



# Data Usability: The Forgotten Segment of Environmental Data Workflows

Shannon Dosemagen\* and Emelia Williams

Open Environmental Data Project, New Orleans, LA, United States

## OPEN ACCESS

### Edited by:

Michael C. Kruk,  
National Oceanic and Atmospheric  
Administration (NOAA), United States

### Reviewed by:

Stephen Formel,  
National Oceanic and Atmospheric  
Administration (NOAA), United States  
Mathew Biddle,  
U.S. Integrated Ocean Observing  
System, United States

### \*Correspondence:

Shannon Dosemagen  
shannon@openenvironmentaldata.org

### Specialty section:

This article was submitted to  
Climate Services,  
a section of the journal  
Frontiers in Climate

Received: 28 September 2021

Accepted: 25 May 2022

Published: 22 June 2022

### Citation:

Dosemagen S and Williams E (2022)  
Data Usability: The Forgotten  
Segment of Environmental Data  
Workflows. *Front. Clim.* 4:785269.  
doi: 10.3389/fclim.2022.785269

While there has been a rapid increase in the use of participatory science methods over the last decade, the usability of resulting data in addressing situations of environmental injustice is often overlooked, neglected, or used as political fuel for ignoring inconvenient truths. The inability of data to be used for policy, regulation, and enforcement impedes its usefulness in various situations depending on user requirements and governance scales. On the other hand, there are vast open datasets that could be useful for communities and researchers, but these data are often difficult to find, use, or repurpose, beyond their original intent. This article unpacks the data usability problem at the frontier of environmental governance and decision-making, suggesting that by prioritizing environmental data as a public good, there are clear mechanisms for ensuring data usability toward participatory environmental governance. The authors are interested in uncovering the policies and behavioral and bureaucratic patterns that have remained static as participatory science methods and tools have advanced. It is necessary to understand where and when associated tools, methods, and platforms have failed to ensure that data is usable and useful for communities attempting deeper engagement and representation in environmental governance.

**Keywords:** community data, environmental governance, environmental justice, data usability, public good, open source, environmental data

## INTRODUCTION

Data about the environment and its impact on health come from many places, including scientists and researchers, government, and communities who are activated to collect their own data. There are an equal number of issues with environmental data: scarcity in some places and overabundance in others; difficulties collecting data based on timing, accessibility of tools, and technical complexities of data requirements; figuring out where and how data can be disseminated for use in different scenarios. While citizen science (Shirk et al., 2012) has dominated the language and landscape of participatory science, this article is interested in forms of participatory science such as community science (Dosemagen and Parker, 2019) and community-owned and managed research (Heaney et al., 2007). These center scientific practice around the questions of communities, seek to build co-equal partnerships between communities and scientists, and aim to leverage multiple forms of data (e.g., quantitative data from sensors, traditional, and local knowledge)

to an actionable end<sup>1</sup>, often in support of addressing environmental injustices. This article is also interested in the role of already available open government datasets<sup>2</sup> and the benefit for communities and other researchers beyond the original intent of use.

In efforts to collect and share data and information as part of environmental governance processes, there are limited cases or examples that show how community data follows a streamlined process from collection by communities to its use in decision-making within and between communities and tribal, local, state, national, and global governance processes. While there is demonstrable progress—notably the inclusion of water quality monitoring data in local, state, federal, and multi-lateral processes such as the Sustainable Development Goals<sup>3</sup> and through legislation such as the Crowdsourcing and Citizen Science Act of 2016<sup>4</sup>—the problem of *data usability* is often overlooked or neglected, in part allowing inconvenient environmental truths to perpetuate. Likewise, data streams coming from scientific institutions (e.g., research institutes, government agencies, and universities) often struggle to solve the data “last-mile” usability problem (Celliers et al., 2021). In other words, frameworks have been created for ensuring these data streams meet certain standards for enabling access and usability, but we have yet to figure out how to format data for a variety of different user needs and governance scales beyond original intent. This perspective article unpacks the data usability problem at the frontier of environmental governance and decision-making.

The sophistication of participatory science continues to grow, and progress has been made toward increasing actionable data, yet there are limited instances of data and information from communities being used in ways that demonstrate clear integration with policymaking and ongoing, collaborative interaction between government and communities around environmental governance and management. Often, data collected to demonstrate a potential environmental issue (see for instance Allen, 2003) is paired with long-term and ongoing community activism. The popular route of public notice-and-comment leaves much to be desired as it does not account for power differentials, creates further inequity through lack of access to political know-how, and allows for an information request without having a feedback loop through which response

is guaranteed to the comment provider (Rahman, 2011). Data from communities can provide rich contextual and time-sensitive information in environmental governance decisions, like permitting affordances from industrial plants or land stewardship practices for endangered species. The overused *data pipeline* analogy suggests a clear route from community data collection to enforcement of rights (see **Figure 1**), but our workflows underperform when it comes to ensuring data are usable and useful for communities attempting deeper engagement and representation in environmental governance (see **Figure 2**).

The onus of working within existing data systems has long been placed on communities. This is exemplified through priority placed on training communities to interact with existing workflows, rather than internal agency self-reflection on where data workflows complicating community involvement could better function. It is the responsibility of government, with insight and advice from civil society, to correct data workflow issues and to modernize and update the infrastructure that supports them. This can happen by prioritizing environmental data as a public good (i.e., data that works for all) which can emphasize the necessity and value of diverse data and information in environmental governance (Williams et al., 2021). While methods and tools for monitoring have proliferated (for instance through next-generation sensors or the value that local and traditional knowledge can bring toward adding context to environmental datasets), the policies, behavioral patterns, and bureaucratic systems around data have remained relatively stagnant.

## WHY NOW: THE OPPORTUNITY FOR A WHOLE OF GOVERNMENT APPROACH

With the Biden-Harris Administration declaring a “whole-of-government”<sup>5</sup> approach to environmental justice (Justice40<sup>6</sup> and the need for climate action, it is an opportune time to think differently about where data can be useful in governance processes and also the ways in which data moves between actors—from community to government, government to community, researchers to communities. Historically, community data is used by communities and, in certain cases, researchers and government, to call attention to potential environmental and health issues, often resulting in establishing a baseline for further research, indicating the need for additional monitoring, or assisting media campaigns in support of community goals (National

<sup>1</sup>See for instance the American Geophysical Union’s Thriving Earth Exchange, Public Lab and the Association of Science and Technology Centers.

