

# MATERIAL HEAT ABSORPTION AND THE URBAN HEAT ISLAND EFFECT

2026 GLOBE PROGRAM - GROUP 4  
Presentation - 18/01/2026

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# 1. INTRODUCTION

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



less  
vegetation



More Heat-absorbing  
materials



More Heat emissions



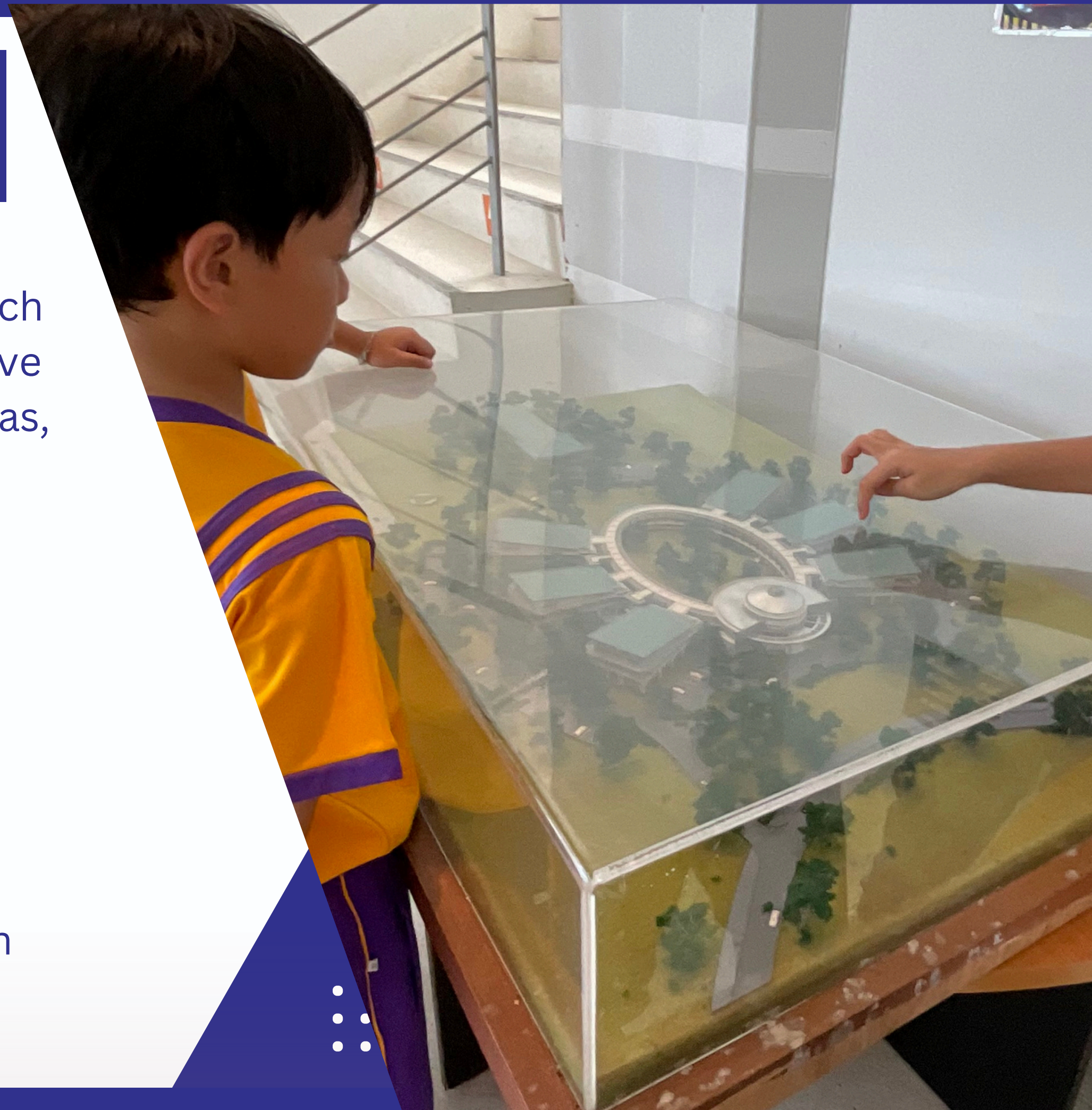
city geometry

## Why are the temperatures different?

The city areas are warmer due to the type of materials used to build and construct things such as metal, asphalt, concrete and more, which have a high heat retention capacity while in rural areas, there's more plants which can reduce heat significantly with transpiration

## How does it happen?

The urban heat island effect happens because cities replace natural cooling materials such as tree or woods with materials that retain heat and other than that there are dense building clusters which traps heat and lack of vegetation which could cool the air significantly.



