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Urban greening and cool surfaces

The effectiveness of climate change adaptation strategies within the context of Budapest

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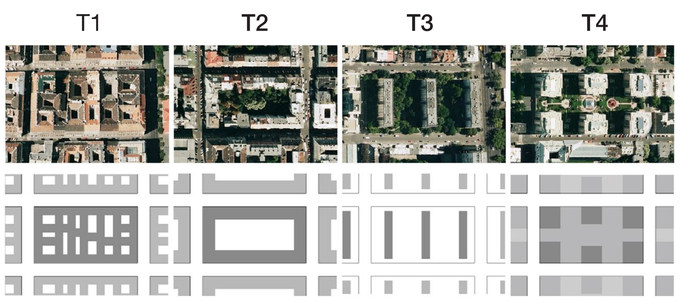
Introduction

The poster presents interim results from the research evaluating the effectiveness of different UHI mitigation strategies through the lens of urban block typologies. Since the effectiveness of such strategies is highly context specific, the research argues for sensible approaches that start with the analysis of existing conditions and assess the applicability of possible solutions. Once the problems are identified, the goals can be formulated and priorities assigned. Is the goal to improve human comfort, reduce energy consumption or both? Will the focus be on day- or nighttime conditions?

Once targets are set, the issue of assessment and reporting arises. While the number of studies evaluating the effectiveness of UHI mitigation strategies at the micro-scale grew rapidly over the past years, most of them were limited in terms claimed microclimate improvements were reported: they often relied on values from a particular point in space and/or time. The current presentation aims to draw attention to—and to start a discourse on—how the effectiveness of UHI mitigation strategies are assessed and reported in numerical simulation studies.

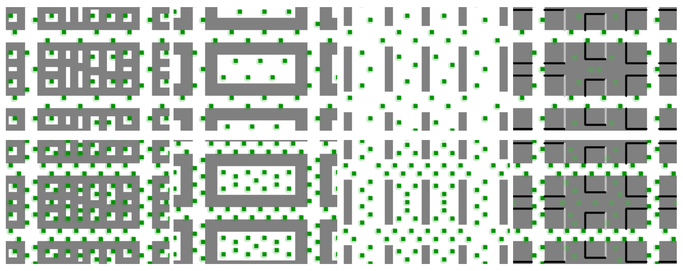


Budapest's metropolitan block typologies and their idealized models

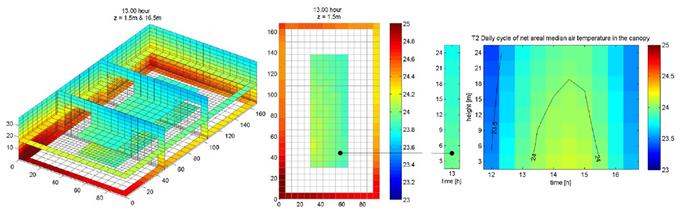
Methodology

The study employed ENVI-met 4.0 for microclimate simulations and MATLAB for the analysis and visualization of the results.

- the cases are idealized versions of the four historic metropolitan urban block typologies of Budapest
- the models consists of 9 identical urban blocks arranged in a 3x3 grid layout and have a 6 m horizontal and 3 m vertical resolution
- the baseline model has no buildings
- simple forcing is utilized with hourly air temperature and relative humidity values of a typical July day in Budapest
- the simulations are run for two days, but only the second day is considered in the analysis
- the scenarios evaluated are: (p) high-albedo pavements (0.25 increase); (r) high-albedo roofs (0.25 increase); (s) 15% canopy cover (18 m shade trees); (st) 15% canopy cover & high-albedo pavements; (t) 30% canopy cover (18 m shade trees); (tr) 30% canopy cover & high-albedo roofs.
- the analytical approaches utilizes areal medians calculated at different heights and times, and mean values calculated over the day and/or the urban canopy
- the assessment focuses on changes in potential temperature and mean radiant temperature within the UCL



