

Planetary Boundary Initiative Newsletter

SEVENTH EDITION · Q2 2026



Planetary Boundaries
Science



POTSDAM INSTITUTE FOR
CLIMATE IMPACT RESEARCH



While Planetary Boundary science has advanced tremendously over the past decades, we still lack a deep understanding of the intricate, yet pivotal connections between many biological and physical functions of the Earth system.

In late 2023, the **Potsdam Institute for Climate Impact Research** and its partners launched a major scientific effort to improve both our ability to model how the Earth system evolves under the pressure of human activity, as well as our ability to measure the state of the Earth system at a high temporal resolution: **Planetary Boundaries Science (PBScience)**.

WELCOME TO THIS SEVENTH NEWSLETTER OF THE **PLANETARY BOUNDARY INITIATIVE (PBI).**

Here, you find updates on **Planetary Boundaries Science** and related research efforts conducted at the Potsdam Institute for Climate Impact Research (PIK) and beyond. Read on for news on our steadily growing science initiative, cutting-edge Planetary Boundaries (PB) research results, and exclusive insights into the PBScience effort.



PAPER PUBLISHED ON QUANTIFYING EARTH SYSTEM RESILIENCE

Text: Jonathan Donges/Bruce Phillips | Visual: Harteg et al./GLOBAIA

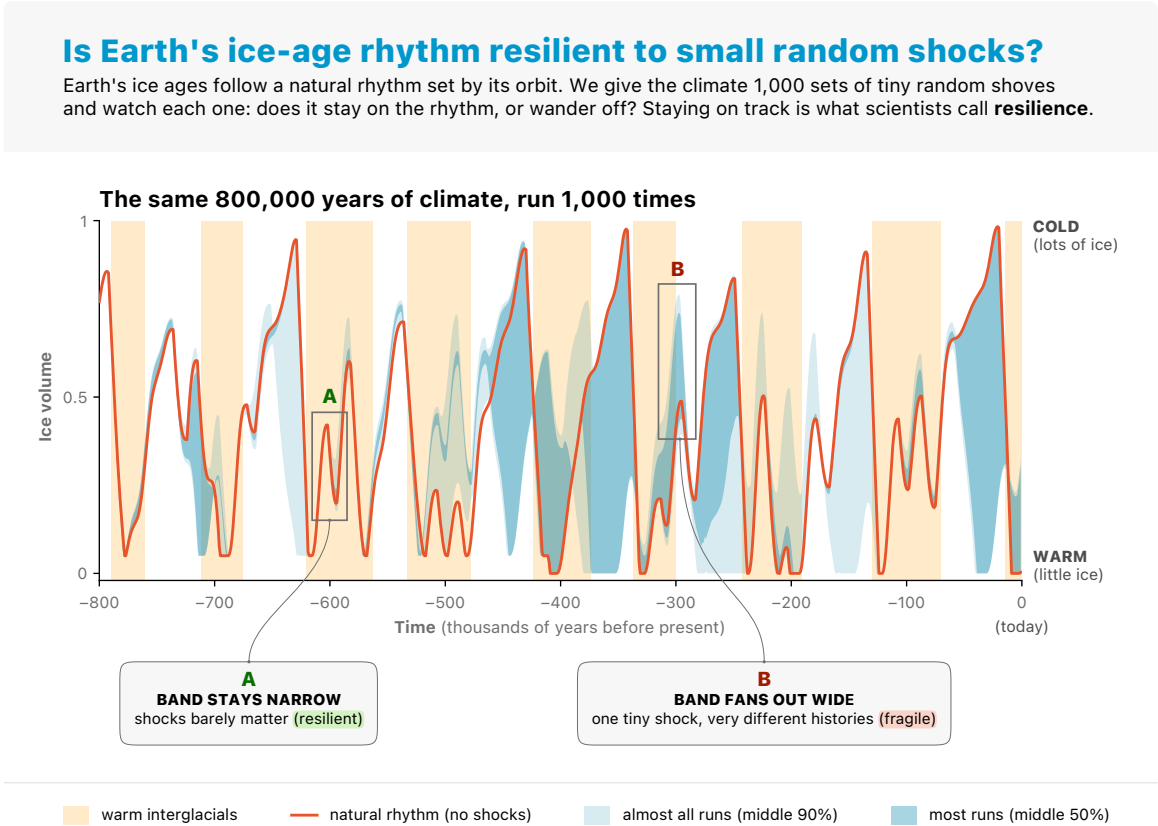
Understanding how Earth’s climate responds to shocks is central to defining a safe future for humanity. New work from PB-Tip researchers Dr. Jonathan Donges and Dr. Nico Wunderling offers fresh insight into this question by looking deep into the planet’s past.

