Amsterdam University of Applied Sciences

# Tackling Urban Heat Vulnerabilities through Co-creation:

*Combining meteorological, social, and environmental indicators to identify and prioritize project locations for mitigating heat stress in urban areas*

Symposium - Hitte in de Stad: Hete Hangijzers
27 June 2023

Stephanie Erwin – Amsterdam University of Applied Science (AUAS)
Sába Schramkó – Amsterdam University of Applied Science (AUAS)

Creating Tomorrow

# Cool Towns - AUAS research team (2021-2023)

**Stephanie Erwin, MLA**
**Senior Researcher**
**Climate Resilient Cities**

Climate resilience
Landscape Architecture
Urban planning & design
GIS

**Sába Schramkó, MSc**
**Researcher**
**Climate Resilient Cities**

Climate resilience
Architecture
Urban design

**Gideon Spanjar, PhD**
**Senior Project Leader**
**Climate Resilient Cities**

Climate resilience
Landscape architecture
Neuro-architecture

**Dante Föllmi, MSc**
**Junior Researcher**
**Climate Resilient Cities**

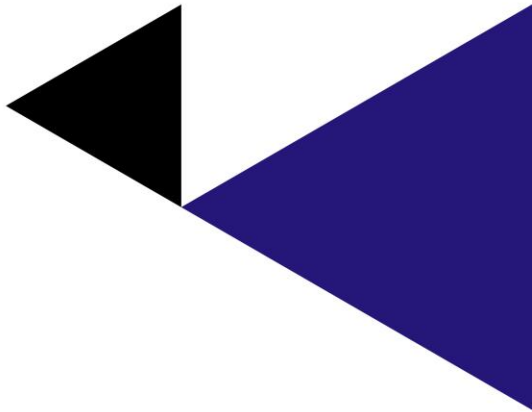
Climate resilience
Land & water management
GIS

**Jeroen Kluck, PhD**
**Professor**
**Climate Resilient Cities**

Climate resilience
Engineering
Hydrology

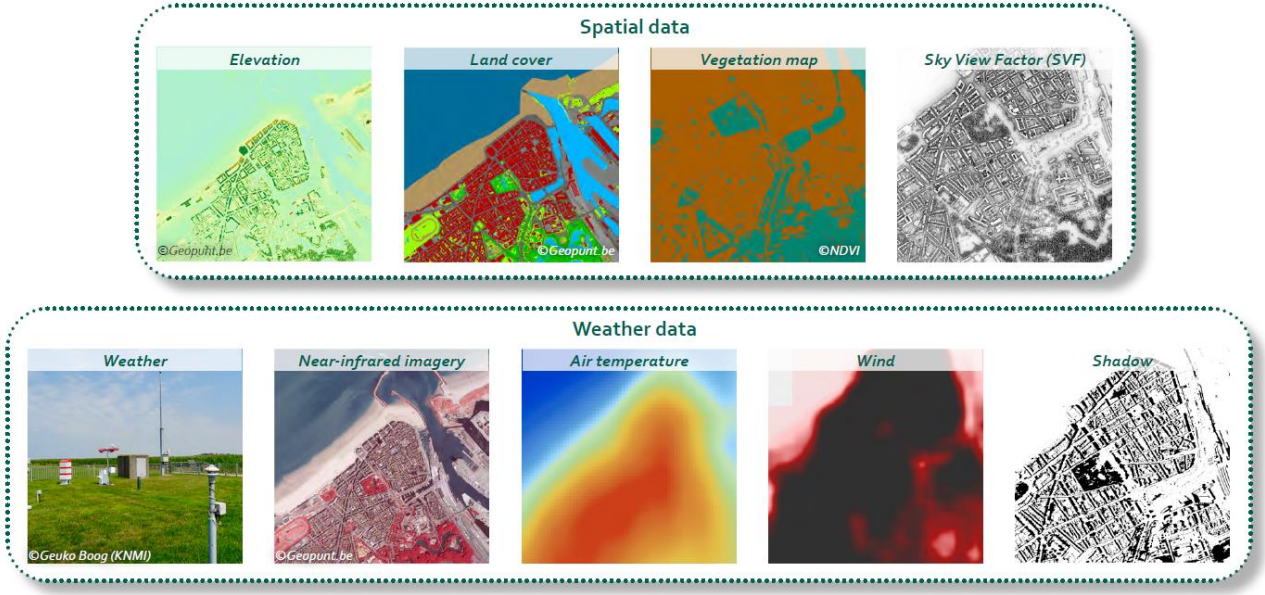
# Why do we need to identify and prioritize heat stress mitigation projects?

- Increasing heat stress risks with detrimental effects to the liveability of public spaces
- No clear spatial overview of where action is needed
- Heat stress impairs vital urban functions, poses risks to citizens' health
- Cities becoming densely populated = pressure on attractive cool public places



# Conventional methods

Meteorological, remote sensing and modelling techniques to identify potential areas vulnerable to heat stress




(Urban Heat Atlas. Spanjar et al., 2023)

# Conventional methods

Exclusively relying on thermal comfort models fails to consider important socio-environmental dynamics and vulnerabilities

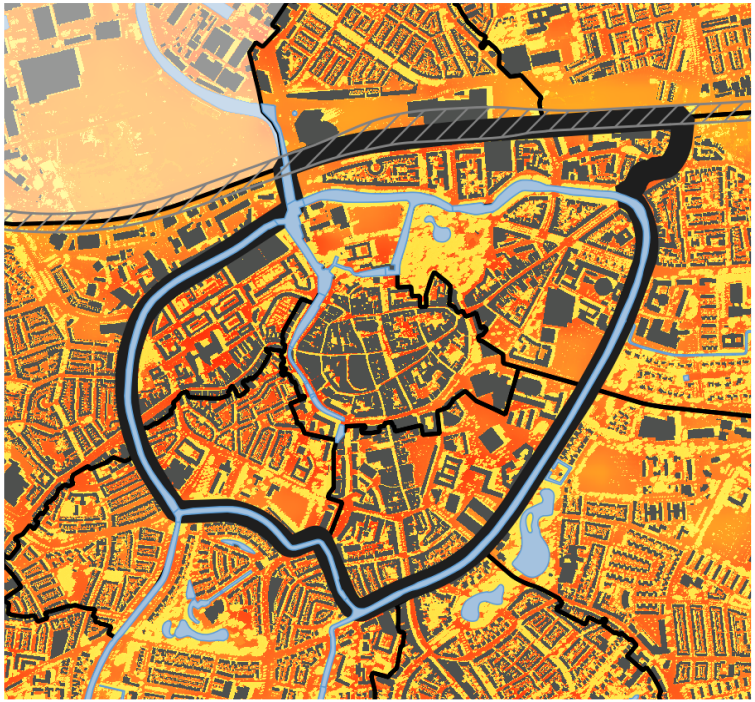
Conventional methods do not go far enough


(Urban Heat Atlas. Spanjar et al., 2023)

# Where do we focus?

Prioritization proves difficult without a comprehensive overview.

