THE URBAN HEAT ISLAND HOTSPOTS IN THAILAND

Presentation - 2026

2026 GLOBE PROGRAM - GROUP 4

NAKHON SI THAMMARAT

1. INTRODUCTION

The urban heat island effect (UHI) causes urban areas to be 2–4°C warmer than surrounding rural areas due to several factors.

Reduce vegetation

Heat-absorbing materials

Heat emissions

Urban geometry

Why does this happen?

Cities are warmer because concrete and metal surfaces trap and retain heat more than natural rural areas.

How does it happen?

The diverse areas are replaced by buildings and roads, surfaces that are not very comfortable with heat.

OBJECTIVES

1. Identify 6 Land Cover types in Nakhon Si Thammarat and compare their surface temperatures (Day & Night) using one-way ANOVA (alpha=0.05).

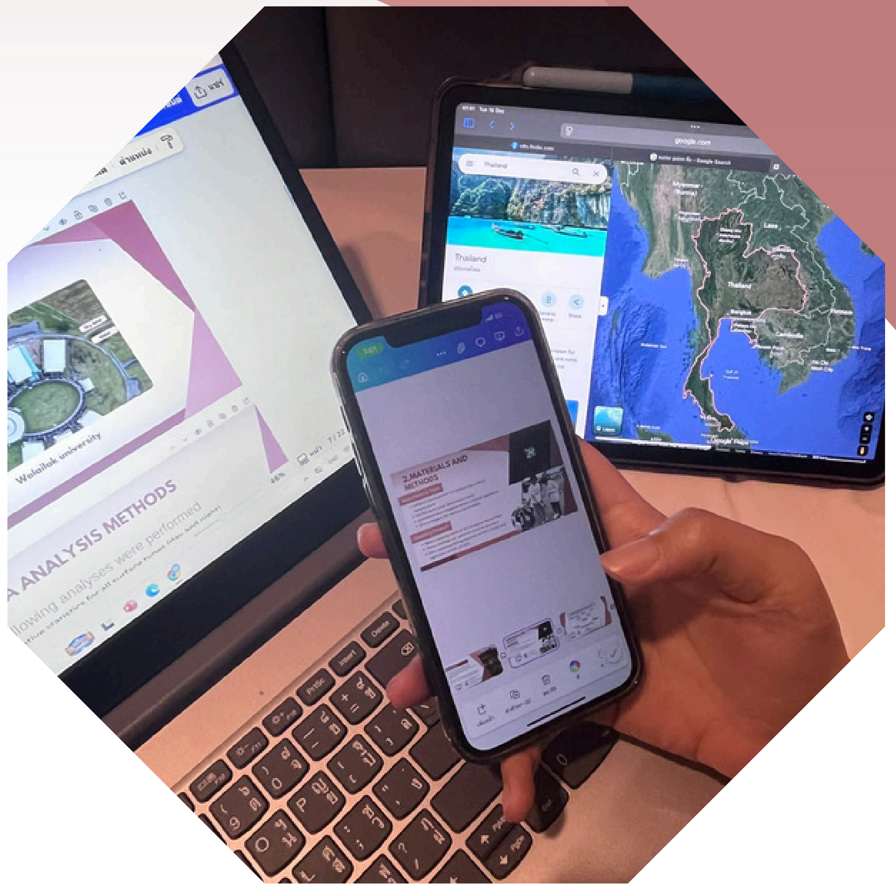
2. Study the 2-hour temperature shift (heat retention patterns) of each surface type from 2 PM to 8 PM.

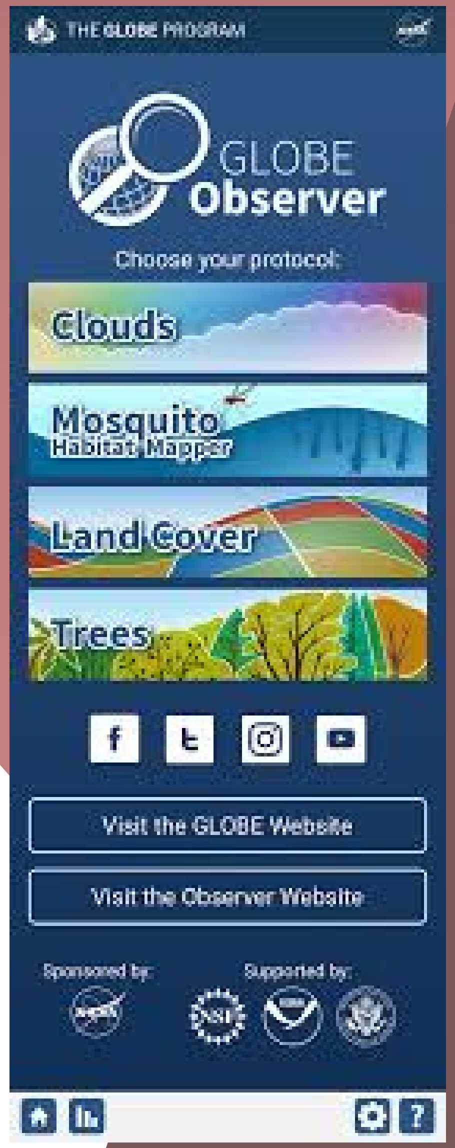
3. Compare the average LST (Day, Night) results from Nakhon Si Thammarat to those from 3 other provinces including Sara Buri, Suphanburi and Trang for both groudshooting and satellite data

