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Practicing environmental data justice: From DataRescue to Data Together

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*The authors are all a part of Environmental Data & Governance Initiative (EDGI), a fundamentally collaborative organisation discussed in this commentary, whose practices and activities would not be possible without the coordinated efforts of all our members.

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The Environmental Data and Governance Initiative (EDGI) formed in response to the 2016 US elections and the resulting political shifts which created widespread public concern about the future integrity of US environmental agencies and policy. As a distributed, consensus-based organisation, EDGI has worked to document, contextualise, and analyse changes to environmental data and governance practices in the US. One project EDGI has undertaken is the grassroots archiving of government environmental data sets through our involvement with the DataRescue movement. However, over the past year, our focus has shifted from saving environmental data to a broader project of rethinking the infrastructures required for community stewardship of data: Data Together. Through this project, EDGI seeks to make data more accessible and environmental decision-making more accountable through new social and technical infrastructures. The shift from DataRescue to Data Together exemplifies EDGI's ongoing attempts to put an "environmental data justice" prioritising community self-determination into practice. By drawing on environmental justice, critical GIS, critical data studies, and emerging data justice scholarship, EDGI hopes to inform our ongoing engagement in projects that seek to enact alternative futures for data stewardship.

KEYWORDS
data activism, decentralised web, environmental data justice, Trump administration, web archiving

1 | INTRODUCTION

Political shifts within the US government since the 2016 elections have threatened the integrity of federal environmental agencies and environmental policy. A series of Executive Orders by President Trump (Davenport & Rubin, 2017; Greshko et al., 2017) and the appointment of Scott Pruitt as US Environmental Protection Agency (EPA) Administrator have led to the reversal of a ban on a neurotoxic pesticide, a proposal to rescind Obama's Clean Power Plan, and cuts to important environmental programs – most notably those that protect minorities and vulnerable populations (Eilperin & Dennis, 2017; Lipton, 2017; Paris et al., 2017). These political shifts raise questions about the value and integrity of environmental information, including concerns about public access to data and continuity of data collection, especially in cases where important environmental research programmes are threatened by US federal budget cuts.

The Environmental Data and Governance Initiative (EDGI) is a consensus-based, geographically distributed organisation of academics, professionals, and organisers formed in response to these political challenges in November 2016 (Knutson et al., 2018). Since then, EDGI has worked to document, contextualise and analyse changes to environmental data and

governance practices in the US. Our projects include archiving data sets, interviewing EPA and Occupational Safety and Health Administration (OSHA) employees about conditions inside those agencies, and monitoring federal environmental agency websites for changes in access and content. EDGI has developed protocols and a web platform called Scanner in order to enable analysts to track and characterise website alterations, including language changes and access reductions in climate-related content (EDGI Website Monitoring Committee 2017a; 2017b). EDGI has also written "rapid response research"[1] papers on how the EPA is being undermined, current threats to environmental justice, and the Trump administration's pattern of removing or altering important web-based environmental information and resources (DiCamillo, 2017; Dillon et al., 2017; Paris et al., 2017; Rinberg et al., 2018; Sellers et al., 2017; Underhill et al., 2017).

In this paper, we reflect on the changing nature of EDGI's grassroots data archiving work: from a project to "save" government environmental data to a broader project of rethinking the infrastructures required for community stewardship of data. In this commentary we focus on data set archiving rather than ongoing website monitoring. However, we recognise the two are intimately linked. We describe the DataRescue movement, which began in December 2016 at a "Guerilla Archiving" event hosted by the Technoscience Research Unit (TRU) at the University of Toronto. As crucial as DataRescue has been for raising awareness about the vulnerability of government data, it also raised questions for us about the politics of data and data stewardship. The focus on *saving* existing data meant that DataRescue events did not address broader questions of how and why these particular data are collected by federal agencies in the first place. Taking these concerns seriously led us to rethink our approach going forward and ask: how can we build the social and technical infrastructures to make data and decision-making more accessible and accountable?

