Introduction

Approaching digital anthropocene(s): A *Double Vision*

James Maguire[†], Astrid Oberborbeck Andersen[‡], Rachel Douglas-Jones[§]

Abstract

It is becoming increasingly difficult to address environmental questions without considering how they overlap and intersect with digital concerns. We observe and make our understandings of environments through, for example, digital devices, spreadsheet accounting and carbon calculations. Conversely, we make the digital through the appropriation of environmental forms; crafting metals and plastics into sleek handheld devices, while powering our data use through vast quantities of energy consumption. We have brought epochal shifts into being through rhetoric, disciplines, and geological measures. Yet the 'we' of these statements is an unevenly distributed set of actors, whose politics is pressing. While it is evident that the anthropocene is constituted through colonial histories, what this collection foregrounds is how deeply interwoven it is with the tools, devices, and computational logics that are part of such histories. In this special issue, we bring together four anthropology and Science and Technology (STS) scholars, each of whom offers a different empirical instance of *approaching digital anthropocenes*. Through various modes of sensing, governing, intervening, and speculating, each article *reveals* a particular colonial legacy that *provokes* an alternate form of politics (proto, limit, civic, and pre-figurative). What is revealed in each case, we claim, is the legacy of a colonial infrastructure that whilst saturated in forms of technological inequality and injustice also affords a counter political re-imagining through digital mediations.

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[†] IT University of Copenhagen, Technologies in Practice Research Group, jmag@itu.dk (corresponding author)
[‡] Aalborg University, TANT Lab, aoan@ilk.aau.dk
[§] IT University of Copenhagen, Technologies in Practice Research Group, rdoj@itu.dk

Struggles over data are also struggles over infrastructures, are also struggles over our life supports, are also struggles over what futures are possible, what gets to be in the world and what is destroyed.
Murphy 2022: 48

In the summer of 2020, 4S/EASST, the core joint conference of Science and Technology Studies hosted between national associations of Europe and North America, moved online. As the COVID-19 pandemic changed worlds, modes of academic association changed too: the editors of this special issue hosted the panel *Approaching the Digital Anthropocene* online on Zoom, from a small meeting room in Copenhagen, Denmark. The call for papers, issued prior to the outbreak of the pandemic, had been posed as a question, inviting colleagues in STS to respond: What does the conjunction of these equally contested terms imply?

The resulting panel of papers, a selection of which are presented in this issue, offer varying answers on how the digital and anthropocene inflect one another, while simultaneously troubling empirical and analytical distinctions. These two vast phenomena, each with their own significant bodies of literature, warrant, we argue, mutual reading and ethnographic interrogation, wherein the concerns of one illuminate those of the other. It is tempting to partition these concerns into material and epistemic camps: the digital as a tool by which the anthropocene is known, and anthropocene climate realities as produced by digitalization's extractive and resource hungry demands. However, the analytical need is, we suggest, more than the cultivation of 'artful attention' (Myers 2017: 5) at the interface of local and large-scale concerns. It is at once an ethnographic and a theoretical challenge, requiring attention to the properties of the concepts in play, and seeking ways through analysis that resist reification of concepts or places. As such, this introduction demonstrates 'anthropocene(s)' as approached through 'the digital,' and vice versa: a pluralizing invitation to readers to chart their own analytic paths through the digital anthropocenes of their fieldsites and worlds.

Our starting point can be characterized as a *double vision* (Haraway 1988). First is the observation that it has become increasingly difficult to address environmental questions without considering their digital constitution. Here we gesture towards environmental work as oftentimes computationally mediated. Take, for example, the forms of modelling that constitute the Intergovernmental Panel on Climate Change's (IPCC's) reporting system. Extensive computer simulations of various interconnected earth systems are part of a larger data infrastructure whose reporting outputs have become the standard bearer for what constitutes climate knowledge and expertise. Such modelling, as Paul Edwards (2010) has suggested, plays

a central role in enacting that which we refer to as 'the climate', its differential impacts, various possible futures, as well as the modes of intervention necessary to limit negative planetary effects (see also Knox 2020). Conversely, it is equally difficult, we suggest, to consider computational practices without reference to the various environmental forms that infuse and enliven them. Here, we point out how such practices are very much embedded in wider environmental infrastructures (Jensen in de la Cadena and Lien 2015). Take, for example, how the writing of a piece of code or the training of an algorithm figures the environment in various, and oftentimes obscured, ways. Recent estimates suggest that large language model training sets (LLMs) emit, on average, the same levels of CO_2 as driving a standard family car for 700,000 kilometers (Maguire et al. 2022; Strubell, Ganesh, and McCallum 2019). On the face of it, these observations appear somewhat obvious. But the urge to articulate them stems from what we find to be a still commonplace understanding of computational and environmental practices as segregated: worlds apart, rather than worlds conjoined and interdependent.

