Urban green spaces as nature-based solution in the Caribbean? Diurnal and seasonal variation of cooling effects

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ITC

The urban climate in the humid tropics

- Urban heat island effect and climate change:
  - Energy consumption, greenhouse gas emissions, human health, air pollution.
- Cooling of urban green spaces varies across climatic regions; most published knowledge on temperate climates
- Humid tropics
  - Wetness and high moisture availability
  - High thermal admittance and lower albedo of large, dense canopy vegetation
  - Knowledge gaps: seasonal variation, combined effects of influences

Set up of the study

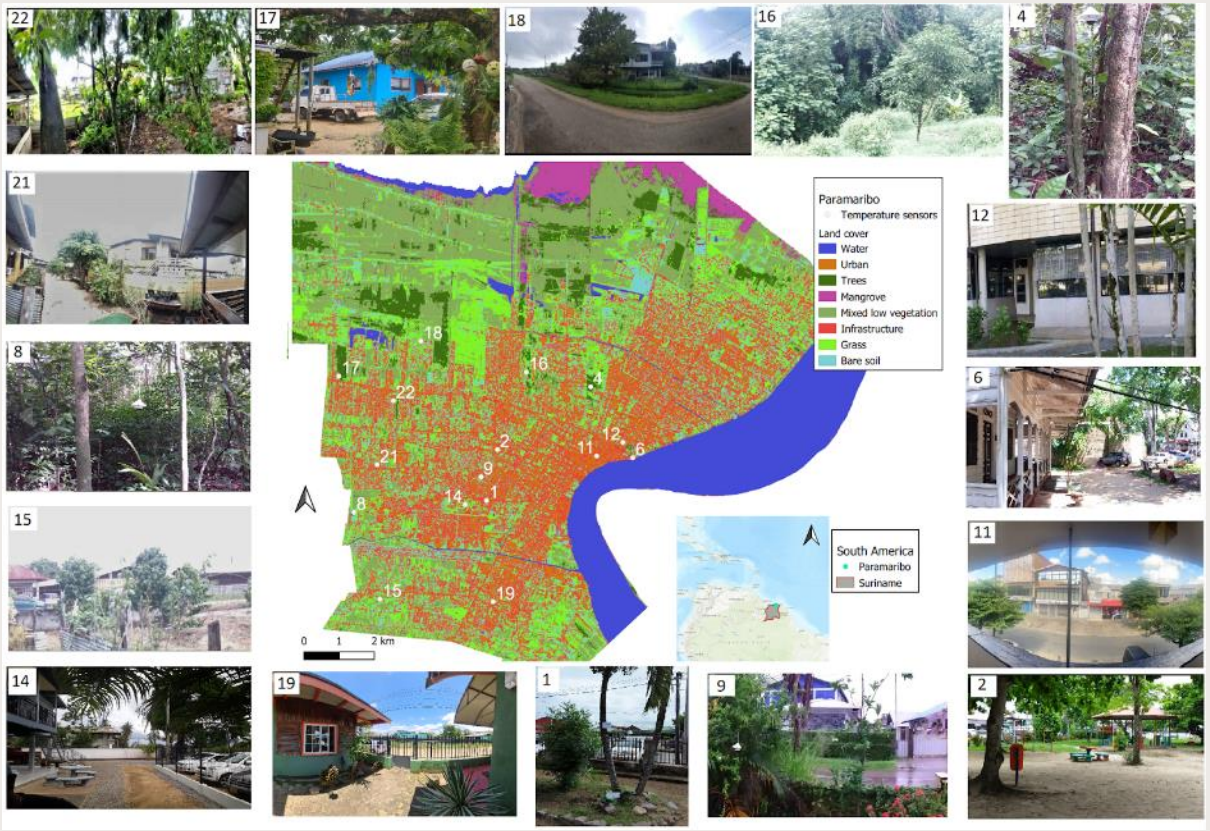
- Aim: to explore how urban green spaces and other factors influence diurnal and seasonal micro-climate cooling.

