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## **Distributive Justice, Geoengineering and Risks**

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### **About the Author**

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# Distributive Justice, Geoengineering and Risks

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## **ABSTRACT**

It is generally recognised that the *potential* positive and negative impacts of geoengineering will be distributed unevenly both geographically and temporally. The question of distributive justice in geoengineering thus is one of the major ethical issues associated with geoengineering. Currently, the question of distributive justice in geoengineering is framed in terms of who gets what (potential) benefits and harms from geoengineering, i.e. it is about the distribution of the *outcomes* of geoengineering. In this paper, I argue that the discussions on distributive justice in geoengineering should not be *outcome-based*. Instead, it should be *risk-based*. I identify *two* problems for framing the question of distributive justice in geoengineering in terms of the distribution of its outcomes, i.e. the 'if and then' syndrome and the limited applicability of distributive principles in geoengineering policy, and suggest risk is a more proper object of distribution in the case of geoengineering. Following Hayenhjelm, I argue that the object of distribution in the case of fair distribution of risk should be (i) sources of risks and (ii) precautionary measures. I shall then demonstrate how it can be applied to the question of distributive justice in geoengineering. Finally, I end this paper by exploring the possible responses to the question of distributive justice in geoengineering by three major accounts of distributive justice, i.e. egalitarianism, prioritarianism, and sufficientarianism.

**KEYWORDS:** *Geoengineering, Distributive Justice, Risk, Uncertainty, the 'If and then' Syndrome*

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## Introduction

Geoengineering is the idea of “deliberately alter[ing] the climate system to counter climate change” (IPCC 2013, 27), and it is generally recognised that its potential positive and negative impacts will be distributed unevenly both geographically and temporally.<sup>1</sup> The question of distributive justice in geoengineering thus is one of the major ethical issues associated with geoengineering. For example, in an overview of the ethics of geoengineering, Preston notes that “efforts must be made to distribute the benefits and burdens of [geoengineering] fairly... To the degree that the characteristics of an engineered climate can be predicted, choices will have to be made about who gets what in a geoengineered world” (Preston 2013, 30). Similarly, in their analysis of sulphate aerosol geoengineering<sup>2</sup> from the perspective of distributive justice, Svoboda, Keller, Goes and Tuana (2011) discuss how harms and benefits of sulphate aerosol geoengineering ought to be shared among individuals in accordance with John Rawls’ (and Rawlsian), Ronald Dworkin’s, Amartya Sen’s, and the desert-based theory of distributive justice, and examine whether sulphate aerosol geoengineering meets the requirement of distributive justice in accordance to those theories. These examples illustrate *one* way to explore the question of distributive justice in geoengineering, i.e. who gets what (potential) benefits and harms from geoengineering. In short, this approach is about the distribution of the *outcomes* of geoengineering. While I am sympathetic to this approach, framing the question this way can be inadequate and misleading, particularly because it fails to take seriously the condition of risk and uncertainty in geoengineering.

In this paper, I argue the discussions on distributive justice in geoengineering should not be *outcome-based*, i.e. it should not focus on the distribution of (potential) benefits and harms from geoengineering. Instead, it should be *risk-based*, i.e. it should focus on the distribution of the risks associated with geoengineering. In the next section, I identify two problems for framing the question of distributive justice in geoengineering in terms of the distribution of the outcomes, i.e. the ‘if and then’ syndrome and the limited applicability of distributive principles in geoengineering policy, and suggest risk is a more proper object of distribution in the case of geoengineering. Following Hayenhjelm (2012), I argue that the objection of distribution in the case of fair distribution of risk should be (i) sources of risks and (ii) precautionary measures.

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<sup>1</sup> For an overview of different types of geoengineering and their global and regional, long-term and short-term impacts, see Vaughan & Lenton (2011), Harrison & Hester (2014).

<sup>2</sup> Sulphate aerosol geoengineering refers to the injection of sulphate aerosols into the lower stratosphere to cool the climate.

I shall then demonstrate how it can be applied to the question of distributive justice in geoengineering.<sup>3</sup> Finally, I end this paper by exploring the possible responses to the question of distributive justice in geoengineering by three major accounts of distributive justice, i.e. egalitarianism, prioritarianism, and sufficientarianism.

