IASS WORKING PAPER
Institute for Advanced Sustainability Studies (IASS)
Potsdam, March 2015

Workshop Report

Procedural Governance of Field Experiments in Solar Radiation Management

A reflection on the workshop: "Understanding Process Mechanisms for the Governance of SRM Field Experiments"

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* The authors would like to thank Dr. Neil Craik, Dr. Jeff Ardron and Andy Parker for their valuable comments on the report, as well as Dr. Jason Blackstock and Jack Doughty for their contributions in workshop planning.

Funding for the workshop was provided by The Institute for Advanced Sustainability Studies, The University of Waterloo and The Centre for International Governance Innovation.

Workshop Organisers:
The Institute for Advanced Sustainability Studies, The University of Waterloo, The Centre for International Governance Innovation, University College London

Disclaimer:
This report addresses an emerging debate regarding the regulation of novel proposals for field research in the area of solar radiation management (SRM). It draws heavily on outcomes from a workshop held in Potsdam in April 2014 entitled "Understanding Process Mechanisms for the Governance of SRM Field Experiments" (hereafter referred to as the 'Potsdam Workshop'). It also draws upon insights from other activities in which the workshop organisers participated during this period. This piece is therefore a reflection on the part of the authors on these meetings and does not necessarily reflect the views of all participants or organisers.

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1. Background

1.1 Motivation

Recent years have seen an increase in the scientific attention paid to the study of SRM, a sub-set of techniques for climate engineering. SRM techniques seek to actively manage the radiation balance of the Earth on a planetary scale in order to forestall the effects of anthropogenic climate change. Concurrent calls for progress toward the creation of clear governance arrangements for research on SRM have followed (SRMGI, 2012), due to various concerns about the risks that such activities may present to the environment and about their complex social and political implications. While a number of important steps have been taken – primarily through the articulation of various sets of governance principles in a number of studies published by scientific and policy institutions (Rayner et al. 2013; UNESCO, 2011; BPC, 2011) – to date these have been carried out at a high level of abstraction.

Recent debate has been increasingly focused on the governance of perturbative SRM field experiments. With concrete concepts for field tests beginning to emerge (Dykema et al. 2014; Keith et al. 2014), the question of what constitutes appropriate governance for SRM experiments becomes pressing. This report, and the workshop on which it reflects, were therefore motivated as a response to the prospect of SRM field experiments and attendant concerns in expert and advocacy communities that applicable safeguards for minimising the risks and addressing the concerns they present may be inadequate at present, i.e., that principles have yet to be put into practice.

This report aims to aid decision-makers and other interested parties in understanding the complex scientific and social issues that proposals for field experiments and their regulation must navigate by highlighting the tensions between these concerns and suggesting some initial steps that might be taken to address them. This includes options for procedural governance that were the focus of the Potsdam Workshop.

1.2 Linked activities

This report draws upon discussions at three meetings held during the Spring of 2014.

The primary source of this report's reflections was the Potsdam Workshop, organised by researchers at the Institute for Advanced Sustainability Studies (IASS), the University of Waterloo (UW) and University College London (UCL). The scope and format of the Potsdam Workshop was primarily shaped by links to two ongoing projects carried out by researchers at the IASS, UW and UCL. These projects examine the potential roles of Environmental Impact Assessment (EIA) and research disclosure mechanisms (CIGI, 2013) for climate engineering research governance, and are supported by grants from the Social Sciences and Humanities Research Council of Canada and the Centre for International Governance Innovation (CIGI), respectively. The workshop was therefore utilised as an opportunity to further develop these projects, both of which are targeted at understanding the role of procedural governance as a mode of regulation in SRM field research.

In addition to this meeting, in March 2014 a group composed primarily of natural scientists and engineers met at Harvard University to explore and refine a set of hypothetical SRM field experiments (Keith et al. 2014). This was the first attempt by natural scientists to articulate a portfolio of possible field research activities across a range of SRM techniques, including small-scale experimental activities that participants of the Harvard Workshop are interested in undertaking (Dykema et al. 2014). Such information provides

an important input into the SRM governance discussion, allowing for a clearer understanding of the properties of perturbative SRM field experiments that may be conducted in the near future. Suggestions for procedural mechanisms that might form future parts of a governance architecture for SRM research can now be examined against concrete experimental concepts. Its outcomes form an important part of the SRM research governance picture presented here.

