

Is shade all there is to It?

Quantifying the Contribution of Tree Transpiration to Cooling Cities

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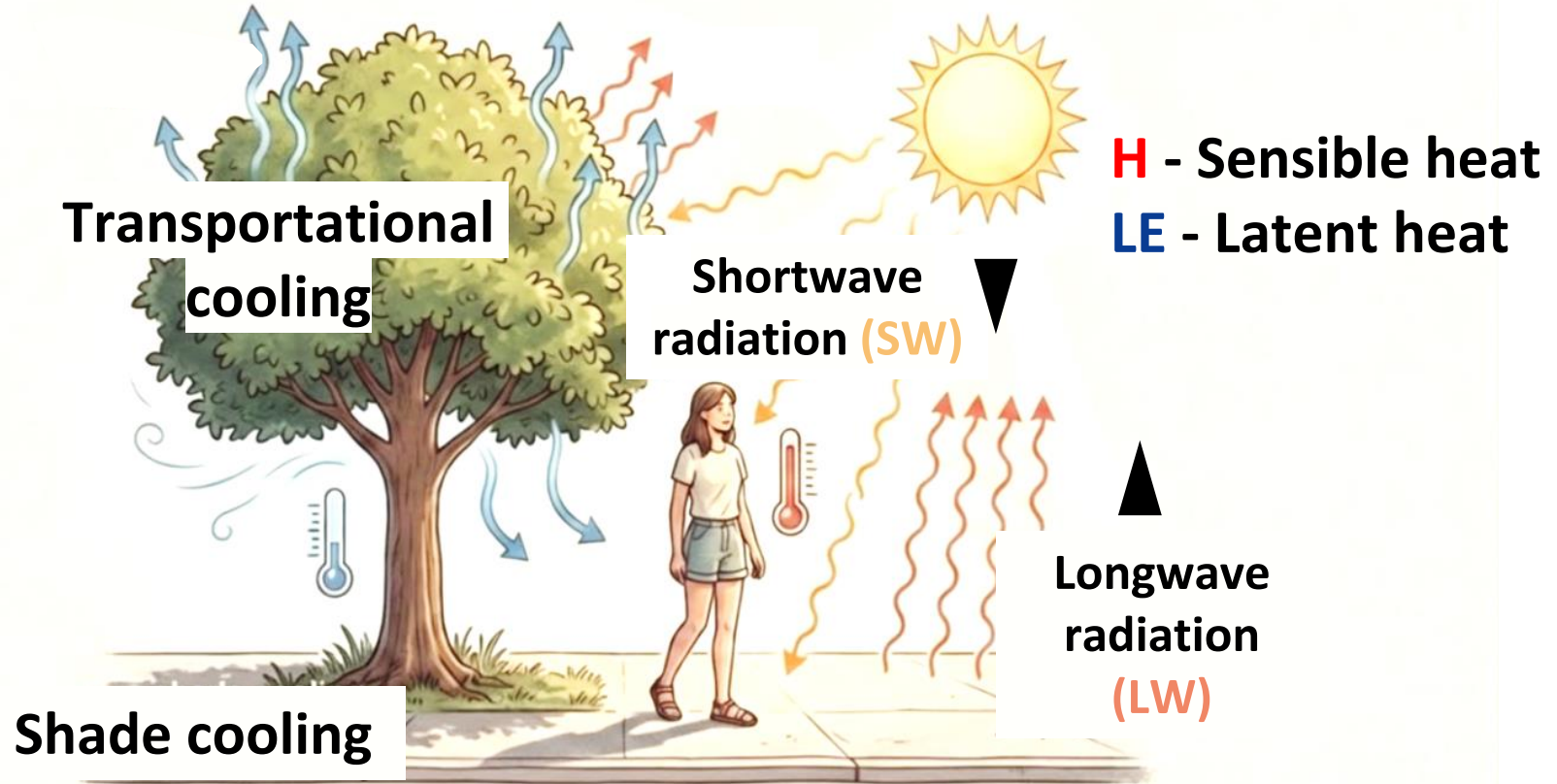






Is shade
all that
trees
provide?

