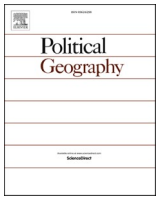
Political Geography 97 (2022) 102697

Contents lists available at ScienceDirect

Political Geography

journal homepage: www.elsevier.com/locate/polgeo



Full Length Article

Unpacking climate services: Knowledge politics, beneficent humanitarianism and the realpolitik of risk management in China

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ARTICLE INFO

Keywords:
Climate services
Knowledge politics
Anticipation
Risk instruments
Climate change

ABSTRACT

In the last four decades, climate services (CS) have moved from being limited forecasting tools in their predictive capacity to becoming involved in the shaping of risk assessment instruments with global reach affected to enhance adaptation to climate change. Yet, they have been relatively overlooked by human geographers and critical risk theorists, whose interests have been to document the political processes involved in shaping climate change and the global scientific enterprise it has generated. By looking at the ways in which CS have been developed and exported to countries deemed as climate-vulnerable, the paper sheds light on two simultaneous kinds of knowledge politics that are occurring at the interstices of global human security aspirations and the realpolitik of local practices. The first emerges from the ways in which CS political relevance has been secured by climate scientists in the midst of grand developmentalist and humanitarian ambitions, what we have called beneficent knowledge politics. The second comes from the nitty-gritty of risk management practices in countries to which CS are exported, in this case China, and highlights how a myriad of knowledge and sensitivities involved in shaping risk and science have been overlooked by the superseding ideals underpinning the production of CS and their application to wider climate adaptation agenda. By doing so, the paper contributes to the geographies of risk and emergencies as well as to the geographies of science by enhancing our understanding of the knowledge politics at play in the development of and resistance to technocratic climate governance.

1. Introduction

In its latest special report on the risk of a global increase in temperature of 1.5 °C by 2030, the Intergovernmental Panel on Climate Change (IPCC, 2018) is clear: we are on the brink of catastrophic climate change. In a world with a human population approaching 8 billion individuals, this additional warning from the IPCC, along with the recent Sixth Assessment Report warnings (IPCC, 2021), leaves uncertainties about both the frequency and the magnitude of climate-related extreme events (e.g. floods, heat waves, or droughts) becoming central to a panoply of political concerns about how to deal with such an unprecedented set of interrelated issues. These concerns have helped to shape what many have now defined as 'the' global climate emergency (see GAR, 2019, International Federation of Red Cross and Red Croissant Societies (IFRC), 2020). This climate emergency is perhaps made more explicit in the realms of disaster risk reduction (DRR) and humanitarian in which preparedness has become a key concept in organising anticipatory actions. For example, players such as the United Nations Office for Disaster Risk Reduction (UNDRR), the European Civil Protection and Humanitarian Operations of the European Commission (ECHO) and the Red Cross and Red Crescent Climate Centre have been central to pushing for early warning systems (EWS) to be at the forefront of preparedness strategies (IPCC, 2012, 2014, 2018; GAR, 2019; International Federation of Red Cross and Red Croissant Societies (IFRC), 2020; UNISDR, 2015; WMO, 2011a). Part of these organisations' interest in EWS was made possible by the leadership of the World Meteorological Organisation (WMO, 2011b), which in 2009 decided to create the Global Framework for Climate Services (GFCS).

This framework aimed at promoting EWS through the development and use of climate services (CS) which are capable of providing improved sub-seasonal forecasts (15–60 days ahead) and seasonal scenarios (forecasts for 3–6 months ahead). In the words of the GFCS, CS are seen as the best way to operationalise climate monitoring and modelling information into services that would "enable society to better manage the risks and opportunities arising from climate variability and change" (GFCS-Global Framework for Climate Services, 2014a: iii). Such services

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https://doi.org/10.1016/j.polgeo.2022.102697
Received 22 February 2021; Received in revised form 13 May 2022; Accepted 9 June 2022
Available online 2 July 2022

incorporate assisting governments, humanitarian players and decision-makers to improve their preparedness efforts, which are meant to cope with "slow-onset hazards like droughts", including the pre-positioning of stocks, contingency planning and, in most cases, assisting the organisation of agricultural practices aimed at securing food production (GFCS-Global Framework for Climate Services, 2014b: 4). In the space of a decade, CS have moved from being perceived as odd and as low skill forecasting products to becoming involved in the shaping of global anticipatory strategies (e.g., Sendai Framework for Disaster Risk Reduction, 2015–2030). CS are seen not only as enhancing more rationalised decision making but also as promising users that they will develop better "cost-effective methods to mitigate risk" and will reinforce "the ability of national and local preparedness systems to respond earlier and better" to imminent threats related to climate change (DG ECHO, 2020 https://ec.europa.eu/echo/what/humanitarian-aid/disaster_preparedness_en). If the popularity of CS can be partly explained by the proliferation of global risk assessment instruments in the interconnected realms of DRR, humanitarian aid and insurance sectors, the politics involved in shaping their global relevance as well as their reception requires to be better understood.

In this paper, we explore the great diversity of knowledge politics that both constitutes and challenges the reproduction and spatialisation of global risk assessment technologies such as CS. For the sake of clarity, we define knowledge politics as the results of various socio-spatial negotiations concerning the inclusion and exclusion of particular sets of epistemologies and practices that are implicated in the fabric of technological devices such as CS and in the making of technologies of governance such as risk management (see Elwood, 2010: 352, Burns, 2014: 51). By looking at the ways in which CS have been developed and exported to so-called climate-vulnerable countries, the paper sheds light on two types of knowledge politics that exist simultaneously. The first type of knowledge politics emerges from the ways in which the political relevance of CS has been secured by climate scientists in the midst of grand developmentalist and humanitarian ambitions through a liberal 'will-to-care' for those facing climate-related risks and disasters. By looking at this first kind of knowledge politics, the paper argues that CS, via their capacity to epitomise humanitarian values and ambitions through climate science, became more than forecasting technologies, they became self-evident necessities in the 'war' against climate change. The second kind of knowledge politics arises from risk management practices in countries to which CS are exported, in this case China, and highlights how particular sets of relations to, beliefs in and meanings concerning climate-related risk and climate science resists the uptake of global risk instruments such as CS.

