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A Politics of Global Datasets and Models in Flood Risk Management

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ABSTRACT: Momentum and interest have gathered around global flood risk datasets and models (GFMs). Such tools are often argued to be particularly useful in contexts where relevant data – such as stream flow and human settlement location – is sparse, inconsistent, or non-existent. As a relatively new technology, the technical limitations of GFMs – as specifically *technical methodological* challenges – have been quite well explored in existing literature. However, through engagement with literature, government policy documents and plans, and interviews with academic and commercial experts in Colombia, Ethiopia, India, Malaysia, and the UK, we show that their relevance and utility in reality cross-cut the technical, the political, and the social.

We argue that GFMs risk becoming another means through which states and other powerful actors re-imagine floods as technical challenges, while they are at root political-economic dilemmas (cf. Ferguson, 1994). This is linked to the ways that such technologies advance, becoming increasingly computationally powerful and accurate, and to the mutually reinforcing roles they play in relation to various 'fantasy plans' produced by governmental and other agencies (Weinstein et al., 2019). By focussing on an extended case study in the Akaki Catchment, Ethiopia, we argue that such fantasy plans – like those blueprinting urban development – serve to buttress state power through the performance of stability and reliability, while they avoid effectively tackling, or may even exacerbate, the political-economic realities which drive unequitable and unsustainable development. Such forms of development are directly linked to increasing flood risk both locally and globally.

INTRODUCTION

Momentum and interest have gathered around global flood risk datasets and models (here, for brevity's sake, GFMs). Borne out of advancements in remote sensing (e.g. satellite- and aircraft-based) technology, computational processing (speed and algorithms), and urgent efforts to understand and respond to one of the world's most dangerous and costly natural hazards (Lindersson et al., 2020), these are represented by a growing and increasingly diverse range of digital information sources and tools (e.g. Ward et al., 2015; Trigg et al., 2016; Bernhofen et al., 2018; Ward et al., 2018; Carr, 2020; Mulligan et al., 2020; Ali et al., 2021; Bernhofen et al., 2021; Dottori et al., 2021; Feng, 2021; Liu et al., 2021; Bernhofen et al., 2022; Devitt et al., 2023). In simple terms, these combine global or near-global digital elevation models (DEMs; 3-D representations of the topography of the planet, obtained generally through space-based technologies) or digital terrain models (DTMs) together with geospatial datasets representing things like population and settlement density and type. Computer-based simulations of how water might flow and pool in such virtual mimics of real-world landscapes can then be used to assess 'flood risk'. In the academic, commercial, and governance literatures and other places where these models are discussed, developed, deployed, and promoted, flood risk is usually understood to consist of a combination of three elements: flood hazard, flood exposure, and flood vulnerability. Hazard refers to a combination of the probability and magnitude of flood in any particular area; exposure "to the location and characterization of population and economic and environmental assets in a hazard-prone area; and vulnerability to the susceptibility of those assets or people to suffer damage and loss (e.g.; due to unsafe housing and living conditions, or lack of early warning procedures)" (Dottori et al., 2021, 254). Usually, risk is calculated in terms of economic costs due to things like damage to infrastructures and effects on population mortality.

Such GFMs are often argued to be particularly useful in two research and policy areas that longer-standing, more geographically curtailed flood-risk-related datasets and models cannot handle or respond to in the same way. Firstly, they are said to be useful for estimating flood risk across massive, intersecting spatial and temporal scales, representing planetary hydrologic and hydraulic processes in the past, present and future (Ward et al., 2013; Winsemius et al., 2013; Grimaldi et al., 2019). This makes them particularly attractive to those wanting to understand, for example, how climate changes in the next decades might affect flooding, and to plan accordingly – sometimes taking into account the effects of flood protection measures (Scussolini et al., 2016; Ward et al., 2017; Dottori et al., 2018). Secondly, they are argued to be useful in contexts where relevant data – such as stream flow or human settlement locations – is sparse, inconsistent, or non-existent (e.g. Ward et al., 2015; Yan et al., 2018; Bola et al., 2022). In such cases, remotely sensed data (Muthusamy et al., 2021), computerised global flow simulations (Smith et al., 2015), or data adapted from data-rich, hydrologically similar locations can be used to fill in the gaps, so to speak (UNISDR, 2015). This can be applied to less well-known areas within 'developed' nations – such as the United States – which are otherwise topographically, hydrologically, and demographically extensively and actively measured, sampled, and surveyed (Wing et al., 2018). More often than not, though, GFMs are said to be useful in the context of 'developing'[1] nations whose forms,

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[1] In the interests of readability, we will not continue to put 'developing/developed country' in scare quotes. However, we have done so in these first instances in recognition of and broad agreement with the long-established argument that European colonial countries only built their national wealth, technology, and so on through taking from, exploiting, or otherwise underdeveloping other parts of the world (Rodney, 2018). As such, 'developing countries' are not somehow 'behind' independently of the advance of those colonial nations, but as a direct consequence of it. At the same time, the very notion of what it means to be 'developed' contains all kinds of unfounded assumptions and prejudices about human needs, wants, and existence (Peet and Hartwick, 2015).

flows, and patterns of water, land, and human settlement are less extensively locally surveyed and archived, or where access to what data there is can be difficult and time consuming (Butte et al., 2022; Chan et al., 2022; Singh and Dhanya, 2024).

GFMs, then, offer a tantalising potential to predict with some accuracy interactions between future flooding, climate change, effects on humans, associated economic losses, and possible ways to ameliorate these effects and losses in, conceivably, every corner of the globe. This makes them attractive to – and indeed they *are* actively employed by – a host of actors influential within the intertwined world-making infrastructures of global knowledge production, global governance, and global development. This includes but is not limited to researchers at organisations such as the United Nations Office for Disaster Risk Reduction (UNDRR, 2015), the World Bank (Oladokun et al., 2023), national departments and agencies responsible for national flood risk management (FRM), the (re)insurance industry, built environment investors, and researchers at academic institutions (ourselves included) (Ward et al., 2018; UNDRR, 2022; Oladokun et al., 2023).

As a relatively new technology, the technical limitations and challenges posed by GFMs have been quite well explored in existing literature – including in relation to the ways in which flood risk estimation can be massively affected by which hazard, vulnerability, and exposure datasets one chooses (Trigg et al., 2021; Bernhofen et al., 2022) – and in relation to problems of resolution and relevance to complex, real-world urban and rural topographies and scenarios (McClean et al., 2020). Highlighting limits of scale and resolution with GFMs is particularly relevant as researchers and others increasingly attempt, as observational and computational technologies advance, to apply these tools at national and potentially even some sub-national scales as opposed to their relatively more established use at the global scale (Carr et al., 2024).

