

# **Green infrastructure for climate resilient cities: Potentials and planning strategies**

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# Climate change impacts

Intensification of urban heat island



Pluvial flooding



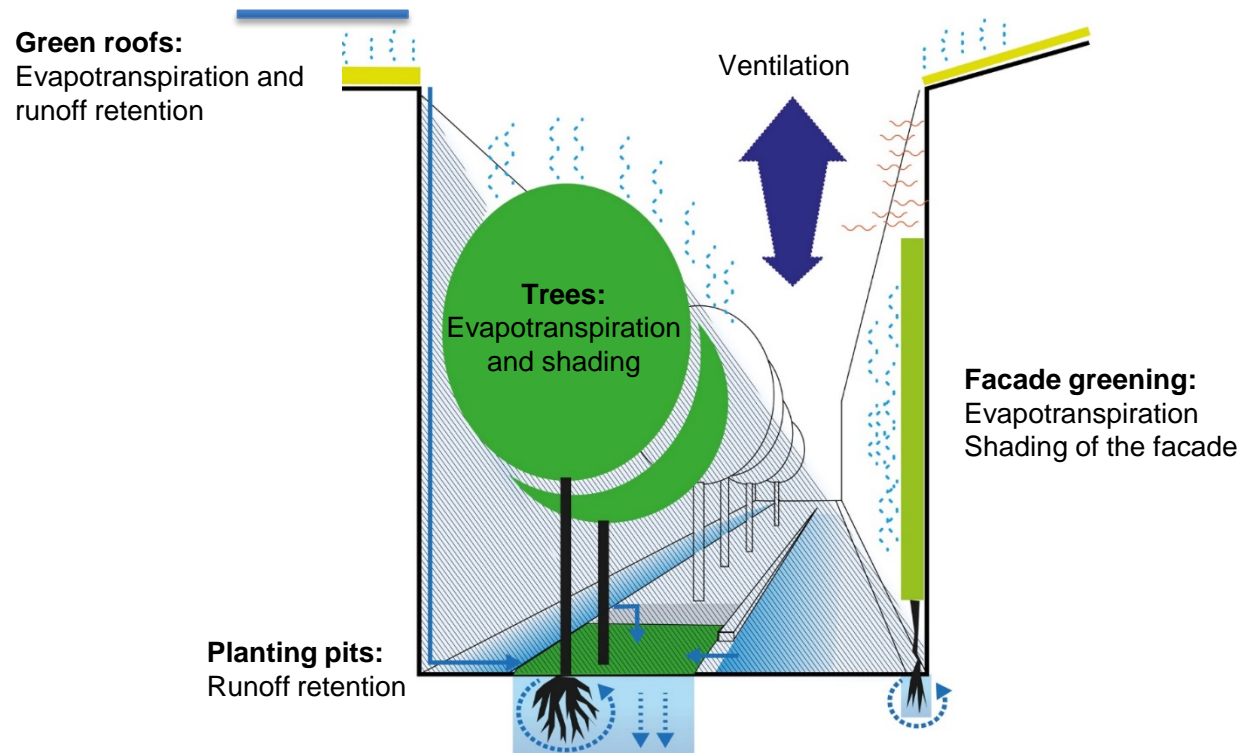