2.MATERIALS AND METHODS

Instruments & Tools

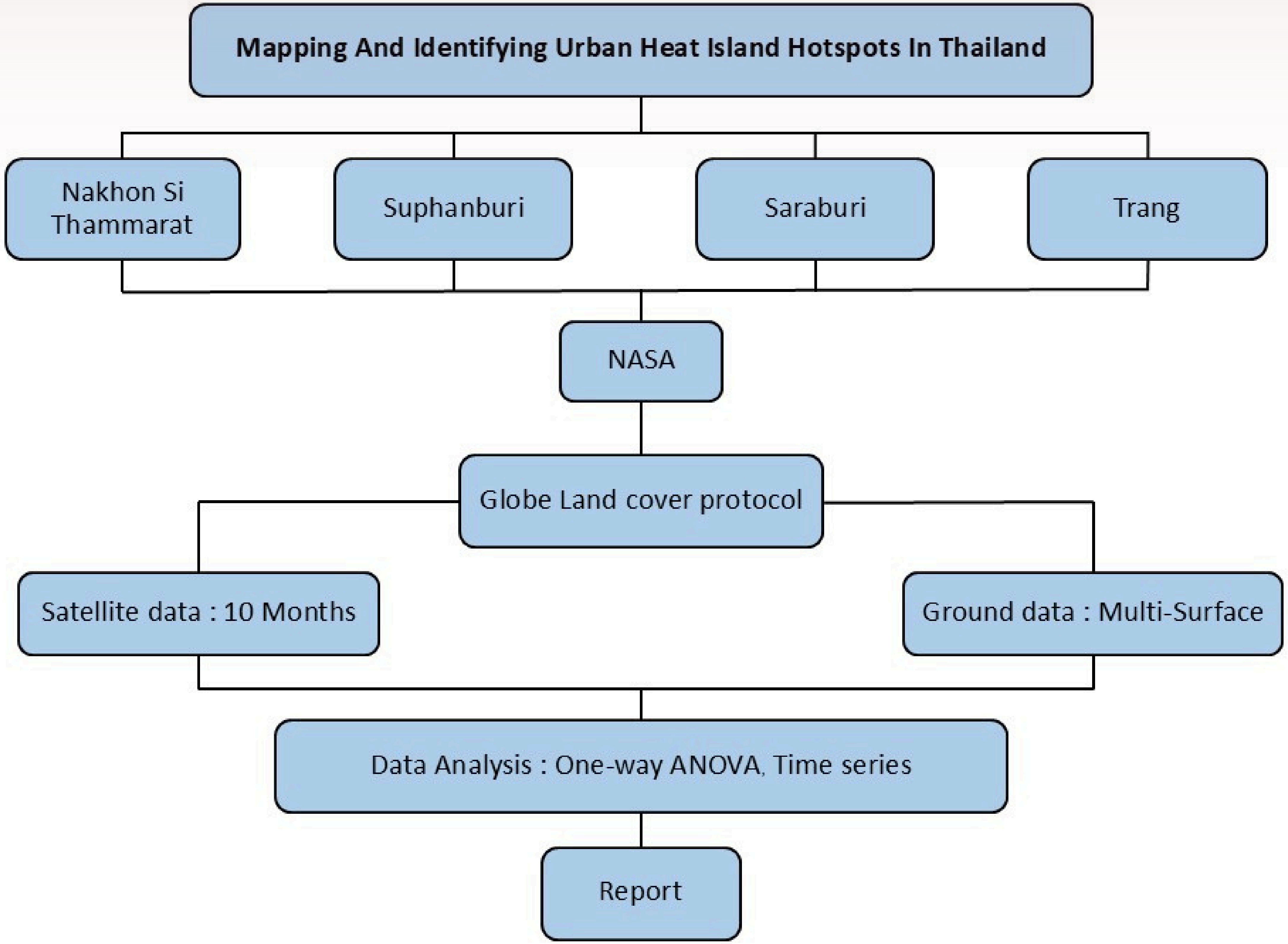
- Infrared thermometer for measuring surface temperature
- GLOBE land cover observation tools
- Standard meteorological sensors (NASA Appeears)
- Drone imagery for surface verification





Sampling Protocol

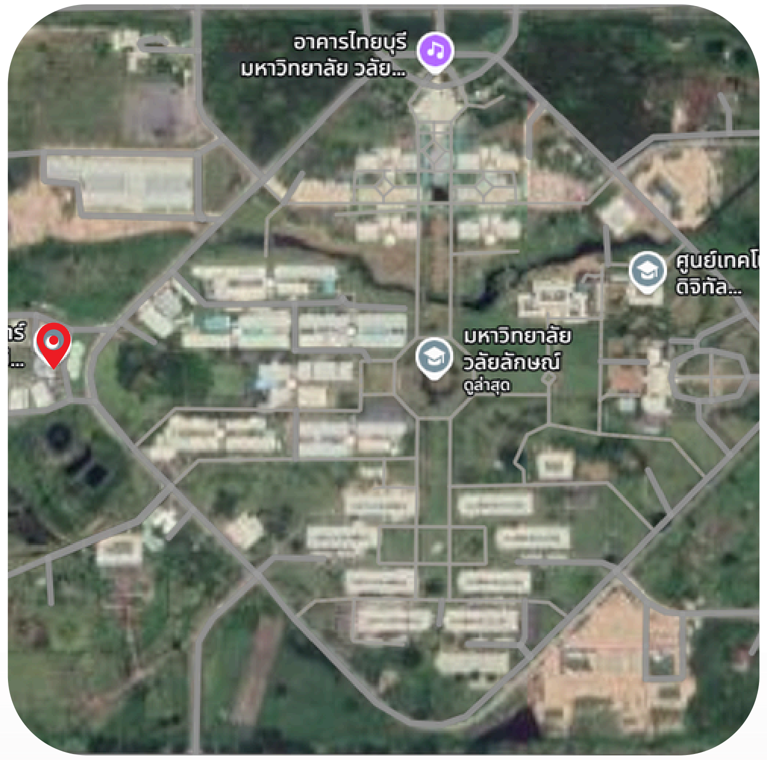
- Measurements taken at 50 cm above the surface
- Three readings per point to improve accuracy
- Data collected during daytime (10:00–12:00) and nighttime (18:00–20:00)


