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Earth system boundaries and Earth system justice: sharing the ecospace

Joyeeta Gupta[a], Klaudia Prodani[a], Xuemi Bai[b], Lauren Gifford[c], Tim M. Lenton[d], Ilona Otto[e], Laura Pereira[f], Crelis Rammelt[a], Joeri Scholtens[a] and Joan David Tàbara[g]

[a]Amsterdam Institute for Social Science Research, University of Amsterdam, Amsterdam, The Netherlands; [b]Fenner School of Environment & Society, Australian National University, Canberra, Australia; [c]School of Geography, Development and Environment, University of Arizona, Tucson, USA; [d]Global Systems Institute, University of Exeter, Exeter, UK; [e]Wegener Center for Climate and Global Change, Karl-Franzens-Universität, Graz, Graz, Austria; [f]Global Change Institute, University of the Witwatersrand, Johannesburg, South Africa; [g]Department of Geography, Universitat Autonoma de Barcelona, Barcelona, Spain

ABSTRACT

The literature on planetary and Earth system boundaries calls on humans to live within those boundaries. Sharing such limited ecospace raises questions of justice. Global environmental assessments and scholarship are increasingly paying attention to justice issues, yet inadequately define how to share the limited ecospace. Against this background we ask: how can global environmental assessments' concerns for justice be enhanced through an Earth system justice framework that guides how the global community could share limited ecospace? Based on an analysis of how justice concerns are addressed in the Assessment of Assessments and global environmental change projects, we build an Earth system justice framework that discusses how ecospace can be shared fairly through the setting of Earth system boundaries and the provision of minimum resource needs for all, and how this can be achieved through an equitable redistribution of resources, rights, and responsibilities focused on addressing inequality, overconsumption, and harmful accumulation.

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1. Introduction[1]

Since 1950, increasing resource use and waste has impacted the Earth system and society across scales, harming humans and nature (United Nations Environment Programme [UNEP] 2019. This has led to proposals for planetary/Earth system

CONTACT Joyeeta Gupta j.gupta@uva.nl

boundaries (Rockström *et al.* 2009, Dyckman 2020) which limit the available ecospace – '. . . the space that people can use if they want to sustain the earth's resources and continuously reuse them' (Gupta 2016, p. 272). This ecospace can be shared in more, or less, equitable ways (Gupta 1998).

Much of this ecospace has already been unequally divided through colonialism, land grabs, and unbounded economic growth. While since 1950, average GDP has grown, trade and the economy has increased by 10 and 5 times respectively, and extreme poverty has declined (Piketty 2014, UNEP 2021), inequality in resource use, pollution (Milanovic 2013) and exposure to pollution have also grown (Gupta *et al.* 2019). Despite action from environmental justice movements and governments (Berkhout *et al.* 2021, Dale 2021), opposition to government regulation, exploitation of the commons, and cuts to social programs, many associated with neoliberal ideas, have furthered degradation and inequality (Blaikie and Brookfield 2015). Finding just ways to live within the ecospace remains an enduring challenge.

Four reasons justify sharing ecospace. First, a limited ecospace calls for finding transformative ways for sharing it (Rammelt *et al.* 2022) including a rethinking of market mechanisms to allocate scarce resources. These mechanisms often lead to increased resource prices, making them unaffordable for the many, and concentrating capital and wealth. For example, water privatization in many regions has created water stress for poor farmers (Bakker 2003).

Second, the need for just approaches is increasingly demonstrated in global assessments of scholarship on environmental issues and global governance work (see sections 2 & 3 below), legitimizing further work in this field. Third, this broadbased scientific consensus is also supported by the global political consensus in the 2030 Agenda for Sustainable Development (United Nations [UN] 2015) which calls for reducing inequality and simultaneously addressing social, ecological and environmental challenges, and in human rights, transboundary water and environmental treaties. Finally, considering justice may increase the chances of broad public acceptability of necessary measures (UNEP 2021). Behavioural experiments show that perceptions of fairness among the parties involved can lead to norms that motivate collaboration and restraint from overharvesting while increasing inequality may lead to vicious cycles of overexploitation and resource scarcity (Liebrand *et al.* 1986, Gampfer 2014, Owusu *et al.* 2019).

Hence, we ask: How can global environmental assessments' concerns for justice be enhanced through an Earth system justice (ESJ) framework that guides how the global community could share and flourish within the limited ecospace?

The scope of this paper is limited. In choosing assessments as a starting point, we are building on how justice scholarship is moving from niche to mainstream in environmental assessments and global governance scholarship. Section 2

examines how the 'Assessment of Assessments' (UNEP 2021) – frames justice. Section 3 surveys the growing focus on environmental justice concerns within the epistemic communities working on global environmental governance; and Section 4 extracts the core common elements of justice from the previous two sections as critical elements of our perspective on Earth system justice. Our aim is to make proposals that can work within the existing institutional framework.

Our Earth system justice (ESJ) proposal aims to define the safe and just boundaries that can define the ecospace, and share the ecospace substantively through access to minimum resources and allocation of the remaining resources, risks and responsibilities. ESJ has emerged from several years of research and conversations among social and natural scientists from the the Global North and South and is part of the ongoing work of the Earth Commission. ESJ goes beyond planetary justice (Biermann and Kalfagianni 2020) to be explicit about goals and governance interventions. ESJ also recognizes the legitimate critique that there is no singular 'anthropos' that has caused the current sustainability crisis and that this needs to be recognized in how we address justice and equity in the Anthropocene (Preiser *et al.* 2017).

2. Environmental assessments call for just transformations, not concrete visions on how to share the global ecospace

The global community has synthesized environmental scholarship for three decades. Making Peace with Nature (MPN) (UNEP 2021) reviewed 25 assessments (including on climate (IPCC), biodiversity (IPBES), environment (GEO) and resources (IRP)) to send an integrated message to the UN conference celebrating 50 years since the first Stockholm conference on the Human Environment in 1992.

