

Introduction: Tackling environmental injustice in a post-truth age

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It is difficult to make sense of a historical moment when you are caught in the middle of it – and difficult to tell if it even *is* a moment, or just a small part of something far bigger. Over the past few years we have witnessed rising authoritarianism, extreme weather events attributed to climate change, the fallout from political populism, and – as this book goes to print – a global pandemic. In 2016, the Oxford English Dictionary made *post-truth* its word of the year, defining it as: “denoting circumstances in which objective facts are less influential in shaping public opinion than appeals to emotion and personal belief.” Two years later, the OED’s word of the year was *toxic*, chosen because of the “the sheer scope of its application … in an array of contexts, both in its literal and more metaphorical senses.” For all of these worrying trends, it is tempting to make proclamations about imminent global catastrophe and the novelty of our toxic, post-truth times. However, the Brave New World has been heralded for decades.

In the 1980s, the Bhopal and Chernobyl incidents sent shock waves around the world, highlighting the catastrophic consequences of industrial disaster. These followed in the wake of Rachel Carson’s book *Silent Spring* (1962), a powerful indictment of the use of chemical pesticides, and coincided with the growing US anti-toxics movement. The anthropologist Kim Fortun (2012, 446–449) describes the 1984 Bhopal gas tragedy as the beginning of an era of “late industrialism” characterized by pervasive and normalized disasters: a “world noisy with

media”; a “world of even more experts”; and a world where “people can’t think ... paralyzed by issue complexity.”

And yet we *must* think. This book comes at a critical juncture for questioning claims about the environment and the nature of science and expertise. A new political climate of “alternative facts” and “fake news” has threatened to reduce science and expertise to an unaccustomed diminution. As Lockie (2017, 1) puts it: “post-truth politics could hardly stand in more direct opposition to the values most of us bring to scholarship, research, and advocacy.” The election of Donald Trump in the USA and the Brexit referendum in the UK in 2016 ushered in a new era of post-truth. However, post-truth politics is hardly the preserve of the global North. Populist leaders such as Narendra Modi in India, Vladimir Putin in Russia, Recep Tayyip Erdogan in Turkey, and Jair Bolsonaro in Brazil have all offered their own versions of post-truth. Such populism has introduced a new wave of climate change denial, and alongside this political tumult, environmental vulnerabilities are deepening at both global and local levels. As we write this book, Trump is defunding environmental protection and has pulled the USA from the Paris climate agreement; Brexit is threatening to derail environmental regulation in the UK; and Bolsonaro is opening up vast tracts of Amazonian rainforest – the world’s largest carbon sink – to permanent exploitation. What does this mean for the role of science in environmental controversies?

Environmental justice is about making claims about the environment (Bullard 1990; Walker 2012; Schlossberg 2013). Around the world today, ethnic minority and low-income communities continue to be disproportionately burdened by toxic pollution (Bullard and Wright 2009; Pellow 2018). Environmental injustice appears wherever social inequality and pollution collide. For decades, environmental justice activists have campaigned against the misuses of science, while at the same time engaging in community-led citizen science. Polluted communities have faced uphill environmental justice battles against powerful corporations and state regulators to prove their cases of toxic exposure (Bullard 1990; Taylor 2014; Pellow 2018). Some communities have engaged in “popular epidemiology” (Brown 1993) by doing their own health surveys, monitoring, and research, in the absence of official information. Others have forged important “citizen–expert alliances” (Allen 2003) in their campaigns, drawing not only on work from professional scientists, but also on the skills of lawyers, economists, artists, and journalists.

In an age of post-truth politics, where science and expertise are increasingly under attack, what is the role for grassroots citizen science in environmental justice campaigns? Amid populist politicians and denigrated experts, environmental justice activists face new challenges. Yet the availability of new digital technologies, “big data,” and the Internet has meant greater community involvement in pollution monitoring. Neighborhood mobilization has become

an increasingly widespread phenomenon and a powerful means of making claims about environmental threats. The specter of post-truth has not only created a new set of environmental concerns (such as the shift toward even greater climate change denial in the USA), but has also undermined the very notion of what it means to be an expert. Rarely have science and expertise been so questioned, diminished, and vulnerable as they are today. These changes have surfaced at a time when more people than ever are able to produce and circulate their own forms of knowledge across various media platforms. Knowledge claims about the environment – wherever they come from – face “post-factual” ways of being dismissed (Lockie 2017). This book, which grapples with questions about the production of knowledge, and the place of science within society, is thus well timed to respond to these debates.

Toxic Truths examines the role of science, politics, and values in the global struggle against environmental injustice, from e-waste extraction in urban Ghana to “strongly participatory” citizen science in southern France; from toxic tours in Ecuador to “soft confrontation” in China. By using the phrase “toxic truths” we highlight the heterogeneity of perspectives about pollution, which are rarely fixed, certain, or uncontested. Yet we also acknowledge that not all understandings of pollution are rendered equal: some toxic truths are given elevated status, while other perceptions of pollution are sidelined. It is not just multiple truths about toxic pollution and the environment that exist, but also political ecologies in which the silencing of certain truths may have toxic consequences. Which truths count and which are ignored is a central question within environmental justice and citizen science in a post-truth age.

The contributions in this book argue for the importance of science, knowledge, and data that are produced *by* and *for* ordinary people living with environmental risks and hazards. Yet we are also attuned to the fact that data alone will never be enough to halt environmental injustice, especially as toxic pollution is so embedded within global and local structures of inequality (Boudia and Jas 2014). We highlight inspiring case studies of community-based participatory environmental health and justice research; different ways of sensing, witnessing, and interpreting environmental injustice; political strategies for seeking environmental justice; and ways of expanding the concepts and forms of engagement of citizen science around the world. We emphasize the enduring legacies of environmental justice activism and participatory citizen science, while also drawing attention to emerging struggles and strategies. Together, these interdisciplinary contributions ask critical questions about how to overcome widening environmental inequality around the world, pushing the analytical boundaries of existing concepts and practices within the environmental justice movement. By examining the enduring salience of expertise in everyday life, the

contributors to this book underscore the importance of environmental justice and public engagements with science in a post-truth era.