In this paper we examine GFMs as *techno-political* phenomena across multiple scales of governance*.* As we began the early research processes for this study, it quickly became clear that there were many different potential avenues to be explored in terms of the politics of GFMs, from the developmental histories and presents of the supporting space-based technologies rooted in various nations' military-industrial complexes (Green, 2006; Dawson, 2018, 2021) to the use of GFMs in the (re)insurance industry where, as one industry insider told us, profit is the overriding motivation. As an interdisciplinary international research collaboration,[2] we chose to focus on the opportunities GFMs seem to offer academics and planners, as mentioned above. That is, the opportunity to apply GFMs at national and sub-national scales, to enable researchers to 'jump over' local politics – and the reality of what all this might mean in practice. This to us seemed a pressing, relevant, and necessary issue to address. As such, the paper sets out to answer the question:

> How do GFMs interact with on-the-ground political, institutional, and social realities, and do they reinforce or ameliorate underlying drivers of flood risk?

After outlining our methodology and theoretical perspectives, we answer this question first by drawing on existing studies and our expert interviews to contextualise flood risk management (FRM) data in Ethiopia, Colombia, India, Malaysia, and the United Kingdom. This makes it clear that 1) in all country contexts flood, as a major and increasing risk, intersects in mutually exacerbating ways with existing political, economic, and social inequalities and 2) aside from the United Kingdom, GFMs in these countries do represent our two purported opportunities indicated above (i.e. to use at national or smaller scales

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and to elude local politics). Then, focusing on an extended case study based in the Akaki River Basin, Ethiopia, we highlight the effective limits of recent – albeit constructive – moves to better integrate GFMs with local contexts and concerns. Such limits derive from the ways in which political-economic interests override and undermine even the best intentions of planners and policy makers to build sustainable and inclusive urban spaces. These often tend to ultimately reinforce, or at least not challenge, underlying drivers of (unequally faced) flood hazard, exposure, and vulnerability. In conversation with evidence from the other four country contexts, we show this problem is not limited to Ethiopia.

INTERROGATING GFMs ACROSS FIVE COUNTRIES

This paper offers an exploratory analysis of our primary research question with the aim of revealing key dimensions of this space in each country context. To do so, we draw on literature reviews; government policy and planning documents; semi-structured interviews (individual and in groups) with academic, government, and industry FRM experts (n = 32, conducted between 2021 and 2024) in all five countries (Ethiopia 11, Colombia 3, India 4, Malaysia 3, United Kingdom 11); and attending public flood risk governance meetings – alongside our own author team's collective decades of expertise and knowledge. The choice of these five countries for this study was partly expediency, but they do present a global geographical spread across the spectrum of countries as conceived in the global development imaginary (i.e. Ethiopia lowest, United Kingdom highest, etc) – especially relevant, we argue, considering the topic of this study as briefly outlined above. In addition, these case studies enable us to analyse the application of GFMs within national and sub-national contexts, a scale that, as mentioned, researchers and others are increasingly interested in applying GFMs to.

In line with the perspective many of Science and Technology Studies (STS) scholars, we take GFMs to be political in a way that is not limited to the human and that necessarily cross-cuts domains of science, technology and society (or nature and culture; c.f. Latour and Woolgar, 1979; Callon, 1984; Law, 2008; Latour, 2013). Relatedly, we hold to the notion of the hydrosocial – spearheaded by such authors as Swyngedouw (1999, 2004, 2009) and Linton (Linton and Budds, 2014) – which understands water and society as an ongoing process which "make and remake each other over space and time" (Linton and Budds, 2014: 170). Thinking across these two perspectives, while GFMs ostensibly offer new ways to see and know the world and its hydrological processes more comprehensively than ever before, they do so by necessarily changing the world they purport to represent. They do this in many ways, including by the new associations of things, people, waters, and places they help bring together; new ways of seeing, imagining and thinking about waters that they make possible; and through the previously impossible interventions in the flow of water they might facilitate – and the myriad implications this could entail for humans and non-humans alike. As such, we need to think very carefully about how such technologies are and might be deployed in a world already riven by inequalities when it comes to many aspects of life, including flood risk. Relatedly, we also situate ourselves within political ecology. With roots in Marxist dialectics (Greenberg and Park, 1994; Boelens et al., 2016), this is a broad church which for us importantly recognises that the mutual co-emergence of natural-cultural domains normally does so under conditions of unequal human power relations. These relations tend, by intent and/or wider structural logics, to accrue wealth and other benefits to some human beings more than others.

With this as our theoretical starting point, we outline the form of these emerging techno-political phenomena through exploring the five country and subnational contexts in the main body of the paper below. In each of the cases, research and impact was focused on subnational regions, typically geographically close to host research institutions. These were the Upper Cauca River Basin (UCRB), running south to north along west-central Colombia from the Andes range to the Atlantic Ocean; Central Ethiopia across several water basins (including the Akaki, which runs through Addis Ababa); the Johor River Basin in Malaysia on the southern border with Singapore; and the Yamuna River Basin (which includes Delhi) in north-central India. In the UK, we look at the region of Yorkshire and the Humber in the

north of England. With part of the author team based at the University of Leeds, this offered us access to relevant experts and ongoing FRM governance processes. Thus, in order to explore the political concerns that GFMs entail at subnational scales (considering the trajectory of GFMs mentioned above), and drawing on the vast expertise and knowledge (published and unpublished) represented by researchers and policy stakeholders across the research group, we analyse the dynamics we engaged with at these regional scales, set within their national contexts. Analysis of this complexity requires empirical detail, and therefore we focus on Ethiopia as an exemplar of a developing country with patchy FRM-related local data. This allows us to delineate and clarify tensions and gaps more specifically.

In short, we argue that GFMs risk becoming another means through which states and other powerful actors re-imagine floods as technical challenges when they are at root political-economic dilemmas (cf. Ferguson, 1994). This is seen through the mutually reinforcing roles they play – or in the future may play – in relation to various 'fantasy plans' produced by governmental and other agencies (Weinstein et al., 2019). Such fantasy plans – such as those blueprinting urban development – serve to buttress state power through the performance of stability and reliability, sometimes actually attracting investment, while avoiding effectively tackling the political realities which drive unequitable and unsustainable development. Such forms of development are directly linked to increasing flood risk, both locally and globally. This is exacerbated to the degree to which there is a gap between policy and the reality of the implementation of those policies. Such a gap is seen in all five countries included in this study.

This is far from being a problem exclusive to the developing world. We purposefully include the UK in order to demonstrate that 'even' where high-resolution data and abundant local flood risk models mean that GFMs are rarely, if ever, needed, the future of managing flood risk is an open question because of political economic realities and pressures. Ultimately, we hope to contribute to establishing a critical discourse around GFMs that might help them realise their potential to contribute to the fundamental global need for more equitable and sustainable futures, especially as these relate to flood risk.