## Two Problems with Potential Benefits and Harms: Uncertainty and Risk in Geoengineering

Like other new and emerging technologies, the consequences of geoengineering are uncertain. The uncertainty in geoengineering is in part due to the complexity and chaotic nature of the climate system, which geoengineering attempts to interfere with (IPCC 2013), and it is also in part due to the fact that the eventual outcomes of geoengineering will be determined by its effectiveness (Royal Society 2007; Vaughan & Lenton 2011; Harrison & Hester 2014). Moreover, the society's responses to geoengineering research and its implementation will too add to the uncertainty of the outcomes of geoengineering (see, e.g. Sollie 2007; Healy 2012; Hunter 2013). Uncertainty in geoengineering entails that its *outcomes* cannot be reliably predicted, which presents an immediate challenge to the discussions on the question of distributive justice in geoengineering proceed in terms of potential benefits and harms, i.e. the outcome-based approach, because the outcomes cannot be reliably known before an implementation, nor will the potential benefits and harms *always* actualise. Accordingly, answers to the question of justice in geoengineering based on potential benefits and harms are at best inconclusive and at worst wrongheaded.<sup>4</sup> More specifically, the discussions based on potential benefits and harms are derived from the input assumptions about the climate system, geoengineering and the society's responses to them, and thus they only concern *possible states of affairs* and they are conditional upon the truth of those assumptions. Moreover, as the outcome-based approach focuses on the distribution of benefits and harms from geoengineering, uncertainty of the outcomes entails the possibility of erroneous (re)distribution if the projected benefits and harms do not actualise. More radically, it can be argued that uncertainty in geoengineering can mute the discussions on distributive justice in geoengineering based on the (potential) outcomes of geoengineering, as we cannot reliably predict them, or at least we do not know whether or not they will

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<sup>3</sup> Different types of geoengineering options are associated with different types of risks, but the fact that there are different types of risks has little implication for my claim that analyses of distributive justice in geoengineering should be risk-based.

<sup>4</sup> Hunter (2013) has discussed similar problems with justice-based objections to synthetic biology arise from uncertainty, but he has not drawn the distinction between outcome and risk in his discussion, nor has he discussed the applicability of normative distributive principles in policy-making.

actualise before an implementation, thus talks about distributive justice and the outcomes of geoengineering can only be guesswork. I shall not pursue the radical argument in further details, but the radical argument from uncertainty is useful in illuminating one of the difficulties for the outcome-based approach.

The outcome-based approach becomes especially problematic when they conflate possible states of affairs with actual (or future) states of affairs, and stage them as the central concerns for ethical reflection. The problem can be characterised by what Nordmann labelled as the 'if and then' syndrome: "an if-and-then statement opens by suggesting a possible technological development and continues with a consequence that demands immediate attention. What looks like an improbable, merely possible future in the first half of the sentence, appears in the second half as something inevitable. And as the hypothetical gets displaced by a supposed actual, an imagined future overwhelms the present" (2007, 32).<sup>5</sup> In short, the 'if and then' syndrome reminds the danger of overlooking the epistemic gap between 'might' and 'being' (or 'will be'), and wrongly emphasises the merely possible as the most ethically significant; at the same time, the 'if and then' syndrome also calls attention to a failure to recognise the more *immediate* ethical concerns in the normative analysis of new and emerging technology.

To illustrate the problem with the outcome-based approach with an example, Svoboda *et al.* have sought to show that sulphate aerosol geoengineering could not satisfy the requirement of distributive justice specified by various theories of distributive justice by noting the potential harms from sulphate aerosol geoengineering (2011, 161-167). Yet, as I have already pointed out, whether or not the potential harms will actualise (and the severity of the actualised harms) will depend on various technical and social factors in the context of (post-)implementation; Svoboda *et al.* thus can only conclude that sulphate aerosol geoengineering *might* not satisfy the requirement of distributive justice specified by different theories of distributive justice, depending on whether or not the predicted harmful events happen (and, the individuals are indeed harmed by those events). In short, their arguments are at best inconclusive; however, their argument can also be misleading – by giving an impression that sulphate aerosol