Environmental justice: an incomplete history

Environmental justice is an affirmation of an unequal present and a yearning for a better future. In this sense, the movement and discipline are both utopian and dystopian. The terms *environmental justice* and *environmental injustice* are difficult to define, being variously descriptive, normative, hopeful, pessimistic, political, and mobilizing (Holifield et al. 2018). To paraphrase David Schlosberg (1999), there is no such *thing* as environmental justice: much like the term “environmentalism,” any attempt to pin down the concept in a definitive manner necessarily excludes an array of other definitions. Arguably, the breadth and flexibility of the term explains its enduring appeal. At its core, environmental justice is based on the principle that all people have the right to be protected from environmental threats and to benefit from living in a clean and healthy environment.

Early environmental activism and research focused on the disproportionate burden of environmental hazards near to ethnic minority and low-income communities, linked to the concept of environmental racism in the United States (see Bullard 1983, 1990; Bullard and Wright 2009; Agyeman et al. 2016). The report *Toxic Wastes and Race in the United States* (1987), by the United Church of Christ Commission for Racial Justice, gained wide public attention as the first study to document national patterns of racial discrimination in the siting of hazardous waste facilities. In 1991, leading environmental activists of color gathered at the first People of Color Environmental Leadership Summit in Washington, DC and adopted 17 principles of environmental justice, which continue to inspire generations of environmental justice activists (see Pellow 2007). Since the early 1990s, the language and frame of environmental justice has expanded, spreading *horizontally* to a broader range of issues and places, *vertically* to the global scale of environmental injustices, *conceptually* to include the human relationship to the nonhuman world, and *temporally* to consider future generations and longer time scales (Almond 1995; Meyer and Roser 2010; Nixon 2011; Schlosberg 2013; Martinez-Alier et al. 2016; Davies 2019). Such is the reach of the concept that environmental justice activism and scholarship “has now expanded to encompass almost everything that is unsustainable about the world” (Holifield et al. 2018, 2).

In historical terms, the environmental justice movement is a relatively recent phenomenon – a “millennial” movement – born in the 1980s out of the civil rights, anti-toxics, and community health movements in the USA. Although the

academic discipline of environmental justice is reasonably new, environmental violence and inequality are certainly not recent occurrences. Contemporary hazards such as microplastic contamination, nuclear radiation, and e-waste seem to embody our late-modern age, but the existence of waste and pollution pre-exist the dawning of the so-called Anthropocene (Alexis-Martin and Davies 2017). Despite claims that we have entered a “new age of toxicity” (Walker 2011: xi), our relationship with environmental pollution is built on centuries of unequal social relations. As Pellow (2018, 9) argues, there is a “long environmental justice movement” which predates the first well-documented grassroots toxic struggles in the USA, such as the Warren County protests in 1982, or the Love Canal disaster in 1978. The *longue durée* of the environmental justice movement can be traced back to other moments and struggles, including indigenous involvement in the Earth Day protests of 1970, or the Memphis Sanitation workers strike in 1968 (Zimring 2015). Casting our net wider still, this extended view of environmental justice presents the movement as not just a product of the 1980s or “a child of the sixties” (Guha 2014, 1), but the culmination of environmental history that stretches back much further in time and space. Just as environmental pollution can reveal its consequences slowly over time (Nixon 2011), a corollary can be found with the environmental justice movement, which emerged gradually and is still unfolding today.

Writing in the late nineteenth century, sociologist W. E. B. Du Bois published what could be considered an environmental justice study of Philadelphia (Du Bois 1899), and scholars have found documents that evoke environmental justice themes from hundreds of years prior. For instance, writings in the wake of a yellow fever epidemic in 1793 are possibly “one of the earliest environmental justice documents” (Taylor 2011, 280), and over a century before this, toxic factories were being relocated near black communities in what is now Manhattan. In England, the first extensive environmental inequalities triggered by the Industrial Revolution and the squalor of rapid urbanization were met by protest in 1831, with “cholera riots” throughout many towns and cities (Porter 2005), as well as artistic invocations of the environment through the wistful words of William Wordsworth (1770–1850) and the bucolic romanticism of William Morris (24 (1834–1896), among many others. Beyond Europe, others have argued that environmental injustice and subaltern environmentalism are as old as colonization itself, with environmental inequality being a cornerstone of settler/colonial governance since at least the seventeenth century (Whyte 2016; Murphy 2017; Pellow 2018; Pulido and De Lara 2018; Sealey-Huggins 2018). Though some have highlighted the emergence of a “green imperialism” since the early 1700s (Grove 1996; Bonyhady 2003), others have argued – more convincingly, we feel – that “a core component of European colonization was the

production of many environmental injustices, as people and land were exploited for the benefit of colonizers" (Pellow 2018, 9). Toxic pollution is entrenched within the long injustices of colonialism, racism, and the patriarchy "that require land and bodies as sacrifice zones" (Liboiron et al. 2018).

Not only is the history of environmental justice temporally deep, it is also geographically diverse and still expanding. Any account of environmental justice will therefore remain incomplete, not least because it is still being written. Right now, across the world, thousands of communities are embroiled in the midst of ongoing toxic struggles. Environmental justice also belies its seemingly American past, and today it is increasingly clear that "the concept has travelled to different places" (Holifield et al. 2018, 2). Despite scholarly work on environmental justice remaining skewed toward American case studies (Reed and George 2011), many scholars have demonstrated how issues of environmental justice are truly *global* in nature (Walker 2009a; Armiero and Sedrez 2014; Guha 2014; Pellow 2018). This book adds empirical credence to this, with case studies from twelve countries spread across five continents. Through these chapters we will see how environmental justice is spatially dispersed, reaching far beyond the confines of the USA and the racialized geographies of the Deep South where the phrase "environmental justice" was first coined (Bullard 1990).

