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## The expanding roles of Global South countries in solar radiation modification diplomacy: indicators, cases, and equitable pathways forward

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Supplementary material for this article is available [online](#)

### Abstract

Global South countries are increasingly engaging in diplomacy surrounding solar radiation modification (SRM). However, few attempts have been made to document this expanded activity, and none assess its broader significance. In this article, we analyze the last decade of SRM activities in the Global South. We use the vision of anticipatory diplomacy, which calls for proactive efforts to anticipate and govern future scientific developments, to evaluate how well this recent activity is positioning Global South countries to lead on SRM research and decision-making. Through this lens, we identify 6 indicators of increased engagement: (1) expansion of research funding, (2) growing involvement in science and policy leadership, (3) growing involvement in public-facing discussion and debate, (4) the creation of new regional networks, (5) growing NGO-led efforts, and (6) an increase in government statements. We further analyze four case studies that illustrate different ways actors in the Global South are engaging across diplomatic venues that could facilitate anticipatory diplomacy on SRM. Together, these insights challenge existing narratives and framings of SRM politics and diplomacy premised on either a North-South divide, or a monolithic or uninvolved Global South. We take a first step towards reconstructing a novel narrative of SRM politics premised on recognition of growing expertise across the Global South and the multiple and increasingly diverse and influential roles and positions Southern countries are taking on. To deepen this engagement we underscore three recommendations, rooted in principles of anticipatory diplomacy: (1) expand funding for Global South research; (2) ensure regional expertise informs decision-making; and (3) strengthen North-South and South-South collaborations.

## 1. Introduction

Climate vulnerable countries in the Global South have the most at stake in decisions about solar radiation modification (SRM), but the field has long observed that most research, discussion, and governance activity is concentrated in the Global North (e.g. Preston and Carr 2018, Hourdequin 2019,

Biermann and Möller 2019, Sugiyama *et al* 2020, Dove *et al* 2024, Quagraine *et al* 2025a)<sup>7</sup>. In this paper we demonstrate that Global South participation in SRM research and politics has accelerated within the past decade, and for the first time we document this expanded activity and analyze its significance in global SRM politics. In so doing we challenge existing narratives of SRM politics that treat the Global South as monolithic and lacking involvement, influence, or agency. In contrast, we reconceptualize Global South participation and leadership in SRM research and politics as growing and varied, albeit uneven and still constrained by well-documented disparities in, for example, research funding. Additionally, we challenge existing narratives that conceptualize SRM as a North-South issue, in which a North-South divide plays a central role in driving SRM politics. We instead show that Global South countries have taken on a spectrum of positions and roles in SRM diplomacy, and North-South coalitions spanning states, experts, and civil society organizations are already a central force driving SRM politics. Altogether, these insights necessitate novel approaches to conceptualizing and studying the roles Global South countries are playing in SRM politics and governance, now and into the future.

We draw on advancements in science diplomacy to evaluate how well this recent activity is positioning Global South countries to more actively lead on SRM research and decision-making. This would ensure diplomatic discussions reflect their own diverse hopes, concerns, and priorities. We argue that the lens of anticipatory science diplomacy (hereafter ‘anticipatory diplomacy’) is especially useful in navigating this terrain. Anticipatory diplomacy is a new approach to science diplomacy that focuses on anticipating potential science and technology developments to ‘proactively govern and deploy scientific advances together for the benefit of humanity, well before they become sources of disruption, instability or inequality’ (GESDA 2025, p. 4). To do so, anticipatory diplomacy aims to connect diverse communities and leaders from across sectors, disciplines, and social and geographic divides, and to empower these actors with the capacity to proactively anticipate, understand, and govern emerging technologies and scientific issues (GESDA 2025). To strengthen the conceptual utility of anticipatory diplomacy, we offer two contributions. First, we emphasize the importance of ensuring Southern ‘ownership’ in North-South coalitions as the key to building durable anticipatory capabilities (Khan *et al* 2018). Second, we highlight the need to anticipate not only advancements in science and technology, but also social, political, and economic developments, which can shape technological advancement and its impacts (e.g. MacKenzie and Wajcman 1999).

Importantly, anticipatory diplomacy was developed in response to today’s crises, including as related to renewed Great Power competition (Goddard 2025), democratic backsliding (Carrier and Carothers 2025), and faltering multilateralism, illustrated most clearly with the 2026 US withdrawal from dozens of international organizations (Lee and Amiri 2026) (see also, e.g. Guilbaud *et al* 2023; United Nations 2025, Sternfels 2026). This landscape provides clear challenges for multilateral diplomacy on high-stakes science and technology issues as well as specifically for greater Global South participation and influence. Anticipatory diplomacy calls for acknowledging ‘the geopolitical context by leveraging competitive dynamics to find new avenues for cooperation, unlocking agile, responsive coalitions which can rapidly create and test blueprints for action’ (Geneva Science and Diplomacy Anticipator (GESDA) 2025, p. 15). This is critically important for SRM, as academics and security practitioners have recently begun to seriously scrutinize its potential implications for security, conflict, and geopolitics. This work underscores overall that SRM could be geopolitically disruptive, as it could empower an actor to shape global or regional climates in ways that could advance its strategic interests or harm others (e.g. Dalby 2015, Grisé *et al* 2021, Corry *et al* 2024, Lazard *et al* 2025, Power 2026). Anticipatory diplomacy, and broader international cooperation writ large, is needed to manage these risks, among others.

In this article, we examine Global South participation in SRM research and governance over the past decade, documenting and analyzing the significance of the rise in Southern participation. We develop a novel set of empirical indicators of growing Global South engagement in SRM research and governance and analyze case studies that illustrate different ways in which actors in the Global South are engaging across four different types of diplomatic venues that could facilitate anticipatory diplomacy around SRM. This analysis demonstrates that over the past decade, Global South countries and experts are becoming more involved in SRM activities related to research, assessment, and diplomacy and are exerting influence on key governance outcomes. However, Southern participation remains limited and uneven, due

<sup>7</sup> We define Global South in line with the Finance Center for South-South Cooperation, which has Special Consultative Status with ECOSOC of the United Nations and is reflective of the current state of global climate discussion and SRM in particular. See [www.fc-ssc.org/en/partnership\\_program/south\\_south\\_countries](http://www.fc-ssc.org/en/partnership_program/south_south_countries). We recognize that the term ‘Global South’ is imperfect as the Global South is not a monolith nor is it static, and the term obscures the diversity of cultural, economic, and environmental contexts within and between countries. Despite its limitations, we use the term Global South because it highlights structural asymmetries that are central to governance, power relations, institutions and finance.

to entrenched disparities in funding, vulnerability, and capacity, as well as a disconnect between experts and policymakers.

The article is organized as follows. Section 2 provides a brief background on SRM and recent activity surrounding its research and governance. Section 3 elaborates the vision of anticipatory diplomacy and offers two advancements. Section 4 identifies and explains six key indicators of expanding Global South involvement in SRM diplomacy. Section 5 illuminates and analyzes this growing involvement through the lens of four case studies. Section 6 draws two cross-cutting conclusions from the case studies that illustrate the challenges and opportunities current diplomatic activity faces in achieving the vision of anticipatory diplomacy and distills recommendations for enhancing Global South engagement. Finally, we conclude in section 7 by briefly reflecting on what our contributions mean for SRM politics and debate going forward.

## 2. Background: A primer on SRM and its governance

SRM refers to a suite of proposed technologies that aim to cool the Earth by reflecting a small amount of incoming sunlight, by enhancing the Earth's albedo (i.e. the Earth's ability to reflect sunlight), or by making it easier for infrared radiation to escape the Earth's atmosphere. Several technologies are proposed as ways to implement SRM, including stratospheric aerosol injection (SAI), marine cloud brightening (MCB), Cirrus Cloud Thinning, and space-based solar radiation reflection methods. SAI and MCB are considered the most plausible forms of SRM, as current research suggests they may be relatively cost-effective, technologically feasible, and fast-acting (NASEM 2021).

However, there is still a lot of uncertainty about their efficacy and impacts, and their consideration raises novel social, political, ethical, and ecological risks and challenges (NASEM 2021, UNEP 2023). One overarching political concern is that global governance and international decision-making on SRM would not be just, inclusive, or democratic, and would instead reflect and further reinforce unequal power relationships between Global North and South (e.g. Smith 2018, Stephens and Surprise 2020, Biermann *et al* 2022).

Research and commercial activity on SRM has increased in recent years and although states have yet to formally take steps to assess or govern SRM research, diplomatic discussions are gaining speed. SRM is being discussed at the highest levels in international environmental politics, including within the United Nations Environment Programme (UNEP), the United Nations Environment Assembly (UNEA), and the United Nations Secretary General's scientific advisory board, among others. This reflects growing concern that, amid insufficient emissions cuts, limits of adaptation in the face of rising climate impacts (WMO 2025), and insufficient financing for mitigation and loss and damage, some actors might contemplate SRM. This raises urgent questions about governance, ethics, and global equity (IPCC 2023).

Developments in the Global North also indicate growing concern and attention towards SRM. Under the current administration of President Trump in the United States, efforts to quell SRM activities (whether real or perceived) have also skyrocketed in the United States, with its environment protection agency (EPA) taking action<sup>8</sup>, and multiple state legislatures introducing bills to ban SRM<sup>9</sup>. Further, the European Commission, in a joint communication to the European Parliament and the Council on climate and security nexus, declared its intent to apply the precautionary principle and comprehensively assess the risks and uncertainties associated with SRM, citing 'ethical, governance and political issues' as the basis for promoting discussions on a potential international governance framework for such technologies (European Commission 2023). In 2024, the Scientific Advice Mechanism to the European Commission also presented an evidence review of SRM and opined on the need for precaution, proposed a Europe-wide moratorium on SRM use, and the need for a global governance system for decision-making enshrined with strong justice and good governance principles (European Commission 2024).

Additionally, public and philanthropic funding of SRM research has ramped up in the past five years. In 2025, the United Kingdom's Advanced Research and Innovation Agency (ARIA) funded £56.8 million in projects related to SRM, including outdoor experiments<sup>10</sup>. In 2020, the United States Congress allocated \$4 million to the National Oceanic and Atmospheric Administration to conduct research on SAI and MCB (Fialka 2020). Additionally, since 2020, scientists in Australia have been conducting research of geoengineering options for protecting the Great Barrier Reef from coral bleaching, funded by the

<sup>8</sup> [www.epa.gov/geoengineering/government-action](https://www.epa.gov/geoengineering/government-action).

<sup>9</sup> <https://srm360.org/us-bans/>.

<sup>10</sup> [www.aria.org.uk/opportunity-spaces/future-proofing-our-climate-and-weather/exploring-climate-cooling](https://www.aria.org.uk/opportunity-spaces/future-proofing-our-climate-and-weather/exploring-climate-cooling).

Australian government (McDonald *et al* 2019, Foster *et al* 2025). Lesser amounts of public funding are committed from the European Union and China<sup>11</sup>. Research funding has also increased from philanthropic sources, including a recent \$40 million commitment from the London-based Quadrature Climate Foundation (Temple 2024).

