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**PROPOSALS FOR EXPERT MEETINGS AND WORKSHOPS FOR THE SEVENTH  
ASSESSMENT CYCLE**

**Expert meeting on High-Impact Events and Earth System Tipping Points**

(Prepared by the Co-Chairs of Working Groups I, II and III)

(Submitted by the Secretary of the IPCC)

## PROPOSALS FOR EXPERT MEETINGS AND WORKSHOPS FOR THE SEVENTH ASSESSMENT CYCLE

### Expert meeting on High-Impact Events and Earth System Tipping Points

*Rule 7.1 on IPCC Workshops and Expert Meetings in the Appendix A to the Principles Governing IPCC Work establishes, inter alia, that “IPCC Workshops and Expert Meetings are those that have been agreed upon in advance by an IPCC Working Group, or by the Panel as useful or necessary for the completion of the work plan of a Working Group, the Task Force on National Greenhouse Gas Inventories or a task of the IPCC. Only such activities may be designated as “IPCC” Workshops or Expert Meetings. Their funding should include full and complete provision for participation of experts from developing countries and countries with economies in transition. [...]*

*An IPCC Expert Meeting focuses on a specific topic bringing together a limited number of relevant experts. The relevant Working Group/Task Force Bureaux, or the IPCC Chair, will identify and select participants to Expert Meetings.”*

The topic of “High-impact events and Earth system tipping points” remains associated with large uncertainties and was addressed separately and to varying extents by the Working Groups (WG) during the Sixth Assessment Cycle. More detailed information and stronger consensus is needed for assessing and responding to the risk associated with abrupt changes and threshold behavior in the climate system and cascading effects. This knowledge gap was also mentioned in the Global Stocktake Synthesis Report, and highlighted in government submissions on priorities for the Seventh Assessment Cycle (IPCC-LX/INF. 7, Rev.1).

Noting the specific nature of the topic, the considerable recent growth in literature and the wide range of views in the scientific communities, as well as the urgency to address this in preparation for a consistent and comprehensive assessment in AR7, this proposal is to hold an Expert Meeting ahead of or shortly after the first Lead Author meeting for AR7, likely in Q4/2025.

As coordination of this topic with the international climate science community is of high relevance, and since high-risk events are identified as a [key topic](#) by the World Climate Research Program (WCRP), this Expert Meeting is planned to be organized with the partial support of the WCRP.

The proposal for an Expert Meeting on High Impact Events and Earth System Tipping Points has been prepared jointly by the Co-Chairs of Working Groups I, II and III with the support of their respective Bureaux and the WCRP, under the leadership of WGI.

## 1. Context

Earth System high-impact events and tipping points can induce substantial, impactful and potentially irreversible changes in the climate system, ecosystems or human systems. The IPCC Sixth Assessment Report (AR6) Glossary defines a “tipping point” as “*a critical threshold beyond which a system reorganizes, often abruptly and/or irreversibly.*” The nonlinearity of the underlying system typically creates this behavior. In mathematical terms, tipping points are well described by dynamical systems theory when the system has two stable states and an external parameter drives an abrupt change of state.

The AR6 Working Group I (WGI) assessed tipping points in the Earth system, such as a potential collapse of the Atlantic Meridional overturning circulation (AMOC) and its possible consequences, abrupt changes in weather patterns and the water cycle, as well as strongly increased Antarctic ice sheet melt. Abrupt change and threshold behavior also exist in ecosystems, for example mass bleaching events for warm water corals or forest dieback. While the associated uncertainty is generally very high, there is also high confidence that such events cannot be ruled out and that they would cause severe consequences.