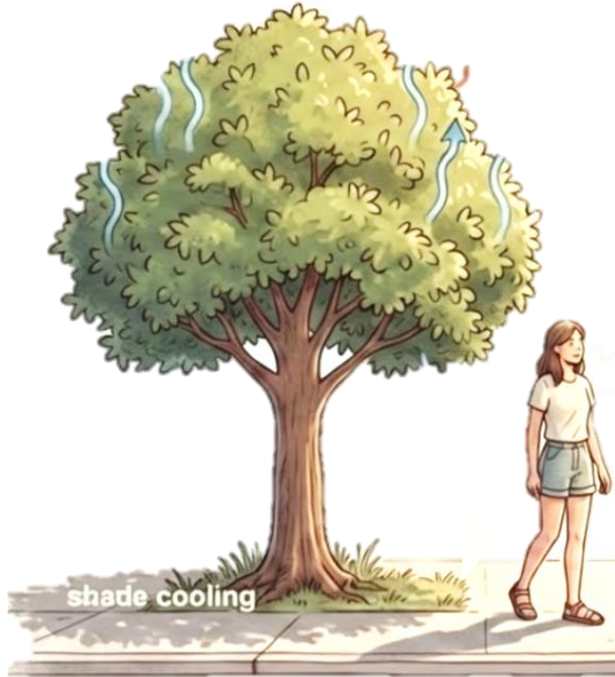
$$\text{Energy Balance ; (Net SW) + (Net LW) = H + LE}$$



Thermal Comfort

What we actually feel

- Universal Thermal Comfort Index (UTCI)
- Physiological Equivalent Temperature (PET)



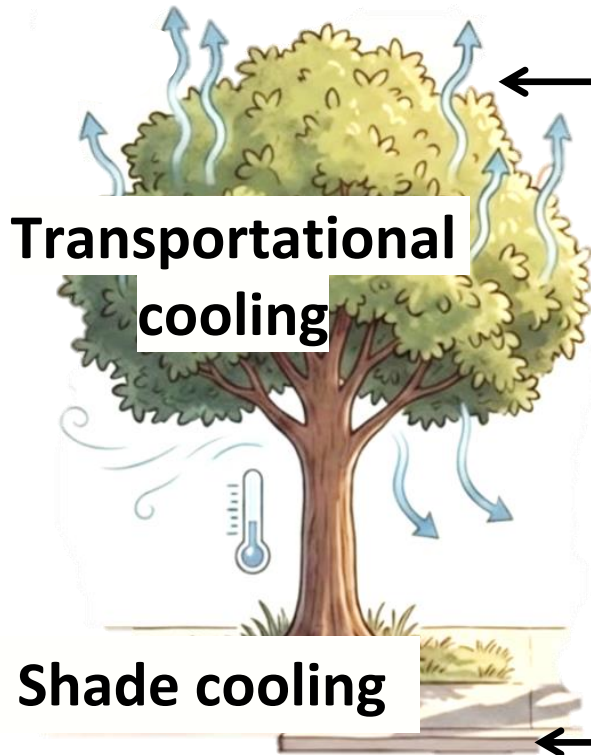
Climatic components:

- Air temp
- Humidity
- Wind speed
- **Radiation**



Mean radiant temperature (MRT)

