

# THE ROLE OF URBAN CLIMATE MAP IN PHNOM PENH'S FUTURE DEVELOPMENT PLAN, CAMBODIA

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Chhinh, & Lutz Katzschner



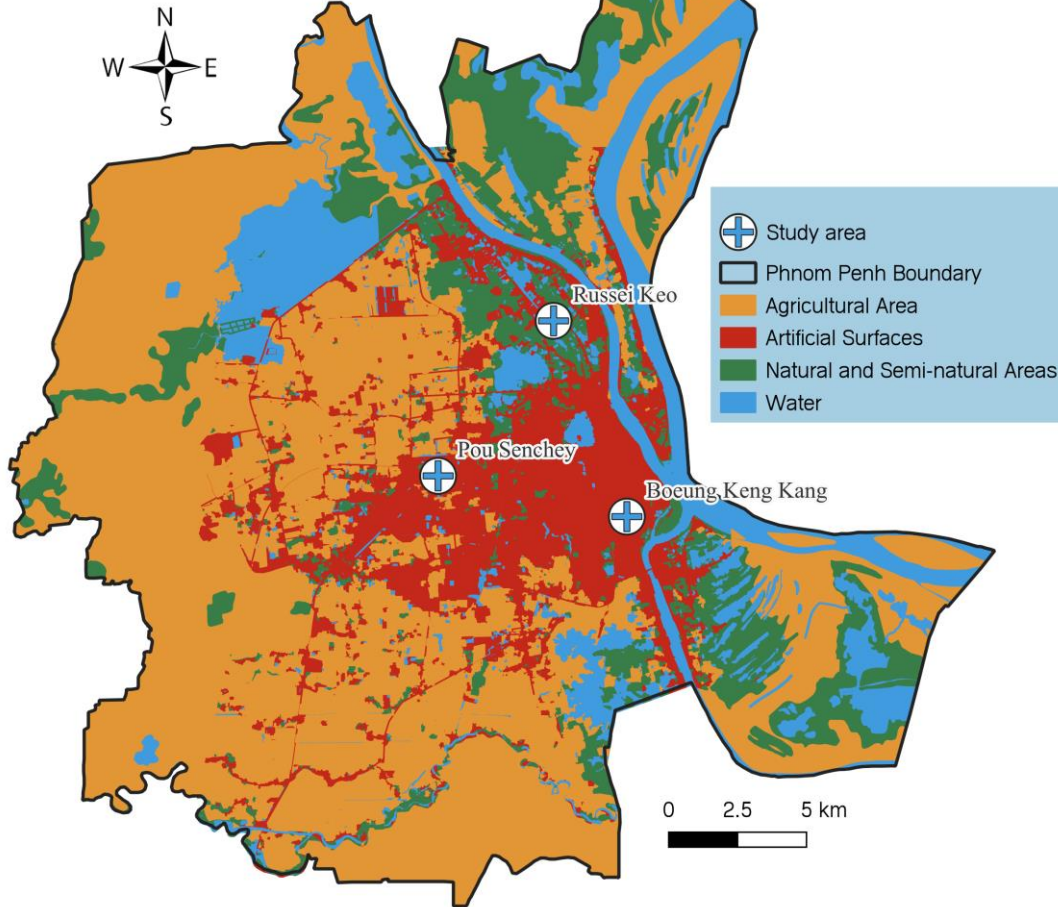
# Outline

- Land use map of Phnom Penh
- Urban climate map of Phnom Penh
- Urban climate analysis
- Case study of simulation
- Urban climate design strategy
- Guidelines for urban climate design recommendations and climate analysis
- Case study of measurements
- Climatology is active in climate protection and climate adaptation
- What next?

