Climate risks and Planning

USP Studio II, 4-2-2021

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Overview and Context

- **Framings** of urban planning with respect to climate change and extreme weather events | IPCC, SDGs, risk definition
- Emergence of the notion of societal resilience | socio-spatial resilience
- Examples and ongoing work from Finland and abroad | computational planning support systems

- Spatial planning | […] gives geographical expression to the economic, social, cultural and ecological policies of society. It is at the same time a scientific discipline, an administrative technique and a policy developed as an interdisciplinary and comprehensive approach directed towards a balanced regional development and the physical organisation of space according to an overall strategy (European Regional/Spatial Planning Charter 1983)

Who Am I?

- Master's, Urban and Regional Planning [sustainable urban design]
- PhD, Geography [spatial economics, urban simulation, CC adaptation]

- Senior Researcher, Climate Change and Society Group, Finnish Meteorological Institute.
- Assistant Professor in Sustainability of Complex Urban-Rural Systems, University of Twente.

- In a nutshell: Combining science with operational spatial planning with computational methods.

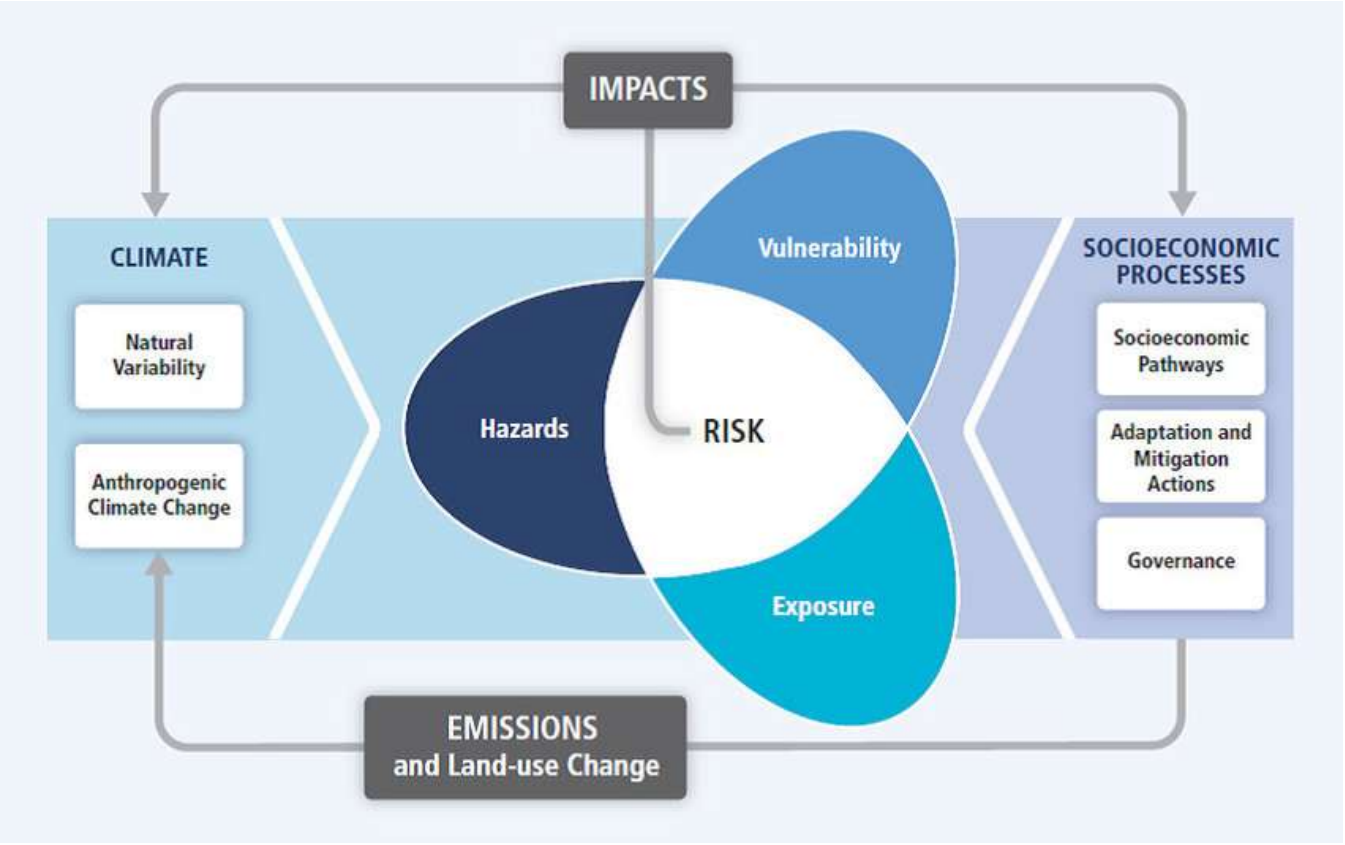
Key climate change risks for cities

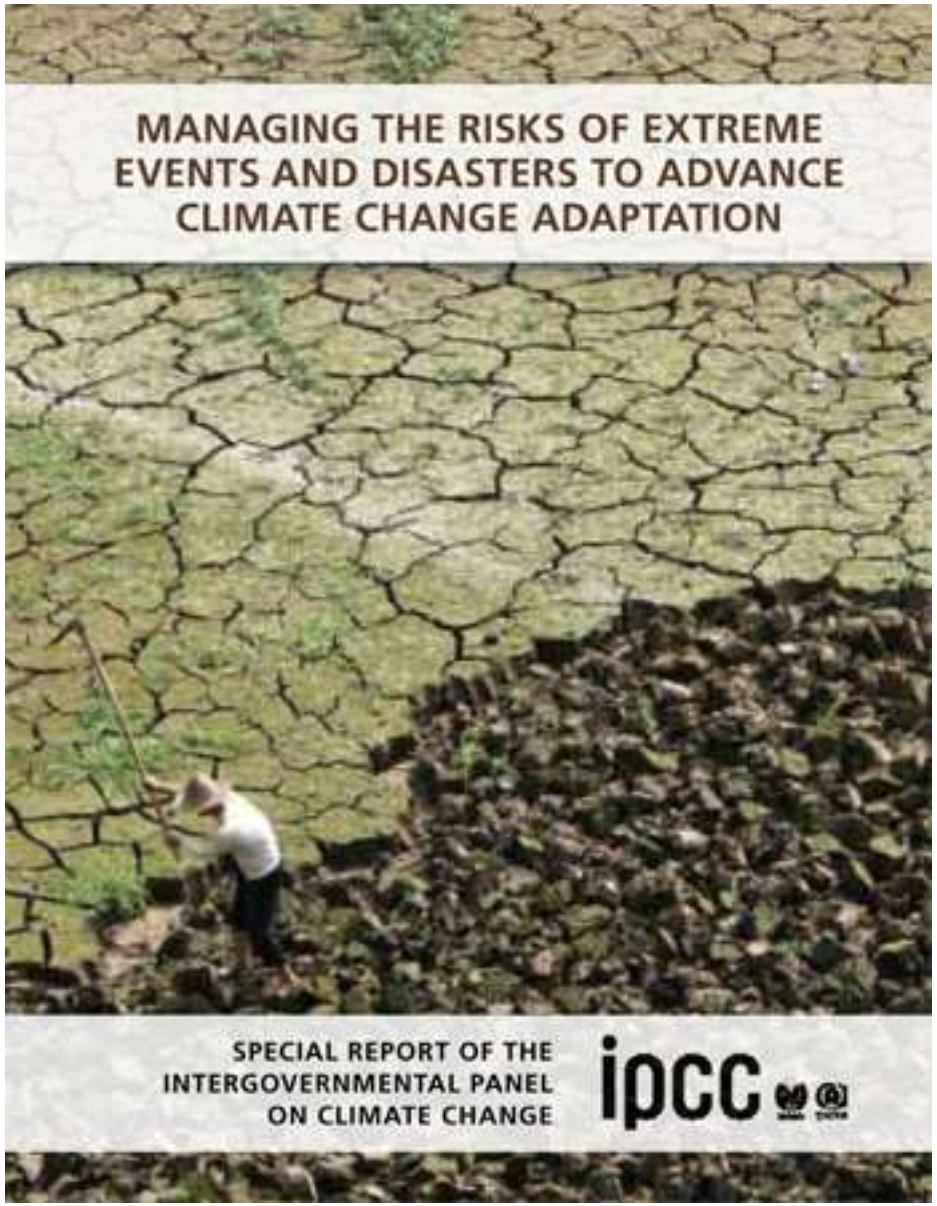
- Temperature extremes, human health and epidemiology, flooding, drought, and water scarcity have been indicated as the main CC risks for cities and urban areas since IPCC AR4 (2007) & AR5 (2014).

- For European cities, esp. heatwaves and flooding (AR5 2014).

- Climate change affects intensity but also temporal and spatial patterns of heatwaves.

Risk framework (IPCC 2012)





Implications for **planning goals** vary…

- **Heatwaves**: Energy use and performance, mortality, productivity, emergency preparedness, disaster relief, building standards, climate architecture and site planning.

- **Flooding**: Steering urban growth outside floodplains, harmonizing planning institutions with real estate markets, increasing the share of nature-based solutions for flood regulation, information & behavior.

- **Health and epidemiology**: Density, micro-housing, green infrastructure, mobility patterns, residential location patterns.

…and in some cases, the implications are stark. Consider the existential trajectory of settlements.

Cities are complex but incomplete systems that cannot be fully controlled

Sassen S **2017** 'The city: A collective good?' **The Brown Journal of World Affairs** XXII(II): 119–125.

‘Sustainable’ but non-resilient, unlivable futures

Emphasis on a few urban phenomena | Poorly understood distribution of impacts across space, activities and population groups | Aggregate emphasis vs bottom-up realities

IJEA

International Journal of Epidemiology, 2019, 1101–1112
doi: 10.1093/ije/dyz008
Advance Access Publication Date: 27 February 2019
Original article

Environment, Green Space and Pollution

How urban characteristics affect vulnerability to heat and cold: a multi-country analysis