Double Vision for digital anthropocene(s)

We draw upon a *double vision* inspired by Donna Haraway (1988): a situated analytic prompting scholars to see how these putatively separated worlds are very much folded within one another. Haraway proposed double vision as a feminist means of resisting simplicity: a way of opening up to the possibility of worlds that are otherwise to more dominant, and oftentimes binary, patriarchal logics. Cultivating *double vision* is, therefore, not to see *more* (adding digital concerns to anthropocene issues, or vice versa) but to see *differently*; to resist, in the first instance, the imposition of what Tess Lea (in de la Cadena and Lien 2015: 452) terms "plot coherence" on "the fragmentary nature of our insights" and refuse a binary separation of 'digital' and 'anthropocene'.

It does more than this, however: doubling our vision means attempting to bring these folded concerns into view simultaneously. It is thus a call to specify the multifaceted and complex relations that take shape along the contours of such folds, and through which various articulations of digital anthropocene(s) have the potential to be seen. In Alberto Corsín Jiménez's (2018, 7) terms, double vision is a "technique for producing descriptions of complexity whose capacities are at once contained within yet exceed the legacies of naturalism". So, the second sense of double vision, in making accounts that contain yet exceed, is to engage with struggles over "*how* to see" (Haraway 1988: 587; Vera this issue; Mirza this issue; Vaughn this issue). In what follows, we thus organise the interdisciplinary bodies

emerging at this intersection of literature by walking the reader towards the anthropocene through the digital, and then, conversely, back towards the digital through the anthropocene. Following the contours of these moves pushes us to expand our sense of locale; we follow not only into the worlds where the digital and the anthropocene are materially made and felt, but where they are monitored, designed for, calculated and mobilised. For us, as for Haraway, taking on 'double vision' demands attention to formations of power and scale. And as we will discuss a little later, digital-anthropocene fieldsites tend to span the full range of corporate, military, colonial, and activist power relations, that, while bound up with capitalist relations, also extend beyond them (Nelson, Hawkins, and Govia 2023: 2100).

In adopting double vision as method we also encounter a third sense, its excess: it does not afford a geometric view, with clearly defined borders, static beginnings, or end points (Harvey 2012). Instead, it helps us see mutable contours, their forms and textures as they fold within one another. For the philosopher Michel Serres, the fold constitutes "the manifold ways of reconfiguring that which is considered proximal and distal in space and time" (Serres and Latour 1995: 60) and arises through particular forces and contexts (see Maguire 2020: 718). Mutable contours loop: feedback and feedforward processes mutually inform and constitute, more Möbius strip than line. Our approach is thus to invite the reader into the concerns of this porous, interdisciplinary body of literature with a view to travelling along the möbius strip of our narrative. The risk here is that in being *turned upside down* along the way, readers might become somewhat disorientated as 'digital' concerns become more difficult to separate from 'anthropocene' ones. Such motion makes double vision an anti-binary practice, where one encounters disorienting folds and, at times, various forms of excess: in approaching digital-anthropocenes, vision is exceeded as the sole arbiter of sense-making, and narratives are extended as a technique of unfolding meaning (Mirza; Vaughn, this issue). Instead of distinct disciplinary "domains bumping into one another" (Jensen in de la Cadena and Lien 2015: 450) this special issue aims to make visible how the contours and folds of various digital-anthropocenes can be mapped and articulated. At these meeting points between anthropology, STS, media studies, geography, political ecology and more, we invite scholars to make visible the urgent, often unnoticed, forms of politics that arise from their mutual implication.