Where do we focus?  It looks hot everywhere.



(Urban Heat Atlas. Spanjar et al., 2023)

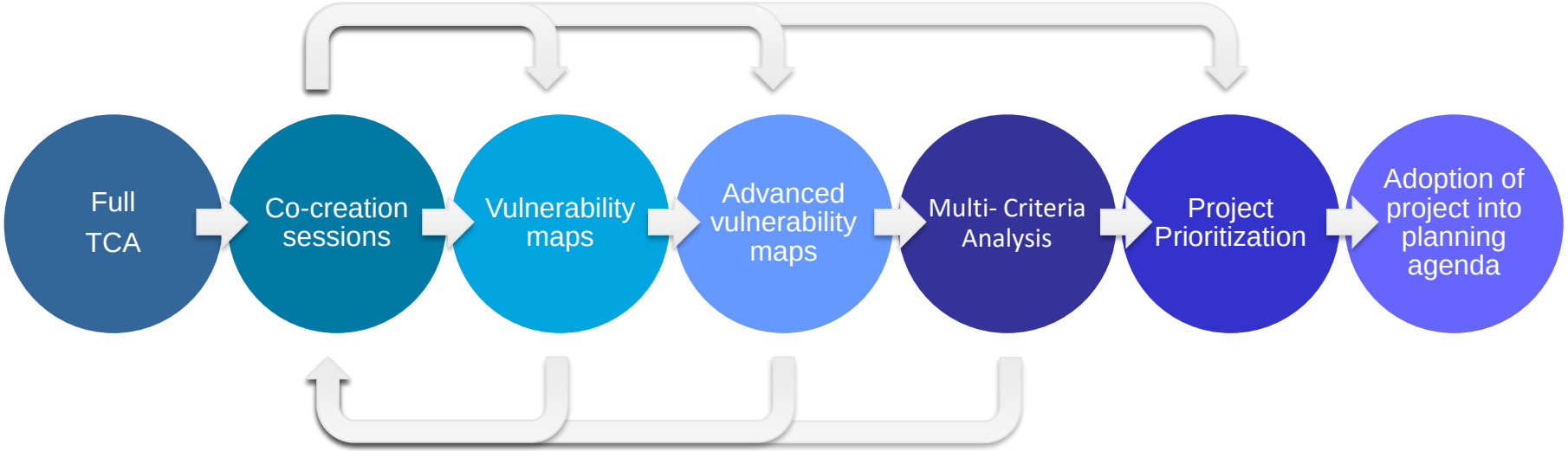
# Methodology: context

## identifying & prioritizing projects

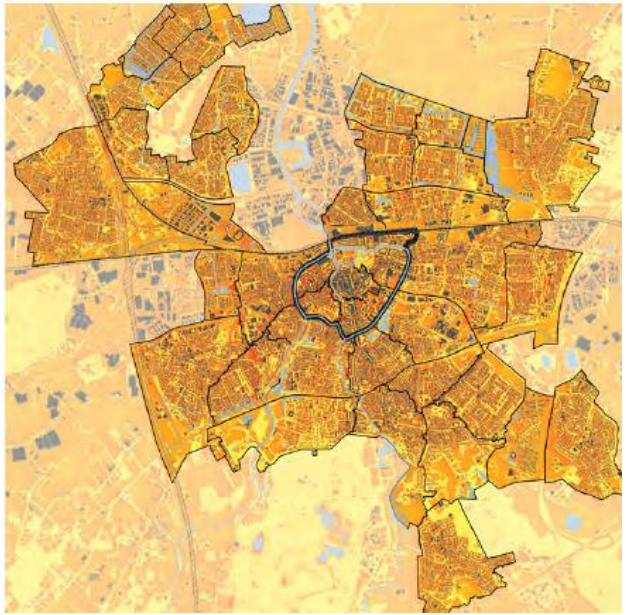
- Was developed partially within the Interreg 2 Seas region CoolTowns Project 2019-2023
- Was further developed at the request of the Municipality of Breda in the Netherlands

