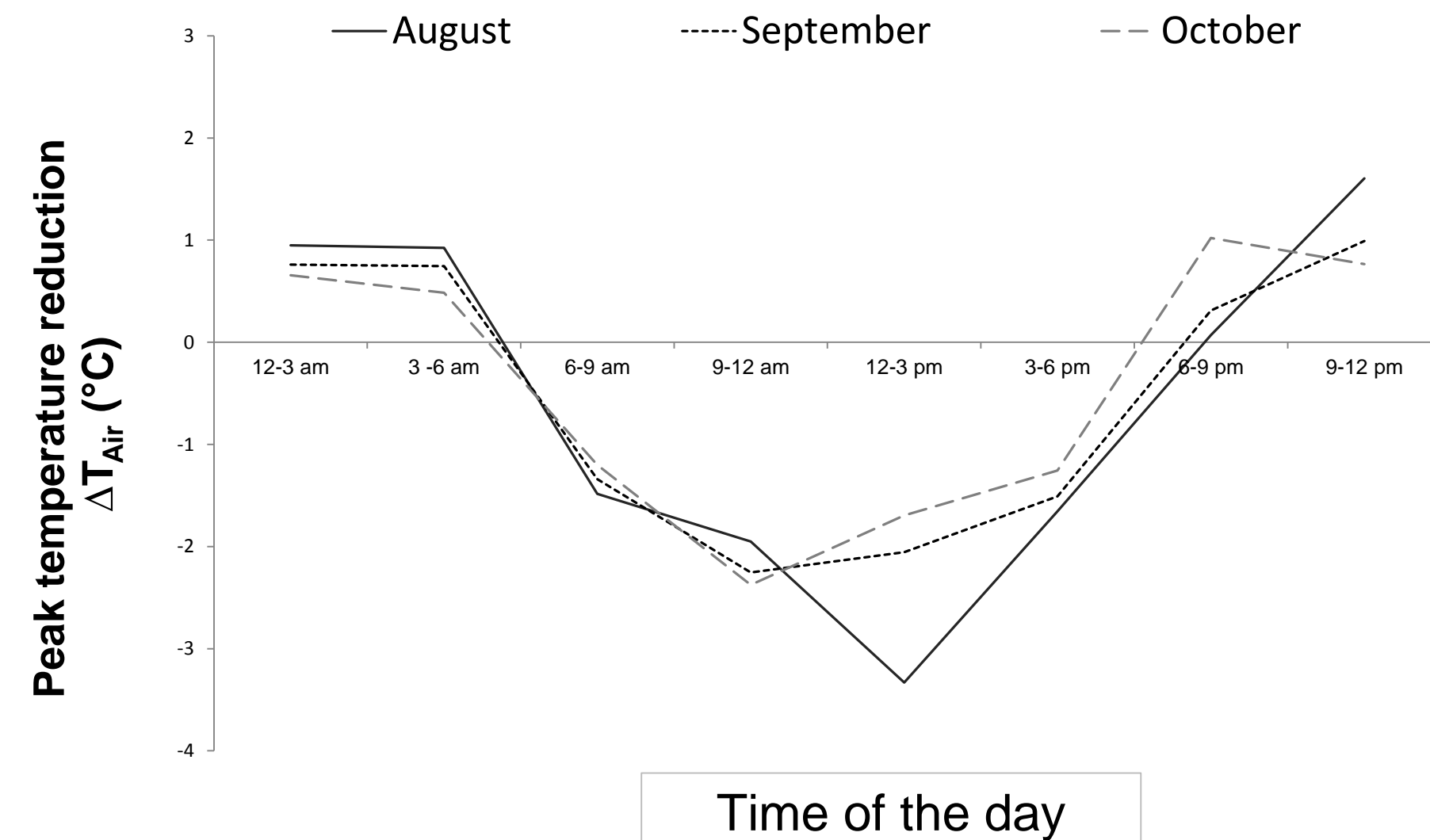
Techniques used.....





Cooling effect

Combined with the shading and evapotranspirational cooling, air temperature at the centre of the canopy was up to 3.5 °C cooler than the outer periphery.



