MODELING THE URBAN THERMAL FIELD IN SOUTHEAST BRAZIL: A CASE STUDY IN INDAIATUBA

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Modélisation du champ thermique urbain au sud-est du Brésil : Une étude de cas à Indaiatuba

Mots-clés : climat urbain, température de l'air, îlot de chaleur urbain, utilisation des terres
Keywords: Urban Climate, Air Temperature, Urban Heat Island, Land Use and Cover

Introduction

Human interference in the functioning of natural systems can be observed through a series of processes, and among the most significant is the removal of vegetation cover for the construction of urban infrastructures (Oke, 1987). In this context, it is expected that the suppression of vegetation will lead to a change in the radiation balance, due to the new geometry and albedo of the built surface, characterized by different thermal and aerodynamic properties (Cardoso and Amorim, 2017). Such urban processes culminate in climatic phenomena that affect the health and well-being of the population, particularly urban heat islands (UHI).

The 2022 census carried out in Brazil indicated 203 million inhabitants in the country, with the Southeast region concentrating 84.8 million of them, which represents 41.8% of the total population. Furthermore, more than half of the population (124.1 million people - 61%) lives in urban centers in Brazil (IBGE, 2022). These data show the importance of studies on the urban climate to guarantee a pleasant and healthy environment for the country's population. Therefore, the present study aimed to evaluate the thermal field of the city of Indaiatuba (southeast region of Brazil), based on spatial modeling and considering land use and coverage. In this sense, it was also possible to verify the spatial occurrence of UHI in the municipality.

1. Methodology

The study area corresponds to the municipality of Indaiatuba, which is located in the State of São Paulo (Brazil) and has a population of 255.788 inhabitants (IBGE, 2022). According to the Köppen classification, the region's climate is characterized as Cwa, tropical with dry winters (IAC, 2013). To achieve the objectives of this work, air temperature measurements were made using mobile transects during 2021. The transects were realized at different times of the year to understand thermal differences depending on atmospheric changes.

Field work took place at night, between 9pm and 10pm, as this is the time when UHI are best characterized (Amorim *et al.,* 2021). The route chosen for the transects comprised the North-South and East-West directions, with the purpose of covering different portions of the city (Fig. 1). Data from mobile transects were modeled in conjunction with Landsat 8 images for thermal assessment of the area. In this sense, maps of land use and cover were created, as well as simple linear regressions were carried out to verify the correlation of air temperature with the type of land cover – built area, low vegetation and dense vegetation (Amorim *et al.,* 2015). Subsequently, multiple regression calculations were performed, in which chosen variables were used simultaneously to simulate the thermal gradient of the area.

2. Results and Discussions

From the maps generated, it was found that the highest temperatures are in the center of the municipality towards its north and northwest portion (towards Campinas), in other words, the highest temperatures are concentrated in the most densely built area and in areas that are expanding. On the other hand, areas further away from the urban center, as the southern portion, had lower temperatures when compared to central areas, highlighting the occurrence of UHI (Amorim *et al.,* 2021).

In the southern portion of the municipality there is little urban density, with areas characterized by agricultural production and pastures, as well as a greater number of vegetated areas. The observed pattern of UHI in this study has already been verified previously in another location in the state of São Paulo (Cardoso and Amorim, 2017), indicating that there is also a relationship with the types of construction (materials used), waterproofing and paved areas.

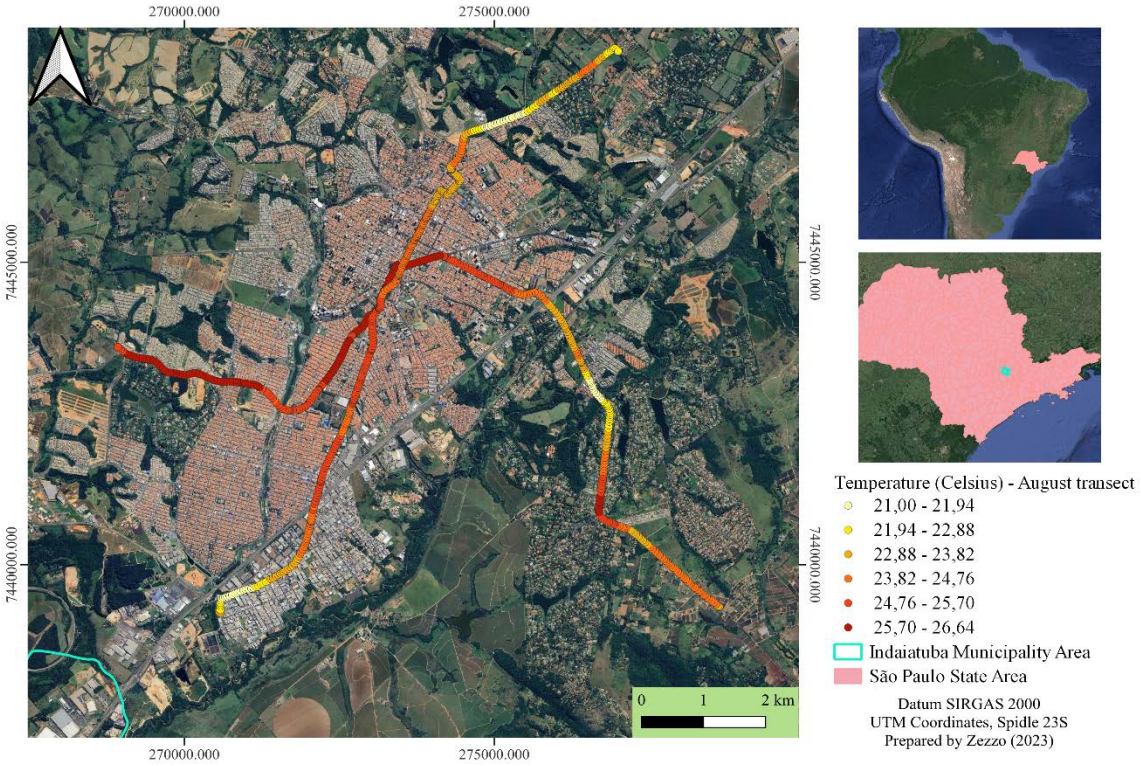

Figure 1. Map of the municipality of Indaiatuba with an indication of the routes taken by the transect at night on August 21, 2021 (dry season). The same figure also shows the temperatures obtained in the sections covered.

Conclusion

The spatial reproduction of field data such as the spatial delimitation of UHI can be interesting to decision makers, facilitating local interventions to minimize high temperatures. Thus, it is understood that the cartographic products produced can have different purposes, complementing the materials used as subsidies in urban planning, for example.

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