URBAN SUSTAINABLE DEVELOPMENT

GOVERNANCE, FINANCE AND POLITICS

Edited by
Pedro Vormittag
Marianna Albuquerque
Eugénie L. Birch

CEBRI Rethink Tank
RIO CAPITAL DO G20 BRASIL 2024
Rio PREFEITURA

URBAN SUSTAINABLE DEVELOPMENT

GOVERNANCE, FINANCE AND POLITICS

CEBRI
Rethink Tank

Published by CEBRI – Brazilian Center for International Relations

Editors
Pedro Vormittag
Marianna Albuquerque
Eugénie L. Birch

Editorial Coordinator
Bruno Zilli

Editorial Support
Iuri Rosario
Marcelo Gribel

Text Preparation
Barbara Pires

Graphic Design
Presto Design

Cover
Presto Design
Guilherme Bussinger
André Ducci

Executive Coordinators
Feliciano de Sá Guimarães
Julia Dias Leite
Luciana Gama Muniz

Communications and Marketing Manager
Gabriella Cavalcanti

Head of the Rio G20 Committee
Lucas Padilha

URBAN SUSTAINABLE DEVELOPMENT

GOVERNANCE, FINANCE AND POLITICS

Edited by

Pedro Vormittag
Marianna Albuquerque
Eugénie L. Birch

Knowledge Partner Institutions

Dados Internacionais de Catalogação na Publicação (CIP)
(Câmara Brasileira do Livro, SP, Brasil)

Urban sustainable development : governance, finance and politics /
edited by Pedro Vormittag, Marianna Albuquerque, Eugénie Birch.
-- 1. ed. -- Rio de Janeiro : Centro Brasileiro de Relações Internacionais - CEBRI, 2024.

Vários autores.
Bibliografia.
ISBN 978-65-992269-8-4

1. Desenvolvimento sustentável - Aspectos econômicos 2. Finanças públicas - Brasil 3. Governança pública 4. Sustentabilidade social 5. Urbanismo I. Vormittag, Pedro. II. Albuquerque, Mariana. III. Birch, Eugénie.

24-234457 CDD-338.9

Índices para catálogo sistemático:
1. Desenvolvimento sustentável : Economia 338.9
Aline Graziele Benitez - Bibliotecária - CRB-1/3129

ISBN: 978-65-992269-8-4
CDL
9 786599 226984

Contents

Preface 9
Pedro Vormittag and Marianna Albuquerque

Section 1. Conceptual Foundations 16

1. Integrating Climate Mitigation and Adaptation Strategies in Cities 19
Candice Howarth

2. Sustainable and Productive Cities and Urban Sustainable Development: A Developing Countries Perspective 41
Arkebe Oqubay

3. The City Meets Practical Ethics 79
Adela J. Gondek

4. Urban 20: Six Editions of City Diplomacy at the Highest Level 102
Fernando Straface & Mariana Cammisa

5. For a City Network Jurisdiction 122
João Carlos Cochlar

Section 2. Global Paths to Impact 146

1. How the *Cidade Maravilhosa* Became More Marvelous, Lessons for the G20 149
Eugénie L. Birch

2. Enlightened City Leadership: A New Model for a Sustainable Urban Future 191
H.E. Fahd Al-Rasheed

3. Advancing the Urban Climate Finance Agenda: The Green Cities Guarantee Fund 207
Mauricio Rodas

4. Climate Change Perceptions in the Urban Global South and Its Implications 229
Yoon Jae Ro, Seungho Lee and Munsu Kang

5. Cognitive and Smart Cities: A New Perspective 252
Hazem Galal, Rajat Chowdhary, Mounir Kabbara and Cristina Reyes

6. Funding Sustainable Infrastructures for Cities 267
Riatu Mariatul Qibthiyyah

7. Bridging the Gender Digital Divide in the Americas: An In-Depth Look at the Municipal Level 294
Rebecca Bill Chavez

8. Transparency, Accountability and Justice: Why Governments Must Share Flood Protection Planning Leadership with Frontline Communities 314
Paul Gallay, Amelia Ding, Hellas Lee, Victoria Sanders and Bernadette Baird-Zars