MPN finds that three interlocking crises – climate change, deforestation and land degradation, and biodiversity loss – reduce human wellbeing now and into the future. MPN calls for rapid reductions in resource use and pollution. It recognizes the need for just approaches and references justice-related terms frequently: inequality 54 times, equal (70), equity (50), access (119), just (219), transformation (124), fair (19), justice (3), allocation (1), benefit sharing (1) times. Despite this, MPN does not explore what justice might entail; who is accountable for environmental damage, where and how; how to address inequality in resource use and pollution; and how just transformations can be realized. This may be because many scholars see justice as normative, justice scholarship is often philosophical and discursive, the selection criteria for reviewing relevant justice issues may be limited. However, MPN presents some clear messages:

First, *environmental degradation undermines the achievement of the SDGs and their goals of eradicating poverty and hunger, ensuring resource access for*

all, and reducing inequality. MPN argues that 'the burden of environmental decline is unjustly distributed' (p. 51) and threatens 'the achievement of SDGs' (p. 27). It states that 'Inequalities in environmental opportunities and burdens along ethnicity, gender, race and income levels hamper efforts to reduce inequalities within and among countries (SDG 10)' (p. 25), may exacerbate social conflict (p. 34) and increase infectious disease. (p. 35, 25) Second, *environmental degradation exacerbates vulnerability*. MPN discusses the injustices associated with vulnerability to harm from environmental change. The poor and otherwise disadvantaged are disproportionately harmed by environmental change (Eakin and Luers 2006), while they maybe less responsible for such harm. MPN argues that vulnerability results from 'socioeconomic developments, such as in population, trade, consumption and inequality' (p. 87) and that 'inequalities start at birth and accumulate through life in all countries' (p. 58). Recognizing that vulnerability is not innate and that environmental degradation exacerbates inequality is a first step towards arguing about what needs to happen.

Third, *reducing inequality and addressing vulnerability requires addressing issues of access to resources and services and supporting livelihoods*. MPN recognizes that 'Removing inequality requires steps to address individual and community property rights, persistent poverty, hunger, education, equity and inclusion in resource management' (p. 34), especially for local communities and small-scale artisanal fisheries (p. 122). This requires meeting access to clean water (p. 121), clean and affordable energy (p. 17, 35), 'basic nutritional requirements', access to 'long-term employment, adequate income and dignified and equal working and living conditions for everybody involved in agricultural value chains' and enabling people to cope with 'strong price fluctuations' (p. 152, 34). The report thus elaborates on meeting minimum access issues but does not really show how inequality can be addressed.

Fourth, *although inequality is addressed more in terms of meeting minimum needs than in terms of changing the allocation of responsibilities, risks and resources, it provides hints about what changing such an allocation may mean*. Beyond minimum access, MPN does not discuss allocation mechanisms except for 'changing dietary choices and consumer behavior in high-income countries and groups' (p.16) and that SDG achievement 'will require large changes in economic activities, national accounts, financial systems and governance. Securing equitable access to goods and services while averting dangerous climate change and avoiding environmental harm will require major structural changes in economic activities' (p. 119). MPN proposed 'Measures to prevent and reduce conflict include supporting co-management regimes for collaborative water management, fostering equity between water users (while maintaining minimum flows for aquatic ecosystems) and promoting transparency and access to information' (p.130). Equitable sharing of

water and biodiversity is mentioned (p. 130) while on climate change, the report states that 'rapid reductions' of emissions are to be achieved 'on the basis of equity, and in the context of sustainable development and efforts to eradicate poverty'. 'The connections between eradicating poverty and reducing inequality and addressing climate change are embedded in the sustainable development goals' (p. 68). Thus the report emphasizes in different places that systems need to change and provides some hints but does not create a systematic narrative.

Fifth, MPN calls for *just transformations*. Its authors argue for alternative measures such as 'a Genuine Progress Indicator to correct GDP . . .' (p. 33). Transformation of the food, water and energy systems must occur 'in an equitable, resilient and environmentally-friendly manner' (p.16), address drivers (p. 54) and 'major shifts in investment and regulation are key to just and informed transformations that overcome inertia and opposition from vested interests' (p.15). It calls for education, knowledge generation and sharing but notes that this requires 'transformations in human health, equity and peace' (p. 103). MPN argues that 'Transformation can also enable the realization of the collective vision of a sustainable future for humanity, one that involves a rapid and thorough decarbonization, food security for all, an end to poverty, harmony with life on land and beneath the water, and substantial improvements in justice and fairness' (p.101). It highlights that 'A sustainable future is achievable, and it can be a just and prosperous one. . .' but that this 'requires the transformation of economic and financial systems' (p.119). Finally, 'participatory and equitable processes can raise public acceptance of transformative change' (p.104, 102, 129, 36, 133).

Thus, MPN shows that: (a) environmental degradation undermines SDG achievement; (b) vulnerability created by inequality makes environmental impacts worse and increases harm; (c) reducing inequality requires providing basic needs and services for all; (d), production and consumption patterns need to change; and (e) a just transformation is necessary and possible. It creates the groundwork needed for developing an Earth system justice narrative.

3. The rise of environmental justice concerns in global governance scholarship

3.1 Introduction

Making Peace with Nature shows that global assessments do account for some justice issues but do not address the full scope of global environmental justice. Different terms have been used to conceptualize justice but Figure 1 shows, based on a review of selected terms in SCOPUS that the term 'environmental justice' has become more acceptable and popular when

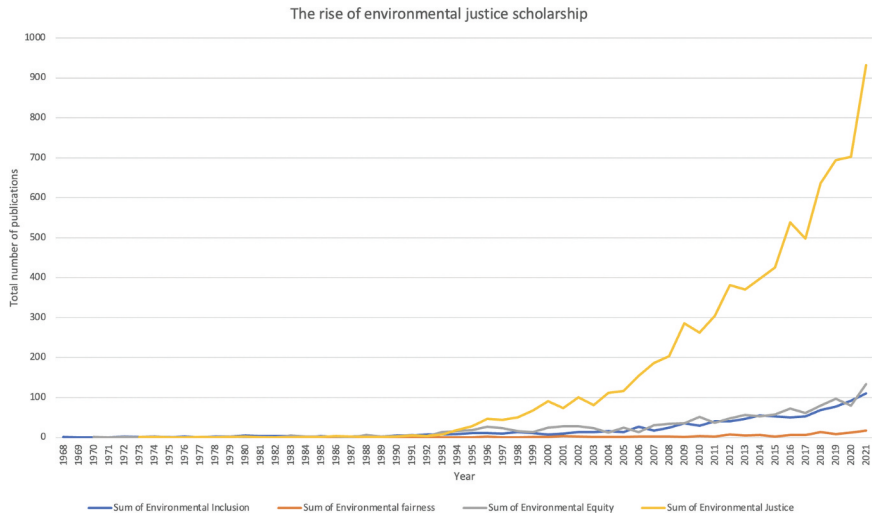

Figure 1. Rising scholarship on environmental justice.Note: The search was conducted on SCOPUS for the period 1968–2021 using the following search terms in titles, abstracts, and keywords: "environmental justice," "environmental fairness," "environmental equity," and "environmental inclusion."

compared to environmental inclusion, equity and fairness[2] and may also reflect the rise of environmental justice movements worldwide (Temper and Shmelev 2015).

