Climate-resilient urban design

Problems, action points and role for the business community

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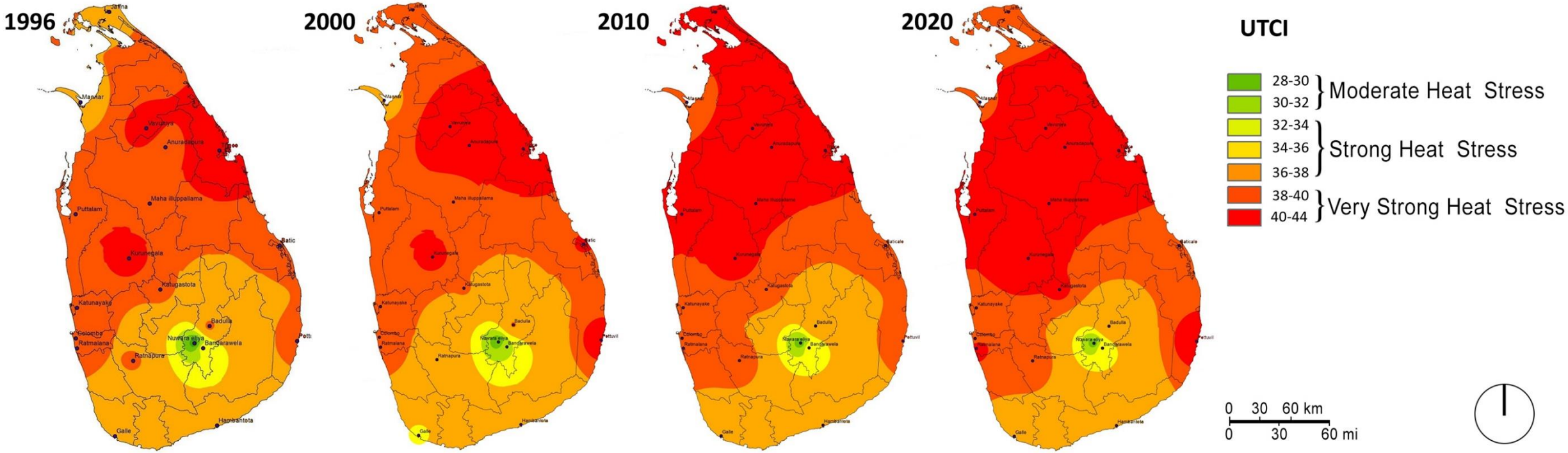
Sri Lanka Climate Summit 2024
Day 03: Climate Risks and Opportunities for Sri Lankan Businesses

Outline

- Scale and nature of outdoor climate challenge in Sri Lanka
- Heat Risk in our cities
- Options for heat adaptation in the urban built environment
- Governance and financing of heat management
- Thoughts on way forward with the business community

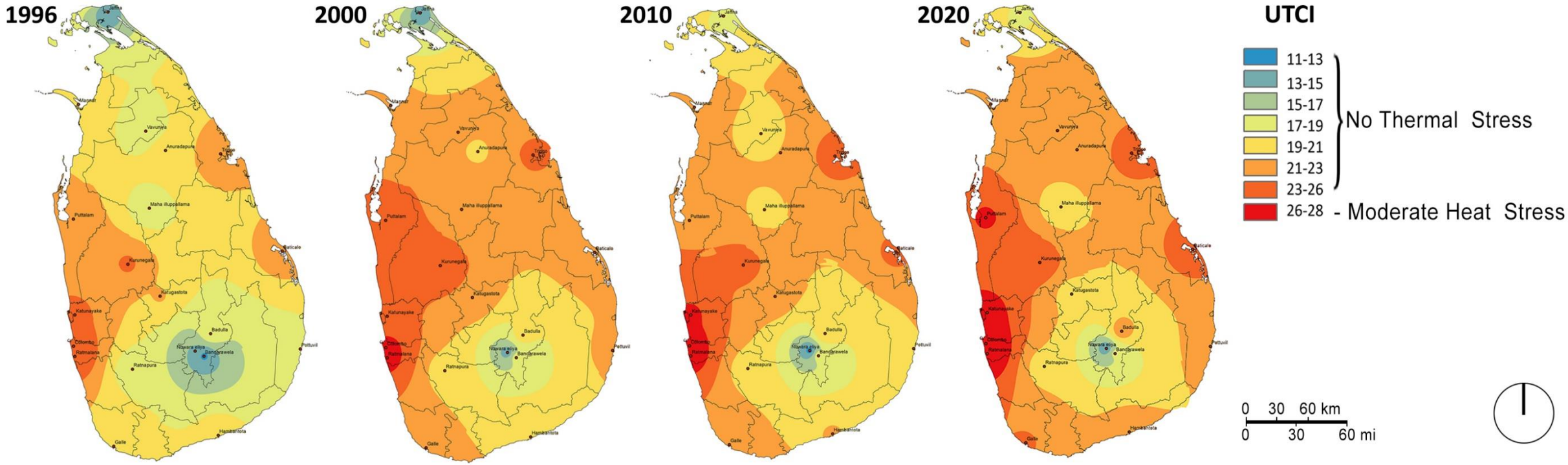
The Challenge



Thermal comfort across Sri Lanka in the WARMEST month (April)