Empirically, these two kinds of knowledge politics were captured through a set of 21 semi-structured interviews conducted with climate and weather forecasters, policymakers, environmental risk managers and state-owned energy sector managers in four Chinese cities (Beijing, Shanghai, Wuhan and Changsha) which are all known for their vulnerabilities to climate-related hazards and their booming populations. An additional 3 semi-structured interviews were conducted with international organisations involved in promoting the development of CS for DRR and humanitarian purposes at the World Meteorological Organization in Geneva by Nobert (letters are used to anonymise the authorship for the reviewing process), who has also attended two of the UK Met Office's climate service development meetings held in Exeter, England in 2016 and 2017. All of the interviews that took place in China were conducted in Mandarin Chinese by Wen and the material was subsequently translated into English by a professional translator, while interviews conducted by Nobert were in English and discourse analysis of this interview material was performed by both authors (Foucault, 1969). All material was collected in accordance with the ESRC good practice guide to research conduct, meaning that permissions for recording and taking notes were provided by those participating in the research. Interviews conducted in China offered opportunities for observations and field note taking (as recording interviews in China requires getting governmental permissions, which can be a difficult and lengthy process) (Mathews, 2011); a supplementary source of information that allowed us to triangulate our interview data with grey literature discourse analysis that focussed on the development and expansion of CS globally (e.g. WMO, GFCS, IFRC, UNDRR, UK Met Office) but also that investigated their export to China (Chinese government). This overall material and our analysis allowed us to argue that while the humanitarian ideals embodied by CS have been foundational to their mobilisation as global risk instruments, the assumed universality and cosmopolitanism of the values and morals they purport to embody have underestimated the complexity and plurality of DRR discourses and practices that shape the realpolitik of risk management. This argument allows us to recast how global risk assessment instruments gain popularity in the wider context of climate change but also to challenge their potential ability to transform and homogenise the response to climate-related risks.

Building on this argument, the paper unfolds into four interrelated sections. First, it engages with the politics of climate and risk governance in geography and argues that the high level of attention given to the governmentality of climate science has inadvertently predefined what counts as knowledge and power in understanding the development of late-modern risk assessment instruments such as CS. The section stresses that while the governmentality of risk and science offers a valuable way to explore knowledge politics, there is also a need to engage with the grounding principles and values that guide the development and use of security apparatus such as CS. This point allows us to move to the second section of the paper in which we engage with what we define as beneficent knowledge politics. This beneficent knowledge politics refers to the ways in which climate knowledge has been assembled and promoted through a strong human security impetus and that was central to building CS' political credibility amongst international organisations responsible for climate-related risks management. The section argues that by embodying humanitarian morals and commitments, CS worked to create a world in which the universality of Westernised climate epistemologies has been assumed as unquestionable. By focusing on the case of global science partnerships developed between the UK and China, the third section provides a glimpse at three epistemic junctions, which are points at which the universal way of addressing climate knowledge take a different meaning and directions from those that CS proponents expect. We argue that those junctions allow us to capture the knowledge politics of risk management practices, in which different conceptions of risk management and climate science resist to the global processes of knowledge exports. Finally, the paper concludes by highlighting the importance of understanding how knowledge politics works in understanding the governance of risk and science in the context of global climate change. This conclusion also stresses that CS development reveals various forms of contradictions to monolithic and universal solutions (and critiques of them) to adapting to and living with climate-related risks and hazards.

2. Risk instruments, knowledge politics and the rise of technical humanitarianism

Until recently, most of the literature written on CS has been dominated by climate scientists concerned with the technical limits of forecasting capacities (Vaughan et al., 2016) and with how to improve the visualisation of the information produced by seasonal and sub-seasonal forecasts (Lorenz et al., 2015). Although this is not surprising, it is highly significant for those interested in the knowledge politics of climate science. This is because the fabric of climate insecurity has been largely defined as an external threat that consists of hydrometeorological and atmospheric processes. In a way, climate insecurity has allowed climate science to connect with humanitarian and DRR actors (i.e. OCHA, UNDPA) in the prescription of technical–managerial measures concerned with bridging science with policymaking, which have enabled CS to become seen as one of the 'best' responses to climate adaptation objectives by many (see Hewitt et al., 2012, GFCS-Global Framework for

Climate Services, 2014a,b,c; Street, 2016, Alexander & Dessai, 2019). As highlighted by political geographers (e.g. Barnett, 2020; Dalby, 2009; Mason, 2014), climate insecurity also means a return to the functionalist and hazard-centric Chicago school of natural disasters (e.g. Burton et al., 1993; Kates, 1978; White, 1945) and thus abandoning decades of critiques (mainly from radical geographers from the 1970s and 1980s) that have exposed the political cogs involved in the production of vulnerability (e.g. O'Keefe et al., 1976; Pelling, 2011; Watts, 1983; Wisner et al., 2004). Not only has this return to functionalism allowed a depoliticisation of risk management, but it has also favoured a knowledge politics in which computer sciences, administrative and behavioural sciences are key in addressing climate insecurity (e.g. Street, 2016).