Coastal & riverine flooding

1: <http://www.abendzeitung-muenchen.de/>

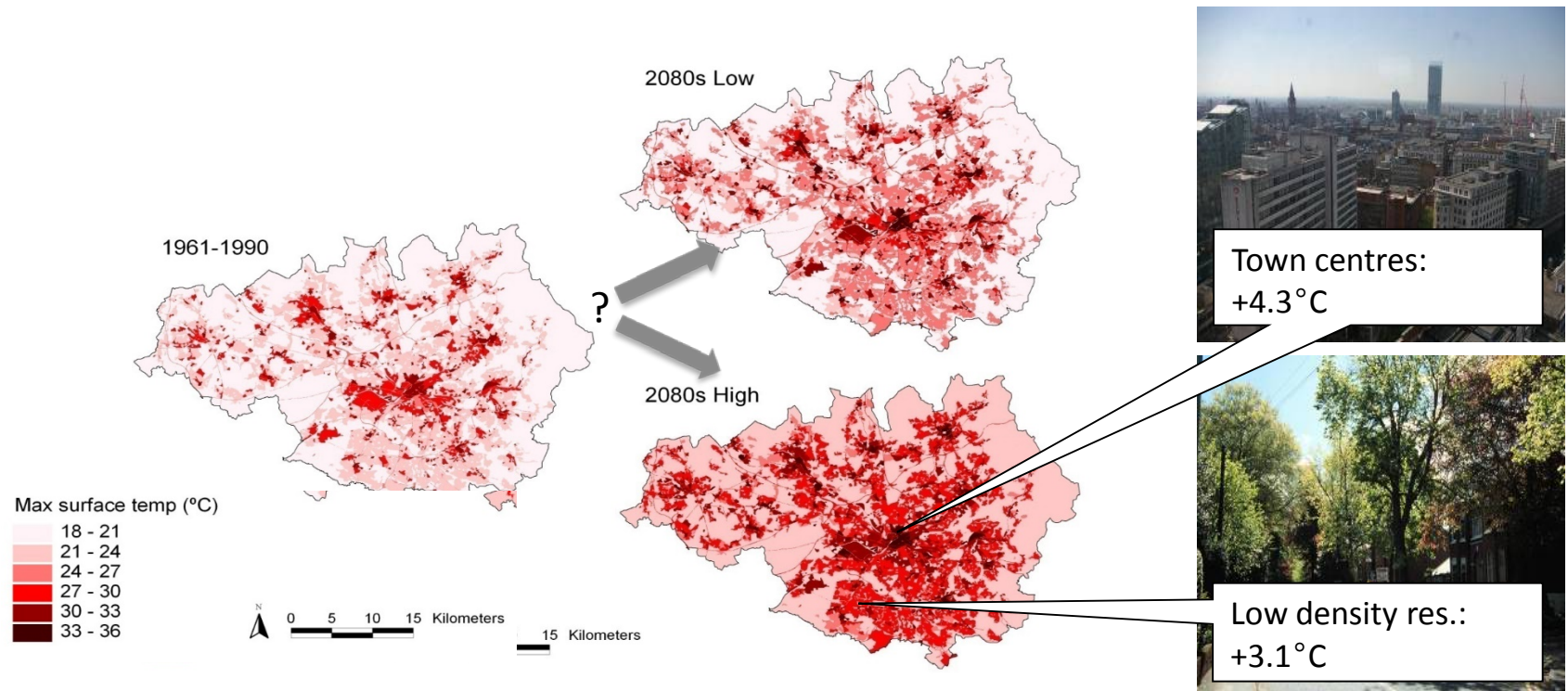
2: <http://www.bbk.bund.de/>

3: <http://www.thecitizen.co.tz/News/national/Dar-City-to-sink-in-next-five-decades/1840392-2314864->

