https://doi.org/10.1038/s41561-025-01904-z

Extreme weather event accountability

Extreme weather and climate-related disasters are escalating in severity, frequency, and impact. Global climate policy must embed formal mechanisms that attribute these events and their consequences to major carbon emitters, ensuring accountability and accelerating the implementation of effective mitigation strategies.

In 2025, the consequences of global climate inaction were clear. Storms struck Mozambique and Madagascar in January; heatwaves scorched Europe, the Mediterranean, and East Asia in July–August; hurricanes and cyclones devastated the Caribbean and Southeast Asia later in the year. These extreme weather events caused severe damage and socio-economic disruption[1]. Far from isolated, these hazards are the predictable outcome of decades of rising greenhouse gas emissions and insufficient mitigation efforts. At COP30 in Belém, Brazil, scientists highlighted progress in linking climate impacts to fossil fuel emissions[2] — a pivotal step towards holding emitters accountable — but these insights failed to translate into binding commitments for mitigation and adaptation[3]. As we enter 2026, it is important that advances in extreme weather attribution are integrated into climate policy to guide effective actions.

Extreme event attribution uses historical observations and modelling to quantify the contribution of anthropogenic climate change to specific events and trends. Current approaches are most robust for widespread and relatively long-lasting heatwaves and large-scale temperature extremes, while short-lived, localized events — such as flash floods or severe storms — remain harder to attribute with confidence due to high natural variability. Compound events, where multiple hazards interact, pose an even greater challenge because of their complex and nonlinear dynamics.

Encouragingly, advances in high-resolution climate modelling and coordinated multi-model comparisons are steadily improving the predictability of extreme weather events while reducing uncertainties in attribution. In this issue, for example, an

An aerial view of Black River, Jamaica, Thursday, 30 October 2025, in the aftermath of Hurricane Melissa.

Article by Ping Chang and colleagues shows that a climate model ensemble with 10–25 km resolution and enhanced representation of mesoscale convective systems can more accurately capture the observed spatial distribution and intensity of daily extreme precipitation. Multi-model comparisons add further value; rather than relying on a single set of structural assumptions, ensembles integrate diverse model structures, revealing patterns that individual models may miss. This diversity provides a more robust foundation for attributing both long-term climate trends and extreme events to specific forcings[4].

Yet, despite these advances, key uncertainties remain — particularly regarding the mechanisms driving compound events or record-breaking extremes. These challenges have spurred interest in complementary approaches that move beyond assessing whether an event was more likely under climate change, focusing instead on how its underlying atmospheric dynamics were influenced. The storyline approach examines extreme events by constructing physically plausible sequences of conditions such as specific atmospheric circulation patterns to explore how they shape an event's development[5]. Rather than focusing on probabilities, it isolates the role of climate change in influencing key atmospheric variables, providing clearer insight into the mechanisms behind extremes. Another promising direction is the use of machine learning to generate counterfactual scenarios, depicting what an event might have looked like in the absence of climate change[6].

Attribution matters because it is more than a scientific exercise — it is fundamental to climate justice and the determination of liability[7]. Communities that contribute the least to greenhouse gas emissions are often hit hardest by floods, droughts, and storms, yet lack the resources to prepare and recover. Attribution science helps bridge this equity gap by pinpointing those most responsible for climate damage and guiding compensation and loss-and-damage funding[8]. Without integration of attribution into global policy, fair and legally defensible climate accountability will remain out of reach.

This urgency was evident at COP30, where Amazon Indigenous communities shared powerful testimonies about climate impacts on their lands and called for stronger forest protections, recognition of Indigenous rights, and fair climate financing[9]. These communities face severe droughts and floods that threaten their livelihoods. Indigenous leaders stressed that attribution science can support their claims for justice, while reinforcing their authority and participation in climate governance. By demonstrating causality, attribution studies provide a powerful tool for advocating equitable policies, influencing legal frameworks, and ensuring that Indigenous knowledge and rights are integrated into decision-making processes.

The path forward to extreme weather event accountability is clear. Governments must integrate attribution science into climate negotiations and official COP agreements to directly link emissions to impacts. Climate science has given us the tools to understand the causes of extreme weather events — now policymakers must act decisively to turn knowledge into justice and action.

Published online: 12 January 2026

References

1. *State of the Climate Update for COP30* (World Meteorological Organization, 2025).
2. Quilcaille, Y. et al. *Nature* **645**, 392–398 (2025).
3. Rodrigues, M. & Tollefson, J. *Nature* **648**, 11–13 (2025).
4. Gillett, N. P. et al. *Geosci. Model Dev.* **18**, 4399–4416 (2025).
5. Feser, F. & Shepherd, T. G. *Commun. Earth Environ.* **6**, 677 (2025).
6. Trok, J. T., Barnes, E. A., Davenport, F. V. & Diffenbaugh, N. S. *Sci. Adv.* **10**, eadl3242 (2024).
7. Callahan, C. W. & Mankin, J. S. *Nature* **640**, 893–901 (2025).
8. Coumou, D. et al. *PNAS Nexus* **3**, pgae277 (2024).
9. Urzedo, D., Tester, O. & van Leeuwen, S. Finally, Indigenous peoples have an influential voice at COP30. They're speaking loud and clear. *The Conversation* (17 November 2025).