Simath and Emmanuel, 2022, https://doi.org/10.1007/s00484-022-02328-9

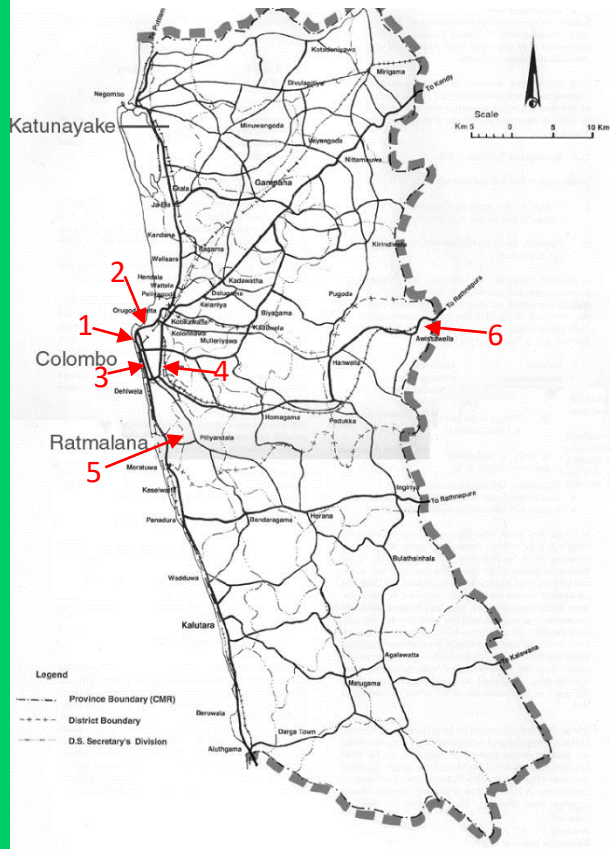
The Challenge



Thermal comfort across Sri Lanka in the COOLEST month (January)

Simath and Emmanuel, 2022, https://doi.org/10.1007/s00484-022-02328-9

Urban Heat Island in Colombo



1=CBD; 2= Old town; 3=Highway;
4=High-density residential; 5=Suburb;
6=Rural fringe

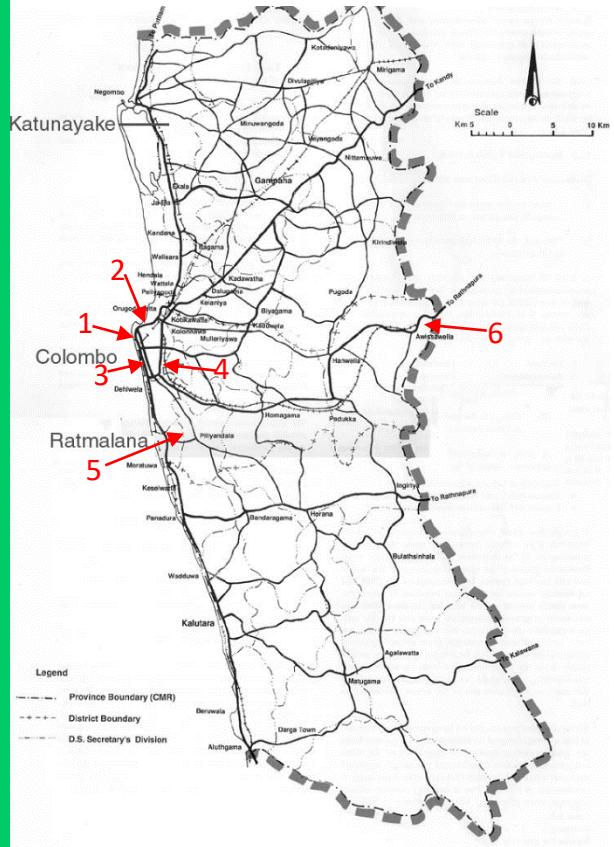
1 CBD – Up to 34 story-high buildings, completely paved, street perpendicular to & and open to sea

2 Old town – Narrow streets (< 7m), tall buildings (>15m), completely built-up, parallel to sea

3 Busy Highway – Main north/south artery, walls of buildings both sides, little/no vegetation parallel to sea

Emmanuel and Johansson, 2006, https://www.int-res.com/articles/cr2005/30/c030p189.pdf

Colombo UHI . . .



