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The 2026 state of the climate report: challenges and opportunities

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Abstract

Earth's climate system is moving deeper into uncharted territory. We present the 2026 update of planetary vital signs that track the state of Earth's climate system, alongside indicators of the human activities driving ongoing change. Of 16 climate-related indicators, seven are currently at record extremes. Several indicators also show evidence of accelerating trends or abrupt shifts, raising concerns about increasing climate instability, interacting feedbacks, and the growing risk of crossing critical tipping points. Human activities, particularly fossil fuel combustion, remain the dominant drivers of these changes. Despite the worsening trends, encouraging signs of societal changes are emerging, including the rapid expansion of renewable electricity and battery storage, although progress remains far below the scale and speed needed to stabilize Earth's climate system. Rapid reductions in greenhouse gas emissions, effective adaptation, ecosystem protection, and transformative societal change remain essential to reducing climate risks and securing a more resilient and sustainable future.

Keywords **planetary vital signs, greenhouse gas emissions, fossil fuel consumption, renewable energy transition, Earth system stability**

We are witnessing the rapid destabilization of the Earth's climate system. This is no longer a warning for the future; it is a diagnosis of the present. Earth's life-support systems are being pushed beyond stable limits, with changes unfolding faster than our ability to respond. Human activities are driving profound shifts in the atmosphere, oceans, and biosphere. Carbon dioxide levels in the atmosphere are higher now than any time in the last 2 million years (IPCC 2021). Across the globe, extreme heat, floods, droughts, storms, and wildfires are no longer rare events but defining features of a changing planet. For example, July 2026 was the hottest month on record for the contiguous United States (1895–present) (NOAA 2026), while global ocean temperatures also reached a record high for July (figure S1). Climate-related changes appear to be accelerating and intensifying, raising concerns about reinforcing feedbacks and crossing of tipping points, with po-

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tential irreversible impacts. Climate change is increasingly interacting with global biodiversity loss, freshwater stress, food insecurity, pathogens, and geopolitical instability, amplifying risks across interconnected human and natural systems. Yet, the gap between scientific understanding and societal response continues to widen despite mounting evidence of escalating risks. The evidence for accelerating climate and ecological disruption is now so compelling that attention must shift toward rapid decarbonization as well as adaptation, resilience, scalable responses, and transformative systemic change. Crucially, the communities least responsible for historical emissions, particularly in the Global South and small island states, are bearing disproportionately severe and early consequences, raising fundamental questions of climate justice that must inform both policy and science.

Amid these intensifying risks, important signs of societal and technological transformation are also emerging. Solar and wind power are expanding rapidly worldwide, with low-carbon sources providing roughly 43% of global electricity generation in 2025 (Ember 2026a). This signals the emergence of a new clean-energy era, the Age of Electricity. At the same time, advances in energy storage, adaptation planning, ecosystem restoration, and climate response tools are providing new opportunities to reduce risks from climate change and strengthen resilience across human and natural systems. Although current progress remains far below what is needed to stabilize the climate system, these developments suggest that large-scale societal transformation remains possible and still within reach.

In this report, we update the vital signs of the planet and the human activities driving their rapid change. We provide a clear synthesis of the latest evidence for scientists, policymakers, and the public while identifying the risks ahead and the opportunities for meaningful action still available. Documenting change is no longer enough. We must also communicate what it means and what actions are needed. As scientists, we have a responsibility to communicate these realities with clarity and urgency. This report is part of our ongoing effort to deliver timely, accessible updates on rapidly intensifying climate change.

Planetary vital signs

Of 16 planetary vital signs spanning greenhouse gas concentrations, temperatures, the oceans, ice, energy balance, and wildfire, 7 (44%) are currently at record extremes, and several show evidence of acceleration or abrupt shifts (figure 1; and see table S1 for data sources and methods).

Global greenhouse gases and temperature

Based on year-to-date averages, concentrations of the three most important greenhouse gases, carbon dioxide, methane, and nitrous oxide, all reached record levels again in 2026 (figure 1a–c). In May of 2026, atmospheric CO_2 concentration exceeded 428 ppm, which is ∼50% greater than pre-industrial levels (figure 1a). These rising greenhouse gas concentrations, largely generated by burning fossil fuels, continue to intensify Earth's energy imbalance and long-term warming. The last four years have also seen numerous temperature records broken (figure S1). Beginning in early autumn of 2026, a very strong El Niño event is expected to cause substantial additional warming, putting the year on track to be one of the hottest on record (figure 1d; Hausfather 2026).

Oceans and ice

Glacier thickness and Greenland ice mass are now at record lows (figure 1i, l). In recent decades, the Greenland ice sheet has undergone a series of intense melting episodes contributing to a sixfold increase in extreme summer meltwater volume (Bonsoms et al. 2026). In addition, minimum Arctic sea ice extent and Antarctic ice mass change are also near record extremes (figure 1i, k).

