

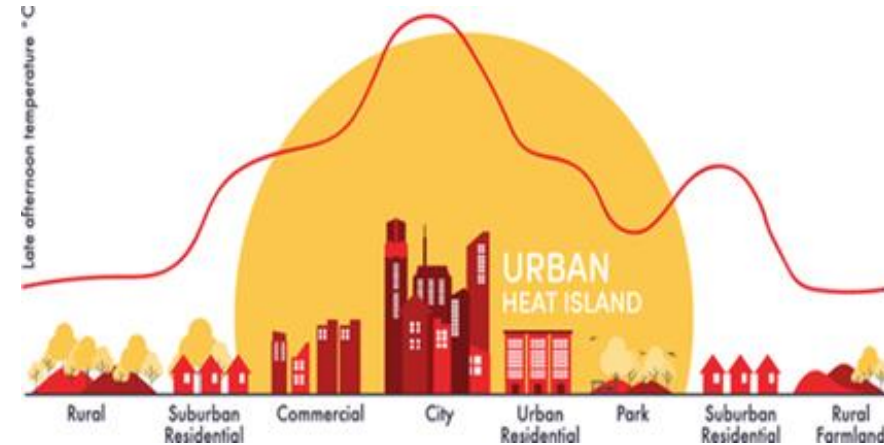
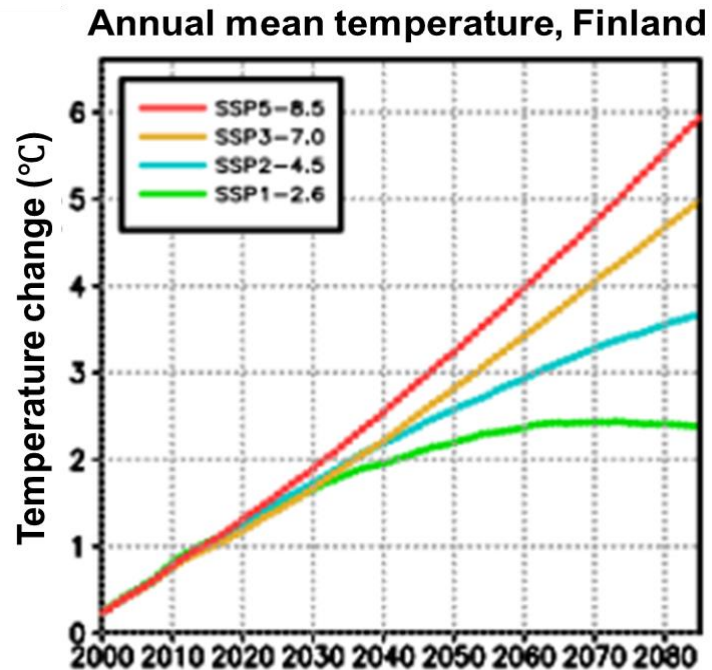
Demonstration projects - Urban growth scenarios in changing climate

Reija Ruuhela, Athanasios Votsis, Tuukka Rautio, Milla Mikkola and Timothy R. Carter

