



City

Analysis of Urban Change, Theory, Action

ISSN: (Print) (Online) Journal homepage: www.tandfonline.com/journals/ccit20

Understanding the functioning of urban climate finance through topologies of reach

Fritz-Julius Grafe, Giuseppe Forino, Arabella Fraser, Hanna Hilbrandt & John Hogan Morris

To cite this article: Fritz-Julius Grafe, Giuseppe Forino, Arabella Fraser, Hanna Hilbrandt & John Hogan Morris (13 Dec 2023): Understanding the functioning of urban climate finance through topologies of reach, City, DOI: [10.1080/13604813.2023.2284383](https://doi.org/10.1080/13604813.2023.2284383)

To link to this article: <https://doi.org/10.1080/13604813.2023.2284383>



© 2023 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group



Published online: 13 Dec 2023.



Submit your article to this journal [↗](#)



Article views: 673



View related articles [↗](#)



View Crossmark data [↗](#)

Understanding the functioning of urban climate finance through topologies of reach

Fritz-Julius Grafe^{ORCID}, Giuseppe Forino, Arabella Fraser, Hanna Hilbrandt and John Hogan Morris

Urban climate action is increasingly understood through the lens of finance: through financial agendas, interests, and practical tools which enable 'bankable' or profitable interventions. While the literature is rife with criticism of the normative foundations and exploitative effects of this approach, it fails to capture the variegated ways in which finance configures, and is configured by, particular urban sites and spaces of power. This contribution extends our cartography of urban climate finance by bringing to light the relational dynamics of financial practices and the ways in which they span across diverse urban sites in topological ways. It has now become a common refrain among development and finance institutions that urban climate finance is, in fact, difficult to realize. A central reason for this is the perceived lack of possibilities to generate returns for investors. A topological perspective offers a relational view on the spatial practices through which new places are to be enrolled into the use of climate finance with the aim of stabilizing financial investment. Concentrating on the notion of 'topological reach', we show how climate finance, through its particular demands for bankability, creates new urban presences through spatial

Keywords **urban climate finance, topologies, bankability, climate urbanism, adaptation finance**

URL <https://doi.org/10.1080/13604813.2023.2284383>

© 2023 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group
This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0/>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited. The terms on which this article has been published allow the posting of the Accepted Manuscript in a repository by the author(s) or with their consent.

mechanisms of stretches, folds and distortions. By examining these topological mechanisms across a breadth of empirical material sourced from the individual research of the coauthors, we unpack the ways in which climate finance strategies are extended by a limited set of actors across space, often dominating and instrumentalizing urban climate action imaginaries and practices, while also failing to address a wide range of concerns and communities which fall outside of the operational parameters and speculative horizons of finance. The topological perspective provides us with the tools to make these struggles visible and opens up avenues to contest contemporary climate finance practices on the ground and to decenter the overarching narratives that drive contemporary climate finance.

Introduction: relational geographies of urban climate finance

Urban climate finance has been pivotal in shaping sustainability strategies for the 21st-century city. Not least since the adoption of the Sustainable Development Goals (SDGs), financial and policy elites—development banks, city networks, governments at all scales, and private sector advocacy groups—have focused climate action on the mobilization of private capital for investment in urban infrastructural solutions for mitigation and adaptation. As this call for ‘bridging the infrastructure financing gap’—a calculated difference between available and needed funds—has come to dominate narratives about climate solutions, it has shaped the instruments and policies of climate action as well as the modalities and sites of climate intervention. For instance, it has delineated the geographies of climate intervention through perceptions of bankability, i.e. the viability of establishing a reliable return on investment for a given project.¹ As key global finance institutions, such as the World Bank, and related actors, such as FMDV (Global Fund for Cities Development), CPI (Climate Policy Initiative) or C40 (Cities Climate Leadership Group), have geared their spatial practices of investment in urban climate finance around notions of bankability, they have significantly curtailed the variety of viable climate responses and sites of possible investment (CCFLA 2021; Goodfellow 2020; United Nations 2019). Consequently, it becomes necessary to understand its socio-spatial relationalities.

Research in geography and urban studies has widely criticized these narrow terms of climate action, their expansion of profit-driven development strategies, and the replication of ‘unicorn planning schemes’ (Rebentisch et al. 2020) across a diversity of urban sites (García-Lamarca and Ullström 2022; Hilbrandt and Grubbauer 2020). Scholars working with approaches in policy mobility, political economy, and political ecology have effectively shown how variegated forms of climate finance have been ‘rolled-out’ (Peck and Tickell 2002) into new sites of intervention—dominating ever-widening landscapes of extraction and profit-making. As Grafe, Hilbrandt, and van der Haegen (2023) note, such scholarship

has worked with a set of approaches to understand the spatialities of these efforts. This has included scalar approaches to the emerging risk geographies (Christophers, Bigger, and Johnson 2020; Johnson 2021); the extensive spatial imaginaries of the ‘socio-ecological fix’ in which capital expands boundaries to moves towards ‘green’ forms of accumulation (Chambers 2021; Schindler and Kanai 2018), and network approaches to the mobility of policy interventions (Faulconbridge and Grubbauer 2015). Our intervention aims to make a theoretical and empirical contribution to understanding these engagements with the variegated workings of power that dominate geographies of climate finance.

First, considering a range of climate finance interventions operating across urban geographies, we highlight the utility of reading contemporary urban climate finance as a set of topological mechanisms. In particular we consider three mechanisms of reach—stretches, folds and distortions—and the ways in which they exercise power. Complicating our understanding of these mechanisms, we argue, fosters a deeper understanding of the spatial relations forged through different modes of political/economic engagement: the diverse connectivities and presences established through climate finance mechanisms.