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<sup>5</sup> Nordmann's discussion of the 'if and then' syndrome is intended to be a critique of speculative ethics, but it is not my aim to evaluate if Nordmann's critique is successful or not in this paper. The 'if and then' syndrome is useful here in highlighting the emphasis on *possible* states of affairs and the negligence of *present states of affairs*.

geoengineering *will* cause such harms, and therefore *will be* unjust.<sup>6</sup> Here, I am *not* challenging the claim that sulphate aerosol geoengineering *might* fail to satisfy the requirement of distributive justice, it might well be; what I attempted to point out is the conditionality of the outcome-based approach and the danger of conflating possibility with actuality (or necessity) in arguing against or for geoengineering. In short, insofar as the outcomes of geoengineering cannot be reliably predicted, and they are determined in part by factors in the context of use, the outcome-based arguments will inevitably be weak.<sup>7</sup>

More importantly, however, is their focus on the distribution of potential outcomes of geoengineering appears to signify a form of ethical hypermetropia, i.e. a farsightedness in normative analysis that fails to perceive a more *immediate* ethical concern in the question of distributive justice in geoengineering. It is worth to be reminded that geoengineering raises the question of distributive justice *not only* because of the eventual benefits and harms from it will be distributed unequally, which is the focus of Svoboda *et al* and, more generally, of the outcome-based approach. Geoengineering raises question of distributive justice *also* because it imposes differentiated degree of risks to various regions and various groups of individuals, which in itself is ethically problematic regardless of whether or not the risks associated with geoengineering materialise. Hence, geoengineering risks ought to be taken more seriously in the discussions.

Another problem with the outcome-based approach is its limited application in geoengineering policy. Ideally, *normative* distributive principles derived from various theories of distributive justice should perform these *two* functions: (i) normatively evaluate distribution patterns (and institutions responsible for them), and (ii) guide policy-making and institutional design such that the

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<sup>6</sup> To be fair, Svoboda *et al.* have acknowledged the uncertainty in geoengineering in their discussion, and thus they do acknowledge the conditionality of their argument. However, they think the research on the potential impacts of sulphate aerosol geoengineering via simulation and modelling has provided sufficient evidence to rest the burden of proof on the proponents of sulphate aerosol geoengineering. To the extent that simulation and modelling *cannot* capture technical and social factors arise in the context of use, I am less certain than Svoboda *et al.* on where the burden of proof should rest.

<sup>7</sup> My formulation of the argument focuses on the *implementation* of geoengineering, but it applies to both geoengineering research *and* implementation of geoengineering. It is indeed possible to speculate the outcomes of geoengineering research, but speculation only denotes *possible* states of affairs, and whether those possible states of affairs will actualise depend on various technical and social factors that are likely to be unforeseeable in/during geoengineering research. Again, instead of focusing on potential benefits or harms that might or might not actualise, I believe the discussions on distributive justice and geoengineering research should focus on risks associated with geoengineering research.

resulting distribution patterns are just.<sup>8</sup> In the context of geoengineering policy, normative distributive principles (and theories of distributive justice) should enable us to evaluate if a distributive pattern resulting from a particular geoengineering option is just, and *also* to guide the development and implementation of geoengineering in accordance with some accounts of distributive justice. In the following, I show that the outcome-based approach can only perform the first function but not the second, i.e. it can only be used in rejecting (or approving) particular forms of geoengineering but it cannot provide other policy recommendation, such as *how* a particular geoengineering should be implemented, etc.

My case against the applicability of normative distributive principles in the outcome-based approach is drawn from our inability to distribute the (potential) benefits and harms from geoengineering. Without the capacity to distribute the (potential) outcomes of geoengineering, it is impossible to attain distribution patterns recommended by various normative distributive principles. To illustrate this argument, consider two distribution patterns, X and Y:

Distribution Pattern X: In a group of 10 individuals, every individual will be provided 1 unit of goods.

Distribution Pattern Y: In a group of 10 individuals, a designated individual will receive 5.5 units of goods, and the remaining 9 individuals will be provided 0.5 units of goods.

Evaluating X and Y with a simplistic form of egalitarian distributive principle, i.e. every individuals should have the same amount of goods, X is considered to be fair, whereas Y is not, because individuals in Y do not receive the same amount of goods. Also, the simplistic form of egalitarian distributive principle should recommend a change in distribution pattern such that each individual in Y will receive the same amount of goods. Now, assume that it is theoretical and practically impossible to change the distribution pattern in Y, the simple egalitarian distributive principle can *only* conclude that Y is unjust, but it cannot provide any useful recommendation to ameliorate the situation in Y, because it cannot *ex hypothesi*.

