Evaluating Human Cooling Strategies in Urban Environments

Ivan Lee[a], Dr. Terry Gillespie[b], Dr. James A. Voogt[a]

a – Department of Geography, University of Western Ontario, London, Ontario; b – School of Environmental Sciences, University of Guelph, Guelph, Ontario
Contact email: ilee23@uwo.ca

Summary

Increased temperatures due to climate change will likely increase the occurrence of heat related illnesses. The objective of this study is to, through the use of field measurements, evaluate the effectiveness of various cooling strategies. Among the 4 strategies tested (changing the albedo of clothing, using an umbrella, tree and building for shade), the results indicate that each of the strategies does produce a significant effect. Preliminary analysis indicate that the albedo and building shade strategies was the most efficient, while the tree and umbrella strategies were the least effective. Differences in absorbed radiation likely played the largest role in this ordering.

Background and Introduction

Prolonged exposure to high temperatures can have many negative impacts on human health, including death.

Temperature increases due to human induced climate change will likely increase the occurrence of heat related illnesses, especially in urban areas due to the urban heat island effect

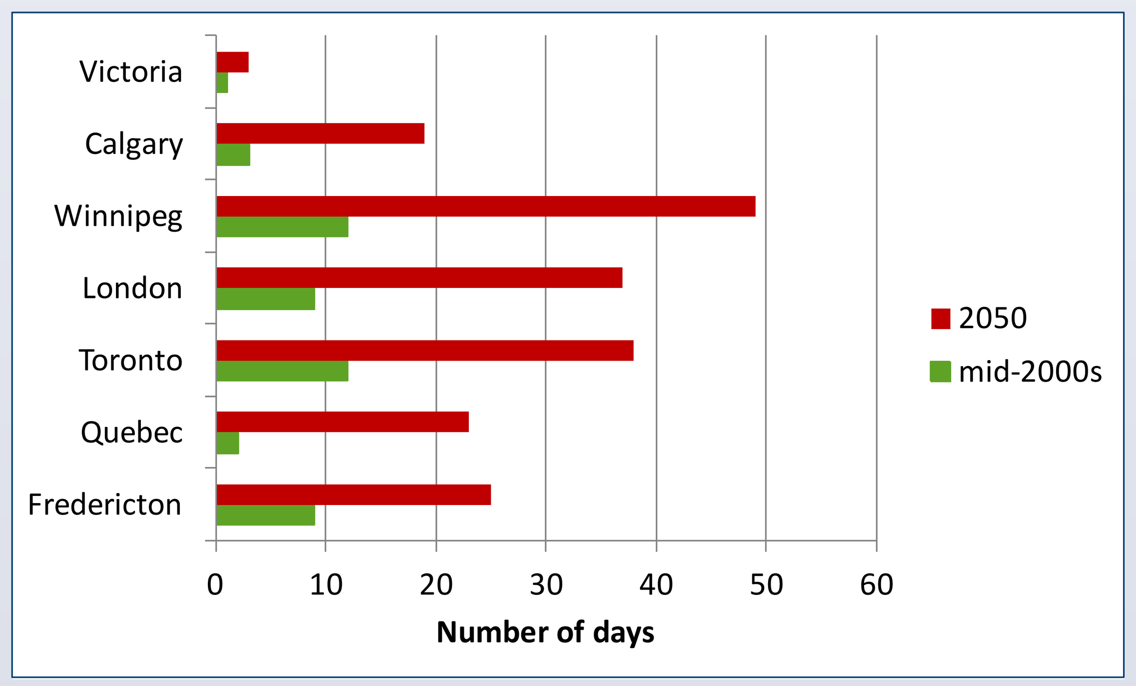

Figure 1: Number of days exceeding 30 ˚C in select Canada cities adapted from Hengeveld et al. (2005)

Cooling strategies that individuals can use are theoretically sound, but there is a lack of empirical studies quantifying their effectiveness. Quantification is important as it can be used by Public Heath units to advise the public during times of extreme heat.

Objectives

Through field measurements, the objectives of this study are to:

1)Verify that a series of cooling strategies do produce significant cooling;

2)Rank and analyse the effectiveness of the previously mentioned cooling strategies.

Methodology

i) Location and approach

Cooling strategies was tested at two different locations at the University of Western Ontario (UWO) in London, Ontario.; one representative of a downtown core, the other representative of a residential area.

At each location, measurements will be done where the strategy is used (the strategy site) and when it is not (the reference site) during clear and sunny days.

Methodology (continued)

ii) Heat indices and equipment setup

The relative decrease in the COMFA heat index was used to evaluate the strategies; the methodologies in Kenny et al. (2008) and Kenny et al. (2009) were used to calculate the COMFA value for each strategy(a lower value indicates less heat absorption).

