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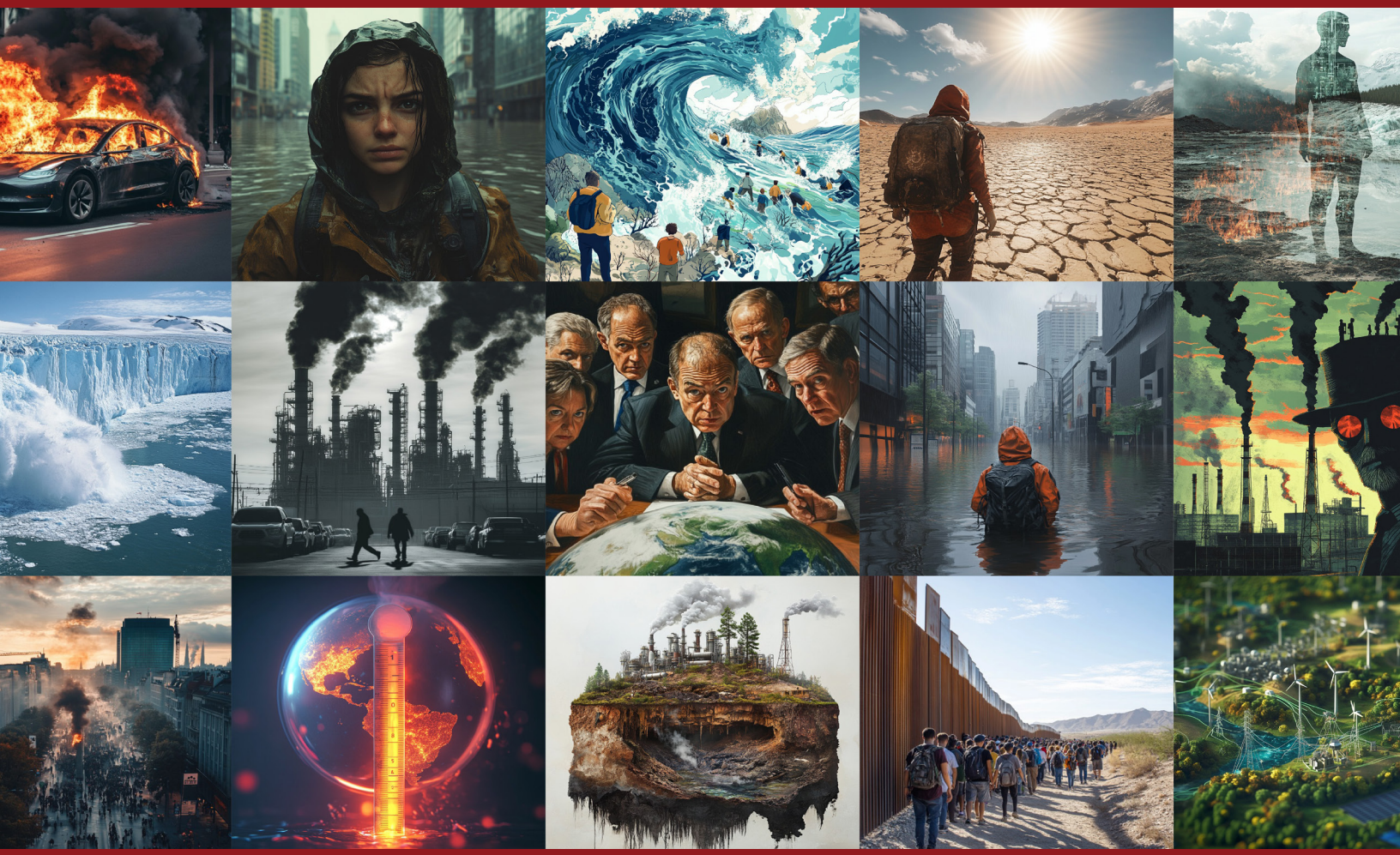

Navigating the Climate Crisis: Information Integrity and the Challenge of Climate Mis/Dinsinformation

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Cover image:

This mosaic was generated using MidJourney AI, combining various images created from prompts centered around the theme of "climate mis/disinformation". Each image within the mosaic symbolizes different aspects of the climate conversation—from extreme weather events, industrial pollution, and migration, to the influence of mis/disinformation on public perception and policy. The composition illustrates the growing challenge of confronting climate mis/disinformation in the digital age, where visual media plays a significant role in shaping public perception.

