Urban Resilience

Ron Boschma

Pierre-Alexandre Balland

On hazards, crises & urban resilience

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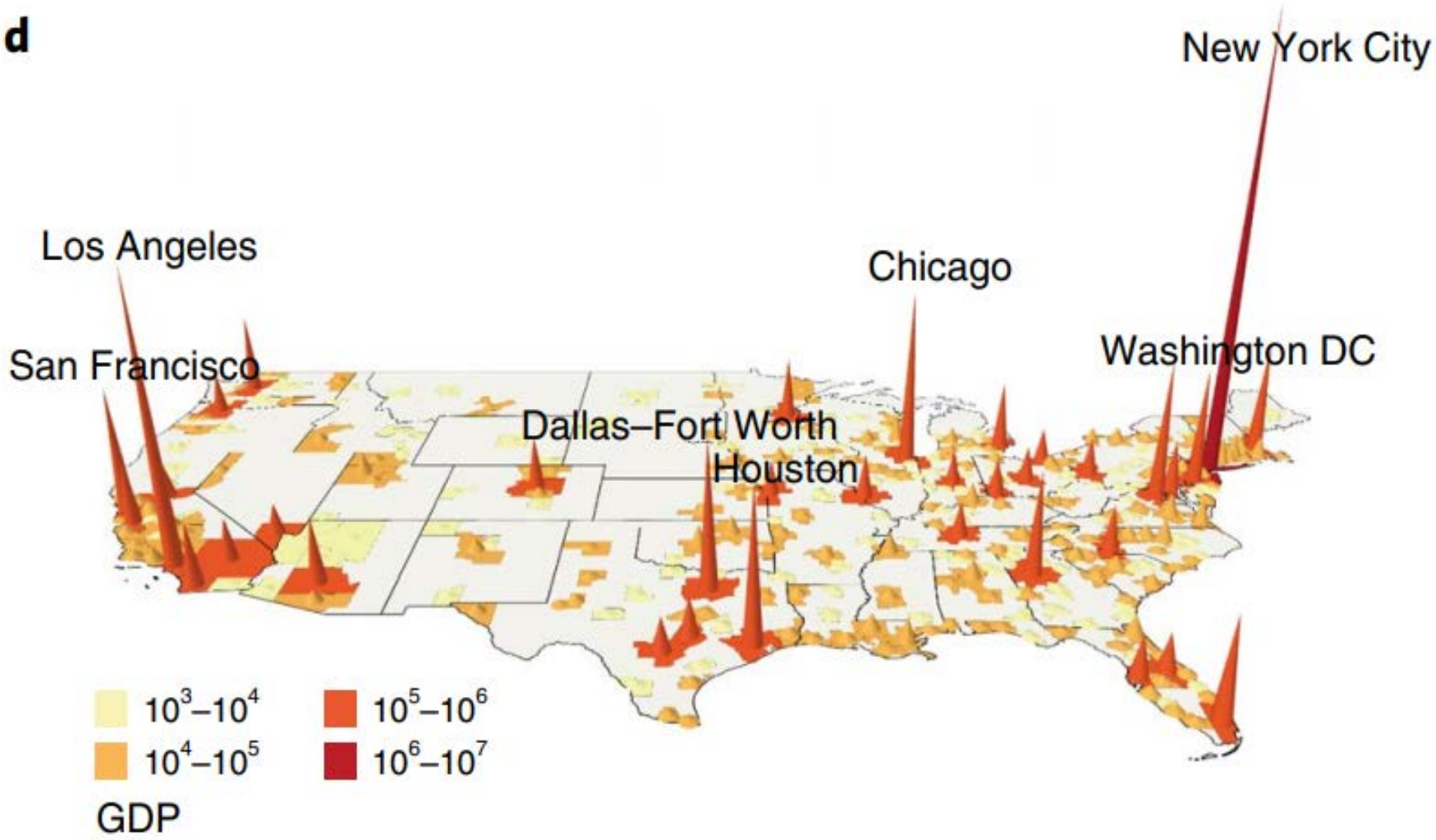
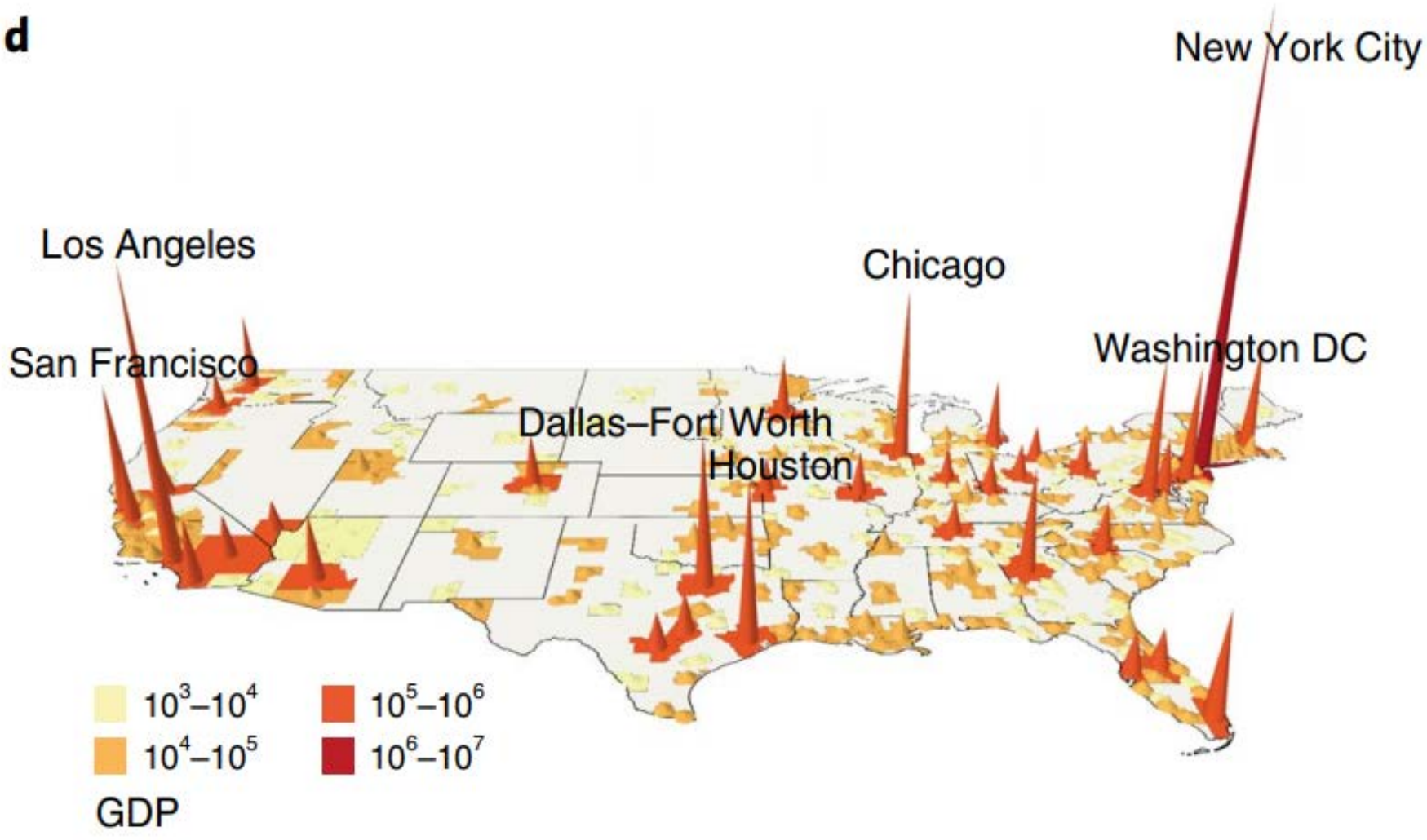
Pandemic & systemic risk

