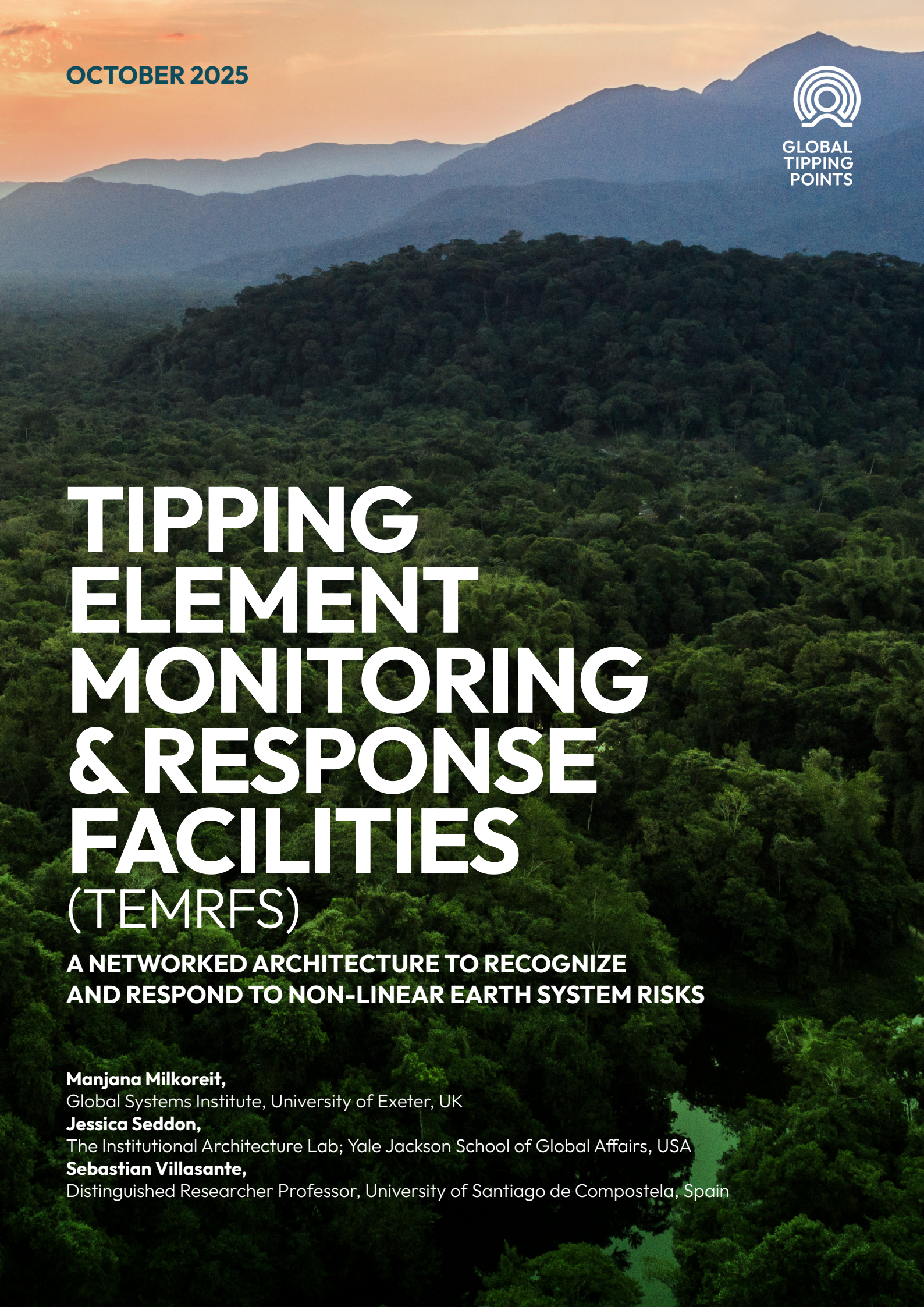


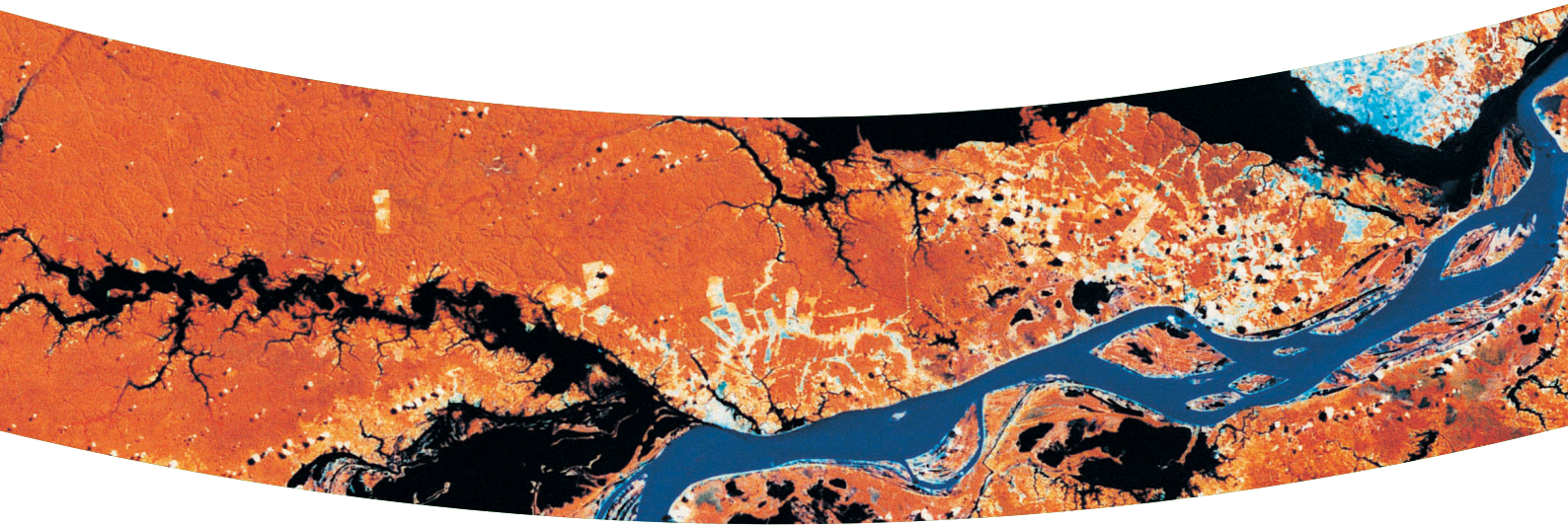
OCTOBER 2025

GLOBAL TIPPING POINTS

TIPPING ELEMENT MONITORING & RESPONSE FACILITIES (TEMRFS)

A NETWORKED ARCHITECTURE TO RECOGNIZE AND RESPOND TO NON-LINEAR EARTH SYSTEM RISKS

Manjana Milkoreit,
Global Systems Institute, University of Exeter, UK
Jessica Seddon,
The Institutional Architecture Lab; Yale Jackson School of Global Affairs, USA
Sebastian Villasante,
Distinguished Researcher Professor, University of Santiago de Compostela, Spain



THE RATIONALE

Global climate governance needs to respond to the severe risks of Earth system tipping processes – nonlinear and largely irreversible reorganizations in components of the Earth system, including ice sheet melt, dieback of biomes like coral reefs or forests, and ocean current collapse, which are driven primarily by global temperature increase. Each tipping process has distinct biophysical and socio-economic impacts, all with major implications for human wellbeing. These include food and water insecurity, accelerating sea-level rise, loss of livelihoods and migration, economic disruption, and social instability. Tipping risks are not future risks, not even low likelihood high impact events, but present risks today (Global Tipping Points Report, Sections 2 and 4).

