PREK MOHA TEP PARK (BATTAMBANG, CAMBODIA)

Heat Mapping Analysis of Nature-based Solutions for Urban Cooling

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Agenda

- Background
- Study Objectives
- Nature-based Solutions Concept
- Methodology
- Baseline Conditions
- NbS Performance
- Key Findings - Baseline v NbS
- Conclusions
- Next Steps

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Background

Battambang challenges

Rapid urbanisation increasing pressure on liveability and infrastructure

High urban heat exposure due to:

- limited tree canopy
- extensive impervious surfaces
- low shade availability

Frequent flooding linked to drainage limitations

Vulnerable populations disproportionately affected

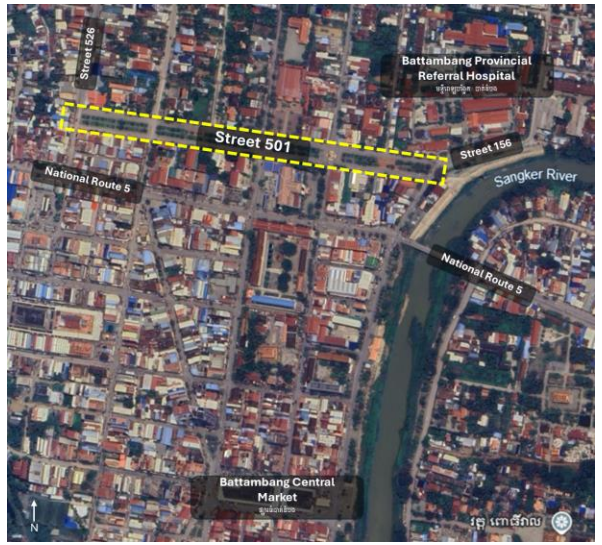
Why Prek Moha Tep Park (Street 501)?

Key east–west urban corridor

Connects hospital, market and National Route 5

Existing median park underutilised due to heat stress

Priority location for climate resilience and public realm improvement



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Study Objectives

Overall aim

Quantify the cooling benefits of Nature-based Solutions (NbS) along Prek Moha Tep Park to support evidence-based investment and planning.

Key objectives

Quantify spatial heat patterns and hotspots

Model cooling performance of NbS interventions

Support stakeholder engagement and decision-making

Assessment focus

Thermal comfort (UTCI)

Mean radiant temperature (T_{mrt})

Air temperature

Pedestrian-scale heat exposure

Study area

Prek Moha Tep Park corridor plus 50 m surrounding buffer.

Cooling hot cities

Uncomfortable hot conditions for pedestrians are created through incoming radiation from the sun and hot urban surfaces.

Unshaded areas expose pedestrians to heat from the sun

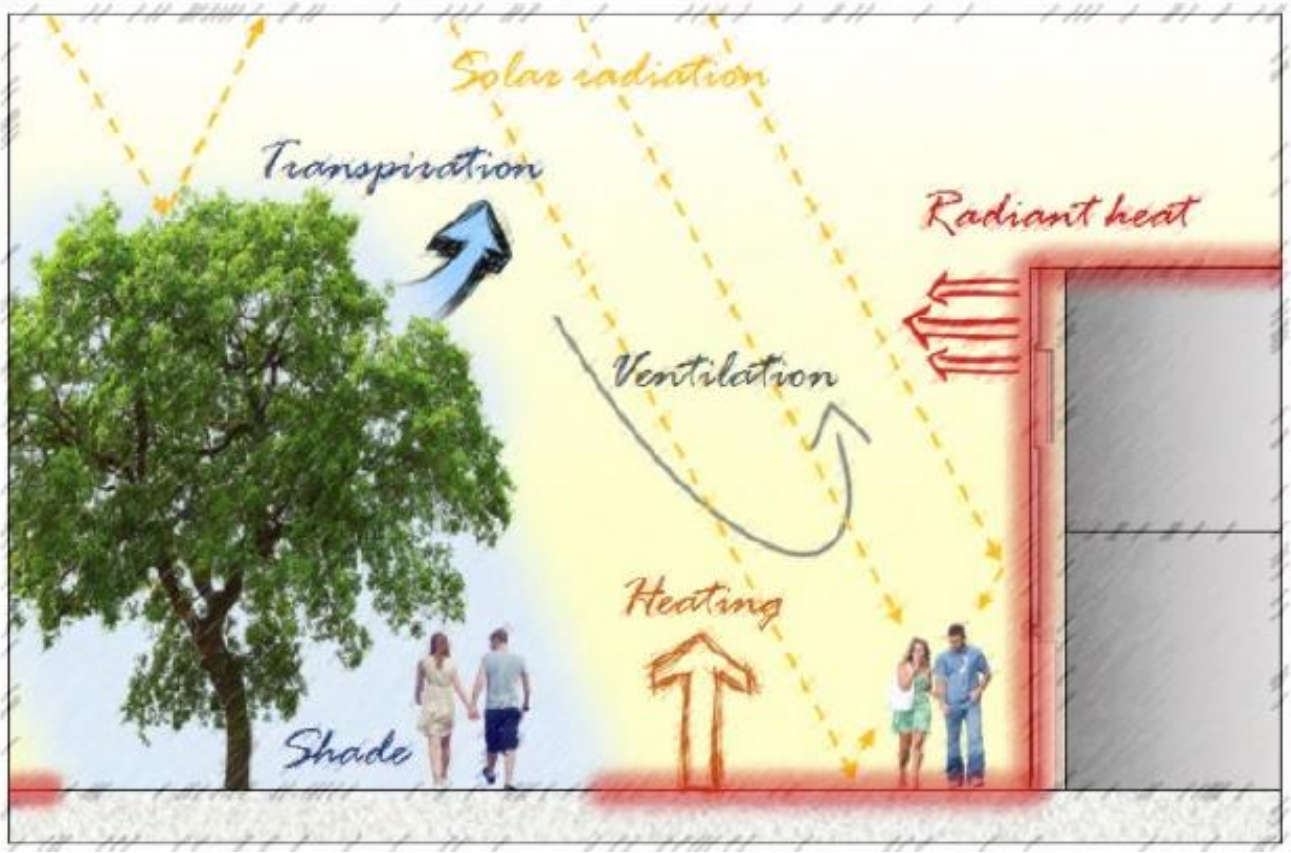
Surfaces in unshaded areas (roads, sidewalks, buildings) also absorb this heat and add additional amounts of heat to people in the area

