Operationalising complexity of societal tipping processes towards sustainability: Criticality and critical agency
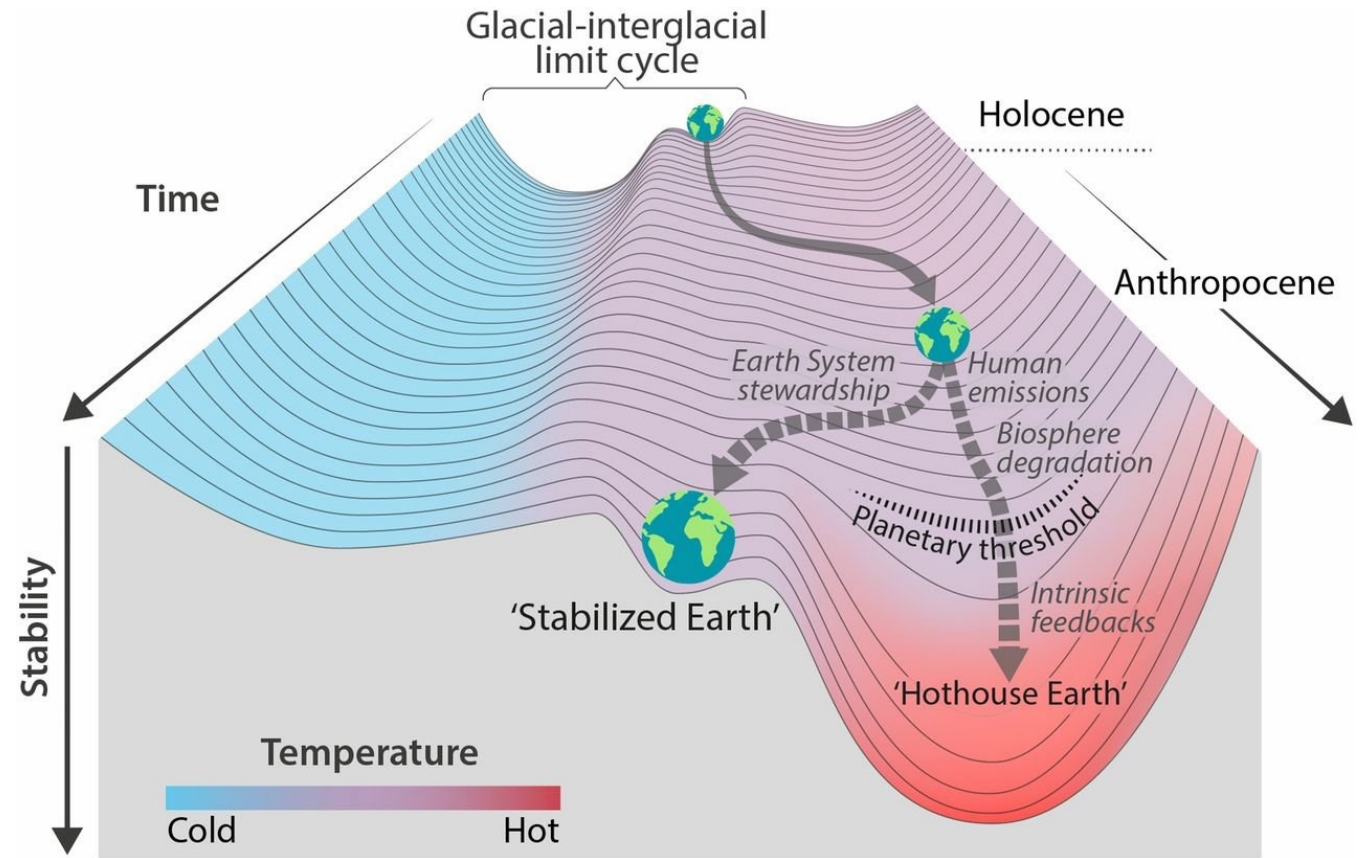
Dr. E. Keith Smith

University of Bern
Oeschger Centre for Climate Change Research
October 2, 2023

Agenda

- The promise of social tipping
- Social tipping definition, examples, methods and critiques
- Criticality perspective
- Critical Agency
- Comments and discussion

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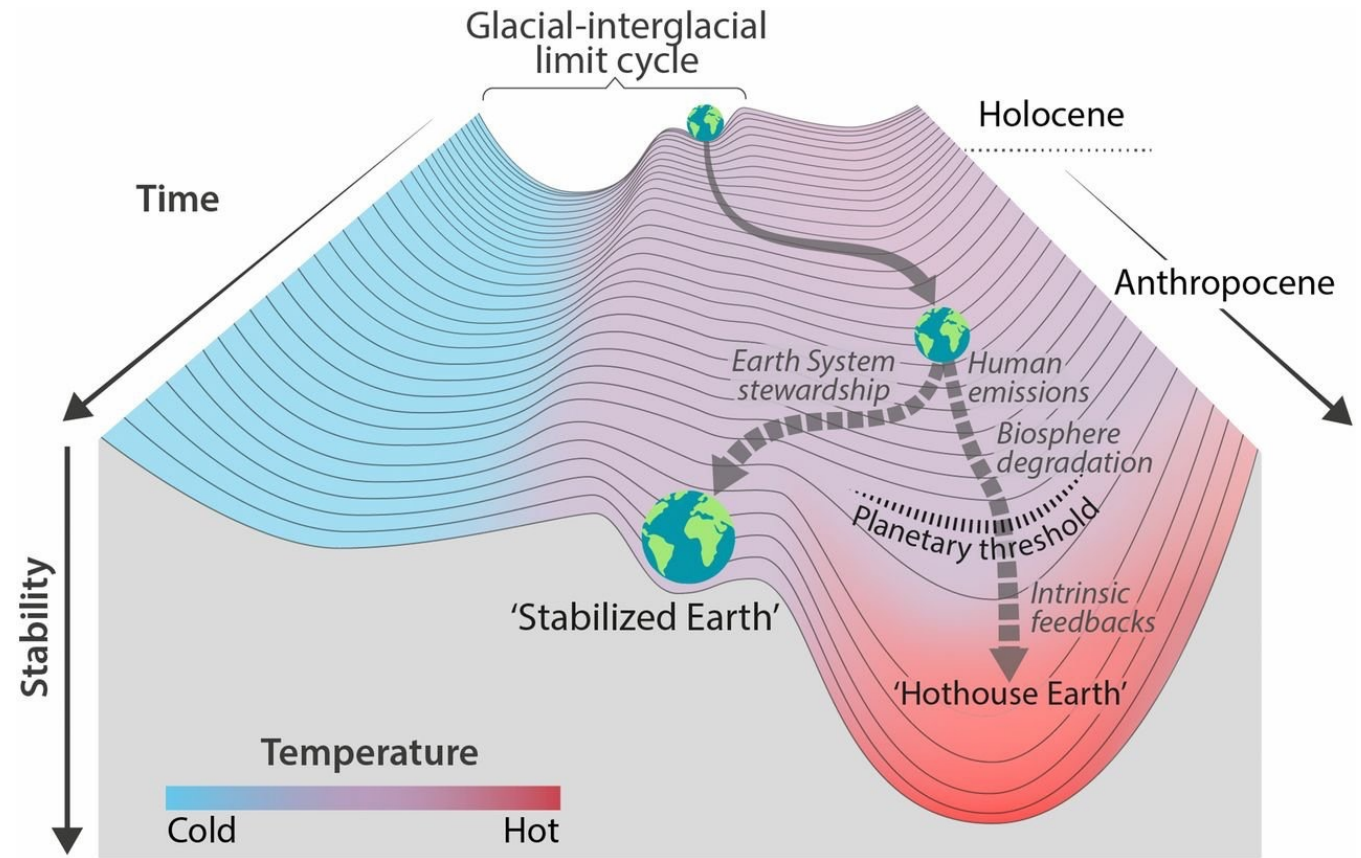
The Promise of Social Tipping

- Earth System on a path trajectory towards potentially transgressing planetary thresholds

Steffen, W., Rockström, J., Richardson, K., Lenton, T. M., Folke, C., Liverman, D., ... & Schellnhuber, H. J. (2018). Trajectories of the Earth System in the Anthropocene. *Proceedings of the National Academy of Sciences*, *115*(33), 8252-8259.

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3

The Promise of Social Tipping

- Earth System on a path trajectory towards potentially transgressing planetary thresholds

- Potential for interrelated, potentially irreversible systemic changes

Steffen, W., Rockström, J., Richardson, K., Lenton, T. M., Folke, C., Liverman, D., ... & Schellnhuber, H. J. (2018). Trajectories of the Earth System in the Anthropocene. *Proceedings of the National Academy of Sciences*, *115*(33), 8252-8259.
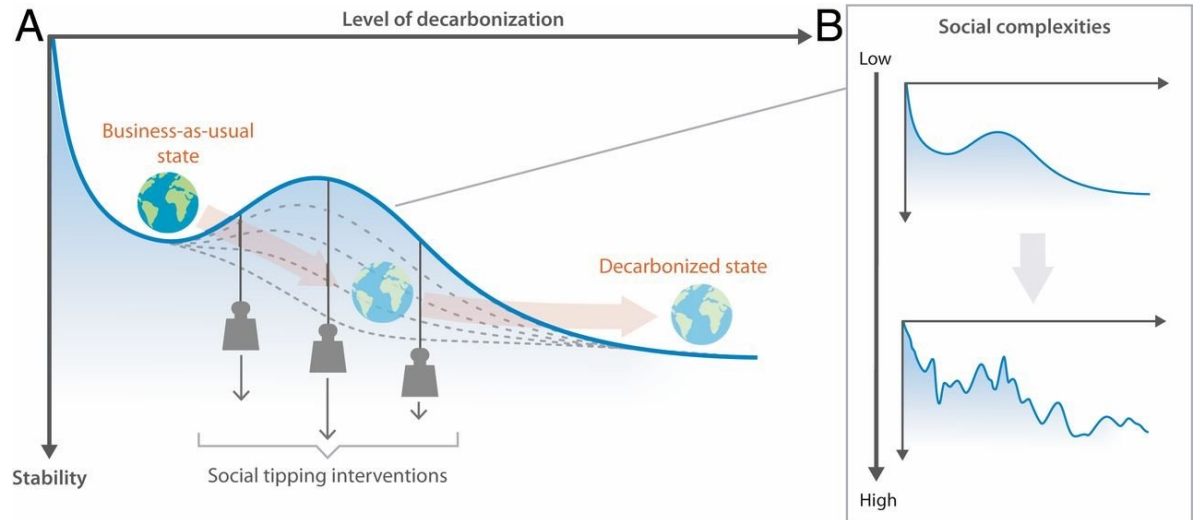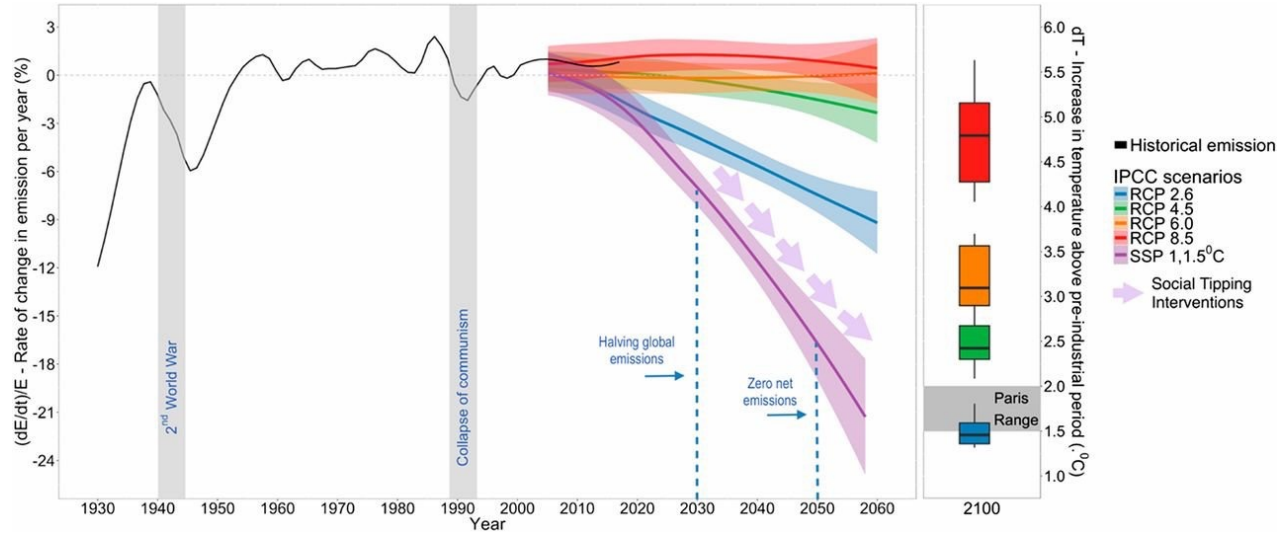
The Promise of Social Tipping

- Earth System on a path trajectory towards potentially transgressing planetary thresholds