Their study examines glacial–interglacial cycles (ice ages and in between them) over the last one million years, using a climate model to test how the system reacts when pushed off balance. By introducing both small and large disturbances to global ice volume, the researchers were able to observe how quickly and under what conditions the climate system snaps back to its natural trajectory.

The key findings:

Earth’s climate is far more resilient during warm interglacial periods, such as the Holocene, (the last 10,000 years or so) than during colder glacial phases.

In warm periods like the one we live in today, the climate system tends to recover more easily from disruptions. In contrast, during peak glacial conditions, the system is more sensitive and slower to return to equilibrium. This is particularly important today as greenhouse gas emissions drive current warming.



Harteg, J., Wunderling, N., and Donges, J. F.: **Quantifying resilience in non-autonomous and stochastic Earth system dynamics with application to glacial-interglacial cycles**, Earth Syst. Dynam., 17, 673–686, <https://doi.org/10.5194/esd-17-673-2026>, 2026.

NEW PAPER ON AMAZON TIPPING RISK

Text: Bruce Phillips | Visual: GLOBAIA & Ariane Doehring

PB-Tip scientists Dr. Nico Wunderling and Dr. Boris Sakschewski co-authored a key new paper, now published in the journal Nature. It found that around two-thirds of the Amazon Rainforest could shift into degraded forest or savanna-like ecosystems at 1.5-1.9°C of global warming if deforestation increases to roughly 22-28 percent of the Amazon. Without additional deforestation, by contrast, such large-scale changes would likely occur only at much higher warming levels of around 3.7–4°C.

