Among the many proposals for solar radiation management (SRM) geoengineering, the most technically and politically feasible is probably the injection of sulfate aerosols into the stratosphere. This process would increase the albedo (reflectivity) of the atmosphere, preventing some solar radiation from reaching the surface and producing a cooler overall climate (Budyko 1974, also see reviews by NRC 1998 and Rasch et al. 2008). In this paper, we examine sulfate aerosol SRM that is initially restricted to the Arctic, under the assumption that policymakers will want to test sulfate aerosols regionally before deploying them globally (as in Keith, Parson, and Morgan 2010). The Arctic is the ideal test bed for experimenting with sulfate aerosols, since it has a relatively low population and a relatively high importance to global climate due to its rapid ice loss and the associated climactic feedback loops (Caldeira and Wood 2008). This paper will be devoted to exploring ethical and governance issues related to Arctic SRM geoengineering specifically, but our results should be easily generalizeable to other cases of SRM geoengineering, and to geoengineering in general.

The essential problem we examine is how to implement technically complex policies in a democratic manner. This problem derives from the inescapable tradeoff between democratic and technocratic governance (Jasanoff 1990). Democratic governance delegates governance decisions to the people or
their representatives. Most political theorists believe this system is the “fairest” way to make decisions that affect the entire society (where “fair” is nebulously defined, but the sense still generally understood). But there are several sorts of issues where democratic governance appears particularly vulnerable to poor decision-making: technically complex issues that the public does not understand, issues that materialize over time-scales longer than the accountability of public representatives, or issues with financial stakes large enough to incentivize significant corporate spending on lobbying or misinformation campaigns. Unfortunately, the issue of climate change meets all three of these criteria, and therefore democratic governance seems uniquely ill-suited for producing a solution. This failure of democratic governance has led to the recent interest in geoengineering as an alternative to the massive social commitment to sustainability apparently required for an ideal solution to climate change.

In contrast to democratic governance, discussions of geoengineering thus far have assumed it would be implemented in a technocratic manner (e.g. Asilomar 2010, Royal Society 2008, Keith, Parson, and Morgan 2010). Technocratic governance is governance by elites, generally understood to be a small group of experts who are believed to understand the technical or scientific complexities at issue better than the general public. Since at present only 3% of the public is familiar with the term (Leiserowitz 2010), any deployment of geoengineering in the near future would necessarily be decided and implemented by a council of experts and would therefore reflect technocratic governance. Technocracy appears attractive since it can lead to quick policy
action that bypasses the slow and cumbersome democratic process, and this is especially appealing when the democratic process appears to fail as with climate change. But technocracy also has important drawbacks, which we group into three categories.

The moral critique is related to the idea of political representation described above. Representative governance rests upon the idea that public policy ought to be consonant with and expressive of public values (however they are construed) in order to be legitimate. In problematic cases like climate change, it can be difficult to define a consensus of public values and difficult to apply that consensus to policy, which makes technocracy attractive. But it is critically important to understand that in a democratic society these battles about public values cannot be avoided. Technocratic governance ought to be a solution for implementing consensus policies; it is not appropriate in a democratic society to implement controversial policies in a technocratic way.

The emergence of a global anti-geoengineering movement underscores the importance of broadly accepted political legitimacy in geoengineering governance (e.g. “Hands Off Mother Earth”) (Hands Off Mother Earth 2010). Insufficient political legitimacy is a common source of failure for technocratic governance (as in the failed FDA regulation of nitrites and the failed EPA regulation of 2,4,5-T in the 1970s and 1980s; Jasanoff 1990), since it offers no mechanism for generating legitimacy if it encounters political or public opposition.

Finally, as currently conceived, the SRM geoengineering currently under consideration by scientific and political elites does not consider the sorts of
knowledge to be included in their governance model, even though scholars have noted that international programs tend to ignore local and indigenous knowledge unless specific care is taken to include them (Martello 2004). This knowledge provides an important complement to traditional scientific inquiry; for example, indigenous knowledge has been vital to coastal sea ice monitoring and understanding the effects of climate change on indigenous species such as caribou (Krupnik and Jolly 2002).