In contrast, critical geographers have shown how human security and climate (in)security(ies) are mechanisms of a governance that are seeking to produce and regulate new forms of life such as the 'climate vulnerable' or the 'climate refugees' (Dalby, 2009; Grove, 2010, Mason 2010). Additionally, the geographies of risk and emergencies (e.g. Adey & Anderson, 2012; Anderson, 2010; McGowran & Donavan, 2021) have demonstrated how the development of risk governance instruments such as CS coincide with the wider effects of a biopolitics of environmental security and liberalism (de Goede & Randalls, 2009, Amoore, 2013; Grove, 2014; Collier & Lakoff, 2015) and thus to document how biopolitics functions through modern technologies of governance. For Michel Foucault (2004: 8), these technologies are apparatuses of security that, above all, necessitate the development and use of probabilistic thinking to fix the limits of governmental interventions (Hacking, 1999). They are technologies involved in shaping various forms of normative thinking and practices such as adaptation or resilience to climate change (see Braun, 2014). This Foucauldian influence has not only been pivotal to the development of the geographies of risk and emergencies, but has also provided the capacity to document the spatio-temporal effects of biopolitical technologies of governance, for example insurance-based adaptation strategies (Grove, 2010, 2012), anticipatory instruments ranging from flood risk mapping (Elliott, 2021; Krieger, 2013) to catastrophe modelling (Gray, 2021: 198). This work has enabled us to understand how various assemblages of practices/mechanisms that aim at assessing and acting upon potential risks are shaped. Climate services fall easily into this category. Central to the emergence of risk assessment instruments, is their capacity to produce, shape and organise what counts as knowledge (Dillon, 2007). It is a capacity that poses questions about what kind of knowledge risk instruments mobilise and what kind of knowledge gets sidelined by their utilisation.

Although most critical inquiries looking at the wider geographies of climate science are not always explicit about their Foucauldian lineage, the governmentality (the art of governing) lens they often used made it possible to identify the various assemblages of practices that have led to the development, spatialisation and application of climate-related risk instruments worldwide (e.g. Demeritt, 2001; Edwards, 2010; Mahony & Randalls, 2020, Keele, 2019). When this governmentality framing is applied to the social studies of CS, it has served to illuminate sets of institutional limits to the development and application of these 'new' kinds of risk assessment instruments (Lourenço et al., 2016; Webber, 2019; Webber & Donner, 2017) and to highlight various sets of practical and political challenges related to their operationalisation (Harjanne, 2017; Harvey et al., 2019). Although this emerging literature has allowed us to gain a better understanding of the social life of CS, it has also played an important role in framing climate-related risk as something that can be contained, pre-empted, anticipated and universalised through multi-hazard risk instruments. While this stream of work is useful for understanding the relationship between knowledge politics and governmentality in the use and development of CS, it often builds on an understanding of risk that minimises the epistemological diversity which exists outside the realm of mainstream DRR research.

Other scholars have engaged more directly with the epistemological tensions emerging from using CS as risk assessment instruments with global reach. This work has been mainly involved with looking at the epistemological tensions occurring through the co-production of knowledge involved in shaping CS products. Most of this scholarship is, in essence, realists and functionalist, and it has worked to identify different sets of knowledge and practices that can fuse in the design of more effective CS aimed at enhancing the use of climate-related information in risk management (Lemos et al., 2002; Dilling & Lemos, 2011; Daly & Dilling, 2019, Gerlak 2020). Although the core of this scholarship has sought to develop CS as risk assessment instruments with global reach, it has also indirectly helped us to map how power relations are shaped through CS and how they are negotiated through various codes of conduct and practices that define 'local' and 'global' knowledge among CS proponents. Although this critical take on the top-down development and application of global CS is useful in understanding the politics of global North-global South inequalities in international scientific endeavours, it indirectly assumes a climate science that is ontologically immutable and animated by a universal affect. In some ways, this literature relates to what Sheila Jasanoff (2015: 4) defines as sociotechnical imaginaries, which are "institutionally stabilized, and publicly performed visions of desirable futures, animated by shared understandings of forms of social life and social order attainable through, and supportive of, advances in science and technology".

Although it is difficult to see the real addition that sociotechnical imaginaries make to Foucault's (2004) concept of apparatus-*dispositifs*, they help us to see how risk assessment instruments such as CS become deployed globally through technical optimism. While STS scholars have demonstrated that sociotechnical imaginaries are indeed contested (e.g., Lawless, 2020; Levidow & Raman, 2020; Mahony, 2019; Polleri, 2020), the specific ideas and concepts guiding their political narratives into desirable futures propose a knowledge circulation that is often described as totalising and unidirectional. This conceptualisation of knowledge politics latently reproduces the rest of the world, and the global South in particular, as a passive entity that has no choice but to accept the unavoidable power from Westernised scientific enterprises. These interpretations of knowledge politics are not wrong, especially if sociotechnical imaginaries are used to promote certain ideals and beliefs about the world in the production of a univocal future, but they tend to be less useful for revealing the mosaic of knowledge hidden under these broadly defined imaginaries. This is because although sociotechnical imaginaries tend to tell us what counts as dominant knowledge and power in the production of technocratic governmentalities, they tell us less about how alternative epistemologies of science are shaped and mobilised.

Therefore, the centralising forces helping CS to become global cannot only be attributed to a knowledge politics resulting from neoliberal imaginaries, governmentalities and rationalities. It also requires exploring how CS universality has been made possible, a task that demands looking at the mobilisation of "sympathy and technology" with the purpose of installing the morality of a liberal will-to-care for those vulnerable to climate change (Fassin, 2012: x,; Reid-Henry, 2014). Although the geography of humanitarianism has developed alongside the geographies of security and emergencies (e.g. Reid-Henry, 2013, 2014; Lopez et al., 2015; Pallister-Wilkins, 2018, 2020), its focus has remained essentially on unveiling the various governmentalities of liberal humanitarianism (Lester, 2002, Barnett, 2011, Pallister-Wilkins, 2015b; 2018). Except for the development of digital humanitarianism and the transformation of humanitarian practices by big data (Burns, 2014), the relationship between humanitarianism and forecasting science, and CS in particular, is lacking to our understanding of how knowledge politics functions. Drawing on Simon Reid-Henry's work (2014: 428), humanitarianism consists of a "practical site of moral reasoning in which compassion […] is calibrated to and put to work in the world". However, although the calibration of compassion has been well documented through violence and conflicts, how compassion is calibrated through anticipatory technologies and instruments such as CS has not been well documented yet, especially regarding how it has played a role in the knowledge politics of climate science.