Second, an empirical engagement with the global geographies of urban climate finance across diverse sites and fields of intervention highlights the impacts of climate financial paradigms. To illustrate the emergence of these topologies in empirical detail, we talk across a series of climate interventions: the eThekweni Municipality Transformative River Management Programme, implementations of stress testing in the banking sector and a World Bank Housing program. Each of these empirical explorations draws on the individual research of the coauthors to reveal—not only novel spatial relations—but power struggles over their implementation. Put in conversation, these sites reveal the workings of ‘actually-existing’ urban climate finance that is fundamentally topological: urban sites are enrolled through a variety of practices and formats that are informed by the financial sector’s own struggles to implement more climate concerned practices. These aims are part of a wider effort to decenter dominant narratives and practices of climate finance. As the editors of this Special Feature argue in their introduction, decentering dominant notions of climate finance in research and practices requires provincializing narratives and bringing new theorizations in view. Thinking about urban climate finance through a topological lens not only adds to this effort as it highlights new lenses to understanding financial capitalism under climate change, but it also widens empirical accounts of climate finance’s spatialities. By bringing multiple sites of intervention into conversation, we seek to elucidate some of the relations and functioning of the contemporary imprint of climate finance on urban geographies.

Topological reach

Topological thought in geography and cognate disciplines in social sciences follows a branch of mathematics focused on geometric properties in which structural relations remain the same despite the changing of their shape or form (Allen 2011, 285). These literatures have adopted and reformulated the

topological ‘vocabulary of twists and folds’ (Allen 2011, 289) to capture the changing spatiality and intensity of political and economic power relations (e.g. Faulconbridge 2013; Goldman, Daly, and Lovell 2016; Harker 2017; 2020; Langley 2020; Martin and Secor 2014; Pryke 2017). Such an approach emphasizes ways in which different forms of political and economic authority can have a ‘detached presence’ in other sites and arenas (Allen 2016, 53). In these accounts, topologies are frequently utilized as a tool to overcome the shortcomings of some territorial readings of space that struggle to capture a globalized world characterized by fluidity and variegated forms of connection and disconnection. Further, topological analysis is deployed to add nuance to accounts that tend to view scalar forms of power through ‘vertical or horizontal imagery’—authority from above—rather than more extensive arrangements or interactions that establish or maintain that hierarchy (Allen and Cochrane 2010, 1072–1073).

An engagement with forms of power is particularly relevant for climate finance research, because the way in which authority is divided between public and private agencies and frameworks should lead us to widen our notion of ‘top down’ or ‘center out’ forms of authority (Allen 2004). For example, climate finance regimes involve a tangled web of treaties signed by sovereign states, policies designed by transgovernmental institutions and the development of voluntary standards by private sector and non-governmental institutions. Such authorities interact as unstable ‘polycentric’ networks, rather than simply exhibit a higher sphere conditioning actions at purportedly lesser levels (Bracking and Leffel 2021, 709). Likewise, private and public institutions at the local, sub-state, national and international level undertake various forms of divestment, disclosure and investments in ways that cast doubt on accounts that prioritize the most centralized or cash rich institutions. Finally, topological thinking breaks with assumptions about the fixity of spatialized hierarchies. Rather such thinking highlights the shifting and modulated functioning of social relations. It thus lends itself to underline key characteristics of contemporary climate finance practices, where different sets of actors come together to collaborate on specific projects for a limited time. What emerges are ‘experimental’ governmental, socio-technical and strategic processes that temporally operate through a ‘plethora’ of different urban fields, such as ‘eco-city initiatives’ (Bulkeley and Broto 2013, 364–366) or large urban projects (Schindler and Kanai 2018). Such urban climate finance experiments may take root, but many others do not necessarily get realized at all, are then reimaged and repurposed, or are completely abandoned.

Moving beyond the idea that power is simply ‘extended outwards’ across a territory or through a network, a focus on topological reach destabilizes the assumption that the intensity of power ‘lessens’ the more it is extended across distance (Allen 2016, 2, 17). Rather than viewing power as being ‘extended outwards or downwards over space’ (Allen and Cochrane 2010, 1073), a topological conception of reach is ‘more about presence than distance’ (Allen 2016, 2). In such terms, reach consists of a ‘relational arrangement’ where power constructs and reconstructs ‘the spaces of which it is a part by stretching, folding, or distorting relationships to place certain outcomes within or beyond reach’ (Allen 2016, 2). This perspective lends itself to an analysis of

climate finance's discriminatory practices, where the bankability of projects determines which places it chooses to engage and by what means (Hilbrandt and Grafe 2023).

Allen sketches out three distinct forms of topological reach that help us to show how power operates within climate finance relationships, namely folding, stretching, and distorting. First, situations where forms of authority are made more 'proximate' without 'any loss of focus' can be characterized as instances of 'folding in reach' (Allen 2016, 43). On the one hand, folding could involve 'drawing' in actors within 'close reach by establishing a broadly simultaneous presence through shared-time technologies' (Allen 2016, 49). On the other hand, this might be better conceived as central forms of authority and expertise being lifted out and then re-embedded 'further away' (Allen 2016, 53). Second, 'stretching to reach' is a less direct way for central authority to leverage reach topologically. Stretching is the 'exercise of decision-making practices and ruling that require the legitimacy of practices to be acknowledged elsewhere' (Allen 2016, 51). This form of reach is often much more indirect because authority could not be recognized from afar. Third, topological distortion involves placing things 'beyond or out of reach' (Allen 2016, 53). These distortion practices can be considered to be an alternative form of authority to both folding and stretching. Given that our analytical emphasis here is presence, rather than distance, this process typically involves actions such as diverting decisions or issues to different 'political scales' or delegating them to different 'jurisdictions'.