These surfaces remain hot after sunset and take a long time to cool down

Areas with shading from trees reduce the amounts of heat on pedestrians and surfaces underneath are cooler

Vegetation also provides cooling through evaporation of water, converting heat into water vapour and cooling the area

Water bodies also provide evaporative cooling



Nature-based Solutions Concept

Design features

Rain gardens (x4)

Rows of passively irrigated trees (south and north)

Expanded public spaces and seating

Improved pedestrian accessibility

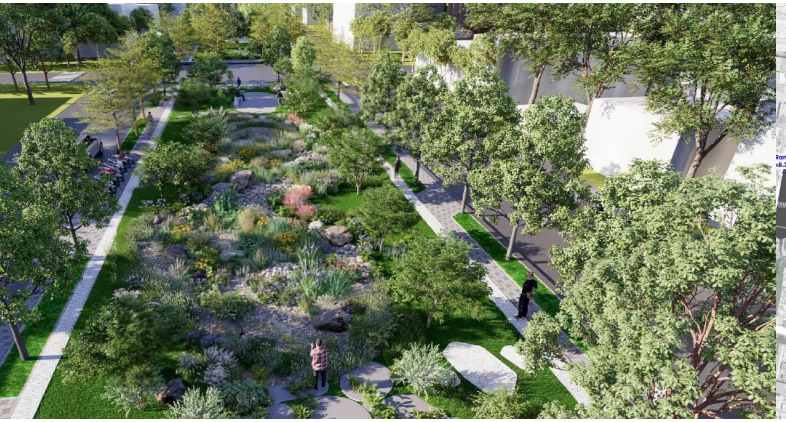
Recreation and public amenity upgrades

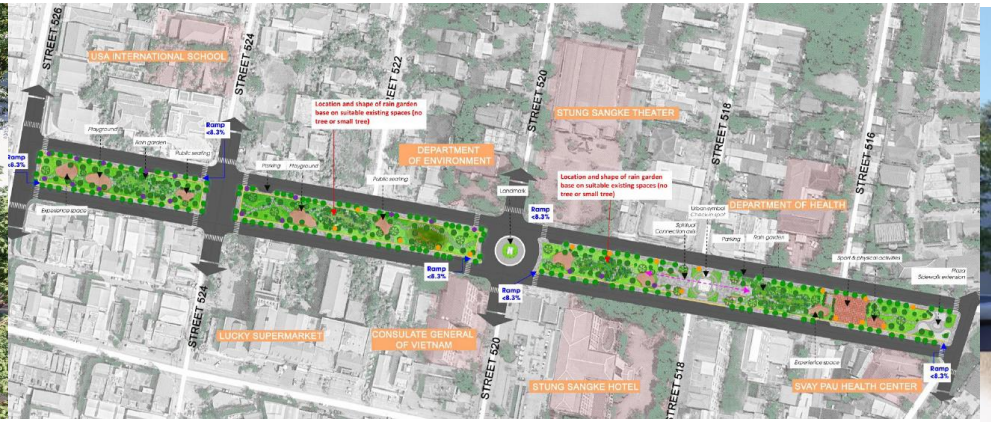
Design intent

A multifunctional urban corridor integrating:

- stormwater management
- public amenity
- accessibility and recreation
- urban cooling

Importantly, the design was not specifically optimised for heat reduction.





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Methodology

Modelling framework

Two complementary models used

- **SOLWEIG** - Fine-scale pedestrian thermal comfort and shading. Outputs include UTCI (°C), mean radiant temperature (T_{mrt}, °C), spatial heat exposure.
- **UT&C** - Air temperature, hydrology and evapotranspiration. Outputs include (air temperature (°C), humidity (%), surface energy and water balance.

Scenarios assessed

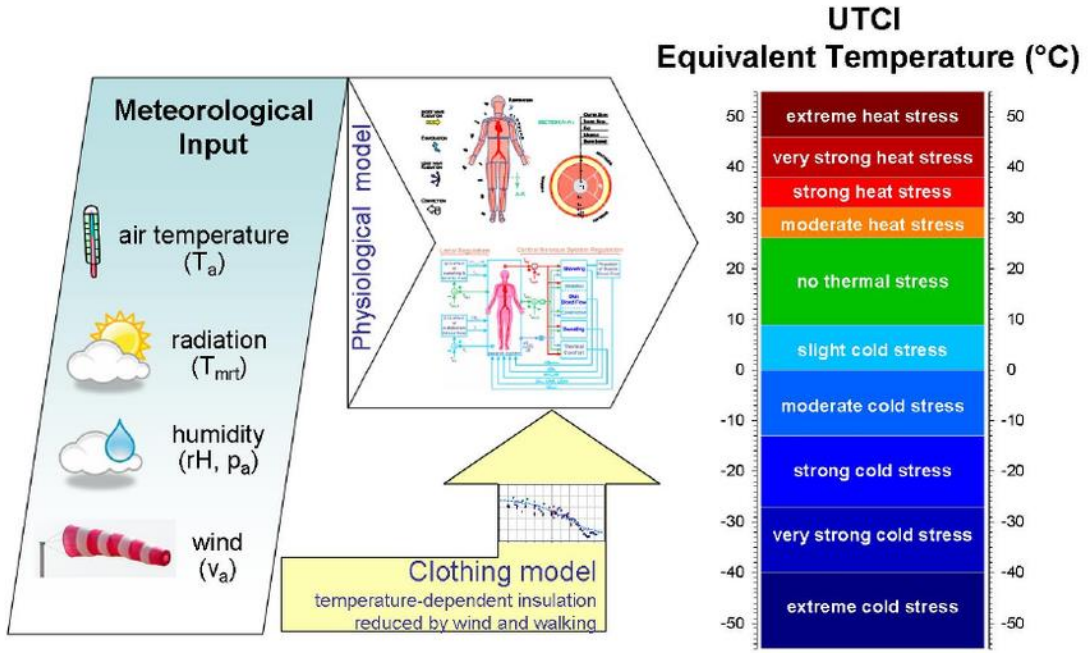
- Baseline (existing conditions)
- NbS scenario (proposed design)

Modelling assumption

- We model the median and a 50m buffer around it, but only the median is changed in the redesign

What is UTCI?