In the following section, the paper will consider the idea that the technical development of CS cannot only be the fruit of technical optimism and neoliberal science animating Jasanoff's (2015) sociotechnical imaginaries but should instead be seen in conjunction with a liberal will-to-care. In doing so, the paper will show how this morally driven scientific enterprise that has become CS has also made it more difficult for certain epistemologies of risk and science to gain credibility in relation to the development of global adaptation strategies.

3. From the periphery to the centre: assembling climate services through beneficent knowledge politics

CS's beginnings can be traced back to the Global Atmospheric Research Programme (GARP), which was put in place by the combined efforts of the WMO and the International Science Council (known as the ISCU) in October 1967. However, it is in how CS became politically relevant that one can find the essence of their emergence. In order to gain real traction capable of transforming a concept into an object, CS needed to fulfil a political aim. Therefore, the promises of linking rational decision making with humanitarian ambitions became central to this task. In the realm of humanitarian studies, the concept of beneficent governance has been developed to translate how the needs for international interventions or the state of exception are legitimised through a sense of caring for the weak, the poor or the marginalised (Agamben, 1995; de Wall, 1997; Fassin & Pandolfi, 2010; McFalls, 2011; Redfield, 2013). In the context of climate change, though, this beneficent governance has been translated by climate scientists as a capacity to put in place a will-to-care through which CS could be seen as technical interventions for the public good, and hence as being capable of anticipating extreme weather events while protecting the most vulnerable (Barnett, 2011). Drawing on our discourse analysis of the grey literature about CS's development, we focused on the ways in which humanitarian and developmentalist ideals have been mobilised to justify CS's expansion as global risk instruments. While we could have looked at the ways in which technical innovations in the realm of climate science have led CS to gain scientific credibility for policy makers, we have focused instead on how their expansion was linked to the formation of a beneficent knowledge politics that has made CS necessary, self-evident and universal for climate scientists and the international DRR community. In turn, this research interest has allowed us to identify three main events that have been important in the fabric of a beneficent knowledge politics of CS's development and that has been underpinning their expansion. The first is the identification of a global vulnerability to climate change, the second concerns the technical embodiment of a neo-humanitarian will-to-care and the third translates the rise of adaptation practices as emancipatory technology.

The first event is linked to the identification of a global threat, and it is in the droughts that impacted the former USSR and the Sahel region in the 1970s that we can see this menace taking place. Together, both droughts led to a global threat to wheat production and resulted in worldwide food insecurity (see Robertson, 1974), which in turn led to international organisations including the UN having additional concerns about climate-related risks. This unsettling situation became clearer following the Club of Rome modelling predictions and the 1972 Stockholm Conference on Human and Environment, at which a better understanding of the causes behind climate change was demanded of the WMO by global leaders (UN, 1973, Recommendations 20 and 70). This interest culminated in the creation of the WMO's Panel of Experts on Climatic Change in 1974. In its final report, the panel stressed that "it would seem reasonable to determine the impact on food production in different parts of the world, on the basis of reasonable assumptions for the seasonal and inter-annual variability of most climatic parameters" (WMO, 1977: 54). It is through those ambitions that the contours of CS became more concrete and were portrayed as potentially helpful for a number of specialist users, which underscores the relevance of climate science playing a role in securing global food production:

> "information regarding the impact of climate variability on human activities is essential for application in the decision-making process. The methodology to be developed for this purpose therefore should aim at making it possible to present ultimately the impact of climate variability in terms of production figures costs, or other similar measures which can be used directly by economists, planners and politicians". (WMO, 1977: 54)

Following these recommendations (the report was finalised in 1976, but was made public by the WMO in 1977), another milestone in the development of CS was the creation of the US National Climate Program Act, which was passed in February 1977. This Act put in place an ambitious climate-related research programme aimed at maintaining national security (e.g. food supply, human health, transportation and energy during a Cold War period; see Edwards, 2006), launching an international appeal for the development of collaborations targeted at gathering global climate data, organising measurement campaigns (US Congress—H.R.6669, 1977–1978) and enhancing the communication between several states and federal departments. The importance of this programme is not only revealed by its budget, which had reached almost US$65 million by 1978, but also by how the stake of national security was superseded by the requirement for the interdependency of food supply (especially cereals), an issue that contributed to the creation of the first World Climate Conference (WCC-1) and subsequently to the creation of the World Climate Programme (WCP). By advocating the need for developing global anticipatory interventions technologies meant to deal with the potential impacts of climate change, the establishment of the WCP is the second event involved in the production of a beneficent knowledge politics.

Jointly sponsored by the WMO and the ISCU, the WCP (which started formally in 1980) aimed "to provide means to foresee possible future changes of climate and to aid nations in the application of climatic data and knowledge to the planning and management of all aspects of man's activities" (WMO, 1979: 715). It is important to note that at the centre of these initiatives, the significant plea made by the WMO was that these objectives required "leadership and co-ordination among international bodies and close collaboration among nations" (WMO, 1979: 715). These objectives not only aligned with the American National Climate Programme Act and US military interest in the climate but also played an important role in solidifying the place of CS in the new vocabulary that aimed at making climate science relevant to international aid and development endeavours. This intention was demonstrated during the WCC-1 proceedings (WMO, 1979: 716, emphasis added):

> "There is an immediate need for nations to utilize existing knowledge of climate and climatic variations in the planning for social and economic development. In some parts of the world, there is already sufficient information to provide many applied *climate services*. However, only a start has been made; data and expertise are generally lacking in developing countries. Programmes must be set up to assist them to participate fully in the World Climate Programme through training and the transfer of appropriate methodologies."