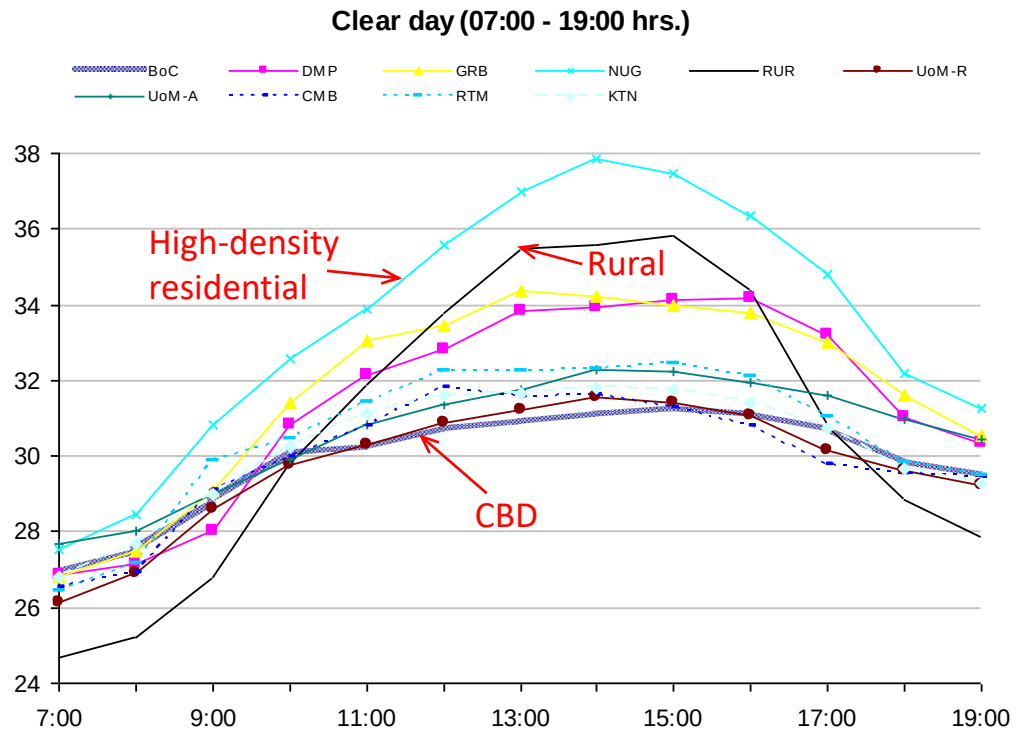
1=CBD; 2= Old town; 3=Highway; 4=High-density residential; 5=Suburb; 6=Rural fringe

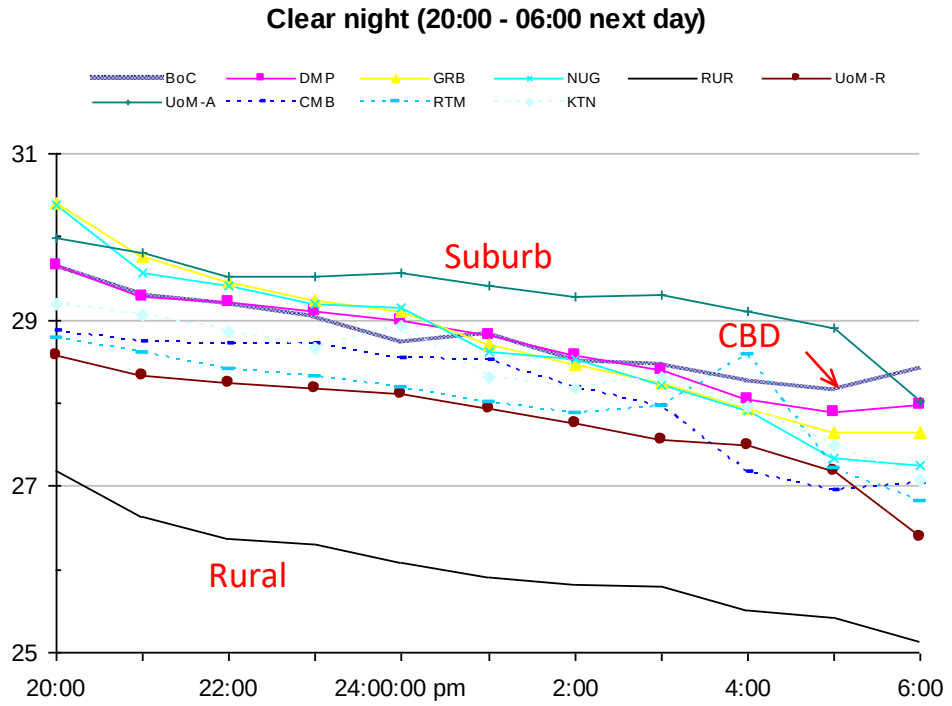
High-density Residential – Single-to-four story mixed use, little greenery, away from sea

Suburb – Medium-density built cover, significant greenery, soft land cover, 2 km away from sea

Rural – 45 km away from city center, very little building cover, open green, 30-45m above city level

