Minding the Gap? CE, CO_2 Abatement, Adaptation and the Governance of the Global Climate

Sebastian Harnisch*

Abstract: The current discourse on Climate Engineering (CE) lacks a thorough understanding of the complex interaction between CE and CO_2 abatement and adaptation measures. Too often, the debate has become deadlocked between scholars who fear CE may supersede substantial abatement/adaptation and those who favour CE supersession for economic benefits. This paper examines how plausible standards for a legitimate test of solar radiation management techniques (SRM) change the scope and sequence of CE and CO_2 abatement and adaptation measures. The core argument is that a "window of responsibility" for legitimately testing SRM techniques may be smaller and may appear sooner than conventional wisdom has it.

Keywords: Climate engineering, climate politics, governance, international cooperation
Klima-engineering, Klimapolitik, Governance, internationale Zusammenarbeit

1. Introduction

Climate engineering (CE), the intentional technical intervention into the global climate system on a planetary scale, is commonly understood to be a (plausible) response to the failure of international CO_2 abatement efforts. This is one of the fundamental assumptions of the emerging research field of "Climate Engineering studies" (TAB Gutachten 2012: Chapt. 6). And yet, can you imagine a world that is either devoid of further efforts to reduce CO_2 and full of CE, or in which current efforts abatement pick up enough speed so that no CE would be needed? What realistic policy patterns in response to these two scenarios and what adaptive behaviour can we expect? Last but not least: What policy mix should we aim for? And who is "we"?

Among the characteristics of the emerging "Global Governance of Climate Engineering", we may anticipate at least these four recurring behavioural patterns:

1. *Institutions of the current climate change regime will address CE when the costs of establishing new CE-specific agreements outweigh their relative benefits*. International Relations scholars recognize that state and non-state actors address new policy problems in old institutions rather than creating new ones, because of the costs already invested for their establishment and the proven reliability of their mechanisms for transparency, controls and sanctions, which enhance their attractiveness vis-à-vis new treaties, conventions etc. (Keohane 1989). Therefore, as the current United Nations Framework Convention on Climate Change (UNFCCC)-based regime already incorporates mechanisms for carbon-negative or -neutral technologies, CE methods to intervene in the carbon cycle, so called carbon dioxide removal (CDR) techniques are likely to be addressed in modified arrangements of the current regime.
2. *As the current CE discourse moves beyond the limits of scientific deliberation into the public and policy spheres, the focus of the debate on regulating CE research, testing and implementation will shift accordingly*. In the early days of the CE governance discourse, i.e. immediately after Paul Crutzen had reinvigorated the debate in 2006, several groups of CE scholars thought about self-regulation of the emerging field to address the potentially detrimental effects of unhindered research and testing activities on current CO_2 reduction and adaptation efforts. Indeed, the Oxford Geoengineering Program hosted a group of scholars shortly before the Asilomar Conference on Geoengineering, with the aim of preventing an early and permissive consensus on CE research by establishing strict principles. One of these principles was the declaration that Climate Engineering should be considered a public good. In addition, the Asilomar conference itself issued a (guarded) set of guidelines for research conduct. Moreover, the Royal Society, together with several partner institutions, established the so-called SRMGI, the Solar Radiation Management Governance Initiative, which calls for the active deliberation of rules for research on and testing of techniques which intervene in the reflectivity of the earth (SRMGI 2011). However, as both the Convention on Biodiversity (CBD) and the IPCCC have taken up the issue lately, regulation is unlikely to remain within the academic domain. Rather, as the experience with the so-called SPICE (Stratospheric Particle Injection for Climate Engineering) project in the UK indicates, other actors, the wider interested public and political decision makers will intervene and try to set the course while weighing the risks and (potential) benefits of CE. Ceteris paribus, as the potential temporal and temperature leverage of various SRM techniques appears to be much larger than for CDR techniques, the regulation of the former will probably move much faster up the public agenda than the latter (Schäfer & Zürn 2011: 22).
3. *The unilateral application of SRM technologies is (highly) unlikely*. In the debate on CE, the probability that some capable country or even individual may implement SRM to manipulate the climate has ranked high on the agenda of those scholars who stress the risks of CE (Ricke et. al. 2008, Blackstock et al. 2009; Virgoe 2009; Bipartisan Policy

* Dr. Sebastian Harnisch is Professor for Political Science at the University of Heidelberg. He would like to thank Miranda Böttcher and Stephanie Uther for their various comments and support in drafting this article.This article was peer-reviewed.

Center 2011: 12). Implicit to this assumption is the idea that a country or even an individual – a "lone Greenfinger" (Victor 2008: 324) – would be able to reap the benefits of CE without facing the costs, including the detrimental effects on precipitation and temperature patterns in other regions.

