International Cooperation and the Governance of Geoengineering

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Good morning! First of all, many thanks to the IPCC for inviting me to deliver this keynote lecture on 'International Cooperation and the Governance of Geoengineering'. Yesterday, Granger Morgan ended his presentation by suggesting that 'we should not jump of the cliff' without knowing what to do (in reference to why more research was needed on geoengineering before any further decisions could me made). Actually, on my last trip to Lima, I *did* jump off a cliff, in an attempt to paraglide over the Pacific Ocean along the beautiful Costa Verde! Having done that, I know a little bit about paragliding. But in hindsight I wonder, if things had gone wrong, who would have been responsible? Would it have been me or would it have been the parachute? Would it have been the responsibility of my trainer? What if I had floated across and landed in some other territory? Whose responsibility would that have been? What kind of compensation could I have expected? What kind of compensation might *I* have been expected to deliver? In a sense, the governance of geoengineering research throws up very similar questions when we consider the uncertainties surrounding the technologies and their impacts. Thus, we have questions on assigning responsibility, on determining intent, on honouring national boundaries, and on estimating compensation.

Four questions

So, what I am going to do today in my presentation is to try and explore a few questions about what kind of governance arrangements might we expect to evolve over time. It is hard to predict but I want to lay out some factors that might influence the design of geoengineering governance. In doing so, I want to pose four questions. First, why would we want to govern geoengineering in the first place? Secondly, why would we want to cooperate? I will make a distinction between the need for governance and the possibility of cooperation. And then I'll pose a question on what governance options we currently have. Finally, what kinds of functions for which motivations of various actors might we expect to see in the governance arrangements?

In my lecture, I use five assumptions. One is that certain types of geoengineering technologies might be relatively cheaper than climate mitigation strategies (Keith, 2000; Barrett, 2008; Keith, Parson and Morgan, 2010; Morgan and Ricke, 2010). Two, states are currently investing in geoengineering research for the purposes of climate-related actions but, three, capabilities change over time and other motivations could guide behaviour in future, which are difficult to anticipate. Four, in addition to climate related concerns, countries are also concerned about technological leadership, especially in new areas of research and, five, uncertainty increases mistrust.

Why govern geoengineering?

So on to my first question: why govern geoengineering? At the very outset, governance might itself take very many different forms. We could be considering outright prohibition; or we could be discussing permission, or regulation (Catherine Redgwell referred to these choices in her presentation). Then the question is: what is to be governed? Are we talking about all types of geoengineering technologies? Or are we talking about Solar Radiation Management (SRM) or Carbon Dioxide Removal (CDR)? Are we only concerned with large scale experiments?

And what would be the scope of international governance? Would it be through *ad hoc* principles (Victor 2008, Victor et al., 2009; Keith, 2010) or via formal rules (Virgoe, 2009; Lloyd and Oppenheimer, 2011)? Would it be at the multilateral level (Lin, 2009; Berg, 2011) or only as a subset of countries (Benedick, 2011) with current levels of technological capability? While we explore these questions, it is useful to refer to the Royal Society report of 2009, which suggests that the governance of geoengineering cannot be simply answered through scientific metrics; ethical, political and legal dimensions will inevitably influence the debate (Royal Society, 2009).

Now, if geoengineering were to be governed internationally (and that is the scope of the presentation that I have been asked to deliver), we have a bottom up set of principles and codes of conduct: the Oxford Principles (Rayner et al., 2009) and the 2010 Asilomar Principles (Asilomar Scientific Organizing Committee, 2010) are quite similar. But they do not identify what would be the underlying motivations of the different actors that might be interested in the international governance of geoengineering. I, therefore, wish to identify the mix of material interests as well as ethical concerns, because both of these sets of issues influence processes and outcomes. Then, we need to explore how the motivations would influence the functional form of governance.

So what are these material interests in geoengineering? First of all, these interests stem from the current levels of uncertainty with regard to the science, so some countries and scientists might argue that you need to retain the freedom to experiment with geoengineering technologies. Without such further research and experiments, the state of our knowledge would not be robust enough for policymakers to make informed decisions (Crutzen, 2006; MacCracken, 2009; Blackstock et al., 2009; Morgan and Ricke, 2010; Benedick, 2011). In this sense, if international rules were to be introduced in this scenario, they would be considered *status quo-ist*, a constraint on a single country's freedom of manoeuvre in future.