Mapping And Identifying Urban Heat Island Hotspots In Thailand
Nakhon Si Thammarat
Suphanburi
Saraburi
Trang
NASA
Globe Land cover protocol
Satellite data : 10 Months
Ground data : Multi-Surface
Data Analysis : One-way ANOVA, Time series
Report

SAMPLE AREA

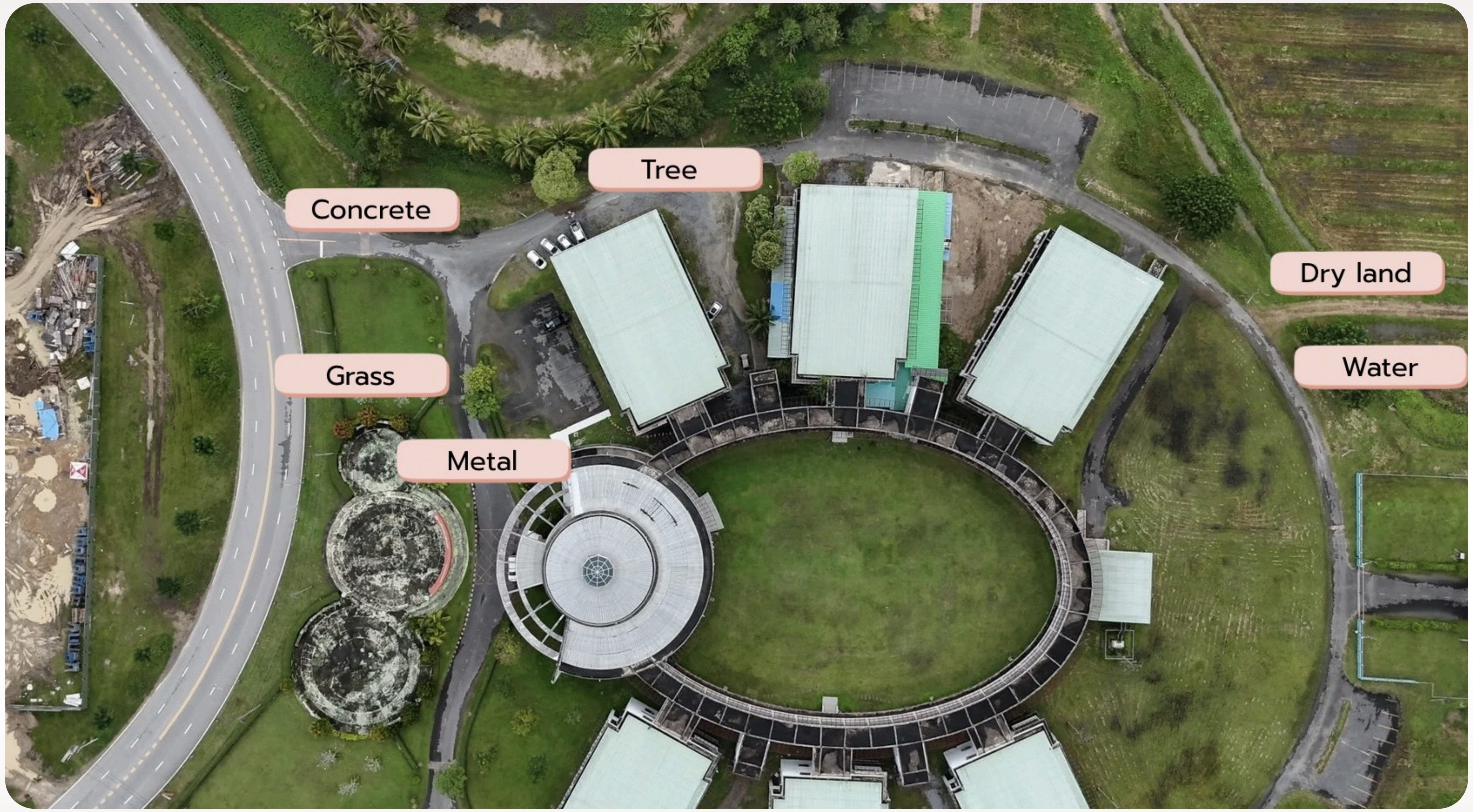
Thailand

Nakhon Si Thammarat



Walailak university

SURFACE TYPES



Walailak university

2.1 DATA ANALYSIS METHODS

The following analyses were performed

- Descriptive statistics for all surface types (day and night)
- One-way ANOVA to test temperature difference.

Software & Tools

Google Earth

Google Map
for spatial mapping

Nasa Earthdata
platform for satellite
data access

Google Sheets
XLMINER for data
management & ANOVA

Globe Observer
app for field data
collection

3.RESULTS AND STATISTICAL ANALYSIS

Daytime findings

Nakhon si thammarat
Warmest surface Metal (37.86°C)
Coolest natural Trees (21.2°C)
LST 38.04°C