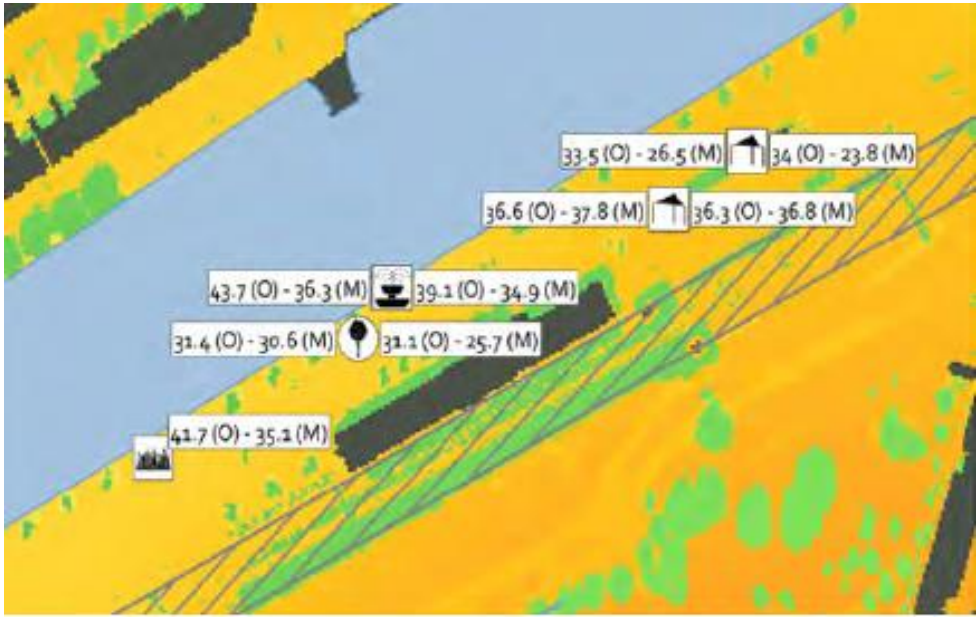
# Methodology: overview

## identifying & prioritizing projects



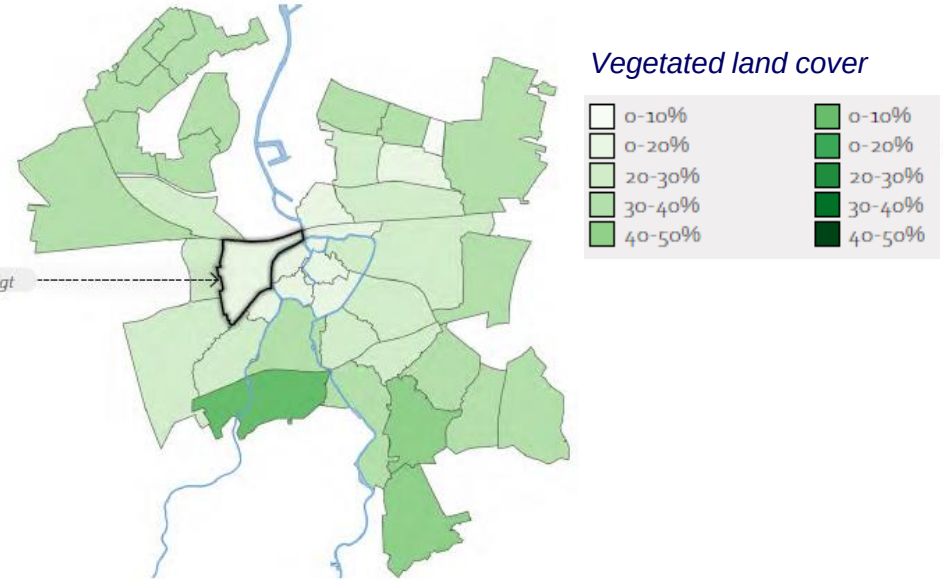
# 1. Full thermal comfort assessment (TCA)



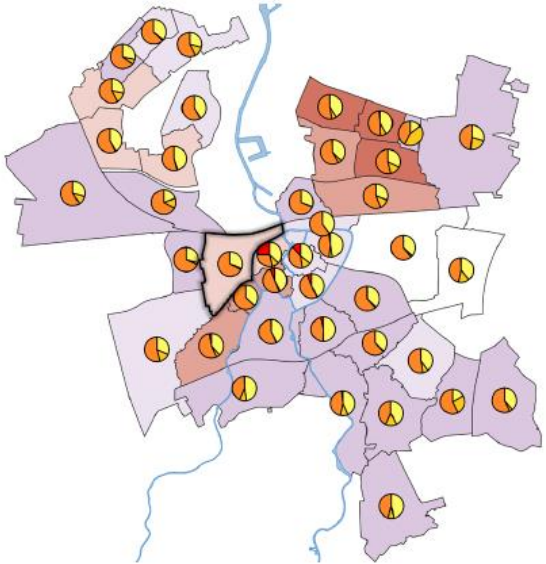


# 2. Co-creation sessions with municipal stakeholders

# 3. Inventory and analysis: neighborhood vulnerability



# 3. Inventory and analysis: neighborhood vulnerability



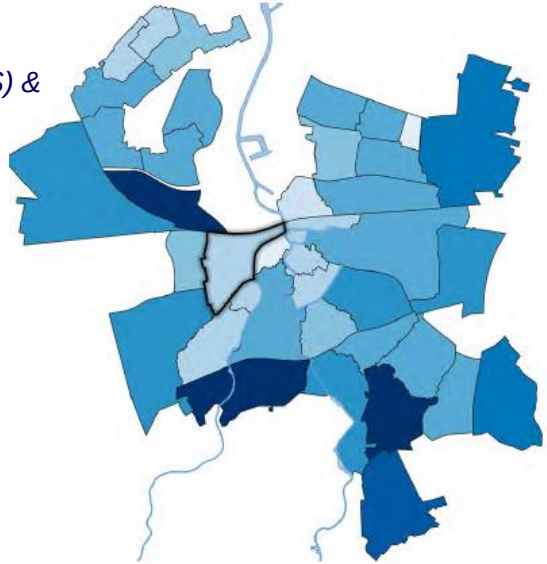
*Socioeconomic status (SES) & heat stress levels (PET)*

*Socioeconomic status*

- Extremely below city average
- Strongly below city average
- Moderately below city average
- Slightly below city average
- Slightly above city average
- Moderately above city average
- Strongly above city average

*Heat stress levels*

- 46-51 Extreme Heat Stress (LV2)
- 41-46 Extreme Heat Stress (LV1)
- 35-41 Strong Heat Stress
- 29-35 Moderate Heat Stress
- 23-29 Slight Heat Stress



*Cool outdoor ground level area per inhabitant*

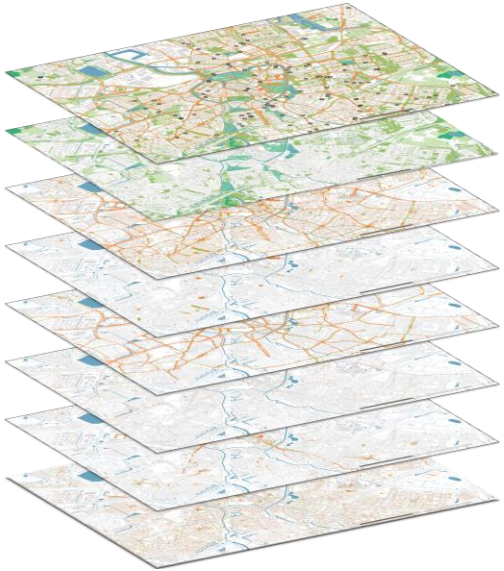
- 0-10 m² [PET < 35 °C] / inhabitant
- 10-20 m² [PET < 35 °C] / inhabitant
- 20-30 m² [PET < 35 °C] / inhabitant
- 30-40 m² [PET < 35 °C] / inhabitant
- 40-50 m² [PET < 35 °C] / inhabitant
- 50-75 m² [PET < 35 °C] / inhabitant
- 75-100 m² [PET < 35 °C] / inhabitant
- 100-125 m² [PET < 35 °C] / inhabitant
- 125-150 m² [PET < 35 °C] / inhabitant
- >500 m² [PET < 35 °C] / inhabitant



4. Co-creation sessions with municipal stakeholders

# 5. Synthesis: Advanced vulnerability map

Where do people experience heat stress?
Where do people experience coolness?