The oceans continue to absorb the vast majority of excess heat generated by greenhouse gas emissions. Based on preliminary data, ocean heat content and sea level are at record highs (figure 1e, g). Ocean heat content is rising at an accelerating rate, and the resulting thermal expansion of seawater accounts for approximately 56% of the global sea level rise observed in recent decades (Liang et al. 2025). Marine heatwaves have also increased in frequency and intensity, contributing to coral bleaching, ecosystem disruption, and regional climate extremes (Wernberg et al. 2025).

Energy balance

Earth's energy imbalance, the difference between the amount of solar energy Earth absorbs and the amount of energy it radiates back into space, characterizes heat accumulation throughout the entire climate system, making it one of the most comprehensive indicators of climate change (WMO 2026). An increasing energy imbalance means that more heat is accumulating throughout the climate system, contributing to rising air temperatures, ocean warming, sea-level rise, and more frequent and intense extreme weather events. The recent rise in the energy imbalance may be partly due to a cloud-related reduction in albedo (figure 1m), potentially linked to aerosol-cloud interactions (Goessling et al. 2025). However, other work argues that it may be fundamentally tied to circulation changes associated with El Niño (Zhang et al. 2026), or connected to a weakening of the global carbon sink on land (Ke et al. 2024).

Wildfires

Global tree cover loss due to fires was 10.8 million hectares in 2025, its third-highest level on record (figure 1p). Global forest fire carbon emissions have increased substantially in recent years, largely due to trends in extratropical regions where fire activity is strongly influenced by climate (Jones et al. 2024). Increasing wildfire activity is both a consequence of climate change and a growing source of greenhouse gas emissions creating a positive feedback loop that further amplifies global warming (Liu et al. 2014), with severe implications for global biodiversity and human health (Kriit et al. 2026). These dynamics have disproportionate impacts on forest-dependent and Indigenous communities, who often have limited adaptive capacity.

The human enterprise

Human activities, including energy use, food production, economic growth, and land-use change, continue to drive many of the rapid changes occurring across the Earth system (figure 2). Global human population size reached a record high in 2026, and continues to increase by roughly 1.3 million people per week, although the rate of increase is slowing (figure 2a). As of 2024, ruminant livestock population and per capita meat production were also at a record high (figure 2d). Ruminant livestock population size is

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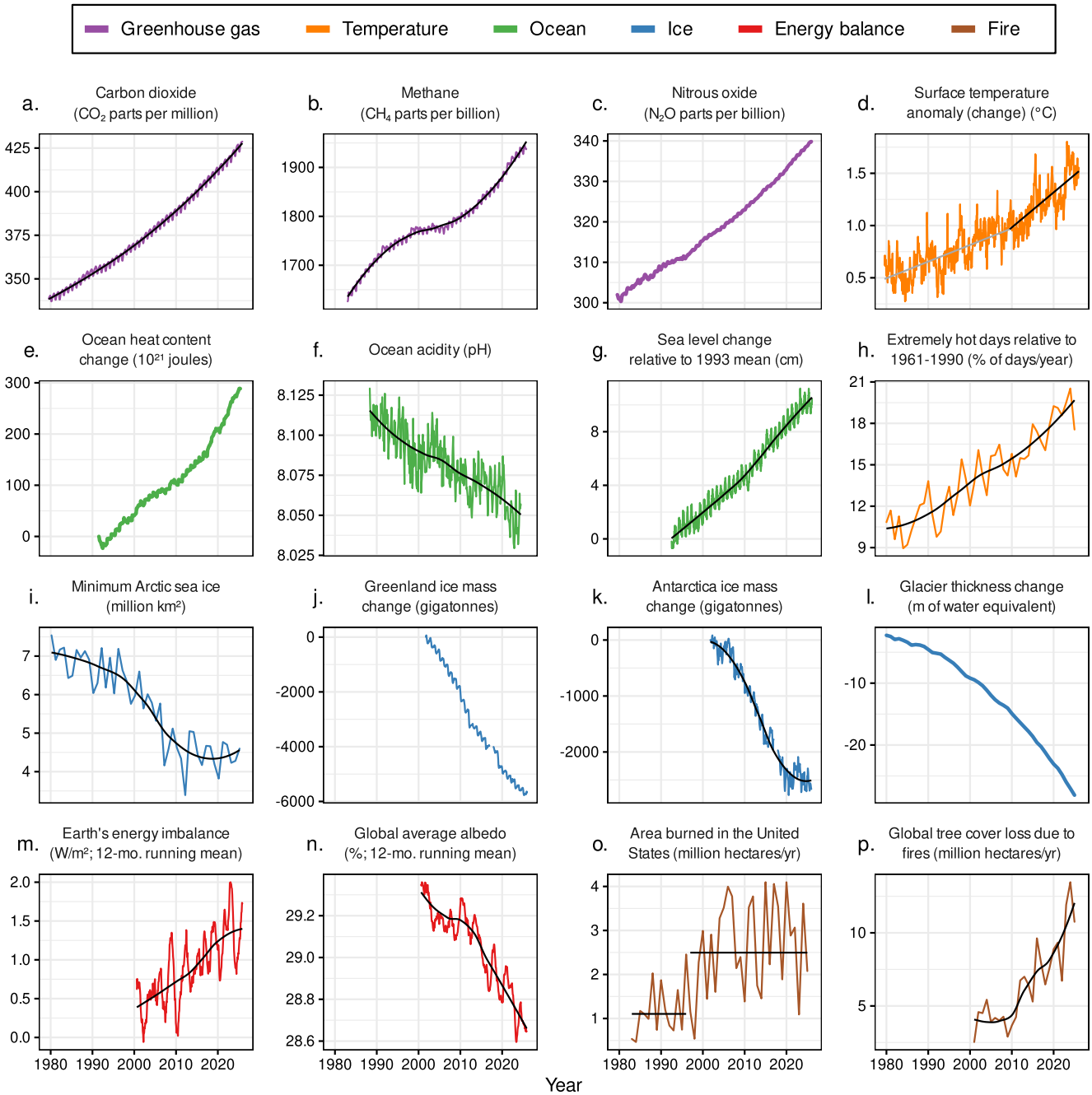