1. Describing seasonal and diurnal patters of air temperature , relative humidity and land surface temperature

2. Quantify cooling effects at various locations in Paramaribo

3. Relationship between location characteristics and urban micro-climate

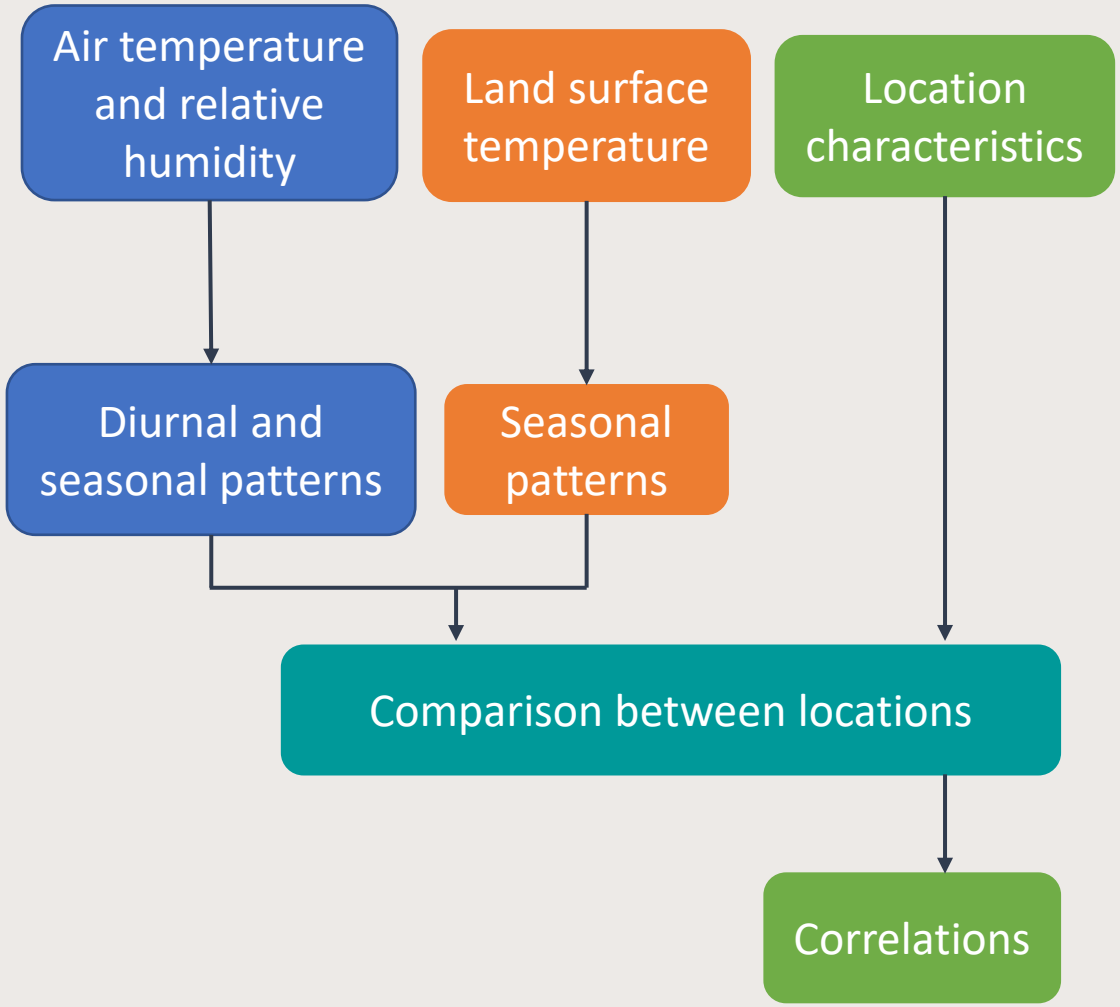
Case study: Paramaribo



- 16 locations
  - Share of trees, share of impervious surface
  - Type of vegetation structure
  - Surface cover and ground type at sensor
- Data: July 2021 – June 2022
  - air temperature
  - relative humidity
  - land surface temperature (2018-2022)
  - Location characteristics in 10 m and 300 m buffer
- Material: Kestrel Drop (D2) wireless sensors
- Data collected through field work, GIS and citizen science