The following analysis provides an account of how these three mechanisms of reach—'folding in reach', 'stretching to reach', and placing things 'beyond or out of reach'—are practiced within urban climate finance interventions. To be sure, we do not claim that these are the only spatial relations at play: as Christopher Harker (2017) and others (Hilbrandt and Grafe 2023) have shown, topological relations are entangled in and overlay with networked and metric accounts of power. As the subsequent case examples show, power struggles over stabilizing and expanding geographies of climate finance work through practices of reach, but they also speak of metric and networked relations of power.

Modalities of reach: thinking across the diversity of climate finance

Three empirical examples show how a topological perspective can further our understanding of the power dynamics at play in urban climate finance. While multiple topological relations are at play in each of these examples and together they showcase the complexities and multiple modalities of reach, we are using each case to forefront a particular modality of reach: First, we examine how folding practices are implemented in Durban, South Africa; second we illustrate how stretching plays a central role in recognizing climate change in the global financial system; third we explore the distorting effects that occur during the implementation of climate finance projects using the example of an ongoing World Bank program. Together, they highlight both the diverse ways in which reach is practiced and the multiple sites are enrolled in these efforts.

Ethekwini Municipality Transformative River Management Programme, Durban, South Africa

The first case explores the eThekweni Municipality Transformative River Management Programme (TRMP) as a form of folding reach. The TRMP began in 2009 in the eThekweni Municipality, also known as Durban, South Africa, a city with longstanding issues of water management (from drinkable water to wastewaters and river waters) (Carbonell et al. 2023). The TRMP is one of the most complex experiments that a city authority has executed to date to blend multiple forms of public-private climate adaptation finance. Aiming to leverage the scale and timespan of finance required to address climate adaptation and transformative river management systematically and sustainably, the topological practice of folding emerges in the enrollment of a vast network of different actors over the history of the TRMP, including its financial efforts and investments for urban adaptation. These actors range from multi—and bilateral donors and their networks to private capital at various scales from local businesses to insurers, and to local government departments and communities (C4o Cities Finance Facility 2019; Cartwright et al. 2013). The resulting governance structure challenges notions of hierarchies of scale, lending itself to a topological approach to analysis. In Durban, central forms of powers and authorities are lifted out towards more localized institutions but are then re-embedded at the local level (which included, for example, employing a local project manager funded by external international finance, but working as part of a local institution). Indeed, this case raises questions about relations and practices of power in a context in which an adaptation program was initiated by local actors but with funds provided by C4o Cities Finance Facility (CFF), a public-private initiative of international investors supporting urban institutions to prepare ‘finance-ready’ and bankable projects. Therefore, while the program was initiated by local actors, local necessities became incorporated into the agenda of international investors, including an expected 20-year return on co-investments (e.g. by private landowners, other governments, and third parties) (C4o Cities Finance Facility 2021).

The process of creating bankable projects in order to leverage further finance thereby mobilized the involvement of CFF—and its investors—as an external funder. In turn, CFF’s involvement has paved the way for other investors, such as the French Agency for Development (AFD) and UN agencies. Therefore, investment practices for urban climate action are legitimized across other powerful investors, topologically stretching the exercise of decision-making along the governance landscape. However, this also raises questions about how actors become enrolled in particular urban spaces, to the exclusion of others (Forino, Fraser, and Tandarić 2023; Hilbrandt and Grafe 2023), and how powers are redistributed across governance networks and relations.

Central to persuading a range of public and private actors (e.g. the municipality, businesses, property owners, and global climate funders), to invest in stream and river transformation adaptation projects and ensure shared objectives amongst different stakeholders is the preparation of a project ‘business case’ (C4o Cities Finance Facility 2021). This business case is based on a cost-benefit analysis and its tangible metrics derive from a hydrological and climate vulnerability assessment. In turn, although a range of diverse global investors and actors

(e.g. funders, donors, and managers) have become involved, the ‘finance-ready’ projects targeted river management at a very local scale, on a specific section of the river. This has also allowed investors to meet their explicit aim of keeping the number of stakeholders and diversity of interventions within ‘manageable limits’ to ensure that the project’s goals were ‘technically feasible’ in relation to both investors’ requirements and local expectations. As a topological practice of distortion, tangible metrics have been used to justify the need for, and delegate climate responsibility to, other stakeholders, using measurable revenues and economic benefits as persuasive leverage.

While the case needs further investigation for both folding and the other forms of topological reach, it initially reveals the processes of topology at work in ways that defy conventional governance notions of scale and territory. The intensity of folding reach occurring at such a site of inclusion in contemporary climate finance regimes, contrasts with the relatively small scale of the intervention in terms of its biophysical limits (actual coverage in terms of river length). The authority of international climate finance is made more proximate—but does not lose focus—through various processes of localization, including the financing of local personnel and the enrollment of networks of stakeholders to ensure the financial investment is sustainable, institutionally, and financially. Beyond re-embedding power and authorities at the local level through forms of folding, the case also reveals the presence of other forms of reach, which stretch and distort authorities and power through the governance arena, across time and space. However, the case also reveals the epistemological and practical limits of folding to address the complex problem of urban adaptation, as it becomes defined by the practices of bankability and manageability, in ways that create rhetorics of success and multi-sector collaboration around local climate projects (Bond and Galvin 2023) but that might limit the socially transformative potential of such projects (Galvin and Bond 2022).

Macro-financial climate regimes

The second case explores global geographies of urban climate finance by putting stretching as a form of reach into sharper focus. The stress testing of financial institutions for their exposure to climate risk reveals stretched forms of topological power. Standard stress testing exercises see the application of a hypothetical scenario of low probability-high impact events—designed by regulatory authorities such as a central bank—to the balance sheets of banks within a regulatory jurisdiction to assess the resilience of these banks. Firms instructed to undertake this climate risk analysis have to simulate the impact of climate change pathways and associated scenarios drawn up by central bank officials on their balance sheets, thus providing an example of the relatively direct ‘lifting out’ and re-embedding of regulatory authority within private financial institutions (Allen 2016, 51).

