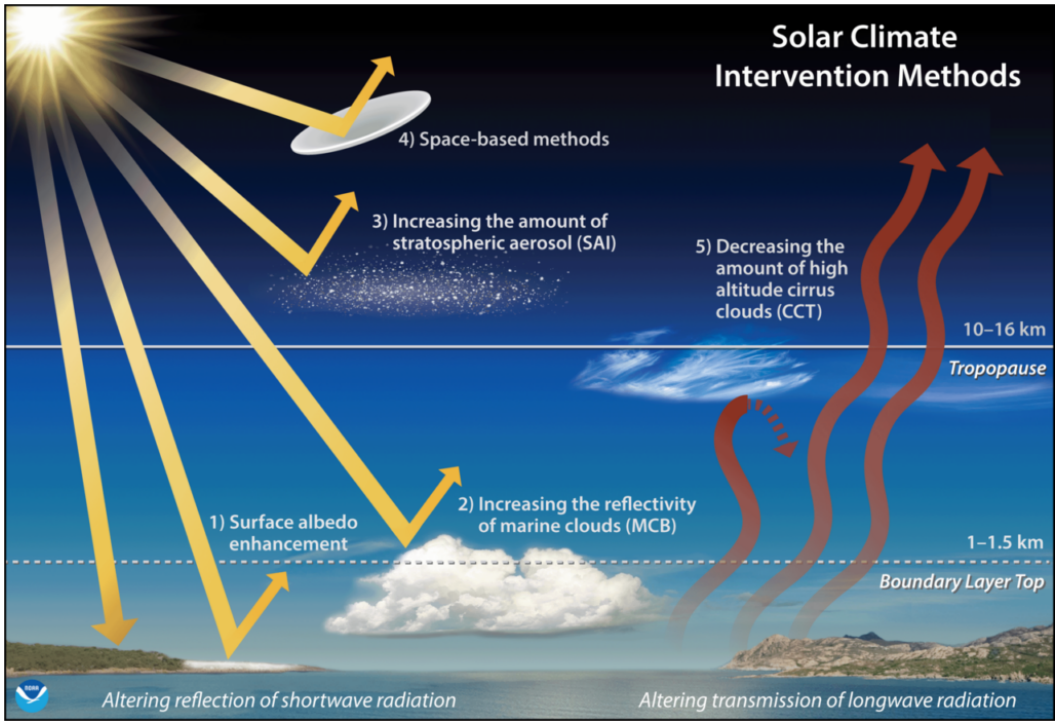
As we wrote in part 1, a Swiss-led proposal to the UN Environment Assembly (UNEA) to establish an expert group on solar radiation management (SRM) proved divisive and was eventually withdrawn. Here we explore why, and what that means for any global conversation about SRM.

SRM has long generated concerns that, as a powerful lever on the Earth system, it could have unwanted side-effects and generate political and ethical risks, as well as lowering temperatures. But rules and norms about such technologies are patchy, and recent unauthorized experiments have set alarm bells ringing.



Different forms of Solar Geoengineering (NOAA/CIRES)

With good will on all sides, a UNEA resolution might have been a step towards a genuinely global assessment process, respecting a wide range of knowledge types and facilitating well governed research that would help everyone understand the issues at stake. But it wasn't to be.

Business as usual?

At one level, the failure was business as usual. As in 2019, when the Swiss brought forward a similar draft, the proposals this year were dramatically watered down over a series of negotiations. Eventually they got pared back to merely exploring options for setting up a

'repository' for voluntary collation of already existing scientific information.

But even this failed to find agreement. The visibly crestfallen Swiss withdrew the resolution, muttering words like 'disappointing', 'starting-point', and 'worthwhile'. Perhaps it was – worthwhile, that is – this time around, because we got some clarity on at least five fronts.

What counts as 'knowledge'?

Firstly, there were deep divides about what sorts of knowledge are valid, and whether, how and by whom new knowledge might be generated, despite almost everyone at UNEA-6 wanting to learn more, and at least see more equitable access to knowledge.

Both this round and the last, the US – and Saudi Arabia – resisted efforts to widen the types of knowledge with which SRM be evaluated. The US insisted on 'science first' as a way to avoid 'prejudging' SRM. But for others this was already prejudging the kinds of knowledge that would be relevant, and as presuming that SRM would be desirable as long as 'the science' deemed it so.

