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Editorial

Advances in Urban Biometeorology

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With the increase of urbanization, a significant factor playing an important role in global warming, the scientific community has been required to provide solutions addressing the negative impact of climate and the general atmospheric environment on cities, along with the improvement of these conditions for humans. The urban heat island affects not only quality of life, but in many cases also affects morbidity and mortality. Urban planning plays a very important role in this, and various studies have shown the importance of taking into account human thermal sensation in order to mitigate the negative consequences of urbanization and strengthen the resilience of the society [1–8]. This special issue focuses on the assessment/modeling of human thermal sensation and exposure to ambient air pollution within urban agglomerations. The various papers focus on different scales and climatic contexts, all with the common theme of identifying the effect of urban configurations, such as buildings, parks, and streets, on humans' health and well-being.

More specifically, the paper of H. Lee et al. "*Modification of human-biometeorologically significant radiant flux densities by shading as local method to mitigate heat stress in summer within urban street canyons*" analyzes the physical processes, which are characteristic of shading in terms of urban human biometeorology, through experimental investigations into the thermal effects of shading by a building and tree canopies, conducted in Freiburg, southwest Germany, during typical Central European summer weather. Urban human biometeorology, that is, the human-biometeorological concept to assess the thermal environment, refers to the variables of air temperature Ta, mean radiant temperature Tmrt, and physiologically equivalent temperature PET—based on the energy balance model of the human body. With respect to both shading devices, the Ta reduction did not exceed 2°C, while PET as a measure for human heat stress was lowered by two thermal sensation steps. The results show the crucial significance of the horizontal radiant flux densities for Tmrt and consequently PET.

The effect of urban structures on thermal comfort indices in the extreme climate region of the Russian Far East, as well as the seasonal dynamics in different urban zones at the capital of the Jewish Autonomous Region, Birobidzhan, was studied by J. L. Bauche et al. in "*Human-biometeorological assessment of urban structures in extreme climate conditions: the example of birobidzhan, Russian Far East.*" The difference of thermal values for three zones with different vegetation and build-up density shows the influence of urban planning on the local microclimate. The moderating effect of dense built-up and inner city vegetation on extreme thermal conditions becomes clear when comparing all zones. Through the analysis of daily and monthly timelines it was possible to determine preferable times of the day for inner city outdoor activities. The results indicate that, with a total of 170 days per year with PET values below 0°C, Birobidzhan can be considered as a region of extreme cold stress. This suggests that adaptation based solely on behaviour and clothing is not sufficient, but adaptation of the urban surroundings and therefore the identification and choice of preferable urban structures are necessary.

In a similar work, P. T. Nastos and A. Matzarakis "*Human bioclimatic conditions, trends, and variability in the Athens University Campus, Greece*" attempt to identify human thermal bioclimatic conditions in the Athens University Campus (AUC). The quantification of human thermal sensation in such a place was considered of a great significance due to the great gathering of student body and members of University. The analysis of the bioclimate is carried out, using PET. Results reveal that approximately 45%–65% of the days within the year, from 08:00 to 19:00, experience PET values greater than 18°C (thermal comfort), while 13%–23% of the days (mainly during summer period) are characterized by strong/extreme thermal stress from 09:00 to 16:00. Regarding the strong/extreme cold stress, it appeared for almost 50% of days from midnight to early morning hours (06:00). Regarding the extreme conditions, the intense heat waves that occurred during summer 2007 along with extreme cold during December 2003–February 2004 were also analyzed. These were compared to the respective average bioclimatic conditions of the study period, indicating that the occurrence of extreme human-biometeorological conditions is of high concern for the future climate, especially for very crowed areas, such as AUC.

Long-term estimations in a tropical coastal city of Dar es Salaam, Tanzania are carried out by E. L. Ndetto and A. Matzarakis in "*Effects of urban configuration on human thermal conditions in a typical tropical African coastal city,*" in order to determine the effects of buildings' heights and street orientations on human thermal conditions at pedestrian level. A typical urban street and a park were chosen as representative urban environments. Results, as interpreted in terms of the thermal comfort parameters of mean radiant (Tmrt) and PET, indicate that urban configurations influence significantly the two parameters. In particular, optimal reduction of Tmrt and PET values are observed on the north-south reoriented streets and with increased building heights. Simulation results on a small urban garden provide a novelty in design implications and management of open spaces in cities.

In the study of C. H. Lin et al. "*Thermal comfort for urban parks in subtropics: understanding visitor's perceptions, behavior and attendance,*" an effort towards thermal comfort assessment for urban parks under the climatic conditions of Taiwan is conducted, through field interviews, observations, and micrometeorological measurements. The WBGT is used as the thermophysiological index to investigate the effects of thermal conditions on visitors' thermal perception and adaptive behaviors in outdoor urban spaces. Observation results show that the overall attendance is influenced by sun and thermal conditions. There is a robust relationship between thermal sensation votes, as well as thermal acceptability, and thermal environment, in terms of WBGT. The upper and lower limits of 80% acceptability are 26°C WBGT and 20°C WBGT, respectively.

