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Section D. International Cooperation on Solar Radiation Modification Research

Summary

If the United States were to pursue SRM research, **it would be in our interest to engage in appropriate international cooperation.** International cooperation could promote, e.g., knowledge gains, a common international understanding of research needs and results, resource savings, socializing best practices (such as acting with full transparency), and reducing the prospect of irresponsible experimentation and/or deployment.

Cooperation could involve one or more areas of SRM-related research and could take various forms, ranging from modest (e.g., an exchange of experts) to extensive (e.g., a full-blown international consortium).

Potential cooperation partners could be engaged based on any number of criteria or perceived benefits, including countries with expertise, available funding, or capacity in a particular area; countries with limited opportunities or capacity in a certain area; and countries with access to particular ecosystems (e.g., the ocean or the Arctic).

Introduction

This section addresses various aspects of international cooperation on SRM research that could be considered by the U.S. Government. It does not address options for international cooperation regarding the more political function of decision-making on potential climate intervention deployment.

This section begins with reasons for potential cooperation (the "why") and proceeds to consider the subject matter of potential cooperation (the "what"), the forms of potential cooperation (the "how"), and the types of potential international partners (the "who"). It notes the desirability of conducting any international cooperation in this area with full transparency in order to model good behavior for others and to build confidence, particularly among those who might otherwise be suspicious of research activities.

Potential Benefits of International Cooperation

There are several reasons why the U.S. Government might consider partnering with other countries on one or more areas of SRM research.

In the broadest sense, were the United States to pursue a large-scale program of SRM research, it would presumably be in our affirmative interest to begin to build a common international understanding of research needs and results. Were there ever a need to seriously consider deploying climate intervention, whether proactively or reactively—or a need to respond to its deployment or imminent deployment by someone else—it would be desirable to have a shared empirical basis to inform thinking and promote evidence-based decision-making.

Further, developing a norm of cooperation and related transparency, as well as taking steps to socialize best practices for conducting research, could help reduce the prospect of irresponsible experimentation and/or deployment.

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More specific reasons could include, e.g.:

- The U. S. Government could gain knowledge—e.g., if another country's researchers were looking into the same problem or had capabilities unavailable within the United States.
- The U.S. Government could share knowledge with interested researchers/countries.
- Cooperation could accelerate results, which would be particularly important if the research had an urgent timeframe.
- Cooperation could result in cost savings, either because it involved a deliberate cost-sharing arrangement or because it promoted efficiency (e.g., in the case of avoiding redundancy or overlap).
- Cooperation with the United States could afford opportunities not otherwise available to researchers from other countries, particularly developing countries, including access to U.S. innovation hubs and facilities (e.g., national laboratories).
- Cooperation could help build and/or maintain relationships between researchers as well as countries. It could be particularly important to cooperate with developing countries.
- Cooperation could help promote a well-designed U.S. research program as a model for other countries.
- Cooperation could help reduce the stigma that might be associated with such research—i.e., that it can only be accomplished in service of the interests of more economically advanced countries.

Scope of Potential Cooperation

International cooperation might involve any one or more of the topics that may be identified as part of a U.S. Government research program (science, technologies, etc.).

With respect to any given topic(s), cooperation might relate to, e.g., the identification of needed research; the norms governing the conduct of research; the carrying out of research itself (e.g., observations, computer modeling, laboratory studies, field research, workshops); and/or the assessment of research results.

Cooperation on SRM could usefully involve an international assessment of scenarios and strategies and their associated consequences. For example, it might document and expand the scientific foundation for SRM scenarios and implementation strategies and provide a comprehensive analysis of their intended and unintended consequences for climate and the physical environment broadly. Such an assessment would support future research activities by identifying where knowledge and understanding seem sufficient and where significant gaps remain.

Cooperation would not need to be limited to SRM research per se, but could also include related research and assessment, e.g., fundamental atmospheric research that could improve overall climate modeling; comparative risk assessment (e.g., including the climate risks, such as tipping points, for which SRM might be a potential response); and climate intervention in the context of various climate risk management strategies.

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Potential Approaches to Cooperation

As with the reasons for cooperation and topics for cooperation, there are many options regarding "how" cooperation might be carried out.

In terms of the **type** of cooperation:

- At the more modest end of the spectrum, it could involve inviting foreign scientists into a U.S. research project (e.g., to enable access to high-performance computing capabilities for scientists from countries where they might otherwise not have such access), or having U.S. scientists join another country's research project.
- At the opposite end of the spectrum, it could entail a full blown, self-selected international consortium involving sustained collaboration on a wide range of research areas, as well as on associated modalities, e.g., cost sharing, data sharing, etc.

As elaborated below, another type of cooperation would involve the creation of an open international database that researchers would be encouraged to use to record their activities, data, and results.

In terms of the **forum** for cooperation:

- Bilateral cooperation would not generally raise the issue of creation of a forum.
- Multilateral cooperation might take place through an existing forum/process (e.g., the World Meteorological Organization's World Climate Research Program) or pursuant to a new arrangement(s) created for this purpose.

A one-size-fits-all approach would not be necessary, i.e., the "how" might differ depending upon the "what." The U.S. Government might pursue a modest form of cooperation with respect to one research question or type of research and a more extensive cooperative arrangement with respect to another. Alternatively, cooperation on the conduct of research might take place in numerous forms, while a single international forum might be tasked with the scientific/technological assessment of research.

