Knowledge Diversity for Climate Change Adaptation:

A Social-Ecological-Technological Systems (SETS) Approach to Mental Models

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Abstract

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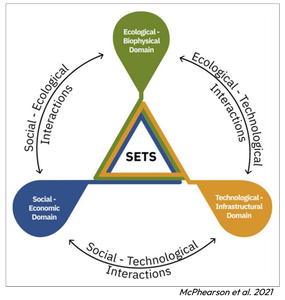
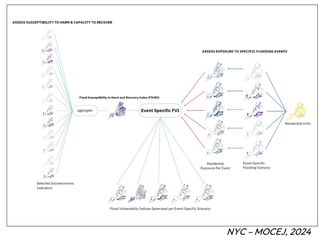
References

1 – Adaptation Through Knowledge Co-Production

Effective urban adaptation planning requires understanding the impacts and risks of extreme weather events as experienced and perceived by urban stakeholders. Framing cities as **socio-ecological-technological systems (SETS)** has been recently embraced as an effective approach to handle urban complexity, merging socio-ecological and socio-technological systems frameworks.



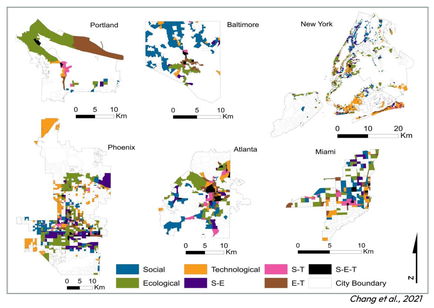
McPhearson et al. 2021



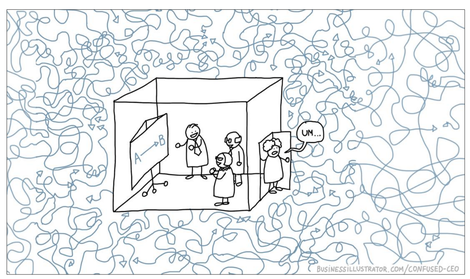
NYC - MOCEJ, 2024

Knowledge co-production is increasingly used to develop climate services (i.e. risk and vulnerability assessments, data visualization tools…), supporting the integration of end-user needs into tools and indicators. These processes enhance their usability, legitimacy, and relevance for adaptation planning.

Climate services – such as risk and vulnerability assessments – are widely used to identify prioritize vulnerable communities, as well as to plan and design adaptation interventions.

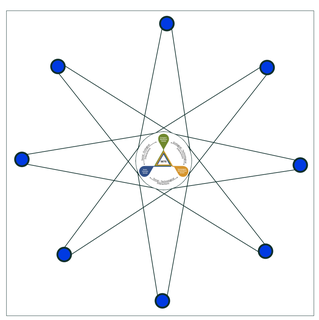


Chang et al., 2021



By over-relying on quantitative, measurable data, risk assessment tools tend to **oversimplify the representation of risk and impacts** experienced by cities, which are extremely complex and interlinked.

Co-production processes also tend to overlook the diversity of interdisciplinary knowledge held by participants. Critically reflecting on knowledge diversity – *differences in how actors perceive climate risks as interactions across social, ecological, and technological domains* – can provide key insights on recurrent narratives, biases, and knowledge gaps that steer problematization in particular directions.



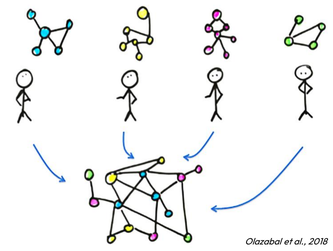
2 – Mapping Knowledge Diversity

We draw upon empirical experiences co-producing climate services to ask:

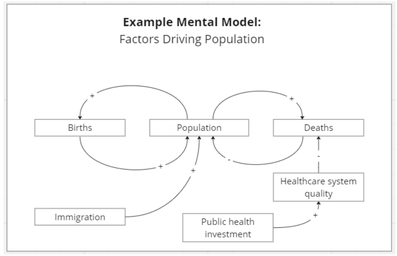
*How do experts involved in local urban adaptation to extreme weather events differently frame the **social**, **ecological**, and **technological** interactions of risk and adaptation to extreme weather events?*

Ultimate goal: to support the co-production of knowledge and the development of research agendas for urban climate change adaptation by identifying distinct framings, biases, and knowledge gaps.