Climate science (through the prospect of CS) was called on to play a role in international development by 'assisting' developing countries and allowing CS to help those 'left behind' in an era of fast scientific development. Making CS part of the grand ideal of development also means making them capable of embodying what Michael Barnett (2011: 31) defines as neo-humanitarian discourses and ambitions. This neo-humanitarianism is animated by "ideologies that proclaimed that the rich and powerful had an obligation to 'teach' the rest of the world" how to deal with human security, leaving climate scientists and development economists "to accelerate the development of the Third World, rarely questioning the assumptions that they knew what was best" for developing nations (Barnett, 2011: 130). In this particular context, the WCP as well as the WCC-1 provided the impetus for the internationalisation of climate-related research and modelling activities with the

capacity to promote West/global North' expertise as indispensable in realising international development aims. The promotion of this expertise was also animated by a will-to-care for the global South that provided the perfect base from which climate scientists could promote CS during the discussions that required action on climate change. This will-to-care became more explicit in the aftermath of the *Our Common Future* report (the Brundtland report, 1987), in which what defines 'our' is left to the managerial spirit of Western scientists and aid institutions such as the UNDP and the World Bank (Escobar, 1996). Climate scientists also participated in pushing this managerial attitude through the technological optimism of the 1990s. By assisting sustainable economic development through the same will-to-care for those in need, the commitment to 'teaching' the global South about how to use climate science led to the second World Climate Conference (WCC-2). The global capacity to stabilise and put compassion at the heart of a scientific development allowed CS to legitimise and normalise the global North's technical ideal and development spirit regarding dealing with potential climate disruptions.

These scientific and moral commitments were strengthened further following the Second International Conference on Early Warning held in Bonn, Germany, and the adoption of the Red Cross and Red Crescent's Declaration and Agenda for Humanitarian Action, in Geneva, both organised in 2003. Their aims were to call for the integration of EWS into government policies to minimise the impact of climate-related disasters on vulnerable populations. Those calls were heard and materialised into action by the 2005–2015 Hyogo Framework for Action (UNISDR, 2005), in which prevention and preparedness became the key modalities of disaster risk reduction. At the centre of the Hyogo Framework is the interest in championing "weather and climate modelling and forecasting, communication tools and studies of the costs and benefits or risks assessment and early warnings" (UNISDR, 2005: 8), which provided the perfect basis for the third event involved in solidifying a beneficent knowledge politics of CS: moving CS to the centre of DRR strategies and international policymaking through adaptation to climate change.

In line with the Hyogo Framework, the third World Climate Conference (WCC-3, 2009) was organised under the title Climate Predictions and Information for Decision Making at the end of August 2009, in Geneva. The aim of the conference was to provide an "international framework for climate services that link science-based climate predictions and information with the management of climate-related risks and opportunities in support of adaptation to climate variability and change in both developed and developing countries" (WCC-3 2009: 3). The main idea was to ensure "climate forecasting tools could be used to develop warnings with longer lead times for improved sectorial planning" (WCC-3 2009: 9) while "reducing the current adaptation deficit" of those in need (WCC-3 2009: 31). Although the WCC-3's scientific success is often attributed to the creation of the Global Framework for Climate Services (GFCS), its real, political, achievement has been to frame CS as emancipatory tools for those vulnerable to climate change. One striking example is the launching report of the high-level taskforce of the GFCS published in 2011 (WMO, 2011a) and entitled "Climate Knowledge for Action: A Global Framework for Climate Services—Empowering the most vulnerable" (WMO, 2011a). Thus, through the GFCS, CS proponents were able to support international development ambitions that became justified by a liberal will-to-care (e.g., Hyogo and Sendai Frameworks, UN Sustainable Development Goals). The net result was turning CS into a compassionate force that works to solidify a knowledge politics that reproduces the same geopolitical asymmetries that have led to the political economy of climate change. In turn, those asymmetries predetermine those seen as vulnerable to climate-related risks as waiting to receive the 'right' knowledge to act on climate-related risks and hazards and to become empowered of their own destiny. Underlying those humanitarian aspirations, the co-production of knowledge becomes the capacity to empower the most vulnerable to climate change. For example, co-production is promoted as the capacity to achieve "climate-smart decisions that will enable better management of the risks and opportunities of climate variability and change" (WMO, 2018: 3). Although CS proponents have often been vocal about the need to ensure the representation of non-scientific knowledge in co-production efforts (e.g. Vincent et al., 2018; Bremer et al., 2019), the "unquestioned normativities and values" embedded in the co-production process itself have remained largely unchallenged by CS proponents (Chilvers and Kearns 2020: 351–352). What consists of the 'right' or 'good' scientific knowledge is made self-evident by the emancipatory role it plays in actualising 'local' adaptation practices to climate change. For CS proponents, climate services have become a way to tackle the inequalities in opportunities to adapt to climate-related risk and hazards as well as to achieve 'climate smart' decisions. Thus, CS have become more than simple risk instruments: they are positive risk instruments capable of transforming the world into a better place, a place that can be understood through the knowledge and practices of the global North.

As this section shows, science alone was not enough to make CS become risk instruments with global reach. Instead, climate scientists needed to make the CS project concrete and relevant to those in search of global and uniform solutions to dealing with climate change. Building on the moral authority of humanitarianism became essential for situating them at the core of an anticipatory adaptation response. In addition, this position made it crucial to build on compassion for the 'vulnerable' global South to make CS more of a priority so that they reached policymaking agendas. Yet underneath the will-to-care that those humanitarian aspirations convey, one can find a myriad of knowledge and sensitivities involved in shaping risk and science that have been overlooked by the superseding ideals underpinning CS production and application. CS-related knowledge politics is not just visible through the process of science globalisation and humanitarian ideals; it is also perceptible through the variety of epistemologies of risks and science that have been undermined by assuming that there is a universal application and understanding of global risk instruments. As the next section will show, knowledge politics also exists at the interstices between global aspirations and local practices, allowing us to see those portrayed as 'vulnerable' to mobilising other forms of intentions and needs than those initially targeted by CS proponents.