This is a highly unlikely scenario for several reasons: First, an individual is hostage to the legal system of his or her host state. As this state will have to face liability claims from states negatively affected by CE measures – as in the case of hosting terrorists, for example – it is improbable that an individual will launch a detectable SRM project without the host state's consent. Secondly, a state or a small group of states may launch an SRM effort if their private gains outweigh the public gains and the losses accumulated by the international community by far. If this were not the case and thus public gains outweighed public losses, the group deploying CE would want to spread the costs for the provision of the public gains equally among the benefitting states. In a scenario where private gains are high and also public losses are high, in the form of detrimental side effects for other concerned states, the affected states are likely to either take direct countermeasures or to rely on diplomacy or other coercive measures, such as sanctions, to counter SRM implementation (Horton 2011). In short: when SRM is deployed to offset a climate emergency,[1] the potency of the CE measures taken will most likely trigger a countermeasure to prevent (un)intended negative side effects.

4. *A mix of abatement, adaptation and CE measures, both CDR and SRM, is the most probable strategy in the future.* In a future world of CO_2 reduction, a mix of adaptive and reductive and, in the end, palliative strategies is likely. In fact, the UNFCCC has already started to include CDR equivalent mechanisms – such as natural sinks – which store and do not effectively reduce CO_2 emissions.[2] In a similar way, several CDR technologies simply enhance the natural effect of CO_2 storage in oceans or terrestrial reservoirs. In turn, as it is becoming ever more probable that current and future abatement efforts will suffice to stop further CO_2 emissions, not to speak of effectively reducing CO_2 concentration in the atmosphere, it is becoming ever more likely that SRM will have to play a role in preventing serious climate incidents and in enhancing the capacity to respond by the international community.

Against this background, the following analysis argues that the current debate in the CE community on the interdependence between the three strategies – abatement, adaption and climate engineering – is too constricted to resemble future real world patterns. Some studies have made substantial forays into understanding first broad patterns, especially with regard to CDR and abatement, but an in-depth discussion of the interaction is yet to be instigated (Wigley 2006; Keith 2010; Tanaka 2010).

This brief essay is not an extensive discussion of both CDR and SRM interaction with abatement and adaption. Rather, this is more a framing essay, or a hypothesis-generating study on some of the most likely patterns. Part II surveys and analyzes the current debate on the topic. Part III examines the case of SRM testing and its impact on abatement in particular. It is held that, contrary to the current consensus in the CE discourse, SRM testing may have to be scheduled much earlier than thought in order to meet legitimate concerns about the test's fallout.[3] By offering this new perspective on the interaction of SRM testing and abatement strategies, the article does not come down in favour of or against small or large scale tests of SRM techniques. Rather, the gist of the argument is that there is a much smaller "window of responsibility", in which a SRM test is a test and not pre-emptive deployment, than what the current consensus in the CE community acknowledges.

2. CE, Abatement and Adaptation: A Brief Digest of their Interaction

There have been significant areas of progress in research on the abatement-CE nexus. At the risk of excluding others, this article will focus on three. First, we have some basic understanding of the difference between the CDR- and the SRM-abatement interaction. In one of the most comprehensive studies on the topic so far, Rickels et al. (2011: 138) conclude that CDR technologies, due to their CO_2-neutral or CO_2-negative effects, have few detrimental side-effects on current abatement and adaption strategies. While one may argue that any other instrument than CO_2 emission prevention provides unnecessary incentives to prolong problematic CO_2-intensive consumption patterns, the international community has come together in interpreting this strategy as legitimate and necessary, given the challenges ahead (Lowe et al. 2009).[4] In addition, some CDR measures such as biochar and afforestation hardly differ from 'natural sinks' (Lehmann et al. 2009).

Secondly, in comparison, our knowledge about the abatement-SRM nexus is rather limited. Several reasons may be responsible for this: on the one hand, the field of CE research (and SRM research in particular) is rather young. Most systematic studies on the early dynamics of the CE discourse in various countries show that the CE debate started in earnest only after Paul Crutzen's ground-breaking article in 2006 (TAB-Gutachten 2012); on the other hand, some of the most advanced discourses, e.g. in the US, the UK and Germany, have become politicized already and thus polarized early on (TAB-

1 There are various definitions of the term „climate emergency", which differ in scope, parties concerned and time-scale of response, cf. Lenton 2008. Most of the literature, however, neglects that risk and threat perceptions vary also across different cultures and political systems so that it is very hard to pinpoint specific triggering events for certain actors or states.