# Regulating services of UGI

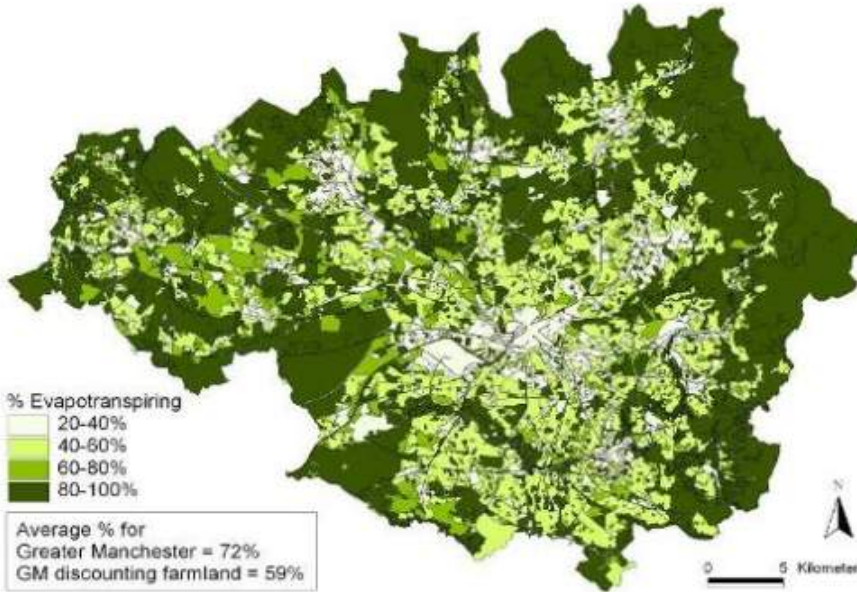


# Intensification of heat island effect in Manchester

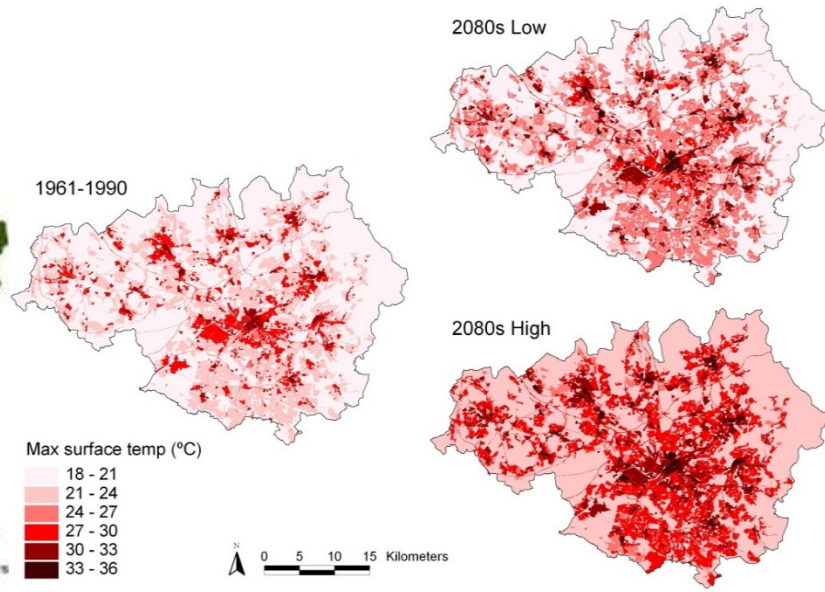


# Green buffers

## Green cover



## Temperature increase until 2080



# ± 10 % green in the town centres of Greater Manchester

## High emission scenario:

- No change in green cover in town centres:
- + 10% green cover:
- - 10% green cover:

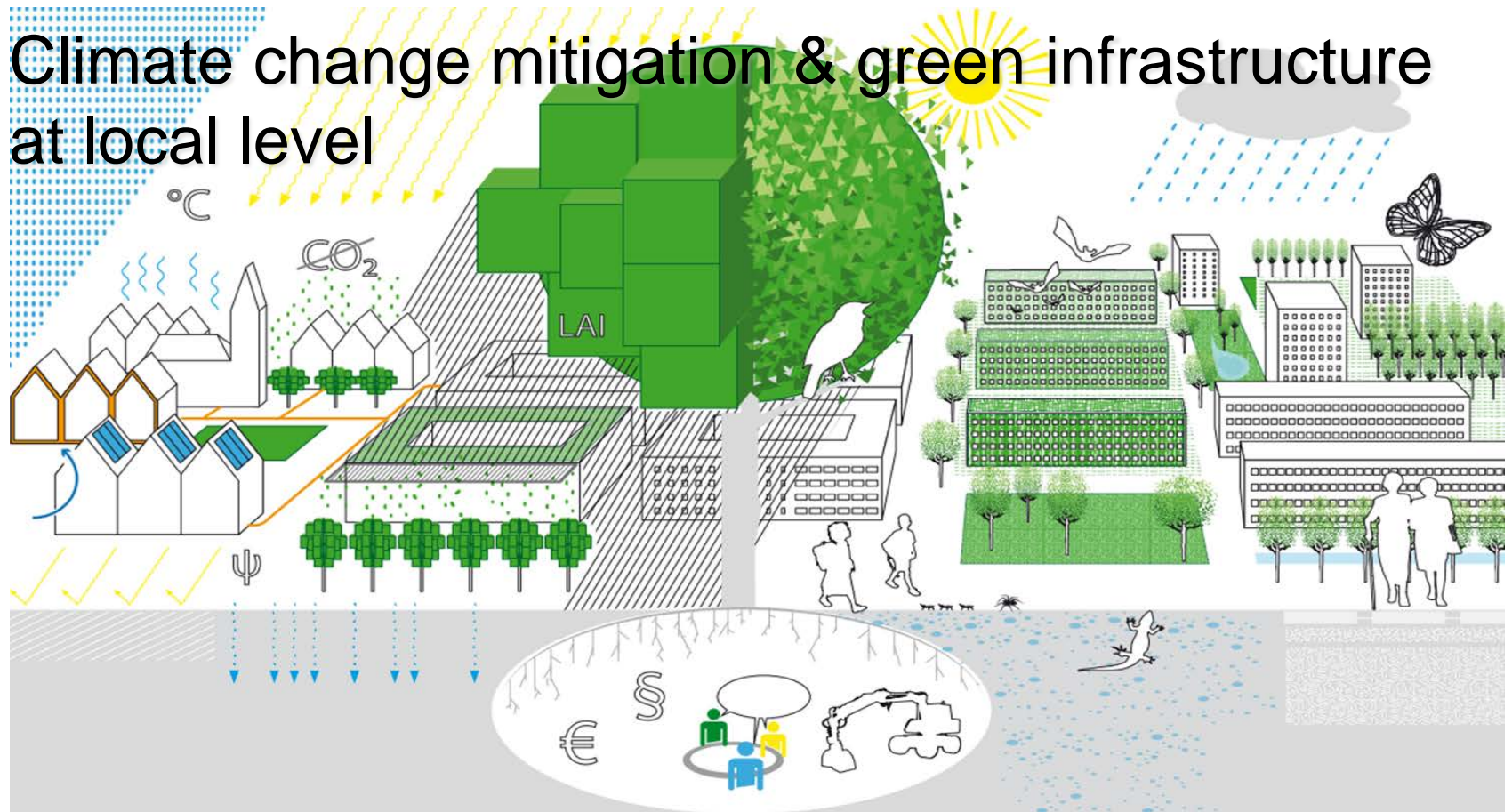
## Surface temp.

+ 4.3° C  
+ 0.6° C  
+ 8.2° C

### Adaptation Strategies for Climate Change in the Urban Environment (ASCCUE)

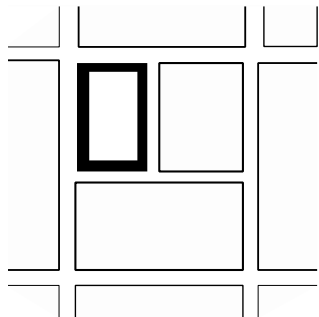
Consortium members: CURE (University of Manchester), CRiBE (Cardiff University),  
DCEE (University of Southampton), OCSD (Oxford Brookes University)