Instead of examining the scattered justice scholarship, we focus on how environmental justice concerns have evolved within two global epistemic communities i.e. the International Human Dimensions Programme's (IHDP) project on Institutional Dimensions of Global Environmental Change (IDGEC) and the follow-up Earth System Governance project which falls under Future Earth – the world's largest social science network. These two programmes aimed to create a global epistemic community on global to local environmental change issues. The justice literature produced has been theoretical, discursive, focused on specific issues and solutions, but has been limited in terms of actionable suggestions as to how humans might equitably share its limited ecospace.

3.2 Environmental justice issues within IDGEC/ESG: From behavioral approaches via access and allocation to theorizing planetary justice

Behavioural approaches: The IHDP/IDGEC's New Institutionalist program (1995–2008) aimed to understand causality (how do institutions influence behavior), performance (why do some institutions work and some not) and design (how can one improve institutional design) (Young *et al.* 1999). The

scholarship revealed that 'justice' was implicitly addressed via discussions of international cooperation through collective action or social practice models (Young 2001). Collective action models build on the utilitarian logic of consequences by March and Olsen (1998) and focus on the rational actor maximizing net benefits through markets and market-based institutions, preferring smaller governments; this may lead to 'thin' market justice (Ehresman and Okereke 2015).

Scholars from the social practice school assessed whether action is appropriate and legitimate and how and which norms become institutionalized through customs or socialization; they call for constraining the market through social movements or through the regulatory authority of a legitimate democratic government. In 2009, the project ended by reviewing institutional scholarship on global environmental change and examining institutional performance, inter alia, in terms of equity (Young *et al.* 2008).

Operationalizing justice as access and allocation: Going beyond how institutions and people interact to solve problems, the follow up Earth System Governance (ESG) project focused on effective, efficient and equitable strategies for managing an increasingly unstable Earth system. ESG operationalized justice into access (to basic resources and services) and allocation of the remaining resources, risks and responsibilities (Biermann *et al.* 2009, Gupta and Lebel 2010). A review of ten years of ESG scholarship revealed that issues of access are prioritized over allocation (Kalfagianni and Meisch 2020, Gupta and Lebel 2020), not least as access has been included in the 2030 Agenda. This matches our analysis of how Making Peace with Nature addresses access and allocation.

Theorizing Planetary justice: Most recently, ESG scholars have called for 'a fundamental departure from old thinking about justice in 20th century "Holocene" terms' (Biermann *et al.* 2020, para. 3) and have set up the *Task Force on Planetary Justice Research*.) Planetary justice

> 'encompasses traditional concerns of environmental justice but foregrounds that the entire human and non-human world is now at stake, not merely a locality . . . goes beyond traditional understandings of ecological justice, which we see as a more ecocentric idea . . . [and], in contrast, is concerned with justice among humans as well as between humans and the natural world . . . [and] is equally concerned with the global and the local, with state and non-state actors, and with individuals and collectives' (Biermann *et al.* (2020, para 3).

It focuses on social-ecological systems and the resulting moral obligations across geography, time, and the community of life at a local to planetary scale (Dryzek and Pickering 2019, Biermann and Kalfagianni 2020, Dirth *et al.* 2020, Hickey and Robeyns 2020, Gupta *et al.* 2021).

Legal scholars are increasingly focused on planetary justice in the Anthropocene (Ebbesson 2010, Kim and Bosselmann 2013, Pereira 2014,

Kim and Mackey 2014, Lawrence 2014, Kotzé and French 2018, Kotzé and Kim 2019, Cardesa-Salzmann and Cocciolo 2019, Kotzé 2019, Stephens 2019). Kotzé and Kim (2019) conceptualize Earth system law in terms of regulatory object (spanning environmental, ecological and Earth law), and jurisdictional scope (international to planetary). They argue that international environmental law could transform into planetary Earth law through: (a) protecting individuals' environmental rights, rejecting the ecocentric-anthropocentric dualism in favour of life as social-ecological systems; (b) a future-orientation given unpredictable Anthropocene conditions (Bai *et al.* 2016); and (c) a move from ecological to geological timescales. Jurisdictional change would see a transformation from a state-centric order through a non-state-centric order to a planetary law paradigm. Other authors call for international environmental law to be embedded within an overarching goal, or *Grundnorm* (Cardesa-Salzmann and Cocciolo (2019); cf (Kim and Bosselmann 2013, Kim and Mackey 2014) as in its absence, international environmental law only manages the externalized risks of our economy and is currently embedded in particular understandings of private property and cost-benefit analysis. They call instead for a global environmental constitution (Kotzé 2019) and citizenship that is informed by planetary boundaries, the socio-environmental impacts of the global socio-economic metabolism (GSM), human rights and obligations, and global justice. There are also calls for translating planetary boundaries into legal boundaries (Chapron *et al.* 2017, Stephens 2019). This runs parallel to discussions that *human rights* law requires a new, 'Anthropocene-relevant reading' (Hey 2018) and that the *Declaration on Human Rights and Climate Change* sees human rights as indispensable to addressing climate change (Davies *et al.* 2017).

However, this growing convergence in global environmental assessments and scholarship on the need to incorporate justice concerns in the governance of global environmental problems has often been lost in discussions about what exactly is justice and has not always been accompanied by actionable, pragmatic suggestions as to how humanity might equitably share its ecospace through the existing international institutional architecture. The next section aims to address this gap.

4. Conceptualizing Earth system justice as a way to share ecospace

4.1 Multiple perspectives on justice

Justice is an essentially plural and multi-dimensional concept (Kalfagianni and Meisch 2020). Whereas some promote core common elements of justice (Wells 2008), others argue for plurality in justice (Schlosberg 2007) and call for critical climate justice scholarship to 'reframe mainstream debates to

usher in critical attention to social impacts, outcomes, and justice concerns' (Sultana 2022, p. 118). Moreover, while some scholars focus on the local level and critique the opaqueness and risks of global policies (Lövbrand *et al.* 2015, Boelens *et al.* 2018, Hulme 2020), others argue that in the Anthropocene one must also consider global justice issues (Kotzé and Kim 2019). Straddling both of these divides, we argue below that global environmental degradation and increasing inequality are best addressed by identifying some common elements of justice, which are both capable of cultural, religious, and philosophical contextual adaptation and exist within a broader framework of multiple value systems in order to ensure a stable Earth for human and non-human species' well-being. Such core values need to focus on how humans collectively share the ecospace.