The example above is analogous to the case of geoengineering, i.e. the potential outcomes of geoengineering *cannot* be distributed unless we have the

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<sup>8</sup> Of course, there are debates on the proper role of normative distributive principles in political philosophy. It is not my aim here to argue for the view that normative distributive principles *must* be policy-guiding; however, I think, an approach that allows normative distributive principle to offer policy recommendation is at least *practically* more preferable in the context of geoengineering than one that does not.

capacity to control the climate system such that we can change the distribution patterns of the benefits and harms from geoengineering, or in short to specify “who gets what in a geoengineered world”. In other words, the applicability of normative distributive principles is limited to the rejection or approval of various geoengineering options with reference to the potential outcomes of geoengineering. In response to this, some might argue that while we cannot distribute the potential benefits and harms from geoengineering directly, we can still distribute – or, redistribute – the consequences of geoengineering indirectly by means of compensation, i.e. by compensating those who are harmed by geoengineering, or even by providing *ex ante* compensation to those who will be harmed by geoengineering.<sup>9</sup> So construed, in the case of geoengineering, some forms of redistribution are indeed possible.

I do not deny the importance of compensation in *fully* addressing the question of justice in geoengineering (see, e.g. Svoboda & Irvine 2014; Wong, Douglas & Savulescu 2014). Indeed, I agree that compensation is required to address the harms – particularly, unforeseeable harms – brought by geoengineering. However, compensation does not provide the answer to the limited applicability of normative distributive principles I have outlined. For instance, in the case of *ex post* compensation, normative distributive principles come in play only *after* the implementation, thus their applicability remains limited in planning and devising geoengineering; and, in the case of *ex ante* compensation, normative distributive principles too have limited role because the focus is economic and does not concern *how* geoengineering is to be implemented. In this respect, compensation only adds another layer to determine whether or not a geoengineering option is permissible.

The limited applicability of normative distributive principles is due to the framing of the question using the potential benefits and harms from geoengineering, which we have no control over. If normative distributive principles are to contribute to geoengineering policy beyond merely rejecting or approving various geoengineering options, then a different object of distribution is needed, and relatedly a move away from the outcome-based approach is required. In the following section, I shall argue that unlike potential benefits and harms from geoengineering which we have no control over and thus cannot distribute, there is a sensible way to talk about the distribution of risk. So construed, focusing on geoengineering risks allows us to bypass the problem of limited applicability of normative distributive principles in geoengineering policy,

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<sup>9</sup> The viability of offering *ex ante* compensation, of course, depends on our knowledge of the impacts of implementation, and relatedly the degree of uncertainty in geoengineering.

and offers an alternative approach that can provide policy recommendation beyond the permissibility of geoengineering.

Given the two problems for the outcome-based, i.e. the danger of the 'if and then' syndrome and the limited applicability of normative principles in geoengineering policy, I think we have good reasons to abandon it. In addition, the imminence of risks as an ethical concern in the question of distributive justice in geoengineering and the possibility of a meaningful discussion on the distribution of risk suggest a shift towards a risk-based approach is needed.

### 3. Distributive Justice and Geoengineering: A Risk-Based Approach

Central to the risk-based approach is the distribution of risk.<sup>10</sup> Recently, Hayenhjelm (2012) has offered an instructive account of how risks can be fairly distributed, which can serve as a theoretical basis for a risk-based approach to the question of distributive justice in geoengineering.<sup>11</sup> She argues that the considerations of a fair distribution of risk should be framed in terms of (i) sources of risks and (ii) precautionary measures. Accordingly, a risk-based approach should focus on distributing sources of risks and precautionary measures related to geoengineering, but not its potential outcomes. I shall not repeat the details of Hayenhjelm's discussion, but it is useful to outline the reasons for taking sources of risks and precautionary measures as the objects of distribution.