# Climate change mitigation & green infrastructure at local level



# Potential for adaptation in three urban types

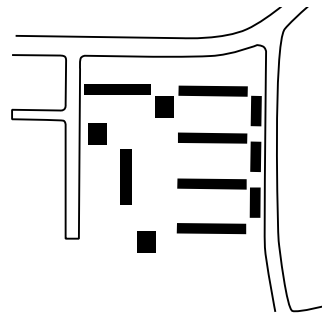
Perimeter blocks



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Munich - Maxvorstadt

Multistorey blocks



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Munich - Neuaubing

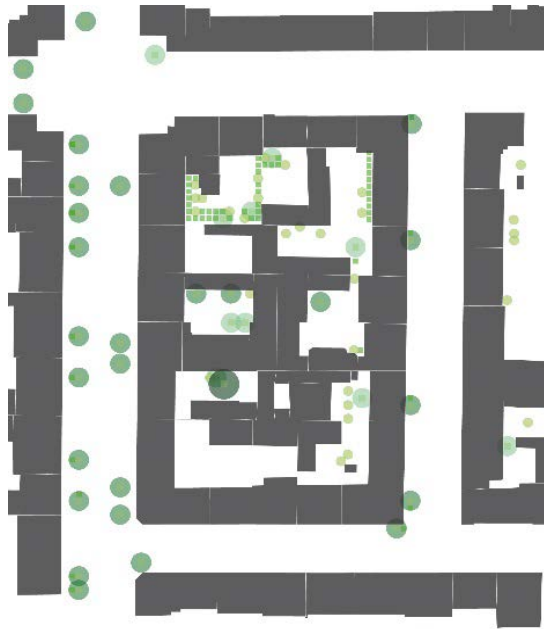
Historic town centre



© Microsoft Corporation

Würzburg - Heidingsfeld

# Perimeter block, Munich



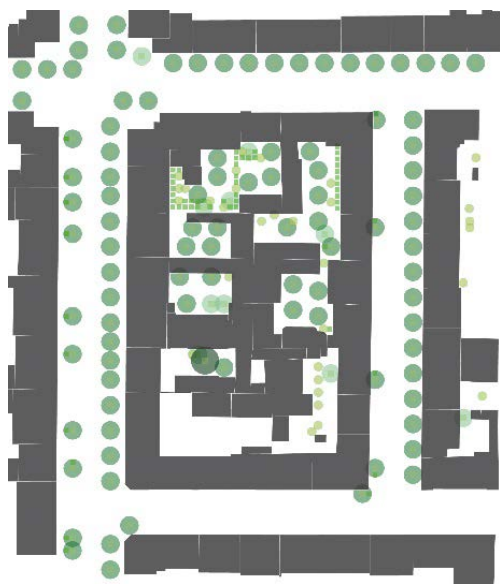
Green cover → 9%



# Greening scenarios



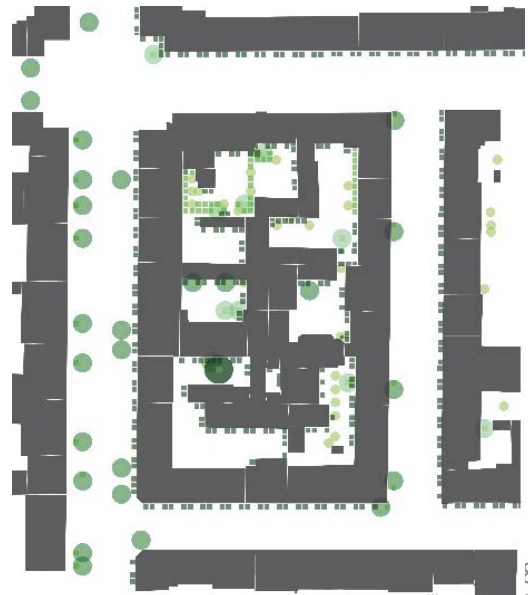
**Trees → 24% (+15%)**



**Green roofs → 18% (+9%)**



**Façades → 12% (+3%)**



# Potential of GI elements to improve thermal comfort (PET)

| Scenario<br>R = Realistic, M = Maximum |       | Today  | 2050  |
|--|-------|--------|-------|
| Tree R                                 | (24%) | - 10.3 | - 4.0 |
| Tree M                                 | (34%) | - 13.0 | - 7.1 |
| Roof R                                 | (9%)  | 0.0    | + 6.3 |
| Roof M                                 | (47%) | - 0.5  | + 6.3 |
| Façade R                               | (4%)  | - 5.1  | + 0.9 |
| Façade M                               | (11%) | - 9.8  | - 4.1 |