9. Policy Implications for Climate Adaptation in the Context of Nonlinear Impacts and Catastrophic Risks 358
Amy Campbell and Jeff Schlegelmilch

10. Shaping Sustainable Urban Mobility: How Current Narratives Drive Change 376
Clarisse Cunha Linke

11. Climate, Equity and Health Problems in Road Transport: Closing the Popular Transportation Gap 393
Jacqueline M. Klopp

12. Sustainable Cities in the Gulf Cooperation Countries 413
Mohamed Abdelraouf

13. China's Urban Green Infrastructure Construction 453
Xin Dong and Li Zhuang

14. A Conversation with Policymakers, Mayors, and Urban Specialists: An African Perspective on Sustainable Urban Development and the G20 471
Arkebe Oqubay

15. Integrating Climate Disaster Risk within an Interdisciplinary Urban Agenda: Lessons Drawn from the Brazilian Experience 496
Andrew J. Kruczkiewicz, Camila Pontual, Jessica Weinberg, Isabella Pereira and Walter Baethgen

16. Mobilizing Finance for Climate Adaptation and to Build Back Better 519
Frederic de Mariz

Contributors 549

Knowledge Partner Institutions 564

9.

Policy Implications for Climate Adaptation in the Context of Nonlinear Impacts and Catastrophic Risks

Amy Campbell and Jeff Schlegelmilch

While climate adaptation has taken a greater role in the discourse and policy discussions about the climate crisis, integration of risk is generally based on obsolete, linear notions of impact (e.g. twice the change is twice as bad). The latest understanding of climate risk identifies that not only is risk non-linear but there are also tipping points or thresholds that will cause cascading runaway impacts. Once crossed, the full impacts are hard to predict and harder to reverse. But by pairing a more robust understanding of risk into our climate adaptation policies, we can help to avoid these catastrophic outcomes and provide more time for climate mitigation efforts to help reduce the overall threats from climate change.

Non-linear risk can be understood in two ways here: warming, with continued warming beyond 1.5°C accelerating us towards tipping points, and secondly the cascading risk to so many other facets

of society (financial crises, displacement, etc). Rapid warming is *compounded* by "risk cascades" (Benton et al. 2023, 37) as other factors (movement of goods, money, fuel, etc)—overarchingly, we face a collective polycrisis. Timothy Clack et al. argue "attention in politics is often afforded to the urgent at the expense of the important" (2023, 1). We argue that this urgency is now here and that we need immediate as well as long-term solutions from policymakers and civil society actors alike to help reduce the worst impacts of climate change that are already unfolding.

Nonlinear Climate Risk, and Why We Are Out of Time

Non-linearity and cascading effects expand the bounds of adaptation policy, which must now be far more systemic. However, risk is dangerously undercalculated in climate policy. The world is on track to warm by 2.5-2.9°C above pre-industrial levels by 2100 with current policy commitments (UNEP 2023) and we have seared through the 1.5 degree Celsius Paris Agreement temperature goal. We are already seeing the impacts of climate change through increased frequency of extreme weather events. Some are easier to link to climate change than others, but events like prolonged and more severe heat waves, increases in wildfires, outbreaks of severe storms, extreme flooding events, and the severity of tropical cyclones are all exemplative of the types of extreme events that we are expecting to see more of as a result of uncontained climate change.

The costs of these disasters are also continuing to grow: climate-related disasters caused over $4 trillion in economic losses from 1970–2021 with a sharp increase in the past two decades (Climate Policy Initiative 2023). Global insured losses from catastrophes

reached $120 billion in 2022 (CPI 2023). This is particularly devastating for the Least Developed Countries (LDCs) and Small Island Developing States (SIDS) where climate disasters have caused economic losses equating to more than 5% of their gross domestic product (GDP) (UN 2023). In more severe instances, climate disasters have induced losses exceeding 10–30% of developing countries' GDP (WMO 2023).