Hayenhjelm notes that risk imposition usually involves distribution of activities with an expected probability of harm, which is an estimate of the frequency of

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<sup>10</sup> The term 'risk' is used to refer to different concepts, for example, Hansson has identified five uses of the term:

- (1) Risk = an unwanted event which may or may not occur.
- (2) Risk = the cause of an unwanted event which may or may not occur.
- (3) Risk = the probability of an unwanted event which may or may not occur.
- (4) Risk = the statistical expectation value of unwanted events which may or may not occur.
- (5) Risk = the fact that a decision is made under conditions of known probabilities ("decision under risk") (2004, 10).

He notes that (4) is the standard understanding of 'risk' in risk analysis, which is often based on *objectivist expected utility* that is calculated with *objectivist probabilities* with *objectivist utility*. Hansson has pointed out the limitations of the standard understanding of 'risk' in philosophy and ethics of risk, which I shall not repeat here. Here, it is useful to note that Hayenhjelm's account of distributive justice and risk can be viewed as providing another route to argue against the standard understanding of 'risk'. As her account introduces considerations that are not readily accounted for by "the statistical expectation value of unwanted events which may or may not occur", i.e. sources of risks and precautionary measures, to be included in the distribution of risk.

<sup>11</sup> While there is an increasing attention to philosophy and ethics of risk (see, e.g. Lewens (2007), Asveld & Roeser (2009), Roeser *et al.* (2012), Hayenhjelm & Wolff (2012), Hansson (2013)), relatively little has been said about distributive justice. Hayenhjelm's discussion on the topic is particularly useful for the current purpose, as she explicitly reflects on the object(s) of distribution in the distribution of risk.

such a harm to occur for those activities. Accordingly, imposing a risk on a group of individuals is to subject them to an activity that carries a specific chance of harm; however, such a chance of harm will not be distributed equally among the group because who will actually be harmed depends on a variety of factors beyond merely being subjected to the activity and exposed to the chance of harm it carries. Moreover, as Hayenhjelm rightly notes, the probability denotes the frequency of an event to occur for a given reference class, but not for a particular individual. She thus rejects the probability of harm of an activity as a proper object of distribution in the distribution of risk, as it says little about individuals' actual chance of suffering from the harm. In other words, even if each individual is subjected to the same risky activity, it does not entail that each of them will have the same chance to suffer the harm it brings; and, therefore, an *equal* distribution of probability of harm of an activity entails neither an equal (or fair) distribution of chance of harm for individuals, nor an equal (or fair) distribution of outcome for them.

Instead of the probability of harm of an activity, Hayenhjelm suggests sources of risks, together with the appropriate knowledge of the determinants of the harm, enable us to distribute the actual chance of harm, e.g. by allocating (or relocating) the sources from individuals who are highly susceptible to the risks to those who are less susceptible, one can then distribute (or redistribute) their actual chance of suffering from the harm. Moreover, she also points out that it is possible to manage, to some extent, the actualisation of harm by providing precautionary measures to reduce the risks and thus the (actual) chance of harm.<sup>12</sup> Through distributing the sources of risks and precautionary measures against those risks, we can then indirectly distribute chance of harm and the outcome. Here, it is important to note that the distribution of sources of risks and the distribution of precautionary measures are two distinct, but interrelated, dimensions for the distribution of risk. Ideally, a fair distribution of risk will consist both a fair distribution of sources of risks and a fair distribution of precautionary measures. Yet, in cases where individuals are exposed to additional amount of sources of risks, it could in principle be remedied by a provision of extra amount of precautionary measures to them, and *vice versa*.

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<sup>12</sup> Following Lenman (2008), Hayenhjelm argues that the distribution of precautionary measures can be viewed as treating each individual *equally*, and thus is an additional reason for taking precautionary measures as the proper object of distribution in the distribution of risk. I agree with Lenman and Hayenhjelm on the importance of respect for individuals in answering the question of distributive justice; however, I think their position ties too closely with contractualism. As the provision of precautionary measures has significant implication to actualisation of harms, the distribution of precautionary measures should be indispensable in discussion of just (or fair) distribution of risk regardless of the one's theoretical commitment.

Having outlined the reasons for taking sources of risks and precautionary measures as the object of distribution in the distribution of risk, I now turn to the case of geoengineering and demonstrate how a risk-based approach works. In considering whether or not a geoengineering option is just, the risk-based approach will assess the distribution of the sources of risks associated with a geoengineering option and the distribution of precautionary measures against the potential harms from it. However, it should be reminded that since different geoengineering options operate in different ways, the applicability of the criteria might vary from one option to another.