But international rules are also needed to rein in runaway unilateral action in an uncertain technological field (Victor 2008; ETC Group, 2010b; Keohane and Victor 2011; Lloyd and Oppenheimer, 2011). In a sense, countries are concerned about the unanticipated outcomes as

well as the current knowledge base that is available to them: in terms of the implications for rainfall and the hydrological cycle (Bala et al., 2008; Brovkin et al., 2009), the tropical forests (Eliseev et al., 2010), the ozone layer (Royal Society, 2009; Heckendorn et al., 2009), the oceans (Scott, 2005; Lampitt et al., 2008; Trick et al., 2010), and the so-called 'termination effect' (also see Robock, 2008; Robock et al., 2008; Robock et al., 2009; Leinen, 2011). Moreover, countries want to rein in unilateral action because they fear that some might gain a technological edge and are not certain of the uses to which those technologies might be put to. So, in a sense what we have is a bit of a dichotomy in the positions of individual countries. They might favour rules that give them maximum flexibility while keeping other countries off balance.

What are the ethical concerns that arise with regard to geoengineering? Some argue that there is a danger that if we pursue SRM or CDR activities there will be little or no action on climate mitigation (Caldeira and Wood, 2008; Keith et al., 2010). Others take a stronger position that they oppose any interference with nature. A more difficult question is ascertaining the *intent* behind the research in geoengineering technologies (Fleming, 2007; Barrett, 2008). Further, many NGOs have argued that they have a say over actions that have an international impact (ETC, 2010a; Banerjee, 2011; NGOs letter, 2011). And then there are also ethical questions about intergenerational equity, since future generations who might face the consequences of a "geoengineered climate" would have had no say in how the research was conducted in the first place (Burns, 2011; Brown Weiss, 1992; UNFCCC Art. 3(1)).

When we translate these ethical questions in terms of the legitimacy of a governance structure, that is the entities that are governed would need to give explicit or implicit consent over those arrangements, then we have concerns about the process and we have concerns about the outcomes. On the process side, they want to participate in forums at which the rules might be drawn up. Secondly, they need to have the power to influence these rules and, thirdly, they need to be fully informed and be aware before they can give consent on the governance arrangements.

And these governed entities (countries, civil society and scientific communities) have concerns about outcomes as well. Would capability over research and deployment drive the design of governance arrangements? What kind of intent would derive from growing scientific capability over time? Who would do the monitoring, transparency and the review of the data that comes out of research endeavours? And how would disputes be resolved and decisions enforced?

Why cooperate?

If these are the interest-based and ethical concerns that emerge if we choose to govern geoengineering, the question that arises is: why should we wish to cooperate?

Here, we need to make a distinction between cooperation and coordination. A lot of scientific research has been *coordinated* internationally because the participating countries or research groups have a common goal and what they try to work out is how different parties would contribute towards that common goal. There are several examples: the International Geophysical Year, 1957-58; the World Climate Research Programme (since 1980); the European Centre for Nuclear Research (since 1954); the International Thermonuclear Experimental Reactor, and so forth (Blackstock and Ghosh, 2011).

Some research cannot be conducted nationally because the nature of the scientific inquiry requires research to be conducted at the international level (such as, measuring ocean acidity, carbon dioxide concentrations in the atmosphere, and the impact on monsoons and soil moisture) (Crutzen, 2006; Caldeira and Wood, 2008; Blackstock et al., 2009; MacCracken, 2009). There are also financial constraints for single countries. There are demands for being inclusive in the research process. There are political constraints about who contributes and who controls the research activity. And there are issues about public engagement in the research activity. Coordinating scientific experiments would entail difficult decisions; decisions about funding, building the capacity over time to conduct research, coordinating research institutions, reviewing the results, transparency with the general public, and outlining the areas of future research.

If we can *coordinate* over research, should we automatically *cooperate* over the governance of that research? Of course, in order to do so, first we need to identify the thresholds very clearly (Morgan and Ricke, 2010). Are we only restricted to laboratory studies, small scale experiments, medium to large scale field trials, or are we also talking only about deployment? I would argue that some form of governance arrangement would be needed at all stages but they would not be the same: no one size fits all.

The case for cooperation is slightly different from the case of coordination over a single scientific goal. The case of cooperation over governance arrangements derives from the fear of what anarchic governance arrangements might deliver. Again, we must refer back to the dichotomy that we identified earlier: states want to retain freedom for themselves but wish to constrain others. So, anarchy offers flexibility for one's own country and allows one to develop interests over time as the technologies evolve over time. But would new rules be sufficient to constrain powerful states, or would they simply lock in the weaker ones? In the literature, the demand for an international regime to promote cooperation derives from at least three conditions: lack of a framework to establish legal liability, positive transaction costs, and

imperfect information between parties (Keohane, 1983; also, Stein, 1982; Abbott and Snidal, 1998). While some of the literature seems to suggest that geoengineering (and specifically, SRM) *research is actually a benign problem* (Horton, 2011), merely a coordination problem, I argue that *SRM governance is actually malign problem*. It is a much more difficult issue to resolve because the case for cooperating over the governance of geoengineering is based very much on fact that we have imperfect information about geoengineering activities, their intent and their impact, and because we don't have a framework to establish legal liabilities over actions by states and non-state actors.

