Article:
Cox, S., Morris, J.H. and Taylor, Z.J. (2026) Inscription networks: finance, infrastructural power, and the governance of climate risk. Journal of Cultural Economy. ISSN: 1753-0350

https://doi.org/10.1080/17530350.2026.2678262

Journal of Cultural Economy

ISSN: 1753-0350 (Print) 1753-0369 (Online) Journal homepage: www.tandfonline.com/journals/rjce20

Inscription networks: finance, infrastructural power, and the governance of climate risk

Savannah Cox, John Hogan Morris & Zac J. Taylor

To cite this article: Savannah Cox, John Hogan Morris & Zac J. Taylor (04 Sep 2026): Inscription networks: finance, infrastructural power, and the governance of climate risk, Journal of Cultural Economy, DOI: 10.1080/17530350.2026.2678262

To link to this article: https://doi.org/10.1080/17530350.2026.2678262

Published online: 04 Sep 2026.

JOURNAL OF CULTURAL ECONOMY
https://doi.org/10.1080/17530350.2026.2678262

Inscription networks: finance, infrastructural power, and the governance of climate risk

Savannah Cox [a], John Hogan Morris[b] and Zac J. Taylor[c]

[a]Urban Studies & Planning, University of Sheffield, Sheffield, UK; [b]Geography, University of Nottingham, Nottingham, UK; [c]Department of Management in the Built Environment, Delft University of Technology, Delft, Netherlands

ABSTRACT

The decade since the Paris Climate Agreement has seen soaring demands for climate risk information within the financial sector. While much scholarship attributes these developments to novel disclosure-oriented governance regimes, we situate them in longstanding state-market entanglements. As climate impacts intensify, markets now central to state operations – property, bond, insurance, and securities markets – are confronting new forms of destabilization. These pressures generate heightened demand for climate risk knowledge – and, elevate the profile and authority of incumbent private authorities whose risk assessments have long steered market behavior. We show how Moody's Investor Services and its analytics arm are expanding and consolidating their authority by producing and circulating consequential inscriptions of climate risk across the markets in which it is embedded. We refer to these pathways as climate risk inscription networks, and suggest that they exercise a significant amount of power over how climate change is governed today. By supplying property, bond, insurance, and securities markets with authoritative climate risk information, these networks are fueling and reinforcing uneven geographies of (dis)investment, speculation, and decline. As importantly, these networks are shifting the terrain of climate governance toward financial practices of risk management.

ARTICLE HISTORY
Received 24 July 2025
Accepted 12 May 2026

KEYWORDS
Climate change; risk; climate risk; finance; infrastructural power; Moody's

A critical juncture for action on physical climate risk?

> 'Financial markets and private companies … are in an "arms race" for climate intelligence. Some firms have announced decarbonization plans, while others are pledging to double down on fossil fuels. Regulators, struggling to keep up, have asked for more disclosure'
> - Lee Harris, *The American Prospect*, 2023.

In 2023, commentators described an emergent 'gold rush' in physical climate risk analytics: explosions in demand for information on the exposure of people, land, and property to the risks of extreme weather and related losses. This burgeoning business of physical climate risk data and analytics has been fueled at least in part by the widespread adoption of sustainability analysis and reporting requirements by regulators, banks, and other financial institutions following the 2015 Paris Climate Agreement (Condon 2023). It stands to grow even further as states – including the

CONTACT Zac J. Taylor z.j.taylor@tudelft.nl

United States – backpedal on their climate mitigation commitments, thereby heightening the financial system's exposure to the physical consequences of climate change (Clark 2025).

A significant body of scholarship has argued that this seemingly novel 'gold rush' reflects longstanding modes of neoliberal governmental reasoning. If armed with appropriate information, markets can accurately price risk – including climate risk (Bracking 2019; Bracking and Leffel 2021; Christophers 2017). This work has been essential in explaining why recently-assembled disclosure regimes, taxonomies, and reporting standards have become such prominent sites and forms of climate governance. Yet this focus on problematizing the supposed novelty of formal disclosure regimes and diagnosing their underlying logics risks overlooking a second, equally consequential driver of demand for climate risk information: growing awareness of, and anxiety about, climate change among markets that have become infrastructural to state operations – chiefly property, bond, insurance, and securities markets (Braun 2020; Braun and Gabor 2020). As climate impacts intensify, disruptions or anticipated losses within these markets create pressures to recalibrate what counts as risk. These pressures generate powerful new demands for climate risk knowledge, and in turn elevate the status of incumbent private authorities whose risk assessments have become integral to how these markets function. Seen through this lens, the climate risk 'gold rush' is not only indicative of 'old' neoliberal reasoning or governance styles taking on new forms. It is also an effect of how key players within longstanding state-market entanglements are themselves beginning to govern climate change: through financial infrastructures and mechanisms that were never designed to address it.

Our analysis explores how and to what effect such governance is taking shape today. To do so, we combine work on infrastructural power in international political economy with work on inscription devices developed in governmentality studies and science and technology studies (Latour 1987; Miller and Rose 1990). Inscription devices are the individual techniques that render complex phenomena such as risk into simplified representations, or inscriptions, that can travel (e.g. credit ratings or hazard maps). We show that consequential inscriptions of climate risk are moving through property, bond, insurance, and securities markets in two key ways: directly, through new climate-specific models and hazard maps, and indirectly, through climate proxies such as credit ratings, property values, and insurance premiums. We refer to the pathways through which these inscriptions move as *climate inscription networks*: epistemic circuits through which climate risk becomes intelligible, authoritative, and actionable to actors across these markets and the institutions that depend on them – often via proxies that have no explicit reference to climate change.

To understand how these inscription networks take shape and with what consequences, we examine an exemplary institutional site from which climate inscriptions are being made and made to travel: Moody's Corporation. Valued at US$89bn, Moody's Investor's Services rates the creditworthiness of state and corporate borrowers, while its analytics branch Moody's Analytics provides ancillary economic research and consulting services (Cash 2018a). We show how the circulation of risk inscriptions across multiple nodes within the Moody's network – forged through decades of growing reliance on its private risk knowledge in the public and private sector – is shaping private and public sector action on climate change today. These inscriptions and the routes along which they travel are also generating and consolidating new forms of power. As financial systems and their constitutive parts – from homeowners and cities to regulators and banks – grapple with a rapidly warming world, actors like Moody's are positioning themselves as vital, for-profit authorities on climate change. In becoming crucial arbiters of where climate risk resides and over what time horizons it matters, Moody's and similar risk rating authorities are already shaping geographies of (dis)investment, speculation, and decline – and in ways that often elude conventional modes of contestation, deliberation, and debate.

The article is structured as follows. The next section situates our argument within broader scholarly debates on climate governance and infrastructural power, and outlines the methodological approach used to trace climate inscription networks. The third section draws on extended fieldwork to examine how Moody's climate risk inscriptions – both direct climate assessments and indirect proxies – circulate across municipal bond markets in the United States, institutional real estate

finance, central banking, and insurance-linked securities markets. The fourth and final section reflects on the implications of these findings for how climate risk is being governed today and considers the broader stakes for climate politics.

Infrastructural power and inscription devices: ways of following emergent forms of climate authority

Many scholars locate the climate risk analytics 'gold rush' in the proliferation of (supra)national financial sustainability initiatives over the past decade (Bracking 2015, 2019; Bracking and Leffel 2021; Christophers 2017; Grote and Zook 2022; Maechler 2023). Initiatives such as the Task Force on Climate-related Financial Disclosures (TCFD), the International Sustainability Standards Board, and the European Commission's Platform on Sustainable Finance created sustainability taxonomies, reporting standards, and risk disclosure regimes in the expectation that better information would make climate change a 'relevant notion' for domestic financial sectors and political systems and in turn shape market behavior (Engen and Asdal 2025, 462).

As these initiatives have rolled out, scholars have investigated their logics and governance effects. The substantial confidence placed in disclosure for improving decision-making has led several scholars to conclude that initiatives like the TCFD express rather than depart from neoliberal governmental rationalities – rationalities which have long organized climate governance (see, e.g. Böhm, Misoczky, and Moog 2012; Lohmann 2010; Newell and Paterson 2010). In one prominent account, Christophers (2017, 1109) stresses that initiatives like the TCFD are 'predicated on explicitly neoliberal understandings of both (financial) market dynamics and the behavior of institutional actors in those markets: […] markets are efficient and process relevant information with such efficiency that market prices always incorporate and reflect all such information.' In other words, once climate risk is reported through initiatives like the TCFD, relevant markets and institutional actors will take it into account through pricing and investment. The stakes for market-oriented climate governance are clear: as far as market stability is concerned, climate change requires little more than a "light touch' regulatory approach' (ibid, 1109). Others have extended this critique further, arguing that the 'products and market experiments' emerging in Paris-era climate finance initiatives do more to 'concentrate [power] with financial actors' than promote 'accountability and transparency' and may therefore not be up for the task of addressing climate change (Bracking and Leffel 2021, 2, 17).

These accounts are crucial for explaining why disclosure regimes have become central sites of climate governance. Yet a focus on the broader neoliberal logics of disclosure may obscure a second source of demand for climate risk information: the strain that climate change is placing on the very markets on which states now depend to perform core functions. States have long relied on property, bond, insurance, and securities markets to support public provision, from financing infrastructure and providing housing to pooling risk and transferring catastrophic losses. When these markets face mounting, climate-linked losses or volatility, existing repertoires for assessing and allocating risk come under pressure. These developments, in turn, heighten the need for new forms of climate risk knowledge. As importantly, the same developments amplify the influence of the actors whose risk assessments already steer these markets – especially rating agencies, which are longstanding brokers of risk knowledge across market contexts.

