Title: Microclimatic thermal benefits through urban greenspaces – influences of species and growth conditions

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Urbanization is strongly changing our landscapes and altering the ecological processes to make our cities warmer. Greening cities and particularly planting trees seems to be one of the most effective options to mitigate those problems. However, due to the high heterogeneity of the urban environment, considerable uncertainty still exists at microscales concerning the magnitude, pattern and the process of microclimatic regulation through greening. We continuously measured within and outside canopy air and surface temperature, sap flow of two contrasting tree species - *Tilia cordata* and *Robinia pseudoacacia* at different street canyons in Munich, Germany along with the bio-meteorological and edaphic variables over the summers of 2015 and 2016. Results showed that tree shading can cool surfaces by 8-24 °C and reduce radiant temperatures by 5-7 ºC thus improving human comfort. Moreover, within canopy *air temperature reduction* (AT) can peak up to 3-4 ºC and underneath up to 1-2 ºC depending on the soil moisture since the AT coupled well with water flux over a spatial and temporal scale. Thus have direct implications for the radiation energy balance of urban micro-climates. When *T cordata* trees were grown at an open square within grass lawns (OGS) showed a 30% higher tree transpiration (E) at mid-day compared to the trees grown at a circular completely paved square (CPS), hence higher transpiration induced air cooling effect (2.3 kW/tree at OGS compared to 1.9 kW/tree at CPS). This implies that urban areas with majority of its tree plantings in open green squares will increase boundary layer cooling much faster compared to those planted in narrow paved squares. Additionally, we found a significant vertical gradient of air temperature from tree canopy to the ground level. The magnitude of cooling or warming from the canopy to the ground was significantly related to the tree species and on the paving of surfaces. With higher leaf area index and growth rate, diffuse porous species – *T. cordata* showed almost three times higher E compared to a ring porous species – *R. pseudoacacia*, surprisingly the air temperature at 1.5 m height from the ground was significantly cooler under *R. pseudoacacia* than *T. cordata* trees. This was mainly due to the sensible heat flux exchange

from the much exploited soil under the *T. cordata* trees compared to the almost moisture saturated soil under *R. pseudoacacia* trees. The study greatly improved our knowledge of the biophysical control of the whole tree transpiration hence cooling in the urban environment to be used in climate models and optimizing the human thermal comfort at outdoor urban environment.

Literature

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