Oftentimes these increases in disasters are presented in graphics with normalized data, and gradual increases year over year, represented by a bumpy line with an upward slope. This gives us the impression that these changes are linear. However, those involved in climate research know that this picture does not tell the whole story. We have been overly attentive to notions of linear climate risk—focusing on high-probability and usually lower-impact (although still devastating) outcomes (OECD 2022). But these increases in averages are being driven in part by disproportionately more *severe* events. These types of high-impact and "low-probability" outcomes are often discarded—considered outliers or are otherwise left out of the policy calculus. But these events demonstrate non-linear impacts, and hint at the dangers of climate tipping points.

Tipping points, according to the Intergovernmental Panel on Climate Change (IPCC), are irreversible levels of change and do "not return to the initial state even if the drivers of the change are abated" (IPCC 2022). A tipping element is a component of the Earth system that is susceptible to a tipping point—the most cited example is the Arctic ice sheet melt. Once melted past a certain point, not only will it likely never recover, but ocean currents, atmospheric circulation, and shifts in weather patterns can be permanently altered. This would lead to significant sea level rise,

as well as: low-latitude coral reef die-off, boreal permafrost abrupt thaw, global ocean current disruption including severe cooling in Europe, mass displacement in South Asia, Africa, and Southeast Asia, more intense storms, and disruptions to marine ecosystem. There are two important threads here: irreversibility, and further cascading risk across the earth system once this happens.

The 2023 Global Tipping Points report (McKay et al. 2023) details tangible and imminent climate tipping points: the die-off of warm-water coral reefs; the runaway melting of Greenland and West Antarctic ice sheets; the collapse of the North Atlantic subpolar gyre's circulation. There is now emerging evidence that the oceanic tipping points in the Atlantic Meridional Overturning Circulation (AMOC), the North Atlantic Subpolar Gyre (SPG), and the Antarctic Overturning Circulation are likely to have "far-reaching consequences for the rest of the climate system" and could lead to "strong impacts on human societies and the biosphere" (Ritchie et al. 2023).

We do not need to be climate scientists to appreciate the weight of this reality: once breached, cascading impacts and compound risk mean unpredictable and dangerous acceleration of impacts in the world's most vulnerable regions.

As a recent example of the challenges of integrating risk into climate adaptation and disaster resilience, the unprecedented flooding in Rio Grande do Sul, Brasil, displaced 580,000 people and impacted over 1.5 million people. This flooding was predicted, but the risk and vulnerability were not sufficiently communicated to officials. Ninety percent of the 497 municipalities in Rio Grande do Sul were impacted by the rain and flooding (Sader 2024). In August 2023 in the United States, wildfires devastated Maui in Hawaii,

causing $5.5 billion in damage. These wildfires were predicted by climate scientists for years and yet it was the United States' deadliest wildfire in the last 100 years (Partyka and Erdman 2023). In May 2023, flooding and landslides caused devastation in Rwanda—the scale of the flooding was unexpected, but the flooding itself was not unexpected (Braun 2023). The year 2023 was a year of constant climate disaster, with equally constant amnesia towards these disasters hitting our headlines, and the damage from all of these disasters could have been significantly lessened by integrating risk into adaptation policy development.

Of course, climate mitigation, or reducing emissions, is the most effective way to avoid tipping points. And these tipping points make climate adaptation and disaster management much harder. But it will also make climate mitigation more difficult. Some climate tipping points would reduce the "remaining carbon budget for reaching temperature objectives" (OECD 2022, 60). Once tipping points are crossed, many would further amplify surface temperatures somewhat unpredictably and uncontrollably. As such, emissions reductions would need to be even larger and will be far more expensive than previously thought to meet stated temperature targets. Emissions from permafrost have already lowered the carbon budgets for achieving 1.5°C and 2°C (Canadell et al. 2021). If the vast majority of the G20 and developed countries in the United Nations Framework Convention on Climate Change (UNFCCC) are struggling to hit Net Zero by mid-century now, consistently missing and altering Net Zero targets year on year, carbon budgets will be inordinately more strained once climate tipping points accelerate. This reinforces the case for urgent and more effective *adaptation* policy—tipping points and cascading impacts require adaptation policy to withstand far wider extremes than currently

planned for. This means the economic costs of the climate crisis have been underestimated, mitigation and adaptation policies are ill-equipped, and cascading climate risks will far outstrip the technological, diplomatic, and financial levers we have available.