Unfortunately, 'scientific' knowledge on SRM is often equated with a body of results from climate model simulations of interventions. SRM seems to reduce overall climate risks when experimentally deployed in simulated future worlds. But such simulations exclude thornier environmental, practical and (geo)political issues that would make geoengineering much messier and less optimal in reality than it appears in 'model-land'.

Many developing countries wanted to include social, legal, ethical, human rights, geopolitical and security dimensions – and governance – in the remit of the 'repository' (or any assessment process). The US argued that anything other than strictly scientific content would be 'premature'. Implicit in this position was a sense of primacy of the natural sciences – and knowledge about biophysical climatic effects – over the social and political sciences. From this perspective, knowledge generated by the humanities and law, let alone from indigenous ways of knowing, is not even on the radar.

Location, location, location

Secondly, this hierarchy of knowledge was a major reason why the location was contentious. In 2019 the US argued that any assessment should be located in the IPCC and not UNEP. The IPCC has a narrower scientific remit and culture than UNEP, which is cherished by developing countries especially for its broader approach to sustainability and development

and its information services to less well-endowed countries.

In 2024 the US argued something remarkably similar. This time the preferred venue for any information collation or assessment was the recently announced scientific 'lighthouse' process of the World Climate Research Programme (WCRP). Few details yet exist of the WCRP lighthouse activity on climate intervention, but the co-chairs are both scientific modelers, and the WCRP defines its vision as 'A world that uses sound, relevant, and timely *climate science* to ensure a more resilient present and sustainable future' (emphasis added).

SRM's multipolar moment

Thirdly, the SRM cast has changed, even if much of the script was familiar. In 2019 it was largely the US (and the Saudis) facing off against the EU (who had a radical flank in Bolivia). In 2024 many more developing nations came prepared to intervene and African countries led the charge. Climate vulnerable states including Vanuatu and Pakistan, and others concerned about unauthorized experimentation, also got involved.

Whilst wanting to improve access to information about the risks SRM might involve, Africa, and indeed most developing country participants, also wanted to avoid legitimating new research, experimentation and unchecked development of the technologies.

Between the US and African positions, the EU found itself somewhat 'stuck in the middle' with the Swiss proponents. No longer the main counter-weight, the EU took up an 'honest broker' role. But it followed a somewhat uni-polar playbook of seeking pragmatic compromises around a US center of diplomatic gravity, one that may no longer exist as it once did.

What we saw In Nairobi instead was a microcosm of an increasingly multi-polar – that is, decentered and pluralistically led – international order, where middle income and smaller states are better coordinated and demanded equal recognition. As one delegate put it, the divisions also reflected different 'world-views' – something to which 'every country has a right', not just the West.

Who's afraid of the big bad governance?

Fourth, not everyone currently wants governance. Under a Biden White House which has made emissions reductions a priority at home, and produced a report on SRM research only under congressional pressure, US intransigence on SRM governance might seem strange.

But if a multi-polar order is emerging, international relations theory suggests that 'great powers' will seek to maintain their freedom of maneuver.

The US routinely exempts itself from international legal commitments and restrictive norms, from the Treaty of Versailles to the International Criminal Court. Its positions at UNEA have followed this tradition. 'Sequencing' was now the preferred term: no governance – or member state views – before science has spoken (the IPCC assessment apparently wasn't enough). Another delegate suggested to us that the US sees itself as having a technological lead in this area – which it might keep by limiting the sorts of information shared. At any rate, avoiding steps towards regulation would leave them free to develop norms and policy on SRM as they see fit.

Did other major powers show signs of following suit?

Russia supported the US in deleting text that might have implied freedom of access to geopolitical and security assessments of SRM. Neither Russia, China nor India actively supported reference to 'non-use' or condemnation of unauthorized experiments. India though was much more supportive of the original Swiss knowledge gathering proposals than the US, while China and Russia largely held fire.

Less powerful states, on the other hand, generally supported processes and fora that could lead towards governance to restrict research, or especially development, of such technologies in risky ways. A resolution focused only on science, that neither moved towards discussion of governance, nor clearly stated a precautionary position regarding risks, would have been of little worth to them. It might also have been interpreted as undermining previous decisions in other Multilateral Environmental Agreements.

SRM – a minority interest?

Fifth, SRM really is quite unpopular in global terms. Virtually every country involved expressed concerns and seemed to view deployment of SRM as illegitimate. No-one wants to develop material SRM infrastructure yet, as far as we know. Text recognizing the African leaders' call for 'non-use of solar radiation management' was (re)introduced in every draft where the text was negotiated. Looking ahead, a moratorium on development and deployment might actually enable careful research and knowledge exchange by reducing the risk of a rush to deployment.

