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Editorial

Advances in Urban Biometeorology 2014

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Biometeorological conditions in outdoor urban spaces and the energy consumption as well as thermal comfort in residential buildings are modified due to environmental factors and the complex structure and development of urban agglomerations. The quality of life in an urban or rural environment is influenced significantly by bioclimatic conditions, both short and long terms. The urban heat island, intensified by heat waves in the future projections [1, 2], not only affects quality of life, but in many cases also affects morbidity and mortality [3–6]. Thus, the quantification of thermal comfort conditions in urban residential areas and the required adaptation strategies [7–9], along with the implementation of green buildings, the decrease of energy consumption, and the urban planning and design [10–13] are considered of high concern by the scientific community and urban planners in order to mitigate the adverse consequences of urbanization.

This special issue, which has become the first issue in a series of special issues, which will be published each year, in order to have a long-term impact, focuses on the assessment/modeling of human thermal sensation within urban areas. The high quality papers concern different scales and climatic contexts, identifying the effect of urban configurations such as buildings, parks, streets, and residential areas on humans' health and well-being.

More specifically, the paper of H. L. Lokys et al. analyzes the impact of climate change on human thermal comfort over the next century using two common human-biometeorological indices, the Physiologically Equivalent Temperature (PET) and the Universal Thermal Climate Index (UTCI) in three regions of Luxembourg, Western-Central Europe. The climate change projections are based on a multimodel ensemble of 12 transient simulations (1971–2098) with a spatial resolution of 25 km. The findings of the analysis confirmed the general decrease in cold stress as well as the general increase in heat stress for the region of Luxembourg with respect to the human-biometeorological indices PET and UTCI in detail. Regarding the changes in the index classes, they can be distinguished between cold and heat stress. The changes in heat stress tend to already appear in the near future (2041–2050), whereas the heat stress levels changes become statistically significant in the far future (2091–2100).

Dynamic observations using a digital video camera, at a stepped plaza situated at the outdoor public recreational garden of National Museum of Natural Science (NMNS) in Taichung City, Taiwan, have been conducted by K.-T. Huang et al. in order to perform on-site measurements of the physical environment and observations of user behaviors, including their resting positions, movements, and stay durations. The primary findings of this study are as follows. (1) More people rested on the stepped plaza during the cool season compared with the hot season. The number of people present during the hot season decreased as temperatures increased. The temperature ranges at which most people were present were 34°C PET–36°C PET during the hot season and 20°C PET–22°C PET during the cool season. (2) More than 75% of users preferred shaded areas. Users also stayed longer in shaded areas than they did in sunny areas. (3) Besides, using thermal comfort theory and previous local on-site investigations, the authors describe and verify the relation between behavior and the thermal environment. It is proved that the observed subjects demonstrated an extremely high tolerance to increased summer temperatures despite their psychological preferences for lower air temperatures. People substantially preferred to conduct activities in shaded areas even during the cool season.

R. Vitt et al. present a human-biometeorological information scheme developed for tourism purposes for the medium-sized Hungarian city of Szeged that could be used also for urban planning. It compares thermal and climatic differences between the city and its surroundings. Meteorological data comes from one urban and one rural station and covers the period 2000 to 2011. The thermal index Physiologically Equivalent Temperature (PET) at 14 CET was used in order to quantify thermal stress conditions by means of the frequencies of PET classes, and the precipitation conditions, for each ten-day interval of the month for all the year, were analyzed. The authors shed light on the Climate-Tourism/Transfer-Information-Scheme, which gives a clearly arranged overview of the most important meteorological and biometeorological factors, which influence tourism potential and recreation. The results indicate that there are differences of PET values during the day, as in summer heat stress occurs more frequently in urban areas at 14 CET, and thermal acceptance is more probable in the rural surroundings. On the contrary, cold stress is more frequent in rural areas during winter, due to the absence of heat storage of buildings and low wind speed. Based on the little horizontal distance between the urban and the rural stations, there are marginal differences of precipitation.