# Effect of tree plantings on thermal stress

Baseline



Realistic trees → - 10 %



**PET**

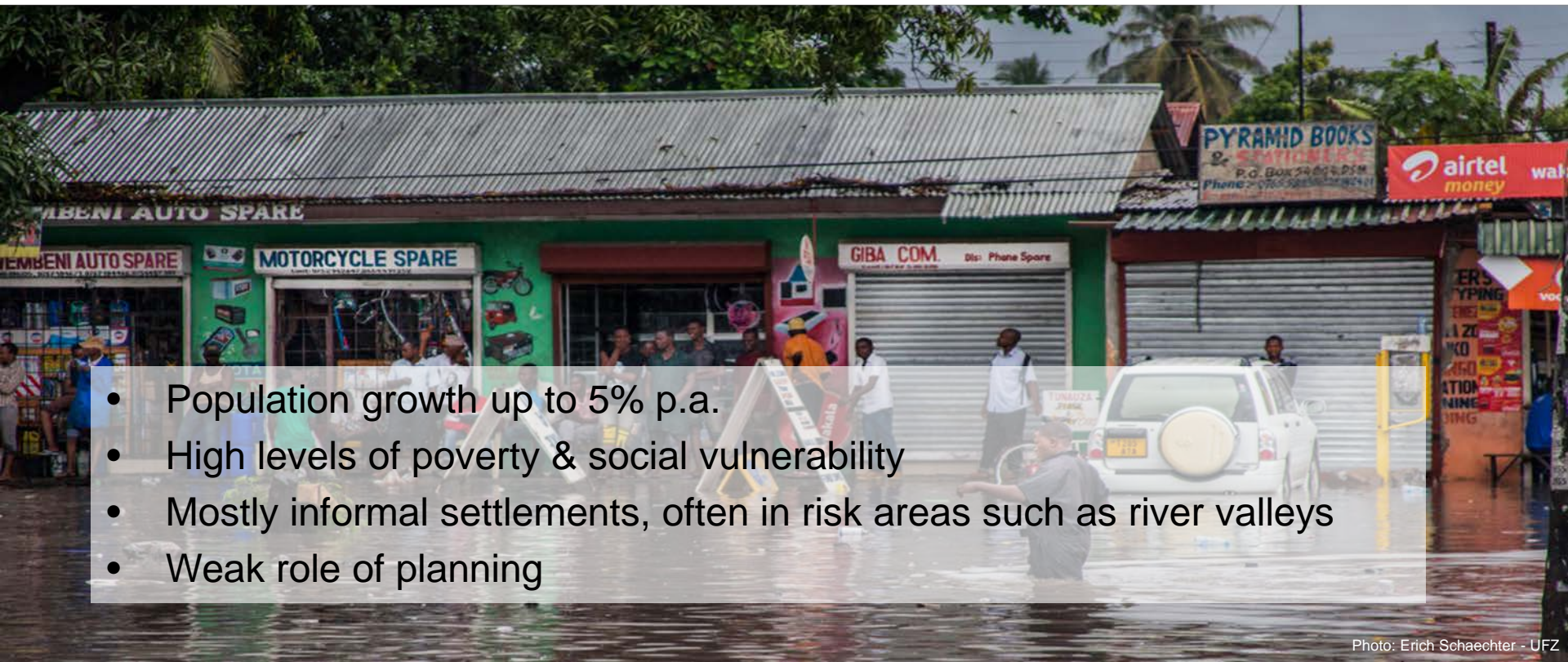
- below 31 °C
- 31 to 35 °C
- 35 to 39 °C
- 39 to 43 °C
- 43 to 47 °C
- 47 to 51 °C
- 51 to 55 °C
- 55 to 59 °C
- 59 to 63 °C
- above 63 °C

