Clash of Geofutures and the Remaking of Planetary Order: Faultlines underlying Conflicts over Geoengineering Governance

Special Issue Article

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Abstract

Climate engineering (geoengineering) is rising up the global policy agenda, partly because international divisions pose deep challenges to collective climate mitigation. However, geoengineering is similarly subject to clashing interests, knowledge-traditions and geopolitics. Modelling and technical assessments of geoengineering are facilitated by assumptions of a single global planner (or some as yet unspecified rational governance), but the practicality of international governance remains mostly speculative. Using evidence gathered from state delegates, climate activists and modellers, we reveal three underlying and clashing 'geofutures': an idealised understanding of governable geoengineering that abstracts from technical and political realities; a situated understanding of geoengineering emphasising power hierarchies in world order; and a pragmatist precautionary understanding emerging in spaces of negotiation such as UN Environment Assembly (UNEA). Set in the wider historical context of climate politics, the failure to agree even to a study of geoengineering at UNEA indicates underlying obstacles to global rules and institutions for geoengineering posed by divergent interests and underlying epistemic and political differences. Technology assessments should recognise that geoengineering will not be exempt from international fractures; that deployment of geoengineering through imposition is a serious risk; and that contestations over geofutures pertain, not only to climate policy, but also the future of planetary order.

Policy Implications

- Assessments of the feasibility and desirability of geoengineering technologies should never be based solely on knowledge produced under idealised conditions, (e.g. climate modelling or integrated climate and economic modelling).
- Assessments of technologies with global implications should factor in risks and complications generated by the international fragmentation of world politics and histories.
- Institutional designs for governing geoengineering should incorporate diverse and situated forms of knowledge as well as involve broad participation.
- Though they sometimes should be treated separately, an overarching governance framework for both CDR and solar radiation management (SRM) is needed to avoid deterrence of mitigation ('moral hazard').
- A governance process for geoengineering technologies, separate from climate governance, should be established at the United Nations Environment Programme (UNEP).

Climate change is a global challenge impacted by, but also contributing to, international disputes. Emissions of climate-changing greenhouse gases are still rising, and the challenge may not be met without the intentional deployment of planetary technologies that act to reduce or reverse the effects of climate change – often collectively called 'geoengineering'. Assessments of the feasibility and desirability of geoengineering techniques (National Academy of Sciences, 2015; Royal Society, 2009) typically underplay social and political challenges, in particular those posed by the inescapably international context in which these climate interventions are being developed and would be deployed.

Conventionally such interventions are grouped into those designed to reflect or manage incoming sunlight ('solar geoengineering' or 'solar radiation management' or SRM) and those to remove carbon dioxide from the atmosphere ('carbon dioxide removal' or CDR) (Royal Society, 2009). The models used to evaluate potential geoengineering interventions tend to rely on idealised scenarios and assumptions about global control, distribution, or aggregation (McLaren, 2018). In earth system models (ESMs) it is effectively presumed that SRM would be operated or governed by a single global planner acting to maximise global welfare (Keith and MacMartin, 2015; Royal Society, 2009). Economic modelling

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presumes that governance can be facilitated by calculation of a 'global aggregate utility' function within which winners could compensate losers (despite multiple societies valuing and assessing impacts differently) (Wiertz, 2015). In integrated assessment models (IAMs), the deployment of CDR is driven by idealised assumptions of global imputed carbon prices and discounted future costs, with at best simplistic representations of geographic constraints (Low and Schäfer, 2020).

Given the starkly multiple and uneven nature of the international, the key question is: how likely is it that comprehensive, functional and just global governance approximating these assumptions could emerge? The geopolitical question: could such an intervention be safely and legitimately deployed? is very different from the scientific question: could geoengineering cool the earth? Furthermore, technologies and social and political regimes co-evolve (Tyfield, 2012) but given that social life is never singular (Rosenberg, 2016), each co-production is also subject to the context of multiple interacting societies. The burgeoning geoengineering governance literature (Reynolds, 2019b) engages international relations in a limited fashion (Corry, 2017b), while dedicated international relations scholarship on geoengineering remains sparse (Corry, 2017b; Horton and Reynolds, 2016) and mostly speculative, often based on idealised accounts of the international system as consisting of formally equal and rational state actors who cooperate or compete (e.g. Lloyd and Oppenheimer, 2014), sometimes modelled via game theory (Heyen et al., 2019; Ricke et al., 2013; Urpelainen, 2012). There has so far been little empirical exploration of the underlying international dynamics that geoengineering actually engenders.

This paper breaks new ground by presenting evidence gathered in relation to international negotiations around a draft resolution specifically on 'governing geoengineering' put forward at the 4th UN Environment Assembly (UNEA) in Nairobi in March 2019. Switzerland, along with diverse but mainly Southern supporters including Micronesia and Senegal, proposed a resolution[1.] asking UN Environment to conduct a study, advised by an independent panel of experts, to ascertain the 'current state of the science', 'actors and activities with regard to research and deployment', 'current knowledge of potential impacts including risks benefits and uncertainties' and 'challenges related to current, and potential governance frameworks' for diverse geoengineering technologies, and draw conclusions on their possible governance. The preambular material acknowledged existing relevant activities at other UN bodies (the Intergovernmental Panel on Climate Change (IPCC); Convention on Biological Diversity (CBD), the London Protocol, etc.), stressed the broad distinction between SRM and CDR, and highlighted concerns over risks to sustainable development and the environment and the lack of multilateral governance of geoengineering. Beforehand the Swiss draft had been deemed 'open' and 'helpful' and the venue 'particularly fitting' by commentators sympathetic to further research, although anti-geoengineering campaigners described it as too weak (Forum for Climate Engineering Assessment, 2019). In the event, the resolution was opposed in and around a series of negotiating sessions by a vociferous minority of states, led by the US and Saudi Arabia.

As we observed these discussions, and interviewed protagonists, the main objections raised publicly were that: (1) the technologies were too diverse to warrant a collective study (CDR and SRM being taken as more meaningful categories); (2) the proposed study was premature; and (3) UNEA was not the appropriate venue, and such an assessment should be left to ongoing work at the IPCC (Jinnah and Nicholson, 2019; Reynolds, 2019a). Although a series of concessions were made in response to all three points we observed continuing opposition, with further concerns expressed over the role of precaution (Jinnah and Nicholson, 2019), and new objections to text declaring that geoengineering should not be a substitute for emissions reductions. Ultimately the opponent states declared opposition to the idea of a resolution of any kind at UNEA4 and the draft resolution was withdrawn.

If the questions of diversity, timeliness and venue had been the only or real issues at stake, the implications of the collapsed negotiations might be limited. However, we argue these disagreements should be understood in the context of underlying clashes over how geoengineering can be understood, about the nature of world politics (in terms of structure, leading actors and political logics) in which geoengineering might be developed and deployed, and how decisions might legitimately be made about geoengineering as a key aspect of a new planetary order (combined geopolitical and Earth system arrangements). Such disagreements have deep ramifications not only for which institutions should evaluate geoengineering and when, but also for who can participate, using what sorts of evidence, and with reference to which values or principles.