# HYPOTHESIS AND RESEARCH QUESTIONS

1. We need to check the temperature of these 7 surface types: **Cooler Natural** (Water, Trees, Dry ground, Grass) and **Hotter Artificial** (Concrete, Metal Roof, Asphalt)



2. Find why the temperature is different than each other in different time (11AM, 2PM and 3PM).



# 2. MATERIALS AND METHODS

## Materials

Infrared Thermometers for surface temperature readings.

## Sampling Protocol

- Measurements taken at 1 foot above the surface
- Three readings per point to improve accuracy
- Data collected during daytime at 11 AM, 2 PM and 3 PM



# 2.1 DATA ANALYSIS METHODS

The following analyses were performed

- Descriptive statistics for all surface types
- One-way ANOVA to test temperature difference.

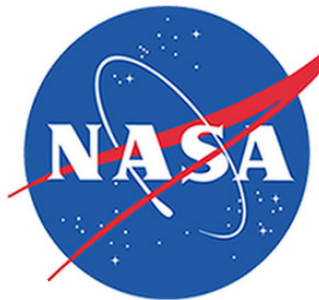
## Software & Tools



Google Earth  
for seeing part of  
the Earth and the  
heat of the Earth  
from the satellites



Thermometer  
For finding the  
temperature of  
different types of  
stuff



NASA Earthdata  
platform for satellite  
data access



Google Sheets  
XLMINER for data  
management & ANOVA



GLOBE Observer  
app for field data  
collection

# Mapping and identifying Urban Heat Island Hotspots in Thailand

Nakhon Si  
Thammarat

Globe land  
cover protocol

Ground Truthing Collection  
(infrared Thermometers)