As Robert D. Bullard, who is often noted as the father of the discipline, has argued in his pathbreaking book *Dumping in Dixie* (1990), environmental pollution and toxic dumping have always followed "the path of least resistance" (Bullard 1990, 3). Environmental injustice and toxic pollution not only reflect social inequalities, they also sustain them. Some have argued that environmental justice should be viewed as "deeply intersectional" (Malin and Ryder 2018), not only because the experience of pollution rarely fits neatly into isolated silos of social injustice – along traditional lines of race, class, gender – but also because of the changing material complexities of pollution itself, where *multiple* toxicants often overlap, interconnect, and intersect in unpredictable ways. Other aspects of environmental injustice, however, have remained tragically entrenched. More than three decades after the first wave of environmental justice research, the same toxic geographies in the Deep South that inspired this movement are still being exposed to high levels of chemical pollution and the barely concealed violence of environmental racism (Davies 2018, 2019). Power and politics have always been central to the story of environmental justice. Across the world today, many years after Bullard's pioneering work, the ubiquity of pollution is only matched by its unevenness.

What do we mean by justice?

Environmental justice is an empirically grounded or “shoe-leather” discipline, emerging from the real-life problems and harsh realities of grassroots activism. As such, environmental justice scholarship has “always worn its normative heart on its sleeve” (Edwards et al. 2016, 754), less concerned perhaps than other disciplines with finer semantic points, such as the meaning of the term “justice.” When scholar-activists have been confronted with the actualities of environmental violence and seen first hand the damage that toxic inequality can cause, it is little surprise that much research has focused on the resistive potential of creating “facts” about pollution, rather than the philosophies of what “justice” might actually look like. In doing so, earlier environmental justice research has “assumed that *injustice* is self-evident and unproblematic” (Walker 2009b, emphasis added).

But what does “justice” actually mean within environmental justice? Increasingly, academics have questioned the meaning of “justice” within the uniquely interdisciplinary practice of environmental justice scholarship (e.g., Ottinger 2017; Pellow 2018; Allen 2018), with some suggesting that the intricacies of actually-existing environmental justice highlight the inherent multivalence, plurality, and diversity of what “justice” can actually mean (Schlosberg 2004). When it comes to the lived experience of environmental injustice, there can in fact be “multiple, even incommensurable, variations of justice” (Lyons 2018, 421). Likewise, other scholars have highlighted the overlap between differing types of injustice, suggesting “different forms of injustice tend to maintain and reinforce each other” (Bell and Carrick 2018, 102). Broadly speaking however – and to give context to the interventions made in this book – we highlight three significant lenses through which justice has been approached within environmental discourse: distributive (geographical); procedural (participatory); and capabilities (well-being). Elements of all three versions of justice can be found throughout the case studies presented in *Toxic Truths*.

The first tranche of environmental justice scholarship, for example, highlighted *distributive* notions of justice: that is to say, they were concerned with the geographic placement of environmental hazards in relation to marginalized communities (Bullard 1990; Cutter 1995). The unbalanced geography of environmental hazards, which shifts with the contours of race and class, provided the initial motivation for environmental justice research, and pioneering studies within this interdisciplinary field found that “blacks and other economically disadvantaged groups are often concentrated in areas that expose them to high levels of toxic pollution” (Bullard 1990, 6). In this book, Roberto Pasetto and

Ivano Iavorone ([Chapter 9](#)) follow this distribution orientated form of justice, with a focus on polluted sites in Italy. Through an epidemiological analysis, they highlight how the placement of environmentally hazardous industry disproportionately impacts women, children, and ethnic minorities. Anneleen Kenis also touches on the theme of distributive justice in her chapter on air quality in Antwerp and London ([Chapter 13](#)). She highlights how the scale and geographies upon which distribution is measured are a politicized phenomenon: “there is not just one space, not just one environmental justice that can be claimed, but rather a continuous negotiation about where to draw the fault lines.” Using geographic distribution as a cornerstone of environmental justice has been criticized, however. As Walker described, “without carefully reasoned accounts of the ways in which socio-environmental inequality mattered and ‘injustice’ was being produced, the value of revealing difference was severely diminished” (Walker [2009b](#), 204). The need to expand ideas of justice beyond distribution was emphasized further when environmental justice scholarship moved beyond the highly racialized geographies of the USA.

A further body of environmental justice research places justice as a *procedural* concern. This form of environmental justice was born out of participatory democracy, and places the focus of justice squarely on access to decision making and accurate information upon which to base decisions (Yenneti and Day [2015](#)). The procedural turn within environmental justice also came from the realization that decisions about environmental burdens are often made by the people who are least likely to be directed affected by them, or who may even derive benefit (Bell and Carrick [2018](#)). As Bullard and Johnson ([2000](#), 7) explain, procedural justice is centered around the “meaningful involvement of all people regardless of race, colour, national origin or income with respect to the development, implementation and enforcement of environmental laws, regulations and policies.” This move from a distributional to a procedural logic of justice, which involves public hearings and access to reliable information, is predicated on the redistribution of power relations (Pellow [2018](#)).

In this book, Barbara Allen’s research in southern France most closely aligns with this form of justice ([Chapter 2](#)). Allen’s contribution highlights how strongly participatory science can produce more sustainable outcomes, and thus become “an incredible tool for shaping local and even national environments.” Likewise, Peter Little’s chapter on e-waste pollution in Ghana ([Chapter 6](#)) discusses the how grassroots (re)presentations of pollution through participatory photography can help “democratize science.” As a criterion for recognizing systematic wrongdoing, procedural justice also relates to the *recognition paradigm* of environmental justice (see Whyte [2018](#)). However, this interpretation of justice has been criticized for relying too heavily on appeals to the state for recompense,

when – paradoxically – it is the state that is often the *source* of hegemonic environmental violence. As is so often the case, “the state and its related systems are part of the structure of toxicity that allows the ubiquity and tonnage of toxicants to be produced and circulate in the first place” (Liboiron et al. 2018, 336). In other words, pursuing environmental justice through a procedural lens places too much weight on the hope that the state and the legal system will ultimately – through policy change, advocacy, and the enforcement of regulations – protect those it is currently helping to injure. In this book, Xinhong Wang and Yuanni Wang address this tension through the notion of “soft confrontation” (Chapter 10), highlighting how activists in China have to confront very carefully forms of pollution that are ultimately linked to a repressive government. Yet neutralizing justice to only mean involvement in decision making can also stifle the significance of environmental justice struggles. As Ambriz and Correia (2017, 54) argue, “representation and participation, however important, are never enough.”

