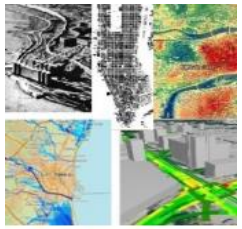

SUPTM 2026: 3rd Conference on Future Challenges in Sustainable Urban Planning & Territorial Management

Analysis of Urban Heat Islands in São Paulo: Development of a Statistical Model for Mitigation and Sustainable Planning

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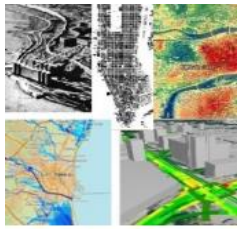
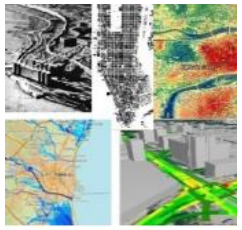


Introduction

- Accelerated urbanization has intensified the **Urban Heat Island (UHI)** phenomenon in large metropolitan areas.
- In São Paulo, this process increases thermal discomfort and socio-spatial inequalities.
- A statistical understanding of environmental variables associated with air temperature is essential for **sustainable urban planning**.

Objective

- To develop and validate a **Multiple Linear Regression (MLR) model** to analyze the influence of environmental variables on the UHI phenomenon in São Paulo.



Study Area

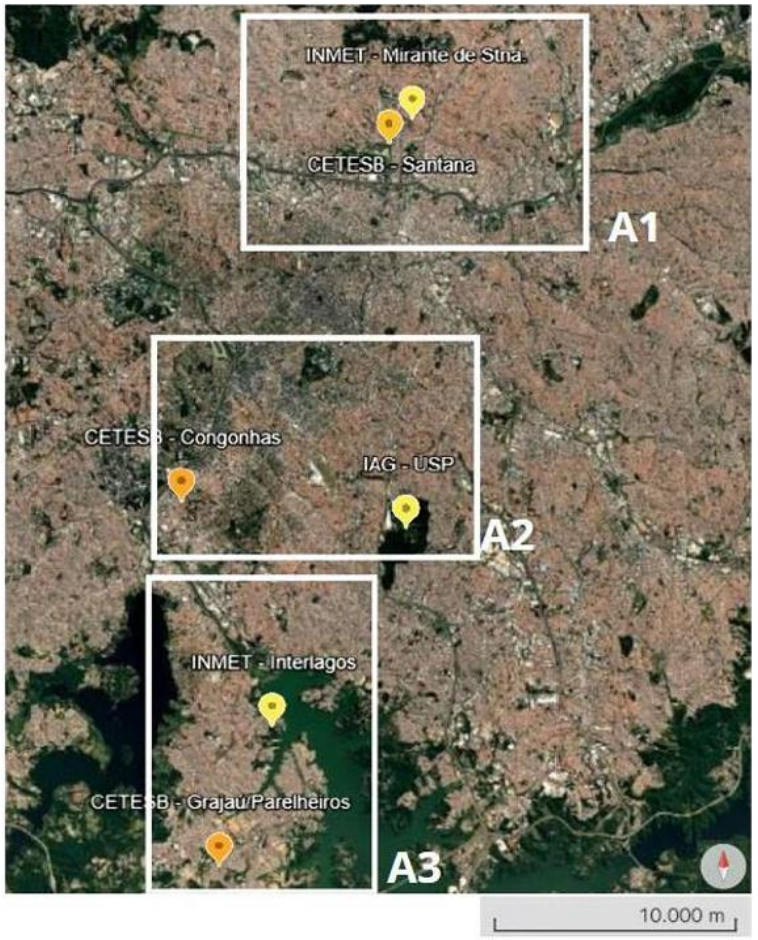
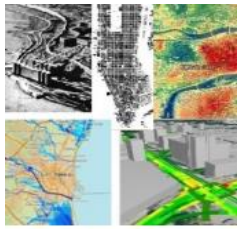


Figure 1. Location of the study areas.



Methodology

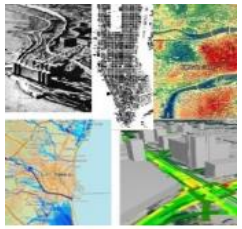
Study period: 2019–2023 (monthly averages)

Variables

- **Dependent variable:** Monthly average air temperature (°C)
- **Independent variables:**
  - Monthly average relative humidity (%)
  - PM2.5 concentration (µg/m³)
  - Monthly precipitation (mm)

Procedures

- Data cleaning and standardization (Excel®)
- Statistical modeling using **Multiple Linear Regression (OLS method)** in EViews®
- Model validation through:
  - F-test
  - Adjusted R^2
  - White Test (homoscedasticity)
  - Jarque–Bera test (normality of residuals)
  - Multicollinearity analysis



Results

Absence of multicollinearity: the correlation matrix among the independent variables showed no strong linear relationship between them, indicating the absence of multicollinearity.

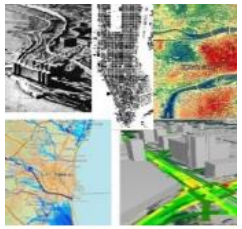
Expected residual value equal to zero: when evaluating the model, the residuals $E(Ui)$ were found to be very close or equal to zero.

Homoscedasticity: to assess the model's homoscedasticity, the White Test was applied, which yielded a Probability value of 0.058097, higher than the significance level of α=0.05, indicating the absence of heteroscedasticity.

Absence of residual autocorrelation: to evaluate this assumption, the Jun e Box test and the correlogram were applied. Probability values higher than the significance level of α=0.05, together with the correlogram, confirm the absence of autocorrelation among the residuals.

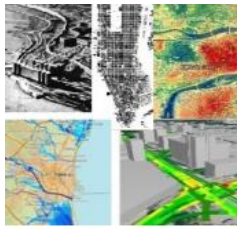
Normality of residuals: the Jarque–Bera test was applied. The Probability value of 0.484546, higher than the significance level of α=0.05, indicated that the residuals follow a normal distribution.

Figure 2. Results of the statistical model validation tests.



Discussion and Conclusions

- The results confirm the relevance of atmospheric and pollution-related variables in UHI dynamics.
- The model supports evidence-based decision-making in urban planning and climate adaptation.
- Although the explanatory power is moderate, it is consistent with the complexity of urban climate systems.
- The proposed MLR model effectively identified key environmental drivers of the Urban Heat Island phenomenon in São Paulo.
- The methodology is replicable and suitable for sustainable territorial management.
- Future studies may expand the model by incorporating land-use variables, vegetation cover, and socio-economic indicators.



Thanks!