Another workshop held in March 2014 at the Environmental Defense Fund headquarters in San Francisco focused on SRM governance within the US national context, aiming to identify key considerations that should enter the decision-making process on whether or not to approve individual proposals for perturbative SRM experiments.

Due to the relevant linkages in topical focus, the findings of these meetings were communicated through joint participation of organisers.

A further meeting, held in February 2015 and organised by researchers at the University of Waterloo, the Harvard Kennedy School of Government and University College London continued to develop the procedural mechanisms discussed at the Potsdam Workshop.

2. The Potsdam Workshop

2.1 Key themes and scope

The Potsdam Workshop activities centred on the following areas:

- **Developing a scientifically and politically nuanced understanding of the risks posed by, and concerns associated with, SRM field experiments.** Key areas of investigation concerned whether, how, why and in what circumstances SRM field experiments present a 'special' case for the governance of science. 'Special' in this case may refer to the unique scientific, environmental, political or other implications that research carries.

- **Exploring the dual roles that procedural and substantive regulation can play in the governance of scientific research.** In particular, the workshop considered why the procedural principle of transparency has figured so prominently in debates about climate engineering to date and how it might be applied through the mechanisms discussed.

- **Determining the extent to which two procedural mechanisms – EIAs and research disclosure mechanisms – may account for the risks and concerns posed by small-scale experiments.** Applications of these mechanisms in other areas of scientific and environmental governance were discussed and contrasted with the case of SRM field experiments. Discussions about mechanism design covered questions such as what the scope of activities covered by the mechanisms might be, what stakeholder audiences they might inform, what political processes they might influence and what institutions might be involved in their application.

2.2 Format and participation

The Potsdam Workshop took place over the course of two full days. On day one, participants were presented with the portfolio of experimental proposals developed at the Harvard Workshop as well as with a number of case studies about previous outdoor activities related to SRM research. These presentations were followed by plenary and breakout discussions aimed at developing a joint understanding amongst participants of the nature of the concerns and risks that these activities may present and their novelty as objects of governance. Day two featured two half-day exercises exploring the applicability of EIAs and research disclosure mechanisms to addressing these risks and concerns. The workshop agenda can be found in the Appendix.

Participants were selected because of their expertise and familiarity with SRM research governance. The workshop participants list can be found in the Appendix.

3. SRM Experiments

3.1 A typology of SRM field experiments

The Potsdam Workshop opened with a presentation of the experimental portfolio developed at the Harvard Workshop, given by David Keith. This sparked deep conversations and much disagreement amongst participants about the types of risks and concerns that experiments may present, both as individual activities and as a portfolio representing SRM field research in general. As such, it may be useful to provide the reader with a brief account of the experimental typology presented by Keith.

The Harvard typology encompasses five modes of research, four of which would involve field experimentation, with the fifth being *laboratory research*.

One such mode of research is *technology development*. These activities aim to test the hardware and operational capacities necessary for deployment, for example, particle-spraying technologies or aircraft platforms. These may require some field experiment components which could involve small environmental perturbations.

The mode of research that would likely be the initial focus of field experimentation is *process studies*. These research activities aim to enhance understanding of the small-scale atmospheric or other processes that would be impacted by SRM. This might include, for example, the impacts of sulfate particles on stratospheric chemistry or passive observations of ship track formation. Such experiments would necessarily be of very small-scale and involve little or no environmental perturbation.

According to the Harvard typology, the next step would be to conduct *scaling tests*, which aim to bridge the gap between the various scale domains of models. The kinds of experiments encompassed within this mode might include marine cloud brightening experiments that test both microphysical particle interactions and larger physical interactions of clouds over meso-scales. These experiments would involve environmental perturbations that could present localised risks over relatively short time periods.

The largest scale mode of research is *climate response testing*, which aims to understand the global climatic impacts of the interventions in question. According to Keith and his colleagues, this type of research would need to take place over the course of a decade or more at a global scale, involving incremental variations to the scale and characteristics of the perturbation in order to develop an increasingly better understanding of SRM and its global climatic impacts (Kravitz et al, 2014). A climate response test would thus be indistinguishable from the deployment of SRM.

3.2 Physical risks

The physical risks posed by such experiments might include impacts on the natural environment, such as changes in atmospheric composition, hydrology and surface temperature. Depending on the scale and characteristics of such changes, there may be attendant risks for human and ecological health in the area impacted by experimentation.