Image Upload with GLOBE  
Observer App

Data Analysis. One-way ANOVA,  
Time Series

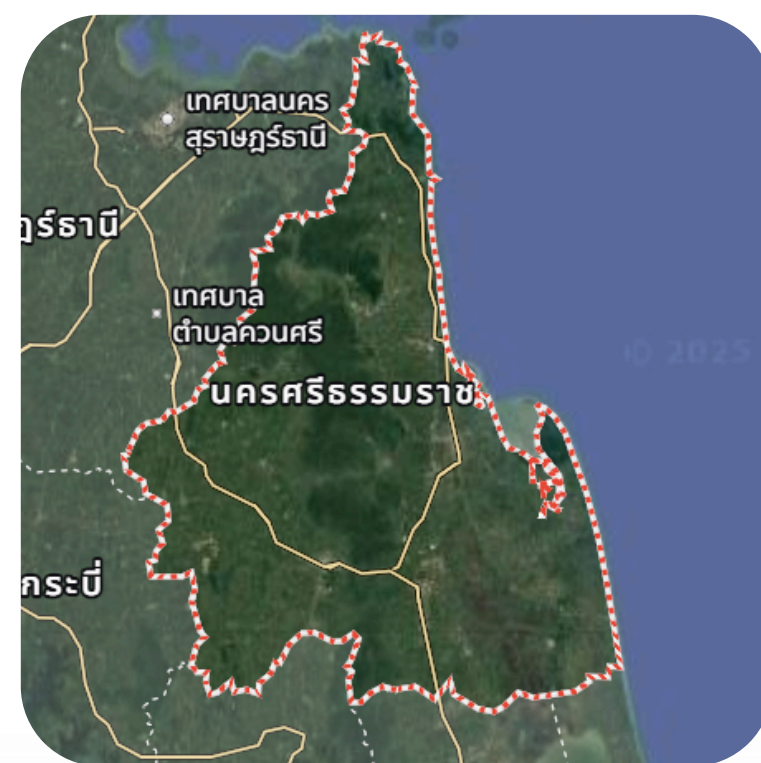
Report

## EXPERIMENTAL DESIGN

# STUDY AREA



**Thailand**

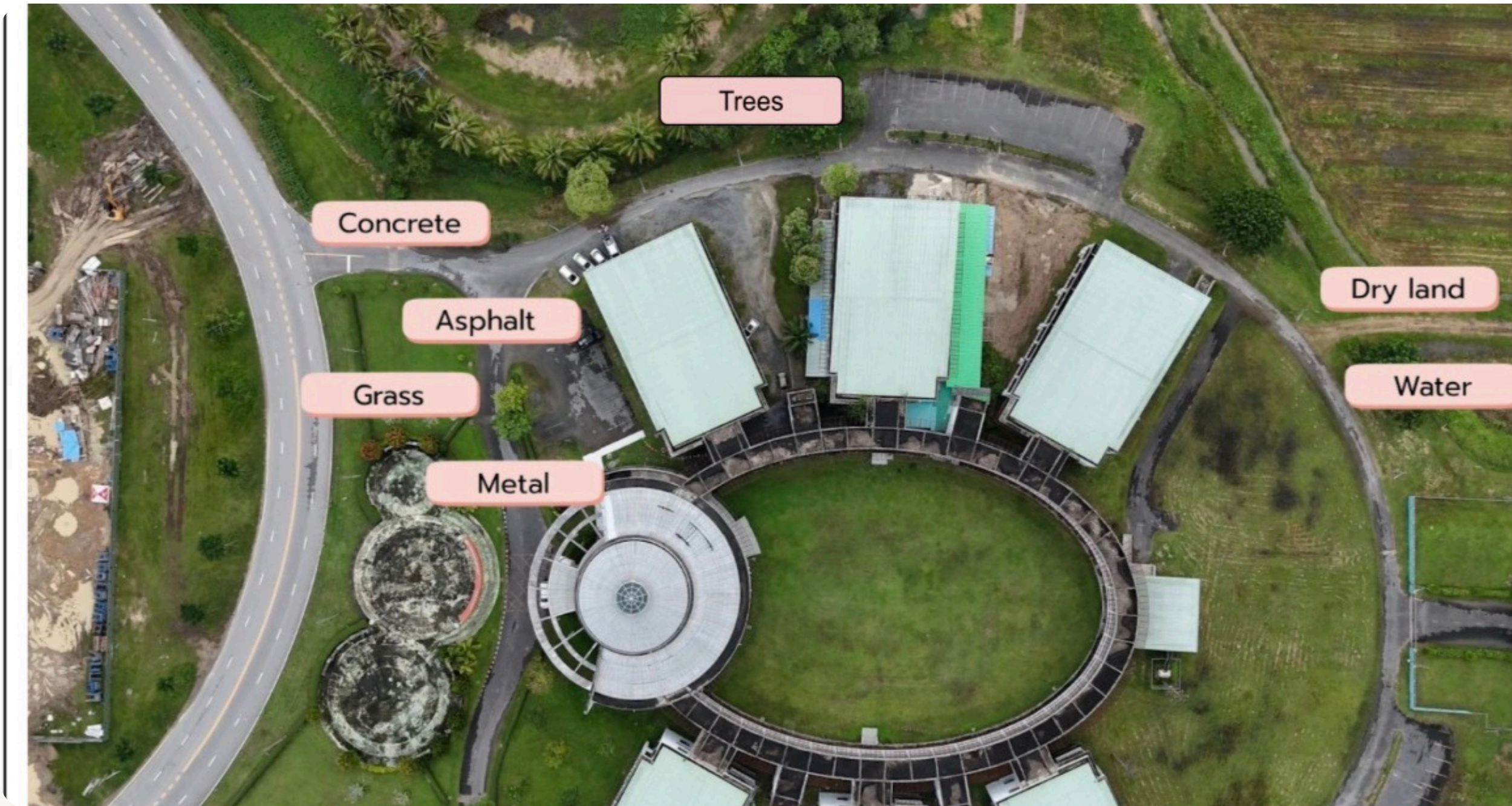


**Nakhon Si Thammarat**



**Walailak university**

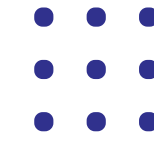
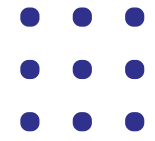
# SURFACE TYPES



**Walailak university**

# STATISTICAL ANALYSIS

## 3.1 RESULTS



### 11 AM findings

Nakhon si thammarat  
Warmest surface Concrete  
(50.74°C)  
Coolest natural Trees  
(26.09°C)

### 2 PM finding

Nakhon si thammarat  
Warmest surface Asphalt  
(51.05°C)  
Coolest natural Trees  
(30.77°C)