UTCI represents "feels-like" outdoor temperature considering air temperature, humidity, radiation, wind, human heat response.



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Climate Inputs & Modelling Conditions

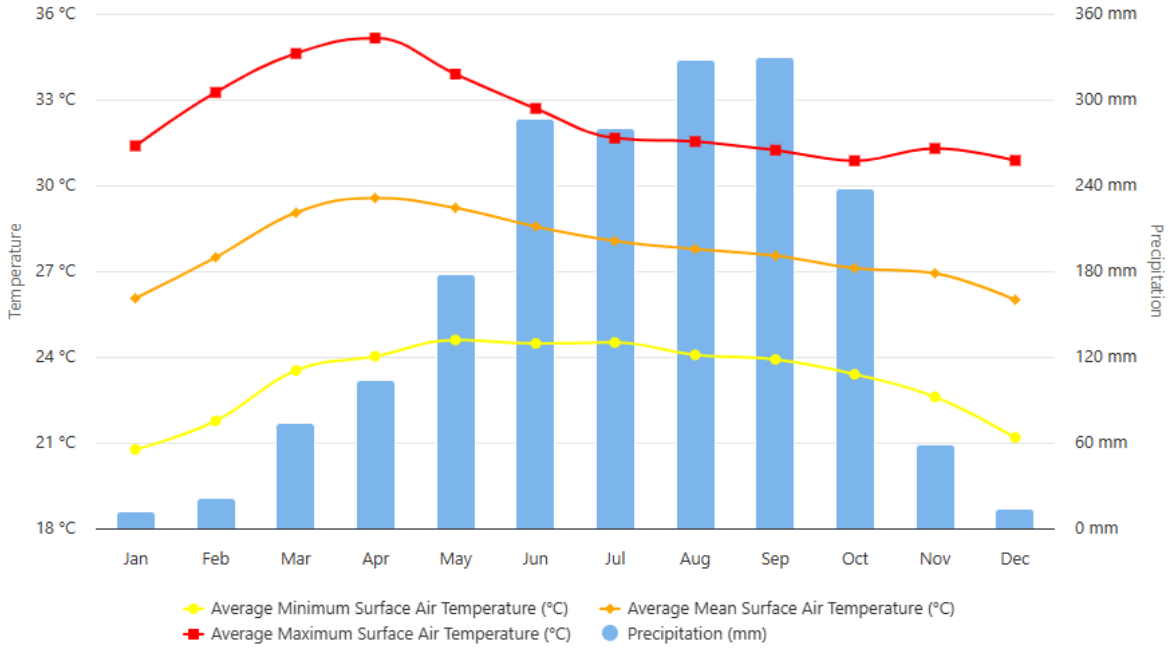
Battambang has a **tropical savanna climate** with a long hot dry season (Nov–Apr) with peak heat conditions typically occurring in March–April.

21 February 2020 was selected as a representative hot-season day for detailed pedestrian thermal comfort modelling.

This day is representative of **high heat conditions regularly experienced during Battambang's dry season**, with clear-sky conditions, air temperatures ranging from 22–34°C, and relative humidity varying from around 35–75% across the day.

The study assessed a **representative hot-season day rather than peak or extreme heat conditions** as the scale and nature of the proposed NbS interventions are unlikely to substantially reduce extreme heat. Focusing on typical high-heat dry season conditions therefore provides a more appropriate basis for evaluating practical and consistently realised cooling benefits.

Air temperature modelling also assessed a broader **two-week hot period (15–29 February 2020)** to evaluate sustained corridor-scale cooling trends.



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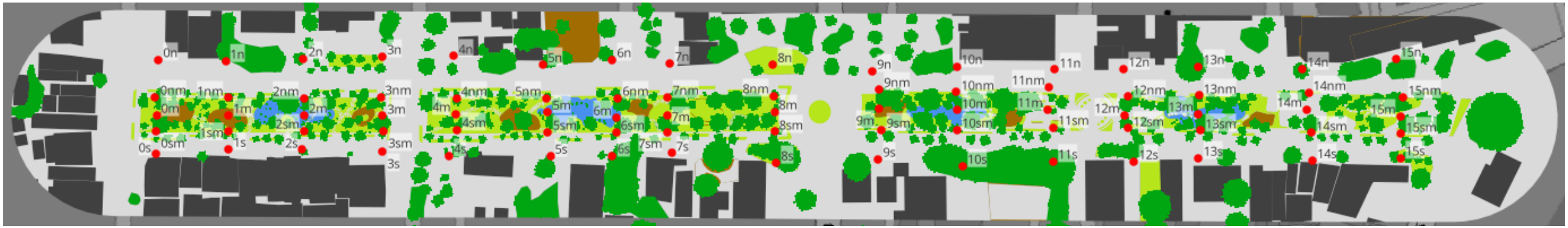
Baseline Conditions

Key characteristics

- Extensive paved surfaces
- Limited canopy cover
- High solar exposure



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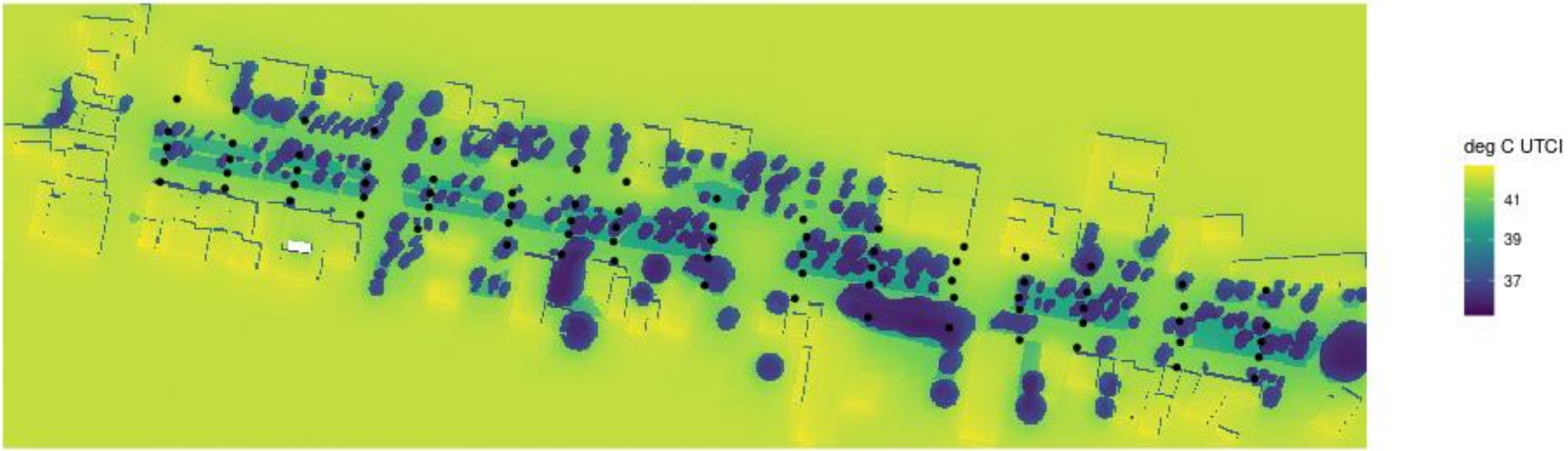
Baseline Conditions

