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EDITORIAL

Putting climate services in contexts: advancing multi-disciplinary understandings: introduction to the special issue

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Climate services include the creation and provision of climate information to assist with decision making. Over the last decade, efforts to produce and circulate climate services have increased in scale, diversity, complexity, and spread. In particular, the climate service movement has gained momentum following the Third World Climate Conference agreement to launch the Global Framework for Climate Services (in 2009) and the publication of the *Climate Knowledge for Action* report (World Meteorological Organization 2011). Climate service products and institutions build on, and extend, existing meteorological services and seasonal forecasting efforts (Lemos et al. 2002; Broad et al. 2002; Ziervogel and Calder 2003), national climate forecasting programs (such as those within the United States Climate Program Office and the United Kingdom Climate Impacts Programme), and the climate knowledge for society movement (Vaughan and Dessai 2014).

The climate service movement represents a fundamental attempt to reconfigure how climate science is produced and used, and the relationships between science and society—the 'servitization' of climate science (Harjanne 2017). There is widespread recognition that 'loading dock' models of science production are ineffectual in supporting decision making (Cash 2006) with scholars showing that climate forecasts must instead be responsive to the needs and decision-contexts of users (Buizer et al. 2016; Dilling and Lemos 2011; Lemos and Morehouse 2005). Accordingly, science producers seeking to be societally relevant have shifted from the linear delivery of 'information' to the iterative provision of a 'service'. These attempts to improve climate information target a variety of 'user groups' and sectors, including farmers and food security managers (Carr et al. 2016; Vincent et al. 2017; Tall et al. 2018), natural resource and water managers (Lemos 2015; Rayner et al. 2005), health services (Jancloes et al. 2014; Lowe et al. 2017), and engineers and urban planners (Giordano et al. 2019; Steynor et al. 2016; Webber 2017).

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However, despite improvements in available climate information (Vaughan and Dessai 2014) and diverse efforts to actively engage with potential users, in practice climate services have rarely informed climate decision-making (Brasseur and Gallardo 2016; Lubchenco 2011). Although individual success stories are observed in the scholarly literature, sustained and systematic gaps remain between the production of climate information, its use in decision-making, and, most importantly, the societal benefits that are the intended result. In part, this can be explained by the fact that the drive to develop climate services has principally come from climate scientists themselves, despite the growing recognition amongst scholars and practitioners of the need for collaboration and the complex and interdisciplinary nature of the climate services challenge.

Although climate scientists, researchers, and modellers have much to contribute toward increasing understandings of the climate system, their contributions are thus far largely technical and continue to rely on linear models of climate service delivery. For example, much of the climate services literature have emphasized challenges such as: the need for increased observation, modelling, and prediction capacities, (Asrar et al. 2013; Vaughan et al. 2016); technical characteristics such as spatial and temporal scales of forecasts (e.g. Graham et al. 2011); and improvements in communicating the information contained in climate services (Trenberth et al. 2016; Lorenz et al. 2015). As a result, 'producers' and 'suppliers' propel the climate service movement (Lourenco et al. 2016). At the same time, proponents suggest the need to commercialize and marketize climate services (e.g. Street 2016), emphasising the need to measure and quantify benefits in order to justify, promote, and stimulate investment in climate services (e.g. World Meteorological Organization 2009, 2015). These trajectories have allowed little space for critical reassessments that examine the underlying assumptions and practices embedded within the climate service paradigm, or the resultant social, political, cultural, and ethical implications.