This article, produced and published by the Information Integrity Lab, is written by Nicolas Rutherford, senior analyst at the Information Integrity Lab (InfoLab), University of Ottawa, with contributions from Marc Lalonde, senior advisor at the Computer Research Institute of Montreal (CRIM).

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FOREWORD

Mis- and disinformation—the sharing of false narratives—can distort public perceptions of realities and crises and impede or delay actions required to address them. These phenomena exploit public uncertainty and political polarization, and can result in a growing distrust in institutions.

Climate change is an issue that has been targeted by mis- and disinformation. The accelerating climate crisis, marked by unprecedented global temperatures, severe weather events, and rising sea levels, demands urgent and coordinated global action. Yet, as scientific consensus around the human-driven nature of climate change has grown, so too has the proliferation of false narratives.

In this article by the Information Integrity Lab, we take stock of false narrative campaigns, sometimes well-orchestrated by vested interests, that cast doubt on scientific findings and undermine efforts to build consensus on necessary climate actions. In the digital age, these tactics have evolved, with AI-driven content, algorithmic amplification, and online echo chambers playing a central role in spreading false or misleading information about climate change. The result is a fragmented public understanding of the crisis that hinders collective action and complicates efforts to achieve global climate goals.

The intersection of technology, mis/disinformation, and climate change demands a multidisciplinary approach to both climate action and information integrity. To confront these challenges, this text highlights the need for fostering climate literacy, building resilience to disinformation, and ensuring that the public has access to accurate, transparent, and science-based information. Ultimately, combating climate mis/disinformation is essential for the creation of informed, collective action in the face of one of humanity's greatest challenges.

With support from the Trottier Family Foundation, the Information Integrity Lab at the University of Ottawa is preparing to host a Summit on Climate Change Mis/Disinformation in June 2025. In the lead-up to this event, the InfoLab will also organize a conference focused on Video and Multimodal Mis/Disinformation related to Climate Change, in partnership with the Computer Research Institute of Montreal (CRIM).

We hope that this initial review will provide a framing for further research and focused discussion by a wide range of domestic and international stakeholders on information distortion that is impacting the climate debate, and climate action.

— Jennifer Irish
Director, University of Ottawa
Information Integrity Lab

I. CHARACTERIZING CLIMATE CHANGE

AI image generated using Midjourney from the prompt : "Depict the melting of glaciers in Antarctica and Greenland, contributing to sea-level rise."

Climate change is a major global issue. The growing number of extreme heat days, extended droughts, and more severe storms worldwide are indicators that the Earth's climate is warming, according to the global scientific community, which expresses this with an extremely high degree of confidence and near-unanimity.[1]

So far in 2024, 15 countries have broken their national daytime heat records, along with 130 monthly temperature records and thousands of local highs, spanning regions from the Arctic to the South Pacific.[2] Notable extreme temperatures include 50.9°C in Aswan, Egypt, on June 7, 2024, 44.6°C in Navrongo, Ghana, on May 1, 2024, and Mexico tying its national record of 52°C in Tepache on June 20, 2024. Meanwhile, provisional data from the European Union's Copernicus Climate Change Service showed that July 22, 2024, recorded the highest global average surface air temperature ever, reaching 17.16°C.[3]

The ability to detect and understand global warming trends today is the result of a combination of advanced tools and long-standing scientific processes. Technologies like satellite systems and computer models have revolutionized our capacity to monitor Earth's climate, offering real-time data and complex simulations (Guo, Zhang & Zhu, 2015). These are supplemented by historical records—data from ice cores, ocean sediment, and tree rings—that allow scientists to trace climate patterns over thousands of years (National Research Council, 2007). Together, these tools and techniques provide a comprehensive view of both present-day and historical climate shifts.