Approaching the anthropocene through the digital

To begin in scholarship on the digital is to inhabit a set of promissory imaginaries, from the techno-solutionism of ecomodernists (Asafu-Adjaye et al. 2015) to the extolling of AI and

machine learning as revolutionary sites of climate interventions (see Cowls et al. 2021). And even though such promises—latent in technological discourse for some time now (Carey 1992; Morozov 2013)—oftentimes reach beyond their current methodological capabilities, their seduction (automation, productivity, efficiency, growth and the like) continues unabated (Brevini 2022; Santarius et al. 2022). The form such promises take is varied: it might be the belief that Emily, one of Matthew Archer's interlocutors in Kenya, has in the capacities of drones, satellites, GPS, and blockchain to curb "the rapid encroachment of soy plantations into the Amazon rainforest" by "plot[ting] the boundaries of rainforest-adjacent farms and then use[ing] satellite imaging to check whether they were expanding into neighboring rainforests from year to year" (Archer 2021: 283). In stories like this, digital technologies are salvific, their presence and implementation signal the advent of change. Another promise might take the form of "computer keyboards made out of carrot and spinach extracts [or] mobile phones that 'plant' sunflower seeds when they decompose" (Gabrys 2011: 152), signaling a computation practice that is benign to, rather than destructive of, its environments. It might even look like digital "games that invite users to interact virtually with conservation landscapes" (Fletcher 2017: 153; cited in Turnbull et al. 2023: 4), a field of research that explores the relationship between in-game conservation action and its broader impacts in the lives of gamers.

At the same time as scholarship on the imaginaries of digital technologies has soared, researchers have also followed the digital and anthropocene into their sites of *epistemic production*. As the anthropologist Kim Fortun remarked of the conceptualisation of the anthropocene, "cultural analysts need to understand the history behind the concept, and the dynamics and 'thought styles' of the community of earth scientists who developed it" (Fortun 2021: 18). That community, Walford (2016: 47) commented, took seven years to make a recommendation regarding the concept's "plausibility", making a contrast with "the speed with which the term appeared to colonise—and polarise—conversations about environmental issues within anthropology and STS". We might also want to understand the styles shaping its reception, such as one embodied by science journalist Eric Roston. Fortun describes the news coverage of the 2016 *Science* article, as Roston remarked that "[w]e humans… installed a new operating system for our 4.5 billion years old planet" (cited in Fortun 2021: 15). This version of *an* anthropocene, (and here is a fold for us) is *already* computational, a ('cultural') software upon the ('natural') hardware of the planet; a computation that produces a dichotomy upon which rests the weight of the political and analytical challenges before us.

As digital data are sought and mobilised as a means of making anthropocenes as knowledge forms, the digital turns anthropocenes into an artifact on the move. The epistemic labours of 'knowing nature' have, for decades, taken the form of scholarship on the production of environmental knowledge. In the early 2000s, Fortun was already exploring the central, *folded in* role of data practices within environmental politics, arguing that "environmental information systems *structure what people see* in the environment, and how they collaborate to deal with environmental problems" (2004: 54; *emphasis added*). Paul Edwards' *A Vast Machine* (2010) and Geoffrey Bowker's *Memory Practices* (2008) also documented the digital's role in the construction of environmental knowledge, its contingencies and histories laying empirical and scholarly groundwork that attunes us to data practices, infrastructural negotiation and the construction of much of what has come since. Today, new techniques for seeing and knowing the environment are tied to precision-driven, automated AI and machine learning technologies, putatively delivering near-real-time capabilities to a range of environmental monitoring and assessment issues.

Opening his article about coastal drift and erosion in Louisiana, for example, geographer Eric Nost (2022: 105) invites you to imagine yourself, "sitting on the beach, taking in the sun and the sea, and watching the waves roll and crash left to right", before remarking that it's too bad that "it's a computer simulation", laying bare the hard work actually involved in studying data integration and the pathways of making data available for decision-making. Similarly, in his *Book of Waves*, Stefan Helmreich (2023: 14) traces the international history of how the 'wave' came to be known, modelled, inserted into the forms of modelling that constitute the Intergovernmental Panel on Climate Change's (IPCC's) reporting system.