Scholars studying the science-society interface have long emphasized that science should be more accountable, transparent, and responsive to citizens (Jasanoff 2004), especially for 'wicked problems' such as climate change (Jasanoff and Wynne 1998). These science-society scholars recognise that changes in the interactions between climate information and adaptation decisions have expansive effects (Jasanoff 2010; Mahony and Hulme 2012; Miller 2004). Underlying these insights is a commitment to situating science-policy relations in their social, political, and cultural contexts and the assertion that the ways that knowledge is produced, circulates, and is consumed—such as through climate services—reshapes our world and our lives (Goldman et al. 2018; Meehan et al. 2018). For instance, some scholars have questioned the "predict-then-adapt" model of climate adaptation decision-making (Dessai et al. 2009; Hulme et al. 2009), noting that it reduces the future to climate (Hulme 2011), thereby inhibiting other knowledge systems, alternative political movements, and potentially effective and novel policies (Rice et al. 2015). Climate services, therefore, are not a neutral activity, but rather reflect particular values and priorities and can exacerbate existing inequalities (Lemos and Dilling 2007). The distribution of climate services globally is also highly uneven, with little relationship between vulnerability and the availability of climate information (Georgeson et al. 2017). This research highlights that the contexts of climate adaptation are striated with politics and uneven power relations (Lindegaard 2018; Nightingale 2017; Webber 2016; Eriksen et al. 2015). It is these power laden contexts that can constrain or enable the potential for producers and users to engage in collaborations to produce climate services, as well as the climate change adaptation decisions and actions that such 'co-produced' climate services are intended to encourage.

This special issue broadens the climate service conversation to include interdisciplinary scholarship. Although the idea of climate services has reoriented the science-society interface

with respect to climate change, scholars have thus far paid remarkably little critical attention to its logics, potentials, and impacts (Webber and Donner 2017; Tadaki et al. 2014; Hulme et al. 2009). Important unexamined questions include how have climate services reshaped science-society interactions? Whose priorities are reflected within existing climate service enterprises, and who stands to benefit? And, can climate services ultimately enable effective climate change adaptation, particularly for those vulnerable groups they are intended to serve? In order to attend to this gap, research must understand climate services within existing decision-making hierarchies, institutions and constraints, and question underlying assumptions and practices and analyse global governance structures. This special issue begins such a conversation by engaging rich empirical case studies from varied geographies with critical social methodologies and theories. This interdisciplinary conversation pushes the boundaries of existing research about climate services, unearthing substantive and structural—rather than technical—limits to global climate services, and how these might be redressed in diverse social, political, and cultural contexts.

The papers in this special issue are situated along and throughout the 'value chain' of climate services: from the construction of diverse forms of climate information, brokering, and intermediary work to the use of climate services and governance across the chain itself (see Harvey et al. this issue). At the site of climate data and its production and analysis, Keele (this issue) examines the role of consultants in delivering climate change adaptation in Australia. Keele posits four logics that govern the way knowledge is created through consulting a client-focus, an orientation towards solutions, a need for resource efficiency, and self-replication. The result of providing climate services through consulting is, therefore, a shift away from generating knowledge as a public service that is accessible and of high quality towards providing knowledge for private profit and for specific, often large, and well-resourced clients. Creating climate services in this way risks prioritising customisation over inclusion and access. Nost's (this issue) political-economic analysis of the coastal Master Plan process in Louisiana, USA, also explores the role of adaptation planners and scientists in creating climate services. In the context of land loss, the government has instigated a process to identify adaptation projects by combining information about funding constraints, science, and the input of key stakeholders. Although the coproduction of information with stakeholders is often the goal of climate services, Nost finds that this creates winners and losers and can exacerbate vulnerabilities. Co-producing climate services with powerful users, for instance the oil and gas industry, prioritises their interests over others, for instance coastal and wetland restoration. Further, the coastal modelling process prioritises optimisation of projects rather than the pursuit of potentially transformative adaptation options focused on the question of what a sustainable coast would be. In short, Keele and Nost show that who makes climate services, and under what political economic conditions, matters for who gains from the use of those services and they kinds of adaptation decisions they invite.

