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Assessment of Thermal Regulation before Urban Tree Cover Restoration in Verona, Italy

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BACKGROUND

Green spaces offer various essential regulating ecosystem services, with trees playing a significant role in mitigating urban heat island effects. In the éVRgreen project, we evaluated the potential of greenness to reduce air temperatures in Verona, Northern Italy, to serve as a baseline assessment before implementing an intervention of tree-cover restoration.

METHODS

In the municipality area, we assessed blue/green cover (water, grass/agriculture, trees) and grey cover (bare soil, impervious surfaces) at >200,000 random locations (points) using i-Tree Canopy software. We installed 50 stations that monitored temperatures 2.5 m above ground. We estimated the percentage of blue/green spaces in 200-m radial buffers around each station by determining the proportion of sampled locations in the corresponding land cover classes. We retrieved data of land surface temperatures (LST) from the Landsat 8 satellite and spatially associated it with the sampled locations. We analysed whether land cover can mitigate summer LST (16 July 2024) and winter air temperatures (January 2025).

RESULTS

On 16 July 2024, the median (1st-3rd quartiles) LST was 37 (35-40) degrees Celsius in 61,335 locations covered by trees and 45 (43-47) degrees Celsius in 44,458 locations covered by impervious surfaces (p<0.001) (Table 1). In January 2025, daily temperatures were on average 0.49 degrees Celsius lower in areas with a percentage of blue/green cover within 200-m buffers greater than 49% (the median across 50 stations), compared to areas with lower blue/green cover (p<0.001).

CONCLUSIONS

The results showed that urban vegetation has a substantial cooling potential. Median ground-level temperature differences between vegetated and impervious surfaces reached 8 degrees Celsius on a typical hot summer day in Northern Italy. Smaller, consistent differences were also observed for winter air temperatures. Therefore, tree cover restoration can be an effective public health strategy for thermal regulation in cities facing climate change.

Table 1. Descriptive statistics of Land Surface Temperature (°C) at the sampling locations by land cover class

Land cover class	*n*	*Median (Q1-Q3)*
Water	*3163*	*33 (31-37)*
Tree/Shrub	*61335*	*37 (35-40)*
Grass/Herbaceous	*85739*	*40 (38-42)*
Soil/Bare Ground	*8472*	*42 (38-44)*
Impervious surfaces	*44458*	*45 (43-47)*

n = number of sampling locations; Q1: first quartile; Q3: third quartile

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