Adaptation possibilities to climate change with green infrastructure in urban environment

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Introduction

The attempts to reduce the negative effects of climate change in urban environment primarily focus on overheating protection and decrease of UHI effect primarily. Green infrastructure has a prominent role in this adaptation process. In this study, we present the microclimatic differences within a medium sized Hungarian city – Kecskemét –, which refer to UHI formation. We analyse green surfaces in the downtown, which have an important role in UHI effect reduction and overheating protection. As a conclusion, we make suggestions about green infrastructure as an adaptation tool.

Materials and methods

The preceding findings revealed that the UHI effect and its intra-urban variability are observable throughout the whole year, but the highest values can be measured in summer. International researches agree that in urban level, green infrastructure is one of the key tools in the mitigation of this phenomenon. Many measurements show the differences between green spaces and vegetation-free areas. In London, greenspace is reducing the UHI effect by 31% (Doick et al., 2014). Others found a strong correlation between topography and land-use and UHI intensity (Ketterer – Matzarakis 2014). According to Tsilini et al., (2015) urban gardens decreased the surface temperature by 10 °C compared to areas with no vegetation. The evaluation of cooling effects of gardens, street trees, green roofs etc. could also help understanding how green infrastructure can be integrated into urban environments (Feyisa et al., 2014). This includes that the cooling effect of urban trees is highly associated with sky view factor (Tan et al., 2016), which shows the importance of the canopy density.

In our research, we measured the urban climate with five Netatmo NRG01-WW weather stations in Kecskemét, which give us a climatic cross-section of the town. We analysed 10 August 2017 – 10 November 2017 period. The measured parameters were the following: temperature, precipitation, humidity and wind. Because green surfaces can play a significant role to reduce UHI effect, we made qualitative and quantitative survey about the green areas of Kecskemét downtown (size of green areas, number, type and health of the trees). We used Google Street View and a simplified version of EU method for health status classification, with three health classes (1 – good; 2 – medium; 3 – bad health condition).

Results and discussion

Differences in temperature manifested mainly in night cooling between city districts. We measured 1,5-2 °C differences between the densely built downtown measure point and the loosely built downtown edge or the intermediate measure points, with higher nightly

temperatures in the downtown. However, there is no significant difference in the daytime warming. In the precipitation, there may be a significant difference between the city centre and downtown edge (data can show almost 30 mm difference within one day).

Green areas of the downtown approx. 60 ha, which is about 30% of the investigated area. This value is relatively high, although it is important to consider that the size of the coherent green spaces has an important role in UHI effect reduction. In the downtown of Kecskemét the biggest coherent green area is about 5 ha. This extension can have a significant impact on the urban microclimate, but other green areas in the downtown are too small for a similar impact. Because of this, in case of the vegetation of the downtown, emphasis should be placed for shielding and decreasing of the daytime overheating. To achieve this we need healthy canopy with high density. A significant part of the woody vegetation surveyed by the city centre is in poor condition. Our results show that more than 50% of the trees are in medium or bad health condition (class 2 or 3). This indicates that bigger part of the trees can reach upper limit of their viability within 10-15 years.

Conclusions

Our temperature measurements indicate the presence of the Urban Heat Island phenomenon in Kecskemét. The differences in precipitation between different points of the city reflect the unpredictable rainfall patterns; within a distance of 1 km, there is a deviation of up to 30% in the rainfall. It confirms the necessity and urgency of urban rainfall management. The problems from abundant rainfall and lack of precipitation ameliorated with the help of this management, and it is easier to maintain green territories also. Our examination outlined that great emphasis should be placed to increase the extent of urban green spaces for which different elements of green infrastructure (green walls, green roofs) should be used. To achieve the best shading effect of the green areas, proper and continuous maintenance of the present vegetation is also important.

References

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