However, it is important to accept that some of these cascading impacts are already locked into the system. Even if decarbonization efforts pick up pace, the system is irrevocably and irreversibly changed. The AR6 technical summary makes clear that equilibrium climate sensitivity has a "very likely" range of 2°C to 5°C (IPCC 2021). The AR6 working group also makes clear that the risk associated with crossing tipping points remains moderate, with high confidence, at ~1.1°C—which we have already surpassed (IPCC 2021; United Nations 2023). The current warming of ~1.1°C *already lies within* tipping point uncertainty ranges (McKay et al. 2022). The bottom line is that we are too late to prevent all risk through climate mitigation efforts alone. We concurrently need to adapt to the impacts that cannot be avoided. As climate adaptation is increasingly the center of attention in the climate crisis discussion, at the UNFCCC Conference of Parties (COP) through the Global Goal on Adaptation indicator development, Loss and Damage Fund, and New Collective Quantified Goal negotiations coming to a head, non-linearities in climate systems must be incorporated in the earliest stages of climate adaptation policy as climate systems are *inherently non-linear* (Horton et al. 2016).

Now as these tipping points are breached, cascading impacts and compound risk will cause impacts to fast accelerate. Inertia means there will be impacts from the emissions we have already released until this very moment and continue to release as we debate climate mitigation policy approaches. The strict bounds that

politicians and senior policymakers currently require—specificity of frequency, financing, scope—will become more impossible to meet in developing policy under pressure.

Key questions policymakers should be grappling with include:

- How do we incorporate sudden, large-scale, and irreversible transformations in climate into climate adaptation and disaster resilience strategies within national and international governance?
- How do we embed an understanding of non-linear climate risk in national governments with limited capacity, funding, and time to design policy?
- How can we incentivize expensive and uncomfortable climate decisions under hazard conditions that are inherently imprecise, although generally clear within wider confidence intervals, in their predictions of risk?

The Case for a More Just Adaptation

As with many aspects of climate change, the burden is not shared equally, nor are the resources for supporting adaptation and building resilience distributed equitably. At the Conference of Parties, the vast majority of UNFCCC developing nations will be calling for more concessional climate finance and loss and damage compensation. There is only so much adaptation finance physically available. Funds available in Overseas Development Assistance are severely limited, competitive, and painfully slow to get approval. And our understanding of risk, and what that means in a global framework and a backdrop of climate justice, is still a work in

progress. But we do have enough information to do better with the resources that are becoming available.

While talking about risk, we also need to recognize that risk is about more than just Hazard. Utilizing the United Nations Office for Disaster Risk Reduction (UNDRR) equation for risk, Risk = (Hazard x Vulnerability) / Capacity to Cope (UNDRR 2020). This means that risk is only one set of variables. The underlying vulnerability of critical infrastructure, as well as social, health, and economic vulnerability, are all critical contributors to risk. And the ability to garner resources to support climate adaptation, disaster response, and recovery are central to risk, yet are inequitably distributed throughout the world. Even if we were all exposed to the same hazards (which we are not), our risk would still be disproportionately distributed in a manner that makes the most vulnerable even more vulnerable and at higher risk in the face of disasters.

Climate risk is also inherently geopolitical. There is a growing chorus of nations focusing on national security implications and moving in the direction of climate security. Securitizing climate risk inherently moves attention toward protectionism and appeasing domestic and national political tensions. Climate security as a field is currently neglecting to prioritize vulnerability; this approach leaves a swathe of unrecognized value in multilateralism, geopolitics, and meeting adaptive capacity needs. But vulnerability is also an inherently transnational issue.