We draw inspiration from environmental justice (EJ), critical GIS, and critical data studies scholars and organisers concerned with the politics of representation and knowledge in order to frame our preliminary thoughts on "environmental data justice" (EDJ; Dillon et al., 2017). These areas of scholarship demonstrate how data are embedded in historical, political, economic and social contexts, and outline counter infrastructures and tactics which have sought to use data to enact alternatives. Informed by these countering moves, we make the case for connecting the emerging framework of "data justice" to EJ in order to enact more equitable alternative futures. We conclude by reflecting on our role in the early stages of Data Together, a project EDGI is undertaking with qri.io and Protocol Labs, formed in part out of our involvement in DataRescue (EDGI 2017d). Using our discussions of EDJ, we identify active tensions in the ongoing Data Together initiatives, which include the creation of an open source prototype for decentralised archiving of web pages and data sets.

2 | GRASSROOTS DATA RESCUE

In the aftermath of the 2016 US presidential election, there was widespread public concern that the Trump administration would seek to eliminate or alter web pages and data sets, given the actions of the Bush administration to hinder access to chemical safety data after 9/11 (Dahl, 2004), and the Harper government's actions against scientists in Canada (Rapp Learn, 2017). Mobilising quickly, local organisers hosted 49 DataRescue events to archive US federal environmental web pages and data sets in cities across the US and Canada between December 2016 and June 2017 with support from EDGI and the DataRefuge project at the University of Pennsylvania. The first of these public "Guerilla Archiving" events was held on 17 December 2016 at the University of Toronto, organised by the TRU and EDGI (Figure 1). At that event more than 150 scholars, students, technologists, and activists gathered to nominate key data sets for inclusion in the Internet Archive's Wayback Machine. The Internet Archive is a non-profit digital library and creator of the Wayback Machine, a browser-based application that can play back snapshots from different moments of the Archive's more than 308 billion preserved web pages (Internet Archive 2017; Wayback Machine 2017). The University of Toronto event also sought to strategise how to deal with links and data sets that would not be preserved through available automated methods.

Over the course of 49 events, DataRescue attendees nominated over 63,076 web pages as "seeds" using a custom browser extension developed prior to the first event (EDGI 2017b). In addition, more than 22,000 data sets were identified as candidates for non-automated preservation. Several hundred of these were "harvested" through a workflow developed by EDGI and the Data Refuge project, and uploaded to the DataRefuge repository (DataRefuge 2017). One criterion in identifying which data sets and web pages to archive was their importance to EJ activism, in particular data sets that provide a "user friendly" interface to understanding the prevalence of toxicants in communities. For example, early on we archived the EPA's Enforcement and Compliance History Online (ECHO) portal, which collates industry emissions and regulatory actions data (EPA ECHO 2018).

When DataRescue participants nominated pages as seeds, they were instructing the Internet Archive to save a copy of that specific page, and also to start "crawling," or systematically visiting web pages and following links, making copies of

FIGURE 1   Attendees at the "Guerilla Archiving" event organized by the TRU and EDGI at the University of Toronto. Photo: Geoffrey Vendeville.

intermediate pages along the way (Goel, 2016).[2] However, crawler software (including the Internet Archive's Heritrix) is not able to fully archive and discover links to data sets and web pages on all sites, partly because of the underlying web technologies and internet infrastructure, and partly because of resource and storage constraints. Heritrix in particular will overlook websites with user-initiated interactive content or websites that are highly dynamic; as a result not everything is discovered or meaningfully archived (EDGI n.d.).[3] This means web pages including the EPA Pesticide Chemical Search (PCS), which provides information and access to data on chemicals only after queries are submitted by Chemical Name or CAS Number/PC Code, would not be meaningfully archived (EPA PCS 2018). At many events, attendees developed custom solutions in cases like this to "scrape," or extract, links and data sets that the crawler would likely not automatically process. To aid in this process, EDGI members created a toolkit to support local organisers, a categorisation system for federal agency sites to coordinate across events, and scripts for custom scraping solutions (EDGI 2017c). The evolving workflow developed with the DataRefuge project addressed "chain of custody" and metadata considerations, seeking to provide verification (and citability) for these community-preserved data sets if the originals were no longer accessible (DataRescue Workflow 2017).