A recent uptick in cancelled and proposed outdoor experiments and controversies surrounding them also suggests attention towards SRM is gaining steam, and yet a lack of societal engagement could impede outdoor research efforts. In 2024, a team of researchers from the University of Washington conducted an outdoor MCB experiment in Alameda, California, which was ultimately shut down by local authorities, in part due to an initial lack of transparency and an insufficient approach to engagement (Flavelle and Bates 2024, Hair 2025, Jinnah and Dove 2025). Also in 2024, a team of researchers at Harvard University cancelled a long-discussed experiment known as the stratospheric controlled perturbation experiment, also due in part to disagreements over how to engage publics and other impacted communities (Jinnah *et al* 2024). Most demands for public engagement in these cases have arisen from communities that are located near experiment sites. And yet, if ever deployed, SRM would have global implications and impacts. As awareness of SRM rises across the globe, demands for engagement surrounding some outdoor experiments may begin to arise from broader communities and countries, including from climate vulnerable countries in the Global South.

The most recent and potentially disruptive development is an uptick in venture capital funding to private start-ups seeking to develop SRM capabilities and create commercial opportunities. Most notably, Stardust Solutions is an Israeli-American company that has raised \$75 million in venture capital funding, out of a total of approximately \$116 million in funding across 9 private SRM companies (Hiar 2025). Stardust, which claims to have developed a proprietary aerosol, is seeking to secure US government contracts for a global deployment program as soon as 2030 and is reportedly lobbying Congress for a regulatory framework for outdoor experiments, which it views as necessary to secure public approval (Hiar and Mathiesen 2025, Mathiesen and Hiar 2025).

Awareness of myriad risks and challenges associated with SRM research and potential deployment has spawned a rich governance scholarship focused on SRM. The governance literature has explored and debated key questions related to whether, how, when, why, and by whom SRM research and potential deployment should be governed. Many experts have outlined important governance needs for SRM research and any potential deployment. Most of these have emphasized the need for enhanced participation from countries in the Global South in international decision-making, and have called for enabling mechanisms such as increased transparency and international collaboration, research and governance capacity building, public engagement, best practices for research, ethical principles, and inclusive assessment processes (e.g. NASEM 2021; McDonald *et al* 2019, Chhetri *et al* 2018, Hubert 2021, Carabajal *et al* 2025, Dove *et al* 2024). Like other areas of SRM research, most governance proposals have been developed in the Global North, further underscoring the need for greater involvement of voices from the Global South in governance discussions (AGU 2024, Quagraine *et al* 2025a).

### 3. Anticipatory diplomacy as a vision of enhanced engagement

Anticipation is crucial for ensuring that countries from the Global South take an active role in shaping the governance infrastructure needed to deal with climate change and SRM. Given the transboundary nature of SRM, multilateral mechanisms, foresight, and international partnerships are essential to prevent unilateral decision-making that, inevitably, will affect every country worldwide. In this section, we outline and build on the concept of anticipatory diplomacy, which we argue provides a vision of a more robust diplomatic landscape to guide present and future diplomacy around SRM (see also Carabajal and Pombo 2024).

As pioneered by the Geneva Science and Diplomacy Anticipator (GESDA), anticipatory diplomacy draws on the traditional science diplomacy<sup>12</sup> that enabled global cooperation and wide-ranging benefits in the 20th century on issues related to, for example, environmental challenges such as ozone depletion, space exploration, and health and infectious diseases. However, GESDA recognizes that increasingly rapid advancements in science and technology have the potential to transform every dimension of society, leaving diplomacy and governance trailing (GESDA 2025). Anticipatory diplomacy therefore aims

<sup>11</sup> <https://srm360.org/article/srm-funding-overview/#endnotes>.

<sup>12</sup> Science diplomacy is, broadly, 'the use of scientific collaborations and knowledge exchange to build bridges between nations' (GESDA 2025, p 7).

**Box 1. —The Four Pillars of Anticipatory Science Diplomacy (recreated from (GESDA) 2025).**

|                              |                                                                                                                                                                                  |
|------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Science anticipation.</b> | Identify and scope out the major scientific advances with the highest potential to reshape humanity and the planet.                                                              |
| <b>Honest brokering.</b>     | Convene and connect diverse communities to discuss and align early on the implications and applications of emerging science, thus expanding the scope for action in the present. |
| <b>Global action.</b>        | Prototype early multilateral solutions and frameworks that maximise the benefits of future science advances and minimise their potential risks.                                  |
| <b>Capacity building.</b>    | Empower communities and leaders with the tools to anticipate, understand, harness and govern emerging science for the benefit of humanity.                                       |

to implement proactive approaches in line with the pace of technological breakthroughs and the accelerated pace of societal changes in a fragmented world. In this sense, to be effective, science diplomacy needs new tools, mindsets and leadership skills to embrace the high levels of uncertainty and complexity in today's context. To benefit humanity as a whole, multilateral systems should include extended collaboration, including scientists, diplomats, private actors, and communities from Global North and Global South countries (GESDA 2025, p 4). The concept has only recently been introduced to the academic literature, and used so far to shed light on current activity and future possibilities related to a range of issues including, for example, global environmental problems, transboundary water issues, COVID-19 and vaccines, the search for extraterrestrial life, and the human right to science (Lopez 2024, Porsdam and Porsdam Mann 2024, Profitiliosis 2024).

These four pillars of anticipatory diplomacy (Box 1) could serve as guidelines to shape an innovative and inclusive framework for addressing the complexities of SRM, one which has potential to place actors from the Global South on more equal diplomatic footing as those from the Global North in terms of research and decision making.

First, anticipation not only enhances flexibility but also allows governments and institutions to play a proactive, action-oriented role—taking advantage of opportunities, assessing risks and benefits, and balancing trade-offs. Second, anticipation can foster collaborative approaches in proactively connecting diverse social and institutional actors across geographies, disciplines, and sectors. As we demonstrate in section 5, regional and international institutions are well prepared to play the role of 'honest broker' in SRM (Pantovic *et al* 2024). While building partnerships takes time, it ensures that the outcomes of knowledge production are more relevant, salient, and legitimate for all stakeholders involved (Carabajal and Hidalgo 2022).

Third, given the planetary scale of scientific advancements and emerging technologies, building new and innovative coalitions—whether national, regional, or international, and including collaborations between the Global South and Global North—is essential to enable collective deliberation and to articulate shared values and priorities. Finally, and perhaps most importantly, responding to the complexity and uncertainty posed by emerging technologies will require anticipatory capacities, not only more evidence-based information but also the ability to draw on that knowledge to support decision-making for the benefit of society. Access to relevant and contextual knowledge, together with capacity-building efforts across communities, will empower them to participate in anticipatory activities by strengthening their ability to anticipate, understand, harness, and govern emerging technologies such as SRM.

As Carabajal and Pombo (2024) explain, while there is no silver bullet for solving complex global problems, anticipatory diplomacy—if practiced effectively—can benefit the most vulnerable regions by fostering North–South and South–South collaboration, enabling information sharing and capacity-building for informed decision-making, and nurturing multilateral science–policy processes. In the context of SRM, anticipatory diplomacy therefore 'does not mean endorsing technological deployment but rather seeking a more comprehensive and informed debate to anticipate, shape, and guide the future' (Carabajal and Pombo 2024).

We extend the vision of anticipatory diplomacy by offering two contributions to strengthen its effectiveness under conditions of geopolitical turbulence and uneven power dynamics between the Global North and South. First, we emphasize that North–South and South–South collaborations can only build durable anticipatory capacities—meaning those capacities remain in the Global South over time—if capacity building programs and North–South collaborations and coalitions are owned and led by participating countries in the Global South (Khan *et al* 2018). This involves ensuring Global South countries

are empowered to lead decision-making on both: which anticipatory capacities are most needed in their local contexts; and how funding and other resources should be used to build them (Dove *et al* 2024).

Second, we emphasize that alongside anticipation of potential developments in science and technology, we must also anticipate social, political, legal, and economic developments, which will also shape how science and technology will impact society (Pool 1997, MacKenzie and Wajcman 1999, Jørgensen *et al* 2009). For example, scenario-based research finds that political considerations will affect the technical design of an SRM deployment (Dove *et al* 2021; see also Beckage *et al* 2025). Effectively anticipating future science and technology developments and their impacts therefore requires attention towards anticipating the possible future social contexts that shape—are shaped by—science and technology.

Next, we build on this vision of anticipatory diplomacy to present a novel set of empirical indicators of growing Global South engagement in SRM research and politics, and then we analyze four case studies that illustrate different ways in which actors in the Global South are engaging across international and regional diplomatic venues.

#### 4. Indicators of growing Global South engagement in SRM research and politics

This section identifies six key indicators of a growing role for the Global South in SRM diplomacy: (1) expansion of research funding, (2) growing involvement in leadership positions, (3) growing engagement in public-facing discussion and debate, (4) the creation of new regional networks, (5) growing NGO led-efforts, and (6) an uptick in government statements on the issue. These novel indicators complement but extend previous indicators of Global South engagement focused on publications (Dove *et al* 2024) and speaker lists at SRM events (Biermann and Möller 2019), and our preliminary qualitative assessment of these indicators highlights multiple strands of ongoing activity in the Global South that have not yet been explored in detail in the peer-reviewed literature.

##### *Indicator 1: Expansion of research funding*

The first indicator of a growing role for the Global South relates to an expansion of research funding to researchers based in the Global South. The indicator is defined as the amount of SRM-related research funding, regardless of source, flowing to researchers of any discipline based in the Global South. This work has been spearheaded by the Degrees Initiative<sup>13</sup>, whose mission is to change ‘the global environment in which SRM is evaluated, ensuring informed and confident representation from developing countries.’ In 2018 the organization launched the world’s first SRM modeling fund aimed exclusively at the Global South, and in 2024 it also launched the world’s first fund for social science research on SRM in the Global South. According to the Initiative, the funds are together now the largest SRM research program in the world’ and have supported over 259 researchers working across 42 projects in 27 developing countries, awarding over \$5 million as of May 2026<sup>14</sup>. Total global research funding still flows overwhelmingly to researchers in the Global North, with \$188 million going to the Global North through 2024, and only \$3.5 million to the Global South<sup>15</sup>. Despite this disparity, Global South researchers have a significant impact on the research landscape. As of January 2026, researchers funded by the Degrees Initiative alone have published 64 peer-reviewed publications on the topic, with more in the pipeline, including this one<sup>16</sup>.