# 5. Synthesis: Advanced vulnerability map

**Layers to overlay on top of PET model:**

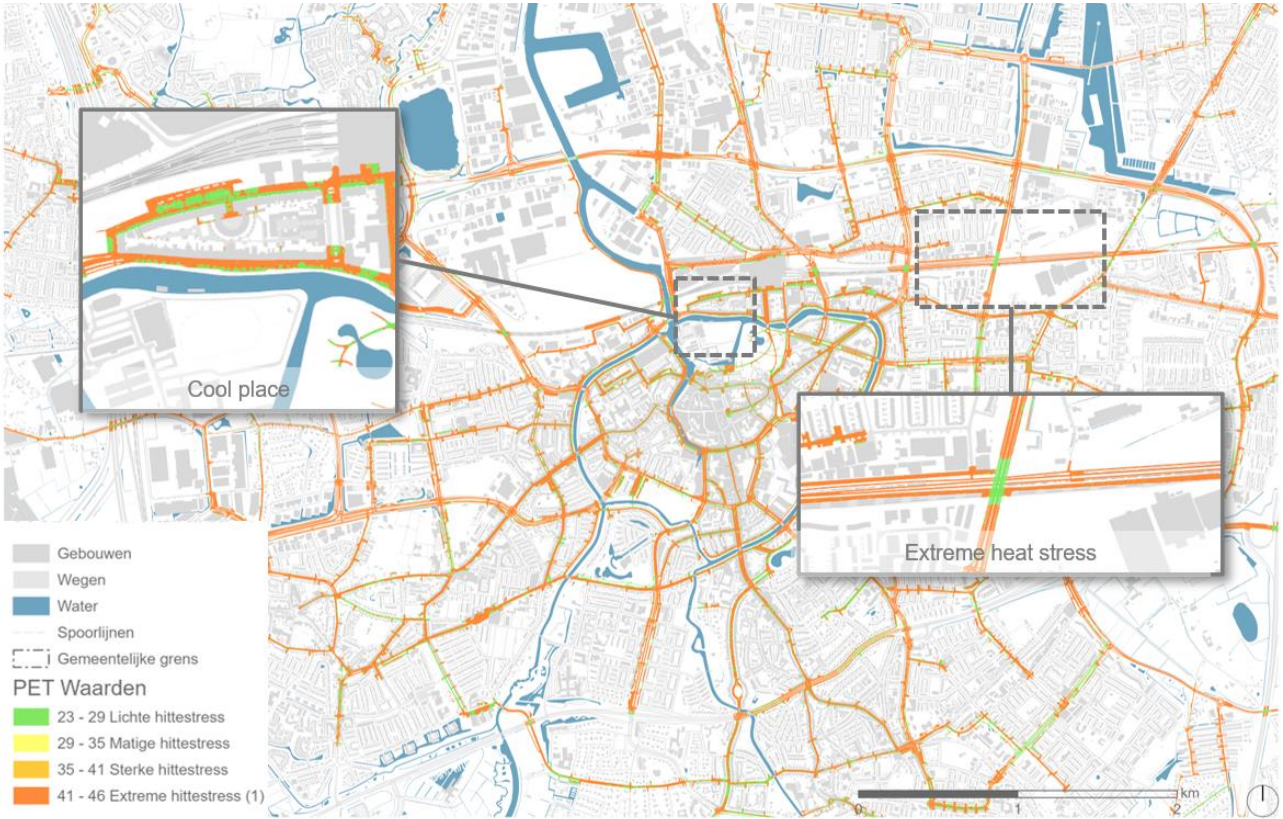
Vulnerable locations such as:
- Public transportation stops,
- Playgrounds,
- Childcare,
- Healthcare related facilities,
- and educational facilities, etc.

Future and/or planned developments such as:
- Street improvements
- Infill and retrofitting neighborhoods
- and commercial and housing, etc.

Mobility network such as:
- Primary and secondary slow traffic routes
- Public transportation routes
- Bike share locations, etc.

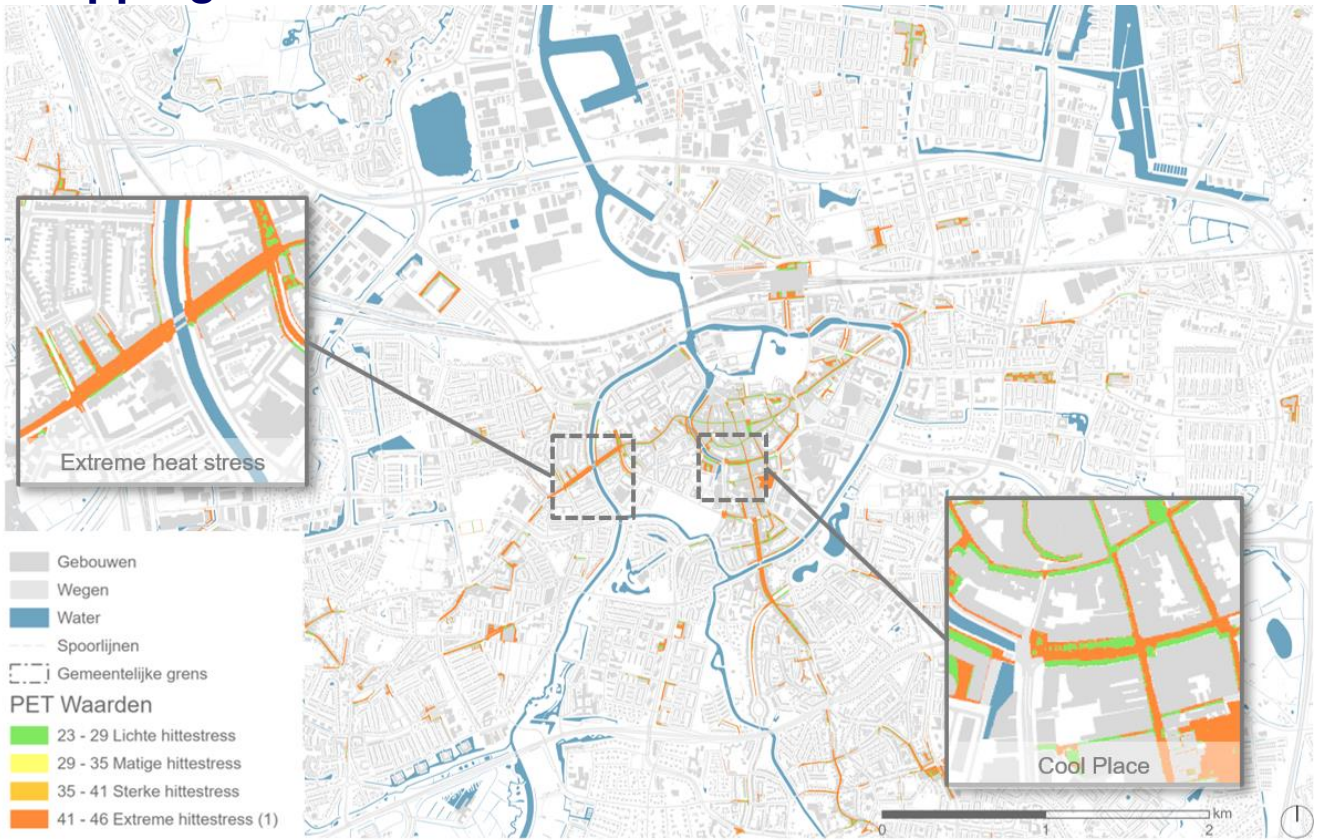
Locations to “stay” such as:
- Squares,
- Shopping streets,
- Parks and recreational areas.