4. Climate services, epistemic junctions and the kaleidoscope of Chinese risk management

The UK Met Office (UKMO) and its Hadley Centre has been a longtime leader in the development of climate forecasts and is widely recognised as a leading organisation in the realm of climate-related research.These qualities were made clear in the 2015 UK Spending Review, in which the Conservative government decided to invest £150 million in scientific development through the former Business, Innovation and Skills (BIS – now Business, Energy & Industrial Strategy (BEIS)) Department, which channelled aid and development assistance funds in the shape of 'science and innovation partnerships' for which the UKMO became a benefactor known as a 'delivery partner' (in British administrative jargon) through the Newton Fund. Created in 2014, the Newton Fund helped to promote the "wellbeing of communities and economic benefits" in investing countries (grants-schemes-awards/grants/newton-fund/" title="https://royalsociety.org/grants-schemes-awards/grants/newton-fund/">https://royalsociety.org/grants-schemes-awards/grants/newton-fund/), hence helping British entrepreneurial science to extend collaborations with the global South. One strong motivation behind the development role given by the UKMO was to promote its expertise in CS through a will-to-care for the most vulnerable, which emphasises that

> "[b]etter climate information helps prevent humanitarian disasters and economic setbacks that can be the result of a changing climate. Climate information plays a crucial role in national development

planning, allowing governments to manage development opportunities and climate risks. The UK supports development through climate services via large range projects." (DECC, 2015: 6)

One of those projects was the development of the so-called Climate Science for Service Partnership China (known as the CSSP), in which China was selected by the UKMO as an ideal partner to export climate science. With China as a delivery partner, the UKMO could reinforce its ties with the Chinese Academy of Science and, perhaps more importantly, with the Chinese Meteorological Administration (CMA). In the words of the UKMO, this 'golden' opportunity should allow the UK to share its "expertise to develop cutting-edge science needed to support climate-smart decision making, [and] helping authorities to navigate the challenges of a changing climate that impact the resilience of populations" (DECC, 2015:9). The aim of the CSSP was and still is to position the UKMO as a helper whose task is to guide Chinese authorities towards realising resilience through the use of CS and to "enhance decision makers' capabilities as they assess risks faced by the country and the wider South East Asia region" (DECC, 2015: 9).

What became apparent in the beneficent ambitions underscoring the CSSP is the strong impetus to bring compassion for the climate vulnerable back into the framing of the UKMO initiatives, translating the international aims of the GFCS into local action. This irreproachable ambition pictures CS as transposable entities or, as proposed by Bruno Latour (1987) many decades ago, as immutable mobiles that remain unaltered throughout important transformations, such as being inserted into different political contexts. Although international organisations such as the IFRC, the World Bank, the WMO and UNDRR advocate a greater uniformity in the discourses and practices leading to adapting to climate-related risks and hazards, the knowledge politics of CS is not restricted to advancing human security and anticipatory action as new sets of philosophies and modalities of emergency management. It is also complexified by the realms of emergency management already in place in countries deemed to be climate vulnerable. This complexification appears through the subtleties of Chinese risk management, which have come to evade the beneficent knowledge politics guiding the GFCS's and the UKMO's exportation strategies. This complexification reveals epistemologies of risk that seem to contrast with the cosmopolitan aims behind the development of CS and the kind of futures they ought to deliver. When talking to Chinese research participants, it became clear that different understandings of risk and science were not noticed, or, were simply lost by the UKMO's enthusiasm. This does not mean that China's climate change adaptation practices reflect a certain exceptionalism in the ways in which both science and risk management are performed, but rather that the Chinese case and the CSSP initiative offer a lens through which we can better understand how certain world views on risk and science might struggle to fit into a larger project such as CS (Burns, 2014; Miller, 2015).

By looking at the Chinese response to the UKMO's CSSP initiative, we can identify three epistemic 'junctions' where the knowledge politics of CS practices emerges. Those junctions consist of meeting points where the global ambitions driving the development and export of CS products meet the 'nitty-gritty' realm of civil protection and risk management. It is where the universal world introduced by CS is challenged by the existence of alternative spatio-temporalities, scientific rationalities and trustworthiness in the management of hazards. The first junction emerges from the spatio-temporal frictions occurring between the predetermined futures projected by CS proponents (e.g., better adaptation and resilient practices) and the hard-hitting reality of the 'actual' that dominates risk management decision making. Because CS can provide longer lead times in climate predictions, they have been sold by the WMO, the UKMO and the GFCS as providing a fragment of stability in the sea of uncertainties that defines the unfolding future of climate change. However, this focus on the formation of long-term futures through seasonal and sub-seasonal forecasts has overlooked why forecasts are used in China and, perhaps more importantly, what their social relevance is in decision making for those defined as 'users' by CS proponents. Those users are in turn meant to inform climate-vulnerable populations with specific information that will lead to the formation of resilient practices. Although most interviewees involved in this project mentioned being interested in CS forecasting products, their long-term scenarios conflict with the short-term temporal relations that emerge from their daily lives and responsibilities. This was revealed when DRR strategies were discussed. A forecaster working on developing national climate forecasting facilities said:

"[E]ntities focused on the prevention and mitigation of natural disasters, say transport or tourism, they don't tend to require such long-term forecasting. One to ten days or one to seven days is usually enough. The Ministry of Land and Resources and bodies involved in the control of geological hazards usually require medium-term forecasts." (**Weather forecaster, Beijing**).