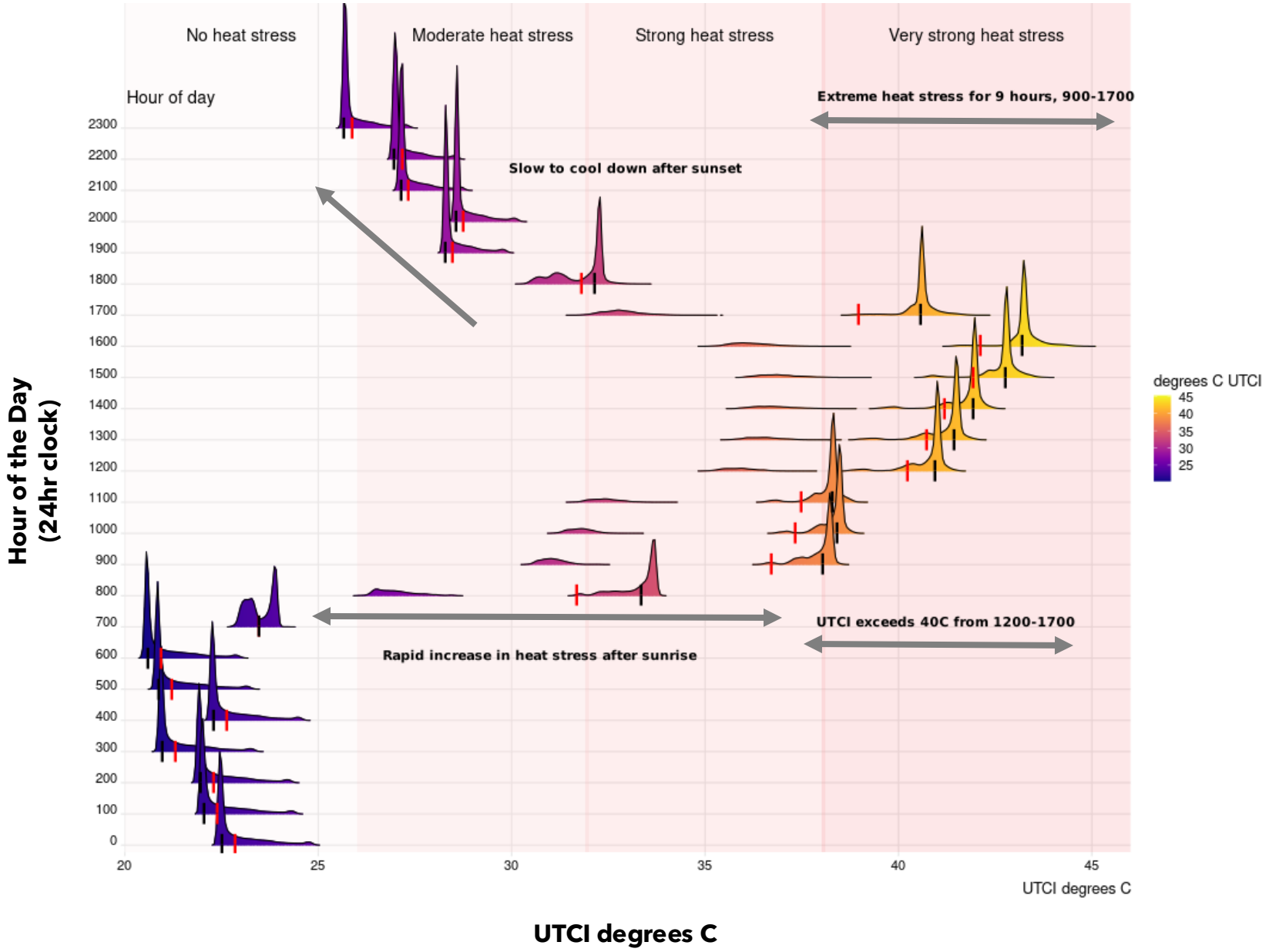
Large sections remain exposed during peak heat



Existing shaded areas are already cooler with trees providing the most measurable benefits

Spatial distributions of UTCI (◦C) across Street 501 on 21 February 2020 at 2pm for baseline scenario.

Baseline Conditions



This graph shows 24 hours of the day from the bottom to top, showing the same thing as the previous slide, the amounts of the street that are hotter or cooler

Spatial distributions of UTCI at 1.5m high (pedestrian height) across Street 501 for on 21 February 2020 for 24 hours for the baseline scenario.