### 3 PM findings

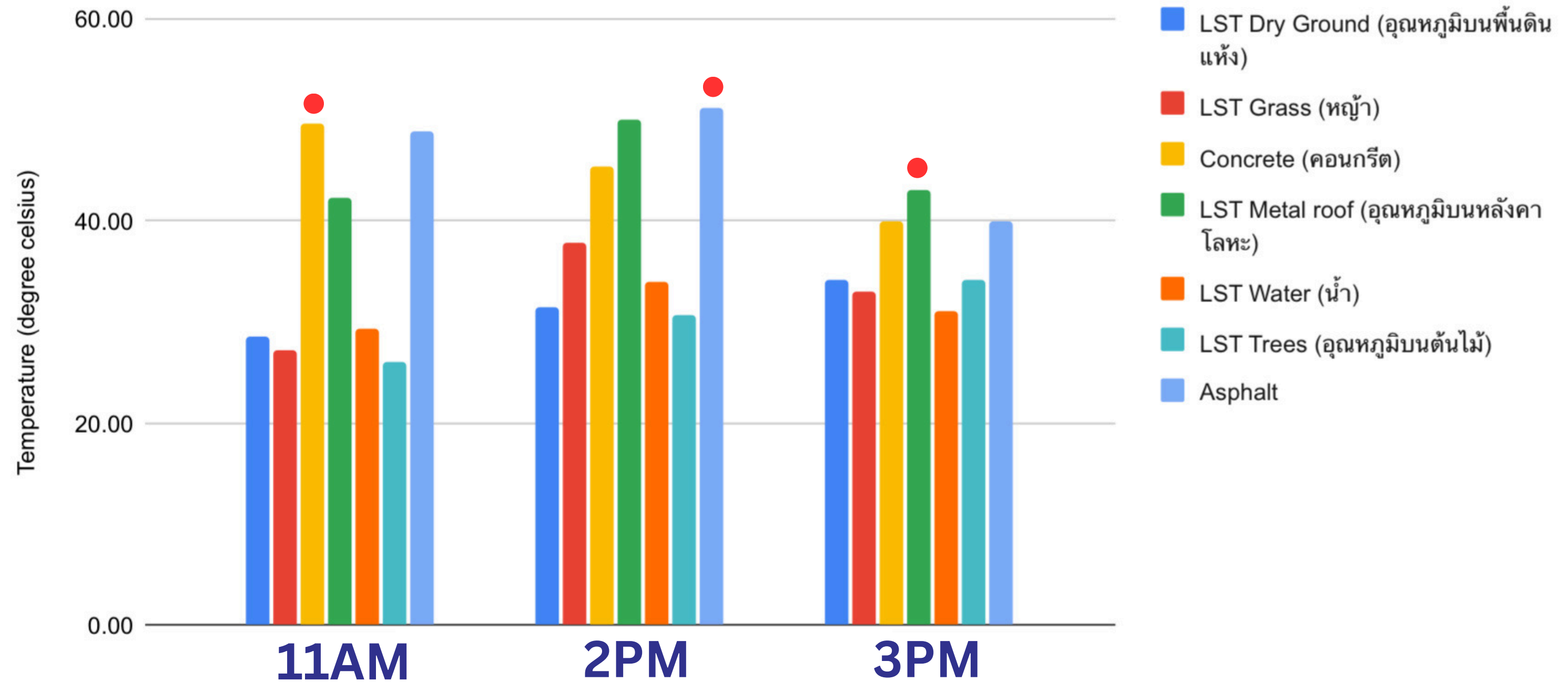
Nakhon si thammarat  
Warmest surface Metal  
(43.10°C)  
Coolest natural Water  
(31.11°C)

### Statistical Significance (ANOVA)

All tests show  $p \sim 0 < 0.05$  - 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).

# 3.2 HEAT RETENTION PATTERN IN NST

Heat Retention Pattern In NST



# 4. DISCUSSION



## Key findings

### 1. Thermal Extremes (High vs. Low)

- **Hottest Surfaces:** Asphalt and Concrete are the main heat contributors, reaching nearly 50°C. These man-made materials absorb and trap solar radiation significantly.
- **Coollest Surfaces:** Trees and Water remain the coolest areas (around 26-30°C). This confirms that natural surfaces effectively reduce heat through evaporation, transpiration and shading

# 4.1 DISCUSSION

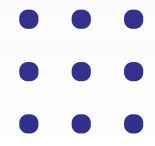


## Key findings

### 2. Material Behavior (Heating Speed)

Metal Roof: Heats up very quickly (rapid heating) to peak temperatures at noon but also cools down fast when sunlight decreases.