<sup>2</sup>In 2019, the OPEN Government Data Act, a component of the Foundations for Evidence Based Policymaking Act (<https://www.congress.gov/bill/115th-congress/house-bill/4174/text#toc-H8E449FBAEFA34E45A6F1F20EFB13ED95>), was turned into law. This, “requires federal agencies to publish their information online as open data, using standardized, machine-readable data formats, with their metadata included in the Data.gov catalog.” (<https://www.data.gov/meta/data-gov-at-ten-and-the-open-government-data-act/>).

<sup>3</sup>See for example: Monitoring drinking water quality for the Sustainable Development Goals (<https://www.nature.com/collections/gdiahjefdh/>) and UNEP Monitoring Water Quality (<https://www.unep.org/explore-topics/water/what-we-do/monitoring-water-quality>).

<sup>4</sup>15 U.S.C. §3,724. Crowdsourcing and citizen science (<https://uscode.house.gov/view.xhtml?req=granuleid:USC-prelim-title15-section3724&num=0&edition=prelim>).

<sup>5</sup>Fact Sheet: President Biden Takes Executive Actions to Tackle the Climate Crisis at Home and Abroad, Create Jobs, and Restore Scientific Integrity Across Federal Government (<https://www.whitehouse.gov/briefing-room/statements-releases/2021/01/27/fact-sheet-president-biden-takes-executive-actions-to-tackle-the-climate-crisis-at-home-and-abroad-create-jobs-and-restore-scientific-integrity-across-federal-government/>).

<sup>6</sup>Justice40 does not explicitly mention data accessibility or usability, though the recommendations from the White House Environmental Justice Advisory Council reference community data input extensively and could signal a future push to incorporate (<https://www.whitehouse.gov/omb/briefing-room/2021/07/20/the-path-to-achieving-justice40/>).

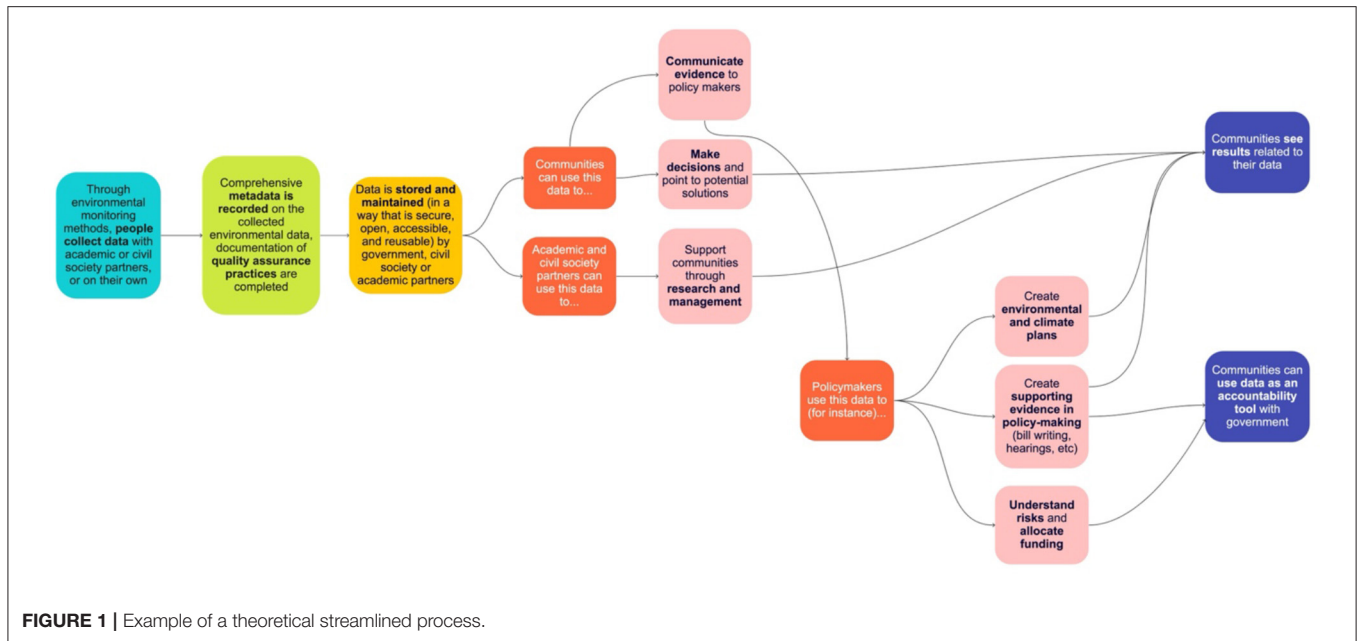


FIGURE 1 | Example of a theoretical streamlined process.