Many delegations explicitly rejected a risk-benefit approach to assessment in favor of a precautionary orientation with emphasis on *known risks* over *uncertain benefits*. It seems

many understand that the benefits of SRM seen in models are in no way guaranteed to arise in real world applications, given the extent of environmental, technical, economic, social and political uncertainties.

Most strikingly, some of the countries most vulnerable to climate change – including Pakistan and Fiji – presented positions vehemently opposed to the very idea of SRM and were most outspoken in highlighting that they saw many more, and more serious risks than benefits.

Presuming that such skeptical views are ill-formed opinions, or ones that will be changed simply by more science or information, seems foolish – not least given the fraught history of climate debate. Furthermore, anyone claiming a mandate to research or develop SRM based on arguments of a moral duty to the global poor and vulnerable, would need to explain why the representatives of many of those states have either rejected SRM or stood hard on the demand for it be treated with strong precaution.

What of precaution?

Despite apparent consensus around non-deployment any time soon, and no obvious appetite for development as opposed to research, no deal was reached. In 2019 those wishing to see further assessment of geoengineering pinned the collapse on EU demands for precaution and the combination of carbon dioxide removal (CDR) and SRM in the same resolution. In 2024 CDR was not included, and reference to precaution was perhaps more widely seen as 'constructively ambiguous' – as was noted in an early intervention – not a matter for interminable debate.

But understandings of 'precaution' still mattered. Those wanting language about 'potential risks and benefits' implicitly interpreted precaution as referring to the climate threat; while those favoring reference to 'negative impacts' or 'risks and concerns' were clearly applying precaution to SRM itself. The latter view was most strongly expressed in a proposal to change all references to 'potential risks' of solar geoengineering to 'unacceptable risks'.

Where next?

Regardless of UNEA-6's latest non-decision, research continues to be funded in more developed nations (e.g. US, UK) and at small scale in some developing countries through the Degrees Initiative. Private sector attention is growing – with start-ups in the US and Israel ('Stardust Solutions'), (at least) seeking to commercialize SRM. A practical application of precautionary governance seems increasingly urgent.

Most states want to know more – especially about the risks. African, Latin American and South American countries consistently emphasized both 'gaps' in knowledge and the dominance of Northern knowledge. Many saw some form of repository as a way to improve access to information on SRM and favored some version of a synthesis of existing knowledge – although in both cases the details were contested.

Will we learn?

Perhaps if the African leaders' call last year for a non-use mechanism had been acknowledged at UNEA-6 alongside other existing intergovernmental statements and decisions, and if a broader range of knowledges had been admitted into the repository alongside well governed and fairly distributed research, a deal might have landed, despite US and Saudi concerns.

Signalling clearly that deployment is off limits for now, and extending precautionary governance to research, to minimize risks of a 'slippery slope' to deployment, could help assuage concerns that are driving demands to focus on gathering and sharing only *existing* information. A better regulated space could also help ensure wider involvement in research. Brazil's early call for funding for research capacity-building found support from several developing countries, but was later opposed by both the US and the African group, for different reasons. Allaying fears of a research free-for-all could be paired with resources for developing countries to undertake research according to their own needs and objectives. Without that developing countries will continue to struggle to understand the broad range of risks – or potential benefits – associated with SRM in context.

A cloudy future?

As it is, the 'Make Sunsets' and 'Stardust Solutions' of this world, driven by commercial incentives, can continue to develop – and experiment. A new US administration may prove less committed to mitigation, and less reticent about SRM research. And if research and development continue without effective governance, the risk that SRM might distract from accelerated mitigation will inevitably grow. The US delegation advocated wording reaffirming the Paris goals, but offered no practical plan for how to avoid SRM playing into the hands of political and commercial interests that have much to lose from the rapid decarbonization required.[1]

As the dust settles on UNEA-6, we are left without intergovernmental knowledge sharing and research governance and coordination. A research-race may well escalate among leading states, while others are left to their own devices to navigate the scientific, political,

ethical and democratic challenges that SRM poses.

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[1] One Major Group delegate suggested to us that a possible model for curtailing such risks might be to first commit to the Fossil Fuel Non-Proliferation proposal.

[The text above was lightly edited on Mach 10th to correct some typographical errors]