Potential Partners

Potential cooperation partners might include, e.g.:

- countries with researchers already working on a topic of interest to the United States;
- countries with researchers having expertise in a particular research topic;
- countries with available funding;
- countries whose researchers have limited opportunities, e.g., certain developing countries;
- countries with frontline communities, particularly developing countries, who are most affected by the impacts of climate change (e.g., small islands, etc.) and/or the potential impacts of SRM;
- countries with particular industries relevant to conducting research;
- with respect to field research, countries with access to particular geographical features or ecosystems (e.g., the ocean or the Arctic region), dependent upon particular weather systems (e.g., monsoons), or geographically isolated (to isolate the effects of research); and/or

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- all countries, as would be the case if one or more issues—or an across-the-board assessment—were taken to a global forum.

In some cases, the U.S. Government might choose to put constraints on potential partners, such as limiting cooperation to, e.g., countries committed to strong mitigation action—lest it appear that research on SRM would somehow be at the expense of mitigation—and/or countries with a strong commitment to acting transparently.

Cooperation might also focus on climate intervention as a security-related response to extreme climate impacts. Of note is the May 14, 2022 G7 Foreign Ministers' Communiqué, which, in the context of "climate, peace and security," recognized that exceeding tipping points could lead to destabilization of different regions, further recognized the need for further scientific study, and underscored "the urgency for immediate and comprehensive scenario planning as a crucial element of a preventive and climate-sensitive foreign and security policy, as well as for building the capacity to respond to the outcomes of such events should they occur."[83]

Transparency

To the extent that the U.S. Government were to engage in SRM research, it would be important for such research to be as transparent as possible, whether carried out with international cooperation or not. Such transparency would include reporting of past, ongoing, and planned research activities as well as ensuring that all data, tools, and software used were available, accessible, and understandable to all.

Transparency related to international cooperation could be pursued through creation of an international database of research activities, data, and results, recognizing that there may be overlap between intervention-specific research and climate research more generally. Alternatively, such a database could be created by the United States, with the option to accept international submissions.

In either event, being fully transparent about such research activities could help encourage others to be transparent about their activities.

[83] G7 Foreign Ministers. (2022, 14 May). G7 Germany 2022 Foreign Ministers' Communiqué. https://www.g7germany.de/resource/blob/997532/2039866/59cf2327ee6c90999b069fca648a2833/2022-05-14-g7-foreign-ministers-communique-data.pdf?download=1

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Section E. Coordination of Federally Funded Research into Solar Radiation Modification

Any large-scale, multi-agency Federal research program into SRM would be coordinated by the U.S. Global Change Research Program (USGCRP). This coordination role is mandated by the Global Change Research Act of 1990 and would apply to all Federally funded research into SRM, whether performed domestically or internationally, and whether involving natural or social science work.

The Federal government conducts or funds limited research into SRM. Congress has directed NOAA to fund SRM research as part of its Earth's Radiation Budget Program for the last several years. This supports several observational and modeling activities in NOAA, NASA, and with partner organizations (e.g., the University Corporation for Atmospheric Research, NOAA Cooperative Institutes, and academia). NOAA and NASA are cooperating on sampling the lower stratospheric aerosol layer in the Stratospheric Aerosol processes, Budget and Radiative Effects (SABRE) mission using the NASA WB-57 high-altitude research aircraft. NOAA and DOE co-organized a workshop in Fiscal Year 2022 to evaluate the research needs that can inform SRM.

Indirect funding of SRM research is distributed across the Federal Government's research enterprise through establishing and supporting capabilities needed to "model, analyze, observe, and monitor atmospheric composition,"[84] and "climate impacts and the Earth's radiation budget."[85]

These capabilities range from satellite observations to laboratory experiments, to modeling, to data management and reporting.

The Global Change Research Act of 1990 established USGCRP to "provide for development and coordination of a comprehensive and integrated United States research program which will assist the Nation and the world to understand, assess, predict, and respond to human-induced and natural processes of global change." USGCRP is an active organization with broad representation across the Federal global change research agencies, some of whom are already conducting basic research relevant to understanding important processes linked to SRM. The mandate, capabilities, and scope needed to coordinate Federal research in SRM exist within the USGCRP. Therefore, USGCRP is the best-suited entity to lead any needed coordination of Federally funded SRM research.

Of particular interest in research coordination will be the needed investments in social sciences, and the coordination/integration of that research with the natural sciences. The USGCRP 2022–2031 Strategic Plan suggests this approach by stating that the Program will coordinate research into "how human systems may respond to and be affected by alternative adaptation, mitigation, and intervention actions."[86]

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[84] From the Congressional language mandating this report: https://docs.house.gov/billsthisweek/20220307/BILLS-117RCP35-JES-DIVISION-B.pdf

[85] Ibid.

[86] USGCRP. (2022). *The U.S. Global Change Research Program 2022–2031 Strategic Plan*. U.S. Global Change Research Program, Washington, DC, USA. https://www.doi.org/10.7930/usgcrp-2022-2031-strategic-plan

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In addition to USGCRP, other interagency coordination bodies would be relevant. The U.S. Group on Earth Observations (USGEO), the National Science and Technology Council (NSTC) Subcommittee on Ocean Science and Technology (SOST), and the Interagency Council for Advancing Meteorological Services (ICAMS) have strong connections to relevant natural science research work in the relevant agencies but have traditionally focused less on social science research. Other socioeconomic research forums do exist. For example, engagement with the Climate Security Advisory Council (CSAC) provides connections to the national security community, which would likely be important to provide insight into the potential for international outcomes of specific SRM scenarios.