L. A. Égerházi et al. in "*Application of microclimate modelling and onsite survey in planning practice related to an urban micro-environment*" perform numerical simulations of thermal comfort conditions by means of the urban microclimate model ENVI-met in a popular children's playground located in Szeged, Hungary. Bioclimatic conditions are quantified using PET and thermal stress maps are created in two different periods of typical summer and autumn days. The study aims to reveal the seasonal and diurnal spatial patterns of the simulated thermal conditions and thus the degree of heat stress in different parts of the playground. Furthermore, the momentary spatial distributions of the visitors triggered by the microclimatic conditions of the area are analyzed. Remarkable differences in the thermal conditions are found depending on the sun elevation and the resulting shaded conditions as well as the radiation of the heated surfaces. The spatial distribution of the visitors seems to be highly influenced by the patterns of the thermal conditions, but the location and the preference of the playground equipment also affect this. To evaluate the possible causes of the people's behavior, an on-site questionnaire survey was conducted with possible modification requirements related to the design of the playground.

In the modeling aspect of outdoor biometeorological conditions, K. P. Moustris et al. "*One-day prediction of biometeorological conditions in a mediterranean urban environment using artificial neural networks modeling*" deal with the 24-hour prognosis of the outdoor human-biometeorological conditions in an urban monitoring site within the greater Athens area, Greece. For this purpose, artificial neural networks (ANNs) are applied in order to predict the maximum and the minimum value of the PET, one day ahead, as well as the persistence of the hours with extreme human-biometeorological conditions. The results show that extreme heat stress appears in 10% of the examined hours within the warm period of the year, against extreme cold stress for 22.8% of the hours during the cold period of the year. Finally, human thermal comfort sensation accounts for 81.8% of the hours during the year. Concerning the PET forecast, ANNs have a remarkable forecasting ability to predict the extreme daily PET values one day ahead, as well as the persistence of extreme conditions during the day, at a significant statistical level of $P < 0.01$.

Findings of the study by A. Lopes et al. in "*Lisbon urban heat island updated: new highlights about the relationships between thermal patterns and wind regimes*" update the results of the research published in 2007 and bring more precise information about the relationship between the UHI (urban heat island) and the regional and local wind systems in Lisbon. The highest frequencies of temperature differences higher than 0°C are found in the city centre. In the green park of Monsanto, the highest frequency occurred between −2 and 0°C. During the summer, the effect of the breezes is observed in Belém, lowering the air temperature. The "strong" UHI (intensity > 4°C) occurred more often during the summer, with median values of 2°C by night and 1.8°C by day. The highest frequencies of UHI occur for winds between 2 and 6 m/s, and are not associated with atmospheric calm events, as pointed out in the literature. Winds above 8 m/s inhibit the occurrence of strong UHI in Lisbon.

The assessment and comparison of variations in air temperature and vapour pressure (vis-à-vis relative humidity) against a crowd of runners—the herd effect—are studied by P. Wong et al. in "*Microclimate variations between semienclosed*

and open sections of a marathon route." The work evaluates conditions in two different environmental settings along the marathon course, a semienclosed (tunnel) versus an open space (suspension bridge). A series of small iButtons was deployed at strategic locations along the course to undertake minute-by-minute measurements of air temperature and relative humidity. It is found that herd effects of varying degrees are present in both the semienclosed and open settings. Various environmental differences also play a role in ameliorating or amplifying the climatological effects of the herd of runners. Microclimatic variations in different environmental settings and crowd conditions could have an impact on runners. This knowledge can inform the design of marathon routes and establishes the feasibility of employing the iButton logging sensors for widespread deployment and monitoring of meteorological situations.

The last paper in this volume is by J. H. Amorim et al. "*Pedestrian exposure to air pollution in cities: modeling the effect of roadside trees,*" who evaluate the exposure of students to traffic-emitted carbon monoxide (CO) in their daily walk to school, with a particular emphasis on the effect of trees and route choice. The study is focused on the city centre of Aveiro, in central Portugal. Time evolution of the georeferenced location of an individual was tracked with a GPS for different alternative walking routes to a school. Spatial distribution of CO concentration was simulated with a computational fluid dynamics (CFD) model. An exposure model was developed that associates the georeferenced location of the student with the computed air quality levels (at an average breathing height) for that specific grid cell. For each individual the model calculates the instantaneous exposure at each time frame and the mean value for a given period. Results show a general benefit induced by the trees over the mean exposure of the student in each route. However, in the case of instantaneous exposure values this is not consistent along the entire period. Also, the variability of the estimated exposure values indicates the potential error that can be committed when using a single value of air quality as a surrogate of air pollution exposure.

We expect that this special issue will help journal readers to understand better the impacts of various aspects of urban biometeorology. We trust that this volume will be a valuable reference to researchers, academics, planning authorities, practitioners, and policy makers.

Acknowledgments

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