The inclusion of a more diverse group of researchers from the Global South is changing the face of the research community, diversifying it beyond a grouping of a few rich white men (Biermann and Möller 2019, Stephens and Surprise 2020). Substantively, these researchers are shifting the field towards more policy-relevant lines of inquiry focused on impact assessment (Dove 2025). Southern scientists have further emphasized the importance of understanding the potential impacts of SRM on sectors that are locally important in certain regions and countries, such as on agriculture, health, pastoralism, and hydrology (e.g. Patel *et al* 2023, Vioni *et al* 2023, Quagraine *et al* 2025b, Gulizia *et al* 2025; see also Dove 2025). These researchers are currently working with international modelling teams to ensure the next generation of experiments under the Geoengineering Model Intercomparison Project (GeoMIP) meet the needs of Southern scientists (Vioni *et al* 2023, 2025), and southern researchers are also increasingly active participants at semi-annual GeoMIP meetings, the Gordon Research Conference,

<sup>13</sup> The Degrees Initiative was previously the Solar Radiation Management Governance Initiative (SRMGI).

<sup>14</sup> <https://degrees.ngo/degrees-launches-worlds-first-research-fund-for-srm-social-science-in-the-global-south/> Up to date funding statistics can be found on the Degrees Initiative website at <https://degrees.ngo/impact/>.

<sup>15</sup> <https://srm360.org/article/srm-funding-overview/>.

<sup>16</sup> [www.degrees.ngo/published-research/](http://www.degrees.ngo/published-research/); Degrees quarterly newsletter—January 2026.

and other SRM related events. Further indicative of growing Southern involvement, the 2025 GeoMIP meeting was held for the first time in the Global South in South Africa, coinciding with the Degrees Global Forum, which was the largest and most diverse international meeting on SRM to date<sup>17</sup>.

Other indicators of increased funding for Southern researchers include funding from ARIA's new climate cooling research program, Harvard University, the Simon's Foundation, and Reflective<sup>18</sup>. Funding will likely continue to flow to researchers in the Global South as funders acknowledge the importance of their involvement in research, but it would also need to ramp up considerably to approach parity with funding in the Global North. For now, domestic funding from Global South research institutions remains limited; however, the growing visibility and participation of Global South researchers can help generate pressure for national and regional investment from domestic institutions.

*Indicator 2: Involvement in positions of leadership in science and governance bodies*

Global South researchers are also increasingly active in international SRM assessment activities and are increasingly taking on positions of leadership in national and international science and governance bodies. The second indicator is defined as the number of researchers or other practitioners based in the Global South serving in roles in SRM-related science or governance bodies on national or international levels. A total of 27 researchers from the Global South funded through Degrees have been authors or editors on IPCC reports and 14 will contribute to the 7th assessment report, including two as Vice-Chairs<sup>19</sup>. Some of these researchers also authored recent high level international reports and assessments on SRM, including the One Atmosphere report from the UNEP 2023, UNESCO's report of the World Commission on the Ethics of Scientific Knowledge and Technology (COMEST) on the ethics of climate engineering (COMEST 2023), and AGU's Ethical Framework Principles for Climate Intervention Research (AGU 2024). Five researchers from the Global South also sit on the interim scientific steering committee for the world climate research programme's lighthouse activity on climate intervention research<sup>20</sup>. Efforts are also ongoing to better connect growing SRM expertise in the Global South with national policymakers, including most notably multiple regional sessions for researcher and policymaker dialogues organized in conjunction with the 2025 Degrees Global Forum<sup>21</sup>. Importantly, because the total number of Southern experts are comparatively few, they are often overbooked, and so it is difficult to involve them in additional activities. Thus, while their role is important, there is still a bottleneck linked to limited human capacity<sup>22</sup>.

*Indicator 3: Involvement in public-facing discussions and debates*

Researchers from the Global South also contribute to public facing SRM discussions and debates. The third indicator is defined as the number of contributions from Global South actors to public-facing discussions and debates related to SRM. For example, three of twelve co-authors of the SRM non-use agreement are from institutions in the Global South and more have added their names as signatories to the associated open letter (Biermann et al 2022). Some researchers from the Global South also signed onto open letters organized in response to Biermann et al calling for additional research into SRM<sup>23</sup>.

Global South researchers are also increasingly participating in international public-facing debates about SRM. For example, African climate experts opined on the topic in the New York times as well as most recently in the Guardian<sup>24</sup>, and representatives from African civil society were quoted in a recent press release from the HOME Alliance condemning the decision to host the 2025 Degrees Global Forum in South Africa. The international debate among Southern researchers continued with the newly formed African Climate Intervention Research Hub, composed of African scientists involved in SRM research, which countered the HOME Alliance perspective in its own statement<sup>25</sup>. Irrespective of one's position on SRM, these debates are essential and reflective of a growing engagement from African countries on this topic.

<sup>17</sup> <https://degreesglobalforum.org/>.

<sup>18</sup> [www.hks.harvard.edu/centers/cid/voices/2023-gem-incubation-fund-award-recipients#solar-radiation-modification-impacts-based-dashboard-1847900](http://www.hks.harvard.edu/centers/cid/voices/2023-gem-incubation-fund-award-recipients#solar-radiation-modification-impacts-based-dashboard-1847900). [www.simonsfoundation.org/funded-project/characterising-the-global-and-regional-impacts-and-risks-of-alternative-materials-for-stratospheric-aerosol-injection/](http://www.simonsfoundation.org/funded-project/characterising-the-global-and-regional-impacts-and-risks-of-alternative-materials-for-stratospheric-aerosol-injection/).

<sup>19</sup> [www.degrees.ngo/ipcc-ar7-contributors/](http://www.degrees.ngo/ipcc-ar7-contributors/).

<sup>20</sup> [www.wcrp-climate.org/ci-overview](http://www.wcrp-climate.org/ci-overview).

<sup>21</sup> [www.degrees.ngo/dgf25-roundup/](http://www.degrees.ngo/dgf25-roundup/).

<sup>22</sup> We are grateful to an anonymous reviewer for making this important point.

<sup>23</sup> <https://climate-intervention-research-letter.org/>; [www.call-for-balance.com/signatories](http://www.call-for-balance.com/signatories).

<sup>24</sup> [www.nytimes.com/2023/04/18/opinion/geoengineering-climate-change-technology-africa.html](https://www.nytimes.com/2023/04/18/opinion/geoengineering-climate-change-technology-africa.html). [www.theguardian.com/environment/2025/dec/15/we-must-not-stop-research-on-solar-geoengineering](https://www.theguardian.com/environment/2025/dec/15/we-must-not-stop-research-on-solar-geoengineering).

<sup>25</sup> [www.degrees.ngo/african-scientists-respond-misrepresentations-solar-geoengineering-research/](http://www.degrees.ngo/african-scientists-respond-misrepresentations-solar-geoengineering-research/).

*Indicator 4: The creation of new regional networks*

The fourth indicator is the creation of regional SRM-related networks in the Global South. This indicator is defined as the number of networks, hubs, or other institutional arrangements designed to coordinate SRM-related activity across a specific region. For example, initiated in 2025, the African Climate Intervention Research Hub aims to coordinate research on SRM and its potential impacts, ethics, and governance across Africa. Similar forms of coordination have been discussed for Southeast Asia<sup>26</sup>. Additionally, in Latin America and the Caribbean, a team of researchers from Argentina and the United Kingdom, funded by the Degrees Initiative, the World Health Organization (WHO), and ARIA, has launched a project on the ethics and governance of SRM. The initiative aims to build and strengthen a regional network of scientists, policymakers, and communities, focusing on capacity building to address the implications of SRM and co-produce knowledge that supports informed decision-making. The project is hosted by the Inter-American Institute for Global Change Research (IAI) ensuring the engagement of countries across the Americas, bridging the gap between science and policy<sup>27</sup>.

Since 2016, there have been at least 18 new initiatives launched in Latin America alone related to SRM, whereas to our knowledge no SRM events were held in the region prior to 2016. Similar initiatives are emerging in other regions as well. Table S1 in the supplementary material, for example, showcases several initiatives organized in the Latin America and Caribbean region aiming at bridging the gap between science and policy, strengthening linkages among Global North and Global South organizations and countries, and also raising awareness of SRM in the region. Though currently these efforts are small scale, they indicate growing efforts to inform Global South publics and build their capacity to participate in discussions on SRM.

*Indicator 5: Growing NGO led efforts focused in the Global South*

A fifth indicator of increasing Global South engagement is that Southern NGOs are increasingly involved in SRM activities. This indicator is defined as the number of NGOs based primarily in the Global South that are leading or involved in SRM-related activities or programs. For example, the Green Africa Youth Organization (GAYO) has several activities focused on SRM, including a climate intervention education program for youth, which includes developing SRM-related coursework in partnership with a network of African universities to ensure ‘that African nations will not merely be passive recipients of global climate policies but active contributors and decision-makers’<sup>28</sup>. Additionally, Emerging Climate Frontiers (ECF) is an African-led organization that hosts an SRM program designed to foster ‘informed, inclusive, Africa-led dialogue and research on SRM’s risks, potential benefits, governance frameworks, and implications for the continent’<sup>29</sup>. The organization is involved in a range of activities including hosting virtual dialogues, information sessions, and hosting an SRM fellowship program<sup>30</sup>. Other local organizations have also hosted a handful of events aiming to engage local communities as well as policy and climate practitioners on SRM<sup>31</sup>.

The US-based Alliance for Just Deliberation on Solar Geoengineering (DSG) continued to play an important role in catalyzing this work by Southern NGOs (and policy makers)<sup>32</sup>. DSG focuses on building governance capacity and foundational knowledge in civil society in the Global South to ensure ‘that vulnerable communities and nations play a meaningful role in shaping SRM discussions’<sup>33</sup>. It does so by working with local partner organizations in the Global South to ‘expand networks, promote collaboration, and ensure climate-vulnerable regions have a voice in the global conversation on [SRM]’<sup>34</sup>. For example, its recent activities include engagements in South Asia, Southern Africa, and Latin American and the Caribbean to bring local and international academia and civil society organizations together to develop capacity, perspectives, and identify engagement strategies and needs with respect to SRM in their local and regional contexts. Importantly, DSG’s capacity building model aims to ensure Global South ownership of its programs in the long term by empowering its NGO partners to make key decisions about how its programs will meet partner needs. It designs its programming in response to

<sup>26</sup> [www.degrees.ngo/second-sea-workshop/](http://www.degrees.ngo/second-sea-workshop/).

<sup>27</sup> [www.iai.int/en/news/detail/IAI-and-CONICET-promote-debate-on-emerging-technologies-ethics-](http://www.iai.int/en/news/detail/IAI-and-CONICET-promote-debate-on-emerging-technologies-ethics-).

<sup>28</sup> <https://greenafricayouth.com/2024/10/07/empowering-africas-youth-gayos-groundbreaking-initiative-in-climate-intervention-education/#>.

<sup>29</sup> Emerging Climate Frontiers. Terms of Reference for Solar Radiation Management Fellow. <https://drive.google.com/file/d/1AI178WvMy5UddAD0w5tcjX4cgvbXmtDW/view>.

<sup>30</sup> <https://ecfrontiers.org/>.

<sup>31</sup> We are grateful to Trisha Patel for sharing information on some of these activities. See also Dove (2025).

<sup>32</sup> The authors would like to acknowledge affiliations with DSG. Hassaan Sipra is the Director of Global Engagement for DSG. Previously, Zachary Dove was a Research Fellow and Sikina Jinnah was a Research Collaborator with DSG.