While such stress testing exercises often entail the exercise of legally enshrined public authority over the amounts of high-quality capital private institutions should maintain and thus the trading activities banks can undertake, climate stress testing regimes promulgate distinct forms of stretched authority between banks and risk analytics firms. These latter forms of power require the ‘legitimacy’ of decision-making to be ‘acknowledged elsewhere’ (Allen 2016, 51).

For example, the Bank of England's 2021 Climate Biennial Exploratory Scenario (CBES) required a range of banks and insurers to model their exposures to physical climate risks and the policy driven risks associated with a transition to low carbon economies. Participating firms needed to assess the impact of three potential climate pathways across scenarios of early policy action, late policy action and no additional action. The Bank of England's No Additional Action scenario explicitly focused on physical risks—due to no prior mitigation actions—which would be significant drivers of insurance liabilities and asset depreciations relating to urban infrastructures. In this scenario residential properties in UK locations most exposed to physical risk would be difficult to re-mortgage because they would 'fall in value due to severe flooding and/or become uninsurable' (Bank of England 2022, 15). The projected general insurance losses were highly geographically concentrated, with 10% of four-digit postcode districts accounting for two thirds of these liabilities. Similarly this scenario yielded extremely concentrated default risk, as nearly half of the mortgage defaults in the scenario occurred in 10% of the postcode areas analyzed. In short, this no additional action scenario addressed direct risks to investments in climate vulnerable urban sites, and opened up questions about the sustainability of current approaches to reinsuring existing real estate investment, the specter of insurance premium rises and the possibility of new sources of risk and return for catastrophe bond investors (Morris and Collins forthcoming). Climate scenario analyses therefore constitute a softer register of power that seeks to prompt banks and insurers to reassess the viability of their current investment patterns across a much longer timeframe and climate pathway.

The reception of any stress test results by the financial media and market actors often depends on the perceived credibility of the methodologies employed in the design of these regulatory exercises (Langley 2013). In the context of the climate stress testing exercises developed by a range of central banks within the NGFS, the high-level climate change pathways that are widely employed as the test scenario are considered to be blunt instruments that miss more localized climate phenomena (Pitman et al. 2022). The legitimacy of the CBES—and the exercise of central bank authority—therefore would always hinge on the ability of participating institutions to translate the stress tests climate scenarios into more granular climate data. This technical task of modeling of physical climate change posed challenges to banks and insurers because these institutions currently do not have 'complete expertise in house' about such a new area of financial risk management (Kashyap 2022, 8). Insurance firms participating in the CBES recognized the epistemic authority of climate and catastrophe risk modeling firms and contracted them to provide expertise, data and models that would allow them to better capture localized climate phenomena in their submissions relating to the No Additional Action scenario. For example, the well-established catastrophe risk analytics firm Risk Management Solutions (RMS) had initially established legitimacy in providing data and modeling for financial institutions when it assisted insurers with the physical climate change risk to liabilities' component of Bank of England's 2019 General Insurance Stress Test. Building on this commercial success, RMS had advertised its services to

insurers and banks ahead of the more prominent 2021 CBES (Matthewman 2021, np). One (re)insurer participating in the CBES—Canopus—purchased RMS Climate Change Models and this allowed them to develop a picture of ‘North Atlantic hurricane climate change risks’ (RMS 2021, np). In such a way, the recognition of the expertise of climate modeling firms by financial institutions and insurers led to the stretching of private authority through the technical devices of probabilistic models. An analytical sensitivity to forms of topological reach helps us to identify distributed forms of financial agency and power that operate through ‘hybrid collectives’ of different institutions, technical devices, and human inputs (Callon 2005; Pryke 2017). In this case, the inculcation of private epistemic authority within the central bank led stress testing process helps to sketch out future climate risks that will have financial implications for investment in urban real estate in climate vulnerable sites. However, the aggregated financial losses generated through the physical climate risk scenario were widely considered to be underestimated. Such results have promulgated an intellectual environment in which epistemic authority is being contested and exerted in different ways. This exercise gave financial regulators the opportunity to peer into the risk management processes of banks and insurers. When reflecting on the performance of these firms, Bank of England staff noted financial firms’ excessive deference to external expertise and exhorted participating firms to develop a greater appreciation of the limitations of, and uncertainties around, climate and catastrophe risk modeling (Bank of England 2022; Kashyap 2022). The central bank provided guidance for firms going forward on best practice in the assessment of physical climate risk. Alternatively, both academics and the (re)insurance industry have held the ‘top down’ nature of climate pathways and macro-economic scenarios responsible for the underestimation of losses as they miss localized climate conditions that will determine the size and scale of losses (Pitman et al. 2022; Ranger, Mahul, and Monasterolo 2022). Following the completion of the exercise are calls for greater use of ‘bottom up’ scenario design and modeling employed in the catastrophe reinsurance sector to scrutinize the broad-brush results produced by the high-level climate scenarios that central banks prescribe in climate scenario analyses (Ranger et al. 2023). In such a way, the perceived weaknesses of the 2021 CBES exercise have allowed the legitimacy of regulatory expertise to be further challenged and has further boosted the status of private sector risk management techniques within the reinsurance industry which have been viewed—and legitimized—as an important benchmark for climate risk estimation (Morris and Collins 2023). Private risk analytic firms continue to support banks and insurers in the UK as they respond to the Bank of England’s advice and are providing assistance to American financial firms as they undergo the Federal Reserve’s own climate scenario analysis this year. Thus, more direct forms of topological reach exercised by central banks appear to be catalyzing softer yet potent registers of private epistemic authority. This risk modeling expertise already plays a key role within the property reinsurance business and such authority is stretching further across the financial system, in no small part due to the way that stress testing regimes are legitimizing their risk management techniques.