In the world of climate services, a wide variety of new and established intermediaries now facilitate the circulation of useful knowledge between producers and users. In Belize, where commercial and subsistence agriculture is sensitive to the vagaries of weather and climate, Haines (this issue) explores how advisers, NGOs, extensions agents, and farmers associations negotiate expertise and authority under conditions of uncertainty. Haines finds a series of tensions and mismatches in the process of circulating climate services for agriculture: routine bureaucratic and procedural blockages when issuing and circulating forecasts; disagreements about the responsibility for providing agricultural advice and absorbing the risks of acting on, or not, forecasts; and negotiations over what counts as expertise. As others in this special issue also show, this case

highlights the importance of existing power relations in mediating climate services; successful climate services for agriculture depend on the politics and political economies of agrarian lives, and diverse moral economies of decision making. Daly and Dilling (this issue) also focus on existing power relations in processes of co-producing climate services in two international projects that sought to improve adaptation processes and outcomes at the local scale in Tanzania. Bringing together normative understandings of co-production (that pursue co-production in order to create 'usable' knowledge) and analytical understandings of co-production (that see knowledge and society as coproduced), the paper shows that knowledge politics are integral to climate services endeavours. Despite a stated aim to diversify and democratise participation and outputs, the climate services projects reaffirmed scientific authority and institutions. The article highlights the politics of salience, credibility and legitimacy, and the trade-offs between each of these facets of climate services: salience is easily achieved with a scientific approach to downscaling, whereas credibility and legitimacy are relational, negotiated, and contested.

Like Haines and Daly and Dilling, Harvey and colleagues trace the evolution of climate services in Burkina Faso and Ethiopia to show that there are increasing numbers of NGOs and non-state organisations acting as intermediaries in the climate service ecosystem. Harvey et al. find that since the early 2000s, climate services have emerged as a clear vision in both countries, and while there have been significant infrastructural developments over this period, there remain financial and human resource constraints and gaps in terms of a user orientation. While a consolidated vision and an increasing number of intermediary NGO actors may seem a positive step—and Harvey et al. do find examples of innovations in communicating climate information to better suit users—the associated 'projectisation' raises issues of accountability, coherence and coordination, scalability, and sustainability.

At the user end of the value chain, Gerlak and Greene (this issue) analyse how the Global Framework for Climate Services (GFCS) frames vulnerability and the vulnerable—one key, intended target of climate services. Conducting a rigorous document analysis of key GFCS texts, Gerlak and Greene find relatively few discussions of the sites of and reasons for vulnerability to climate change. Moreover, when GFCS documents define vulnerability, describe and locate the vulnerable, and identify causes, they predominantly mobilises outdated, 'exposure' driven forms of vulnerability. In terms of redressing vulnerabilities, Gerlak and Greene show that the GFCS fails to consider the complex processes that intersect in local contexts. There is a risk that the GFCS will facilitate climate services that do not prioritise the most vulnerable users and do not invite adaptations that reduce vulnerability amongst users. Also focused on the relations between producers and users, Kalafatis and colleagues (this issue) unpack trust between Native American Tribes (Tribes) and Climate Service Organisations (CSOs) in the USA. Collaborations between Indigenous peoples and scientists for climate services may lead to more socially just outcome, but, in the USA—and indeed other settler colonies—scientists' practices and opinions have sometimes undermined previous collaborations. In this context, Kalafatis and colleagues develop a survey to measure members of Tribes and CSOs perceived potential benefits and harms from climate service collaborations. The survey finds that although both categories of respondents identified benefits, such as 'creating new knowledge', the Tribe-affiliated respondents rated the risks of harms higher than CSOs did. Subsequent interviews also highlight the necessity of trust as a system of shared responsibility in pursuit of not only tangibles such as new knowledge but also intangibles such as sovereignty and accountability. Both of these cases, the GFCS and collaborations between Tribes and CSOs, show the powerful relations that reach across the climate services value chain and the care required to ensure that these relations can produce socially just outcomes.