The third major form of justice that we highlight here takes inspiration from American philosopher Martha Nussbaum (2011) and Indian economist Amartya Sen (2009) and is concentrated on *capabilities*. The capabilities approach to justice is centered around the ability of individuals to live freely and unhindered in the world, and, though linked to the location of environmental hazards, “is a thicker notion of justice than one concerned only with distribution” (Day 2018, 25). In short, a capabilities approach is about ensuring the well-being of a population, where “justice is not about achieving an appropriate distribution of things between people, but rather about people being able to live lives that they consider worthwhile” (Edwards et al. 2016, 755). In this sense, this form of justice relates more closely to the praxis of environmental justice, with its focus on the everyday abilities of people to live happy lives. In this book, elements of the capabilities approach to justice can be found in Elizabeth Hoover’s fascinating account of the Akwesasne tribe’s search for environmental justice (Chapter 11). Though the capabilities approach to environmental justice is, for some, a “core theoretical edifice within which to understand and theorize (environmental) justice” (Edwards et al. 2016, 758, parenthesis in original) others have criticized it for overly emphasizing *individual* experiences of environmental injustice (Dean 2009). The lack of attention to the wider community, as well as a failure to attend to the larger structural forces that sustain environmental inequality, is sometimes overlooked.

This also allies itself with Pulido’s long-standing critique of environmental justice: that it has “focused largely on procedure and has not significantly tackled underlying structural inequality, regional capital investment patterns, or pollution reduction, and as such can only achieve marginal gains” (Pulido 1994).

The wider political scaffolding upon which environmental inequality is built is of key importance. As others before us have argued, environmental justice “epitomizes the tension at the heart of any radical normative project: its radical aspirations constantly come up against the constraints of what is politically possible to mainstream society” (Edwards et al. 2016, 766). The somewhat conciliatory approach of some forms of environmental justice have led other scholars to propose a more radical alternative (Pulido and De Lara 2018). For example, David Pellow proposes “critical environmental justice” (Pellow 2018) as a framework for addressing limitations and tensions within earlier generations of environmental justice research, foregrounding four pillars of critical environmental justice: (1) *intersectional* forms of inequality and oppression; (2) the role of *scale* in the production and possible resolution of environmental injustices; (3) recognition that social inequalities are deeply embedded in *state power*; and (4) *indispensability*, arguing that “excluded, marginalized, and othered populations, beings, and things … must not be viewed as expendable but rather as *indispensable* to our collective futures” (Pellow 2018, 26). Drawing on the three different meanings of justice outlined above, we now turn to the practice of seeking environmental justice through public and participatory engagements with science.

Environmental justice and citizen science

Environmental justice activists typically adopt dual orientations toward science, of mistrust and reliance: (1) challenging the methods, questions, and uses of science, particularly in the context of vested corporate interests, while (2) relying on science itself, as a necessary tool to make investigations, provide evidence, and make arguments. Many environmental justice scholars have embraced the term “citizen science” as a way of describing community-based participatory science to tackle toxic problems (Ottinger 2017; Martinez-Alier et al. 2016; Gabrys et al. 2016). Other environmental justice researchers use different terms for similar practices, including “civic science” (Fortun and Fortun 2005; Wylie 2018), “popular epidemiology” (Brown 1993), “street science” (Corburn 2005), “community-based participatory research” (Allen; Brown et al.; Rhodes et al.; Shamasunder et al., this volume), and “participatory sensing” (Loreto et al. 2017), among others. Wylie (2018) proposes that “civic science” could help to distinguish between grassroots-led and professional science-led kinds of citizen science, and also to get away from the language of “citizens.” We recognize the limitations of citizen science as a concept, but we nonetheless use this term as a shorthand description for a wide range of public engagements with science within environmental justice struggles.

Citizen science has become a popular concept within academic research, activism, and public engagement worldwide (Riesch and Potter 2014). The term “citizen science” was originally coined by the British Science and Technology Studies scholar Alan Irwin in 1995 to highlight the importance of citizen expertise and knowledge for environmental policy, particularly science produced by and for ordinary citizens. Around the same time, American ornithologist and participatory research organizer Rick Bonney (1996) used the term “citizen science” to refer to scientific projects in which the public is involved in data collection for scientific research, for example to report observations of birds, wildlife, and plants. Strasser et al. (2018) trace two distinct historical precedents for the emergence of these different types of citizen science: the radical science movements from the 1960s and 1970s, on the one hand, and amateur naturalists, on the other. Reflecting its origins, citizen science today encompasses different levels of public engagement with science, from data sensing and crowdsourcing (see de Albuquerque and de Almeida, this volume) to deeply participatory research including the design, collection, and analysis of research (see Allen, this volume).