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Building and Environment

journal homepage: www.elsevier.com/locate/buildenv



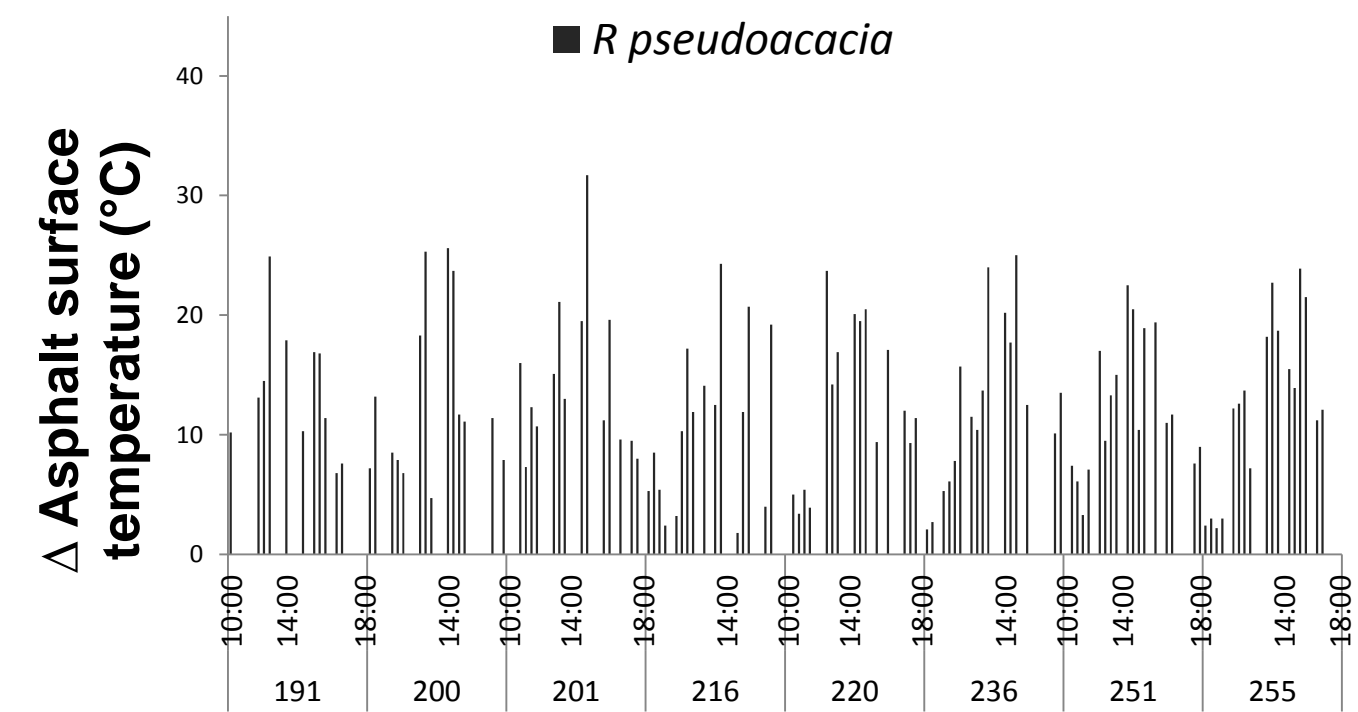
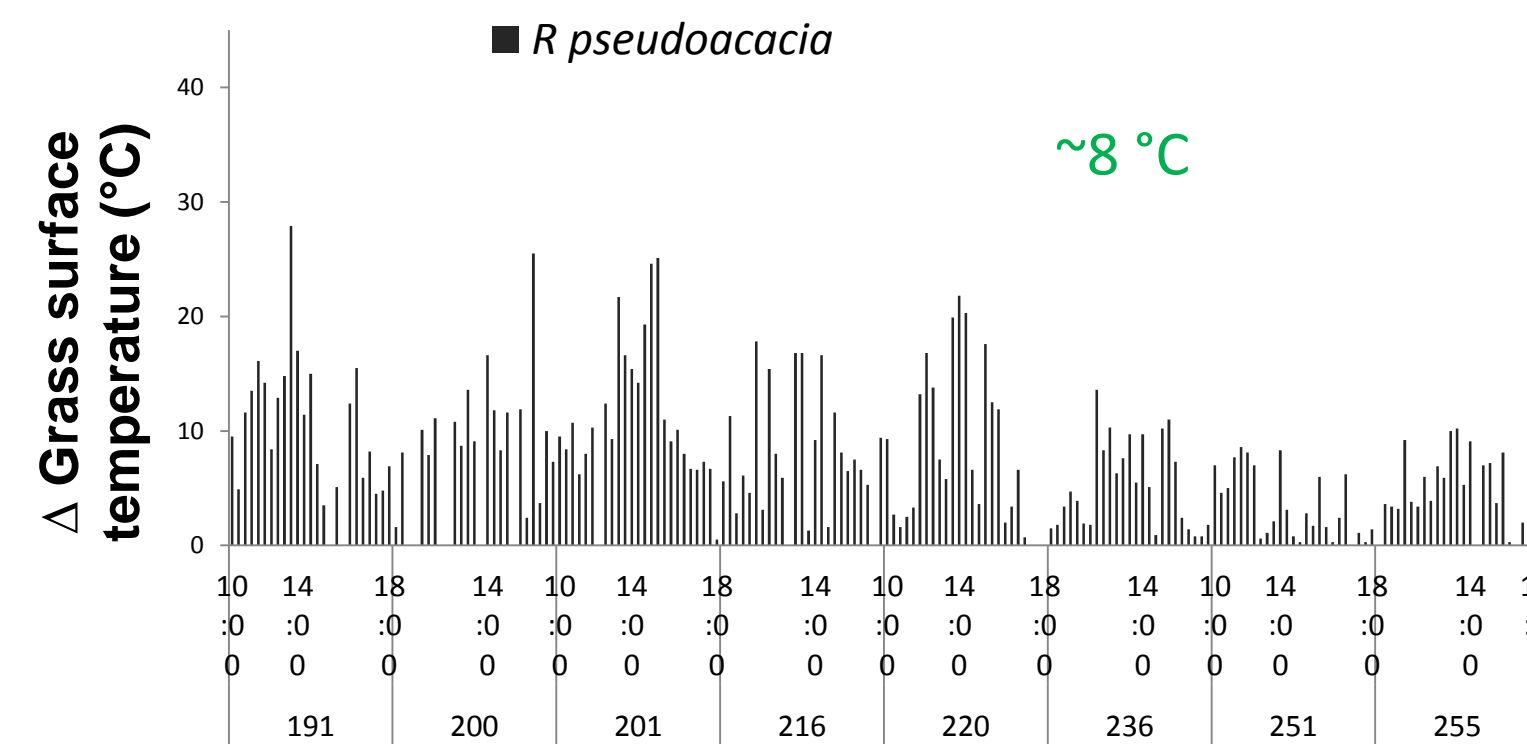
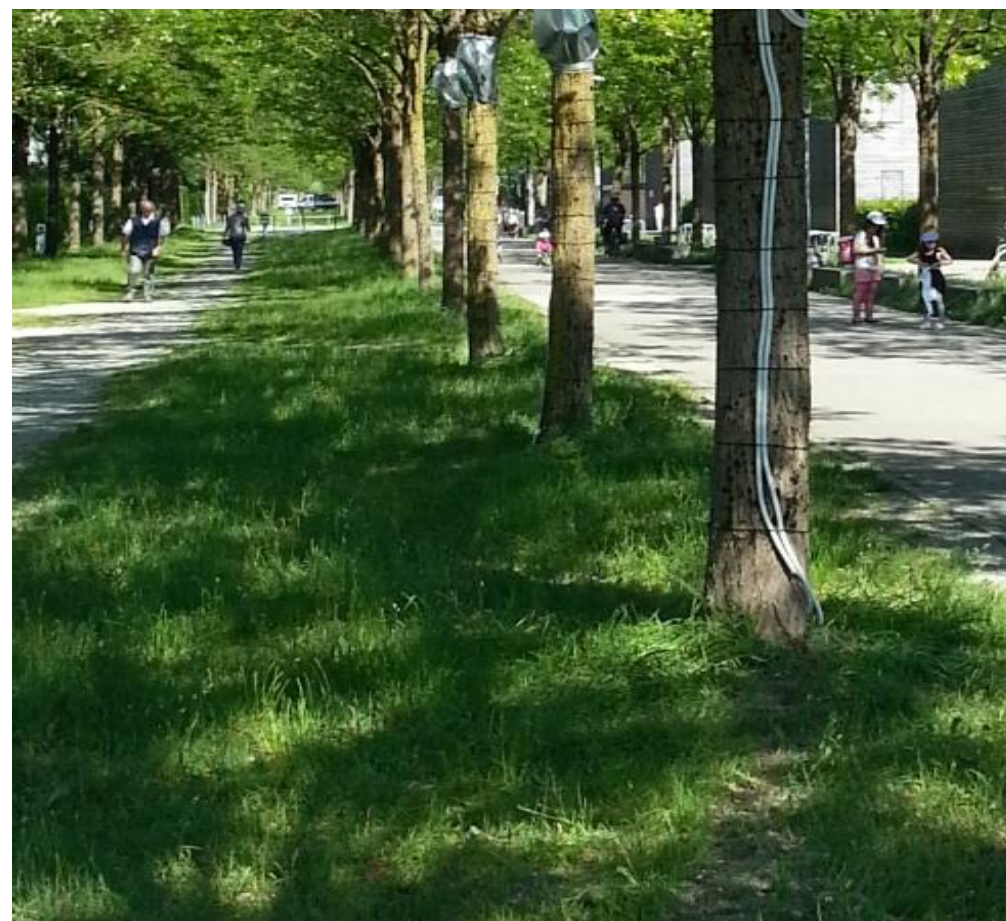
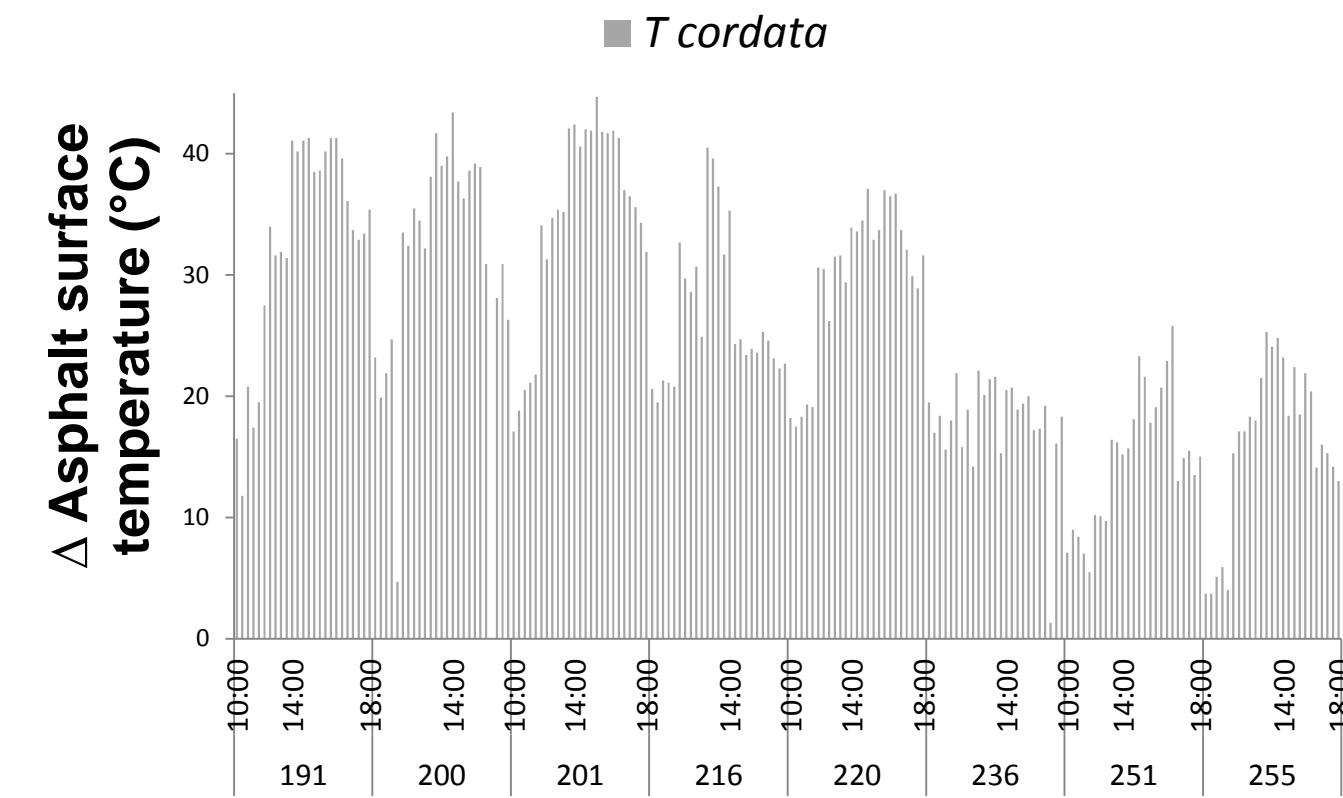