The World Bank's Resilient Housing program

Alongside the mechanisms of reach illustrated in the above examples, this third case allows us to illustrate spatial distortions, i.e. disconnections and disturbances that create spaces of absence or, in John Allen's topological terms, place things 'beyond or out of reach' (Allen 2016, 53). The implementation of the World Bank's Global Program for Resilient Housing (GPRH) usefully exemplifies how Climate Finance Programs instigate such distortions.

The program is designed to reduce disaster risk in precariously built residential sites in low-income areas in cities of the Global South through housing retrofits, targeting vulnerable residents living in hazard prone areas. While it responds to the increasing social harms and economic costs emerging from natural hazards, the program can also be understood as a paradigm shift in housing policy insofar as it promotes retrofitting existing 'informally built' housing stock. Long focused on micro-credit schemes for new-built housing only (Mader 2018; Soederberg 2014), it is piloting ways to use climate finance in existing housing stock. To this end, it seeks to link residents living in these high-risk areas with both state subsidies and private investment (World Bank 2022, np). At the same time, the GPRH is set up with the aim to overcome what the program defines as a three-pronged gap of policies, institutions, and resources (World Bank 2019, 7). This includes, amongst others, shortcomings in policy implementation, private sector participation; housing subsidies programs, and available data, such as municipal risk maps (World Bank 2019).

To address these gaps and achieve these aims, the program has run pilot projects in numerous countries (including Colombia, Mexico, Indonesia, and Peru). Implemented by a Built Change²—a USA based NGO—the pilots worked to collect, generate and compile big data in a few steps: first neighborhoods are mapped through street cameras and with techniques adapted from Google Street View—replacing manual mapping with clipboards through advanced technologies. Second, drones allow to produce cartographica data at a new scale and; third, through machine learning algorithms critical information is extracted on a house-by-house level from the collected image data (material, height, etc.), which is then aggregated in forms of 'building passports'.³ In overlaying the collected data with information on natural hazards, the passports indicate reparation needs and investment risks for each individual house. As an interviewee from the World Bank reported, these passports thus allow for the design of material interventions for retrofitting in areas that were previously considered too risky for investment since data were unavailable, and investment opportunities too small scale and insecure. Aggregating the data into investment possibilities for entire neighborhoods would enable the identification of risks in lending and retrofitting alike, making interventions in previously unreachable sites of informal housing a bankable commodity, thus a possibility for profit-generation for the construction industry as well as credit, and insurance markets (interview, 20.01.2022). To support this expansion of bankability, the World Bank seeks to enable policymakers to design housing subsidy programs, which connect local families to the local financial market.

At the time of writing, it remains to be seen if these ideas will materialize and scale up. Yet, the GPRH shows how the drive to make the housing of urban communities 'bankable' can outright bypass the municipal scale and

its associated perceived (in)competencies to generate data and its sovereignty over this data. In this sense we can understand the GPRH through the World Bank's mechanisms of reach—when they use advanced technical means to generate data on remote neighborhoods. Crucial for our interest in topologies, the GPRH thereby folds in new connections by reaching into previously unavailable neighborhoods to the interest of financial markets. At the same time, the program is indicative of mechanisms of distortion: While our investigation on the implementation of this program in different sites is still ongoing, our data suggests that the program is bypassing public responsibilities, such as disaster risk planning. While in political terms, the program's application of technology and data circumnavigates bureaucratic processes and democratic powers, in topological terms, authority over territory is not downloaded in scalar terms, but technology allows cutting across distances to reach into the neighborhoods in focus. For instance, the definition of 'relevant' data categories now falls to actors not subject to mechanisms of political accountability by affected citizens—in this case the data engineering company Development Seed.

To 'prioritize the allocation of home improvement subsidies that will increase housing resilience' (World Bank 2019, 32) and generate an opening for the sale of loans, the World Bank seeks to extend its power over the management of knowledge across territory in ways that cut out and reach across the topographical space so that properties can be systematically valued, prized, and commodified (to 'fix' questions of resilience). Were GPRH to be implemented at scale—like for instance through the changes that are implemented in housing policy in Columbia currently—the side effects of this might include the weakening of local authority through the establishment of (temporary) parallel structures that undermine local authorities' capacities to frame and determine their own futures. At the same time, it remains to be seen if the program will actually expand local construction markets and what the impacts on neighborhood relations exactly are, in order to determine the tensions between topological and territorial readings of space in more detail.

Conclusion

The case studies highlight the different power logics and distributions exercised through new spatial relations and connections reconfigured between an assemblage of city-focused actors, including financial institutions, policymakers, the private and development sectors, insurance providers and city networks. The topological relations of reach resulting in and through these relationships and connections are variegated. The first case explores how folding practices in Durban relate to local adaptation practices for riverine water management, with power redistributed across the governance network and then re-embedded at the local level. The second case shows the process through which the architects of the financial system itself are trying to accommodate climate change, and how central the concept of stretching is for distributing these changes. The third case explores the distortions that can arise from these practices by example of the GPRH program.

Applying the lens of topological reach allows for numerous learnings. We learn that the enrollment of spaces into climate finance, or the creation and stabilization of a climate change oriented financial system per se, works foremost through relational spatial practices. To create new investment spaces, global finance and climate governance actors reach across metric geographies to build fluid dependencies that aim to facilitate climate finance's own reproduction. A topological perspective highlights that climate finance is not just an expansionary process of ever-increasing inclusion of evermore cities, but a process that functions by creating presences, new outsides, distortions and even forms of violence in the control it is increasingly exerting over places that at first impression might appear as far removed. Understanding the folding and stretching of space through the exertion of power, maps out a new geography of climate finance that is characterized by distortions and new outsides.

