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PERSPECTIVE

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Climate catastrophe: The value of envisioning the worst-case scenarios of climate change

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Abstract

Many now argue that we should think about the previously unthinkable risks of climate change, including societal collapses and human extinction. Calamitous images of the future are not pathological or counterproductive: it is both necessary and valuable to imagine the worst-case scenarios of climate change. Critics of climate catastrophe often group together all visions of disastrous futures under labels like doomism or pessimism. This is unhelpful and greater nuance is required. We need to distinguish between climate doomists (who see catastrophe as imminent and unavoidable) and climate risk realists (who see catastrophe as one potential future that should be avoided). We also need to split apart the different ways of envisioning climate catastrophe to understand their distinct strengths and weaknesses. We outline and compare three alternative modes of viewing the worst-case scenarios of climate change: foresight, agitation, and fiction. The first centers on modeling catastrophic climate scenarios, the second on the use of images of climate catastrophe for political action, and the third on fictional visions of future climate disasters. These different approaches are complementary and should be better integrated to create more comprehensive models of the future. All of them would benefit from viewing the future as uncertain, reflecting on the social position of the author, and guarding against the authoritarian "stomp reflex" that can be induced by discussions of crisis and emergency.

This article is categorized under:

Assessing Impacts of Climate Change > Evaluating Future Impacts of Climate Change

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KEYWORDS

apocalypse, climate catastrophe, climate fiction, environmental politics, foresight and forecasting

1 | INTRODUCTION

The public discourse about climate change has become increasingly desperate in the last decade. While there is nothing new about apocalyptic accounts of climate risk (Buell, 2010; Hulme, 2008; Skrimshire, 2014), visions of bleak futures are increasingly prominent. The Media and Climate Change Observatory, which monitors media coverage of climate change, suggests that the term "climate catastrophe" is being used more frequently, with usage of the phrase doubling in American news outlets and tripling in British ones between 2020 and 2021 (Simpkins, 2021). Similarly, Oxford Languages (2019) found that the term "climate emergency" was used more than 100 times more in the media in 2019 as compared to 2018.

Talk of climate catastrophe is evident across different groups concerned with climate change. Influential figures in the climate movement, from Greta Thunberg and Extinction Rebellion to the Secretary-General of the United Nations António Guterres, have adopted apocalyptic language (Cassegård & Thörn, 2022; Skrimshire, 2019). Scientists have called for an exploration of potential catastrophic outcomes, ranging up to global societal collapse and human extinction (Kemp et al., 2022a; Penuelas & Nogué, 2023; Ripple et al., 2022; Steel et al., 2022). In 2019, over 11,000 scientists signed a statement warning of the "catastrophic threat" posed by climate change (Ripple et al., 2020, p. 8). Popular culture also reflects these fears, with fictional visions of climate change imagining desolate and uninhabitable future worlds (Engélibert, 2019; Johns-Putra, 2016; Trexler, 2015).

Scholars have given ample attention to climate futures and how these can be differentiated (Granjou et al., 2017; Low, 2017; Muiderman et al., 2020). However, none have investigated this rising emphasis on catastrophic climate change scenarios.

We argue that envisioning extreme climate risks is useful in a variety of ways. That said, the discussion of climate catastrophe requires greater care and nuance. We address the most common criticisms of discussing climate catastrophe and suggest that a clear distinction is needed between climate doomists (who see catastrophe as imminent and unavoidable) and climate risk realists (who see catastrophe as one potential future that should be avoided). Similarly, there are different approaches to considering climate calamities: foresight by analysts, agitation by (mainly) political actors, and climate fiction by writers and artists. We analyze the strengths and weaknesses of each of these. As summarized in Table 1, foresight, agitation, and fiction have distinct producers, audiences, objectives, and functions. Each of these approaches is distinct and none is inherently about extreme risks. Climate fiction can be utopian and foresight exercises (particularly economic modeling) can downplay future risks. That said, each of these can and has been used to effectively explore climate endgames.

We conclude by discussing how combining these different approaches, using a climate risk realist framing, reflecting on the authors position and being aware of how discussions of extreme risk can be used to justify undemocratic emergency responses (a "stomp reflex") can all help to inform safer and more effective ways of exploring catastrophic climate scenarios.

TABLE 1 Three modes of envisioning climate catastrophe.

Mode	Primary producers	Primary audiences	Primary objective	Primary functions
Foresight	Scientists, economists, and philosophers.	Policymakers, politicians, businesses, and activists.	To assess the likelihood of the worst-case scenarios of climate change being realized.	To provide information about worst-case climate futures and shape responses.
Agitation	Political actors, for example, activists.	The public, governments, and other activists.	To encourage climate action.	To demonstrate the stakes of the crisis, the necessity of action, ward off false optimism, and shape responses.
Fiction	Creators, such as writers and filmmakers.	The broader public.	To imagine and explore future worlds where climate catastrophe has become a reality.	To question implicit assumptions and highlight the limits of knowledge about the future.