Based on interviews with participants at the negotiations as well as the draft resolution (see endnote 1) and amendments and revisions to it considered during the meeting, and additional interviews with climate modellers and activists, we explore how the aspirations and interpretations of negotiators draw on wider processes in which modellers, activists and others construct public narratives of geoengineering. First we set out how geoengineering, although it does not exist in implemented form, takes shape in the form of diverse 'future practices' such as modelling, scenarios, images, resolutions, etc. These embody or represent not just potential technologies but also necessarily 'truths' and future worlds and procedures. Via analysis of these, the (surprisingly bitter) conflict over a mere study of geoengineering is put into the context of a wider struggle over knowledge, justice and strategy in climate politics. We find that overall the evidence suggests that common assumptions in geoengineering research, presupposing comprehensive future governance of geoengineering, are unwarranted in a world where actors clash over goals as well as underlying interests but also differ on knowledge-politics and visions of world futures. As one of our interviewees put it: 'You won't get geoengineering governance at all, unless it's done ... in a week, without anyone knowing back in capitals' (NH:1). Assessment of future geoengineering

technologies should thus factor in not just climate risks but also those posed by probable imposition via global power relations.

The UNEA event was the first explicit attempt to begin to shape a global regime for geoengineering governance, but it was not the first salvo in the international contestation of geoengineering – and is unlikely to be the last. Meetings of the Convention on Biological Diversity (CBD) (Talberg et al., 2018), and of the London Convention had previously discussed particular aspects and forms of geoengineering, and rehearsed some arguments about possible forms of governance (Ginzky and Frost, 2014). Moreover, although a unique event, the Nairobi summit forms part of the ongoing history of international climate politics in which states with large fossil reserves and interests, including Russia, China, Saudi Arabia and the US have had a record of opposing an effective global carbon regime (Ciplet et al., 2015; Depledge, 2008). Notably, the US, already famous for its exceptionalist foreign policy tradition (Hughes, 2014; Ruggie, 2009) – exempting itself from the CBD, for example, has in recent years both adopted a more antagonistic stance to global climate policy, and become the world's leading fossil energy exporter (Guliyev, 2020). In these respects, the underlying dynamics revealed here are also likely to persistently shape future geoengineering debates, and indeed, wider contestation over the planetary order.

Geoengineering as future practice

Although geoengineering technologies do not yet exist as technical systems operating at scale to affect the global climate directly, 'geoengineering' exists plentifully as ideas, experiments, model scenarios, policy and such like, all of which produce effects in the present by representing possible futures. In other words geoengineering exists in the form of 'future practices' by which we mean activities that 'create images, policies or socio-technical artefacts that will have lasting effect in and for the future' (Esguerra, 2019, p. 963). Future practices are not simply imaginings but are underpinned by socio-material objects, 'future objects' (Esguerra, 2019, p. 964), including models, scientific apparatus, scenarios, pictorial or textual representations, and intergovernmental treaties or resolutions. They also have a discursive dimension in the form of narratives and understandings of the phenomenon (e.g. a (modelled) +3°C world with solar geoengineering). Future practices matter because they not only *describe* or *project* possible futures, but also *affect* the future – they are constitutive 'techniques of prospection' (Mallard and Lakoff, 2012, p. 339), especially when backed by material, cultural and political resources of production.

Concerns regarding constitutive or performative effects of geoengineering future practices have hitherto focused on how it might deter or delay mitigation efforts (McLaren, 2016b) (also referred to as 'moral hazard', Lin, 2013). However, geoengineering future practices potentially generate a wider range of effects – elements in what Sheila Jasanoff (2020, p. 29) calls predictive politics: '(s)cientific discoveries and their applications have opened up the future as a space of political struggle in countless ways'. For Jasanoff (2020, p. 41), 'the dynamics of the move from the politics of the world-as-it-is to that of worlds-yet-to-come demand a sharper awareness of the moves being made in this transition'. We categorise such moves in three groups.

First, (and most obviously) future practices produce truth-claims about what geoengineering could be or do. We call this *truth-making* work in that it not only puts forward claims about what geoengineering and the climate system is like, but thereby also establishes a 'truth regime' that allots epistemological authority to particular actors and methods, that in turn circumscribe the range and types of climate technologies 'on offer' (Stoddard and Collins, 2016).

Second, future practices implicitly or explicitly produce and rely on presumptions about the wider world that geoengineering might enter. To discuss or study geoengineering involves depicting, modelling, imagining, abstracting from or planning for, not just technical devices, but future worlds surrounding them. This relates not just to climate trends, but also to political and social relations, dynamics and expectations, and underlying ontological understandings of what exists, for example, in temporal and spatial terms. In line with Beck and Mahony (2018), we call this *world-making* work.

Third, future practices also generate understandings and expectations relating to how and where decisions on whether or how to implement geoengineering will be made, and who influences – or has a voice in – them. As Hajer (2003, p. 88) points out, although normally thought of as the *result* of politics, 'public policy often creates a public domain' including specific political identities – we only find out what we want and who we are when a proposition is put up about the future. Policy formulation is but one type of future practice, that has this, what we term, *action-making* function, particularly critical to the legitimacy of imagined future geoengineering.

Applying an internationalised version of cultural political economy, we emphasise the many implications of multiple coexisting societies, as a critical part of the ways in which social imaginaries and political economic regimes coproduce societal orders (Groves, 2014; Markusson et al., 2018). In such processes different versions of truth, world and action-making are interwoven generating different configurations of what we term 'geofutures': anticipatory integrated, performed versions of what geoengineering is, what criteria to evaluate it against, what governance it warrants and how action might be taken. Even outside international fora, such processes are affected by the coexistence of multiple, uneven societies. But studying geoengineering future objects at the UN Environment Assembly in Nairobi, we focus on a context where the effects of the international are particularly unavoidable.

We identify three main *geofutures* in circulation around the time of the Nairobi negotiations: the 'idealised', 'situated' and 'pragmatist'. Not all actors adopted a single, pure geofuture, but identifying ideal-types illuminates the key cleavages. It follows from this that we cannot pre-define

'geoengineering' to only include certain types of technology, since such boundary work (Gieryn, 1983) is part of each contested geofuture. We ask instead how the UN resolution process exposed ongoing socio-technical struggles over definitions of geoengineering, with different countries stressing different access to geoengineering science, valuing different forms of knowledge and highlighting different risks (from famine to stranded fossil assets).

