Walking towards a cliff-edge

Can a combination of participatory and agent-based modelling approaches help make tipping-point disasters feel like real possibilities?

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Issues from Complexity

Caroline Field:

"*we do not understand how systems fail*"

- Both social and ecological systems are complex and their combination even more so!
- This means that it can be that such systems look to be coping right up to the moment they collapse
- To prevent such collapse costly action needs to be taken much earlier
- However, simple, reductionist models do not have a good track record at predicting such collapses

Issues from Human Social Realities

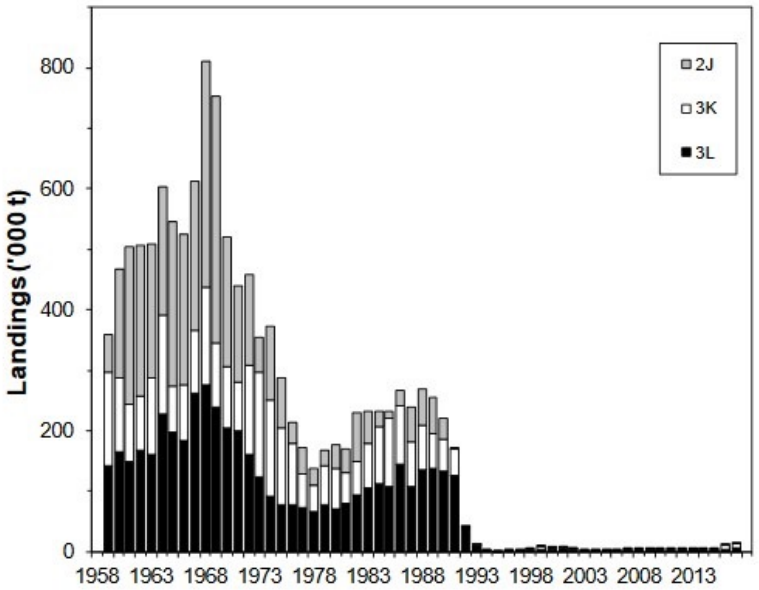
Caroline Field:
"*people do not care about risks*"

Caroline Field:
"*people do not change behaviours unless it is meaningful for them*"

- Political will to change is often lacking as the *collapse does not seem real until it happens*

An example: the North Atlantic Cod Fishery Collapse

- In July 1992 Canada's fisheries minister placed a moratorium on all cod fishing off the NE coast of Newfoundland and Labrador. That day 30,000 people lost their jobs and hundreds of years fishing for cod off those coasts ended.
- Simplistic models being used predicted healthy stocks up until 1989, and hence *had made the problem worse*.
- Concerns raised by some fishermen were ignored and did not influence modelling and projections
- Policy Makers (and indeed the scientists involved!) seemed to look for signs that "business as usual" was OK



Participatory Futures Methods

Caroline Field:
"*we all know our local systems quite well*"

- One can get a group of experts together to consider various plausible futures
- But stakeholders often have different values, viewpoints, language and goals
- One can get a group of stakeholders together to consider various plausible futures narratives
- But these futures tend to be concentrated on near-term and predictable risks

Lisa Schipper:
"*whose voices are influencing the knowledge that makes its way to decision makers and influences policy?*"

Main Issue

How to get the complexity and long-term future projection but in a stakeholder relevant manner?

The proposed solution

To iterate repeatedly between:

1. Stakeholder consideration of futures in the form of narratives

2. Socio-ecological simulations that can capture some of the complexity of the systems, including their unpredictability

Resulting in some believable visions of a future within complex socio-ecological systems

Agent-Based Socio-Ecological Simulation

- Socio-Ecological Simulation denotes a family of computational methods including agent-based modelling (ABM)
- It models societies and individual agents acting and reacting within synthetic environments;
- Helps create artificial societies&ecologies representing real-world counterparts (past, present, future)
- Apt for capturing the complexity of real-world systems one can imagine playing out over time

About ABM

- It can include more of the complexity and mess that stakeholders observe
- It is more interpretable in common-sense ways (each person or entity is represented by corresponding entity in the simulation etc.)
- It does not predict *probabilistically* (what is likely to happen) but explores *possibilistically*
- Easier to include mechanisms that stakeholders know about in common-sense ways
- Its output is easier to relate to narrative scenarios