2 | CLIMATE RISK REALISM AND DOOMISM

Some see the surge in thinking about catastrophic climate scenarios as a problem. Critics claim that discussion of extreme climate risks is flawed and counterproductive. This is because they believe it is liable to misrepresent the scientific consensus (Mann, 2021), distract from practical solutions (Shellenberger, 2020), create counterproductive policies (Burgess et al., 2022), undermine effective environmental politics (Swyngedouw, 2022), and induce fatalism (Hulme, 2020).

None of these concerns is convincing. Numerous books and articles have examined and discussed catastrophic climate scenarios without misrepresentation of the science (Kemp et al., 2022a; Lynas, 2020; Richards et al., 2021; Steel et al., 2022). There is no reason that considering extreme risks will slow decarbonisation or hinder adaptation. Instead, a lack of effective risk assessments can slow action and create faulty policies (Kemp et al., 2022a, 2022b, 2022c). Nor is there strong or convincing evidence that considering extreme risks will inevitably lead to apathy. Certainly, political discussion of extreme risk, whether it be climate or terrorism, can invoke emergency powers and a stomp reflex (Kemp, 2021). However, this can be guarded against, as we outline in section 6.4 of this paper.

The evidence does not suggest that fear-based messages will automatically deter action or that hope-based messages are necessarily more effective. While meta-analyses have had mixed results on the consequences of fearful messaging on climate change (Peters et al., 2013; Tannenbaum et al., 2015), the most recent meta-analysis concludes that fear-based messaging is effective at changing intentions, attitudes, and behaviors under most circumstances, and there were no observed situations which made it counterproductive (Tannenbaum et al., 2015). This echoes a wider body of literature on fear-based messaging in public health, marketing, and risk communication (Reser & Bradley, 2017). The idea that fear (or any emotive affect) will breed fatalism needs greater nuance. Emotions are not simple levers to be pulled with a message to elicit a reaction (Chapman et al., 2017). Several factors influence whether fear-based messages will have the desired effect. Effective endgame exploration requires a broader communication strategy, such as choosing the right messenger and frame (Colvin et al., 2020). Moreover, democracies require open and honest communication and risk assessments, an objective that should not be clouded by messaging concerns.

The debate over catastrophic climate change and messaging needs greater nuance. We need to draw a clear line between climate doomism (invoking inevitable and near-term catastrophe) and climate risk realism (evidence-based discussions of catastrophic risk that allow for uncertainty and political agency). Doomers believe we should prepare for adapting to a near-term post-collapse world, while climate risk realists see catastrophe as one potential future that should be assessed and guarded against. The current debate unhelpfully and falsely tends to lump the two together (see, e.g., Shellenberger, 2020). Scholars and activists who regard catastrophe as possible but avoidable are not the same as those who regard it as inevitable and unavoidable. Indeed, the worry for some environmentalists is that doomist exaggerations discredit legitimate fears about climate change (Mann, 2021).

This is a vital distinction. Fear-based messaging which suggests that calamity is inevitable is naturally far more likely to trigger anxiety and fatalism than a discussion of extreme risks which stresses that these are uncertain, and action can be taken. Negative effects from fear-based messaging may be possible but can be mitigated. This is more likely to occur by using a climate risk realist lens.

3 | FORESIGHT

Foresight is a broad set of methods that looks to outline the parameters of plausible futures (Cuhls, 2003; Martin, 2010). Forecasting aims to make quantitative, probabilistic estimates about future events. These tend to be events with a tightly limited set of outcomes, most often a "binary bet" with an event either happening or not (Taleb, 2020). In this literature, catastrophic climate risks are neglected, but not completely ignored. Several studies and exercises have explored extreme risks using foresight and forecasting tools.

Broadly speaking, the approaches discussed in this section are concerned with using present knowledge about the climate crisis to make estimates about the likelihood of climate-related catastrophes, including societal collapse and human extinction, occurring in the future. However, there are a range of different methods employed by analysts for this purpose. Comprehensively reviewing each foresight tool is a formidable task that is well beyond the scope of this piece. Instead, we highlight the most relevant techniques and assess their strengths and weaknesses for investigating catastrophic climate risk.

The most direct efforts to estimate the catastrophic outcomes of climate change come from philosophers in the subfield of existential risk studies, most prominently Toby Ord and William MacAskill. Ord gives climate change a 1 in 1000 chance of directly threatening extinction or collapse (Ord, 2020) and MacAskill concludes that "it's hard to see how even [7-10°C of warming] could lead directly to civilizational collapse" (MacAskill, 2022, p. 136).

Unfortunately, these predictions are simplistic and unconvincing. While ostensibly focusing on the question of whether climate change is an existential risk, they answer a different question. Ord analyses whether climate change will make every inch of land uninhabitable for humans. MacAskill assesses whether climate change will make agriculture impossible. These are cases of attribution substitution: the authors have swapped a broad difficult question for a different more tractable one (Kemp et al., 2023). Moreover, these analyses ignore risk cascades, responses, and vulnerabilities. Indeed, neither Ord nor MacAskill propose a discernible or replicable method. They instead rely on what we term "eye-balling": making rough guesses after qualitatively weighing up a few different variables.