This special issue also includes articles concerning the governance and conceptualisation of climate services across the value chain. Alexander and Dessai (this issue) review literature on public administration, service management, and service marketing to focus on the needs of users through a service logic and culture. Alexander and Dessai propose that climate services might usefully adopt the idea of servicescapes, in particular, and emphasise the subjective experiences of users. A greater focus on the physical, symbolic (and more) designs of servicescapes might allow for more adaptive uses of the climate services themselves. At the organisational scale, Owen and colleagues (this issue) reposition the US Climate Assessment for the Southwest (CLIMAS) program—a key climate service organisation in the region—as part of a social learning system for climate resilience. Rather than a boundary organisation or simple source of climate data, CLIMAS operates through transdisciplinary communities of practice who collectively and flexibly address complex problems for the Southwest by creating new knowledge that is usable. But, as part of a social learning system, CLIMAS extends its responsibility beyond generating science to include communicating, convening and connecting, consulting, collaborating, and training. Owen and colleagues show that the relationships and interactions that stretch beyond CLIMAS, but are constitutive of the social learning system, are necessary for generating useful knowledge and climate services.

At the scale of specific climate service products and communication formats, Knudson and Guido (this issue) outline a methodology for addressing the 'missing middle' between seasonal climate forecast communication and use: intermediate phone calls between providers and users. Where participatory workshops provide opportunities for multi-way communication, they can be resource and time intensive. In turn, the one-way communication of seasonal climate forecasts through SMSs can be frequent and far-reaching, but less effective for facilitating use. Drawing from their insider/outsider experience implementing a development intervention for coffee farmers in Jamaica, and conducting research about it, Knudson and Guido demonstrate that phone calls between providers and users can overcome existing limitations in communicating seasonal climate forecasts while simultaneously providing information about usage and contextual factors that might constraint usage.

In addition to providing detailed analysis of promises and pitfalls across the climate services value chain, the articles assembled here introduce several themes pertinent to the climate service community. Several of the authors raise the need for both practitioners and observers of climate services to build on the knowledge of existing literatures. This ranges from an increased orientation towards theories of new public management in building services or social learning systems, longstanding analytical understandings of the causes of vulnerability, anthropological and developmental studies inspired approaches to pinpointing hierarchies of knowledge and failures of the project form, and political economic analyses of the implications of reworking or blurring the boundaries between public and private actors and actions. If climate services are to contribute to meeting the climate change challenge in the time and manner required, then it is imperative that the field build on this research rather than needlessly repeating problems well established in affiliated academic fields. The articles also emerge across the spectrum of practitioner and academic with authors often negotiating insider/outsider statuses—being both programmers of climate services, and observers and critics. Given this, the opportunity for translating these new research findings and lessons from other fields is great.

The most pressing theme that reverberates across the articles relates to power and politics. The articles identify winners and losers, and the way winners and losers are created through the pursuit and application of climate services—be they Native American Tribes compared to Climate Service Organizations, or oil and gas companies compared to fishers on the Louisiana

coast. Climate services can be, or—as shown in the cases explored in this issue—often are, maladaptive because they exacerbate or create new vulnerabilities and forego opportunities for transformational adaptations. Power and politics, therefore, operate across processes of creating climate services, moving through intermediaries and brokers, when they land to influence decisions, and through the climate service technologies themselves. Indeed, the articles in this issue continually ask and demonstrate the imperative to constantly ask: climate services for whom, and climate services by whom? Across the contributions, the authors examine the implications of producing climate services for powerful actors at the expense of making publicly accessible, accountable climate knowledge, of only including some social contexts and histories, knowledge systems, or voices, and of a failure to centre the most vulnerable users. Similarly, the articles show that it matters who produces the climate services and under what conditions, whether they are private, public, or civil society organisations and funded through the short-term projects of international aid. In short, this collection raises the stakes for the climate service community and research, showing the importance of attending to politics, accountability, responsibility, and accessibility in order to realise the great promise of climate services.