CONSIDERING GFMS IN HIGHLY FLOOD PRONE, ALREADY CONTESTED, UNEQUAL COUNTRY CONTEXTS

In order to approach our primary research question, we first need to sketch a picture of flood risk and locally produced FRM-related data in each country, as well as how these interact with broad political, institutional, and social realities. This primarily literature-driven section sets the stage for a sub-headed section, driven by stakeholder interviews, on the roles or potential roles of GFMs in helping to ameliorate flood risk in such contexts.

Flooding has become one of the most common disasters in *Ethiopia*. According to the WHO and the National Disaster Risk Management Commission (NDRMC), the first half of 2024 alone saw more than 560,000 people affected by heavy rains and flooding, including the regions of Afar, Amhara, Central Ethiopia, Oromia, Sidama, Somali, South Ethiopia, South West Ethiopia, and Tigray, and the Dire Dawa City Administration (WHO, 2024).

In *Colombia*, large geomorphological and climatic contrasts have been linked to a high probability of various disasters, including landslide and flood (Chavez-Arias et al., 2024). Located within the Intertropical Convergence Zone (ITCZ), it regularly experiences hurricanes and storms (Bernhofen et al., 2022) – with some resultant flooding causing damages running into billions of US dollars (Hoyos et al., 2013).

India is one of the world's most flood-prone countries, with 113 million people exposed (Singh and Dhanya, 2024). Floods are an annual occurrence and vary across the country in their cause and impact. While most occur during the monsoon months spanning from June to September, different regions of the country receive rainfall at various times of the year, leading to disparities in flood patterns. Coastal flooding is extensive, while extreme weather events lead to fluvial flood risks to city dwellers from inland water sources (Pakhale and Nale, 2023: 1177).

Flooding represents the most severe disaster in *Malaysia* where, in the last decade, floods have destroyed thousands of homes and caused billions of US dollars' worth of damages. People have also lost their lives, with floods in 2021 killing nearly 50 people and causing the evacuation of 400,000 (Chan, 2014; Karki, 2016; Rahman, 2022; Rosmadi et al., 2023). A significant portion of Malaysia's river basins – 85 out of 189 – are prone to recurrent flooding (Lin and Billa, 2021). The basic cause of flooding is heavy rainfall, with most incidents occurring during the Northeast Monsoon between November and February (Bernhofen et al., 2022).

Driven by its maritime and moist climate, 6.3 million properties in the *United Kingdom* are currently at risk of floods from rivers or seas. Recent years, including 2007, 2015, 2019, and 2024, have seen major events, incurring billions of pounds worth of losses (Carvalho et al., 2023; Pitt, 2008; Morris and Grierson, 2024; Wu et al., 2024).

Across the world, vulnerability to and ability to cope with floods are inversely associated with people's positions within unequal, intersecting social hierarchies (Hallegatte, 2016; McDermott, 2022) – whether this be ethnicity and class in the UK (Fielding, 2012; Hassan and Paris, 2023), race and wealth in Colombia (Sarmiento, 2024), political association and wealth in Ethiopia (Nygren and Wayessa, 2018), migrancy status in Malaysia (Elmhirst et al., 2017), or caste and political connection in India (Santha, 2014). In all countries, significant ongoing and predicted increases in flood risk are connected to climate change (Kumar et al., 2019; Chan et al., 2022) – and in all countries except the UK, to processes of rapid urbanisation (Singh and Singh, 2011; Ranganathan, 2015; Bahinipati et al., 2017; Safiah Yusmah et al., 2020; Sehra and Punia, 2020). Such urbanisation, commonly characterised as 'uncontrolled' (although we will consider some evidence below that this might be a bit of a misnomer), causes flood risk to increase for a number of reasons. The increase in impermeable surfaces reduces the ability of water to sink into the soil, gathering rather at bottlenecks, which flood, often quickly and without warning. Drainage systems, if developed at all, are often done so after the fact, and are often inadequate, while municipalities might lack resources to maintain and clear such drainage systems (Kumar et al., 2023). Coupled with this, much urbanisation is driven by the arrival of resource-poor people, driven to the city to seek work or (particularly in the cases of Ethiopia and Colombia) by violence and conflict elsewhere in the country. Settling in floodplains where land can be cheaper, they often become triply vulnerable to flood: 1) they live in a zone prone to flooding, 2) their homes can be poorly built, and 3) they may (as documented in India, Ethiopia, and Colombia) not be given legal status and so be denied full infrastructural services such as piped water, drainage, and sewerage, and they may be forcefully relocated (Bhan 2016; Baviskar, 2020; Sarmiento, 2024).

DATA/GOVERNANCE ISSUES – AND THE POTENTIAL OFFERED BY GFMS

To try to ameliorate flooding through early warning systems, more effective responses, or planning which is more aware of and attuned to hydrological and hydraulic conditions, authorities and/or supporting academic research institutions in each country included in our study deploy various kinds of in-place local monitoring tools. These include rain and river stream flow gauges, generating data which can be used in computer-based flood risk models. Ideally, such information would effectively complement traditional satellite-based data, such as rainfall patterns produced by national meteorological departments. However, in Ethiopia, Colombia, India, and Malaysia, we see varying degrees of limitations to the utility of this locally-produced data and the models developed from it – limitations which necessarily intertwine governance and technical issues. In each case, GFMs have been used or explored for their utility in stopping some of these gaps. With one of the richest locally produced FRM data and modelling tools in the world, the UK is a somewhat different case, and we return to it farther on in the discussion.

In *Ethiopia*, experts have related that there is often not enough locally-generated observed stream flow data available or accessible, nor is there enough data or information available to those affected at local scales. Often there is a lack of research into the impact on people. What data there are is accessible

to researchers (either behind a paywall or for free). However, these data are often of poor quality. Lack of maintenance of measuring instruments in the field leads to inconsistency in measurements, and a limited number of instruments is available. There can also be a complicated bureaucratic process to accessing data if you are not in touch with the relevant gatekeepers or if you do not know the individual department to enable access. Other authors have found similar FRM data-related issues (e.g. Taye et al., 2024: 10). With its significant gaps in local data production, Ethiopia is perhaps particularly well-suited to the possibilities offered by GFMs – in terms of access and to fill in gaps in relevant data. Indeed, efforts have been made to these ends, e.g. Carr et al. (2024), who worked with a number of global datasets (as well as local sets where available), including the FABDEM Global DEM, WorldCover, and ERA5 Reanalysis rainfall, to estimate flood risk at the city scale of Addis Ababa (see also Legass et al., n.d.).