www.groenparamaribo.org

Methods

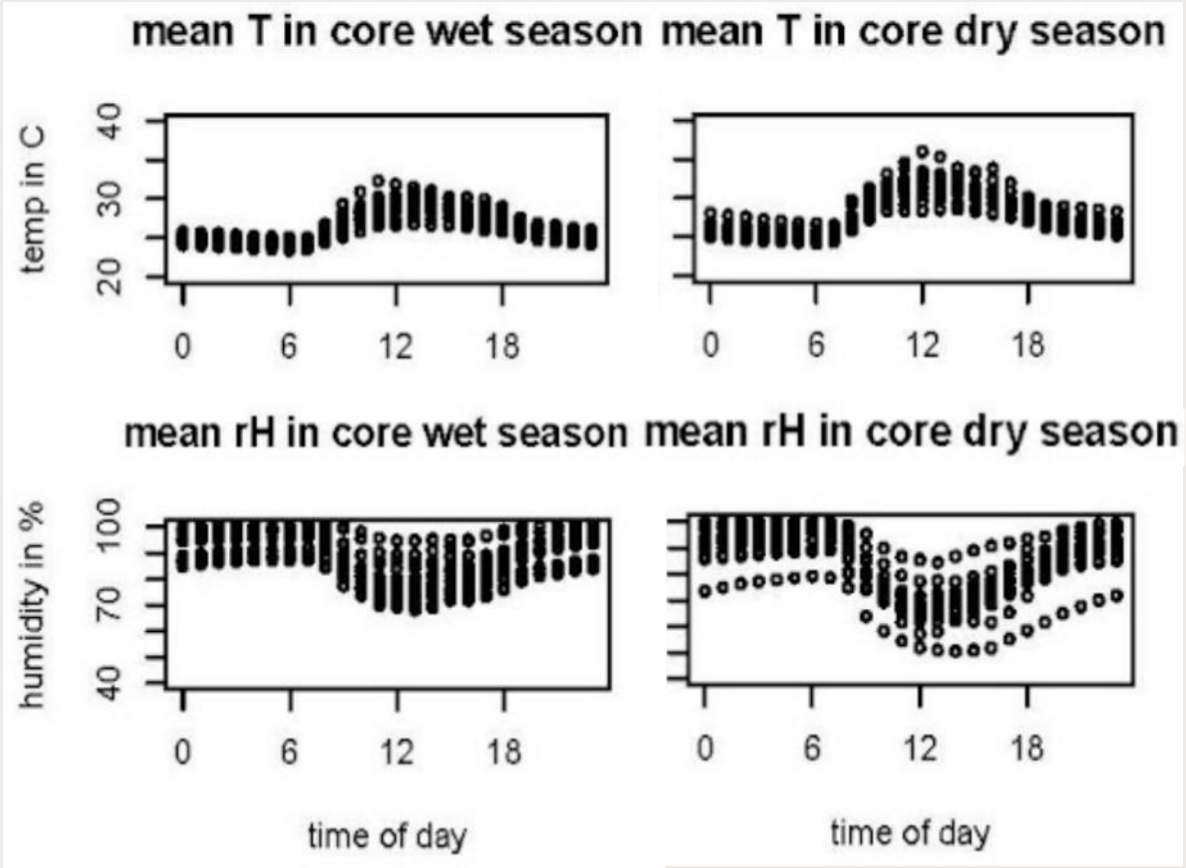


1. Description of micro-climate patterns

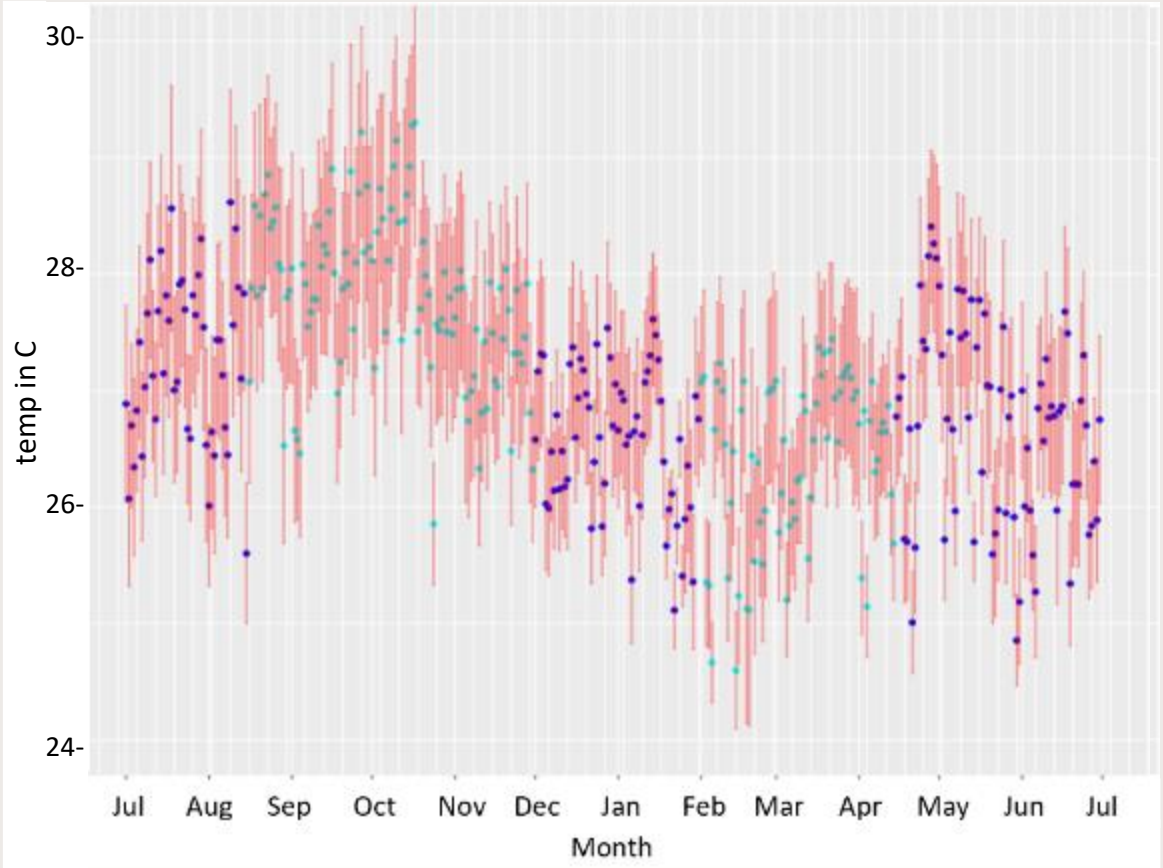
2. Cooling: temperature differences at each location
   - During 24 hours
   - At coolest and warmest hour in dry and wet season
   - Nighttime minimum and range
   - On the hottest days