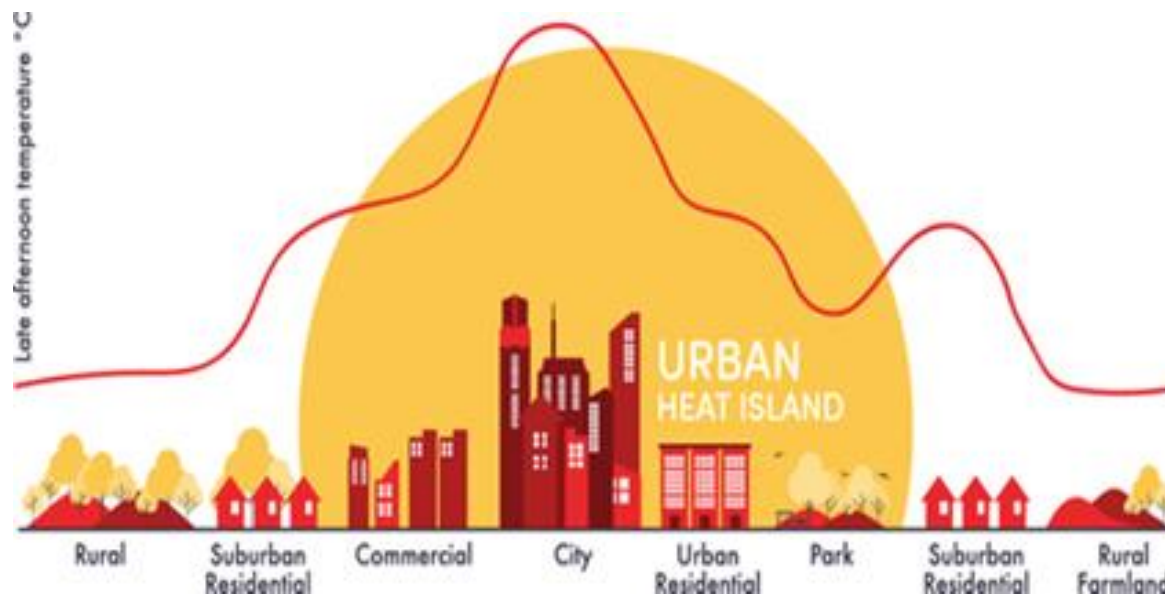


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Climate change + urban growth => *urban heat island* (UHI) effect amplifies the temperature increase locally



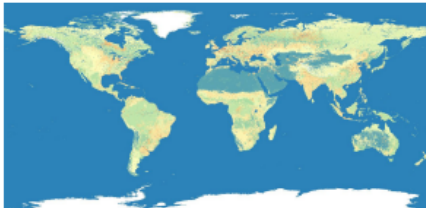
Urban heat island (UHI)



- The temperature in the urban areas can be several degrees higher than in the surrounding rural areas
- In winter, the UHI is mainly due to the waste heat energy of buildings, traffic and industry
- In summer especially, solar radiation is absorbed into urban structures leading to higher air temperatures in the built environment
- Urban sprawl, densification and dark surfaces within the built environment intensify the UHI
- Green and blue infrastructure serve to mitigate the UHI

Local Climate Zones (LCZs)

Global ECOCLIMAP-SG dataset
300 x 300 meters resolution
Natural and Urban (LCZ) land types