UHI on a clear day

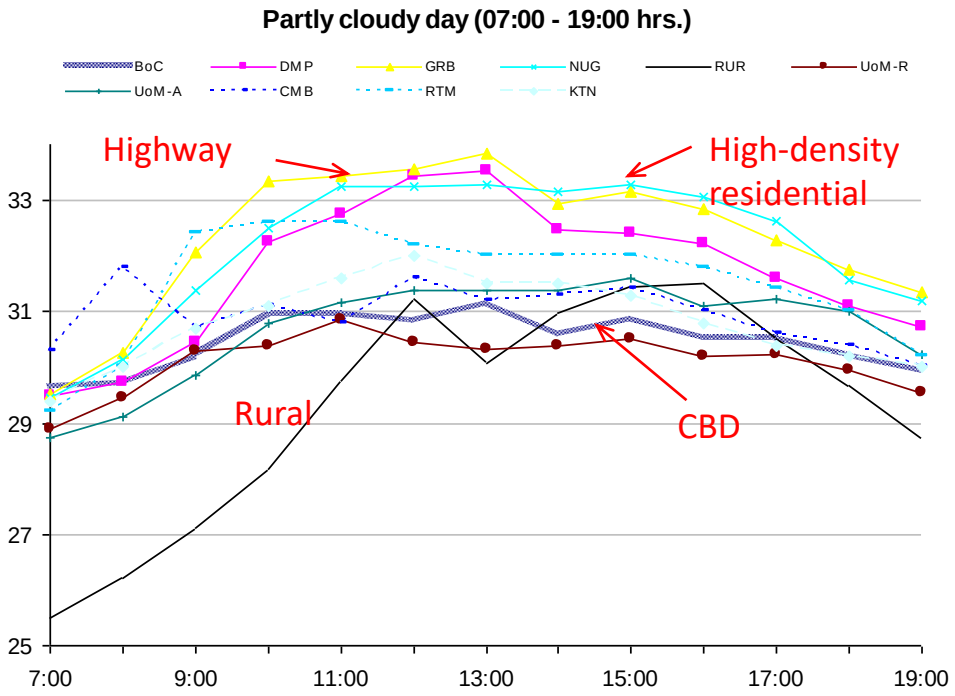


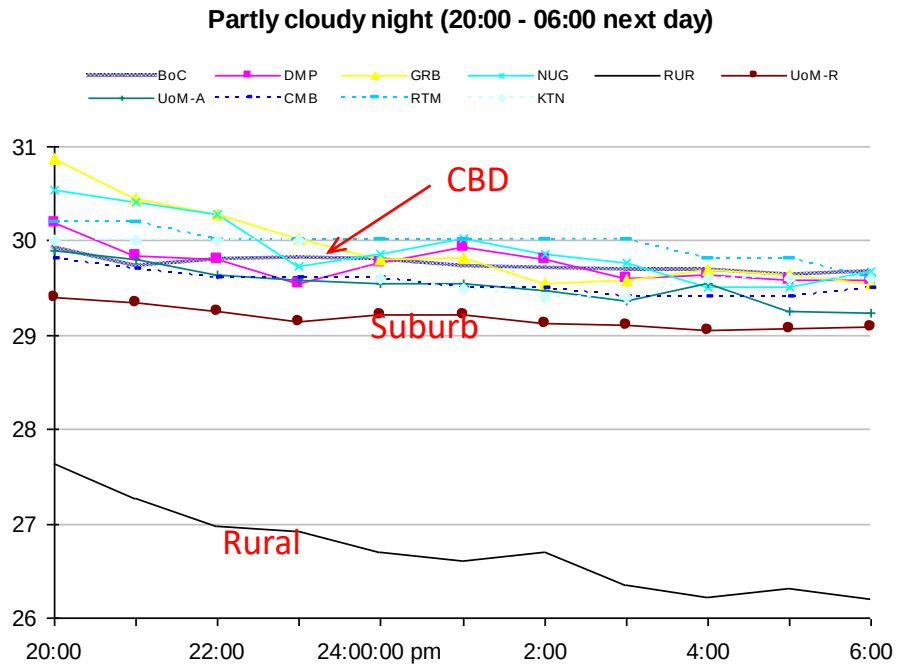


Central Business District (CBD) Coolest during the day; “Cool Island”?