For Anne Pasek, Hunter Vaughan, and Nicole Starosielski (2023: 1; *emphasis added*) there is now a shift occurring. If scholarship that aimed to "rebut the supposed *immateriality* of the (digital) sector", has largely achieved its aims, a new challenge "lies in assessing and responding to the quantification of digital networks' environmental impacts". These authors are thinking of the serious challenges faced by carbon footprinting methodologies in the "quantitative study of ICT's climate impacts" (2023: 2) has a critical role in the making-manageable of environments, in order to 'do' digital-anthropocenes. Kristin Asdal's (2008: 130) attention to "systems of accounting" in Norwegian pollution control demonstrating the economic imperatives in "accounting for nature". Close interrogation of carbon accounting, enacted as "materially-discursively arrange[d] between heterogeneous entities—databases, files, paper, words, numbers—in and between office spaces, enabling them to stage emission facts as stable

and singular" (Lippert 2015, 1), making markets along the way. In his UK based fieldwork, Theo Stanley (2022) takes us on a day out with a DJI M33 airframe drone in the Scottish Highlands, where he and Eric, an eco-entrepreneur, are hunting not for game but "carbon stored in landscapes" by measuring various capacities of ecosystems using "drones, satellites, lasers, artificial intelligence, robotics, eDNA sampling" (2022). We follow his research through to the Excel spreadsheets calculating the UKs Woodland Carbon Code, wherein, he tells us, "an algorithm produces a number: the amount of carbon the scheme is expected to sequester in the following 100 years. This determines how many carbon credits a scheme is worth" (Stanley 2022).

The forms of knowledge these authors document in-the-making provide the basis for governance and decision-making, negotiation and (in)action. They are also increasingly generated by diverse actors, all seeking to make and register claims on ways to manage anthropocene effects, or to mark anthropocene harms. From cities to forests, to the extension of Foucaldian environmentality for the era of the smart city, sociologist Jennifer Gabrys (2014: 45) has demonstrated that it matters who does the sensing. [1] In worlds of civic sensing, despite the liberatory hopes and potential of bottom-up data collection, Gabrys' work has consistently warned that "political arrangements and practices potentially delimit urban 'citizenship' to a series of actions focused on managing data" (Gabrys 2014: 30) reshaping cities into "datasets to be manipulated" (2014: 32; see also Mattern 2021). If a city now risks becoming a dataset, and its citizens data generators and managers thereof, the political grounds of citizenship shift under a "computational apparatus" that constitutes itself as an environment (Gabrys 2014: 45). Gabrys' recent work demonstrates how technologies used to measure and manage forests, turn those forests into technologies themselves, shifting that which was previously thought of *as* environment, through sensing, data and computing, into an optimized, augmented, *managed* service provider (2020: 7). Such transformational management is a signature of smartification, the broader umbrella under which many sensing technologies trade (Rothe 2020; von Essen et al. 2023; Blair 2022). And when smartification projects escape the city, they bring their promises, rhetoric and shine to forests, agriculture, shipping, wastewater management, energy grids and so on. As such, Kintzi and Faxon (forthcoming) invite us to see smartification as an evolution of what Tania Li identified as "rendering technical" (2007: 123), a move which allows

[1] 'Participation' takes on different politics when it is streamlined towards existing economic processes (Gabrys 2014: 45; see also Kelty 2020).

us to see how objects become simplified and neutralized into bounded targets of improvement. Creating such bounded targets is a particular art of computational sciences, as we now examine.

