Compensation for Geoengineering Harms and No-Fault Climate Change Compensation

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Climate Geoengineering Governance Working Paper Series: 008.

Published online 08 April 2014

Climate Geoengineering Governance (CCG)

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Compensation for Geoengineering Harms and No-Fault Climate Change Compensation*

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ABSTRACT

While geoengineering may counteract negative effects of anthropogenic climate change, it is clear that most geoengineering options could also have some harmful effects. Moreover, it is predicted that the benefits and harms of geoengineering will be distributed unevenly in different parts of the world and to future generations, which raises serious questions of justice. It has been suggested that a compensation scheme to redress geoengineering harms is needed for geoengineering to be ethically and politically acceptable. Discussions of compensation for geoengineering harms, however, sometimes presume geoengineering has presented new and unique challenges to compensation that cannot be readily accommodated by existing compensation practices. The most explicit formulation of this view was recently presented by Toby Svoboda and Peter J. Irvine, who argued that two forms of uncertainty in geoengineering—namely, ethical uncertainty and scientific uncertainty—

* Pak-Hang Wong and Tom Douglas wrote the manuscript; Julian Savulescu revised and edited the manuscript. All authors discussed the arguments and commented on the manuscript at all stages.

make it immensely difficult to devise an ethically and politically satisfactory compensation scheme for geoengineering harms.

In this paper, we argue against the view that geoengineering presents new and unique challenges relating to compensation. More specifically, we show that placing these challenges within the broader context of anthropogenic climate change reveals them to be less serious and less specific to geoengineering than some appear to believe.

KEYWORDS: *Geoengineering, Anthropogenic Climate Change, Harms, Ethical Uncertainty, Scientific Uncertainty, No-Fault Compensation*

ACKNOWLEDGEMENT: *This work was conducted at the Institute for Science, Innovation and Society and Oxford Uehiro Centre for Practical Ethics as part of the Climate Geoengineering Governance Project (http://geoengineeringgovernance.org) funded by the UK Economic and Social Research Council (ESRC) and the Arts and Humanities Research Council (AHRC) - grant ES/J007730/1. The authors would like to thank Steve Rayner and Clare Heyward for helpful suggestions and comments.*

1. Introduction

The Intergovernmental Panel on Climate Change's (IPCC) recent inclusion of geoengineering – that is, "deliberately alter[ing] the climate system to counter climate change" (IPCC 2013) – in the Summary for Policymakers of the Working Group I Report has confirmed the increasing prominence of geoengineering in the climate change debate. Whatever benefits various geoengineering options may offer, it is clear that the deployment of most, if not all, geoengineering options could also have some harmful effects.[1] Moreover, it is predicted that the benefits and harms of geoengineering will be distributed unevenly in different parts of the world and to future generations, which raises serious questions of justice (Svoboda *et al* 2011). It has been suggested that a compensation scheme to redress geoengineering harms is needed for geoengineering to be ethically and politically acceptable (GAO 2010; SRMGI 2011; Bunzl 2011; Abelkop & Carlson 2012; Holton *et al* 2013; Svoboda & Irvine forthcoming).[2]

Discussions of compensation for geoengineering harms, however, sometimes presume geoengineering has presented new and unique challenges to compensation that cannot be readily accommodated by existing compensation practices. The most explicit formulation of this view was recently presented by Toby Svoboda and Peter J. Irvine (forthcoming), who argued that two forms of uncertainty in geoengineering—namely, ethical uncertainty and scientific uncertainty—make it immensely difficult to devise an ethically and politically satisfactory compensation scheme for geoengineering harms. In this paper, we argue against the view that geoengineering presents new and unique challenges relating to compensation. More specifically, we show that placing these challenges within the broader context of anthropogenic

[1] For an overview of various geoengineering options and their potential side effects, see Royal Society (2009), Vaughan & Lenton (2011).

[2] This is *not* to assert that a satisfactory compensation scheme for geoengineering harms is *sufficient* to justify the deployment of geoengineering, but to say that it is *necessary* for the deployment to be ethically and politically acceptable.

climate change reveals them to be less serious and less specific to geoengineering than some appear to believe. [3]

First, we address the concerns relating to ethical uncertainty. We argue that the concerns raised by Svoboda and Irvine are similar to those raised by compensation for harms from anthropogenic climate change more generally, and indeed to those raised by compensation schemes in general. We also suggest, by drawing on the wider discussion about the compensation for anthropogenic climate change-related harms, a possible strategy for answering these challenges.