For example, July 2024 was the hottest July on record, with global surface temperatures rising 1.21°C above the 20th-century average, continuing a 14-month streak of record-breaking temperatures.[4] In the Arctic, sea ice has shrunk by almost 40% since satellite tracking began in 1979, signaling dramatic regional changes.[5]

Meanwhile, melting glaciers and ice sheets in Greenland and Antarctica have partly contributed to a 20 centimeter total rise in global sea levels since 1900, a trend further driven by the thermal expansion of warming ocean waters.[6]

While the Earth's climate has undergone natural cycles of change for millions of years—evidenced by paleoclimatologists' studies of sediment cores, fossil records, and other geological data—today's climate change is distinct in several critical ways. Not only is the current warming happening about 10 times faster than any climate shift in the last 65 million years[7], it is also primarily driven by human activities, such as the burning of fossil fuels, large-scale deforestation, and intensive industrial agriculture. These activities—deeply rooted in our modern economic growth models and resource extraction—release massive amounts of greenhouse gasses (GHGs), including carbon dioxide and methane[8], into the atmosphere (IPCC, 2021). As GHG concentrations rise, the Earth retains more heat, leading to higher global temperatures, more extreme weather patterns, and shifts in climate systems that disrupt ecosystems and human societies alike (IPCC, 2021).

As aptly synthesized by Briggle (2024), today's climate change represents a "change in the ways things change", highlighting its unprecedented speed and human-driven nature. At this rate of change, the latest comprehensive report[9] (2021) by the Intergovernmental Panel on Climate Change (IPCC)—a body of the United Nations that assesses and reports the work of thousands of climate scientists worldwide—paints a stark picture of the future if current trends continue :

Global warming of 1.5°C and 2°C will be exceeded during the 21st century unless deep reductions in CO2 and other greenhouse gas emissions occur in the coming decades. Global surface temperature will continue to increase until at least mid-century under all emissions scenarios considered.

Each additional fraction of a degree of warming brings new risks and intensifies existing ones, related to sea-level rise, permafrost degradation, biodiversity loss, water scarcity, more extreme weather events, and food insecurity. These environmental stresses are expected to exacerbate human migration and conflicts over resources, further impacting global stability and security (Warner et al., 2010 ; Burrows & Kinney, 2016).

It should be noted that our understanding of global warming has emerged from over a century of scientific work. In 1896, Svante Arrhenius theorized that human-induced greenhouse gas emissions could warm the planet.[10] Even earlier, in 1827, the physicist Joseph Fourier discovered the greenhouse effect, recognizing that Earth's atmosphere retains heat from the Sun, keeping the planet at a habitable temperature—without this natural greenhouse effect, Earth's average temperature would be around -18°C instead of 15°C, making life as we know it impossible (Environment Canada, 2007). Later on, in 1859, John Tyndall identified the specific gasses responsible for this heat retention—carbon dioxide and water vapor—emphasizing how even trace amounts of these gasses in the atmosphere significantly influence global temperatures.[11]

Likewise, Eunice Foote demonstrated that carbon dioxide placed in a glass cylinder heated up faster and retained heat longer than other gasses, hinting at its role in amplifying the natural greenhouse effect.[12]

Today, organizations like the IPCC continue to refine our climate knowledge, offering clear, actionable insights into human-caused global warming, based on many more decades of interdisciplinary research and peer-reviewed science.

Through the ongoing work of ecologists, geologists, environmental scientists, and other researchers, we are also observing that humanity's impact on Earth's systems extends way beyond climate change. Indeed, our development models, which have historically prioritized industrial growth, mass production, and high consumption, have come with widespread environmental degradation and disruption of natural systems (Fletcher et al., 2024). For instance :

- Habitat destruction, pollution, and overexploitation of resources have significantly accelerated the rate of biodiversity loss.[13] The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) estimates that around 1 million animal and plant species are now threatened with extinction (IPBES, 2019).