Figure 1. Time series of climate-related responses. For surface temperature anomaly (d), estimates based on a segmented linear regression model are shown in gray (prior to 2010) and black (beginning in 2010). For area burned (o), the black horizontal lines show changepoint model estimates, which indicate abrupt shifts (figure S3). For other variables with relatively high variability, local regression trendlines are shown in black. The variables were measured at various frequencies (e.g., annual, monthly, weekly). The labels on the *x*-axis correspond to midpoints of years. Sources and additional details about each variable are provided in supplemental file S1.

currently rising by ~0.7 million per week. The increase in calories produced for livestock feed and non-food uses has contributed to a decline in the efficiency of the agricultural system; as of 2020, only half of the calories produced on croplands were available for direct human consumption, with beef production accounting for the largest total loss of calories during feed-to-food conversion, highlighting major inefficiencies in the global food system (West et al. 2026).

Global economic growth during the last 4 years followed a strong post-pandemic rebound, with annual growth rates averaging around 3% over this period (United Nations 2026), associated with a forecasted increase in primary energy demand of about 2% (IEA 2025a). World gross domestic product rose to an all-time high in 2024 (figure 2i). The share of new cars sold that are electric reached a record high in 2025, reflecting continued growth in the adoption of low-carbon transportation technologies (figure 2o).