Process studies would be of very low to negligible physical risk because of their small scale. The process studies contemplated at the Harvard Workshop, for example, would result in smaller environmental perturbations than many other accepted scientific and commercial activities such as controlled pollutant release experiments and air travel.

Scaling tests, on the other hand, may present a non-trivial level of physical risk depending on their scale and location. Technology development activities would likely pose minimal or negligible risks to the environment, but these would also vary depending on the character of the activities undertaken. With climate response tests at the planetary scale, a clear distinction between experimentation and deployment is no longer possible – if these kinds of activities were ever carried out they may pose significant transboundary risks to the global environment.

It has been argued that such experiments should proceed in sequence (Keith et al. 2014), with a number of process experiments and scaling tests of increasing scale preceding any experiments aimed at testing the climatic response of large-scale interventions. The results from smaller-scale experiments would be needed to provide evidence that any larger tests would not carry an unacceptable level of risk, though they likely could not guarantee complete safety.

Though they are not being seriously contemplated at present, regulation of the potential transboundary environmental impacts of large-scale field experimentation may become an important element of SRM governance in the future and should be considered at national and international levels. At the same time, the smaller-scale experiments that carry very little to no direct physical risk to the environment still raise legitimate concerns due to other factors discussed below.

3.3 Social concerns

Much of the concern about the possible impacts of small-scale SRM field experiments arises from the complex socio-political context within which research is situated. These concerns frequently relate to the possible future impacts of early-stage research – both on the environment and on society. While these concerns are often attributed to individual experiments or research activities, they also reflect a more general set of apprehensions about how the knowledge and public debate generated by SRM research will influence society. As such, they cannot be easily differentiated along the same lines as the scale-based typology developed at the Harvard Workshop.

Many commentators question the wisdom of supporting a field of research that might prove a distraction from other climate policy options (a so-called 'moral hazard') (Lin 2013; Keith, 2000). Others argue that SRM has inherently undemocratic characteristics (Szerszynski et al, 2013), or that once research leaves the laboratory, it will give rise to supporting constituencies and societal momentum towards deployment in the absence of solid scientific or societal consensus as to its benefits and risks (setting research on a 'slippery slope' towards deployment) (Cairns, 2014; Low et al., 2012).

There are also opposing concerns that embody the idea that 'knowledge is better than ignorance', especially in a situation where very little is currently known about the technologies in question. These arguments suggest that the greater risk lies in abstaining from SRM research because SRM may prove use-

ful given the scale of the climate change problem, and because simple SRM experiments may provide information that benefits climate science more generally. In addition to this, outdoor research may prove that SRM is unacceptably dangerous and/or ineffectual. Humanity may be better served by finding this out sooner rather than later.

These interrelated concerns have been articulated in different variants by a number of scientists, activists and other commentators. However, many of the arguments share the similarity that they tend to project apprehensions about the future impacts that SRM research might have on society's ability to make wise decisions regarding its potential deployment onto the debate about how upstream research activities are governed. This can be seen, at least in part, as a reflection of concerns that arose in response to the development of other controversial technologies that have a history of co-optation by private interests (Kastenhofer, 2010). It also reflects a growing understanding that science is subject to many of the same biases as other social endeavours, and not only impacts, but is itself impacted by social phenomena occurring outside of its traditional domain (Jasanoff, 2003). Seen in this light, a key objective of governance is to ensure that research is undertaken firmly in the public interest, with appropriate consideration for and humility over its possible future consequences, uncertain as they are. This objective applies to all levels of research, from laboratory activities through the various stages of field experimentation.

4. Procedural Mechanisms for Operationalising Transparency

4.1 Why procedural governance?

With such complex scientific and social terrain to navigate, substantive rules (setting hard thresholds between what can and cannot be done by proponents of activities) can be difficult to agree upon. This situation is hardly unique to SRM research. It suggests a needed turn to procedural governance, for example, by setting rules regarding cooperation, information disclosure, and assessment in order to build an open and deliberative foundation, which may help to inform and shape future decision-making efforts.

Discussions of SRM governance to date have focused largely on the elucidation of key principles that might be applied to adequately account for the various risks and concerns that the research and potential deployment of SRM raises. Chief among these, and perhaps the least openly contested of them, is the procedural principle of transparency.

Craik and Moore find that transparency is assumed to play two overarching governance functions in SRM research: to minimise risks by making them apparent to those with the power to intervene in avoidance of such risks, and to build trust between various stakeholder constituencies in order to create a more fair and effective decision-making environment (Craik and Moore, 2014).