Gathering future objects

We gathered diplomatic, scientific and activist future objects, using literature reviews, observation and deliberative interviews to identify overall patterns and divisions underlying the failure of the resolution to be passed. A series of semi-structured interviews were undertaken at the UNEA meeting in Kenya; and at a school on climate justice in Nigeria convened by a leading geoengineering critic (the Health of Mother Earth Foundation), in July 2019; supplemented with interviews using telephone or online video calling techniques. In total 29 individuals in three groups were interviewed about how they understand 'geoengineering' and regarding diverse questions arising from the draft resolution: eight members of government delegations to the UNEA meeting (including both Northern and Southern countries, a majority of the countries that attended the geoengineering resolution informal meetings, and all those most vocal during negotiations); 15 civic society representatives (at UNEA, and at the HOMEF School), predominantly (11/15) with individuals from the global South (including a mix of declared opponents of geoengineering, and those undecided but interested in the topic); and six climate/geoengineering modellers (all from the global North, but representing all the major research groups in this area, undertaken in July and August 2019). Interviewees in the first two groups were solicited within the relevant meetings, while interviews with modellers were secured by direct outreach. The gender and ethnic mix of the different groups of interviewees is diverse. Government delegates were ethnically very diverse, although around three-quarters male. Civic society representatives were almost exclusively people of colour, with around one-third women. Modellers were all white, but half were women. All respondents gave their prior informed consent to the interviews, under an assumption that their responses would not be attributed to them, unless they volunteered otherwise. The Swiss proposal provided a focus for the interviews conducted in Nairobi. In the other interviews aspirations and prospects for governance of geoengineering were discussed in more general terms. In what follows, quotations are labelled with a two letter identifier: in each case the first letter refers to the group (C = civil society; M = modeller; N = negotiator) and the second codes anonymously for the different informants.

Three clashing geofutures

In this section we examine how our diverse respondents engaged with geoengineering and its potential regulation and we outline three ideal-typical positions (summarised in Table 1). First, the *idealised* geofuture is constructed primarily through reductionist and rationalist truth-making revolving around modelling science. This presents geoengineering as an instrumental technological means to alleviate climate harms, reduce the costs of climate action and enhance distributive justice, but also relies on simplified expectations of a global actor (or multilateral governance) acting on behalf of a global constituency. We then describe a contrasting *situated* geofuture in which geoengineering is treated as inevitably part of multiple cultural, political and economic relations. This links the technology to emissions histories and material examples and patterns of exploitation, corruption and conflict, typically presenting geoengineering not as climate governance but as an imposition of power, likely to sustain fossil extractivism – for some even representing a new dimension of colonialism. Finally, a *pragmatist* geofuture rooted in a complex, multi-level and negotiated understanding of the world represents geoengineering as a signifier of failure to address the climate challenge through effective mitigation. From this position, geoengineering merits exploration, but with a precautionary stance both in terms of its material effects and its political implications. Here procedural justice is important, and governance is necessary to avoid unaccountable or illegitimate geoengineering and unwanted risks such as 'termination shock'.

The idealised geofuture

In the idealised geofuture shared by many of the modellers and some of the state delegates interviewed, CDR and SRM technologies are assessed largely abstracted from social, political, legal and international contexts, obviating the need for the collective term 'geoengineering'. Once 'demonstrated' against scientific or technical criteria, each discrete technology could be inserted by policy makers into the world to reduce 'climate risks' (also understood separately from wider societal and historical factors). 'Governance' may be desirable but is essentially exogenous to the technology.

The future practice that facilitates this idealised view best is modelling – in some cases treated as the sole mode of reliable and policy-relevant truth-making (Heymann and Dahan Dalmedico, 2019). UNEA delegates arguing that the resolution would undermine geoengineering assessment at the IPCC referenced the importance of good modelling: 'The IPCC is where the science base should be pursued . . . Modelling is good at the IPCC' (NH:2). Even though the idealised nature of such knowledge is acknowledged, its policy-relevance is taken for granted: 'Modelling is critical to understanding . . . and gives information to policy makers that allows them to act accordingly' (MD:1). Another modeller considers that 'Geoengineering [modelling] work focused on 1.5 or 2 degrees [C] is inherently policy relevant' (ME:1).

Opponents of the UNEA study pointed to ongoing assessment by the IPCC which:

> has the right mechanisms for science to inform governance: governments ask scientists to go and

Table 1. A comparative summary of the three ideal-typical 'geofutures'

	Geofuture		
Future practice	Idealised	Situated	Pragmatist
Truth-making (privileged epistemology)	Rationalist, reductionist	Historical, experiential and practice-oriented	Negotiated, interpretive
World-making (ontology)	Formally equal (rational) state actors Objectivist ontology	Structural (post-colonial) dominance Structural Ontology	Multi-level governance and institutions Complexity
Action-making (power & politics)	Hegemonic	Imposed	Contested
Ideal action-making;	Globalist	Democratic	Multilateral
Feared action-making:	Unilateral	Uneven	Fractious
Characteristic:			
Agency	Individual. Aggregated (e.g. through markets)	Collective. Uneven and constrained	Multi-level. Conditioned (e.g. by norms, Institutions)
Role of governance (of geoengineering)	Primarily enabling	Primarily constraining	Potentially both/either constraining and/or enabling
Role of models	'Truth machines' for projecting outcomes – for decision-making	'Tools of power', determined by inputs – for legitimating decisions	'Sandpits' for exploring possibilities – for risk management
Evaluative criteria	Climate outcomes, economic cost	Justice, social and cultural survival	Sustainable development (multiple criteria)
Orientation to future/risk	Can be modeled, quantified, demands management	Uneven, imposed, demands participation	Undetermined, demands precaution
Justice	Distributive, consequentialist (Secondary consideration)	Multiple, including recognitional (Primary consideration)	Primarily procedural (On par with other aims)
Research vs Deployment (of geoengineering)	Easy to separate, rational assessment	Hard to separate, inevitably distorted by interests	Interactions, risk of slippery slope

> do research, get expert review, then review by governments and publics, followed by negotiation of the [summary for policy-makers]. Repeated as needed to 'keep up with the science'. This works for us. (NH:3)

IPCC processes rely on peer-reviewed publications, which offer a filtered and idealised set of results. Yet opponents of the resolution objected to the 'narrow remit of UNEP on the environment' and argued 'The IPCC bases its work on 3,000 scientists and is approved by governments' (NG:1). Such arguments were made even while acknowledging that on geoengineering, the IPCC would be reliant on just a few models and modellers (NH:4) and that a UNEA study would be broader in scope and methods.

Modelling also implicitly involves world-making and the idealised position projects a rational, technocratic policy making environment. One modeller explicitly suggested a technocratic governance model, using the Federal Reserve as an analogue 'fiscal policy is decided politically, much else is delegated as "technical"' (MB:1). In such a model, modelling would gain 'an entirely new use' as 'operational, adaptive forecasting' (MB:2) despite difficulties in attributing causes. Modelling assumptions also tend to reflect (and reinforce) 'the view that solar geoengineering could or will be used in the global general interest' (MF:2). Almost all modelling 'implies global top-down governance' (MF:3). Similarly, the geoengineering model intercomparison project (geoMIP) 'doesn't deal with justice, but implies a single global controller' (MB:3). The complications of the international feature only weakly in the idealised geofuture.