Ambition: to combine dimensions

Stakeholder participatory Futures approaches

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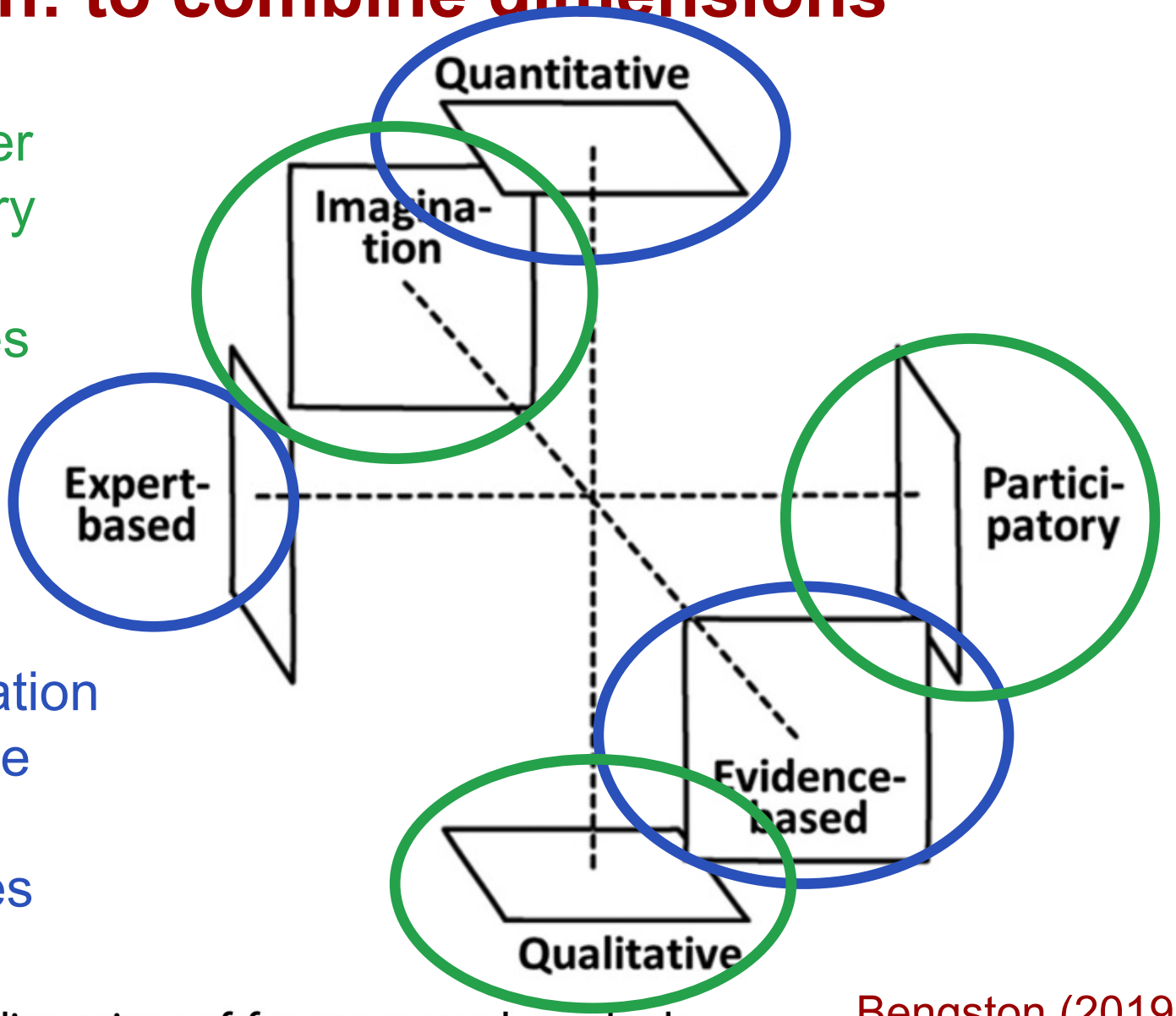
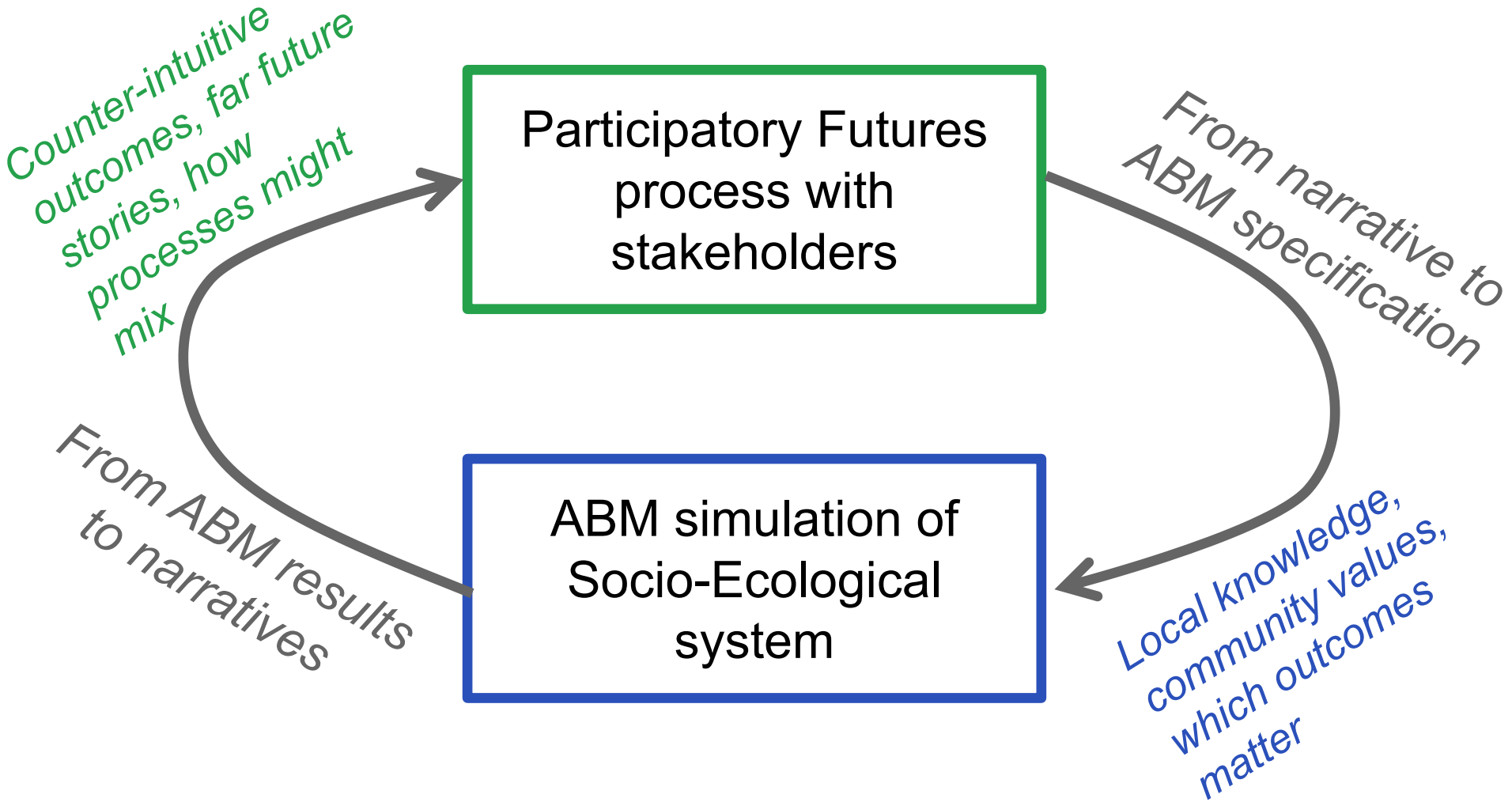
ABM exploration of possible future trajectories