For the distribution of the sources of geoengineering risks, we have to distinguish between the risks associated with technical artefacts and infrastructures of geoengineering and those associated with the overall impacts of implementation. So long as we *cannot* direct specific changes in the climate system and the precise location(s) where those changes happen, which are the sources of risks associated with the overall impacts of an implementation, the distribution of the sources of geoengineering risks will mostly concern with geoengineering options that are intensive in the use of technical artefacts and infrastructures that are themselves risky or potentially harmful, or those that have ostensible local impacts. For these geoengineering options, the question should therefore be framed in terms of the *siting* of geoengineering options, i.e. whether they – being the sources of risks and potential harms – are being distributed fairly. For other geoengineering options which do not have ostensible local impacts, and for the overall impacts of implementation, the sources of geoengineering risks cannot be the object of distribution in the distribution of geoengineering risks; however, they remain useful in exploring the question of distributive justice in geoengineering, as we can – with appropriate knowledge of the determinants of harms, capture the distribution of (actual) chance of harms from geoengineering options.

The distribution of precautionary measures, on the other hand, is more broadly applicable to various geoengineering options. The aim is to distribute precautionary measures to reduce the geoengineering risks and thus (actual) chance of harms from geoengineering. Accordingly, the question of distributive justice in geoengineering should focus on: (i) risks of geoengineering options for various locations, including both the risks associated with technical artefacts and infrastructure and those associated with the overall impacts of implementation; (ii) precautionary measures available for the reduction of those risks; and, (iii) the distribution of the precautionary measures to regions where geoengineering

risks are expected to be materialised, or to individuals who are susceptible to the geoengineering risks.

I shall now contrast the risk-based approach to the question of distributive justice in geoengineering with the normative analysis of sulphate aerosol geoengineering by Svoboda, Keller, Goes and Tuana (2011, 161-167). In their analysis, they note that sulphate aerosol geoengineering is likely to reduce precipitation considerably in Africa, South America, and southeastern Asia, which in turn could threaten food production and fresh water supplies in those regions. They then argue that the potential outcomes of sulphate aerosol geoengineering violate normative distributive principles in various theories of justice, and thus being unjust (or unfair). It is useful to point out that their normative analysis is based on the probability of the harmful events associated with the implementation of sulphate aerosol geoengineering; however, the probability of the harms of the implementation says little – if not nothing – about the regions’ or the individuals’ chance of suffering from the harms. In short, their normative analysis has failed to take into account whether (and how) the harms of an implementation of sulphate aerosol geoengineering will be actualised; and, without that, it is difficult to see why an implementation of sulphate aerosol geoengineering will be unjust and for whom it will be unjust.

Unlike their analysis, a risk-based approach begins by looking at the distribution of sources of geoengineering risks. In the case of sulphate aerosol geoengineering, it will not be possible to distribute the sources, as the risks are associated with the overall impact of implementation which we have no control over;<sup>13</sup> and, the knowledge we have about sulphate aerosol geoengineering suggests that some regions, e.g. Africa, South America, and southeastern Asia, will have more (actual) chance to be harmed by sulphate aerosol geoengineering. For the risk-based approach, however, it does not immediately imply that sulphate aerosol geoengineering will be unfair. To determine whether or not an implementation of sulphate aerosol geoengineering will be unfair, the risk-based approach also requires us to examine the precautionary measures provided to those regions for the reduction of the risks of droughts and thus (actual) chance of being harmed by them. Indeed, if a policy to implement sulphate aerosol geoengineering is accompanied by a policy to provide those

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<sup>13</sup> The sources of risks of sulphate aerosol geoengineering will become important for the distribution of geoengineering risks if (i) sulphate aerosols are found to be potentially harmful for individuals, or (ii) the injection of sulphate aerosols is found to have site-specific impacts. In cases of (i) or (ii), the locations of implementation should be a consideration in the question of distributive justice in geoengineering.

regions suitable precautionary measures, e.g. drought prevention and mitigation facilities, it is less obvious that the policy will necessarily be unjust.