Eye-balling risk assessments are a minority approach, but more popular methods do not fare much better. Quantitative economic models, particularly Integrated Assessment Models (IAMs), are the predominant way of exploring climate damages. These modeling approaches aim to estimate future climate damages and produce a social cost of carbon (SCC). However, none to date have explicitly modeled catastrophe and some cannot. For instance, the most influential and widely used model architecture—Nordhaus's Dynamic Integrated Climate-Economy model—is incapable of producing a permanent economic collapse. This is due to unrealistic, exogenous assumptions about growing labor productivity and continuous full employment of the labor force (Keen, 2021). In short, even in the throes of complete societal breakdown, the workforce is unprecedently productive. The closest attempts to examine extreme risks using economic models have been studies that incorporate physical tail risks and climate tipping points (Cai et al., 2016; Dietz, 2011; Dietz et al., 2021; Lontzek et al., 2015). These unsurprisingly create far higher damages and SCCs, but fall short of projecting catastrophic impacts approaching societal collapse or extinction.

There are deep-rooted problems with IAMs. Even the best IAMs are not fit for modeling climate damages, let alone catastrophic scenarios. They do not capture the basic ingredients of any accurate and complex risk assessment such as compound hazards, risk cascades (whether it be certain ones such as more disease, or more speculative ones like interstate conflict), and maladaptive societal responses. Their results are heavily influenced by subjective variables such as the discount rate, climate damage functions, exogenous growth rates, and risk preferences. Moreover, efforts to calculate a damage function are ultimately futile: they are untestable, depend on unreliable proxies such as past weather impacts, and try to produce discrete numbers for a socially complex and geologically unprecedented scenario (Pezzey, 2019). It is thus unsurprising that the IPCC Working Group II in the Sixth Assessment Report highlighted that low agreement and a large spread of estimates means that there is no current best guess, or even a robust range, for climate damages (IPCC, 2022, p. 67). The underlying problem is that they aim to do the impossible by producing precise numbers about damages, a process that necessarily underplays the complex, uncertain, plural, and unprecedented nature of climate futures. IAMs are unfit for extreme risk analysis and have rarely tried to do so.

We have focused on IAMs since these have historically been the most widely used and influential form of climate damage modeling. A range of other economic approaches exist, but none have yet addressed the fundamental problems of relying on a process of extrapolating into the unprecedented (Pezzey, 2019), or modelling relevant variables (Kemp, et al., 2022a).

A more promising approach to foreseeing climate catastrophe is expert elicitation. This method refers to a wide range of techniques focused on surveying and aggregating expert opinion, as well as encouraging deliberation. These include the Delphi technique, scenario construction, role-playing, war-gaming, and horizon scans (Kemp, 2023). Some have begun to use these techniques to consider catastrophic climate change risk. Examples include Chatham House's *Climate Change Risk Assessment*, which predicts that climate change "will likely drive unprecedented crop failure, food insecurity and migration" (Quiggin et al., 2021, p. 3) and the World Economic Forum's *Global Risks Report*, which positions climate change as part of a broader "'polycrisis' centred around natural resource shortages by 2030" (World Economic Forum, 2023, p. 7).

However, there are problems with these expert elicitation techniques. Scenario planning alone has numerous schools of thought but there is little empirical evaluation on the effectiveness of these different approaches, and often not even the level of reporting needed to allow for comparisons and review (Cordova-Pozo & Rouwette, 2023). Moreover, most expert elicitation methods lack a strong track record, with one exception being versions of the Delphi Method, such as the Investigate Discuss Estimate Aggregate protocol, which has some evidence of accuracy in both forecasting tournaments and near-term horizon scans (Kemp, 2023; Kemp et al., 2020).

TABLE 2 Foresight.

Method	Strengths	Weaknesses
Eye-balling	Simple; easy to understand and communicate.	Overly simplistic; often relies on attribution substitution; not replicable; missing cascades and vulnerabilities.
Economic Modeling	Replicable; can include empirical information.	Opaque; inappropriate extrapolation; highly subjective and questionable assumptions; poor proxies for damage function; misses cascades, vulnerabilities, maladaptive responses, and threat–threat interactions.
Expert Elicitation	Can capture a wide array of trends and information; ability to incorporate risk cascades and responses; transparency; track record (for some methods).	Wide array of methods; difficulties in replication; often missing cascades and vulnerabilities.
Forecasting	Strong, verifiable track record.	Not appropriate for risks beyond a year or more complex questions; unknown efficacy for very low-probability.

Some have even used forecasting techniques to put a numerical prediction on climate catastrophe. Online platforms which crowdsource quantitative predictions, such as Metaculus, have posed questions such as the likelihood that a climate disaster this century will lead to a loss of 95% or more of the global population, estimating a 1% chance (Metaculus, 2018). The most systematic and comprehensive attempt to date is a report on *Forecasting Long-Term Risks and Climate Change* from the Good Judgment Project. They posed a set of 22 questions to a team of "superforecasters," including whether climate change will be a cause of human extinction by 2100 and 2300 (Good Judgement Project, 2022). The estimated probability of a climate-driven extinction was around 1% for 2100 and 3% for 2300. Another tournament using a refined forecasting method reported a total extinction risk (including from climate) of 1% (from superforecasters) to 6% (from experts) (Karger et al., 2023).