- Potential for interrelated, potentially irreversible systemic changes

- Widespread search for solutions
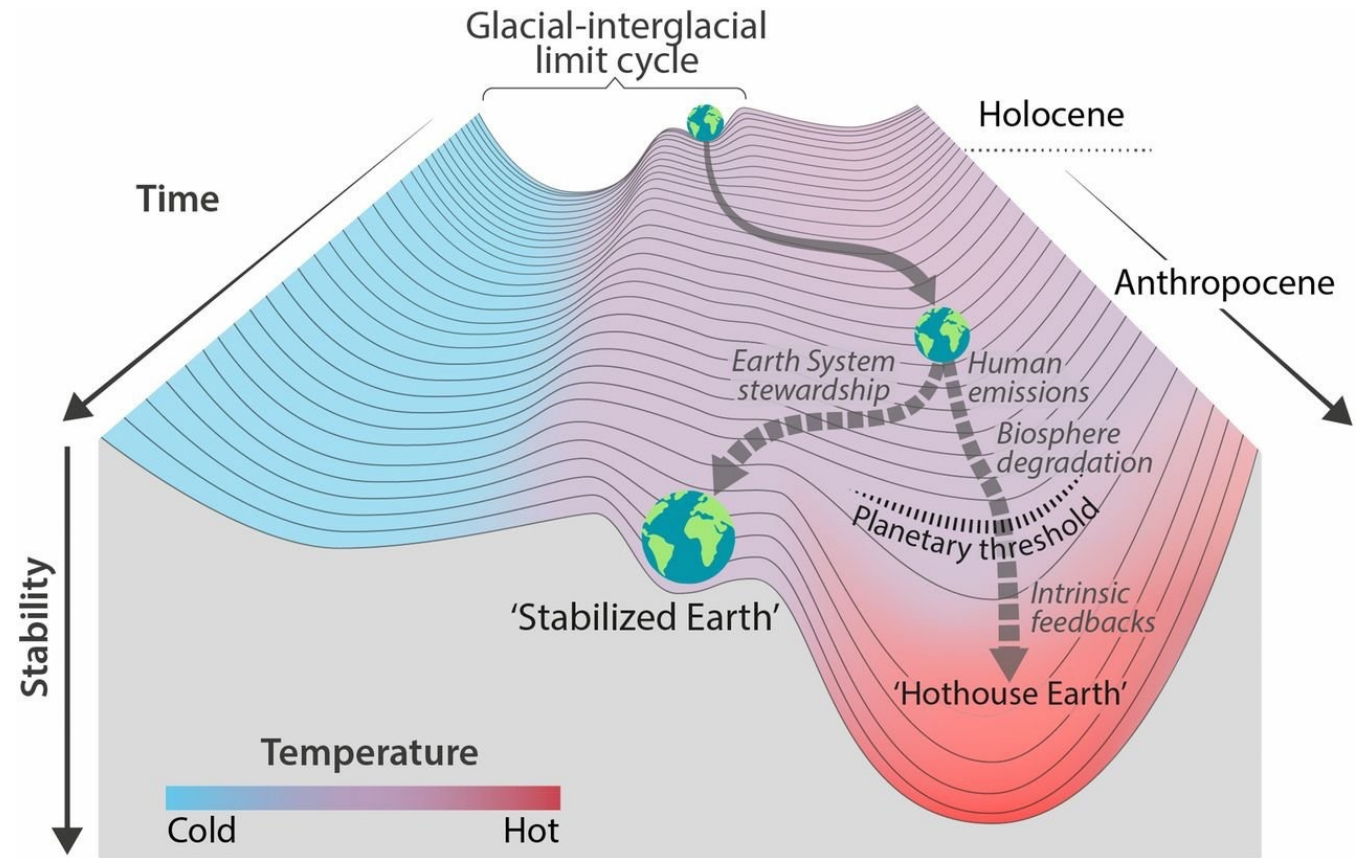
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The Promise of Social Tipping

Otto, I. M., Donges, J. F., Cremades, R., Bhowmik, A., Hewitt, R. J., Lucht, W., ... & Schellnhuber, H. J. (2020). Social tipping dynamics for stabilizing Earth's climate by 2050. *Proceedings of the National Academy of Sciences*, *117*(5), 2354-2365.

The Promise of Social Tipping

The Atlantic ✔
@TheAtlantic

Al Gore thinks America is 'extremely close to a political tipping point' on climate change, @isaacdovere reports:

theatlantic.com
Al Gore: America Is Close to a 'Political Tipping Point' on Climate Cha...
The former vice president discusses how the politics of the environment have changed considerably over his decades of advocacy.

5:28 AM · Jan 4, 2019

Social tipping points are the only hope for the climate

A new paper explores how to trigger them.

By David Roberts | @drvolts | Jan 29, 2020, 10:10am EST

Photo by Brasil2/iStock

Studies Show We're Tipping Climate. It's Up to Us to Tip It Back.
Experts weigh in on how to change the systems and behaviors leading us to catastrophe

Big Setbacks Propel Oil Giants Toward a 'Tipping Point'

A surprising mix of environmentalists, pension fund managers and big money investors have scored startling victories against oil

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The Promise of Social Tipping

Science

POLICY FORUM | **CLIMATE CHANGE**

Sensitive intervention points in the post-carbon transition

We must exploit socioeconomic tipping points and amplifiers

J. D. FARMER, C. HEPBURN, M. C. IVES, T. HALE, T. WETZER, P. MEALY, R. RAFATY, S. SRIVASTAV, AND R. WAY   Authors Info & Affiliations

nature

Determinants of emissions pathways in the coupled climate–social system

Frances C. Moore, Katherine Lacasse, Katharine J. Mach, Yoon Ah Shin, Louis J. & Brian Beckage

32k Accesses | 4 Citations | 586 Altmetric | Metrics

Ecological Economics
Volume 192, February 2022, 107242

Analysis

Social tipping processes towards climate action: A conceptual framework

Ricarda Winkelmann [a, b, 1], Jonathan F. Donges [a, c, 1], E. Keith Smith [d, e, 1], Manjana Milkoreit [f, 1], Christina Eder [d], Jobst Heitzig [g], Alexia Katsanidou [d, h], Marc Wiedermann [g], Nico Wunderling [a, b, i], Timothy M. Lenton [j]

Social tipping dynamics for stabilizing Earth's climate by 2050

Ilona M. Otto, Jonathan F. Donges, Roger Cremades, +10, and Hans Joachim Schellnhuber   Authors Info & Affiliations

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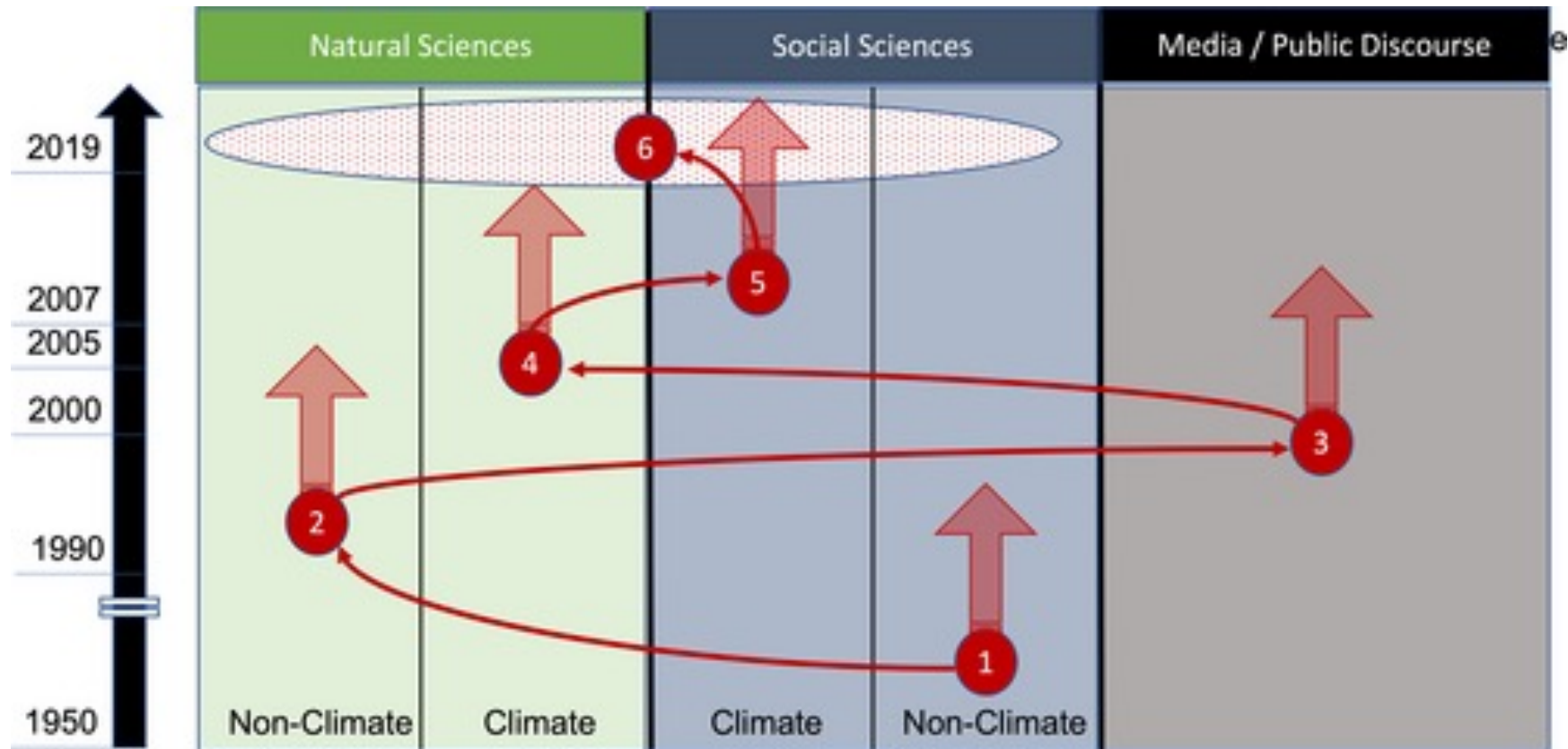
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Social Tipping - Definition

Milkoreit, M. (2023). Social tipping points everywhere?—Patterns and risks of overuse. *Wiley Interdisciplinary Reviews: Climate Change*, *14*(2), e813.

Social Tipping - Definition

- [Small] changes within a social system (or in it's environment)

- Triggers rapid transformation to qualitatively different state

- Driven by 'runaway', mathematically positive, internal feedback

Open questions:
- Size of the change?
- Irreversibility?
- Normatively positive/negative?
- How to detect/predict/identify?
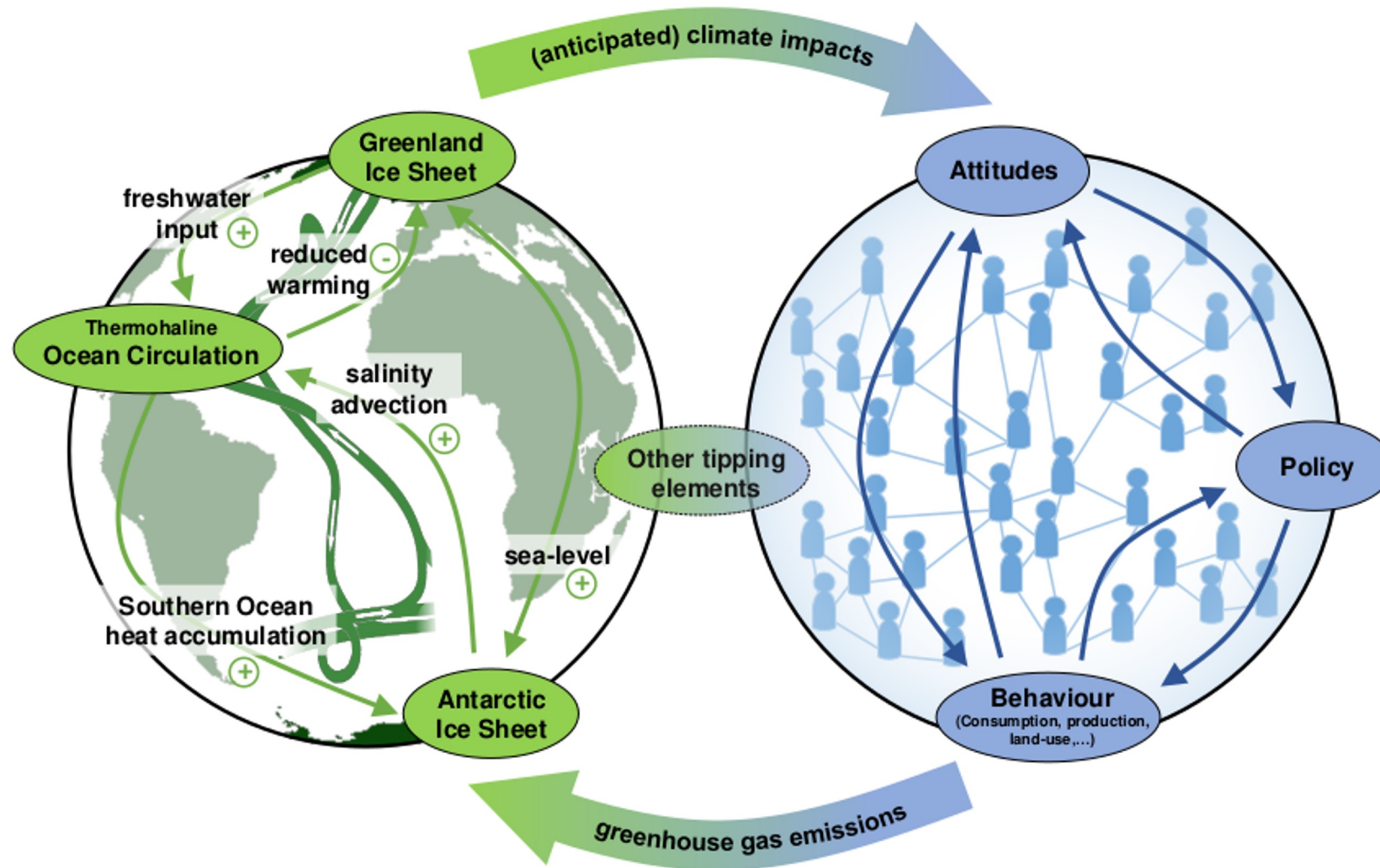
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Social Tipping - Definition

Smith et al. (under revision, ERL):
https://osf.io/d8scb

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Social Tipping – Elements/Historical Examples

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Social Tipping – Elements/Historical Examples

Sharpe, S., & Lenton, T. M. (2021). Upward-scaling tipping cascades to meet climate goals: plausible grounds for hope. *Climate Policy*, *21*(4), 421-433.