<sup>33</sup> [www.sgdliberation.org/](http://www.sgdliberation.org/).

<sup>34</sup> [www.sgdliberation.org/our-work/global-engagement](http://www.sgdliberation.org/our-work/global-engagement).

the needs of its global partners, including its climate intervention network, where early career professionals from around the world working on SRM are empowered to explore how best to shape the future of SRM and climate governance; and its residency program, which offers early- and mid-career professionals across diverse fields the opportunity to learn about SRM and explore it from the lens of their expertise, actively removing barriers to entry in SRM research. DSG's model is likely to yield an increase in Global South engagement across NGOs and other actors over time.

#### *Indicator 6: An increase in government statements on SRM*

Finally, an important sixth indicator of growing Global South engagement is an increase in government statements on SRM. This indicator is defined as the number of SRM-related public-facing statements issued by countries or regional intergovernmental bodies in the Global South. Notably, the Mexican government announced its intention to ban SRM-related experiments in their territory after a balloon release in Baja California in late 2022 by a private US-based startup Make Sunsets (Temple 2023, Carabajal et al 2025). This activity was conducted without community participation or government engagement, thereby lacking transparency and oversight. Further, the African Ministerial Conference on the Environment (AMCEN) in 2023 issued a decision 19/6 calling for 'a global governance mechanism for non-use of [SRM]', effectively urging an international moratorium on these technologies (AMCEN, 2023). Additionally, AMCEN in its 2025 decision 20/9 reaffirmed their 'full rejection of any attempt to promote SAI or other forms of [SRM] technology as a climate change mitigation solution' (United Nations Environment Programme 2025).

#### *Using the indicators to empirically evaluate anticipatory diplomacy*

A central part of the vision presented by anticipatory diplomacy is that countries in the Global South are empowered to anticipate and shape possible SRM futures in line with their own priorities, knowledge, narratives, and vulnerabilities. The empirical indicators of growing Global South engagement presented here can be used to evaluate and track over time how well each pillar of anticipatory diplomacy is being realized in practice, and where deficits remain. For example, tracking research funding across the Global South can be used to evaluate how well the science anticipation pillar is practiced because Global South-led scientific research is needed to anticipate the most salient potential risks and benefits of SRM in each country and region. This indicator can also be used to evaluate how well the capacity building pillar is being practiced, because research funding is needed to build durable capabilities that enable Global South countries to effectively understand, anticipate, and shape possible futures with and without SRM. Table 1 below provides an evaluative framework for anticipatory diplomacy by specifying how each empirical indicator operationalizes a pillar of anticipatory diplomacy (see section 3).

## 5. Case studies of Global South involvement in SRM diplomacy

The indicators identified in the previous section show what the expansion of Global South engagement looks like across several areas. Here we analyze four cases of Global South engagement in SRM diplomacy to illuminate how the South's growing involvement is changing the SRM diplomatic landscape in practice. The cases illustrate how Global South actors are engaging across four types of diplomatic venues: intergovernmental scientific assessment bodies; United Nations decision-making bodies; multilateral treaty-based negotiations; and regional intergovernmental institutions.

### 5.1. Intergovernmental Panel on Climate Change (IPCC)

#### 5.1.1. Evolution of SRM in IPCC reports

The IPCC, established in 1988 by the World Meteorological Organization (WMO) and the UNEP, is the leading authority on climate science, with 195 member countries and thousands of expert contributors. Through its three Working Groups on physical science, impacts and adaptation, and mitigation, it delivers assessments that are policy-relevant but not prescriptive, shaping climate policy worldwide and underpinning United Nations Framework Convention on Climate Change (UNFCCC) negotiations. As the body that synthesizes evidence and frames global climate debates, the IPCC's inclusion of SRM in its recent assessment reports carries major implications for both science and diplomacy. Given the high uncertainty and political contention around SRM, an anticipatory and inclusive assessment remains critical. This case study examines how SRM has evolved within IPCC and subsequently positioned it as an enabling institution for anticipatory diplomacy.

The IPCC's growing confidence that climate change is driven mainly by human activities and projection that warming will exceed the 1.5 °C temperature goal has contributed to the interest in SRM as a potential climate response option. However, as the IPCC notes, SRM raises significant political, ethical,

**Table 1.** Using the empirical indicators as an evaluative framework for anticipatory diplomacy.

| Empirical indicator |                                        | Pillar of anticipatory diplomacy                                                                      | Explanation                                                                                                                                                                                                      |
|---------------------|----------------------------------------|-------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1                   | Research funding                       | <ul style="list-style-type: none"> <li>• Science anticipation</li> <li>• Capacity building</li> </ul> | Funding Global South researchers (Degrees, ARIA) enables anticipation of SRM's potential risks and opportunities and strengthens scientific capacity in the South.                                               |
| 2                   | Involvement in positions of leadership | <ul style="list-style-type: none"> <li>• Science anticipation</li> <li>• Global action</li> </ul>     | Involving Global South researchers in international assessment (e.g. IPCC) or governance bodies enables more robust anticipation of potential impacts and can lay the foundation for multilateral arrangements.  |
| 3                   | Engagement in public-facing debates    | <ul style="list-style-type: none"> <li>• Honest brokering</li> <li>• Global action</li> </ul>         | Engaging in public-facing debates on SRM (e.g., open letters, editorials) spurs discussion on the implications of SRM among diverse actors and can help motivate and find common ground for multilateral action. |
| 4                   | Regional networks                      | <ul style="list-style-type: none"> <li>• Honest brokering</li> <li>• Capacity building</li> </ul>     | Creating new regional research networks (e.g. African Climate Intervention Research Hub) builds capacities across regions and facilitates dialogue between diverse scientists and policymakers.                  |
| 5                   | NGO activity                           | <ul style="list-style-type: none"> <li>• Honest brokering</li> <li>• Capacity building</li> </ul>     | NGO activity in the Global South (e.g. GAYO) catalyzes awareness and discussion between diverse communities and strengthens capacity to understand, discuss, and govern SRM.                                     |
| 6                   | Government statements                  | <ul style="list-style-type: none"> <li>• Global action</li> <li>• Science anticipation</li> </ul>     | Government statements on SRM (e.g. AMCEN) provide early policy signals which may enable alignment on multilateral frameworks and catalyze additional efforts to bridge science and policy.                       |

and practical challenges that extend beyond the scientific assessments covered in its reports. Since 1988, the IPCC has broadened its focus from physical climate science to integrated assessments of impacts, adaptation, mitigation, and cross-cutting responses, with growing attention to geoengineering. The 2011 IPCC Expert Meeting on Geoengineering marked a turning point by clarifying concepts and recommending that CDR and SRM be assessed alongside mitigation and adaptation using common criteria that include effectiveness, risks, governance, ethics, and social acceptability (IPCC 2012).

Since its 5th Assessment Report (AR5) (2014), the IPCC has cautiously included SRM discussions, but highlighted that SRM methods remained largely theoretical, with high uncertainty and profound governance, ethical, and social challenges. In AR6 (2021–2022), the treatment of SRM matured and the report recognized that while SRM could, in theory, reduce global temperatures or offset some climate impacts, it would not address ocean acidification, carried high risks of uneven regional effects, and raised critical questions of reversibility, termination shock, and global governance. The literature has expanded especially through modeling exercises but empirical evidence and governance frameworks remain limited. For instance, AR6 warned that limiting warming to 1.5 °C or 2 °C requires rapid, deep emissions cuts across all sectors. The report calls for major reductions in fossil fuel use, rapid renewable energy deployment, efficiency gains, and demand-side changes, while noting that some carbon dioxide

removal will be unavoidable. However, the report finds high agreement that SRM cannot replace emissions cuts and would only mask, not solve, climate change. SRM could temporarily offset some warming impacts but carries serious risks, including ozone depletion, health and food security threats, and geopolitical conflicts, making it a highly uncertain and controversial option (IPCC 2023).

Over time, the IPCC has shifted from near silence on SRM to a more structured and cautious assessment of SRM reflecting its consideration of SRM within a broader portfolio of climate responses. This shift is due in part to a growing number of studies from the Global South that has informed the assessment process. However, it consistently underscores that SRM is not a substitute for deep mitigation and adaptation, and that its risks, uncertainties, and ethical dimensions demand continued international scrutiny. Recent processes indicate the IPCC is poised to cover SRM in future assessments. The IPCC's 7th Assessment Report (AR7) will, for the first time, explicitly assess SRM with Working Group I examining the physical science basis and Working Group II evaluating the associated risks, impacts, and uncertainties alongside those of unabated warming. This framing is expected to influence global debates on SRM, though challenges remain, including the political sensitivity of language in the summary for policymakers, and the need to weigh the risks of SRM against the escalating dangers of unchecked warming.

#### *5.1.2. Balancing Northern and Southern voices on SRM in IPCC*

The inclusion of SRM in AR7 brings North–South politics directly into the IPCC process, with significant implications for how the issue is framed and received. Since most SRM research and funding originates in the Global North, there is concern that the scientific evidence assessed will reflect Northern priorities and interests, while the Global South where climate impacts are most acute and SRM side-effects could be most disruptive has limited capacity to shape the debate. However, with more participation (over 20) of Southern researchers in AR7 and a growing output of published papers on regional impacts, Southern researchers are beginning to build greater capacity to influence the discussions even if parity with Northern counterparts has not yet been reached. This asymmetry risks reinforcing existing inequities and deepening broader geopolitical divides. At the same time, the IPCC's mandate to produce consensus-based, policy-relevant but not policy-prescriptive assessments means that how SRM is presented will be equitably contested.

Stronger Global-South authorship and leadership would enhance the legitimacy of IPCC findings, counter perceptions of Northern dominance, and highlight development-relevant risks such as precipitation shifts and agricultural impacts. For instance, Global South experts have become increasingly involved in IPCC discussions on SRM in recent years though authorship and leadership remain inequitable. For example, some Global South researchers participated in the AR7 scoping meeting while others are also expected to play a larger role in AR7, supported by the more than 50 publications on regional impacts emerging from the Global South. Such involvement creates opportunities for Southern researchers to contribute to decisions on whether and how to include SRM in the IPCC assessment, bringing regional perspectives directly into the framing stage. While the imbalance in authorship and funding persists, these contributions signal a gradual shift toward broader geographic representation and capacity to shape the SRM debate.

#### *5.1.3. Building equitable Global South participation on SRM in IPCC*

Global South perspectives would encourage the IPCC to frame SRM as a governance challenge as well as a technical one, with rights-based safeguards. Regional blocs like the AMCEN and the Alliance of Small Island States could then use IPCC outputs to effectively advance proposals regarding related topics as moratoria, consent thresholds, or non-use declarations, shaping multilateral negotiations as recent African ministerial initiatives have shown. While stronger Southern leadership risks politicising assessments (as the role of Global South experts could be seen as political rather than neutral because they come from regions hit hardest by climate change and with sensitive political debates), rigorous scientific standards and procedural safeguards can preserve neutrality. Equitable authorship, targeted capacity support, and regional foresight dialogues would ensure broader participation, making IPCC outputs more legitimate and policy-relevant. Additionally, AR7's integration of governance, ethics, detection/attribution, and regional impact analyses, with targeted support for Global South experts would produce concise, clear, decision-relevant uncertainty language to shape early, inclusive dialogue on research norms, consent frameworks, and precautionary safeguards, positioning its assessment as a foundation for equitable and proactive global governance of SRM.