**Objects**

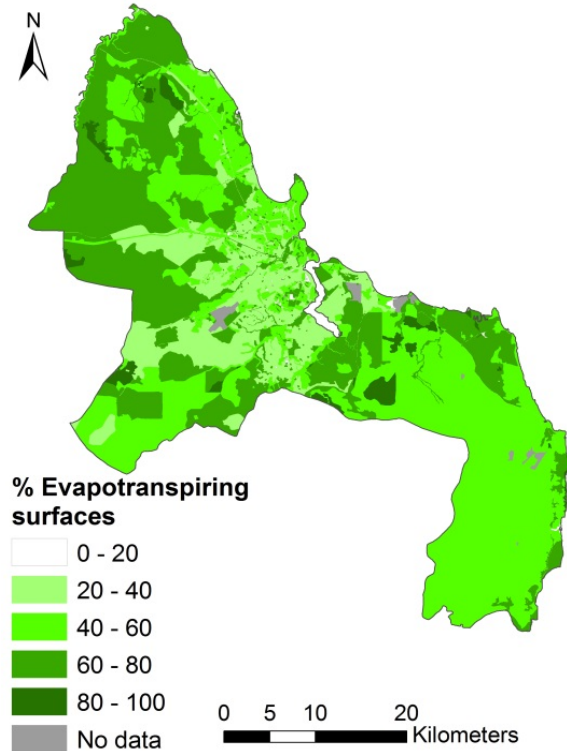
- Buildings

At 3 p.m. in 1.4m height

# Climate change and urban vulnerability in Africa

- 
- Population growth up to 5% p.a.
  - High levels of poverty & social vulnerability
  - Mostly informal settlements, often in risk areas such as river valleys
  - Weak role of planning

# Green infrastructure in Dar es Salaam



## Important provider of ecosystem services:

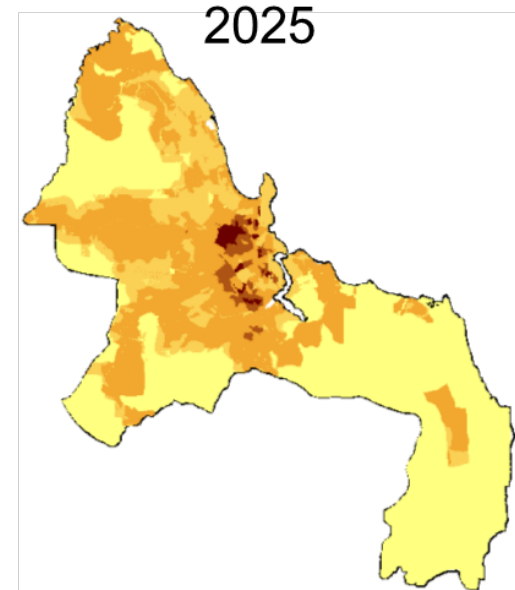
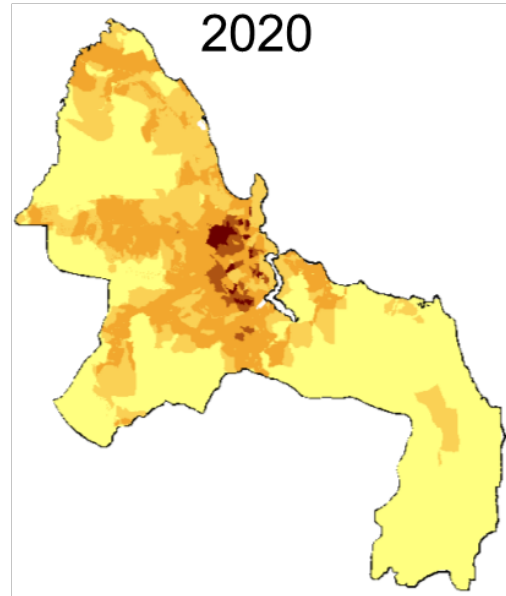
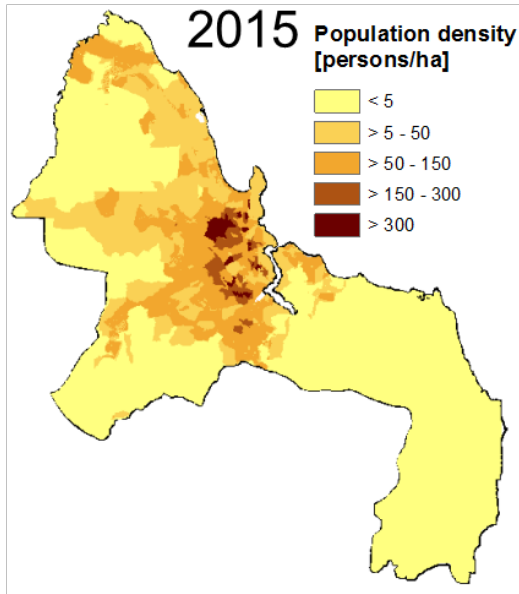
- Food, medicine, fuel, fibres ...
- Moderation of UHI, stormwater & flood retention