Various procedural mechanisms might be applied to provide clearer procedural rules regarding the disclosure of information about SRM research. At the workshop, two types of disclosure mechanisms were discussed: Environmental impact assessments and research registries and clearinghouses. The insights below, which were generated at the Potsdam Workshop, raise key scoping questions regarding how information about the risks and concerns presented by SRM field experiments could be disclosed in such a way as to reduce research risks and build trust.

4.2 Environmental impact assessment

EIA has become the standard process through which activities that may present environmental harms are assessed to determine the nature and extent of potential impacts and possible mitigation strategies and to project these findings into decision-making processes. Their examination as a procedural mechanism for governing SRM field experiments is highly relevant given the likelihood of their application in this context. At the Potsdam Workshop, Neil Craik presented research on the potential application of EIAs to SRM field research. Participants deliberated on how various EIA practices might capture (or fail to capture) the risks and concerns posed by the Harvard portfolio of field experiments.

At a basic level, EIAs require proponents of potentially harmful activities to:

- Engage in prior scientific assessment of potential impacts
- Make information available to the public
- Provide opportunity for public consultation
- Consider assessment and public input in decision-making processes

EIAs do not, however, typically require avoidance or mitigation of impacts as a substantive obligation. In this sense, EIAs can be seen as transparency mechanisms that are focused on impacts and support consultation and decision-making, rather than a mechanism by which substantive rules are enforced. 'Impact' in this sense can mean any effect caused by a proposed activity on the environment including human health and safety, flora, fauna, soil, air, water, climate, landscape and historical monuments or other physical structures or the interaction among these

factors; it also includes effects on cultural heritage or socio-economic conditions resulting from alterations to those factors (Espoo, 1991).

This broad interpretation of the term opens up EIAs to potentially addressing some of the social concerns associated with SRM field experiments. Workshop participants pointed out, however, that tiered assessments (CEQ, 2014) of policies, programmes and plans, as well as strategic environmental assessment (Kyiv, 2003) are modes of assessment that might be better suited to dealing with social concerns than traditional EIAs, but that these are generally less well developed, especially outside of Europe.

There are a large number of issues that require further exploration regarding the application of EIAs to SRM field experiments. A number of these were pointed out at the workshop:

- What triggers an EIA? A criterion often invoked is "likelihood of significant harm", but for small-scale SRM experiments, potential harms from environmental impacts would almost certainly fall below any existing threshold that would trigger an EIA.

- EIAs often require reflection on behalf of proponents as to whether there are less risky alternative courses of action that could be taken. But how broadly should alternatives be framed in the context of SRM research? For example, should research on technologies and capacities for mitigation and adaptation be considered alternatives in this sense?

- On what basis should notice be provided? Affectedness or interestedness? How are these defined and what form should notice take, given the potentially large number of stakeholders that might be considered 'interested parties'?

- Does uncertainty present a particular problem that is unique in the SRM context? Is precaution an appropriate response, and how can it be applied in this context?

- Should SRM governance be integrated into existing EIA structures, or does it require a specialised regime given its unique characteristics?

- EIA processes generally seek to avoid or mitigate environmental change, but for SRM, environmental change is the goal. How does this dilemma apply to small-scale activities that do not seek to effect environmental change in their own right but rather to test the feasibility of technologies that would?

- How might the results of an EIA relate to the taking of final decisions regarding whether and how research proceeds? On what basis can such decisions be seen as legitimate, and is there a risk that narrowly defined EIAs could be used somewhat nefariously to justify research activities?

EIAs will almost certainly play a role in the assessment of physical impacts resulting from proposed SRM field experiments, particularly if research moves from process studies to scaling tests that may have transboundary implications. In the shorter term, the application of EIAs for SRM field experiments may be highly influential as well: the way in which EIAs are framed and applied for high-visibility initial field experiments may set a precedent for the perceived legitimacy of such experiments and the future use of EIAs in their governance. How social concerns are addressed in these initial assessments may be of particular interest. EIAs might be seen to play a key role in increasing the 'social intelligence' of a proposal or project, while ensuring that any physical risks posed are minimised to a level that is broadly acceptable to interested and affected parties.