The exploration of these practices of reach has illustrated climate finance's ability to twist space to generate its own conditions of success, i.e. the ability to create bankable projects. Generating bankable projects requires a conventionally secure and reliable investment space, which stands in tension with the variety and complexities of cities and their interactions with climatic changes. As we have shown, engaging these places requires creating specific forms of data to enable folding, it needs proofs of concept that are reproducible to allow for stretching and it necessitates willing actors that are enrolling in its different schemes. The eThekweni example has shown how project selection and implementation at the local level can be dependent on the needs of international investors and how complex governance structures emerge as a consequence of the accommodation of such investor expectations. Actors are folded in to establish a non-hierarchical pastiche of planning and oversight practices to facilitate 'finance ready' projects. Bankability emerges as being bounded by investor expectations, accompanied by the task of translating local needs into digestible metrics that can inform their decision-making.

Furthermore, bankability is bounded by the wider implementation of climate change uncertainties into the finance system itself. In this regard the topological approach allows us to understand how macro-economic climate finance practices do not just trickle down from central bank initiatives such as the implementation of stress testing, but how in turn authority and practices are stretched across institutions both from central banks and emerging private sector actors that claim the stake of being able to quantify climate change impacts on markets. Bankability emerges as a fragile metric that merges investors' subjectivities with constantly evolving knowledge bases.

Between these practices of reach, distortions are created across space. Parallel structures emerge and vanish with the implementation of individual projects, complementing, extending, compromising, bypassing or even overriding local authorities and sidestepping processes of political oversight. There is some evidence that bankability might be tied to the format of small and isolated projects that are more easily quantified and evaluated, as well as potentially placed beyond means of political intervention, seeking only limited support from those that are immediately affected by it (Grafe, Hilbrandt, and van der Haegen 2023).

Practices of bankability emerge as fundamentally topological, drawing in actors and resources from across spaces to facilitate individual projects,

while at the same time practices are informed by the generation of translated local knowledges and shifting macro-economic conditions of an increasingly climate-inflected financial system itself. In this concerted effort, the notion of bankability leads to practices predominantly focused on stabilizing the conditions for investment, while turning a blind eye towards the distortions it causes. These emerging fragilities of these stabilizing practices pose a major threat to the success of global climate responses that aim for just and equitable futures. Using a topological perspective to examine climate finance thus enables us to decenter these predominant practices by pointing out the mechanism by which the center is stabilized and by extension new spaces of exclusion are created.

These conceptual interventions have their own limitations. The examples presented are just some of the cases of how urban climate finance is topologically shaped across time and spaces and distributed across governance processes, multi-scale authorities, and power logics to set—and obtain—conditions for bankable investments. More examples from other types of projects, with other actors and in other sectors, can reveal further theoretical and empirical aspects of these dimensions. In addition, for the three case studies, further empirical research on the ground is under development. This can provide more nuanced narratives of climate finance experiences in future research outputs. These limitations, therefore, can put new research into view. Future scholarship is required that interrogates the boundaries of climate finance—i.e. the spaces where current modes of climate finance cease to function—how they evolve, how they reconfigure and rescale themselves and what relationships and connections they foster, and through which instruments and tools this occurs. As the notion of bankability comes to dominate climate action, further scholarship could expand an analysis of how this notion shapes projects themselves, including their financial architecture and climate impact.

These case studies aim to decenter dominant narratives to urban climate finance and foster understandings and interventions that are more expansive, imaginative, and equitable, that include openings for structural change and social justice. To do this, we need to understand the framings, practices, and power relations at play in existing topological climate finance practices to then be able to move beyond them. We have shown here how a topological frame can expose the mechanisms by which a ‘center’ contemporary climate finance practices is reinforced and reproduced through folds, stretches and distortions that serve to enable the notion of bankability. By examining this geography of climate finance, we can use the topological frame as a tool to question the emerging boundaries of climate finance and move beyond them with a more inclusive approach (see for example the contribution on ordinary climate finance in this Special Feature).

Notes

- 1 CCFLA publications such as the “The state of cities climate finance” reports spell out this narrative and prescribe responses that reproduce an approach to climate finance that builds on making profit

through carbon accounting and/or (green) infrastructure investment (CCFLA 2021). See also here for a definition of bankability as utilized by a majority of climate finance actors <https://citiesclimatefinance.org/publications/what-is-bankability/>

- 2 <https://buildchange.org/>

- 3 <http://devseed.com/housing-passports-labeling/>

Disclosure statement

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

Funding

The author received financial support for the research, authorship, conceptualization and/or publication of this article through the Urban Studies Foundation [grant number USF-SSA-210206] as well as the Swiss National Science Foundation [grant number 10001A_197113].