3. Influencing factors: correlation analysis

1. Diurnal and seasonal patterns

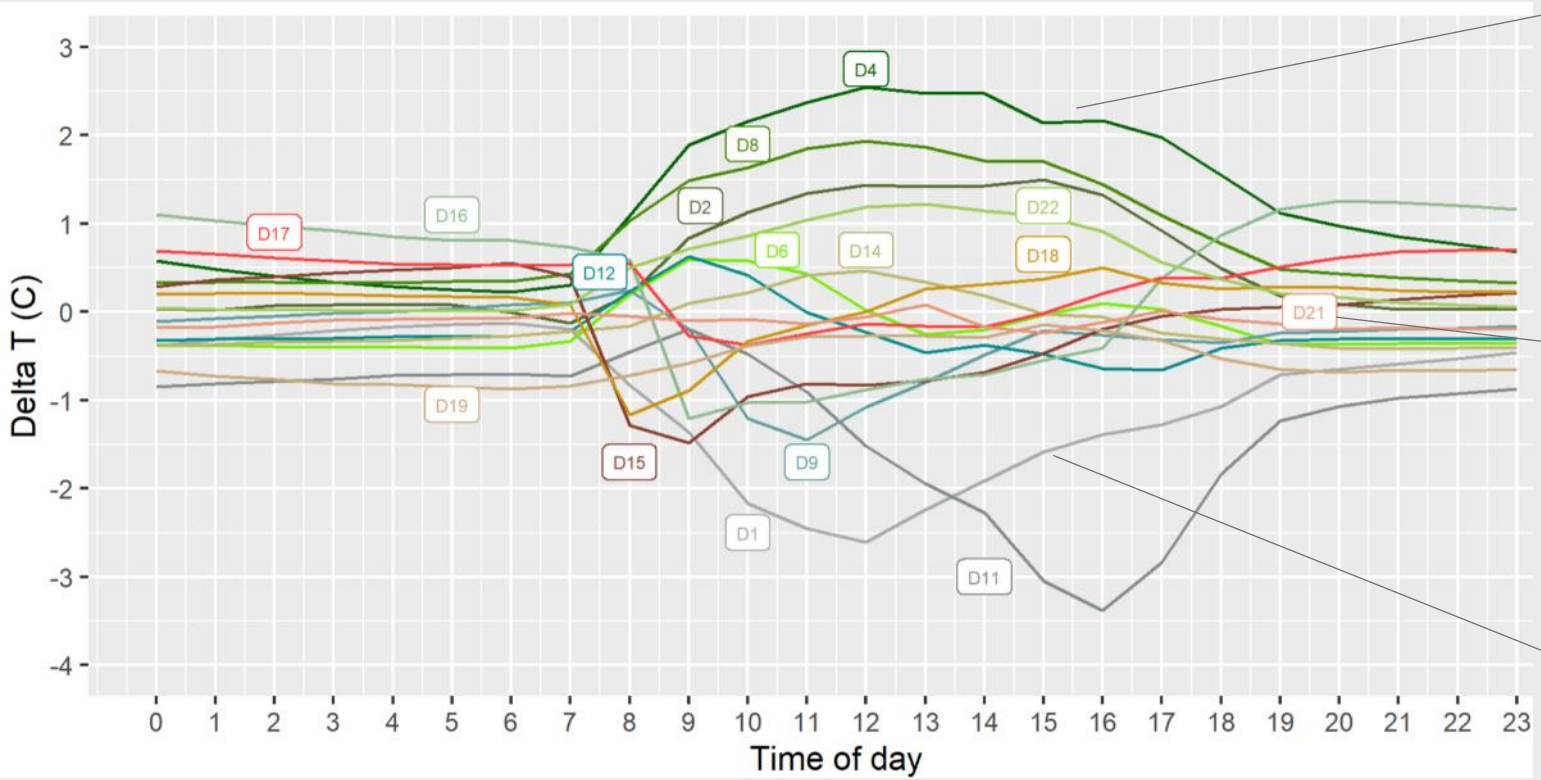


Hourly mean temperature and relative humidity



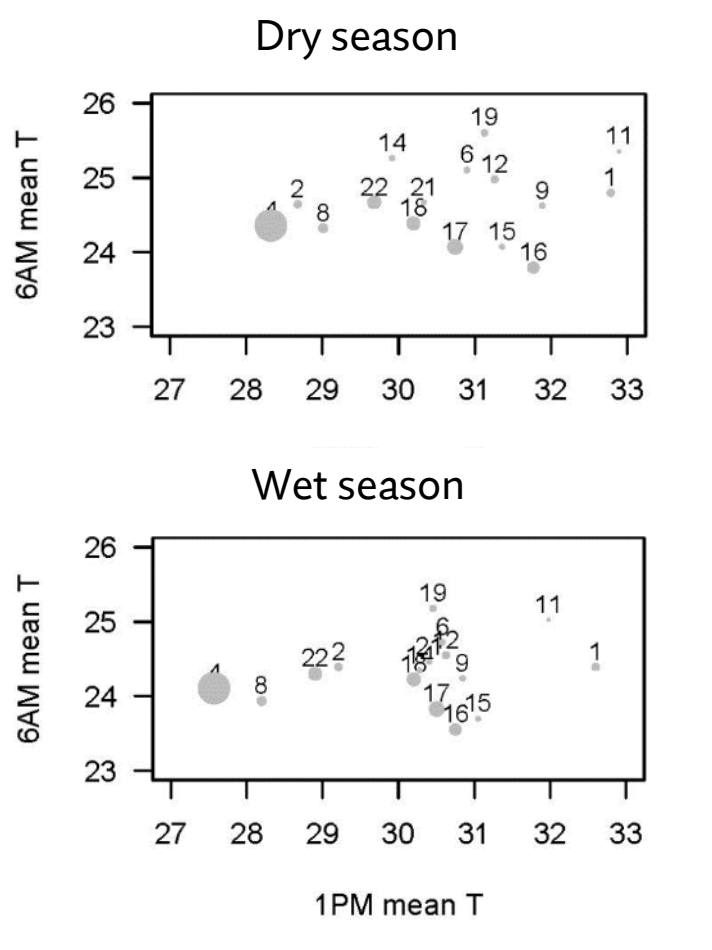