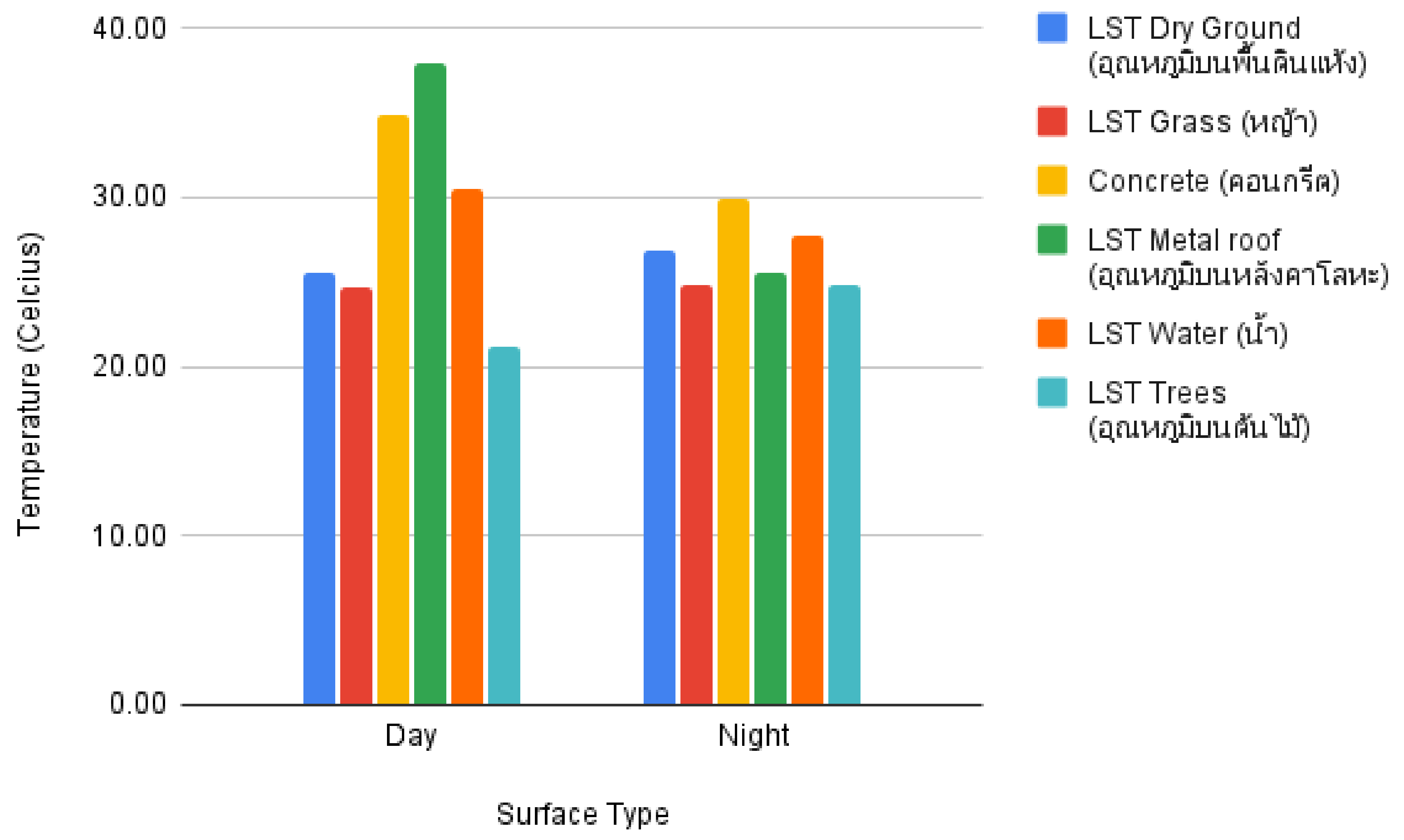
Nighttime finding

Nakhon si thammarat
Warmest surface Concrete **(29.93°C)**
Coolest natural Trees **(24.78°C)**
LST **26.36°C**

Statistical Significance (ANOVA)

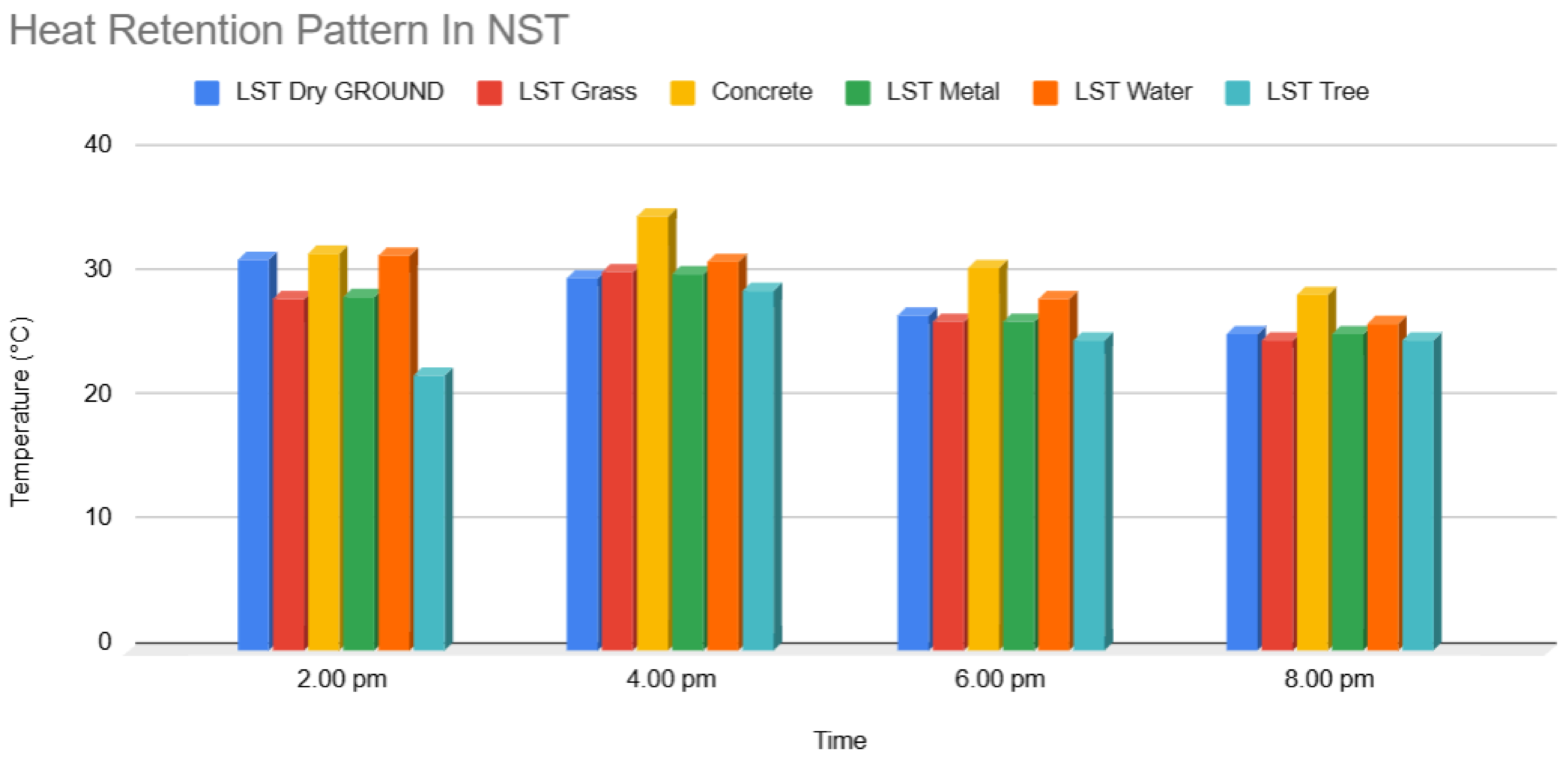
All tests show p ~ 0 < 0.05 - temperature differences are real & significant.
Largest heat-retention effect: Nakhon Si Thammarat Night (F = 41.33).
Strongest daytime UHI: Nakhon Si Thammarat Day (F = 178.25).