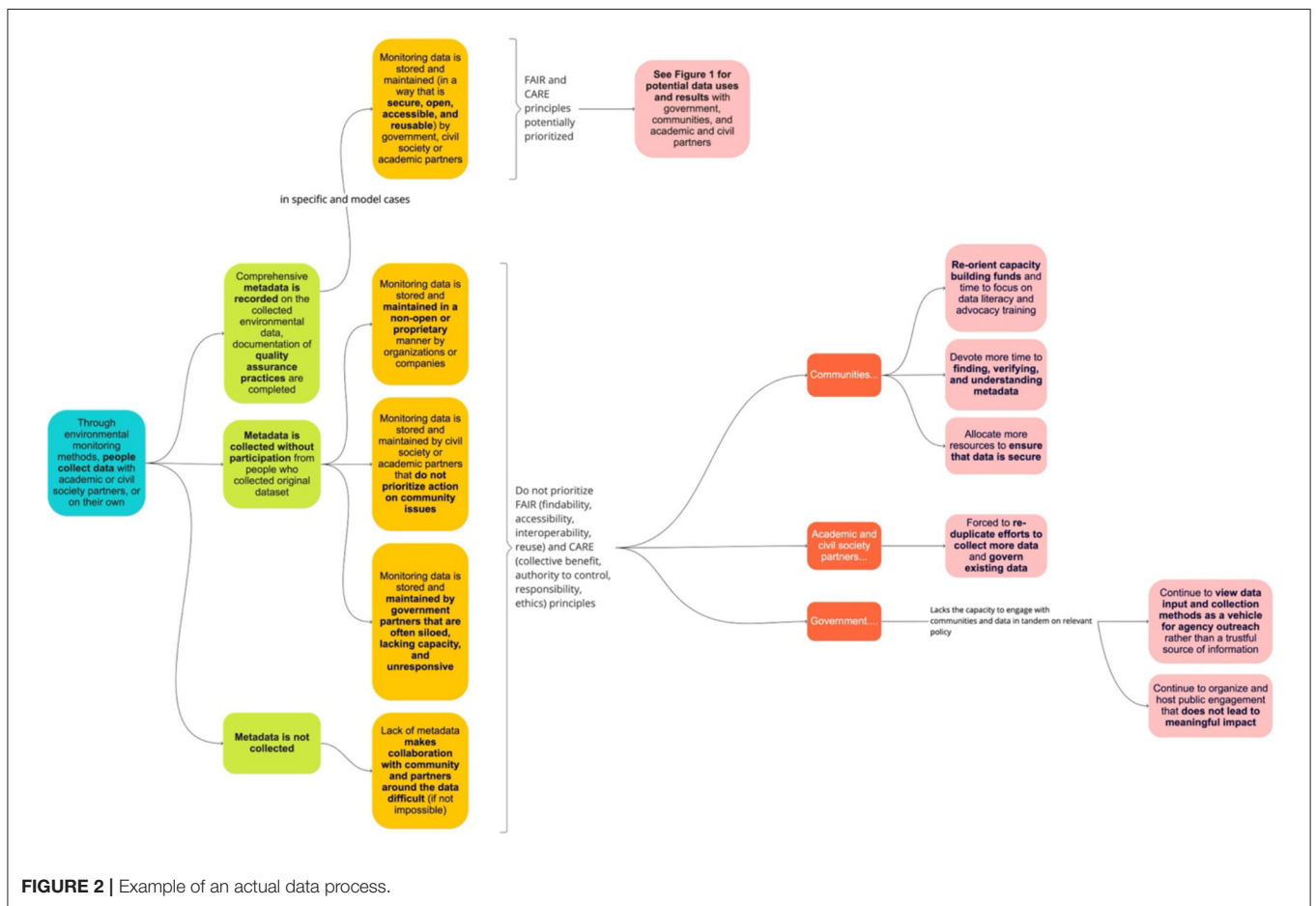


FIGURE 2 | Example of an actual data process.

Advisory Council on Environmental Policy Technology, 2016). Rarely though, do we see environmental data used to provide an ongoing system of collective accountability between community, government, academia, and industry. The use of data as a tool should be prioritized by government and the broader public as a public good; explicit nomenclature that designates data as such can highlight its use as a tool for collective accountability. It is here that we need to focus our efforts.

To achieve a whole-of-government approach to environmental justice and climate change mitigation efforts, agencies should embrace addressing and solving questions of data use and accessibility that people have pressed for years<sup>7</sup>. In addition to the Administration's openness to incorporating environmental justice into national agendas, there is also demonstrated intent toward action from Congress such as the introduction of the *Environmental Justice Mapping and Data Collection Act of 2021*<sup>8</sup>, *Environmental Justice Act of 2021*<sup>9</sup> and the *Environmental Justice for All Act*<sup>10</sup>. The federal government's movement on this stands on the foundation of more localized and regional action, largely catalyzed over the past 5 years, in state, city, and mayoral offices.

Though tools such as *EJScreen*<sup>11</sup> and the *Climate and Economic Justice Screening Tool*<sup>12</sup> offer useful demographic data, these tools primarily are a means for understanding and identifying environmental justice communities (Barnes et al., 2021), rather than increasing access to national systems of environmental governance. These tools, as well as new modes of enhancing public data literacy and education, are

<sup>7</sup>For instance, see the case studies in the 2016 NACEPT report (National Advisory Council on Environmental Policy Technology, 2016), the 2018 NACEPT report (National Advisory Council on Environmental Policy Technology, 2018), and reports by the Environmental Law Institute in 2020 (Moodley and Wyeth, 2020).

<sup>8</sup>The *Environmental Justice Mapping and Data Collection Act of 2021* notes that it "aims to create and authorize funding for a system to comprehensively identify the demographic factors, environmental burdens, socioeconomic conditions, and public health concerns that are related to environmental justice and collect high-quality data through community engagement and a government-wide interagency process. These data would be used to build layered maps depicting which communities experience environmental injustices" (<https://www.congress.gov/bill/117th-congress/senate-bill/101>).

<sup>9</sup>The *Environmental Justice Act of 2021* aims "to improve research and data collection relating to the health and environment of populations of color, communities of color, indigenous communities, and low-income communities, including through the increased use of community-based science" (<https://www.congress.gov/bill/117th-congress/senate-bill/2630?q=%7B%22search%22%3A3A%5B%22S.+2630%22%2C%22S.%22%2C%222630%22%5D%7D&s=2&r=1>).

<sup>10</sup>The *Environmental Justice for All Act* seeks "to improve Federal research and data collection efforts related to— (1) the health and environment of communities of color, low-income communities, and Tribal and Indigenous communities..." (<https://www.congress.gov/bill/116th-congress/house-bill/5986/text>).

<sup>11</sup>*EJScreen* is the Environmental Justice Screen and Mapping Tool, developed and used by the EPA "to screen for areas that may be candidates for additional consideration, analysis or outreach as EPA develops programs, policies and activities that may affect communities" (<https://www.epa.gov/ejscreen/how-does-epa-use-ejscreen>).

<sup>12</sup>The *Climate and Economic Justice Screening Tool* is in its public beta form, developed by the Council of Environmental Quality "to help Federal agencies identify disadvantaged communities that are marginalized, underserved, and overburdened by pollution" (<https://screeningtool.geoplatform.gov/en/#3/33.47/-97.5>).

valuable and needed, but must be paired with programs such as environmental justice training for federal employees and the increased distribution of funds to environmental justice communities. Such programs and support should seek to identify and leverage places where data, information, and input from communities could be used to create multi-stakeholder, collaborative models of governance that value and encourage the use of environmental data and information. This can include a range of inputs from traditional ecological knowledge to "good enough data" (Gabrys et al., 2016) that demonstrate where trends might be emerging.