Francesco Sera,[1]* Ben Armstrong,[1] Aurelio Tobias,[2]
Ana Maria Vicedo-Cabrera,[1] Christofer Åström,[3] Michelle L Bell,[4]

Abstract

Background: The health burden associated with temperature is expected to increase due to a warming climate. Populations living in cities are likely to be particularly at risk, but the role of urban characteristics in modifying the direct effects of temperature on health is still unclear. In this contribution, we used a multi-country dataset to study effect modification of temperature–mortality relationships by a range of city-specific indicators.

Methods: We collected ambient temperature and mortality daily time-series data for 340 cities in 22 countries, in periods between 1985 and 2014. Standardized measures of demographic, socio-economic, infrastructural and environmental indicators were derived from the Organisation for Economic Co-operation and Development (OECD) Regional and Metropolitan Database. We used distributed lag non-linear and multivariate meta-regression models to estimate fractions of mortality attributable to heat and cold (AF%) in each city, and to evaluate the effect modification of each indicator across cities.

Results: Heat- and cold-related deaths amounted to 0.54% (95% confidence interval: 0.49 to 0.58%) and 6.05% (5.59 to 6.36%) of total deaths, respectively. Several city indicators modify the effect of heat, with a higher mortality impact associated with increases in population density, fine particles ($PM_{2.5}$), gross domestic product (GDP) and Gini index (a measure of income inequality), whereas higher levels of green spaces were linked with a decreased effect of heat.

Conclusions: This represents the largest study to date assessing the effect modification of temperature–mortality relationships. Evidence from this study can inform public-health interventions and urban planning under various climate-change and urban-development scenarios.

Key words: Temperature, heat, mortality, epidemiology, cities, climate

Symposium on Planning for Climate Adaptation

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Equity Impacts of Urban Land Use Planning for Climate Adaptation: Critical Perspectives from the Global North and South

Isabelle Anguelovski[1,2], Linda Shi[3], Eric Chu[4], Daniel Gallagher[3], Kian Goh[5], Zachary Lamb[3], Kara Reeve[6], and Hannah Teicher[3]

Abstract

A growing number of cities are preparing for climate change impacts by developing adaptation plans. However, little is known about how these plans and their implementation affect the vulnerability of the urban poor. We critically assess initiatives in eight cities worldwide and find that land use planning for climate adaptation can exacerbate socio-spatial inequalities across diverse developmental and environmental conditions. We argue that urban adaptation injustices fall into two categories: acts of commission, when interventions negatively affect or displace poor communities, and acts of omission, when they protect and prioritize elite groups at the expense of the urban poor.