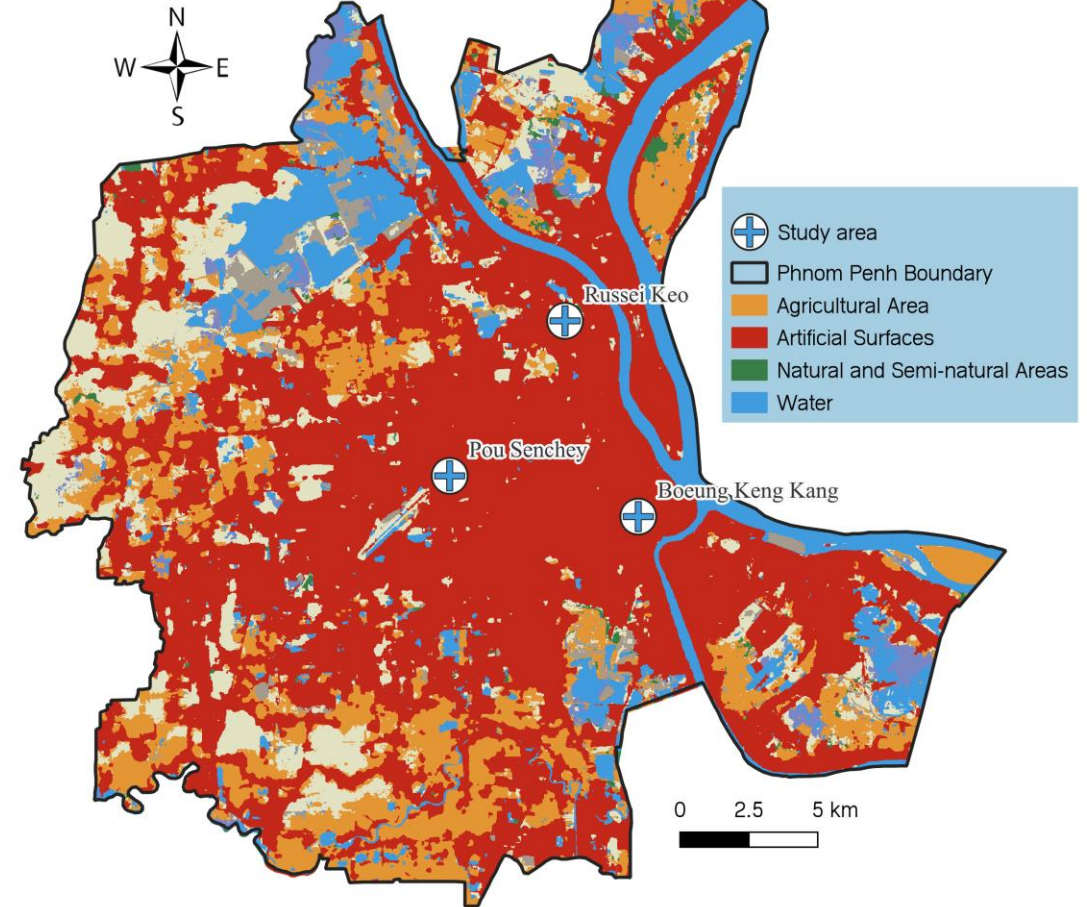


# Land use map of Phnom Penh in 2023

2003

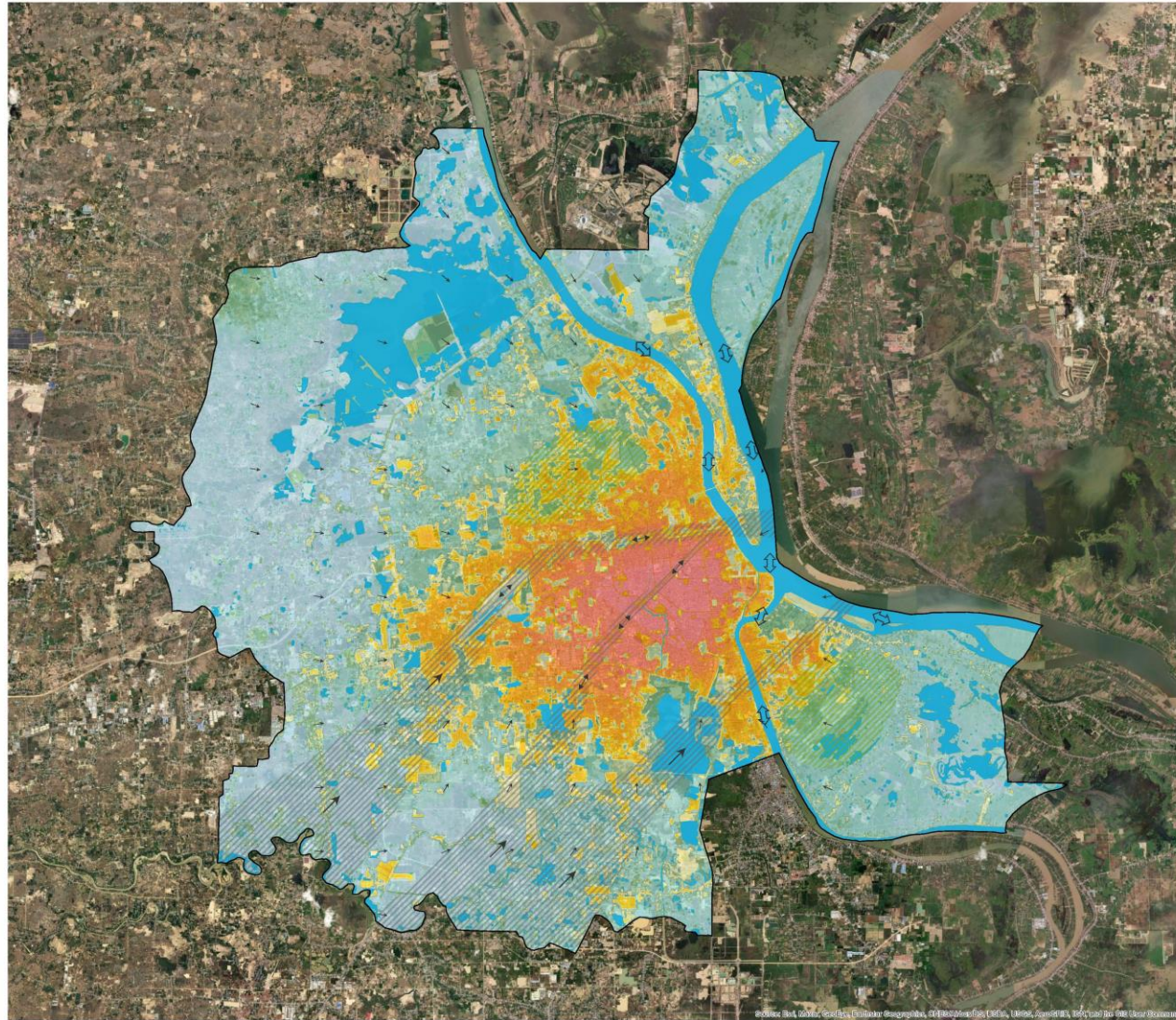


2023





# Urban climate map of Phnom Penh



## URBAN CLIMATE MAP PHNOM PENH 2022 ver.02

### Climatope

Category	Name
Light Blue	Strong cooling potentials
Green	Moderate cooling potentials
Light Green	Slight cooling potentials
Yellow	Reduced heat load
Orange	Moderate heat load
Red	Strong heat load

### Dynamic pattern

Category	Name
Vertical double-headed arrow	Ventilation corridor
Upward arrow	Wind direction air paths
Vertical double-headed arrow	Wind direction air paths for all seasons
Diagonal hatched pattern	Main air paths
Green diagonal hatched pattern	Good ventilation

## WP5 Urban Climate អាកាសធាតុទីក្រុង

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Scale 1:100,000  
1 cm = 1000 m

FONA  
Research for sustainability

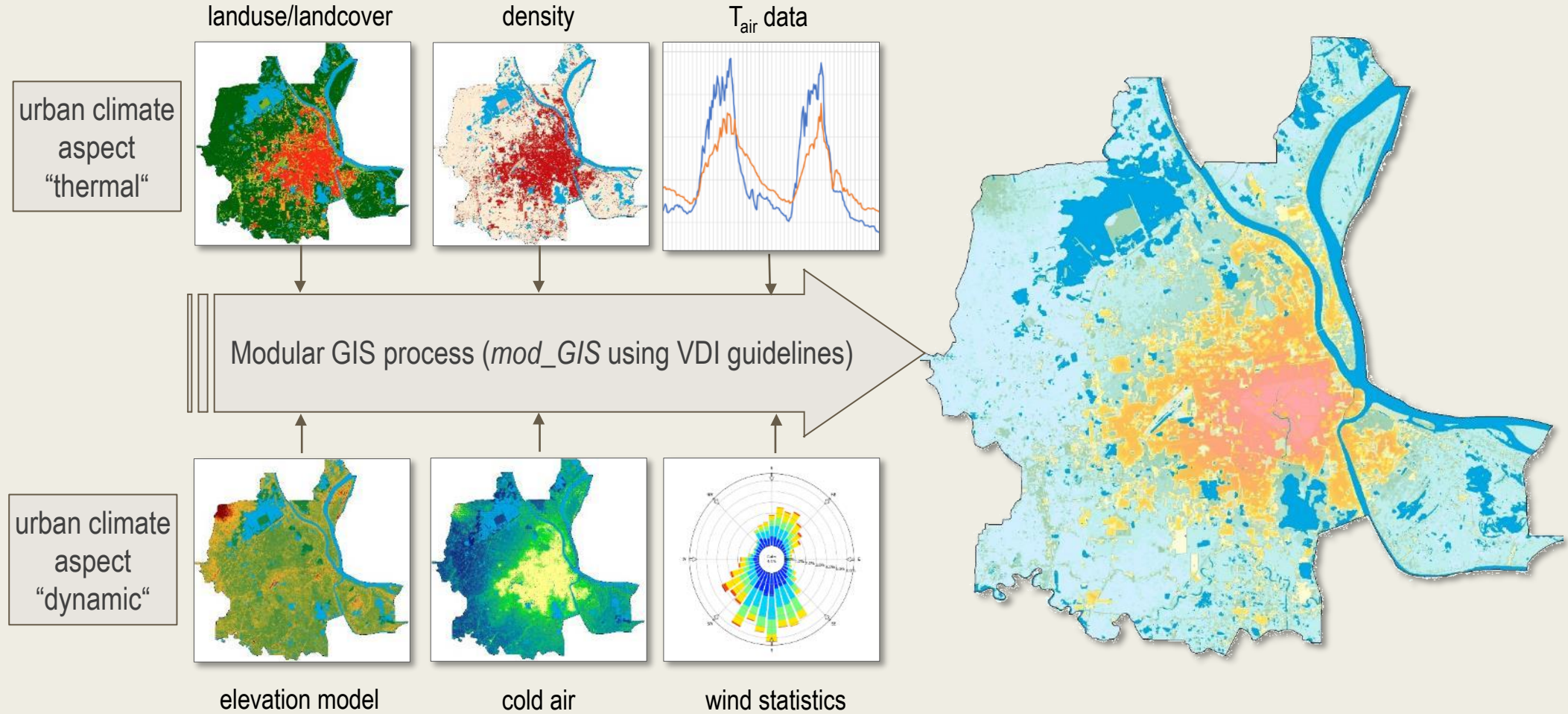
INKEK  
Institute for climate and energy concepts  
Kapski, Jan 2023