In practice many state representatives as well as most modellers recognised serious uncertainties, particularly in attributing actual outcomes to geoengineering interventions (especially SRM) and thus in controlling it. 'We wouldn't know the full consequences of [solar geoengineering] even several years after deployment' (MF:1), and therefore could not fine-tune and control it. 'Models cannot attribute effects in practice', so could not realistically be used for governance (MG:1). As a result, any geoengineering governance 'would need a liability regime, because people will fight over attribution' (MD:2). Dependent on a liability or insurance regime, the 'discrete technology' view begins to break down (Horton and Keith, 2019).

Even in the multilateral setting of UNEA, reliance on modelling allows concerns regarding the political fragmentation of the world to be suspended. The idealised model-based assessment typically treats questions of justice as outside its remit, and potentially inappropriate in objective scientific research. Modellers suggested that in modelling: 'why interventions are important is incidental' (MF:4), and: 'Modelling is not really intended to target justice … I don't want to get into that' (MD:3). Nonetheless some argued that their work suggested conclusions for justice in similarly simplified forms: 'It would be possible to design a global deployment that benefited most regions in a distributionally just way' (MF:5). Scenarios in which SRM is used to 'shave' the peak off global temperatures 'imply that differential regional impacts or precipitation over-compensation won't be an issue' (MA:2) – a claim echoed in the literature (Horton and Keith, 2016; Irvine et al., 2019). One modeller even saw 'transgenerational equity and justice … embodied in doing geoengineering modelling', presenting the geoengineering options they modelled as 'solutions that are egalitarian, rather than depending on the wealth of countries' (MA:3). This respondent echoed complaints that consideration of geoengineering was being held back by rich world concerns:

> we need to hear from those vulnerable to climate change … not from the safety of the Finnish forests … without a doubt, the developing world would see SRM as a reasonable thing to be considered against alternatives of adaptation and suffering. (MA:4)

This matters because modelling science is expected to inform – if not lead – policy at a multilateral level. One modeller observes that one might 'seek a way to get global agreement over a geoengineering schema by tailoring it in the model and in the real world to provide wriggle-room against climate temperature targets' (MB:4). Several respondents argue that 'overshoot' scenarios (in which carbon budgets and temperature targets are breached and SRM used) would 'inform meaningful debate' (MA:5, MC:1). Thus, modelling science and the global politics are acknowledged as co-constitutive of each other, though clearly with the truth-making leading the world-making.

At the same time the primary context for the selection of model scenarios and the material in published papers is academic incentives and review criteria rather than political or ethical considerations. Reviewing of papers in disciplinary scientific journals gives 'no incentives to embed justice or similar issues' (MF:6) while 'defensibility of technical and policy options is of little relevance' (MA:6). In published papers, simulations are often selected from multiple model runs to provide the best illustration of the findings (ME:2). In describing some modelling that included interactions this modeller explained the criteria for choosing what to publish:

> We had to choose one scenario to publish … so considered what was most palatable to reviewers, most impactful, defensible in assumptions … this was an invited piece on solar geoengineering, so we weren't going to say that CDR could do it all. (ME:3)

It is in this context that the IPCC – with its dependence on modelling studies – would guide policy.

Thus, in the idealised geofuture modelling and other scientific future objects delimit what 'geoengineering' is in terms of its mechanisms, efficacy and legitimacy. Although it considers political contexts as incidental to its own truth-making, the same knowledge is considered able to provide a basis for policy decisions. This is linked to an underlying (and highly stylised) belief about knowledge leading rational action in a context of global governance, particularly via the

processes of review and consultation in the IPCC. Moreover, in the idealised view, research is categorically separate from deployment, and there is therefore little need for governance of research, while governance of deployment is an issue that can wait.

The situated geofuture

By contrast, some state representatives and most civil society respondents promoted a very different geofuture rooted in an understanding of geoengineering *situated* in a world structured by a long history of unevenly distributed benefits and power. Issues such as climate outcomes, carbon balance, environmental side effects and technical plausibility are not ignored in evaluating geoengineering, but these are interpreted within a situated frame of reference, and the status of knowledge produced from experiments or models is not automatically privileged nor assumed to be neutral. This closely echoes Haraway's (1988) definition of 'situated knowledge'. Situated respondents were typically, but not exclusively, from the global South, and tended to emphasise the political context, often also raising cultural or spiritual concerns, in ways Northern respondents tended not to.

A key source of knowledge is the historical legacy of previous technological and geopolitical developments. From a southern situated position, the spectre of colonialism is never far from the debate. Geoengineering is 'colonising the skies,' (CH:1) and putting 'the developing world back at the mercy of the rich world,' (CG:1). One state delegate contextualised their demands to improve geoengineering knowledge, as 'not about "capacity building" … "Capacity building" is nothing, just a new way to keep Africa behind. Or a way to make others think the same way you do, rather than letting them think for themselves' (NF:2).

Where the idealised position foregrounds truth-making practices over world-making, in the situated geofuture that hierarchy is reversed. Geoengineering is not a discrete technological apparatus but a feature of the world-system and its continuation. Geoengineering 'allows those whose actions are causing the problem to continue … and to profit' (CH:2); 'addresses only the symptoms of the problem' (CF:1); and could 'make things worse – entrench the fossil fuel economy, providing it continued power and legitimacy' (CE:1). Respondents raised multiple justice-based concerns that geoengineering might be imposed without consent (CM), involve control over patents (CC), ignore indigenous knowledge (CG), and if relied upon instead of adaptation, could increase the risks of sea-level rise for the poorest (CB); concerns exacerbated by the fear that decisions would be made by corrupt, extractivist governments.

While the idealised global actor might be imagined to deploy geoengineering to save the vulnerable South, here the technologies are firmly positioned as Northern in terms of research, potential deployment and the interests that it would serve. Research and deployment are inextricably interlinked, and both demand governance to constrain them. Moreover, the technologies are understood in the context of previous global governmental regimes. Like structural adjustment programs (administered by 'global' institutions such as the IMF), if geoengineering were to be deployed, its withdrawal or maintenance 'will be used as a threat to enforce behaviour … this would be totally unacceptable in African society – we will not tolerate more external control … colonialism left cross-generational trauma. Geoengineering is yet another "white man's thing"' (CC:1). The perceived control provided by geoengineering exacerbates geopolitical imbalance: 'It's warfare at another level … motivated by fear of "the other" and the desire to be able to threaten them,' (CC:2) and 'hands control over the global thermostat to the rich, elite, North' (CF:2).