Keywords
land use planning, climate adaptation, resilience planning, critical adaptation studies, environmental justice

Critical Commentaries

Urban Studies

Urban Studies
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Urban green gentrification in an unequal world of climate change

Anders Blok
University of Copenhagen, Denmark

Abstract

Over the past few decades, notions of environmental, ecological or green gentrification in cities

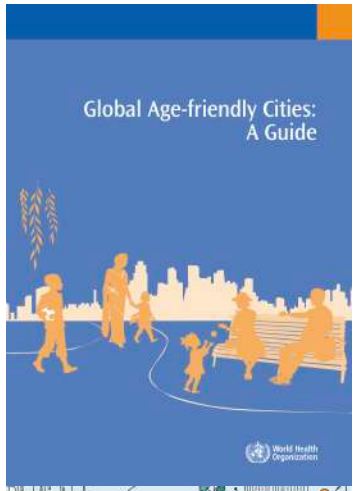
Growing Cities Sustainably

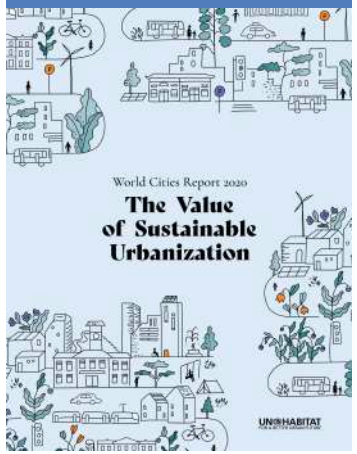
Does Urban Form Really Matter?

Marcial H. Echenique, Anthony J. Hargreaves, Gordon Mitchell, and Anil Namdeo

Problem, research strategy, and findings: It is commonly asserted that so-called compact development is the urban form most able to sustainably accommodate growth by reducing travel distances and

The paradigm of city planning in recent decades has been to promote the compact city of dense development focused around urban centers of employment and local services to reduce the need to travel long distances and to make cities more vibrant. This is a reaction against sprawl induced





Sustainable, resilient and inclusive societies – the path towards transformation

Together 2030 Written Inputs to the UN High-Level Political Forum on Sustainable Development (HLPF) 2018

The diverse challenges and interlinked uncertainties of globalization and climate change demand societies to become more and more flexible to withstand crises, reinventing themselves in resilient, integrated, sustainable, multi-dimensional and inclusive ways. The United Nations Agenda 2030 for Sustainable Development recognizes the importance of transforming societies through sustainable, resilient and inclusive paths, encompassed by the interlinked and universal Sustainable Development Goals (SDGs).

A broader concept of systemic resilience must be developed that recognizes the interconnectedness, volatility, uncertainty and complexity of challenges. This concept must address the challenges in a sustainable and inclusive way, as both solution and a preventative approach to new crises. This means making the concept of 'leaving no one behind' a reality and bringing the poorest and most marginalized to participate fully in society.

Resilient, sustainable and inclusive societies demand a shift beyond transactional approaches to development towards a collective perspective of joint social capital values such as mutual trust, solidarity, helpfulness and friendliness that strengthen the international cooperation. Countries must cooperate to address the systemic and overlapping inequalities in wealth distribution, gender, income, disability, age and indigeneity or ethnicity, among others.

Fostering resilience requires a holistic and integrated approach to the SDGs, catalyzing progress across the three pillars of sustainable development, addressing, for instance, climate change and protecting the environment and services it provides, the livelihood and structural challenges of changing demographics and technologies and realizing human rights and protections to all. National and local governments should adopt a human-rights based approach to implementing the SDGs, in particular, with respect to those under review this year at the HLPF, focusing on: the rights to water and sanitation; the right to an adequate standard of living; including access to modern energy services; and the right to adequate housing, the right to the city, and the right to a healthy environment.

Building a safer, healthier and more resilient future for people, animals and nature demands for us to rethink the way we produce, distribute and consume energy, food, water and how we protect our common goods.

TOGETHER 2030

Sustainable, resilient and inclusive societies – the path towards transformation

Together 2030 written inputs to the UN High-Level Political Forum on Sustainable Development(HLPF) 2018

From policy to action

www.together2030.org

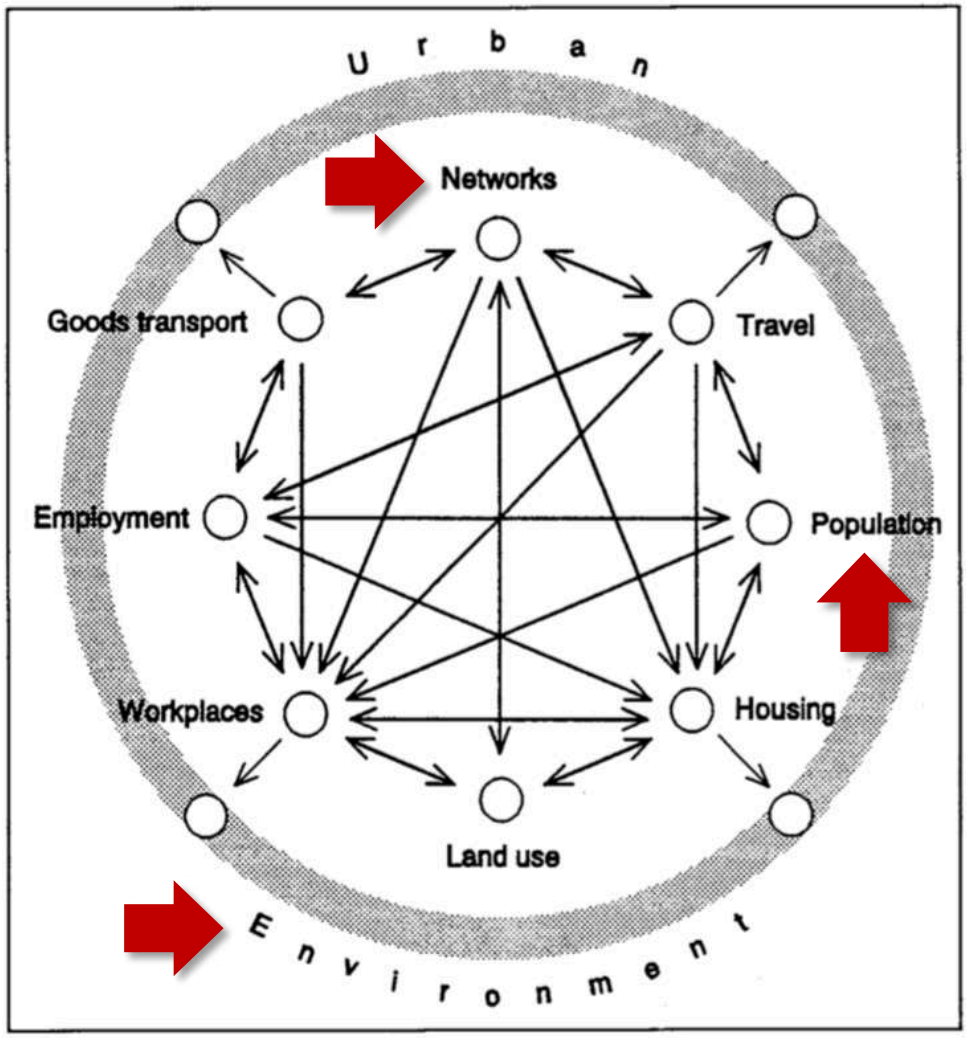
Therefore, **social** complexity, with implications for spatial planning…