ផែនទីវិភាគអាកាសធាតុទីក្រុង

Urban climatic map in mesoscale with a grid size of 20 m



# Urban climate map data input





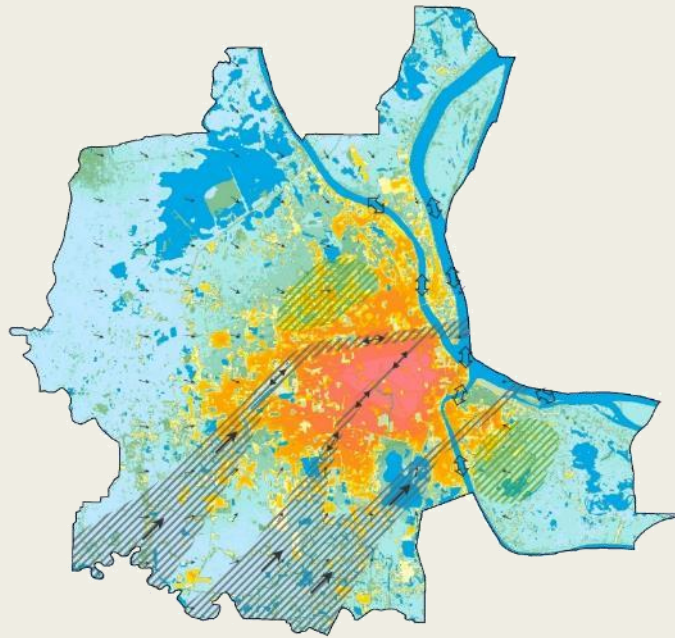
# Urban climate analysis

## MESOSCALE: Urban Climate Analysis & Map

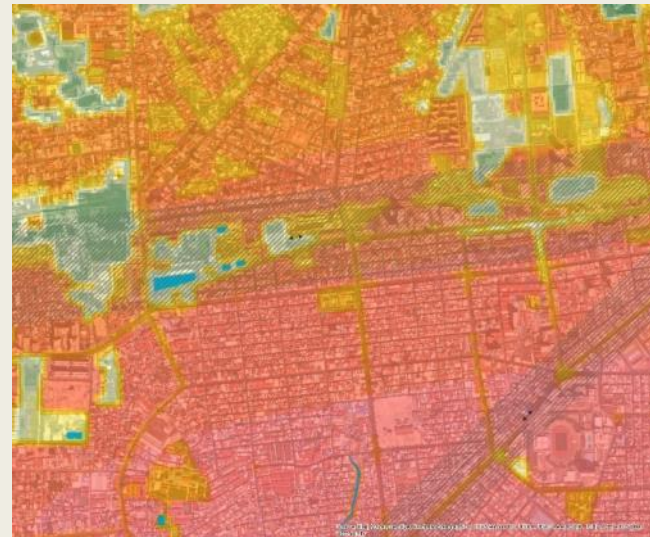
Climate functions, climatope characteristics, ventilation, heat load

## MICROSCALE: Microclimate Analysis

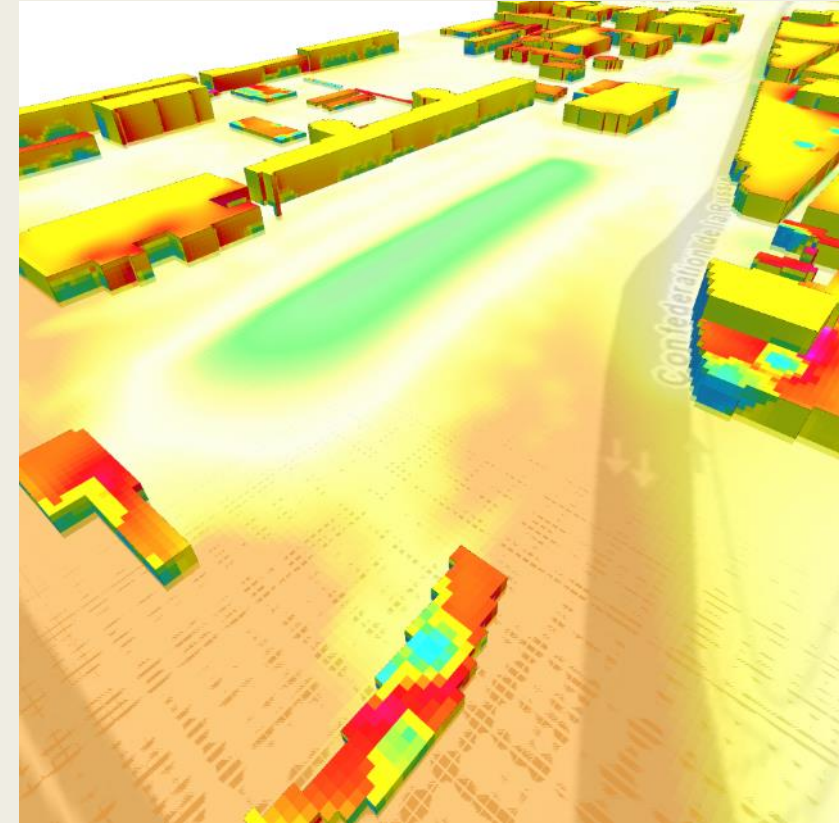
Local climate conditions, effect of buildings and single vegetation