To develop this point, we draw on scholarship in international political economy and economic sociology, and on recent work theorizing infrastructural power in particular (Biersteker and Hall 2002; Braun 2020; Braun and Gabor 2020; Fourcade 2017; Fligstein and Habinek 2014; Petry 2021; Strange 1996; Wansleben 2023). Braun (2020, 397) animates his work on infrastructural power with the following puzzle: why did financial sector interests 'win' in economic governance reforms following the financial crisis? Where some would point to financial sector capacities to lobby regulators (instrumental power) or their general, 'too big to fail' importance in the global economy (structural power), Braun (2020, 400) directs attention to specific ways in

which financial markets have become embedded in states (see also Pagliari and Young 2016; Young and Pagliari 2017; Woll 2016). In recent decades, Braun notes, central banks increasingly turned to specific markets – in this case securitization and repo markets – to implement monetary policy. This reliance created what Braun terms an *infrastructural entanglement*: a condition in which financial markets and their mechanisms become embedded in, and indispensable to, the operations of states. Importantly, these entanglements do more than create and maintain state dependencies on markets. They also grant those markets and their specific mechanisms infrastructural power:[1] capacities to shape and steer decisions among the actors who have come to rely on them.

Our central claim is that these infrastructural entanglements are not just key drivers of the contemporary 'gold rush' in climate risk analytics; they are also the central channels through which authoritative knowledge about climate risk travels today. Yet this claim raises a crucial analytical question: how is climate risk made into the kinds of knowledge that can circulate across these channels? To answer that question, we bring IPE traditions to science and technology studies as well as governmentality scholarship. These fields emphasize that liberal forms of government depend in crucial respects upon intellectual technologies, practical activities, and social authority associated with expertise (Miller and Rose 1990). One crucial dimension of expertise, and thus the exercise of power, is the inscription device: a technology such as a map, figure, or chart that reduces aspects of the world into two-dimensional, calculable forms and representations (Latour 1987; Rose-Redwood 2006, 2012; Rose and Miller 1992). These devices establish a 'route' or network of travel between the world being represented and those observing (or producing) its representation, thus enabling the former to be governed from a distance. Understood this way, power is distributed and operates through networks that include humans, but also 'equipment, technical devices, and algorithms' (Callon 2005, 4).

When gauged through the lens of infrastructural power, inscription devices become central to understanding how financial markets govern climate change and animate contemporary turns toward disclosure. It is not just that these markets lobby for 'light touch' measures such as climate risk disclosure frameworks, or are likely to receive them anyway given the neoliberal logics underlying those frameworks (Christophers 2017). It is that financial markets already depend on risk inscriptions – whether related to creditworthiness (the credit rating), property valuation (the property value), or exposure to various hazards or losses as in insurance markets (the insurance premium or catastrophe model output) – to guide their own behavior.

As the climate changes, two important dynamics emerge. First, these markets are demanding new inscriptions of risk – for example, models that illuminate asset exposure to flood risk. Second, already existing inscriptions – such as bond ratings, property values, and insurance premiums – are taking on a new valence: they are *proxies* for climate risk. That is, they act as authoritative representations of climate risk and vulnerability even if they make no explicit reference to climate change at all (Cox 2022; Elliott 2026; Gray 2021; Kob 2020; Taylor 2025).

In such cases, financial markets govern climate futures not only by measuring or anticipating climate change and related hazards. They also do so by translating losses and risks that can be associated with climate change (e.g. large-scale property damages from a wildfire or flood event) or broader structural conditions that climate change is expected to intensify (e.g. a dwindling tax base) into inscriptions that are already intelligible to, and circulating across, financial markets and the states that rely on them (see Collier and Cox, under review). These inscriptions include asset and insurance premium prices, portfolio weighting, and bond ratings, among other examples. It is through (1) the creation and combination of climate inscriptions – both direct climate risk assessments and indirect climate proxies – and (2) their circulation across existing state-market entanglements that climate change is increasingly being evaluated and acted on by the financial sector. We refer to the routes along which these inscriptions travel as *climate inscription networks*, which we suggest are an increasingly consequential terrain of climate governance.

Tracing climate inscription networks: some reflections on case selection and methodology

This paper emerges from a broader, multi-year research trajectory focused on climate risk and financial governance. Rather than beginning with a single site or actor, our approach and argument developed through three separate research projects that, we would come to see, were deeply related: one examining municipal bond markets and urban climate adaptation; a second investigating central banks and climate-related stress testing; and a third exploring real estate- finance, climate risk, and re/insurance (Cox 2022, 2025; Morris 2018; Morris and Collins 2023; Taylor 2020; Taylor and Aalbers 2022; Taylor and Knuth 2025). Across these domains, one actor – Moody's – repeatedly surfaced as consequential: not simply as a provider of climate analytics, but as an authority whose ratings, expertise, and reports were routinely embedded in regulatory documents, investment and underwriting protocols, and public sector planning.

That Moody's emerged as a center of analytical gravity for this work is, in retrospect, unsurprising. As large parts of the climate transition have been formally or effectively delegated to financial markets, the pivotal risk assessment mechanisms already employed in those markets have been empowered further – chief among them rating agencies, whose ascent and operations we now briefly sketch out (Downey 2025; Eich 2025; Folkers 2024; Gabor and Braun 2025). The big three rating agencies – Moody's, Standard & Poor's, and Fitch – have long acted as 'cognitive life of capital' (Sinclair 2005, 62). During the twentieth century, states and corporations increasingly turned to capital markets to finance their operations and needed some indicator of investment risk. Rating agencies already offered those indicators in the form of ratings, which they often refer to as 'opinions' on the likelihood that a corporation or (sub)sovereign state will default on debt obligations. Importantly, these ratings operated not merely as market signals; they also acted as private mechanisms of economic governance, structuring access to credit and shaping capital flows (Fourcade 2017; Sinclair 2005, 62).

In the 1970s, states began formally embedding credit rating authority in regulatory frameworks (Barta 2025). In 1975, for example, the US government designated Moody's, S&P, and Fitch as Nationally Recognised Statistical Rating Organizations (NRSROs), which meant that their ratings would be referred to in a range of financial regulations[2] (Cash 2023). To be widely held, a security would need a rating from at least one, if not two NRSROs. As Abdelal and Blyth (2015) argue, the subsequent wave of financial internationalization in the late 1980s and early 1990s further consolidated the authority of ratings and the rating agencies who provided them, as access to US capital markets became increasingly contingent on ratings issued by NRSROs. A similar dynamic unfolded in Europe. The creation of the Euro area required new rules for collateral eligibility, and in 2005 the European Central Bank (ECB) effectively delegated the determination[3] of eligible collateral to private rating agencies (Orphanides 2017). Later, the ECB would further extend this delegation by allowing rating agencies to determine the eligibility of sovereign debt as collateral (Orphanides 2020).

Taken together, these regulatory changes help to explain how the 'opinions[4]' offered by rating agencies have become infrastructural in multiple spheres of public and private economic life – and why, as we will see, financial market players who have come to rely on them have welcomed the incorporation of climate risk into Moody's' operations. At a practical level, Moody's' climate maneuvers remove the need for analysts, traders and investors to engage directly with unfamiliar climate metrics or alter existing risk practices, regardless of how well climate risk can be effectively translated into credit risk metrics (see van 't Klooster and Prodani 2025). Most importantly, because credit ratings anchor expectations about asset liquidity (Barta 2025), folding climate risk into ratings ensures that climate change is governed through existing judgments about market safety and tradability.

To show how these climate risk inscriptions are being produced and circulated across the markets in which Moody's is already enmeshed, we employed what economic geographers have

described as a 'following' method (Cook 2004). This approach involves tracing the circulations of financial instruments, metrics, and actors across space and time in order to demystify the social and epistemic relations that (re)produce financial systems. As such, it generated substantial primary and secondary material – archival documents, policy reports, interviews, and fieldnotes – that we cannot present in full here (see Table 1). What we offer instead is a focused account that selectively draws on this broader empirical archive to illuminate how and to what effect Moody's has come to constitute a climate inscription network.[5] We explore four key nodes of this network: municipal bond markets, central banking, real estate-finance and insurance-linked markets (see Table 2). In particular, we investigate: (1) how inscriptions such as qualitative and quantitative climate risk scores, climate surveys, and catastrophe models are traveling from Moody's to each node, and (2) how these inscriptions are shaping specific climate governance practices – specifically on urban resilience, climate risk assessment and regulation, and climate stress testing – across each node.

Climate authority in formation: the case of Moody's

Municipal bond markets

In November of 2017, Moody's Investor Services announced that it would account for climate vulnerability in its municipal bond rating practices. Given the high climate exposure of the predominantly North American municipalities that comprise much of the US$4 trillion municipal bond market – one of the world's largest public borrowing markets – many investors welcomed the development. Reinsurance executives interviewed, for example, said that they had lobbied rating agencies to incorporate climate vulnerability into the municipal bond rating process – an implicit concession of rating agencies' infrastructural power. Executives reasoned that the incorporation of climate vulnerability in rating processes could push municipalities to reduce their climate risk exposure – in no small part because many cities rely on bond markets, and therefore strong credit ratings, to pay for infrastructure, and will want to act in ways that are 'rewarded' by bond markets. The payoff for reinsurance was clear: official investments in risk reduction could reduce insured losses and prompt purchase of reinsurance products (Personal Interview, 21 June 2018).