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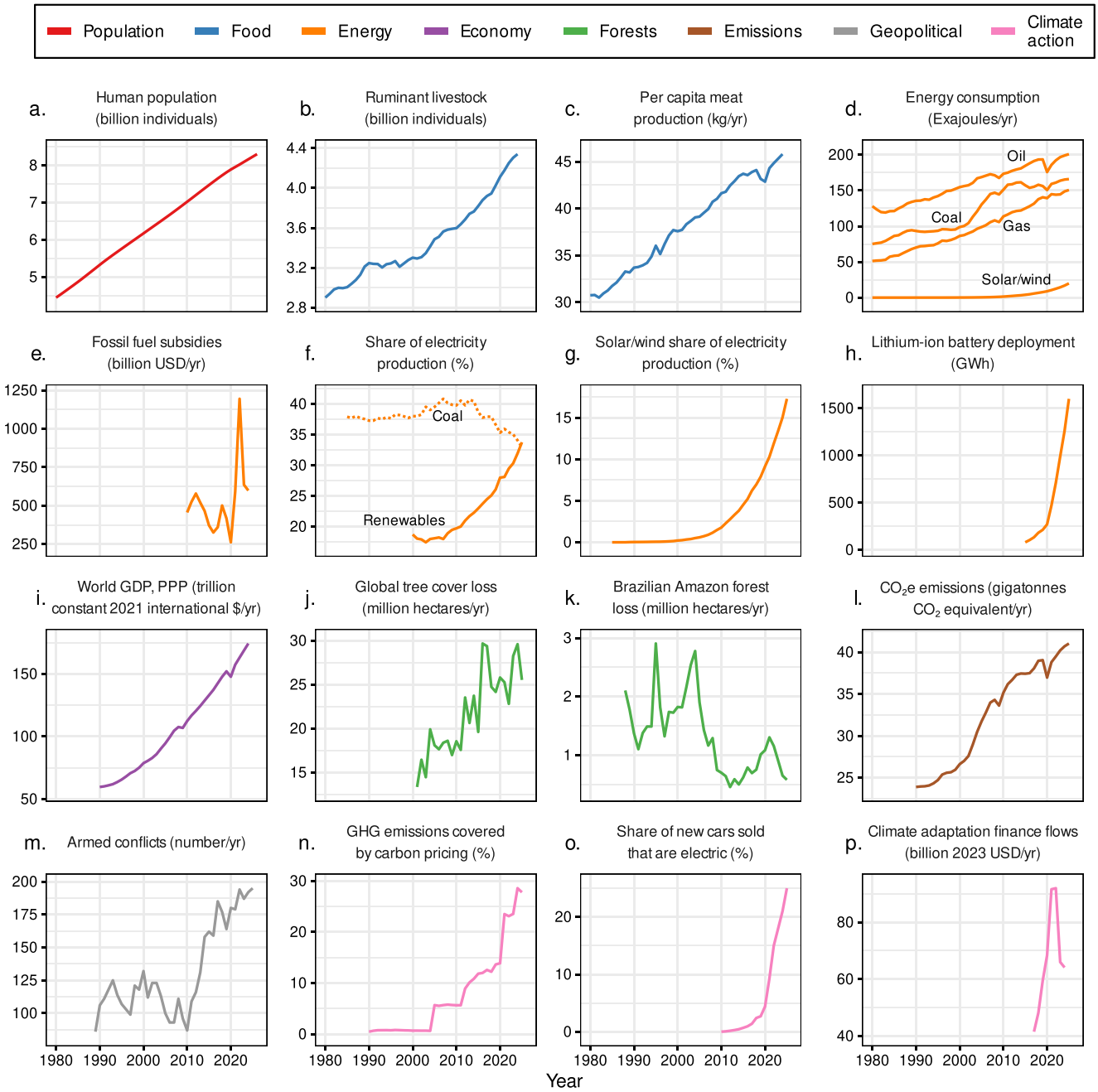

Figure 2. Time series of climate-related human activities. In panel (j), tree cover loss does not account for forest gain and includes loss due to any cause. For panel (d), statistics are based on total energy supply (The Energy Institute 2025); hydroelectricity and nuclear energy are shown in supplemental figure S4. Sources and additional details about each variable are provided in supplemental file S1.

Energy

Fossil fuel consumption increased by 0.9% in 2025, with oil (+1.0%), coal (+0.4%), and gas (+1.3%) all reaching record highs (figure 2d). There was also a rise in annual energy-related CO_2 emissions, which surpassed 41 Gt for the first time (figure 2l). Also in 2025, solar and wind energy consumption increased by approximately 18% (figure 2d). Although this growth was rapid, renewables still represented a much smaller share of total energy consumption than fossil fuels. Continued growth in global energy demand meant that renewable expansion was insufficient to displace fossil fuel consumption, resulting in record levels of both fossil fuel use and CO_2 emissions. As of 2024, more than 90% of new utility-scale renewable projects provide electricity more cheaply than the least expensive new fossil fuel power alternatives (IRENA 2025). In 2025, for the first time in more than a century of coal-dominated electricity generation, renewable energy sources (solar, wind, hydropower, and other renewables) have surpassed coal globally, marking a potentially historic turning point in the transition toward clean energy (figure S2, figure 2f).

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Geopolitics

War and armed conflicts bring profound human and environmental costs, yet they can also expose systemic vulnerabilities that catalyze overdue change. Recent geopolitical tensions, including the conflicts involving Iran and Ukraine, have exposed the vulnerability of global energy systems that depend heavily on fossil fuel supply chains, with disruptions and price volatility prompting renewed focus on energy security (Al-Sarihi 2026). Such risks can accelerate the transition to domestic renewable energy as countries seek to reduce external dependence and build more resilient energy systems (Wang et al. 2024; figure S1). Emerging policy responses in regions such as Europe and Asia suggest that energy security concerns may now rival climate mitigation as a primary driver of renewable energy deployment, with evidence showing that geopolitical risks can accelerate renewable energy adoption, particularly in advanced economies (Li et al. 2026). However, rising geopolitical tensions can also jeopardize multilateral climate and other enviromental agreements, as well as trigger armed conflict, resulting in substantial greenhouse gas emissions that are often unaccounted for in global inventories (figure 2m; Neimark et al. 2026).