- Large-scale clearing of forests for agriculture, urban development, and resource extraction has transformed landscapes, reduced biodiversity, and disrupted climate patterns around the world. The Food and Agriculture Organization (FAO) reports that the planet loses about 10 million hectares of forests each year (FAO, 2020).

- Increased absorption of carbon dioxide by the oceans has led to acidification, adversely affecting marine life, particularly coral reefs and shell-forming organisms. The National Oceanic and Atmospheric Administration (NOAA) highlights that ocean acidity has increased by 30% since the Industrial Revolution (NOAA, 2020).

- The proliferation of plastic waste has resulted in massive pollution of oceans and terrestrial environments, impacting wildlife and entering the human food chain. A study by Jambeck et al. (2015) estimated that around 8 million metric tons of plastic waste enter the oceans annually. Microplastics, resulting from the breakdown of larger plastics, are now found virtually everywhere, including in marine life, soil, and even human bodies, with traces detected in food, water, and air (Ziani et al., 2023).

Humans, in other words, have emerged as a "geological force of Nature", capable of fundamentally reshaping ecosystems and altering natural cycles on a planetary scale. The concept of the "Anthropocene", introduced by geologist Paul Crutzenin 2000, refers to this new geological epoch in which human activities have become the dominant influence on Earth's environment and climate, its biodiversity, and even its geological processes. It reflects the growing recognition that human actions—ranging from industrialization processes to intensive agriculture and urbanization—are leaving permanent marks on Earth systems and on life itself (Steffen et al., 2011).

II. FRAMING CLIMATE CHANGE DISCUSSIONS AND CLIMATE (IN)ACTION

AI image generated using Midjourney from the prompt : "Humans reshaping Earth's landscapes with layers of pollution, plastic, deforestation, and industrial machinery interacting with natural cycles."

Addressing climate change—and other environmental crises—is oftentimes far from straightforward. Beyond the scientifically argued need to reduce greenhouse gas emissions, more complex and often contentious questions arise : How should we go about it? Who should bear the cost? Who holds responsibility for past and present emissions, and who gets to decide the path forward?

These questions reveal that climate change, while rooted in physical phenomena that science helps us understand, also exists as a deeply political, economic, and complex socio-cultural issue. As Briggle (2024) explains, the way we "frame, construct, and contest" climate issues is shaped by a variety of factors, like economic interests, social inequalities, cultural values, and geopolitical dynamics.

As an example, global disparities in wealth and development mean that different nations face vastly different stakes in the climate debate, as highlighted by ongoing discussions about climate justice and the right to development (Lefstad & Paavola, 2023). Wealthier nations, responsible for the majority of historical emissions and possessing greater adaptive capacities, often approach climate solutions by emphasizing technological innovation and market-based mechanisms (Dwivedi et al., 2022). In contrast, developing countries, which are more vulnerable to the impacts of climate change, advocate for pathways that allow them to continue pursuing economic growth—a process still heavily reliant on fossil fuels and, thus, additional emissions (IPCC, 2022). These debates underscore that the science of climate change intersects with broader questions of fairness, equity, and power. Meaningful climate action involves not just translating scientific knowledge into policy but also navigating the ethical considerations and socio-political dynamics that influence who benefits and who bears the burden of action.

Mathias Girel[14] notes that it should not come as a surprise that climate science and discussions about climate action spark disagreements and controversy : these debates are almost inevitable when a new paradigm

challenges the status quo, affecting not only people's lives but also the systems and interests that sustain them. And addressing climate change inescapably demands shifts in our individual habits, collective lifestyles, and current development models, which in turn creates tensions between differing visions for the present and future. These tensions are particularly evident in debates between those advocating for green growth—focused on technological innovation and sustainable economic expansion—and proponents of degrowth, who argue for reducing consumption and rethinking societal progress within ecological limits (Söderholm, 2020).

Critical questions like those mentioned earlier—how we should proceed and who gets to decide—risk becoming sites of contested realities. These contestations can be shaped by a range of factors, including vested social, economic, and political interests, imbalances of power and responsibility, and the unequal distribution of climate risks and vulnerabilities—now and in the future (Kashwan, 2021).