As a leading authority on climate science, the IPCC can play a fundamental role in anticipatory diplomacy on SRM by shaping the conditions under which proactive international dialogue becomes

possible. Specifically, its evolution of SRM from silence in its earlier assessments to explicit consideration in current AR7 depicts progressiveness which indicates global concern requiring collective attention. In relation to the four pillars of anticipatory diplomacy (see Box 1), the body is well positioned to advance anticipatory diplomacy across each pillar. It plays a key role in anticipating SRM's potential impacts through its efforts to synthesize scientific knowledge of the benefits, limits, and risks of SRM, including consideration of uneven regional impacts and governance gaps (science anticipation). By aiming to achieve global representation in its membership, this subsequently provides a legitimate foundation upon which diplomatic actors and multilateral forums can convene and base early governance discussions (honest brokering). While the IPCC's mandate limits its ability to direct broker negotiations as well as not providing any outcome prescription, its assessments can catalyse global action in complementary institutions such as with the UNFCCC and the UNEA (global action). Further, by including and strengthening the capacities of Southern experts, the IPCC contributes to efforts to broaden capacities needed to understand, research, and govern SRM (capacity building). By recognizing and framing SRM as a subject requiring early governance attention, the IPCC positions and establishes a space within which institutions can convene dialogues, build capacities and precautionary approaches enabling informed, inclusive, and proactive governance discussions as well as meaningful choices.

## 5.2. United Nations Environment Assembly (UNEA)

Established in 1972 and headquartered in Nairobi, Kenya, the UNEP provides environmental monitoring, informs policy making, and coordinates action to support international cooperation on critical environmental challenges at various scales. UNEP's original policy making body was the 54-member Governing Council, which provided policy guidance to promote international environmental cooperation, and coordinated environment-related activities with other UN bodies and member states.

At Rio + 20 in 2012, the Governing Council was renamed the UNEA and expanded to allow universal membership of all 193 member states. Its resolutions, while not legally binding, set the global environmental agenda, guide the work of UNEP, and can be precursors to more formal legal instruments (Jinnah and Dove 2025). Specifically, UNEA's mandate is to: 'to set the global environmental agenda; provide overarching policy guidance and define policy responses to address emerging environmental challenges; undertake policy review, dialogue and the exchange of experiences; set the strategic guidance on the future direction of UNEP; and foster partnerships for achieving environmental goals and resource mobilization.'<sup>35</sup>

UNEA uses a consensus-based decision-making system among its 193 member states. Although UNEA allows for broad participation from non-state actors, such as international organizations and major groups and stakeholders, only member states have voting rights. UNEA meets every two years in Nairobi to consider issues related to a host of environmental topics, including pesticides, water, desertification, among many others. This case study examines how UNEA has emerged as a key arena for international debate on SRM, including how North–South coalitions have tried but so far failed to advance global efforts to anticipate and govern SRM within the body.

### 5.2.1. Two resolutions: UNEA as a site of emerging SRM debates

In recent years, UNEA has become a key arena for discussions on SRM. The inclusion of SRM on UNEA's agenda in 2019 and 2024 sessions (UNEA-4 and UNEA-6, respectively) was significant, as it marks the first high-profile, global diplomatic discussion of this contentious climate response option (Jinnah and Nicholson 2019, Jinnah and Dove 2025). The UNEA SRM discussions opened the gates for possibly managing SRM technologies within multilateral frameworks, and provided insights into how Global South-led science diplomacy is necessary for discussions and decisions around the ethics and governance challenges inherent in SRM research, technological development and potential deployment considerations (Corry et al 2024).

At UNEA-4 (2019), Switzerland introduced a resolution (supported by several other countries, including Mali, Burkina Faso, Niger, the Federated State of Micronesia, and Mexico) calling for UNEP to assess the science and governance of geoengineering (CDR and SRM combined). The resolution was quite modest, proposing that the UNEA executive director assess: criteria for defining geoengineering technologies, the current state of science, including on the risks and benefits; the current state and challenges of governance frameworks; relevant actors and activities; and possible future governance (Switzerland 2018a, Switzerland 2018b). The resolution was supported by some member states, citing

<sup>35</sup> <https://www.unep.org/environmentassembly/>.

urgency, given rapid scientific developments in geoengineering and lack of climate action. Others resisted, notably, the United States and Saudi Arabia, who argued that such an assessment should happen, or may already be happening, in other relevant scientific bodies (e.g. IPCC). There was also disagreement around the scope of technologies under the term ‘geoengineering,’ the role of the precautionary principle, and fear that negotiations on such technologies would threaten climate commitments made under other agreements, such as the Paris Agreement’s mitigation primacy and the Convention on Biological Diversity’s precautionary approach to addressing climate change (IISD 2019, Jinnah and Nicholson 2019, Sipra and Talati 2024). Despite informal negotiations resulting in a shorter, revised draft resolution that called for a global, intra-agency, collaborative assessment report, consensus was not reached and Switzerland eventually withdrew the draft resolution (IISD 2019).

At UNEA-6 (2024), Switzerland (along with Guinea, Monaco, and Senegal) again submitted a draft resolution, this time focused solely on SRM, which was withdrawn due to lack of consensus. In particular, the African Group of negotiators served as a bloc to stall negotiations, leading to Guinea and Senegal withdrawing their support for the draft resolution (Biermann and Gupta 2024). Deliberations and negotiations between member states raised significant concerns (some similar to UNEA-4) around technological and scientific gaps between countries in the Global North and South in terms of considering and/or developing such technologies, overlap with other institutions, and a fear that adoption of such a resolution would signal SRM as an acceptable form of climate action (IISD 2024). However, many member states also saw it as a crucial need to contend with this challenging and complex issue through the adoption of a resolution but recognized that the non-binding nature of UNEA decisions remains a hurdle to grapple with (Hassan 2024). Major groups and stakeholders warned against SRM, urging inclusivity and just transition, with calls for a ban on SRM open-air tests, and urging for adoption of a global non-use agreement for SRM.

In addition to the resolutions, it should be noted that UNEP, in partnership with WMO, also organized a consultative workshop and science-policy dialogue in May 2025 to facilitate learning among member states and key stakeholders on SRM, concluding that trust would have to be a ‘foundational element’<sup>36</sup>. It further organized a second such event in September 2025, which has not yet released a final report.

Positions on SRM at UNEA/UNEP are not mapping neatly along North–South lines. Coalitions have been fluid and issue-specific: many Global South member states from Africa, SIDS, and Latin America coalesced around precaution and development of ‘inclusion-first’ processes. Some European member states aligned with those aims, and several research agencies in the Global North supported bounded information gathering under strict safeguards, while a few powerful states resisted UN-led institutionalization altogether. That mix is creating cross-cutting alliances, across and within regions, shaped as much by trust in governance and equity concerns as by geography, which will likely be tested further in future UNEA proceedings. The debates at UNEA thus far have revealed grey areas. Several member states and major groups opposing any step that could normalize SRM are up against others that seek tightly scoped, transparent information gathering (often on risks only) to build capacity, and some pressed to include potential benefits in order to compare policy options.

This moving center of gravity from whether to study SRM to under what terms, with whose representation, and with what guardrails, is raising a critical question for anticipatory diplomacy: given its geographic location in the Global South, its history of building collaborations and capacity, and its consensus-based decision making structure, can UNEP and UNEA play a central role in building anticipatory diplomacy around SRM, and how? If it can, there are of course limitations, largely due to the fact that UNEP lacks organizational status within the United Nations system (i.e. it remains a program rather than a specialized agency). This relatively weak institutional status limits UNEP’s governing capacity, as it cannot, for example, compel compliance with mandatory requirements. However, UNEP is particularly well suited to serve as the core foundation for anticipatory diplomacy around SRM as it is already a global leader with respect to all four pillars of the anticipatory diplomacy framework (see Box 1), with for example, fostering international cooperation through consultative workshops and science-policy dialogues (honest brokering), access to information (capacity building), leading the global treaty negotiations around plastics, building on rich experience in other areas such as chemicals (global action), and it also offers analysis and guidance on emerging technologies such as AI (science anticipation). In these ways, UNEP could build on this deep experience to become an ideal site for anticipatory diplomacy around SRM.

<sup>36</sup> [www.unep.org/events/workshop/consultative-workshop-and-science-policy-dialogue-solar-radiation-modification](http://www.unep.org/events/workshop/consultative-workshop-and-science-policy-dialogue-solar-radiation-modification).

### 5.3. Convention on Biological Diversity (CBD)

#### 5.3.1. Evolution of SRM in CBD decisions

The CBD is a multilateral environmental agreement that was opened for signature at the Rio Earth Summit in 1992 and intended as a key tool for achieving sustainable development. Its three main goals are the conservation of biological diversity, the sustainable use of natural life, and the fair and equitable sharing of the benefits from the use of genetic resources<sup>37</sup>. Its Conference of the Parties (COP) provides advice, recommendations, and nonbinding decisions to guide implementation of the Convention as well as two additional protocols on biosafety and genetic resources.

This case study examines how collaboration between Global South countries and mostly Northern NGOs helped make the CBD the first multilateral forum to address a broad set of technologies packaged under the label of ‘climate-related geo-engineering,’ thereby framing subsequent discussion on the status of SRM under international law. Attention towards SRM was preceded by discussion at the CBD’s COP 9 (Bonn, 2008), when civil-society groups, notably the Action Group on Erosion, Technology and Concentration (ETC Group) and Greenpeace, raised alarms over commercial proposals for large-scale ocean fertilization, a proposed method of marine carbon dioxide removal. Several Global South delegations supported a precautionary position, including the African Group (with prominent contributions from South Africa, Nigeria, and Ethiopia), as well as Costa Rica (IISD 2008)<sup>38</sup>. Several other Southern countries, including Venezuela and the Philippines joined the EU and Norway in calling for a moratorium on *in situ* ocean fertilization (IISD 2008). The negotiations resulted in a decision that urged governments to prevent ocean fertilization activities on a precautionary basis, while allowing only small-scale scientific research under controlled conditions (Morgera 2011).

Building on the precedent set in Bonn on ocean fertilization, in 2010 the CBD went further at COP 10 in Nagoya. Parties broadened their concern to include all ‘climate-related geo-engineering’ activities, including SRM<sup>39</sup>. Country positions clustered into three main camps, which persisted in the following CBDs and included mixed coalitions between Global South and North. First, a precautionary/non-deployment camp, with Tuvalu, the Philippines, Costa Rica, Grenada, Bolivia, Philippines, and the African Group, aligned with NGOs, argued that no geoengineering activity should proceed until there is an adequate scientific basis and associated risks are considered (IISD 2010). Second, a conditional research-only camp, including Brazil, advocated for allowing only small-scale scientific studies within national jurisdiction and in a controlled setting, while the EU and Norway urged a cautious approach and emphasized strengthening the scientific basis before experiments (IISD 2010). Finally, a more permissive camp, which included Japan, suggested that some geoengineering activities could be beneficial for biodiversity and climate (IISD 2010).