# Slow traffic routes & intersections



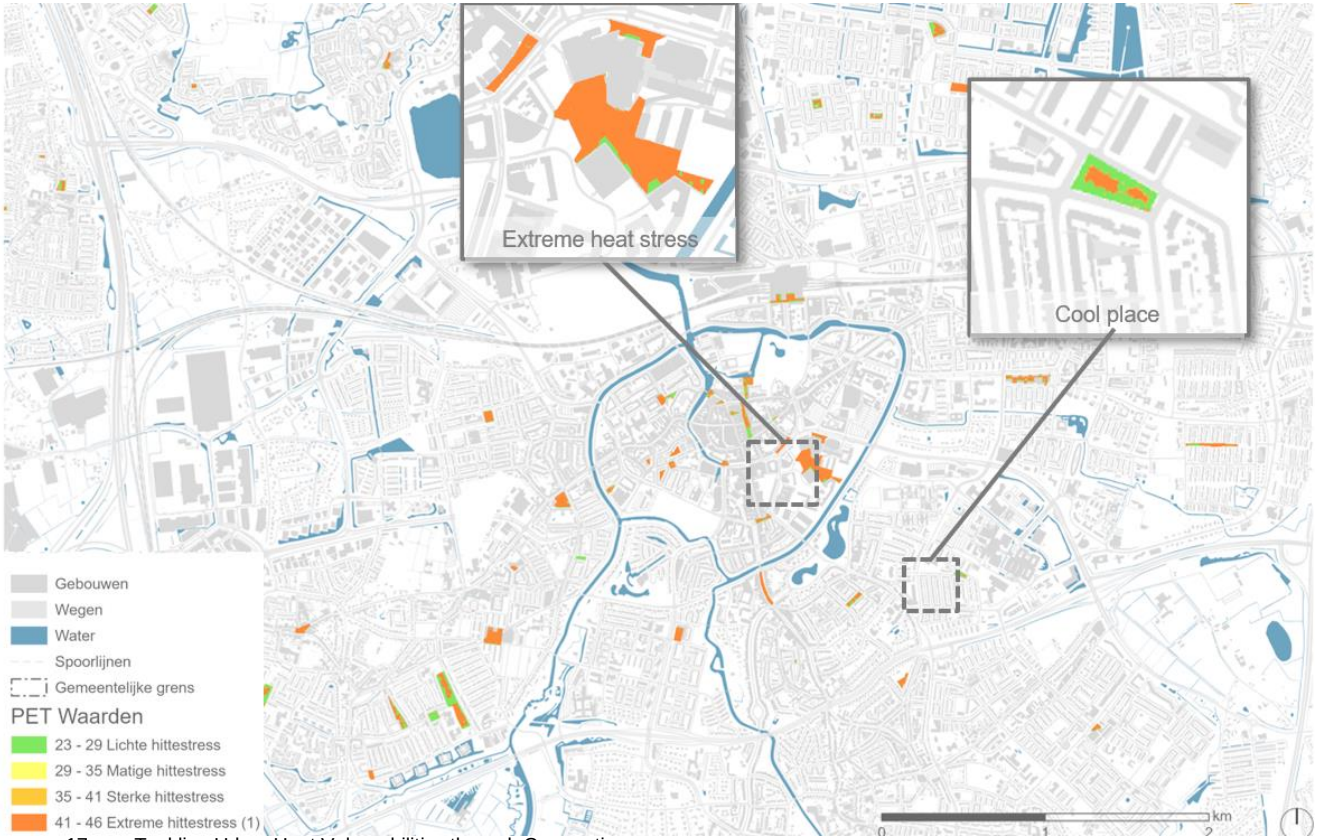

- Strava
- Input from stakeholders
- Local GIS data
- Traffic counts
- Expert analysis - digitized