Social Tipping – Elements/Historical Examples

Winkelmann, R., Donges, J. F., Smith, E. K., Milkoreit, M., Eder, C., Heitzig, J., ... & Lenton, T. M. (2022). Social tipping processes towards climate action: a conceptual framework. Ecological Economics, 192, 107242.
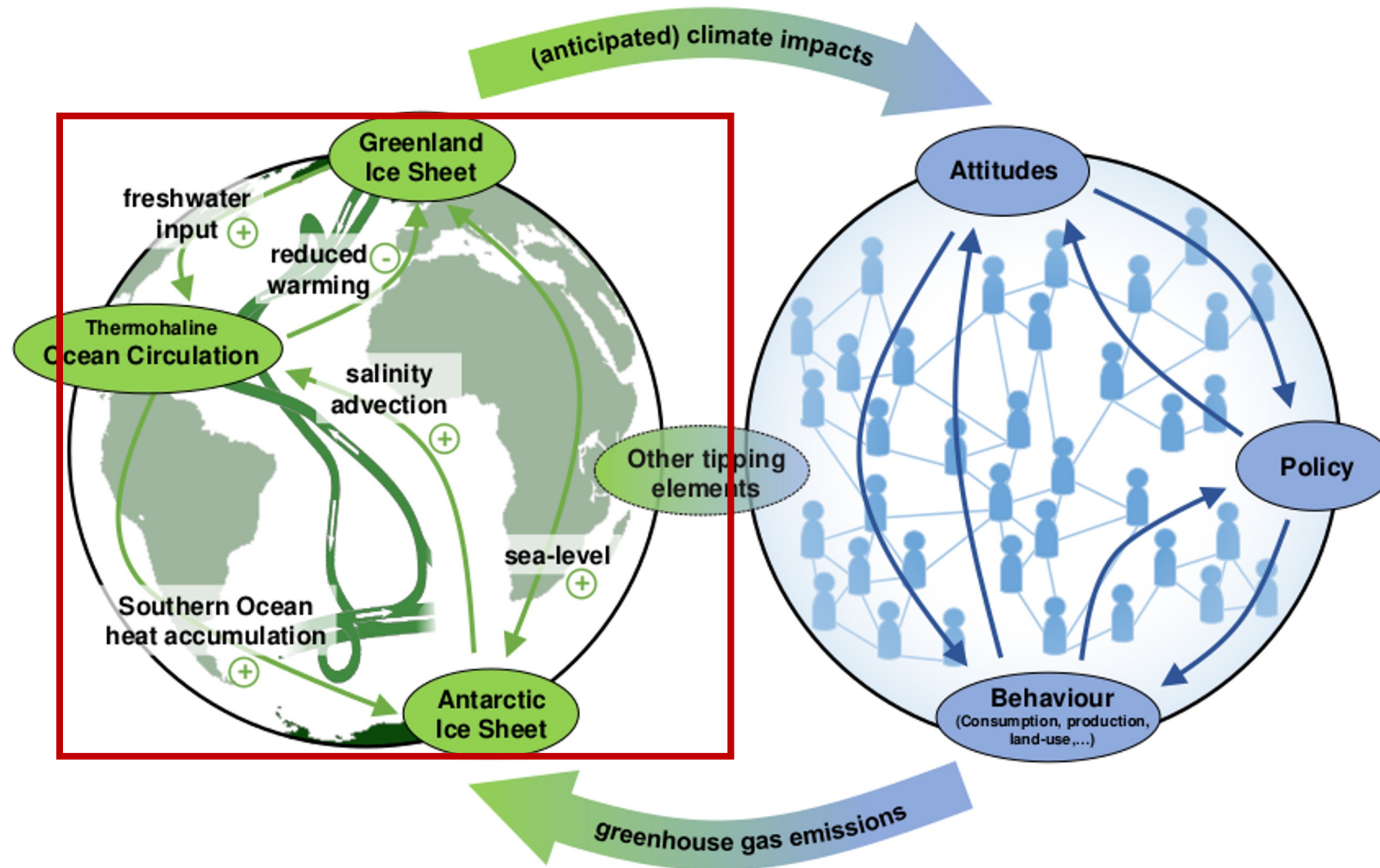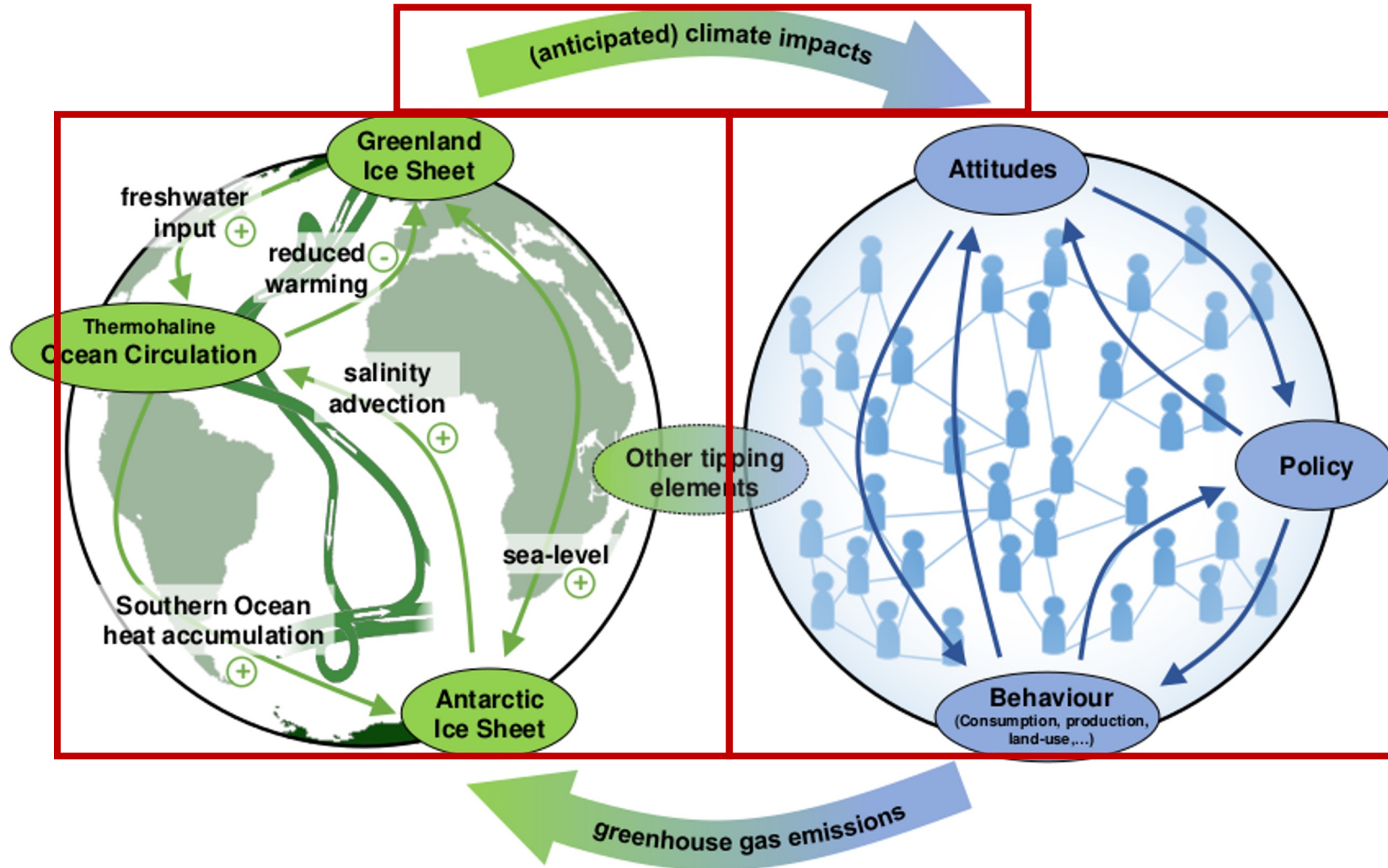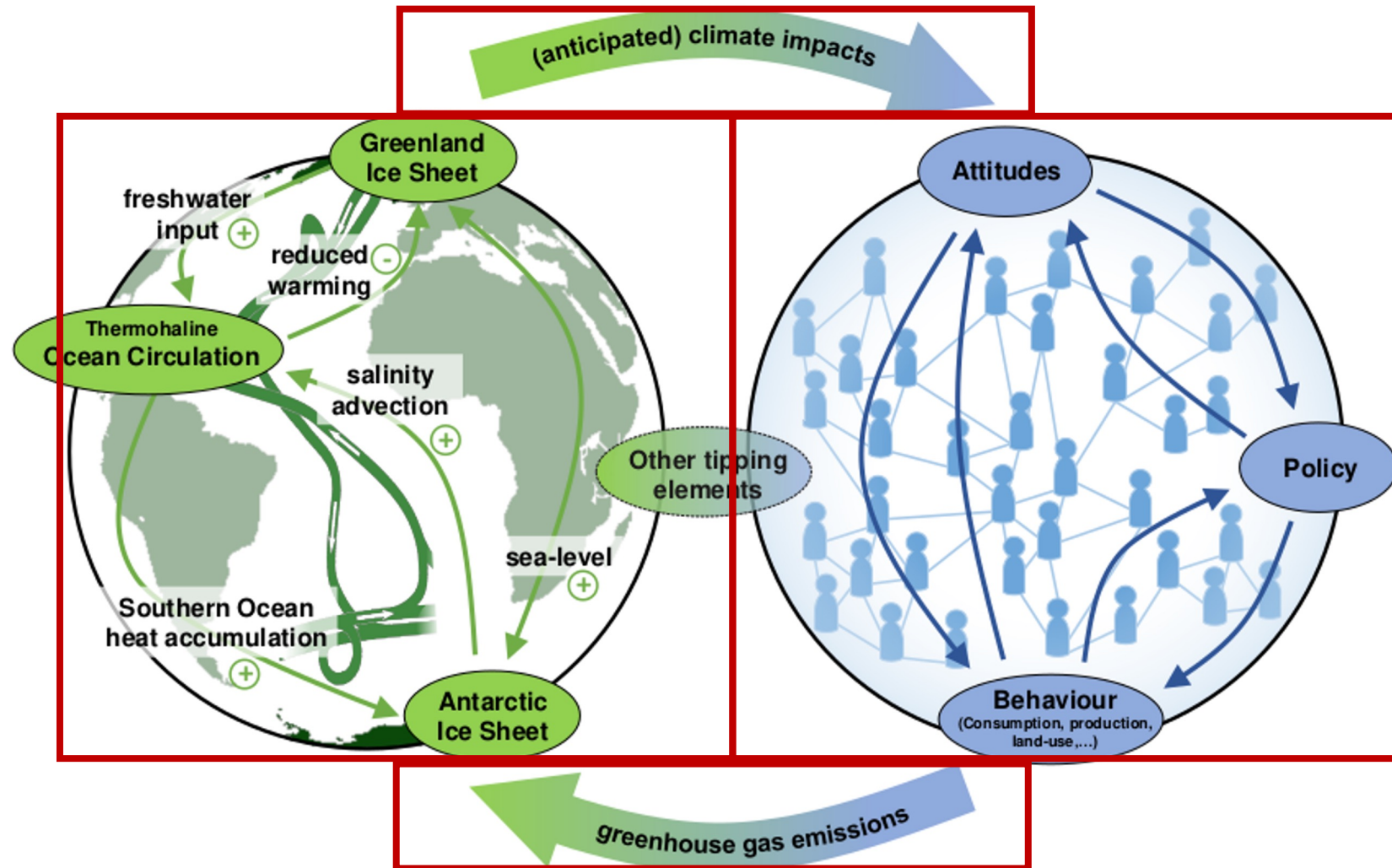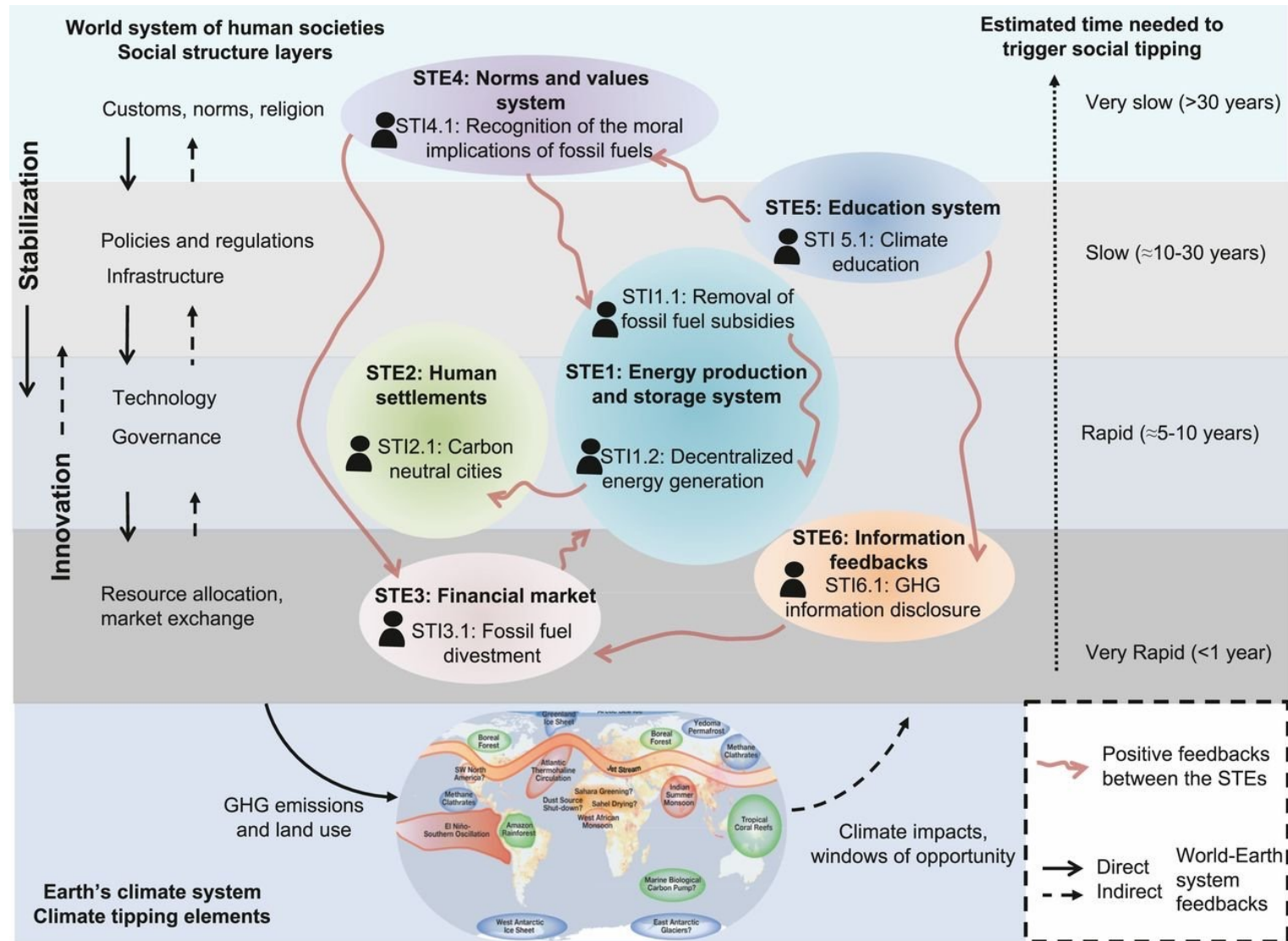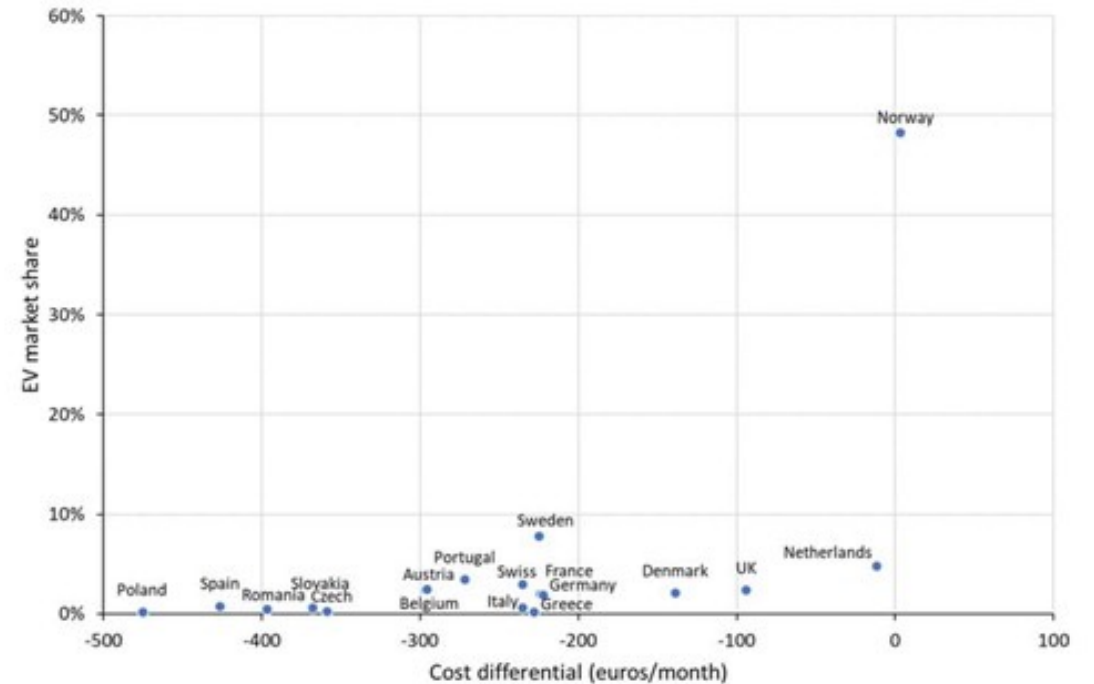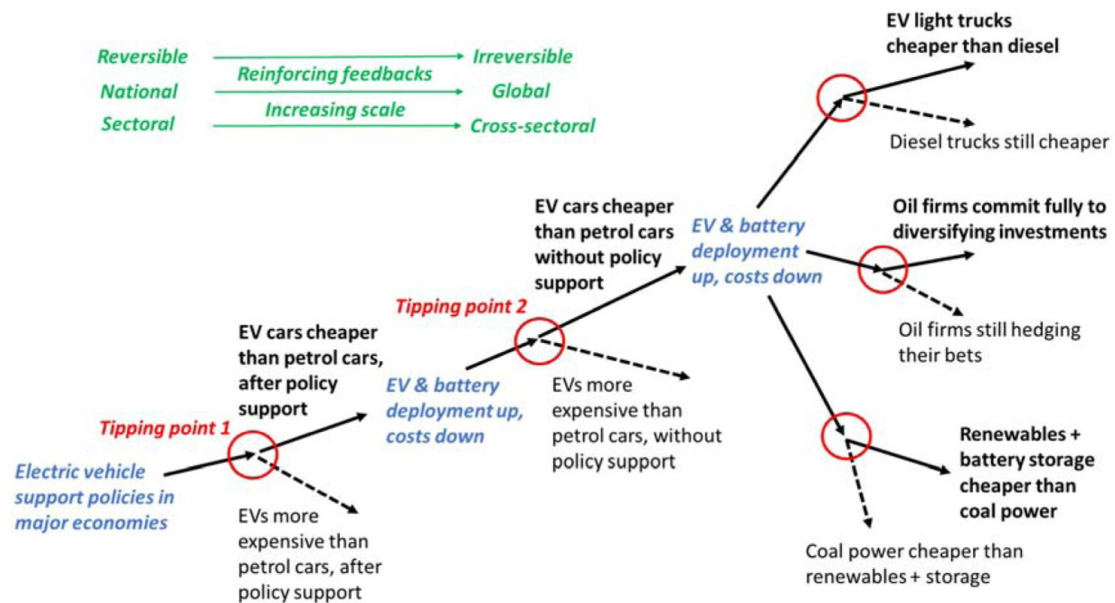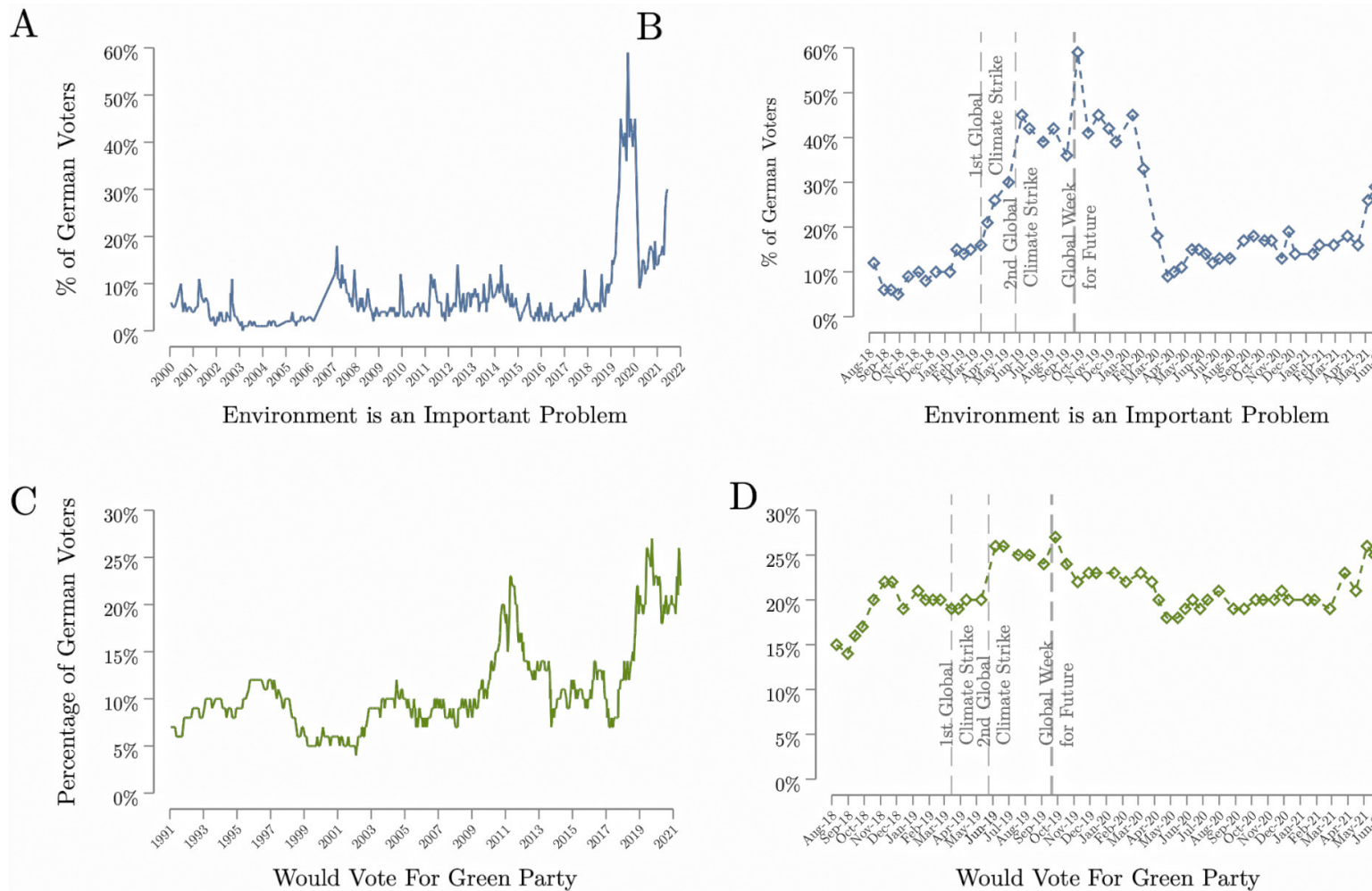
Social Tipping – Measurement (dynamic systems modelling)