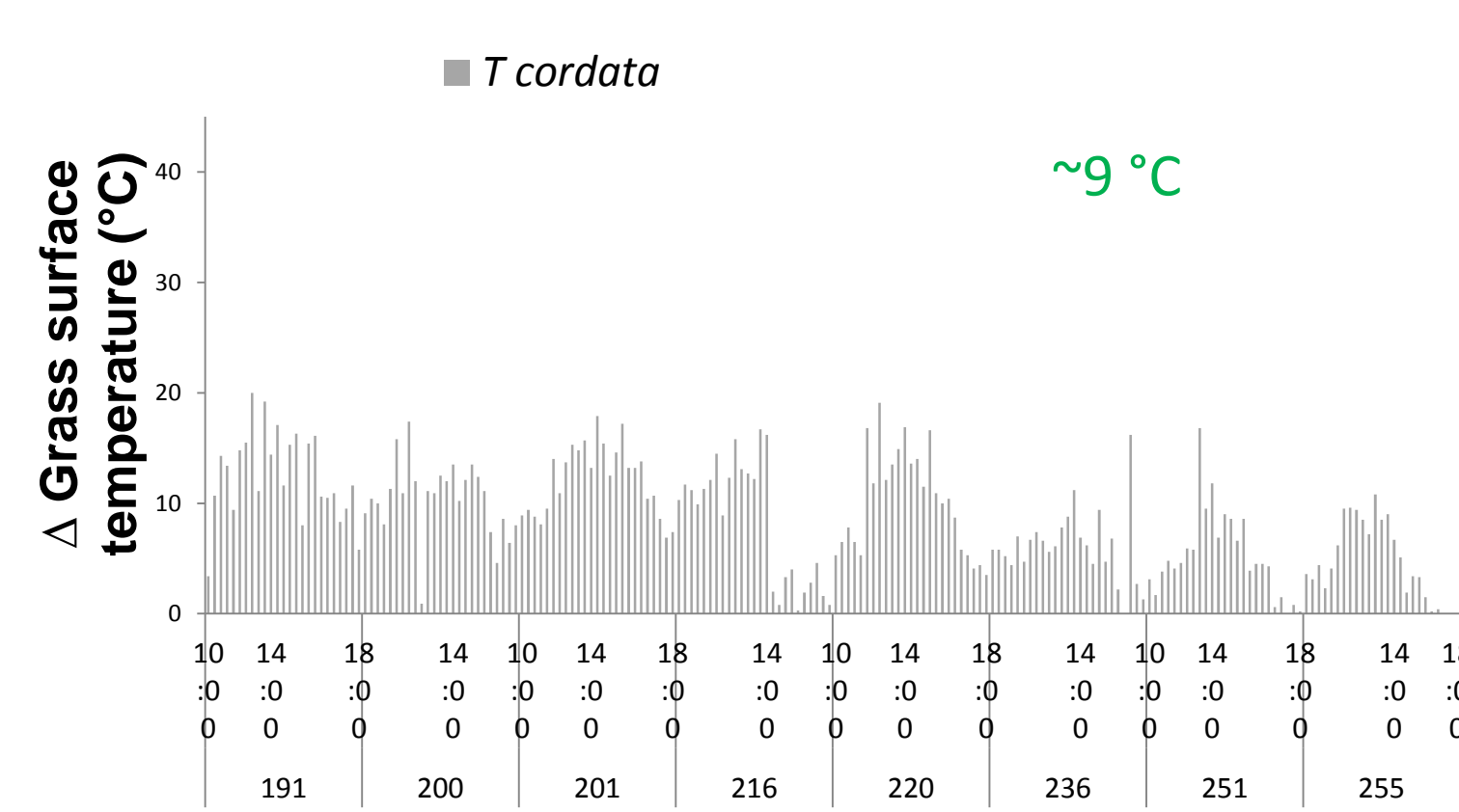
Within canopy temperature differences and cooling ability of *Tilia cordata* trees grown in urban conditions