We argue here in favor of an Earth system justice (ESJ) approach (Gupta et al. 2023) that builds on the consensus justice ideas as developed within MPN – environmental degradation undermining SDG achievement and exacerbating vulnerability, and the need to reduce inequality through providing access to minimum resources, changing production and consumption patterns, and promoting just transformations (see 2). We also recognize ideas emerging from global governance scholarship in terms of the need to operationalize through: finding grundnorms, enabling access and allocation, and recognizing the role of collective action and social practice models in solutions (see 3). Here we argue that an ESJ approach needs to start from defining safe and just planetary boundaries that then define an ecospace. It subsequently needs to meet minimum needs within such an ecospace. The remaining ecospace then needs to be allocated according to some fair principles. Clearly this will not be easy, as there may be legal (e.g. property rights to water, secretive investor-state contracts, unregulated privatization and land grabbing etc.), political (e.g. erosion of democracy, the rise of the far right), socio-cultural (marketing that promotes a consumer culture), and economic (the problem of stranded resources, technological and infrastructural lock-in, flawed metrics of growth) barriers. Below we define and share ecospace (see Figure 2).

4.2 Defining the ecospace: Earth system boundaries and the 3 I's of justice

Environmental scholars show that, following present consumption patterns, environmental degradation, and population trends, the world's ecospace is limited. But how limited is it? That depends on whether we take an anthropocentric perspective or go beyond it, rejecting human exceptionalism. Beyond anthropocentrism, there is scholarship on what humans owe other species and their relationship with other species. Non-anthropocentric justice can be grouped into justice that is owed to other beings that can 'feel'

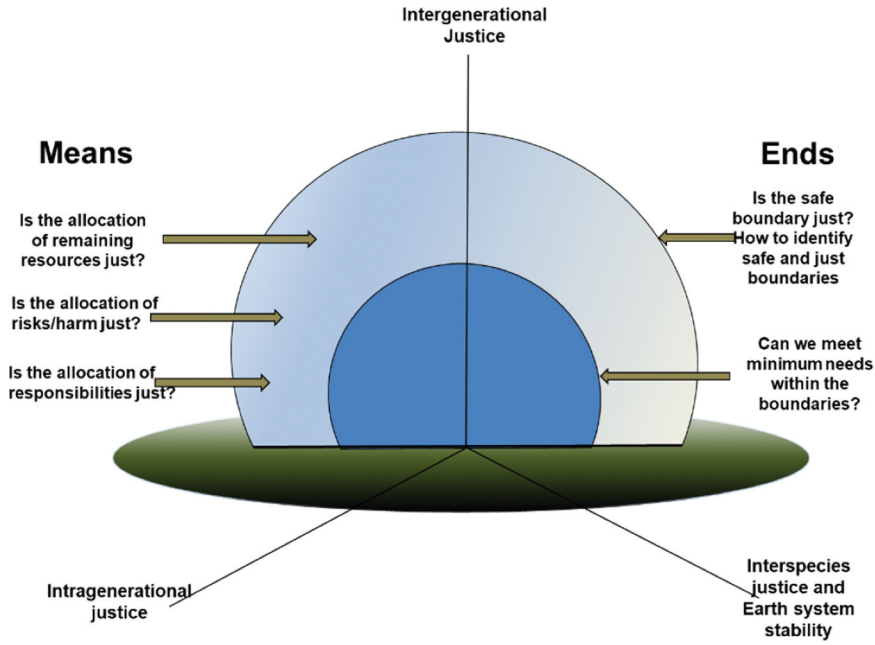

Figure 2. The scope of Earth system justice: Safe and just boundaries, minimum access and just allocation of remaining resources, risks and responsibilities.

(sentientism); justice for all living beings (biocentrism), and justice which includes all biotic communities and ecosystems (ecocentrism). Anthropocentric justice, on the other hand, focuses on justice between generations (intergenerational), within generations (intragenerational), between fellow citizens (nationalist), between states (international), and between individuals irrespective of domicile (global).

Building on this rich tradition, we argue that if ESJ is to enable discussions on how the global ecospace is to be shared, its scope should minimally encompass '3 I's' (Gupta et al., 2023) – interspecies justice (Burke and Fishel 2020) and Earth system stability (I1); intergenerational justice (I2) (Meyer 2021), and intragenerational justice (Okereke 2006); the latter can be further conceptualized to include international (Blake and Smith 2021), inter-community, and individual justice (Kahl 2022). An intersectional justice lens (see Amorim-Maia *et al.* 2022) can be further used to focus attention on marginalized groups in both inter- and intragenerational justice considerations.

It is essential to ensure that humans live in harmony with Mother Earth, respecting nature's limits and processes. Thus, our scope of justice includes justice to other species and Earth system stability to ensure the continuation of life-support systems as well as recognizing their existence value

(interspecies justice and Earth system stability) (I1). Since we need to live in harmony with species and ecosystems, this requires setting boundaries (e.g. with respect to land and water use) from local to global levels; hence we focus on Earth system boundaries (ESBs) and not just planetary boundaries. This may not, however, protect all species and ecosystems adequately, as we are in the midst of the sixth biodiversity extinction event. Moreover, we found it more fruitful to inductively, rather than deductively, operationalize 'interspecies justice and Earth system stability' through discussions with experts in the different biophysical domains – climate change, water, nutrients, aerosols – based on their own scholarship. This led to domain specific analysis – on climate change the focus was on avoiding tipping points; on groundwater it was to remain within recharge levels; on the biosphere it was based on recognizing that too many injustices had already occurred to other species and ecosystems and we have to find boundaries at both global and per square kilometre level. This was not a philosophical exercise, but a pragmatic operationalization based on existing scholarship and expert judgement.

Second, the scope of ESJ concerns duties between past, present and future generations in order to account for the temporal dimensions and trade-offs related to resource use and environmental degradation. This is captured within intergenerational justice (I2). This can be further operationalized into different components, including determining whether the boundaries are just.

Third, ESJ includes attention to intragenerational justice or justice in the here and now. Generally, this refers to the need to prioritize the needs of the poor and of developing countries (e.g. see Rio Principle 6; the right to development) and attention to issues of allocation. It includes (a) international justice or justice between nations; (b) inter-community justice focuses on justice within and between local communities; and (c) individual justice focuses on justice for individuals from the human rights perspective.