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Key Baseline Findings

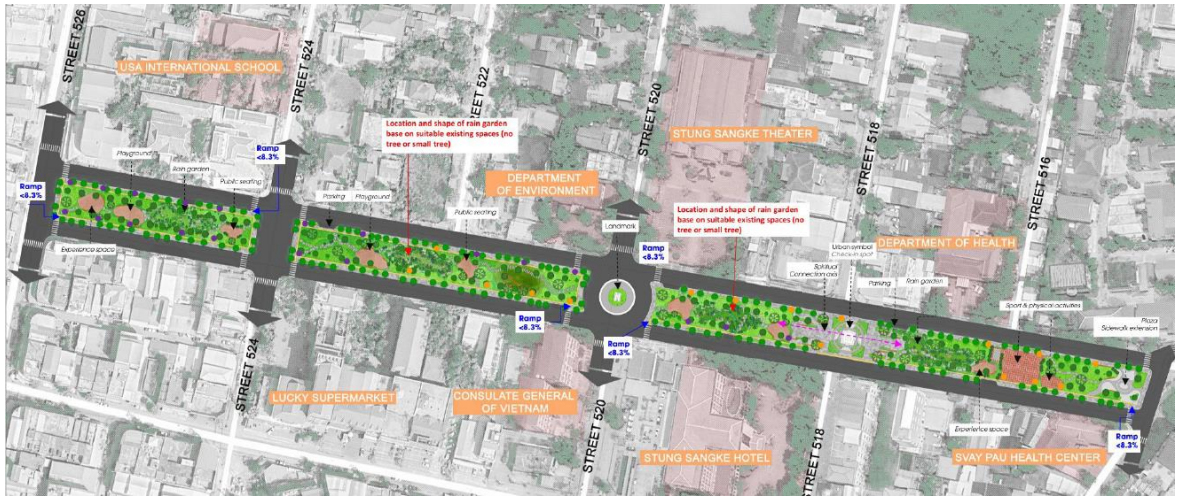
Current conditions create **prolonged daytime heat stress** that significantly reduces thermal comfort.

Large areas of the corridor remain **highly exposed to solar radiation**, with only limited relief provided by existing shade.

NbS Performance

Land cover changes (Baseline → NbS)

- Tree canopy increased from **17% → 21%**
- Paved surfaces reduced from **49% → 45%**
- Grass cover reduced from **10% → 8%**
- Corridor remains dominated by impervious surfaces (72% baseline, 68% in NbS scenario)



Key modelling assumptions

- Existing median vegetation assumed to already be irrigated under baseline conditions
- Raingardens represented as water, slightly overestimating evaporative cooling
- Building form and street geometry unchanged between scenarios

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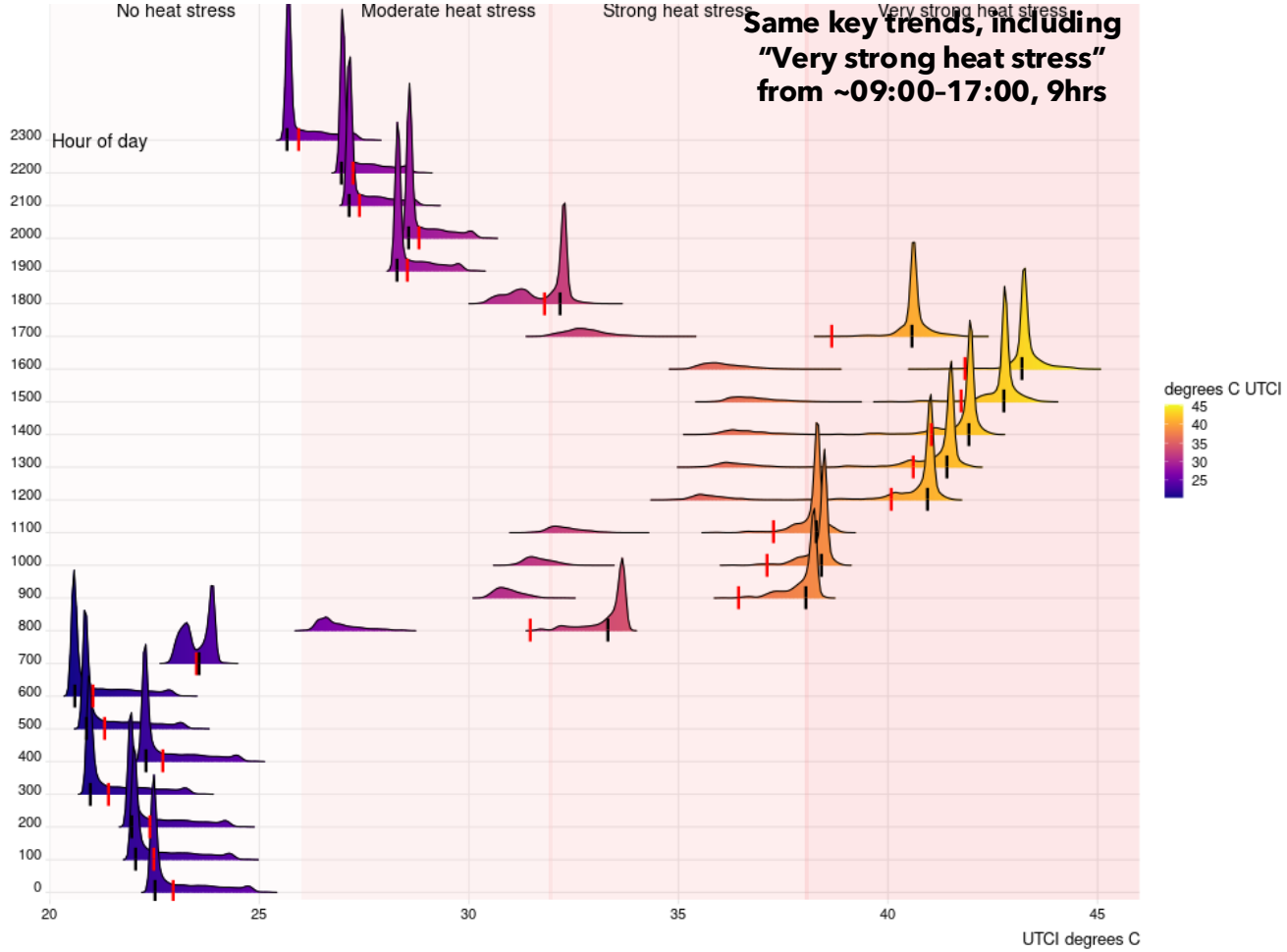
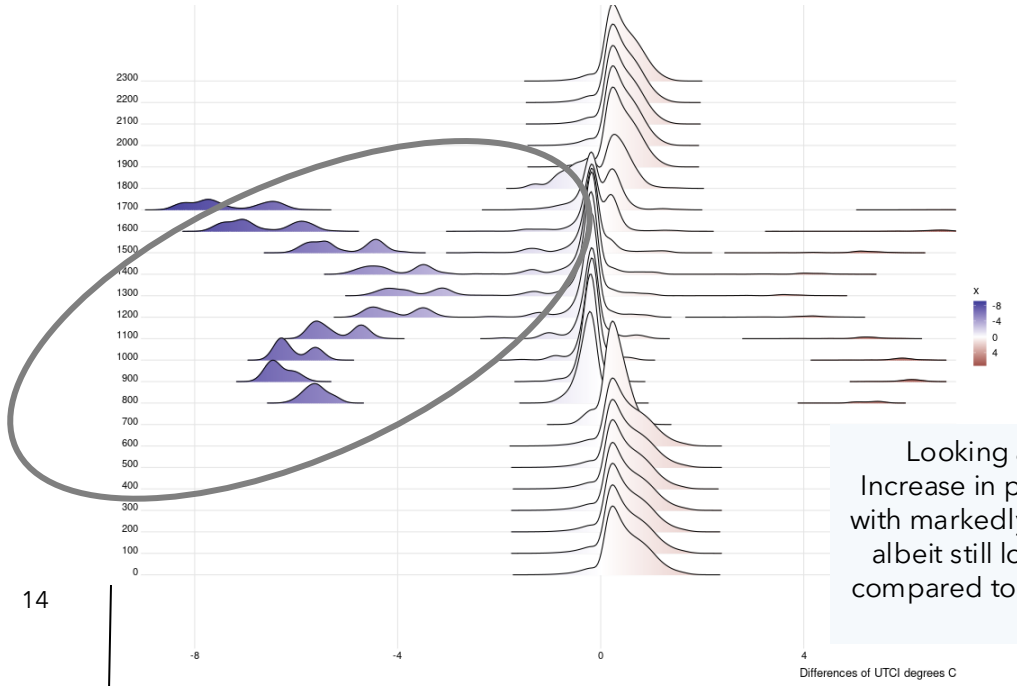
NbS Performance