Mohammad A. Rahman ^{a,*}, Astrid Moser ^b, Thomas Rötzer ^b, Stephan Pauleit ^a





Shading effect



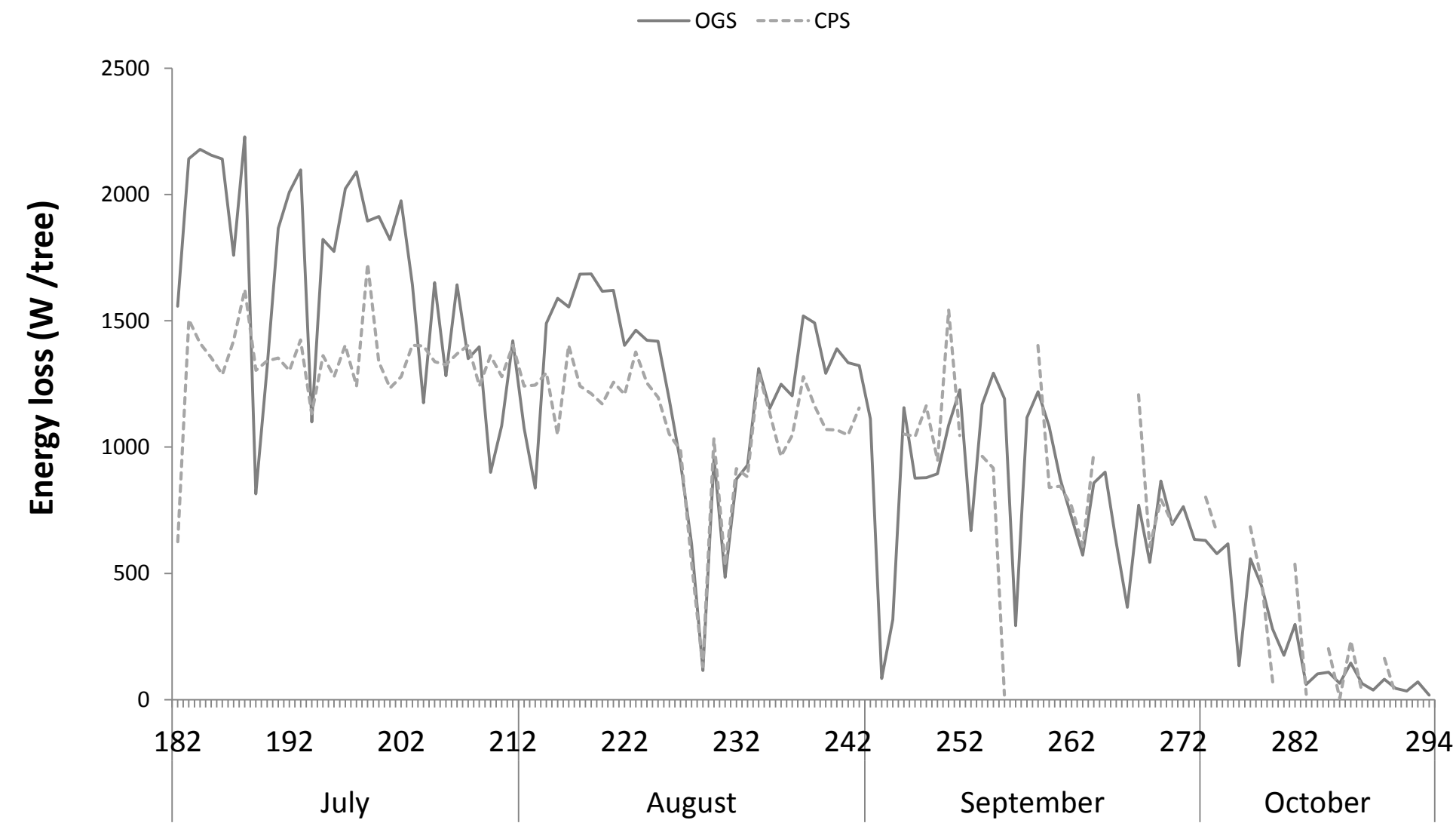
Time and Julian day

Time and Julian day

Rahman et al. (under review). Comparing the transpirational and shading effects of two contrasting urban tree species.

Evapotranspirational cooling

Open green square provided ~ 25% better transpirational cooling compared to the paved narrow square



Water loss	Energy loss	ΔT Underneath tree *	ΔT within canopy *
55-68 l/day	1.6-2 Kw/tree	1-2 °C	3-4 °C