In response to the failings of both democratic and technocratic governance, a lot of attention has been given recently to the concept of deliberative democracy. The idea is to circumvent the logistical difficulties with generating and measuring public opinion on technically complex issues, while still confronting the representational and knowledge-based issues by taking a representative small subset of the population as a proxy for the whole. The composition of the subset and the nature of the deliberation may vary widely, but the goal is for the subset to reach a considered opinion that represents what the public values would be if the public had the time and resources available to reflect on their opinion.

There is a small but growing body of literature on the panoply of varieties of deliberative democracy. Rowe and Frewer (2005) have identified more than a hundred forms, including citizens’ juries (Coote and Lenagan 1997), consensus conferences (Guston 1999), deliberative polling (Fishkin and Luskin 1999), and focus groups (Rosener 1975). Most of these have only been tried in very small academic settings, or are not useful or relevant for geoengineering. Even the
best examples of deliberative democracy exist on much smaller scales than the Arctic, and indeed the application of deliberative democracy to geoengineering governance would represent by far the largest and most important example of deliberative democracy in history. That said, the governance issues surrounding geoengineering are sufficiently complex and the stakes are high enough that it is worthwhile to explore the potential of deliberative democracy in this realm. To do so, I will start by surveying some of the most successful applications of deliberative democracy to date and drawing from them lessons for geoengineering governance. Some of these case studies are drawn from a previous group project I participated in for the Government Accountability Office earlier this year.

**Deliberative polling: Success in China’s Zeguo township**

Policymakers in China’s Zeguo township introduced deliberative polling as a way to democratize local policy-making in the process of prioritizing infrastructure projects for the coming year. The projects, designed by local officials, included new bridges, roads, a school and city gardens. The process was a more formalized version of their tradition of holding *kentan* or ‘sincere heart-to-heart’ discussions where similar kinds of local issues were debated and discussed (Fishkin 2010). Deliberative polling asks participants to prioritize approximately a dozen infrastructure projects among the roughly 30 possible. The town’s leadership makes an explicit commitment to abide by the decisions of the polling, thus ensuring the implementation of those projects with the most votes. Zeguo’s
deliberative polling process has several additional features that distinguish it from its largely informal predecessor:

- Random sampling is employed to attempt to produce results that are representative of the population, while eschewing party influence and interest group pressure.

- Trained moderators ensure equal opportunities for to allow citizens to hear different points of view and become informed of the trade-offs to any given policy before expressing their preferences in confidential questionnaires.

- Government buy-in is achieved, demonstrated by the binding nature of the polling and implementation of the results of the deliberative poll.

The Zeguo example provides a compelling example of how policymakers can ascertain informed, representative, opinion. In the case of geoengineering in the Arctic, clearly there is no way to obtain the opinion or consent of such a large number of people. But by using a deliberative poll, it is possible to gain a sense of the temperature of opinion on an issue, while also ensuring that the opinion is informed and that the public has had a chance to consult, ask questions, and deliberate.

*Participatory budgeting: lessons from Porto Alegre*

Porto Alegre, Brazil has developed a deliberative democratic process known as participatory budgeting, in which municipal governments allow citizens to participate in budgetary processes. The process emerged from direct negotiations between government officials and civil society leaders, who sought
solutions to address the various health and welfare concerns affecting citizens (Torres et al. 2003). Public budgeting programs are year-long decision-making processes in which citizens negotiate among themselves and with government officials in organized meetings over the allocation of capital investment on public works projects such as health care clinics and schools. Citizens attend meetings during which they vote for public policies and elect delegates to represent the community to the local government.