In many ways, EDGI's early archiving work represented a response to a crisis as we rapidly prepared for worst case scenarios. Thousands of people connected at DataRescue events over a shared concern about threats to environmental and climate data at DataRescue events. By trying to *save* existing data, however, DataRescue events ultimately did not address broader questions about why federal agencies collected these data in the first place and how they currently use them. Further, EDGI's archiving neither accounted for the scale of the data, nor the ongoing and complex kinds of technical and policy considerations that their digital preservation and stewardship involves. Reflecting on the social and technical impossibilities of what DataRescue attempted, legal professor and librarian as well as EDGI member Sarah Lamdan notes

the gaps in existing federal records laws, notably the Federal Records Act, which were drafted prior to the invention of the internet despite the fact that most government information today is "born digital" (Lamdan, 2018).

We regrouped around these concerns at an online DataRescue Town Hall on 1 April 2017, where we celebrated our shared accomplishments, identified challenges, and heard feedback from event organisers. Within EDGI, we reflected collectively about our role in facilitating these events as well as possibilities for any broader movement going forward. By setting our sights on US environmental and climate data across federal agencies, we had defined a project large enough to get lost in. Approaching a large-scale and distributed project meant there was no easy way to determine when we would be done. We could not look at a single catalogue and identify all the federally published data – even a seemingly comprehensive catalogue like data.gov is incomplete (Harmon, 2017). Finally, we recognised our archiving workflow required a large amount of continued participation to balance efforts from those with interest (enthusiasm) and those with domain expertise. These hard-earned, but invaluable, lessons inform our emerging EDJ working group, development of the Scanner platform for website monitoring, and our involvement in the Data Together partnership (EDGI, 2017d).

Environmental Data and Governance Initiative begins from the position that data are not inherently good, or even neutral (EDGI 2017e), and yet our initial work in DataRescue did not necessarily reflect this commitment. During the coordinated rescuing of data we found it difficult to continue our previous critiques of the politics of data collection and stewardship in which we would ask how those data had originally been collected, how they had been used to advance agencies' interests, or how they might be made use of by different publics. Taking these concerns seriously led us to rethink our work and to develop a set of practices we term EDJ, which centre on providing just access to, interpretation of, and control of data as important goals both in and of themselves and as means to broader socio-environmental transformations. As EDGI moves from DataRescue to Data Together, we seek to bring scholarship on EJ, critical GIS, critical data studies, and data justice together in productive conversation through the framework and practices of EDJ.

3 | CRITICAL INTERVENTIONS ON DATA

Environmental justice scholars and organisers have grappled with the politics of environmental data for decades. They have challenged exclusions from environmental knowledge production, asking who gets to collect authoritative environmental data, and through what process. They have also produced alternative forms of environmental data, since most information about pollution in the US is industry self-reported or reliant on inadequate or incomplete collection methods (Agyeman et al., 2016; Altman et al., 2008; Brown, 1992; Corburn, 2005; Ottinger, 2013; Saxton, 2015; Shapiro et al., 2017). As one example, in the 1990s, organisers from a neighbourhood on the border of a Shell chemical facility in Louisiana developed a low-cost method of air quality monitoring, called "air buckets." They did so because they discovered that the state – which had declared Shell Chemical's air quality emissions "safe"– was relying on inadequate data on the air they breathed (Allen, 2003; Lerner, 2005; Ottinger, 2010). The state was collecting data on the average of toxic chemicals over long 24-hour periods, and comparing these to ambient air standards. Louisiana organisers—who called themselves the Louisiana Bucket Brigades – argued that these averages flattened out short-term spikes in air pollution levels, and therefore obscured the moments they were most at risk. Instead, the Bucket Brigade used bucket sampling to rapidly collect data on air quality during these moments of peak emissions. In doing so, they demonstrated the capacity of fence-line communities to produce scientific knowledge about air quality and improve environmental decision-making. Through these and other campaigns, EJ advocates have questioned "what counts as data, what data are collected, and whose interests do they serve?" (Dillon et al., 2017, p. 1; Warren & Dosemagen, 2011).