This forecaster also said that long-term forecasts generally associated with CS and meant to improve DRR strategies worldwide are not a priority for Chinese risk managers. Instead, it seems that short-term (24hrs–2 days) and medium-term forecasts (3–15 days) are preferred. There are very simple reasons for this that seem to have been missed by CS proponents and were explained further by a policymaker from Wuhan, whose role involves making decisions about food production at the national and provincial levels. He said that

"decision-makers surely value climate forecasts, though not as much as weather predictions, but they sometimes doubt the credibility of the products … They may make some anticipatory preparations based on the forecast, but they don't take actions entirely upon it like they do upon weather prediction. One reason is the long lead time of climate forecast and the other reason is its great uncertainty." (**Policymaker, Wuhan**)

This quotation reveals why policymakers who are involved in DRR strategies as well as planning for food security in China seem less enthusiastic about CS than proponents had expected. Although the practicality of seasonal forecasts has often been debated in the literature on CS (see Gerlak et al., 2020), what blocks their usefulness cannot only be linked to technical questions. It is also down to the knowledge politics of emergency management that has not been well understood by CS proponents and that occurs at the junction of universal and global futures promoted by the UKMO and the GFCS with the futures activated by Chinese emergency management practices. By emphasising the preference for short-term planning in the management of climate-related risks and hazards, CSSP partners reiterate the temporal specificities within which Chinese risks managers operate, which seem to have been overlooked by CS enthusiasts and equally by those interested in the governmentality of climate science. While CS products can be seen as global instruments of human security that are involved in the homogenisation of DRR knowledge and practices, the insistence by both policymakers and forecasters on the dominance of short-term planning reveals a knowledge politics that contests this homogeneous interpretation. In effect, while recognising the potential value of the longer lead time provided by CS, they are also highlighting organisational priorities and knowledge familiarity that do not allow them to see CS as playing a crucial role in the planning of their operations. Most importantly, this spatio-temporal friction allows us to see what CS proponents have not perceived in the dead angle of grand universal adaptation ambitions: epistemic tensions resulting from using uncertainty in the management of hydrometeorological risks and hazards. Those epistemic tensions are linked to the second epistemic junction, which we define here as scientific rationalisation.

Beneath the scientific optimism and the humanitarian ideals animating the development and export of CS, one finds the junction of scientific rationalities, which is where the so-called global, or assumed Westernised vision of best science, meets with the more opaque and complex layers of realpolitik. This junction occurs between the world of

the rationality of decision-makers, which is grounded on certainty, and the 'more honest' world of uncertainties associated with CS forecasts. For example, through discussions with river managers who deal with electricity production, it became evident that what seems to be the most interesting aspect of CS to them is not the ability to see the general trend of seasonal information but whether they can use CS to reassure their users that they know what they are talking about:

> "At our Department, we deal with regulation, or to make it simpler – either we are dealing with water storage, the advance release of water or staggering times to adjust the amount of water. To give three days' notice is enough time for the large reservoirs. Why is it not good to exceed this? Because when you go over three days, you have to make adjustments in line with electricity and shipping. If your accuracy is not sufficiently high and yet you have already made plans, then when it comes down to it, you may not be able to implement them." (**Water manager, Wuhan**)

Although CS are promoted as representing an improved understanding of forecasts' uncertainties (defined as a plus value for decision making by CS proponents), the realpolitik of the decision making involved in Chinese risk and water management shows that what is at stake here is not the ability for forecast receivers to read uncertainties, but rather the necessity to be accurate. By bringing the importance of accuracy back into the discussion, this interviewee shows how the normalised route of best science defined by the CS community is not deterring the institutions involved in risk management to seek accurate, and thus deterministic, forecasts. This affirmation allows us to grasp a persisting scientific rationality that does not get subsumed by the sophisticated probabilities of CS. Instead, it calls for the importance of accuracy to be recognised in decision making and thus for a kind of knowledge and practice that fits the capacity of governmental institutions to keep their political relevance (as safeguarding and trusted organisations). Although it is not uncommon to see this kind of resistance towards the use of probabilistic scenarios in the realm of risk management (Demeritt et al., 2010), expectations of and a need for exact science offer a glimpse at the myriad ways to define what counts as 'best' science and at how accuracy is used to pluralise what 'best' adaptation practices means. For example, when Chinese climate forecasters were asked about their interest in using CS to manage natural disasters (as promoted by the wider CS community), one of them summarised the shared attitude of fellow forecasters (provincial and regional) regarding what prevents them from using CS:

> "being forecasting personnel, [what is important] is the level of accuracy. This is because our high-quality service is built on a foundation of supplying accurate forecasts. So I think that improving accuracy is a very important component. In terms of climate information services for the entire country, one could say that we are doing pretty well. This is because it has been priority for the government and each of the departments for so many years. Now there is a great deal of pressure on us to report accurately." (**Climate forecaster 1, Beijing**).

What is striking about this quote is the importance of accuracy, which shows a scientific rationality that seems at odds with the purpose of seasonal forecasts. On the other hand, it allows us to see how the intersubjectivity of accuracy makes various institutions involved in DRR able to keep their political legitimacy whilst protecting those vulnerable to climate-related hazards. Accuracy is thus more than a Cartesian metric way of knowing about hazards (see Burns, 2014). It is also a part of the social fabric that relates several institutions, experts and non-experts via the communication of and action on climate-related information. Thus, the scientific rationality underlying the development and export of beneficent CS has not incorporated the social relevance associated with accuracy as a unifying concept of risk management. In other words, accuracy is also a way to relate to and to claim institutional identities that do not let themselves become homogenised by global anticipatory ambitions. By highlighting the importance of accuracy, we can see how an understanding of CS as global risk assessment tools is suddenly challenged at the junction of an alternative scientific rationality. This knowledge politics is important in showing how different epistemologies of risk take place and express themselves in practices, and it is also linked to a third junction where CS become negotiated and challenged: trustworthiness. We are not talking about trust in the ability of CS to detect potential climate-related risks and hazards here, but rather, just as accuracy, trust in terms of a process that plays a relational role in holding together the political structure that organises risk and hazards management in China.