What governance options are available?

So, what are the governance options that are currently available? Schematically, when we are talking about the options for governance, we can do it in four ways: at the national level; we could adopt *ad hoc* rules and principles; we could adapt existing treaties; or we could create new treaties (Blackstock and Ghosh, 2011). All four options have benefits and demerits. The first three primarily allow you to retain more flexibility, greater sovereignty, and the speed with which governance arrangements emerge would be much quicker. But there are issues about whether there is an international level where disputes may be resolved. Who decides the rules by which these research activities would be governed? How would we draw in the public if we were to adopt only *ad hoc* principles? How would we deal with the overburdened agendas that already exist within existing treaties? And, therefore, there is a potential case for a new treaty, but then the demerit is that there is a time lag before governance arrangements would emerge. There is also probably a fatigue over negotiating more environment treaties, especially when the existing ones have not been delivering all that they were designed for.

Many existing treaties have some relevance to geoengineering governance. But there are challenges, such as whether the regimes have adequate governance capacity or whether challenges related to ethics of processes and outcomes are sufficiently addressed. The Convention on Long Range Transboundary Air Pollution (CLRTAP) has protocols regulating sulphur emissions but many emerging economies are not included in the Convention. The Montreal Protocol on Substances that Deplete the Ozone Layer is a successful regime but is applicable to geoengineering only if sulphate aerosols are found to be damaging ozone. The Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques (ENMOD) is essentially a dormant treaty and deals with the military applications rather than peaceful applications of potential geoengineering technologies. The International Maritime Organization (IMO) has the 1996 London Protocol on Assessment Framework for Ocean Fertilization. The question is whether the IMO Assembly can easily extend links to pollutants and greenhouse gases within its mandate to cover geoengineering research activities as well. The United Nations Environment Programme (UNEP) could extend

its mandate but at present it is unclear whether there is sufficient cohesion within its Environment Management Group to permit this. The UN Framework Convention on Climate Change (UNFCCC) has near universal membership, so it is inclusive. But it suffers from an overburdened agenda and slow progress in negotiations. Finally, the Convention on Biological Diversity (CBD), at the last Conference of the Parties in Nagoya in 2010, introduced a moratorium on climate-related geoengineering activities that may affect biodiversity, until there is adequate scientific basis to justify such activities. But this is a non-binding 'guidance' to the Parties and exempts small scale scientific experiments.

So, what we can conclude is that no single regime is available legally to govern SRM research. Some are potentially applicable to all geoengineering methods, some are applicable to a few specific methods, and some are applicable to the activities with which one engages in geoengineering research.

Which functions for what motivations?

In other words, we are concerned with not just the existing treaties but the nature of governance that we should expect to evolve over time and under what conditions would the governance arrangements change. For that, we need to develop a functional framework for assessing geoengineering governance, and what I propose here is to consider at least three essential governance functions: making decisions, monitoring actions, and resolving disputes (Abbott and Snidal, 2009; Ghosh, 2011; Ghosh, 2010; Ghosh and Woods, 2009; Chayes and Chayes, 1995). And I wish to map them along with the interest-based and ethical concerns that I discussed earlier (see table 1).

Let us take the governance function of making decisions. If a country wanted to retain flexibility so that it could engage in research activities and develop geoengineering technologies over time, it would prefer a limited scope of international governance. At the same time, it might want international governance to be restrictive for other countries if it feared their intentions, or feared that they might get a technological edge. Process legitimacy is determined in terms of how inclusive the process is versus the ease of decision-making in a small group setting, rather than having 192 countries on table. Outcome legitimacy depends on the voting rules that are adopted, whether consensus-based, equally weighted or capability-driven weights for voting.

Similarly, for monitoring actions, if a country wanted to retain flexibility, it would rely on self-reporting on geoengineering research activities. If it, instead, wanted to constrain others, it might insist on multilateral institutional reporting along with independent verification. On the ethical concerns, the review procedures would to be inclusive in process and the quality and timeliness of the reporting would have to be salient for the parties involved.

On resolving disputes, again to retain flexibility, a country might prefer decentralised, national-level adjudication for its own research activities but would prefer a centralised, multilateral system to constrain others. And on the ethical concerns, the question is with what ease could countries access such dispute settlement forums and with what effectiveness would they able to enforce the decisions that emerged?

Let me spend a few minutes exploring, very schematically, two potential scenarios as thought experiments. Case 1 is June 2012 (table 2), a year from now, and I deal with three countries. Country A is Annex I and it has both the capacity to and wants to undertake large scale geoengineering experiments. The predicted outcomes of such experiments are based only on existing computer models. Country B is a large Non-Annex I country, it has a few scientists working on geoengineering research, but it does not have a nationally funded large research programme. The computer models predict that rainfall patterns within Country B might be affected by large scale geoengineering experiments. Country C is a small island state, it has negligible scientific capacity, and predicted outcomes suggest negligible impact on its territory at present.