The Environmental Protection Agency (EPA)<sup>13</sup> and other federal agencies have a complicated road ahead in which they'll be required to address large-scale systems change across a gamut of activities from transportation and land-use to infrastructure upgrades. Environmental data has a role to play in these scaled changes, to provide a clear understanding of what resources are needed in which geographies. To create truly just systems of environmental governance in which data that already exists and data that is created by communities is valued as part of the process, it is necessary for government to (1) consider administrative justice<sup>14</sup> alongside environmental justice, and (2) to understand the entrenched behavioral and cultural challenges that government faces before becoming open to this form of data collection. It is also necessary to reconsider administrative justice as, "a set of principles for shaping humane relationships between citizen and state" in the "small places," in the interactions between civil servants, between government and community (Doyle and O'Brien, 2020). A truly whole-of-government approach must include these "small places" and data questions (Doyle and O'Brien, 2020). Federal agencies that collect and share environmental data, such as NOAA, USGS, and NASA, can and should support these efforts, but as a regulatory agency whose mission is to ensure human health (in addition to environmental protection), the EPA is best positioned to lead such change.

## WHY THIS: DATA AS A TOOL TOWARD ENVIRONMENTAL JUSTICE

Early signals from the Biden-Harris Administration point to environmental justice as a route for building conversations about the role of environmental data and information from impacted communities. The focus on a whole-of-government approach to environmental justice will increase the propensity of government to identify the needs of environmental justice communities. However, the authors contend there is a more significant role for community data in decision-making. Amplifying this role can be accomplished by not only creating more data and maps to show the distribution of environmental injustices, but also by creating

<sup>13</sup>While we acknowledge framing this paper to focus on EPA limits the whole-of-government approach to one agency, the authors do so to help narrow the discussion. Further exploration of how other agencies are addressing these topics is a possible future route of work.

<sup>14</sup>We note that this term is specifically used as a concept in law and judicial systems, but we use it here in parallel with the concept of environmental justice to underline the complexity of administrative systems.

data accessibility, literacy and transparency for a plethora of researchers from community to academic. Government should also look to the less acknowledged places where communities can provide direct guidance on program rollouts. For instance, in funding programs, identifying where points of input in grantmaking processes about how funds are spent can lead to a stronger balance in the distribution of these funds. The work of identifying places of input has begun with the White House Environmental Justice Advisory Committee and their Interim Final Recommendations for the Climate and Economic Justice Tool (WHEJAC, 2021), but there is additional work needed to streamline this process and ensure that less acknowledged communities are involved.

Additionally, the whole-of-government approach to infrastructure and environmental justice seems to have its limits within the Biden-Harris administration, namely when it comes to the oil and gas industry, as they recently announced an increase of exports of liquefied natural gas (Natter and Dlouhy, 2022) and are outpacing the Trump administration in issuing drilling permits on public lands (Phillips, 2022). These types of environmentally harmful activities point to places where community environmental data could bolster calls for government accountability by providing, for instance, information on the lived experiences of and impacts on communities in proximity to this harm. Only when our infrastructure allows for access to both data and decision-making across the places where influence sits, will we move from a *whole-of-government* to a *multi-sector collaborative* governance model.

While environmental justice is the focus, a method of collecting data to address these injustices<sup>15</sup>—citizen science (and to some extent community science)—has previously made large strides in becoming part of agency agendas. There is an interagency working group on crowdsourcing and citizen science<sup>16</sup>, the National Advisory Council on Environmental Policy and Technology (NACEPT)<sup>17</sup>, wrote two substantial reports on citizen science, and there is a law encouraging the increased use of citizen science in Federal Government<sup>18</sup>. However, one of the key agencies required to interface with community data, EPA, has historically viewed data input and the methods for collecting it as a vehicle for agency outreach and engagement. While EPA has created resources such as the quality assurance toolkit (Environmental Protection Agency, 2022b), houses an environmental monitoring tool loan program (Environmental Protection Agency, 2022a), and provides regional funding for citizen and community science projects, less capacity has been directed at systemic Agency-wide integration of community data and the infrastructure needed to

ensure this data is used. There is also a problematic history of how communities seeking to be part of the environmental data infrastructure have been categorically dismissed or viewed as data contributors (rather than co-equal partners); they have filled in gaps for government agencies that lack the political, social, or economic capacity to achieve their mission of environmental and health protection<sup>19</sup> and management. Community data is not a replacement for government inaction, or an avenue leading to community-industry partnerships, but should be seen as a way for communities to build agency in political decision-making (Ottinger, 2013; Shapiro et al., 2017).

The reason we place value on community data is that this data and information can serve to socially situate issues, provide different perspectives, and communicate how people are experiencing environmental injustices and the burden of pollution<sup>20</sup>. Notably, ensuring the role of community data and information in environmental governance can show us the value of pairing scientific data alongside contextual information, for instance indicating there are multiple truths to how people experience living in polluted environments<sup>21</sup>. Community data can also help agencies forecast areas where future interventions are required with trend data collected by communities. Being able to proactively point to out-of-pattern events is invaluable—especially as we see the increasing effects of the climate crisis.

Community data can additionally provide new partnership and outreach opportunities for agencies to work with scientists, community organizers and advocates, educators, designers, and technologists. These partnerships are integral to ensuring that, as our innovation landscape around the next generation of environmental sensors increases, technology, and its resulting data are usable by agencies. The incorporation of environmental data from communities requires an openness and willingness on the part of agencies to examine and explore both these new environmental data technology frontiers and their own complex and difficult-to-navigate administrative systems. Working with communities, and their data and information, can demonstrate a willingness for agencies to collaboratively achieve EPA's mandate<sup>22</sup> environmental and human health protection. This participatory collaboration will require a switch from the mindset of being a gatekeeper of this responsibility to being a conduit for working in partnership with the public. Building in processual transparency and points of clear input for communities, can work against the legacy of distrust in government by environmental justice communities.

In the Biden-Harris Administration, there is also a notable financial commitment, for instance, to increased air quality monitoring (Environmental Protection Agency, 2021), and billions allocated to cleaning up legacy pollution and investments in the nation's water infrastructure (Mock and

<sup>15</sup>Citizen science and environmental justice and their influences can be described as a feedback loop, which can be positive or negative. See Figure 12.1 in *Citizen Science, Health, and Environmental Justice* (Ceccaroni et al., 2021).

<sup>16</sup>Crowdsourcing and Citizen Science (<https://digital.gov/communities/crowdsourcing-citizen-science/>).

<sup>17</sup>National Advisory Council on Environmental Policy and Technology (<https://archive.epa.gov/epa/faca/nacept.html>).

<sup>18</sup>15 U.S.C. §3724. Crowdsourcing and citizen science (<https://uscode.house.gov/view.xhtml?req=granuleid:USC-prelim-title15-section3724&num=0&edition=prelim>).