Transpiration vs shade cooling



Biological function - absorbing radiation

Latent heat (LE) transferred in
the H_2O phase exchange

▼ **LE** decrease ▲ **H** increase

**What happens to MRT as a major
Thermal comfort component if
trees transpire less?**

Physical function - blocking SW radiation

Methods

We developed an experimental design to isolate transpiration from shade



Kaolin ● 2,4-D ● Control ●

Results

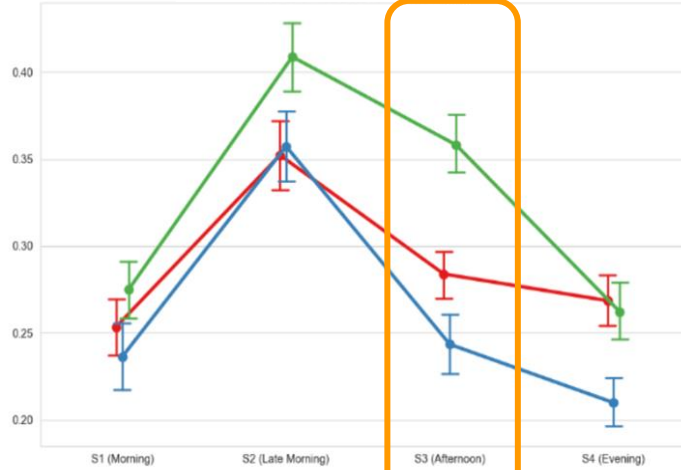
physiological
activity
reduced in

23%

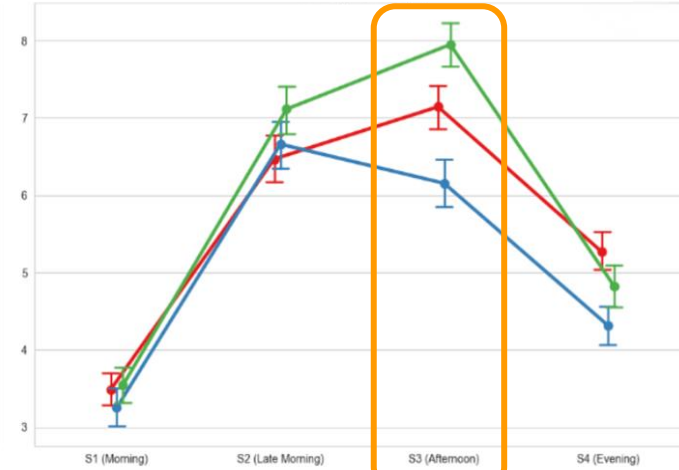
Leaf
temperature
increased

$p < 0.05$

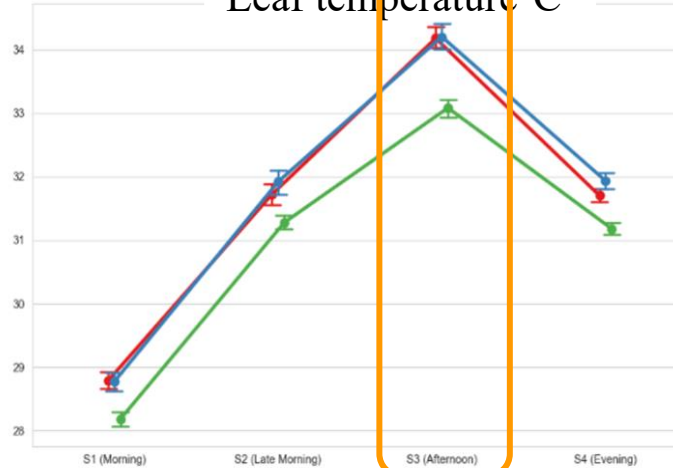
stomatal conductance
 $\text{mol m}^{-2} \text{s}^{-1}$



