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A tipping point is a system threshold beyond which change becomes self-perpetuating until a qualitatively different stable state is reached. For example a rainforest turns into a grassland, or an ice sheet melts completely. Such shifts are non-linear, and practically irreversible.

Fears that growing human impacts might push aspects of the global climate past such ‘tipping points’ are not new. Such concerns have appeared in both [popular science](#) and [fictional](#) accounts of the Earth’s changing climate for decades.

The extent and identity of such tipping points, and the possible timing of tipping events remain hotly debated. But [scientific scholarship](#) predominantly endorses not only the existence of such thresholds for important aspects of the climate system, but also the likelihood that some of those thresholds will be exceeded even if global average temperature rises are constrained within 1.5°C.

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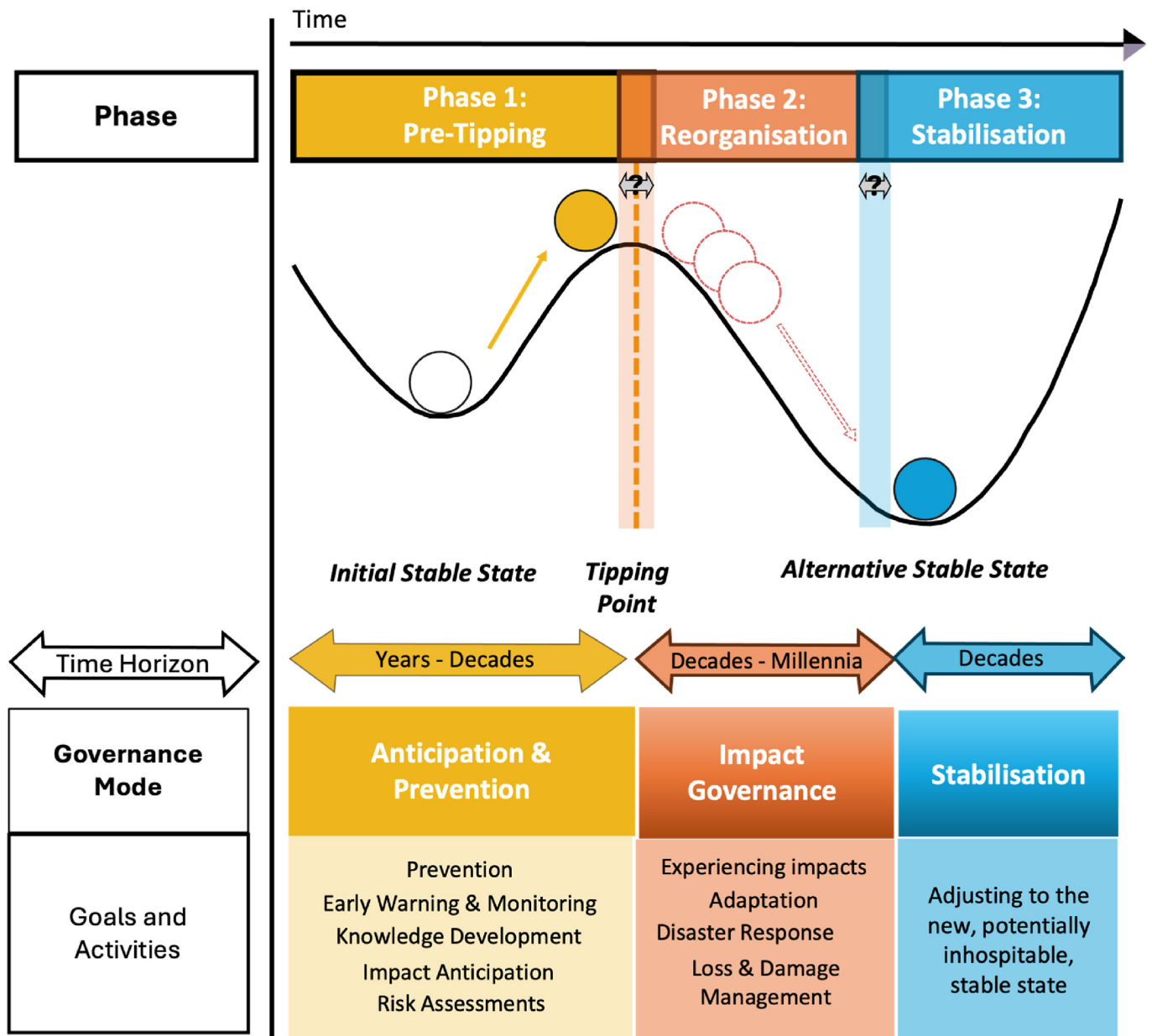