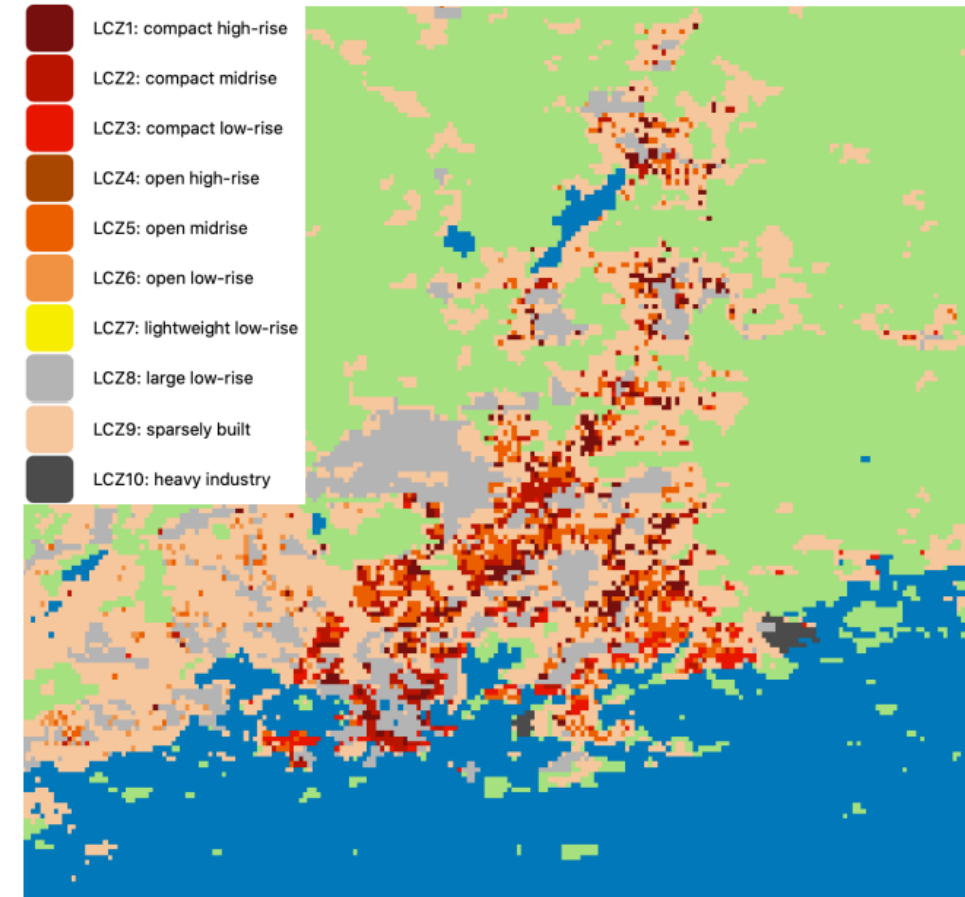
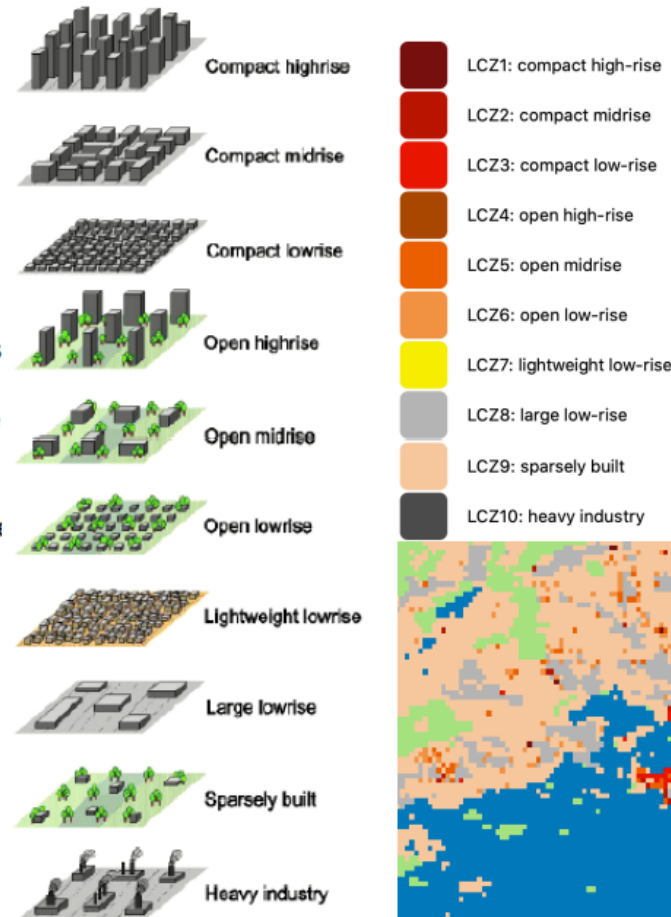


URBAN LAND USES

- 24. **LCZ1: compact high-rise**
- 25. **LCZ2: compact midrise**
- 26. **LCZ3: compact low-rise**
- 27. **LCZ4: open high-rise**
- 28. **LCZ5: open midrise**
- 29. **LCZ6: open low-rise**
- 30. **LCZ7: lightweight low-rise**
- 31. **LCZ8: large low-rise**
- 32. **LCZ9: sparsely built**
- 33. **LCZ10: heavy industry**

NATURAL LAND USES

- 1. sea and oceans
- 2. lakes
- 3. rivers
- 4. bare land
- 5. bare rock
- 6. permanent snow
- 7. boreal broadleaf deciduous
- 8. temperate broadleaf deciduous
- 9. tropical broadleaf deciduous
- 10. temperate broadleaf evergreen
- 11. tropical broadleaf evergreen
- 12. boreal needleleaf evergreen
- 13. temperate needleleaf evergreen
- 14. boreal needleleaf deciduous
- 15. shrubs
- 16. boreal grassland
- 17. temperate grassland
- 18. tropical grassland
- 19. winter C3 crops
- 20. summer C3 crops
- 21. C4 crops
- 22. flooded trees
- 23. flooded grassland

