Using trees as a temperature mitigation strategy in Camden, New Jersey

Poster · August 2018

DOI: 10.13140/RG.2.2.13086.64323

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Introduction

Urban trees, either as standalone plantings or as part of a tree pit, are a popular stormwater management tool. Beyond the aesthetic and stormwater management contributions, trees are widely accepted as reducing ambient air temperature. There is, however, limited quantitative information regarding the temperature mitigation.

This study monitored air temperature at locations throughout Camden, NJ. Sensors were installed under trees of different sizes or attached to poles using a statistical experimental design. The tree size (small or large), canopy (intersecting or non-intersecting), and street orientation (predominantly north-south or east-west) and period (daylight or nighttime) were experimental design factors.

Method

A monitoring network was designed that considered (Fig .1)

Tree categories

- No tree (NT)
- Large tree with intersected canopies (LIC)
- Large tree with non intersected canopies (LNIC)
- Small trees (ST) (less than 20-m tall)

Street's orientation

- North-South Street (N/S)
- East-West Street (E/W)

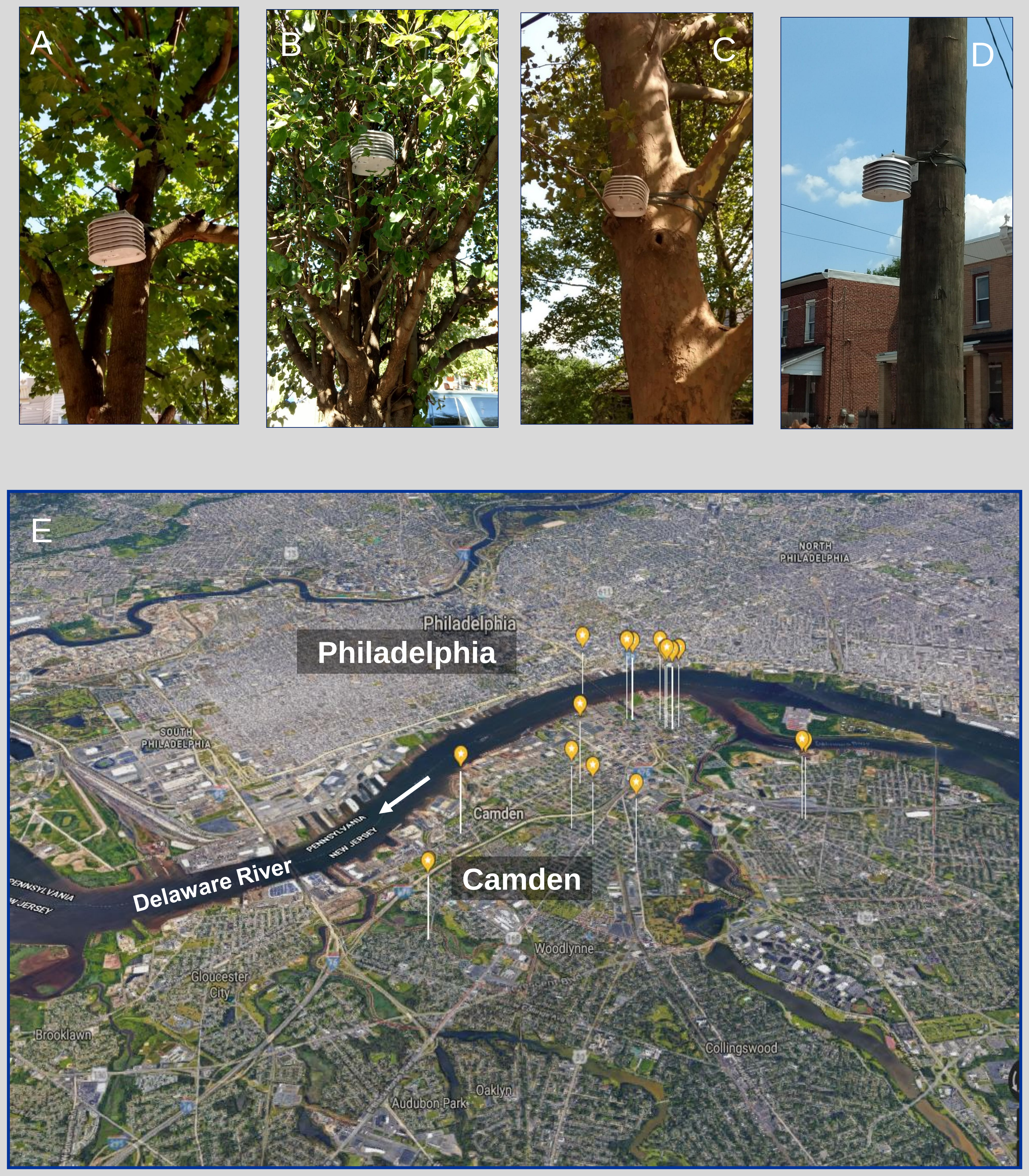

Figure 1. Sensors installation (A to D) and monitoring network (E)
www.google.com/maps/place/Camden,+NJ/@39.9340656,-75.1364264,14929m

Results

This study recorded temperatures at 10-minute intervals from early August through late November 2017 using logging thermistors mounted in radiation shields about 4 m above the ground surface.