Moore, F. C., Lacasse, K., Mach, K. J., Shin, Y. A., Gross, L. J., & Beckage, B. (2022). Determinants of emissions pathways in the coupled climate–social system. *Nature*, *603*(7899), 103-111.
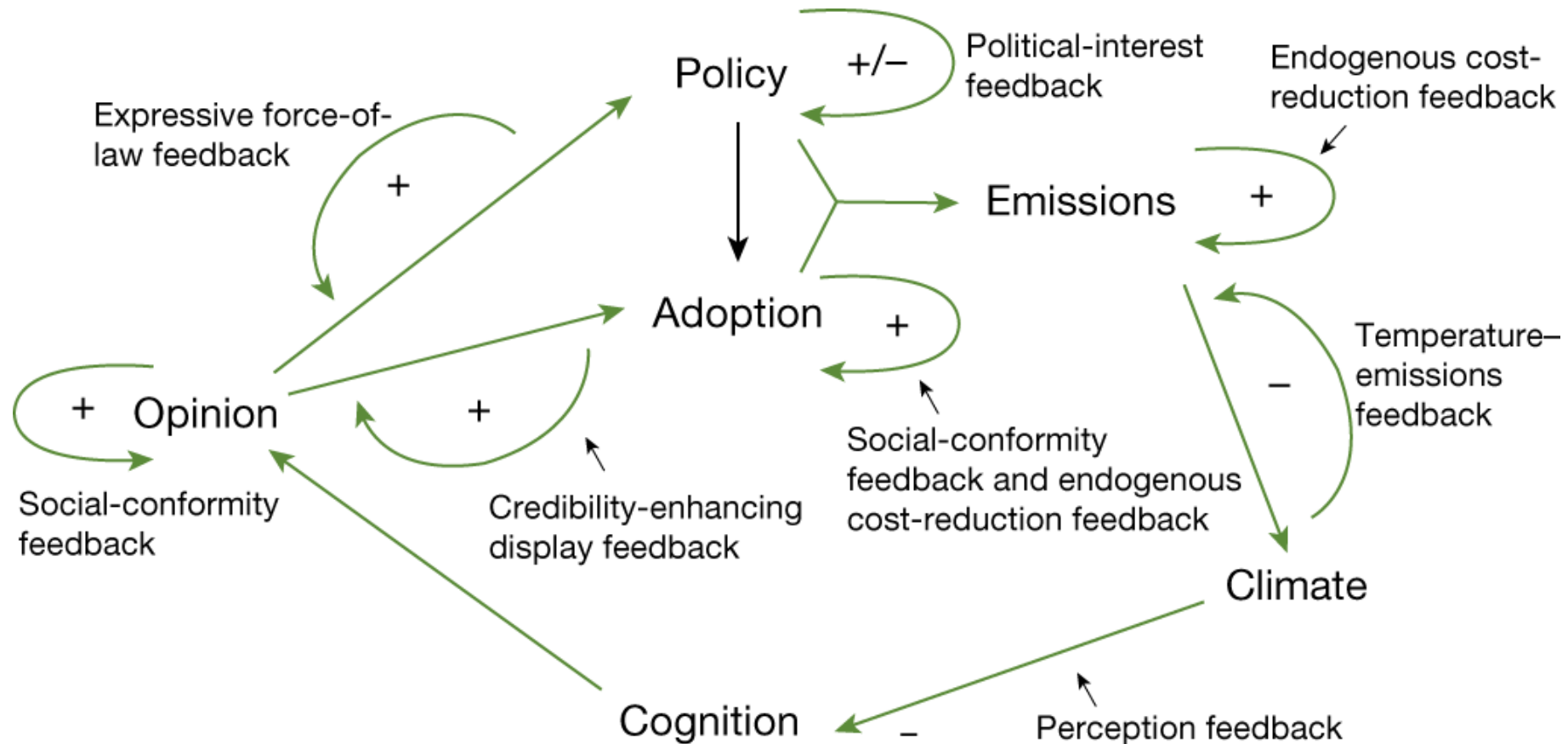
Social Tipping – Measurement (network-based modelling)
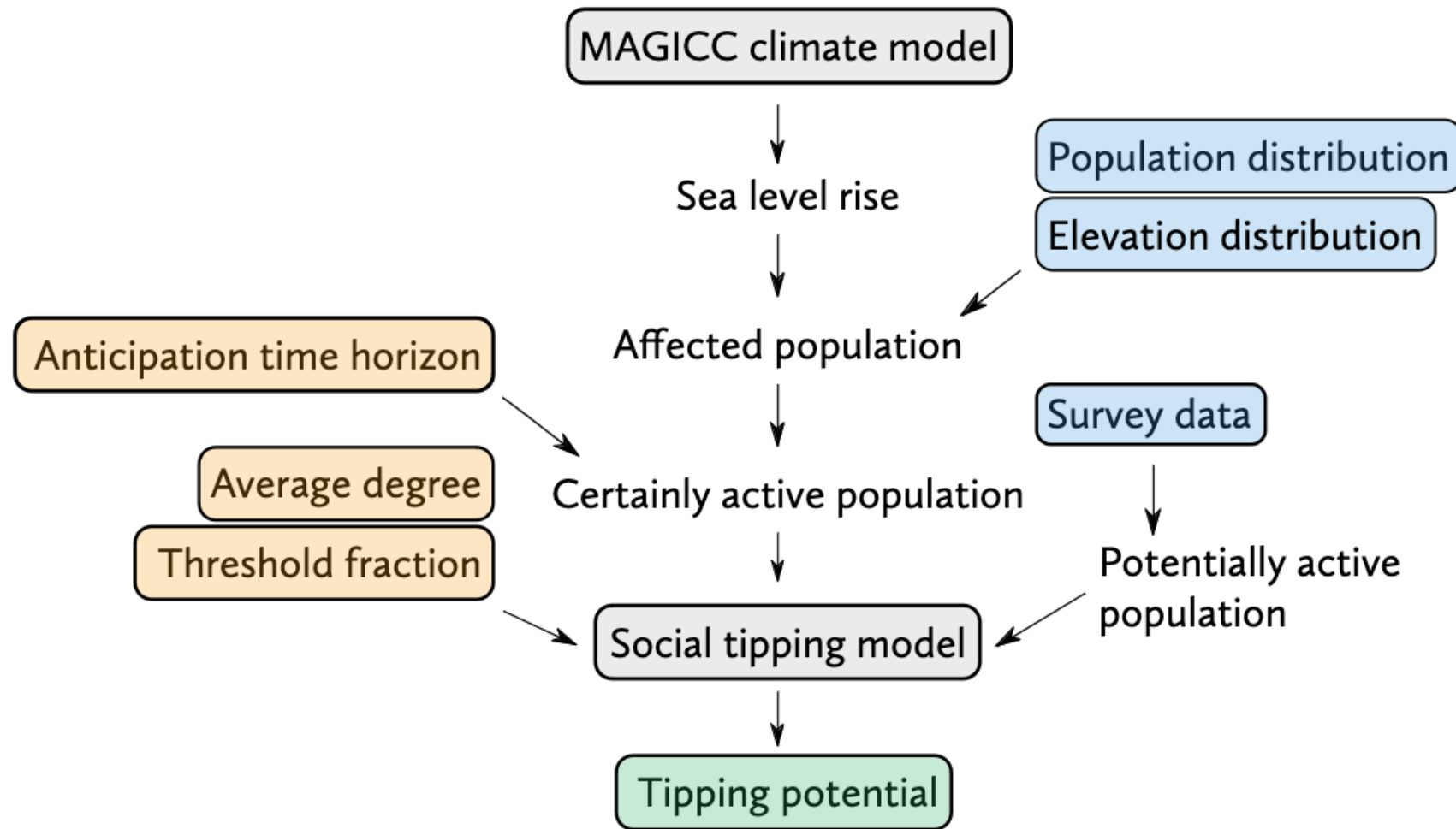
Smith, E. K., Wiedermann, M., Donges, J. F., Heitzig, J., & Winkelmann, R. (2023). A global social activation model of enabling conditions for positive social tipping–the role of sea-level rise anticipation and climate change concern. EGUsphere, 2023, 1-34.