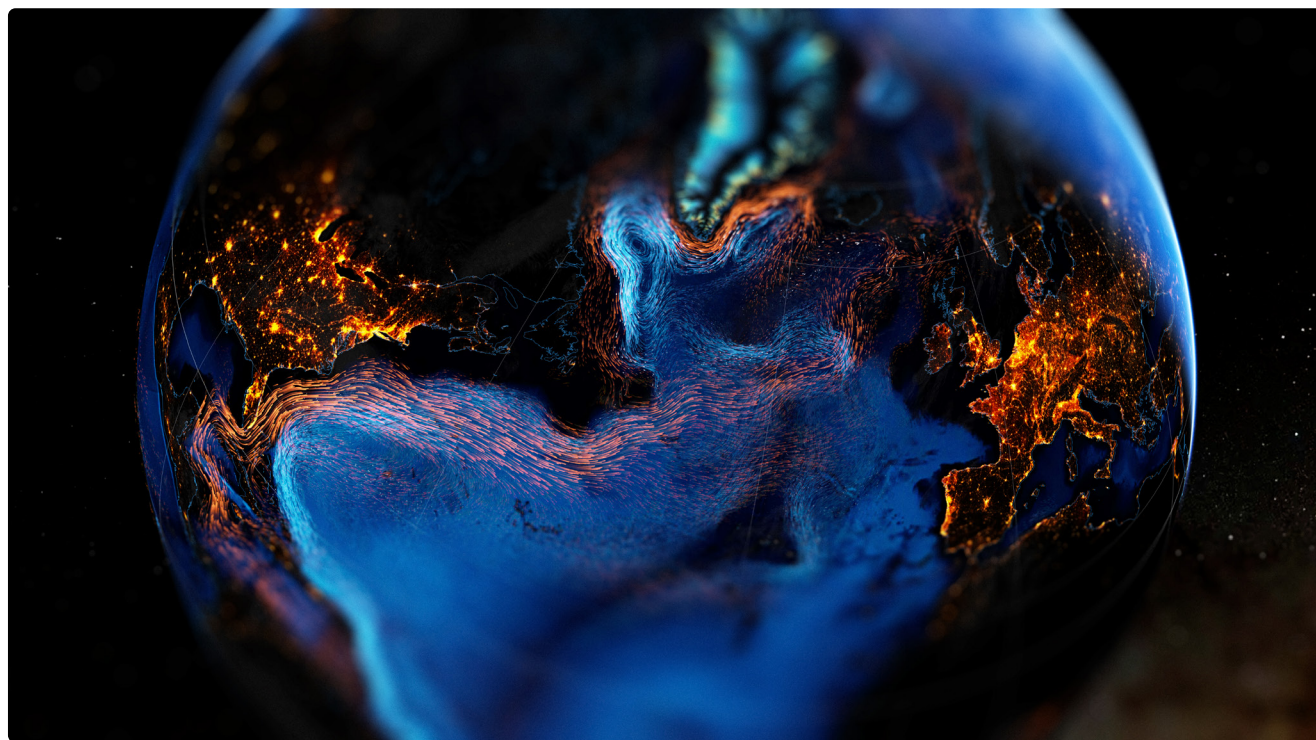
With around 17-18 percent of the Amazon forest already lost, this places the system close to the critical range identified in the study. The scientists emphasized that halting deforestation and restoring forest cover could substantially strengthen the Amazon’s resilience to unavoidable warming.

A short video by Ariane Doehring explains more here: <https://www.youtube.com/watch?v=LrQTVDbCtqc>

Read more on PIK’s website: [Deforestation lowers threshold for Amazon degradation to below 2°C warming](#)



Wunderling, N., Sakschewski, B., Rockström, J., Flores, B. M., Hirota, M., Staal, A. (2026): Deforestation-induced drying lowers Amazon climate threshold. Nature. DOI:10.1038/s41586-026-10456-0



NEWS FROM TIPMIP

Text: Sina Loriani | Visual: GLOBAÏA

The Atlantic Meridional Overturning Circulation (AMOC) is a major ocean current system that may tip in the future, with significant consequences for the planet and humans, in particular those living in Europe and global monsoon regions. Its stability depends a lot on the surface water conditions in the North Atlantic, which are expected to be affected by ongoing climate change (due to warming oceans, rainfall changes and, increasingly, the melting ice sheet over Greenland).

To better understand these dynamics and the potential tipping of the AMOC, the TIPMIP-Ocean domain orchestrates a series of computer simulations. To this end, the authors, including many project scientists, published the **TIPMIP-Ocean protocol** ([Swingedouw et al., submitted to Geoscientific Model Development](#)). This protocol (as all TIPMIP-protocols) is a recipe describing how to run a set of standardized experiments with state-of-the-art Earth System models, such that modeling groups worldwide can contribute and compare their results.

Such model intercomparison projects (MIP) are an important quantitative cornerstone of systematic assessments, e.g. as done by the IPCC. The core activity in this regard is the **Coupled Model Intercomparison Project (CMIP)**, which currently enters its latest stage of coordinating the large climate models. Other MIPs such as TIPMIP greatly benefit from the practices and infrastructures put in place by the CMIP community over the past decades. Recently, PB-Tip scientist and TIPMIP data manager Dr. José Licón-Saláiz was appointed member of the [CMIP infrastructure panel](#), which facilitates standardized procedures (how to name variables, how to publish data, etc.).