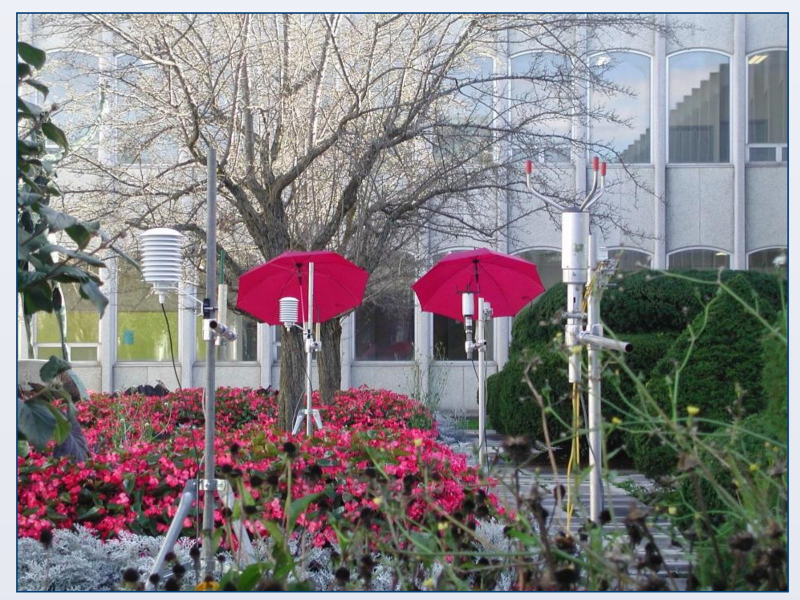

Figure 2: Residential setting

Figure 3: Downtown setting

The strategies that were tested are:

a) Wearing lighter coloured clothing (albedo strategy);

b) Standing in the shade of a building (building strategy);

c) Using an umbrella as shade (umbrella strategy);

d) Standing in the shade of some trees (tree strategy).

Results and Discussion

Wilcoxon Signed Rank tests determined that each of the strategies, in both settings, significantly decrease the COMFA value (at an alpha level of 0.05).

A Kruskal-Wallis test determined there are significant differences among the relative decreases in the COMFA values caused by the different strategies in the different settings (at an alpha level of 0.05).

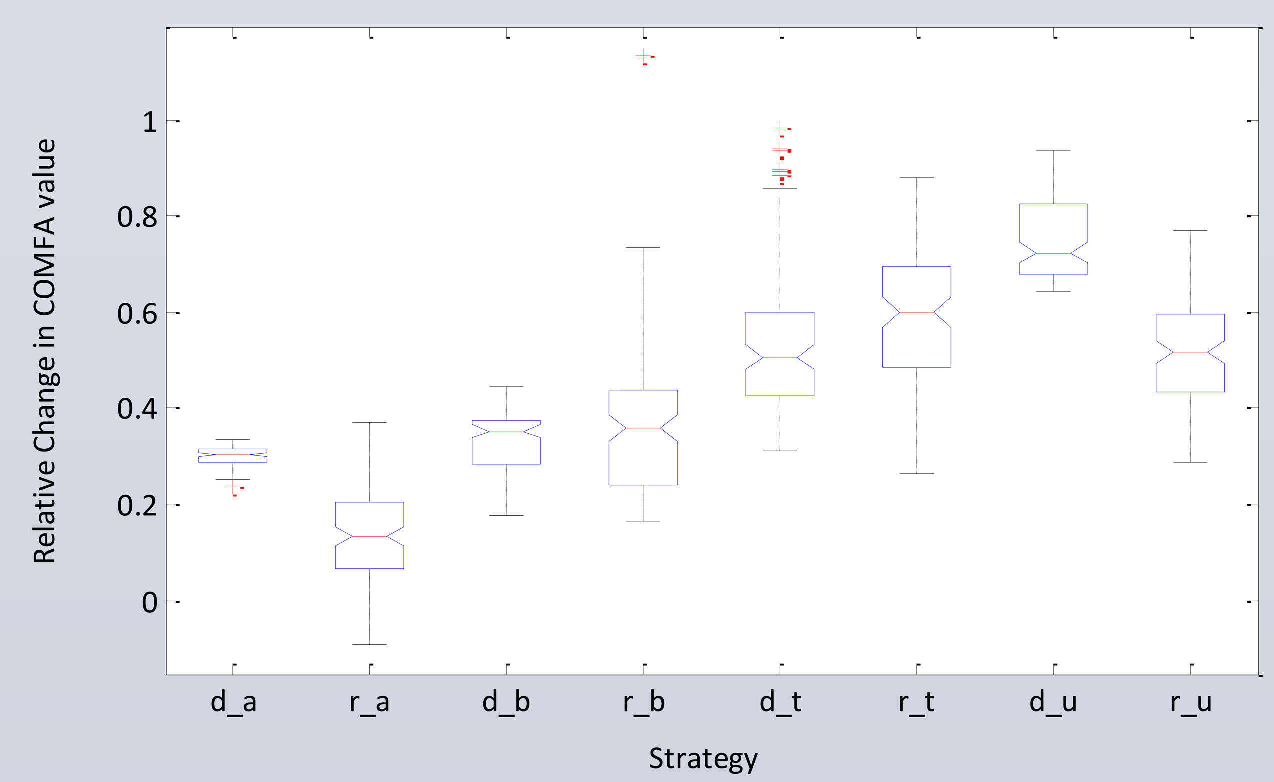

Figure 4: Box plot of the relative change in COMFA values (strategy value/reference value) caused by the different strategies; d = downtown, r = residential, a = albedo strategy, b = building strategy, t = tree strategy, u = umbrella strategy.