Approaching the digital through the anthropocene

To approach the digital through the anthropocene is to notice how different starting points can produce distinct sites of attention while continuing to fold back on the concerns laid out above. The anthropocene makes Earth's history, geological formations, minerals, and energy available for thinking, focusing attention on the environmental forms, goods, and processes that animate and vivify digital life. Thus, approaching the *times* of the digital—with its almost unliveable temporalities (Crary 2022)—through the *temporal depths of the anthropocene* is jarring. Media theorist Jussi Parikka's *A Geology of Media* (2015: 27) offered just such depth, insisting on deep times and "long-term durations and geophysical assemblages". Digital technologies depend on planetary pasts, their geological formations and affordances. Building technologies that facilitate data production and collection *on* the anthropocene involves the unceasing extraction of rare earth resources at accelerated rates. Coltan, the portmanteau of columbite-tantalite, is the iconic metal of a hungry electronics sector and its extractive politics. In his research in the Democratic Republic of Congo, a site both of vast reserves of Coltan and complex networks of violence, Jeffrey Mantz (2008: 42) comments that "coltan's commodity chain and its relevance to our planet may be mystifying to the 14 year old kid who has been lured away from us to the seductive virtual world of Halo 3, it certainly is not to financiers who operate in the real world of global exchange". Writing before Fridays for Future, Mantz perhaps under-estimates the naivety of a fourteen-year-old, and over-estimates the 'real world' assigned to financiers, yet tracing the intermediaries, traffickers, and metallurgical plants that pattern on to post-cold war environments, he notes the colonial patterns onto which extraction of Coltan, like rubber before it, maps (Hochschild 2020). Yet 'green' extractivism, upon which renewable technologies depend, also follows such patterns: research into the extraction sites of lithium in the saltflats and wetlands spread across the Chilean, Argentinian and Bolivian borderlands, for example, documents the vast water demands placed on ecosystems by battery chemical supply chains as well as the indigenous dispossession that has ensued (Acuña and Tironi 2022; Blair et al. 2023; see also Park 2023). To approach the digital through the anthropocene is thus to notice folds where disjunctive temporalities come into relation. Here, looping contours make visible how earth making materials enliven the digital, while the same digital technologies (as data producers) inform our very understanding of those earthy processes, the deleterious effects of

their materials, as well as the forms of extractive disempowerment and injustice they propagate. And this also alerts us to the colonial logics undergirding these relations, logics that create parallels between materials extraction and the data extractions they afford (Kidd 2019: 956).

But the planetary emergency interrupts and re-shapes computational presents and futures, making visible the *vulnerability* of digital worlds to the environments in which they exist, and the instability of the present and coming collapses. In line with Bowker and Star's classic text (1999), particular events—the fires, storms, floods that are all too common—continue to make digital infrastructures more visible. [2] Here, another fold emerges: as anthropocene forces threaten digital worlds, those very same worlds are complicit in exacerbating the threat as digital materialities and dependencies intensify land use, resource extraction, pollution, and carbon emissions. These folds and complicities remind us that the internet as we know it depends heavily on the physical, cables running across seabeds (Starosielski 2012; 2015) or the 'cloud', however ephemeral its referent, embodied in massive, energy consuming data centres (Hu 2015). More recent work has highlighted that not just computing infrastructure but also computing *action* has significant emissions consequences (Strubell, Ganesh, and McCallum 2019; Kaack et al. 2022). Estimates suggest that AI linguistic training models can emit the equivalent of five times the lifetime emissions of an average American family car (*ibid)* Seen thus, the number of dependencies multiply: routing and light technologies, internet protocols and standards, electricity grids, cooling systems, various forms of skilled and unskilled labour, economic devices and models, and importantly, particular socio-cultural forms (values and imaginaries) all need to work together to realise such planetary connectivity (Johnson and Hogan 2017; Maguire and Winthereik 2021).

At the same time, the language of calculating and describing the consequences of the anthropocene is one of risk, most often computed through various technologies of calculation. So, while the forces and materialisms of the anthropocene pose grave risks *to* the digital, quantifications of such risks come *through* the digital itself. Yet folds continue to propagate on this contour as risk moves beyond calculations within spreadsheets and models to become materialized digital surveillance technologies located at physical sites. At times compounding vulnerabilities during crisis: say, for example, when a high profile, real time, smart city digital flood warning system—installed in the city of Zhengzhou, in the central province of Henan, China—fail due to the floods caused by heavy rains it was supposed to warn about (Pan and

[2] Time alone may do the rest, as Taylor notes, with data vulnerability conjured against fragile hardware futures (2021: 89).

Borak 2021). As Liu (2022) put it "without a signal, or electricity, the promise of the smart city is broken". These risks—known and anticipated—are today put to work in the service of a vast array of financial products, with computational modelling, and digital data capture, forming the basis of astounding insurance for 'environments at/of risk', such as that described by Jens Christiansen (2021) for Quintana Roo's coral reef, or the spiralling for-profit conservation industry (Dempsey and Bigger 2019; Lock 2021). Yet much work to counter the impacts of anthropocene crisis on digital infrastructure remains out of public view. When companies break data centre construction contracts because of the costs of cooling servers on a heating planet, or broker new relations in a new nation precisely because of its green image (Maguire and Winthereik 2021), it can be difficult for researchers to get past security barriers, non-disclosure agreements, or steep geopolitical hierarchies.