Concrete & Asphalt: Show "High Thermal Inertia." They heat up and hold onto the heat for a long time, causing the area to stay hot even in the late afternoon.



# 4.2 DISCUSSION



## ▶ Future goals

- Sustainable Development

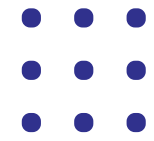


- Climate Resilience

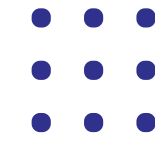


- Smart City Technology





# 4.3 IMPACTS

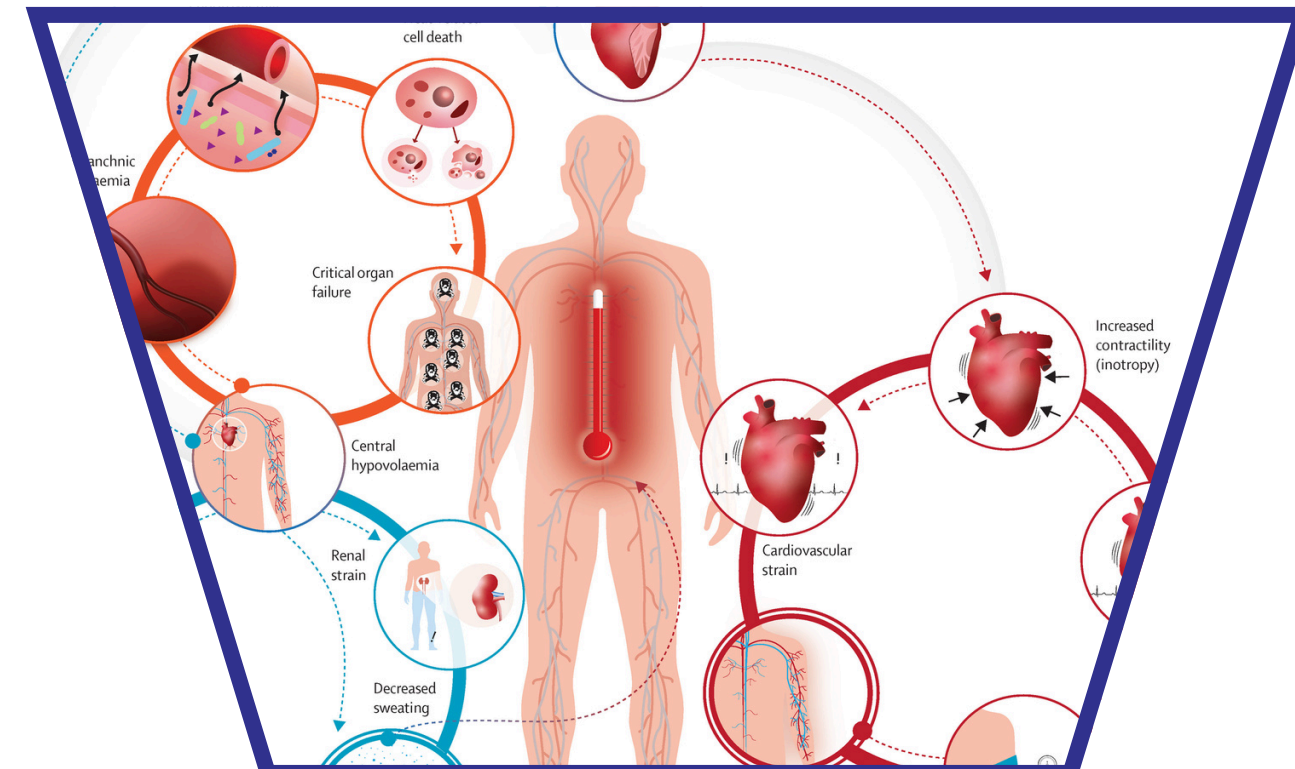


## Advantage

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

## Disadvantage

- Higher temperatures in the city than the surrounding rural areas
- Increased electricity use for air conditioning
- Higher risk of heat stress for residents
- Dense building holds more heat which can cause discomfort



# 5. CONCLUSION

## Keys Takeaways

Land Cover Matters: The type of material strongly affects temperature. Artificial surfaces like Asphalt and Concrete became the hottest (up to 50°C), acting as heat traps.

Nature Cools Down: Natural surfaces like Trees and Water remained significantly cooler (around 30°C) throughout the day due to shading and evaporation.