While forecasting tools such as superforecasters have a decent degree of accuracy for tightly bound questions within a year, they decay in accuracy thereafter. There is no strong evidence for accuracy above random guesses when it comes to longer time-frames such as decades (Tetlock & Gardner, 2015). We also do not know if these methods are accurate for very low probability tail risks, for instance distinguishing between probabilities of 0.1% and 0.0001%. Forecasting may have a good reputation and track record, but it is for now not suitable for exploring long-term catastrophic climate risk (Kemp, 2023).

Each approach to foreseeing climate catastrophe has some advantages, and several severe flaws. These are summarized in Table 2. Overarching problems include unknown/poor track records, and a lack of incorporation of risk cascades, maladaptive responses, and other global catastrophic threats. In particular, a significant, common flaw across attempts to foresee climate catastrophe is their sheer simplicity. Asking whether climate change is an existential threat is misleading. The impacts and consequences of any given level of warming will depend on the wider scenario, including the technologies in use, societal fragility and responses, and the presence of other catastrophic threats.

Despite these problems and tensions, the methods discussed here have the potential to inform democratic deliberation over responses to climate risk. Exploring catastrophic futures through foresight can allow for better risk management and decision-making, encourage action, and inform resilience measures, including emergency measures such as geoengineering (Kemp et al., 2022a).

4 | AGITATION

Exploring calamitous climate futures has political relevance. It reveals the stakes at hand: the bleakest trajectories expose the deepest potential costs of inaction (Kemp et al., 2022b). While some in the environmental movement stress the need for hopeful accounts of climate futures, there is a strong catastrophic current to contemporary climate activism (Cassegård & Thörn, 2022; Skrimshire, 2019). Prominent figures in the environmental movement have deployed alarming rhetoric with the aim of mobilizing action on the climate crisis. However, activists and politicians have used

predictions about the catastrophic consequences of climate change in different ways. Just as there are distinct modes of foresight, there are also distinct modes of agitation, each with their own strengths and weaknesses.

It should be stressed that there are important differences between foresight and agitation. The former explores the probability and pathways of climate-related risks, while the latter is focused on galvanizing climate action. The three forms of agitation outlined below–warning, pessimism, and millenarianism–each have distinct advantages and disadvantages in compelling action and advancing democratic debate.

Environmental activism often uses the rhetoric of climate catastrophe as a warning. It aims to incite a reaction by raising the specter of a calamitous future. The Secretary-General of the United Nations António Guterres warns that "we must close the emissions gap before climate catastrophe closes in on us all" (UN News, 2022). It should be stressed that, for (most of) these political actors, catastrophic outcomes are possible but they are also *avoidable*. Political and social changes in the present can help to avert crisis in the future. These tendencies in environmental politics are compatible with climate risk realism insofar that they regard the future as malleable and changeable.

However, political theorists have highlighted a problem with catastrophic warnings about climate change: depoliticization (Marquardt, 2020; Pepermans & Maeseele, 2016; Swyngedouw, 2022). The concern here is not that climate catastrophe demotivates people but rather that it papers over distinct and antagonistic positions on the environment, thus undercutting democratic deliberation on the climate crisis. Movements like Extinction Rebellion (Swyngedouw, 2022) and Fridays for the Future (Marquardt, 2020) falsely reduce the options open in the future to either the apocalypse or its prevention, suggesting that humanity has a universal interest in the latter over the former. This consensual approach avoids debate about different climate trajectories and ignores differences in class, ethnicity, and nationality (Swyngedouw, 2022). Moreover, there is a fear that climate apocalyptic rhetoric might create a state of emergency, in which powerful actors are permitted to take repressive actions in the name of saving the world, thus encouraging the "stomp reflex" discussed further below (Kemp, 2021; Rothe, 2020).

While most environmentalists use images of catastrophe to warn people about the consequences of inaction, others have adopted a different approach. The eco-miserabilists (Thaler, 2023) or post-apocalyptic environmentalists (Cassegård & Thörn, 2022) argue that it is too late to act on the climate crisis. Catastrophe is now locked-in; there is no alternative. The climate pessimists are particularly associated with the Dark Mountain and deep adaptation tendencies in the United Kingdom and the collapsology movement in France, all of which have strong online followings (Cassegård & Thörn, 2022; Davidson, 2023; Moser, 2019; Thaler, 2023). In terms of action, these tendencies argue for adaptation rather than mitigation; the task is now to prepare for the worst rather than prevent it.

For their critics, the pessimists have a deleterious effect on the climate movement. The statement that catastrophe is inevitable not only obscures the empirical evidence on the likely outcomes of climate change, but also induces fatalism (Malm, 2021). While fear-based messaging need not produce apathy, the charge of doomism becomes more relevant when environmentalists suggest that collapse is unavoidable.