- …understanding of a population group's or locality's **adaptive responses** to change or challenges.
- …knowledge of and flexibility to accommodate the **diversity of socio-spatial processes** that compose urban and regional systems.
- …understanding and addressing the **distribution of livability** [and vulnerability-exposure to threats] across socio-spatial domains.
- …accounting for the **temporal** evolution of socio-spatial processes.

Fundamental processes of urban & regional models

A model of urban models

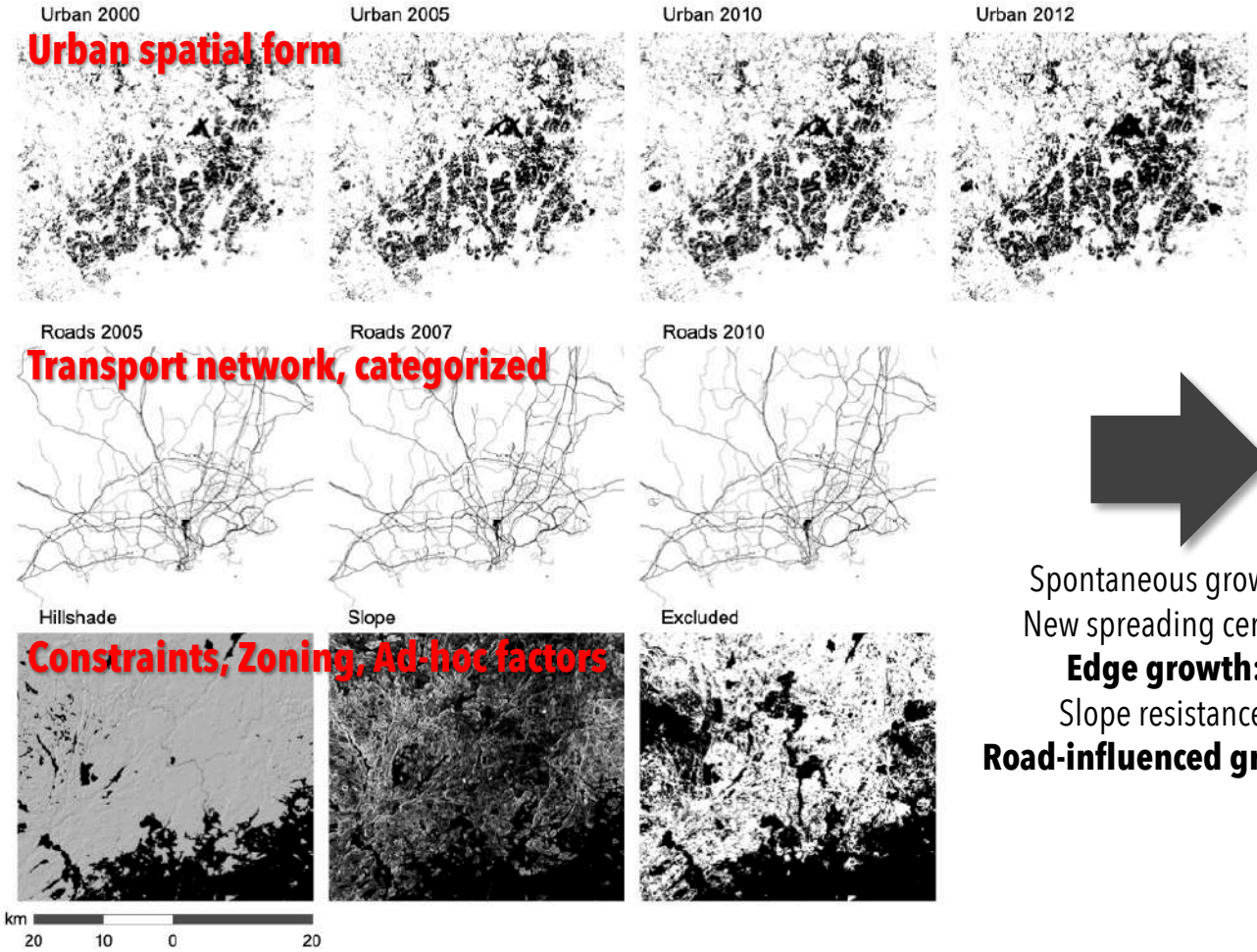
Wegener M 1994 'Operational urban models: State of the Art' J. American Planning Association 60(1): 17-29.