Overall thermal profile remains similar to baseline

- The interventions improve localised thermal comfort but do not substantially alter overall corridor-scale heat conditions due to the continued dominance of impervious surfaces and the localised scale of the interventions.
- Prolonged daytime “very strong heat stress” persists across much of the corridor.
- Northern areas generally remain more exposed during midday





Looking at **differences**:
Increase in proportion of street with markedly cooler conditions, albeit still localised and small compared to the entire corridor.

NbS Performance

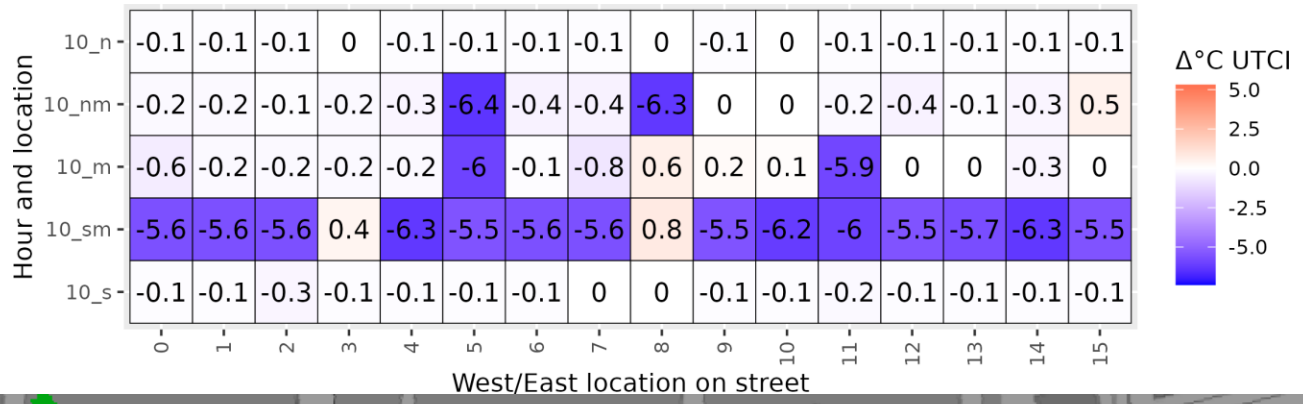
Thermal conditions were assessed along a series of **west-east transects across the corridor** to compare heat exposure at different locations within the street cross-section.

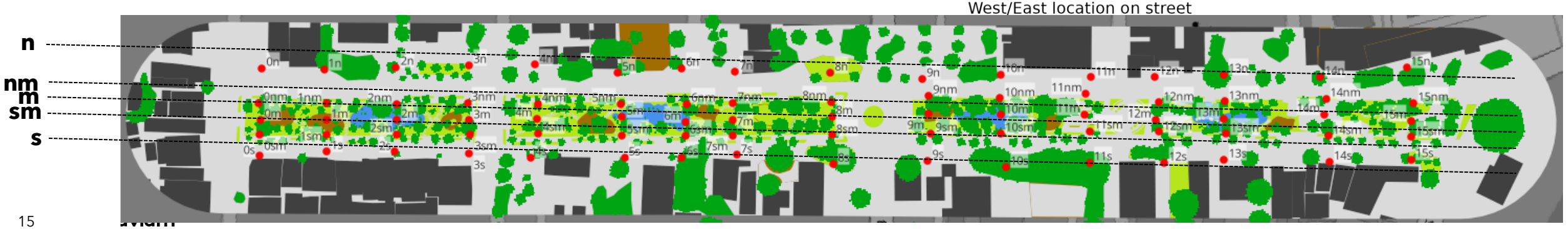
Transect naming convention

- **n** = north side of street
- **nm** = north median edge
- **m** = centre of median
- **sm** = south median edge
- **s** = south side of street

Changes in UTCI can then be compared between the baseline and NbS scenario to summarise where thermal comfort is changing, by how much and where.

The below example shows results for the 5 transects (one per row) at 10am, moving west-east along the x-axis.





NbS Performance

Substantial localised cooling benefits are observed

Increased tree canopy substantially improves local thermal comfort through shading.