4.3 Research registries and clearinghouses

EIAs can serve to publicly disclose important information about environmentally perturbative activities, especially with regard to the disclosure of physical risks. However, there are a number of other mechanisms that have been applied elsewhere and might be adapted for the SRM research case in order to apply the transparency principle more fully. Examples come from a variety of scientific fields and policy arenas and include research registries and results databases for clinical medical trials (Sim et al., 2006) and nano-materials (D'Silva and Van Calster, 2010), as well as online information clearinghouses that support decision-making in international legal bodies, for example, through the Cartagena Proto-

col of the Convention on Biological Diversity, which regulates trade in genetically modified organisms (Gupta, 2010). Registries, clearinghouses, databases and other disclosure mechanisms can be constructed in a variety of ways depending on the context of their use and what they are intended to achieve.

With this in mind, Potsdam Workshop participants explored the potential construction of a bespoke disclosure mechanism for SRM research by deliberating on a set of variables pertaining to its possible design. The objective of this exercise was to inform any future efforts towards the construction of a research registry or information clearinghouse for SRM research, something that has been suggested by a number of institutions (SRMGI, 2012; UK Secretary of State for Energy and Climate Change, 2010) and academics (Craik and Moore, 2014; Dilling and Hauser, 2013; Blackstock, 2012).

The design variables discussed were: a) *Aims and audiences* – for what purposes should information about SRM experiments be disclosed and to whom?; b) *Scope* – what kinds of information should be disclosed?; c) *Ownership and institutional structure* – which institutions should be involved in setting the rules regarding disclosure?; d) *Enforcement* – what incentives might ensure that rules regarding disclosure are followed?; and e) *Adaptability* – to what degree should a disclosure mechanism be designed to be flexible and how might this be achieved?

Key mechanism design considerations identified by these five breakout groups included:

- The aims of disclosure should include trust-building between stakeholders, shaping researcher behaviour toward less risky activities, improving scientific processes through sharing of best practices and affirming the public's right to know about research.

- Disclosure of information can occur at various points in the research process including research proposal development, application for funding, EIA or other assessment of the project, and disclosure of data and results.

- Disclosure should address any private-sector involvement or intellectual property claims, either of which should be considered dubious due to widespread agreement that research should be conducted to support public rather than private interests.

- Drawing a clear line around what types of activities should be subject to disclosure obligations is potentially difficult, not least because of the similarity of SRM research to other atmospheric science research. Such definitional challenges raise the prospect of voluntary self-declaration by scientists of their research as 'SRM-relevant', or for disclosure obligations to be dependent upon requests from interested or affected parties.

- Institutional ownership of a disclosure mechanism requires epistemic jurisdiction over the scientific field as well as enforcement capability or ability to incentivise the behaviour of key actors, particularly research proponents.

- SRM presents a significant challenge in identifying institutions with the perceived neutrality to act as an 'honest broker' of information because of value-based disputes over its appropriateness.

- The existence of positive incentives for information disclosure will be a key element in any successful SRM research disclosure regime. Incentives for researchers to disclose might include: the creation of a trustworthy 'brand' for research, access to an inventory of research projects, standardisation of researcher best practices, and enhanced access to research data for comparison and experimental duplication.

- A periodic process to review the mechanism's effectiveness may provide an avenue for continual improvement, and an enshrined ethos of openness and malleability may also contribute to the adaptive capacity of the mechanism over time.

It is unlikely that a single mechanism could adequately account for each of these considerations. Despite this, workshop participants generally agreed that the careful creation of one or more disclosure mechanisms – achieved through collaboration between scientists, appropriate regulatory institutions, and wider sets of interested stakeholders – may be an important step toward minimising the risks of SRM research and building trust between key actors.

5. Concluding Reflections: Governing SRM Field Experiments

Because research into SRM is currently at such an early stage, there are presently no serious proposals for large-scale experimentation that could pose significant environmental harm. Proposals for smaller-scale outdoor research activities are, however, beginning to emerge and do present concerns that deserve the attention of governance scholars and policymakers in the immediate term. The possibility that such experiments may pose some level of physical risk, and that the way in which this is evaluated may set important precedents for later (and potentially larger-scale) research activities, suggests a need for governance to account for these physical risks in some fashion. EIA has a long history of application to activities that may pose such risks, and steps should be taken to further elucidate its appropriate application to SRM field research. Furthermore, a clearinghouse or research registry disclosure mechanism could act as a central source of information about ongoing research activities, including the nature and scale of their physical risks and how these are addressed by proponents.