We use the 3 I's to assess proposals for Earth system boundaries. We ask: do Earth system boundaries minimize significant harm to other species and/or ensure Earth system stability (I1), minimize or otherwise address significant harm from past generations to current ones (I2a) and from current ones to future generations (I2b), and how do present generations minimize harm to each other (I3)? In principle, boundaries that meet the I1 criteria also meet the I2b criteria in protecting the stability of the Earth for future generations, but may not adequately meet the criteria of protecting present generations from past harm (I2a). This means that the I1 criteria may have to be sharpened or complemented with other standards to reduce or address significant harm to current generations. The boundariesoften may not meet the I3 criteria of protecting individuals, communities and countries from harm. Defining what is significant harm is challenging given that millions of people are harmed today from environmental degration. We note that our I1, I2 and I3 criteria cannot reduce harm to *all* people and *all* species/ecosystems as the levels of

harm today are already exceedingly high. Leaving no one behind is becoming increasingly impossible from a harm perspective. Moreover, making space for future generations is likely to require heavy sacrifices from current generations.

4.3 Sharing the ecospace: guaranteeing minimum access to resources

The identification of boundaries limits the available local to global ecospace and may even shrink this ecospace over time. Hence, we operationalize substantive justice in terms of access and allocation of resources (Gupta and Lebel 2020). We take a prioritarian approach to justice to argue for ensuring minimum access rights without placing additional pressures on the Earth system (Fanning et al., 2022; O'Neill *et al.* 2018, Hickel 2019, Rammelt *et al.* 2022). Such minimum access enables humans to have a dignified life and even escape from poverty and flourish and may enhance the adaptive capacity of people to environmental threats (Grecksch and Klöck 2020). Moreover, the inability of many to access basic resources and services such as clean air and water, energy, and health care can be attributed to systemic exploitation, discrimination, and exclusion of these people from the benefits of development. Such minimum access can be a first step in sharing ecospace in line with the aspirations of the Millennium and Sustainable Development Goals and the longstanding human rights tradition. In our ESJ research we have operationalized such minimum needs and calculated its impacts on boundaries. Our thought experiment shows, however, that meeting minimum needs in the unequal world of 2018 led to further crossing planetary boundaries even though the emissions of the 3 billion people at the bottom was not more than that of the top 1–4% (Rammelt *et al.* 2022). This implies that without redistributing the available resources it will be impossible to meet these social goals within Earth system boundaries.

4.4 Sharing the ecospace: equitable allocation of the remaining resources and related responsibilities

However, rules to allocate resources often hamper access. Scarce resources become expensive in the market. Private sector engagement in sanitation services, for example, has made access to affordable services difficult (Dellas 2011). The financialization of the food sector has led to food price volatility and reorientation towards export markets which affects food affordability (Galaz 2014, Schroeder 2014), and the extraterritorial impacts of biofuel policies in e.g. Europe have led to changes in land use in exporting countries (Lima and Gupta 2014). Sharing ecospace will also require discussions regarding how transboundary waters can be allocated between riparian states. The 1997 UN Watercourses Convention recommends equitable and optimal utilization of the waters and has unpacked this into several criteria; yet

many countries are reluctant to engage in such equitable sharing (see e.g. Onencan and Van de Walle 2018 Sharing ecospace on climate change requires an understanding of how the limited greenhouse gas emissions should be allocated between countries and how the risk of stranded assets is to be shared (Gupta *et al.* 2020).

Thus, sharing ecospace via markets, trade and investment is challenging (Gonenc *et al.* 2020). There is growing evidence of how Northern countries are selling their wastes to the South – plastics, electronics (Cotta 2020), old ships and so on – since it is 'cheaper' to do so despite huge environmental consequences. Trade rules affect resource use and allocation worldwide, and often environmental protection is only supported when it also facilitates open trade (Kim 2016); moreover, trade itself has major environmental impacts (Conca 2000). Investments tend to be directed at high economic returns and have led to greater investment in fossil fuel (Gupta *et al.* 2020), in harmful use of pesticides (Schroeder 2014), and the promotion of a wasteful, consumption-oriented economy (Ehresman and Okereke 2015).

Sharing ecospace equitably involves tackling three key drivers of Earth system change and vulnerability: inequality, overconsumption, and harmful accumulation and investment. While environmental scholarship has paid considerably less attention to the rich rather than the poor (Otto *et al.* 2019, we argue that a better balance must be struck. Addressing the corrosive effect of increasing inequality on people's ability to share ecospace can include both pre-distributive (minimum wages rules; free education; rent controls; anti-trust laws etc.) and re-distributive measures (tax justice, debt justice for climate reparations (Táíwò and Bigger 2022)) (Chancel *et al.* 2022). Overconsumption can begin to be addressed by encouraging discussions on the idea of limitarian justice. The idea of economic limitarianism (Robeyns 2019) is that no one should hold surplus money, defined as the money that one has in addition to what is needed for a fully flourishing life. It is argued that a world in which no one would be above this 'riches lines' would be a better world. We propose reframing and extending this concept to not only refer to money, but also to key natural resources such as water, food, energy, and living infrastructure. In line with Robeyns (2019), we propose that when surplus resources no longer contribute to people's well-being and negatively affect the wellbeing of others, their consumption may be limited in order to meet urgent unmet needs and finance actions that tackle planetary degradation; the latter have higher urgency from an evolving human rights perspective than the desires of the rich for luxurious lifestyles. Lastly, greater scrutiny and accountability is needed in order to monitor and govern harmful accumulation and investment, including accumulation by dispossession (Mrozowski 2019), accumulation without dispossession (e.g. rising developing country debt, contract farming in many countries) (Shrimali 2016), and, most recently, reparative accumulation (e.g. some

instances of green finance) (Cohen *et al.* 2021). This process of redistribution of the global ecospace may therefore also entail a reframing of who owes what to whom, as it is also increasingly being argued in the climate domain.

4.5 Sharing the ecospace: equitable allocation of responsibilities with respect to harm caused

Those who are most affected by negative environmental impacts are often those least responsible for them. Therefore, equitably assigning responsibilities for remedying vulnerability and exposure to such impacts is important to prevent the burden of action from quietly shifting to those suffering from environmental harm (Pichler *et al.* 2017). It is urgent to critically reinsert the principle of no significant harm in the global political agenda. This principle was not adopted in the climate change and biodiversity conventions and the 2030 Agenda. However, it is very much part of international water law. Concretely, responsibility for harm could involve preventative measures (principles of precaution, due diligence, environmental standards, environmental and health impact assessments, notification of planned measures, prior informed consent, disaster risk reduction etc.) (Raftopoulos and Short 2019) as well as restorative ones (compensation, reparation, injunctive relief that stops an activity causing harm, liability, extended producer responsibility, allocation of loss and damage, and adaptation) (Gupta and Schmeier 2020).