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Social Tipping – Measurement (early warning signals)

Dablander, F., Heesterbeek, H., Borsboom, D., & Drake, J. M. (2022). Overlapping timescales obscure early warning signals of the second COVID-19 wave. Proceedings of the Royal Society B, 289(1968), 20211809.

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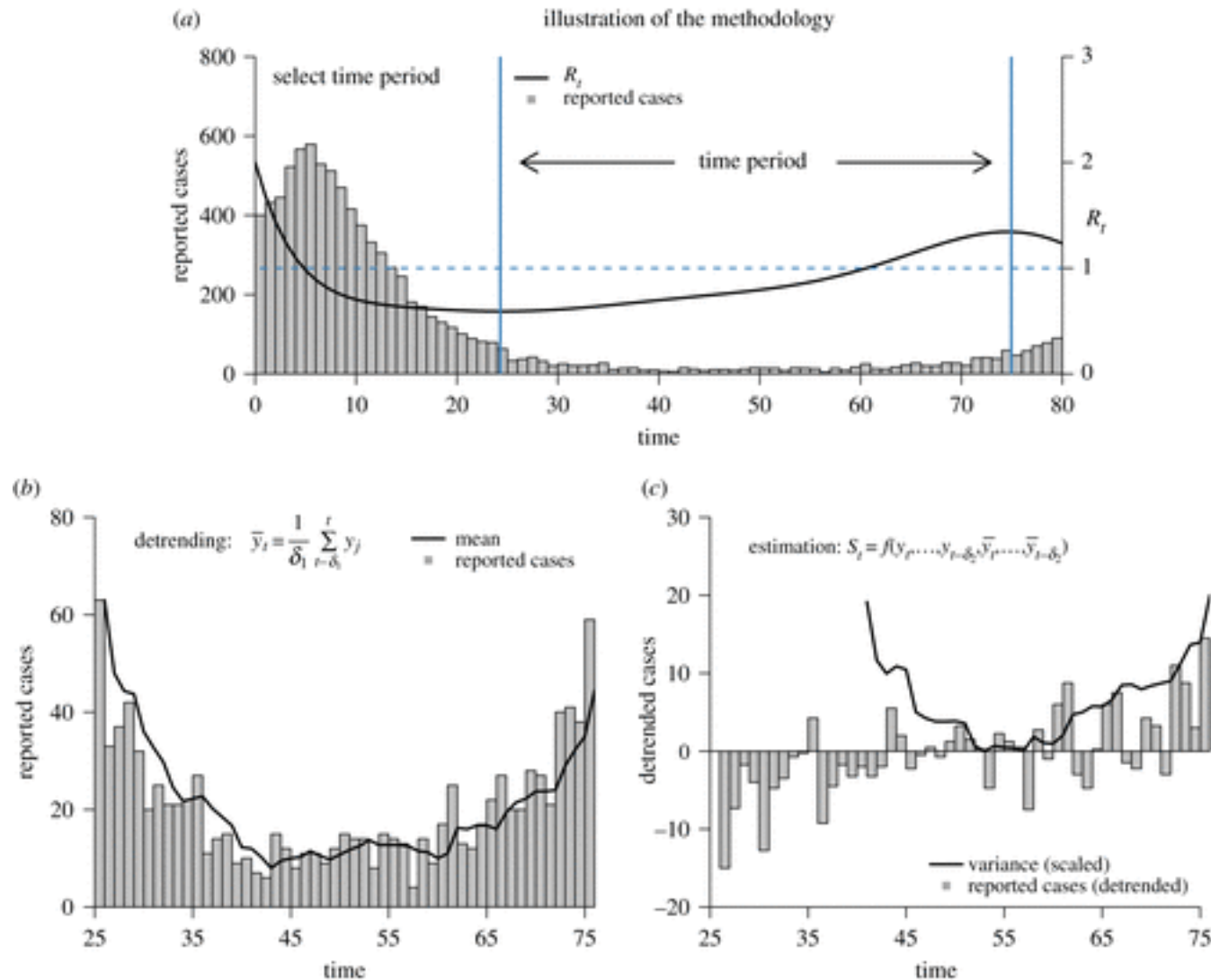
Social Tipping – Measurement (survey data)

Taxes:
  (Baseline = 3) No new tax)
  1) Increasing prices by 30%
  2) Increasing prices by 15%
Earmarking:
  (Baseline = 2) General government budget).
  1) Public environmental and climate protection programs
  3) public programs for low-income households
  4) Reduce income taxes
  5) No tax revenues
Regulation:
  (Baseline = 4) No such rules)
  1) At least 75% vegetarian meals
  2) At least 50% vegetarian meals
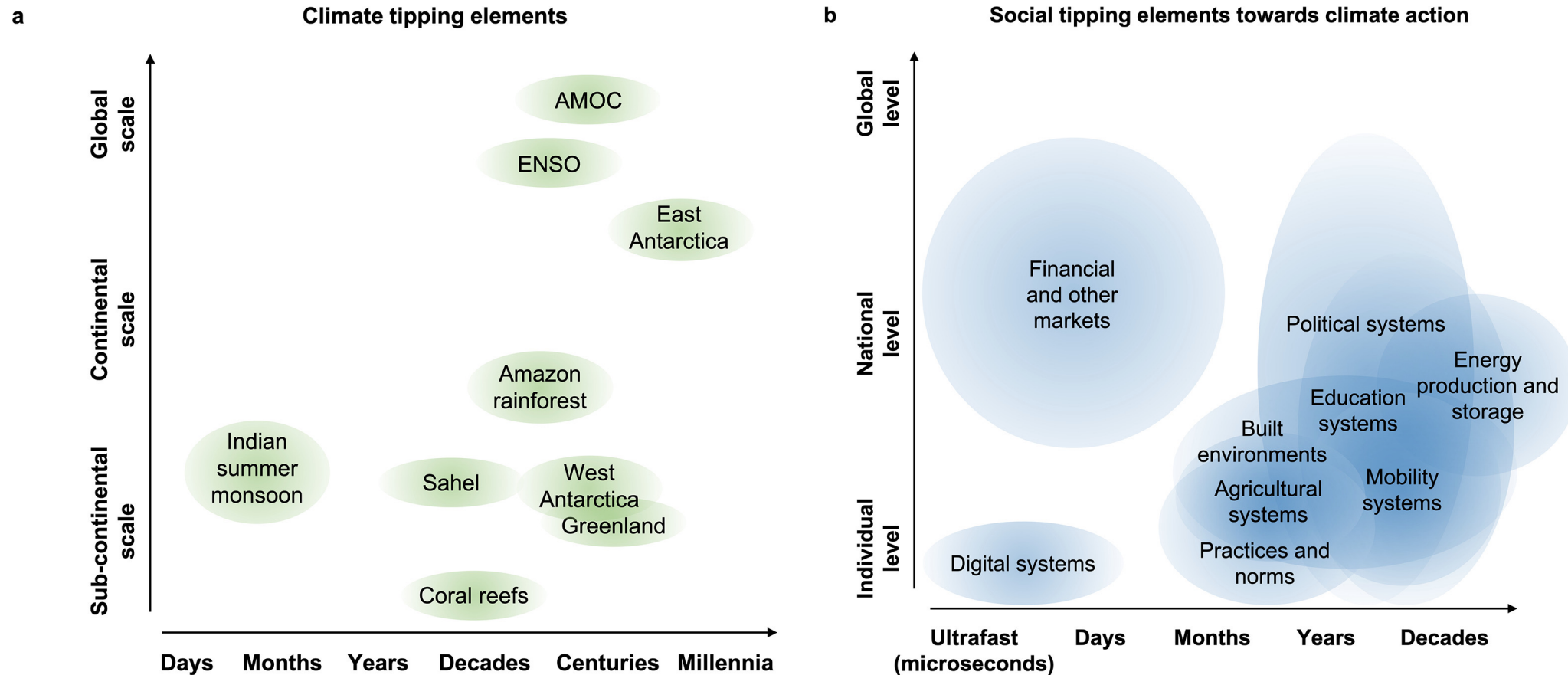 3) At least 25% vegetarian meals
Discounts:
  (Baseline = 3) No discounts)
  1) Reducing prices by 30%
  2) Reducing prices by 15%
Standards:
  (Baseline = 3) Standards kept at current level)
  1) Organic practices (no antibiotics/chemicals) & no cages
  2) Stringent limits on antibiotics/chemicals & large cages
Campaigns:
  (Baseline = 3) No campaigns)
  1) Frequent campaigns
  2) Occasional campaigns
Subsidies:
  (Baseline = 3) Keeping subsidies at current level)
  1) Eliminating subsidies
  2) Halving subsidies
Framing:
  (Baseline = Control)
  Animal Welfare
  Global Climate
  Local Environment
  Personal Health
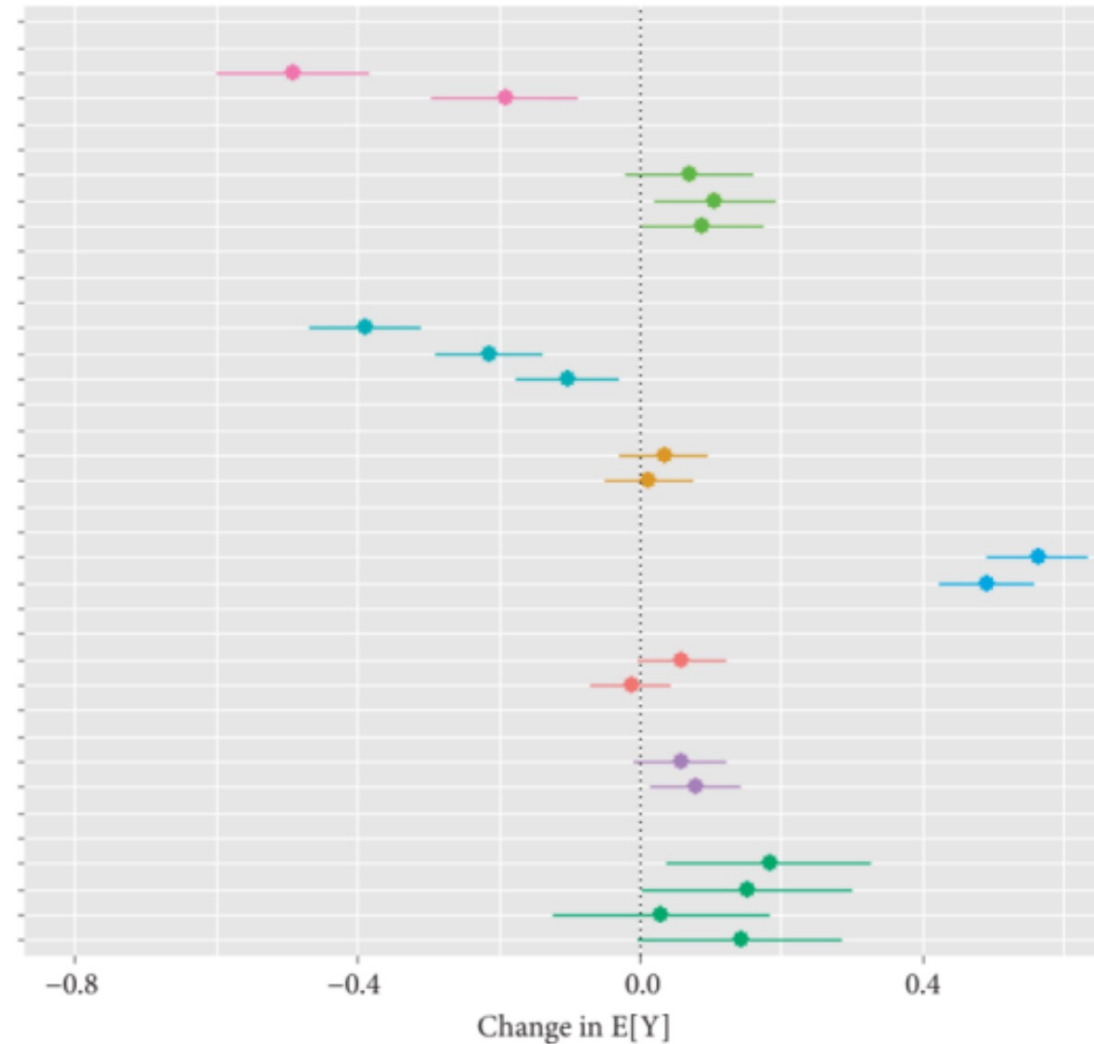
Change in E[Y]