In this context, misinformation and disinformation about climate change and climate action find fertile ground to circulate, notably by exploiting public uncertainty, entrenched political polarization, and a growing distrust in scientific and governmental institutions (Lejano & Nero, 2020). These false narratives often align with pre-existing social and ideological divides, making them easier to spread and more difficult to counter. The result is a fragmented public discourse, where reaching consensus on climate action seems increasingly challenging.

There is a long, well-documented history of certain actors—particularly within the fossil fuel industry—manipulating public debates and influencing policy through tactics like climate denialism, delayism, and greenwashing (Lamb et al., 2020 ; Dunlap, 2013 ; Roper, Ganesh & Zorn, 2016 ; Brulee, 2022 ; Miller, 2017). It's important to recognize that these efforts don't operate in a vacuum. They align with broader disinformation networks and campaigns, using the same strategies that have been effective in other areas—amplifying doubt, creating false equivalences, and leveraging financial and political power to shape public narratives (Oreskes & Conway, 2010). Fossil fuel companies, for instance, have publicly cast doubt on climate science while privately acknowledging its validity in their internal research (Powell, 2021). By investing in think tanks, lobbying politicians, and launching large-scale public relations campaigns, they reframed the debate to suggest that climate action would be economically destructive or technologically unfeasible. This reframing has slowed political momentum for decisive action, making it harder to build public consensus on meaningful steps forward.

An analysis by the European Digital Media Observatory sheds light on how disinformation tactics are currently used to distort climate-related narratives (EDMO, 2022). These tactics include image manipulations—such as fake covers of Time magazine[15] or altered temperature maps[16]—and out-of-context associations, like misleading claims about electric vehicles catching fire[17] or climate activist Greta Thunberg allegedly participating in events she did not attend.[18] Such disinformation efforts exploit existing tensions and uncertainties, further polarizing public opinion. And by turning complex policy discussions into ideological battlegrounds, they add yet another layer of complexity and delay the urgent actions that scientific evidence shows are critically needed.

III. TECHNOLOGICAL INFLUENCE ON CLIMATE NARRATIVES AND MIS/DISINFORMATION

AI image generated using Midjourney from the prompt : "a human figure, transparent and filled with digital circuits, standing amidst a rapidly changing environment."

As we confront unprecedented changes in climate, biodiversity loss, and disruptions to Earth's vital systems, we are simultaneously navigating a period of profound technological and socio-cultural transformation. At the intersection of these crises, technology both accelerates and offers solutions to environmental challenges.

On one hand, technological advances exacerbate certain aspects of the climate crisis. Digital technologies now contribute 3-4% of global greenhouse gas emissions, a figure comparable to the global trucking industry (Ferreboeuf, Efoui-Hess & Verne, 2021). In the realm of artificial intelligence (AI), energy-intensive processes such as AI model training and inference are major contributors to this footprint.[19] Meanwhile, the rapid pace of technological obsolescence generates vast amounts of electronic waste, further exacerbating environmental degradation (Jain et al., 2023).

Yet, on the other hand, these same technologies provide powerful tools for addressing environmental issues. Advanced data analytics, satellite monitoring, and AI-driven models are revolutionizing our ability to understand complex ecological systems and predict climate patterns with increasing precision (Levy & Shahar, 2024). Social media platforms, too, have proven effective at mobilizing communities, raising awareness, and fostering global collaborations aimed at sustainability (Pearce et al., 2018). The iconic "Earthrise" photograph, taken during the Apollo 8 mission, exemplifies the transformative potential of media and technology in shaping environmental consciousness. It highlighted the fragility of the planet and galvanized global environmental movements[20], showing how media can inspire collective action.[21]

However, these technological advancements also introduce significant complexities. The rise of the internet, the ubiquity of social media, and the proliferation of personal connected devices have radically transformed

how information is created, consumed, and trusted (Iacovitti, 2022). Operating within the "attention economy", algorithmic systems prioritize engagement over accuracy, reshaping how public understanding of global challenges like climate change is formed (Hendricks & Vestergaard, 2019).