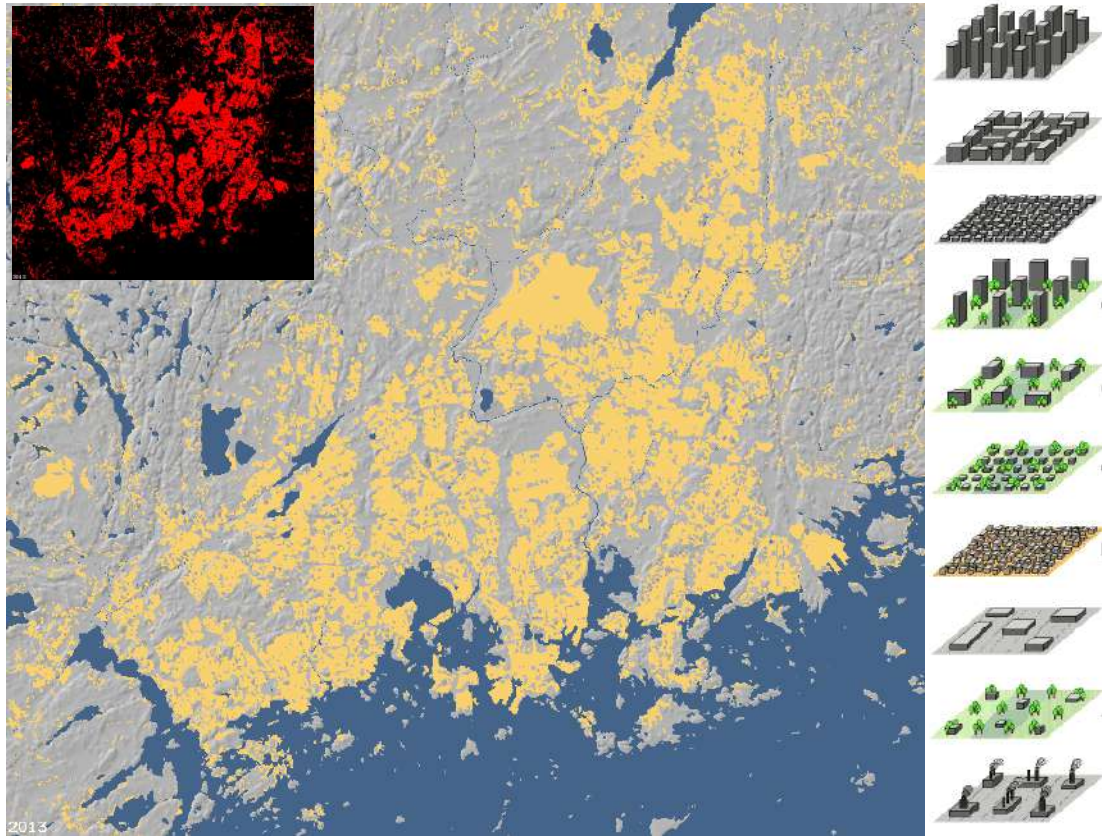
Applicable to all main paradigms of spatial governance:

- **Political** versus **technological** paradigms in planning
- **Aesthetic** versus **rational** paradigms in planning
- **Comprehensive** versus "**muddling-through**" planning

Cellular automaton model of Helsinki's urbanization under various flood adaptation options



Spontaneous growth: 01
New spreading center: 29
Edge growth: 56
Slope resistance: 42
Road-influenced growth: 61



Annual spatial growth of Helsinki Urban Region by 2040 (left)
Extension to **Local Climate Zones** (right).

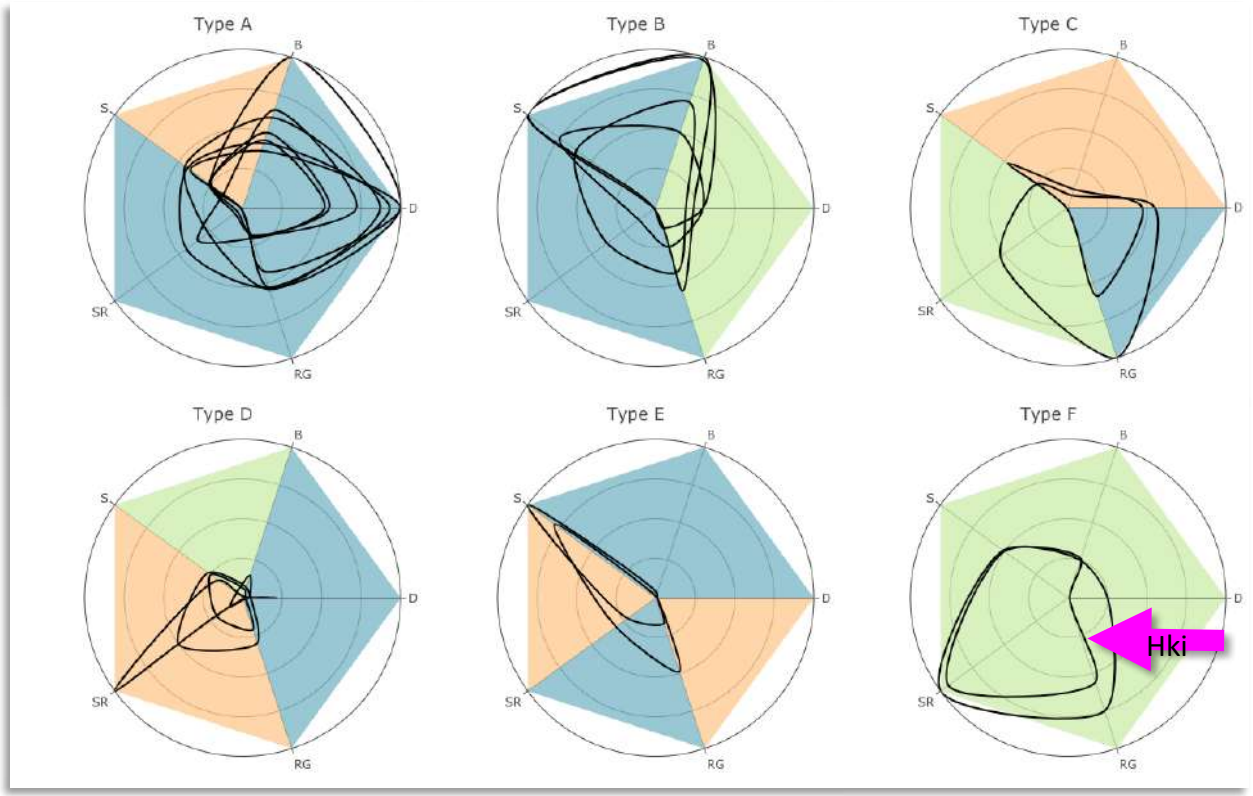
Votsis A **2017** 'Utilizing a cellular automaton model to explore the influence of coastal flood adaptation strategies on Helsinki's urbanization patterns' **Computers, Environment and Urban Systems** 64: 344–355

Spatial planning inferences

Helsinki [metropolitan region] has been consistently scoring high in sustainability or livability rankings at various spatial scales.