Forests

Tropical primary forest loss decreased by 36% in 2025 compared to 2024 (Goldman et al. 2026). The deforestation rate in the Brazilian Amazon rainforest decreased for the fourth straight year in a row, reaching its third lowest level in 38 years (figure 2k). Globally, tree cover loss rate also declined in 2025, but remains at its sixth-highest level since 2001 (figure 2j). At the same time, conversion of native grasslands, savannas, and other non-forest ecosystems continues to contribute substantially to biodiversity loss and greenhouse gas emissions, despite receiving less attention than deforestation. Furthermore, the land carbon sink may be weaker than previously believed, in which case the land biosphere could be closer to transitioning to a net carbon source than predicted by current models (Randerson et al. 2025). Record heat is increasing carbon dioxide released by plants, soils, and other living organisms, a trend likely to become more pronounced under future climate change and further reinforce global warming (Dong et al. 2026).

Escalating risks

Beyond gradual climatic change, growing evidence suggests that the climate system may be entering a period of increasing instability characterized by accelerating warming, cascading feedbacks, tipping elements, and rising risks of irreversible change. Increasing energy imbalance, rising ocean heat content, weakening carbon sinks, and accelerating ice loss all point toward a climate system accumulating heat and stress at rates that may exceed earlier expectations. Extreme weather is also intensifying across many regions of the world, demonstrating how climate change is increasingly affecting people's daily lives (table 1). Recent years have brought increasingly destructive heatwaves, floods, droughts, storms, and wildfires that are causing growing losses of life, infrastructure, food security, biodiversity, and economic stability. Extreme weather disasters are complex phenomena that arise from the interaction between climatic hazards and human social systems, rather than from climatic hazards alone. They are shaped by differences in social conditions that determine who faces the greatest risks and vulnerabilities (Kelman et al. 2015).

The past year has demonstrated the growing human and economic toll of extreme weather events worldwide (table 1). In October 2025, Hurricane Melissa, one of the strongest Atlantic hurricanes on record, caused 95 deaths and more than US$12 billion in damages across the Caribbean. Severe flooding also affected multiple regions, including Indonesia in November 2025, where a tropical storm and monsoon rains caused 708 deaths and widespread infrastructure damage, and Vietnam in November 2025, where record rainfall killed 90 people and inundated 235,000 homes. Extreme heat also remained a major concern; in June 2026, a severe heatwave in Europe caused approximately 14,000 deaths according to a preliminary estimate (Callahan 2026). All of these events were at least partly attributable to climate change (see table S2 for associated attribution studies).

The rate of global warming appears to have accelerated, rising from ~0.05°C/decade between 1880 and 1970 to ~0.19°C/decade between 1970 and 2010, and finally to ~0.36°C/decade between 2010 and 2024 (figure 3). A similar acceleration has been found to be statistically significant since roughly 2015 (Foster and Rahmstorf 2026)). The acceleration may be partly related to reductions in aerosol pollutants that previously masked a portion of greenhouse gas warming (Hansen et al. 2025). Faster warming could compress adaptation timelines, increase the likelihood of crossing tipping thresholds, and reduce the margin for avoiding irreversible impacts. On the other hand, other analyses find that the observed warming, including the 2023–2024 global temperature spike, is consistent with state-of-the-art climate model simulations (Mann et al. 2026). Even if warming is closely tracking model projections, key impacts such as the rise in extreme weather events may not be well captured by the models (Li et al. 2025).

Growing concern also surrounds the destabilization of climate tipping elements. The Atlantic Meridional Overturning Circulation (AMOC), which transports warm water northward and cold water southward, may be particularly important because of its interactions with other tipping elements (Wunderling et al. 2024). Melting of Arctic sea ice and the Greenland ice sheet may weaken the AMOC, which could alter precipitation patterns, disrupt marine ecosystems, and increase drying in parts of the Amazon rainforest. Observational constraints project that the AMOC could weaken substantially, potentially more than projected by many current climate models (Portmann et al. 2026). In addition, after accounting for multiple planetary-boundary transgressions, the Amazon rainforest may be more vulnerable to tipping than previously recognized. Although the forest may remain resilient to climate warming alone up to 3°C–5°C, the combined effects of warming and deforestation could push it past an irreversible threshold at just 1.5°C–1.9°C of warming (Wunderling et al. 2026).

Globally, recent estimates suggest that amplifying climate feedbacks involving warming-induced greenhouse gas emissions from natural sources including permafrost, wetlands, freshwaters, and wildfire could increase post-2020 anthropogenic warming by roughly 20%–30% by 2100 (Abernethy et al. 2026). Continued warming and interacting feedbacks may increase the risk of a self-reinforcing "hothouse" trajectory characterized by weakening carbon sinks, accelerating ice loss, ecosystem degradation, and additional greenhouse gas release (Ripple et al. 2026). Although substantial uncertainties remain, recent observations suggest that some climate-system changes may already be unfolding faster than expected.

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Table 1. Recent extreme weather events since September 2025.