The risk of abrupt, irreversible tipping processes in specific Earth system elements demands **sciencebased, anticipatory, and agile governance across scales** (Global Tipping Points Report 2025, Section 1). Science – broadly defined to include traditional and ecological knowledge – is essential for representing the local-to-planetary changes in the Earth system. These are chemical, physical, and biological realities that will not be revealed through bargaining, market interactions or other ways of aggregating human preferences. The capacity to anticipate, and to build shared acceptance of potential futures amidst uncertainty, is required for mobilizing significant resources in the present to avoid or build resilience to system reorganizations. Agility and flexible coordination across scales are crucial for responding to changes that can be spatially varied and temporally uncertain, even when the direction of change is clear.

Building these capacities, in turn, requires the **institutional architecture for ongoing, regular, multi-scale and multi-dimensional interactions between science, policy, civil society and the private sector** in order to provide early warnings of such changes, guide prioritization and design of policy and other responses, generate operational information to support policy implementation and accountability, and provide timely feedbacks to inform course correction. Such iterative, operational, integration of not only climate science, but also insights from natural and social sciences, goes well beyond most current models for science-policy exchange. The necessity of looking beyond narrow technical aspects of policy to engage and accelerate business and civil society action poses additional challenges for linking knowledge and sustained responses.

While Earth system tipping dynamics share a common root cause in global temperature increase, each element has its own regional economic, political and social context, often with additional drivers at regional and local levels, distinct time scales, and implications for adaptation. Given this diversity as well as the challenges of building deeper integration between processes for producing knowledge about complex system changes and negotiating and implementing a response to it, we propose the establishment of a network of Tipping Element Monitoring & Response Facilities (TEMRFs). Each node would be designed to:

- **Observe and represent** the dynamics of the Earth system tipping element, including early warning signals of approaching a tipping point,
- **Recognize** the implications of policy choices for driving/containing tipping point risks and consider the socioeconomic impacts of non-linear system shifts,
- Organize and support timely, internationally coherent, multi-level **response strategies.**

Each network node would be specific to the needs and characteristics of a particular tipping element. Linking these nodes together, at first perhaps as a cohort to explore potential institutional architectures and over time as a network with established standards and protocols for sharing information and collaborating would enable peer learning and coordination to address interlinked drivers and impacts as well as cascading dynamics across the tipping elements. The combination of in-depth, closely knit nodes within a looser mesh structure would enable more multi-dimensional, integrated Earth system risk observation and response capacity at the global scale.

PRIORITY TIPPING ELEMENTS

Tipping Element	Key Risks	Potential Locations	Potential Partners
Coral Reef Systems	Loss of food security and livelihoods, decline of tourism-based income, loss of coastal storm protection, loss of biodiversity	Indo-Pacific, Caribbean, Australia	UNEP Coral Reef Unit, International Coral Reef Initiative, national, subnational and local governments
North Atlantic Subpolar Gyre / AMOC	Cooling and drying in Northern Europe, sea-level rise along North American East coast, hydrological changes in the Amazon, effects on West African monsoon, shift of Inter-Tropical Convergence Zone	Iceland, Denmark, UK, EU, Canada	Nordic Council of Ministers, Arctic Council, EU, UK Met Office, EU Copernicus, Woods Hole, NOAA, Inuit Circumpolar Council, Sami Parliament
Greenland Ice Sheet	Sea level rise in different world regions	Greenland, Denmark,	Nordic Council of Ministers, Danish Meteorological Institute, NASA, ESA, Arctic Council, Inuit Circumpolar Council
Amazon Rainforest	Loss of biodiversity and ecosystem services, changes to regional hydrology with impacts on agriculture and power production, loss of livelihoods and cultures, homes, and habitats.	Amazon Region	Amazon Cooperation Treaty Organization, Science Panel for the Amazon, Amazonian governments, Indigenous Amazon G9, Amazon Concertation, Amazon Cities Forum

CORE STRUCTURE & FUNCTIONS OF EACH TEMRF

These facilities will provide real-time monitoring, issue actionable early warnings, and support technical as well as political/diplomatic processes from scenario development to regional coordination of investments and effort. The protocols for science-policy interaction would be designed to foster adaptive learning and capacity building in policy maker communities across multiple scales and help develop targeted response strategies for the most at-risk planetary systems.

