Energy Research & Social Science 44 (2018) 209–221

Contents lists available at ScienceDirect

Energy Research & Social Science

journal homepage: www.elsevier.com/locate/erss

Original research article

Whose climate and whose ethics? Conceptions of justice in solar geoengineering modelling

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ARTICLE INFO

Keywords:
Geoengineering
Justice
Modeling
Climate policy
Stratospheric aerosol injection (SAI)

ABSTRACT

The role of underlying assumptions about justice in the construction of climate geoengineering knowledge is explored, based on a review of climate modelling studies focused on stratospheric aerosol injection. Such emerging technologies would create distinctively new climates, closer to the present climate than those resulting from unabated emissions; but with different winners and losers, in part as a result of implications for energy systems. Embedded presuppositions about the nature and practice of modelling are exposed, as are unexplored and narrow utilitarian and distributional conceptions of justice. The implications of these underlying assumptions and values for the discourses of climate geoengineering are considered. It is argued that they obscure the identification and consideration of a range of potential injustices arising in the pursuit of climate geoengineering; and create and reproduce asymmetries in power regarding the discourses and evaluations of climate geoengineering prospects. In particular, optimistic climate geoengineering discourses risk sustaining elite interests in high-carbon energy economies. Some suggestions are offered to improve the design, deployment and interpretation of climate engineering models in trans-disciplinary research so as to mitigate these problems.

1. Introduction

Climate geoengineering is increasingly debated as a response to the problems of climate change and excess carbon emissions from energy systems. In various forms it appears to offer a technical fix that may well deter or delay a transition to clean energy [1–4]. In this paper I explore ways in which underlying utilitarian and consequentialist presuppositions about justice, expressed in climate modelling practices and results, may contribute to misleading discursive framings of technological optimism regarding the dominant form of solar climate geoengineering: stratospheric aerosol injection. In turn these framings risk stimulating a moral hazard effect in which geoengineering substitutes for mitigation, thus sustaining other negative impacts and injustices of fossil fuel extraction and use.

Climate geoengineering techniques are typically divided into carbon dioxide reduction (CDR) and solar radiation management (SRM). CDR involves removing greenhouse gases from the atmosphere, and, as a technical fix, promises future recovery of current emissions. CDR is not considered further here, but is already embedded in climate pathways models as a means to square carbon budgets to meet particular temperature targets [5–7]. SRM reduces the proportion of the sun's heat captured in the earth system, typically by reflecting more sunlight. Stratospheric aerosol injection (SAI), which dominates the geoengineering literature [8], would reflect sunlight by dispersing small particulates into the stratosphere using aircraft, artillery or a balloon-lofted pipe, and thus reduce global temperatures through the same basic mechanism as occurs with large volcanic eruptions.

Although such interventions are yet little more than technological imaginaries and their future evolution as co-constitutive parts of socio-technical systems largely unknowable [9], increasingly detailed climate modelling work using Global Circulation Models (GCMs) has begun to sketch possible distributional climatic consequences of such imagined SRM interventions, treating them as concrete objects. As in the case of CDR, here the models also co-constitute these technological imaginaries, with very limited scope for empirical validation, and do so in a charged policy space in which the politics of climate denial largely prevents constructive questioning of modelling and its assumptions. This means that climate modellers arguably bear an elevated responsibility to consider the possible social consequences of their work. This paper seeks to suggest ways in which modellers, other climate researchers and policy makers could act reflexively to enhance contributions to justice in climate policy.

To fully investigate the justice implications of climate geoengineering means considering how it might affect people across plural dimensions of distribution, vulnerability, capability, structural inequalities, procedure, recognition, and restoration or correction [10–17]. Climate change is not simply a justice issue because its effects are spatially and temporally uneven, as often presumed in the climate

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https://doi.org/10.1016/j.erss.2018.05.021
Received 3 July 2017; Received in revised form 14 May 2018; Accepted 18 May 2018

geoengineering modelling literature, it is also a justice issue because vulnerability to those effects is also uneven, and tightly inter-linked with existing economic, political and cultural injustices and power imbalances, in which the victims are often poorly recognized, their rights not respected and compensation resisted [18,13,19–21]. Moreover, responses to climate change are also tightly interwoven with energy systems and their justice implications [16,22,99]. Geoengineering may imply significant energy demands, impact differentially on different energy sources, or promise to reduce climate risk while allowing continued exploitation of fossil fuels [3,4]. It cannot be assumed simply that a reduction in overall climate risks will necessarily enhance justice. It is important to ask who will lose or gain, where, when, and in what respects.

As outlined below, modelling of SAI predominantly suggests that it could – at a gross, global scale – significantly reduce, or at least mask, the impacts of unabated climate change. And, given that existing and likely impacts of climate change are disproportionately borne by the poor and disadvantaged, it might be argued that the deployment of SAI would enhance justice [23]. But there are also reasons to significantly qualify or even dismiss such a claim. First SAI is not a perfect substitute for mitigation [24], and the distribution of residual and novel impacts could be important for an unknown proportion of the poor and disadvantaged. Second, insofar as SAI acts as a substitute for, or deters, mitigation [3,25], any negative side-effects of SAI would be magnified, and any co-benefits of mitigation reduced. Moreover any failure of SAI in practice would then result in more severe climate impacts than had mitigation not been deterred [26], although the justice implications of this would depend to some extent on whose emissions had continued. In particular, if SAI permitted greater use of fossil energy in poor Southern countries, it might enhance energy justice, but if it rather sustained energy rich lifestyles in the global North, the opposite would result. Third, justice arguably has richer and plural dimensions – beyond those defined in terms of consequential harms and benefits [15] – in which climate risk may be a poor proxy for justice. In this paper I explore how the presumptions and practices of climate geoengineering modelling tend to downplay such qualifications, thus sustaining a discourse of climate geoengineering that despite being cautious, is nonetheless inappropriately rosy.