A Fuzzy Cognitive Mapping Exercise to Capture Mental Models



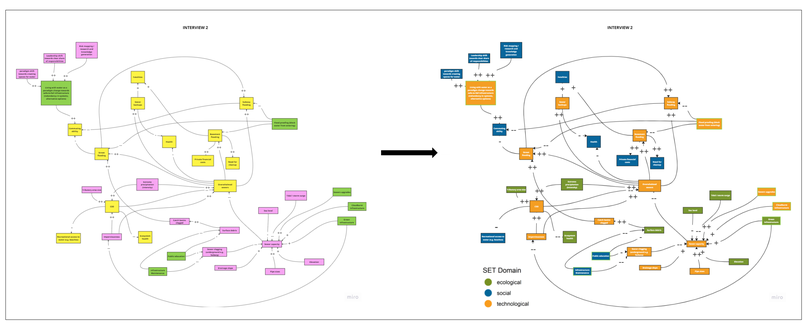
Olazabal et al., 2018



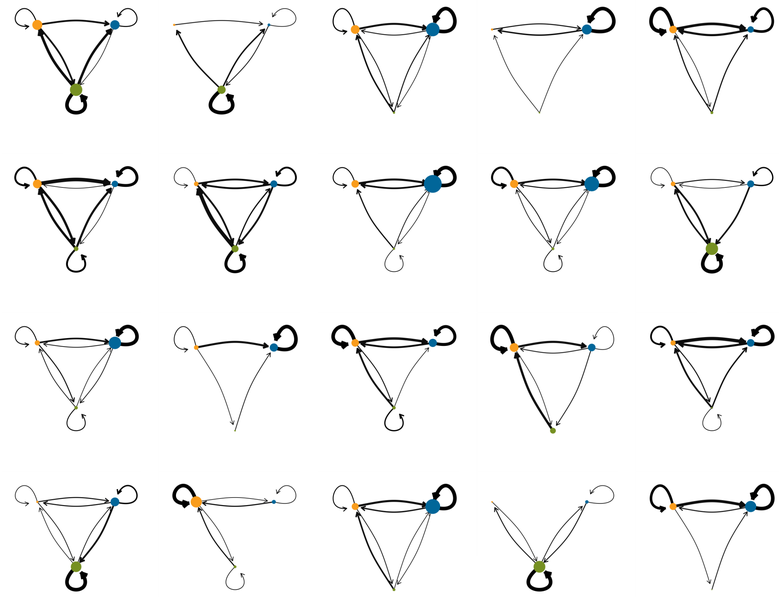
Case Study: Extreme Precipitation in Ney York City

- 20 individual interviews (10 policy makers + 10 researchers).
- Multiple sectors represented (health, green infrastructures, transportation, sanitation, emergency management).
- Fuzzy Cognitive Mapping exercise based on three questions:
  - *What are the short and long term impacts of extreme precipitation in NYC?*
  - *Are there any drivers, pressures, or developments that exacerbate these impacts?*
  - *What responses could alleviate these impacts and/or pressures in order to adapt NYC to extreme precipitation?*

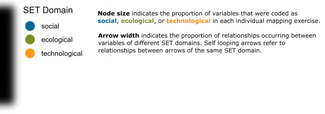
Data Processing: SETS Coding of FCM Components

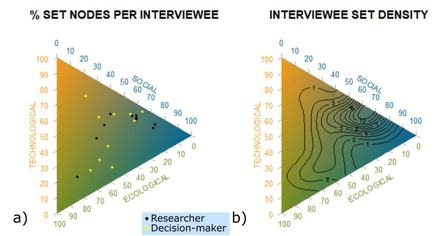


3 – Diversity, Biases, and Knowledge Gaps

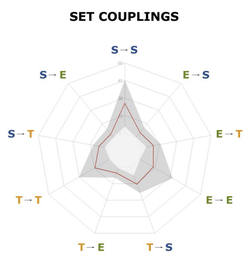


RESULT 1 Only 4 out of 20 interviewees drew all the possible SET couplings → Mental models uncover partial representations of the whole system in each individual.





RESULT 2 **Social** and **Technological** variables were much more present than **ecological** ones, except for mental models drawn from ecology experts, hinting at potential siloed knowledge on the **ecological** domain.



RESULT 3 Intra-domain couplings (**S→S**, **E→E**, **T→T**) are much more abundant than inter-domain (**S→T**, **S→E**…) → Potential knowledge silos confirm a need for facilitating boundary crossing between disciplines.

RESULT 4 While inter-domain couplings were rare across the interviews, the most mentioned interactions between specific variables were mainly **T→S** couplings → hints at a general framing of NYC's challenges as chains of infrastructural failures that impact society.

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1) Institute of Environmental Science and Technology, Universitat Autònoma de Barcelona, Spain, **2)** Basque Centre for Climate Change, Leioa , Spain, **3)** Urban Systems Lab, The New School, New York, NY, USA, **4)** Ikerbasque - Basque Foundation for Science, Bilbao, Spain, **5)** Cary Institute of Ecosystem Studies, Box AB, Millbrook, NY, USA, **6)** Stockholm Resilience Centre, Stockholm University, 106 91 Stockholm, Sweden, **7)** Beijer Institute of Ecological Economics, The Royal Swedish Academy of Sciences, Stockholm, Sweden **8)** Institute of Environmental Science and Technology & Department of Computer Science, Universitat Autònoma de Barcelona, Barcelona, Spain, **9)** Department of Computational Social Sciences and Humanities, Barcelona Supercomputing Center, Barcelona, Spain, **10)** Department of Geography, Humboldt-Universität zu Berlin, Berlin, Germany