While it would be a problem if the entire environmental movement adopted the idea that climate catastrophe is inevitable, it can perform useful functions in shaping public engagement with the crisis. For instance, Mathias Thaler, analyzing the Dark Mountain collective, suggests that the eco-miserabilists combat false optimism (Thaler, 2023). Their pessimism demonstrates the deep-seated nature of the unfolding disaster, which requires not only political changes or technological innovation, but potentially a deep and radical socioeconomic transformation.

A final tendency amongst the agitators is millenarianism. Theological accounts of the apocalypse, which traditionally involves a movement from catastrophic breakdown to a utopian society, have been influential in the environmental movement (Rothe, 2020; Skrimshire, 2014). Some in the pessimist camp have adopted this temporal schema. For example, the collapsologists suggest that the climate-induced collapse of industrial society will produce a sustainable society based on small-scale, self-sufficient communities (Davidson, 2023). They advocate preparing for the catastrophe by experimenting with new forms of living. The millenarians are vulnerable to many of the same criticisms as other pessimists but there are distinct advantages to their approach. This tendency, while engaging with the negative feelings on the climate crisis, strengthens the green utopian impulse (Garforth, 2017). Positing the complete collapse of the current order offers an occasion to reimagine it. It encourages activists to reflect on the institutions and practices necessary for a society resilient to climate catastrophe.

As with foresight, each approach to agitation has advantages and flaws. These are summarized in Table 3. Problems include misrepresenting the evidence on the likelihood of climate catastrophe, falsely suggesting that there is nothing to be done to prevent the worst, and depoliticizing climate change. These shortcomings can be addressed by bringing agitation into greater dialogue with foresight and imagination.

TABLE 3 Agitation.

Method	Strengths	Weaknesses
Warning	Demonstrates the stakes of climate change; mobilizes people on the crisis.	Depoliticizes the crisis; implies a consensual approach; masks over antagonistic interests.
Pessimism	Questions false optimism; highlights catastrophes in the here and now; encourages comprehension of the worst-case scenarios.	Skews the empirical evidence on the likelihood of catastrophe; potentially induces fatalism about political action; discredits the climate risk realists.
Millenarianism	Reinforces the green utopian impulse; fosters the imagination of wholly alternative societies.	As above, misrepresents the evidence, fosters inaction, and discredits climate risk realists.

Despite these problems, agitation fulfills several vital functions for the environmental movement, including clearly communicating the gravest risks of the climate crisis to the public and governments, warning against optimistic accounts of the future by accentuating the negative, and positing ways of surviving in the face of catastrophic climate change. In this manner, agitation has the potential to aid democratic debate about extreme climate futures and foster public engagement.

5 | FICTION

In popular culture, speculative accounts of future climate catastrophes are now commonplace. The most prominent medium associated with visions of apocalyptic futures is climate fiction, which Adeline Johns-Putra simply but effectively defines as "fiction concerned with anthropogenic climate change or global warming as we now understand it" (Johns-Putra, 2016, p. 267). Climate fiction has surged in the past two decades and become a stand-alone genre (Streeby, 2018; Trexler, 2015). Some authors imagine utopian climate futures, with the solarpunk literary movement envisioning worlds of clean energy and egalitarian social relations (Williams, 2019). However, unsurprisingly, there is a strong apocalyptic current in contemporary climate fiction (Engélibert, 2019), with floods proving a particularly popular way of imagining the disasters of the future (Bracke, 2019; Trexler, 2015).

Apocalyptic climate fiction can fulfill some of the functions associated with foresight and agitation. For instance, Kim Stanley Robinson's *The Ministry for the Future* (2020) convincingly weaves together an array of trends in a manner comparable to the best work in scenario and wargaming exercises. Alongside an account of catastrophic climate change—involving a heatwave in India that kills millions—it also integrates possible advances in lethal autonomous weapons and block-chain technology, as well as societal responses ranging from geoengineering experiments and eco-terrorism to the creation of new UN departments. Many climate fiction texts also have a warning function. Their accounts of catastrophe, like those of climate activists, demonstrate the consequences of inaction in the present. The horror of living in the parched world of Paolo Bacigalupi's *The Water Knife* (2015) or the watery world of Kassandra Montag's *After the Flood* (2019) reinforces fear-based messages on climate change.

However, fiction also makes some novel contributions to exploring climate endgames. It should be stressed here that climate fiction conforms to different standards to foresight and agitation. It is not directly concerned with either offering accurate portrayals of the future or in mobilizing people to engage in political action. A climate fiction text may be effective in its own terms while presenting a highly fanciful (even fantastical) future and failing to deliver clear lessons for activists (Milkoreit, 2016). The fact that fiction has no obligation to be accurate may lead some to dismiss it. This would be a mistake. Fiction fulfills a number of functions that have a broader relevance beyond entertainment alone and can help to inform both agitation and foresight.