3.1 OBJECTIVE 1: SURFACE TEMPERATURE COMPARISON IN NST

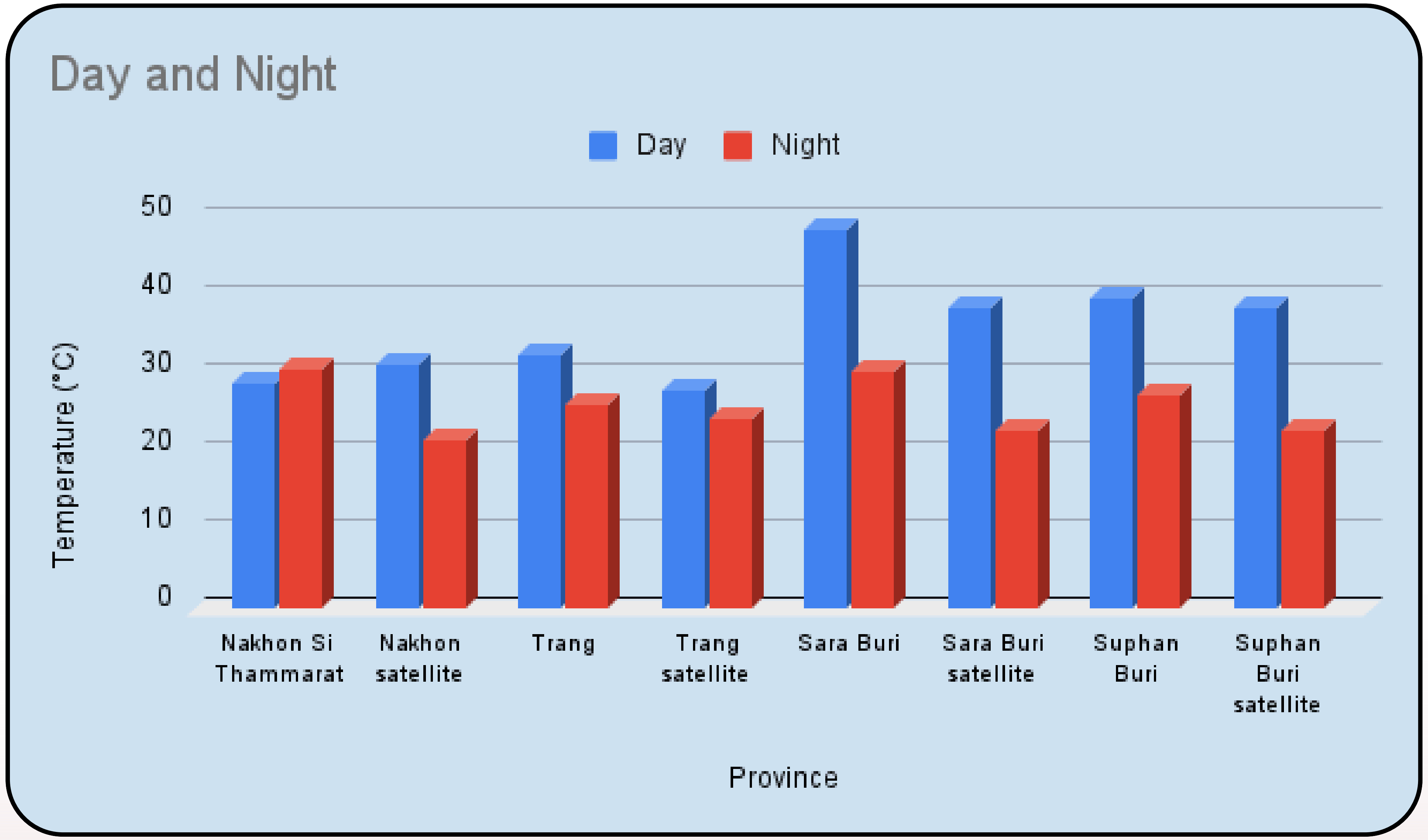


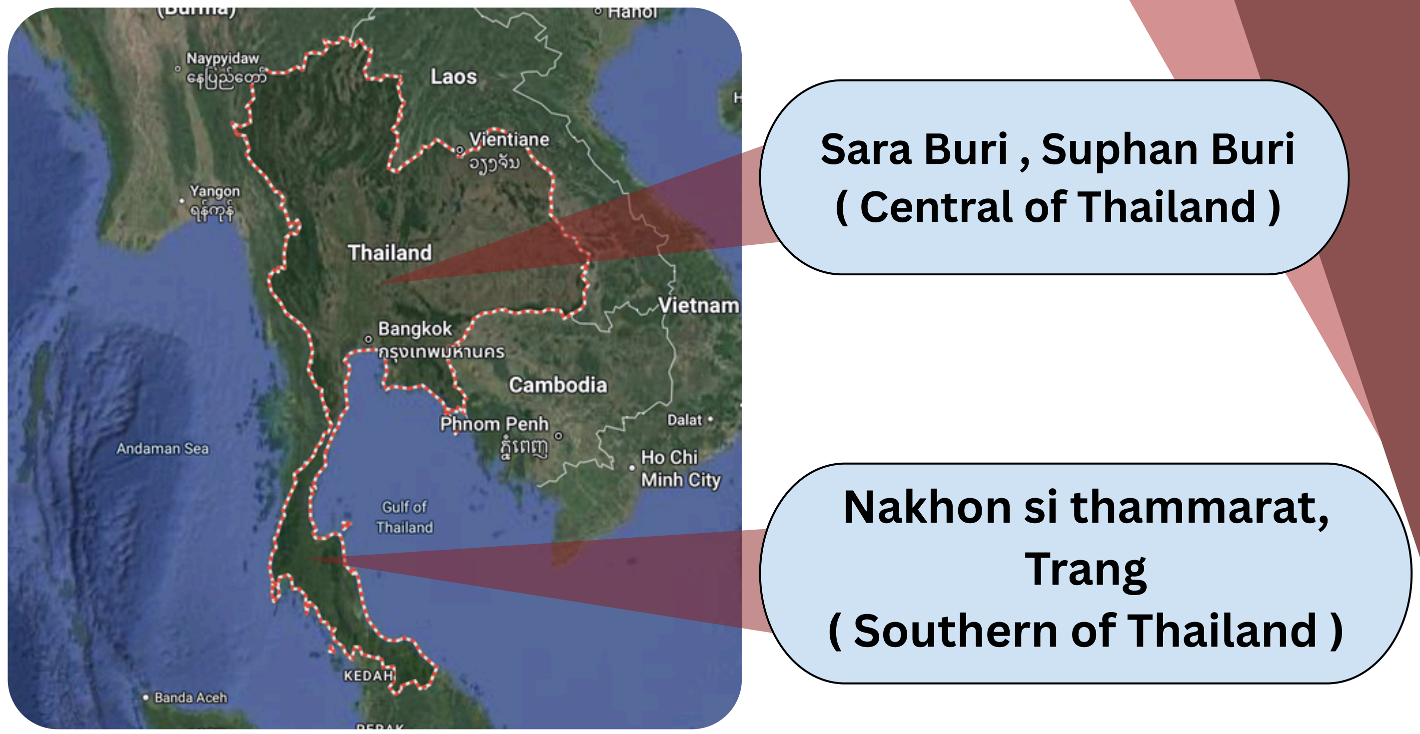
Day(Average) vs Night (Average)

3.2 OBJECTIVE 2: HEAT RETENTION PATTERN IN NST



3.2 OBJECTIVE 3: GROUND TRUTHING VS SATTELLITE COMPARISON





- The southern part of Thailand has a lower satellite temperature due to clouds, rain, and dense vegetation.
- High humidity and the influence of the sea help reduce surface temperature.
- However, the region feels stuffy in everyday life due to humidity.

4. DISCUSSION

Key findings

1. Thermal Extremes

- **Hottest Surfaces:** The Metal Roof (37.86°C) and Concrete (34.78 °C) are the absolute highest heat contributors during the daytime.
- **Coolest Surfaces:** Trees (21.2 °C) and Grass (24.62 °C) maintain the lowest LSTs, validating that greenifying urban areas is the most effective approach to reducing surface heat.

2. Nighttime Heat Storage

- Concrete exhibits high thermal inertia, dropping only 0.4 °C at night (from 4 PM), which makes it a significant contributor to the nighttime Urban Heat Island (UHI) effect.
- Water stores significant heat, dropping 3°C but slowly releasing energy that elevates ambient temperatures after sunset.

3. Context

- The mild UHI in Nakhon Si Thammarat is likely mitigated by abundant vegetation and coastal influence.
- The data is highly accurate as ground measurements align well with satellite LST.

4. DISCUSSION

Sattellite applications

Identifies urban hotspots

helps inform heat-sensitive urban planning and supportsthe design of buildings and spaces to reduce heat.

Urban heat island data in Nakhon Si Thammarat helps identify high-temperature areas and supports heat-sensitive urban planning. It improves building and public space design by promoting shading, ventilation, and green spaces.