Benefits are highly localised, with UTCI reductions of:

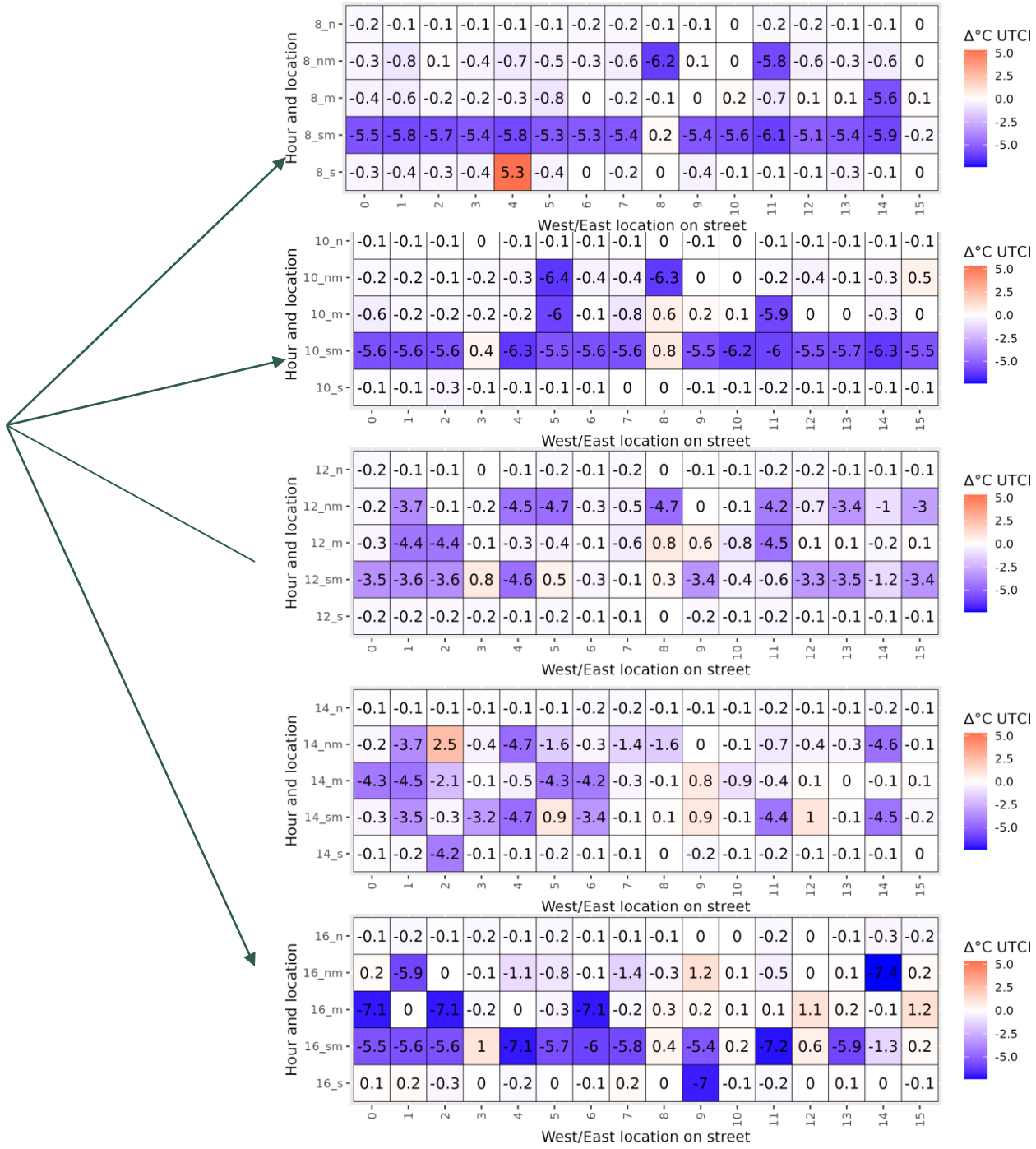
- 5–6°C across heavily shaded areas (e.g. 8am, 10am and 4pm)
- 3–4°C across surrounding pedestrian areas

Greatest improvements occur during the late morning and early afternoon. In some locations, conditions shift from “very strong heat stress” to “strong heat stress.”

Key mechanism

Cooling is driven primarily by:

- reduced solar radiation
- lower mean radiant temperature
- reduced surface heat storage



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NbS Performance

Air Temperature

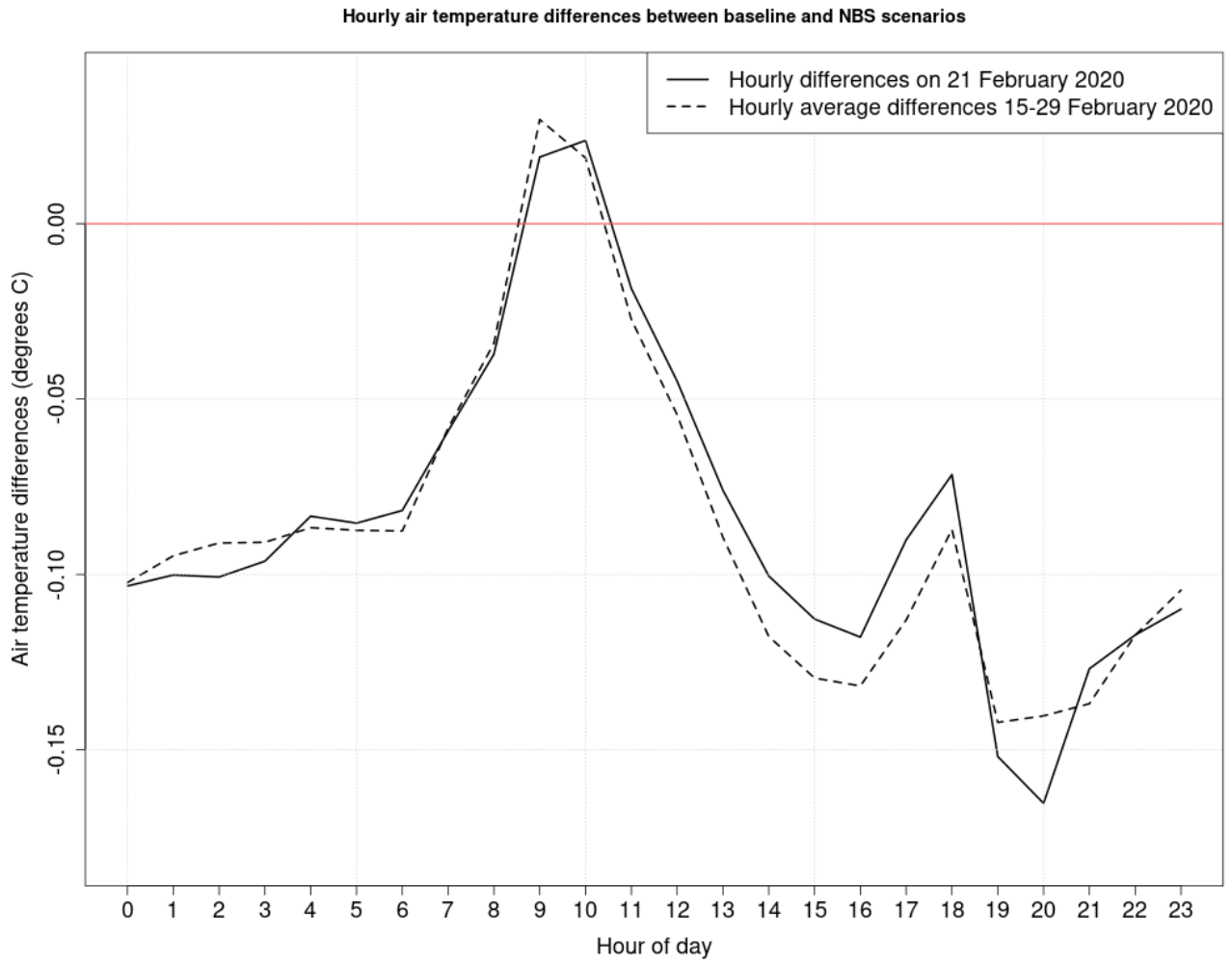
- Site-scale air temperature reductions are limited (approximately **0.17°C**).
- There are small reductions in the afternoon and evening, with minor increases observed in some morning periods