Models with 15% and 30% canopy cover



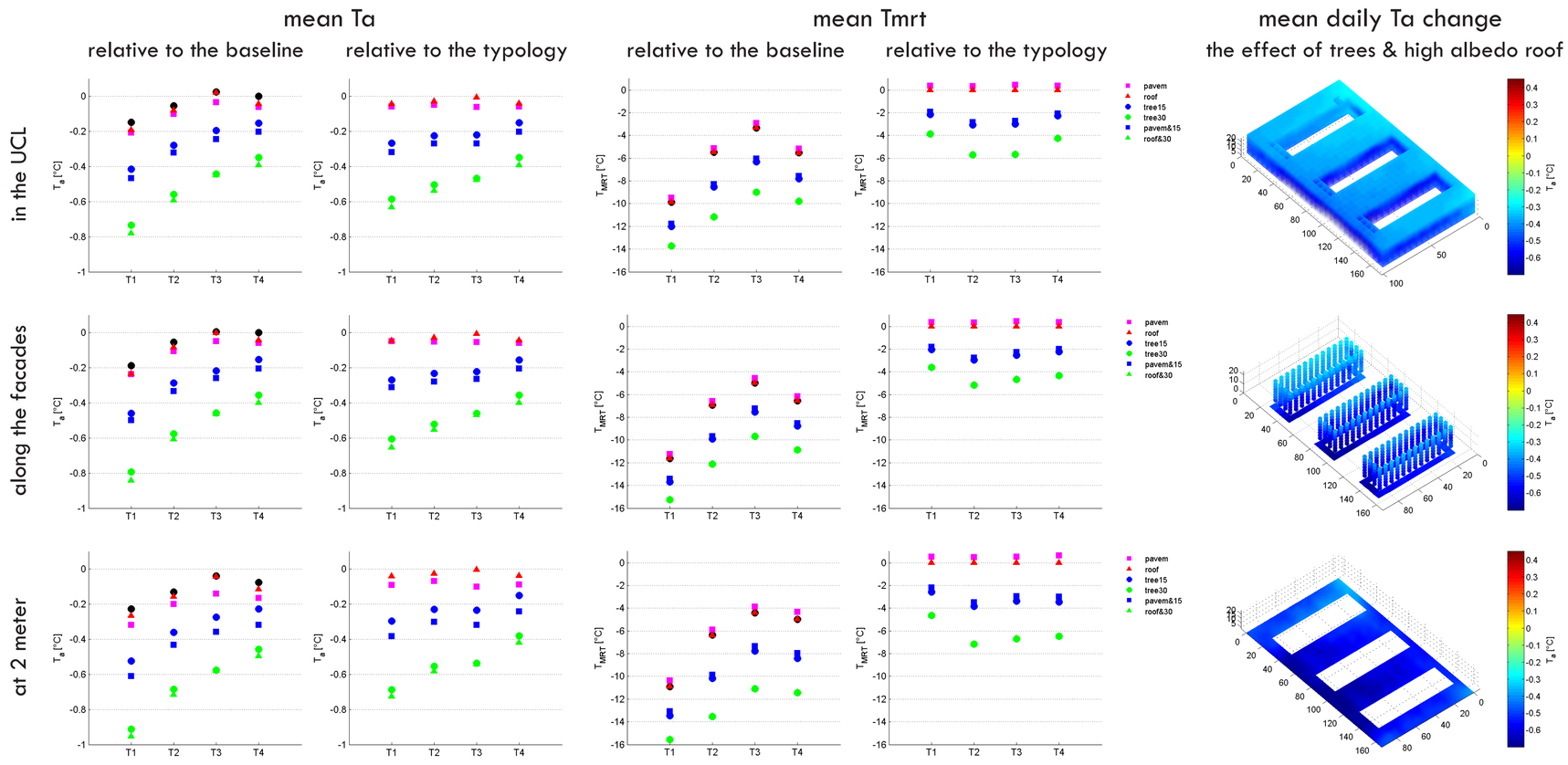
Analytical procedure

Conclusion

The analysis indicates that shading plays a leading role in governing the climate within the UCL—be it the from trees or building. The high-albedo approach—that also aims to modify the radiative environment and thus to reduce air temperature—are least effective when: (1) they remain shaded for the most part of the day (e.g. pavements in the case of high-density configurations), and/or (2) when their surface ratio is small compared to other surfaces (e.g. roofs in the case of low-density configurations, or pavements in the case of T2). At configurations where shading from buildings is already dominant, trees contribute to the microclimatological improvement less by decreasing radiation than by reducing turbulence and hence retaining cooler batches of air between buildings. In addition, some strategies—when applied jointly—can diminish each other's the mitigation potential. Thus, the effect of various approaches are not necessarily cumulative.

Results

SCENARIO ANALYSIS



THE INFLUENCE OF DIFFERENT ADAPTATION SCENARIOS ON THE UCL, ILLUSTRATED THROUGH TWO TYPOLOGIES