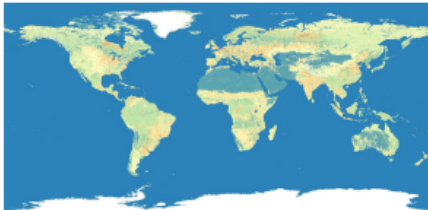


ECOCLIMAP-SG for Pääkaupunkiseutu in 2018

In Helsinki the most common types of LCZ are open midrise and open low-rise

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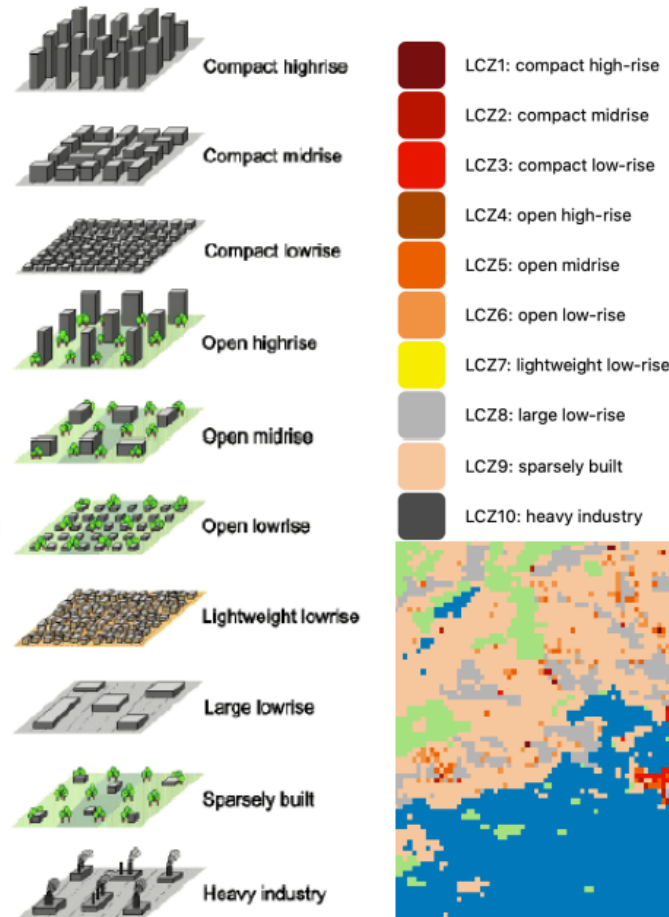