<sup>19</sup>The EPA mission is to protect human health and the environment. Read more at: <https://www.epa.gov/aboutepa/our-mission-and-what-we-do>.

<sup>20</sup>For more on the situation of knowledge, see *Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective* (Haraway, 1988).

<sup>21</sup>Communities can use environmental data to create information that demonstrates experience of lived situations and other forms of knowing (see for instance Celliers et al., 2021).

<sup>22</sup>The EPA mandate is derived from the Reorganization Plan No. 3 of 1970 (<https://archive.epa.gov/epa/aboutepa/reorganization-plan-no-3-1970.html>).

Lowenkron, 2021). Paired with a focus on squarely placing routes of community input (not simply data collection) and accountability into the infrastructure of these financial commitments would signal the potential for a transformative approach to environmental injustices.

## HOW WE GET THERE: SYSTEMS FOR COLLECTIVE ACCOUNTABILITY

To deepen the whole-of-government approach and create an ongoing commitment to both the work of environmental justice and environmental justice communities, policy frameworks should incorporate the willingness to explore and expand an ongoing system of collective accountability for environmental protection, management, and governance. This is a complex problem that requires a multi-faceted approach through which we collaboratively, (1) build models for new ways to think about incorporating diverse datasets and their metadata, while also considering how to strengthen the current governance landscape data lives in, (2) standardize across both new and old data systems to support collective accountability, and (3) build legitimacy in new data systems through this accountability.

To be successful in creating new systems of collective accountability, changes in bureaucratic culture that lead to administratively just systems should be created. While many people in government agencies are proponents of incorporating community data and information and recognizing the value of collaborative governance, these are not agency-wide mandates. For instance, only recently has the White House Office of Science and Technology Policy explicitly advised that “where appropriate, ITEK<sup>23</sup> can and should inform Federal decision making along with scientific inquiry” (Lander and Mallory, 2021). Instead, many times community input is seen as an administrative burden in a system already weighed down by bureaucracy (Harrison, 2017). Those that see community input as a burden often actively resist—in both conscious and unconscious ways—the work necessary for environmental justice (Harrison, 2019). When the bureaucratic system of data input and analysis by the agency causes additional delays, there are failures in systems leaving limited choices for remedy. These delays and blockades increase the failures of systems in addressing environmental justice concerns (Goldman, 2000).

There are also places for considering hybrid social, legal, and technical approaches to the way data becomes available for government use. These places must consider and design for the representation of a diversity of perspectives, respect the boundaries of communities in sharing (as well as the necessity of sovereignty) and ensure that there is a place of input beyond public comment processes and the mechanics of town halls and public hearings. For instance, the Open Environmental Data Project (OEDP) has been working on conceptualizing a community data hub model that is (a) decentralized for collaborative ownership within each community and (b) reflective of collective governance models<sup>24</sup>; at the same time, it

recognizes the importance and necessity of federated systems<sup>25</sup> so that communities (and their data) can speak to each other and government infrastructure (see **Figure 3**). OEDP pairs these concepts and prototypes with models that tell the story of the pain points these types of systems would encounter through network amplifying conversations (i.e., OEDP’s Brain Trusts or *Data Dialogues* series). These dialogues help us to identify the complexities of usable data in ways that look at them as opportunities for creating new systems or thinking in different ways that will help us to alleviate environmental data burdens.

Through a dual approach that ensures *environmental data is a public good*—it is non-rival and non-excludable—we mechanize its ability to be an accountability measure in both directions—from government to communities and from communities to government. The space of community environmental data and governance is ripe for this change.

## DISCUSSION: ENVIRONMENTAL DATA AS A PUBLIC GOOD

The roots of environmental injustice in the United States span further back than the start of the environmental justice movement or the EPA (Altman, 2021) into the early industrial period of U.S. history (or, one could argue, early colonization). Yet a century later, we are just starting to acknowledge that a whole-of-government approach is needed to address these issues. To make this whole-of-government (and community) approach it is necessary to ensure the place of *environmental data as a public good* (see **Figure 4**).

A public good serves the well-being of a populace. It is past time to ensure both our *available* environmental data and environmental data that are *collected* both on hyper-local scales and by, for instance, sensor networks, are allowed this position in society. The state of pollution combined with the climate crisis means we need an all-hands-on-deck approach to solve these problems. Our solutions are in the data, the technology, and the ability for people to share what they know based on local and lived experience. But it is necessary to put structures in place so that in building environmental data as a public good, we ensure a stronger and clearer emphasis on data “reusability”<sup>26</sup>. There are three main ways in which this can happen:

**Ensure that administrative justice<sup>27</sup> is part of the environmental justice whole-of-government approach.** The whole-of-government approach to addressing environmental injustices will not work without putting specific attention toward

consensus among stakeholders on a formal set of policies designed and implemented to generate public value” (Bianchi et al., 2021).

<sup>25</sup>Federated systems enable “queries to be sent between disparate data repositories, or nodes in a federation.” For more on the benefits, risks, and elements of a federated system (see Herrman, 2019).

<sup>26</sup>FAIR Principles address reusability, the closest acknowledgement of data usability beyond original intent, though known problems exist with maintenance of data under these principles (Wilkinson et al., 2016).

<sup>27</sup>In “New Directions in Environmental Justice Research at the U.S. Environmental Protection Agency: Incorporating Recognition and Capabilities Justice Through Health Impact Assessments” the authors also note the importance of capabilities and recognition justice in relation to environmental justice work with communities (Eisenhauer et al., 2021).

<sup>23</sup>Indigenous Traditional Ecological Knowledge.