2 The UNFCCC's Kyoto Protocol – currently the primary platform of national commitments for CO_2 reduction – limits credit for emission reduction via sinks to 'human-induced land-use change and forestry activities'. However, its definition of a sink as "any process, activity or mechanism which removes a greenhouse gas, an aerosol or a precursor of a greenhouse gas from the atmosphere" may be interpreted as being open to including CDR technologies, e.g. marine or terrestrial bound, in the future (Kyoto Protocol to the United Nations Framework Convention on Climate Change 1997: Art. 3.3).

3 Cf. Chairman Bart Gordon of the US HOR Committee on Science and Technology argues that; "it is the opinion of the Chair that some SRM strategies such as stratospheric injections, if proven viable, should be reserved as an option of last resort to be used only in the case of a "climate emergency," and when other options have been exhausted." (US HOR 2010: 40).

4 This finding is also shared by a several recent national and international policy reports on CE: Bipartisan Policy Centre 2011; GAO 2011; UBA 2011; Royal Society 2009.

Gutachten 2012; Boettcher 2012). Two main arguments can be identified, which are regarded by many of their protagonists as incomensurable: A first position holds that the causal relationship between SRM research and abatement is clear and negative, that is, the higher the amount of SRM research, the lower the willingness to engage in serious CO_2 abatement. This view is based on the assumption that the low costs of some SRM measures, sulphur injection into the stratosphere in particular, and their (assumed) effectiveness do create an (un)intended insurance effect, which may be interpreted as a "moral hazard" (Schneider 2001: 409; Lawrence 2006: 77; Keith 2000: 25; 2010: 498).

According to this view, the certainty about the (assumed) low costs and high efficiency of the measure would lead to a reduction in the willingness to face the (assumed) high costs and low efficiency of current abatement efforts. A subsequent argument holds that SRM research creates a "slippery slope" towards deployment because measurable testing may require rather large-scale field experiments for some technologies and, due to the entrenchment of the powerful interests of research institutes, research will lead to deployment (Caldeira 2008).

In essence, SRM thus induces a bifurcated negative response: on the one hand, SRM research leads to a growing negligence of alternative strategies, even before research has proven that SRM works; on the other hand, while SRM may lower global (and or regional temperatures), these intended effects will be accompanied by unintended consequences on other climate parameters, such as precipitation, ocean currents, etc. (Ricke et al. 2010).

A second group of researchers holds the same view that the causal relationship between CE and abatement is straight forward. However, they insist that the consequences should be appraised as positive rather than negative. In this reading, the negligible costs and high efficiency of sulphur injection by far outweigh the (potential) costs and detrimental effects on other climate parameters. In short, in this particular reading, cost adversity trumps risk adversity (Teller et al. 2002; Carlin 2007, Barrett 2008: 45; Bickel & Lane 2009).

These two positions mark the debates' extremes, with only a few researchers having thus far taken up positions in between. These few studies have focused on the scope conditions of actor's choices from an environmental economics perspective. In a recent study, Moreno-Cruz found that SRM deployment may induce expanded abatement efforts in those states and regions which suffer most from the negative externalities of the earlier deployment. According to this logic, the parties affected will try to use their enhanced abatement capacity to reduce the CE implementation incentives for the deploying state.

In a first attempt to make a case against this line of reasoning, it could be argued that this strategy is open only to those states which may engage in a very large-scale and sustained abatement effort (at presumably great cost) to offset the short-term "temperature gains" achieved by a deploying state. Given the high costs of the alternative abatement strategies, it is more plausible to assume that affected states would not use costly abatement measures to offset temperate gains, but rather resort to the counter deployment of aerosols, which would quickly reduce the detrimental consequences of the initial deployment. Moreover, as sulphur injection, as the most likely technique to be deployed, will be introduced into the stratosphere by airplanes, the state affected by the initial deployment may want to prevent further flights and may well be able to do so at a lesser cost than would be incurred by the alternative full exploitation of its abatement capacity.

In sum, the current CE debate appears to be too restricted and too estranged from the current debates on CO_2 abatement and adaptation to inform a balanced discussion on the benefits and costs of CDR and SRM research, testing and deployment. To instigate a more thorough debate on the CE-abatement-adaptation nexus, the following section critically assesses the political scope and timing for a test of SRM technologies.[5]

3. Opening the 'Window of Responsibility': A New Approach to SRM Testing

"While it is clearly premature to begin any large spatial-scale test, it is not premature to consider the implications. For SRM approaches to be available as an option by, for example, 2050, as an insurance policy against either high climate sensitivity or insufficient emissions reductions, then we would either need to begin tests decades earlier, or face the prospect of decisions about a full-scale implementation without sufficient information to ensure that we understand the effects" (MacMynowski et al. 2011: 5045).