Results and Discussion (continued)

The albedo strategy was the most effective, then the building strategy and the tree shading and umbrella strategy were the least effective; preliminary analysis indicate that the setting does not have a large impact on the effectiveness of a strategy.

The likely reason for this ranking is due to the greater decrease in absorbed radiation caused by the albedo and building strategies; there is some variation in the amount of convective cooling between strategies but this probably played a smaller role.

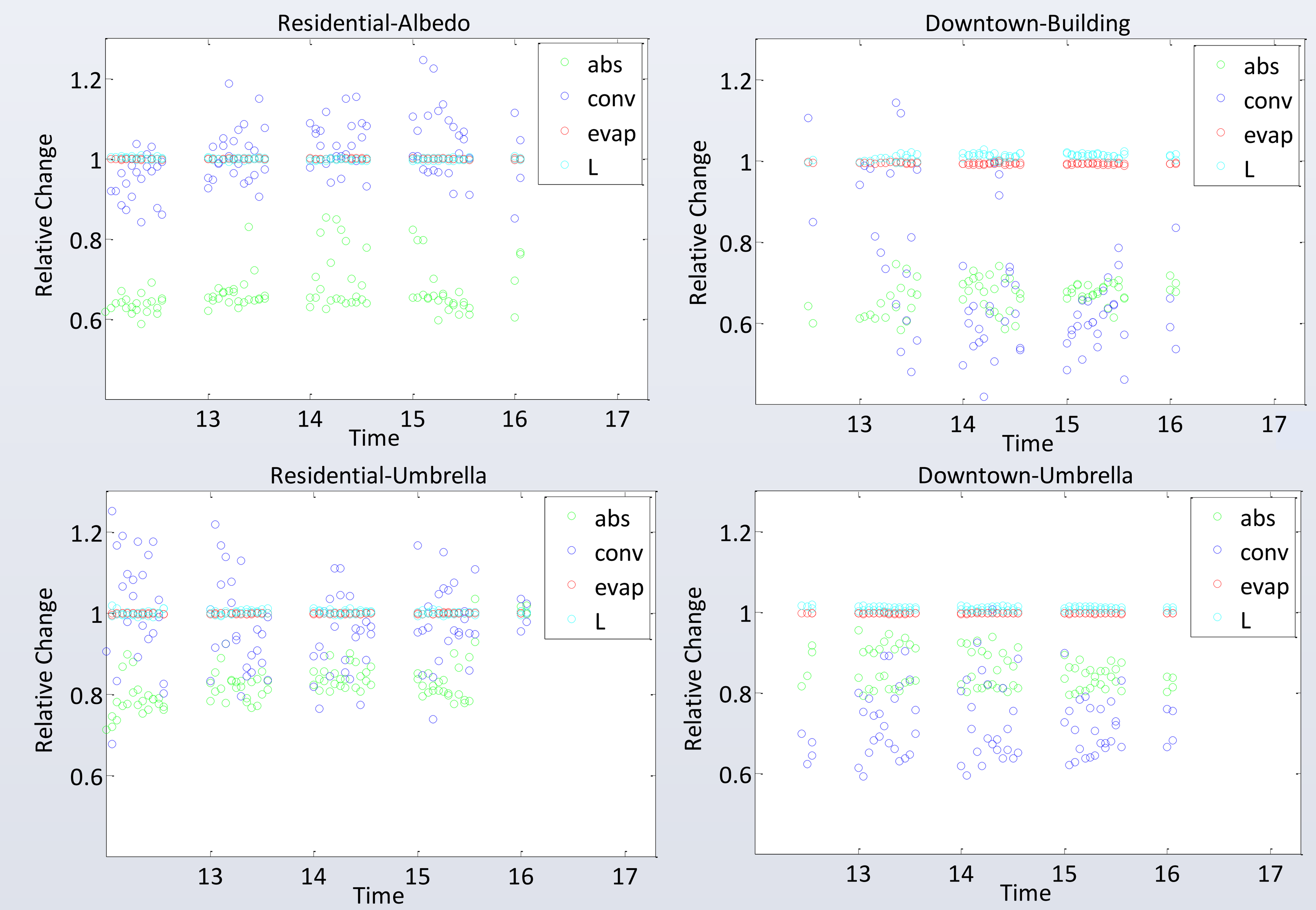

Figure 5: Relative change of components of the COMFA value (strategy value/reference value) for various strategies and settings throughout the day; abs = absorbed radiation, conv = convective heat flux, evap = latent heat flux, L = longwave radiation emitted.

Future work on this project will involve furthering analysing the data to determine the reasons why one strategy is more effective than another.

References

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