Put in positive terms, climate fiction has three key strengths, each of which has the potential to advance democratic debate and public consciousness on the climate crisis. First, climate fiction, like many other genres of speculative writing, is concerned with estrangement. That is, the presentation of a new world that is radically different to the reader's empirical reality (Suvin, 1979). In comparing the current world against an imaginary future ravaged by climate change, reader's cognitive assumptions and cultural expectations are reshaped (Death, 2022; Thaler, 2022). Climate fiction questions political and cultural presuppositions by constructing a world where they no longer hold. For example, Emmi Itäranta's *Memory of Water* (2014) foregrounds something often taken for granted: plentiful fresh water. The novel

imagines how the scarcity of water has led to a rise of authoritarian governments concerned with controlling the resource and new religious movements that sacralise water.

Estrangement in climate fiction also carries tensions. The readers of climate fiction are, for the most part, already aware of the seriousness of the environmental crisis (Schneider-Mayerson, 2018). It is thus unclear whether the fictional worlds presented challenge their assumptions. Moreover, to pique the imagination, the future world needs to be fundamentally worse, yet this runs the risk of becoming a dramatic and entertaining spectacle (Ghosh, 2016). Estrangement easily slips into escapism from present pressures, rather than a prompt to reflect on them. For instance, while the popular television series *Game of Thrones* (2011–2019), which thematises the relationship between political change and environmental change in a fantasy kingdom, can be understood as a form of climate fiction, it would be wrong to say that viewers (or even its producers) were consistently conscious of its allegorical status (DiPaolo, 2018). Awareness of the Anthropocene in culture is often unconscious (Bould, 2021). It appears in flashes rather than intense reflection.

Alongside estrangement, climate fiction also plays a reflexive role, offering a self-critical commentary on the stories we tell ourselves about climate change (Marshall, 2015). Like estrangement, this is concerned with questioning assumptions, but it is attuned to the assumptions of the environmental movement itself. For instance, Black, Indigenous, and postcolonial writers have challenged aspects of how climate catastrophe is envisioned in the Global North (Death, 2022; Mitchell & Chaudhury, 2020). Novels such as *The Swan Book* (2013), by Waanyi writer Alexis Wright, and *Goliath* (2022), by Nigerian American writer Tochi Onyebuchi, demonstrate the parochial nature of imaginaries of climate catastrophe common amongst environmentalists by highlighting the resonances between visions of future ecological breakdown and the past and present oppression of Indigenous and Black people respectively. The apocalypse has already happened for many oppressed peoples and future climate catastrophe is an extension of these disasters (Davidson & da Silva, 2022; Whyte, 2018). Whereas catastrophe may be unprecedented for privileged populations in the Global North, this is not universally true.

Reflexivity also carries risks. By emphasizing the continuity of past, present, and future, it might create the impression that there is nothing new about climate change (Simon, 2017). The catastrophic risks associated with climate change are novel, even for the most vulnerable. Given this, care should be taken not to simplify texts like *The Swan Book* and *Goliath*. They represent a productive mixture of reflexivity and estrangement, constructing a new world in ways that echo the familiar world of the present. These imaginative narratives draw attention to current plights, how these could worsen, and what can be learned from communities already facing extreme risks (Yoshinaga et al., 2022).

The final function of fictional visions of climate catastrophe is its capacity to expose the *limits* of our knowledge of the future. Fredric Jameson famously suggested that science fiction demonstrates "our utter incapacity to imagine [the] future" (Jameson, 2004, p. 46). For Jameson, we are trapped within the ideological coordinates of the contemporary moment. More particularly, visions of climate catastrophe tell us more about the writer's social position in the present rather than how the future will unfold. Climate fiction represents a form of "speculative memory," rearranging familiar aspects of the past and present (authoritarian governments, bloody wars, and the massacre of peoples) to imagine an alternative future (Crownshaw, 2017, p. 889). Through no fault of their own, writers struggle to imagine the *otherness* of climate-changed futures, with established genres, narrative techniques, and cultural imaginaries straining to capture the vastness and strangeness of the climate crisis (Clark, 2015).

This failure is productive insofar that it teaches epistemic humility. There are aspects of climate catastrophe that are beyond present comprehension. The danger is that emphasizing the limits to knowledge could imply that thinking about the future is pointless. This is an exaggeration. The inability to imagine the future highlights the *partiality* of visions of catastrophe. Different current social positions reveal different aspects of the unfolding climate catastrophe. For instance, climate fiction focused on the Global North, like *Memory of Water*, has value insofar that it evokes the unprecedented nature of the crisis, even if doing so involves supressing the historic continuities that come to the fore in novels like *The Swan Book* and *Goliath*.

The strengths and weaknesses of estrangement, reflexivity, and epistemic humility are summarized in Table 4. Climate fiction focuses on destabilizing taken-for-granted aspects of the present and highlighting the limits of knowledge about the future. Apocalyptic fiction also helps the public to better understand the climate crisis. By revealing uncertainty and implicit assumptions it can make for more critical and self-reflective readers. That is, readers who are more equipped for deliberation and hence better citizens. These strengths will be particularly important in our consideration of its relationship with foresight and agitation in the next section.