Fesenfeld, L. P., & Sun, Y. (2023). Enabling Positive Tipping Points in Public Support for Food System Transformation. The Political Economy of Food System Transformation: Pathways to Progress in a Polarized World, 256.

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Social Tipping – Complexity

a   **Climate tipping elements**

b   **Social tipping elements towards climate action**

Winkelmann, R., Donges, J. F., Smith, E. K., Milkoreit, M., Eder, C., Heitzig, J., ... & Lenton, T. M. (2022). Social tipping processes towards climate action: a conceptual framework. *Ecological Economics*, *192*, 107242.

Social Tipping – Complexity

- Non-deterministic associations
    - True cause and effect in social systems?
    - Generalizability?

- Irreversability?

- Can we ever identify 'tipping point' or triggering mechanism?

Social Tipping – Criticism (Milkoreit 2023)

- Social tipping presumes systems can be manipulated and the intervention will have the desired effect

- Solutions are overly-deterministic (panacea)

- Not reflective of open-endedness of transformation development pathways

- Current literature is often abstract, often struggling to identify generalizable triggering mechanisms, specific critical thresholds and predictive tipping points

Milkoreit, M. (2023). Social tipping points everywhere?—Patterns and risks of overuse. *Wiley Interdisciplinary Reviews: Climate Change*, *14*(2), e813.

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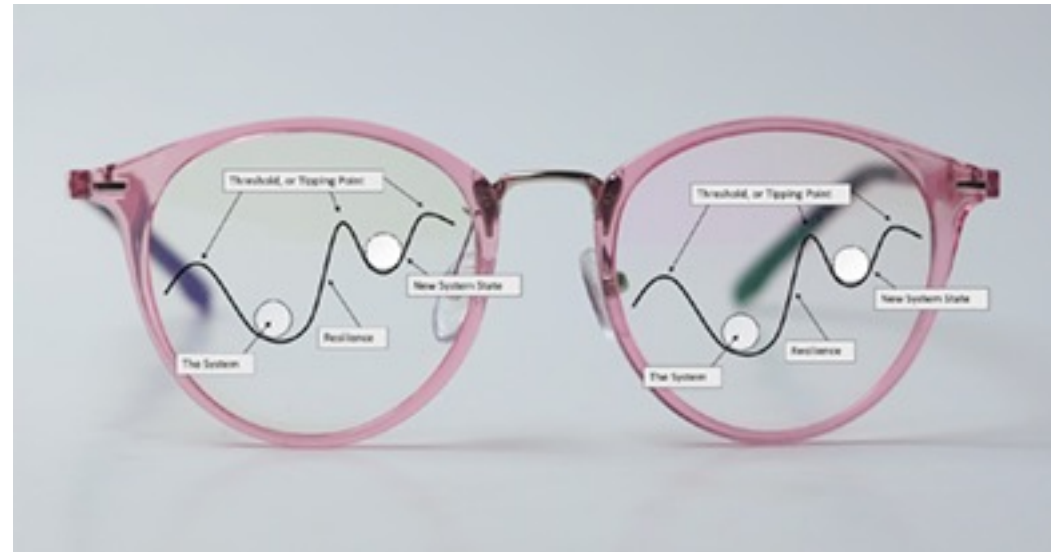
Criticality and critical agency in societal tipping processes towards sustainability

Authors: E. Keith Smith*† (1), Niklas Kitzmann† (2,3), Manjana Milkoreit† (9), Ricarda Winkelmann† (2,3), Anne-Sophie Crépin (4,17), Christina Eder (5), Niklas Harring (6), Jobst Heitzig (2), Alexia Katsanidou (5,18), Timothy M. Lenton (7), Franz Mauelshagen (8), Kelton Minor (10), Ilona M. Otto (16,2), Armon Rezai (12), Jürgen Scheffran (13), Isabelle Stadelmann-Steffen (14), Rick van der Ploeg (15), Nico Wunderling (2,17), Jonathan F. Donges*† (2,17)

Criticality Perspective

- Criticality is **the susceptibility of a system to experience tipping processes**

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Criticality Perspective

- Criticality is **the susceptibility of a system to experience tipping processes**

- Fostering high levels of criticality within a system is a **necessary condition** for societal tipping processes

Criticality Perspective

- Criticality is **the susceptibility of a system to experience tipping processes**

- Fostering high levels of criticality within a system is a **necessary condition** for societal tipping processes

- Shift focus away from identifying unknown (or unknowable) specific triggers and towards fostering systemic conditions
  - tipping may develop from a multitude of intentional (or unintentional) triggers (e.g. interventions, events, or perturbations).
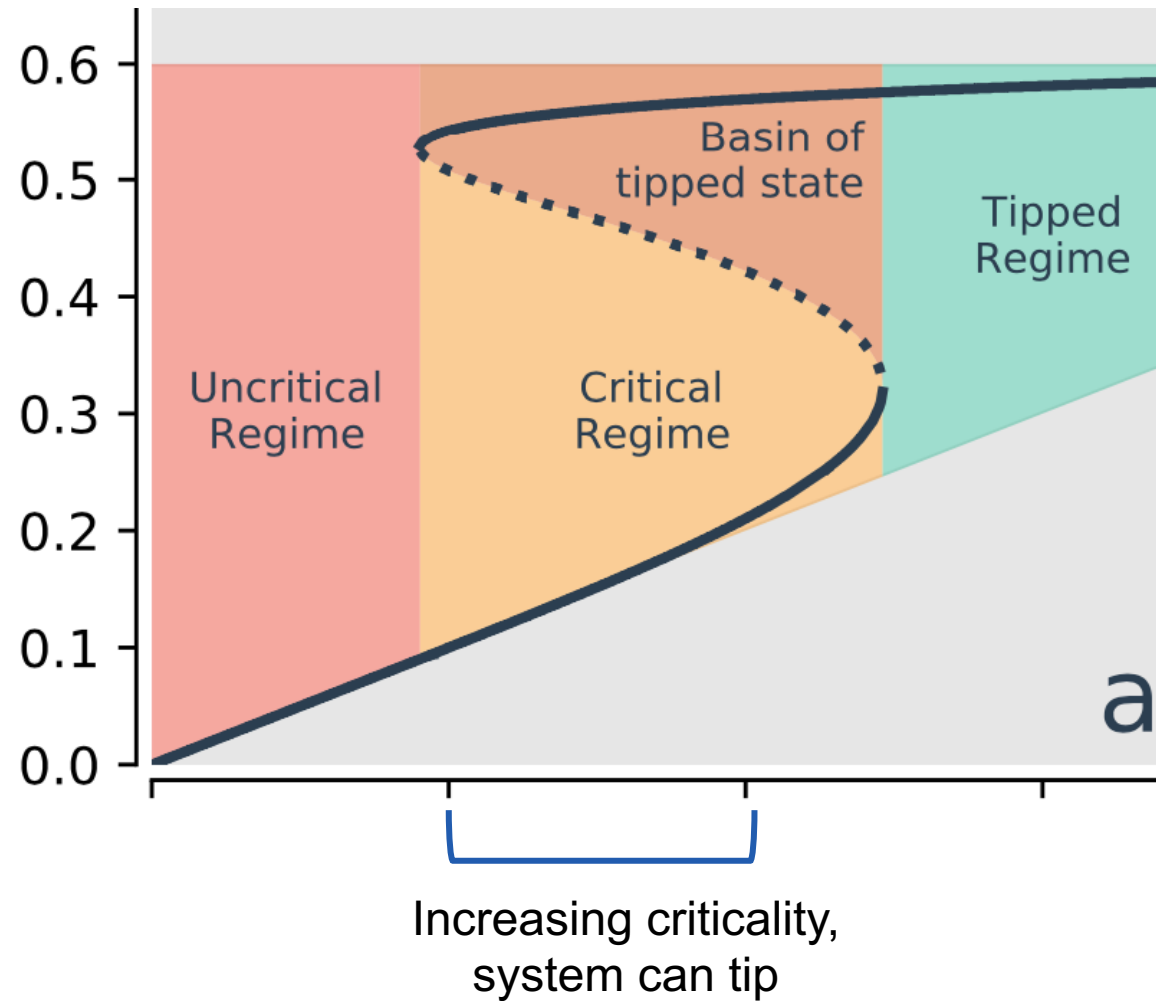
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Criticality Perspective
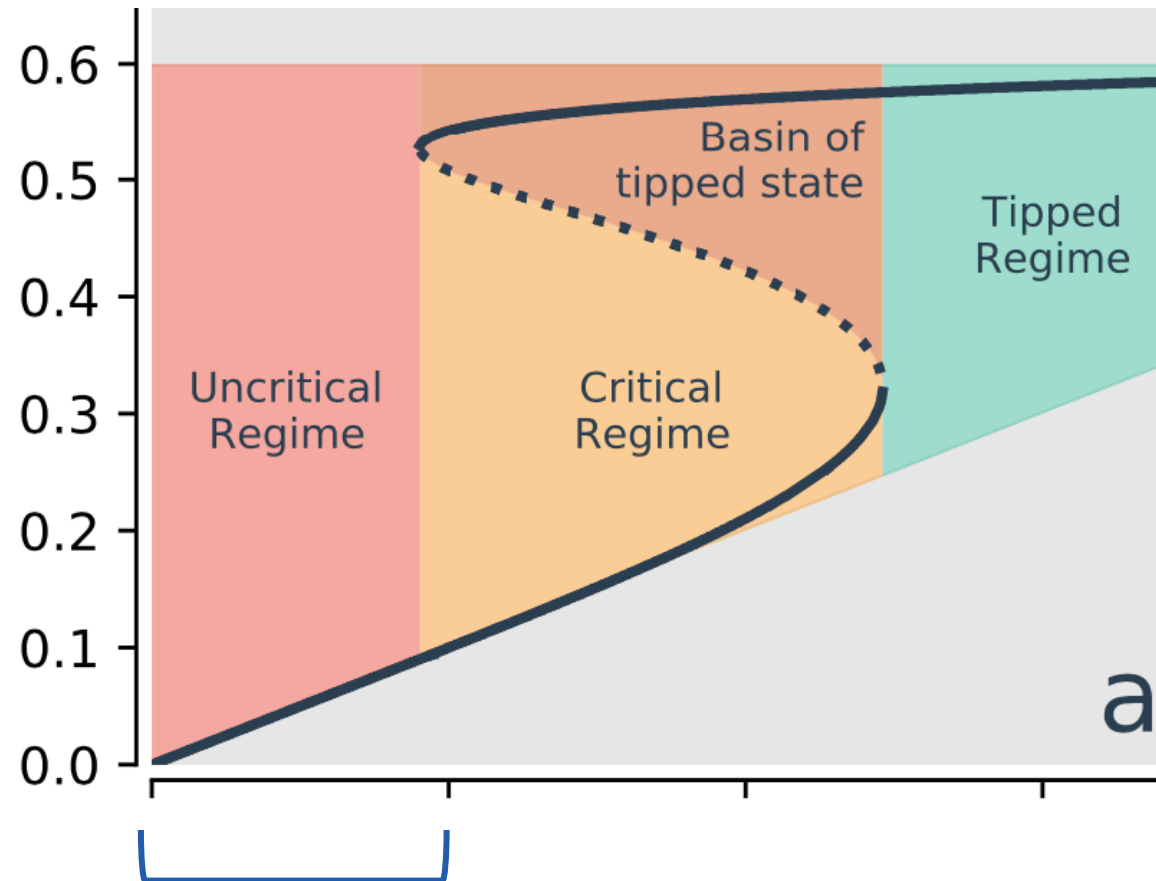
Low criticality, system will
not experience tipping

Smith, E. K., Wiedermann, M., Donges, J. F., Heitzig, J., & Winkelmann, R. (2023). A global social activation model of enabling conditions for positive social tipping–the role of sea-level rise anticipation and climate change concern. EGUsphere, 2023, 1-34.