Daily mean temperature 2021-2022

2. Cooling effects of urban green spaces

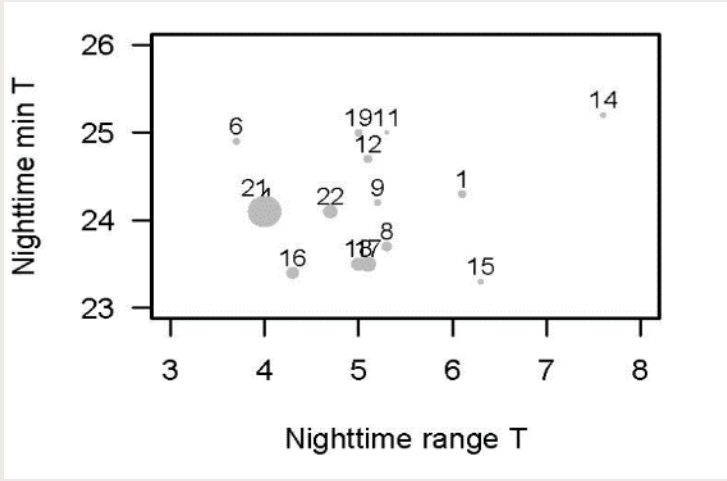


Temperature differences of locations

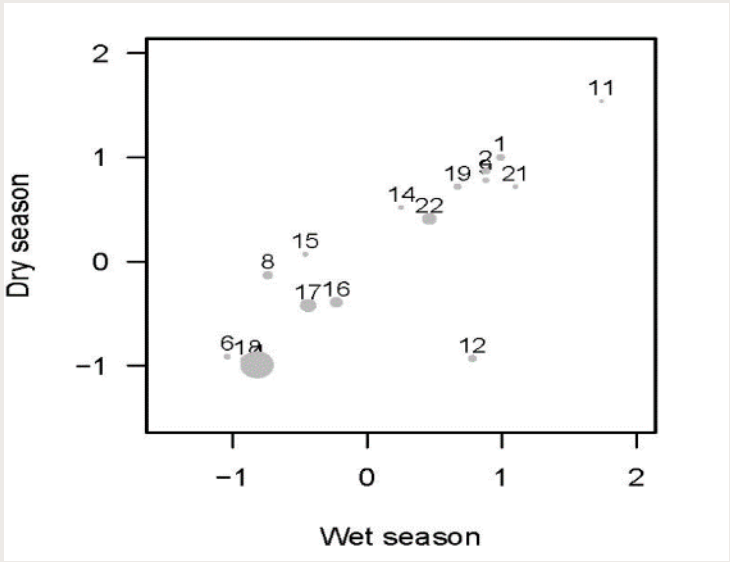
2. Cooling effects of urban green spaces