But what the firm's risk accounting would mean in practice, and how it would be made actionable, remained opaque. As we learned in interviews with agency officials, Moody's analysts faced two main challenges: identifying the climate exposure of individual municipalities, and determining how to translate that exposure into ratings. The answers to these questions are ongoing.[6] But they are also beginning to steer what counts as 'valuable' climate governance in cities.

A handful of inscription devices and practices help explain how and to what effect Moody's is answering these questions. According to publicly available reports on its climate methodology, Moody's initially drew from public sources, like the National Climate Assessment, to disaggregate

Table 1. Data collection and research methods.

Node	Methods
Municipal bonds	14 interviews with rating agency analysts and local government officials; 30 hours of participant observation at relevant local government adaptation and resilience events, Moody's climate risk webinars; documentary analysis of relevant Moody's reports and local government planning documents.
Real estate-finance	15 interviews with senior real estate-finance industry actors and climate risk consultants in North America, Europe, and Southeast Asia; organization or participation in multiple climate risk and real estate expert roundtables in the US and EU; extensive participant analysis at industry fora; documentary analysis of relevant Moody's reports and real estate-finance industry gray literature.
Central banking	7 interviews with participants in the 2021 CBES; 40 hours of participant observation at relevant industry and supervisor climate stress testing and scenario analysis webinars; documentary analysis of relevant reports, and publications from RMS, Moody's, the Bank of England, the BCBS and the NGFS.
ILS markets	10 interviews with catastrophe risk analysts and (re)insurers; 40 hours of participant observation at relevant climate science and insurance fora and workshops; documentary analysis of relevant Moody's reports, and publications from the NGFS and CGFI.

Table 2. Risk inscriptions and their networks.

Node	Primary interest in climate risk	Key Inscriptions	Route of Travel	What's happening?	To what effect?
Municipal bond markets	• Contribution to the odds of bond default	• Localized climate data sets • Climate exposure scores for properties • Surveys and local news • Prior bond ratings	• Rating agency analysts to rated municipalities, officials • Municipal officials to taxpayers (asked to approve a bond backed by property taxes)	• Identifying 'where' and 'what' climate risk is in municipalities, and the time horizons over which climate risk matters in a credit rating • Establishing indicators of local 'resilience' and 'vulnerability' to climate change • Identifying measures that can 'reduce' vulnerability and build resilience	• Short time horizons, e.g. the 10–15 year horizons of a bond, frame understandings of when climate risk matters • Existing credit risk indicators become climatized (e.g. indicators of climate vulnerability) • Governments prioritize adaptation investments that secure vital infrastructures, tax bases
Real estate-finance	• Contribution to the odds of credit (default) risk (for securities) and devaluation or stranding (for assets) • (Re)insured losses	• Climate data sets • Catastrophe risk models • Maps • Transaction ratings	• Risk advisory to institutional investors and financiers Institutional investors and financiers to regulators Institutional investors and financiers to peers and local property market actors	• Assessing property-level exposure to catastrophe risk within existing pools of commercial mortgage-backed securities	• Climate risk established as a potential problem for institutional investors in commercial mortgage-backed securities • Potential risk management solutions delineated for investors, e.g. additional insurance products
Central banks	• Asset impairment • Expected credit losses • (Re)insured losses	• Climate data sets • Climate and weather models • Scenario software • Stress test results • Maps	Central banks to banks and insurers Risk analytics firms and consultancies to banks and insurers Banks and insurers to central banks	• Assessing bank and insurer exposure to physical risks • Reporting of methodologies and exposures to supervisors • Public release of aggregated financial loss estimates by supervisors	• Banks building in-house capabilities in climate risk modeling • Insurers considering a wider range of perils, exposures, and geographical regions in their risk assessments • Home insurers setting higher premiums or withdrawing from particular geographic regions

(*Continued*)

Table 2. Continued.

Node	Primary interest in climate risk	Key Inscriptions	Route of Travel	What's happening?	To what effect?
ILS markets	• Likelihood of (insured) losses of a particular magnitude	• Catastrophe risk models • Property exposure data sets and AI models • Casualty risk data sets and AI models • Questionnaires	Risk analytics vendors and cat modelers to (re)insurers Risk analytics vendors and cat modelers and (re)insurers to ILS market investors ILS market participants to Moody's Ratings	• A series of mergers and acquisitions relating to casualty and post code level property exposures to extreme weather • Market research ascertaining demand for new ILS ratings methodology	• Consolidation of core expertise, data, inscriptions and reputational capital in catastrophe risk modeling • (Re)insurers pricing property risk with greater granularity • Climate change included and priced as a type of casualty risk • Machine Learning used to fill in the gaps in data sets used by re(insurers)

climate risk exposure (e.g. to extreme heat, drought, and sea level rise) across time and space. However, the firm has increasingly turned to private companies, like climate data firm 427 Management (427) for quantified municipal climate knowledge. Analysts at 427, in which Moody's Analytics purchased a majority share in 2019, pitched their firm's value through its ability to create future-oriented climate exposure scores at the city- and county level. According to 427 documents (427 2018), analysts create these scores through a proprietary index method, which combines several precipitation- and temperature-based indices for individual counties and cities and enables their comparison. Importantly, indices draw on historical conditions in their forecasts, which as of this writing extend from 2030-2040. For one analyst interviewed, the short time horizons of the index method have led her to discount the importance of longer-term climate risks, like sea level rise, in her evaluations of municipal climate vulnerability (Personal Interview, 20 January 2019). A focus on shorter term climate risks has persisted in rating agency analyses, which analysts justify by pointing to the shorter-term horizons of municipal bonds themselves (Personal Interview, 24 November 2024).

Quantitative exposure scores are just one inscription in Moody's' emerging municipal climate knowledge. Much of that knowledge comes from qualitative sources, such as local newspapers, surveys and phone calls with municipal officials.[7] In exchanges with officials, analysts draw on exposure scores and local media coverage on climate change to ask geographically specific questions about a municipality's climate risk. In the low-lying city of Miami Beach, for instance, analysts ask how sea rise will impact its economy and tax base, as well as how and when officials will address those impacts through capital planning (Personal Interview, 19 June 2019). But in interview after interview, the most important inscriptions of climate risk – already existing bond ratings and those issued after a disaster – had nothing to do with climate change per se. Indeed, many were issued well before Moody's said it would begin to take climate change into account in its rating process. Moreover, climate change only mattered insofar as it would impact a municipality's ability to make debt payments – a judgment that analysts admitted was in some regards speculative (Personal Interview, 24 November 2024). Nevertheless, because these ratings speak to the relative strength or weakness of a municipality's economy – itself the key item of concern for rating agency analysts in general and as the climate changes – they increasingly act as climate proxies: authoritative

indicators of how a municipality is likely to fare in future disasters (Personal Interview, 21 January 2018; 20 November 2024).

At the time of writing, analysts have not by and large priced climate risk into their operations (Klusak et al. 2021). And yet, the firm's announcement has still compelled or reinforced the decisions of many municipal governments to act. In the words of one official in Broward County, Florida, 'the general increase in solicitation of information about [climate] resilience weighs heavy … it calls all of us to be much more engaged on the resiliency initiatives and organize infrastructure and planning standards to minimize our risks' (Personal Interview, 30 January 2019). These sentiments were echoed by resilience officials in New Orleans, who suggested that Moody's 'holds the key to [their] future,' and that their growing focus on climate change made it imperative that 'they get their [resilience] planning right.'[8] Other officials interviewed indicated that they welcomed Moody's announcement. For these officials, and pointing to the infrastructural power that the agency wields in cities, Moody's highly publicized forays into climate risk gave the devising and implementation of urban climate adaptation plans a sense of urgency that they had otherwise lacked among key groups. As one land use attorney and sea level rise official in Miami told us, 'it just helped make the business case for resilience. Once we could show that climate change isn't just some future environmental problem but an economic [problem] that is already eating away at our pockets, we got more people at the table [for resilience planning]' (Personal Interview, 20 June 2019).

Of course, and as these quotes suggest, the agency's growing interest in climate risk – and the particular inscriptions that help collect and reflect that risk – have done more than support or incentivize climate action among municipal governments. They have also shaped how municipal governments frame the value of climate action more broadly and thus the kind of work that climate action should do. In public and private settings, urban officials often couch the worth of resilience measures – think storm-proofing buildings and key transportation systems, for instance – in terms of creditworthiness (see City of Miami Beach 2019; City of Virginia Beach 2016). These framings help explain and justify why officials often prioritize adaptation and resilience projects that safeguard property values – the backbone of creditworthiness – over those that mainly promote social wellbeing (Cox 2022). As importantly, municipal officials feed these projects back into rating agency offices via Moody's climate surveys and telephone calls on the subject. In doing so, these officials are not simply responding to questions; they are also bolstering rating analyst understandings of urban climate resilience – and thus shaping analyst expectations of what they should observe in other cities that are taking climate risk 'seriously.' In other words, through the use of inscription devices such as surveys, interviews, and prior bond ratings, Moody's is increasingly becoming an authority regarding what 'counts' as resilience, and a powerful if not surprising ally among urban resilience advocates. This is a clear instance of infrastructural power (Braun 2020). Even in the absence of formal pricing changes, the embeddedness of Moody's ratings in municipal operations leads government officials across a range of urban economies to reorganize their planning and communication around what they believe rating agencies will want to see.