Representation (of Tipping Element Dynamics)

- **Real-Time Monitoring**: Use satellites, ocean buoys, in-situ sensors, AI, and regionally developed and/or tailored models of relevant climate, ecological, and socio-economic processes to identify and track key indicators.
- **Threshold Proximity Analysis & Alerts**: Monitor early warning indicators for approaching or passing critical tipping thresholds; issue regional and global warnings on system destabilization, threshold proximity, threshold passing, and anticipated impacts.
- **Focused, Integrated Research on Drivers and Implications of Tipping Elements**: Specific research programmes to integrate climate, ecological, and social science to better characterize the interactions across chemical, physical, and biological processes at various scales, including the interplay between environmental change and human social dynamics.
- **Diverse Knowledge Systems Coexistence & Data Equity Framework:** Incorporate knowledge systems from Indigenous Peoples and local communities to enrich risk assessments with context-specific insights and enhance the cultural legitimacy of anticipatory governance measures.

Recognition (of Tipping Element Risks among other policy considerations)

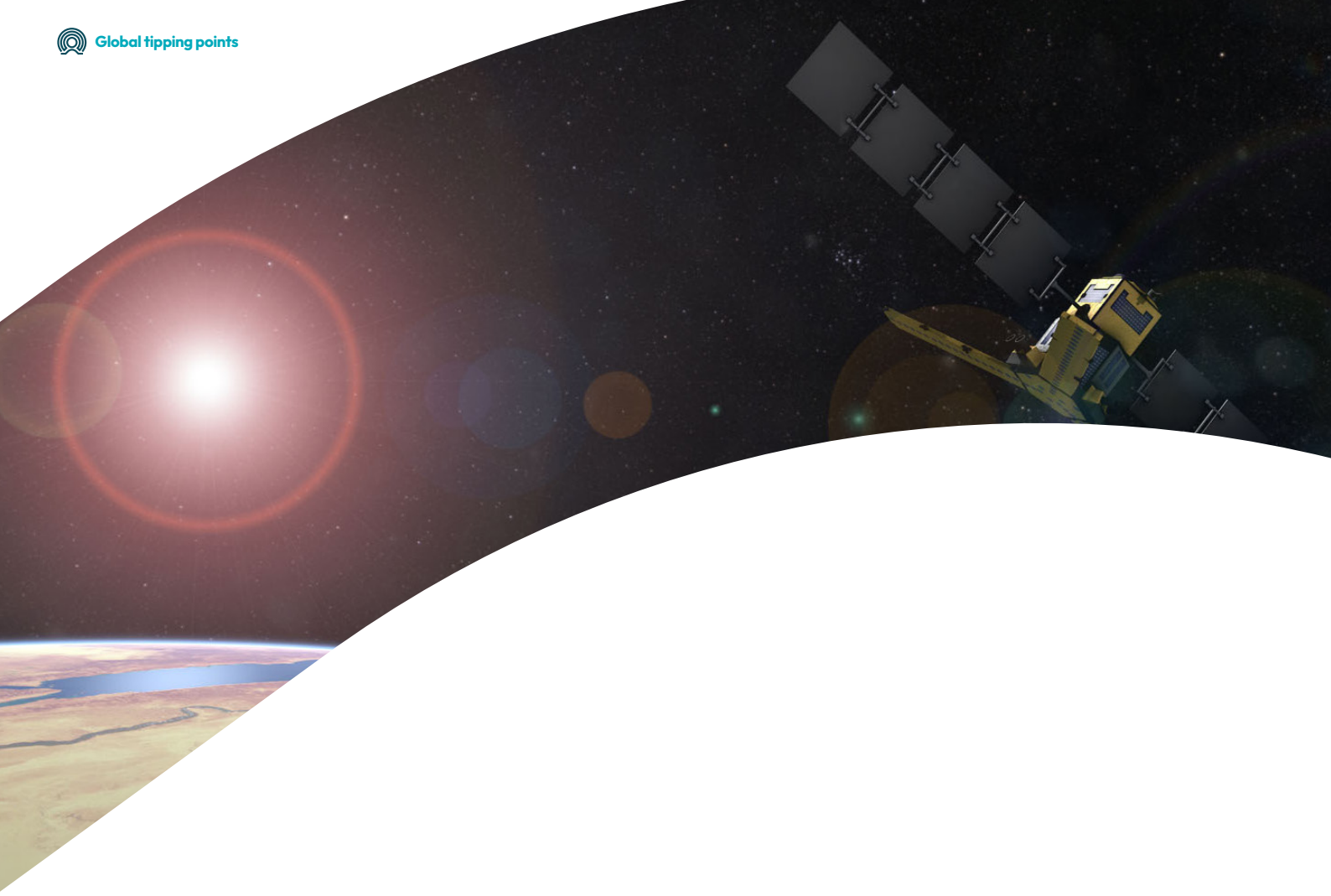
- **Risk Assessment & Foresight**: Produce future scenarios, and stress-test possible policy responses, allowing decision-makers to analyse the consequences of different interventions and weigh these among other priorities. Through the network, these could be coordinated across tipping elements to include risk and impact assessments for tipping cascades.
- **Response Pathway Support**: Provide a platform for the development of intervention, adaptation, and emergency response strategies at the science-policy-society interface.
- **Intertemporal Planning Capacity**: Provide a scaffolding for explicit recognition of events and impacts over longer time horizons along with present policy considerations in allocating resources and effort.