1.1. The significance of models and modelling

Before discussing the detailed findings and implications of climate geoengineering modelling, it is necessary to briefly consider the status and purpose of such scientific models. Researchers have developed increasingly sophisticated computer models – using both physical principles and historical climate data – in efforts to predict and understand the implications of rising greenhouse gas concentrations [27–29]. Despite substantial uncertainties, climate models have contributed to a substantial improvement in our understanding of the relationships between energy systems and climate change. In the context of climate engineering, they provide illuminating opportunities to simulate - and experiment with – alternative conditions, scenarios and pathways in ways that are simply impossible empirically. This implies a responsibility to communicate assumptions and limitations carefully and clearly, but in the context of bitterly contested climate politics such caveats are rarely heard, even when offered. As a result climate models have been described as 'seductive simulations' [30] and 'technologies of hubris,' offering a misplaced modernist concept of management and control that pre-empts political discussion [10]. They are embedded in an administrative risk-management social imaginary [31] which depoliticizes climate change in critical ways [32]. They as act as gatekeepers of claims about climate change [33] and as boundary-ordering devices between science and authority that sideline uncertainty [34]. As a result modelling co-constitutes particular sorts of worlds. As in the case of energy system research and models [22], climate models tend to constitute technologically-framed worlds, rather than social ones. Nonetheless, such models are now being deployed and further refined technically to explore the potential implications of climate geoengineering. It must be stressed at this point that the constructivist effects of modelling are not the intentional product of modellers, but an emergent result of the co-production of models, technologies, discourses, imaginaries and institutions in this space. This makes for a difficult epistemological and methodological challenge. Empirical investigation of the beliefs and intents of modellers (for instance through qualitative interviews), although potentially useful, could not reveal and explain such outcomes. Here a critical, discursive review of the modelling literature is applied in an effort to begin to expose the co-productive relations between models and values which structure climatic imaginaries. An analysis of the outputs of practices (the modelling literature) is an essential first step in exposing and understanding presumptions arising in the social imaginary which shapes such practices. At times I will speculate as to modellers' motivations, but the central case I seek to make is that their modelling practices embody and construct particular ethics and values regardless of modellers' intentions.

Because the future state of the climate and the effectiveness of climate policy are complex and indeterminate, the status that models are granted critically structures the interpretation of scientific evidence. Models may be treated in diverse ways across a spectrum from 'truth machines', to more honest 'sandpits' for experimentation [35] or 'props in games of make-believe' [36]. Audiences for models must 'play the game', which makes modelling a social activity [37]. So the use and interpretation of models depends heavily on a shared language, vocabulary and grammar and is thus co-constituted with disciplinary discourses. Wiertz [38], suggests that model-based climate geoengineering research shapes social and political expectations around technologies, whilst underlying presumptions, such as the models' reliance on a "*figure of a single rational decision maker who designs and evaluates the performance of the technology*" (p. 454) remain unquestioned. Wiertz challenges us to question the "*relation between model-based and social visions of climate futures*" and the ethical and political questions raised by the practice of climate geoengineering modelling. Modellers often appear reticent to engage directly with such questions – which admittedly extend beyond the quantitative evidence base provided by modelling – within the scientific literature (as outlined in Table 1). Yet in this very unwillingness, they tend to import unquestioned presumptions from the dominant social imaginary [31] into their practices and interpretations, which can in turn be exposed by qualitative discursive analysis.

This is a space in which scholarship is sparse. There is work on the ethics of the technologies and policies of climate engineering [50–52], some of which engages explicitly with economic modelling using Integrated Assessment Models (notably [53]). Examinations of climate geoengineering from a science and technology studies orientation seek to open up framings and narratives to assist with the evaluation of climate geoengineering proposals [54,55] but this work tends to lack a clear normative dimension with respect to justice [11]. Finally, there are some researchers who use or examine modelling processes and seek to modify and weight outcomes in an effort to represent ethical or justice concerns (e.g. [56,48]). This latter literature forms part of the papers examined here, and as will be seen, the epistemology involved tends to privilege certain forms of ethical judgement and certain values of justice.

This paper focuses therefore on exploring and unpacking both explicit and hidden assumptions about justice. These presumptions arise at several levels: first in the modellers' interpretation of their models' outputs; second in the modelling practices; and third in values or conceptions of justice which researchers (typically unquestioningly) import into their modelling and analysis. The first part of the paper addresses each of these levels in turn, based on a focused review of the modelling literature. The second part of the paper then discusses how these interpretations, practices and values relate to discourses and framings of climate geoengineering with respect to risk, vulnerability