Within the radical science movement tradition, citizen science emerged out of calls for the democratization of science and expertise to include perspectives from wider publics (Irwin 1995). For decades, scholars of science and technology studies (STS) have argued that scientific expertise is highly political and embedded in power relations (Irwin 1995; Epstein 1996; Fischer 2000; Frickel et al. 2010). With its calls for epistemic democratization, some commentators have suggested that STS is implicated in post-truth politics, an allegation that many STS scholars refute (see Collins, Evans, and Weinel 2017; Sismondo 2017). For example, Frickel (2017, 2) highlights an important difference between the early science movement and the US March for Science in 2017: “today’s science movement is not contesting what shapes scientific questions, methods and uses as it did in the 1970s. Rather, this mobilization is responding to what many see as a growing threat to science itself.” Reflecting on issues of trust in science, Collins et al. (2017: 582) remark that in STS debates, “understanding who can legitimately contribute to expert debate requires social scientists to use their special understanding of the formation of knowledge to reject the misuse of expertise by certain elite experts and give credit to the work of low status, experience-based experts.” Similarly, Allen (in this volume) argues that “the kinds of new knowledge that residents of environmentally compromised communities produce, while different from the science they are arguing against, are substantively and categorically opposite from the popular press version of ‘alt facts’ in our post-truth era.”

Drawing upon research projects spread across five continents, *Toxic Truths* interrogates several ways that local communities, residents, and activists engage

with science. We foreground many community-based participatory research projects that align with different typologies of citizen science, across a continuum of levels of participation (Haklay 2013). Yet, through attending to the power of embodied experience and witnessing pollution and the politics of science, we remain critical about the capacity of citizen science to enact environmental justice. As others have noted (see Chilvers 2008), caution is needed when viewing public participation as a panacea for solving environmental inequalities – not least, due to the ever-increasing professionalization of citizen-led processes, with participation itself “becoming a lucrative industry” (Castree 2016, 411). Consequently, this book seeks to expand concepts and methods of citizen science, unpacking assumptions and questioning conventions. The contributors interrogate the meaning of “justice” within the environmental justice movement (see Chapter 2), and question the role and interpretation of citizenship within citizen science research (see Chapter 11).

The use of citizen science in environmental justice creates a tension between, on the one hand, producing contextual, embodied knowledge rooted in subjective experience that can aid environmental justice advocacy, and, on the other hand, producing knowledge that will be regarded as rigorous, trustworthy, and suitably scientific. These tensions are all the more pertinent in a post-truth age.

Tackling environmental injustice in a post-truth age

Questions over trust in science, facts, and values have always been central to environmental justice struggles. These questions have endured and intensified in recent years. What, if anything, is different for grassroots environmental conflicts in a post-truth context? According to Mair (2017, 4), the invocation of post-truth presents a “new phase in an ongoing struggle – over theories of truth, belief and knowledge, in the context of a radically altered information environment.” The post-truth age was heralded by the 2016 election of Donald Trump and the UK vote for Brexit, but the idea of post-truth has a longer history. According to the Oxford English Dictionary, “post-truth” was coined in 1992 in an article about the Persian Gulf War and Reagan in the *Nation* by Serbian-American playwright Steve Tesich (Kreitner 2016). The term gathered pace in subsequent years, reaching fever pitch in 2016.

Post-truth “emphasises the weakness of factual, science-based explanations in the face of strong narratives or a compelling story” (Berling and Bueger 2017). To put it another way, “the post-truth condition enables us to see more clearly the complementarity of politics and science as spheres of thought and action. Each in its own way is involved in a struggle for ‘modal power’, namely, con-

trol over what is possible" (Fuller 2018, 181). In the context of environmental justice struggles, where competing facts and values are brought to the fore, it is possible to see such questions through a post-truth lens.

While the "post-truth" label has stuck, there has been a backlash against the term for being elitist, asymmetrical, and derogatory (Collins, Evans, and Weinel 2017; Jasonoff and Simmet 2017). After all, truth has long been a contested terrain (Shapin 1994). Jasonoff and Simmet (2017, 752) argue that the idea of post-truth is ahistorical and remind us that "debates about public facts have always also been debates about social meanings, rooted in realities that are subjectively experienced as all-encompassing and complete, even when they are partial and contingent." To what extent is the terrain of struggle shifting?

Unlike other social movements, environmental justice has also become an academic field in its own right, where – in an ideal world – scholars, activists, and citizens coalesce around a shared goal. A rare blend of expertise and political mobilization is needed to achieve environmental justice, making the role of experts critically important (Ottinger and Cohen 2011). As Cole and Foster (2001, 20) suggest, the environmental justice movement can be likened to a river nourished by a series of tributaries, each one offering a different utilization of expertise. Yet we should be aware that "producing knowledge of environmental injustices has too often fallen short in helping rectify them" (Holifield et al. 2018, 9).

"Perhaps the notion that truth has been cast aside in the public sphere is itself at fault," Jasonoff and Simmet (2017: 752) argue: "The very idea of a 'post' implies a past where things were radically different, a past whose loss we should universally mourn." The authors make the provocative case to "restore truth to its rightful place in democracy" (2017, 751) and to engage "more energetically with the aims of truth-making" (2017, 766). In *Toxic Truths*, we take up this call. How can we engage critically, rigorously, and energetically with "the aims of truth-making" in the context of environmental justice?

Toxic and environmental health threats "are first and foremost political issues, involving economic and societal choices" (Boudia and Jas 2014: 23). At the same time, scientific knowledge and techniques "play a determining role in rendering the toxic world visible and in making the resulting issues public" (Boudia and Jas 2014, 2). The health risks of toxic pollution are often overlooked due to the problem of "undone science" (Frickel et al. 2010), scientific research that faces political barriers to being done, typically because it poses a threat to established authority. In a post-truth era where science itself is increasingly under threat, the problem of undone science is even greater.

However, reproducing data is not enough to create the political change necessary to prevent the circulation of toxicity. We know from climate change

consensus that scientific facts – no matter how convincing – will never be enough on their own. When it comes to seeking environmental justice, however authentic, peer-reviewed, and citizen-led the toxic truths are, if political structures go unchanged, environmental injustice will persist. Shapiro, Zakariya, and Roberts argue in this book ([Chapter 14](#)) that “the most open-sourced, inexpensive, accurate, and easy-to-build sensor will not amount to an environmental justice excalibur or a toxin deterring shield.” Indeed, the scholarly practice of environmental justice needs grounding in the harsh realities of persistent pollution. Too often, small-scale environmental justice victories and academic successes are positioned as panaceas for far-reaching environmental inequalities.