In *Colombia*, despite various improvements and initiatives in FRM – such as early warning systems in some places sparked by the 2010-2011 La Niña events (e.g. Werner et al., 2025) – many challenges remain. In the UCRB specifically, expert consultation raised concerns that data measuring hydrological flow for rivers is only collected every couple of weeks, undermining the chances of timely a response to floods, which may develop at hourly – let alone daily or even weekly – scales. Either way, interview data suggest that financial and human resources across the country are often limited, with not enough capacity to collect data at the municipal level. Poor management of data (including lack of centralisation) seems to reflect a wider governance issue: the hiring of non-experts as a result of nepotism, political agendas, and corruption, while data is sometimes used as a bargaining chip for political leverage. This influences the accessing of data and information. In some places, there is limited public access to data due to limited internet access and knowledge on the existence of these kinds of data. On the west coast, Renteria-Mena et al. (2024) report a scarcity of meteorological and hydrological monitoring stations, alongside no early warning system and serious issues with urban planning. Elsewhere, the country's complex topography and remoteness (such as in the Mojana region in north of the country [Velasquez et al., 2024] or along parts of the Magdalena River [Kettner and and Brakenridge, 2020]) or the risk of violence associated with illicit crop production and transport (Shenouda, 2022) make producing and accessing hydrological data extremely difficult. GFMs have helped plug some of these gaps, including the use of optical and SAR from the Landsat Sentinel-1[3] and Sentinel-2 datasets to understand agricultural recovery in the Mojana region after floods in 2021 (Velasquez et al., 2024) and the global Multi-Error-Removed Improved-Terrain (MERIT) DEM to predict the impacts of sea level rise along the pacific and Caribbean coasts (Nevermann et al., 2023).

At the national scale, we have heard about the lack of support in territorial planning processes, especially at the local level such as in municipal risk management councils. Other issues are connected to the lack of political will to plan ahead for flood risk management – this despite the fact that a preventative approach is proposed in the 2012 Law 1523. At the same time, an overall top-down approach where decisions are taken at the national or regional level can undermine the participation of all stakeholders in planning processes. Siddiqi et al.'s ethnographic exploration of this preference for expert-led intervention found that this might partly be a "consequence of Colombia's troubled political history, with bureaucrats wary of bringing people's voices into policy planning debates for fear of this space being taken over or captured by the conflict, and the partisanship associated with it" (Siddiqi et al., 2019: 30). This, interviewees told us, is all complicated by a lack of clarity in the roles and competencies assigned to institutions in FRM as a result of overlapping functions between national, regional, and local institutions.

In *India,* in terms of national datasets, we heard scepticism expressed about the reliability of damage data collected after floods (due to the likely lack of adequately trained investigators); that the high price of high-resolution DEM models might take such models out of the reach of some states; that there are gaps in socio-economic data (sometimes related to the time lag between censuses); and about the reliability of gauge and rain data provided by government agencies such as the Indian Meteorological

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[3] Sentinel-1 is a satellite that is part of the European Union's earth observation Copernicus program (Ecosystem, 2025).

Department. As other authors have found (Mohanty et al., 2020), we heard about the fragmentation of hydro-meteorological data across agencies and agencies' reluctance to share data with one another (Kumar et al., 2019; Singh and Mohanty, 2023). However, there are moves to develop open-source, government-led sharing of data, including geospatial data (see Datagovernance.org).

There is also a lack of fine-grain, reliable data on socio-ecological factors at a local scale, integrating technical, social, environmental, economic, legal, and institutional dimensions, undermining the accuracy of flood risk assessments and hampering efforts to develop effective adaptation strategies aimed at targeted deployment. To some extent, GFMs can and have been used to make up for deficiencies in data accessibility or for data types that are needed but simply not collected. Global datasets have offered value to fill some of these gaps, including providing validation against locally produced data on topography, precipitation, and vulnerability in various regions of India, including Delhi (Bernhofen et al., 2022; Singh and Mohanty, 2023; Singh and Dhanya, 2024).

Nevertheless, even if such diverse forms of high-quality qualitative and quantitative data were to be generated, accessed, and integrated, "even if we have a perfect model", as one local modelling expert put it to us, "and we have 100 percent confidence that the model is going to give the actual way, the realistic way the system is behaving, then we would also need to educate administrators or the actual agencies and organisations [responsible for flood risk management and response]".

In other words, this is the governance-related (dis)connect between research efforts and practical implementation, and while there have been some significant reported improvements (e.g. Jain and Singh 2023; Zimmerman et al., 2023), serious issues of flood-risk governance are faced in different ways across the country (Fanaian and Fanaian, 2023; Hakkim and Deb, 2023; Mukherjee, 2023), including the ineffective allocation of responsibilities among a large number of different agencies (Gupta, 2017) and a need for more flood adaptation measures in Indian cities (Singh et al., 2021; Ahmad, 2023) – increasing flood risk and scuppering responses such as evacuation (Tomar et al., 2021: 15).

In *Malaysia*, despite the installation of infrastructure for flood mitigation, forecasting and warning systems, the effectiveness of these systems has been hampered by various factors, including 1) focusing on structural measures like building fortifications and diversions for rapid disposal of waters rather than a holistic approach to flood management (Chong and Kamarudin, 2018; Chan et al., 2020); and 2) FRM data challenges. This includes poorly documented and often incomplete historical flood damage data (Romali and Yusop, 2021). While district-level data can be obtained, interviewees told us that it can involve a bureaucratic process that takes time. Moreover, different departments have their own projects with their own key performance indicators and may collect the same data without consolidating. Additionally, data on flood risk is frequently treated as confidential and is not made public, further complicating emergency planning (see also Chan, 2014). Although much data is generally of good quality, inconsistencies between years and differences in data collected across states make comparisons difficult (Olcese et al., 2022). At the local level, experts felt, data can be poorly managed, leading agencies to be reluctant to share it, while the process of data collection for different agencies varies according to their respective needs and policies. The fragmented state of existing data sets may have led to poor inter-agency decision-making (Zulkifli et al., 2021: 11).

Thus Malaysia is again a country where researchers are assessing the potential of applying global datasets in FRM – for example, to sidestep bureaucratic limitations on stream-flow data (Tan, 2014) or to make up for missing rain gauge data (Olcese et al., 2022) and low rain gauge coverage in different regions of the country (Syakira et al., 2023). Clearly, local FRM data limitations are both part of and reflect wider issues of flood risk governance in Malaysia. In a recent review of the relevant literature (2000-2022), Rosmadi et al. (2023) found that studies reported four main areas of weakness: 1) inadequate coordination and communication, including agencies working at cross purposes, leading to issues with both FRM-built infrastructure and ineffective communication during disasters; 2) inadequate manpower and assets for logistics, including personnel, boats, and helicopters for rescue operations, especially at

local government levels – again, bureaucracy is an issue, impeding the purchase of such assets; 3) inadequate public awareness, with possible implications for land use with negative impacts on flood risk; and 4) inadequate power and authority, including the Department of Irrigation and Drainage's inability to legally reject development projects which might increase flood risk, and conflict of authority and overlapping of jurisdiction between different responsible agencies. This is connected to a three-tier governance structure, in which drainage and irrigation fall under both federal and state jurisdiction (Nagheeby et al., 2023; see also Polaine et al., 2022; Tajuddin et al., 2023). Others have additionally found issues related to an inadequate consultation and incorporation of stakeholders and local and indigenous knowledge in local development plans (Chan, 2014; Karki, 2016).