References

Asrar G, Hurrell J, Busalacchi A (2013) A need for 'Actionable' climate science and information: summary of the WCRP Open Science Conference. Bull Am Meteorol Soc:8–12

Brasseur GP, Gallardo L (2016) Climate services; lessons learned and future prospects. Earth's Future 4:78–89

Broad K, Pfaff ASP, Glantz MH (2002) Effective and equitable dissemination of seasonal-to-interannual climate forecasts: policy implications from the Peruvian fishery during El Nino 1997-98. Clim Chang 54:415–438

Buizer J, Jacobs K, Cash D (2016) Making short-term climate forecasts useful: linking science and action. PNAS 113(17):4597–4602

Carr E, Fleming G, Kalala T (2016) Understanding women's needs for weather and climate information in agrarian settings: the case of Ngetou Maleck, Senegal. Weather Clim Soc 8(3):247–264

Cash D (2006) Countering the loading-dock approach to linking science and decision making: comparative analysis of El Nino/Southern Oscillation (ENSO) forecasting systems. Sci Technol Hum Values 31(4):465–494

Dessai S, Hulme M, Lempert R, R Pielke JR. (2009) Do we need better predictions to adapt to a changing climate? Eos 90(13):111–112

Dilling L, Lemos MC (2011) Creating usable science: opportunities and constraints for climate knowledge use and their implications for science policy. Glob Environ Chang 21(2):680–689

Eriksen S, Nightingale A, Eakin H (2015) Reframing adaptation: the political nature of climate change adaptation. Glob Environ Chang 35:523–533

Georgeson L, Maslin M, Poessinouw M (2017) Global disparity in the supply of commercial weather and climate information services. Sci Adv 3:e1602632

Giordano R, Pilli-Sihvola K, Pluchinotta I, Matarrese R, Perrels A (2019) 'Urban adaptation to climate change: climate services for supporting collaborative planning' *Climate Services*. https://doi.org/10.1016/j.cliser.2019.04.004

Goldman M, Turner M, Daly M (2018) A critical political ecology of human dimensions of climate change: epistemology, ontology, and ethics. WIREs Climate Change 9:e526

Graham RJ, Yun WT, Kim J, Kumar A, Jones D, Bettio L, Gagnon N, Kolli RK, Smith D (2011) Long-range forecasting and the global framework for climate services. Clim Res 47:47–55

Harjanne A (2017) 'Servitizing climate science - Institutional analysis of climate services discourse and its implications' *Global Environmental Change* 46: 1-16

Hulme M (2011) Reducing the future to climate: a story of climate determinism and reductionism. Osiris 26(1): 245–266

Hulme M, Pielke R, Dessai S (2009) Keeping prediction in perspective. Nat Clim Chang 3:126–127

Jancloes M, Thomson M, Costa MM, Hewitt C, Corvalan C, Dinku T, Lowe R, Hayden M (2014) Climate services to improve public health. Int J Environ Res Public Health 11(5):4555–4559

Jasanoff S (2004) States of knowledge: the co-production of science and social order. Routledge, London