## But from 2002 - 2008 loss of:

- 9% of farmland
- 29% of woodlands
- 8% of large trees

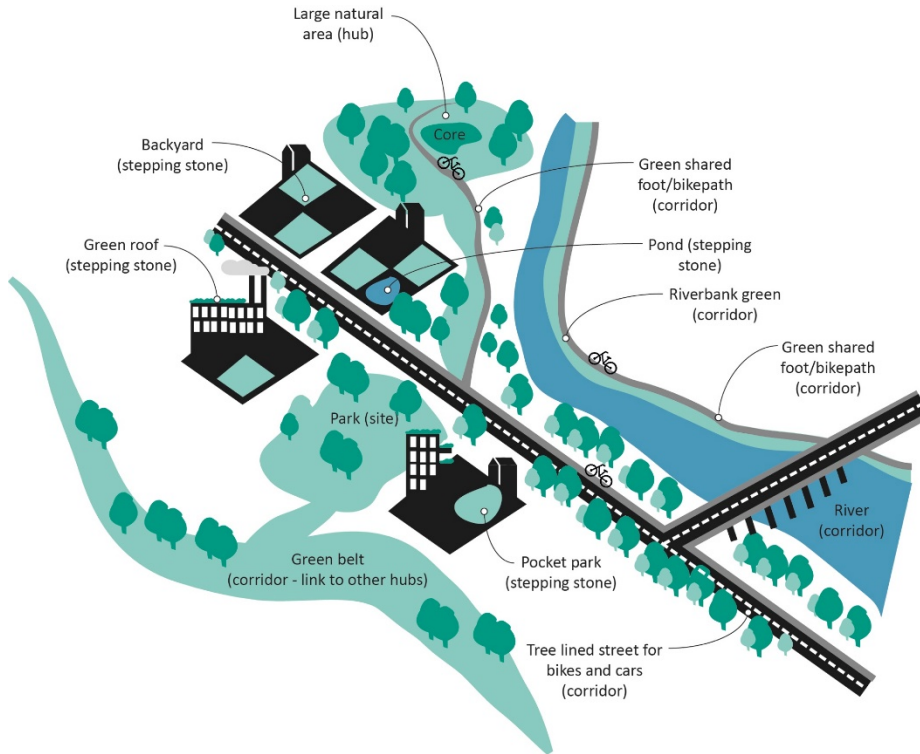


# What might happen until 2025



- Increase of settlement area from 47% to 53%
- Increasing population density in new settlements from 150 to 350 inh./ha would save more than 5000 ha of farmland

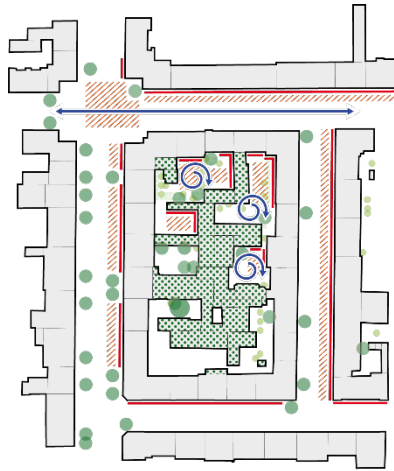
# Strategic planning of urban green infrastructure



- Green networks that provide multiple benefits for achieving social, ecological and economic goals
- From natural green space, parks & gardens to green roofs
- Key principles:
  - connected
  - multifunctional
  - grey & green integrated
  - socially inclusive

# Guidance for CC adaptation via UGI at local level

- Current**
- Grass
  - Shrub
  - Tree
  - Large tree
- Measures**
- Shading of facades
  - Shading of open spaces
  - Roof greening
  - Preservation/ enhancement of ventilation
  - Avoiding barriers in main wind direction



## Priorities for UGI measures:

- Shading of sun-exposed surfaces
- Creation of retention areas
- Ventilation



Thank you!