Real estate-finance climate risk assessment

Inasmuch as the growing authority of Moody's' climate inscriptions catalyzes climate actions in municipal governments, its authority also reverberates to another critical terrain of state-market entanglement: real estate-finance. To generate tax revenues and fund public services, US local governments often rely on property markets – (see Shi and Varuzzo 2020), and institutional real estate investors play an increasingly important role in them (see Aalbers et al. 2023). How real-estate finance actors understand and act on climate risk therefore stands to greatly shape the fates of cities, states, and other financial actors that rely on property markets as the climate changes. And here, Moody's also emerges as a key broker of risk knowledge.

In parallel to developments in municipal bond markets, Moody's has rolled out climate risk analysis services for real estate-finance actors, from large institutional investors and their asset managers to the buyers of secondary market products like commercial mortgage-backed securities. Institutional real estate-finance actors channel trillions of dollars of capital into variegated geographies of property through a variety of instruments and strategies, ranging from mortgage products to investment trusts (Aalbers et al. 2023). Moody's' rationale here tracks with the case of municipal bond assessments of climate and credit risk: real estate-finance institutions must increasingly grapple with the climate risks embedded in the assets in which they are invested, yet lack well-established, consistent and comparable means for doing so (Elsamny 2026; Taylor and Erasmus 2022; Vanhuyse, Piseddu, and Moberg 2023).

Traditionally, institutional real estate-finance actors defer to re/insurers to manage the catastrophe risk exposure of the assets they finance or in which they invest (Taylor 2020). Statements like 'if it's insurable, it isn't a material concern for us' are common refrains in the sector. Such sentiments speak to the authority ascribed to re/insurers, risk modelers and other advisors crucial in the working of this market. However, shifting regulator demands for sustainability disclosure, capital provider demands for sustainability-aligned funds, and, in a growing number of cases, rising costs of re/insurance and worries about protection gaps in underlying portfolios, are fueling demand for more bespoke climate risk analytics in the sector, above and beyond the climate risk proxy offered by an insurance premium. At the same time, institutional real estate-finance actors face a wide range of challenges for assessing and acting on climate risk. These range from ambiguity about new and competing regulatory regimes, to a lack of well-codified tools and decision-making processes to interpret and act on climate risk information. Moreover, demands for, and cultures of, risk assessment and management vary between types of real estate-finance actor and within the geographies in which they invest: Dutch commercial real estate investors adopt distinctive risk taking appetites and mitigation strategies in comparison to Singaporean peers, for example (Taylor and Erasmus 2022).

Amid this complexity, drives to institutionalize climate risk assessment are, in the words of a senior representative from a major institutional investor in the US, 'a challenging time (…) because all of these traditional indicators and models are pointing to conclusions that may be different from a climate-centric way of thinking' (ibid, 13). Here, the investor drew a sharp contrast between the short-term boom prospects in markets like Greater Miami and longer-term questions about the region's capacity to offset the effects of climate change. A second investor phrased this dilemma somewhat differently: 'How do we start to make decisions in the absence of clear information which is aligned with what we believe to be the right long-term trajectory of our investments?' (ibid, 13).

Against this backdrop, a lucrative if unwieldy market for real estate-finance climate risk assessment has emerged at this juncture of regulatory, analytical, and decision-making uncertainty, with Moody's capitalizing on it. Just two years after acquiring 427, Moody's announced a $2 billion plan to acquire RMS, one of the largest vendors of catastrophe risk models ('cat' models), a crucial climate inscription device. The purchase provided Moody's with access to RMS's proprietary catalogue: some 400 cat models in 120 countries (Moody's 2021). Widely used by property re/insurers globally, cat models are actuarial devices that distill several contingencies – physical hazards, engineering characteristics, and financial data – into a probabilistic assessment of potential losses. Model outputs shape risk finance market practices by guiding how re/insurers price risk, where they write policies, the extent to which they choose or are required to procure additional capital to pay for potential losses, and how they are regulated by sovereign authorities (Gray 2021; Taylor 2025). Cat models help forge broad consensus around the very idea that low probability, high impact catastrophic events can be made legible with sufficient confidence to attract large volumes of risk financing capacity at reliable rates of return, by way of transnational re/insurance markets (Johnson 2013; Taylor 2020). By virtue of these crucial sense- and market-making functions, many financial

institutions, including but not limited to re/insurers, increasingly look to cat models to render the complexities of climate risk into actionable insights – even if models themselves are generally premised on historical events, rather than forward-looking projections (Colven et al. 2025; Taylor 2025). In acquiring RMS, Moody's thus bought a profitable position as one of the core authorities on risk management within the financial system.

Building on this acumen, Moody's jointly markets inscription devices such as RMS cat models and 427 risk maps to real estate-finance actors seeking climate risk insight. As a proof of concept, Moody's deployed cat models to investigate the property-level catastrophe risk exposures baked into pools of commercial mortgage-backed securities (CMBS), collectively worth $368.7 billion (Salz, Wheeler, and Webb 2022). Following the exercise, Moody's implored would-be CMBS investors to 'ask questions' about insurance coverage on the assets underpinning the highest-risk loans, whether 'business interruption insurance has been sufficiently sized' for commercial tenants, and if the underpinning assets have a sufficient geographical diversification regarding their physical risk exposure (ibid, n.d.). While such questions are clearly intended to highlight Moody's' services for sale, they also reinforce a particular range of problem- and solutions- framings, which seek to secure the financial returns of individual firms or instruments, rather than to facilitate material risk reduction per se. Acting on this line of thinking, a real estate-finance institution may come to purchase more insurance, charge a risk premium for capital given the underlying exposure of an instrument, or more explicitly disclose exposure to hazards to other stakeholders in the value chain to meet their climate risk management mandates.

The CMBS demonstration is also one of several examples of how Moody's seeks to integrate physical climate risk analysis with its proprietary catalogue of conventional property-, market- and deal-level data – all regularly used by financial institutions to assess, evaluate, and at times rate the creditworthiness of real estate transactions. These demonstration exercises aim to show longstanding financial institutions how they can incorporate climate risks within an incumbent field of investment risk assessment practice, as they struggle to distill climate complexity and contingency into indicators and actionability (Taylor and Erasmus 2022). In other words, the integration of cat models with a broader suite of property market analytics is a means of confidence-building: it '[enables] (real estate) industry participants to build resilience into their portfolios and engage in more forward-looking decision-making,' in the words of one Moody's executive (Pollack 2021, n.d.). That is, Moody's does more than capitalize on real estate-finance institutional demand for risk analytics; it helps to cohere, codify, and inculcate authoritative ways of understanding and acting on real estate-finance climate risk in an emergent and fragmented landscape of knowledge, interests, and responsibilities.

The take-up of inscription devices devised and circulated by Moody's has crucial implications for how stakeholders entangled within the real estate-finance system act on climate change – and expect others within the system to act on it. Such authority fosters networked forms of anticipation, bringing real estate climate risks into the present, traveling from investor and re/insurers' board rooms to city planning departments in frontline 'risky' cities, and to local buyers and small-time investors in those very places in ways that begin to remake property relations in the present in uneven ways (Knuth et al. 2025; Taylor 2025; Taylor and Aalbers 2022).

Climate risk assessment in banking and insurance

The expanding use of climate stress testing in banking and insurance offers a powerful window into how climate inscription networks extend into regulatory regimes – often via tools developed by incumbent actors like Moody's. This section illustrates how central banks and financial regulators, while seemingly directing climate governance agendas through mandated disclosures and scenario analysis, are increasingly reliant on private infrastructures – risk models, consulting services, and climate data providers – to execute these mandates. What emerges is a recursive, state-market

entanglement in which Moody's and its subsidiaries help define the terms and techniques by which financial institutions and regulatory bodies are expected to know and govern climate risk.

In the past five years, over 30 central banks who are members of the Network for Greening the Financial System have required banks and insurers they supervise to undertake climate scenario analysis exercises. These exercises aim to (1) help banks and insurers understand the climate risk exposure of their business models pending specific government policy actions on decarbonizing economies, and (2) devise actions to address climate risks today and in the future (Morris and Collins 2023). For example, in 2021 the Bank of England required regulated banks and insurers to model and report the losses they could expect to accrue across three stylized scenarios: early, late, or no additional UK policy action towards achieving Paris Agreement temperature targets. While climate change is a new issue for central banks, climate stress testing is not a wholly novel activity (Langley and Morris 2020): it effectively modified elements of the processes and methodologies of the Bank of England's existing stress testing regimes for banks, treating climate change as an 'exploratory risk' alongside innovations in Fintech, disruptions in shadow banking, and a severe liquidity freeze (see Morris and Collins 2023).