Microclimate characteristics, in relation to green-area development and the reflectivity of exterior coating materials, using field measurements of temperature in the urban area of Changwon City, South Korea, were performed by B. Song and K. Park. Furthermore, the effects from improving the thermal environment were identified for various land-use types, and their characteristics were determined by microclimate modeling of temperatures using ENVI-met model [14]. The analysis of the temperature change (according to the space design), taking into account increases in reflectivity and development of green areas for different types of land use, showed distinct temperature-reduction effects due to creation of green spaces in areas where buildings and artificial cover materials were densely distributed (i.e., commercial and single residential areas). Besides, the effects of thermal improvement due to green-area development and increasing reflectivity differ depending on land use.

B. Jänicke et al. studied the effects of façade greening on outdoor human bioclimate, using firstly observational data to answer the question: How large is the reduction of *Tmrt* in front of a greened façade compared to a bare one at a study site? Afterwards, they applied the models ENVI-met, RayMan, and SOLWEIG to the same site in order to evaluate the general performance of the models in simulating *Tmrt* and other variables relevant to assessment of human bioclimate, contributing to the intercomparison and evaluation of these models in a complex urban environment. Finally, the authors investigated if the models are able to simulate the observed alteration of *Tmrt* in front of the façade greening. In conclusion, the effect of façade greening on outdoor human bioclimate was limited in this case study because only a small reduction *Tmrt* in front of the façade greening was detected. Hence, façade greening has only a minor effect in reducing outdoor heat stress. With a façade greening attached to more than one façade in a street canyon or courtyard the effect on *Tmrt*, however, might be enlarged. The general ability of ENVI-met [14], RayMan [15], and SOLWEIG [16] models to simulate *Tmrt* was reasonable as expected for well-established models. Nevertheless, the deviations from observations vary largely between different studies. Additionally, the deviations from observations for other variables (specific humidity, long-wave downward, or short-wave upward radiation) were higher and might impede the models' ability to assess heat stress.

A long-term climate measurement in the third largest city of Taiwan was implemented by F.-C. Liao et al., for the check of accuracy of morphing approach on generating the hourly data of urban local climate. Based on observed and morphed meteorological data, building energy simulation software EnergyPlus was used to simulate the cooling energy consumption of an air-conditioned typical flat and the thermal comfort level of a naturally ventilated typical flat. The simulated results were used to quantitatively discuss the effect of urban microclimate on the energy consumption as well as thermal comfort of residential buildings. The result showed that the morphing approach has good accuracy in forecasting temperature and relative humidity. In terms of the error of cooling energy consumption, the percentage error of the observed and predicted meteorological data is slight with a range of 0.49%–1.06%. However, the meteorological data generated from the morphing approach made moderate errors in the assessment of thermal comfort in a naturally ventilated space. This suggests that the climatic data generated from morphing approach are suitable for the analysis of energy consumption of air-conditioned buildings, but not suitable for the diagnosis of indoor thermal comfort level of naturally ventilated buildings.

H. Liu et al. investigated whether urban development of Shenzhen City, China, has altered the heat balance of the ground surface, thereby influencing climatic variables as well as the reference crop evapotranspiration (ET_0) changes. The daily, monthly, and annual climatic variables and ET_0, from 1954 to 2012, were computed using the FAO Penman-Monteith equation (PM), and these parameters were analyzed to study the temporal trends of ET_0 and meteorological factors. The trends and the time points of abrupt changes of ET_0 and meteorological factors were tested using Mann-Kendall methods. The results of the analysis indicated that the development of Shenzhen City greatly affected the local climatic conditions. The mutation point for most climatic variables is observed at approximately 1978, the onset year for urban development. ET_0 first decreased from 1954 to 1978 and then increased quickly and reached a maximal value of 1373 mm during the period from 1992 to 2012. Besides, sensitivity analysis showed that ET_0 is most sensitive to relative humidity, followed by air temperature, sunshine hours, and wind speed.

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