Transpiration
 $\text{mmol m}^{-2} \text{s}^{-1}$



Leaf temperature $^{\circ}\text{C}$



Peak heat stress :
13:00-15:00



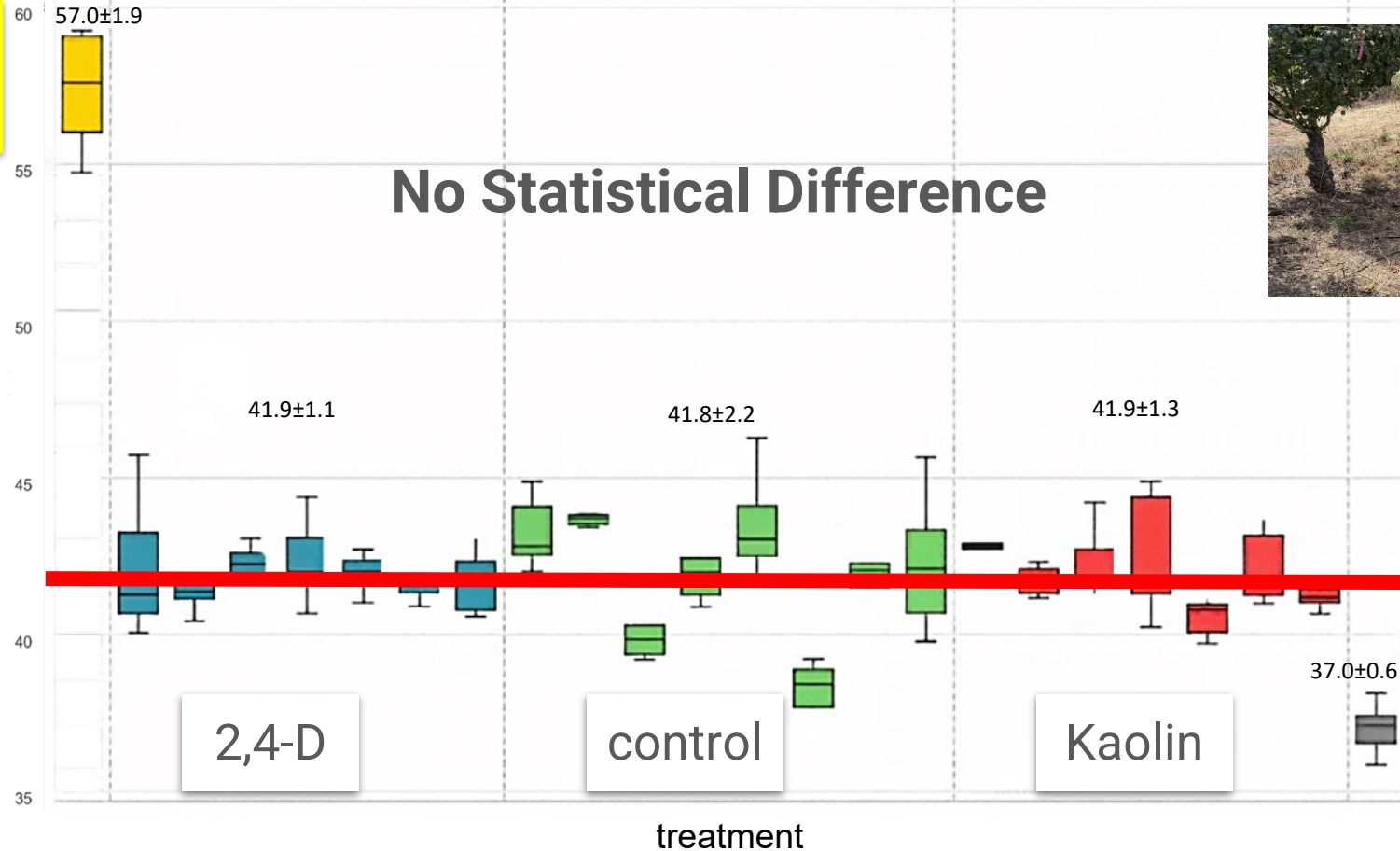
Kaolin ●
2,4-D ●
control ●

Mean Radiant Temperature Results

Full
Sun

No Statistical Difference

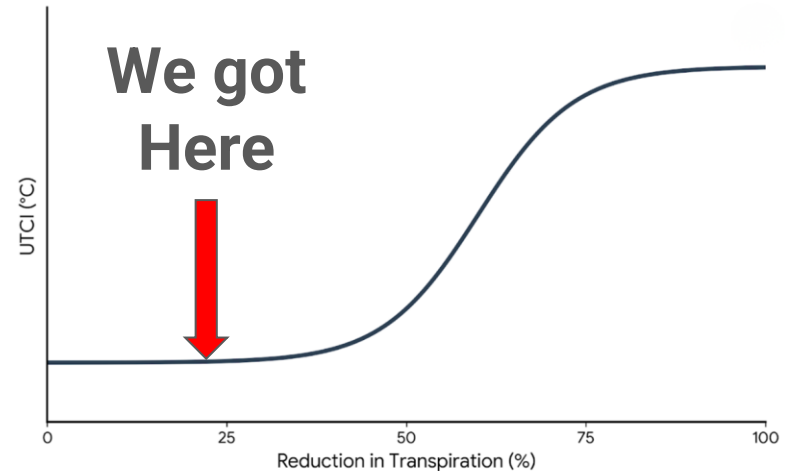
MRT (°C)



Full
Shade

Conclusions and Future Work

- Transpiration reduction did not alter MRT
 - Leaf temperature increased
 - Focus on air temperature rather than MRT
- Developing a predictive model
- Implement in urban planning



Thank you !