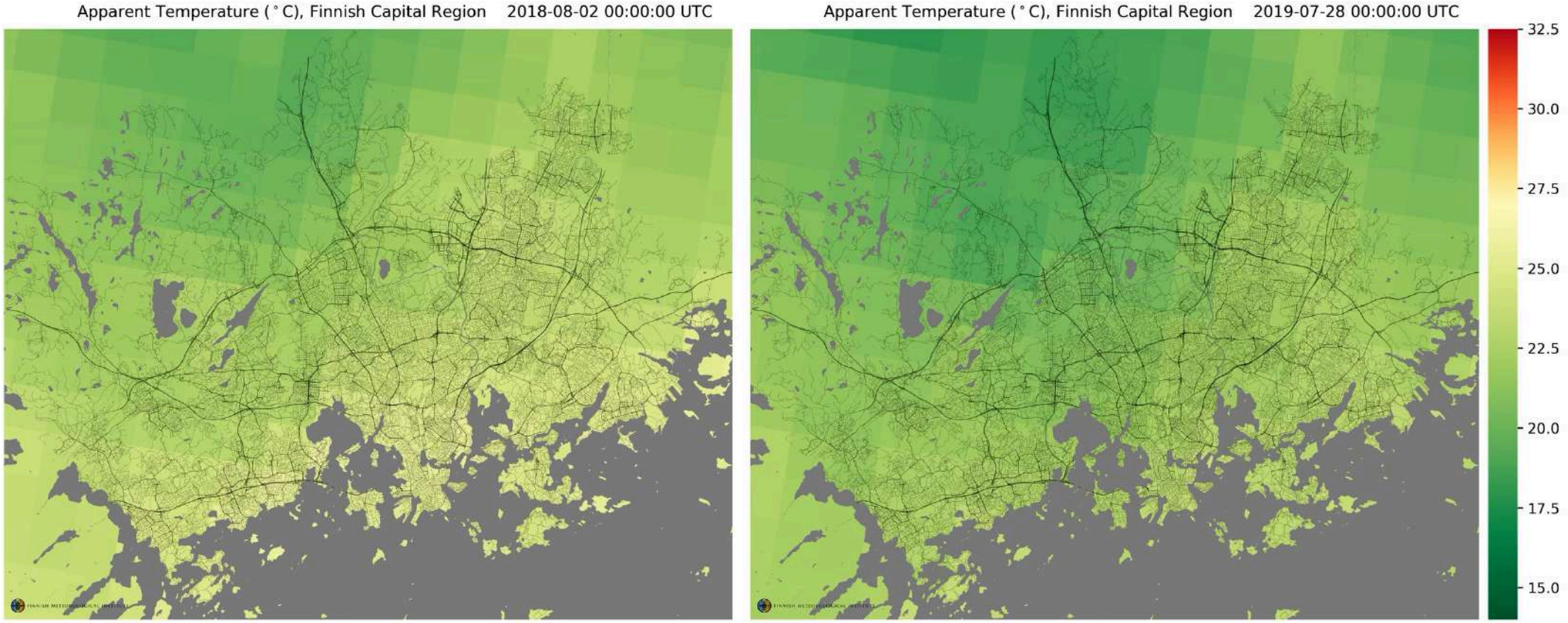
- Transport-oriented growth, moderate growth rates
- Consolidation, in-filling of existing urbanized patches
- Contiguous expansion of existing urbanized patches
- Multi-nodal tendencies that control sprawling patches
- Green and blue infrastructure
- Densification (suburban, urban)

Quality of Life Index, Quality of Living Ranking, Gini coefficient, Happy Planet Index, Environmental Performance Index, Worldwide Governance Indicators



Votsis, A, Haavisto, R **2019** 'Urban DNA and sustainable cities: A multi-city comparison' **Frontiers in Environmental Science: Land Use Dynamics**, https://doi.org/10.3389/fenvs.2019.00004

Helsinki’s 2018-2019 heatwaves



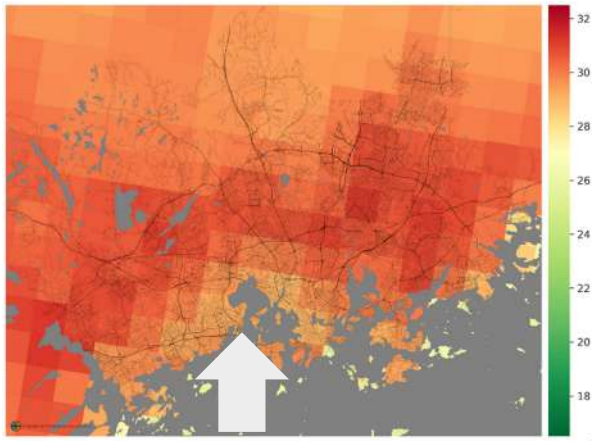
Source MEPS operational forecast archive (2.5km, hourly), accounting for the built environment.
Data Gridded multidimensional arrays with 50+ meteorological variables.
Method Computation of Apparent Temperature (T, rel. humidity, radiation, [wind speed]).
Example The animation reproduces the two hottest days of the two heatwave events.

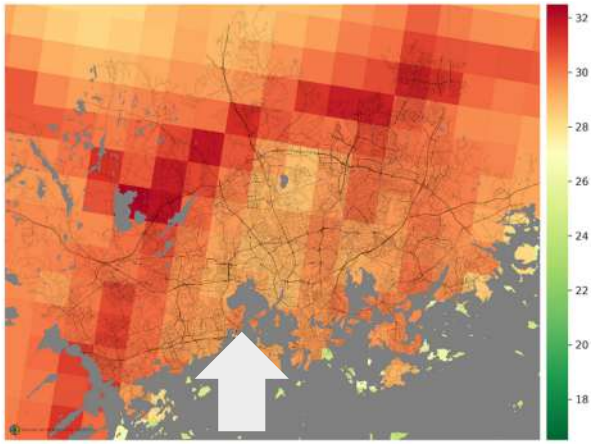
Influence of weather patterns stronger than global urban form

morning

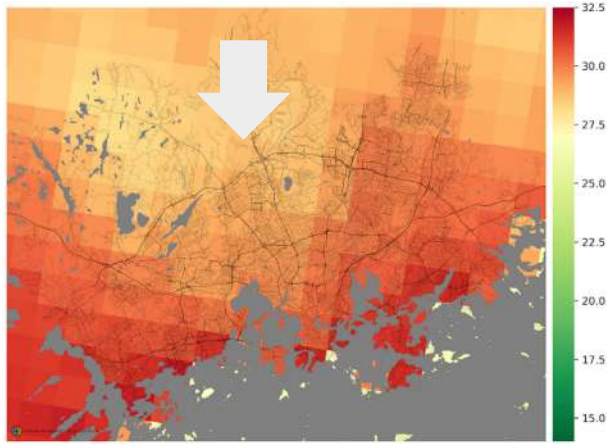
afternoon

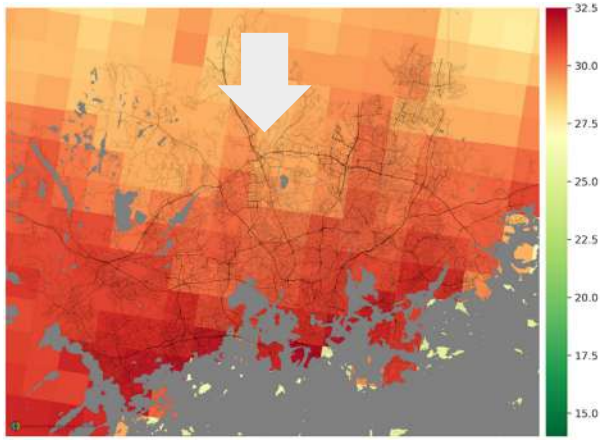
2nd August 2018
southerly flow





28th July 2019
northerly flow





Apparent temperature (°C)

The point being that UHI and urban form are not always the determining factors for heatwave exposure.