While the Bank of England's stress tests are nominally state-driven,[9] the channels through which they are enacted are deeply private. Moody's subsidiary RMS produces analytical tools which some regulated banks and insurers employ when they undertake modeling exercises. RMS had previously assisted UK insurers who had participated in the Bank of England's 2019 General Insurance Stress Test with their analyses of exposures to physical risks (Matthewman 2021). RMS' well established reputation in the private sector for its risk modeling was attractive to insurers undertaking the CBES. As one participant said, the 'integration of the latest science relating to climate change' through the proprietary RMS Climate Change Models allowed them to 'confidently assess North Atlantic hurricane climate change risks' (RMS 2021, n.d.).

Although 2021 CBES participants later expressed skepticism regarding the usefulness of the headline loss figures generated through the tests (CFRF and CGFI 2023a, 2023b, 2023c), it is still clear that the practices undertaken, and devices used, by stress test participants are shaping climate risk management trajectories and the understanding of climate-related risk in the financial sector. For one, the tests consolidated the epistemic authority of firms that collect and analyse climate data because 'the wisdom of the market' became 'the wisdom of a few key third party providers' CFRF and CGFI 2023c, 6). Furthermore, the underlying climate risk models are becoming highly profitable industry standards within a domestic financial system that is still relatively self-regulating. Participating banks report that the stress testing exercises have prompted them to build in-house modeling expertise (CFRF and CGFI 2023b), which UK regulators like the Bank of England are keen to see as part of their ongoing efforts to make the UK 'an increasingly conducive and low-friction location for (re)insurers [and insurance-linked securities business] to take off' and thrive (Evans 2023). Moreover, the stress testing practices have engendered incremental change in the ways that banks analyze risk by 'connecting across datasets that had not been connected before' (CFRF and CFGI 2023b, 4).

Underscoring the ways in which Moody's practices are becoming embedded in organizational practices well beyond it, participating insurers have also called for more integration of CBES scenarios into the catastrophe and climate risk models provided by third party vendors. Integration in turn would require greater coordination between government regulators and risk modeling firms such as RMS (CGFI 2023a). Meanwhile, the insurers advancing central bank interests by using RMS models are considering a wider range of perils, risk exposures, and geographical regions in their work (CFRF and CGFI 2023a), thus presenting the possibility of creating new re/insurance markets. However, these profitable advances come at a cost: insurers report that they expect to transfer increased (climate-linked) losses onto policyholders through higher premiums (Bank of England 2022).

Moody's has since sought to capitalize on its climate stress testing reputation by partnering with management consulting firm McKinsey & Company to develop and sell climate stress testing and

scenario analysis tools, which they are marketing to banks and insurers beyond the UK who will be subjected to regulatory climate stress tests in the future (Segal 2022). Such tools therefore stand to set precedents regarding what 'cutting edge' risk management practices consist of among public regulators and thus inform debates about whether to take more muscular regulatory interventions, such as revising capital requirements or demanding banks and insurers produce detailed transition plans.

Consolidating and extending authority in insurance-linked securities (ILS)

Where prior sections explored the ways that Moody's inscriptions are circulating through existing state-market entanglements, this fourth and final example emphasizes prefigurative action: the ways that Moody's is anticipating future demands within the insurance-linked securities (ILS) market and, in doing so, paving the way for new entanglements. States, insurers, and reinsurers increasingly turn to ILS markets – especially catastrophe bonds – to transfer disaster risk to capital markets (Johnson 2013; Taylor 2020), thereby creating new and deepened forms of financial interdependence between public and private institutions. Moody's 2021 acquisition of RMS enables it to market a range of consultancy services and software packages relating to the impact of catastrophic events, portfolio analyses, risk transfer mechanisms, and risk modeling tools for underwriters, ILS portfolio managers, analysts, and investors (Moody's n.d.). At one level, this acquisition represents a straightforward expansion of Moody's services, particularly in the climate risk knowledge domain. More significantly, however, it positions Moody's to play an important role in the emerging field of climate risk securitization. By integrating RMS modeling capacities into its broader ecosystem of ratings, climate data, and analytics, Moody's is positioning itself to define future standards of risk assessment and provide the tools on which re/insurers and ILS market participants increasingly rely. In doing so, it may help shape how capital flows to disaster-stricken states and communities, influencing their ability to recover from extreme weather events.

As in other cases, this emerging form of power arises in response to a practical problem: the re/insurance industry continues to face major limitations in how it calculates loss estimates for casualty and property risk.[10] Publications summarizing the confidential discussions between meteorologists, climate modelers and reinsurers collaborating in CGFI climate science and re/insurance industry workshops have highlighted the need for much more comprehensive data, and especially at a higher resolution.[11] Crucially, these discussions identify Artificial Intelligence (AI) and Machine Learning (ML) as key to overcoming these constraints, highlighting their potential to 'bring down computational costs', speed up 'data processing' and 'downscale global climate data' (CGFI 2024). Perhaps unsurprisingly, in 2024 Moody's announced the acquisition of Praedicat, an analytics firm specializing in machine learning applications for casualty and liability risk (Moody's 2024) alongside CAPE Analytics, a geospatial AI firm producing property-level risk assessments. Both companies develop tools that translate complex climate exposures into granular, decision-ready risk data for insurers, reinsurers, and investors. Praedicat's climate casualty platform uses machine learning to generate liability scenarios, map exposures across more than 128,000 companies, and track climate-related litigation involving commercial defendants in the United States. CAPE, by contrast, produces address-specific property risk assessments using proprietary AI models, geospatial and insurance claims data, and claims to provide pricing and underwriting services to nearly half of the top 50 property insurers in the US (Moody's 2025a; Simpson 2025).

More than just responding to widely known issues raised by market participants, Moody's is undertaking its own industry research to position itself at the forefront of future developments in catastrophe reinsurance and the securitization of catastrophe risk. At the heart of these efforts was the March 2025 release of a Moody's Ratings Discussion Paper entitled 'ILS Futures' (Moody's 2025b). This Discussion Paper explicitly solicited responses from ILS industry participants to nine questions relating to 'market dynamics, transaction or security-specific structural features, data disclosure and modeling practices of this asset class' (Evans 2025). Moody's Ratings (2025b) has

stressed that this paper marks a first step in 'potentially producing a new rating methodology for catastrophe bonds' – raising the specter that their infrastructural power may intensify, as the knowledge they produce could shape the operations of a bond market on which many countries depend for post-disaster recovery resources.

Developments in this space are still extremely uncertain, and industry journalists 'understand that whether (the new rating methodology) goes ahead will depend on the feedback received' (Evans 2025). Yet the recent acquisitions of relevant proprietary AI models for property and casualty risk and commercial research presented here do indicate that Moody's is establishing a position of market power in the securitization of physical climate risk. Moreover, Moody's' prefigurative authority reflects the temporal dynamics explored throughout this paper: not merely responding to state mandates or disclosure regimes but moving ahead of them, scripting future regimes of climate valuation through proprietary tools and selective anticipation. In this way, Moody's is not simply participating in burgeoning climate risk markets; it is actively constructing the knowledge infrastructures under which those markets operate.

Shifting terrains of climate governance: the powers and perils of climate inscription networks

This paper has investigated the complex webs of knowledge and authority that are increasingly creating the epistemic conditions for climate action today, which we have described as climate inscription networks. Rather than restating their architecture, we conclude with a discussion of their possible powers and effects: chiefly, to render climate change an object of financial management – and in doing so, shift the terrain of climate governance toward practices of financial risk management.

One important effect of this shift is temporal. Because inscriptions embed and translate climate risk into existing financial practices – for example of risk rating and assessment – the time horizons of climate risk are made akin to the time horizons of financial practice, which are often relatively short. This is problematic as climate risks unfold unevenly – from singular events, as in wildfires, to slow, incremental changes in landscapes, as in sea level rise. Because many climate risks exceed the temporal frames of existing financial practice, they are often discounted – a key driver of the climate crisis itself (Condon 2023; Doganova 2024). We can already see elements of future discounting at play in climate vulnerable regions like Greater Miami. There, officials have couched the value, significance, and lifespan of various public resilience interventions, like investments in sea walls or road-raising to stem flooding, in terms of 20–30 year municipal bond cycles (Cox 2022, 2024). Equally, real estate investors show an open disinterest in the region's climate resilience beyond their 5, 10, or 20 year investment horizon – and finance accordingly (Taylor and Aalbers 2022). In combination, these local state and market practices may sustain near-term confidence in high-risk geographies, and in doing so defer a broader financial and material reckoning with climate risk that ultimately compounds vulnerability over time.

A second important consequence is spatial. Climate change and its attendant risks will be felt globally, whether in terms of general trends (e.g. global warming) or as a result of sheer interconnectedness (e.g. disaster events in one place produce knock-on effects, like supply chain disruptions, that will be felt elsewhere), and therefore require multi-sited and multi-scalar interventions. However, the translation of climate risk into existing financial practices divides vast swaths of the planet into increasingly-granular units of absolute and relative risk. These divisions matter. For one, the partitioning of deeply interconnected places into seemingly discrete units of evaluation contributes to siloed and ultimately myopic understandings of how climate change impacts unfold and should be governed. Moreover, as these superfine inscriptions of climate risk circulate across the financial system, public and private investors may see some bond issuances, insurance policies, mortgages, and loans – and therefore places and people – as too risky for investment (De Vera, Jacobs, and Bigger 2025; Perry 2021). Others, through the same process, may remain or become more valuable.