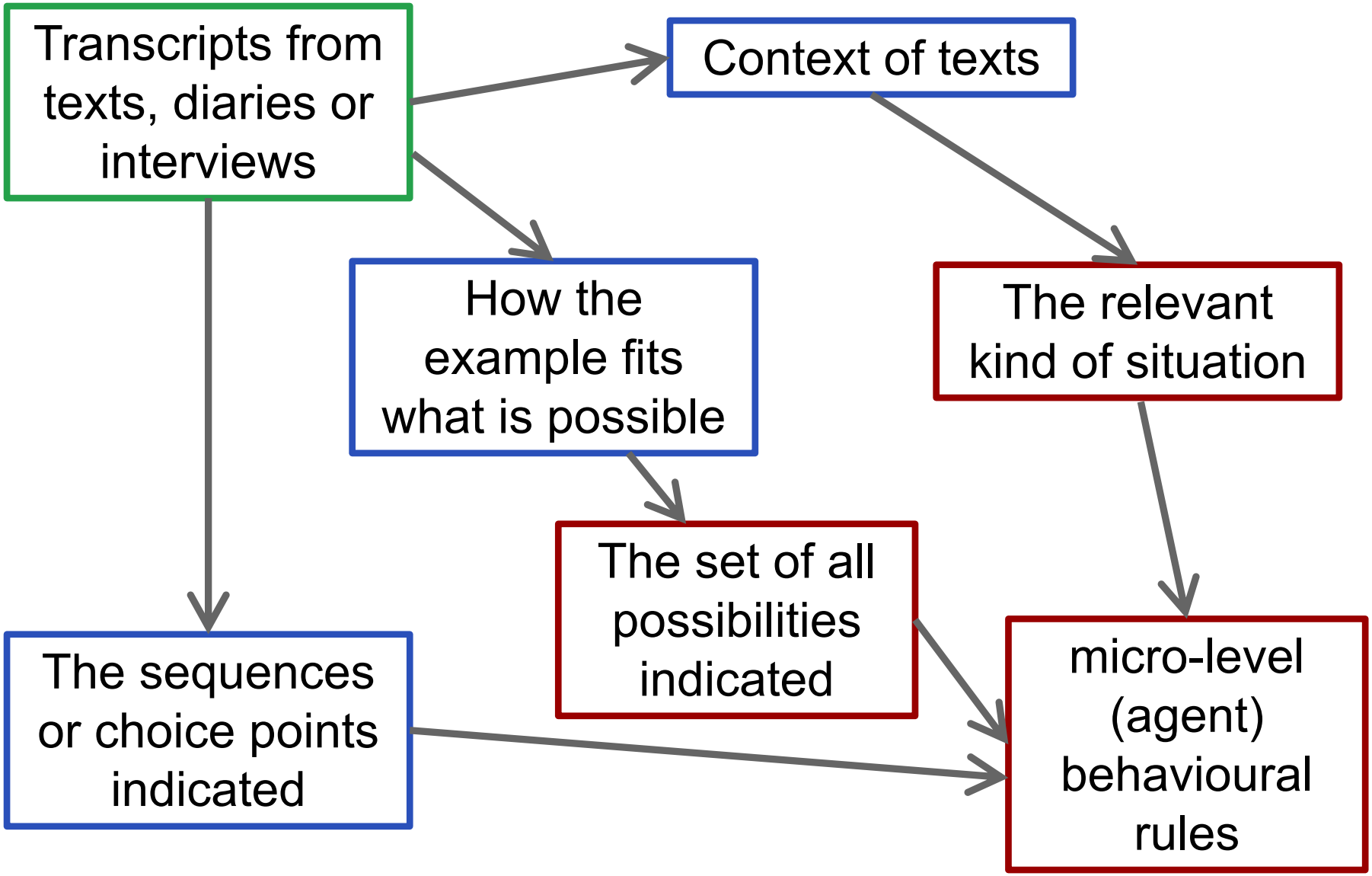
Three dimensions of futures research methods.