Systemic risk management



Balland, P.A., Jara-Figueroa, C., Petralia, S., Steijn, M., Rigby, D., and Hidalgo, C. (2020) Complex Economic Activities Concentrate in Large Cities, *Nature Human Behavior*

Systemic risk management



The tail is becoming fatter as connectivity (complexity) increases – we need new paradigms of risk management

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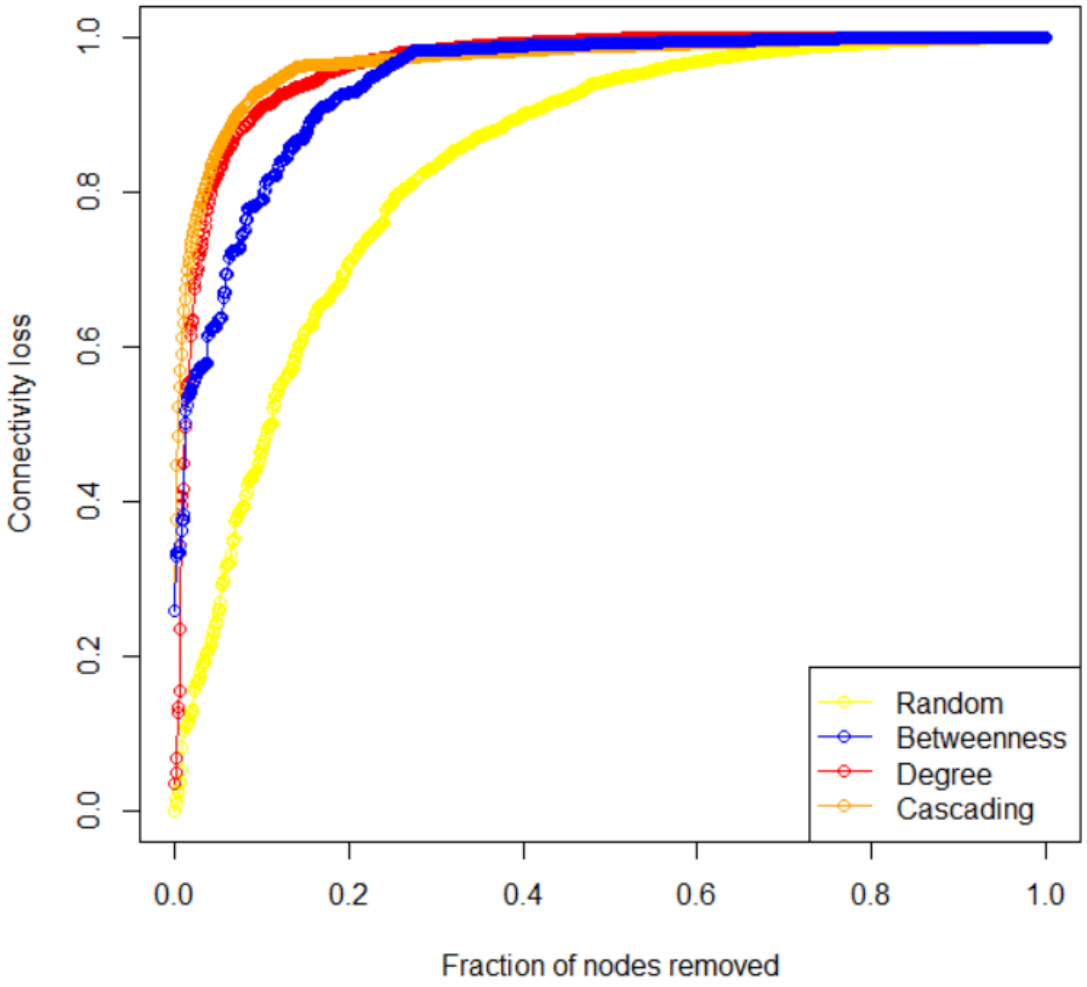
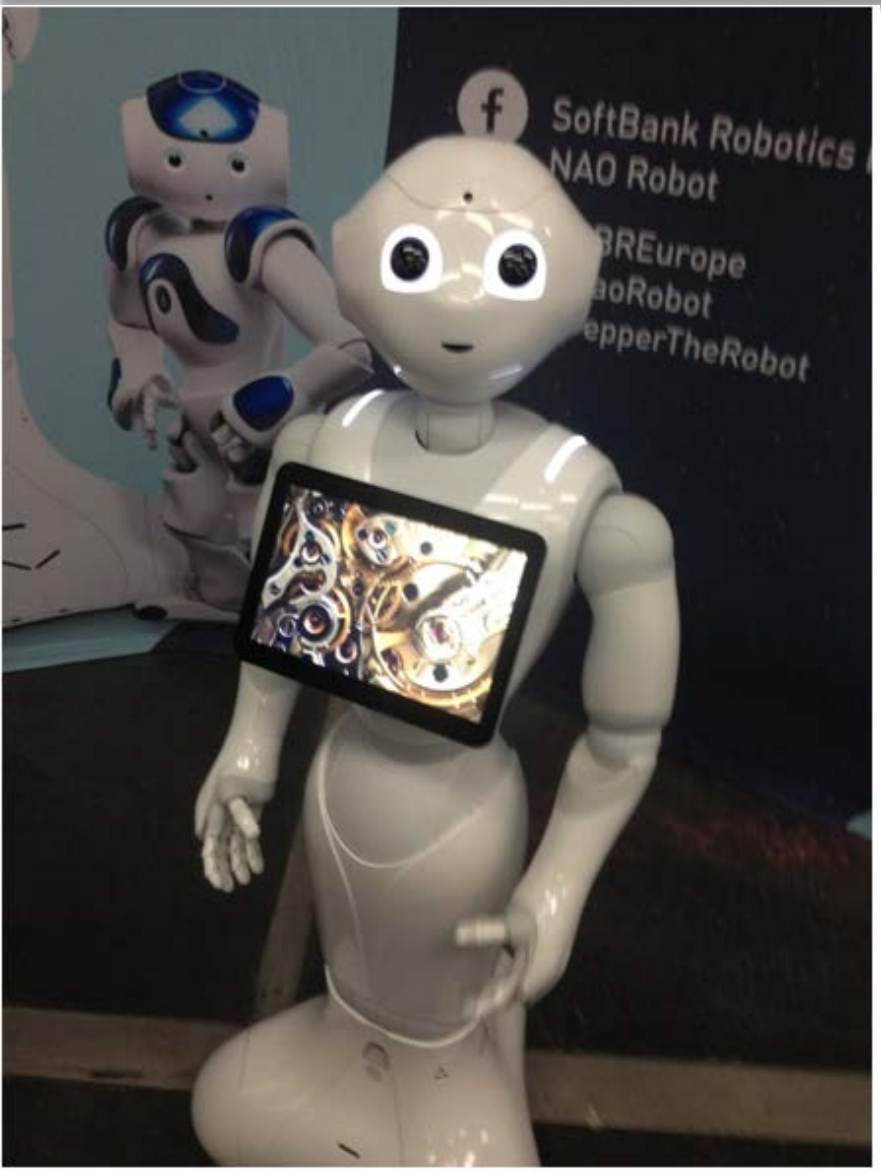
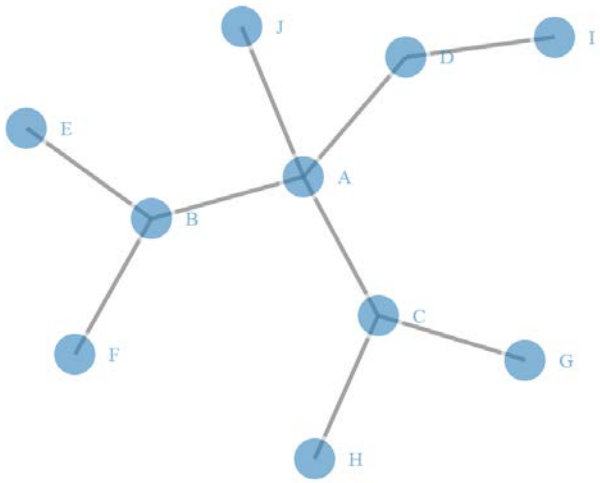
- Conceptualizing cities as complex adaptive systems
- Useful concepts of robustness, adaptation, and transition