One can increasingly see these diverging climate pathways at work within highly exposed, high value property markets. Sticking with the Greater Miami example, the increasingly climate risk-attuned rent-seeking strategies of real estate actors, acting with the inscriptions we have discussed here, are producing new and deepened forms of uneven development, fueling devaluation and downgrading in some communities, and speculative revaluation and inward capital mobility in others (Colven et al. 2025; Taylor and Aalbers 2022). These dynamics extend well beyond the urban North. Exploratory research anticipates significant sovereign credit rating downgrades in Majority World nations absent near-term climate action (Klusak et al. 2021), and soaring borrowing costs among already climate vulnerable countries over the next decade (Buhr et al. 2018). Put differently, as these granular inscriptions circulate, entire nations and geographic regions that are highly susceptible to climate change may lose access to key capital markets just when they need that capital the most – or retain access on increasingly exploitative terms.

Third, and perhaps most importantly, these translations effectively neutralize climate risk as a moral or planetary imperative (see Koslov 2019). Because climate risk is inscribed into existing financial practices, it only matters insofar as it disrupts an existing order of things – in this case that of the financial system. To be sure, the reclassification of climate change as a financial rather than political problem may enable significant climate action, which we have recounted here (see also Collier and Cox 2021). But that action may come at a high political cost: it redistributes to financial infrastructures, institutions, and practices that were never designed to address it – and that often operate 'beneath open and immediate political conflict' (Pierson 2016, 129; see also Grafe et al. 2025). In this way, climate inscription networks do not only inform climate governance, they also shift its terrain: from (however imperfect) spaces and processes of collective deliberation, as in multinational climate treaties or local adaptation planning, to financial practices of financial risk assessment and valuation. Drawing on Slobodian (2023), we might understand these networks as constitutive of epistemic 'zones:' institutional configurations that, much like the special economic and legal zones Slobodian describes, work to insulate economically consequential forms of decision-making from broader political contestation. Here, key questions of what and where climate risk is – as well as how to act on it – are posed and resolved primarily through financial practices, often with minimal public visibility or oversight despite their far-reaching, collective consequences.

There are many emergent zones to which scholars might direct their attention going forward – whether by tracing the inscription practices and networks of reinsurers, private equity funds, development banks, or mortgage markets as they come to grips with climate change (Cox, Morris, and Colven 2025; Knuth et al. 2025). Doing so enables scholars not only to analyze the configuration and consolidation of climate authority today, but to better understand how climate futures are increasingly shaped within – and constrained by – longstanding state-market entanglements and the financial practices that bind them.

Notes

1. Braun develops this argument by engaging with Mann's (1984) original conceptualization of infrastructural power. Where Mann deploys the term to explore state and civil society capacities to shape each other, Braun (2020, 400) focuses on what he considers to be an 'underappreciated' aspect of these two-way power relations: the power of non-state actors, and in particular those within the financial sector, over state actors.
2. Many of these regulations had been in place since the creation of the 1933 Securities Act and the 1934 Securities and Exchange Act (Cash 2018b).
3. The role of rating agencies would be to produce credit ratings for assets that would then be benchmarked against a threshold rating specified by the ECB.
4. This is also the legal status of the ratings provided by Moody's, S&P and Fitch.
5. This decision required 'condensing particular patterns and repetitions whilst ignoring others' in order to better understand and demonstrate co-evolving relationships which cannot be captured in terms of 'effective causality' (de Goede 2012, 33; Law 2004, 113).
6. They may soon have valence beyond North America, as municipal bond markets are increasingly being built in cities of the Global South.

7. As Fourcade (2017) notes, quantitative risk scores, like algorithms, are used for corporations and individuals rather than (local) sovereigns.
8. This is of considerable importance in New Orleans. After Hurricane Katrina, the city received ratings downgrades that effectively locked it out of the bond market for years – forcing the city to rely on federal and state aid that officials noted was often slow to arrive and reduced their capacities to make transformative adaptation investments.
9. Although central banks should properly be considered hybrid state-market actors (Vogl 2014), they have been instrumental in drawing and rearticulating boundaries between state and economy, with their exercises producing what some have called 'state effects' (Coombs and Thiemann 2022).
10. While the UK Treasury and Financial Conduct Authority have been running various consultation processes around regulatory reform to ILS-markets for nearly a decade, at the time of writing this has not materialized as concrete policy change.
11. Extreme weather events occur at a 1-kilometre scale, and so they require data at that high a resolution. Data at a lower resolution is likely to produce inaccurate estimates of localized atmospheric conditions which will skew loss estimates. Met Office (2024) scientists estimate that the 'physics-based models' currently being used are unlikely to be able to produce information around the globe at the 1km scale for 10–12 years.

Acknowledgements

The authors would like to thank Valentina Ausserladscheider, Natascha van der Zwan, Rami Kaplan, Jens van 't Klooster, Leonard Seabrooke, Giulia Mennillo, Natalia Besedovsky, Johannes Petry, and Zsófia Barta and three anonymous reviewers for their constructive comments on earlier drafts, as well as Sarah Knuth for encouraging us to bring our work together. This collaboration was enabled by an Urban Studies Foundation Seminar Series grant, 'Decentering urban climate finance: relational comparison in theory and practice.'

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

This work was supported by Urban Studies Foundation [Grant Number: USF-SSA-210206].

ORCID

Savannah Cox https://orcid.org/0000-0001-7686-0865

References

427. 2018. Assessing Exposure to Climate Change in U.S. Munis. Accessed 12 December 2022. https://www.unisdr.org/preventionweb/files/58426_muniriskpapermay2018.pdf.

Aalbers, M. B., Z. J. Taylor, T. J. Klinge, and R. Fernandez. 2023. "In Real Estate Investment We Trust: State De-Risking and the Ownership of Listed US and German Residential Real Estate Investment Trusts." *Economic Geography* 99: 3.

Abdelal, R., and M. Blyth. 2015. "Just Who Put You in Charge? We Did." In *Ranking the World: Grading States as a Tool of Global Governance*, edited by R. Abdelal, M. Blyth, A. Cooley, and J. Snyder, 39–59. Cambridge MA: Cambridge University Press.

Bank of England. 2022. *Results of the 2021 Climate Biennial Exploratory Scenario*, [online]. Accessed August 14, 2022. https://www.bankofengland.co.uk/stress-testing/2022/results-of-the-2021-climate-biennial-exploratory-scenario.

Barta, Z. 2025. "Manufacturing Gravity: Credit Ratings as the Makers of Safe Assets." *New Political Economy* 31 (3): 582–600. https://doi.org/10.1080/13563467.2025.2594707.

Biersteker, T. J., and R. B. Hall. 2002. "10 Private Authority as Global Governance." *The Emergence of Private Authority in Global Governance* 85:203. https://doi.org/10.1017/CBO9780511491238.011.

Böhm, S., M. C. Misoczky, and S. Moog. 2012. "Greening Capitalism? A Marxist Critique of Carbon Markets." *Organization Studies* 33 (11): 1617–1638. https://doi.org/10.1177/0170840612463326.

Bracking, S. 2015. "The Anti-Politics of Climate Finance: The Creation and Performativity of the Green Climate Fund." *Antipode* 47 (2): 281–302. https://doi.org/10.1111/anti.12123.