Following the research by Gillner et al., (2015), temperatures of 17°C and 30°C were selected for grouping (Fig.2). In Camden site:

- 114 days monitored (08/01/2017-11/22/2017)
- 24 hot days (Maximum temperature ≥ 30° C)
- 12 cold days (Maximum temperature < 17° C)
- 78 average days (17°C ≤ Maximum temperature < 30° C)

The groups were analyzed separately using Factorial Analyses of Variance to test the significance of the categorical variables (Fig. 3 & Fig. 4).

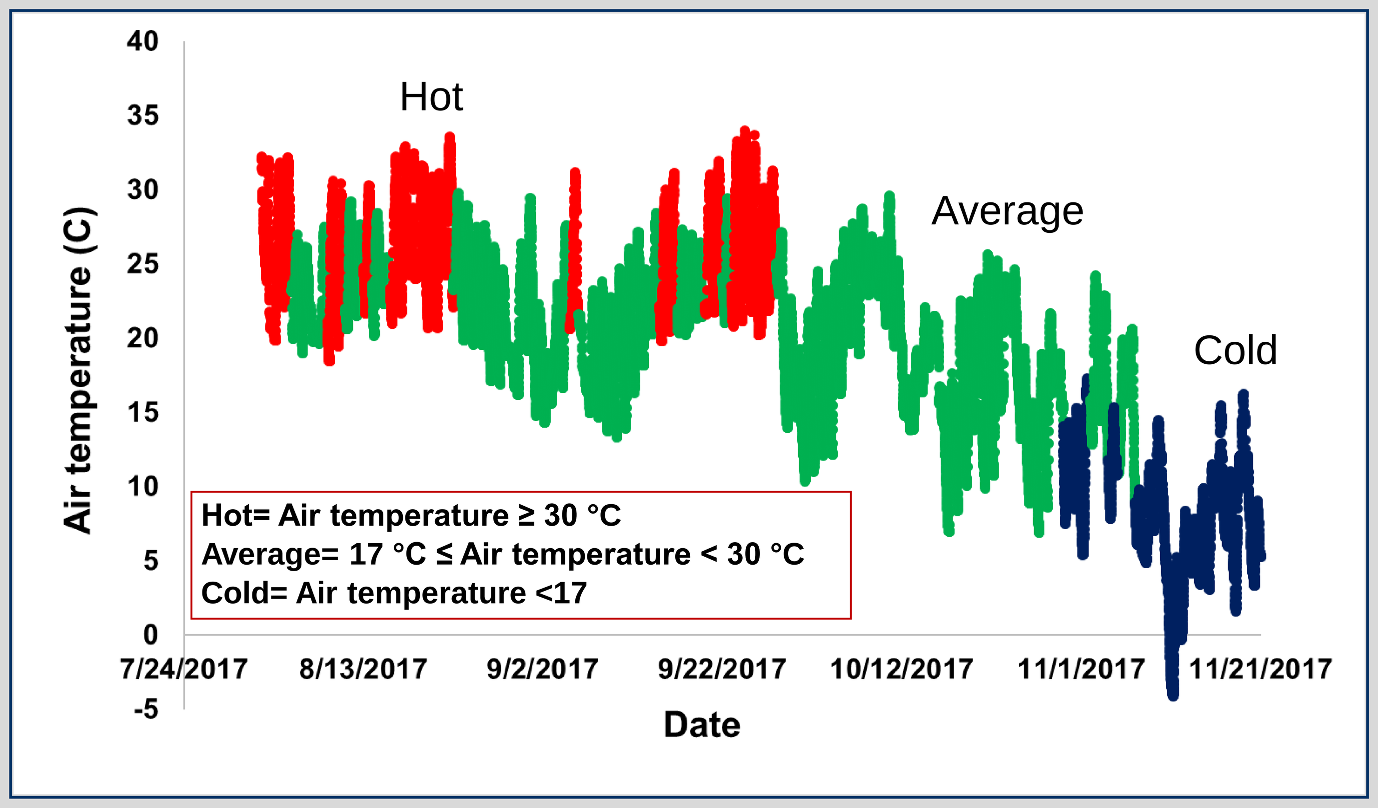

Figure 2. Recorded temperature of sensors and category of days

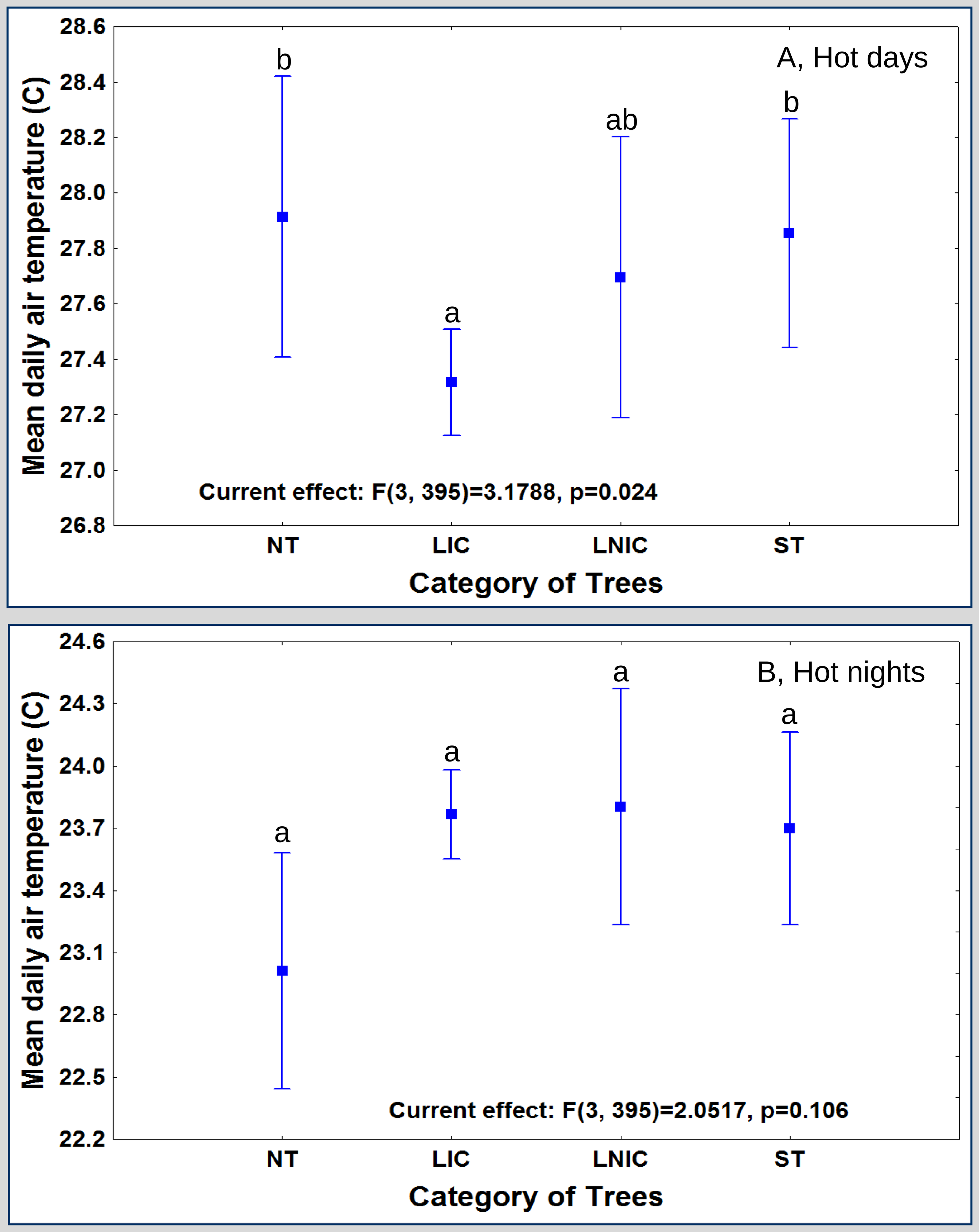

Figure 3. comparison of air temperature with tree categories (A: Hot days, B: Hot nights) * Letters a and b shows the statistical groups