What do we get in terms of a governance arrangement? In this case, in terms of making decisions, both countries A and B might adopt *ad hoc* codes of conduct. At the same time, country B, the large Non-Annex I country would demand greater mitigation action in country A; it would not want to give a clean chit to country A regarding its mitigation commitments and responsibilities. Process legitimacy would be limited: there might be a small group process with A and B involved, but C might not be included or might choose not to be party to the discussions. Monitoring would largely depend on self-reporting but country B, which fears the impact on its territory, would want to verify the data and would demand an independent review. Since a multilateral review mechanism might not emerge within a year, the only assessments would be within the scientific community. The resolution of disputes would likely occur through country A's national jurisdiction. Country B, fearing the consequences, might seek international jurisdiction but there is currently no regime available to do so.

Let us look at one more case and I'll conclude. In this case, we are in year 2025; countries A, B and C remain same (table 3). Here, we suppose that country A has already undertaken experiments for a full decade and has a lot more information about the risks associated with geoengineering. Country B, frustrated by the lack of climate action in many Annex I countries, decides in the face of serious climate-related catastrophes that it wants to deploy an SRM technology. In country C the scientific capacity continues to remain negligible.

Here, we might expect more rules to have developed but enforcement would still be constrained. So, on the question of making decisions, we might expect that, over time, countries A and B have evolved some formal rules to govern geoengineering technologies. Process legitimacy

would be enforced through all parties being party to the discussions. The voting rules, like in many other treaties, could be based on consensus. Monitoring actions would depend on self-reporting plus independent monitoring of the facilities and research. All parties would insist on reviewing the results along with the scientific assessments that emerge from the research. Finally, on the resolution of disputes, country B (the country that is deploying a geoengineering technique) would insist on national jurisdictions. But we might also expect some sort of an international dispute resolution mechanism to develop. The only problem is that while country A could access such a multilateral mechanism, outcome legitimacy might still remain constrained. This is because small countries like C might not have the resources and legal capacity to use the mechanism, a lesson learned from the experience of several other international regimes. Moreover, we cannot know for sure if there would be any means to enforce any decisions against large countries, like A or B.

What I have basically proposed to you is that when we talk about changes in the governance of geoengineering over time, international cooperation is not a given. We need to consider the interest-based concerns that countries have, which are choices between retaining flexibility for oneself while constraining others, and at the same time we have to consider the balance of ethical concerns, both related to process and outcomes. The governance arrangements that emerge shift over time would vary in their effectiveness and legitimacy. It is hard to predict outcomes in advance. But it is worthwhile keeping these factors in mind as we engage in a difficult debate on governing geoengineering research and technologies.

I thank you very much for your time and attention!

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Table 1: Which functions for what motivations?				
	Interest-based concerns		**Ethical concerns**	
	Maintain flexibility	*Constrain others*	*Process legitimacy*	*Outcome legitimacy*
Making decisions	Scope of international governance limited	Scope of international governance broad	Inclusive process vs. Ease of decision-making in small groups	Equally weighted voting rules vs. Capability-driven voting
Monitoring actions	Self-reporting	Institutional reporting plus verification	Inclusiveness of review procedures	Quality and timeliness of reporting
Resolving disputes	Decentralised adjudication, including market instruments	Centralised adjudication plus centralised/ decentralised enforcement	Ease of access to dispute settlement forums	Ability to enforce decisions against powerful countries
Source: Author				

Table 2: 2012 – Limited international cooperation				
	Interest-based concerns		**Ethical concerns**	
	Maintain flexibility	*Constrain others*	*Process legitimacy*	*Outcome legitimacy*
Making decisions	A & B: ad hoc codes	B: demands mitigation action	A & B C not included	Consensus
Monitoring actions	Self-reporting	Verify data	No review	Scientific assessments
Resolving disputes	A's national jurisdiction	B seeks international jurisdiction but no regime available	No clear dispute resolution	Limited power to enforce, except reputation costs
Source: Author				

Table 3: 2025 – More rules but limited enforcement				
	Interest-based concerns		**Ethical concerns**	
	Maintain flexibility	*Constrain others*	*Process legitimacy*	*Outcome legitimacy*
Making decisions	Formal rules governing specific geoengineering techniques	Formal rules governing specific geoengineering techniques	All parties involved	Consensus
Monitoring actions	Self-reporting plus...	Independent monitoring facilities	All parties review results	Scientific assessments
Resolving disputes	B's national jurisdiction	Multilateral dispute resolution mechanism	A has access to multilateral dispute resolution mechanism	But limited means of enforcement
Source: Author				

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