Bengston (2019)

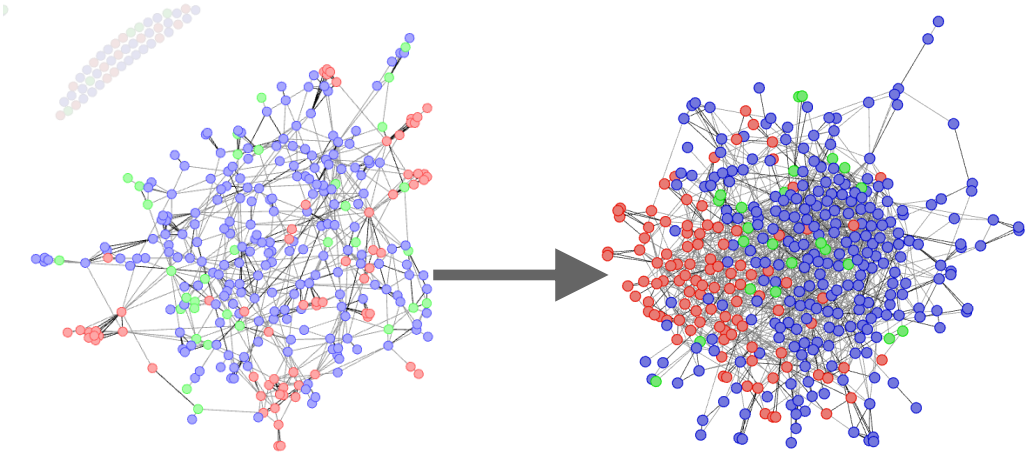
Two key translation processes
involved in the iteration