This example is particularly interesting because it includes, and creates leadership from within, a low-income population (Torres et al. 2003). This provides a useful analogue to SRM deployment in the Arctic, where affected communities may lack access to education, and lack a history of political mobilization or issue articulation. Yet in the case of Porto Alegre, the technical complexity of various budget options was not a barrier to participation and leadership for people who lacked access.

The Porto Alegre public budgeting approach also secured government buy-in. By instituting a system dependent on civic engagement and informed participation, it shifted the power dynamic between the local government and the public, with the result that the public could hold the government accountable for its actions.

The World Bank commissioned the Porto Alegre case study (Torres et al. 2003) to determine the effectiveness of the participatory budgeting process. It found that among cities that implemented participatory budgeting, there was a noticeable improvement in the accessibility and quality of various public welfare
amenities. The participatory budgeting process was also popular; the number of participants rose from 1,000 in 1990 to 40,000 less than ten years later. Such a huge increase in public participation suggests that bottom-up governance is politically viable and practically feasible, even among low-income and/or uneducated populations. Technical complexity of the issues, lack of access, and poverty are not inherent barriers to participation and understanding of the issues that directly affect their communities.

Austria’s Neusiedler See-Seewinkel National Park

The deliberative process for establishing the Neusiedler See-Seewinkel National Park in Austria involved the cooperation of two national governments (Austria and Hungary) and required consensus among conflicting viewpoints (e.g., park use for agriculture versus tourism, hunting and fishing, and environmental protection). When an initial government proposal proved unsuccessful, policymakers adopted a more bottom-up approach to deliberation by allowing landowners (including indigenous people), community groups, and private businesses to communicate directly with policymakers through a park planning committee (Stringer et al. 2006). The park planning committee gave local citizens an opportunity to share their unique and profound expertise of the environment, and soil and climate change effects on the land under debate. This committee also encouraged negotiation between traditional opponents of the various scientific, economic, and social complexities at issue. Furthermore, small-scale landowners were encouraged to form interest groups and choose
representatives for direct involvement in the negotiation process (Stringer et al., 2006). These representatives ensured high-level stakeholders (Austrian and Hungarian national governments and environmental NGOs) considered the positions of local stakeholders in the final decision-making process. Thus, a process that began as an attempt by national governments to dictate public land use policies to local communities evolved to include deliberative democratic approaches that achieved consensus and developed a park reflecting local priorities.

Implementation of a deliberative democratic approach that includes stakeholder engagement in the Arctic would provide an infrastructure that recognizes the unique expertise of local and indigenous people and values them as legitimate stakeholders. Knowledge sharing between local stakeholders and those implementing geoengineering technologies potentially educates local communities about the risks and benefits they are most likely to face while providing a process through which consensus or consent can be reached. The unique expertise of indigenous people in the Arctic on how climate change truly affects their environment and utilization of this knowledge through stakeholder engagement can improve the comprehensive nature of drafting policies on SRM technology deployment and governance.

*Northern Canada’s Mackenzie Valley Resource Management Act (MVRMA)*

The MVRMA was enacted in 1999 to formalize land and water management procedures in the Mackenzie Valley region of Canada’s Northwest
Territories. The Act was designed explicitly to incorporate indigenous perspectives and to democratize the policy process as much as possible (Fitzpatrick et al. 2008). One of the first major issues to be reviewed under the MVRMA was the “Snap Lake Project”, a diamond mine to be constructed at the head of the Lockhart River. The MVRMA demanded an environmental assessment (EA) due to public concerns about “issues of sustainable development” (Fitzpatrick et al. 2008). Seventeen organizations asked to join in the EA, and all were accepted. The most successful feature of the EA was a ten-day series of “technical sessions” where interested members of the public or affiliated organization participated in third-party-moderated discussions with the mine developers and were able to present concerns and ask questions of them. There was a subsequent five-day public hearing as well before eventual approval of the mine. According to follow-up interviews (Fitzpatrick et al. 2008) all involved parties were generally satisfied with the process; the most significant suggestion for future EAs under the MVRMA was the inclusion of “participant funding” – public money guaranteed to anyone who wants to participate in the deliberative process, offered as an attempt to equalize the power relation between the (typically wealthy and powerful) developers and the (typically less wealthy) natives. As this form of deliberative democracy actually incorporates indigenous perspectives in the Arctic, it offers an excellent example for geoengineering governance, and we incorporate many of its features below.