city wide map



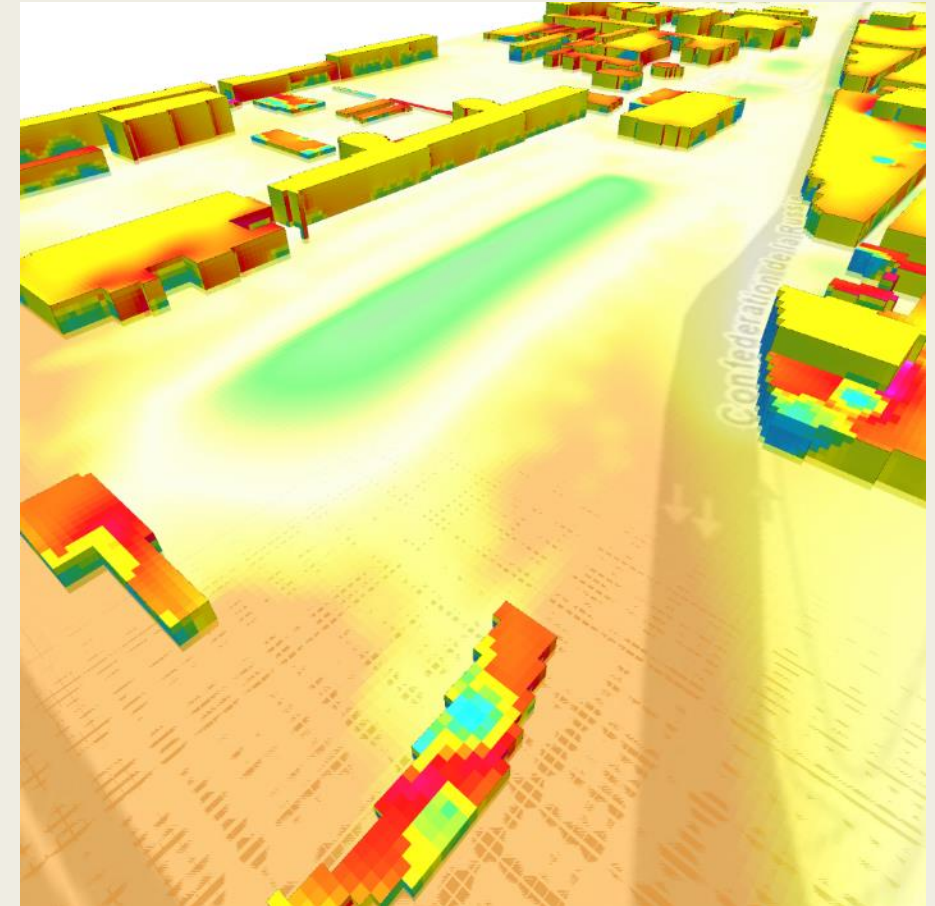
neighbourhood design and open spatial planning





# From urban climate to local conditions

- For neighborhood design more specified analyses are needed.
- Microclimate analyses show the effect of buildings or the influence of urban green and different open space materials.