Event category	Event	Date	Description
Wildfires	New South Wales Wildfires	October 2025	Large wildfires threatened residential areas, damaged property, and forced evacuations in areas near Sydney
	Florida Wildfires	April 2026	A major wildfire outbreak occurred in southwest Florida, causing evacuation orders to be issued
Strong winds	Mediterranean Cyclone Harry	January 2026	Cyclone Harry damaged homes and businesses and may have contributed to a boat capsizing, resulting in upwards of 380 deaths
Heavy precipitation	Bali Floods	September 2025	Bali, Indonesia, experienced its worst flooding in more than 10 years; at least 17 people died as a result
	Cyclone Ragasa†	September 2025	Typhoon Ragasa was an extremely powerful cyclone that caused landslides and flooding in parts of Southeast Asia and South China; it resulted in at least 40 deaths and more than US$2.86 billion in economic damages.
	Storm Amy†	October 2025	Storm Amy was an extratropical cyclone that affected parts of Western and Northern Europe, killing four people and causing more than 832,000 power outages
	Hurricane Melissa†	October 2025	Hurricane Melissa was a Category 5 hurricane that tied the record for the strongest Atlantic hurricane by wind speed; it resulted in 95 deaths—primarily in Jamaica and Haiti—and more than US$12.2 billion in damages
	Albania-Greece Floods	November 2025	A slow-moving low-pressure system brought prolonged heavy rainfall to western Greece and southern Albania, triggering flash floods, landslides, infrastructure damage, and disruption to transport
	Vietnam Floods	November 2025	Record-breaking rainfall in south-central Vietnam led to floods that killed 90 people, resulted in 235,000 houses flooded, and caused US$341 million in economic damages
	Indonesia Floods	November 2025	A tropical storm and monsoon rains in Sumatra, Indonesia resulted in 708 deaths and catastrophic damage to local infrastructure, farmland, and shops
	Colombia Floods	February 2026	Intense rainfall in northern Colombia affected more than 58,000 families and resulted in 18 deaths
	Storm Nils	February 2026	Storm Nils caused major impacts across Western Europe, killing one person, damaging transport networks, and leaving 850,000 homes without power
	Brazil Floods	February 2026	Heavy rainfall in southeastern Brazil caused floods and landslides that killed 73 people and displaced more than 5500
High temperatures	India Heatwave	April 2026	A severe heatwave affected large parts of India, placing significant heat stress on millions of people
	EU Heatwave	May 2026	A heatwave in Western Europe caused at least seven deaths and affected public health, energy systems, and agriculture
	Antarctic Heatwave	June 2026	Stations across the Antarctic Peninsula recorded temperatures far above seasonal averages
	EU Heatwave	June 2026	An extreme heatwave caused approximately 14,000 excess deaths and severely affected public health
	North America Heatwave	June –July 2026	A heatwave across the eastern United States and southern Canada caused severe storms and power outages, affecting about 50 million people
Low temperatures	North American Winter Storm	January 2026	A winter storm in the United States and Canada led to multiple fatalities and widespread flight cancellations and power outages

Note: We list numerous recent events that may be at least partly related to climate change. Event descriptions are primarily based on the ones provided in the Climameter hazards database (ClimaMeter 2026). Links to Climameter attribution analyses are given in the "Event" column of supplemental table S2. Where applicable, we have updated the event impacts ("Description" column) using news and other sources as was indicated with hyperlinks in table S2. Information on the Climameter methodology is given in Faranda and colleagues (2024). This list of events is not intended to be exhaustive. Events labeled with a dagger (†) also involve strong winds. Some of these extreme weather events may be at least partly related to changes in jet streams (Stendel et al. 2021, Rousi et al. 2022).

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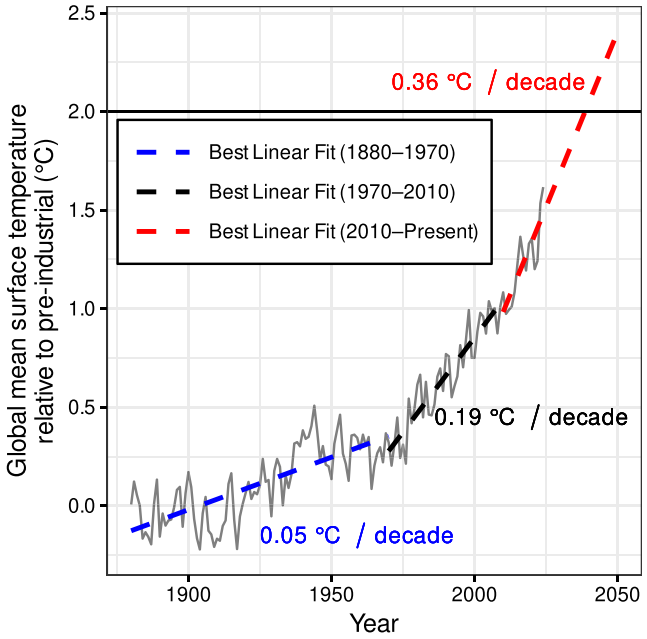

Figure 3. The rate of warming appears to be accelerating. At current rates, 2°C above pre-industrial levels could be reached before 2050. Temperature data come from Rohde and Hausfather (2020). See supplemental file S3 for details.