# Shopping streets



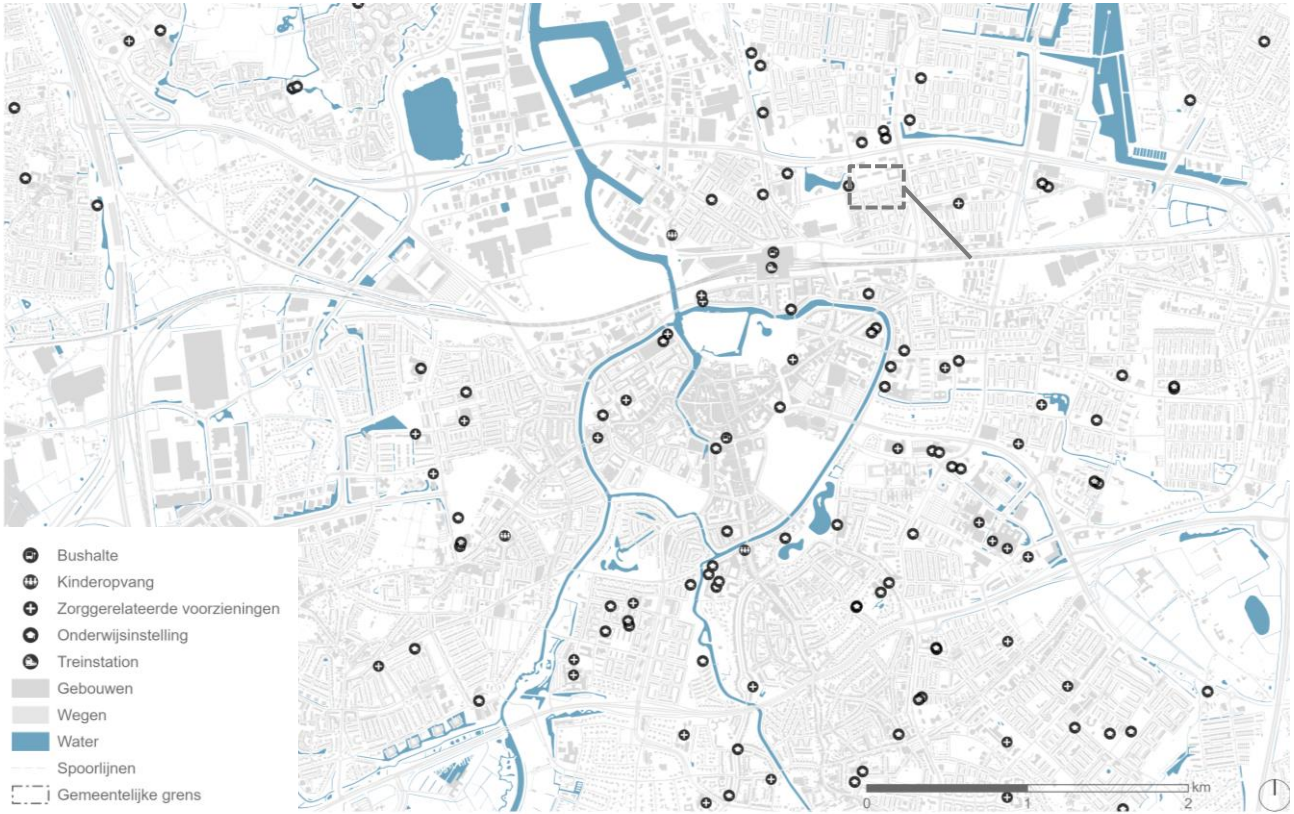

- Open Street Maps
- Input from stakeholders
- Local GIS data
- Expert analysis - digitized

# Squares, school yards & playgrounds



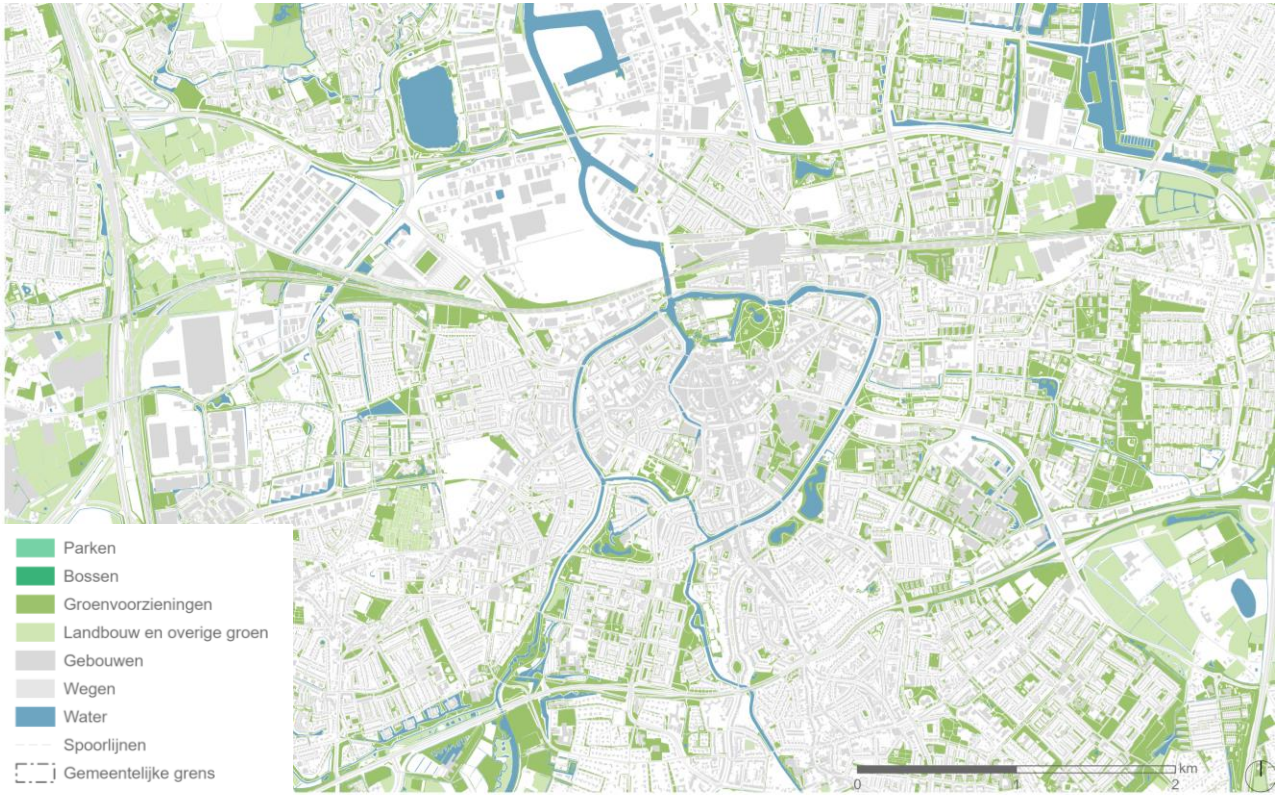

- Open Street Maps
- Input from stakeholders
- Local GIS data
- Expert analysis - digitized

# Vulnerable locations




- Open Street Maps
- Input from stakeholders
- Local GIS data
- Expert analysis - digitized

# Green spaces




- Open Street Maps
- Input from stakeholders
- Local GIS data
- Expert analysis - digitized

# Combine all the layers together


- Gives an overview of where heat stress occurs linked to use
- Next step prioritization

# 6. Multi-Criteria Analysis (MCA) for project prioritization

Squares, playgrounds and slow traffic intersections:

- Percentage surface area with extreme heat stress (PET > 35 ° C)
- Primary function (shopping centre, school, care facility, etc.)
- Type of slow traffic route
- Primary and secondary slow traffic intersections
- Amount of benches present