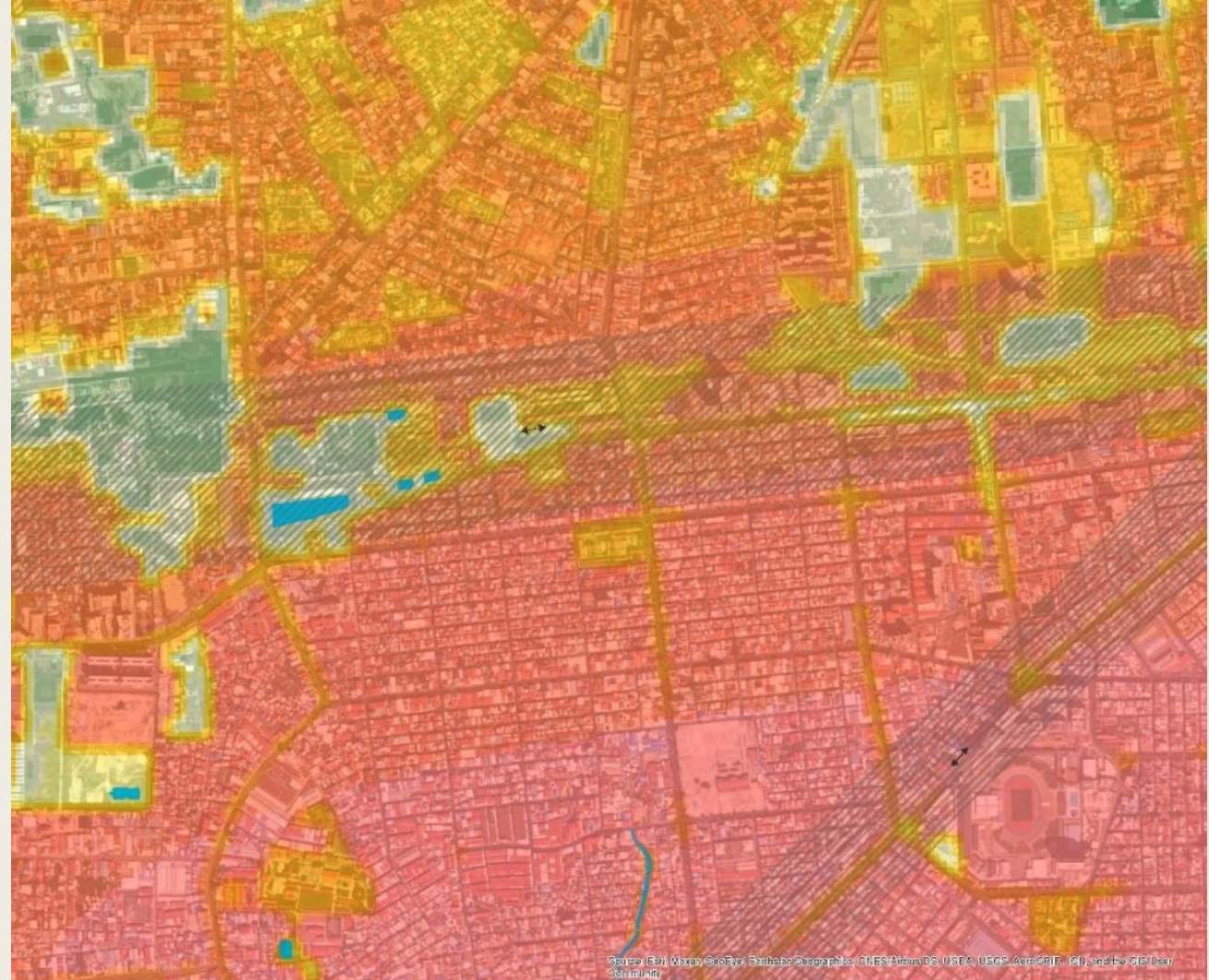


# Underlying data of urban climate map

Effects of

- *individual building*
- *trees*
- *and surface materials*

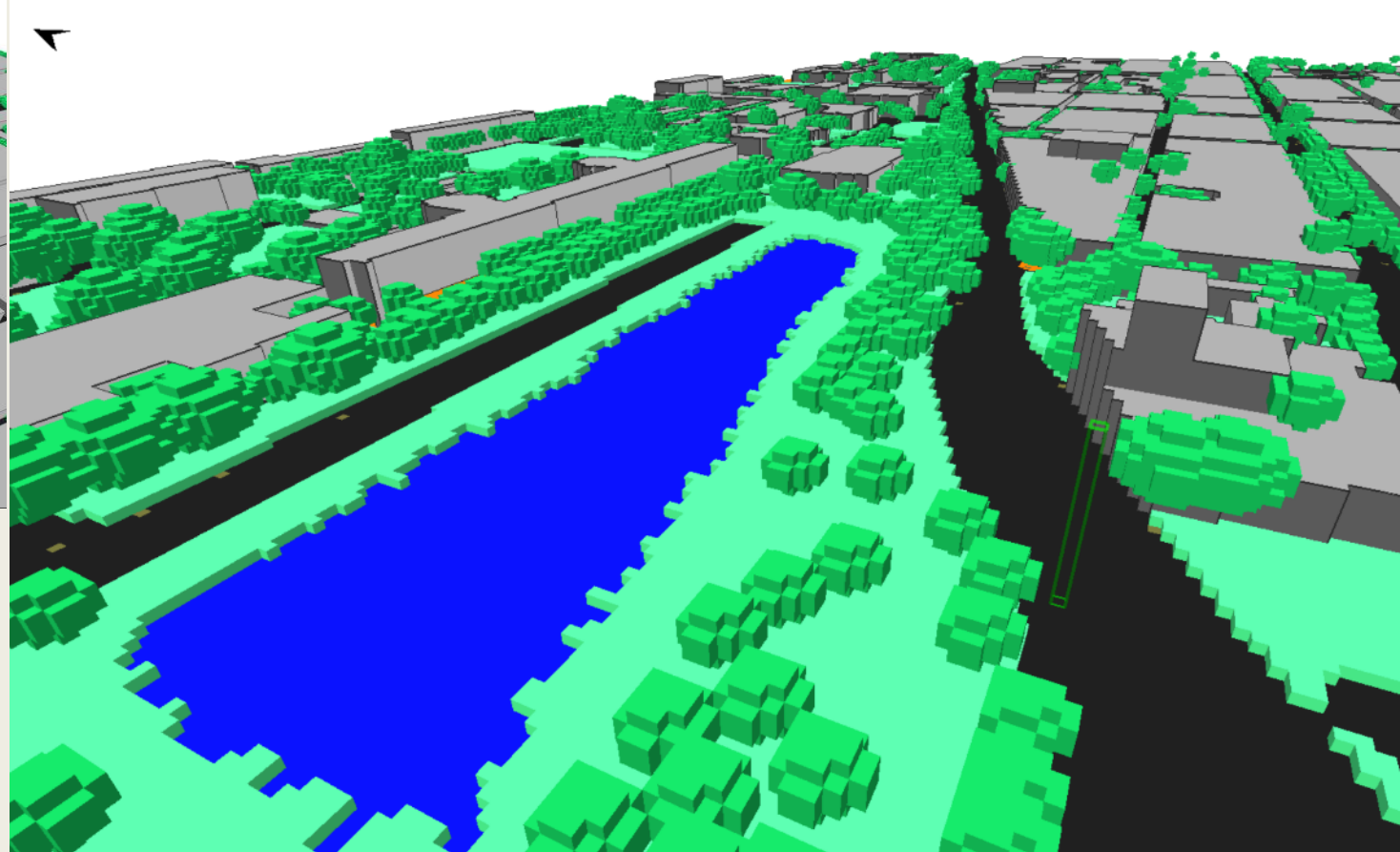
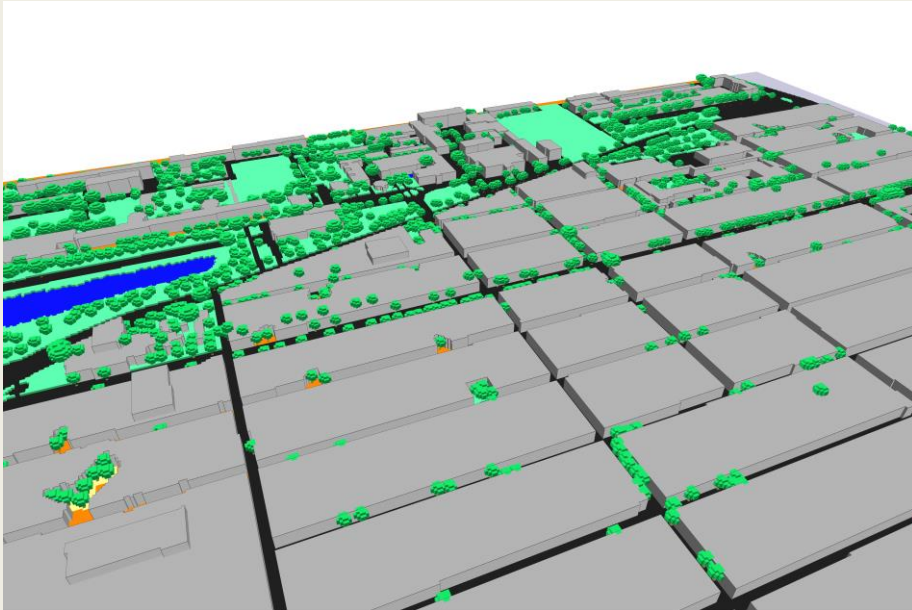
*on microclimate*