The risk-based approach is also useful in guiding policy on geoengineering research. For geoengineering research that is expected to produce potentially harmful outcomes, the research itself could be viewed as a source of geoengineering risks. The risk-based approach thus requires us to examine the agendas of the research and evaluate who will be subjected to the risks and is likely to be harmed. If the research *disproportionally* affects one group of individuals, then it could be deemed as unfair with respect to the distribution of the sources of geoengineering risks; and, the risk-based approach calls for a provision of suitable precautionary measures to those who will be adversely affected by the research, for the research to be fair.<sup>14</sup> One practical implication of the risk-based approach for geoengineering research is that it calls serious attention to the need of research on precautionary measures *in conjunction* with geoengineering research.

### Distributing Geoengineering Risks: Egalitarianism, Prioritarianism, and Sufficientarianism

So far, I have argued against the outcome-based approach to the question of distributive justice in geoengineering, and have suggested a shift to a risk-based approach. I have also show how a risk-based approach would look like and work with Hayenhjelm's account of distributive justice and risk. What remains unexplored is how geoengineering risks *should* be distributed. To answer this question, one must first provide a normative account of a fair distribution. Doing so, however, requires a more detailed examination of various theories of distributive justice, and a defence of a version of them. In effect, in *actual* policy-making, what views of distributive justice are acceptable is likely to depend on the social and cultural circumstances (Rayner 1995), and to defend a specific account of distributive justice might be not be fruitful – or, it might even be counter-productive – for guiding geoengineering policy. So, instead of arguing for a specific theory of distributive justice and justifying a particular way to distribute geoengineering risks, I shall illustrate what three major accounts of

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<sup>14</sup> The notion of disproportionality, however, is not unproblematic. Particularly, whether or not an imposition of risk is disproportionate will be decided by individuals' beliefs and values, including their perception of risk and harm. So construed, the question of (dis)proportionality is in itself a normative question remains to be answered.

distributive justice, i.e. egalitarianism, prioritarianism, and sufficientarianism, recommend on the distribution of geoengineering risks.<sup>15</sup>

Egalitarianism holds that equality has intrinsic value, and thus inequality is in itself wrong or unfair. In the crude form, egalitarianism aims at an *equal* distribution of the relevant *distribuendum* (see, e.g. Rawls 1971; Dworkin 1981a, 1981b; Cohen 1989; Arneson 1989; Temkin 1993). A geoengineering policy based on an egalitarian view of justice requires an equal distribution of geoengineering risks, that is – an equal exposure to the sources of geoengineering risks on the basis of our knowledge about the determinants of the harms and an equal provision of the precautionary measures against those risks. In cases where precautionary measures are not equally distributed, the sources of geoengineering risks *must* be allocated away from those whose precautionary measures are insufficient. Alternatively, when equal exposure to the sources is impossible, the provision of precautionary measures *must* be enough to offset the inequality in the distribution of sources. Hence, an egalitarian view of justice does not imply that each individual should be exposed to the exact same amount of the sources and/or should be provided the exact same amount of precautionary measures under the geoengineering policy.

A major problem for the egalitarian view of justice is known as the “levelling down objection” (Parfit 2000). The “levelling down objection” points out that it is possible to achieve equality by reducing the general level of well-being, and if equality is the *only* aim of distributive justice, it has the counter-intuitive result that a situation where every individual *equally* worse off is better than a situation in which some individuals are better off – even very slightly – than others. In the context of geoengineering policy, it entails a counter-intuitive consequence that maximising exposure to the sources or minimising precautionary measures is morally acceptable so long as the goal is to achieve equality in the distribution of geoengineering risks. There are various responses to the levelling down objection proposed by egalitarians. For example, egalitarians might accept that equality is *neither* the only intrinsic value, nor the sole consideration in the distributive justice (see, e.g. O'Neill 2008; Hausman & Waldren 2011). In short, those who attempt to ground geoengineering policy on an egalitarian view of justice, at least, have to account for the levelling down objection.

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<sup>15</sup> Unfortunately, all these accounts of distributive justice have a variety of formulations, and it is beyond the scope of this paper to offer a comprehensive review of them. For an overview of these accounts of distributive justice, see Vallentyne (2007), Meyer & Roser (2006).