The extent to which governance arrangements can and should seek to accommodate the various socio-political concerns associated with SRM field experiments is perhaps of even greater urgency and is highly contested. Some scholars advocate an approach that emphasises the importance of pre-emptive decision-making (usually anchored in participatory modes of consultation) about whether and under what conditions any field experimentation should take place, prior to the investigation (through field experiments) of the physical risks that SRM may pose. Others see a more immediate need to gather additional information about the possible risks of SRM deployment through experimental research, which from this perspective should not be slowed down by onerous governance requirements and associated consultation processes. There are also concerns that a highly consultative approach conflicts with norms of scientific freedom. How such norms can be accommodated in an age of 'post-normal' science, where the risks and benefits generated by scientific research are so clearly (and in the case of SRM, so ubiquitously) transferred onto society, is an immediate question facing SRM research governance.

This tension between the need to learn about the risks of SRM and the need to make decisions about what constitutes appropriate research behaviour in order to investigate those risks was the central point of contention at the Potsdam Workshop. It is a tension made all the more difficult to navigate in the case of SRM research because of the ticking clock of climate change that drives SRM research in the first place, and the varying interpretations of how fast that clock is ticking amongst those involved in these discussions.

In dealing with this tension between investigation and precaution, the application of procedural regulations has some initial advantages over substantive rule-setting. Procedures may be designed to assist in the navigation of this dilemma rather than aim to settle it at a time when there is no clear agreement amongst interested parties regarding what should and should not be conducted in the open environment. Substantive rules will, of course, need to be developed in this area, but their proper development should be seen as necessarily supported by processes of deliberation rather than as a separate activity.

Precautionary proposals for the regulation of SRM experiments often emphasise consultation and stakeholder participation as key governance activities. However, these approaches face the difficulty of defining what constitutes a stakeholder in the first place, and because of the resource and time intensity required by such processes, they may present a significant barrier to research. While these concerns are well-founded, the claim that governance is nonetheless important at the early stages of research in order to account for the potential impacts of SRM technology development is warranted – the conduct of early-stage activities may influence the characteristics and likelihood of deployment and may be steered accordingly. This could occur in multiple directions, with more research not necessarily increasing the likelihood of deployment and vice versa. More to the point, it is the character of research in terms of cooperation and transparency that may provide a more tangible link between upstream (early research stage) and downstream (deployment related) activities. A cooperative and transparent international research programme may make it more likely that, if SRM research becomes more prevalent or should SRM ever be deployed, it continues to have these characteristics and is thus more likely to be pursued in the global public interest, with potential benefits pursued while avoiding risks and conflicts.

One possible element of an approach to bringing these realisations into synergy is to recognise the various levels at which SRM research might be governed, including at the programme or policy level rather than solely at the level of individual experiments. To date, SRM research has mostly been proposed in piecemeal fashion, presenting a small target for the more ambitious governance activities regarding consultation. If these more ambitious governance activities were directed at the level of a programme encompassing numerous research components including field research, or at the level of national or international policymaking and agenda-setting, a wider technology assessment process, including higher degrees of consultation and a focus on broader social concerns, may be more readily applied. However, since such extensive, coordinated SRM field research programmes are not yet under consideration, it is prudent to also consider initial forms of governance that are more appropriate to the field testing plans currently being discussed.

Discussion at the Potsdam Workshop suggested that EIAs as well as research registries and clearinghouses hold promise in supporting research activities at these multiple levels, first and foremost by making research transparent, but also as platforms for consultation and dialogue between interested and affected parties – thereby supporting the principles of participation and cooperation.

Applying such mechanisms to SRM research is, of course, not the only governance action that might be taken. Participants at the Potsdam Workshop also highlighted the possibility of developing a code of conduct that could provide overarching guidance to scientists on best practices, the development of high-level technology assessment processes (which might augment traditional EIAs or be applied independently in order to more adequately address social concerns), and further development of community norms and institutions in the field of SRM science that ensure that transparency, cooperation and public participation continued to be pursued through a variety of activities.

The Potsdam Workshop and associated meetings in Cambridge and San Francisco proved useful in highlighting the complexity of the various concerns and risks that SRM research poses. Crucially, a number of these concerns, particularly those associated with the broader social context of SRM research, arise at the outset of SRM research and are triggered even by outdoor experiments that carry little or no direct physical risks. Nevertheless, proposals for conducting such research are beginning to emerge and need to be addressed through some form of governance. Currently, recognition of these issues is only beginning to develop in academia – and even less so in policy circles – and agreement about the right course of action vis-à-vis the governance of SRM field experiments has not been broadly reached. These issues bring into clear focus the importance of collaboration and dialogue between the machinations of science and governance, so that rules that set a precedent for transparency, cooperation and participation can emerge alongside any scientific research that aims to give us a better picture of the risks that SRM may pose.