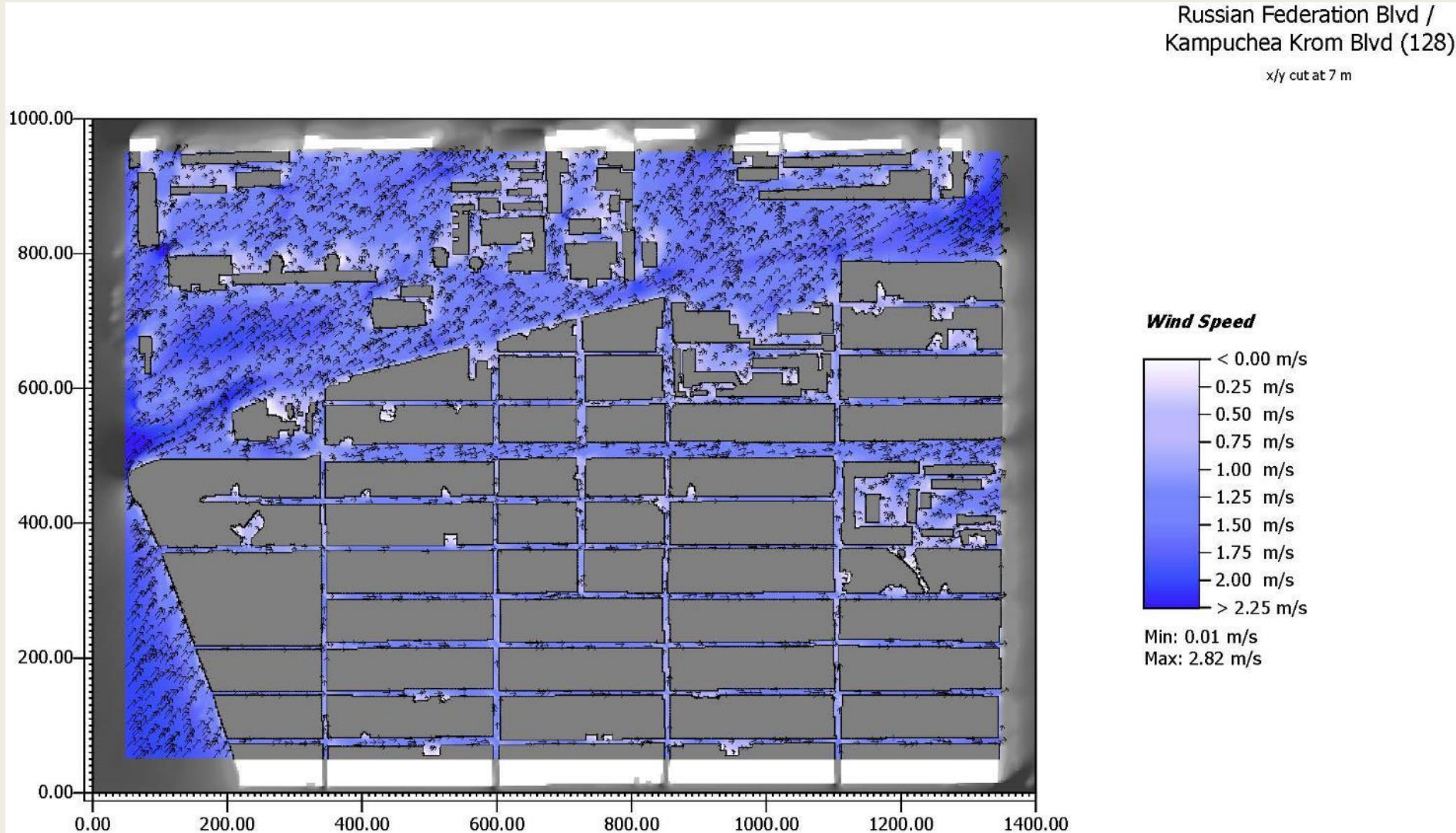


# Case study of simulation





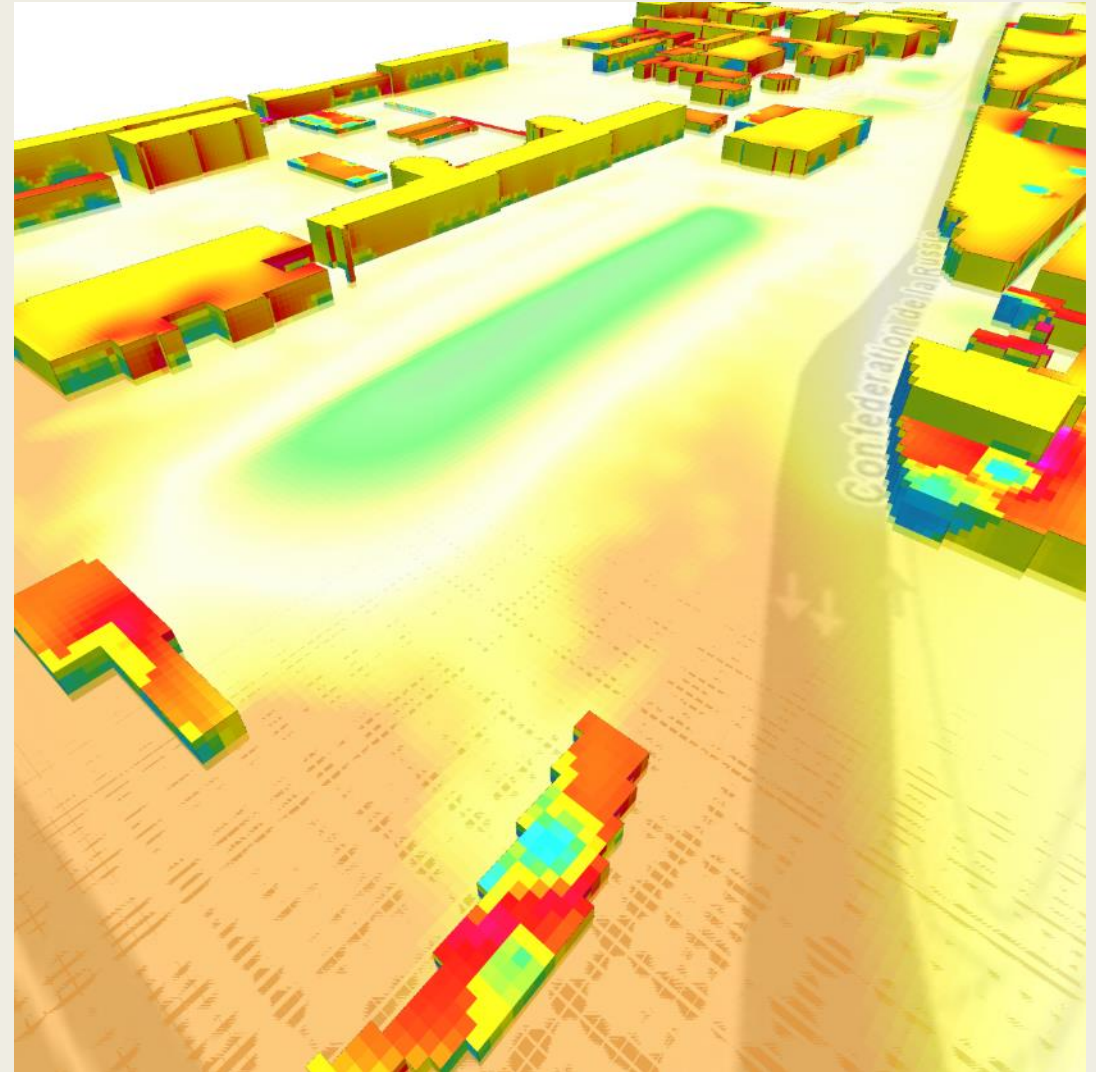
# Wind field (incoming wind from the Southwest)





# A variety of different climate parameters help characterising the local climate & can be used as guidelines for planning

- Radiation (sun, shadow but also reflections and long-wave thermal radiation)
- Air temperature
- Relative humidity
- Wind
- Bioclimate (thermal comfort) indices