4. DISCUSSION

Future urban planing strategies

- Sustainable Development

- Climate Resilience

- Smart City Technology

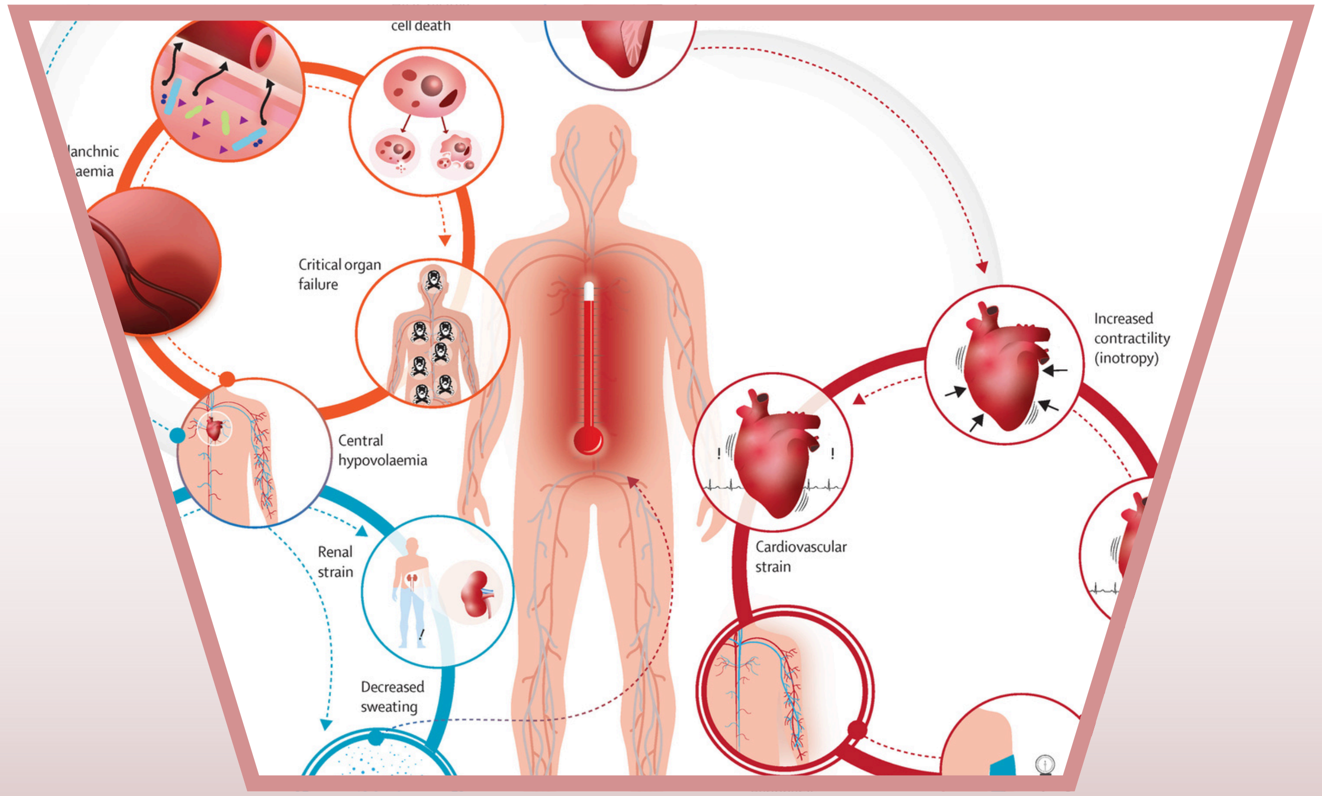
4.1 IMPACTS

Advantage

- Roads dry faster after rainfall
- More active city life in the evening and at night
- Supports urban economic activities

Disadvantage

- Higher temperatures in the city the surrounding rural areas
- Increased electricity use for air conditioning
- Higher risk of heat stress for residents
- Heat stored by concrete and asphalt surfaces



5. CONCLUSION

This study analyzed the surface urban heat island (SUHI) in Nakhon Si Thammarat using ground temperature data and remote sensing. The results show that land cover strongly affects surface temperature, while coastal areas, vegetation, and water bodies help reduce heat. The study suggests increasing green spaces, water features, and heat-reflective materials to improve climate resilience.

CREDIT

Assoc. Prof. Dr. Krisanadej Jaroensutasinee

Assoc. Prof. Dr. Mullica Jaroensutasinee

Mr. Teeradetch Onmake

Mr. Babey Dimla Tonny

Miss Ladawan Suksai

REFFERANCES

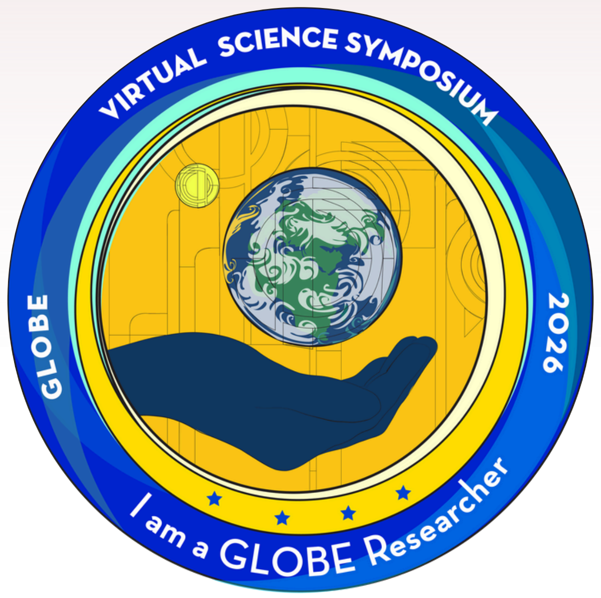
1. Shi, H., Xian, G., Auch, R., Gallo, K., & Zhou, Q. (2021). Urban Heat Island and Its Regional Impacts Using Remotely Sensed Thermal Data—A Review of Recent Developments and Methodology. Remote Sensing, 13(8), 1–24. https://doi.org/10.3390/land10080867
2. Zeng, F. F., Feng, J., Zhang, Y., Tsou, J. Y., Xue, T., Li, Y., & Li, R. Y. M. (2021). Comparative Study of Factors Contributing to Land Surface Temperature in High-Density Built Environments in Megacities Using Satellite Imagery. Sustainability, 13(24), 13706. https://doi.org/10.3390/su132413706
3. Weng, Q. (2009). Thermal Remote Sensing of Urban Climates. CRC Press.
4. Susca, T., Gaffin, S. R., & Dell'Osso, G. R. (2011). Positive effects of vegetation: Urban heat island and green roofs. Energy and Buildings, 43(12), 1892–1899.. https://doi.org/10.1016/j.envpol.2011.03.007
5. World Bank. (2024). Urban Overheating & Adaptation Measures: Documents & Reports. (General citation for UHI and its impacts on mortality/energy). https://documents1.worldbank.org/curated/en/099062524063514821/pdf/P5006821d3e407019180b01e8375e134497.pdf
