Solar Radiation Management and the Sustainable Development Goals

Holly Buck, Ph.D. / Summer/Autumn 2020
What this talk will cover

1. Possible implications of Solar Radiation Management (SRM) for the SDGs
2. Research gaps in understanding those implications
3. Governance needs for avoiding risks to the SDGs
Which of these have been studied with regards to SRM — beyond just speculation?
Metrics that are used as proxies for understanding the impacts of SRM

Temperature
Precipitation

Figure 1. Results of a literature survey of climate engineering studies investigating solar radiation management (SRM, yellow), terrestrial carbon dioxide removal (CDR, green) and marine CDR (blue). Studies that investigate various methods are shown in gray. The size of each circle refers to the number of studies that used the respective indicator (ranging from 3 for sea level to 64 for surface air temperature), colors indicate the relative proportion of the studies referring to the specific classes of CE method(s). Indicators are located approximately in the physical space they refer to.
SRM and food security (SDG2)

- Studies on crops have to examine many things, including CO2 fertilization effect, precipitation changes, and the effect of changes in available sunlight.

Fig. 4: Partial and total effects of SRM on yields.

From: Estimating global agricultural effects of geoengineering using volcanic eruptions

Jonathan Proctor, Solomon Hsiang, Jennifer Burney, Marshall Burke & Wolfram Schlenker

Nature 560, 483–488 (2018) | Cite this article
SRM and health (SDG 3)

- Increased UV exposure would increase mortality, but reduced ozone exposure decreases mortality.
SRM and health (SDG 3)

• Relief from heat stress?
• Impacts on mosquito-borne illness?
• Changes in monsoons affecting cholera, bacterial meningitis, other disease?

Climate engineering needs a clean bill of health

Colin J. Carlson & Christopher H. Trisos

*Nature Climate Change* 8, 843–845(2018) | Cite this article
SRM and water availability (SDG 6)

- Precipitation changes under SRM are not linear
- Changes in precipitation and evaporation could be the best measures for water availability
- Changes to plants under high CO2 concentrations matter for understanding changes in the water cycle and water stress
- Very large research gaps in terms of understanding the hydrological response to SRM
**SRM and clean energy (SDG 7)**

- Small reductions in concentrated solar power output; less impact on photovoltaics as they can use diffuse radiation
- Impacts on hydroelectric, others?
- Mitigation deterrence dynamic?
SRM and climate action (SDG 13)

Reynolds et al., 2018) Ref 770. The literature shows low agreement on whether SRM research and deployment may lead policy-makers to reduce mitigation efforts and thus imply a moral hazard (Linnér and Wibeck, 2015) Ref 771. SRM might motivate individuals (as opposed to policymakers) to reduce their GHG emissions, but even a subtle difference in the articulation of information about SRM can influence subsequent judgements of favourability (Merk et al., 2016) Ref 772. The argument that SRM research increases the likelihood of deployment (the ‘slippery slope’ argument), is also made (Quaas et al., 2017) Ref 773, but some also found an opposite effect (Bellamy and Healey, 2018) Ref 774.
SRM and life below water (SDG 14)

• SRM may be able to mitigate heat stress in reef ecosystems
• Ocean acidification continues

Coral bleaching under unconventional scenarios of climate warming and ocean acidification

Lester Kwiatkowski, Peter Cox, Paul R. Halloran, Peter J. Mumby & Andy J. Wiltshire

Nature Climate Change 5, 777–781(2015) | Cite this article
SRM and life on land (SDG 15)

• SRM could be dangerous for biodiversity if suddenly stopped
• Could SRM help species who have nowhere to go or can’t move fast enough? We don’t know
SRM and peace, justice and strong institutions (SDG 16)

- Lots of speculation about whether SRM could be weaponized or cause a “climate war”
- No research on whether it might support peace / reduce conflict as compared to a world with climate change
- IPCC SR 1.5: “There is robust evidence but medium agreement for unilateral action potentially becoming a serious SRM governance issue (Weitzman, 2015; Rabitz, 2016), as some argue that enhanced collaboration might emerge around SRM (Horton, 2011).”
Takeaway: The research is extremely preliminary and almost everything could be considered a “research gap”