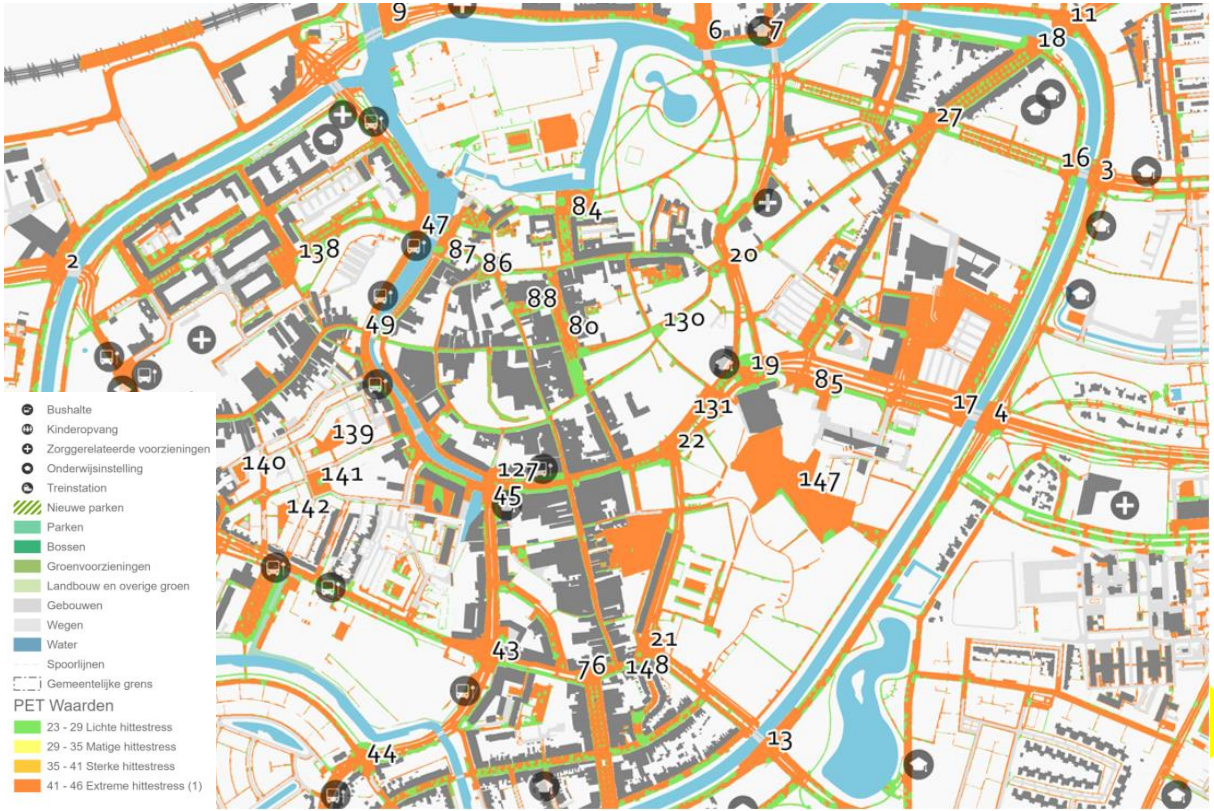
## 72 squares and playgrounds

| | | Location | Function | Seats | Route | % above 35 |
|---|---|---|---|---|---|---|
| 2 | 33 | Speeltuin Donkslagen | Speeltuin | 2 | Tertiair | 100% |
| 3 | 35 | Speeltuin Heksenwiellaan | Speeltuin | 3 | Tertiair | 100% |
| 4 | 49 | Speeltuin Heiveld | Speeltuin | 2 | Tertiair | 100% |
| 5 | 57 | Speeltuin Bramentuin | Speeltuin | 0 | Tertiair | 100% |
| 6 | 66 | Speeltuin Don Boscoplein | Speeltuin | 2 | Tertiair | 100% |
| 7 | 50 | Speeltuin Zonnedauw | Speeltuin | 1 | Tertiair | 100% |
| 8 | 29 | Speeltuin Juliana de Lannoystraat | Speeltuin | 4 | Tertiair | 100% |
| 9 | 46 | Speeltuin Nieuwe Daalakker | Speeltuin | 2 | Tertiair | 100% |
| 10 | 52 | Oude Vest | Horeca | 3 | Primair | 99% |
| 11 | 36 | Speeltuin Priemkruid | Speeltuin | 5 | Tertiair | 98% |
| 12 | 53 | Winkelstraat Wilhelminastraat | Winkelstraat | 0 | Primair | 97% |
| 13 | 38 | | Speeltuin | 0 | Tertiair | 97% |
| 14 | 10 | Graaf Hendrik III Plein | Winkelgebied/Parkeren | 6 | Primair | 97% |
| 15 | 60 | Plein van Gastelveld | Speeltuin | 0 | Tertiair | 95% |
| 16 | 65 | Verbeetenstraat | Winkelgebied | 0 | Tertiair | 95% |
| 17 | 17 | Speeltuin Talmastraat Breda | Speeltuin | 0 | Secundair | 94% |
| 18 | 68 | Chassé Promenade | evenemententerrein | 4 | Primair | 94% |
| 19 | 2 | winkelcentrum heksenwiel | Winkelcentrum | 12 | Primair | 94% |
| 20 | 39 | Speeltuin Rijtsweg | Overig | 4 | Tertiair | 94% |
| 21 | 61 | Pelmolenshof | Speeltuin/parkeren | 0 | Tertiair | 94% |
| 22 | 43 | Haagsemarkt | Winkelstraat | 12 | Secundair | 93% |
| 23 | 47 | Speeltuin Hoge Daalakker | Speeltuin | 2 | Tertiair | 93% |
| 24 | 67 | Dr. Struyckenplein | Winkelgebied | 0 | Primair | 92% |
| 25 | 6 | Kloosterplein | Culturele | 11 | Primair | 91% |
| 26 | 26 | Speeltuin Midenerf | Speeltuin | 4 | Tertiair | 90% |