Why reductions are modest

- Site remains influenced by surrounding impervious urban surfaces
- Vegetation still limited relative to paved area
- Local cooling dispersed by atmospheric mixing

Key messages

- While air temperature reductions are modest, the NbS interventions still deliver substantial improvements in pedestrian thermal comfort through reduced radiant heat exposure and increased shading.



Key Findings - Baseline v NbS

- Existing conditions create prolonged severe heat exposure
- NbS interventions significantly improve pedestrian comfort locally
- Cooling effects depend strongly on canopy placement and continuity
- Air temperature reductions remain modest
- Even moderate increases in urban canopy can meaningfully improve park usability and liveability.

City-wide benefits of nature-based solutions

While this study only redesigned one street, adopting NbS across an entire city can have broader benefits, such as reducing the impacts of heatwaves, the number of days, durations, and severities, such as this example from Bangkok

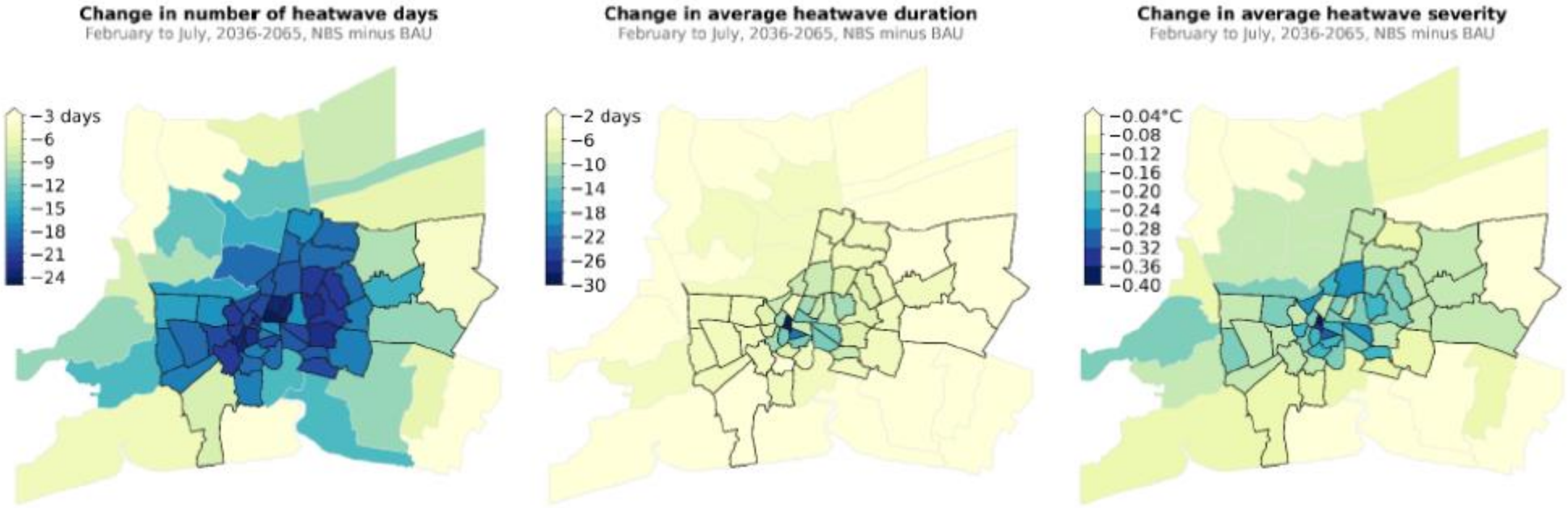


Figure 17 Extreme heatwave characteristics dampened by nature-based solutions (BKode, 2025)

Conclusions

Overall conclusion

Both scenarios continue to experience prolonged daytime heat stress during typical hot-season conditions; however, the Prek Moha Tep Park NbS concept delivers meaningful localised improvements in pedestrian thermal comfort, primarily through increased shading.

Main takeaway

- NbS can substantially improve how hot public spaces *feel*
- Greatest benefits occur in shaded pedestrian areas
- Cooling outcomes are highly spatial and design dependent

Recommendations

- Maximise canopy continuity along pedestrian paths and other high-use areas
- Maintain irrigation and vegetation health
- Consider additional canopy or shade cover expansion to achieve additional cooling

"Nature-based Solutions can meaningfully improve thermal comfort and public space usability in tropical cities, even where reductions in overall air temperature are modest."