ORCID

Fritz-Julius Grafe  <http://orcid.org/0000-0002-0014-4843>

References

- Allen, J. 2004. "The Whereabouts of Power: Politics, Government and Space." *Geografiska Annaler. Series B, Human Geography* 86 (1): 19–32.
- Allen, J. 2011. "Topological Twists." *Dialogues in Human Geography* 1 (3): 283–298. <https://doi.org/10.1177/2043820611421546>.
- Allen, J. 2016. *Topologies of Power: Beyond Territory and Networks*. Abingdon: Routledge.
- Allen, J., and A. Cochrane. 2010. "Assemblages of State Power: Topological Shifts in the Organization of Government and Politics." *Antipode* 42 (5): 1071–1089. <https://doi.org/10.1111/j.1467-8330.2010.00794.x>.
- Bank of England. 2022. "Results of the 2021 Climate Biennial Exploratory Scenario", May 24. 1–78. Accessed: 14.11.2022. <https://www.bankofengland.co.uk/stress-testing/2022/results-of-the-2021-climate-biennial-exploratory-scenario>.
- Bond, P., and M. Galvin. 2023. "Conflicting Narratives of Extreme Weather Events in Durban, South Africa. Politically Opportunistic, Experiential, and Climate-Justice Epistemologies." In *Climate Change Epistemologies in Southern Africa*, edited by J. Ahrens and E. Halbmayer, 95–126. New York: Routledge.
- Bracking, S., and B. Leffel. 2021. "Climate Finance Governance: Fit for Purpose?" *WIREs Climate Change* 12 (e709): 1–18. <https://doi.org/10.1002/wcc.709>.
- Bulkeley, H., and V. Castán Broto. 2013. "Government by Experiment? Global Cities and the Governing of Climate Change." *Transactions of the Institute of British Geographers* 38 (3): 361–375. <https://doi.org/10.1111/j.1475-5661.2012.00535.x>.
- C40 Cities Finance Facility. 2019. "Transformative Riverine Management Projects in Durban: Background and Structuring." Accessed 13 February 2023. <https://cff-prod.s3.amazonaws.com/storage/files/s1Js6cQiTg7m4x393utegmODLxW050VuGniwjneS.pdf>.
- C40 Cities Finance Facility. 2021. "Business Case for Durban's Transformative Riverine Management Programme." Accessed 13 February 2023. <https://cff-prod.s3.amazonaws.com/storage/files/9SZZidOZX7XodATZRUvhoDvccXPbZw3qaMuysxtG.pdf>.
- Callon, M. 2005. "Why Virtualism Paves the Way to Political Impotence: A Reply to Daniel Miller's Critique of 'The Laws of the Market.'" *Economic Sociology: European Electronic Newsletter* 6 (2): 3–20.
- Carbonell, L., P. Hofmann, N. Srikiessoon, L. C. Campos, S. Mbatha, M. Lakhnpaul, ... P. Parikh. 2023. "Localisation of Links Between Sanitation and the Sustainable Development Goals to Inform Municipal Policy in EThekweni Municipality, South Africa." *World Development Sustainability* 2: 100038. <https://doi.org/10.1016/j.wds.2022.100038>.
- Cartwright, A., J. Blignaut, M. De Wit, K. Goldberg, M. Mander, S. O'Donoghue, and D. Roberts. 2013. "Economics of Climate Change Adaptation at the Local Scale Under Conditions of Uncertainty and Resource Constraints: The Case of Durban, South Africa." *Environment and Urbanization* 25 (1): 139–156. <https://doi.org/10.1177/0956247813477814>.
- Chambers, C. L. 2021. "A Critique of the 'Socio-Ecological fix' and Towards Revolutionary Rupture." *Area* 53 (1): 114–121. <https://doi.org/10.1111/area.12668>.
- Christophers, B., P. Bigger, and L. Johnson. 2020. "Stretching Scales? Risk and Sociality in Climate Finance." *Environment and Planning A: Economy and Space* 52 (1): 88–110. <https://doi.org/10.1177/0308518X18819004>.
- Faulconbridge, J. 2013. "Mobile 'Green' Design Knowledge: Institutions, Bricolage and the Relational Production of Embedded Sustainable Building Designs." *Transactions of the Institute of British Geographers* 38 (2): 339–353. <https://doi.org/10.1111/j.1475-5661.2012.00523.x>.
- Faulconbridge, J., and M. Grubbauer. 2015. "Transnational Building Practices: Knowledge Mobility and the Inescapable Market." *Global Networks* 15 (3): 275–287. <https://doi.org/10.1111/glob.12078>.
- Forino, G., A. Fraser, and N. Tandarić. 2023. "Towards Adaptive and Transformative Finance for Urban

