Viability of public spaces in cities under increasing heat: A transdisciplinary approach

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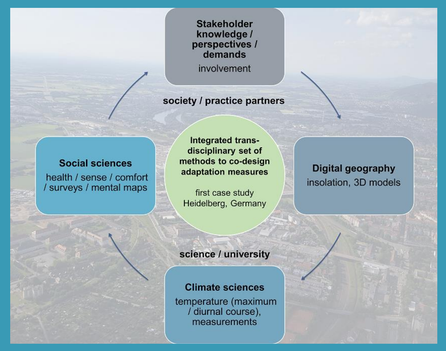
Stakeholder Statement & Motivation

"Cooperation with the scientific community and in particular departments of the University of Heidelberg has become a major factor in technical environmental protection in Heidelberg's city administration, especially in the evaluation and implementation of environmentally relevant aspects in urban development planning. Both sides benefit from the cooperation by supplementing different knowledge resources, perspectives and solution approaches. Especially for the topic of climate change adaptation, we have been able to achieve up-to-date research and practical results in joint projects, which can be directly incorporated into urban development planning processes."

Motivation

- Extreme temperatures can impair the use of public spaces, as heat stress endangers human well-being and health
- Open spaces in cities are important not only for their regulating effect on the urban climate, but especially for their social role and multifunctionality
- Identifying suitable adaptation measures requires a multidimensional approach, accounting for interrelated scientific, social, and practical aspects

Transdisciplinary concept



Transdisciplinary concept of methods to co-design adaptation measures together with relevant stakeholders.

- Research centring on the cooperation between scientists and stakeholders
- Involvement of the relevant stakeholders: citizens, city planners, experts from research and local experts
- Incorporating physical parameters, human perception and practical requirements
- Climatic and meteorological measurements, modelling of solar potential of current and future situations at public squares, survey and mental maps

Methods


Schwetzinger Terrace, Bahnstadt Heidelberg.


University Square, Old town Heidelberg.


Weather station at Bahnstadt, Heidelberg.

Microclimate

Weather stations were installed at two locations for long-term monitoring ambient air temperature and humidity. At both locations, these were placed over grass or vegetation at a distance from surrounding buildings (> 5 m) sufficient to mitigate any effects from the buildings themselves. The measuring height was 2 m above ground. Thermal hygrographs with internal sensors for air temperature and relative humidity were used.

Solar potential

The open source software VOSTOK (Voxel Octree Solar Toolkit) was used for the detailed modelling of the solar irradiation distribution in 3D space and over time. For each location and time step, VOSTOK calculates the solar potential by accounting for direct and diffuse components under clear-sky conditions, which depend on shadowing effects of surrounding objects. Two scenarios were calculated, a current state based on a detailed 3D-building model without vegetation and a future scenario including fully developed vegetation and artificial adaptation and shading measures.

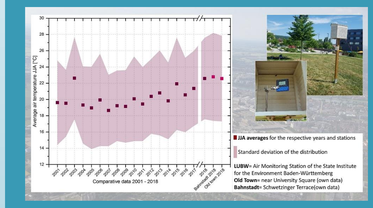
Questionnaire survey

A standardized questionnaire was developed to determine the perception of climate change and the perception or presentation of public spaces in Heidelberg. The survey was conducted as a face-to-face survey with passers-by on several summer days in 2017. The data were evaluated using descriptive statistics and SPSS statistics.

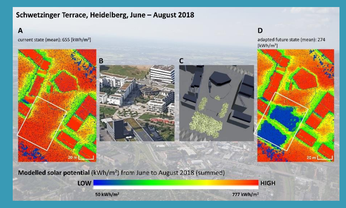
Mental maps survey

Perception research deals with the subjective perception of individuals. Each person develops subjective images of reality. During the mental maps-survey, open questions were chosen in order to find access to the method and to obtain an initial assessment of the respondents' reaction. In addition to the resulting sketches, the dialogues with the interviewees were included in the evaluation. The maps and dialogues were viewed and categorized. The evaluation of the elements presented and the statements made was carried out by coding and counting.

Results



The summer of 2018 was marked by severe heat and drought in many parts of Europe, North America and Asia. Our two monitoring stations installed at the two selected squares in Heidelberg recorded the highest average summer temperature during June to August (JJA) of 22.7 °C in the Bahnstadt. In comparison, the two extreme summers 2015 and 2003 showed an average temperature of 21.9 °C (2015) and 22.6 °C (2003).



The average solar potential at the Schwetzinger Terrace, summed up for the period June-August 2018, is 655 kWh/m², the adapted future state is reduced to 274 kWh/m². At University Square, the average amounts to 450 kWh/m², the mean value for the adapted future state is 228 kWh/m². As shown here, adjustments that enhance shading and minimize irradiation can reduce the solar potential by more than 50 %.

The survey showed a clear perception of more extreme temperatures and weather events. The mental maps highlight possible improvements for public spaces. Citizens identified the lack of shading, the low proportion of green spaces and the social structure of the users of public spaces as the most negative aspects. An increase in the proportion of green areas and the integration of natural elements were the most important factors increasing the quality of stay.

Conclusion

- Measurement results reveal thermal stress in inner-city areas
- Damping and regulating effect of green areas suffers by drought and heat
- Solar radiation can be reduced by approx. 50 % by simple mitigation tools
- Natural design and conservation through integration of vegetation for both public squares and open spaces desired
- Places are perceived very ambivalently, adaptation measures are desired and explicitly mentioned

All results and graphics as published under: Foshag, K., N. Aeschbach, B. Höfle, R. Winkler, A. Siegmund, W. Aeschbach, 2020. Viability of public spaces in cities under increasing heat: a transdisciplinary approach. Sustainable Cities and Society, Volume 59, August 2020, 102215. https://doi.org/10.1016/j.scs.2020.102215; Photos by K. Foshag

Synergy effects: Measures to adapt to urban heat and the desire of the population for attractive design, greening, shading and diversity of uses go hand in hand.