ERSI WORKSHOP AT PIK

Text: Jonathan Donges/Bruce Phillips | Visual: Julia Zinn

The Earth Resilience and Sustainability Initiative (ERSI) workshop held at PIK in May 2026, co-organized by PB-Tip scientists Dr. Jonathan Donges and Max Bechthold, brought together early career researchers from across the world. Coming from universities such as Princeton and Stanford (USA), the Stockholm Resilience Centre (Sweden), and University of Amsterdam (The Netherlands), they explored the latest advances in research on rapid shifts and resilience in the coupled human-Earth system, including how to improve international collaboration on planetary challenges. The ERSI is an important source of talent for research on Planetary Boundaries, Earth system tipping points and Earth resilience.



BEES AND BEARS EVENT, BERLIN

Text: Bruce Phillips | Visual: Bears and Bees

Dr. Levke Caesar, Dr. Kasra Rafiezadeh Shahi and Bruce Phillips represented the PBScience lab at the Bees & Bears first “Climate Kitchen” in Berlin, where entrepreneurs, NGOs and businesses meet to discuss solutions for sustainability. Their presentation highlighted that the **Earth** system depends on 9 interconnected layers that together define the safe operating space for human life on Earth: the Planetary Boundaries.

The Q and A discussions covered everything from communication, to solutions to how to help businesses navigate sustainability in relation to the Planetary Boundaries framework.



POTSDAM SCIENCE DAY: CLIMATE RESEARCH IN ACTION

Text: Bruce Phillips | Visuals: Hannes Rauhe

At this year’s Potsdam Science Day on the Golm campus, the Potsdam Institute for Climate Impact Research (PIK) and the Kopernikus Project Ariadne invited visitors to experience climate research and the energy transition up close. Through interactive exhibits, hands-on experiments, discussions, and virtual reality, visitors of all ages explored topics ranging from Planetary Boundaries and ocean circulation to climate-resilient coffee production, hydrogen, flexible electricity grids, and socially just heating transitions.

The event brought together more than 40 research and education institutions from Brandenburg and welcomed around 7,800 visitors, creating a lively public space for dialogue between scientists and society. By making complex questions of climate change, energy systems, and transformation tangible, PIK and Ariadne helped show how research can inform practical pathways toward a more sustainable future.



HOW REALISTIC IS CLIMATE SCIENCE IN THE BOOK “PROJECT HAIL MARY”?

Text: Bruce Phillips | Visual: Bruce Phillips & Amazon MGM Studios/Sony Studios

In this episode from our YouTube Channel Planetary Boundaries Science, PBScience Lab co lead, Dr. Levke Caesar, breaks down the dramatic climate scenario at the heart of Andy Weir’s novel **Project Hail Mary**—where the Sun dims and humanity attempts a last-ditch fix by releasing massive amounts of methane into the atmosphere.

The video explores whether such a plan could work, what real climate physics says, and why large-scale climate interventions are far riskier than they appear in fiction.

See the video here <https://www.youtube.com/watch?v=GJsouT2HV9g>.



THE FRESHWATER PLANETARY BOUNDARY NEW VIDEO WITH DR. YASSMIN HESHAM

Text & Visual: Bruce Phillips

Climate change, together with large-scale land and water use, is pushing the freshwater cycle further away from a stable state, as defined by the Planetary Boundary for freshwater change. This boundary is already considered to be transgressed, reflecting a long-term trend that jeopardies the freshwater cycle’s ability to support vital climatic and ecological Earth system processes. A new video from the lab featuring PIK Scientist Yassmin Hesham interviewed by Bruce Phillips goes into the causes and solutions to “save the water cycle”.

See the full video here <https://www.youtube.com/watch?v=gIIXiGvhBmM>.



PBSCIENCE TOPICS AT EGU

Text: ERSU, Clara Nicolai | Visual: Ariane Doehring

Many project scientists joined the annual **EGU General Assembly**, Europe's largest geoscientific conference, which took place from 02-08 May 2026 in Vienna. It is Europe's largest geoscientific conference with almost 22,500 participants from 125 countries; 58% of the abstracts were identified as contributions from Early Career Scientists.