- Areas? A Framework to Analyse the Responsiveness of Adaptation Finance to Urban Challenges in the Global South." *Environment and Urbanization*, <https://doi.org/10.1177/09562478221143591>.
- Galvin, M., and P. Bond. 2022. "Flood-prone Durban ill-Equipped to Weather the Climate Crisis." *Mail & Guardian*, April 19. Accessed 13 February 2023. <https://mg.co.za/top-six/2022-04-19-flood-prone-durban-ill-equipped-to-weather-the-climate-crisis/>.
- García-Lamarca, M., and S. Ullström. 2022. "Everyone Wants This Market to Grow': The Affective Post-Politics of Municipal Green Bonds." *Environment and Planning E: Nature and Space* 5 (1): 207–224. <https://doi.org/10.1177/2514848620973708>.
- Goldman, M. J., M. Daly, and E. J. Lovell. 2016. "Exploring Multiple Ontologies of Drought in Agro-Pastoral Regions of Northern Tanzania: A Topological Approach." *Area* 48 (1): 27–33. <https://doi.org/10.1111/area.12212>.
- Goodfellow, T. 2020. "Finance, Infrastructure and Urban Capital: The Political Economy of African 'gap-Filling'." *Review of African Political Economy* 47 (164): 256–274. <https://doi.org/10.1080/03056244.2020.1722088>.
- Grafé, F.-J., H. Hilbrandt, and T. van der Haegen. 2023. "The Financial Ecologies of Climate Urbanism: Project Preparation and the Anchoring of Global Climate Finance." *Journal of Urban Affairs*. Epub ahead of print.
- Harker, C. 2017. "Debt Space: Topologies, Ecologies and Ramallah, Palestine." *Environment and Planning D: Society and Space* 35 (4): 600–619. <https://doi.org/10.1177/0263775816686973>.
- Harker, C. 2020. *Spacing Debt: Obligations, Violence, and Endurance in Ramallah, Palestine*. Durham: Duke University Press.
- Hilbrandt, H., and F.-J. Grafé. 2023. "Thinking Topologically about Urban Climate Finance: Geographical Inequalities and Mexico's Urban Landscapes of Infrastructure Investment." *Urban Geography*. Epub ahead of print.
- Hilbrandt, H., and M. Grubbauer. 2020. "Standards and SSOs in the Contested Widening and Deepening of Financial Markets: The Arrival of Green Municipal Bonds in Mexico City." *Environment and Planning A: Economy and Space* 52 (7): 1415–1433. <http://dx.doi.org/10.1177/0308518X20909391>.
- Johnson, L. 2021. "Rescaling Index Insurance for Climate and Development in Africa." *Economy and Society* 50 (2): 248–274. <https://doi.org/10.1080/03085147.2020.1853364>.
- Kashyap, A. 2022. "It's the Risk Management, Stupid!". Speech Given at UK Finance, London. Bank of England, July 11, 1–11. Accessed 17 November 2022. <https://www.bankofengland.co.uk/speech/2022/july/anil-kashyap-speech-on-climate-reporting-and-risk-management>.
- Langley, P. 2013. "Anticipating Uncertainty, Reviving Risk? On the Stress Testing of Finance in Crisis." *Economy and Society* 42 (1): 51–73. <http://dx.doi.org/10.1080/03085147.2012.686719>.
- Langley, P. 2020. "The Folds of Social Finance: Making Markets, Remaking the Social." *Environment and Planning A: Economy and Space* 52 (1): 130–147. <https://doi.org/10.1177/0308518X17752682>.
- Mader, P. 2018. "Contesting Financial Inclusion." *Development and Change* 49: 461–483. <https://doi.org/10.1111/dech.12368>.
- Martin, L., and A. J. Secor. 2014. "Towards a Post-Mathematical Topology." *Progress in Human Geography* 38 (3): 420–438. <https://doi.org/10.1177/0309132513508209>.
- Matthewman, J. 2021. "Bank of England CBES: Five Thoughts on Tackling Climate Change Physical Risk Reporting." Moody's RMS, March 8. <https://www.rms.com/blog/2021/03/08/bank-of-england-cbes-five-thoughts-on-tackling-climate-change-physical-risk-reporting>.
- Morris, J. H., and H. Collins. 2023. (Mis) *Managing Macprudential Expectations: How Central Banks Govern Financial and Climate Tail Risks*. Cheltenham: Edward Elgar.
- Peck, J., and A. Tickell. 2002. "Neoliberalizing Space." *Antipode* 34 (3): 380–404. <https://doi.org/10.1111/1467-8330.00247>.
- Pitman, J., T. Fielder, N. Ranger, C. Jakob, N. Ridder, S. Perkins-Kirkpatrick, N. Wood, and G. Abramowitz. 2022. "Acute Climate Risks in the Financial System: Examining the Utility of Climate Model Projections 2022." *Environmental Research: Climate* 1 (2): 1–14. <https://iopscience.iop.org/article/10.1088/2752-5295/ac856f/pdf>.
- Pryke, M. 2017. "'This Time It's Different' ... and Why It Matters: The Shifting Geographies of Money, Finance and Risks." In *Handbook on the Geographies of Money and Finance*, edited by R. Martin, and J. Pollard, 105–121. Cheltenham: Edward Elgar.
- Ranger, N. A., H. Bloomfield, B. Caldecott, and I. Clacher. 2023. "Learning from the 2021/22 Climate Biennial Exploratory Scenario (CBES) Exercise: Recommendations for Central Banks, Supervisors, Financial Institutions and Researchers." *UK Centre for Greening Finance and Investment*, 1–15. <https://www.cgfi.ac.uk/wp-content/uploads/2023/03/CBES-Reports-Recommendations.pdf>.

- Ranger, N. A., O. Mahul, and I. Monasterolo. 2022. *Assessing Financial Risks from Physical Climate Shocks*, 1–49. The World Bank Group. <https://openknowledge.worldbank.org/server/api/core/bitstreams>.
- Rebentisch, H., C. Thompson, L. Côté-Roy, and S. Moser. 2020. “Unicorn planning: Lessons from the rise and fall of an American ‘smart’ mega-development.” *Cities* 101: 102686. <https://doi.org/10.1016/j.cities.2020.102686>.
- Risk Management Solutions. 2021. “RMS Working with Canopus to Enhance Climate Change Risk Analysis with RMS Climate Change Models.” Moody’s RMS, December 13. Accessed 18 November 2022. <https://www.rms.com/newsroom/press-releases/press-detail/2021-12-13/rms-working-with-canopus-to-enhance-climate-change-risk-analysis-with-rms-climate-change-models>.
- Schindler, S., and J. M. Kanai. 2018. “Producing Localized Commodity Frontiers at the End of Cheap Nature: An Analysis of Eco-Scalar Carbon Fixes and Their Consequences.” *International Journal of Urban and Regional Research* 42: 828–844. <https://doi.org/10.1111/1468-2427.12665>.
- Soederberg, S. 2014. *Debtfare States and the Poverty Industry: Money, Discipline and the Surplus Population*. London: Routledge.
- United Nations. 2019. “Financing for Sustainable Development Report 2019.” Inter-agency Task Force on Financing for Development. Accessed 28 December 2022. <https://developmentfinance.un.org/fsdr2019>.
- World Bank. 2019. “Improving Housing Resilience.” Global Program for Resilient Housing, Synthesis Report. Accessed 14 January 2022. <https://documents1.worldbank.org/curated/ru/605571574937088827/pdf/Synthesis-Report.pdf>.
- World Bank. 2022. “Global Program for Resilient Housing.” World Bank Brief, January 21. Accessed 28 April 2022. <https://www.worldbank.org/en/topic/disasterriskmanagement/brief/global-program-for-resilient-housing>.

Fritz-Julius Grafe is at the University of Zurich, Switzerland. Email: fritz-julius.grafe@geo.uzh.ch

Giuseppe Forino is at the University of Salford, UK.

Arabella Fraser is at The Open University, UK.

Hanna Hilbrandt is at the University of Zurich, Switzerland.

John Hogan Morris is at the University of Nottingham, UK.