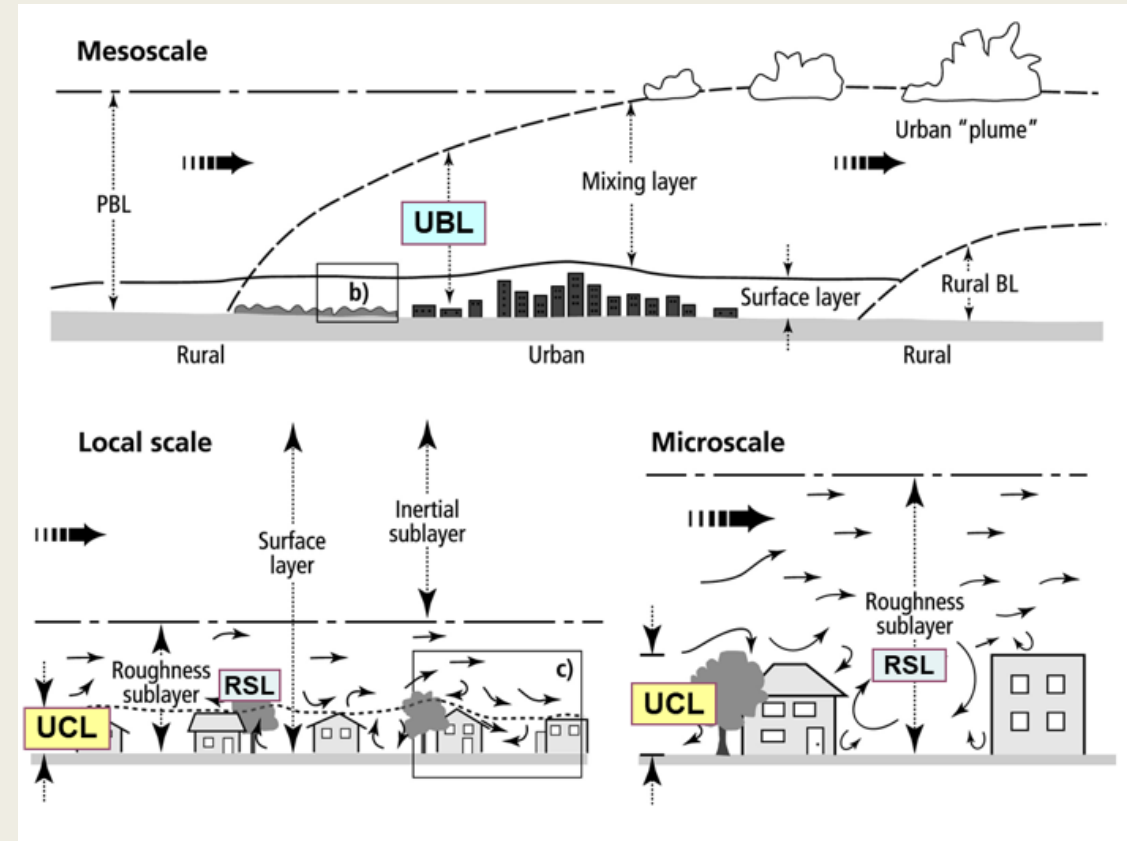
# Urban climate analysis

## MESOSCALE: Urban Climate Analyse Map

Climate functions, climatope characteristics, ventilation, heat load

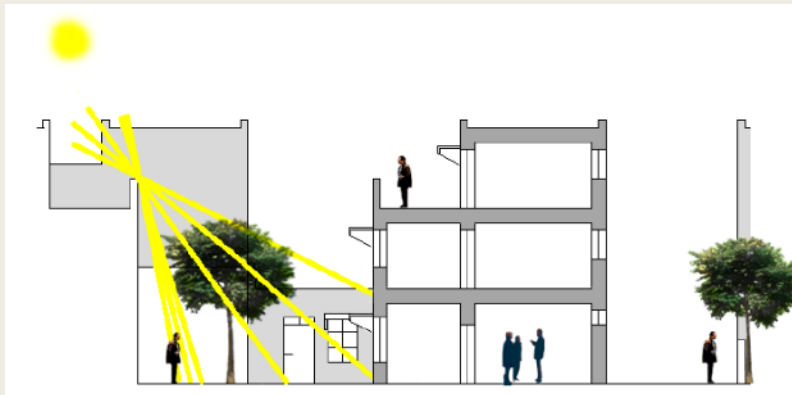
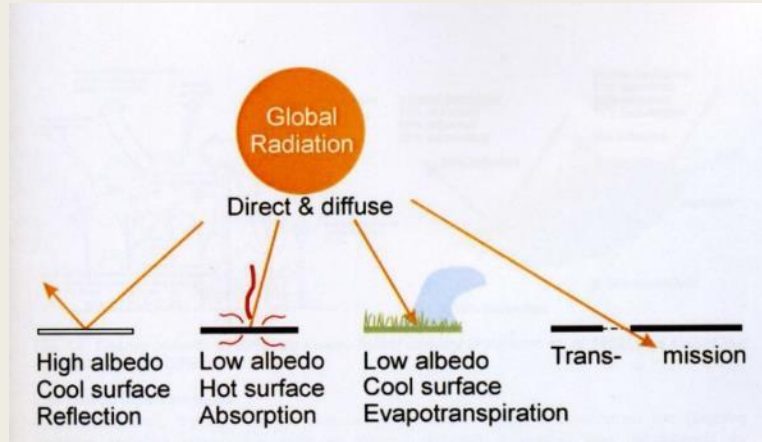
## MICROSCALE: Microclimate Analysis