<sup>24</sup>Collective, or collaborative governance models refers to a “multi-actor collaboration, usually led by a public sector organization aimed at building

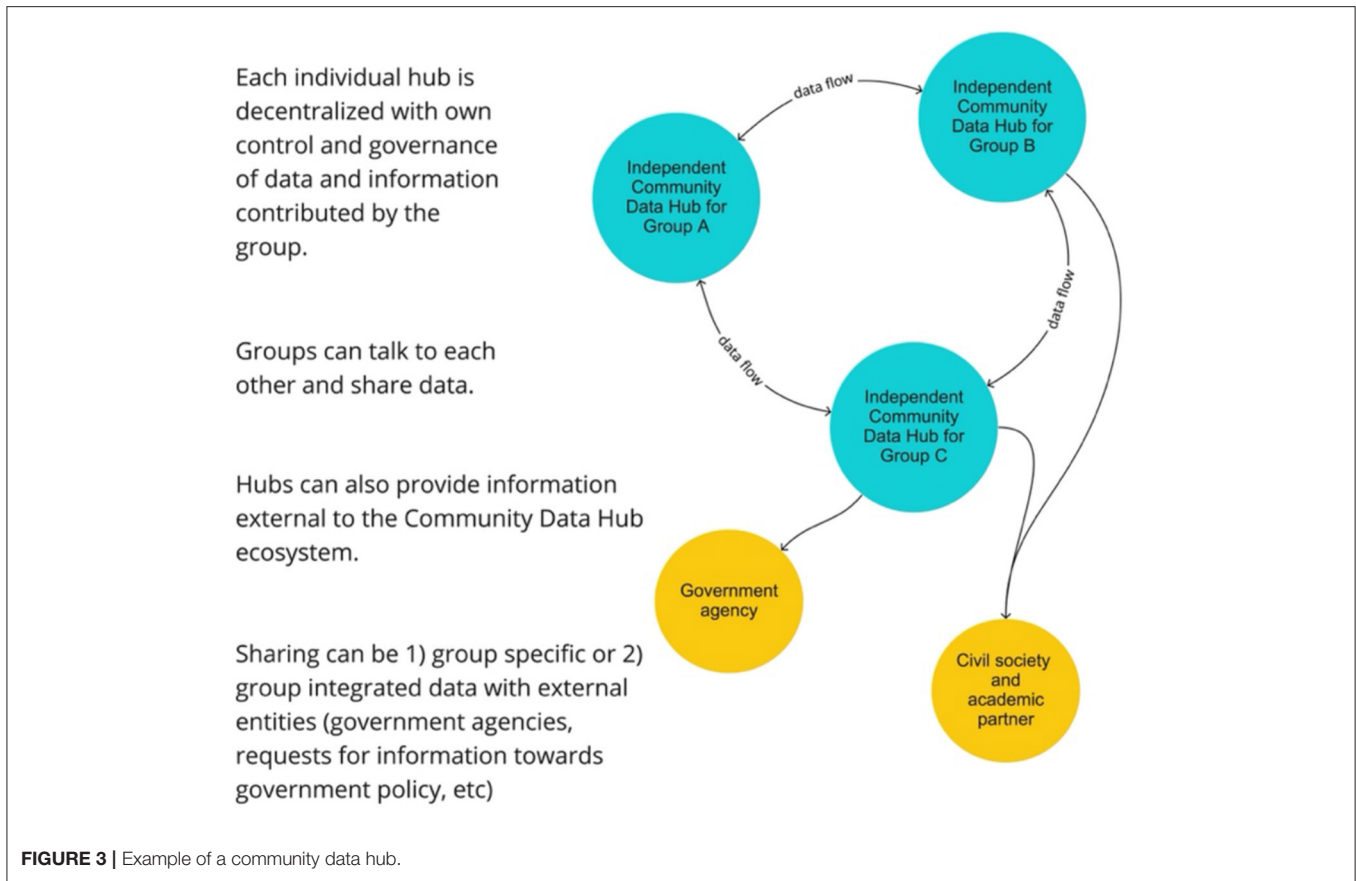


FIGURE 3 | Example of a community data hub.

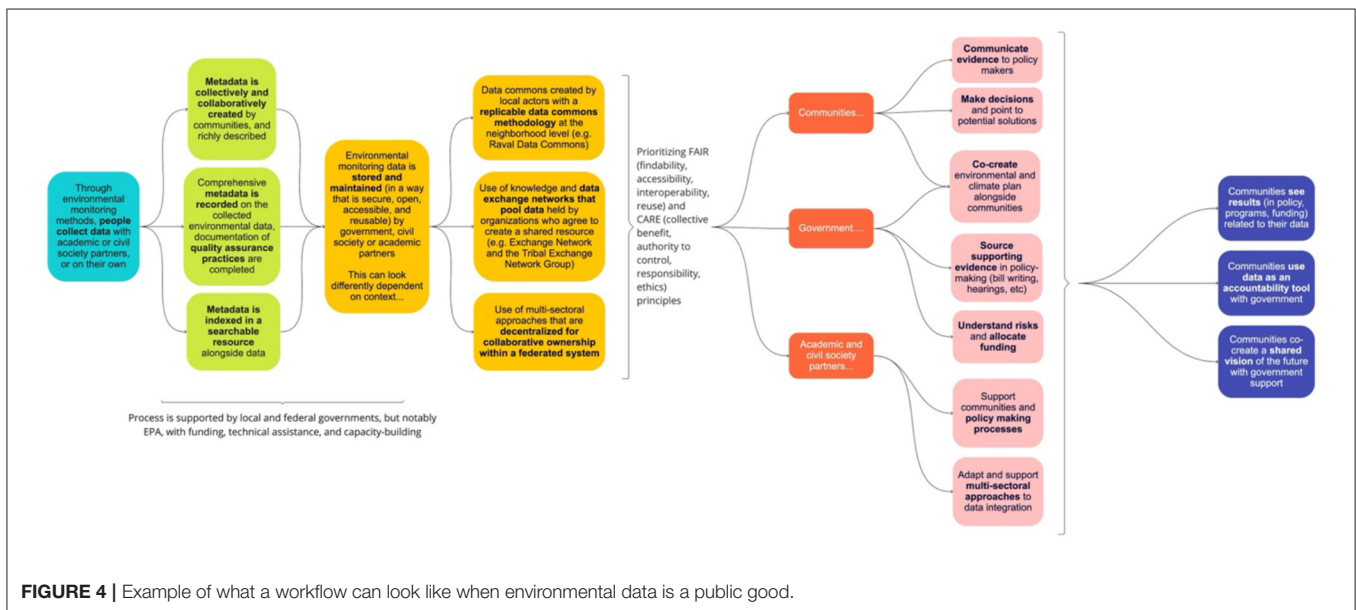


FIGURE 4 | Example of what a workflow can look like when environmental data is a public good.

addressing behaviors and bureaucratic systems that are unjust in themselves and then also exemplified as acceptable in agency workflows (including those related to data). To ensure existing data is usable, findable, accessible, and that there are routes of

input for communities, the administrative behaviors of agencies will need to be examined, alongside technical workflows.