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7. Appendix: Workshop Agenda

Day One: Wednesday April 16

9.30–10.00
Welcome
Explanation and motivation of the workshop
M. Lawrence

10.00–10.45
Previous Field Experiments
A description of past field experiments of climate engineering, including motivations, outcomes and possible lessons for the design of future governance
J. Doughty

11.00–12.00
Portfolio of Possible Future Field Experiments
Detailed explanations of the field experiments designed at science workshop, other outcomes from science workshop
D. Keith

1.00–2.00
Breakout Sessions to Discuss Potential Governance Issues of Proposed Field Experiments
Initial reactions about the issues that governance mechanisms might manage
N/A

2.00–2.30
Report back to Plenary
Feedback from the breakout groups
N/A

2.30–2.40
Brief Workshop Update: Self-Governance in Science & Technology
Brief fill-in on lessons from historical cases of self-governance in other areas of science, explored at preceding workshop in Potsdam
S. Low

2.40–2.50
Brief Workshop Update: Governance of SRM in the United States
Brief fill-in on governance considerations discussed at recent governance workshop
J. Flegal

3.10–5.10
The Wider Governance Context Presentations with discussion:
- Situating Process Mechanisms Within a Wider International Normative and Institutional Frame
- Transparency
- Political Issues

A-M. Hubert, D. Reichwein, N. Craik, J. Blackstock

5.30–6.00
Wrap-up and discussion of next day's activities
S. Schäfer

Day Two: Thursday April 17

9.00–9.45
Presentation on Environmental Impact Assessment
Introduction to intersection of EIA and CE; informs and primes breakout conversations
N. Craik

9.45–11.45
Breakout Groups on Environmental Impact Assessment
Breakout groups discuss important questions about the mechanism and how it may interact with one or more experiment.
N/A

11.45–12.45
Report back to Plenary
One or more members of the group present key aspects of their discussion back to plenary.
N/A

1.45–2.30
Presentation on Disclosure Mechanisms
Introduction to disclosure and CE research. Informs and primes breakout conversations.
N. Moore

2.30–4.30
Breakout Groups on Disclosure Mechanisms
Breakout groups discuss important questions about the mechanism and how it may interact with one or more experiment.
N/A

4.30–5.30
Report back to Plenary
One or more members of the group present key aspects of their discussion back to plenary.
N/A

5.30–6.00
Concluding Plenary
Final group discussion of lessons learned and next steps with wrap-up and thank you
J. Blackstock, N. Craik, S. Schäfer, N. Moore

Workshop Participants

Organisers:

Jason Blackstock (University College London)
Neil Craik (University of Waterloo)
Jack Doughty (University College London)
Nigel Moore (IASS Potsdam)
Stefan Schäfer (IASS Potsdam)

Workshop participants at the Institute for Advanced Sustainability Studies, April 2014. © Harald Stelzer

Participants:

Jeff Ardron (IASS Potsdam)
Rob Bellamy (University of Oxford)
Ralph Bodle (Ecologic Institute)
Jane Flegal (University of California, Berkeley)
Matthias Honegger (Perspectives Climate Change)
Joshua Horton (Harvard University)
Anna-Maria Hubert (IASS Potsdam)
Peter Irvine (IASS Potsdam)
David Keith (Harvard University) [via virtual connection]
Mark Lawrence (IASS Potsdam)
Sean Low (IASS Potsdam)
Achim Maas (IASS Potsdam)
Phil MacNaghten (Durham University)
Andy Parker (Harvard University)
Rosemary Rayfuse (University of New South Wales)
David Reichwein (IASS Potsdam)
Jesse Reynolds (Tilburg University)
Harald Stelzer (IASS Potsdam)
Jack Stilgoe (University College London)
Bronislaw Szerszynski (Lancaster University) [via virtual connection]
Chris Vivian (CEFAS)
Matt Watson (University of Bristol)
Ruben Zondervan (Earth System Governance Project)

IASS Working Paper
March 2015

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DOI: 10.2312/iass.2015.007