

Streszczenie rozprawy doktorskiej w języku angielskim

Urban expansion under conditions of intensifying climate change leads to significant transformations of the local thermal environment. Variability in land cover, high built-up intensity, limited vegetation cover, and the specific geometry of urban areas all influence the urban energy balance, resulting in the formation of a highly heterogeneous thermal mosaic. In the context of the increasing frequency of heatwaves and a growing risk of heat stress, understanding the relationships between urban morphology and thermal as well as biothermal conditions has become crucial for spatial planning and the design of climate adaptation measures.

This dissertation aimed to determine the impact of urban environment structure on local thermal and biothermal conditions across different spatial and temporal scales, using Warsaw as a case study. The dissertation comprised a coherent series of three thematically linked scientific articles, each addressing the specific objectives: **C1.** Identification of the impact of environmental features, parameterised using spatial development indicators, on air temperature characteristics during extremely warm months, and determination of the spatial scale at which these relationships are the strongest; **C2.** Determination of the spatial distribution of thermal “hot spots” and “cold spots”, their associations with land cover types and air temperature regimes on annual and seasonal scales (summer and winter); **C3.** Assessment of the impact of environmental elements on human thermal stress in urban parks across different phases of the growing season and at varying spatial scales.

A multi-source methodological approach was applied, tailored to the specific research objectives. The study utilised data from an air temperature monitoring network, measurement campaigns, and the ERA5-HEAT climate reanalysis, as well as field inventories, satellite imagery, available databases, GIS products, and datasets derived using specialised software. Analyses were conducted at multiple spatial scales (point scale, buffers with radii of 10 m, 50 m, 100 m, and the city scale), as well as temporal scales (selected months, the growing season, and multi-year analyses).

The results indicate that the presence of vegetation is one of the key factors shaping local thermal conditions in the city, particularly with respect to minimum air temperature values and the reduction of thermal stress. At the same time, high built-up intensity and a large proportion of impervious surfaces contribute to the deterioration of thermal and biothermal conditions. However, it should be emphasised that not all of the analysed indicators and spatial scales show statistically significant relationships with the investigated characteristics of the local climate. Built-up areas do not constitute a homogeneous and uniformly unfavourable thermal environment, while green spaces do not always guarantee conditions conducive to thermal comfort. Moreover, the direction of the observed relationships may even reverse. The study also has practical implications and may facilitate dialogue between climatologists, planners, and decision-makers responsible for enhancing urban resilience to climate change.

Keywords: urban climate and bioclimate, urban morphology, spatial development indicators, thermal characteristics