TABLE 4 Climate fiction.

Method	Strengths	Weaknesses
Estrangement	Destabilizes assumptions about the relationship between humanity and nature in the contemporary world.	Too fanciful for a comparison to be made; the "Anthropocene unconscious" is below the level of cognition.
Reflexivity	Challenges dominant conceptions of catastrophe *within* the environmental movement; demonstrates the continuities between disasters past, present and future.	Risks undercutting the unprecedented nature of the climate crisis; the future cannot be reduced to the past.
Humility	Fosters an awareness of the limits of knowledge about future catastrophes; visions of climate catastrophe are always from a particular standpoint and depend on specific cultural tools.	Could imply that there is no point speculating on the future; suggests that firm knowledge of climate catastrophe cannot be attained.

6 | DISCUSSION: BUILDING BETTER CATASTROPHIC FUTURES

There are crucial differences between each view of catastrophic climate change. The goals of foresight, agitation, and fiction are distinct. In broad terms, foresight focuses on creating plausible pictures of future scenarios and forecasting particularly tries to produce precise probabilities and damage estimates. Agitation uses accounts of catastrophic climate change to ignite social change. Fiction creatively imagines apocalyptic worlds to comment on existing social relations.

Integrating the three modes can help address the limitations of each. For example, without grounded and rigorous foresight, agitation can fall into hyperbole and exaggeration. Fiction can highlight speculative yet important and likely variables and scenarios that conservative foresight exercises often overlook, such as new technologies like lethal autonomous weapons.

As such, we stress that climate catastrophe as a whole cannot be dismissed by criticizing any one of its modes. The weaknesses of one mode can be counterbalanced by the strengths of other modes. The value of envisioning the worst-case scenarios of climate change can be defended by attending to the diversity of accounts of future disaster. This does not mean ignoring the differences between the approaches or suggesting that they ultimately cohere around a common set of claims. Instead, our aim is more modest: to assess what each mode of catastrophe can learn from the others with the aim of strengthening its core objectives and functions.

Such a defense of climate catastrophe is significant because, as we have seen, it performs a range of key functions in terms of advancing public knowledge and democratic debate. A moratorium on envisioning climate catastrophe because of its weaknesses risks resulting in a loss of its strengths. Bringing together the approaches creates a more cohesive account of climate catastrophe, thus preventing its easy dismissal by critics.

6.1 | Foresight and agitation

Those studying climate catastrophe through foresight and most actors involved in agitation agree that catastrophe is possible but avoidable. Despite the different conclusions of the studies discussed in the foresight section, most confirm that climate change might have catastrophic consequences, even if the worst-case scenarios (like human extinction) are assigned a very low probability. As such, climate activists are not fearmongering but raising awareness of possible trajectories.

At the same time, foresight offers a critical check on some of the more excessive claims associated with agitation. While agitation relies on foresight, some political actors have misrepresented, misconstrued, or exaggerated scientific findings (Mann, 2021). In particular, the emphasis on uncertainty and complexity in the foresight literature puts into question any claims about the inevitability or likelihood of events like societal collapse or human extinction. This does not mean that pessimism and millenarianism, or the more extreme warnings issued by groups like Extinction Rebellion (see Hallam, 2019), should be rejected. They still perform valuable functions in terms of warning against false optimism and imagining sustainable societies. However, foresight helps to refine these approaches. For instance, proponents of pessimism and millenarianism could explicitly state that they are operating *as if* catastrophe is inevitable to foster a critical perspective on the current social order, while acknowledging the uncertainty around actual climate futures.

6.2 | Foresight and fiction

Both foresight and fiction imaginatively construct the future. Foresight, despite its emphasis on mathematical rigor, requires an element of speculation. Some have embraced this connection, with specialists in future studies proposing ways to learn from science fiction in study design (Zaidi, 2019). Climate fiction is particularly adept at addressing the weakest point of foresight exercises: considering climate risk in a broader context. Robinson's *The Ministry for the Future* places climate catastrophe in relation to wider technological trends such as lethal autonomous weapons and societal responses such as eco-terrorism and geoengineering. Adopting the methods of climate fiction could challenge some of the simplistic models that dominate in the foresight literature and encourage more innovative approaches (Keen, 2021). This will likely require a change in scientific standards. Currently, more restricted models (such as IAMs) are favored because they require less speculation. However, assuming a relatively stationary world and not factoring in technological, social, and economic changes, risk cascades, or societal responses makes these models far less useful and accurate. The scientific community should reward, not punish, more comprehensive modeling efforts, even if these require more informed speculation (noting that all models, even the extrapolation of GDP, is an exercise in speculation).

Foresight and fiction also both emphasize uncertainty. In foresight, the existing methods are not yet equipped to accurately predict climate catastrophe (and may never be) and expert judgment, whether it be in modeling assumptions or a forecast, are influenced by the social position, values, assumptions, and experiences of the author. The same applies to climate fiction. We do not know how accurate or effective it is at exploring the future and the future is forever influenced by the author's present. Democracy and diversity are a remedy for both. Diverse, deliberative, and democratic groups are more likely to reach truthful judgments about the future. They also help to reduce the bias of social position by aggregating across a diverse group.