**While working in current governance systems, create new ones that are responsive to communities and their data needs.**

Change within government processes is slow and introducing and adapting innovative and responsive governance models for scaled use will be incremental. Though it is necessary to work within current environmental governance systems (i.e., public commentary frameworks), the rise of new technology and methods for data collection should encourage us to think about how to use more representative forms of data and information that allow for robust models of community governance. The civic technology movement<sup>28</sup> of over a decade ago provided a plethora of valuable lessons (for instance, Costanza-Chalk, 2020; Harrell, 2020), and models from within government that have been reinterpreted by non-profits<sup>29</sup> and vice versa. The models and frameworks are there to build representative data systems for collaborative environmental governance. While doing so, consideration for what the connective tissues between old and new systems are—and specifically what usability structures need to be put into place—should be central.

**Consider socio-technical touchpoints.** Many times, new technology for data management, storage, and collection does not need to be built from scratch; instead, there is a needed investment in critical digital infrastructure and features that will make environmental data usable and useful. To create better representation, the focus should be on the appropriateness of models of collaborative governance<sup>30</sup>, community ownership, direct routes of input and checks and balances that data provides, and how the data fits into current data systems and yet is proactively designed for future systems<sup>31</sup>. As previously discussed, current problems with bureaucratic workflows point out that these developments must work toward unburdensome

governance structures or they simply will not be used. Also known, through the reflections of researchers and practitioners on the past decade of civic technology (see for instance Costanza-Chalk, 2020), is that any design or technology development that leaves people out, or is created *for*, not *with*, will further problematize the push toward addressing environmental injustices.

Across sectors and working in collaboration, this is an opportune moment to grasp the momentum we're seeing at the top levels of the administration, Congress, and federal agencies to do differently and do better for and with environmental justice communities. To grasp this opportunity, we must recognize the deep histories of misaligned bureaucratic practices that have complicated, or even intentionally or unintentionally prevented, how environmental justice can happen in practice. Building workable routes in our current data systems should be prioritized, while simultaneously encouraging spaces of innovation in which we can consider legacy systems, setting the tone for new ones that allow for proactive and collaborative environmental governance. The rise of environmental data from multiple sources should be considered a public good and we have a collective responsibility to ensure it becomes a *workable* public good for both communities and the elected officials that represent them.

## DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

## AUTHOR CONTRIBUTIONS

SD researched, analyzed, and wrote the article. EW researched, analyzed, and added written contributions to the article. All authors contributed to the article and approved the submitted version.

<sup>31</sup>Future responsive systems could look many ways, but Open Environmental Data Project has suggested a system for a hardware and software platform that integrates dynamic environmental trend data, of known quality, about ecological integrity (<https://www.openenvironmentaldata.org/work/new-models-environmental-context-part-1>).

<sup>28</sup>Civic technology is a “loosely integrated movement that brings the strengths of the private-sector tech world (its people, methods, or actual methodology) to public entities with the aim of making government more responsive, efficient, modern, and more just” (Harrell, 2020).

<sup>29</sup>See for instance, *In the Realm of the Barely Feasible* (Prabhakar, 2020).

<sup>30</sup>Part of creating these touchpoints is to understand and test models that have risen around collaborative governance of resources in other sectors. Communities who are collectively contributing data should have control mechanisms and ownership boundaries in place. Extensive work has been done to this point around the sharing of health data where models such as trusts and collectives have been tested [e.g., Aapti Institute (<https://www.aapti.in/>) and GovLab's Data Collaboratives initiative (<https://datacollaboratives.org/>)]. Querying if a focus on governance could bridge the conversation between data sovereignty and representation in data-based governance decisions for communities is also important.

## REFERENCES

- Allen, B. (2003). *Uneasy Alchemy: Citizens and Experts in Louisiana's Chemical Corridor Disputes*. Cambridge: MIT Press.
- Altman, R. (2021). *Upriver*. Orion. Available online at: <https://orionmagazine.org/article/upriver/>
- Barnes, A., Luh, A., and Gobin, M. (2021). *Mapping Environmental Justice in the Biden-Harris Administration*. Center for American Progress. Available online at: <https://www.americanprogress.org/article/mapping-environmental-justice-biden-harris-administration/>
- Bianchi, C., Nasi, G., and Rivenbark, W. (2021). Implementing collaborative governance: models, experiences, and challenges. *Publ. Manage. Rev.* 23, 1581–1589. doi: 10.1080/14719037.2021.1878777
- Costanza-Chalk, S. (2020). *Design Justice: Community-Led Practices to Build the Worlds We Need*. Cambridge: MIT Press. doi: 10.7551/mitpress/12255.001.0001
- Dosemagen, S., and Parker, A. (2019). Citizen science across a spectrum: building partnerships to broaden the impact of citizen science. *Sci. Technol. Stud.* 32, 24–33. doi: 10.23987/sts.60419
- Harrell, S. (2020). *Design Justice: Community-Led Practices to Build the Worlds We Need*. Cambridge: MIT Press. doi: 10.7551/mitpress/12255.001.0001
- Prabhakar, S. (2020). *In the Realm of the Barely Feasible*. Cambridge: MIT Press. doi: 10.7551/mitpress/12255.001.0001
- Costanza-Chalk, S., Woods, S., Springs, J., Wilson, S., Faustman, E., Bonn, A., et al. (2021). “Citizen science, health, and environmental justice,” in *The Science of Citizen Science*, eds K. Vohland, A. Land-Zandstra, L. Ceccaroni, R. Lemmens, J. Perelló, M. Ponti, R. Samson, and K. Wagenknecht (Cham: Springer), 219–239. doi: 10.1007/978-3-030-58278-4\_12
- Celliers, L., Mániz Costa, M., Williams, D. S., and Rosendo, S. (2021). The ‘last mile’ for climate data supporting local adaptation. *Glob. Sustain.* 4, 1–8. doi: 10.1017/sus.2021.12