Figure 1 from [Milkoreit et al](#): A multi-phase framework for Earth System Tipping Point Governance

Novel governance challenges

Tipping processes present novel and serious governance challenges. Their impacts are distant in time and space from their causes. Their effects are practically irreversible. Existing global environmental governance institutions - even those designed to address climate change - are ill-equipped for such challenges. Conventional governance toolkits

offer few if any tools designed for problems involving non-linear relationships and huge time-lags between cause and effect.

The missing knowledge is not primarily natural science. Rather we need new interdisciplinary research programs focused specifically on tipping-point governance. Political and social science must come to the fore to help develop effective responses to tipping events. Recently published [research](#) distinguishes two critical domains of attention and action. First, measures to help prevent tipping events. Second, measures to help manage the impacts of tipping events. Useful interventions in these two domains will require transformative change in both the institutions and principles of governance.

Transforming governance

Existing institutions have neither the spatial nor temporal reach needed to engage with earth systems at regional and global scales subject to processes playing out over millennia, yet potentially triggered within a few years. Reactive governance based in national sovereignty, expectations of linear change, and market ideologies is hopelessly inadequate.

Even with effective institutions we could not ‘govern’ tipping points. At best we could seek to influence their drivers, and prepare to manage their impacts. Nor can we hope to transform governance systems overnight. We must find opportunities to construct new institutions more appropriate to these concerns. These are needed at global, regional and ‘thematic’ levels – given the diverse scales of tipping elements in oceans, forests and the cryosphere, for example.

But in the interim, we can and should embark on efforts to enhance earth system governance by embedding critical governance principles into existing institutions. The key principles include precaution, anticipation, resilience and justice.

Precaution and anticipation

Precaution is central: put simply, if the evidence suggests tipping might occur in a system between 1.5°C and 3.5°C, we must plan on the basis of the lower threshold. This means redoubling efforts to cut emissions, and reliably constrain temperature rises, [not gambling on speculative technological interventions to cool the planet](#).

Precaution is closely related to anticipation: providing a stronger future-orientation to governance. This includes building capacity to be proactive rather than reactive. In particular we must stop hoping that growing impacts will someday change public opinion

and policy. It also means developing anticipatory knowledge through scenario and futures exercises, and building appropriate monitoring and early warning capabilities.

Resilience

Resilience implies reshaping governance systems to be themselves resilient to the stresses created by growing climate impacts. And establishing governance systems that support resilience and redundancy. We need governance that prioritises interventions that simultaneously cut emissions and build social resilience to impacts.

Such responses include local food systems that reduce reliance on long-distance trade, and build local skills. Or low-carbon energy from renewable energy systems rather than nuclear power, with its needs for cooling water. Resilient systems offer redundancy: multiple options for meeting needs, without critical bottlenecks or failure points. Climate governance for resilience implies rejecting the fetishes of economic efficiency and market based interventions. Instead it demands a focus on whole system thinking to minimize systemic risk.

Justice

The principle of justice appears in at least two key dimensions. Governance in the face of tipping points needs to be procedurally fair, enabling participation by all affected. It must also respect distributional justice, prioritizing those worst off, or worst affected by the anticipated effects of tipping events. Working to avoid tipping points is critical, therefore for intergenerational distributive justice.

But this does not legitimize preemptive or emergency responses that either ignore procedural justice and democracy, or prioritize future interests over addressing inequality now. Earth system justice ([Gupta et al., 2023](#)) offers a sound guide here. It asserts the equal importance of inter- and intra-generational equity, recognizing that increasing equality and inclusion today is critical to minimize harms from inherited inequality in the future.

Research challenges

Turning such principles into reality, and reshaping governance institutions will not be easy. Future governance efforts will need a much expanded body of knowledge providing action-oriented and context-specific insights. In turn this will require new inter- and transdisciplinary research programs across the social sciences, humanities, and natural

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sciences, with an important role for legal scholars.

To read more about the challenges of tipping points for earth system governance, see

Manjana Milkoreit et al, 2024. [Governance for Earth system tipping points – A research agenda](#). *Earth System Governance* Vol 21.