6. Kim, T. K. (2015). Understanding one-way ANOVA using conceptual figures. Korean Journal of Anesthesiology, 68(6), 540–546. https://doi.org/10.4097/kjae.2015.68.6.540
7. Oke, T. R. (1982). The energetic basis of the urban heat island. Quarterly Journal of the Royal Meteorological Society, 108(455), 1–24. https://doi.org/10.1002/qj.49710845502
8. White-Newsome, J. L., Brines, S. J., Brown, D. G., Dvonch, J. T., Gronlund, C. J., Zhang, K., ... & O'Neill, M. S. (2013). Validating Satellite-Derived Land Surface Temperature with in Situ Measurements: A Public Health Perspective. Environmental Health Perspectives, 121(10), 1198–1203. https://doi.org/10.1289/ehp.1206176
9. Shashua-Bar, L., & Hoffman, M. E. (2000). Vegetation as a climatic component in the urban environment. Energy and Buildings, 31(1), 19-26. https://doi.org/10.1016/S0378-7788(99)00018-3
10. Reiners, P., Sobrino, J., & Kuenzer, C. (2023). Satellite-Derived Land Surface Temperature Dynamics in the Context of Global Change—A Review. Remote Sensing, 15(7), 1857. https://doi.org/10.3390/rs15071857
11. McKitrick, R., & Michaels, P. (2007). Quantifying the influence of anthropogenic surface processes and urbanization on global average temperature trends. Journal of Geophysical Research: Atmospheres, 112(D24). https://doi.org/10.1029/2007JD008465
12. Hachem, S., Duguay, C. R., & Allard, M. (2012). Comparison of Satellite-Derived Land Surface Temperature and Air Temperature from Meteorological Stations on the Pan-Arctic Scale. Remote Sensing, 5(5), 2348-2371. https://doi.org/10.3390/rs5052348
13. United Nations. (2016). Habitat III: New Urban Agenda. Quito, Ecuador. https://habitat3.org/the-new-urban-agenda/
14. Awais, M., Li, W., Hussain, S., Cheema, M. J. M., Li, W., Song, R., & Liu, C. (2022). Comparative Evaluation of Land Surface Temperature Images from Unmanned Aerial Vehicle and Satellite Observation for Agricultural Areas Using In Situ Data. Drones, 6(2), 184. https://doi.org/10.3390/agriculture12020184
15. The GLOBE Program. (2025). Surface Temperature Protocol and Data Entry System. https://www.globe.gov/news-events/globe-news/-/newsdetail/10157/globe-surface-temperature-protocol-development-of-a-unique-data-set-to-study-the-earth-webinar-recording-now-available