## 83 slow traffic intersections

| | | Location | % above 35 |
|---|---|---|---|
| 2 | 61 | CornelisJoosstraat-LangeWeide-Kapittelweg-Maasdijk | 99,22% |
| 3 | 55 | Stationslaan-Belcrumweg | 99,04% |
| 4 | 74 | Ettensebaan-Heilaarstraat-Iabc | 98,72% |
| 5 | 26 | NieuweKadijk-Kapittelweg | 98,62% |
| 6 | 34 | ClaudiusPrinsenlaan-Heerbaan-VerlengdePoolseweg | 98,47% |
| 7 | 73 | Ettensebaan-Tuinzigtlaan | 98,08% |
| 8 | 57 | Crogtdijk-Konijnenberg-BackerEnRuebweg | 98,01% |
| 9 | 54 | Trekpot-NieweKadijk-Teteringseweg | 97,03% |
| 10 | 52 | Terheijdenstraat-Terheijdenseweg-Stationslaag | 96,90% |
| 11 | 5 | Julianalaan-Irenestraat | 96,76% |
| 12 | 33 | Tilburgseweg-NieuweKadijk | 96,73% |
| 13 | 69 | Haagweg-Ettensebaan-VincentVanGoghstraat | 95,63% |
| 14 | 56 | Moerlaken-Konijnenberg | 95,10% |
| 15 | 23 | Teteringsedijk-Beverweg-Kapittelweg | 94,56% |
| 16 | 79 | NieuweKadijk-Doornboslaan | 94,22% |
| 17 | 83 | Spoorstraat-Moskesweg | 92,41% |
| 18 | 66 | Lunetstraat-Meidoornstraat-Ravelijnstraat | 91,25% |
| 19 | 39 | FranklinRooseveltlaan-Ginnekenweg-PrinsHendrikstraat | 90,62% |
| 20 | 25 | ClaudiusPrinsenlaan-Beverweg-deLaReijweg | 90,50% |
| 21 | 67 | ZoetelnvaI-Lunetstraat-RatVerleghstraat | 89,94% |
| 22 | 75 | Leursebaan-Iabc | 88,72% |
| 23 | 72 | NieuweHeilaarstraat-Heilaarstraat | 88,61% |
| 24 | 82 | Valkeniersplein-Allerheiligenweg-Valkenierslaan-Overakkerstraa | 88,35% |
| 25 | 35 | JohanWillendFrisolaan-Baronielaan | 86,94% |
| 26 | 64 | Doornboslaan-Teteringsedijk-Teteringsestraat-Ceresstraat | 86,64% |

# Combine the advanced vulnerability and MCA




- Gives an overview of where heat stress occurs linked to use
- Next step prioritization

# Co-creation session questions?

# Co-creation session questions:

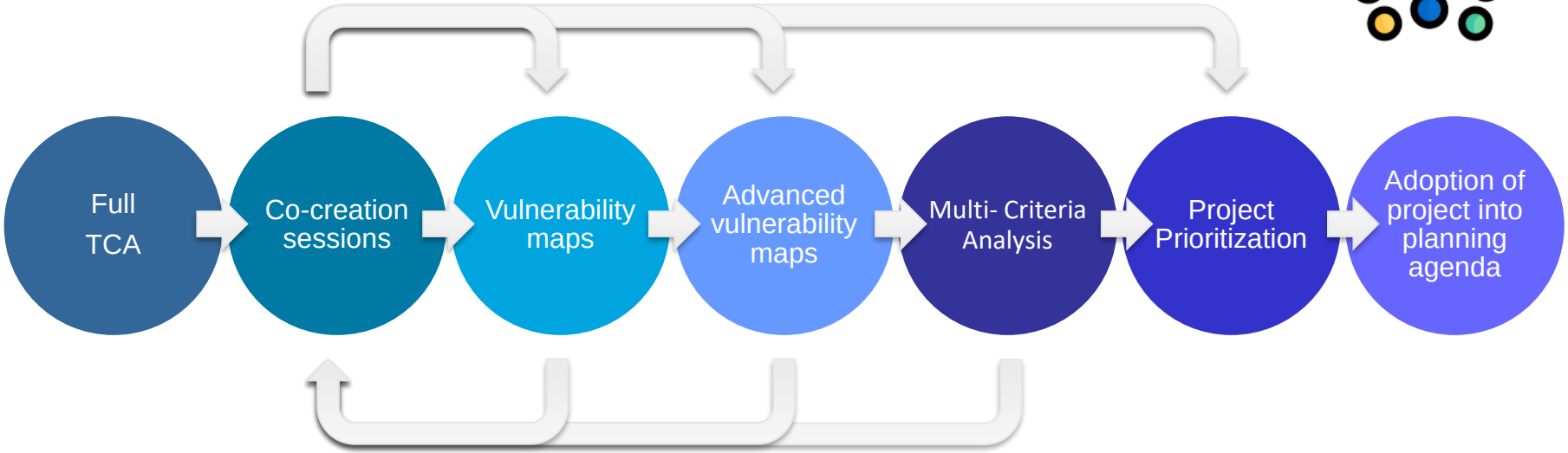
- Given your expertise, which areas experience heat stress?
- Which are locations that require the most attention?
- Within your expertise what are important criteria for prioritizing a project?
  - PET %
  - Function
  - User intensity
  - feasibility
  - Link opportunities with existing projects
  - Co-benefits (higher biodiversity, water management, etc.)

# 7. Co-creation sessions with municipal stakeholders

- Participants were divided into two groups and tasked with determining priority project locations
- They filtered out locations that had recently been redeveloped or were planned for redevelopment soon
- Consensus among participants that playgrounds experiencing significant heat stress should be prioritized
- Created a top 10 list of locations that could be made more heat-resistant in the upcoming years

# Is this something you could use?

## identifying & prioritizing projects



Amsterdam University of Applied Sciences

**Thank you!**
**Questions or comments?**

**Please be in contact if you have any more questions or would like to connect!**

Stephanie Erwin - s.m.erwin@hva.nl
Sába Schramkó - s.k.schramko@hva.nl

Böcker, L. and Thorsson, S. (2014). Integrated Weather Effects on Cycling Shares, Frequencies, and Durations in Rotterdam, The Netherlands. 6, (4), 468-481. doi: 10.1175/WCAS-D-13-00066.1

Ebi, K.L. et al. (2021). Hot Weather and Heat Extremes: Health risks. The Lancet, 398, (10301), 698-708. doi: 10.1016/S0140-6736(21)-1208-3

Elnabawi, M. H., & Hamza, N. (2020). Behavioural Perspectives of Outdoor Thermal Comfort in Urban Areas: A Critical Review. Atmosphere, 11(1), 51. doi: 10.3390/atmos11010051

Spanjar, G., Bartlett, D., Schramkó, S., & Kluck, J. (2022). The Urban Heat Atlas: A standardised assessment for mapping heat vulnerabilities in Europe. Amsterdam: Amsterdam University of Applied Sciences.