Environmental justice advocacy in the US parallels a history of similar efforts around the world, questioning "what counts as data" and creating alternative data. For instance, citizen science and public data were prioritised as global issues in the Agenda 21 portion of the 1992 Rio Conference, where leaders declared that "in sustainable development, everyone is a user and provider of information considered in the broad sense" (Haklay, 1999, p. 6). This tenet of sustainable development, codified at Rio, reflects earlier programmes that were concerned with making data accessible, if not also interpretable. In the 1970s, the UN Environment Programme developed some of the first mechanisms for distributing global environmental data to researchers (e.g., Infoterra; Haklay, 1999). DataRescue and Data Together have precedents in the 40-year history of such environmental information systems (EIS), broadly interpreted as "collection[s] of data sets and information that have some relevance for the study and/or monitoring and/or exploration of the environment" (Haklay, 1999; 1; Fortun, 2004; Haklay, 2003; Sieber, 2000). Some of what we archived at DataRescue events were EIS themselves, such as ECHO.

Geographers have navigated the perils and promise of data through critical GIS and critical data studies. Raising questions about the politics of knowledge similar to those of EJ advocates, critical GIS researchers confront the ethical and

power dimensions of data representation by asking who gets to map and be mapped (Rambaldi et al., 2006; Schuurman, 2000; Thatcher, Bergmann et al., 2016). For instance, scholars have discussed how new geoweb mapping software potentially realigns expertise in transformative ways through forms of "witnessing, peer verification, and transparency" that differ from institutional science (Elwood & Leszczynski, 2013, p. 1). However, researchers have also documented the gendering (Stephens, 2013) and racialisation (Crutcher & Zook, 2009) of access to and the production of these new geospatial data. Critical data studies explain how such "big" data are embedded in historical, political and economic power structures (boyd & Crawford, 2012; Dalton & Thatcher, 2014; Iliadis & Russo, 2016); for instance, by showing data can be exploitative – enrolled in projects of surveillance (Amoore, 2009) and capital accumulation (Thatcher, O'Sullivan & Mahmoudi, 2016).

Seeking to counter these harms, critical data studies and critical GIS scholars advocate for "counter-data" and "counter-mapping" tactics as part of "imagining radical politics with and against data" (Burns et al., 2018, p. 2). They charge designers to become aware of the historical contexts they operate within (Fortun et al., 2016) and design reflexively in order to advance EJ (Gabrys et al., 2016; Moore et al., 2017). Researchers have developed feminist and qualitative approaches to traditionally positivist uses of GIS (D'Ignazio & Klein, 2016; Kwan & Knigge, 2006) and engaged in collaborative mapping with communities (Elwood, 2006; Wilson, 2015).

In line with critical counter-data and counter-mapping approaches, data justice scholars have called for rethinking data studies within a social justice framework. Multi-disciplinary research has emphasised the disciplining aspects of data through surveillance constraining social movements (Dencik et al., 2016), data-driven governance entrenching power asymmetries (Johnson, 2014), and data technologies making the poor visible (Heeks & Renken, 2016). Taylor (2017) calls for establishing a common direction in future data justice research to account for how data can lead to discrimination, discipline and control; acknowledge both the positive and negative possibilities of data; and apply across social contexts. While these conceptualisations of data justice are preliminary, they situate data within structural power relations and promote putting those understandings into practice (Our Data Bodies 2017).

This scholarship has developed alongside long-standing "digital justice" advocacy examining the relationship between datafication and social justice. The Detroit Digital Justice Coalition (DDJC), for instance, has developed principles of equal access, participation from marginalised voices, common ownership of digital tools, and healthy communities (DDJC 2009). DDJC members put these principles into practice through projects that directly engage with pressing issues: promoting equitable open data guidelines (DCTP 2017); hosting community-led DiscoTechs, or "Discovering Technology" workshops, to introduce both the impacts and possibilities of new technology; and producing zines to present communication and information rights in an accessible format (DDJC 2017). This group puts shared understanding, just access to, and control of, data at the core of addressing broader social justice questions.