Solutions

Despite worsening trends and escalating risks, substantial opportunities remain to reduce emissions, strengthen resilience, and help stabilize the Earth system. Effective responses will likely require coordinated progress in adaptation, mitigation, ecosystem protection, technological innovation, and societal transformation.

Adaptation

The widespread and severe extreme weather events provide compelling evidence that mitigation alone is no longer sufficient (table 1). Rather, reducing greenhouse gas emissions should be pursued along with rapid climate adaptations that protect people and nature. Global climate adaptation finance was roughly US$64 billion in 2024 (figure 2p). This is far below the estimated US$310–365 billion per year that will be required in adaptation finance for developing countries alone by 2035 (UNEP et al. 2025). Funding for climate adaptation is unevenly distributed and often routed through national governments, limiting access for local and frontline communities. It also tends to prioritize large infrastructure over community-led approaches, despite evidence of the latter's effectiveness (IPCC 2022a). Closing the gap requires not just more funding, but fairer and more efficient delivery systems.

Despite the extreme shortage of funding, there have been some notable adaptation success stories. The United Nations Environment Programme has assisted with nearly 90 adaptation projects that collectively aim to benefit roughly 3.5 million people (UNEP 2026). Successful adaptation projects often have common elements such as resource sharing, mutually beneficial outcomes, and collective decision-making (Owen 2020). Climate justice must be treated as a structural principle of adaptation policy rather than a supplementary concern, as vulnerable populations in low-emitting regions face disproportionate exposure to climate hazards alongside constrained fiscal and institutional capacity to respond (IPCC 2022a).

As climate impacts intensify, rapidly deployable "fast-track" adaptation responses are becoming increasingly important for reducing risks to people, ecosystems, and infrastructure. Many existing measures can help address escalating threats while also generating important co-benefits such as improved air quality, enhanced biodiversity, stronger water security, and increased carbon storage (table 2, and cites within). For example, mangrove restoration can offer protection against storm surges while enhancing carbon sequestration; shifts toward plant-based diets can reduce the risk of climate-related food system instability while increasing soil carbon and reducing pressure on biodiversity; and distributed solar can reduce the risk of storm-related grid failure while increasing energy security (table 2). Some responses, particularly nature-based approaches such as urban forests, wetlands, and mangroves, can simultaneously strengthen climate resilience and support mitigation goals. However, the effectiveness of many adaptation strategies is expected to decline as warming intensifies, highlighting the need to pair adaptation efforts with rapid reductions in greenhouse gas emissions.

Mitigation

Many climate solutions are already technically feasible and increasingly cost-competitive, although their implementation remains far below the scale and speed required (IPCC 2022b). Because climate change is driven by interconnected energy, economic, ecological, and social systems, meaningful progress will likely depend on integrated responses operating across multiple sectors and scales. In many emerging economies, climate mitigation must also be pursued alongside pressing development objectives, including expanding access to affordable and reliable energy.

A growing number of interactive climate tools are now helping policymakers, researchers, educators, and the public better understand the complexity of climate solutions. For example, the En-ROADS Climate Solutions Simulator allows users to explore how combinations of policies, technologies, and societal changes could influence future warming, energy systems, economic outcomes, and climate risks. Complementing this approach, the Drawdown Explorer provides science-based assessments of a wide range of climate solutions, including their effectiveness, scalability, co-benefits, and potential risks. Such tools can help reveal important tradeoffs, delays, and synergies among climate responses while illustrating how decisions made during the coming decades may shape long-term climate outcomes.

Emerging climate interventions

Recent developments in renewable energy, electrification, battery storage, and ecosystem restoration suggest that some positive social and technological tipping points may already be emerging. More work is needed to reduce environmental impacts of renewable energy infrastructure (Sonter et al. 2020). Rapid declines in the costs of solar power, wind energy, batteries, and electric vehicles are helping accelerate the transition toward low-carbon systems in many regions (Lenton et al. 2022). Global investment in clean energy technologies has also increased substantially in recent years, with growing deployment of renewable electricity, grid-scale energy storage, and electrified transportation. At the same time, expanding interest in natural climate solutions, including forest, wetland,

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Table 2. Fast-track adaptation measures can reduce near-term climate risks while also providing mitigation or ecosystem co-benefits. Their effectiveness is expected to decline as warming intensifies.