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Criticality Perspective

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Criticality Perspective

Large intervention is
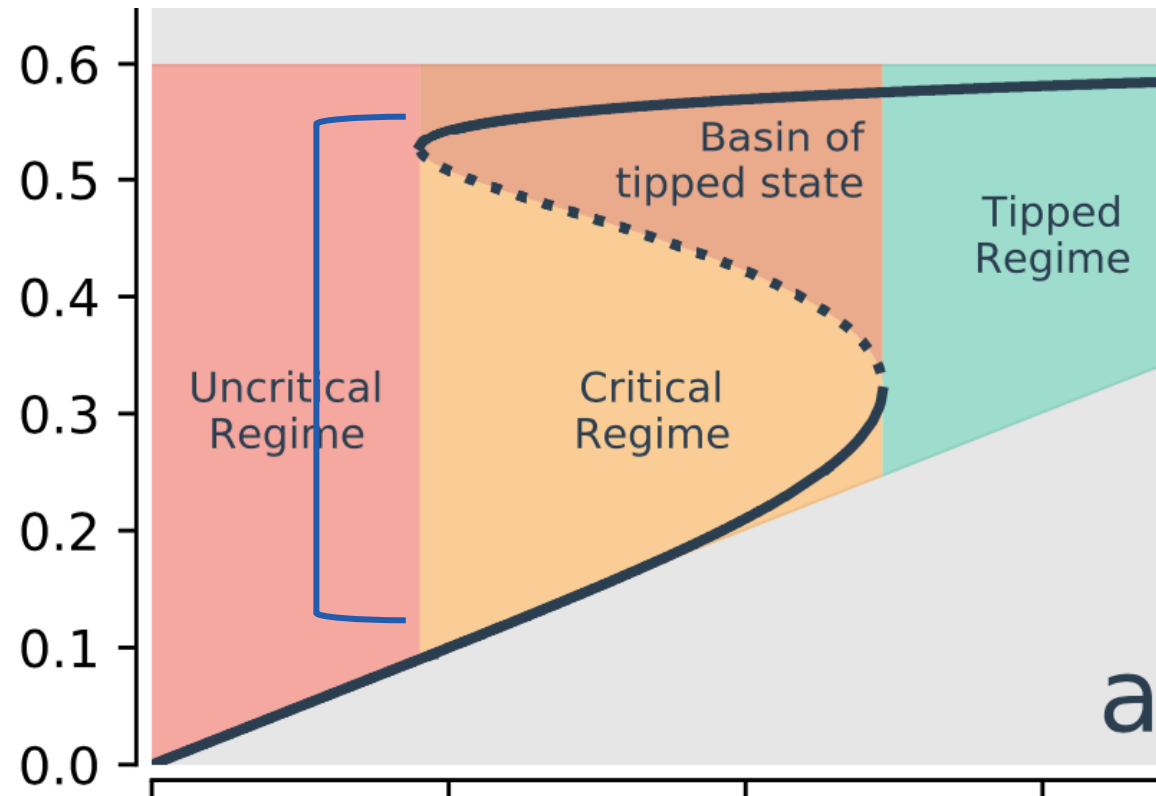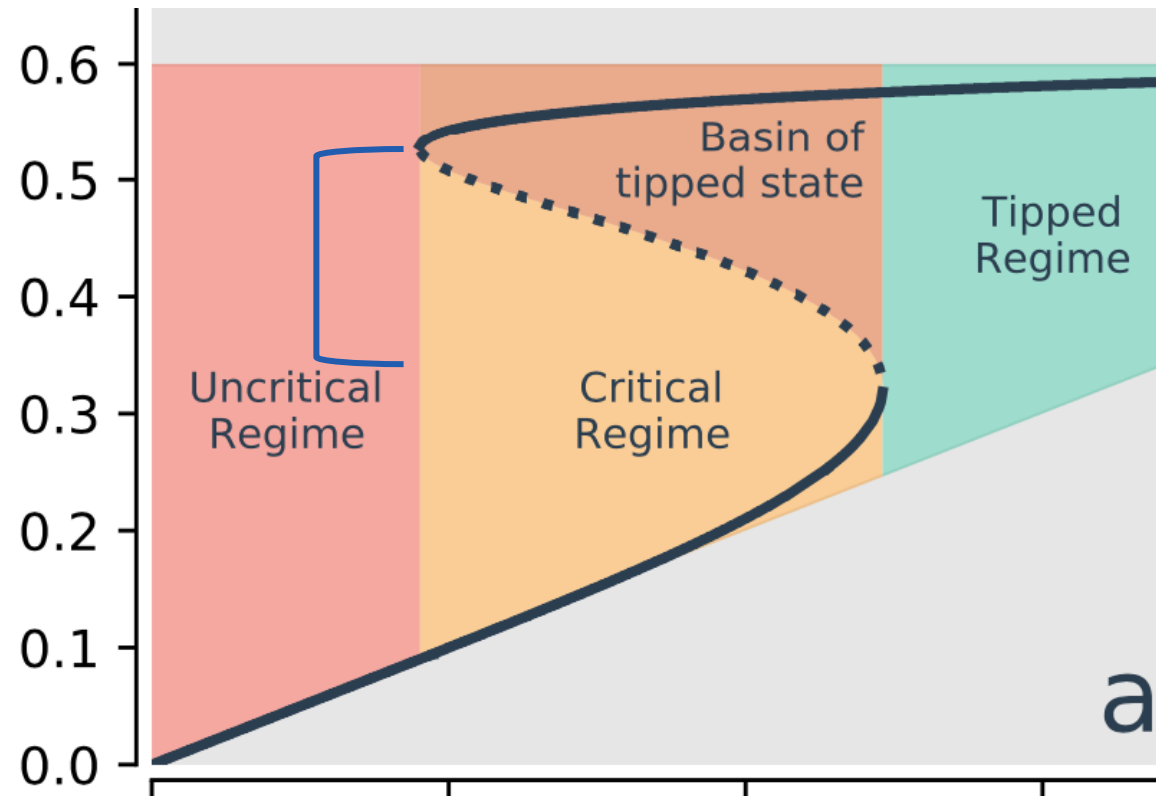required to initiate tipping
dynamics

Smith, E. K., Wiedermann, M., Donges, J. F., Heitzig, J., & Winkelmann, R. (2023). A global social activation model of enabling conditions for positive social tipping–the role of sea-level rise anticipation and climate change concern. EGUsphere, 2023, 1-34.

Criticality Perspective

Criticality is high, smaller
intervention is sufficient to
initiate tipping dynamics

Smith, E. K., Wiedermann, M., Donges, J. F., Heitzig, J., & Winkelmann, R. (2023). A global social activation model of enabling conditions for positive social tipping–the role of sea-level rise anticipation and climate change concern. EGUsphere, 2023, 1-34.

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Criticality Perspective

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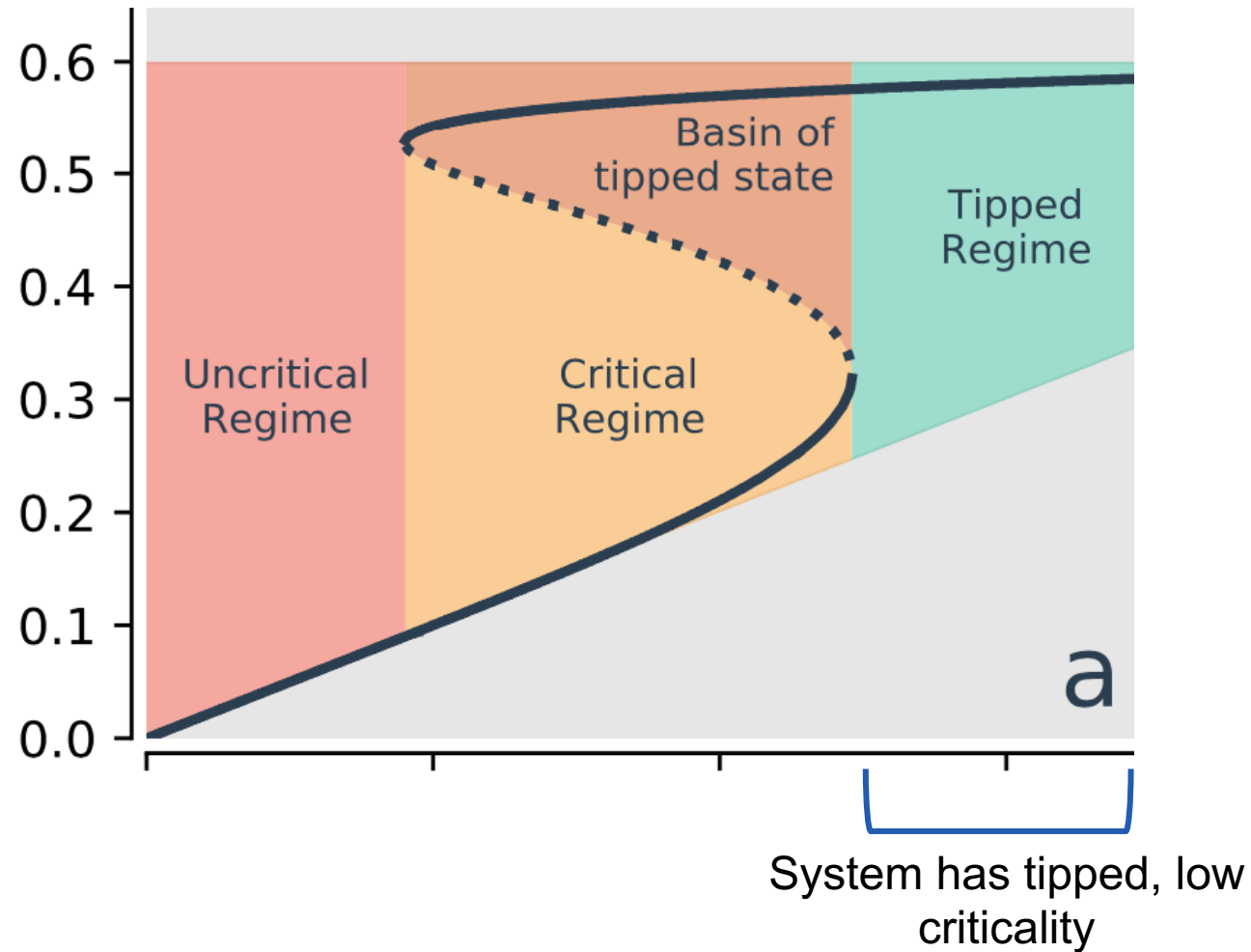
Criticality Perspective

- Focusing on shaping systemic conditions towards, or away from, critical thresholds is actionable

    - Much of social science focuses on mechanisms which maintain or transform systems

- Does not rely upon panacea interventions. Highly critical states can be tipped by multitudes of unknown causes

    - Also facilitates interventions to reduce the likelihood of 'negative' tipping

Criticality Perspective

Criticality Perspective

Targeted intervention

Criticality Perspective
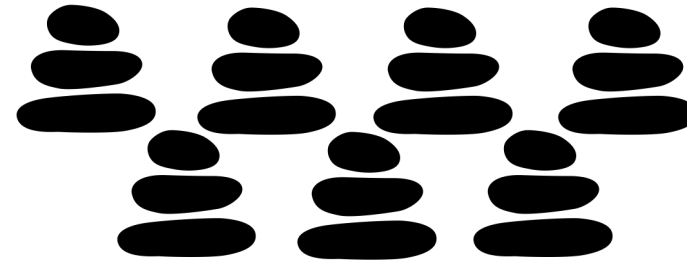
Shifting systemic conditions

Criticality Perspective

Shifting systemic conditions

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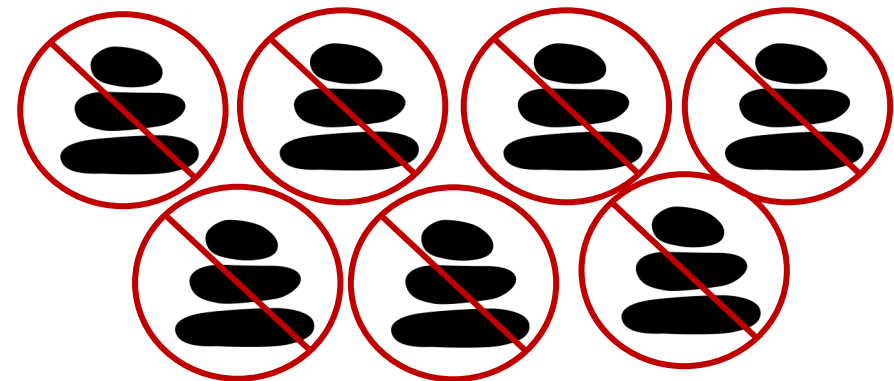
Social systems as complex adaptive systems