Our own organisation, EDGI, formed out of a need to respond to changes in environmental data and governance practices in the US. Reflecting on our early engagements highlighted the limitations of solely rescuing data and have turned our focus to understanding what EJ, critical GIS, critical data studies, and data justice bring to our current projects. We believe understanding environmental dispossession today requires foregrounding concerns about evidence in order to illustrate how environmental data are collected and how they are made accessible or "open," interpretable and usable (or not) (Dillon et al., 2017). The EJ literature has not yet taken up questions about environmental data infrastructure and stewardship. Data justice scholarship can develop and strengthen existing questions in the field; providing frameworks to assess the discriminatory and uneven impacts of data collection as well as new concepts like "data harms" and "automated inequality" (Eubanks, 2018). At the same time, insights from the EJ literature may prove useful to data justice scholarship, showing how data can be a part of envisioning and enacting alternative futures, not just perpetuating harms and injustice. The opportunity of this *environmental* data justice is that advocates do not have to solely adopt a reactive posture to data.

In earlier writing we provisionally defined EDJ as involving:

> Community-based environmental data collection, public (especially online) accessibility of environmental data, and environmental data platforms supported by an open source online infrastructure—in particular, one that can be used and modified by local communities. (Dillon et al., 2017, p. 2)

This definition prioritises community self-determination in data collection, access and interpretation, even if communities may decide to privately hold data that represent them. In short, EDJ aims to "responsibilize the state, corporations, and polluters for their practices" (EDGI 2017a) yet at its horizon are "alternative futures and not just reactive counter knowledges" (EDGI, 2017e). For us, environmental data justice provides a bridge between data justice, which emphasises the disciplining power of data, and EJ, which troubles who data serves, providing a way of seeing data not just as a counter-tactic but as part of a tactic for envisioning alternative futures.

4 | ENGAGING IN ENVIRONMENTAL DATA JUSTICE THROUGH DATA TOGETHER

As EDGI has begun to articulate an EDJ framework we have been asking ourselves how we can animate it through practice. Interest in EDJ has translated into a standalone working group within EDGI, yet the concept is evident across our efforts. For example, EDGI members applied an EDJ framework to contextualise our own use of data in reports on the first 100 days of the Trump administration (Paris et al., 2017; Sellers et al., 2017), and to engage with novel forms of data stewardship via Data Together. Data Together currently exists as a partnership between EDGI, Protocol Labs – a company building open source protocols, systems and technologies to address how information on the internet is stored, located, and moved – and qri.io, a data science company developing data set research tools on the distributed web (Data Together 2017). Data Together initiatives include public engagement through in-person events (Figure 2), topical roundtable conversations through online webinars, and development of an open source prototype for decentralised archiving of web pages and data sets (Figure 3).[4]

The Data Together partnership grew out of conversations between DataRescue volunteers about the shaping effect existing web technologies and internet infrastructure have on models of environmental data stewardship (Baker & Yarmey, 2009), in concert with existing data preservation and governance policies (Rosenbaum, 2010). Responding to the shifting landscape of repositories and information-sharing practices, librarians and archivists have put forward "post-custodial stewardship" as a paradigm that re-positions traditional cultural institutions as collaborators alongside non-state or non-institutional repositories within a cultural heritage ecosystem (Abrams, 2017; Kelleher, 2017). There are also existing software
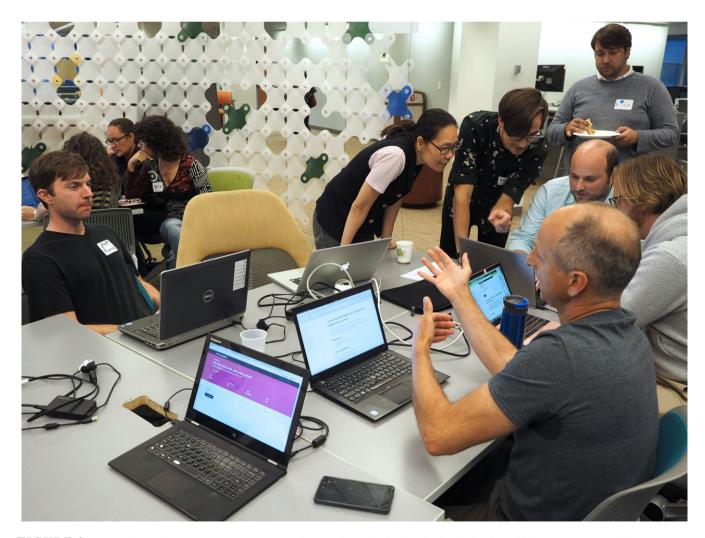

FIGURE 2 Discussion during the Data Together track of the EDGI at 4S (Society for Social Studies of Science) event hosted in Boston, MA in August 2017. Photo CC BY-SA 4.0 Mike Hucka.