Adaptation to non-plannable, but regulatable factors is necessary. Remembering climate architecture?

Local exposure and vulnerability

- Yellow warning: $T_{dmax} \geq 27\ ^oC$ AND $T_{dmean} \geq 20\ ^oC$
- Orange warning: $T_{dmax} \geq 30\ ^oC$ AND $T_{dmean} \geq 24\ ^oC$

	% pop. exposed		% 75+ exposed		% workplaces exposed		% dwellings exposed	
warning	2/8/18	28/7/19	2/8/18	28/7/19	2/8/18	28/7/19	2/8/18	28/7/19
no	0.8	0.7	0.9	0.8	1.1	1.1	0.9	0.9
yellow	30.9	11.6	33.4	9.2	56.4	6.7	34.7	10.3
orange	68.4	87.6	65.7	90.0	42.5	92.2	64.4	88.8

- Exposure varies due to the urban heat island effect, type of built environment [plannable], weather pattern, impact of the sea [non-plannable, but possible to regulate].
- Exposure among different vulnerability groups can (a) be high and (b) vary significantly.

Multiscale decision support tools for what-if analysis

What city-level changes are expected?

How does the **urban fabric** respond? Is it different if I take this or another action?

How are people & buildings affected?

scenarios

policies

policies

policies

Income, Population

Metropolitan housing market

Land use, housing prices, demographics

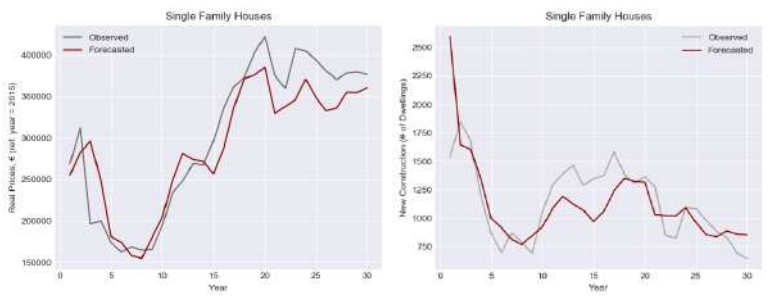
3D buildings

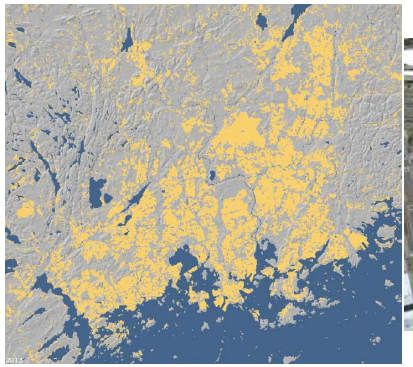
Impacts

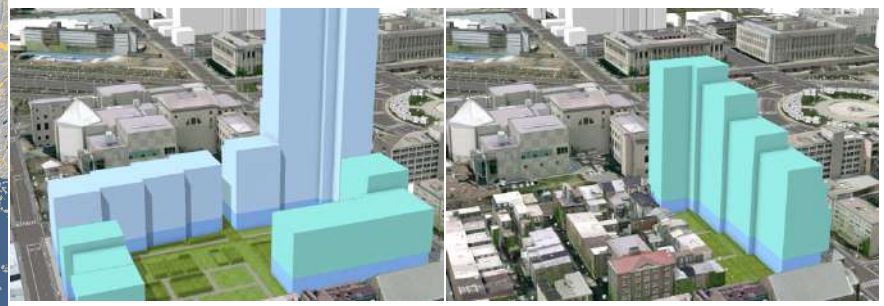
Metropolitan resolution

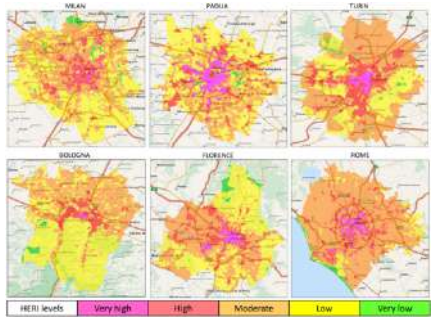
Building block resolution

User-defined resolution







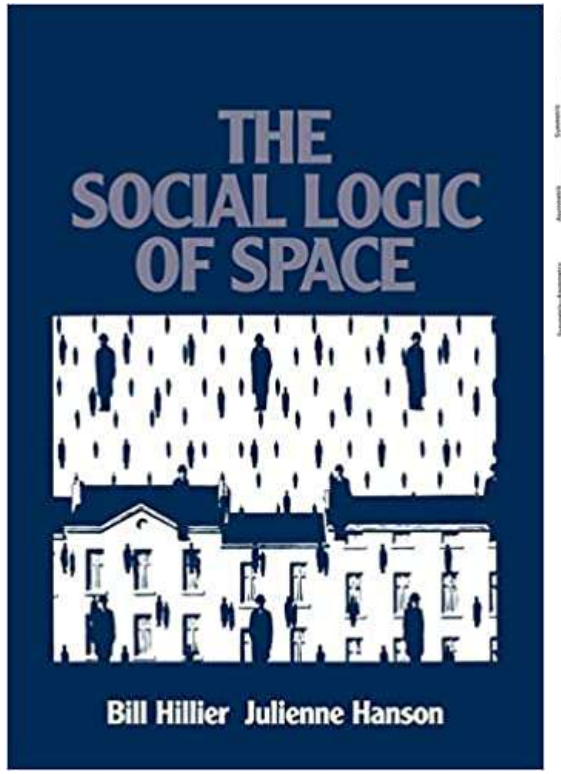