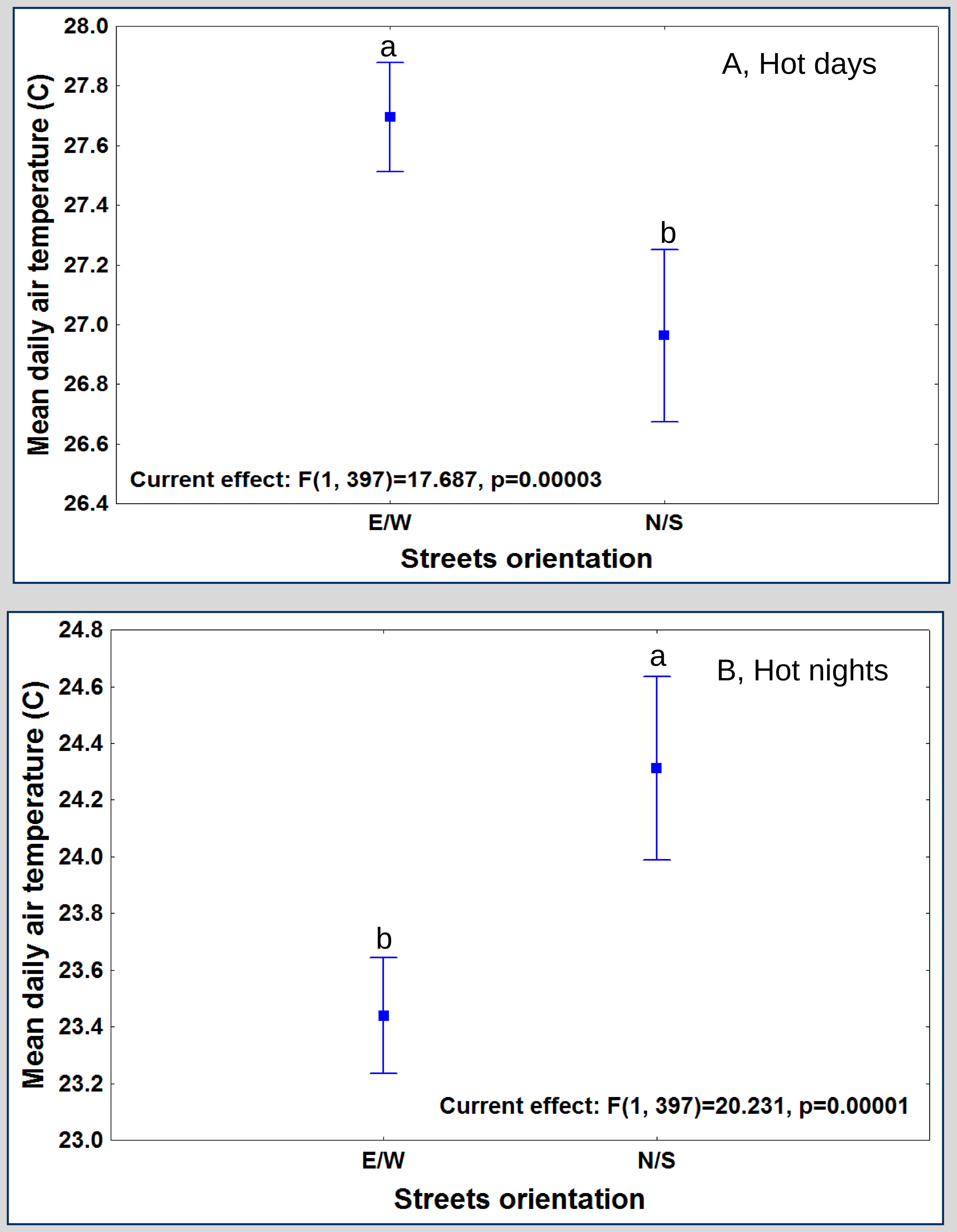

Figure 4. comparison of air temperature with street orientation (A: Hot days, B: Hot nights) * Letters a and b shows the statistical groups

- The results showed mean air temperature under trees with intersected canopies was cooler than air temperature recorded under other categories during hot days.
- Mean air temperature under no tree sites was cooler than recorded air temperature under other categories during hot nights.
- Results showed mean air temperature under trees in E/W streets was significantly warmer than air temperature under trees in N/S during hot days and the reverse pattern was observed during hot nights.

Conclusions

Increasing vegetation covers or reducing the sky view factor through planting trees with larger canopy is suggested to mitigate daytime urban heat island effect. This study simulated urban tree pits and the results suggest selecting suitable type of trees and appropriate distance between tree pits can potentially maximize the both stormwater benefits and UHI mitigation in urban areas. Further investigations into the street orientation effect on air temperature is recommended.

References

1. Gillner, S., Vogt, J., Tharang, A., Dettmann, S., & Roloff, A. (2015). Role of street trees in mitigating effects of heat and drought at highly sealed urban sites. Landscape and Urban Planning, 143, 33-42.