How can we tackle enduring and systemic environmental injustice? Despite the use of participatory citizen science in environmental justice activism, not all efforts lead to political change. Allen (this volume) addresses this challenge by posing the important question: “What kind of science can serve as ‘change-agent’ knowledge – what are the ingredients that can facilitate action?” Several of the chapters in *Toxic Truths* address this question. The interdisciplinary contributions negotiate local and global environmental justice challenges, including toxic exposures, air pollution, and chemical contamination, among others, in rich, empirical detail. The authors draw on a range of qualitative and quantitative social science methods, including community-based participatory research (CBPR), epidemiology, ethnography, visual methods, and other innovative methods of participatory environmental justice and citizen science research. This book therefore mirrors the “methodological pluralism” (Holifield et al. [2018](#), 3) that environmental justice research has been famous for, spanning quantitative and qualitative, ethnographic and activist approaches. These environmental threats are often inflicted on the world’s most marginalized groups, with race, class, indigeneity, citizenship, and other social markers all shaping the topographies of environmental injustice (Pellow [2007](#)). *Toxic Truths* offers inspiring cases of tackling environmental injustice, including the public discovery of emerging contaminants of concern; the power of embodied, contextual knowledge in different local communities with heavy toxic burdens for shaping public perceptions, policy, and activism; the use of sensing to monitor pollution in contaminated communities; and the role of political strategies alongside the use of scientific evidence in environmental justice campaigns.

Structure of the book

Toxic Truths is split into four interconnected sections, each one linking to the next. [Part I](#), “Environmental Justice and Participatory Citizen Science,” presents

four empirically rich case studies of pioneering community-based participatory environmental justice research; **Part II**, “Sensing and Witnessing Injustice,” focuses on the innovative methods and embodied senses that members of the public and academics have adopted to bear witness to, measure, and understand environmental injustice; **Part III**, “Political Strategies for Seeking Environmental Justice,” showcases how pollution can become political, through examples of citizen science projects and environmental inequalities mobilizing and politicizing communities, leading to various acts of resistance; and finally, **Part IV**, “Expanding Citizen Science,” explores the possibilities as well as limitations of citizen science for achieving environmental justice, in conceptual, pedagogical, and political terms.

In the first chapter, Phil Brown, Vanessa De La Rosa, and Alissa Cordner examine the impact of social movements on environmental policy and science, demonstrating how power is embedded firmly within the production of scientific knowledge. They discuss the notion of *toxic trespass* – how industrial chemicals increasingly violate the borders of our bodies and environments. They also show how the continual industrial development of new chemicals has placed citizens at the forefront of science. The authors look in detail at a significant set of hazardous chemicals that are coming to attention – per- and polyfluorinated compounds (PFAS) – and explore the important interconnections between scientific discovery, environmental justice activism, and the political, social, and economic components that reproduce and resist chemical hazards.

Continuing the theme of collaboration between civic organizations and scientific experts, Barbara Allen puts forward the notion of *strongly participatory science*, and details an exemplary community-based project in a polluted industrial zone near Marseille, France. Discussing her long-term collaborative research in the region, she demonstrates how the co-production of environmental knowledge with local communities can create better scientific results, leading to what she calls “knowledge justice.” Allen demonstrates how the public can – and should – be involved at each stage of the research, from defining the environmental problem in the first place, to the data collection and analysis stages. The chapter argues that incorporating embodied public knowledge about environmental health, as well as working in deep collaboration with local communities, can strengthen science in areas of contested environmental risk.

Adding empirical weight to the notion of pollution trespassing the boundaries of human bodies and toxic geographies, Bhavna Shamasunder and her co-authors explore the environmental health impacts of neighborhood oil drilling in Los Angeles, California. Three quarters of the oil wells in Los Angeles are within 1,500 feet (457 meters) of homes, schools, hospitals, or playgrounds, and like many cases of environmental injustice, they are also unequally distributed along

race and class lines. This toxic problem has created a smorgasbord of health issues, with local inhabitants complaining of nose bleeds, asthma, infertility problems, and other illnesses, all linked to the dense concentration of urban oil installations. The authors used household surveys and low-cost sensor systems for their community-based research. The monitoring equipment was positioned and maintained by community members themselves, making this an interesting example of participatory citizen science research. The authors put the health concerns of local residents at the center of their work but argue that scientific data collection is just one part of a larger strategy to improve community health. In this fascinating example of a community seeking *crude justice*, the authors conclude by arguing that “community-academic collaborations [are] of continued relevance in on-the-ground struggles for environmental justice.”

While much environmental justice research has highlighted the distinctly *urban* aspects of toxicity, there are many forms of pastoral pollution that occur far beyond cities, towns, and urban spaces. Sarah Rhodes and KD Brown, along with their scholar-activist collaborators build on the theme of community-driven participatory research and explore the toxic realities of quintessentially rural issues. Moving the geographical focus to the countryside of North Carolina, they explore the environmental racism and pollution of the sprawling hog industry. The region they discuss has the highest density of pig farms in the USA, which has created a number of environmental and health problems. In the wake of Hurricane Florence in 2018, for example, satellite imagery released by NASA showed the scale of this environmental issue, with dark plumes of contaminated floodwater streaming far into the Atlantic Ocean. On the ground, however, the everyday realities of hog farm pollution are daily environmental concerns, with noxious smells, pathogenic microbes, nutrient pollution, and greenhouse gases all impacting the lives of local residents. The authors unpick the politics and environmental racism that is entrenched within the multibillion-dollar hog industry, arguing that “scientific evidence is silenced” in the post-truth era. Written by a coalition of local environmental activists and academics, this chapter draws on a wealth of grounded collaborative research experience. It sets out some key lessons, including the promotion of research equity and the importance of acknowledging the mistreatment of marginalized groups. Echoing Barbara Allen’s chapter in this volume, they also advocate for the close involvement of community members throughout all stages of the research process.