Bracking, S. 2019. "Financialisation, Climate Finance, and the Calculative Challenges of Managing Environmental Change." *Antipode* 51 (3): 709–729. https://doi.org/10.1111/anti.12510.
Bracking, S., and B. Leffel. 2021. "Climate Finance Governance: Fit for Purpose?" *Wiley Interdisciplinary Reviews: Climate Change* 12 (4): e709.
Braun, B. 2020. "Central Banking and the Infrastructural Power of Finance: The Case of ECB Support for Repo and Securitization Markets." *Socio-Economic Review* 18 (2): 395–418. https://doi.org/10.1093/ser/mwy008.
Braun, B., and D. Gabor. 2020. "Central Banking, Shadow Banking, and Infrastructural Power 1." In *The Routledge International Handbook of Financialization*, edited by P. Mader, D. Mertens, and N. van der Zwan, 241–252. Abingdon: Routledge.
Buhr, B., U. Volz, C. Donovan, G. Kling, Y. C. Lo, V. Murinde, and N. Pullin. 2018. Climate Change and the Cost of Capital in Developing Countries. Accessed 24 November 2022. https://eprints.soas.ac.uk/.
Callon, M. 2005. "'What Does It Mean to say That Economics Is Performative?" *' CSI Working Papers Series 005* 2006:1–58.
Cash, D. 2018a. *Regulation and the Credit Rating Agencies: Restraining Ancillary Services*. Abingdon: Routledge.
Cash, D. 2018b. "Sustainable Finance Ratings as the Latest Symptom of 'Rating Addiction'." *Journal of Sustainable Finance & Investment* 8 (3): 242–258. https://doi.org/10.1080/20430795.2018.1437996.
Cash, D. 2023. *A Modern Credit Rating Agency: The Story of Moody's*. Abingdon: Routledge.
CFRF [Climate Financial Risk Forum] and CGFI [Centre for Greening Finance and Investment]. 2023a. Learning from the 2021/22 Climate Biennial Exploratory Scenario (CBES) Exercise in the UK: Survey Report. https://www.fca.org.uk/publication/corporate/cfrf-scenario-analysis-2023-learning-bienennial-exploratory-scenario-cbes.pdf.
CFRF [Climate Financial Risk Forum] and CGFI [Centre for Greening Finance and Investment]. 2023b. Learning from the 2021/22 Climate Biennial Exploratory Scenario (CBES) Exercise in the UK: Banking Consultation Workshop, pp.1–9. https://www.cgfi.ac.uk/wp-content/uploads/2023/03/CBES-Reports-Banking-Workshops.pdf.
CFRF [Climate Financial Risk Forum] and CGFI [Centre for Greening Finance and Investment]. 2023c. Learning from the 2021/22 Climate Biennial Exploratory Scenario (CBES) Exercise in the UK: Insurance Consultation. https://www.cgfi.ac.uk/wp-content/uploads/2023/03/CBES-Reports-Insurance-Workshops.pdf.
CGFI [UK Centre for Greening Finance and Investment]. 2024. Collaborating for Impact: Bridging the Gap between Climate Science and Insurance Industry Practice. https://www.cgfi.ac.uk/2024/06/collaborating-for-impact-insurance/.
Christophers, B. 2017. "Climate Change and Financial Instability: Risk Disclosure and the Problematics of Neoliberal Governance." *Annals of the American Association of Geographers* 107 (5): 1108–1127.
City of Miami Beach. 2019. *G.O Bond Credit Ratings (198-2019)*. Office of the City Manager.
City of Virginia Beach. 2016. *Moody's Update—Coastal Virginia Credit Focus Review*. Report. City of Miami Beach.
Clark, P. 2025. Meltdown: How the Next Financial Crisis Starts, The Financial Times, 26th June 2025. Available at: https://www.ft.com/content/9e5df375-650d-492e-ba51-fb5a34e6ddd6.
Collier, S. J., and S. Cox. 2021. "Governing Urban Resilience: Insurance and the Problematization of Climate Change." *Economy and Society* 50 (2): 275–296. https://doi.org/10.1080/03085147.2021.1904621.
Colven, E., M. Condon, S. Cox, and K. Hereid. 2025. "The Potential and Perils of Financializing Climate Risk Governance: Insights for Urban Policymakers." *Journal of City Climate Policy and Economy* 4 (1): 36–52. https://doi.org/10.3138/jccpe-2025-0007.
Condon, M. 2023. "Climate Services: The Business of Physical Risk." *Arizona State Law Journal* 55:147.
Cook, I. 2004. "Follow the Thing: Papaya." *Antipode* 36 (4): 642–664. https://doi.org/10.1111/j.1467-8330.2004.00441.x.
Coombs, N., and M. Thiemann. 2022. "Recentering Central Banks: Theorizing State-Economy Boundaries as Central Bank Effects." *Economy and Society* 51 (4): 535–558. https://doi.org/10.1080/03085147.2022.2118450.
Cox, S. 2022. "Inscriptions of Resilience: Bond Ratings and the Government of Climate Risk in Greater Miami, Florida." *Environment and Planning A: Economy and Space* 54 (2): 295–310. https://doi.org/10.1177/0308518X211054162.
Cox, S. 2024. "Climate Transparency and the Affective Politics of Adaptation in Miami." *Urban Geography* 45 (10): 1736–1760. https://doi.org/10.1080/02723638.2024.2348957.
Cox, S. 2025. "Bonding out the Future: Tracing the Politics of Urban Climate Finance in Miami, Florida." *Journal of Urban Affairs* 47 (1): 70–86. https://doi.org/10.1080/07352166.2023.2192941.
Cox, S., J. Morris, and E. Colven. 2025. "Centering Work: Toward More 'Social' Accounts of Urban Climate Finance." *City* 29 (1–2): 188–202. https://doi.org/10.1080/13604813.2025.2455233.
de Goede, M. 2012. *Speculative Security: The Politics of Pursuing Terrorist Monies*. Minneapolis: U of Minnesota Press.
De Vera, M., F. Jacobs, and P. Bigger. 2025. "Structural Barriers to Financing Just Adaptation in Majority World Cities." *Journal of City Climate Policy and Economy* 4 (1): 53–68. https://doi.org/10.3138/jccpe-2024-0045.
Doganova, L. 2024. *Discounting the Future: The Ascendancy of a Political Technology*. Princeton, NJ: Princeton University Press.

Downey, L. 2025. "Coercing Finance to Fund Decarbonization: The Democratic Case for Coercion in Funding the Green Transformation." *Review of International Political Economy* 32 (3): 692–713. https://doi.org/10.1080/09692290.2025.2471854.
Eich, S. 2025. "Derisking as Worldmaking: Climate Finance and the Politics of Uncertainty." *Review of International Political Economy* 32 (3): 668–691. https://doi.org/10.1080/09692290.2025.2480794.
Elliott, R. 2026. "The Sociology of Property Value in a Climate-changed United States." *Social Problems* 73 (1): 336–349. https://doi.org/10.1093/socpro/spae074.
Elsamny, M. 2026. Assessment without Adjustment: Climate Risk Tools and Market Inertia in Dutch Real Estate. www.redblueclimate.nl/news/climate-assessment-without-adjustment/.
Engen, S., and K. Asdal. 2025. "The Politics of Climate Risk: How the Climate Issue Is Turned into a Risk Issue through the Little Tools and Operations of Finance." *Journal of Cultural Economy*: 18 (4): 461–474. https://doi.org/10.1080/17530350.2024.2370258.
Evans, S. 2023. Regulator the PRA Still aiming for ILS "take off" in the UK. Artemis, 9th May 2023. Available at: https://www.artemis.bm/news/regulator-the-pra-still-aiming-for-ils-take-off-in-the-uk/.
Evans, S. 2025. "Moodys Ratings Seeks ILS Discussion Paper Feedback, Considers New Rating Methodology." *Artemis*, March 20, 2025. Accessed May 10, 2025. https://www.artemis.bm/news/moodys-ratings-seeks-ils-discussion-paper-feedback-considers-new-rating-methodology/.
Fligstein, N., and J. Habinek. 2014. "Sucker Punched by the Invisible Hand: The World Financial Markets and the Globalization of the US Mortgage Crisis." *Socio-Economic Review* 12 (4): 637–665. https://doi.org/10.1093/ser/mwu004.
Folkers, A. 2024. "Risking Carbon Capital: Reporting Infrastructures and the Making of Financial Climate Risks." *Economy and Society* 53 (3): 504–526. https://doi.org/10.1080/03085147.2024.2348316.
Fourcade, M. 2017. "The Rating of Sovereigns and the Judgment of Nations." In *The Many Hands of the State: Theorizing Political Authority and Social Control*, edited by K. J. Morgan and A. S. Orloff, 103–127. New York: Cambridge University Press.
Gabor, D., and B. Braun. 2025. "Green Macrofinancial Regimes." *Review of International Political Economy* 32 (3): 542–568. https://doi.org/10.1080/09692290.2025.2453504.
Grafe, F. J., G. Forino, A. Fraser, H. Hilbrandt, and J. H. Morris. 2025. "Understanding the Functioning of Urban Climate Finance through Topologies of Reach." *City* 29 (1–2): 203–218. https://doi.org/10.1080/13604813.2023.2284383.
Gray, I. 2021. "Hazardous Simulations: Pricing Climate Risk in US Coastal Insurance Markets." *Economy and Society* 50 (2): 196–223. https://doi.org/10.1080/03085147.2020.1853358.
Grote, M. H., and M. Zook. 2022. The Role of Capital Markets in Saving the Planet and Changing Capitalism-Just Kidding. Available at SSRN 4023071.
Harris, L. 2023. Rise of the Climate Rating Agencies', The American Prospect, 12th April 2023. https://prospect.org/economy/2023-04-12-rise-climate-rating-agencies/.
Johnson, L. 2013. "Catastrophe Bonds and Financial Risk: Securing Capital and Rule through Contingency." *Geoforum; Journal of Physical, Human, and Regional Geosciences* 45:30–40. https://doi.org/10.1016/j.geoforum.2012.04.003.
Klusak, P., M. Agarwala, M. Burke, M. Kramer, and K. Mohaddes. 2021. *Rising Temperatures, Falling Ratings: The Effect of Climate Change on Sovereign Creditworthiness*. Bennett Institute Working Paper, 1–53. Accessed June 7, 2021. https://www.econ.cam.ac.uk/publications/cwpe/2127.
Knuth, S., S. Cox, S. Zavareh Hofmann, J. Morris, Z. J. Taylor, and B. McElvain. 2025. "Interrupted Rhythms and Uncertain Futures: Mortgage Finance and the (Spatio-) Temporalities of Climate Breakdown." *Journal of Urban Affairs* 47 (1): 35–52. https://doi.org/10.1080/07352166.2023.2229462.
Kob, J. 2020. "Curating Disaster: A way to Turn Science into Action in Times of the Corona Pandemic." *Journal of Cultural Economy* 13 (5): 642–651. https://doi.org/10.1080/17530350.2020.1782968.
Koslov, L. 2019. "Avoiding Climate Change: 'Agnostic Adaptation' and the Politics of Public Silence." *Annals of the American Association of Geographers* 109 (2): 568–580. https://doi.org/10.1080/24694452.2018.1549472.
Langley, P., and J. H. Morris. 2020. "Central Banks: Climate Governors of Last Resort?" *Environment and Planning A: Economy and Space* 52 (8): 1471–1479. https://doi.org/10.1177/0308518X20951809.
Latour, B. 1987. *Science in Action: How to Follow Scientists and Engineers through Society*. Cambridge, MA: Harvard University Press.
Law, J. 2004. *After Method: Mess in Social Science Research*. Abingdon: Routledge.
Lohmann, L. 2010. "Neoliberalism and the Calculable World: The Rise of Carbon Trading." In *The Rise and Fall of Neoliberalism: The Collapse of an Economic Order*, edited by K. Birch and V. Mykhnenko, 77–93. Zed Books.
Maechler, S. 2023. "Accounting for Whom? The Financialisation of the Environmental Economic Transition." *New Political Economy* 28 (3): 416–432. https://doi.org/10.1080/13563467.2022.2130222.
Mann, M. 1984. "The Autonomous Power of the State: Its Origins, Mechanisms and Results." *European Journal of Sociology/Archives Européennes de Sociologie* 25 (2): 185–213. https://doi.org/10.1017/S0003975600004239.