Nonetheless, the urgency around data collection necessitated by anthropocene concerns continues to spur *ever more deployments* of digital technologies, despite their vulnerabilities to anthropocene environments, and contributions to vulnerability when they fail. The cry we hear in Sarah Vaughn's essay (this collection)—"we need more data!" rises across fields. We hear it in Mathew Archer's (2021: 287) fieldwork of sustainability standards and their verification, where approaches to "sustainability turned fundamentally on an understanding of transparency and traceability as the collection and dissemination of more and more data". We hear it as data sources for measuring air pollution in Copenhagen multiply, setting Google's "Project Air View" alongside the investment of citizen groups in what Dalsgaard, Haarløv and Bille (2021: 523) call distinct forms of "data witnessing", and in Helmreich's (2023: 228) ethnography of waves, where a lack of funding for ocean monitoring in Brazil leads to "one hundred surfers" being trained "to deliver data in the same format as the Netherlands' Datawell Directional Waverider", the leading wave buoy worldwide. This cry for more data has a long history. In 2014, Carruth and Marzec (2014: 206) were asking "who has the right to control knowledge" in the wake of digitalization? Today, ethnographers study the use of digitally generated models alongside other forms of expertise and knowledge practices (Vaughn 2017) causing "data friction" (Nost 2022: 108; after Edwards 2010). So, we might ask of digital anthropocenes, which types of data, which types of objects produced from that data, and which corresponding "epistemological regimes" (Archer 2021: 10) gain primacy and how? David Turnbull and colleagues observe that the corresponding epistemological regimes are often ones "of control and prediction" which "reshapes the governance of technologies themselves" (Turnbull et al. 2023: 15). With ever more 'things' online, the necessity of bringing digitally informed questions

to novel environmental assemblages becomes pressing. Consider the Monsanto Corporation's "Weed I.D." app: who retains ownership of the data generated by it? Or John Deere's tractor sensors which "stream data about soil and crop conditions and the corporation invite farmers to subscribe (and pay) for access to information that can help them decide, for example, when to plant crops?" (Bronson and Knezevic 2016: 1).

Evidently, more data isn't inherently better: more or different data cannot always refute conclusions and may even consolidate the terms through which a given matter is being contested (Shapiro, Zakariya, and Roberts 2017). The centrality of data in 'organizing the problem' has led to data justice movements, in which data can "(re)creat[e] conditions of possibility for counter-imaginaries and social justice claims to emerge" (Dencik et al., 2019, 875). Such counter-imaginaries are crucial for environmental data justice, the meeting point of data justice and environmental justice (Vera et al. 2019). Vera et al. point out however, that extractive logics "haunt any use of data, even when used towards the ends of justice" (2019: 1014). This gives environmental data justice researchers the task of showing "how, why, and with what effects knowledge is made, shaped and influenced" (2019: 11; see Vera this issue).

In Fortun's description, it is through the building of data infrastructures that scholarly work may yet tackle anthropocene problems, as she turns her gaze to new grounds for collaboration and data management (2021: 29–33). To understand the vulnerabilities of digital infrastructure, subject to changing anthropocene forces, Fortun (2021: 33) would have us realize that our grounds, as scholars, too, "are unstable and we need to rebuild accordingly… instabilities of all structures, and our places within them—are our context and responsibility". With her intervention, we have arrived back at efforts to approach the anthropocene through the digital, having approached the digital through the anthropocene.