5. Conclusion

The closely connected challenges of planetary degradation and increasing inequality have led environmental scholarship and global assessments to increasingly call for environmental and planetary justice and just transformations. Yet these calls often do not offer the necessary concrete suggestions as to how humanity's limited environmental utilization space (ecospace) might be equitably shared. We suggest that an equitable sharing of ecospace might depend on doing politics differently under a new ethical paradigm: Earth system justice. Earth system justice foregrounds the importance of critical engagement with Earth system boundaries in light of interspecies justice and Earth system stability, intergenerational, and intragenerational justice concerns; local through to global efforts to meet the minimum resource needs of all; and an equitable redistribution of resources, rights, and responsibilities that focuses on addressing the drivers of inequality, overconsumption, and harmful accumulation and the reinsertion of the no significant harm

principle in the global political agenda as part of a new Glocal Constitutionalism.

Notes

1. This paper is for a Special Issue on Planetary Justice.
2. Hundreds of papers cover environmental vulnerability and are excluded here as we focused on papers that explicitly covered the justice issues involved in addressing vulnerability.

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ORCID

Joyeeta Gupta http://orcid.org/0000-0003-1424-2660
Klaudia Prodani http://orcid.org/0000-0003-2711-1061
Xuemi Bai http://orcid.org/0000-0001-6556-8041
Lauren Gifford http://orcid.org/0000-0002-8130-4684
Tim M. Lenton http://orcid.org/0000-0002-6725-7498
Ilona Otto http://orcid.org/0000-0003-4935-7660
Laura Pereira http://orcid.org/0000-0002-4996-7234
Crelis Rammelt http://orcid.org/0000-0002-3766-2599
Joeri Scholtens http://orcid.org/0000-0003-2293-5221
Joan David Tàbara http://orcid.org/0000-0002-3086-5414

References

Amorim-Maia, A.T., *et al*., 2022. Intersectional climate justice: A conceptual pathway for bridging adaptation planning, transformative action, and social equity. *Urban Climate*, 41, 101053. doi:10.1016/j.uclim.2021.101053.

Bai, X., *et al*., 2016. Plausible and desirable futures in the Anthropocene: A new research agenda. *Global Environmental Change*, 39, 351–362. doi:10.1016/j.gloenvcha.2015.09.017.

Bakker, K.J., 2003. A political ecology of water privatization. *Studies in Political Economy*, 70 (1), 35–58. doi:10.1080/07078552.2003.11827129.

Berkhout, E., *et al*., 2021. The inequality virus: bringing together a world torn apart by coronavirus through a fair, just and sustainable economy. *Oxfam*, doi: 10.21201/2021.6409.

Biermann, F., *et al*. (2009). *Earth system governance: people, places and the planet. science and implementation plan of the Earth system governance project (*Earth System Governance Report No. 1, IHDP Report No. 20; p. 148). Bonn: IHDP. The Earth System Governance Project.

Biermann, F., Dirth, E., and Kalfagianni, A., 2020. Planetary justice as a challenge for earth system governance: Editorial. *Earth System Governance*, 6, 100085. doi:10.1016/j.esg.2020.100085.

Biermann, F. and Kalfagianni, A., 2020. Planetary justice: A research framework. *Earth System Governance*, 6, 100049. doi:10.1016/j.esg.2020.100049.

Blaikie, P. and Brookfield, H., Eds. 2015. *Land Degradation and Society*. Routledge. doi:10.4324/9781315685366.

Blake, M. and Smith, P.T., 2021. International Distributive Justice. *In*: E.N. Zalta, ed. *The Stanford Encyclopedia of Philosophy*. Summer 2021. Metaphysics Research Lab, Stanford University. https://plato.stanford.edu/archives/sum2021/entries/international-justice/

Boelens, R., Perreault, T., and Vos, J., Eds., 2018. *Water Justice*. Cambridge University Press. doi:10.1017/9781316831847.

Burke, A. and Fishel, S., 2020. Across Species and Borders: political Representation, Ecological Democracy and the Non-Human. *In*: J.C. Pereira and A. Saramago, eds. *Non-Human Nature in World Politics*. Springer International Publishing, 33–52. doi:10.1007/978-3-030-49496-4_3.

Cardesa-Salzmann, A. and Cocciolo, E., 2019. Global governance, sustainability and the Earth system: critical reflections on the role of global law. *Transnational Environmental Law*, 8 (3), 437–461. doi:10.1017/S2047102519000098.

Chancel, L., *et al*. (2022). *World inequality report 2022*. World Inequality Lab. wir2022.wid.world

Chapron, G., *et al*., 2017. Bolster legal boundaries to stay within planetary boundaries. *Nature Ecology & Evolution*, 1 (3), 86–86. doi:10.1038/s41559-017-0086.

Cohen, D., Nelson, S., and Rosenman, E., 2021. Reparative accumulation? Financial risk and investment across socio-environmental crises. *Environment and Planning E: Nature and Space*, 5 (4), 2356–2382. doi:10.1177/25148486211030432.

Conca, K., 2000. The WTO and the undermining of global environmental governance. *Review of International Political Economy*, 7 (3), 484–494. http://www.jstor.org/stable/4177356

Cotta, B., 2020. What goes around, comes around? Access and allocation problems in global north–south waste trade. *International Environmental Agreements: Politics, Law and Economics*, 20 (2), 255–269. doi:10.1007/s10784-020-09479-3.

Dale, G. (2021, June 4). Karl Polanyi's great transformation and the countermovement to capitalism. *Jacobin*. https://jacobinmag.com/2021/04/karl-polanyi-the-great-transformation-neoliberalism-countermovement-capitalism

Davies, K., *et al*., 2017. The declaration on human rights and climate change: A new legal tool for global policy change. *Journal of Human Rights and the Environment*, 8 (2), 217–253. doi:10.4337/jhre.2017.02.03.

Dellas, E., 2011. CSD water partnerships: Privatization, participation and legitimacy. *Ecological Economics*, 70 (11), 1916–1923. doi:10.1016/j.ecolecon.2011.04.007.

Dirth, E., Biermann, F., and Kalfagianni, A., 2020. What do researchers mean when talking about justice? An empirical review of justice narratives in global change research. *Earth System Governance*, 6, 100042. doi:10.1016/j.esg.2020.100042.

Dryzek, J.S. and Pickering, J., 2019. *The politics of the anthropocene*. Oxford University Press. doi:10.1093/oso/9780198809616.001.0001.

Dyckman, C., 2020. Planners' presence in planning for water quality and availability. *In*: E. Deakin, ed. *Transportation, Land Use, and Environmental Planning*. Elsevier, 333–395. doi:10.1016/B978-0-12-815167-9.00017-7.