Cooling at the warmest and coldest time of day

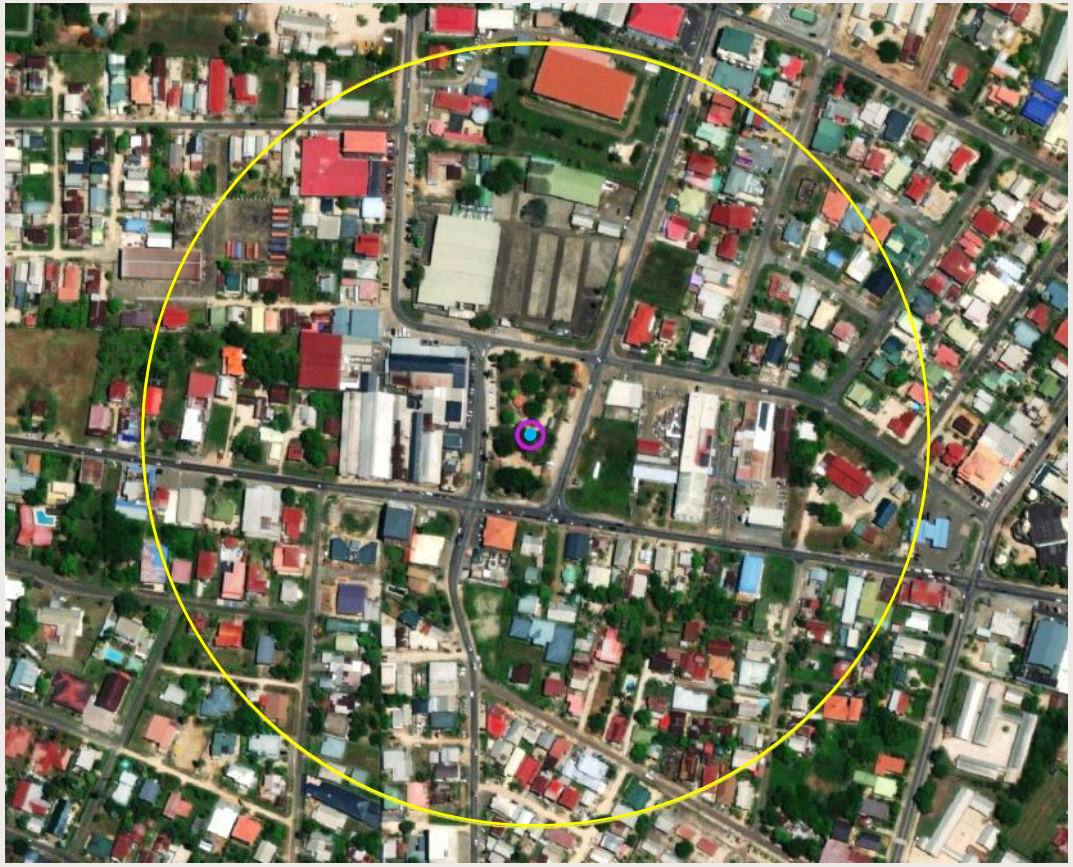


Minimum nighttime temperature vs temperature range (dry season)



Average standardized Land Surface Temperature (LST)