All four chapters in **Part I** share the community-based participatory research tradition of citizen science. These perspectives strongly defend science as a “necessary tool,” scientific argument as “obligatory,” and participatory citizen science as a robust mode of making change. The next part of the book, “Sensing and Witnessing Injustice,” takes a different approach. Here we see how scholars

draw on alternative senses and ways of understanding pollution, including the importance of touch and sight. The chapters in *Part II* discuss how different approaches are needed to make sense of environmental pollution in contested toxic geographies. This section of the book also shifts the geographic focus away from the Global North, to sites less well covered in the annals of environmental justice research, including critical research in sub-Saharan Africa and South America.

The polluted petrochemical landscape of the Ecuadorian jungle is the focus of Amelia Fiske's contribution, which begins *Part II* of the book with an account of "toxic tours." In rich ethnographic detail, she looks at the role of bodily knowledge in comprehending toxicity. Specifically, she examines the act of observing contaminated soil cores using an auger as a means of sensing – or touching – injustice. She explains that the embodied act of smelling, observing, and handling the polluted sludge "makes the toxic histories of oil extraction tangible." Such toxic encounters with the sticky materiality of oil makes the presence of pollution undeniable, allowing those on the tours to better experience what it is like to live alongside petrochemical facilities. By focusing on one prosaic object – the auger – Fiske brings questions of justice to the fore, suggesting that such tactile witnessing becomes part of an "evidentiary assemblage" which includes formal scientific knowledge, but also involves the human senses, memory, and narrative accounts of contested toxic geographies.

Shifting the sensorial focus from *touching* toxic pollution to rendering it *visible*, Peter C. Little draws on long-term ethnographic research in postcolonial Ghana, where he explores the role of participatory photography as a means of documenting environmental injustice in the informal e-waste industry. Focusing on Agbogbloshie – a scrapyard in the capital, Accra – Little explores the extent to which community-based photography augments contemporary environmental justice research. Resting at the intersection of environmental studies and citizen science, the chapter considers how e-waste workers photographically document the toxic risks that they are exposed to in their everyday lives, including circulating images of their own wounded bodies. Though it is profoundly challenging to visually represent structural violence, this form of participatory photography is presented as an alternative way of engaging with local knowledge and embodied experience.

Instead of visualization being used as a tool to explore environmental hazards, Marina Da Silva continues the focus on images by exploring the visual as a form of pollution. She discusses "visual pollution" in urban areas, specifically focusing on the Brazilian city of São Paulo. Da Silva examines the contentious "clean city law" (*Lei Cidade Limpaa*) which legislates against commercial advertisements and signage as well as unsanctioned street art. In 2007 São Paulo became

the first global city to ban adverts in public areas. Though much praised in the media as a radical and progressive move, this legislation took place in a context where other forms of toxicity, such as air pollution, were being sidelined. Like other forms of environmental harm, visual pollution is contested, with disputed thresholds and definitions: the boundary between street art, graffiti, and state-sanctioned advertisements is highly unstable. Drawing on her own visual methodology, Da Silva demonstrates how the contours of visual pollution are subjective, with what “counts” as pollution remaining distinctly political. As is often the case, the legal attempt to control the geographies of pollution also had social consequences. Echoing the “ugly laws” that sprang up in cities across the USA in the early twentieth century (see Schweik 2009), the populist environmental agenda that developed the “clean city law” in Brazil further marginalized the city’s homeless population, who were considered antithetical to the city’s desired aesthetic. This chapter comes at a critical juncture in Brazil’s relationship with the environment: in 2019, Jair Bolsonaro became Brazil’s first “post-truth” president, after running on a populist platform of racism, homophobia, and climate change denial. Environmental justice, beyond that of visual pollution, is an increasing concern in Brazil, with vast swathes of Amazonian rainforest at risk and the new regime threatening to open up indigenous land to exploitation and reduce environmental protections.

All three chapters in *Part II* of the book focus on the role of the senses, not only in exploring what can be defined as pollution, but also in extending the ways in which we can interpret and measure environmental harm. *Part III*, “Political Strategies for Seeking Environmental Justice,” does not take science as its main theme, but instead interrogates the *uses* of science, and the political strategies enmeshed around them. The chapters in this section discuss the terms of orientation to confrontation, from subtle acts of resistance against industrial pollution in China using gradual tactics of “soft confrontation,” to utilizing top-down national data in Italy to achieve environmental justice. Miguel López-Navarro starts *Part III* by investigating one of southern Europe’s largest petrochemical complexes, in Tarragona, northeast Spain. He analyzes how a local environmental group justified and articulated a discourse of confrontation with the regional government and heavy industry. This confrontation was based around an environmental air quality study that they promoted, which was carried out by allied scientific experts. Although the dominant academic discourse of business–NGO (nongovernmental organization) relations is one of collaboration, López-Navarro argues that deliberate confrontation can lead to advances in solving environmental issues. Confrontational stances toward toxic industry do not necessarily prevent successful dialogue or participation in multi-stakeholder deliberation, but can in fact have positive environmental outcomes.

Staying with the theme of investigating large-scale industrial areas, Roberto Pasetto and Ivano Iavarone use an epidemiological surveillance approach to understand the health impacts of contaminated sites in Italy. Placing their study within the history of environmental justice from the USA in the 1980s, the authors explore how communities that have become overburdened by the accumulation of pollution are often also socially deprived. While much environmental justice research adopts community-driven ethnographic perspectives, the authors suggest a “top-down environmental approach” can also be effective in revealing the impacts of toxic pollution and use data from a national monitoring system. Though a macro data approach may overlook the local complexities and unique histories of specific locations, large-scale epidemiological approaches can complement the demands of local communities for environmental justice.