We then turn to the challenges relating to scientific uncertainty. Here, we again argue that the challenges are similar to those we face in seeking to compensate for harms from anthropogenic climate change more generally. We then argue that these concerns could be avoided by incorporating compensation for geoengineering harms within a broader no-fault compensation scheme for all climate-related harms. Moreover, there is in any case an independent reason to prefer this broader approach.

Finally, we draw out some of the policy implications of our arguments and tentatively propose a general climate compensation fund to compensate for geoengineering harms, the negative effects of anthropogenic climate change and other adverse natural climatic events.

2. Ethical Uncertainty in Geoengineering Harms Compensation

Svoboda and Irvine argued that there is *ethical uncertainty* in assigning responsibility for geoengineering harms, and thus it is unclear who ought

[3] We should note that there are different types of geoengineering options, and the scope and degree of (harmful) impacts will vary from one option to another, and that Svoboda and Irvine have limited their discussion only to solar radiation management, i.e. geoengineering options that aim to reflect sun's light and heat back into the space. Yet, their arguments against the possibility of compensation for harms associated with solar radiation management do *not* depend on its specifics, and thus the same line of arguments can be made against other types of geoengineering options too. In short, their arguments can be generalised to geoengineering (understood as a broad category that includes different geoengineering options) insofar as it exhibits ethical uncertainty and scientific uncertainty.

to provide compensation.[4] By "ethical uncertainty", they meant the existing principles in climate ethics for assigning responsibility for compensation fall short of providing a clear answer to the ascription of responsibility for geoengineering harms compensation. In this section, we shall scrutinise their discussion of ethical uncertainty in compensation for geoengineering harms and argue that it fails to show that geoengineering present a new and unique problem for compensation. We should note that the purpose here is not to demonstrate a particular principle is the *correct* principle for guiding compensation responses to geoengineering, nor to assert some principles can *conclusively* resolve what they called ethical uncertainty in geoengineering harms compensation. Our aim is rather to show that discussions of the compensation for geoengineering harms should be placed against the background of the compensation for the negative effects of anthropogenic climate change, and that once this is done, the problem will appear both less specific to geoengineering and less insurmountable.

Svoboda and Irvine argued that familiar principles in climate ethics for assigning responsibility for compensation—namely, the polluter pays principle (PPP), the beneficiary pays principle (BPP), and the ability to pay principle (ATP)—yield *incorrect* verdicts on who ought to fund

[4] In additional to the question of assigning responsibility for geoengineering harms, Svoboda and Irvine also discussed the question of the entitlement to compensation and the amount of compensation to be provided. Here, we shall only examine the question of assigning responsibility for geoengineering harms, as it presents the most direct challenge to the design and implementation of a compensation scheme for geoengineering harms. Yet, our response to their arguments from ethical uncertainty and scientific uncertainty will also provide (partial) answers to the other questions discussed by them. For instance, Svoboda and Irvine noted that there are three possible types of victims: (i) those who are harmed by the impacts of geoengineering, (ii) those who are harmed by negative effects of anthropogenic climate change, and (iii) those who are harmed by missing out on benefits they would have from anthropogenic climate change had geoengineering not been implemented, and they argued that it is ethical uncertainty in determining which types of victims are entitled to compensation. According to the proposal of a *general* climate compensation fund that cover *all* climate-related harms we are arguing for, we believe that those who suffer from climate-related harms (that are beyond one's control) should be entitled to compensation, thus (i) and (ii) do not differ in nature and should both be entitled to compensation. Whether (iii) is entitled to compensation will be determined in part by the definition of 'harm', as well as whether the purported victims deserve the benefits from anthropogenic climate change (see, Bunzl 2011). As for the amount of compensation, our proposal of a general climate compensation fund implies that the amount of compensation is likely to be set at an amount of basic compensation similar to social security at the societal-level.

compensation for geoengineering harms.[5] They attempted to show that the results follow from those principles are counter-intuitive via different imaginary scenarios. For instance, to show that PPP is inappropriate for determining who is responsible for the provision of geoengineering harms compensation, they imagine

> Scenario 1. "[A] developing island state with widespread poverty, whose survival is threatened by sea-level rise, decides to join a coalition of states that deploys [geoengineering]. Since this developing state (and/or individuals within it) would be an agent of [geoengineering], it would be responsible for providing compensation to victims" (Svoboda & Irvine forthcoming).