Matthewman, J. 2021. RMS blog: Bank of England CBES: five thoughts on tackling climate change physical risk reporting. Available at: Matthewman, J. 2021. Bank of England. https://www.rms.com/blog/2021/03/08/bank-of-england-cbesfive- Thoughts-on-tackling-climate-changephysical- risk-reporting.
Met Office. 2024. https://www.metoffice.gov.uk/blog/2024/ai-crucial-to-tackling-environmental-challenges.
Miller, P., and N. Rose. 1990. "Governing Economic Life." *Economy and Society* 19 (1): 1–31. https://doi.org/10.1080/03085149000000001.
Moody's. 2021. Moody's to acquire RMS, leader in climate and natural disaster Risk. 5th August 2022. https://ir.moodys.com/press-releases/news-details/2021/Moodys-to-Acquire-RMS 26.
Moody's. 2025a. Moody's to Acquire CAPE Analytics, Adding AI-Powered Geospatial Property Risk Intelligence to Its Industry-Leading Insurance Risk Models. 13th January 2025. https://ir.moodys.com/press-releases/news-details/2025/Moodys-to-Acquire-CAPE-Analytics-Adding-AI-Powered-Geospatial-Property-Risk-Intelligence-to-Its-Industry-Leading-Insurance-Risk-Models/default.aspx.
Moody's. 2025b. Discussion Paper on Insurance-Linked Securities. https://www.moodys.com/research/doc–PBC_1438686?cid=GAR9PTU7VKT2671.
Moody's. 2024. Moody's and Praedicat: A new vision for casualty insurance risk analytics. 5th September 2024. https://www.moodys.com/web/en/us/insights/announcements/moodys-and-praedicat-a-new-vision-for-casualty-insurance-risk-analytics.html.
Moody's. n.d. Insurance-Linked Securities. https://www.moodys.com/web/en/us/capabilities/catastrophe-modeling/insurance-linked-securities.html#tabs-cdad0ac2c3-item-902e0f180e-tab.
Morris, J. H. 2018. *Securing Finance, Mobilizing Risk: Money Cultures at the Bank of England*. Abingdon: Routledge.
Morris, J. H., and H. Collins. 2023. *(Mis)Managing Macroprudential Expectations: How Central Banks Govern Financial and Climate Tail Risks*. Cheltenham: Edward Elgar.
Newell, P., and M. Paterson. 2010. *Climate Capitalism: Global Warming and the Transformation of the Global Economy*. Cambridge: Cambridge University Press.
Orphanides, A. 2017. ECB Monetary Policy and Euro Area Governance: Collateral Eligibility Criteria for Sovereign Debt.
Orphanides, A. 2020. "The Fiscal–Monetary Policy mix in the Euro Area: Challenges at the Zero Lower Bound." *Economic Policy* 35 (103): 461–517. https://doi.org/10.1093/epolic/eiaa017.
Pagliari, S., and K. Young. 2016. "The Interest Ecology of Financial Regulation: Interest Group Plurality in the Design of Financial Regulatory Policies." *Socio-Economic Review* 14 (2): 309–337. https://doi.org/10.1093/ser/mwv024.
Perry, K. 2021. The new 'Bond-Age', Climate Crisis and the Case for Climate Reparations: Unpicking old/new Colonialities of Finance for Development within the SDGs." *Geoforum; Journal of Physical, Human, and Regional Geosciences* 126:361–371. https://doi.org/10.1016/j.geoforum.2021.09.003.
Petry, J. 2021. "From National Marketplaces to Global Providers of Financial Infrastructures: Exchanges, Infrastructures and Structural Power in Global Finance." *New Political Economy* 26 (4): 574–597. https://doi.org/10.1080/13563467.2020.1782368.
Pierson, P. 2016. "Power in Historical Institutionalism." In *The Oxford Handbook of Historical Institutionalism*, edited by O. Fioretos, T. Falleti, and A. Sheingate, 124–141. Oxford: Oxford University Press.
Pollack, L. 2021. Moody's to Add Climate Risk Scores on Its Analytics Platform. ALM Globest. 13 October 2022.
RMS. 2021. RMS Working with Canopius to Enhance Climate Change Risk. Accessed 13 September 2022. https://www.rms.com/newsroom/press-releases/press-detail/2021-12-13/.
Rose, N., and P. Miller. 1992. "Political Power beyond the State: Problematics of Government." *British Journal of Sociology* 43 (2): 173–205. https://doi.org/10.2307/591464.
Rose-Redwood, R. 2012. "With Numbers in Place: Security, Territory, and the Production of Calculable Space." *Annals of the Association of American Geographers* 102 (2): 295–319. https://doi.org/10.1080/00045608.2011.620503.
Rose-Redwood, R. S. 2006. "Governmentality, Geography, and the Geo-coded World." *Progress in Human Geography* 30(4): 469–486. https://doi.org/10.1191/0309132506ph619oa.
Salz, D., D. Wheeler, and M. Webb. 2022. Screening Environmental and Physical Risk in CMBS Utilizing RMS Hazard Data.
Segal, M. 2022. 'McKinsey, Moody's Launch Climate Solutions Suite for Banks', ESG Today 1 December 2022. Accessed 15 September 2023. https://www.esgtoday.com/mckinsey-moodys-launch-climate-solutions-suite-for-banks/.
Shi, L. and A. M. Varuzzo. 2020. "Surging Seas, Rising Fiscal Stress: Exploring Municipal Fiscal Vulnerability to Climate Change." *Cities* 100: 102658.
Simpson, A. 2025. Moody's to Acquire Geospatial AI Firm CAPE Analytics. Insurance Journal, 13th January 2025. https://www.insurancejournal.com/news/national/2025/01/13/807956.htm.
Sinclair, T. J. 2005. *The New Masters of Capital*. Ithaca, NY: Cornell University Press.
Slobodian, Q. 2023. *Crack-up Capitalism: Market Radicals and the Dream of a World without Democracy*. Random House.
Strange, S. 1996. *The Retreat of the State: The Diffusion of Power in the World Economy*. Cambridge: Cambridge University Press.

Taylor, Z. J. 2020. "The Real Estate Risk Fix: Residential Insurance-Linked Securitization in the Florida Metropolis." *Environment and Planning A: Economy and Space* 52 (6): 1131–1149. https://doi.org/10.1177/0308518X19896579.
Taylor, Z. 2025. "Catastrophe Risk Models and the Management of Built Environments-at-Risk." In *Climate Changed: Models and the Built World*, edited by M. Freilich, I. Turan, J. Varner, and L. Yarina, 134–146. New York: Columbia University Press.
Taylor, Z. J., and M. B. Aalbers. 2022. "Climate Gentrification: Risk, Rent, and Restructuring in Greater Miami." *Annals of the American Association of Geographers* 112 (6): 1685–1701. https://doi.org/10.1080/24694452.2021.2000358.
Taylor, Z. J., and L. Erasmus. 2022. *Climate Migration and Real Estate Investment Decision-Making*. Washington, DC: Urban Land Institute.
Taylor, Z. J., and S. E. Knuth. 2025. "Financing "Climate-Proof" Housing? The Premises and Pitfalls of PACE Finance in Florida." *Journal of Urban Affairs* 47 (1): 53–68. https://doi.org/10.1080/07352166.2023.2247503.
Vanhuyse, F., T. Piseddu, and A. Moberg. 2023. "What Evidence Exists on the Impact of Climate Change on Real Estate Valuation? A Systematic Map Protocol." *Environmental Evidence* 12:24.
van 't Klooster, J., and K. Prodani. 2025. "Planetary Financial Policy and the Riskification of Nature." *Review of International Political Economy* 32 (3): 643–667. https://doi.org/10.1080/09692290.2025.2468316.
Vogl, J. 2014. "The Sovereignty Effect: Markets and Power in the Economic Regime." *Qui Parle: Critical Humanities and Social Sciences* 23 (1): 125–155. https://doi.org/10.5250/quiparle.23.1.0125.
Wansleben, L. 2023. *The Rise of Central Banks: State Power in Financial Capitalism*. Cambridge, MA: Harvard University Press.
Woll, C. 2016. "Politics in the Interest of Capital: A Not-So-Organized Combat." *Politics & Society* 44 (3): 373–391. https://doi.org/10.1177/0032329216655318.
Young, K., and S. Pagliari. 2017. "Capital United? Business Unity in Regulatory Politics and the Special Place of Finance." *Regulation & Governance* 11 (1): 3–23. https://doi.org/10.1111/rego.12098.