Some post-AR6 publications indicate significant risk for tipping points of regional and global significance at global warming levels close to 1.5 degrees above pre-industrial, with potentially severe consequences. Beyond tipping points, the recent IPCC AR6 also highlighted the potential for unpredictable and unprecedented extreme events and outcomes. Major and sudden high impacts can also arise from co-occurring large-scale severe extreme events with potentially irreversible consequences on land (SRCCL; WGI AR6 Chapter 11), that can create large-scale disruptions, for instance, on food production, or water resources, with cascading effects on human societies and on ecosystems. The impacts of climate tipping points and high impacts events require specific attention, including possible adaptation measures and preparedness and issues of governance.

The Earth system has undergone tipping point crossings in the past, from rapid changes in the Earth's history to irreversible regional change in response to climatic events and associated consequences for ecosystems and human societies in more recent periods. These past examples call for a systemic vision and understanding of climate-ecosystem thresholds, feedbacks, multiple time scales involved and resilience to face such transitions. However, the occurrence of abrupt changes linked to tipping points that could be reached under the present rate and extent of human-induced climate change are difficult to constrain based on paleoclimate data because of the unprecedented nature of on-going climate change. It is also unclear to what extent Earth System models are able to predict tipping points due to limitations in scales and processes that are resolved. Finally, it is difficult to assess whether some tipping points may already have been crossed or are close to being crossed. This topic therefore urgently requires scientific progress, and the collaboration of experts from across the globe, and from multiple disciplines and working groups to evaluate and improve our ability to assess risk of tipping points and their consequences as well as potential mitigating and adaptive action.

In response to a call to governments to identify priorities and products for the Seventh Assessment Cycle in October 2023, many countries highlighted tipping points and high impacts events as an important issue to cover, including 18 countries suggesting a Special Report dedicated to topics related to tipping points (IPCC-LX/INF. 6, Rev.1). Although the Panel decided not to have any additional Special Report beyond the Climate Change and Cities Special Report, the issue remains essential to characterize climate risk relevant for adaptation and mitigation strategies. With ample literature being published, it is anticipated that this topic will be a key focus of AR7.

There are, however, different views on what exactly is covered by “tipping points”, in the perception of their importance for climate risk, and in the way to communicate scientific knowledge and uncertainties to the public and media ([Stocker et al., 2024](#)). There is also uncertainty in the extent to which Earth system models can resolve tipping point risks or processes of relevance for some global tipping points (e.g. [Liu et al. 2023](#)).

An Expert Meeting would take stock of all these developments and range of views, work towards building consensus on how to best evaluate risk of high impact events and tipping points, encourage scientific exploration of this topic and publications to inform the AR7, and prepare recommendations for the assessment in each WG of the AR7, including on ways to ensure common understanding and effective communication across WGs.

Ongoing challenges related to high impact events and Earth system tipping points include:

- Lack of homogeneity on what is covered by definitions of high impact events and tipping points across Working Groups;
- Lack of homogeneity on definitions of thresholds across Working Groups;
- High uncertainty of tipping points in relation to timing and global warming levels;
- Uncertainty in the link between severe extreme events and tipping points and the cascading effects of climate tipping points in ecosystems and human systems;
- Lack of early warning indicators for systems at risk of irreversible change or tipping, and potential adaptive/mediating action;
- Limits of adaptation measures to cope with high impact events and tipping points, highlighting adaptation to irreversible changes;
- Lack of adaptation and mitigation policies taking sudden and/or irreversible high-impact events into account.

## 2. Progress during the Sixth Assessment Cycle, and previous cycles

Even though high-impact or abrupt events were not always framed as “tipping points”, IPCC has addressed this topic since its third cycle. One of the Reasons for Concern, established during the Third Assessment Report (TAR) and since used to communicate aggregate risk at different global warming levels, refers to “future risk from large scale discontinuities”.

In the TAR WGI Assessment, potential “*Rapid climate change*” was identified as arising from nonlinearity, creating possible “*surprises in the climate system*”, or “*abrupt events*”, as observed during the last glaciation. Examples cited are “*a possible reorganization of the thermohaline ocean circulation in the North Atlantic resulting in a more southerly course of the Gulf Stream, which would have a profound influence on the climate of Western Europe, a possible reduction of upper-level ocean cycling in the Southern Ocean, or a possible but unlikely rapid disintegration of part of the Antarctic ice sheet with dramatic consequences for the global sea level*”.