Approaching digital-anthropocenes

It is the folds of the varied contours of digital anthropocene landscapes that we seek to critically examine. While this collection cannot develop all the investments described above: temporalities, epistemics, materialities, governance, imaginaries, and calculations, it is attentive to several of them. But the term digital anthropocenes is not a neologism; nor would we claim it to be. It has appeared in, amongst other places, critical scholarship from geography (see Travis 2018; McLean 2020; von Essen et al. 2023). In their incisive piece 'against firsting' Max Liboiron (2021) writes that firsting is "the process through which a scholar presents an act, circumstance or phenomenon generated by man *[sic]*, or accomplishment to have occurred for

the first time" (2017: 109; cited in Liboiron 2021). Liboiron asks their students *why is being first a mark of good research?* a question to which they "reliably" answer "it marks my territory" (2021). This reminder of the territorial dynamics of knowledge making is appropriate for a term like 'anthropocene', critiqued for its own firsting, the way its epoch-defining hubris already contains erasure (de la Cadena 2015; Davis and Todd 2017; Demos 2017; Neal, Addison, and Phan 2022). Indeed, the proliferating array of counter-logisms—Capitalocene, Plantationocene, Chthulucene, Antropo-not-seen, Necrocene, Military-Industrialocene, proliterocene—evidence both the many erasures resident within the term's conceptual ambit and various efforts at critical firsting. And while each of these counter terms is situated within its own history of critique, what they do share is a desire to index and re-center a particular absence or elision, be it the logics of extraction, the institution of slavery, multi-species interconnectivity, mass extinction, or even the industrial war machine. Our aim with this special issue, then, is not to find a particular critical perch from which to *rename* this problematically *singular* term, but neither is it to vivify it, nor its conjunction with the digital. Hence our more tentative choice of the adjective *approaching.* This is less a hedge than a refusal to claim the conjunction as new ground or territory. Instead, approaching signals a means of charting the difficult course through terminological histories and erasures. At the same time, that which is being approached is far from a singular phenomenon. To approach—using double vision as method—allows for pluralization: the somewhat disorientating perspective attained from seeing simultaneously as scholars map and articulate the möbius loops of their fields, opens up for the possibility of *digital-anthropocenes*. Pluralizing, in this sense, is a means of intervening in the various asymmetries that come alongside the politics of singularization. Take, for example, the troubling issue of how to juxtapose (what is articulated as) planetary concerns alongside (what is articulated as) locally, and as such, differentially experienced planetary effects. How to bring the politics of scale and the politics of singularization into relation is the methodological challenge here (Marres 2023: 983–84); disorientating indeed. For us, adopting double vision is less a way to solve this tension and more a way to signal an ethnographic and analytical point of entry to this challenge by being attentive to the *scales* and *politics that emerge from the fieldsites of* our contributors. In this collection, these contributors invite us into their respective fieldsites through modes of analysis that draw our analytic attention to these very scales and forms of politics.

Each of the four articles offers different empirical instances of approaching digital anthropocenes. Not only the various forms of data politics that are embedded within contemporary environmental issues. Nor merely the geologic politics embedded within digital

technologies. More extensively, each article provokes the possibility of an alternate politics that are revealed and generated at specific digital-anthropocene folds. Through sensing, governing, intervening, and speculating, the articles reveal a particular colonial legacy that provokes an alternate form of politics (proto, limit, civic, and pre-figurative). What is revealed in each case, we claim, is the legacy of a colonial infrastructure that whilst saturated in forms of technological inequality and injustice also affords a counter political re-imagining through digital mediations.

In *Sensing in and Beyond the Digital Anthropocene*, Saadia Mirza introduces us to remote discovery archaeologists—a branch of archaeology that deploys digital remote sensing to document physically and politically vulnerable and threatened landscapes. Reflecting on her observations and own training in this field, Mirza produces a visual ethnographic exploration of remotely sensed images of some of the most conflicted landscapes in the US-led War in Afghanistan (between 2010-2014). Here, sensing technologies deployed by research archaeologists are appropriated by the war machine, producing a Eurocentric gaze that seeks to create structure in what it perceives as 'chaotic'. These computationally mediated images are products of colonial pasts and war-torn presents, but they are also "not only" (de la Cadena 2015: 3). Such images, Mirza argues, hold the potential to open new spaces of storytelling in such landscapes. Ethnographic sensitivity to computation, digital cartography, and modelling also allows room for speculation and counter-narratives. Sensing technologies not only afford new ways of seeing and knowing these landscapes, they also provoke, in our reading, a *proto politics* through which the legacies of colonial military interventions are made otherwise. The prefix *proto,* for us, refers to the means through which computationally derived interventions—transduction and liminality for Mirza—both critique and make anew.