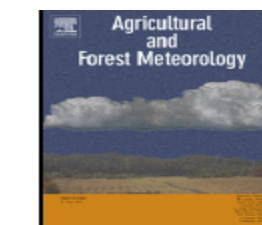
* ΔT = Air temperature reduction



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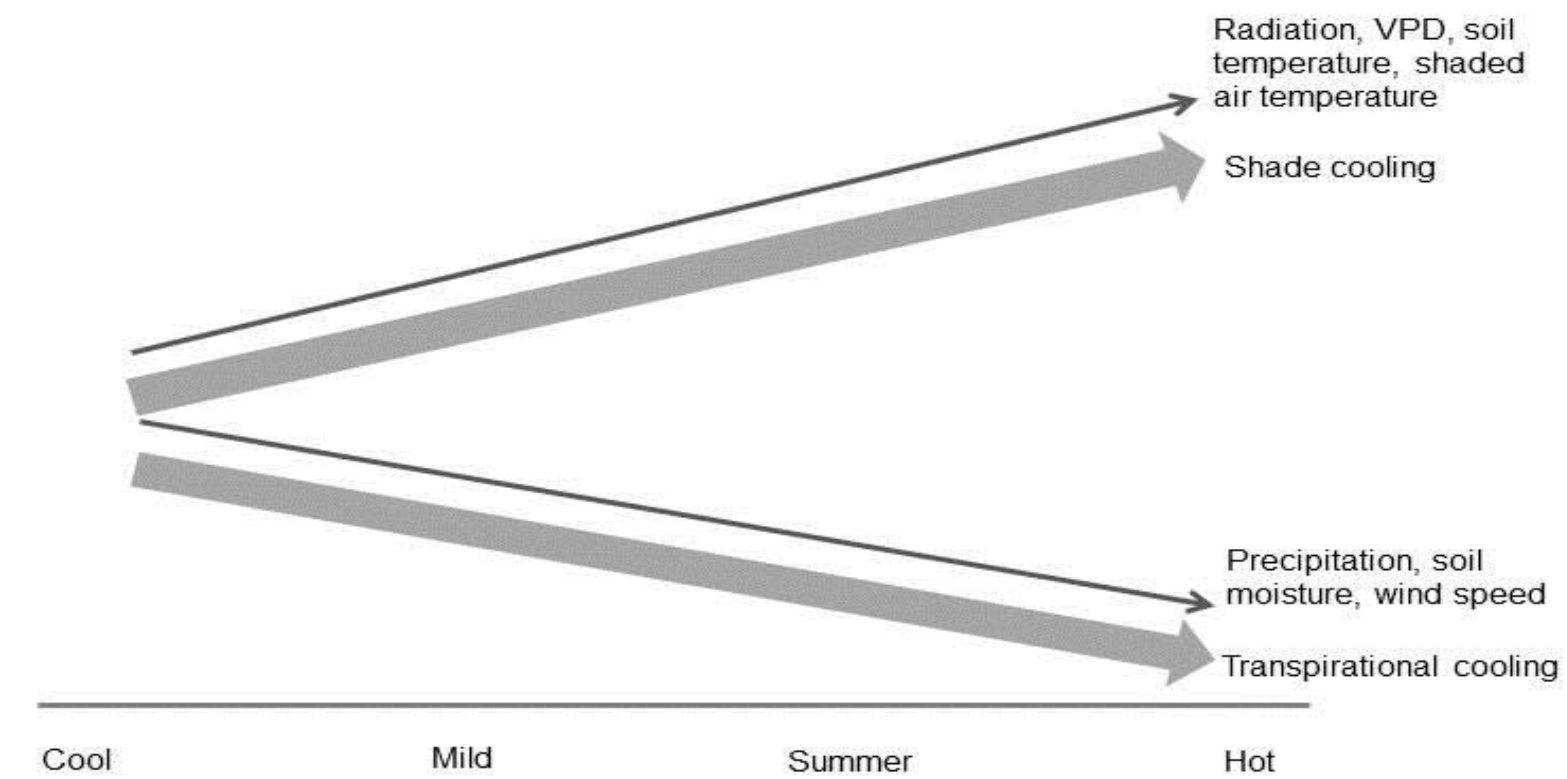
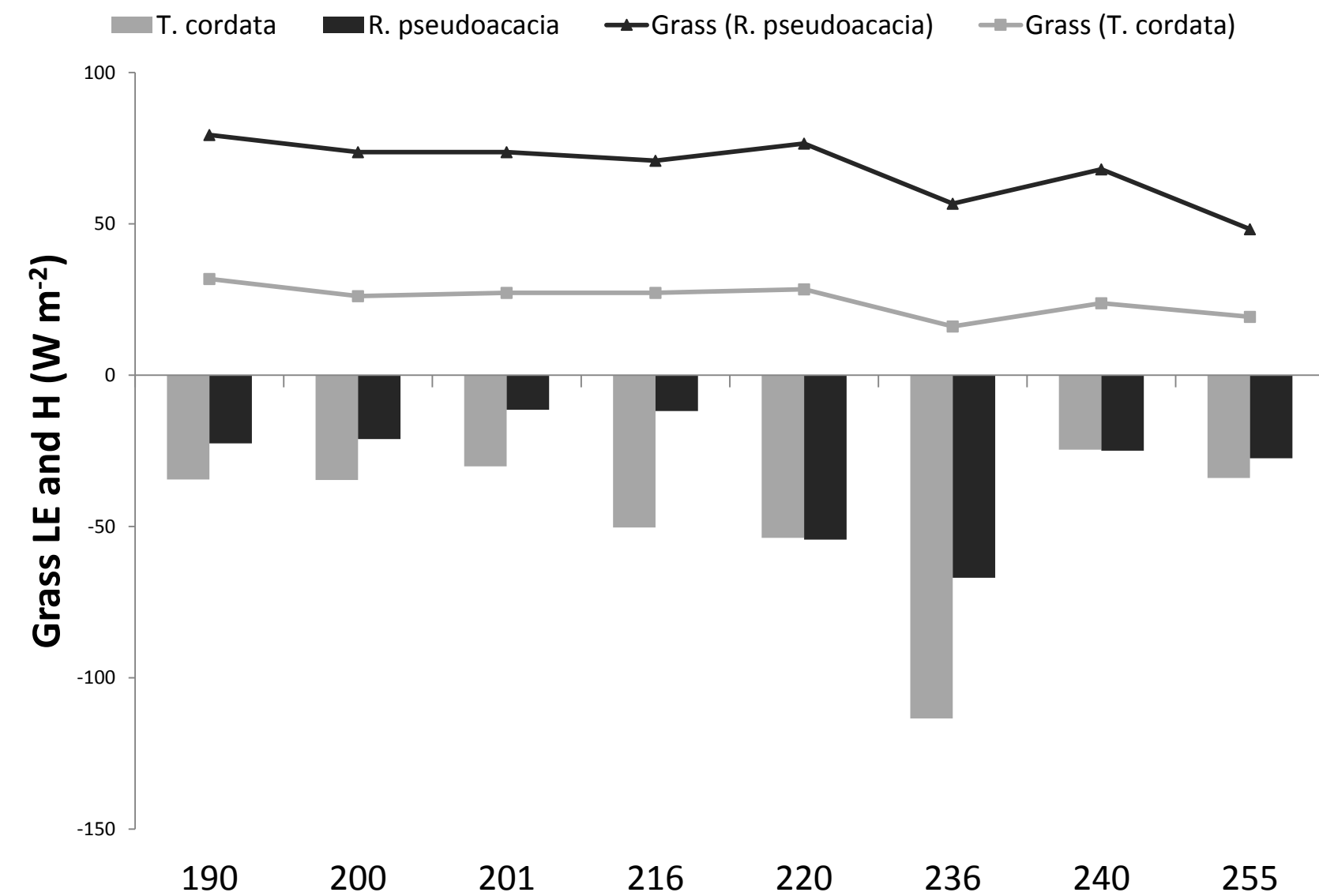
Microclimatic differences and their influence on transpirational cooling of *Tilia cordata* in two contrasting street canyons in Munich, Germany

Mohammad A. Rahman^{a,*}, Astrid Moser^b, Thomas Rötzer^b, Stephan Pauleit^a



Transpirational cooling and human comfort

- *Tilia cordata* provided 3 times higher transpirational cooling; however, $\Delta AT_{1.5\text{ m}}$ below *Robinia pseudoacacia* was higher.
- Shading is more effective as the climate get warmer and the soil gets drier.