Our contributions included science on Earth system resilience in the Anthropocene, focusing on tipping points, Planetary Boundaries, and human-Earth interactions through advanced modeling frameworks (towards sustainable agricultural transitions), data-driven approaches, and interdisciplinary research on critical systems such as the Amazon rainforest, Greenland and Antarctic ice sheets, permafrost and the Atlantic Meridional Overturning Circulation, with an emphasis on developing integrated tools, indices, and simulation protocols like TIPMIP to assess and predict abrupt changes and safe operating spaces under climate change. The PBscience Lab's literature mining expert, Özge Kart Tokmak, presented her latest work on the PB Assistant, an AI-assisted tool for targeted recommendations of relevant scientific literature.

Ariane Doehring, who recently joined the team to support science communication through video storytelling, also attended the assembly. The interviews and impressions will be shared on PIK's social media channels, offering a glimpse into the conference through the eyes of Early Career Scientists.

PARTNERSHIP NEWS



CONCITO WORKSHOP

Text: Luisa Teixeira

The project "From Planetary Boundaries to planetary policy" aims to create and disseminate knowledge on how to develop policy in line with Planetary Boundaries in Denmark and globally.

The project will also be used to bridge the gap between the latest scientific research and political, private, and civil society decision-makers.

Concito held a workshop at PIK with PIK researchers and members of the civil society (with connections to policy-making) to explain how they took the PB framework and most recent PB values into their exercise of downscaling into Denmark and Danish policy-making reality. Several interest exchanges surfaced regarding what is relevant for policy and what is not, and ideas for future exchange and collaboration.

This was a very timely opportunity to engage with yet another great example of how PBScience is transcending its origins within the Earth System Science community. As we are looking to map other such examples of the application of the PB framework and science, we welcome any examples or references of this you may be able to share with us at pbscience@pik-potsdam.de.



PLANETARY GUARDIANS SCIENCE BRIEFING

Text: Bruce Phillips

Our Partners, the Planetary Guardians, had a successful planetary science briefing outlining a science-driven governance challenge: Earth system stability is declining while institutions remain poorly aligned with emerging risks. Researchers emphasized that warming is accelerating, a temporary overshoot of 1.5°C is likely, several major tipping elements—from the Amazon to AMOC—are at risk, and seven of nine Planetary Boundaries have been exceeded. These findings support a shift from traditional global-commons thinking toward a broader planetary commons framework, recognizing that some nationally located systems provide global stabilizing functions.

Participants discussed how governance could adapt through faster-moving coalitions, stronger science-policy interfaces such as Chief Planetary Scientists, and emerging legal tools that reflect shared responsibility for Earth system processes. They also highlighted the need for financial systems to value ecosystems as productive assets, with African institutions advancing nature-finance innovations. Overall, the session underscored that effective planetary stewardship requires integrating science, governance and economics to manage interconnected Earth system risks.

You can see previous briefings here
<https://www.planetaryguardians.org/psb>



OUTLOOK

UPCOMING EVENTS, ACTIVITIES AND PUBLICATIONS RELATED
TO THE PLANETARY BOUNDARY INITIATIVE AND RELATED RESEARCH TEAMS

SEPTEMBER 2026

The Planetary Health Check report 2026 launch

The annual Planetary Health Check report will be released in late September 2026 during New York Climate Week. This will be the most comprehensive and up to date report yet, with deep dives into key emerging risks to our Earth system.

OCTOBER 2026

Living within Planetary Boundaries conference, Berlin

Hosted by The European Environment and Sustainable Development Advisory Councils Network, Umweltbundesamt (the German Environmental Agency) and the German Advisory Council on the Environment, this [conference](#) will discuss how actors in government, research, and civil society can continue to work towards more sustainable futures while acknowledging

THANK YOU...

for your interest in Planetary Boundaries science. By providing us with feedback on our activities, you can help us to continuously improve our outreach efforts:
pbscience@pik-potsdam.de