FIGURE 3 Screenshot of an EPA data set collection hosted on a Data Together node.

precedents, including the open source, library-based digital preservation system LOCKSS, which stands for "lots of copies keep stuff safe" and relies on distributed and redundant storage for electronic records (Stanford University n.d.). Along with these examples we remain mindful of the lessons from long-standing grassroots community archiving projects which engage in powerful forms of re-examining histories, and speak to the need for communities being archived to participate in their archiving (Flinn, 2011; Wakimoto et al., 2013). As a result, we have an interest in exploring whether new technologies can re-frame stewardship and enable communities to hold copies of data that represent them, that are used in decision-making about them, or that they otherwise care about.

One of the core components of the Data Together prototype is its use of InterPlanetary File System (IPFS), a decentralised and peer-to-peer protocol that enables storage and retrieval of resources based on their content (Benet, 2017). Whereas most forms of storage are location addressed – the location of the resource, often represented by a URL, is used to retrieve it – content-addressed storage relies upon *the content itself* in order to access resources. Instead of finding (or not!) an air quality data set at the URL and server it was published to (e.g., https://www.example.com/airquality/data.csv), when that same data set is added to an IPFS node, a copy is made available on that machine that any user can retrieve from a network of peers who have a copy. One way to retrieve a data set on IPFS is by using your browser to visit an IPFS gateway to access that data set using its unique signature, or cryptographic hash (e.g., https://ipfs.io/ipfs/<hash>). Content addressing has significant trade-offs from human-readable identifiers, while it provides verifiable version control, each new version of the data set will generate a new hash based on any changes and is located with that new address. IPFS attempts to mitigate this through a decentralised naming system called IPNS, which uses the unique identity of the peer who hosts the data set to provide a persistent way to access the most recent version. With IPFS, the act of retrieving content becomes the same as hosting a copy. When more people access the data, its hosting becomes more distributed.

If taken up at broad scale, this technology could restructure how information is accessed and distributed globally on the internet. However, the use of IPFS poses questions about long-term data availability. Large, infrequently used, or specialised data sets (which arguably would cover environmental data sets), may not be frequently replicated and, as a result, less available without concerted intervention. However, with data sets in the hands of a community of users, an environmental regulator or corporation would be unable to simply remove data from a server and have it disappear. Further, if the data are altered by either the original publisher or a later user, the unique hash provides a durable mechanism for verifying

the intended data sets remain available. Peer retrieval potentially provides a way for the state and industry to be held accountable for providing persistent access to existing data. It does so by providing tools for verifying alterations, yet it also suggests potential counter-infrastructures where data sets can be held in common by coordinated peers.

Protocol Labs has been the core developer of IPFS and qri.io relies on IPFS to power their analysis and annotation tools. EDGI does not provide the technical capacity for Data Together; instead, we bring our background in EJ and commitment to EDJ to ground experiments in praxis—through an environmental governance and justice use case that connects the development of these technologies to the concerns emerging directly from our grassroots data archiving efforts. In DataRescue, we faced the difficulty of simultaneously acting to save important environmental data, while questioning the limits of data-oriented governance. Likewise, in Data Together we have found a tension in "making" new data infrastructures while also preventing technologically determinist narratives from overwhelming our approach. We tend towards scepticism of grand claims that "opening" internet infrastructures will solve all of our problems, yet see the importance of engaging with experimental alternatives. Informed by EJ, critical GIS, critical data studies, and data justice scholarship we have been probing *how* a broader range of people can archive, *who* controls and stewards any archive, and *where* the archive is constituted given decentralised web infrastructures.