Jasanoff S (2010) A new climate for society. Theory Cult Soc 27(2–3):233–254

Jasanoff S, Wynne B (1998) Science and decision-making. In: Rayner S, Malone E (eds) Human choice and climate change: volume 1 the societal framework. Batelle Press, Columbus
Lemos MC (2015) Useable climate knowledge for adaptive and co-managed water governance. Curr Opin Environ Sustain 12:48–52
Lemos MC, Dilling L (2007) Equity in forecasting climate: can science save the World's poor? Sci Public Policy 34(2):109–116
Lemos MC, Morehouse B (2005) The co-production of science and policy in integrated climate assessments. Glob Environ Chang 15:57–68
Lemos MC, Finan TJ, Fox RW, Nelson DR, Tucker J (2002) The use of seasonal climate forecasting in policymaking: lessons from Northeast Brazil. Clim Chang 55:479–507
Lindegaard LS (2018) Adaptation as a political arena: interrogating sedentarization as climate change adaptation in Central Vietnam. Glob Environ Chang 49:166–174
Lorenz S, Dessai S, Forster P, Paavola J (2015) Tailoring the visual communication of climate projections for local adaptation practitioners in Germany and the UK. Phil Trans R Soc A 323(2055)
Lourenco TC, Swart R, Goosen H, Street R (2016) The rise of demand-driven climate services. Nat Clim Chang 6: 13–14
Lowe R, Stewart-Ibarra A, Petrova D, Garcia-Diez M, Borbor-Cordova M, Mejia R, Regato M, Rodo X (2017) Climate services for health: predicting the evolution of the 2016 dengue season in Machala Ecuador. Lancet Planet Health 1(4):e142–e151
Lubchenco J (2011) Creating a NOAA climate service. In: Written Statement. National Oceanic and Atmospheric Administration, Washington DC http://www.noaanews.noaa.gov/stories2011/20110622_climateservice.html
Mahony M, Hulme M (2012) Model migrations: mobility and boundary crossings in regional climate prediction. Trans Inst Br Geogr 37:197–211
Meehan K, Klenk NL, Mendez F (2018) The geopolitics of climate knowledge mobilization: transdisciplinary research at the science-policy interface(s) in the Americas. Sci Technol Hum Values 43(5): 759–784
Miller C (2004) Climate science and the making of a global political order. In: Jasanoff S (ed) States of knowledge: the co-production of science and social order. Routledge, London
Nightingale A (2017) Power and politics in climate change adaptation efforts: struggles over authority and recognition in the context of political instability. Geoforum 84:11–20
Rayner S, Lach D, Ingram H (2005) Weather forecasts are for wimps: why water resource managers do not use climate forecasts. Clim Chang 69:197–227
Rice J, Burke BJ, Heynen N (2015) Knowing climate change, embodying climate praxis: experiential knowledge in southern Appalachia. Ann Assoc Am Geogr 105(2):253–262
Steynor A, Padgham J, Jack C, Hewitson B, Lennard C (2016) Co-exploratory climate risk workshops: experiences from urban Africa. Clim Risk Manag 13:95–102
Street R (2016) Towards a leading role on climate services in Europe: a research roadmap. Clim Serv 1:2–5
Tadaki M, Salmond J, Le Heron R (2014) Applied climatology: doing the relational work of climate. Prog Phys Geogr 38(4):392–413
Tall A, Coulibaly JY, Diop M (2018) 'Do climate services make a difference? A review of evaluation methodologies and practices to assess the value of climate information services for farmers: Implications for Africa' *Climate Services* 11:1-12
Trenberth K, Marquis M, Zebiak S (2016) The vital need for a climate information service. Nat Clim Chang 6:1057–1059
Vaughan C, Dessai S (2014) Climate services for society: origins, institutional arrangements, and design elements for an evaluation framework. WIREs Clim Chang 5:587–603
Vaughan C, Buja L, Kruczkiewicz A, Goddard L (2016) Identifying research priorities to advance climate services. Climate Services 4:65–74
Vincent K, Dougill A, Dixon J, Stringer L, Cull T (2017) Identifying climate services needs for national planning: insights from Malawi. Clim Pol 17(2):189–202
Webber S (2016) Climate change adaptation as a growing development priority: towards critical adaptation scholarship. Geogr Compass 10(10):401–413
Webber S (2017) Circulating climate services: commercializing science for climate change adaptation in Pacific Islands. Geoforum 85:82–91
Webber S, Donner S (2017) Climate service warnings: cautions about commercializing climate science for adaptation in the developing world. WIREs Climate Change 8(e424):1–8
World Meteorological Organization (2009) Meeting of the WMO forum: social and economic applications and benefits." Final Report. World Meteorological Organization, Geneva

World Meteorological Organization (2011) Climate knowledge for action: a global framework for climate services - empowering the most vulnerable." WMO-No. 1065. World Meteorological Organization, Geneva

World Meteorological Organization (2015) Valuing weather and climate." WMO-No 1153. World Meteorological Organization, Geneva

Ziervogel G, Calder R (2003) Climate variability and rural livelihoods: assessing the impact of seasonal climate forecasts in Lesotho. Area 35(4):403–417