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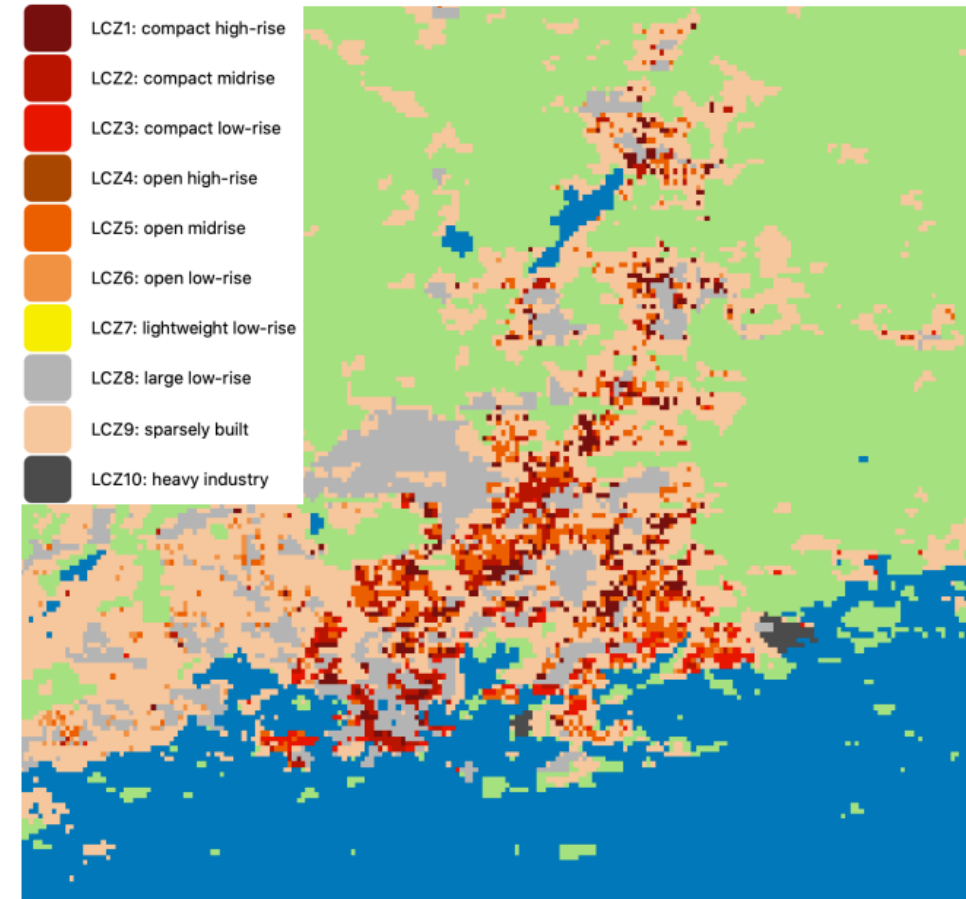
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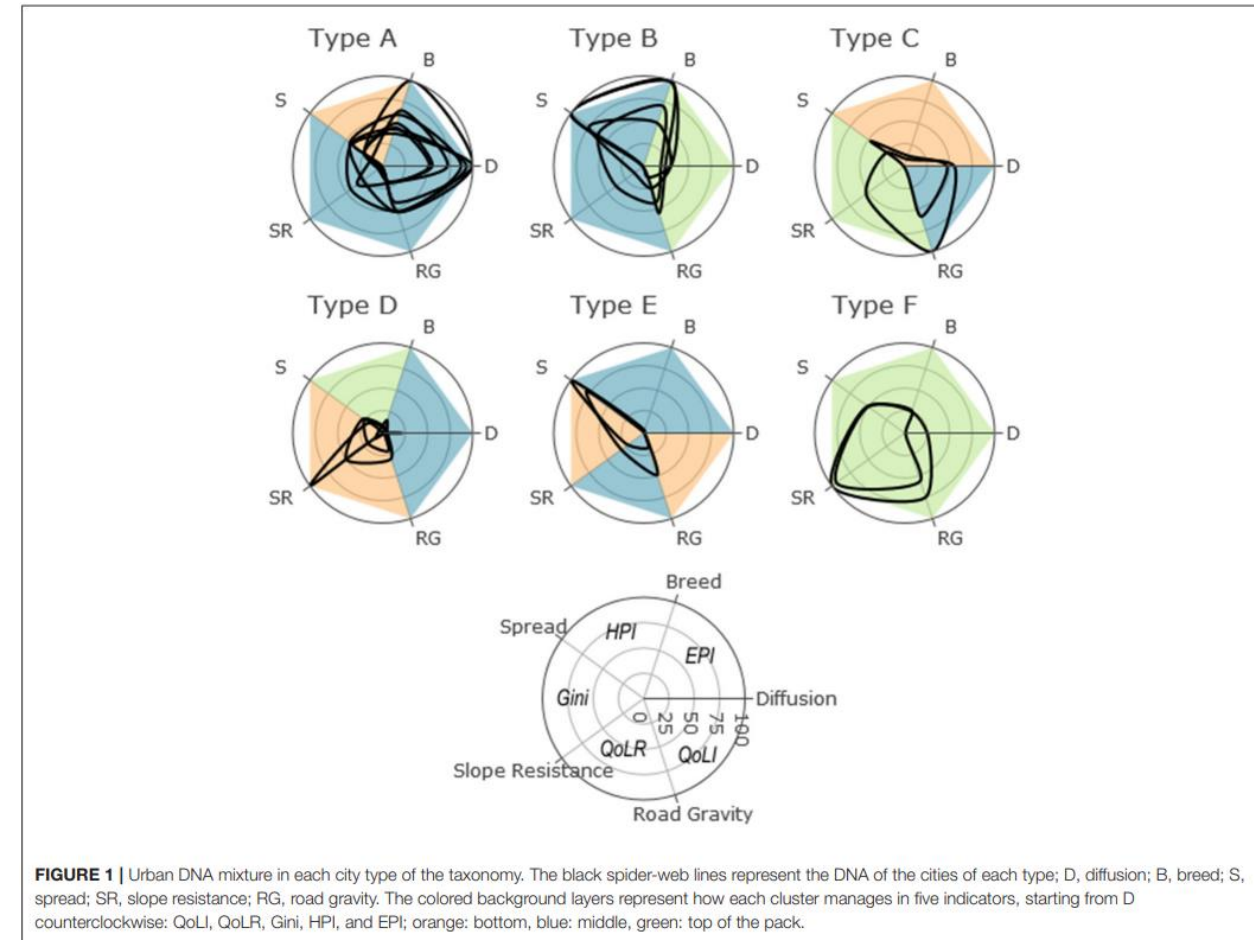
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ECOCLIMAP-SG for Pääkaupunkiseutu in 2018