The mitigation deterrence problem is also cast differently. From the situated position geoengineering threatens to enable powerful interests to avoid action to halt fossil *extraction*, making it in the eyes of one activist: 'a crime against future generations' (CH:3). In terms of action-making work therefore, geoengineering has to be internationally regulated, in part *because* governments cannot be assumed to represent vulnerable populations. For instance: 'SRM would be acceptable in Nigeria because it would allow oil exploitation to continue' (CJ:1) and the 'government would accept [geoengineering] "hook line and sinker" as long as it came with financial incentives' (CG:2). Corrupt politicians 'don't want to understand … as long as it's giving revenue, making them richer … Governments will keep looting' (CK:1). The situated Southern political context thus places hopes for climate justice not on Northern technocratic interventions but on *transformation* of the systems responsible for the climate problem and the extractivism that underpins it.

Whereas in the idealised geofuture uncertainties are something to be addressed by scientific expertise, for the situated, knowledge about geoengineering based on modelling alone is perceived as potentially biased. Civic society respondents universally argued for broad participation in governance, including both multilateral involvement of countries, broad involvement of publics and diversity in forms of knowledge: 'hearing everyone's stories is fundamental to addressing climate change' (CH:4). Practicing that diversity, Southern NGO respondents moved matter-of-factly between scientific, political and spiritual language, with frequent calls for respect for indigenous knowledge and approaches. In talking of the problems arising in using forests to supply biomass for CDR, one noted: 'Forests are not just where people live today, but also the abode of our ancestors … who don't die, but continue in nature when they return to the earth' (CL:2). Another argued that: 'We should work towards ensuring that indigenous beliefs are not totally eroded, so that the global South can also contribute [solutions] … modernisation is eroding the indigenous checks and balances protecting our resources' (CA:1).

Such views were reflected by some government delegates, who sought 'inclusive processes of participation for diverse actors, diverse knowledges and across different dimensions of the problem' (ND:3); and argued that without broad-based information on possible impacts they would be left: 'unable to exercise influence and (without) rights to

participate' (NE:10). The relative openness of UNEA to diverse knowledges and stakeholders was seen as important in this respect.

Not all our Southern respondents were categorically opposed to geoengineering, but even those open to considering it argued for 'strict regulation and broad outreach' (CJ:2). Many civil society respondents thought governance should be preemptive, in the form of a ban, imposed by the United Nations General Assembly (UNGA), the CBD or UNEA. There was little sympathy for governance under the UNFCCC, nor for assessment by the IPCC. Views extended to very harsh prescriptions: 'the Security Council might be the right place [for governance] ... I'd advocate a "total ban and criminalization", because geo-engineering is "terrorism in the making"' (CC:3). Similarly, 'geoengineering should be banned by the CBD and classed as ecocide' (CH:5). Not all went so far, one advocating instead: 'a binding independent international instrument on geoengineering ... with transparent reporting ... [and] a moratorium on deployment until there is a whole governance system' (CM:2). For situated respondents, both SRM and CDR should be subject to 'a multi-national, multi-interest framework to assess potential utilisation, impacts and governance' (CL:3); something 'participative' (CG:3) and 'collective' (CK:2), and involving 'prior informed consent ... respecting rights to self-determination and sovereignty over resources' (CM:3).

Interestingly, most modellers' expectations of *real-world deployment* of geoengineering echo the situated narrative more than idealised modelling. For one, the speed of SRM makes it likely to be considered as climate impacts intensify, but winning intergovernmental agreement would likely require 'tying it up in ongoing diplomacy – trade, military cooperation etc.' (MB:6). Others noted that 'unilateral efforts would likely be suppressed, by trade sanctions or military threats' (MC:2), or 'would risk political crisis in a world of increasing nationalist division' (MG:2), yet still expect 'incremental, unilateral, ungoverned geoengineering' driven by local impacts (ME:4) or even 'as a tool of political diplomacy ... countries might deploy SRM as a way to extract justice from the international community, even deliberately aiming to negatively affect perceived climate villains' (MA:7).

Thus, in the situated geofuture 'geoengineering' is not simply a set of devices but an integrated part of a world-historical system, best understood, not just through climate modelling and economic theory but through disciplines of history, political economy and even religion. The notion of 'governance' envisaged by situated future practices is more comprehensive, going beyond state level agreements to depend effectively on a transformational process of reducing power imbalances and addressing justice beyond only impact attribution and cost distribution.

The pragmatist geofuture

If the idealised geofuture foregrounds truth-making and the situated prioritises world-making, the *pragmatist* focuses on action-making, moving issues of uncertainty and precaution centre-stage in a multi-level world of complexity and uncertainty, where truth is subject to interpretation and negotiation. Those exhibiting this position (including many negotiators) take a precautionary stance regarding both the material and political side-effects of geoengineering, and treat models as merely one means of inquiry about the future. They recognise the value of more situated assessment, not just the idealised view of the IPCC, and apply a pragmatic view of governance as potentially either constraining or enabling for technologies. Questions of fairness are part of their assessments, albeit most strongly in relation to procedural questions.

Where the other geofutures consider climate science somehow capable of precision (either in tailoring geoengineering or controlling it for vested interests) the pragmatist understands science as itself also a source of risk. Those countries supportive of a UNEA assessment of geoengineering highlighted uncertainties about side-effects, and the risks of geoengineering undermining mitigation. Geoengineering technology:

> must be treated with precaution regarding potential negative impacts on the environment or other peoples. If it's possible to use safely ... and without undermining emissions reduction, then it would be OK. But it shouldn't be used as a substitute. (NF:3)

For another state delegate SRM is 'deeply concerning' but the uncertainties about the stability of the climate system mean that ... '[still] we are not ready to reject it entirely' (NE:1).

A key pragmatist aim at UNEA was to build on (or not undermine) existing precautionary governance. One Southern delegate highlighted a choice between upholding precaution, and relaxing control, arguing in favour of 'governance to strengthen the precautionary principle, to confirm the CBD decisions' (ND:1). Another delegate carefully separated their own opinion from their official, more neutral, line: 'Personally, I see geoengineering (especially SRM/Stratospheric Aerosol Injection (SAI) as "very scary" and it should be governed on a precautionary basis' (NC:1).

This emphasis on uncertainty and risk emanating from the scientific knowledge-production means that action-making matters. Research might be usefully conducted, but is not inevitably separate from the risks of potential deployment. Supporters of the resolution called for 'norms and regulations, not just voluntary projects ... It's like the human rights regime. The declaration [the Universal Declaration on Human Rights (UDHR)] isn't enough, it needs regulation to implement it' (NB:1). Governance is needed 'because of the likelihood of transboundary impacts, and worries about geoengineering as a security issue'. This applies to CDR at scale as well as SRM: 'It's also of international significance if a country tries to substitute CDR for emissions reductions' (NB:2).

In the pragmatist geofuture the multiplicity of the international is neither assumed away nor reduced to 'Northern domination'. Rather, it demands inclusion of diverse actors in action-making: 'With a magic wand, I'd ... emphasise governance in a UNEA report. The process should also

involve civil society. We share the same planet, and should work together for the benefits of the environment' (NF:4). Discriminating governance of geoengineering (and research into it) is understood pragmatically as needed both: 'to constrain geoengineering in the face of side effects or irreversible effects . . . [or to] constrain unilateral use by a large power, which could trigger wider conflicts between nuclear-armed states' (NE:2), and 'alternatively to enable it in the face of imminent climate crisis' (NE:3) or to avoid the risk that, like essential drugs, without global governance 'techniques like SRM will get into private hands, and thus be less accessible in case of need' (NE:4). For other delegates, while CDR was seen to merit a precautionary approach, other geoengineering approaches might be 'ruled out following assessment' (NB:3).