PPP requires those who have caused harms to be held responsible for the provision of compensation (see, e.g. Singer 2002, Chapter 2; Caney 2005, 2010). They argued that PPP yields a counter-intuitive verdict in Scenario 1, as it is not "ethically appropriate to require a poor state to compensate victims of a policy that was necessary for that state's survival" (Svoboda & Irvine forthcoming).

Similarly, to show that BPP is inapplicable to the ascription of responsibility for geoengineering harms compensation, they imagine

> Scenario 2A. "[Geoengineering] is deployed over the strong objection of some state and the vast majority of its citizens, but that this state and its citizens happen to benefit from the impacts of [geoengineering]" (Svoboda & Irvine forthcoming).
>
> Scenario 2B. "[S]ome developed state unilaterally deploys [geoengineering] in accordance with its perceived self-interest and with the consent of the vast majority of its citizens, but that in doing so its own citizens are made slightly worse off and those of other states are made substantially worse off" (Svoboda & Irvine forthcoming).

BPP requires those who have unjustly or wrongfully benefitted from an activity to provide compensation to those who are harmed by that activity

[5] They have also briefly discussed the hybridised approaches, i.e. approaches that combine different feature(s) of PPP, BPP, and/or ATP. We will only focus on their discussion of PPP, BPP and ATP here, and will return to their criticism of hybrid principles at the end of this section.

(see, e.g. Gosseries 2004; Page 2012; Baatz 2013). For Scenario 2A, they argued that BPP leads to the counter-intuitive result of requiring a state that is not *causally* responsible for geoengineering harms to be responsible for compensating them. And, they pointed out that since there is no beneficiary in Scenario 2B, BPP fails to identify the right party to be held responsible even if the state deployed geoengineering unilaterally seems to be a clear candidate to bear such a responsibility.

Finally, they imagine

> Scenario 3. "[S]ome developed state refuses to join a coalition of states deploying [geoengineering], arguing against such deployment" (Svoboda & Irvine forthcoming).

ATP requires the advantaged, i.e. the developed state, to be responsible for compensating the disadvantaged (see, e.g. Shue 1999; Caney 2005, 2010). Svoboda and Irvine argued that ATP leads to the counter-intuitive result of requiring a state to compensate for geoengineering harms that it did not cause simply because it has the ability to do so.

We agree that these scenarios highlight ways in which applying one of PPP, BPP and ATP as the *sole* governing principle for compensation can produce counter-intuitive results. Note, however, that this problem is not specific to the compensation of geoengineering harms. Similar intuitions can be elicited regarding attempts to compensate for the negative effects of anthropogenic climate change. Thus consider,

> Scenario 1*: A developing state whose survival is threatened by poverty as a result of unjust treatment by a former colonial power, decides to promote rapid industrialisation, with concomitant contributions to climate change, as a means to combat poverty. Since this developing state (and/or individuals within it) would be an agent of the intensification of anthropogenic climate change, it would be responsible (according to PPP) for providing compensation to victims.

Scenario 1* and 1 only differ in the type of climate-altering actions involved, i.e. rapid industrialisation and the deployment of geoengineering. Just as in Scenario 1, it too seems to be intuitively wrong

to require the poor state to compensate victims of a policy that was necessary for its survival in Scenario 1*, and thus our scenario shows that PPP is problematic without referring to geoengineering. The problem to PPP highlighted by Svoboda and Irvine, therefore, is not new and unique to geoengineering harms compensation; it is in fact a general problem for PPP and compensation for any human-induced climatic event.

The same is true of Svoboda and Irvine's cases against BPP and ATP as well, and similar scenarios can be construed for Scenario 2A, 2B and 3. For instance,

> Scenario 2A*: A policy to bolster carbon-intensive industries is implemented over the strong objection of some state and the vast majority of its citizens, but this state and its citizens happen to benefit from the policy.
>
> Scenario 2B*: Some developed state implements a policy to bolster carbon-intensive industries in accordance with its perceived self-interest and with the consent of the vast majority of its citizens, but in doing so its own citizens are made slightly worse off and those of other states are made substantially worse off.
>
> Scenario 3*: Some developed state refuses to join a coalition of states to intensify carbon-intensive industries, arguing against this path of development.