All urban sites warmer than rural @ night

UHI on a partly cloudy day

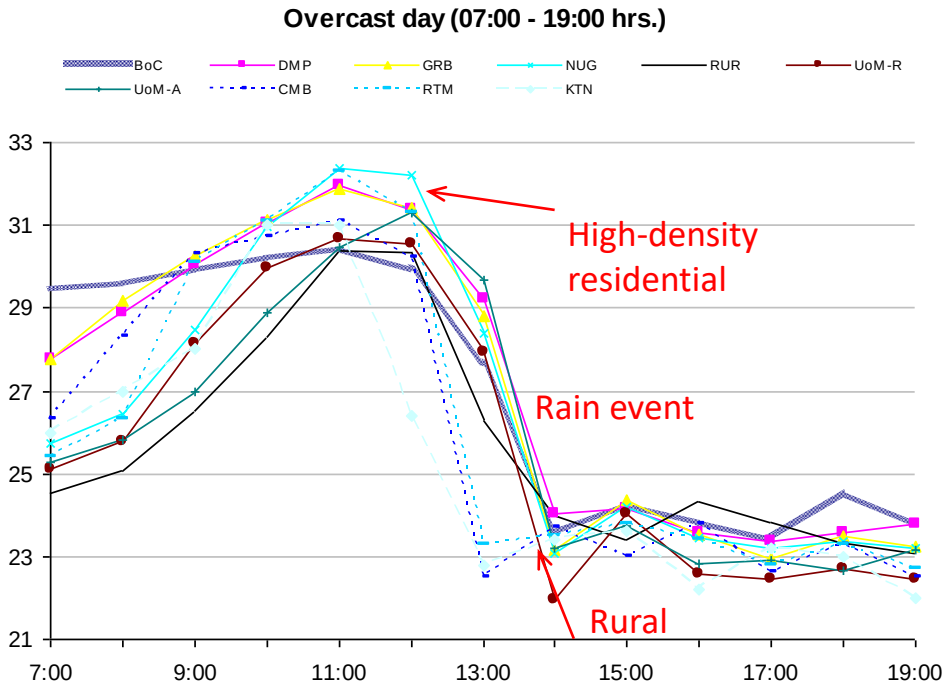


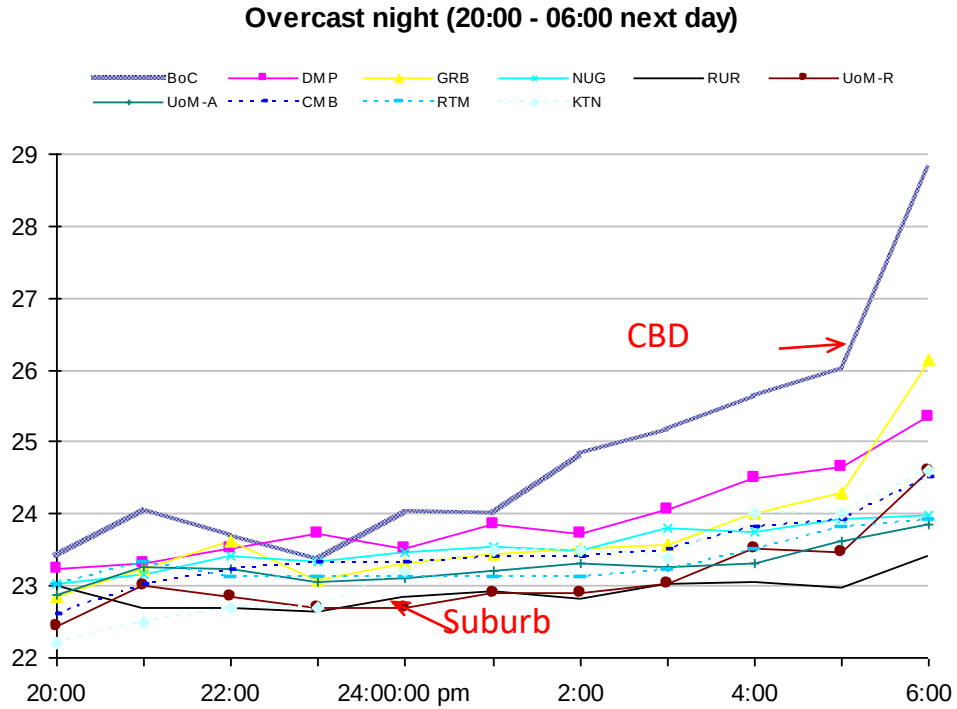


Daytime variations harder to discern;