Meaningful narratives → ABM spec



ABM outputs → meaningful narratives



Social Network Visualisations

Animations on maps

Following single agents over time

```
1953: (person 191) (aged 9) started at (school 1)
1961: (person 191) (aged 17) moved from (patch 1 14) to (patch 11 6) due to
1961: (person 191) (aged 17) stops going to nobody
1961: (person 191) (aged 17) started at (school 0)
1962: (person 191) (aged 18) stops going to (school 0)
1963: (person 191) (aged 19) moved from (patch 11 6) to (patch 7 9) due to
1963: (person 191) (aged 19) partners with (person 142) at (patch 7 9)
1964: (person 191) (aged 20) voted for the blue party
1966: (person 191) (aged 22) voted for the blue party
1967: (person 191) (aged 23) started at (activity2-place 13)
1969: (person 191) (aged 25) moved out of area.
1973: (person 651) (aged 5) started at (school 1)
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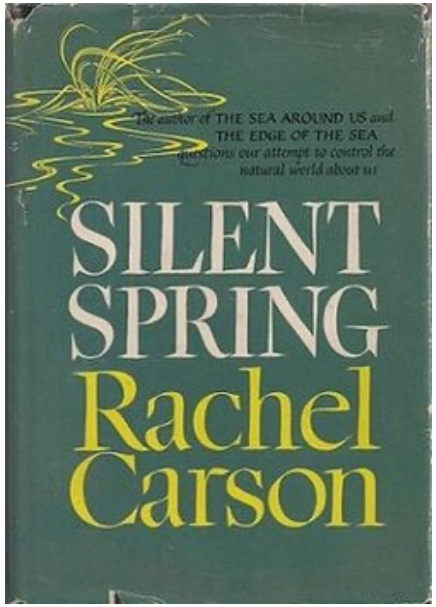
Using the social, spatial and temporal contexts to inform creation of stories

Outlook

- More work done on the Narrative → ABM than on ABM → Narrative processes so far
- Also need to iterate these quickly, naturally and often to achieve results



But science-derived narratives, even longer-term narratives, can be a very powerful focus for political and social change

Some Further References and Resources

Special Interest Group on using qualitative evidence with ABM: https://essa.eu.org/sig/sig-qual2rule/

Special issue 2015: http://jasss.soc.surrey.ac.uk/18/1

Neumann, M. (ed.) (2023) An interpretive Account to Agent-Based Social Simulation, Routledge.

Polhill, J.G. & Edmonds, B. (2023 Online) *Cognition and Hypocognition: Discursive and simulation-supported decision-making within complex systems*. Futures, 148. DOI:10.1016/j.futures.2023.103121

Bhawani, S. (2004) Adaptive Knowledge Dynamics and Emergent Artificial Societies: Ethnographically Based Multi-Agent Simulations of Behavioural Adaptation in Agro-Climatic Systems. Doctoral Thesis, University of Kent, Canterbury, UK. http://cfpm.org/qual2rule/Sukaina%20Bharwani%20Thesis.pdf

Taylor, R.I. (2003). Agent-Based Modelling Incorporating Qualitative and Quantitative Methods: A Case Study Investigating the Impact of E-commerce upon the Value Chain. Doctoral Thesis, Manchester Metropolitan University, Manchester, UK. http://cfpm.org/cpmrep137.html

The End!

Bruce Edmonds' Publications: http://cfpm.org/~bruce/pubs.html

Melania Borit: https://uit.no/ansatte/melania.borit

These slides at: http://cfpm.org/slides