There are numerous frameworks for understanding how climate risk is distributed globally—through trade, migration, and financial systems (Hedland et al. 2018). Viewing the urgent re-framing of vulnerability through a transnational and geopolitical lens. This

is why *vulnerability* should gain just as much traction as national security issues when confronting climate risk. Uncomfortable trade-offs will need to be confronted in designing climate vulnerability metrics to address risk, need, local circumstances, and historical responsibility. At any one time, there will be an urgent competing need for accessible, high-quality, and transparent climate finance, particularly for small island developing states and vulnerable countries in South-East Asia (i.e. Bangladesh), and Sub-Saharan Africa. As an example, if we ignore the contributors to a mega famine in the Horn of Africa, this could lead to as many as 100 million climate migrants seeking new homes (Red Cross 2024), putting new pressures on economies and governments around the world that no nation is prepared to deal with, politically or logistically. This would be another immediate crisis-taking focus that is also needed for long-term and more gradually emerging crises in need of attention before other tipping points are reached.

In attempting to capture this complexity in a digestible and actionable manner, there are a myriad of indices and categorization schemas being developed to simplify this approach. However, no matter how you calculate risk and financial need, you may miss something in developing climate vulnerability indices. Current climate vulnerability metrics such as the Climate Vulnerability Index (CV), Livelihood Vulnerability Index (LVI), and the Notre Dame Global Adaptation Initiative (ND-GAIN) Index have taken great strides in these directions, but do not yet sufficiently capture layers of climate risk and need. There are methodological limitations within indices, and the search for a simplified quantification of risk as well. Looking at an average across multiple hazards will favor countries with larger geographic coverage, while diminishing risk to smaller countries with one or few catastrophic risks, but low risk

for other hazards. Focusing on only the top hazard(s) will ignore the complexity and cost of adapting to numerous categories of hazards. Financial indicators often look at GDP/Capita, but this does not capture access to capital to finance adaptation, which can be driven by debt burden, access to financial markets, and other factors. And low population countries will never compete with the raw economics of large countries in terms of calculated losses.

The sheer complexity of layered climate impacts adds challenge in capturing all dimensions of vulnerability, which also defies consolidating into a single number or ranking of risk. Highlighting factors like *catastrophic* risk in addition to risk across multiple hazards is a step-change in ensuring we are not losing urgent and historically systemic vulnerabilities. Indebtedness, governance, and inequality must all be considered within indices as they relate directly to the capacity to cope, and thus the overall risk. Improving the dimensions of vulnerability we consider when allocating financial resources could shift the dial closer to a new convention or framework for climate-induced movements once displacement fast accelerates.

For data to be integrated, it also needs the legal and governance frameworks in which to implement more robust risk management approaches. The notion of governance and legal frameworks warrants its own space for dedicated discussion. One example of this complexity and importance includes the long-standing legal debate in expanding the 1951 Geneva Refugee Convention to include climate change, as a means to protect those subjects to climate-induced migration. A convention similar to the Kampala Convention, recognizing climate as the *cause* of displacement could progress this conversation (Afzal 2024).

This also does not need to be thought of as a humanitarian gesture or a moral obligation, although both of these lenses are true and appropriate. There are also outsized benefits in the return on investment in more robust climate adaptation and disaster resilience initiatives. This comes from the catastrophic losses averted, as well as an opportunity to use these investments as a stimulus towards a more just resilience into the future. There are competitive advantages in fostering resilient and stable business environments and reducing the risk of shocks from disasters and other disruptions. Recognizing and integrating historically disadvantaged and imbalanced power structures that lead to increased vulnerability, decreased capacities to cope, and thus, increased risk are all components for building stronger and more resilient economies.

Re-envisioning climate risk as a tangible benefit to the bottom line as well as the overall human condition can help to re-frame this almost intractable ask of the global financial landscape. *Avoiding catastrophic risk* is in the interest of every investor, insurer, and philanthropic organization. Climate vulnerability metrics that build in non-linear climate risk, a holistic assessment of socio-economic factors, and financial need will enable adaptation finance and will most effectively distribute funds to the most vulnerable regions.