SLEUTH – urban growth model

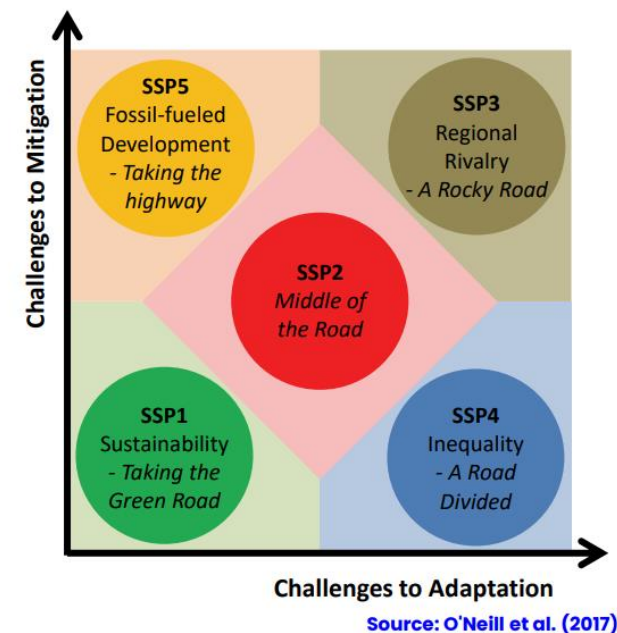
- Cellular automation model
- Described and controlled by five coefficients
 - Dispersion, breed, spread, slope, road gravity
 - on the scale 0...100
- Cities can be clustered into following types:
 - A: Multinodal, dispersed cities, with mixed outcomes
 - B: Multinodal, contiguous, slow-growing cities
 - C: Transport-oriented, dispersed, fast-growing cities
 - D: Large, buzzy, constrained cities.
 - E: Dense, contiguous, fast-growing cities
 - F: Transport-oriented, contiguous, interactive cities
- Current Helsinki could be classified as type F city
- **What kind of urban growth will take place in future in different SSP-scenarios?**



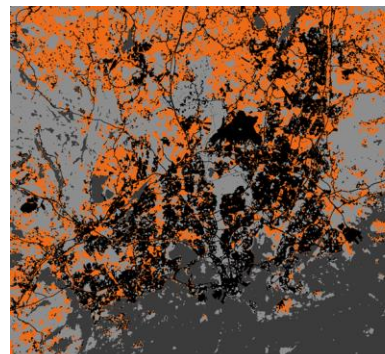
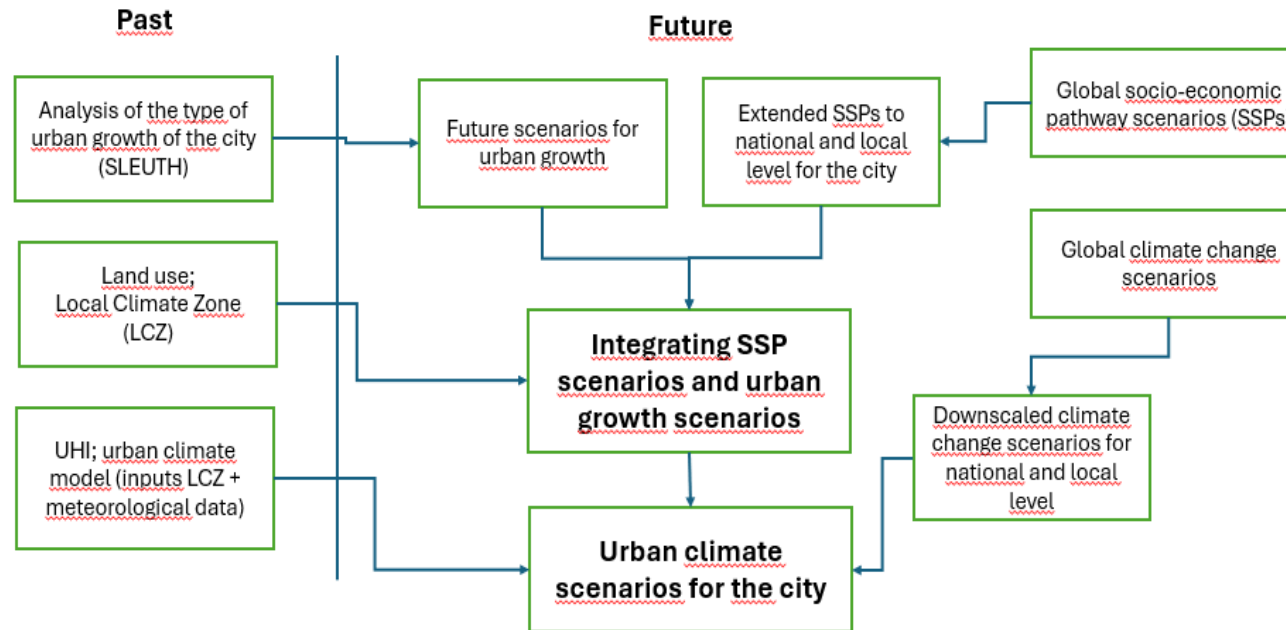
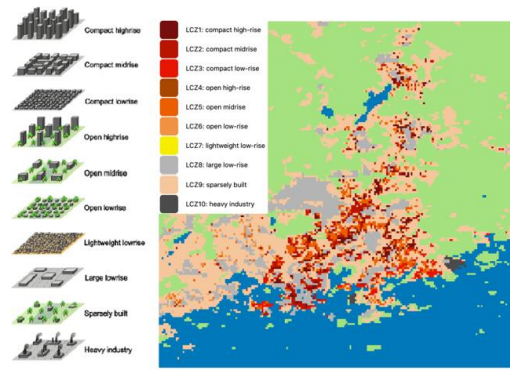
Potential combinations of urban growth and socioeconomic SSP scenarios