Notice that Scenario 2A* and 2B* illustrate the *same* problems to BPP described by Svoboda and Irvine without referring to geoengineering. In other words, BPP requires a state which has *not* contributed to the intensification of anthropogenic climate change to shoulder the burden of compensation in Scenario 2A*, and it too fails to identify the right party to be responsible for compensation in Scenario 2B* because there is no beneficiary. And, Scenario 3* again illustrates the *same* problem to ATP described by Svoboda and Irvine without referring to geoengineering. There, according to ATP, the developed state is required to bear the responsibility for compensation despite not contributing to the intensification of anthropogenic climate change.

In short, the problems with PPP, BPP, and ATP highlighted by Svoboda and Irvine's imaginary scenarios are not specific to geoengineering harms compensation, but are general problems for those principles and compensation for any human-induced climatic event.

In effect, similar problems could be raised in relation to many existing compensation schemes for other kinds of harms. A number of states administer compensation schemes for medical injuries, motor vehicle accidents, past wartime atrocities and the effects of unjust colonial practices among other harms. In all of these cases, financing the compensation *solely* on the basis of causal responsibility (as in PPP), benefit (as in BPP), or the ability to pay (as in ATP) can produce intuitively problematic results.[6] We believe that merely placing the Svoboda and Irvine's concerns about ethical uncertainty within the broader context of other compensation practices helps to reduce the force of those concerns, for in at least some of these other areas, the presence of these concerns would not be taken as a decisive reason for eschewing the possibility of compensation.

There is also a more specific way in which placing these concerns within a broader context helps to diminish their force. As we have seen, the concerns raised by Svoboda and Irvine in relation to compensation for geoengineering harms arise also in relation to proposals to compensate for the negative effects of anthropogenic climate change more generally, i.e. Scenario 1*-3*. But within that context, it has been suggested that these concerns might be abated by adopting some combinations of PPP, BPP and ATP (see, e.g. Page 2008, 2011; Caney 2005, 2010). This seems a plausible strategy in geoengineering harms compensation too, since in each of the cases that Svoboda and Irvine raised (and in each of the variants of these cases that we provide above), applying one of these principles provides intuitively implausible results at least in part *because* it leads to the considerations invoked by the other principles being neglected. For example, it is plausible that PPP yields intuitively implausible result in Scenario 1 and 1* in part because it does not take

[6] For a discussion of some of these cases, see Waldron (1995).

into account the developing state's ability to pay for compensation. Similarly, BPP and ATP yield counter-intuitive results in Scenario 2-3 and 2*-3* in part because they have overlooked the importance of causal responsibility.

Svoboda and Irvine do briefly consider the possibility of solving the challenges they raise by combining PPP, BPP and ATP, but they question the viability of hybrid principles on the ground that "proponents of hybrid principles must meet [the] difficult challenge of explaining why one particular hybrid should be adopted over others" (Svoboda & Irvine forthcoming). This criticism is perplexing, however, for they have already alluded to one possible strategy by which we can assess different hybrid principles: by consulting our intuitions regarding their implications for cases such as Scenario 1-3. Moreover, it is unclear why their doubts regarding hybrid principles should *only* apply to geoengineering harms compensation and not to other compensation practices. This, however, calls into question *all* compensation practices based on hybrid principles and implies that they all face a difficult challenge of explaining why one hybrid principle should be preferred. We take this implausible consequence to be a *reductio* of their argument against hybrid principles.

Of course, we have not provided a definitive answer to the question of how responsibility for compensating geoengineering harms should be allocated. Our discussion does suggest, however, that hybrid principles may provide an answer to it. Indeed, several hybrid principles have already been proposed and developed in climate ethics for assigning responsibility for compensation for harms from anthropogenic climate change, unless geoengineering harms and anthropogenic climate change-related harms are *radically* different, it seems that they too are viable principles to guide the design and implementation of geoengineering harms compensation.

3. On Scientific Uncertainty and Geoengineering Harms Compensation

A more direct challenge to the possibility of a satisfactory compensation scheme for geoengineering harms, we think, comes from what Svoboda and Irvine term "scientific uncertainty". More specifically, they point to the problem of detection and the problem of attribution as two major challenges in compensating geoengineering harms. Briefly, the problem of detection refers to the problem of detecting changes in the climate system, and the problem of attribution refers to the problem of attributing those changes to specific causes (or, a set of causal factors). Both problems arise from the complex and chaotic nature of the climate system and its intricate interactions with non-climate systems. Accordingly, it is difficult—if not impossible—to isolate the impacts of geoengineering from the impacts of climate change in general, and relatedly, to identify who are the 'polluters' or 'beneficiaries' of geoengineering, as causal links between the harms and benefits and the deployment of geoengineering are not readily available.