The 2010 negotiations resulted in Decision X/33, which invited parties to consider guidance discouraging SRM activities unless undertaken under certain conditions including scientific necessity and prior assessment of impacts<sup>40</sup>. As others have noted previously, though this decision is often framed as a ‘moratorium,’ and while it is an important milestone in SRM governance, it was nonetheless a voluntary measure (see e.g. Morgera 2011, Parson and Ernst 2013, Jinnah and Dove 2025). This is in part because countries were ‘invited,’ and not required to follow this guidance. However, decision X/33 has been treated by many NGOs and others as a ‘de facto’ moratorium, which has contributed to subsequent debate on whether and how SRM is already governed, and whether SRM research and deployment is permissible or prohibited under international law (Lin 2015, Reynolds *et al* 2016, Ruddigkeit *et al* 2025).

Between 2012 and 2024, the CBD revisited geoengineering several times (see Convention on Biological Diversity 2017, Convention on Biological Diversity 2024). The decisions were incremental, consolidating a precautionary ‘no-deployment’ signal while leaving a narrow opening for tightly controlled research. Importantly, the guidance provided to parties in these decisions remained voluntary,

<sup>37</sup> [www.cbd.int/convention/guide/default.shtml](http://www.cbd.int/convention/guide/default.shtml).

<sup>38</sup> This section draws on reporting from the Earth Negotiations Bulletin as well as secondary academic articles to attribute country positions in CBD negotiations. Earth Negotiations Bulletin. (26 May 2008). CBD COP 9 highlights: Friday, 23 May 2008 (Vol. 9, No. 447) [PDF]. International Institute for Sustainable Development. <https://enb.iisd.org/events/cbd-cop-9/daily-report-23-may-2008>.

<sup>39</sup> The definition of geoengineering included SRM and carbon dioxide removal but excluded carbon capture and storage from emission sources. See the footnote to decision X/33 para 8 (w) in Convention on Biological Diversity (2010).

<sup>40</sup> Specifically, Decision X/33 invites parties and governments to consider ‘[ensur[ing] ..., in the absence of science based, global, transparent and effective control and regulatory mechanisms for geo-engineering, and in accordance with the precautionary approach and Article 14 of the Convention, that no climate-related geo-engineering activities that may affect biodiversity take place, until there is an adequate scientific basis on which to justify such activities and appropriate consideration of the associated risks for the environment and biodiversity and associated social, economic and cultural impacts, with the exception of small scale scientific research studies that would be conducted in a controlled setting in accordance with Article 3 of the Convention, and only if they are justified by the need to gather specific scientific data and are subject to a thorough prior assessment of the potential impacts on the environment.’ (Convention on Biological Diversity 2010, Decision X/33, par. 8(w)).

including when adopting the language of a moratorium for the first time in 2024. Relevant additional steps taken throughout these decisions include inviting parties to submit information related to their geoengineering activities to the CBD's clearing-house mechanism, and requesting the CBD's executive secretary to review existing regulatory instruments; prepare reports on the state of scientific knowledge on biodiversity-related impacts; and compile broader societal views on geoengineering and its potential impacts, including from governments, Indigenous and local communities, and other interested groups (Convention on Biological Diversity 2017).

Throughout these negotiations, many Global South parties, such as the African Group, Bolivia, Ecuador, Argentina, and others in the Group of Latin American and Caribbean Countries, and the Philippines supported reaffirmations of Decision X/33, the adoption of precautionary framing, and more transparent research frameworks for better understanding the impacts of SRM on biodiversity (IISD 2010, 2015). These states worked alongside some Northern parties such as the European Union to craft the CBD decisions, thereby shaping norms and discussion before pathways for experimentation and deployment are locked in place.

### 5.3.2. *Forging a foundation for North–South collaboration and anticipation*

The CBD has become one of the leading sites of emerging anticipatory diplomacy on SRM, having taken steps to catalyze international discussion on SRM soon after Paul Crutzen broke the taboo on SRM in 2006 by urging expanded research (see Crutzen 2006). The CBD's decisions, though lacking legal weight, have shaped discussion and debate on SRM by framing it as an issue requiring precaution, and parties have usefully identified a range of concerns, including risks stemming from governance gaps and scientific uncertainty. The CBD experience illustrates how anticipatory diplomacy might ultimately lead to multilateral frameworks that deter reckless use of SRM in an emergency by establishing early review and comprehensive impact assessment as a necessary requirement for proceeding with SRM activity. These early steps are needed to anticipate SRM's possible impacts and catalyze global action to address them before SRM is used, if ever.

The CBD's decisions and negotiations also provided structured opportunities for coalitions of states and NGOs to strategically frame issues in ways that shape diplomatic outcomes and international discussion prior to SRM's development and use. The CBD's openness to non-state parties creates fertile ground for coalition building and NGO influence, as observers are able to distribute draft language, offer technical frames, and lobby delegations. The ETC Group in particular was instrumental in advancing a justice-oriented framing in which SRM was not just another potential neutral technical choice, but rather a political and ethical issue that could exacerbate existing global inequities (ETC Group 2010, IISD 2015).

The CBD decisions also illustrate how North–South coalitions and global alignment on SRM can evolve around proposals that are ambiguous enough to capture a range of positions on key decisions related to research and deployment. The CBD decisions reflect an ambiguity where deployment without governance was ruled out but small-scale research was not expressly prohibited. However, the boundary between the two, and the legal status of Decision X/33, has been left unclear (Jinnah and Dove 2025). This created a lack of consensus on the status of SRM under international law, which has subsequently led to considerable debate and contestation over whether and how SRM is already governed. The consequences of this ambiguity have spilled over into other fora such as UNEA (Jinnah and Nicholson 2019). In that sense, the vagueness of the CBD's decisions may have impeded efforts to advance additional multilateral frameworks and initiatives on SRM to close governance gaps and reduce scientific uncertainty.

Nevertheless, the long-standing efforts and experience within the CBD surrounding SRM and the demonstrated ability of Southern countries to shape its decisions position the CBD as a potentially important piece of broader efforts to strengthen anticipatory diplomacy around SRM into the future. CBD parties have already demonstrated leadership on all four pillars of the anticipatory diplomacy framework (see Box 1). It has a track-record of creating a conducive environment for coalition-building and fostering broader societal discussion (honest broker); identifying and compiling information and views on potential biodiversity-related impacts (science anticipation); broadening access to and understanding of information on these potential impacts through reports, meetings, and consultations (capacity building); and producing multilateral decisions that reflect emerging global alignment on potential regulatory frameworks and governance norms (global action).

The challenge is whether and how the CBD's decisions can lay the groundwork for a strengthened governance framework that deters irresponsible activity and expands efforts to anticipate SRM's potential impacts. A key limitation facing the CBD is that its decisions lack legal force and implementation is voluntary (Parson and Ernst 2013; but see Zheng 2025). Several steps would be helpful in strengthening the

CBD's role in anticipatory diplomacy around SRM, including strengthening the legal basis for regulating SRM, encouraging more active participation from silent Global South countries, clarifying the line between research and deployment and the legal status of Decision X/33, and widening non-state participation beyond NGOs, with mechanisms for broader societal involvement, to ensure that decisions are not framed only by advocacy coalitions but by a broader spectrum of affected voices.

#### **5.4. Regional organizations in Latin America and the Caribbean**

##### *5.4.1. Evolution of SRM discussions in Latin America and the Caribbean*

In Latin America and the Caribbean (LAC), debates about SRM remain at an early stage. Only a handful of workshops, webinars, and background papers have been produced, often without coordination. Yet the involvement of two long-standing regional institutions—the Inter-American Institute for Global Change Research (IAI) and the Economic Commission for Latin America and the Caribbean (ECLAC/CEPAL)—marks a turning point. Both institutions play a key role in the region, have institutional legitimacy, and have an important mandate to represent regional perspectives in science and policy discussions, and assist governments in decision making on transboundary topics. Their engagement in SRM initiatives is crucial because it offers an opportunity for the LAC to build collective capacity, articulate regionally specific concerns, and participate more effectively in global diplomacy on SRM governance. This case study examines how IAI and ECLAC have developed initiatives on SRM in partnership with Global North Institutions, what actors have been involved, and what these efforts reveal about North–South collaborations. Together, both institutions address the scientific, policy and diplomacy dimensions of climate governance. Their involvement in SRM initiatives, described in detail below (see also supplemental material) reflects a growing awareness of the need to build and strengthen capacities on SRM in the region through North–South collaborations and evidence-based information to enable the LAC region to create its own narratives and shape the debate.

##### *5.4.2. Initiatives by IAI*

**IAI** is an intergovernmental organization created in 1992 that funds, coordinates, and promotes interdisciplinary research on global environmental change across the Americas. It is composed of 19 countries across the Americas and it predominantly works at the science–policy interface, bringing scientists and policymakers together in the co-production of knowledge, prioritizing capacity building in the region. The IAI has a scientific, transdisciplinary and a capacity building agenda, both articulated to assist decision making. Within the capacity building agenda lies the science diplomacy center aimed at building and strengthening capacities in science diplomacy and multinational collaboration. One of its key pillars is emerging issues in scientific diplomacy and innovation. In turn, the science agenda promotes transdisciplinary science and evidence-based information for decision making.

The IAI has convened some of the most important regional gatherings on SRM in collaboration with international organizations. One key initiative was ‘the Americas Conference on SRM: Science, Governance and Implications for the Region’ held in Jamaica in 2022. This meeting was organized by the IAI along with the Carnegie Climate Governance Initiative (C2G), the Degrees Initiative, the University of the West Indies, and was supported by the U.S. National Academies of Sciences. The event brought together policymakers, scientists, and experts from across the Americas to introduce SRM techniques, explore its potential risks and governance challenges, and emphasize the importance of inclusive deliberation. The other relevant initiative was held in 2025 as a three-part series designed to build regional capacities on SRM. It was co-organized with the Degrees Initiative and The Alliance for Just Deliberation on Solar Geoengineering (DSG). The first virtual workshop provided an introduction to climate modeling and SRM research with attention to regional vulnerabilities. The second virtual workshop explored governance frameworks, ethical and social dimensions, and implications for vulnerable communities. The third one, scheduled in October 2025 in person in Bogotá, simulated multilateral negotiations on SRM governance—an innovative exercise aimed at preparing LAC policymakers for participation in international fora, particularly UNEA. Through these initiatives, IAI has opened up the discussion in the region and positioned itself in a leading role to bridge the gap between science and policy by bringing together experts from the Global North and South to build capacities in the LAC region and advise decision makers on the implications of SRM both regionally and globally.