The Fourth Assessment Report (AR4) re-assessed this topic focusing largely on the abovementioned examples, emphasizing that while some outcomes are unlikely, they cannot be excluded. The WGI Fifth Assessment Report (AR5 WGI) addressed tipping points more generally, together with irreversibility more specifically. It identified the irreversible changes in all climate system impacts but reported that due to the limited number of publications at that time, a deeper consensus finding process during the Fifth Assessment Cycle was warranted. The potential of rapid ice loss, and a sustained decline in the AMOC were highlighted in the Summary for Policymakers but marked as highly uncertain. In contrast, extreme events have been emphasized as a climate risk across Assessment Reports, focusing on changes in intensity and frequency. AR5 WGII stated that with rising temperatures, certain physical systems or ecosystems could face abrupt and irreversible changes, with risks increasing with global warming level. Dieback and degradation in the boreal forests and the Amazonian rainforest were identified as potential tipping elements in the Earth's system due to their extensive size and potential feedback with the carbon cycle. WGII AR5 also found that although regional-scale ecosystem tipping points have not been observed in recent history, there is substantial evidence of their occurrence in the distant past, raising concerns that they could happen in the near future. In the socio-ecological systems, the risk of reaching tipping points due to climate change can be reduced by maintaining ecosystem services through controlling the extent and pace of climate change, and alleviating additional pressures such as overgrazing, overfishing, habitat destruction, and pollution.

The Sixth Assessment Cycle placed a strong emphasis on the topic of tipping points from various angles. The Special Report on Global Warming of 1.5°C (SR1.5) first identified a list of potential tipping points that bear enhanced risks for either the climate system, ecosystems or human systems (SR1.5, Chapter 3, Table 3.7). The risk of crossing critical thresholds associated with those tipping points were assessed for different warming levels, highlighting the lower risk for a global warming level of 1.5°C relative to others. The Special Report on Oceans and Cryosphere had a dedicated chapter assessing extremes and abrupt or irreversible changes in the ocean and cryosphere in a changing climate, to identify regional hot spots, cascading effects, their impacts on human and natural systems, and sustainable and resilient risk management strategies. The possibility of critical thresholds associated with tipping points, and, more generally, the possibility of “low-likelihood, high-impact events” was also recognized in the WGI Report: *“Low-likelihood, high-impact outcomes could occur at global and regional scales even for global warming within the very likely range for a given GHG emissions scenario. The probability of low-likelihood, high-impact outcomes increases with higher global warming levels (high confidence). Abrupt responses and tipping points of the climate system, such as strongly increased Antarctic ice-sheet melt and forest dieback, cannot be ruled out (high confidence).”* A specific box in the Technical Summary (Box TS.9) was devoted to “Irreversibility, tipping points and abrupt changes”, and concluded in most cases there was *low confidence* in the occurrence of studied events, in particular due to limited evidence.

AR6 WGII put emphasis on ecosystems and human systems’ tipping points that could be created by the cascading effects of adverse impacts from climate hazards, in particular along coasts, in urban centers and in mountainous regions. It stated that *“these hazards and cascading risks also trigger tipping points in sensitive ecosystems and in significantly and rapidly changing social-ecological systems impacted by ice melt, permafrost thaw and changing hydrology in polar regions (high confidence)”*. The Report also confirmed risks due to climate “large-scale singular events” as one the five main Reasons for Concern, citing amazon forest dieback and the rapid mass loss in ice sheets. The report concluded with high confidence that adaptation cannot reduce harm in fragile ecosystems such as coral reefs, some forests, sea ice and permafrost systems that reach critical thresholds or tipping points.