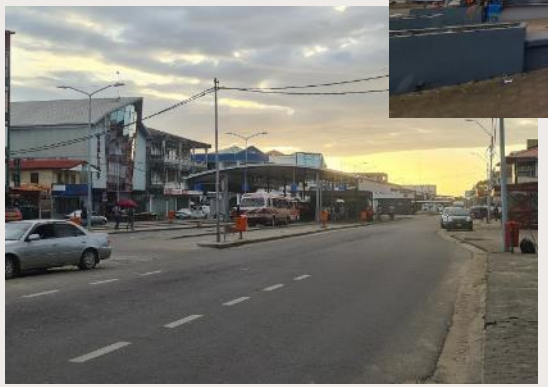
3. Influence of location characteristics



- Significant correlations:
  - The further away from the business centre, the lower the minimum nighttime temperature in the dry season
  - The more trees within 10 m, the lower the mean annual temperature
  - The more trees within 300m,
    - the lower the mean annual temperature,
    - the smaller the temperature range in wet season
    - the lower the LST dry season
  - The more impervious surface within 300 m,
    - The higher the mean annual temperature,
    - The higher the min. nighttime temperature,
    - The higher the LST dry season

Conclusions

- Distinct patterns for the wet and dry season
- Larger share of trees is associated with stronger cooling effects
- More complex vegetation structure is associated with stronger cooling effects
- Larger share of impervious surface is associated with stronger heating



Implications for urban planning

- Ratio of trees to impervious surface for urban design and greening policy for public spaces

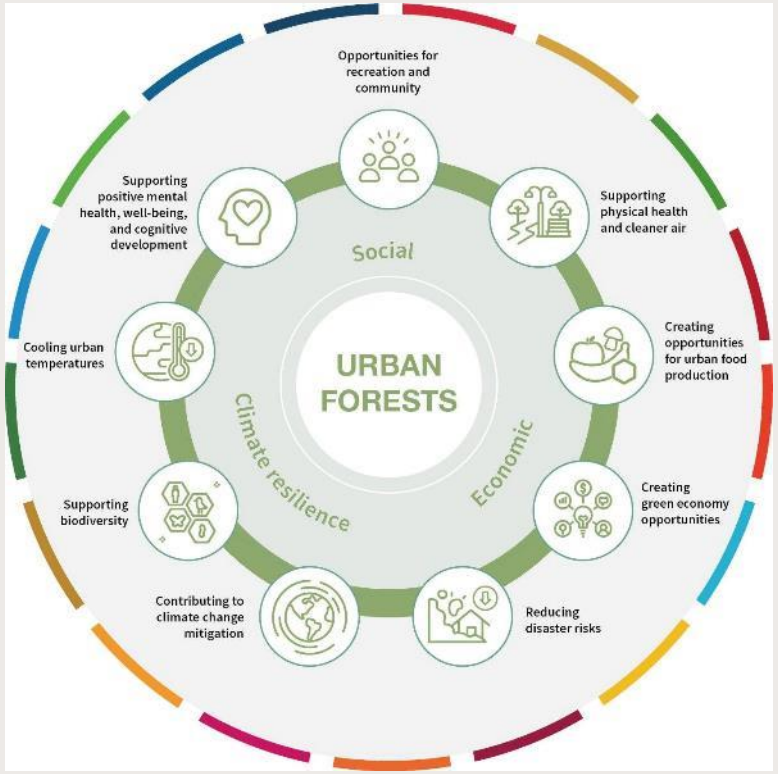
- Consideration of more and different measurement indicators when developing urban planning strategies e.g. for enhancing thermal comfort and reducing risks of increased temperatures

- Urban green spaces can serve as nature-based solutions when adapting to effects of climate change in urban areas. Other benefits can be further assessed.

Implications for urban planning

- Informed urban design and urban greening, and citizen participation can go hand in hand
- Further research on green space configuration, types and tree species traits can support the use of urban green spaces as a nature-based solution in cities for climate adaptation and beyond
- In order to optimally utilize urban green spaces as nature-based solutions, awareness, education and training of students and planners is needed

  (https://www.groenparamaribo.org/en/resources/education-material/)



(source: United Nations Economic Commission for Europe)

Thank you

UTSN twinning (‘18-’21)

NWO (’21-’22)

All volunteering citizen scientists

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