For pragmatists, UNEP/UNEA was a far preferable venue because of its broader and more situated remit and representation. 'Our country counts on UNEP for information and capacity building. UNEP is an international forum that "brings together a wide variety of views" and makes information more "useful"' (NE:5). 'We feel "better protected or represented" by UNEP than by IPCC' (NE:7). Other bodies favoured in the idealised position, like the US National Academies of Science, are problematic because they are 'not concerned with issues and impacts from the perspective of [countries like ours]' who have 'no chance to influence what is considered' (NE:6). Moreover, geoengineering is 'not yet a political football' (to be traded off against other issues) – 'UNEA doesn't tend to do that, unlike the UNFCCC' (NE:8). Again it is telling to compare these comments with modellers' speculations on likely real-world outcomes, which suggest exactly such a politicised form.

In Nairobi, both supporters and opponents of the resolution expressed concerns about the risk of politicisation of governance discussions, with pragmatists seeing a move to the UNFCCC as an attempt to avoid regulation:

> Sending the issue to the IPCC would mean putting it in a voluntary, unregulated space . . . any negotiation would then happen under the UNFCCC . . . The desire of some parties to push this to the IPCC is a delaying tactic and reflects a desire to keep their hands free from restraint. (NB:4)

One vocal Southern supporter of the resolution said 'we are very concerned about power relations and the dominance of rich [countries]. The IPCC is science-based, about climate, not about the technology. UNEA is the right place to assess technology, IPCC is not' (NF:5).

Like the situated geofuture, the pragmatist position also draws on historical experience, in this case that of global governance: 'What happened with Hydrochlorofluorocarbons (HCFCs) is a good example. Once the IPCC got hold of them it needed the Kigali amendment to accelerate progress' (NF:6). Another delegate recognised concerns about interests, noting the influence of tobacco firms on the World Health Organisation: 'NGOs have experience of abuse of science in the multilateral system – we can understand where they are coming from . . . The IPCC is the best we have for science-based governance, but it might be vulnerable to interests' (NB:5).

Several delegates perceived vested interests behind arguments for leaving geoengineering assessment to the IPCC. Such arguments serve the interests of 'the promoters of technologies . . . [and] those climate scientists who want to test their models and hypotheses' (ND:2), said one. For another, they served 'the interests of the fossil fuel industry . . . they don't want governance. On the other hand we [an African nation] want to go as quickly and comprehensively as possible' (NF:7). Another noted that while they could not 'afford to support work at the peer-reviewed level . . . there are strong interest groups paying for "science" to validate their positions', arguing that IPCC has been 'politicised by the decision makers' (NE:9).

Thus the pragmatist geofuture is one in which CDR and SRM are inseparable from scientific and global governance uncertainties, and have to be considered as possible interventions in a difficult context, where vested interests and governance dilemmas hamper the desirable prospect of inclusive and transparent precautionary governance.

Discussion

Understanding the distinctive geofutures exposes deeper differences behind the face-value reasons given for disagreement at UNEA (venue, definitions and timing). Here we discuss three broad implications all of which undergird our overall conclusion that there is little evidentiary basis for assessing geoengineering technology as if broad consensual global governance were a given or even likely. *First*, diplomatic disagreements over venue (and timing and definition) reflect contextualised differences in conceptions of truth, worlds and power – competing geofutures – not simply disagreements over evidence or procedure within a shared social imaginary. *Second*, the idealised and categorised knowledge (including definitions) created by the dominant social imaginaries of science and economics provides insufficient (and possibly misleading) guidance for negotiating the contextual geopolitics of climate intervention. And *third*, negotiating governance in this epistemically, ontologically and ideologically fractured space – already difficult to predict – is not a question of waiting for the right time (and place) – indeed it will likely become even more difficult as climate impacts in the material world grow because such impacts may exacerbate these disagreements, even as they undermine institutions of cooperation.

It's not the venue – disagreement is fundamentally situated

The question of venue became the central flashpoint of disagreement, with idealised support for assessment to be left to the IPCC. According to one delegate, those wishing to support involvement of Southern interests 'should simply

start an independent process to engage and develop Southern capacity' not bring a resolution to UNEA (NH:6).

However, such arguments should not be taken purely at face value. To express concern that the IPCC might be 'distracted' by a UNEA assessment might seem hypocritical coming from countries like the US and Saudi Arabia, which had previously failed to welcome the IPCC 1.5 special report. Moreover, even if the call to move assessment to the IPCC were well-intentioned, it would reduce the likelihood of governance, as well as slowing the process. Opponents of the UNEA resolution objected not only because it presumed 'a particular venue and scope' but also 'a precautionary approach, and specific implications for mitigation' (NH:7). Arguably they feared that a precautionary approach at UNEA would constrain use of geoengineering techniques (especially as a substitute for mitigation). Yet language on precaution is longstanding and common across UN bodies, so there is no guarantee that a shift of venue would result in a less precautionary approach (contra to Jinnah and Nicholson, 2019). While some opponents expressed a fear that geoengineering might be unduly constrained as a response to unavoidable climate change (NH), others were explicitly keen to keep geoengineering available as an *alternative* to conventional emissions mitigation. One opposed delegate even stated, when asked hypothetically about risks of geoengineering replacing greenhouse gas emissions cuts:

> that's what we want [We have] no view on SRM officially – (. . .) and it's OK to be careful. But we are keen to enable CDR/CCS (. . .) We have no worries about mitigation deterrence. Our view is that we can continue using fossil fuels for growth and sustainability because we can use geoengineering and CCS to fight the emissions. (NG:2)

The objectivist (idealised) image of asymmetrically informed actors, with (perhaps divergent) interests negotiating in good-faith in multilateral venues fails to capture such contextualised differences in interests and views on power and justice, which in turn subtend disagreements over knowledge and procedure (expressed as disputes over venue/timing). Situated and pragmatist perspectives alike critiqued the role of interests at the IPCC. And it is in the situated geofuture that mitigation deterrence emerges as an expectation rooted in world histories and extractivism, rather than as a product of inadequate knowledge or rational actors 'gaming' each other for individual benefit. Even in the pragmatist geofuture risk of mitigation deterrence (read through diplomatic histories) becomes material, demanding a precautionary approach.