Threat	Fast-track responses	Potential co-benefits	Example reference
Extreme heat	Urban trees; cooling centers; reflective roofs; heat alerts	↓ heat mortality; ↓ energy demand; ↑ air quality; ↑ carbon storage	Li et al. (2024)
Flooding	Wetland restoration; floodplain protection; permeable surfaces	↓ flood damage; ↑ water retention; ↑ biodiversity; ↑ carbon storage	Moomaw et al. (2018)
Wildfire	Prescribed burns; defensible space; early warning systems	↓ megafire risk; ↓ smoke exposure; ↑ ecosystem resilience	Stephens et al. (2021)
Drought	Drip irrigation; water recycling; drought-tolerant crops	↑ water security; ↑ soil resilience; ↑ food stability	OECD (2025)
Sea-level rise	Mangrove restoration; living shorelines; coastal buffers	↓ storm surge; ↓ erosion; ↑ blue carbon	Macreadie et al. (2021)
Food system instability	Diversified cropping; agroforestry; climate-resilient crops; greater reliance on plant-based foods	↑ food security; ↓ land and water pressure; ↑ biodiversity; ↑ soil carbon	Mbow et al. (2019)
Extreme storms and grid failure	Microgrids; distributed solar; battery storage; resilient infrastructure	↑ energy security; ↓ outage risk; ↓ fossil fuel dependence	IEA (2025b)
Freshwater shortage	Water efficiency; watershed protection; more plant-based diets	↑ water security; ↓ water demand; ↑ ecosystem health	Jasechko et al. (2024)

and mangrove restoration, is creating new opportunities to reduce emissions while strengthening biodiversity protection, coastal resilience, and ecosystem health. Together, these developments suggest that coordinated technological, ecological, and societal changes could help accelerate progress toward a more sustainable and resilient future.

Transformative change

Transformative change is essential to stabilize the climate system and reduce the risk of crossing dangerous Earth system thresholds. Incremental adjustments alone are unlikely to achieve the rapid emissions reductions and societal shifts needed at the scale required, highlighting the need for deep transformations in energy systems, consumption patterns, food systems, economic priorities, and governance structures, in ways that create synergies with biodiversity protection (Pascual et al. 2022). Such changes could also create opportunities to improve human well-being, reduce inequality, and align development with the planet's biophysical limits (Ripple et al. 2024).

Transformative change may also involve the emergence of "positive social tipping points" in which relatively small shifts in technology, policy, finance, or public behavior trigger much larger systemic changes. Recent developments in renewable energy, electrification, and climate policy suggest that such transitions may already be emerging in some sectors (Lenton et al. 2022). Responding effectively will likely require stronger international cooperation, long-term planning, and institutions capable of managing increasingly interconnected climate risks. As climate impacts exceed adaptation limits in some regions, the United Nations' Loss and Damage Fund marks a key step in supporting irreversible losses, though its adequacy will depend on whether it can scale to meet growing needs.

Feelings of anxiety, grief, or helplessness in response to climate change are increasingly common, particularly among younger generations. However, research suggests that community engagement, collective action, education, and participation in local climate solutions can help foster a greater sense of agency, resilience, and hope (Epel et al. 2025). Even relatively small actions, when multiplied across communities and institutions, can contribute to broader societal change and help strengthen public support for climate mitigation and adaptation efforts.

Final words

Despite escalating climate risks, signs of societal transformation are beginning to emerge. Rapid advances in renewable energy, battery storage, adaptation planning, ecosystem restoration, and climate response tools suggest that large-scale change remains possible. The 2026 Santa Marta conference in Colombia marked an important milestone as the first global summit dedicated exclusively to the practical phase-out of fossil fuels (https://transitionawayconference.com/). The meeting established a new international precedent for transitioning away from coal, oil, and gas, involving more than 50 participating nations and 24 formal signatory countries. Although current progress remains far below what is needed to stabilize the climate system, the future trajectory of both the climate system and human societies has not yet been fully determined. The decisions made during the coming years will strongly influence whether future generations inherit a planet with an unstable climate system or a more resilient and sustainable world.

Resources and project website

We encourage readers to use the State of the Climate report series in their work, teaching, and communication efforts; to submit your comments about how you have used these reports, please use this form. The World Scientists' Warning of a Climate Emergency paper (Ripple et al. 2020) now has approximately 15,892 signatories from 167 countries, and the project continues to collect signatures from scientists. To sign or learn more, visit the Alliance of World Scientists website at https://scientistswarning.forestry.oregonstate.edu. To learn about science-based advocacy and view *A Scientist's Warning*, a documentary film on scientists speaking out, visit https://www.youtube.com/watch?v=byXGCPo-80w.

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Data availability

The data underlying this article were obtained from publicly available datasets. The sources of these datasets are described in the article and its online supplementary material.

Supplemental material

Supplemental data are available at *BIOSCI* online.

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Conflicts of interest

We have no conflicts of interest.

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