Prioritarianism offers an alternative to egalitarian view of justice. It does not ascribe intrinsic value to equality, it instead holds that “benefiting people matters more the worse off these people are” (Parfit 2000, 101; also, see McKerlie 1994; Holtung 2007). In accordance with a prioritarian view of justice, the distribution of geoengineering risks will be sensitive to the vulnerability to the geoengineering risks and the (actual) chance of harms from geoengineering, and priority will be given to those who are more vulnerable and have a higher chance of actualising the harms. Accordingly, prioritarians will recommend a geoengineering policy to impose *fewer* sources of geoengineering risks to those who are more susceptible, and provide *more* precautionary measures to those who are likely to be harmed. In short, the aim is promote absolute level of well-being by reducing the risks and (actual) chance of harms of those who those who are more prone to them. Depends on the version of prioritarianism one maintains, the recommended geoengineering policy can either *a/ways* prioritise those who are more vulnerable, or it can prioritise those who are more vulnerable unless sufficiently great benefit arises from not doing so.<sup>16</sup>

The final view of justice I shall consider is sufficientarianism, which maintains “what is important from the point of view of morality is not that everyone should have *the same* but that each should have *enough*” (Frankfurt 1987, 21; also, see Crisp 2003; Huseby 2010; Shields 2012). In other words, sufficientarianism presupposes a threshold of sufficiency, and its aim is to provide that level of goods to every individual. So construed, it does not ascribe intrinsic value to equality, nor does it prioritises the worse off in distribution. In the context of geoengineering policy, a sufficientarian view of justice thus recommends every individual should be sufficiently safe from geoengineering risks, i.e. a sufficiently low exposure to the sources of geoengineering risks and a sufficient provision of precautionary measures against those risks. Of course, the sufficientarian view of justice is not without problems, and particularly relevant here is the threshold of sufficiency, i.e. what is enough. For the sufficientarian view of justice to provide *any* meaningful recommendation to geoengineering policy, it will require an acceptable account of the threshold of sufficiency.

I have outlined the geoengineering policy that would be recommended by egalitarianism, prioritarianism, and sufficientarianism. In short, different

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<sup>16</sup> The discussion here is restricted to the distribution of geoengineering risks, i.e. the sources of geoengineering risks and the precautionary measures against them. If the prioritarian view of justice is applied more broadly to the distribution of well-being, it will have further implication on the geoengineering research and implementation. In terms of geoengineering research, the prioritarian view should recommend research agendas that benefit the worse off. Similarly, it should only recommend implementation that benefits the worse off too.

accounts of distributive justice will evaluate geoengineering policy differently based on the normative criteria they hold, i.e. equality, priority (of the vulnerable regions and individuals), and sufficiency; and, the normative distributive principles correspond to egalitarianism, prioritarianism and sufficientarianism will recommend different geoengineering policy with respect to the implementation. To reiterate, my aim is not to defend any of them as the correct account of distributive justice for the distribution of geoengineering risks, to do so requires a more comprehensive analysis of various versions of those theories and their viability in *actual* policy-making.

## Conclusion

The main purpose of this paper is to illustrate an alternative approach to the question of distributive justice in geoengineering, i.e. the risk-based approach. I have discussed two problems of the outcome-based approach, namely the 'if and then' syndrome and the limited applicability of distributive principles in geoengineering policy. Particularly, I note that the question of distributive justice in geoengineering arises in an important part due to the fact that differentiated degree of risks are being imposed to various regions and groups of individuals through geoengineering research and its implementation. Risks, therefore, ought to be taken as an object of distribution in the context of geoengineering. Based on Hayenhjelm's (2012) account of fair distribution of risk, I demonstrate how geoengineering risks could be distributed. Finally, to show how major accounts of distributive justice can be used in answering the question of distributive justice in geoengineering, I briefly apply the risk-based approach with egalitarianism, prioritarianism and sufficientarianism. It should demonstrate the risk-based approach is a viable – and, indeed, a more fruitful – approach than the outcome-based approach. Although my discussion of the recommendation on geoengineering policy from egalitarianism, prioritarianism, and sufficientarianism is far from complete, it should provide a blueprint for developing a more detailed response to the question of distributive justice in geoengineering via the risk-based approach.

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