While accessing data on toxic pollution is relatively easy in liberal democracies such as Italy or the USA, researching and resisting environmental injustice in more repressive states presents different challenges. Xinhong Wang and Yuanni Wang explore how communities in China confront environmental pollution. Despite a plethora of pollution concerns in the country, the concept of environmental justice has rarely been used explicitly within environmental civil society discourses in China (see Lora-Wainwright 2017; Mah and Wang 2017). This chapter focuses on a voluntary environmental protection organization in Hunan Province and its subtle strategies for seeking environmental justice. The authors examine the careful actions taken by this organization and its efforts to combat environmental pollution, framing these tactics of resistance as a form of *soft confrontation*. As they explain, such soft confrontation allows civil society to negotiate and “push back” against pollution from state-owned industrial facilities, without falling foul of the authorities. Notwithstanding the many obstacles to a fully independent civil society in China, the chapter demonstrates how environmental organizations are successfully able to promote environmental campaigns, often by collaborating closely with government institutions. In a semi-authoritarian context, these local environmental protection organizations must walk the tightrope of depoliticizing their pollution reporting activities while also subtly demanding change. This chapter demonstrates how confronting toxic pollution takes many forms.

The three chapters in *Part III* of the book deal with the notions of confrontation and collaboration. The chapters in *Part IV*, “Expanding Citizen Science,” also keep politics foregrounded, while focusing critically and reflexively on the role of citizen science in seeking environmental justice, in terms of its uses, its power, and its limitations. Elizabeth Hoover begins the last part of the book by critically interrogating what citizen science means to Indigenous communities

that see themselves as citizens of their tribal nation first, and of the settler nation second. By problematizing the notion of citizenship in a settler colonial context, Hoover asks important questions about the role of expertise and science, and considers the cultural, social, and political processes that structure research in Indigenous communities. Drawing on years of grounded community research, the chapter documents the experience of the Mohawk community of Akwesasne, a Native American tribe of about 15,000 people which straddles the international border between Canada and the USA. The search for environmental justice here is complicated by a jurisdictionally challenging situation: Akwesasne land is crisscrossed by three state governments, three tribal governments, and two federal governments. She examines how the tribe set out to determine the extent to which a local contaminated site was impacting community health by cooperating with a research university. Hoover describes how the tribe eventually partnered with the academics on the first large-scale environmental health community-based participatory research project in the area. Using interviews with community fieldworkers, study participants, and scientists, the chapter examines the successes and challenges of this collaborative project. Such collaborative and participatory research can blur the binaries between scientist and citizen, and between subject and researcher.

Building on the theme of critical engagements with citizen science, João Porto de Albuquerque and André Albino de Almeida discuss the concept of citizen science from a *pedagogical* perspective. They highlight how generating data through community involvement in science is just one aspect of its role in environmental justice movements, and different modes of sensing can be used to co-learn about the environment. In conversation with critical theoretical perspectives developed by Brazilian educator and philosopher Paulo Freire (1921–1997), the authors unsettle the asymmetrical relationship that often exists between citizen and expert. For example, one can question how *participatory* citizen science projects really are, where “more often than not, a small group of people (frequently, white and male) are much more actively engaged in shaping the project and making its most critical decisions.” Drawing on Freire, the authors argue that experts and citizens should “educate each other,” with dialogue enabling greater participation and equity in environmental citizen science projects. This theme resonates with Steve Wing’s (2005, 58) call for a “science of environmental justice.” Wing argues that different values and asymmetrical relationships between experts and citizens are important to recognize and address for seeking environmental justice: “Although scientists and communities facing environmental injustices share some interests, differences in their values and social privilege present barriers to the development of a progressive science of environmental justice” (Wing 2005, 62).

Reflecting on a different challenge for citizen science, Anneleen Kenis's chapter examines the difficult work of making pollution political, as a matter of concern (Latour 2004). Citizen movements are often forced to adopt different strategies to put environmental risks on the public agenda. In a comparative study of Belgium and the UK, Kenis explores this tension, discussing the translation and politicization of air pollution. In order for an entity like air to become politically salient, citizens have no choice but to engage with science, and Kenis explores the choices and discursive strategies that citizen movements make during this process. The chapter focuses on how different pollutants and spatial interpretations of toxic air can lead to contrasting forms of political action. Something as seemingly natural and invisible as air can be mobilized in different ways, depending on how the facts about air pollution are constructed. Ultimately, translating air into a political issue is a process that not only involves scientists, but also policy makers, citizens, and other actors.

Concluding this volume, Nicholas Shapiro, Nasser Zakariya, and Jody Roberts look "beyond the data treadmill," exploring the limits of deploying civic science tools to achieve environmental justice. Framing their discussion of citizen science around their own attempts to monitor and communicate toxic formaldehyde risk, the authors reflect on the fact that even the best, most accurate, and easy-to-use pollution sensor will not deter toxins or achieve environmental justice. In other words, creating data about pollution alone will not provide the answer. The authors emphasize how projects that engage with science in order to achieve justice – including citizen science projects – cannot fully escape reproducing hierarchies of knowledge and power. The authors warn that "we should be careful not to assume that providing new data will provide new political answers" and highlight the inherent power relations incumbent to science. They argue against a "politics of enumeration" and suggest citizen scientists look beyond the creation of toxic data, numbers, and exposure information to combat pollution. Instead, "extra-numerical evidentiary projects" that are less concerned with questions of quantity and more centered on social and political change may be more successful. The contributors do not *reject* citizen science in a post-truth age, but instead ask "Yes, and?," calling for a more expansive repertoire of interventionist practices that may help achieve environmental justice.

Overall, the chapters in this book provide rich accounts of environmental justice efforts to engage with science and other forms of expertise to tackle the toxic issues of our times. Although the contributors to *Toxic Truths* write variously from geographical, anthropological, sociological, STS, and activist perspectives, they are united in situating power, politics, and inequality as central to stories of toxic pollution and the attempts to achieve environmental justice.

The chapters capture the current contested realities of pollution in this uncertain age. Together, the contributors lay bare environmental inequalities that are in some sense a continuation of the toxic status quo, but also offer hope for a better, more equitable, and less polluted future.

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