Response Mobilization

- **Stakeholder Interface**: Engage policymakers across scales, scientists, civil society, and the private sector.
- **Communication & Public Mobilization Hub:** Translate technical findings into accessible, actionable messages for the public, media, and civil society to foster awareness, preparedness, and collective action.
- **Finance & Resource Mobilization Mechanism:** Design fast-response financing instruments to channel emergency funds and technical resources toward adaptive efforts triggered by early warning signals.
- **Adaptive Coalition Infrastructure:** Legal and organizational templates for forming (and re-forming) functional partnerships across scales and sectors.

Linking the Nodes

The development of regional facilities could start as a cohort of regional efforts, exploring possible structures for bringing knowledge together with policy and societal decision-making and response capacity. Each TEMRF faces the challenge of developing new institutional architecture(s) for ongoing, iterative interchange between diverse stakeholders – some elements may be shared, while others are adapted to different regional contexts. Building peer relationships between the TEMRFs from the start is also a foundation for identifying shared interests in both science and collaboration in response capacity. These could later be the foundation for linking TEMRFs together.



A DISTRIBUTED, RESPONSIVE SYSTEM TO SAFEGUARD OUR PLANETARY FUTURE

TEMRFs are an urgently needed layer in the emerging architecture for planetary stability. By combining scientific excellence, real-time data, and regional and local engagement, they strengthen the global capacity to detect, prepare for, and respond to planetary destabilization—while the window for prevention remains open.

Feature	Description
Single Tipping Focus	Each facility monitors a specific tipping element with high resolution
Regionally Situated	Located close to the system in question and tied to regional scientific capacity
Bi-directional Science-Stakeholder Link	Designed to translate monitoring into targeted response options
Embedded in Multi-scale Networks	Linked into national agencies, intergovernmental assessment bodies, and subnational actors
Lean, Fast, Applied, Interactive	Agile operations with technical, scientific, and governance expertise

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To access full report

https://global-tipping-points.org