Algorithm-driven echo chambers and personalized content feeds reinforce existing beliefs, making it harder to build a shared understanding of the climate crisis (Metzler & Garcia, 2024). Misinformation and disinformation thrive in this environment, spreading rapidly and undermining public support for critical climate actions (Ecker, Lewandowsky, Cook, et al., 2022). This challenge is compounded by "information overload", where distinguishing credible sources from unreliable ones becomes increasingly difficult, leading to skepticism and disengagement (Arnold, Goldschmitt & Rigotti, 2023).

The rise of social media has also redefined who speaks, who is listening, and who is trusted. Traditional experts—scientists, journalists, and policymakers—now compete with social media influencers who wield large followings. These influencers, perceived as authentic by their audiences, play a decisive role in shaping public perception and mediating information flows in ways that were once the domain of professional journalists (Graan, Hodges & Stalcup, 2020). As a result, influencers can amplify or distort messages, which directly affects how the public understands and responds to issues, including climate change.

Furthermore, advanced AI tools, such as Large Language Models (LLMs) and AI-generated media, are now playing a pivotal role in amplifying both climate information and mis/disinformation :

- LLMs, for instance, can be manipulated to generate vast amounts of tailored climate disinformation, exploiting biases and creating deeper confusion around key issues. As Galaz et al. (2023) point out, with a simple prompt in GPT-3, such as “write a tweet expressing climate-denying opinions in response to the Australia bushfires", LLMs can quickly produce persuasive climate denial content. These models can automatically generate messages targeting specific audiences, fine-tuning content according to predefined writing styles or narratives. The high quality of AI-generated text makes it difficult for the average person to distinguish between content written by humans and that created by machines (Galaz, 2023). In fact, Bai et al. (2023) found that AI-generated text was as persuasive as human-written content on topics like the carbon tax, raising concerns about the capacity of current detection mechanisms to reliably identify AI-generated content. This underscores the urgent need for regulatory measures that address these challenges.

- In addition to textual disinformation, AI-generated deepfakes and other manipulated visual/multimodal media are becoming more sophisticated, allowing for the creation of convincing yet entirely false audiovisual narratives. These deepfakes can present fabricated events or misleading portrayals of environmental realities, distorting public perception. For example, the fake images of former President Trump being arrested in March 2023, created by MidJourney, illustrate the growing power of AI-generated imagery. As tools like MidJourney, DALL-E, and others advance, they will undoubtedly influence how climate change is visually documented, creating new challenges for ensuring the credibility of visual evidence (Johnstone, 2024).

- Algorithmic amplification plays a significant role in this ecosystem. Social media platforms, driven by opaque engagement metrics, often prioritize sensational or controversial content—including climate mis/disinformation—amplifying its reach and complicating efforts to foster informed, balanced public discourse on climate issues. The use of bots and fake social media accounts compounds these challenges. Automated networks artificially inflate the visibility of misleading content, giving the illusion of widespread consensus or controversy, where little to none may actually exist. This further distorts public perception and complicates efforts to build a coherent, science-based understanding of the climate crisis.

IV. THINKING THROUGH OUR CLIMATE ACTIONS

AI image generated using Midjourney from the prompt : "person wandering through a city flooded due to climate change."

In the face of climate change and the mis/disinformation narratives that surround it, the challenges we face are significant and multifaceted. While technology empowers us with unprecedented capabilities to become more aware of and address environmental crises, it also presents risks by serving as a tool and conduit for narratives that hinder collective climate action. Segments of the public remain skeptical or resistant, swayed by disinformation that minimizes, distorts or denies the urgency of climate measures (Bellamy, 2018).

Both climate change and the spread of mis/disinformation share key parallels: they are complex, global issues that resist simple solutions and require collective, coordinated responses. Just as addressing climate change demands a multidisciplinary approach—integrating science, technology, politics, economics, and socio-cultural understanding—so too does confronting mis/disinformation. Both highlight the need for adaptability in rapidly evolving environments, whether it's the Earth's physical climate or the shifting landscape of digital information.