Recommendations for International Climate Policy

In the context of global warming, the solutions are also inherently global. In this climate disaster age, we cannot abandon multilateralism. There is no singularly national solution when the context of our economies, our security, and our personal and professional relationships are global. There is also an acute need

for international governance on tipping points. Whether through the UNFCCC or the UN Security Council, multilateral fora must upskill all nations on the dangers of tipping points to inform national policy accordingly. Some steps that can be taken by nations and multilateral institutions alike include:

1) Inclusion of the growing scientific evidence: Non-linearity should be incorporated at risk-assessment change as part of a range of 1-3 degree Celsius warming pathways. High-impact outcomes cannot be discarded simply for being "low-probability." If a risk has the potential to cause irreversible system change, this must be escalated to politicians. While specificity may be elusive, there is more than enough evidence to inform more robust policy and investments in climate adaptation and disaster resilience in the context of catastrophic risk and tipping points

2) Establish better frameworks for integrating uncertainty: Specificity continues to be elusive, but clear patterns and predictability within confidence intervals provide enough certainty to invest in adaptation and resilience with a particular emphasis on averting tipping point events. Frameworks for managing uncertainty should be adapted to apply to climate adaptation and resilience policy to better support immediate and sustained action to address these growing risks.

3) Incentivize investment where it is needed most: Risk should be framed clearly around the impact on remaining carbon budgets, potential food in security, infrastructure damage and displacement, and overall net cost. Advice to politicians should include "positive tipping points" as

an incentive for investment. This should include multi-dimensional factors such as current and forecasted risk to catastrophic impacts, as well as the ability to pay for critical adaptation measures. This will include looking at risk across multiple dimensions, as well as looking at the ability to pay beyond measures like GDP/per capita, and will need to take into consideration indebtedness, cash reserves, access to financial markets, and other tangible barriers to adaptation and resilience investments.

4) Resist the *status quo* for political decision-making: Policy succumbs to a common facet that is seen across many decision types; we are better incentivized to be reactive rather than proactive. The Catch-22 of "it isn't here yet, so I won't pay for it" from politicians and senior policymakers has to be overcome. The case for disaster preparedness is viscerally clear: cascading risk is locked in. Tipping points are imminent and will be extortionately expensive to fiscal budgets. Cutting aid to the most vulnerable regions puts the wider geopolitical landscape at risk. We know that every dollar spent on disaster preparedness can save up to nine dollars in the future.

The G20 has a particular opportunity as well as a responsibility to address these challenges. The G20 represents 85% of global GDP, 75% of international trade, and nearly two-thirds of the world's population. The affluence of the G20 is codependent on the sustainability of global systems, and a more just adaptation and resilience paradigm will further strengthen these systems. Conversely, these global systems are at great risk with the disruption caused by catastrophic tipping points that will cascade across all

nations. Those most vulnerable will be the first to fall, but none will ultimately be spared the severity of the impacts of the ripple effects of major disasters. There is both a fundamental moral and practical responsibility to rapidly re-frame how climate risk is considered and to re-adjust international climate adaptation efforts in this age of disaster, and while the window for investments in climate adaptation and catastrophic disaster resilience is closing, there is still time, but it is running out.

References

Afzal, Mehreen. 2024. "A Reflection on Climate Mobility: Has Causality Lost Resonance?" *Carnegie Council for Ethics in International Affairs*, May 30. https://www.carnegiecouncil.org/media/article/climate-mobility-causality.

Braun, Stuart. 2023. "Extreme Weather, Climate Shocks: Flooding Taking a Toll on African Nation Rwanda." *DW*, September 05. https://www.dw.com/en/extreme-weather-climate-shocks-flooding-taking-a-toll-on-african-nation-rwanda/a-65556250.

British Red Cross. 2023. "Africa Hunger Crisis: 100 Million Struggling to Eat." *British Red Cross*, December 7. https://www.redcross.org.uk/stories/disasters-and-emergencies/world/africa-hunger-crisis-100-million-struggling-to-eat.

Canadell, Josep et al. 2021. "Global Carbon and Other

Biogeochemical Cycles and Feedbacks." In *Climate Change 2021: The Physical Science Basis*, edited by V. Masson-Delmotte et al. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge: Cambridge University Press.