GFMs AS POTENTIAL ANTI-POLITICS MACHINES

In each of these country contexts, then, GFMs offer the opportunity to jump over the politically entailed frustrations of the local context in order to access 'the data'. Indeed, the majority of GFM-related literature, as with modelling literature more generally across all country contexts, focuses on documenting incremental improvements to techniques, technologies, and approaches (Musa et al., 2023; Syakira et al., 2023; Singh et al., 2024), with artificial intelligence and machine learning perhaps inevitably being explored as solutions to some of GFMs' limitations (Velasquez et al., 2024). There are certainly exceptions (e.g. Dasgupta et al., 2023; Kumar et al., 2023), but overall, governance and other on-the-ground social-political and resourcing challenges tend to feature minimally in such works. Most modellers we have spoken to and various decision-makers working with them are fully aware that "models are just models" and are full of gaps, inconsistencies, and assumptions. However, the knowledge of this itself can foster a confidence that models will be improved incrementally with more and more of the social and physical world included in their calculations, so that they might come *closer* to predicting the future.

We do not doubt that developments in techniques and approaches represent real improvements in our ability to *theoretically* predict floods; this indeed forms a key part of the work regularly undertaken by some of the present author team. But, as Bernhofen et al. (2022) have previously pointed out, for models, for GFMs to be useful, there needs to be in place – at a minimum – the institutional capacity to turn knowledge into planning and action on the ground. To the extent that those working to improve GFMs ignore or do not take such governance challenges sufficiently seriously, there is a risk that these tools may become or may already be playing the role of what James Ferguson famously referred to as an "anti-politics machine" (Ferguson, 1994) – i.e. making out to be technical what are in reality techno-social-political challenges.

In recognition of such challenges and risks, there is certainly starting to emerge a body of practice, research, and literature aiming to connect global modelling to local scales, exploring possibilities for the co-production of knowledge across wider, more diverse stakeholders (Dasgupta et al., 2023). In the countries included in this study, too, are various ongoing attempts to try to put into productive conversation what is theoretically predictable and what is practicable and needed in place, involving a wide group of affected government and citizen stakeholders.

For example, in the Abbay River Basin, Ethiopia, the CAMELS-Eth database works towards, among other things, countering fragmentation issues in water data governance, facilitating data sharing between stakeholders, and allowing for better planning in ungauged catchments through integrating local and global FRM datasets (Teferi et al., 2024). In the UK, a growing experience of community (Landström et al., 2019) and participatory (Maskrey et al., 2021) FRM modelling brings together citizens, government agencies, academics, and others to try to develop mitigation methods that incorporate local knowledge and participation. In Delhi, India, the Water Evaluation and Planning (WEAP) tool involves ongoing engagements with government agencies, NGOs, academic institutions, and community groups that aim to iteratively integrate qualitative and quantitative models so that "modelling outcomes are not

only scientifically robust but also aligned with the social and economic realities of the city" (Kumar and Asfaw, 2024: 143; see also Bhave et al., 2018).

Such work develops important lessons for how those working with GFMs might more effectively engage with local politics and realities towards policy and planning. Messy challenges remain, however, partly due to the hard limits of stakeholder engagement. For example, what happens when there are powerful actors who are not interested in taking part in co-production or even making themselves known to those trying to facilitate such processes? What happens when planning, either through design or through the ways such plans meet the power-laden reality of implementation on the ground, act to entrench social inequalities, serve the interests of elites, and even exacerbate flood risk? In the following sections, we see evidence of elements of such challenges in all five countries.

POWER AND THE LIMITS OF DATA INTEGRATION

In our case study in the *Akaki River Basin, Ethiopia,* we encountered real-time dilemmas of trying to translate GFMs into contexts where plans and realities are pushed apart by the difficult-to-reconcile tensions of economic growth, political control, and ideas of sustainable, socially just cityscapes. To tease out some of these tensions, we devote more space to this example.

Still primarily a rural country, Ethiopia is urbanising fast (Alemayehu et al., 2018; United Nations, 2018; Mohamed et al., 2020; Mersha et al., 2022; Hailu et al., 2023), with urbanisation key to government aims since 1991 of developing and growing the economy rapidly (AACPPO, 2017). At the heart of these economic growth aims, entailing the growth of industry and transport, is Addis Ababa. Addis's population is estimated to have grown from approximately 1.4 million in the mid-1980s to around 5.7 million in 2024 (UN-HABITAT, 2008; Macrotrends.net, 2024), with much construction occurring in the form of informal housing and other unregulated development (Mersha et al., 2022; Hailu et al., 2023; Jacobsen et al., 2024). It is widely recognised that the replacement of forest, water bodies, and agricultural land by built-up areas with impermeable surfaces is worsening the threat of flood in Addis (Beshir and Song, 2021; Addis et al., 2023; Assefa, 2024), which now regularly experiences deadly flooding, in particular flash floods associated with intense rainfall events and river surges (Floodlist.com, 2021). With issues of data availability and quality in Addis mirroring those sketched above at the national scale, there is an urgent need for better data and models to help ameliorate this increasing urban flood risk. GFMs have been proposed as possible viable tools to help to do this, including by ourselves (e.g. Carr et al., 2024). Two Ethiopian graduate students (Eden Seifu and Abel Alemu, co-authors on the present paper), based in Addis, have been involved in working with GFMs to test and develop their utility at the city and sub-city scale.

Seifu has been working with a team at the International Water Management Institute (IWMI), Addis, to integrate global and local datasets, including observed flood events from the Addis Ababa Fire and Disaster Risk Management Commission (AAFDRMC), with citizen scientist-collected data in order to identify flood hotspots and better understand flood exposure. A key idea here is that local knowledge and experience can help paint a richer picture of local contexts than can any existing local and global datasets on their own, with their respective limitations of patchiness and resolution. Other studies have found success with similar approaches (e.g. Schnebele and Cervone, 2013; Luo et al., 2024). The global datasets Seifu has been using are a 30m^2 population density map from the Humanitarian Data Exchange; building footprint and road network data from Openstreetmap; and flood inundation data from a Sentinel-1 2017-2023 dataset (modified from Bekele et al., 2022). Seifu has worked carefully to generate locally grounded citizen-scientist-observed data and insights and to integrate them with GFMs. Briefly,

this has involved recruiting hundreds of volunteers to upload geographically located photographs and videos of flood events to a Telegram[4] group.