More generally, caution over – or downright opposition to – geoengineering arises not primarily in scientific evidence or modelled projections (although both those forms of future objects play important roles) but in conceptions of how the world works and the particular actor's position in it. In particular, opposition arises in perceptions of the world as divided, as contested, and in positions that take the perspective of the disadvantaged and vulnerable. For example, we found southern objections to geoengineering based on the understanding that it would act to sustain existing injustices (e.g. locally polluting oil extraction in collusion with armed militias); while modellers look instead at the theoretical potential for geoengineering to reduce the injustice in climate impacts. Given the world-view inherent in the situated position, it becomes inconceivable – even if it were technically plausible – that a geoengineering deployment configuration would be designed to maximise justice in ways the modellers might suggest. This concerns side effects of large-scale CDR (demands for land or minerals, energy or CO_2 storage spaces), and the potential for modulated and tailored SRM interventions to address temperature 'overshoot'.

This is *not* to argue that the privileged enjoy the luxury of abstraction, and therefore have developed an objective perspective, while the global South adopts a subjective situated geofuture through struggle. Instead we see the privileged position – despite its imagined abstraction – as equally perspective-dependent and embedded in existing social relations. 'Rule makers' and 'rule takers' occupy very different positions. Groups that fear imposition of geoengineering decisions, whether their fear is of geoengineering measures imposed when they aren't wanted, or of being unable to access geoengineering if they did want it, want governance developed (and soon). Those who see an interest in and power to impose geoengineering decisions – among the 'makers' of global power relations (including some elites in Global South countries) – currently resist the development of governance, favouring an ad hoc form of governance, seeing themselves as the actors to legitimately deliver outcomes informed by idealised knowledge. In a situated understanding, it is the US and their allies that might undertake uni- or mini-lateral SRM, not the poor countries of the global South [regardless of what discourse on 'rogue geoengineers' might suggest (The Economist, 2019)].

It's not the definitions – the idealised position is too flimsy to sustain governance

On the face of it, definitions and categorisation were another fault-line in Nairobi, with many arguing that SRM and CDR should be treated distinctively (e.g. NG:2 in the preceding section). Another resolution opponent argued that: 'There is no clarity on what counts as geoengineering . . . we fear a restrictive effect of a list of techniques that might include things of interest to [my Government]' (NA:2).

That material differences between CDR and SRM might merit different treatment is partly a reflection of an Idealised position – in contrast to a situated position from which the *political* similarities suggest the two carry similar risks. In situated and pragmatist geofutures, the potential for near-term mitigation deterrence, and the side-effects of large-scale CDR, are understood as likely injustices or risk-transfers. And when we consider the way CDR is treated as a future object in the contending geofutures, it seems impossible to conclude that its separation from SRM would have ensured the resolution's success, or indeed, even have proved possible.

Even when CDR was textually clearly separated from SRM in the revised draft, the opponents of the resolution still did

not concede the point. In addition while they at times advocated separation, at other stages they sought to bracket not only SRM and CDR together, but to group them also with fossil carbon capture storage (CCS) and other forms of mitigation as 'climate measures', always in service of an argument to avoid precautionary governance. Much CDR and CCS is already effectively authorised and enabled within UNFCCC agreements, and could be largely enabled at a national scale. It is the international implications, such as land-grabs for biomass, impacts on oceans, and the risks of mitigation deterrence, that generate demands for multilateral precautionary governance of such techniques (in contrast with suggestions like those of Bellamy and Geden (2019) for bottom-up governance based in local characteristics). This does not necessarily mean that the opponents of the resolution plan to implement CDR, which instead functions as a promise of future action that facilitates continued fossil extraction and use (as Markusson et al., 2017 found for CCS).

More generally, the idealised geofuture sees geoengineering as one of a series of interventions in the climate, understood primarily through modelling, and governed in the global interest, tailored and modulated to deliver not only climate stabilisation but also some level of distributive justice for those most affected by climate change. As we have seen, this is not compatible with a situated position in the world, nor indeed a pragmatist one. It is not just that the attribution problems of SRM – identified by modellers – might make the technique politically impossible, but that attribution is just one of a host of problems and difficulties related to the international, such as: coordinating action, interpreting other actors' intentions, having diverging interests and knowledges, etc. All these make inclulsive collective governance of geoengineering highly implausible, especially because uneven international politics in this case revolves around predictions and futures. Jasanoff (2020, p. 30) puts it starkly: 'persuading people to opt for any vision of a future world, *the things to come* (. . .) requires a leap into a fictive, unrealized landscape of dreams rather than one of tangible reality'.

Modelling work, however, is an imperfect foundation for governance decisions, and some of the scientists we interviewed noted ways in which idealised future practices of SRM geoengineering might undermine other future practices. One highlighted that. 'solar geoengineering looks far too good in IAMs [integrated assessment models]' – it appears to work perfectly (MF:7), and the framing of the problem as cost-optimisation in IAMs is 'inappropriate for solar geoengineering' (MF:8). The implication here is that mitigation deterrence could be a product not of moral laxity but of the truth-making of the models. Experience with CDR in IAMs bears this out, with bio-energy carbon capture and storage (BECCS) preferentially modelled simply because of the ease of including it, and promises of CDR consistently displacing near-term mitigation because of cost-optimisation and discounting principles (Bednar et al., 2019; Realmonte et al., 2019). The scientist's concerns suggest that similar failings might apply to SRM: although 'solar geoengineering hasn't been used much by those arguing against emission cuts . . . that is coming' (MF:9).

Among modellers and negotiators, models are too often treated or presented as truth-making tools, even when so simplified or abstract that their policy relevance is negligible. Most modellers acknowledged both that just and governable scenarios rely on implausible assumptions, and that models cannot provide the attribution of effects needed to govern SRM in practice. Yet IPCC reliance on modelling science means that model studies as a future practices could have 'lasting effect in and for the future' (Esguerra, 2019) beyond providing hypothetical projections to inform political debate.[2] Modellers' ideas of how modelling could support governance and workarounds for the attribution problem are equally questionable. 'Liability rules' would in turn be embedded in a morass of power relations and cultural debate over corporate and state liability. And 'compensation for side-effects' is not only implausible in a world where loss and damage provisions can't be agreed for climate change itself, and agreed funding for adaptation and mitigation in the global South lags behind promises; but also largely fails to deal with the underlying problem: demands for compensation necessarily reopen questions of attribution. Repeatedly we see governance for geoengineering hitting the same sort of obstacles that have hampered negotiations on mitigation/adaptation for decades.

It's not the timing – a pragmatist geofuture is not a compromise

Concerns over timing also became an argument against the resolution. For one opponent: 'It is premature to put geoengineering into a UNEA resolution' (NC:3) implying that knowledge and understanding was too limited – even as that shortfall was what the resolution purported to help remedy. For another the argument was expressed as: 'There is no rush. It's clear that [SAI] isn't ready to deploy, not at the stage where it could be indemnified against lawsuits or prosecution' (NH:9). But with the understanding revealed by contesting geofutures and outlined above, the idea that a study on geoengineering might be 'premature' appears in a different light. SRM arguably might be deployed in a world facing more severe climate impacts. But such a world is likely to be one less capable of agreeing governance rules (Howard and Livermore, 2019). In such circumstances, the idea of governance delivering forms of geoengineering that reflect global welfare functions through calibrated and targeted interventions is very hard to sustain. Any delay in seeking governance seems more likely to condemn the effort to failure, and meanwhile delay enables further consolidation of the idealised geoengineering geofuture –which risks providing a further reason for delay in urgently needed mitigation.