D. Sustainable development and SRM

There are few studies investigating potential implications of SRM for sustainable development. These are based on a limited number of scenarios and hypothetical considerations, mainly referring to benefits from lower temperatures (Irvine et al., 2011; Nicholson, 2013; Anshelm and Hansson, 2014; Harding and Moreno-Cruz, 2016). Other studies suggest negative impacts from SRM implementation concerning issues related to regional disparities (Heyen et al., 2015), equity (Buck, 2012), fisheries, ecosystems, agriculture, and termination effects (Robock, 2012; Morrow, 2014; Wong, 2014). If SRM is initiated by the richer nations, there might be issues with local agency, and possibly worsening conditions for those suffering most under climate change (Buck et al., 2014). In addition, ethical issues related to testing SRM have been raised (e.g., Lenferna et al., 2017). Overall, there is high agreement that SRM would affect many development issues but limited evidence on the degree of influence, and how it manifests itself across regions and different levels of society.
Local scientific research is critical to understand what modeling results mean to communities on the ground

Why is the West African summer monsoon important for people living there?

The West African monsoon is a wind system that blows over West Africa every year, usually from May to August. As the African continent wars up, it draws in moisture-laden air from the Gulf of Guinea, leading to the heavy monsoon rains. West Africa is highly dependent on rainfall, particularly because agricultural production is virtually rain-fed. But other economic sectors depend on it too, such as hydroelectric power generation. Monsoon rains are therefore crucial for the region’s economy.

Many of SRM’s implications for the SDGs relate to factors beyond SRM use

The implications for the SDGs also have to do with the wider climate policy and development context

- Would SRM affect men and women differently?
- Would SRM lead to more or less inequality compared to non-SRM worlds?
- Could a world with SRM produce more food, but still have less access to food?
- Some of this is unknowable — it highlights that deploying SRM is just one determinant of the climate and development future.
Governance needs in avoiding risks to the SDGs

Existing bodies have some scope for looking at interactions between SRM and particular SDGs, but none is comprehensive

- Convention on Biological Diversity
- Vienna Convention / Montreal Protocol on Substances that Deplete the Ozone Layer
- Convention on Long-Range Transboundary Air Pollution
- UN Convention on the Law of the Sea
Governance needs in avoiding risks to the SDGs

Early stage: governance of research

- Research and assessment that includes the SDGs
- Coordination of existing institutions
Governance needs in avoiding risks to the SDGs

Mid-term

- Governance that addresses questions of compensation, insurance
- Procedural mechanism for inclusive decision-making
- High-level commission modeled on World Commission on Environment and Development?

<table>
<thead>
<tr>
<th>TABLE 1: Relationship between Governance Objectives and Recommendations</th>
<th>OBJECTIVE</th>
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<tbody>
<tr>
<td>Create politically legitimate deliberative bodies</td>
<td>I II III IV</td>
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<tr>
<td>Establish a World Commission on SRM</td>
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<tr>
<td>Establish a Global Forum for Stakeholder Dialogue</td>
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<td>Strengthen cooperation between international organizations</td>
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<td>Assess and improve capacities for regional coordination and conflict resolution</td>
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<td>Continue ongoing assessment role for IPCC and related processes</td>
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<tr>
<td>Develop foresight capabilities</td>
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<tr>
<td>Leverage existing institutions</td>
<td>I II III IV</td>
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<td>Report on SRM research and development activities in the global stocktake under the Paris Agreement</td>
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<td>Institutionalize codes of conduct for responsible SRM research</td>
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<td>Ensure that ongoing research includes international and interdisciplinary collaboration</td>
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<td>Clarify funding streams</td>
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<td>Develop a publicly accessible clearinghouse</td>
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<tr>
<td>Make research transparent and accountable</td>
<td>I II III IV</td>
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<tr>
<td>Develop best practices for risk and impact assessments</td>
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</tbody>
</table>

Each recommendation serves at least one of the four objectives of SRM governance (p.17): I. Keep mitigation and adaptation first. II. Thoroughly and transparently evaluate risk, benefits, and burdens. III. Enable responsible knowledge creation. IV. Ensure robust governance before deployment. Dark shapes (●) indicate a strong connection between a recommendation and an objective. Light shapes (●) indicate a weak connection. Empty cells indicate little or no connection.