Members of this group – intentionally gender-balanced – include quite a diverse cross-section of Addis's society, from high school students to civil service workers to farmers along the lower reaches of the Akaki river. Seifu did this in recognition of the reality, raised by a range of authors (e.g. Strasser et al., 2019; Tedla et al., 2022; Nigussie et al., 2025), that citizen science is not necessarily itself an unproblematic source of politics-free data. Who does and does not observe and report, how and why, and how people are recruited to do such work *matters*, often reflecting existing power relations. During Seifu's work, this was highlighted when several citizen-scientist volunteers, driven by necessity to live in informal housing within the Akaki floodplain, were forced by government agencies to move home. This at one point threatened to undermine the integrity of Seifu's data, since the specifics of how water behaves in particular locations are vitally important when trying to collect on-the-ground observed rainfall data against which to validate and complement remotely sensed data. In the end, while Seifu was able to find other volunteers to carry out observations close by to the original sites, this incident made clear the many intersections of citizen science and local political realities.

Seifu's volunteers were asked to fill in Telegram-based surveys on the severity and regularity of flooding at the sites they identified. Seifu has triangulated this with frequent site visits and with structured and unstructured interviews with people living or working near identified flood spots regarding the extent of flooding, possible causes of flooding, and floods' impacts on people and properties. Seifu is convinced that the local (AAFDRMC flood incident records cross-checked with volunteer-identified sites) and global (population density and infrastructural map) datasets and citizen-science-generated data (flood hotspots in terms of flood regularity, cause, severity, and impact) can complement one another to build a richer picture for planners to work with than can any one element on its own.

Alemu has similarly been working in the Akaki River Basin with a team at the same research institution to integrate different forms of locally generated data, information, and insight with, in this case, a single global dataset (Sentinel-2 land cover data) in order to develop suggestions for locally relevant improvements to flood defence and mitigation infrastructure for city planners to draw on. Like Seifu, he has striven to generate locally derived, specific information and insights to complement this global dataset with its own limitations of resolution. Following an extensive literature review, he identified possible infrastructural measures to counter fluvial flood risk along a stretch of the Akaki. He then consulted with flood risk experts working in Addis, and at the suggestion of these experts he further consulted with officials at sub-city and *woreda* administrative levels in order to ensure that any mitigation measures would be in line with any future infrastructure plans. This included speaking to the AAFDRMC, Akaki Kality Subcity Fire and Disaster Risk Management Commission, the Addis Ababa Environment Protection Authority, and Addis Ababa resilience offices. He further made sure that any such mitigation measures could be modelled with and showed reasonable outcomes in the Hec-Ras modelling platform – where the global dataset enabled him to calculate digital water's interaction with different forms of land cover. He also personally walked a long stretch of the Akaki River and spoke to affected locals about their insights into the causes of flooding and suggestions for improvements to current mitigation measures. Following a second local expert meeting, he ended up with a list of seven measures, including channelisation, detention ponds, and tree planting, which offer more robust, locally grounded possibilities for planners to work with than any form either available local or global datasets could have on their own.

Despite such approaches' significant potential, another look at the contexts in which Seifu and Alemu are working forefronts hard limitations to reduction in flood exposure and vulnerability irrespective of

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[4] Telegram is cell-phone communication app, similar to Whatsapp (which is perhaps more familiar to the reader), but which is much more popular in Ethiopia and able to operate in very weak cell-phone signal contexts.

the (in)accuracy of global datasets and their integration with local data and insight. In order to fit his proposed measures to the present and future infrastructure associated with the Akaki River, Alemu needed information on previous infrastructural projects such as bridges, sewers, and roads and on who was involved in these in order to consult with them. However, linked to the continual change in personnel in such city planning departments, Alemu was in many cases not able to access this information because it simply was not there, with no data transfer in place. This is a common issue, with other researchers having found a similar lack of institutional memory, with similar causes (Addis et al., 2022; Adane, 2023).

The situation is perhaps even more uncertain when looking to the infrastructural *future* of the Akaki – arguably even more important to the kinds of measures both Seifu and Alemu's work indicates. Through literature review and expert consultation, Alemu was encouraged to fit any measures to the *Addis City Structure Plan* (2017-2027) (AACPPO, 2017). This is a comprehensive and in parts remarkably reflective document with an awareness of the significant, critical academic literature accounting for the failure of the previous *Addis Ababa City Development Plan* 2002-2012 and for the nine- and ten-year city plans before them. This includes issues of accountability, lack of citizen consultation, governance disconnections, and resourcing and capacity constraints. The plan offers point-by-point solutions to these issues, envisioning a greener, more inclusive city where the quality of human lives and the ecosystems they depend on are paramount and where "proposed green space planning, which is based on ecosystem services approach, contributes to the reduction of flood risks" (AACPPO, 2017: 173). This is in line with a national move, over the last decade or so, from a crisis-management model to a more holistic and anticipatory FRM approach paired with a cohesive policy and leadership framework. Established in 2015, the National Disaster Risk Management Commission (NDRMC) is responsible for disaster risk management. The NDRMC is mandated to ensure a streamlined DRM approach, including an early warning and response system across all government sectors, from the federal down to *kebele* levels as well as in city administrations. The NDRMC is responsible for coordinating disaster response, risk management, preventive measures, and recovery programs in the country and functions through an established structure with clearly defined duties and responsibilities.

At the level of policy and law, then, the future looks predictable, bright, and inclusive. Unfortunately, all indications are that neither the 2017-2027 *Structure Plan* nor FRM policies are being implemented as planned. Using remotely sensed global land-cover datasets from Landsat-7 and -8, Hailu et al. (2023), for example, found huge variations between planned and actual land use, with notable loss of ecosystem spaces – "water bodies, forest land, and urban green" – replaced by built-up areas. With similarities to the findings of others before them (Bulti and Sori, 2017; Kleemann et al., 2017; Enoguanbhor et al., 2021), they found the main causes of this to be the prioritisation of economic growth over ecosystem spaces, "corruption, non-professionalism in political positions, lack of political will, inadequate development control, and the proliferation of informal settlements [and] lack of effective enforcement of land violations" (Hailu et al., 2023: 12). For Alemayehu et al. (2018: 3), the pace of urban transformation in Addis is such that "plans tend to document what is already there rather than serve as tools for planning the future". Moreover, the *Structure Plan* and the broader, national *Ten Years Development Plan* 2021-2030 (Planning and Development Commission, 2020), both of which prioritise rapid urbanisation, economic growth and industrialisation, are intensely political projects – literally *concretely* connected to the increase in flood risk in Addis. More than this, however, under what has been characterised as the 'developmental state' – a market economy led by strong state intervention – the overall aim, according to Lavers, has been to establish mass industrial employment as a means to replace access to land as the [long-standing] central method for mass distribution, and in this way "maintain political control" (2023: 19).