Errors, attacks, and robustness



Structural flexibility & adaptation





Sustainable Transitions

HappyCow

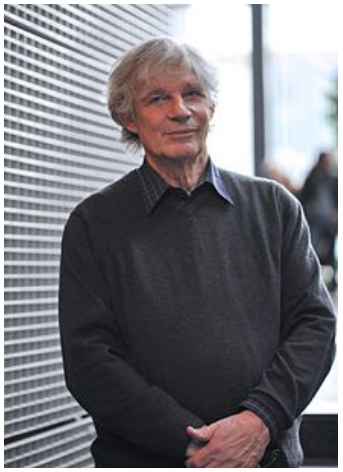
Key questions

- 1. Elements of complexity theory
- 2. What is resilience and what makes complex adaptative systems resilient?
- 3. Evaluate the resilience of what to what?
- 4. How does urban resilience relate to global sustainability?
- 5. How to integrate the economic, social, environmental, and political dimensions for sustainable urban development?
- 6. How to apply resilience thinking for sustainable urban development?

Complexity Theory

Pierre-Alexandre Balland

Key thinkers



Stuart Kauffman
(biology)

Ilya Prigogine
(chemistry)

Albert-László Barabási
(physics)

Warren Weaver
(mathematics)

John Holland
(psychology and electrical engineering)

Brian Arthur
(economics)

Jane Jacobs
(geography & planning)

Complex systems

- Large networks of simple interacting elements, which, following simple rules, produce emergent, collective, complex behavior.

Key complexity concepts

- Interconnectedness

Paradigm shift: individual characteristics → relationships between components

- Synthesis

Analyse the whole (big picture)

- Emergence

Property of a system that emerges from collective behaviour (larger things from smaller parts)

- Self-organization

Some form of overall order arises from interactions between components of an initially disordered system (without central planning)

- Feedback loops

Reinforcing/balancing

- Phase transition

Qualitatively different patterns of organization, separated by sharp boundaries

- Criticality

State of a system ready for a phase transition

→ We need system mapping

Key question

- How do systems with multiple components (and limited communication between them), no central control and simple rules of operation give rise to complex adaptive behavior that involves information processing, computation, evolution and learning?

Key resilience concepts

- Resilience - the capacity of a system to absorb disturbance, change and retain (qualitatively similar) function, structure, identity, and feedbacks
- Complex Adaptive Systems - systems with inherent uncertainty in their dynamics (multiple stable states + self-organization)
- Adaptive Cycle (systems cycle through four phases: rapid growth, conservation, collapse, and re-organization)
- Adaptability - the capacity of a complex system to adjust (external + internal factors)
- Transformability - the capacity of a complex system to create a fundamentally new system when conditions are untenable

Resilience thinking

- Resilience theory is based on complexity science and system dynamics
- Allows to study the dynamics of real world system
- Resilience thinking is a mindset needed to manage and implement change in complex adaptive systems
- Jane Jacobs figured out that cities were best understood as ‘problems of organised complexity’ which refers to “dealing simultaneously with a sizeable number of factors which are interrelated into an organic whole” (Jacobs 1961; 432)

Disorganized complexity (large N small K)/Organized complexity (large N large K)