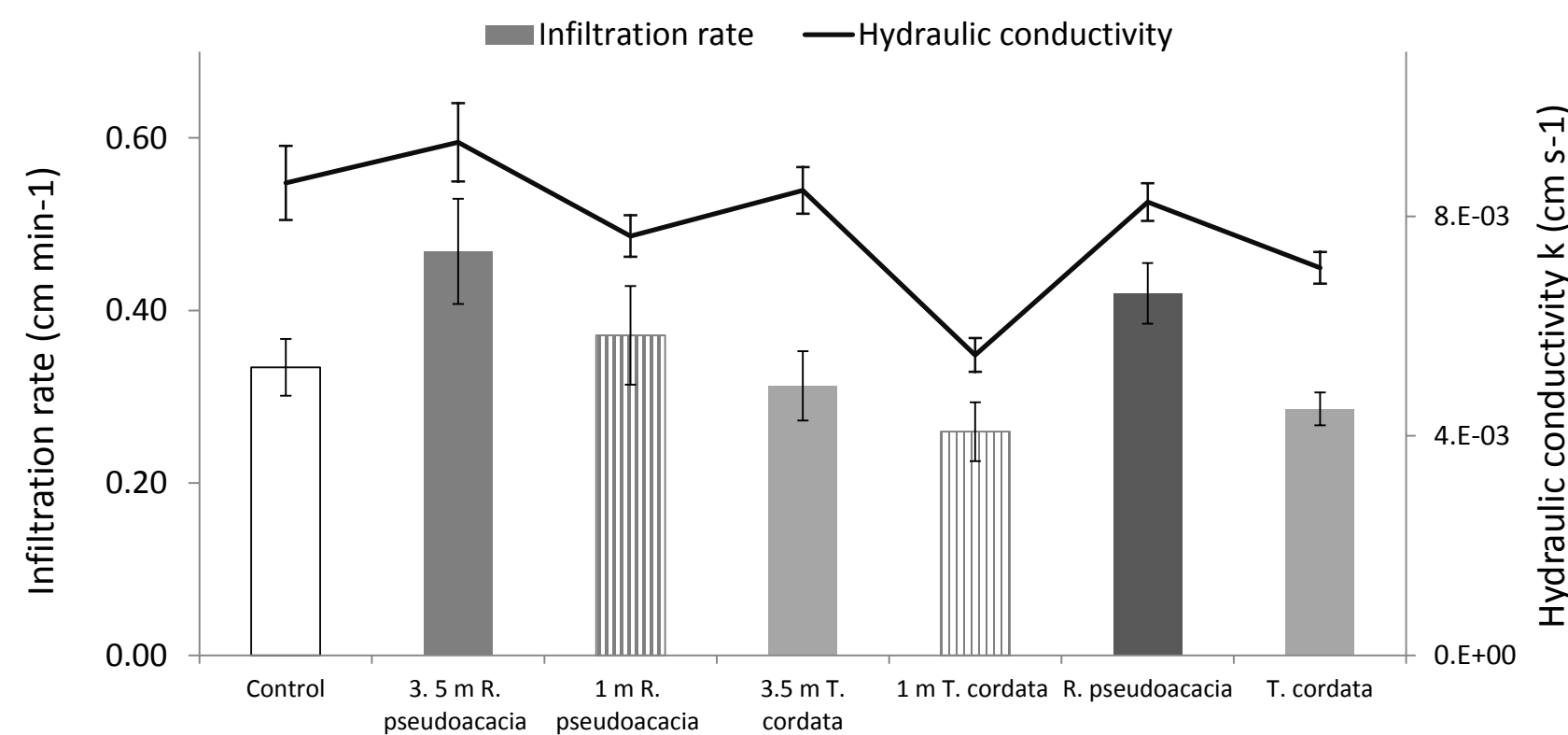
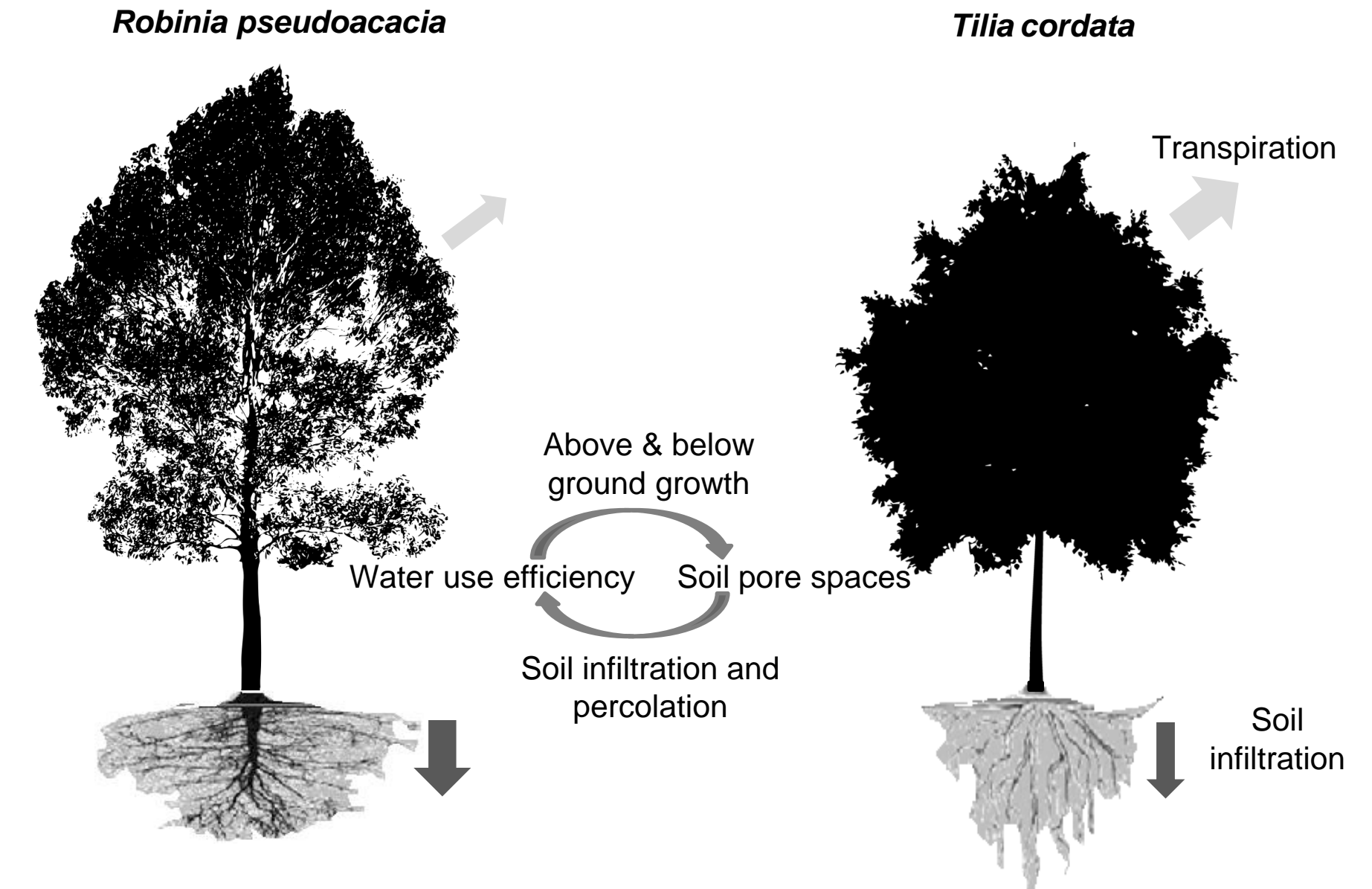
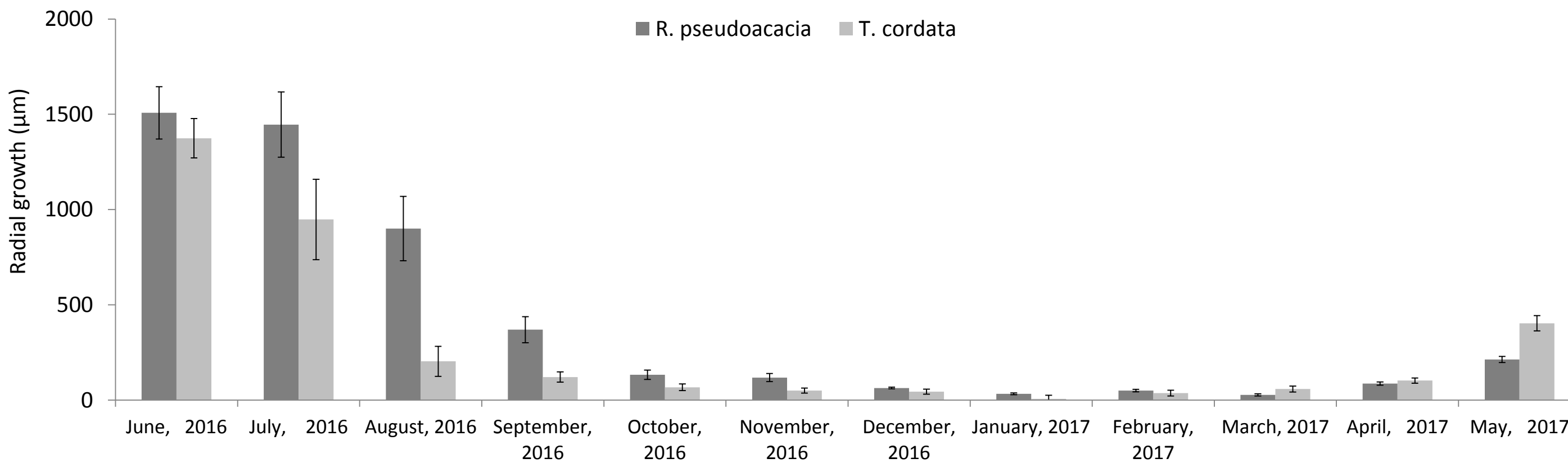
Vertical air temperature gradients under the shade of two contrasting urban tree species during different types of summer days

Mohammad A. Rahman ^{a,*}, Astrid Moser ^b, Anna Gold ^a, Thomas Rötzer ^b, Stephan Pauleit ^a



Species differences – soil infiltration

Species with higher annual growth rate contributes more in soil infiltration



Comparing the infiltration potentials of soils beneath the canopies of two contrasting urban tree species

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Take home message

- With dense canopies surface temperature reduction can be up to 25 °C.
- Air temperature reduction within canopy can reach up to 3-4 °C and 1.6 °C underneath the tree shade if the soil is not water stressed.
- Trees grow best and provide most cooling when grown in open green spaces than paved narrow canyons especially with low water using species.
- Fast growing species such as *R. pseudoacacia* can influence higher infiltration through better fine rooting system.



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