Best Practices
We derive several “best practices” for SRM deployment in the Arctic from the above case studies:

1. Research into the ideal deliberative process for SRM in the Arctic should be funded by the same governments and institutions that currently fund sulfate aerosol SRM research. Funding for this research successfully occurred before (i.e. the 2004 National Nanotechnology Initiative) and could easily occur in this case.

2. The greatest possible diversity of participating populations should be included to properly represent the Arctic residents and achieve legitimacy among the indigenous people.

3. Existing social structures in the areas where deliberation occurs should be used for deliberation to maximize the efficacy of the process.

4. A deliberative process should be instituted that involves an open, two-way communication flow of knowledge without imposition of values on participants by powerful stakeholders.

These are very high-level objectives, and they obscure a number of important details. Some of these details are suggested in the case studies. For example, deliberative bodies can be chosen by random sample to ensure fairness, or they can be constructed to include a cross-section of all the important interest groups. Other important details include the frequency of meetings, the amount of power given to the deliberative groups, and the method of accountability for the people involved in the deliberation. A larger list of relevant choices can be found in Fung (2003) and Rowe and Frewer (2005).
Another helpful set of guidelines for instituting deliberative democracy comes from the framework of Wiklund (2005). Wiklund reviewed academic literature on deliberative democracy for environmental assessment, and developed four principles from discourse theory that he claims ought to be included in any successful democratization of environmental assessment. These principles are useful for geoengineering governance in general, since it can be thought of as environmental assessment writ large. The principles are:

**Generality**: “All those affected, or at least their interests, should be included”

**Autonomy**: “Everyone included should be granted the right of effective participation”

**Power Neutrality**: “Distortions related to administrative, economic, and cultural power must be neutralized to ensure that only the ‘forceless force of the better argument’ affects the outcome”

**Ideal Role-taking**: “Participants must adopt attitudes of reciprocity and impartiality”

The successful deliberative governance examples listed above generally obey these principles, although there are many extremely important issues hidden in the details. Zeguo’s deliberative polling uses random sampling to achieve generality, and as mentioned above we think a cross-section is probably better for the Arctic due to the number of different indigenous groups that ought to be considered. And the participatory budgeting in Porto Alegre depends on an informed and engaged citizenry, which is a stronger version of ideal role-taking.
than simply expecting reciprocity and impartiality – a vision that may be impossible to scale into a larger polity like the nations of the Arctic.

In environmental assessment situations, by far the most difficult to implement of Wiklund’s four principles is power neutrality. The MVRMA is somewhat successful, but as stated above they would need some sort of participant funding to truly neutralize power differentials. Power neutrality is also going to be especially important for geoengineering governance, since there is a particularly sharp difference in power between the various parties in the Arctic who would be affected by SRM geoengineering. In particular, America is likely to be pushing for SRM geoengineering, and (relatively powerless) indigenous peoples are likely to oppose it. In order to have genuine deliberative democracy over this issue, a mechanism to enforce power neutrality for the deliberations is essential.

This paper has two primary objectives. The foremost aim is to convince the reader of the value of deliberative democracy for geoengineering governance. Secondarily, this paper hopes to start a discussion of the nature of that governance by presenting case studies and broad principles from literature and from around the world. Applying deliberative democracy to geoengineering would represent the biggest implementations of deliberative democracy ever conceived, but SRM geoengineering represents one of the biggest scientific experiments ever considered and it is appropriate that the scale of the deliberation match the scale of the experiment.
References


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