Clack, Timothy, Ziya Meral, and Louise Selisny (eds.) 2023. *Climate Change, Conflict and (In)Security: Hot War*. 1st ed. Routledge.

Climate Policy Initiative. 2023. *State and Trends in Climate Adaptation Finance 2023*. Climate Policy Initiative. https://www.climatepolicyinitiative.org/publication/state-and-trends-in-climate-adaptation-finance-2023/.

Armstrong McKay, David et al. 2022. "Exceeding 1.5°C Global Warming Could Trigger Multiple Climate Tipping Points." *Science* 377 (eabn7950). https://doi.org/10.1126/science.abn7950.

Global Tipping Points. 2023. *Global Tipping Points Report 2023: Addressing Planetary Thresholds*. https://global-tipping-points.org/.

Hedlund, Johanna, et al. 2018. "Quantifying Transnational Climate Impact Exposure: New Perspectives on the Global Distribution of Climate Risk." *Global Environmental Change* 52: 75–85. https://doi.org/10.1016/j.gloenvcha.2018.04.006.

Horton, R., Collins, D. C., & Stouffer, R. J. 2016. "The Role of Nonlinearities in the Impacts of Climate Change on Future Extreme Weather Events." *Journal of Climate* 29 (6): 2219–2238.

Intergovernmental Panel on Climate Change (IPCC). 2021. "Technical Summary." In *Climate Change 2021: The Physical Science Basis*, edited by V. Masson-Delmotte et al. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental

Panel on Climate Change. Cambridge University Press.

Intergovernmental Panel on Climate Change (IPCC). 2022: *Climate Change 2022: Impacts, Adaptation, and Vulnerability*, edited by H. O. Pörtner et al. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press.

Organization for Economic Co-operation and Development (OECD). 2022. *Climate Tipping Points: Insights for Effective Policy Action*. OECD Publishing.

Partyka, Gary, and Bennett Erdman. 2023. "Meteorologic Analysis of the August 2023 Maui Wildfires." NASA Goddard Space Flight Center. https://gmao.gsfc.nasa.gov/research/science_snapshots/2023/meterologic-analysis-maui-wildfires.php.

Ritchie, Helen, Colin Harrison, and Paul K. Bijl. 2023. "Tipping Points in Ocean and Atmosphere Circulations." *EGUsphere*, December 11. https://doi.org/10.5194/egusphere-2023-2589.

Sader, Valentina. "Brazil's Tragic Floods Should Put Climate Adaptation at the Top of the G20 and COP Agendas." Atlantic Council, May 14. https://www.atlanticcouncil.org/blogs/new-atlanticist/brazils-tragic-floods-should-put-climate-adaptation-at-the-top-of-the-g20-and-cop-agendas/.

Townend, Ruth, Chris Aylett, and Magnus Benzie. 2023. "Cascading Climate Risks: Strategic Recommendations for European Resilience." *Cascades*, November 23. https://www.cascades.eu/publication/cascading-climate-risks-strategic-recommendations-for-european-resilience/.

United Nations Office for Disaster Risk Reduction (UNDRR). 2004.

"Disaster Risk Reduction Tools and Methods for Climate Change Adaptation." UNDRR. Accessed September 5, 2024. https://www.undrr.org/publication/disaster-risk-reduction-tools-and-methods-climate-change-adaptation.

United Nations. 2023. "Extreme Weather Caused Two Million Deaths, Cost $4 Trillion Over Last 50 Years." *UN News: Global perspective Human stories*, May 22. https://news.un.org/en/story/2023/05/1136897.

United Nations. 2024. "1.5°C: What It Means and Why It Matters." *UN: Climate Action*. Accessed September 5, 2024. https://www.un.org/en/climatechange/science/climate-issues/degrees-matter.

World Meteorological Organization. 2024. *State of the Global Climate 2023*. World Meteorological Organization, March 19. https://wmo.int/publication-series/state-of-global-climate-2023.