Eakin, H. and Luers, A.L., 2006. Assessing the vulnerability of social-environmental systems. *Annual Review of Environment and Resources*, 31 (1), 365–394. doi:10.1146/annurev.energy.30.050504.144352.

Ebbesson, J., 2010. The rule of law in governance of complex socio-ecological changes. *Global Environmental Change*, 20 (3), 414–422. doi:10.1016/j.gloenvcha.2009.10.009.

Ehresman, T.G. and Okereke, C., 2015. Environmental justice and conceptions of the green economy. *International Environmental Agreements: Politics, Law and Economics*, 15 (1), 13–27. doi:10.1007/s10784-014-9265-2.

Fanning, A.L., *et al*., 2022. The social shortfall and ecological overshoot of nations. *Nature Sustainability*, 5 (1), 26–36. doi:10.1038/s41893-021-00799-z.

Galaz, V., 2014. *Global environmental governance, technology and politics: the anthropocene gap*. Edward Elgar Publishing. doi:10.4337/9781781955550.00012.

Gampfer, R., 2014. Do individuals care about fairness in burden sharing for climate change mitigation? Evidence from a lab experiment. *Climatic Change*, 124 (1–2), 65–77. doi:10.1007/s10584-014-1091-6.

Gonenc, D., Piselli, D., and Sun, Y., 2020. The global economic system and access and allocation in earth system governance. *International Environmental Agreements: Politics, Law and Economics*, 20 (2), 223–238. doi:10.1007/s10784-020-09472-w.

Grecksch, K. and Klöck, C., 2020. Access and allocation in climate change adaptation. *International Environmental Agreements: Politics, Law and Economics*, 20 (2), 271–286. doi:10.1007/s10784-020-09477-5.

Gupta, J., 1998. Ecospace rights: sharing or Dividing. *In*: E. Denters and N. Schrijver, eds. *Reflections on international law from the low countries, in honor of paul de waart*. Dordrecht: Kluwer Academic Publishers, 398–414.

Gupta, J. 2016. Towards sharing our ecospace. *In*: S. Nicholson and S. Jinnah, eds. *New Earth politics: essays from the Anthropocene*. Cambridge, MA: The MIT press 271–291. doi:10.7551/mitpress/9780262034364.003.0020.

Gupta, J., *et al*., 2019. Communicating the health of the planet and its links to human health. *The Lancet Planetary Health*, 3 (5), e204–e206. doi:10.1016/s2542-5196(19)30040-3.

Gupta, J., *et al*., 2021. Reconciling safe planetary targets and planetary justice: Why should social scientists engage with planetary targets? *Earth System Governance*, 10, 100122. doi:10.1016/j.esg.2021.100122.

Gupta, J., *et al*., 2023. Earth system justice needed to identify and live within Earth system boundaries. *Nature Sustainability*, 6, 630–638. doi:10.1038/s41893-023-01064-1.

Gupta, J. and Lebel, L., 2010. Access and allocation in earth system governance: Water and climate change compared. *International Environmental Agreements: Politics, Law and Economics*, 10 (4), 377–395. doi:10.1007/s10784-010-9139-1.

Gupta, J. and Lebel, L., 2020. Access and allocation in earth system governance: lessons learnt in the context of the sustainable development goals. *International Environmental Agreements: Politics, Law and Economics*, 20 (2), 393–410. doi:10.1007/s10784-020-09486-4.

Gupta, J., Rempel, A., and Verrest, H., 2020. Access and allocation: The role of large shareholders and investors in leaving fossil fuels underground. *International Environmental Agreements: Politics, Law and Economics*, 20 (2), 303–322. doi:10.1007/s10784-020-09478-4.

Gupta, J. and Schmeier, S., 2020. Future proofing the principle of no significant harm. *International Environmental Agreements: Politics, Law and Economics*, 20 (4), 731–747. doi:10.1007/s10784-020-09515-2.

Hey, E., 2018. The universal declaration of human rights in the anthropocene. *AJIL Unbound*, 112, 350–354. doi:10.1017/aju.2018.87.

Hickel, J., 2019. Is it possible to achieve a good life for all within planetary boundaries? *Third World Quarterly*, 40 (1), 18–35. doi:10.1080/01436597.2018.1535895.

Hickey, C. and Robeyns, I., 2020. Planetary justice: What can we learn from ethics and political philosophy? *Earth System Governance*, 6, 100045. doi:10.1016/j.esg.2020.100045.

Hulme, M., 2020. One Earth, many futures, no destination. *One Earth*, 2 (4), 309–311. doi:10.1016/j.oneear.2020.03.005.

Kahl, V., 2022. A human right to climate protection – Necessary protection or human rights proliferation? *Netherlands Quarterly of Human Rights*, 40 (2), 158–179. doi:10.1177/09240519221092595.

Kalfagianni, A. and Meisch, S., 2020. Epistemological and ethical understandings of access and allocation in Earth System Governance: A 10-year review of the literature. *International Environmental Agreements: Politics, Law and Economics*, 20 (2), 203–221. doi:10.1007/s10784-020-09469-5.

Kim, R.E., 2016. The nexus between international law and the sustainable development goals. *Review of European, Comparative & International Environmental Law*, 25 (1), 15–26. doi:10.1111/reel.12148.

Kim, R.E. and Bosselmann, K., 2013. International environmental law in the anthropocene: towards a purposive system of multilateral environmental agreements. *Transnational Environmental Law*, 2 (2), 285–309. doi:10.1017/S2047102513000149.

Kim, R.E. and Mackey, B., 2014. International environmental law as a complex adaptive system. *International Environmental Agreements: Politics, Law and Economics*, 14 (1), 5–24. doi:10.1007/s10784-013-9225-2.

Kotzé, L., 2019. A global environmental constitution for the anthropocene? *Transnational Environmental Law*, 8 (1), 11–33. doi:10.1017/S2047102518000274.

Kotzé, L.J. and French, D., 2018. A critique of the global pact for the environment: A stillborn initiative or the foundation for Lex Anthropocenae? *International Environmental Agreements: Politics, Law and Economics*, 18 (6), 811–838. doi:10.1007/s10784-018-9417-x.

Kotzé, L.J. and Kim, R.E., 2019. Earth system law: the juridical dimensions of earth system governance. *Earth System Governance*, 1, 100003. doi:10.1016/j.esg.2019.100003.

Lawrence, P., 2014. *Justice for future generations: climate change and international law*. Edward Elgar Publishing.

Liebrand, W.B.G., *et al*., 1986. Might over morality: Social values and the perception of other players in experimental games. *Journal of Experimental Social Psychology*, 22 (3), 203–215. doi:10.1016/0022-1031(86)90024-7.