AR6 WGIII included an assessment of the long-term economic benefits of mitigation from avoided climate change and emphasized the importance of considering climate tipping points (e.g., Box TS.7) and thresholds of irreversible and abrupt changes. The risks of climate tipping points have also supported analytical frameworks for understanding mitigation response strategies and feedback. While mitigation is expected to lower the risk of climate tipping points being reached, current socio-economic scenarios and models have limitations in representing non-linear change and shock events, both related to (climate) risk and mitigation, for example in the context of overshoot scenarios for 1.5°C.

Overall, the Sixth Assessment Cycle has progressed on a range of key topics, but also identified many knowledge gaps. Since the literature cut-off dates in AR6, the number of publications on high-impact events and tipping points has increased considerably. Recent review papers highlight the importance (e.g., [Amstrong McKay et al., 2022](#)) and uncertainty (e.g. [Wang et al., 2023](#)) of tipping points and their need to be considered in communication with policymakers ([Stocker et al., 2024](#)).

### **3. Goals of the Expert Meeting**

The goal of this Expert Meeting is to support the WG-specific assessment linked to high impacts events and Earth system tipping points, which are the subject of intense research and debate in the community. Its objectives include to discuss and agree on definitions, reflect the latest research on tipping elements and threshold behavior in the Earth system, take stock of knowledge gaps, and propose ways of assessing research that consider the broad range of existing views in the scientific community. The EM will also serve to identify and engage with dedicated communities and experts, including with a view to recruiting potential contributing authors that would enhance the diversity of perspectives and regional representation in AR7. The meeting is also aimed at facilitating effective and coherent communication across working groups on tipping points in particular.

#### **4. Participation**

We are proposing that 60 experts attend the Expert Meeting, with equal participation from developing and developed countries. The composition of participants will reflect the relevant range of views and of scientific, technical, socio-economic and governance expertise, striving for gender balance and even representation across geographies, mindful of the specific perspectives of vulnerable regions and communities, and include experts both with and without previous experience in IPCC, in addition to selected AR7 authors with relevant expertise.

The following areas of expertise are required:

- Tipping points and severe events in the ocean, their impacts including on ocean biosphere and carbon cycling and thresholds in ocean biosphere;
- Tipping points, cascading shocks and severe events in land systems, including vegetation changes and transitions, fire, and carbon cycle implications;
- Abrupt and large changes in monsoon systems, and impact on breaching thresholds in the land system;
- Permafrost thaw and its regional impact (water cycle; forests), as well as consequences for the global carbon and methane budget;
- Rapid ice sheet loss and rapid sea level rise;
- Dynamical systems and modeling tools;
- Earth system and related modelling tools and their ability to represent processes involved in tipping;
- Early warning signals and assessment tools that can inform policy making and promote societal preparedness and potential mitigative action;
- Societal risks and impacts, including economic impacts, of abrupt climate change and compound events, e.g., risks to food system from severe or multiple events and circulation changes; polycrises; compound risks;
- Limits to adaptation.

The experts need to cover changes reconstructed from paleoclimatic changes to evaluate evidence of tipping or stability in systems from significantly different climates, instrumental and satellite retrieved stability or vulnerability of systems to enable characterization of risk and early warning, and evidence from models, including earth system modeling, land and food system modeling and societal and integrated impact modeling. It is important that perspectives cover global experiences including those in developing countries and by vulnerable populations.

#### **5. Timing and format**

We propose that the Expert Meeting takes place in Q4/2025 before or shortly after LAM1, over three days.

#### **6. Hosting**

The Co-chairs are seeking a host for this Expert Meeting.

#### **7. Budget and Funding**

The Co-Chairs suggest an addition of a budget line to the 2025 IPCC Trust Fund budget for an Expert Meeting on Tipping Points (60 participants). The requested provision is an increase in budget of CHF 140,400, which comprises DC/EIT support of CHF 120,000 (30 journeys) and Other expenditure of CHF 20,400. This budget request will be complemented by WCRP which indicated they were willing to support in-kind (scientific input, operational support) and financially (exact budget still to be defined).