GROUP 4

Member

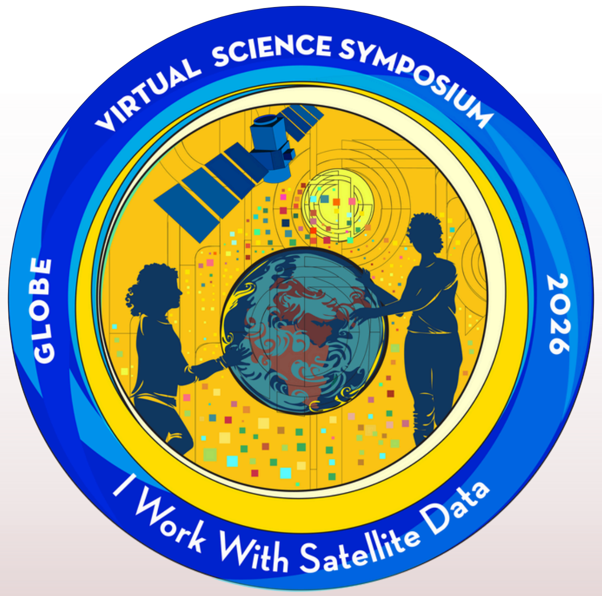
Pacharadanai Petchpan (Pete)
Kawinporn Yapan (Surprise)
Teeratham Thaosakul (Nea o)
Pitchayapa Puimon (Aommy)
Warachanok Sungkhachote (Shaista)
Wiranpat Chuenchit (Baikaow)
Natnicha Srirod (Prae)
Nitchakamol Wanpect (Roung Kao)
Kavita Pongsuwan (Percen)
Jirachaya kerdbuathong (Apple)
Nattapong Aroonsakul (Artie)
Pasit Pusittanont (Bluray)
AnanyalaK Janthong (Phaiwan)
Pattiya Lin (Ice)
Krid Sakjay (Post)
Rawipa Lapmee (Noo Dee)
Thun Suwanaratsamee (Thun)
Poonpoom lnkong (Goitiew)
Punyawee Rojcharoenngam (Yata)
Thanaphorn Chobthamkit (Tonnam)

VSS BADGES

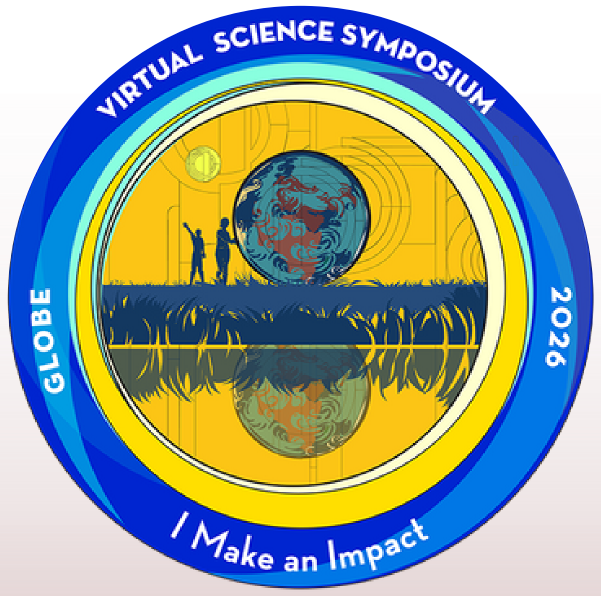


I AM GLOBE RESEARCHER

I WORK WITH A STEM PROFESSIONAL



I WORK WITH SATELLITE DATA



I MAKE AN IMPACT