Lima, M.G.B. and Gupta, J., 2014. The extraterritorial dimensions of biofuel policies and the politics of scale: live and let die? *Third World Quarterly*, 35 (3), 392–410. http://www.jstor.org/stable/24522149

Lövbrand, E., *et al*., 2015. Who speaks for the future of Earth? How critical social science can extend the conversation on the Anthropocene. *Global Environmental Change*, 32, 211–218. doi:10.1016/j.gloenvcha.2015.03.012.

Meyer, L., 2021. Intergenerational Justice. *In*: E.N. Zalta, ed. *The Stanford Encyclopedia of Philosophy*. Summer 2021. Metaphysics Research Lab, Stanford University. https://plato.stanford.edu/archives/sum2021/entries/justice-intergenerational/

Milanovic, B., 2013. Global income inequality in numbers: in history and now. *Global Policy*, 4 (2), 198–208. doi:10.1111/1758-5899.12032.

Mrozowski, S.A., 2019. Violence and dispossession at the intersection of colonialism and capitalist accumulation. *Historical Archaeology*, 53 (3), 492–515. doi:10.1007/s41636-019-00205-8.

Okereke, C., 2006. Global environmental sustainability: Intragenerational equity and conceptions of justice in multilateral environmental regimes. *Geoforum*, 37 (5), 725–738. doi:10.1016/j.geoforum.2005.10.005.

O'Neill, D.W., *et al*., 2018. A good life for all within planetary boundaries. *Nature Sustainability*, 1 (2), 88–95. doi:10.1038/s41893-018-0021-4.

Onencan, A. and Van de Walle, B., 2018. Equitable and reasonable utilization: reconstructing the Nile Basin water allocation dialogue. *Water*, 10 (6), 707. doi:10.3390/w10060707.

Otto, I.M., *et al*., 2019. Shift the focus from the super-poor to the super-rich. *Nature Climate Change*, 9 (2), 82–84. doi:10.1038/s41558-019-0402-3.

Owusu, K., Kulesz, M., and Merico, A., 2019. Extraction behaviour and income inequalities resulting from a common pool resource exploitation. *Sustainability*, 11 (2), 536. doi:10.3390/su11020536.

Pereira, L., 2014. The role of substantive equality in finding sustainable development pathways in South Africa. *McGill International Journal of Sustainable Development Law and Policy*, 10 (2), 147–178. https://search.informit.org/doi/10.3316/informit.915596757825636

Pichler, M., *et al*., 2017. Drivers of society-nature relations in the Anthropocene and their implications for sustainability transformations. *Current Opinion in Environmental Sustainability*, 26–27, 32–36. doi:10.1016/j.cosust.2017.01.017.

Piketty, T., 2014. *Capital in the twenty-first century*. The Belknap Press of Harvard University Press. doi:10.4159/9780674369542.

Preiser, R., Pereira, L.M., and Biggs, R.(., 2017. Navigating alternative framings of human-environment interactions: variations on the theme of 'finding nemo. *Anthropocene*, 20, 83–87. doi:10.1016/j.ancene.2017.10.003.

Raftopoulos, M. and Short, D., 2019. Implementing free prior and informed consent: the united nations declaration on the rights of indigenous peoples (2007), the challenges of REDD+ and the case for the precautionary principle. *The International Journal of Human Rights*, 23 (1–2), 87–103. doi:10.1080/13642987.2019.1579990.

Rammelt, C.F., *et al*., 2022. Impacts of meeting minimum access on critical Earth Systems amidst the Great Inequality, Nature Sustainability. doi:10.1038/s41893-022-00995-5

Robeyns, I., 2019. What, if anything, is wrong with extreme wealth? *Journal of Human Development & Capabilities*, 20 (3), 251–266. doi:10.1080/19452829.2019.1633734.

Rockström, J., *et al*., 2009. A safe operating space for humanity. *Nature*, 461 (7263), 472–475. doi:10.1038/461472a.

Schlosberg, D. 2007. Justice and Plurality. In *Defining Environmental Justice*. Oxford University Press. doi:10.1093/acprof:oso/9780199286294.001.0001.

Schroeder, H., 2014. Governing access and allocation in the Anthropocene. *Global Environmental Change*, 26, A1–A3. doi:10.1016/j.gloenvcha.2014.04.017.

Shrimali, R., 2016. Accumulation by dispossession or accumulation without dispossession: the case of contract farming in India. *Human Geography*, 9 (3), 77–88. doi:10.1177/194277861600900306.

Stephens, T., 2019. What is the point of international environmental law scholarship in the anthropocene? Social Science Research Network. https://papers.ssrn.com/abstract=3382013

Sultana, F., 2022. Critical Climate Justice. *The Geographical Journal*, 188, 118–124. doi:10.1111/geoj.12417.

Táíwò, O.O. and Bigger, P., 2022, April. *Debt Justice for Climate Reparations*. Climate and Community Project (CCP). https://www.climateandcommunity.org/_files/ugd/d6378b_d2d12f75ec8f405a97f336f8a6ddf711.pdf

Temper, L. and Shmelev, S., 2015. Mapping the frontiers and front lines of global environmental justice: The EJAtlas. *Journal of Political Ecology*, 22 (1). doi: 10.2458/v22i1.21108.

United Nations, 2015. *Transforming Our World: The 2030 Agenda for Sustainable Development*. https://wedocs.unep.org/20.500.11822/9814

United Nations Environment Programme, 2019. *Global Environment Outlook – GEO-6: Healthy Planet, Healthy People*. https://wedocs.unep.org/20.500.11822/27539 .

United Nations Environment Programme, 2021. *Making peace with nature: a scientific blueprint to tackle the climate, biodiversity and pollution emergencies*. United Nations. doi: 10.18356/9789280738377

Wells, H.T. (2008, October). *Common core values*. American Bar Association. https://www.americanbar.org/groups/bar_services/publications/bar_leader/2008_09/3301/corevalues/

Young, O.A., *et al*., 1999. *Institutional Dimensions of Global Environmental Change (IDGEC) Science Plan* (No. 9; p. 100). Bonn: IHDP.

Young, O.R., 2001. The behavioral effects of environmental regimes: collective-action vs. social-practice models. *International Environmental Agreements: Politics, Law and Economics*, 1 (1), 9–29. doi:10.1023/A:1010181007938.

Young, O.R., King, L.A., & Schroeder, H., Eds., 2008. *Institutions and Environmental Change: principal Findings, Applications, and Research Frontiers*. The MIT Press. doi: 10.7551/mitpress/9780262240574.001.0001.