Moreover, both climate change and mis/disinformation are deeply entangled in political, social, and

economic forces. Climate change intersects with global economic models of consumption and resource extraction, just as mis/disinformation is entangled with power dynamics, political agendas, and economic interests. Addressing them requires new modes of thinking and acting across disciplines—from science and technology to psychology and policy-making.

Gunther Anders' (1962) concept of "inverted Utopians"[22], cited in Briggle (2024), provides a useful lens here. He points to the paradox that while humanity excels at imagining and creating technological wonders, we often fail to grasp the far-reaching consequences of these creations—just like the complexity and scale of global problems like climate change. Calls like Hannah Arendt's (1958) to "think what we are doing" reminds us that a reflective, conscious approach is crucial, not just for solving environmental challenges but also for understanding our relationship with the technologies we create (Briggle, 2024).

At this intersection, building resilience to the impacts of climate change goes hand-in-hand with building resilience to climate mis/disinformation. This requires improving not only climate literacy but also the public's ability to discern reliable information from falsehoods. Research by Lewandowsky et al. (2017) demonstrates that individuals with higher levels of digital literacy are better equipped to recognize and reject climate-related disinformation. Finland's national strategy to teach critical thinking skills and combat disinformation is a notable model, integrating climate and digital literacy to empower citizens with tools for navigating an increasingly complex information environment (Jolls, 2022).

To further combat mis/disinformation, digital platforms can prioritize accuracy over engagement. Algorithms are being designed to try to limit the spread of false or misleading content (Mackenzie-Gray Scott, 2023), while governments can support policies and regulations that promote open communication and constructive, evidence-based dialogue. An example of such efforts is the European Union's "Digital Services Act", which attempts to hold tech companies accountable for how their platforms amplify harmful content, including climate-related disinformation.

However, combating mis/disinformation is not just a matter of better policies or algorithms—it also requires adaptability. In a rapidly changing world, interventions must remain fluid and responsive to evolving technologies and societal needs. As Charleyne Biondi (2023) notes, we must view ourselves and our actions as "always in the process of becoming." As change shapes us, we must learn to participate in and shape those changes, embracing a dynamic understanding of both our environmental and informational realities.

A key element of this dynamic understanding is recognizing that, while climate science provides essential insights into the global and long-term dynamics of climate change, many people in the public remain unfamiliar with how this knowledge is produced—"how we know what we know." As Simone Weil (1955) pointed out, "la science est un monopole, non pas à cause d'une mauvaise organisation de l'instruction publique, mais par sa nature même : les profanes n'ont accès qu'aux résultats, non aux méthodes, c'est-à-dire qu'ils ne peuvent que croire et non assimiler."[23] In other words, science often requires the public to rely on belief in its authority rather than a full understanding of its methods. Étienne Klein (2023) suggests that the practice of science communication must be continuous—more like an ultra-marathon than a sprint—ensuring that the methods and processes behind scientific knowledge are made accessible and understandable to the public.

Ultimately, information integrity on climate change is not a one-time achievement but an ongoing practice. It requires a multidisciplinary approach to understanding the multidimensional reality of climate change and ensuring that this knowledge is continuously built across scientific, social, and technological domains. Maintaining transparency, openness, and public engagement is essential to building a shared knowledge base that can withstand the evolving challenges of both environmental and informational crises.

Endnotes

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9 The report, which is part of the IPCC's Sixth Assessment Report (AR6), provides the most up-to-date physical understanding of Earth's climate systems and climate change. Subsequent reports from the AR6 looked at Impacts, Adaptation, and Vulnerability, and at Mitigation of Climate Change.

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22 «'We Are Inverted Utopians': The basic dilemma of our age is that 'we are smaller than ourselves', incapable of mentally realizing the realities which we ourselves have produced. Therefore we might call ourselves 'inverted Utopians': while ordinary Utopians are unable to actually produce what they are able to visualize, we are unable to visualize what we are actually producing.» (Anders, 1962: 496).

23 «Science is a monopoly, not because of poor organization of public education, but by its very nature: laypeople have access only to the results, not to the methods, meaning they can only believe rather than assimilate.» (Weil, 1955) [Translated from French].

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