Opening her contribution *The Limits to Computational Growth*, Sarah Vaughn takes us into her meeting with Albert Jones, a meteorology instrument technician whose job it is to improve how data is collected and stored, to increase its usefulness as a resource for the Caribbean Community Center for Climate Change (5C). For Vaughn, a digital database is not merely a technical artifact, it is also a cultural one with world-making potentials. In an intriguing reading of colonial techno-scientific legacies, Vaughn points to her interlocutors'—a group of IT experts and coders charged with developing 5C's climate database—'cry for more data.' Riffing off the idiom of the 'limits to growth' critique, Vaughn postulates a set of 'limits to computational growth' that these experts are daily confronted with. Whether it is a generic lack of data, or an over production of data from sites connected to the tourist gaze (airport weather sensors, for example), or even how these experts actively manage, and in essence *shrink,* their

data sets to avoid being subject to the whims of international donor nations, Vaughn demonstrates Caribbean experts continually seeking to overcome such colonial data legacies in order to provide more effective data for climate mitigation and adaptation strategies. Here, we read Vaughn as describing a type of *limit-politics*, one where limits do not "automatically inspire paralysis", but can also "provoke action" (2023: 9). Through these limits an interesting set of conditions emerge for IT experts to both grapple with the data legacies of their colonial past, whilst re-imagining their climate data in highly uncertain futures.

In *Repairing the Anthropocene: Toward Civic Validity for Environmental Data Justice* Lourdes Vera takes us to the fracking landscapes of Texas, where issues of public and ecological health are at the forefront. Vera combines ethnographic and Environmental Data Justice approaches to explore both the harms produced by fracking on a local community and how they use data to understand and communicate their exposure experiences. State monitoring and regulatory systems do not recognize these experiences as dangerous, and thus 'legibility' and 'validity' are core concepts that Vera mobilizes to make sense of the contrasting ways in which the state and residents mobilize data to support their interests and concerns. Vera suggests "civic validity" as a concept that holds the potential to integrate vernacular ways of experiencing and monitoring toxicity. A new form of civically validated Environmental Data Justice is thus co-created, in which scientific and community modes of sensing and knowing come together. This intervention provokes a *civic politics,* understood as the ways in which localized concerns are mobilized in collective actions and brought to challenge regulatory scientific legacies.

Finally, we turn the conversation towards speculation, as Maguire, Clarke, and Seyfried bring us into the world of *Grow Your Own Cloud (GYOC)*, a speculative design intervention in the realm of DNA storage technologies. The dialogue between the authors opens us up to a disorienting multitude of possibilities created by thinking through the relationship between digital data and DNA. Taking us through two speculative prototypes, the founders of GYOC draw the contours of a speculative world in which flowers and gardens become the environmental forms through which digital data is translated and stored as DNA acids. Looking to re-imagine data-climate relationships through a more than human design frame, GYOC journeys from more classic design prototyping towards an art-science based intervention at the edge of developments within synthetic biology. For us, such speculating both reveals a myriad of ethical questions around Big-Tech data legacies, whilst provoking a *prefigurative-politics* that opens up to a world of nascent eco-tech relations.

Conclusion

As a set of problems to grapple with, digital anthropocenes belong to many disciplines, some of which we have drawn into our conversation above. For anthropologists and STS scholars working ethnographically (and with the inheritances of those schools of thought), there are forms of doubling, dazzle, folding and co-imbrication that can be difficult to keep track of. Our introduction has not sought to organize the terrain into categories, nor add the concerns of one to the other, but to offer one term as the lens through which to look upon the other—a doubling that perhaps loses some familiar reference points as it pushes us to make new alliances, connections, seeking out digital anthropocenes as they are done in practice. Through accounts of sensing, governing, intervening, and speculating, each of the articles in this special issue offers its own instance for thinking through the term digital anthropocenes to ask, "what futures are possible" (Murphy 2022: 48). Drawing upon double vision as a backdrop to these texts means necessarily exceeding the visual and embracing its Möbius-like capacities. Double vision quite literally disorients: it offers us a form of perception ideally suited to a time of shifting grounds and powerful concepts with strong claims—and effects—in the world. Our critical response is to *be* disoriented, to not impose an order on the worlds we study but seek out connections and unexpected openings at the folds of the digital and the anthropocene.

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