Note, however, that this problem is again shared by attempts to compensate harms caused by anthropogenic climate change. Svoboda and Irvine claimed that it is difficult—if not impossible—to detect changes in the climate system, and to establish causal links between specific impacts and the deployment of geoengineering. Yet, if the problem of detection and the problem of attribution, or more generally scientific uncertainty in geoengineering, are due to the complex and chaotic nature of the climate system and its interactions with non-climate systems, then they apply equally to other climate change-related events, too. From a scientific perspective, it makes no difference whether you put something into the system intentionally or not. There is no difference, from a scientific perspective of evaluating effects on the system, whether a perturbation is the result of deliberate geoengineering or unintentional carbon dioxide emissions from human activities.

It can also be questioned whether scientific uncertainty in geoengineering (and in anthropogenic climate change) is impossible to overcome (see, e.g. Allen 2003; Horton *et al* 2013). Let us, however, grant for the moment the problem of detection and the problem of attribution are

irresolvable. Does this mean that we cannot redress the harms caused by geoengineering? Surely, if we cannot isolate the impacts of geoengineering from other climate change-related impacts, or identify who is harmed and benefited by the deployment of geoengineering, it does not make sense to compensate for 'geoengineering' harms for we *cannot* tell if the impacts are really geoengineering-based or not, nor can we tell whether someone is really harmed or benefited by the deployment of geoengineering but not other climate change-related events. However, to adequately redress geoengineering harms (or, harms purported to be caused by geoengineering), all that is required is a compensation scheme that covers *all* climate-related harms, regardless of they are caused by geoengineering, other human activities, or natural factors.

In what follows, we argue first, that there are in fact good reasons to prefer a compensation scheme that is inclusive of harms from geoengineering, other human activities, and natural factors. First, such a compensation scheme would mitigate the problems posed by scientific uncertainty in geoengineering since it would obviate the need to ascertain the causal contribution of different sources to a given harm. Second, there is an independent, fairness-based reason to favour such a compensation scheme.

As we have already argued, it is useful to place the consideration of geoengineering harms compensation within the broader context of the compensation for harms from anthropogenic climate change. We have also noted that it is reasonable to expect some hybrid principles in climate ethics to be applicable to compensation for geoengineering harms and other climate change-related harms. As such, it might be more appropriate to view compensation for geoengineering harms as an expansion of the compensation for anthropogenic climate change-related harms in general, as the applicable principles may be the same in both cases.

The plausibility of distinguishing geoengineering harms, the negative effects of anthropogenic climate change *and* other natural adverse climate impacts can be questioned as well. It has been argued that to the extent

human activities have become a *constitutive* part of earth (eco)systems, a new epoch of Anthropocene has arrived (Crutzen & Stoermer 2000; Crutzen 2002; Steffen *et al* 2011). From the perspective of Anthropocene, a distinction between 'human-induced' and 'natural' climate impacts is questionable. Hence, a general climate compensation fund is more fitting from the perspective of Anthropocene, as it is not based on a questionable distinction between 'human-induced' and 'natural' climate impacts. It is also more desirable with respect to the problems of scientific uncertainty, because it does not need to distinguish different types of climate impacts according to their causal history. A general climate compensation fund will cover climate impacts ranging from geoengineering harms, the negative effects of anthropogenic climate change and other adverse climatic events. In short, the challenges from scientific uncertainty, viewed from the perspective of the Anthropocene, suggest that it is unnecessary to compensate *specifically* for geoengineering harms.

However, it can be argued that geoengineering harms ought to be treated differently because they are results of *deliberate* actions, whereas the negative effects of anthropogenic climate change and other natural adverse climate impacts are not. Accordingly, geoengineering harms are of a different nature from other types of climate-related harms. If geoengineering harms are indeed different in nature, then perhaps they should be treated differently as well.