Nights similar to clear sky conditions

UHI on an overcast day



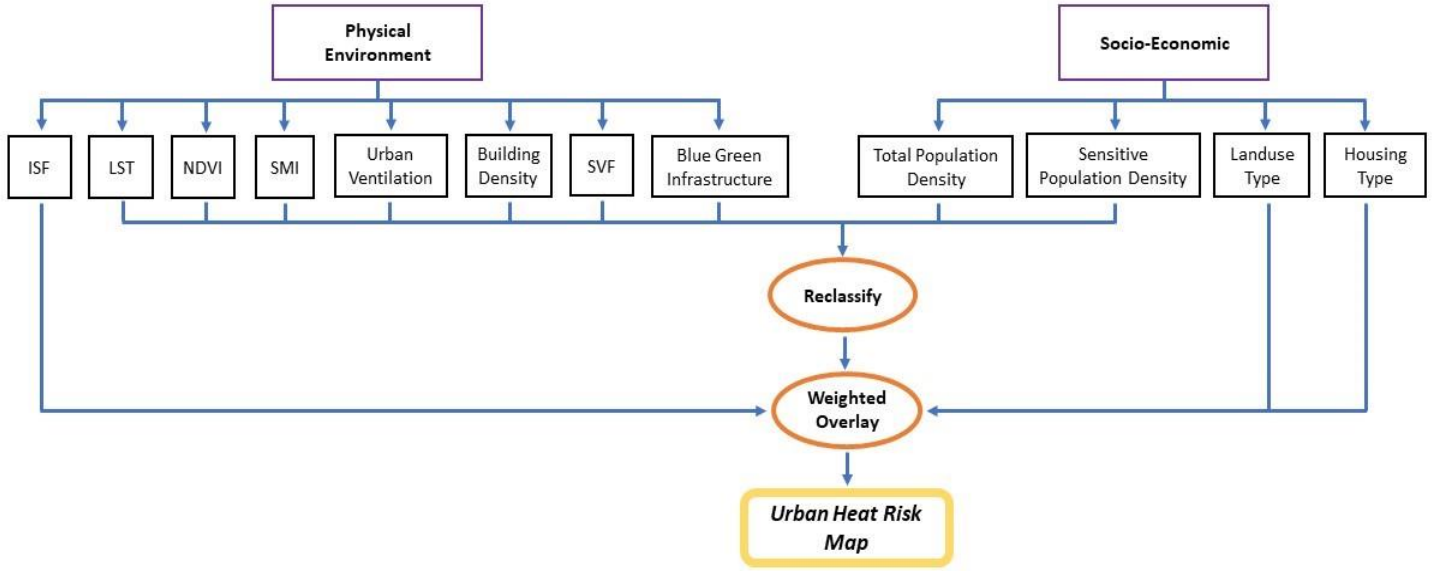


Effect rain event overrides UHI

Cloudy sky suppresses UHI @ night

Heat Risk

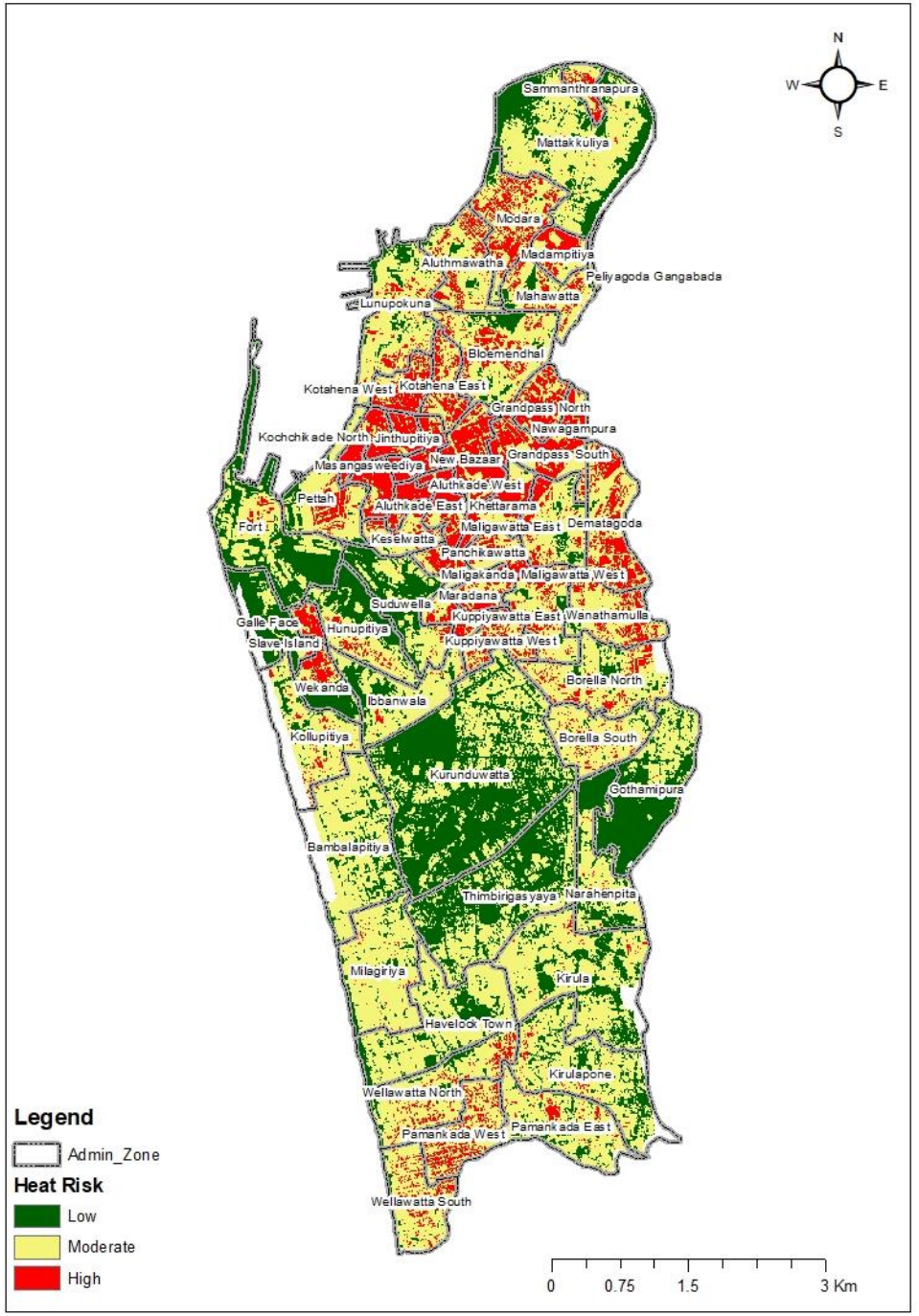
- $Risk = \int (Hazard\ x\ exposure\ x\ vulnerability)$
  - *Hazard = Thermal stress (factor of temperature, humidity, wind and sun)*
  - *Exposure = occupation, housing condition, access to cooling . . .*
  - *Vulnerability = age, co-morbidities, income . . .*



Emmanuel et al., 2023, https://doi.org/10.3390/atmos14020343

Heat Risk in Colombo

- Risk $\propto$ Socio-economic conditions
- Particularly high correlation to:
  - Population density
  - Fraction of ‘Sensitive Population’
  - Housing type
  - Blue-Green infrastructure



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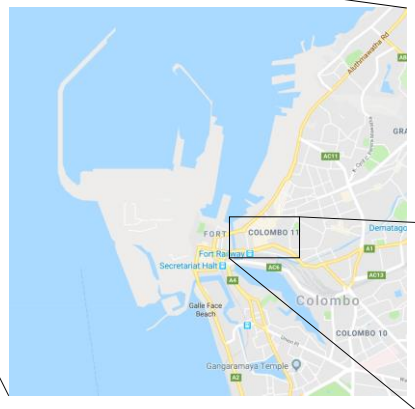
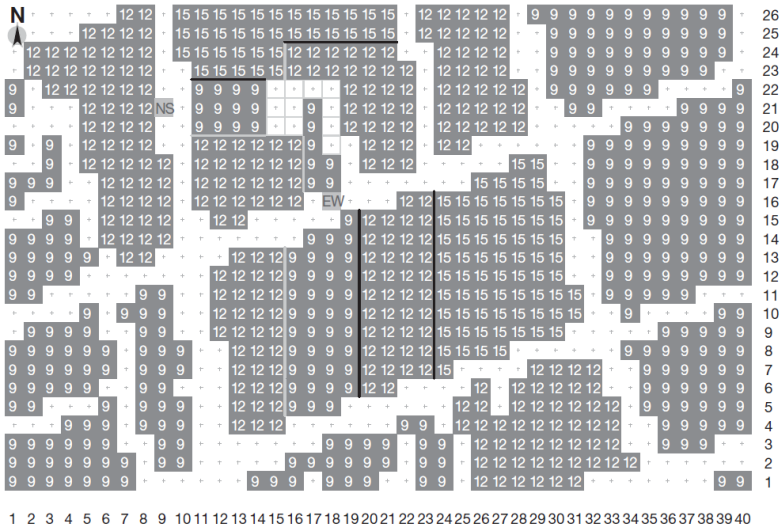
Options for heat adaptation