##### *5.4.3. Initiatives by ECLAC*

**ECLAC** is a United Nations regional commission founded in 1948 and works at the intersection of economic and social development, producing evidence-based analyses and policy recommendations for governments. On climate change, ECLAC has emphasized sustainable development, inequality, and long-term social and economic planning.

Since 2020, ECLAC has also taken a leading role in enabling discussion on climate change and SRM in the LAC region. With the support of C2G and other relevant organizations, ECLAC has complemented IAI's scientific orientation with policy-focused activities including side events, virtual seminars and webinars, and policy-relevant knowledge production. From webinars and side events at different policy-relevant and high level meetings, such as COPs and in-person conferences on climate change, ECLAC has become a regional convener for policymakers, stakeholders and experts in climate change and SRM. One key policy outcome is the release of a background paper titled 'Strengthening regional capacities to address the risk of and from overshooting 1.5 °C global warming in Latin America and the Caribbean in 2024.' Led by Fundación Torcuato Di Tella (Argentina) and funded by C2G, the paper analyzed the risks of climate overshoot for the region and the potential role—if any—for SRM in managing these risks, aiming to build governmental and non-state actor capacities in the region. This document presents SRM within a portfolio of potential responses to the risk posed by overshoot and explores the state of the art of scientific understanding with an LAC focus (Carlino *et al* 2024).

#### 5.4.4. Joint activities

In October 2023, IAI and ECLAC, in partnership with C2G, conducted a survey of government representatives to assess perceptions and levels of knowledge about SRM. Responses from officials in seven countries (Colombia, Costa Rica, Ecuador, Honduras, Panama, Paraguay, and Peru) revealed both limited awareness and significant interest in further information and capacity building on SRM. This was the first systematic attempt to explore LAC governments' positions on SRM and illustrates how these organizations can jointly shape regional understanding.

Joint outreach initiatives in the region have targeted relevant social and institutional actors, such as national government representatives, including decision-makers from ministries of environment, science and technology, foreign affairs, and other scientific agencies in many countries, for instance Argentina, Brazil, Mexico, Jamaica, and others who attended the workshops. Workshops and activities gathered policymakers, researchers, think tanks and NGOs to discuss the technical, political and ethical implications of SRM for the region. A significant outcome of the workshops is that most of the attendees were largely unfamiliar with SRM and have expressed interest but also caution, emphasizing knowledge gaps and governance risks rather than taking positions for or against SRM research. One key feature of these events was the opportunity to build relationships between local experts and policy makers, facilitating mutual trust and policy-relevant knowledge exchange. These interactions represent important first steps toward long-term engagement and ensuring local ownership of the topic.

#### 5.4.5. Building a sense of ownership in North–South collaborations

This sense of ownership has started to take shape through the strengthening of research capacities among local experts, including through assessments of potential local impacts, risks, and benefits of SRM in the LAC region. At the same time, bridges are being built between policymakers and national universities and research groups, such as the University of Buenos Aires in Argentina, the National Autonomous University of Mexico, and the University of the West Indies in Jamaica. These countries are developing capacities to better understand SRM's potential impacts on the region through computer modeling. Moreover, since 2024, Argentina, Brazil and México are also conducting research on the socio-political dimensions of SRM for the region. These research projects are funded by the Degrees Initiative, ARIA, the WHO, and feature collaboration with other relevant institutions leveraging research and policy capacities.

As SRM is not a priority in the region, these initiatives rely mostly on organizations from the Global North, in terms of funding and supporting expertise. Yet, building partnerships with authoritative institutions such as IAI and ECLAC allowed for regional ownership of the issue and enabled researchers and policymakers to better understand the implications of SRM to support informed decision-making. In practice, this ownership manifests in two main ways. First, Latin American research and policy institutions were encouraged to set their own research questions and policy priorities and frame debates around local vulnerabilities, such as potential impacts of SRM on rainfall patterns, water security, and other regional concerns (Camilloni *et al* 2022). Second, by strengthening research and governance capacities, the region can adapt global assessments of SRM to its own socio-environmental realities, ensuring that knowledge and recommendations are contextually and culturally relevant. Despite certain asymmetries between the Global North and South, those partnerships have generally been collaborative rather than prescriptive, with strong emphasis on regional ownership. IAI and ECLAC maintain a neutral stance on SRM by focusing not on advocating for specific policies but on providing evidence-based information to support informed decision-making by regional and national governments. As the IAI

science director observes, 'We cannot think of global solutions without hearing the voices of regions that have historically had less participation in international scientific decision-making.'<sup>41</sup>

The involvement of IAI and ECLAC demonstrates that SRM is no longer exclusively a Northern debate. By convening policymakers and producing contextual knowledge, these institutions have begun to ensure LAC perspectives will be represented in global discussions. Yet this case also highlights key challenges facing regional initiatives that are acting as focal points for anticipatory diplomacy on SRM: dependence on external funding, uneven participation across countries, and the need to sustain regional research infrastructure and capacity building initiatives. Prospects for sustained funding and regional ownership of research infrastructure and capacity building in LAC will likely depend on a combination of growing institutional capacities in the region and strategic engagement with external partners. While countries in the region have contributed least to the climate crisis, the Global North has a responsibility to support initiatives that address its current consequences, including by supporting efforts to research and govern SRM in the region. At the same time, building local capacity is crucial. Many LAC countries are still developing familiarity with these topics, and investing in training, knowledge-sharing and outreach can raise awareness, foster ownership, and incentivize national investments in policy and research agendas. Achieving this balance between the external funding while expanding regional ownership is key for strengthening local capacities to shape research agendas and policy debates.

In terms of anticipatory diplomacy, these initiatives are helping to lay the foundation for LAC engagement in international debates, ensuring that when SRM governance emerges as a pressing global issue, the region is not unprepared or subject to external agendas. The IAI and ECLAC case therefore highlights the importance of regional organizations working alongside broader efforts to advance anticipatory diplomacy around SRM. These organizations' joint initiatives are already demonstrating regional leadership across all four pillars of the anticipatory diplomacy framework (see Box 1). The initiatives enable the region to move from a reactive position to a more proactive role by enabling researchers in the region to study SRM and its potential impacts (science anticipation); connecting local experts and researchers with decision makers, local communities, and government representatives (honest brokering); strengthen regional capacities to understand SRM and bolster regional perspectives in international discussion (capacity building); and build international collaborations that could catalyze future multi-lateral initiatives (global action). In this sense, IAI and ECLAC play the role of boundary organizations (Guston 2001), navigating the interface of science and policy and elevating the voice of the region in global debates. Meanwhile, strengthening institutional collaboration, negotiating long-term commitments, securing stable funding, and building stronger networks will be essential to empower the region, avoid marginalization and foster regional ownership of the issue of SRM.

#### 5.4.6. Case study limitations

Our analysis of these cases is limited primarily by access to data. Specifically, we draw on publicly available information of the process and outcomes of diplomatic activity surrounding SRM across each case, including from reporting efforts such as the Earth Negotiations Bulletin and from secondary sources including other scholarship. Yet the positions of countries and other actors, the process of negotiating and revising treaties and related decisions, and the interactions between actors inside and outside of negotiation halls are either not well documented, or the information is not made public. For example, draft texts and other submissions for UNEA are only available to accredited participants (see McLaren and Corry 2025). Aside from gaining access through accreditation, future research to better understand the influence of Global South actors can pursue several paths, including generating additional primary data using methods like collaborative event ethnography (see Witter *et al* 2015). The use of process tracing using available data would also be helpful in confirming our attributions of Global South influence.

## 6. Discussion: anticipatory diplomacy as a vision to level capacity to anticipate, shape, guide the future

In this section we identify key cross-cutting conclusions that emerge from our empirical analysis of cases of Global South involvement in international diplomacy in section 5. Specifically, we discuss two conclusions related to the persistence of challenges facing growing Global South leadership and the lack of a clear North–South divide on SRM. We draw on examples from each case to explore these conclusions. Overall, the discussion illustrates how Global South participation in SRM research and governance is altogether growing, varied, uneven, and yet still constrained by well-documented disparities. As such,

<sup>41</sup> [www.iai.int/en/news/detail/IAI-and-CONICET-promote-debate-on-emerging-technologies-ethics-](http://www.iai.int/en/news/detail/IAI-and-CONICET-promote-debate-on-emerging-technologies-ethics-).

while our analysis in section 4 illustrates how each diplomatic venue is already emerging as important sites for anticipatory diplomacy, the discussion here explores how the vision of anticipatory diplomacy remains aspirational; current diplomatic activity still falls short of the vision of anticipatory diplomacy in several key ways. We leverage this vision to identify recommendations to enable the Global South's proactive leadership on SRM. Many of these recommendations have been identified previously, indicating their ongoing salience. By putting the prescriptive ideas of anticipatory diplomacy in conversation with our empirical analysis of real-world cases of SRM diplomacy, our discussion reveals important insights into the past, present and potential future roles of the Global South in anticipatory diplomacy on SRM.

*Conclusion 1: Global South engagement is growing but continues to face challenges stemming from disparities in funding, vulnerability, and research capacity and a gap between growing regional expertise and decision-making.*

Our cases collectively show that while some actors in the Global South are increasingly involved in SRM diplomacy and are also having demonstrable influence in some cases, a lack of coordination between SRM experts and policymakers and entrenched disparities in funding, research capacity, and climate vulnerability continue to constrain the Global South's ability to exercise proactive leadership on SRM, which raises challenges for anticipatory diplomacy<sup>42</sup>.

This is shown across our cases. At the IPCC, recent improvements in Global South authorship and leadership and a growing SRM research output from Southern experts still risks being overshadowed by entrenched disparities in North–South participation. The assessment process may reflect Northern interests and priorities because Northern countries still retain most funding and research capacity. From the perspective of anticipatory diplomacy, this threatens the multilateral system's ability to ensure developments in science and technology provide equitable global benefits and minimize the potential risks most relevant to climate vulnerable countries. This is because scientific assessment, as well as the practice of anticipation, is most robust when the knowledge, narratives, values, and worldviews of as many diverse communities as possible are included (see e.g. Stevenson 1996, Stirling and Scoones 2009). Understanding the potential impacts of SRM on diverse livelihoods requires inclusion and respect for the knowledge and experiences of peoples within local contexts (Hourdequin 2019). More equitable inclusion of Global South experts in AR7 and beyond is therefore needed to fully enable the potential of science anticipation because these experts are best positioned to anticipate how SRM might impact development-related sectors and issues that are most directly relevant in their communities, countries, and regions.

In the CBD case, there is uneven participation within the Global South, but those countries that were active were surprisingly decisive in Decision X/33, despite having little research capacity and scientific resources. While this shows the Global South can effectively engage in anticipatory diplomacy to constrain future SRM developments, doing so without access to regional SRM expertise and evidence-based information also poses risks. During earlier negotiations, there was not yet a cadre of Southern SRM experts that could inform the CBD negotiations. During more recent negotiations in the CBD, emerging SRM experts in the Global South were not included in countries' negotiations, creating a missed opportunity to leverage growing regional expertise and knowledge. NGOs have been able to capitalize on this gap by drawing on rhetorical strategies that signaled alignment with the Global South, and amplified the political weight of precaution, resulting in continued pronouncements of support for an ambiguous decision that has created confusion on whether and how SRM is currently governed. From the standpoint of anticipatory diplomacy, exercising influence without regional expertise and cutting-edge scientific knowledge is limiting as it constitutes diplomacy *about* science, but *without* science—the gap between science and diplomacy remains unbridged.