DISCUSSION: FROM ADDIS TO YORKSHIRE, POLITICS COLOURS AND UNDERMINES FLOOD PLANS

In the Akaki example, we can see our critical STS, hydro-social, and political-ecological-theoretical perspectives come to life as the social, ecological, and technological reproduce each other under unequal conditions of human power relations. The data offered by GFMs help to complement local data and vice versa, offering the chance to expand and deepen what it is that researchers are able to 'see', know, and predict regarding flood risk in the Akaki Basin. Meanwhile, the networks of experts, citizen scientists, and novel use of technologies (such as Telegram groups) that help connect in-situ observers and observations create new associations of people, things, and events. Thereby, this work introduces novelty into the world, allowing new imaginaries – well-attuned to local conditions – of what is knowable, possible, and/or feasible as interventions in hydraulic and hydrological flows. It allows different kinds of plans to be developed and proposed and – in theory, at least – enacted.

At the same time, the obligation to tie proposals to (fantasy) plans such as the *Addis City Structure Plan*, which themselves are fundamentally undermined by higher level interests, decisions, and logics which transcend locality – e.g. political control and the prioritisation of economic growth over 'ecosystem spaces' – seriously undermines the success of carefully integrated local and global data. As we have seen, such interests, decisions, and logics are directly linked to exacerbating unequally experienced flood risk. Another way of phrasing this, as we wrote above, might be that "the mutual co-emergence of natural-cultural domains (…) under conditions of unequal human power relations (…) tend, by intent and/or wider structural logics, to accrue wealth and other benefits to some human beings more than others".

It is clear that GFMs are therefore, in this case, not helping to ameliorate underlying drivers of flood risk. Whether or not they could be said to be *reinforcing* such drivers is perhaps less clear. However, to the extent that researchers and planners are obliged to align their work with GFMs with fantasy plans that continue long-standing status-quo situations which themselves exacerbate flood risk, we suggest that GFMs do risk lending their predictive powers to the overall role of fantasy plans as outlined above. That is, to quote ourselves, to "buttress state power through the performance of stability and reliability (…) while avoiding effectively tackling the political realities which drive unequitable and unsustainable development".

Moreover, we have found that this power-entrenching role of flood-related plans is certainly more widespread than Ethiopia alone. In every one of the other four country contexts we looked at, we encountered instances whereby the social and/or ecological benefits of large-scale flood-related plans have been undermined – or intrinsically flawed from the get-go – by their use as rhetorical devices and/or entanglement with overriding interests, decisions, and logics. For example, after 2010-2011 La Niña-related floods devastated parts of Cali, the largest city in the *UCRB, Colombia*, the government set about the Plan Jarillón Project, its largest climate-change adaptation to date, to reinforce the levee which the Cauca River had threatened to breach (Sarmiento, 2024). Based on five years of ethnographic research, Sarmiento (2024) argues that it was only organised, collective acts of political resistance by Afro-Colombians that prevented the Project's associated relocation plans from fully recapitulating existing racialised hierarchies of flood exposure, woven deeply into the social fabric of the city. And this was despite the fact that Afro-Colombians "possess special legal protections according to the 1991 Colombian Constitution negotiated in the post-conflict process and the more recent 2011 Law of Victims and Land Restitution" (Sarmiento, 2024: 7).

Forest City was to be an 'eco-city' mega development at one time aiming to house 700,000 people on reclaimed islands to the south of Johor Bahru City, *Johor Basin, Malaysia*. Sitting on the edge of a state already at increased flood risk because of land use changes driven by the wants of national and international capital in the form of both urbanisation and the agro-industry (Tan et al., 2015), in particular palm oil plantations, Forest City deals in what Avery (2022) refers to as "speculative fictions and green fantasies". Despite promising green, smart living and ecological sensitivity, an open engagement process, and being awarded many ex-ante awards (including those legitimated by the UN) for environmental

sustainability based on its impressively visualised masterplan (Avery and Moser, 2023), the reality looks quite different. Primarily an investment opportunity and enclave of 'sustainability' for the rich, it has destroyed coastal mangroves and reduced the earnings of local fishermen (Avery, 2022; Avery and Moser, 2023). Sand-mining for land reclamation for this and several other Malaysian projects like it risks changing river morphology, exacerbating erosion, and disrupting sediment flow in the Muda River Basin in the north of the country (Massey, 2024). Williams (2016) argues that due to its exceptional strategic investment importance – in this case $100 billion from giant Chinese property development firm Country Garden – this project was able to sidestep the usual planning rules and priorities and did not even appear on any regional or national plans.

Meanwhile, since 1962, with its first twenty-year *Master Plan*, the *Delhi* Development Authority (DDA) has been trying to wrestle some control over its city's infrastructural and social development. Consistently, over these past six decades, actual urbanisation in the Yamuna River basin has not looked much like that in the pages of these plans. These processes have profoundly altered Delhi's hydrological characteristics, including the massive transformation of forest and shrubland into farmlands and settlements (Ahmad et al., 2019), resulting in a substantial increase in runoff. Consequently, flooding events occur more frequently and with greater intensity (Singh and Singh, 2011; Kumar, 2023).

In line with recent international development trends, the (Draft) *Delhi Master Plan 2041* includes a series of 'nature based solution' (NBS) measures. These include a biodiversity wetland park intended to both ameliorate pollution and flood risk in the city (by giving storm waters somewhere to go) and attractive 'green-blue' spaces for Delhi residents to enjoy (DDA, 2021). Such river rejuvenation is intended as a model to be rolled out across the country (Singhal and Gupta, 2024). However, the *Delhi Master Plan's* maps – created according to Parasa (2025) using several open-source global datasets, including OpenStreetMaps and WorldTopoMap – present as empty space flood plains which are in fact inhabited and farmed by many small-scale farmers. Defining such persons' presence as illegal, the government is engaging in rapid, ongoing evictions, allowing the remaking of the area for bourgeois leisure activities and private investment (Singhal and Gupta, 2024). Moreover, the demarcation and labelling of the Yamuna Flood Plain Zone have been altered in the (Draft) *Delhi Master Plan 2041*, with little explanation provided in the baseline studies. This includes a lack of acknowledgment of the 100-year flood line and changes to its delineation. Such justifications are mandated under Section 4 of Chapter II of the *Delhi Master Plan and Zonal Development Plan Rules*, 1959, which have been overlooked, raising concerns about the technical soundness of the planning proposals and the data on which they are based.