	Socioeconomic SSP scenario				
Urban scenario	SSP1	(SSP2)	SSP3	SSP4	SSP5
Polycentric city		(x)	X	(x)	X
Compact city		(x)	X	X	(x)
Natural city	X				

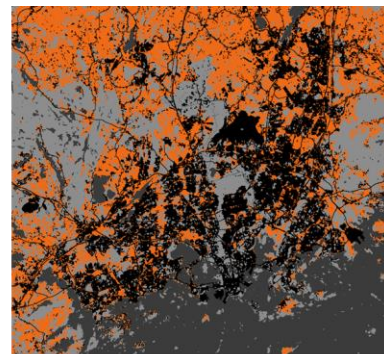
- ❖ Based on the expert judgement, the five coefficients (dispersion, breed, spread, slope, road gravity) are determined for the SLEUTH model runs



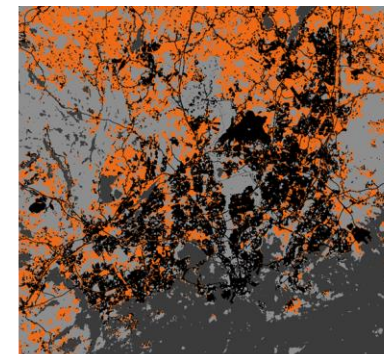
Concept for integrating urban growth, socio-economic and climate change scenarios to produce future scenarios for the urban heat island (UHI) effect



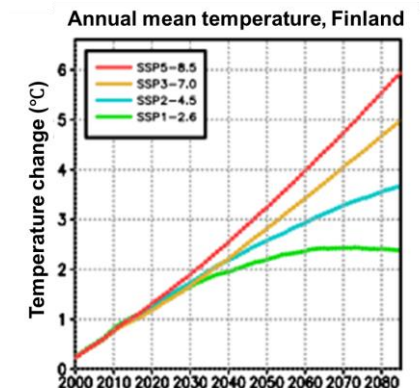
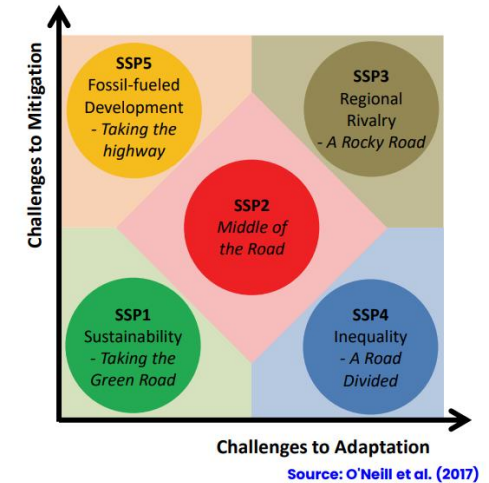
Polycentric city



