A response to Wil Burns: Common Misunderstandings About SRM Geoengineering

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WE WELCOMED the response[1] of Wil Burns to our recent article, "Five solar geoengineering tropes that have outstayed their welcome."[2] In our article, we cited five common but inaccurate claims about SRM. Burns responded to three of our rebuttals, concluding that our article "doesn't wholly dispel many of the concerns outlined in the piece." Ultimately, in his comments we have not found anything that refutes what we wrote. We remain convinced that the claims that we cited are unsupported by existing evidence, unlikely to occur, or greatly exaggerated.

Claim: Once started, SRM Cannot Be Stopped

We cited the claim that "Once started, SRM cannot be stopped," and provided three ways in which SRM could be started and then stopped without incurring termination shock:

A) SRM that has been deployed to a low level could be stopped suddenly without termination shock.

B) Even if deployed to a high level, SRM could be slowly ramped down and phased out, again without termination shock.

C) SRM deployment could be reduced and stopped if negative emissions were deployed to reduce CO_2 concentrations.

Any one of these examples on its own would demonstrate the claim "once you start SRM you can't stop it" to be false. Therefore, Burns would need to rebut all three to resurrect the claim. However, he did not demonstrate that any of these examples is wrong. Instead, Burns expressed his assessment of the likelihood of certain scenarios related to two of our three examples. The fact remains that, despite common claims otherwise, once SRM has been started there are multiple feasible ways to stop it without incurring termination shock, as outlined in our piece. Burns's perception of the probability of certain deployment scenarios does not constitute evidence to counter that.

Claim: SRM is a right-wing project

We cited the claim that "SRM is a right-wing project" and countered it with examples in which those on the political right oppose or mock SRM, and those on the political left support its research. We could have provided many more examples, had space allowed. Burns sought to counter us, not by providing countervailing arguments and evidence, but by

[1] Wil Burns, "Commentary: A Response to "Five Solar Geoengineering Tropes That Have Outstayed Their Welcome" at http://ceassessment.org/commentary-a-response-to-five-solar-geoengineering-tropes-that-have-outstayed-their-welcome-wil-burns/

[2] Jesse L. Reynolds, Andy Parker, and Peter Irvine, "Five solar geoengineering tropes that have outstayed their welcome," *Earth's Future* (accepted and forthcoming) at http://onlinelibrary.wiley.com/doi/10.1002/2016EF000416/full

asserting that it is important to scrutinize "the motivations and interests of actors in the climate geoengineering community to ensure objectivity", and by outlining concerns about intellectual property claims around both SRM and negative emission technologies. We agree with some of these concerns. (In fact, one of us is the primary author of a recent law review article on the role of intellectual property in SRM, in which we address many of these points.)[3] However, nothing that Burns wrote refutes our rebuttal of the common false claim. Indeed, Burns stated that he "concur[s] that this argument [that SRM is a right wing project] lacks support", which we interpret as support for our position.

Claim: SRM would disrupt monsoon precipitation

We cite the claim that "Modeling studies indicate that SRM would disrupt monsoon precipitation," and counter this claim two ways. We demonstrate that modeling evidence strongly indicates that monsoon disruption it is not inevitable. Instead, it would be a predictable consequence only of certain (arguably extreme and ill-advised) deployment scenarios. We also show that a focus upon precipitation impacts (rather than total system moisture) may be misleading. Burns challenges our position through two arguments.

First, Burns asserts that there is nothing to guarantee that humanity would not deploy SRM to such a high level that it strongly reduced monsoon precipitation. This argument is correct but not relevant. Of course, excessive SRM implementation is possible. We think there are some good reasons to believe humanity would not deploy SRM to such levels, but for the issue at hand, this is academic. Burns' faith (or lack thereof) in humanity's ability to deploy SRM at a prudent level does not provide support for the claim that modeling studies indicate that SRM would disrupt monsoon precipitation. To summarize the evidence behind this, modeling studies find a net reduction in monsoon precipitation in India and West Africa only if SRM were to fully offset the warming effects of elevated greenhouse gas (GHG) concentrations. The same studies show that the disruptive effects of global warming on monsoon precipitation (i.e. an increase in most regions) would be more-or-less cancelled out if SRM were deployed to halve this warming effect. Deployment of SRM to a level that caused monsoon disruption would therefore be a choice, and it's one that humanity might conceivably make. But to reiterate, the claim that modeling studies indicate that SRM would disrupt monsoon precipitation, at least on this count, is false.

For his second argument, Burns cites studies that show disruption to rainfall and river runoff following global cooling caused by large volcanic eruptions. On this, we are grateful for Burns' intervention, because it highlights a common but crucial misunderstanding of the science of SRM, and gives us more space to work through it than we had in our *Earth's Future* paper.

Burns is correct that studies such as Trenberth & Dai and Hegerl & Solomon found that the eruption of Mount Pinatubo reduced rainfall and river flow. However, a *sudden* pulse of some cooling (e.g. from a volcanic eruption) and *continuous* cooling (e.g. from stratospheric aerosol SRM) have very different climate responses, as other authors

[3] Jesse L. Reynolds, Jorge L. Contreras, and Joshua D. Sarnoff, "Solar climate engineering and intellectual property: Toward a research commons, "*Minnesota Journal of Law, Science & Technology* (accepted and forthcoming) at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2753833

have noted before.[4] This is because land warms and cools more rapidly than the ocean. This difference between the heating rates of the land and the ocean is what produces the monsoon circulation: bringing moist air to the relatively warm continents in summer, and moving cool, dry air from the continents to the relatively warm oceans in the winter. A *sudden* cooling -- such as that of a volcano -- reduces the land temperature much more than the ocean temperature in the short term, and therefore suppresses the monsoon circulation. A slow ramp-up of the cooling would not produce this large, transient land-sea temperature difference. This means that unless humanity chose to suddenly implement large SRM cooling, the monsoon-suppressing effect observed after volcanoes would be avoided. Thus, the volcanic analogue is an unreliable guide, and does nothing to defend the claim that modeling studies indicate that SRM would disrupt monsoon precipitation.

One may argue that a tweak to the claim would render it accurate: "Modeling studies indicate that SRM *could* disrupt monsoon precipitation". This would indeed be accurate. However, it would still be misleading, as many policies that are reasonable and useful in moderation could be harmful if deployed to an extreme.

[4] See, for example: Alan Robock et al. "Studying geoengineering with natural and anthropogenic analogs." *Climatic Change* 121 (2013): 445-458.