- Doyle, M., and O'Brien, N. (2020). *Reimagining Administrative Justice: Human Rights in Small Places*. London: Palgrave. doi: 10.1007/978-3-030-21388-6
- Eisenhauer, E., Williams, K. C., Warren, C., Thomas-Burton, T., Julius, S., and Geller, A. M. (2021). New directions in environmental justice research at the U.S. Environmental Protection Agency: incorporating recognition and capabilities justice through health impact assessments. *Environ. Just.* 14, 322–331. doi: 10.1089/env.2021.0019
- Environmental Protection Agency (2021). *EPA Announces an Additional \$50 Million Under the American Rescue Plan to Enhance Air Pollution Monitoring*. Environmental Protection Agency. Available online at: <https://www.epa.gov/newsreleases/epa-announces-additional-50-million-under-american-rescue-plan-enhance-air-pollution>
- Environmental Protection Agency (2022a). *EPA's Equipment Loans Program*. Environmental Protection Agency. Available online at: <https://www.epa.gov/citizen-science/epas-equipment-loan-programs>
- Environmental Protection Agency (2022b). *Quality Assurance Handbook and Guidance Documents for Citizen Science Projects*. Environmental Protection Agency. Available online at: <https://www.epa.gov/citizen-science/quality-assurance-handbook-and-guidance-documents-citizen-science-projects>
- Gabrys, J., Pritchard, H., and Barratt, B. (2016). Just good enough data: figuring data citizenships through air pollution sensing and data stories. *Big Data Soc.* 3, 1–14. doi: 10.1177/2053951716679677
- Goldman, B. (2000). An environmental justice paradigm for risk assessment. *Hum. Ecol. Risk Assess.* 6, 541–548. doi: 10.1080/10807030008951327
- Haraway, D. (1988). Situated knowledges: the science question in feminism and the privilege of partial perspective. *Femin. Stud.* 14, 575–599. doi: 10.2307/3178066
- Harrell, C. (2020). *A Civic Technologist's Practice Guide*. San Francisco, CA: Five Seven Five Books.
- Harrison, J. L. (2017). We do ecology, not sociology': interactions among bureaucrats and the undermining of regulatory agencies' environmental justice efforts. *Environ. Sociol.* 3, 197–212. doi: 10.1080/23251042.2017.1344918
- Harrison, J. L. (2019). *From the Inside Out: The Fight for Environmental Justice Within Environmental Agencies*. Cambridge: MIT Press. doi: 10.7551/mitpress/12063.001.0001
- Heaney, C., Wilson, S., and Wilson, O. (2007). The West End Revitalization Association's community-owned and -managed research model: development, implementation, and action. *Prog. Commun. Health Partnersh.* 1, 339–349. doi: 10.1353/cpr.2007.0037
- Herrman, A. (2019). *Federated Data Systems: Balancing Innovation and Trust in the Use of Sensitive Data*. World Economic Forum. Available online at: [https://www3.weforum.org/docs/WEF\\_Federated\\_Data\\_Systems\\_2019.pdf](https://www3.weforum.org/docs/WEF_Federated_Data_Systems_2019.pdf)
- Lander, E., and Mallory, B. (2021). *Memorandum for the Heads Of Departments and Agencies: Indigenous Traditional Ecological Knowledge and Federal Decision Making*. Available online at: <https://www.whitehouse.gov/wp-content/uploads/2021/11/111521-OSTP-CEQ-ITEK-Memo.pdf> (accessed December 1, 2021).
- Mock, B., and Lowenkron, H. (2021). *The Infrastructure Bill Is a Trillion-Dollar Test for Environmental Justice*. Bloomberg CityLab. Available online at: <https://www.bloomberg.com/news/articles/2021-08-11/an-infrastructure-bill-built-on-environmental-justice>
- Moodley, K., and Wyeth, G. (2020). *Citizen Science Programs at Environmental Agencies: Case Studies*. Environmental Law Institute. Available online at: <https://www.eli.org/research-report/citizen-science-programs-environmental-agencies-case-studies>
- National Advisory Council on Environmental Policy and Technology (2016). *Environmental Protection Belongs to the Public: A Vision for CITIZEN Science at EPA*. Eds S. Dosemagen and A. Parker. Report to the Environmental Protection Agency.
- National Advisory Council on Environmental Policy and Technology (2018). *Information to Action: Strengthening EPA Citizen Science Partnerships for Environmental Protection*. Eds S. Dosemagen, A. Parker and D. Bator. Report to the Environmental Protection Agency.
- Natter, A., and Dlouhy, J. (2022). *Biden Risks Undercutting Climate Goal With Wartime Gas Pivot*. Bloomberg Green. Available online at: <https://www.bloomberg.com/news/articles/2022-03-24/biden-risks-undercutting-climate-goals-with-wartime-pivot-to-gas>
- Ottinger, G. (2013). *Refining Expertise: How Responsible Engineers Subvert Environmental Justice Challenges*. New York, NY: NYU Press. doi: 10.18574/nyu/9780814762370.001.0001
- Phillips, A. (2022). *Biden Outpaces Trump in Issuing Drilling Permits on Public Lands*. The Washington Post. Available online at: <https://www.washingtonpost.com/climate-environment/2022/01/27/oil-gas-leasing-biden-climate/>
- Prabhakar, A. (2020). In the realm of the barely feasible. *Issues Sci. Technol.* 31:1. doi: 10.1111/phs.12167
- Rahman, K. S. (2011). Envisioning the regulatory state: technocracy, democracy, and institutional experimentation in the 2010 financial reform and oil spill statutes. *Harvard J. Legislat.* 48:555.
- Shapiro, N., Zakariya, N., and Roberts, J. (2017). A wary alliance: from enumerating the environment to inviting apprehension. *Engag. Sci. Technol. Soc.* 3, 575–602. doi: 10.17351/ests2017.133
- Shirk, J. L., Ballard, H. L., Wilderman, C. C., Phillips, T., Wiggins, A., Jordan, R., et al. (2012). Public participation in scientific research: a framework for deliberate design. *Ecol. Soc.* 17:29. doi: 10.5751/ES-04705-170229
- WHEJAC (2021). *Interim Final Recommendations on Justice40 Climate and Economic Justice Screening Tool & Executive Order 12898 Revisions*. Report to the Council on Environmental Quality.
- Wilkinson, M., Dumontier, M., Aalbersberg, I. J., Appleton, G., Axton, M., Baak, A., et al. (2016). The FAIR Guiding Principles for scientific data management and stewardship. *Sci. Data* 3:160018. doi: 10.1038/sdata.2016.18
- Williams, E., Dosemagen, S., and Hoeberling, K. (2021). *Opportunity Brief: Environmental Data as a Public Good*. Open Environmental Data Project. Available online at: <https://www.openenvironmentaldata.org/research-series/environmental-data-as-a-public-good> (accessed December 17, 2021).

**Conflict of Interest:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

**Publisher's Note:** All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

Copyright © 2022 Dosemagen and Williams. This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.