During a casual discussion with one of our informants, he mentioned that "in China what is important is much more the person and the institutions transmitting the message than the message itself' (**field notes, Weather forecaster, Shanghai**), meaning that someone's trust resides in the interlocutor and the institution this interlocutor belongs to and represents. In other words, the expertise and status of those producing and communicating information has prime importance. This particularity highlights the significance of the social codes implied in the organisation of Chinese daily life, in political networks and in relation to individual responsibilities (Tang et al., 2012). The end result is that while the quantitative nature of CS forecasts is seen as interesting by the chain of actors involved in risk management, the emphasis that CS developers and proponents have put on rational decision making and cost–benefit analysis has eclipsed the significance of social/professional status in defining so-called 'good' risk management. The overwhelming presence of CS as probabilistic risk assessment instruments has made what constitutes trust (accurate knowledge communicated by the right person) and risk (the perception that the state has lost control of the situation) oversimplify the meaning and epistemologies of those concepts. Trustworthiness offers a junction through which the universality of the global North model of risk management (e.g., UNDRR) is pluralised. In effect, by revealing a meaning of trust that reflects the social fabric of risk management rather than the long-term scenarios provided by CS, trustworthiness allows us to understand how the grand ambitions behind CS reflect the political geographies of their proponents and associated institutions (UKMO, GFCS, IFRC) rather than those of the people they are meant to help. Different meanings of trustworthiness also expose a knowledge politics of practices in which alternative valuations of information and decisional roles in the management of risk and hazards cannot be suppressed.

While many interviewees stressed the need to maintain collaborations with WMO partners and with the UKMO more specifically, reflection on this empirical material reveals that the emergence of CS as global risk instruments is challenged by the knowledge politics of risk management practices. This tension is illustrated by a water resource manager highlighting that while "we are very interested in collaborating with the UK Met Office if they have climate forecasting products on precipitations, they need to be applicable to China" (Water resource manager, Beijing). Thus, although CS might be available and collaborations seen as interesting by Chinese partners, risk management involves a series of epistemic junctions that prevents CS from being as relevant as global North proponents and critiques would like to believe. By universalising the need for climate forecasting products as climate adaptation tools, CS proponents have, perhaps unintentionally, undermined the social fabric of risk management and the relevance of alternative ways of thinking about and acting on risk and science.

5. Conclusions

Understanding how CS have moved from being a relatively marginal project to becoming one of the central pieces of contemporary climate science development cannot solely be down to technical improvements, institutional growth or the global appeal of anticipatory governance. It requires looking at the formation of a knowledge politics that has shaped CS as technical devices of human security. It involves looking at how

climate scientists have made sure CS became connected to global sustainability agendas, but also at how the values they embody could not only lead to linking policymaking with complex climate science but could also be capable of delivering a response to the incoming threat of climate change. As demonstrated in this paper, it became clear that through climate scientists, CS development could become an essential element of climate change adaptation and resilience via their participation in holding the fate of humanity together, that is, by becoming associated with humanitarian ambitions. It is thus through a liberal will-to-care for the most vulnerable to climate change that CS gained political credibility and became used to solidify a beneficent knowledge politics through which the definition of the collective remains unquestioned.

However, as we have shown in the paper, the willingness to doing good and care for the most vulnerable to climate change has led CS proponents to normalise particular sets of knowledge and practices that have worked to simplify the complexity and plurality of DRR epistemologies. By drawing on the case of China and the CSSP initiative, this paper has made it possible to explore how climate scientists' general enthusiasm for CS is also confronted by a series of epistemological junctions at which the knowledge politics of DRR practice emerges and challenges the universality of applying CS to daily risk management routines. This closer look at Chinese hydrometeorological risk management allows us to see the collision between what has been made relevant through sets of normativities defining good science and assumptions about the transferability of CS-related scenarios and the realpolitik of those meant to benefit from CS-forecasted futures. Even if the aim of the CSSP was to build scientific partnerships in the spirit of sharing the UKMO's savoir faire and humanitarian sensitivity, the unproblematic way in which the mobility of climate forecasts has been imagined demonstrates a rather simple understanding of the political complexity shaping the management of hydrometeorological hazards. Entering the realm of the Chinese management of climate-related risks shows that the universalised world promoted by CS proponents and endorsed by the UKMO is not free of conceptual and practical boundaries in understanding and acting upon risk and science. Those boundaries are made perhaps more explicit by the different epistemic junctions at which issues of institutional liabilities, the valuation of uncertainties and spatio-temporal planning emerge and disrupt the meaning of risk and what defines 'good' science. Those epistemic junctions are in turn problematic for those who believe in a unified technological fix to deal with a rapidly changing climate, as they call for a much more nuanced understanding of climate change politics. The paper also helps to understand that while it is often easy to see processes of oppressive globalisation as the result of liberal scientific and humanitarian enterprises, the realm of daily practices shows that those homogenisation processes (e.g., riskisation) might have far less influence than many social scientists would like to believe. This raises important questions for the theorisation of knowledge mobilisation in geography and in the social sciences in general. This is particularly true when rethinking the ways in which knowledge politics is constituted, but also how certain sets of beliefs, morals and values interfere in the shaping of an international response to climate change.

Political differences in using and producing science are not surprising. However, what is astounding is that understanding these differences has remained less central to the institutions and scientists worried about the pressing concern of climate change. By looking at the beneficent knowledge politics animating the export of CS on the one hand and at the knowledge politics of risk management practices on the other, it is possible to highlight important contradictions and assumptions in the political responses that are proposed by international organisations (e.g. GFCS, IFRC, UKMO) to deal with complex problems such as climate change. Understanding what has been favoured and what has been made irrelevant to or less visible in global climate adaptation enterprises such as CS allows us to see a plurality of resistant epistemologies and values that have informed the political response to climate change and that could help us to diversify the ways in which we engage with climate change politics more generally.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

First and foremost, we would like to thank all those who have participated to this research and without whom this paper would not have been written. We would also like to thank our colleagues Suraje Dessai and Yim Ling Siu for their inputs and logistical support in the initial stage of our research process. Sebastien Nobert would like to thank Martin Mahony for his insightful suggestions as well as three anonymous reviewers for their constructive criticisms, which have improved the paper. The research for this paper has benefited from the financial assistance of the UK Newton Fund-grant P015348-and from the Social Sciences and Humanities Research Council of Canada-grant 430-2019-00339. All views are those of the authors.

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