Yet, we think there is little ethical difference in moral responsibility for geoengineering and anthropogenic climate change, now that we can foresee the effects of our actions undertaken today. What goes under the name of 'geoengineering' is the intentional manipulation of the climate. Yet, climate-altering actions today, e.g. carbon dioxide emissions, foreseeably and avoidably alter the climate, though unintentionally. Moral responsibility for the effect of an action is arguably a function of the foreseeability of that effect and its avoidability. Thus, we may be morally responsible for geoengineering as much as we are morally responsible for other climate-altering actions. So if compensation will be due for

foreseeable and avoidable effects of climate-altering actions, it too due for intentional geoengineering-based harms.

However, instead of exploring the question about the nature of geoengineering harms and their (dis)similarities with other types of climate-related harms in greater detail, we shall now argue that it is unfair, from the victim's perspective, to treat geoengineering harms differently, and thereby strengthening our claim that a general climate compensation fund is *ethically* more preferable. Differentiated treatments of geoengineering harms are premised on the idea that the provision of compensation ought to depend on the causal history of a climate-related harm. As such, victims who suffer an equal amount of harm, and an equally beyond the control of the victims, could be treated unequally. Thus, consider[7]

> Scenario 4: State B has successfully deployed sulphate aerosol injection, which leads to a reduction of summer monsoon precipitation and resulting in severe droughts in State A. The droughts have killed a large number of people and caused enormous financial damage with crop and livestock failures in State A.
>
> Scenario 5. A volcano has erupted in State D, which has injected sulphate aerosol into the stratosphere. The sulphate aerosol injected by the volcanic eruption leads to a reduction of summer monsoon precipitation and resulting in severe droughts in State C. The droughts have killed a large number of people and caused enormous financial damage with crop and livestock failures in State C.

Differentiated treatments of geoengineering harms could be grounded on the thought that we should compensate the harms in these two scenarios differently. They might maintain, for example, that State A is entitled to a compensation from State B, whereas State C's is not entitled to compensation from State D, because the harms endured by State A were deliberately caused by State B, while the harms suffered by State C were not deliberately caused. Yet, it seems unfair to deny victims of harms

[7] The following scenarios are based on Robock's research, see Robock *et al*. (2013), Robock & Kravitz (2013).

compensation merely because those harms are caused differently, especially when the harms suffered by State C are not within its control. This intuition can be buttressed with a powerful and widely shared conception of fairness according to which any relative disadvantage is unfair if it was not within the control of its victims.[8] This conception of fairness, however, entails something more radical. Now, consider an additional scenario

> Scenario 6: A volcano has unexpectedly erupted in State E, which has injected sulphate aerosol into the stratosphere. The sulphate aerosol injected by the volcanic eruption leads to a reduction of summer monsoon precipitation and resulting in severe droughts in its own territory. The droughts have killed a large number of people and caused enormous financial damage with crop and livestock failures in State E.

The only difference Scenario 6 has from the earlier scenarios is that the harms suffered by State E are caused naturally and no perpetrator can be identified. Yet, if one accepts the conception of fairness we have just outlined, and believes that it is unfair to deny State C to be compensated, it follows that State E ought to be provided compensation too. For the harms, which are caused by a natural event, is also beyond State E's control.

There are two implications of this argument from fairness. First, if the argument is decisive, we should not treat geoengineering harms differently from the negative effects of anthropogenic climate change and other adverse natural climatic events, such as volcanic eruptions, floods, tornadoes, landslides, etc., provided all events were beyond the control of their victims. This lends immediate support to the idea of a general climate compensation fund that covers *all* climate-related harms. Second,

[8] It should be noted that this conception of fairness is not uncontroversial. A broader conception of fairness (see, e.g. Broome 1990) maintains that fairness consists in responding proportionally to the claims of different individuals. The narrower account of fairness that we propose here is intended to supplement the broader account with the view that two individuals can have different claims *only* on the basis of factors within their control. However, one may deny this claim. For example, by arguing the victims of wrongdoings have stronger claims to compensation than the victims of natural misfortunate. It is beyond the scope of this paper to offer a defence of this conception of fairness, but we think the intuitive appeal of this conception warrants a serious consideration of it.

the argument suggests that, in cases where harms were anthropogenic or at least preventable by other people, the payment of compensation should not depend on whether other people were at *fault* for the harm. All that matters is that the harm was not within the control of the victim. Fortuitously, a compensation scheme with these features also offers at least a partial solution to the challenges of scientific uncertainty. Recall that scientific uncertainty posed two problems. The problem of detection was the problem of determining that a change to the climate system had occurred. This would not longer be necessary under the sort of compensation scheme recommended by our argument from fairness. It would need to be shown only that some form of climate-related harm had occurred, regardless whether it was due to any change in the climate system. The second problem was the problem of attribution—the problem of identifying the specific causes of a harm. This would also not be necessary. It would be necessary only to show that the harm was not within the control of the victim (or perhaps, not *reasonably* within her control).