Compact city

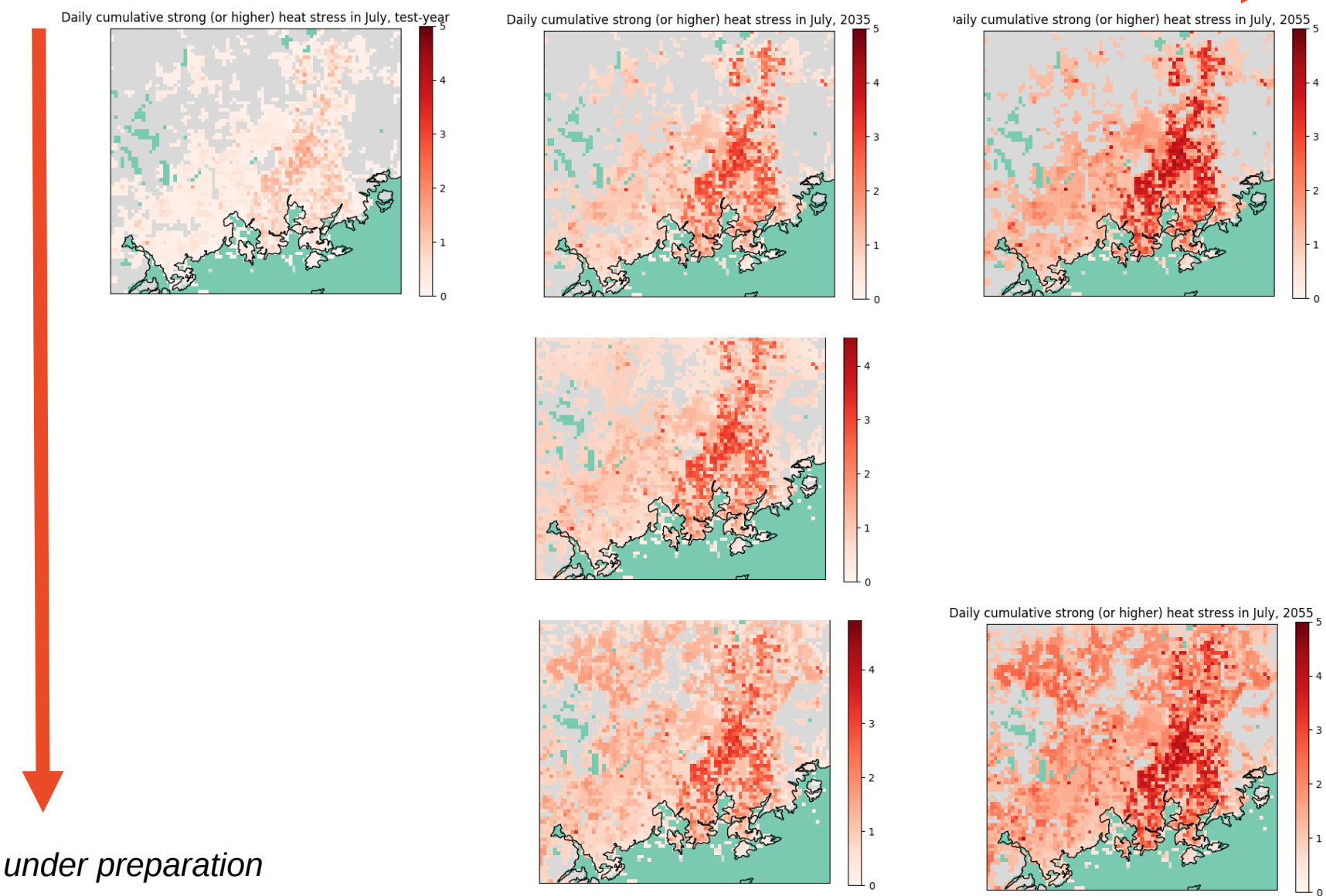


Natural city



Strong (or more severe) Heat stress in July in present and future climate in different urban development scenarios

Time



Densification



Present city

City for 2035

City for 2035,
stronger densification

Votsis et al., under preparation

Conclusions

- Urbanisation continues
- Built environment changes the local climate conditions
- In order to ensure sustainable urban development and a healthy environment for urban residents, we suggest the use of combined urban growth, socioeconomic and climate change scenarios in urban planning and decision-making

Thank you for your interest!



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