Our engagement is timely as a growing and diverse range of civil society voices raise concern over new risks posed by centralised platforms (e.g., Google, Apple, and Amazon) and the "walled gardens" of social media (e.g., Facebook, Instagram, and WhatsApp; Finley, 2017; Kahle, 2015). In 2017 Mozilla Labs launched their first Internet Health Report documenting aspects of a "healthy" internet ecosystem: open innovation, digital inclusion, decentralisation, privacy and security, and web literacy (Mozilla 2017). In addition a mix of policy, social, and technical interventions strive to transition from the mass communication and internet infrastructure that currently exists: community and alternative networks framed as "build your own internet" and focused on local resiliency and autonomy; movements including indie web and re-decentralise, which build communities of practice around alternative web applications; technologies such as blockchains, a form of distributed ledger that powers cryptocurrencies including BitCoin and Ethereum; and new protocols for distributed storage including the Dat project and IPFS. However, these examples of web decentralisation from across the Internet, as well as Data Together itself, are not panaceas. They come with their own tensions and contradictions.

Below, we reflect on challenges and unresolved tensions in Data Together and how we have approached them through EDJ as informed by EJ, critical GIS and critical data studies as well as other scholarship in human geography. Reflection and engagement with critical scholarship provides us early insight into those questions of *how*, *who* and *where* posed above, surfacing underlying assumptions inherent in decentralisation, avoiding uncritical adoption of a participatory or community-oriented approach, and acknowledging the materiality of these new infrastructures.

The concept of decentralised (or distributed) networks owes its popularisation to Paul Baran, whose work with RAND Corporation during the Cold War focused on introducing redundancy in networks so that they could survive potential nuclear attacks (Baran, 1964; Rosenzweig, 1998). While the concept proved popular in the intervening years, the efficacy of these forms of decentralisation has been debated (Barabas et al., 2017) and critical scholarship has investigated how power and control still function through non-centralised protocols (Chun, 2011; Galloway, 2006). Geography's engagement with questions of scale provides a further provocation to the concept of decentralisation, cautioning against both falling into "the local trap" of unduly privileging decentralised networks (Born & Purcell, 2006) and missing how power operates within as well as across scale (McCarthy, 2005; Swyngedouw & Heynen, 2003). We must continually trouble assumptions that decentralised data stewardship, as in Data Together, will automatically prove just. We should also consider how the state and industry may respond with their own rescaling of data.

Within Data Together we have taken up questions around coordinated archiving of data sets by decentralised peers, seeing potential alignment with forms of community-based environmental data collection. The term "community" has been evoked for a variety of forms of collective action, matching a recent participatory turn across disciplines (Marres, 2012; Sieber, 2006; Vines et al., 2013). But as with "the local" or "decentralisation," social theorists note the danger of not carefully unpacking the ways that a pro-community or participatory framing avoids important questions of power within groups and across place (Rocheleau et al., 1996; Sultana, 2009). Thus, as Data Together asks how communities can hold copies of data that represent them or that are used in decision-making about them, we also keep open the question of what community *means*, and how it might work in exclusionary or homogenising ways.

Data Together has not yet adequately engaged with the relationship of decentralised archiving to existing institutions, especially in light of the role they play for the public. For instance, decentralising archival practices could unintentionally undermine the legal requirements and responsibility on the federal government and institutions to responsibly collect and maintain the accessibility of data sets and government records. The Federal Records Act does not currently mandate the preservation of online access, meaning that records can be from ".gov" websites as long as paper copies or offline

electronic iterations exist somewhere (Lamdan, 2018). Further, federal agencies require continued funding to ensure continuity of data collection. As a result, under-funding has been a tactic employed to prevent the creation of environmental and climate data, as seen in the current Trump administration recently cut NASA research on greenhouse gas emissions (Voosen, 2018). Shifting to decentralised approaches reframes the public pressure the federal government and institutions face to reform current practices, and could place an undue burden on communities and organisations that do not have the capacity to archive or collect the immense amount of data generated by the government. As Data Together continues to engage in community-oriented archiving, we need to consider the existing *roles* institutions play and whether and how they could move forward to complement decentralised approaches which recognise and respond to the imperfect world in which we live.