Local climate conditions, effect of buildings and single vegetation



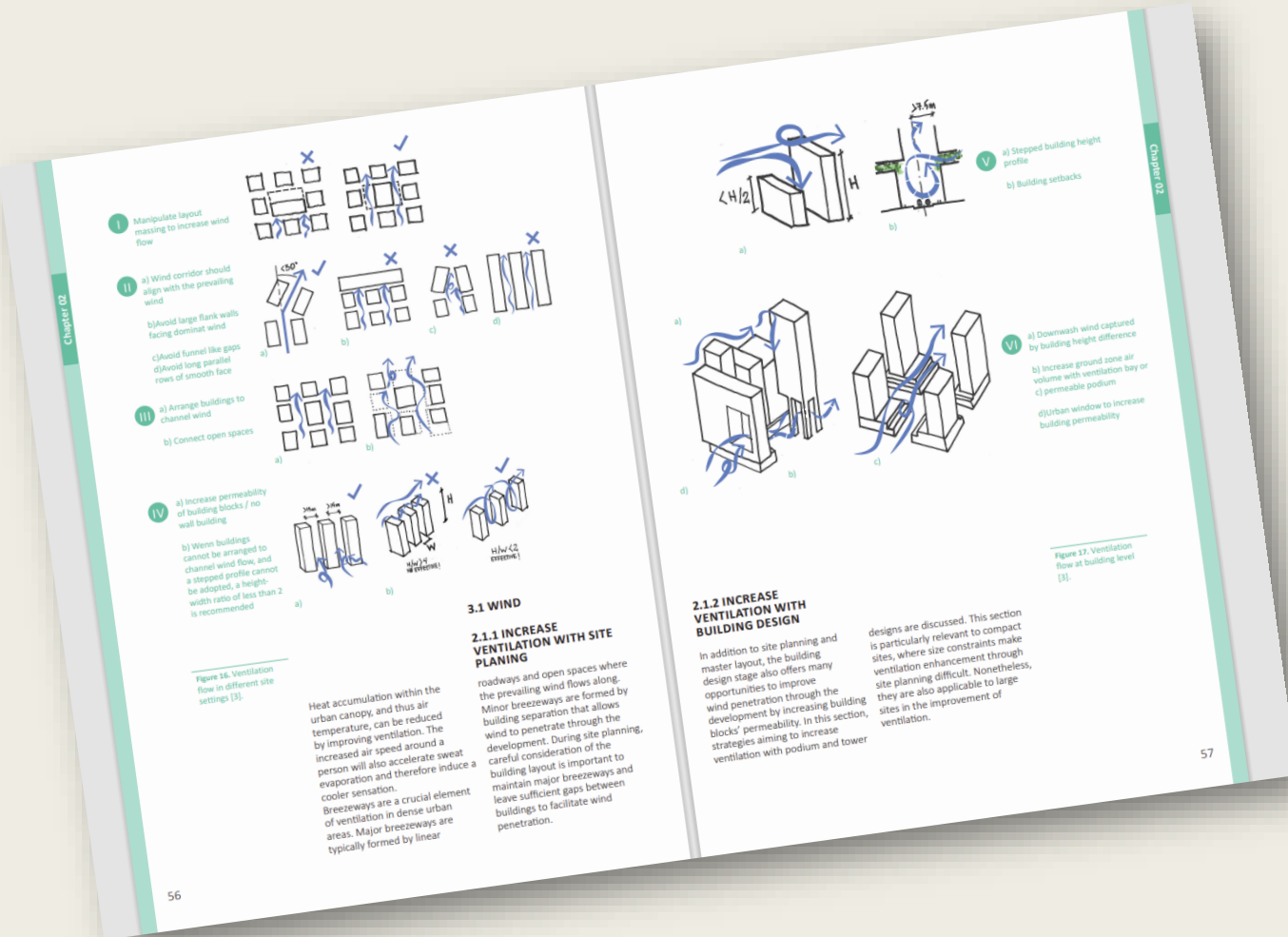


# Urban climate design strategy





# Guidelines for urban climate design recommendations and climate analysis



## Wind

- Increase ventilation with site planning.
- Increase ventilation with building design.

## Thermal radiation

- Reduce direct solar radiation.
- Reduce surface temperature.

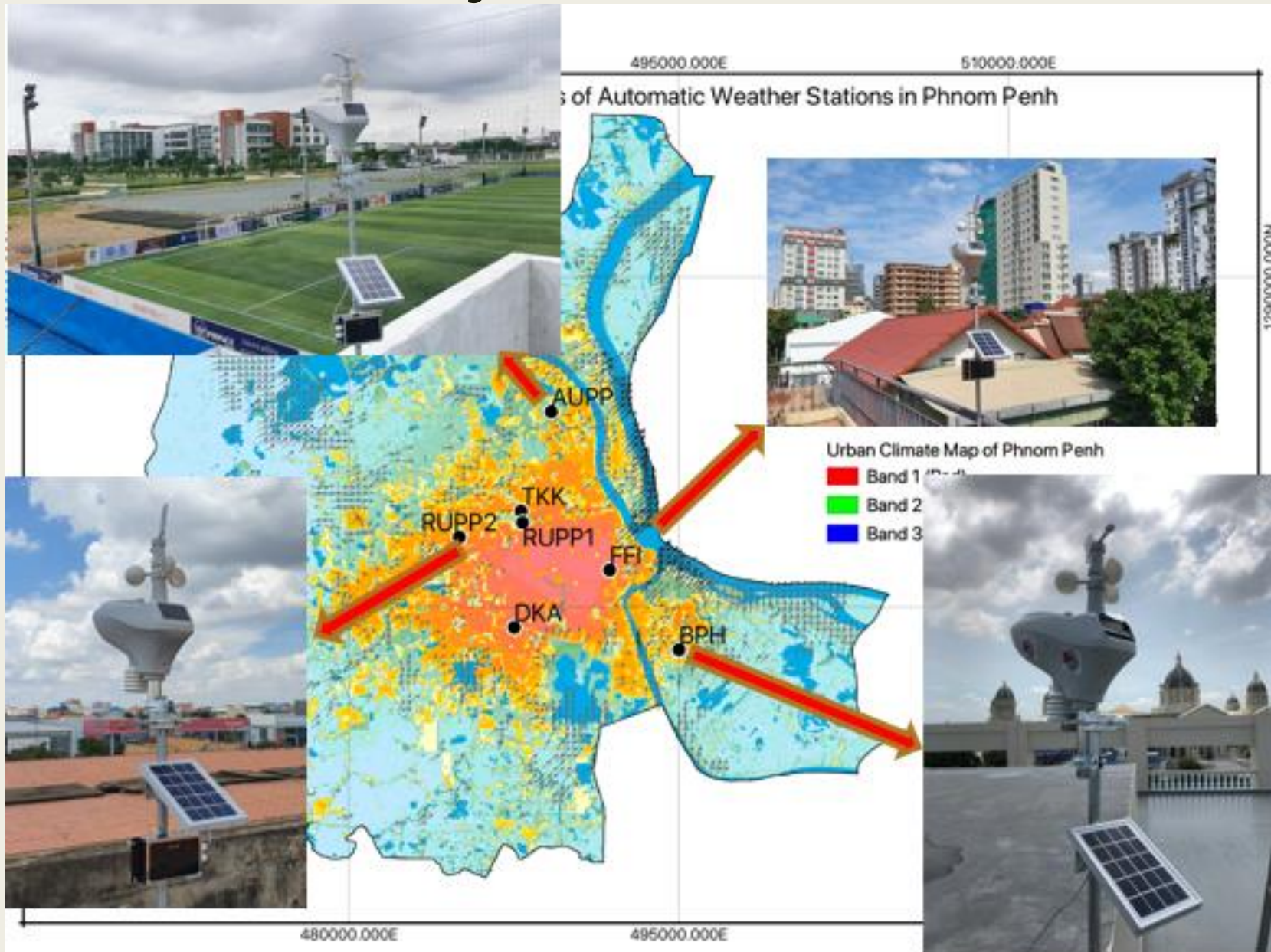
## Temperature

- Increase evaporative cooling.
- Reduce heat accumulation.
- Reduce heat release.

## Precipitation

- Provide rain protection.

# Case study of measurements



# Air temperature difference

The average air temperature difference.

	BKK	PSC
Maximum	15.1°C	13.1°C
Minimum	2.9°C	2.2.0°C
Average	10.1°C	8.7°C



# DVUHI intensity

The daily variation of the UHI intensity.



	Daytime UHI intensity	Nighttime UHI intensity	Increased rate of DVUHI intensity
BKK			
Maximum	15°C	9.1°C	5.9°C
Minimum	2.0°C	0.7°C	1.3°C
Average	9.8°C	4.7°C	5.1°C
PSC			
Maximum	12.9°C	9.6°C	3.3°C
Minimum	1.6°C	0.2°C	1.4°C
Average	8.3°C	4.7°C	3.7°C



# SVUHI intensity

The average daytime and nighttime SVUHI intensity in dry and wet seasons.

	Daytime UHI intensity	Nighttime UHI intensity
Maximum	9.1°C	4.9°C
Minimum	-5.7°C	-3.8°C
Average	1.4°C	0.1°C



# Climatology is active in climate protection and climate adaptation

- ✓ **Design tool** for an urban climatological oriented planning in terms of saving energy in buildings, creating thermal comfort (avoiding heat stress) of open spaces, neighbourhood design
- ✓ **Interactive map** for urban planning processes to be used for architects and planners
- ✓ **Localised** quantification of energy saving with a concrete building by natural potentials (wind and sun)
- ✓ **Heat wave** action plan



# What next?

- Future research will focus on
  - *Urban climate monitoring system*
  - *Green space*
- Possible outcomes of the research
  - *Urban climate map*
  - *Urban climate prediction model*
  - *Tailored development plan for Phnom Penh/Cambodia*