Conceptualized as alternative stable states
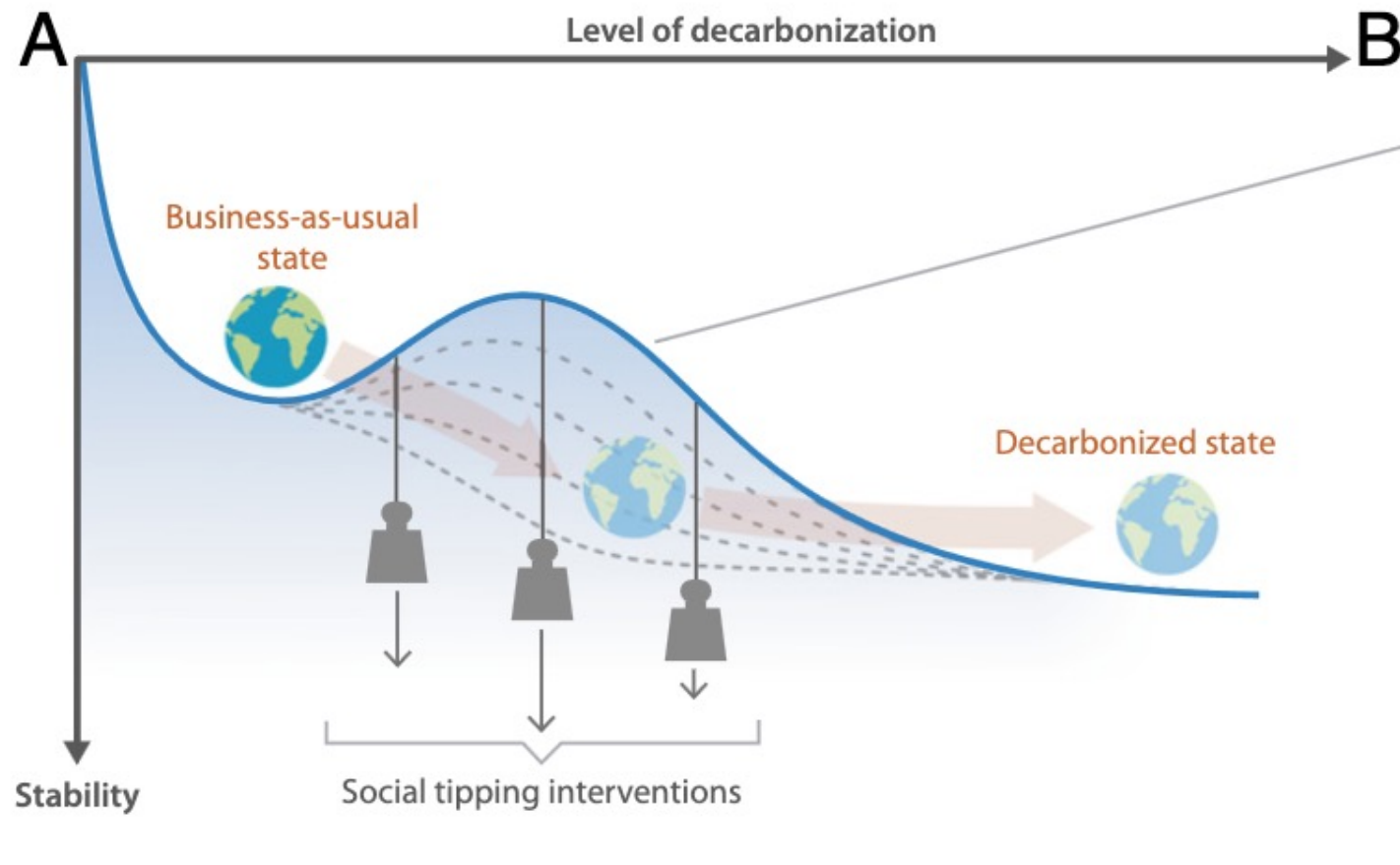
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Social systems as complex adaptive systems

- Societal tipping is more appropriately conceptualized as dynamics within complex adaptive and evolving systems

- Strong coupling to other systems (e.g. socio-cultural, political, institutional, and socio-technological)

- Resulting change is rather open-ended and non-deterministic
  - Better understood as path trajectories and bifurcation than "ball and cup" metaphor

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Critical agency – how to shape criticality

- Critical agency : Intentional manipulation of the criticality of a societal system, creating the enabling conditions fostering tipping processes
  - Agents within societal systems exhibit consciousness, knowledge, reflexivity, and foresight – the imagination and desire to intentionally transform the conditions of a system towards some desired goals
  - 'Strategic' form of agency, where actions taken by multiple actors in multiple locations at multiple levels over multiple time horizons change the system's conditions through diverse transformation phase

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Critical agency – how to shape criticality

Table 1. Phases of enacting critical agency

Phases of critical agency	(i) Orchestrating pre-tipping disruptions	(ii) Imagining and developing alternative trajectories	(iii) Decreasing the resilience of current societal trajectories	(iv) Triggering societal tipping processes	(v) Support preferred development trajectories
Stages of societal tipping processes	Creating enabling conditions			Triggering societal tipping processes	Accelerating path trajectory; Reinforcing and stabilising 'societally tipped' path trajectory
Actions	Raise awareness, initial activism, identify and increase weakness in societal system, develop disruptive technologies	Devise ideal-type for new system states, strategise and develop coalitions, goal-setting	Suppress or reduce processes and structures that stabilise and reinforce societal system	Identify sensitive intervention points, design and implement targeted interventions	Develop incentives, infrastructure, governance schemes to support new trajectory
Goals	Illustrate vulnerability of system, illuminate strategic opportunities	Motivate actors and resources, expand perceptions of what can be	Make alternative trajectories more attractive	Instigate tipping processes	Increase attraction of alternative trajectory, stabilise system
Criticality	Low	Increasing	Increasing	High	Decreasing
System state	Untipped	Untipped	Untipped	Tipping	Tipped

Critical agency – how to shape criticality

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Critical agency – how to shape criticality

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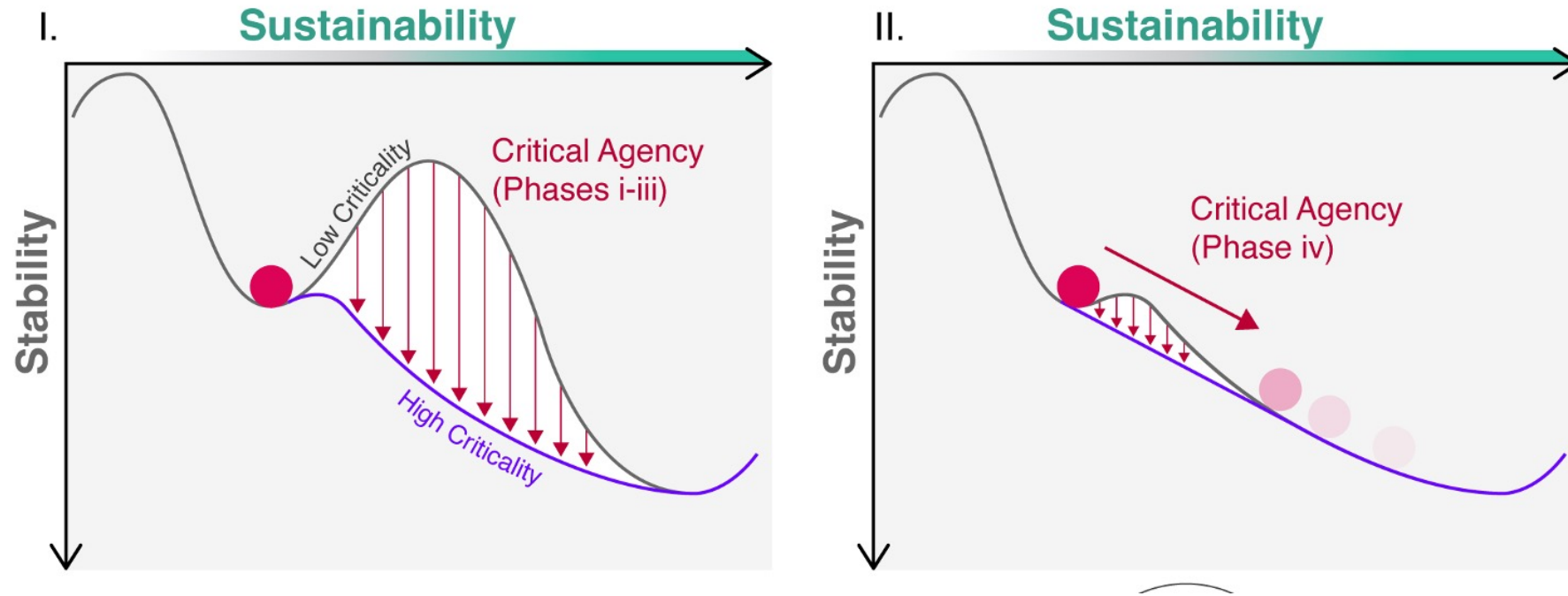| Phases of critical agency	(i) Orchestrating pre-tipping disruptions	(ii) Imagining and developing alternative trajectories	(iii) Decreasing the resilience of current societal trajectories	(iv) Triggering societal tipping processes	(v) Support preferred development trajectories
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Critical agency – how to shape criticality

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Phases of critical agency	(i) Orchestrating pre-tipping disruptions	(ii) Imagining and developing alternative trajectories	(iii) Decreasing the resilience of current societal trajectories	(iv) Triggering societal tipping processes	(v) Support preferred development trajectories
Stages of societal tipping processes	Creating enabling conditions			Triggering societal tipping processes	Accelerating path trajectory; Reinforcing and stabilising 'societally tipped' path trajectory
Actions	Raise awareness, initial activism, identify and increase weakness in societal system, develop disruptive technologies	Devise ideal-type for new system states, strategise and develop coalitions, goal-setting	Suppress or reduce processes and structures that stabilise and reinforce societal system	Identify sensitive intervention points, design and implement targeted interventions	Develop incentives, infrastructure, governance schemes to support new trajectory
Goals	Illustrate vulnerability of system, illuminate strategic opportunities	Motivate actors and resources, expand perceptions of what can be	Make alternative trajectories more attractive	Instigate tipping processes	Increase attraction of alternative trajectory, stabilise system
Critical ity	Low	Increasing	Increasing	High	Decreasing
System state	Untipped	Untipped	Untipped	Tipping	Tipped

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Criticality

Smith, E. K., Kitzmann, N. and Donges, J..F. et al (2023). Criticality and critical agency in societal tipping processes towards sustainability. Under Review.

Criticality

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Criticality Summary

- Social systems are complex adaptive systems. Approaches to tipping should identify and address issues related to complexity

  - The actual tipping point (trigger) is likely unknown, or unknowable

  - Tipping can be 'positive' or 'negative'

  - The outcome of any intervention may not be controllable (multiple potential path trajectories)

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Criticality Summary

- Crucial preliminary step of intentionally re-shaping the system conditions is often overlooked in favour of developing specific interventions aimed at triggering tipping.

- Re-focus on societal tipping processes towards identifying the *criticality* of societal systems, and how strategic actions (*critical agency*) can influencing the likelihood that the system will tip.

- Systems with high criticality are more likely to tip. Tipping may develop from a multitude of intentional (or unintentional) triggers (e.g. interventions, events, or perturbations).

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Criticality Summary

- We can shape these conditions using we strategic actions, critical agency. We develop five actionable phases of critical agency that can be adopted to:
  - increase the criticality of a system
  - foster and trigger systemic tipping processes
  - and stabilise the 'societally tipped' path trajectory

- Goal is to bring social tipping back into the social sciences, to build upon theories of change and transformation to identify how to manipulate systemic conditions towards more 'desirable' path trajectories

Thanks for coming!

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Criticality – Network based perspectives

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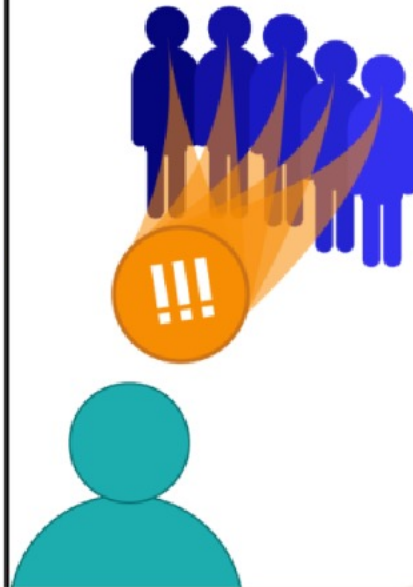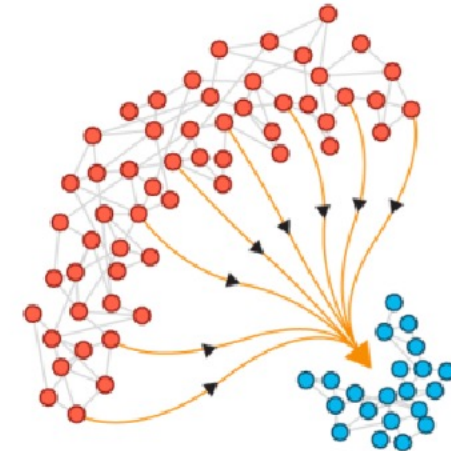# Criticality – Network based perspectives

Smith, E. K., Kitzmann, N. and Donges, J..F. et al (2023). Criticality and critical agency in societal tipping processes towards sustainability. Under Review.