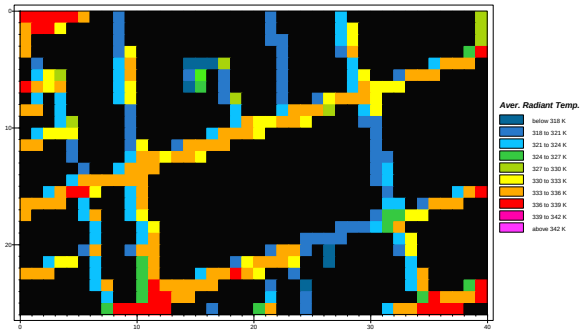
Scenario	Parameters		
	Urban geometry	Surface thermal properties	Green cover
Pettah, Colombo, Sri Lanka			
Base	Uneven, to match existing geometry	$U_w = 1.94\ W m^{-2} K$ $U_r = 6.00\ W m^{-2} K$ $\alpha_w = \alpha_r = \alpha_s = 0.60$	None
Medium-density	All buildings 18 m (6 stories) high	Same as base scenario	None
High-density	All buildings 24 m (8 stories) high	Same as base scenario	None
Green	Same as base scenario	Same as base scenario	10 m (canopy) street trees at 20 m intervals (Stem height = 10 m)
High albedo	Same as base scenario	$U_w = 0.57\ W m^{-2} K$ $U_r = 2.00\ W m^{-2} K$ $\alpha_w = \alpha_r = \alpha_s = 0.90$	None

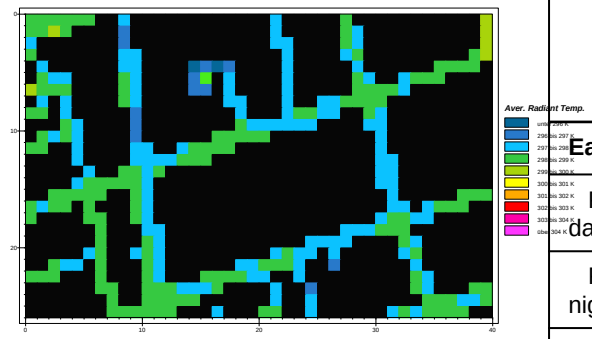
Emmanuel and Fernando, 2007, https://www.int-res.com/articles/cr2007/34/c034p241.pdf