Out of these early currents of the CE discourse, a new descendent of the first, skeptical approach to SRM can be developed. This approach is based on the assumption that testing most SRM technologies, more often than not, requires posting a "significant signal" into the climate system before one can detect a "positive" causal effect of the test on temperature and the scope of the potential detrimental effects on other climate parameters (Robock et al. 2010; MacMynowski et al. 2011). As even a sub-scale test would involve serious risks of detrimental short-term effects, it must not be taken lightly (Robock 2008, 2011). One current report holds:

"Very difficult governance challenges begin to arise where SRM research is conducted outside the laboratory, and when it is not clear that the planned experiments pose negligible risks" (SRMGI 2011: 51).

Against this background, it is plausible to insist that a detectable test has to be conducted well in advance of any large-scale deployment, because a full-scale application of SRM without sufficient knowledge of its (negative) effects does not constitute a test, but a reckless gamble if the "test" were to fail. In brief: if the risk-risk ratio is one to one, the test is a choice between plague and cholera (Graham & Wiener 1995) but not a test in the original sense of the word: a procedure intended to

5 Thus, make no mistake: this article is not a technical or physical assessment of the efficacy of certain testing measures or processes. Rather it is based on the assumption, that any large-scale SRM application will not take place without previous tests, even though it may be argued that the current understanding of natural or industrial sulphur injection into the atmosphere provides sufficient knowledge about the implications of large-scale SRM application.

establish the quality, performance, or reliability of something, especially before it is taken into widespread use.

Thus, the timing, even of a sub-scale SRM test, is critical when viewed in light of its potential (un)intended consequences. To meet the criteria of a precautionary approach, that is to establish the quality, performance, or reliability of SRM application before it is taken into widespread use, the test would have to take place well in advance of deployment and with the consent of the affected parties (Reynolds 2011: 130). Why? Because the test would have to be scheduled to meet the timeframe of the implementation of the best available alternative strategy to offset the temperature effect of the envisioned test.[6]

Having defined the fundamental relationship of a sub-scale SRM test and abatement as asymmetrical – that is, a legitimate SRM test must be scheduled against the timeframe in which the best available alternative strategy would definitely achieve a comparable temperature effect without unintended negative side-effects – one may start to calculate a series of SRM tests that could offer reliable data on the effectuation of such "radiative forcings" that would be needed to counter the temperature effects of a prioritized list of "serious climate events". As the identification of such "climate emergencies" is far from clear and consensual across a broad variety of potentially affected parties, a first step to approach the calculation of an appropriate timeframe for SRM testing, would be to pinpoint a climate situation which sets in motion a negotiation process on the length and breadth of a "window of reasonability" to test SRM. At this time, however, back-of-the-envelope calculations suggest that this "window for responsibly testing SRM technologies" is much smaller and appears likely to close much sooner than the current conventional wisdom in the CE debate has it.

4. Conclusion

In one short decade, but a moment in our planets lifecycle, concern about the serious effects of climate change have given rise to research on strategies that tinker substantially with the earth's climate system. Climate engineering research involves a lot of uncertainties, in terms of ignorance about the effects on given preferences of all the stakeholders involved, and risks, in terms of potential negative effects on the given identities of stakeholders under current behavioural dispositions. Therefore, the respective choices must be weighed carefully, in a manner which involves all stakeholders and parties affected (Gardiner 2010).

Despite some recent advances, social science research on CE still is very far from perfect when it comes to the assessment of the interaction between CE, abatement and adaptation strategies. As indicated, this article has addressed only a very narrow range of plausible interaction patterns.

6 At this time, the best alternative strategy to offset the temperature effect of the envisioned test appears to be a mix of abatement and adaptation measures. Given the length of time and limited leverage of the implementation of such a strategy mix, current appraisals by the IPCCC (2007) suggest that the longer the period before testing, the more radical the abatement-adaptation measures have to be if the test has intolerable results.

By placing SRM testing into a precautionary strategy of climate change response patterns, the suggested course for establishing a "window of responsibility" is meant to broaden a debate that has too often become stuck in a polarized stalemate. By linking the scale of a potential SRM test to the alternative strategy to achieve an equivalent radiative forcing through conventional (proven) instruments of abatement, one plausible guiding principle has been set for responsible policy making. Other principles, such as intergenerational equity, may (and should) be added to find legitimate solutions for the largest possible number of the actors concerned. Ultimately, this debate can only be resolved by the political actors involved, who will have to determine how much risk they are willing to take at which point in time when facing a climate emergency. Rather than taking unnecessary chances, they should choose a responsible course of action.

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