Overall, this continues a practice, at least as old as the DDA's first masterplan, of 'planned illegality' (Bhan, 2013), whereby certain populations, notably migrant workers, are kept in a permanent state of insecurity of tenure, to the economic and political benefit of the elites. Bathla (2022) argues that in the case of huge tracts of 'illegal' tenement housing along the Delhi Mumbai Industrial Corridor (DMIC), such kinds of shifting categorisations of people and place maintain a stock of cheap, insecure, under-serviced housing for workers, and thus cheap labour costs for industries of the DMIC. While such developments and their unsuitable, unplanned drainage and hard surfaces increase flood risk, the people are often neglected when it comes to flood mitigation and response because they are 'illegal'. In this instance, then, it would seem that GFMs have been directly used to create a plan which risks continuing, and perhaps reinforcing, processes which drive (unequally experienced) flood risk.

Neither is the 'fantasy flood plan' a uniquely developing-world problem. The Yorkshire Regional Flood and Coastal Committee (YRFCC) is a governance body with responsibility for connecting national government funding to local FRM measures and is one of 12 RFCCs in *England*. In such meetings in 2022-24, a regular topic was how best for local flood authorities to respond to shocks stimulated by wider, unstable political-economic realities – and the government's ideologically driven responses to these. For example, how to keep up standards when a new government requests you 'look creatively' for ways to speed up project delivery in order to stimulate economic growth? (YRFCC meeting, October 2022). Or how to deal with the extra materials expenses caused by supply chain and inflationary crises associated

with Covid and war? Reporting on a local authority pre-meeting, a Councillor noted that "it was possibly the hardest discussion over the matter of local levy funding that [he has] had (…) on the committee (…). No local authority was in a good financial position due to inflationary pressures and a real reduction in (…) budgets" (Jan 2024 YFRCC meeting). Similarly, an Environment Agency study in flood risk links governance resourcing and/or capacity issues to a host of vulnerabilities in the system, including the effectiveness and clarity of oversight roles (Alexander et al., 2021: 33), collaborative cross-departmental and sectoral working (p. 39), and lack of enforcement in spatial planning (p. 67). Late in 2023, these resource and capacity limitations broke into public awareness following the publication of a National Audit Office (NOA) report which found that government plans to better protect 336,000 extra properties from flooding by 2027 were going to have to be scaled back to around 200,000 (Gatten, 2023; Horton, 2023). Adding to this insecure picture and linked to decentralisation, privatisation, and capacity issues, the report found such serious issues in regards to the "consistency, completeness, and accuracy" of data around the condition of FRM assets that there was a real possibility that the "risk to delivery" of the flood-risk capital program was in reality a quantity unknown to those responsible for this delivery (Davies, 2023: 24, 11). And this despite, as mentioned above, the UK possessing some of the most detailed, extensive, and sophisticated flood-risk datasets and models on the planet.

CONCLUSION

Models – mental, physical, and digital – are immensely important for all kinds of learning about the world. They allow certain kinds of logical simplifications of an infinitely complex reality to function together in ways that usefully mimic how some phenomena in the world actually operate (Frigg, 2022). In FRM, digital models make it possible to generate a large number of plausible scenarios, under varying conditions – which researchers have the power to change – that can help inform decisions about what developments should or should not take place. This includes what infrastructural or other measures might be best in terms of variables such as cost and numbers of homes, people, and businesses protected. As such, continuing improvements in remote-sensing capabilities and computational technologies and the related accuracy and availability of global datasets and models are useful and important ways of addressing flood risk – with, of course, strong caveats about what datasets are combined with which and why (as identified by e.g. Bernhofen et al., 2022, mentioned above). As GFMs and their digital avatars of Earth's human and non-human topographies and liquid fluid dynamics become increasingly feasible and useable at national and subnational scales, they offer a tantalising opportunity. That is, to 'see' and understand what until very recently have been, from the perspective of researchers and planners, if not blank spaces, then a maze of frustrating informational patchiness.

In this paper, we have chosen one of many potential avenues for exploring the politics of these emerging techno-political phenomena: that in this new power lies a risk that the seeming ability to 'jump over' local politics to 'get at' the data will encourage or oblige researchers or decision-makers to work in a way that assumes the world to be more predictable and knowable than it is. This is not necessarily because such improvements affect modellers' or decision-makers' perceptions of the future – although this would present a productive direction for future research. Rather, it is because such datasets either contribute directly to the creation of fantasy plans (as seems to have been the case in Delhi) and/or because researchers have to work *to* fantasy plans that derive from and reflect the visions that political elites wish to portray. As we saw in the Akaki River Basin, Ethiopia, such visions' purposes can be more about rhetoric and control than they are about realistic and just futures. Such fantasies maybe be constructed in planning documents and minds, but they can never be implemented, while the fantasies themselves can create a false sense of action – as was clear in the UK example. Actions taken and justified as a result of such plans are likely to be biased and distributionally discriminatory, as the Delhi, Cali, and Johor examples clearly illustrate.

What we have ultimately identified, though it remains an insight needing further research, is a gap – or perhaps a 'dissonance', a lack of agreement, is the more fitting term here – between the world and our ability to know and act effectively in it. This dissonance is less about modelling, per se, and the inevitable imperfections and simplifications that any model necessarily works with. Technological improvements may help to address some such imperfections while, in a necessarily conjoined effort, researchers, working in grounded ways, can and hopefully will continue to find ways to make global datasets complement more effectively local datasets and vice versa. In addition to this, there is an important body of practice and evidence emerging, working to link GFMs more effectively to not just local data but local realities and knowledges.

No, the dissonance we identify is more of a highlight to the potential hard limits of such efforts to incorporate the local and global data and to include stakeholder voices and knowledge under unequal power conditions and concomitant overriding logics of national and global political economies. To return to our primary research question, it is these logics, the ultimate drivers of increasing flood risk, which – at least in the instances we have looked at – GFMs are not helping to ameliorate. They might even in some ways be seen to be helping to reinforce them, since those deploying them in research and plan-making are obliged to align with, or use them to develop, fantasy plans that continue long-standing status-quo situations which themselves may exacerbate flood risk.

In an important sense, the politics of GFMs that are really going to matter for most people are the politics on-the-ground, in the messy realities where people are seeking to use them. This means that there will be no silver technological nor governance bullets. However, a first step will be to develop a critical, transdisciplinary discourse and practice around GFMs that importantly and more thoroughly thinks across technical and social disciplines as well as with practitioners. Where possible, we suggest, such work should work and think with activists and others actively engaged with opposing the logics of the status quo. Such critical discourse and engagement might help GFMs and the novel complexes of people, things, ideas, knowledge, and capacity to act they are bringing into the world play a role in addressing, rather than aligning with, the key drivers of flood risk.

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