Recommendation

To reduce the heat in our school and city, we strongly suggest increasing green spaces and planting more trees to act as natural cooling systems.



# CREDIT



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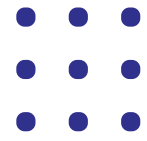
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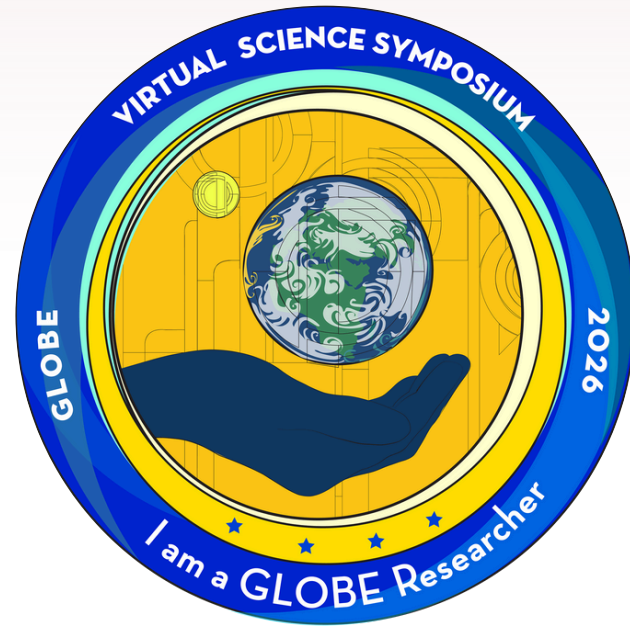
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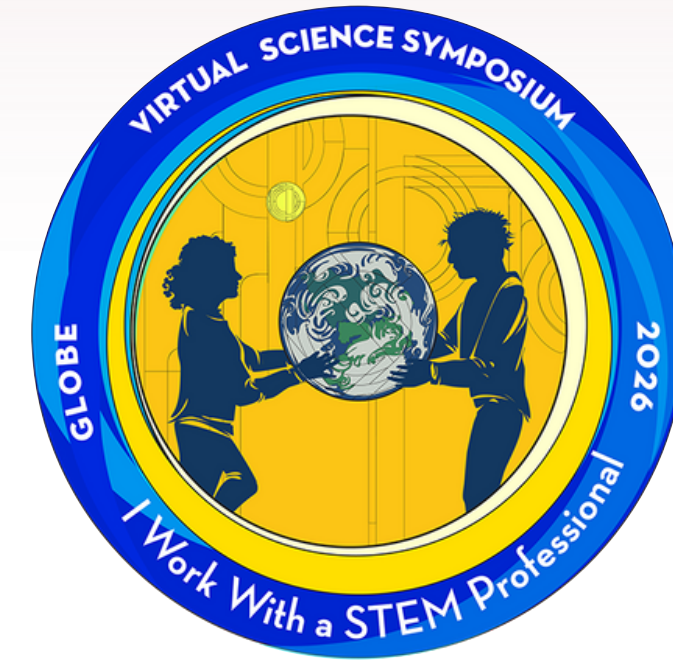
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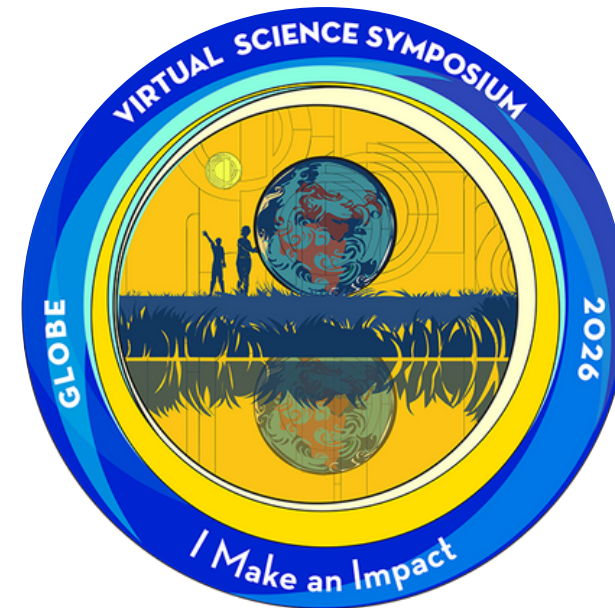
# VSS BADGES



I AM GLOBE RESEARCHER



I WORK WITH A STEM PROFESSIONAL



I MAKE AN IMPACT