6.3 | Agitation and fiction

Agitation and fiction are both concerned with using accounts of catastrophe to undermine complacency on the climate crisis. In other words, climate catastrophe, regardless of its likelihood, has an important cognitive function and political purpose. It draws the connection between actions taken in the contemporary moment and potential mass suffering in the future.

Nevertheless, there are instructive differences. Most particularly, agitation simplifies where climate fiction complicates. Agitation, particularly when concerned with warning, deploys climate catastrophe to demonstrate the fundamental importance of environmental struggles. Climate fiction, especially in its reflexive form, takes a step back, offering a critical lens on the apocalyptic narratives deployed by climate activists.

There is a productive tension between these opposing approaches. On the one hand, fictional accounts of catastrophic futures question the depoliticizing effects of some activist rhetoric on the crisis. Rather than a universal human subject facing off against the climate apocalypse, fiction's emphasis on reflexivity and humility encourages an interrogation of how social position influences our vision of the future.

On the other hand, the urgency of agitation cuts against climate fiction's tendency towards escapism. By emphasizing the stakes of the crisis, it demonstrates that speculative visions of catastrophe are more than mere thought experiments. Thanks to the efforts of the environmental movement to raise consciousness of climate change, no vision of catastrophe (including the more fantastical examples of climate fiction, such as *Game of Thrones*) is untouched by a sense of anxiety and trepidation.

6.4 | Cross-cutting: Beware the "stomp reflex"

Any form of climate catastrophe could incur a "stomp reflex" (Kemp, 2021). It may encourage the use of emergency powers and draconian actions to either prevent or react to a perceived future climate catastrophe (Mann & Wainwright, 2019; Mittiga, 2022). A state of exception gifts power to those atop a hierarchy in the hope of controlling disaster. For example, in the United States, the threat of nuclear war transformed democracy into a "thermonuclear monarchy" and ushered in a new age of secrecy (Scarry, 2016; Wellerstein, 2021). Such emergency measures have proved ineffective and even counterproductive (Kemp, 2021). They not only result in higher casualties when responding

to a disaster, but become sticky and persist over time. The exception becomes the norm and the temporary becomes permanent.

Practitioners of all three types of climate catastrophe need to be aware of the potential for a stomp reflex. Discussing and warning *against* risk incurs a potential *response* risk. There are different ways to mitigate this. In foresight, it could involve including emergency powers and despotic drift into models of climate risk and assessing the dangers of such responses. For agitators, it could include being more precise in their warnings and specifying that responses to crisis need to be democratic and deliberative. For fiction, it could be exploring futures in which a dramatic climate stomp reflex has occurred.

7 | CONCLUSION

The three different approaches to exploring climate endgames (foresight, agitation, and fiction) each have their strengths and weaknesses. Foresight is the most systematic and grounded way of thinking about the future. Unfortunately, it frequently fails in having simplistic methods that ignore risk cascades, societal responses, and other contributors to global catastrophic risk. Agitation can help to mobilize the public, but runs the risk of misrepresenting the evidence, potentially creating fatalism (in the case of climate doomism), and depoliticizing climate change. Fiction can help to create more holistic visions of the future, encourage reflection on how future crisis interacts with past and present injustices, help craft new visions of society, and foster humility. Yet it runs the risk of being too speculative and ignoring the unprecedented nature of current climate change. These approaches, for all their differences, are complementary and can only be improved by combining them. There may be other ways of exploring endgames, and we invite others to further investigate these.

The emphasis of this article has been on the differences and synergies between alternative modes of envisioning the worst-case scenarios of climate change. This is not a general philosophical defense of catastrophic thinking as others have articulated (Dupuy, 2023). Nevertheless, there are some broader lessons that can be drawn from our comparative approach. Effective catastrophic envisioning requires that scholars, activists, and writers alike need to stress that a catastrophic future is uncertain, not inevitable, and reflect on their own social position. We should aim to be climate risk realists (aware of the uncertain and malleable nature of the future), not climate doomists (who see catastrophe as imminent and inevitable). Importantly, the broader scientific community should be careful to distinguish between the two and not lazily brand any discussion of climate catastrophe as climate doomism. In short, climate catastrophe should not be vilified as climate doomism. Drawing on more diverse groups and encouraging deliberation across communities will also help to ensure that our judgments about the future are robust, not biased towards particularly powerful social positions, and highlight the link between current injustices and future disasters. Like cutting emissions, exploring climate endgames requires a diverse, thoughtful, and integrated approach. We cannot view a dangerous and distant horizon with one (or both) eye(s) shut.

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Joe P. L. Davidson: Conceptualization (lead); writing – original draft (equal); writing – review and editing (equal). **Luke Kemp:** Conceptualization (supporting); writing – original draft (equal); writing – review and editing (equal).

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Data sharing is not applicable to this article as no new data were created or analyzed in this study.

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