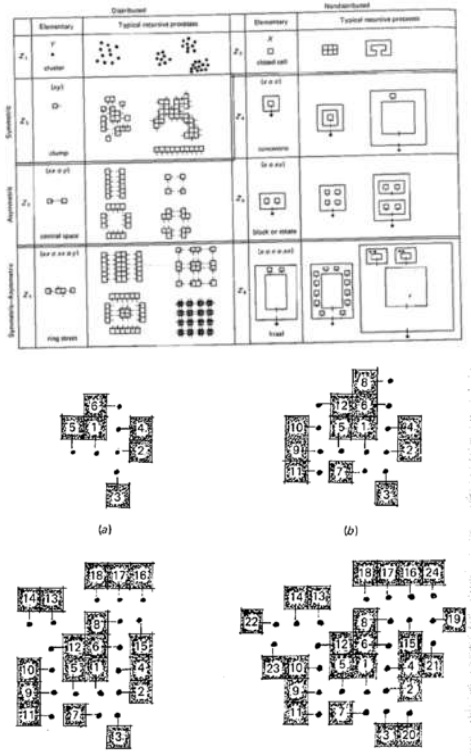
Housing affordability, Energy use, Segregation, Microclimate

A Votsis, A Perrels, A Staffans, A Haapala, R Ruuhela, S Junnila, T Merikoski, T Rautio 2020 'Livable, resilient, sustainable futures? The importance of multiscale, multisector scenarios' **Finnish Academy, Strategic Research Conference Oct 2020**.

A theory and operational framework to understand the way **social** and **physical organization co-generate settlement patterns** and **socio-spatial networks**.

Hillier B, Hanson J **2003** 'The Social Logic of Space' (Cambridge University Press).





Example: Resilience of the elderly through intergenerational public spaces in Singapore (Tiong Bahru neighborhood).

Cities are complex but incomplete systems that cannot be fully controlled

Sassen, S. (2017). The city: A collective good? *The Brown Journal of World Affairs*, XXII(II): 119–125.

From policy to action www.together2030.org

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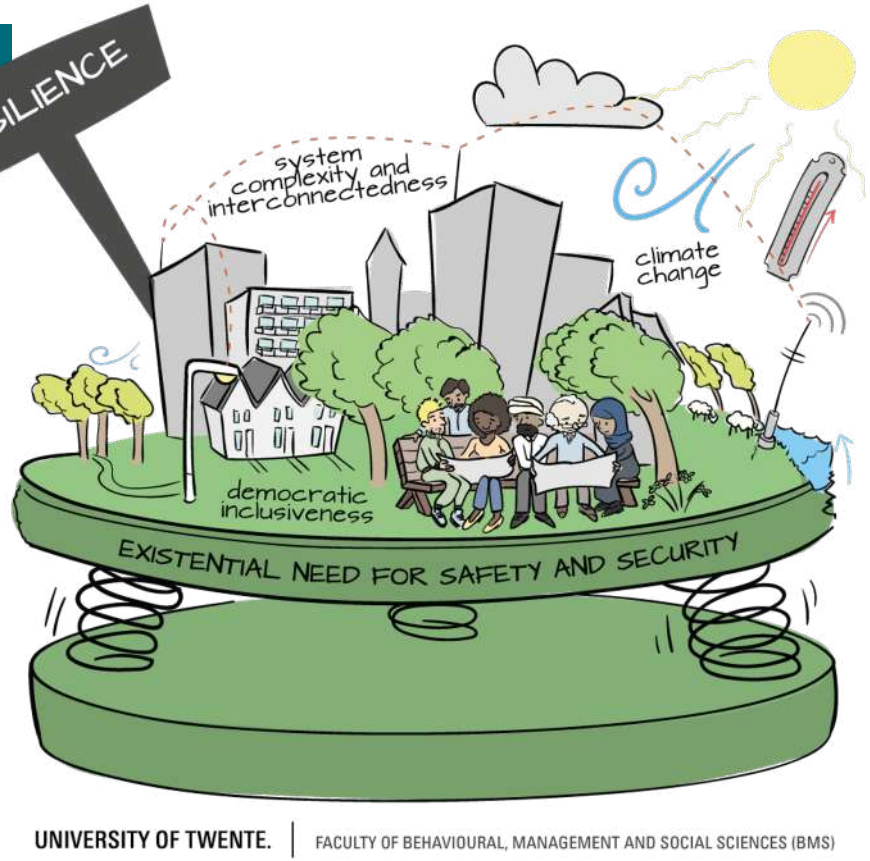
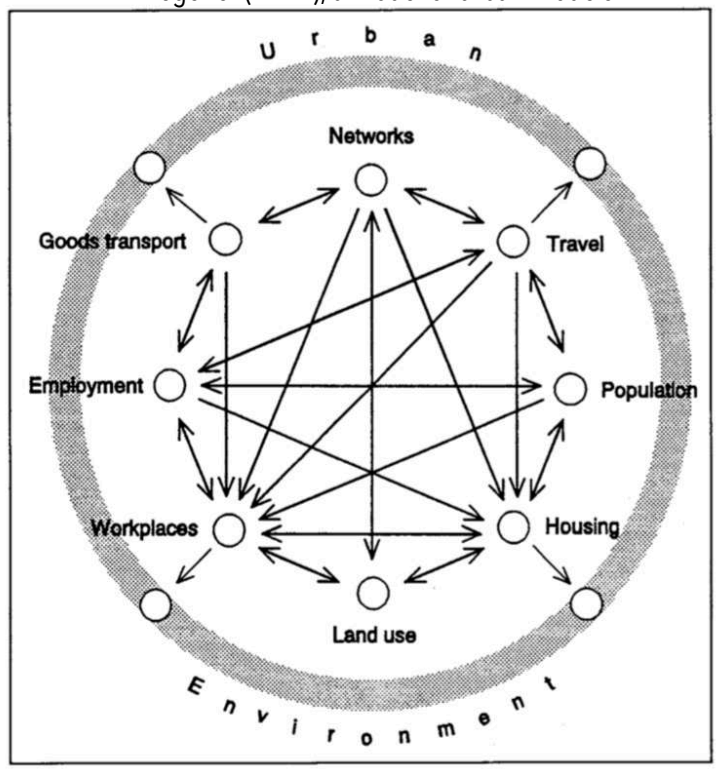


Wegener (1994), a model of urban models:



Scenarios of urban futures need to be scenarios about how the **urban fabric** can be given room to respond and adapt in its own ways to challenges and change | bottom-up, multiple scales and activities, living things; not abstract structures

Thank you! ☺

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