A move towards a general climate compensation fund, however, has a notable policy implication. Particularly, as the fund aims to be *all-inclusive* with respect to the harms caused by various climatic events, be they human-induced or natural, the amount of funding required will be significant. Economically, it might mean that the amount of compensation offered to the victims will not be to restore them to *status quo ante*, but, perhaps, an amount of basic compensation similar to social security at the societal-level.

We should note that our discussion so far has assumed the insurmountability of scientific uncertainty in geoengineering (and anthropogenic climate change). This, however, has been contested (Allen 2003; Horton *et al* 2013). Perhaps, with scientific and technological advancement, scientific uncertainty in geoengineering can be sufficiently overcome in the future. Thus, it is perhaps worth noting that one of our arguments for a general climate compensation would stand intact even if there is little or no scientific uncertainty in geoengineering. The argument

from fairness outlined above does not depend on the truth of scientific certainty, it appeals directly to one of our conceptualisation of fairness, and leads to the conclusion that geoengineering harms should be treated the same as other types of climate-related harms.

4. The General Climate Compensation Fund: A Tentative Proposal

We have argued that geoengineering does *not* present new and unique challenges to compensation, particularly that the design and implementation of compensation schemes for geoengineering harms faces no more difficulties than designing and implementing a compensation scheme for the negative effects from anthropogenic climate change. We have also argued that geoengineering harms should be treated the same as other types of climate-related harms, and illustrated some implications of this position. It should be pointed out that we have not argued for the provision of compensation for geoengineering harms or other types of climate related-harms in this paper—we have argued only that *if* compensation is to be provided for such harms, it should not be dependent on whether the harms were due to geoengineering, anthropogenic climate change, or other natural climatic events. One way of ensuring this would be to introduce a general climate compensation fund.

Here, we wish to remain neutral on how the general climate compensation fund should be financed—it will ultimately depend on what relative weight should be given to ability to pay and contribution to climate-related harms and benefits (insofar as these things can be determined). If it is possible to identify those who have (wrongfully) causally contributed to climate-related harms, then it would in principle be possible to finance the fund entirely through fines imposed on these parties. However, this would effectively result in the 'polluters' being required to compensate both those whom they have harmed (with geoengineering and/or climate-altering actions) and the victims of adverse natural climatic events, assuming there is a meaningful distinction between these. This might seem difficult to justify. Similarly, the fund can be financed entirely by those who have unjustly or wrongfully benefitted from geoengineering

and/or anthropogenic climate change, but it implies that the 'beneficiaries' would be required to give up their benefits *as well as* compensating the victims of adverse natural climatic events. This too seems to be difficult to justify. These concerns suggest that the fund would need to be financed at least in part on the basis of ability to pay.

It is not our intention to elaborate and defend a specific account of how the general compensation fund should be financed, but we think it is helpful to propose *one* way to finance the fund. We suggest the fund can be financed by various states contributing a *small* portion of their GDP to provide basic compensation for the victims of climate-related harms. The tentative proposal we advance will require the wealthy states to contribute *more* to the fund than the less wealthy states and poor states. We believe that such a proposal can be justified by appealing to the duty of *easy* rescue: A has the duty to aid B when the cost for A to do so is *small*, and the benefit to B is very large (Singer 1972, Savulescu 2007). Since our proposal requires only a *small* contribution from the wealthy states, it will have little impact on their wealth (and of the well-being of its citizens), and the benefits to the victims will be sufficiently large, thus could be justified by the duty of easy rescue.

There are numerous issues remain to be resolved if the fund is to be realised. Particularly, there are institutional questions such as "what institution(s) will be responsible for handling the fund?", "how to ensure various states have contribute to the fund?", etc., and operational questions such as "how to determine the threshold to qualify for compensation?", etc. These are important questions for a fully developed account of the general climate compensation fund. To reiterate, it is not our intention to provide a fully developed account of the general climate compensation fund, but merely to point out that it is one way to compensate geoengineering harms and other types of climate-related harms.

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