Finally, Data Together proposes the coordinated distribution of data sets and other resources at the peer or node scale of the internet. Despite the shift in scale, decentralisation evokes something akin to the ethereal discourses of "cloud computing." The reality is that any shift in scale will have material ramifications that must be accounted for. For instance, we have seen how distributed and peer-to-peer technologies (e.g. Bitcoin's blockchain) have had significant environmental costs through electrical usage (Lee, 2017). Scholarly engagement with infrastructure and material culture has prioritised the study of objects and relations that constitute the current internet, revealing a geography of fibre-optic cables (Starosielski, 2015), data centres (Burrington, 2016; Pickren, 2016), and the electromagnetic spectrum (Wong & Jackson, 2015). Calling attention to these "hidden" infrastructures, scholars have developed infrastructural frameworks and inversions for tackling the "taken-for-granted" of invisible labour and complex problems (Bowker & Star, 2000; Bowker et al., 2009). Moving forward with Data Together, we look to explore what emerges through foregrounding the materiality of data infrastructure, especially its invisible labour and environmental costs.

As Data Together engages with questions about what it means for a broader range of people to archive, who has control over the archive, and the materiality of the archive, we anticipate bringing EDJ further into conversation with data justice. Doing so will inform our continued reflection on the role decentralisation plays in counter-infrastructures that prioritise community self-determination in data collection, access, stewardship and interpretation.

5 | CONCLUSION

Environmental Data and Governance Initiative's grassroots data-archiving work has progressed from a stance of saving data to one of reflexively engaging in an attempt to create an alternative social and technical infrastructure for data stewardship. The DataRescue movement raised important questions about data infrastructures and the politics of data that mirror those posed by EJ, critical GIS, and critical data studies scholarship. In seeking to understand how these literatures have confronted the challenge of making data serve progressive ends, this paper highlights these areas as jumping off points, but argues for their connection through a framework of EDJ informed by data justice. For us, EDJ sits at the intersection of (1) emerging critical data studies and data justice concerns that emphasise the disciplining effect of data surveillance and the need to "thicken" or contextualise data; and (2) EJ research and advocacy that place dispossessed communities at the centre of defining and resisting injustices but in ways that do not pathologise them as "damaged" (Tuck, 2009), and which highlight how the *lack* of, or inconsistencies in, environmental monitoring and data collection themselves can represent injustices.

Throughout this commentary we have reflected on challenges and unresolved tensions in one aspect of EDGI's work, Data Together, and suggested how our awareness of them has been informed by this notion of EDJ. As we continue to address questions of a broader range of people archiving, control over the archive, and the materiality of the archive through Data Together, we see EJ, critical GIS and critical data studies as well as other scholarship in human geography contributing to our countering of the "taken-for-granted" and envisioning more equitable alternate futures.

To challenge (environmental) injustice today, the question of data must be addressed, both to recognise how data enable that injustice and how data could be used by communities to name and contest it. As we continue to weave EDJ throughout EDGI's activities, we call on scholars to join us in collaborative explorations around EDJ and continued reflection on the origins, maintenance and transformative potential of data in their own work.

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NOTES

[1] In our use of the term "Rapid Response Research" we are extending the National Science Foundation's classification in proposal guidelines (National Science Foundation n.d.).

[2] In addition to regular crawling of the entire web, the Internet Archive offers Archive-It, a customisable subscription service used by over 400 institutions (including libraries, archives and museums), and runs "End of Term" crawls in order to preserve a snapshot of US government websites (including those ending in .gov and .mil) that are likely to change during the transition to a new administration (Archive-It 2017; End of Term Web Archive 2016).

[3] Heritrix does not have a fully featured browser with a JavaScript interpreter and page model (called a "DOM" or Document Object Model), and by default it does not complete web forms or log into a site and only collects material accessible through Hypertext Transfer Protocol (HTTP/ HTTPS), File Transfer Protocol (FTP), and Domain Name System (DNS). This limits the discovery of links on sites relying upon Asynchronous Javascript and XML (AJAX) to complete background operations and partial page refreshes (Heritrix FAQs 2013).

[4] The fact that Protocol Labs and qri.io are commercial actors raises some concern in light of ongoing trends towards the privatisation of knowledge (Mirowski, 2011). Commercialised data infrastructures mean that the direction of tech development – and therefore, the features of many of the current tools at our disposal – is set by private companies (Eghbal, 2016). Commercialisation is also problematic because it focuses capacity within private entities, when startups fail or are bought out, resources that communities were counting on may not remain available. We believe these issues are part of an important but ongoing conversation. For now, we note that the issue of data loss due to its centralisation in one actor (commercial or otherwise) is exactly what Data Together is meant to address.

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