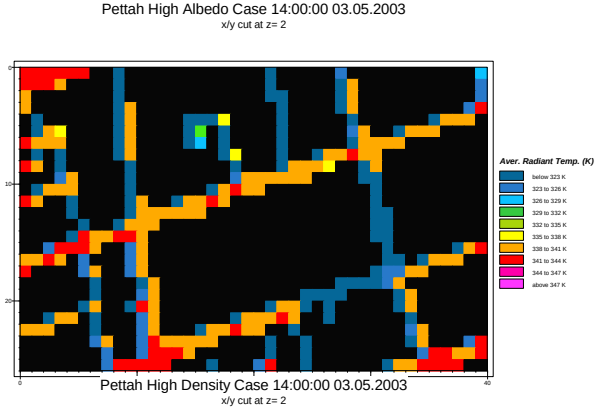
Day

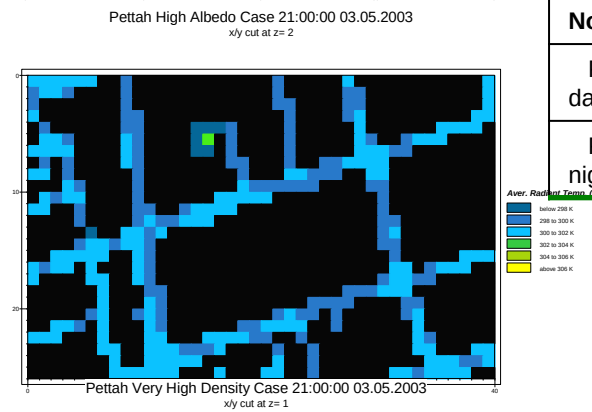
Night

Current



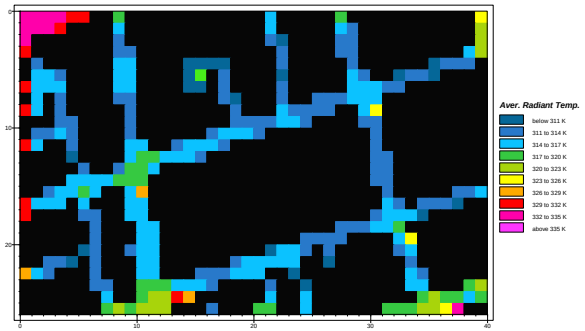


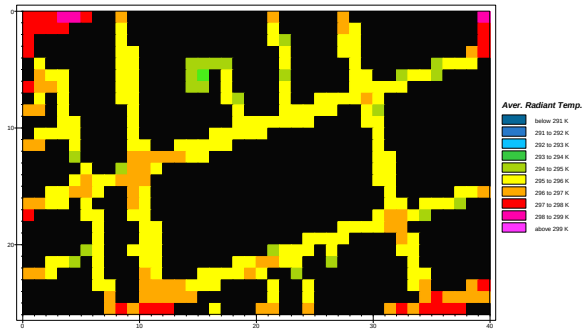




All buildings in white

All buildings taller





	Base case	High albedo case	Green case	Medium density case	High density case	Combined case
East-West Street						
Peak daytime	48 – 63	63 – 66	48 – 63	43 – 55	**37 – 43**	42 – 45
Peak nighttime	24 – 26	23 – 25	24 – 27	23 – 25	**22 – 24**	23 – 24
North-South Street						
Peak daytime	45 – 63	45 – 66	45 – 63	43 – 58	**37 – 43**	42 – 48
Peak nighttime	23 – 26	23 – 24	24 – 27	22 – 25	**22 – 24**	23 – 25

Heat management in cities . . .

- Hazard (thermal stress) is similar in all locations, therefore exposure and sensitivity (i.e. **socio-economic factors**) are important to modulate heat risk
- **Improve housing type and economic conditions** of urban population, rather than merely focusing on reducing temperature
- **Green cover** and **shading** could reduce the heat stress in high heat risk areas, but only if the building footprints are so arranged to create sufficient interstitial spaces, while maintaining the total built footprint
- 'Low' heat risk is a function of green cover. **Maintaining** the already high green cover in 'low' risk areas vital

Governance challenges

STAGE	Process	Barriers
Understanding	*Problem detection*	Hazard not perceived as a problem, lack of data, willingness to use data, perception of the feasibility of response
	Information gathering	
	Problem definition	
Planning	*Develop options*	Leadership, ability to identify/develop goals and options, data availability and usability, clarity of authority and responsibility over selected options
	Assess options	
	Select option(s)	
Managing	*Implement option(s)*	Resources, accountability, legality, monitoring plans, technology, willingness to learn, social and political feasibility to revisit previous decisions
	Monitor outcomes	
	Evaluate effectiveness	

Emmanuel, 2025, Climate-Responsive Urban Design, Edward Elgar (forthcoming)

Governance & Financing

- Heat management should be seen as a **human right**, not just an urban planning problem;
- Heat management is a **COMMONS** issue; (i.e. problem created by all, solutions depend on all) – need for effective/consistent lobbying
- Heat should be part of property portfolio due diligence
- Heat management requires a nuanced urban planning approach
  - Tax incentives;
  - Transfer of Development Rights
  - Earmarked funding (Revolving Loans, Env. Upgrading funds . . .)

Opportunities for all stakeholders

Themes	Sub-themes	Description
Insight	Through research	Context-specific research to unearth urban climate effects
	Through data	Detailed locally relevant data made easily accessible and interpretable by planners
	Through precedence	Learn lessons from other cities but modified according to local needs
Integration	Expert opinion	Seek expert opinion on specific urban climate effects of urban development early in the planning process
	Administrative integration	Consistent and coherent development plans are achieved through coordination of central agencies
	Policy-level integration	Integrate social, financial and cultural benefits, implementation of climate mitigation strategies
	Public consultation	Early involvement of residents and public to capture indigenous knowledge and specific microclimatic effects of urban development at an experiential level

Emmanuel, 2025, Climate-Responsive Urban Design, Edward Elgar (forthcoming), based on Simath, 2022. https://urn.fi/URN:NBN:fi:amk-2021110119141

Opportunities . . .

Themes	Sub-themes	Description
Specify	Focussed guidelines	Specific and clear guidelines for specific ends (such as shading, ventilation, etc.)
	Strategic solutions	Regional, local and micro-level planning solutions that keep the big picture (‘urban climate amelioration’) in mind
	Pick low-hanging fruits	Retrofitting and other solutions to create immediate public benefit that could enable long-term microclimate solutions
	Macro to micro	Start with the ‘big picture’ but focus on local (plot level) action to achieve the former
Exhort	Incentivise	Subsidies, loans and tax incentives to encourage wider uptake of microclimate enhancement policies
	Create awareness	communication strategies tailored according to the target groups, i.e. public, professionals and investors

Opportunities . . .

Themes	Sub-themes	Description
Commitment	Commitment – from document to practice	Policymakers to consider fairness and equity to ensure plans are actually implemented
	Political will and public commitment	Long-term political commitment and public acceptance to encourage political commitment remains high
	Professional ethics	Professional to incorporate microclimate considerations in their advice to clients so as to create long-term commitment
Continuity	Policy continuity	Microclimate action to be taken out of political cycles of action
	Audit and feedback	Continuous audit system which monitors the construction from planning to completion
	Periodic review	Learn lessons constantly and update plans based on emerging evidence

Thank you

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