In this light, the pragmatist geofuture should not be seen as some form of 'compromise' between the idealised and the situated. Rather it holds within it the potential for a distinctive and productive approach rooted in new approaches to action. In this context the right outcome is not guaranteed by a particular process in a particular venue, but rather

through an ongoing engagement with the political, economic and cultural problems at the root of climate change, and a move away from a 'solutionist' understanding of climate as something ultimately solvable (Hulme, 2009).

By definition such governance engagements would be more diverse and participatory, not only at the procedural level, but also in terms of the knowledge and understanding involved. At the UNEA meeting, contestation around knowledge was not just over the interpretation of models and scientific findings (although conflicts continue). We also saw, critically, demands for different forms of knowledge and cultures of precaution on how knowledge about geoengineering should be (safely) generated, and discussed. Sound science was repeatedly cited by opponents of the resolution. By contrast some supporters insisted on language that endorsed 'science and other knowledges' and argued that diverse actors and knowledges are essential to come to a balanced evaluation of geoengineering technologies. When asked for real-world expectations, even modellers rapidly depart from idealised projections and anticipate conflict over localised or regional efforts to geoengineer.

Pragmatist geofutures generate very different visions of who gets to shape the critical future practices of geoengineering. Instead of the IPCC feeding into existing politics of climate change – and its history of repeated delay and prevarication (McLaren and Markusson, 2020), the UNEA potentially opens up opportunities to new groups and interests, notably the most vulnerable and disadvantaged. The choice of venue is in turn a contribution to reconfigured processes of world-making, because decisions on which multilateral systems get reinforced and which get weakened in turn reinforce or remake the political realities of the world.

Conclusions

Despite the failure to agree first steps at UNEA, there is good reason to believe that CDR geoengineering at least may be required to avoid devastating climate change, given the ongoing shortcomings of mitigation policies (IPCC, 2018). But our analysis suggests that global scale geoengineering may even be more difficult to negotiate than mitigation, and hence truth-claims made under the global planner/governance assumption should not be carried over into feasibility and policy debates. The analysis also suggests that the quest for a pragmatic climate policy begins with finding a new configuration of negotiations rooted in a situated understanding of the problems we face.

In this respect the UNEA negotiations (despite the failure of the resolution) successfully raised the profile of geoengineering, and awareness of the complexities implied in seeking to govern it. Indeed the negotiations (as analysed here) exposed that such difficulties go beyond the challenge of rational actors designing appropriate institutions. Our analysis also demonstrates that reasons advanced at and after Nairobi to explain resistance to the geoengineering resolution should not be taken at face value. The clashing geofutures, (re)produced variously through future practices (models, scenarios, policy texts, negotiations, campaigns and more), and outlined above illustrate that questions of venue, timing and definition were an expression of – rather than the cause of – disagreement in an uneven world. The underlying challenge comes from fundamental differences on truth-making, world-making and action-making, exacerbated by the coexistence of multiple, uneven societies, and the belief of *all* participants that their position offers the more valid representation of reality.

The idealised position adopts a technocratic, road-mapping approach to the future (using models as predictions), which fares particularly badly when exposed to international complexities. Posing as abstract objectivism with rationalist institutionalism as 'governance', the imaginaries of the idealised position could in practice only be materialised through the de facto exercise of epistemic, ontological and procedural power. Governance based on the idealised view would be deployed (or omitted) in ways that align with interests of its proponents – keeping geoengineering available to those most likely to have the capability to develop it, including as a means to delay emissions mitigation otherwise politically or economically disruptive to them. The situated position rejects the idealised geofuture and its forms of truth-making in a critique of historical and structural inequality and suggests a route to the future based in bottom-up struggle for transformation. This too struggles to deliver practical tools when exposed to the realities of the international. Yet the understanding of climate and responses to it as – at least in part – a situated product of the politics of the international, should warn us against relying too heavily on future objects (technologies, models, etc.) that draw a globalist veil over historic and international conflicts (Corry, 2017a; McLaren, 2016a). The pragmatist position offers an opportunity to utilise models as projections only, and to build multiple scenarios which respect some situated insights into power and technology. It promises to deliver action-making to reconfigure institutions of governance in necessary and functional ways but has less of a grasp of the politics necessary to get there, stopping short of questioning the role (prospective) technologies play in maintaining a world order that might ultimately negate that governance agenda.

The diverging world-making views reflected in the debate confirm that the challenges of governing geoengineering are at least as bound up with ideas of justice, participation and historic exploitation as mitigation and adaptation policy have proven to be. This case of geoengineering negotiation is specific in its set of actors and the ostensible points of contention. However, in the context of the wider history of environmental struggle and climate politics, it offers broader insights into the interactions of states and groupings (beyond standard political theory), especially in the face of the growing material constraints of environmental impacts and scarcity. Climate governance as a whole needs to embrace history, politics and the international if it is to bridge the gaping 'mismatch between rhetoric, intentions and action' (Stevenson, 2020, p. 1). The idealist and situated worldviews are in deep conflict, and as seen here, pragmatist attempts to establish compromise are not enough when the idealist position is co-evolved with dominant geopolitical institutional regimes, and adopted by some actors to serve vested

interests. In this context some of Jinnah and Nicholson's (2019) suggestions (broadening the IPCC's assessment role, more sharing of information, more attention to distributional implications; generation of more diverse knowledge) may appear desirable, but could not be expected to generate agreement on governance. There are no simple procedural solutions here, but given existing power structures, to generate climate governance that is both pragmatic and situated, we see more prospects in keeping geoengineering *out* of the IPCC/UNFCCC, while perhaps calling the bluff of the idealised on the questions of timing and definitions, with two separate, sequenced assessments of CDR and SRM governance. Critically, such a process, with the 'world-making' power such assessments embody, would further expose the underlying motives of any states seeking to use geoengineering as a cover for continued extractivism and fossil consumption, while allowing those willing to explore geoengineering governance to debate the extent of any regulation and constraints, including the measures needed to avoid any substitution of geoengineering for feasible emissions reductions. In an open clash of geofutures, we see not only new sources of conflict and a reactivation of familiar struggles, but also the possibility of a new planetary order that could respond to *both* international inequalities and the global scale of human impact on natural systems.

Notes

1.. Initial negotiating text available at https://papersmart.unon.org/resolution/uploads/switzerland_-_resolution_submission_-_geoengineering_and_its_governance_-_unea_4_.pdf
2.. There are parallels here with how economic models – despite their shortcomings - are used in economic policy, though the frequency of crashes, and failed predictions should give us pause for thought before applying such an approach to the world's climate.

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