Finally, the IAI-ECLAC case shows how initiatives in the LAC region rely on the Global North for funding and institutional support because SRM is not a priority within the portfolio of strategies to deal with climate change and overall awareness and research funding is low, even in comparison to other regions in the Global South such as Africa. In that context, North–South collaborations that channel external funding and institutional support to the Global South is the necessary first step to enable anticipatory diplomacy. However, the external dependency also means anticipatory diplomacy can suffer if the external support wavers or becomes a source of leverage or influence over Southern partners. And yet without funding from the Global North, many countries cannot develop needed anticipatory capacities. The challenge then becomes how to expand the external funding and institutional commitments that support anticipatory capacity building in this region while maintaining and increasing regional ownership of capacity building initiatives (see also Dove et al 2024, Mutiso 2024).

<sup>42</sup> Some of these issues, most notably a lack of coordination between experts and policymakers and a lack of dedicated or sufficient research funding may exist in countries in the Global North as well.

Anticipatory diplomacy clearly faces many challenges, as it requires broad multilateral capacity to anticipate and shape future developments related to SRM across multilateral initiatives. And yet, our cases show that although the Global South is becoming increasingly active, more informed participation and expanded support is needed. Two key pillars of anticipatory diplomacy—capacity building and science anticipation—provide guidance to address these challenges.

Building from these pillars, we highlight the following two overarching recommendations and provide specific guidance to address challenges related to disparities in funding, vulnerability, and research capacity and a disconnect between regional SRM expertise and decision-making across the Global South:

**Recommendation 1: Expand funding for SRM research in the Global South.**

- a. To maximize policy impact and influence over narratives within international assessments, recipients should consider developing research and expertise in the near term on areas of interest to the IPCC, e.g. reversibility, termination shock, and global governance, in addition to continued research on areas that reflect local and regional priorities.
- b. Research that bridges modeling and socio-political research and engages communities with diverse perspectives in knowledge production is especially needed to develop policy-relevant knowledge.
- c. Additional institutional support for regional networks that aim to coordinate SRM research is needed to expand these into continent-wide initiatives (see Quagraine *et al* 2025a).

**Recommendation 2: Ensure regional experts inform multilateral negotiations and policy-making processes.**

- d. Sustained institutional support for policymaker dialogues and regional networks that aim to increase collaboration between scientists, policymakers, researchers, and other non-state actors is needed to enhance the impact of these activities.
- e. Emerging capacity building efforts focused on building foundational knowledge on SRM and other governance capacities in policymaker and civil society communities are critically important.
- f. In addition to building research capacity, efforts that aim to build researcher's capacities related to science communication, policy advising, and anticipation are also needed.
- g. Targeted capacity support for scientists and researchers working in IPCC assessment processes and other international negotiations can help ensure these experts are able to fully participate in assessments and negotiations.
- h. Given the complexity of SRM, sustained interaction between experts, policymakers, and civil society with ongoing follow-up is needed to build foundational knowledge.

*Conclusion 2: SRM is not a simple North–South issue. Countries in the Global South are taking on varying roles and positions on SRM that do not neatly follow North–South divides.*

The Global South is not only taking on a growing role in international diplomacy on SRM. Our cases also show that countries in the Global South are taking on *multiple and increasingly diverse roles and positions* in international diplomatic initiatives on SRM, including by forging emerging coalitions that are bringing together both state and non-state actors from the Global North and Global South. This means that support for and resistance to SRM as a potential climate response option does not fall neatly along North–South lines. The same is true for positions on more immediate questions related to whether, where, and under what terms should SRM be studied and assessed, with whose representation, and with what guardrails. As a result, the fault lines of international politics and diplomatic contestation on SRM are messier than has commonly been assumed. From the perspective of anticipatory diplomacy, this creates challenges for near-term global agreement on the implications of SRM and development of multi-lateral options for assessment and governance. At the same time, it also means there are opportunities for crafting North–South coalitions that also include collaboration across scientific, diplomatic, civil-society, and other communities when there is alignment on key issues. Leveraging these coalitions will be needed to proactively establish transnational initiatives that enable and govern legitimate SRM research and assessment activity, which can then expand down the road. However, these coalitions face challenges in the near term related to navigating North–South and South–South power dynamics and ensuring the Global South retains regional ownership and autonomy.

These insights also run across our cases. In the IPCC case, as experts from the Global South become increasingly involved in authorship of IPCC assessments, including in positions of leadership, they are expected to take on active roles in ensuring SRM is assessed in line with the diverse interests, priorities, narratives in the Global South. AR7's inclusion of issues related to SRM governance, ethics, and regional impact analyses including of development-relevant risks can likely be at least partially attributed to the involvement of SRM experts from the Global South in AR7 scoping meetings. North–South coalitions within the IPCC assessment process may also emerge between like-minded scientists on certain issues. These coalitions could be catalyzed by pre-existing research collaborations, as for those SRM experts funded through the Degrees Initiative, many of them have worked with SRM experts from the Global North who act as research collaborators through the Initiative's research funds. From the perspective of anticipatory diplomacy, the IPCC's success in forging global agreements on climate change could potentially translate into catalyzing global action and cooperation on SRM if the IPCC's assessment of SRM is widely perceived as legitimate. To that end, more equitable authorship and leadership and an expansion of targeted capacity support for Global South authors would be needed.

In the UNEA case, countries in the Global South have taken on a variety of positions surrounding issues related to whether and how UNEA should assess SRM. At both UNEA-4 and UNEA-6, Switzerland introduced each resolution with the support of a different array of countries including several in the Global South, signaling the potential for continuing North–South diplomatic cooperation on SRM assessment activity. Some countries, notably the Africa group, were instrumental at UNEA-6 in stalling negotiations leading to the withdrawal of the resolution. However, their opposition to the Swiss proposal does not seem to be an absolute rejection of any initiative to establish anticipatory governance of SRM, given their support for a repository of information on SRM and for a non-use agreement (Biermann and Gupta 2024, Jinnah and Dove 2025). Future UNEA meetings could see African countries taking on a wider range of positions on key issues related to SRM assessment, possibly in coalition with countries in the Global North such as some European member states. This may become increasingly likely if the current divide between African negotiators and the deepening SRM expertise in Africa is bridged. Overall, the UNEA case demonstrates that a more complex array of fault lines on SRM appears to be emerging. Issue-specific coalitions between the Global North and South could advance progress towards enabling anticipatory diplomacy by facilitating continued dialogue in between UNEA meetings and cooperation on shared goals outside of the UNEA framework.

In the CBD case, some countries in the Global South took on a more unified precautionary position in favor of restricting outdoor research activity in Decision X/33. These countries' influence on the final text of Decision X/33 was achieved in part due to an emerging coalition between themselves and NGOs opposed to SRM research, based primarily in the Global North. From the perspective of anticipatory diplomacy, coordination between states and NGOs, in addition to other actors such as scientists, is needed to proactively build consensus on global norms and leverage different actor's knowledge and capacity to anticipate and govern SRM research. At the same time, when NGOs persuade states to adopt positions that align with an NGOs' own position, critical questions arise related to power dynamics between North and South. By failing to provide information that reflects a balanced consideration of risks and potential benefits, NGOs' roles as honest brokers and trusted sources of information and expertise can become untenable and Southern countries and communities are disempowered from crafting their own narratives and positions on SRM. Most fundamentally, anticipation of future developments of a technology such as SRM will likely fall short when not adequately informed by a balanced provision of evidence.

Finally, the IAI-ECLAC case shows most clearly how North–South collaborations can be forged to raise awareness and build research and governance capacity on SRM in vulnerable regions while maintaining regional ownership over the issue. It highlights the importance of honest brokering and building partnerships with 'boundary organizations' such as IAI and ECLAC, which are widely regarded as neutral on SRM and credible providers of evidence-based information. This also goes both ways, as the credibility of Northern institutions as honest brokers is critical to building trust and sustained collaborations. The empowerment of Southern organizations in the region, albeit with Northern funding and institutional support, has enabled these organizations to spearhead crucially important dialogue, capacity building, and knowledge sharing activities that, if sustained, can enable the LAC region to proactively develop its own narratives and understandings of SRM. Expanded and sustained institutional support for these efforts can go a long way towards enabling the LAC to in turn shape international debates and negotiate multilateral frameworks that reflect regional knowledge and priorities.

As we have shown, SRM is not a simple North–South issue. Communities and sectors within and across the Global North and South have diverse perspectives on questions such as whether SRM should be considered as a potential climate response option and whether, how, and by whom SRM should be

researched, assessed, and governed. Countries in the Global South in particular include a wide variety of communities and Indigenous groups, and many groups have different understandings of related issues, such as for example, the relationship between humans and nature. Any effort to engage these diverse communities in efforts to build awareness, discuss, and anticipate the potential impacts of SRM on these communities will need to be tailored to local contexts and attentive to a plurality of possible viewpoints to be effective (see, e.g. Jinnah *et al* 2026). Embracing this diversity of perspectives while working proactively to find common ground and build shared norms and goals presents a challenge, but it also highlights an opportunity for anticipatory diplomacy of SRM: the international politics of SRM need not become hopelessly gridlocked in the entrenched North-South politics that stymies proactive cooperation on many issues. Continuing to build on and expand support for North-South collaborations between trusted institutions that are attentive to issues of power, ownership, and leadership will be key to ensuring countries across the Global South are empowered to anticipate, understand, and govern SRM.

Building from these conclusions, we offer the following overarching recommendation to harness emerging North-South and South-South coalitions and increasingly diverse Global South roles and positions in support of proactive multilateral action to anticipate, assess, and govern SRM:

**Recommendation 3: Strengthen North-South and South-South collaborations.**

- a. Southern ownership within North-South initiatives can be prioritized by establishing long-term partnerships with trusted local institutions and transferring decision-making over funding allocations and priority issues to local institutions.
- b. North-South and South-South coalitions and initiatives should be prepared to expand participation to include new partners as positions on SRM change and as effectiveness in capacity building efforts is demonstrated.
- c. NGOs currently focused on lobbying and influencing state positions on SRM should consider refocusing attention towards supporting societal engagement initiatives within the Global South to empower Southern communities to build their own informed perspectives and narratives about SRM from the ground up.

## 7. Concluding thoughts

Biermann and Möller (2019) characterized SRM as a ‘rich man’s solution’ because ‘the discussion about whether and how to engage with [SRM] is shaped by experts from just a small set of countries in the Global North.’ In some ways the situation has not changed fundamentally: Global South involvement remains uneven and overall insufficient in comparison to the central role that these countries should play (Rahman *et al* 2018, Quagraine *et al* 2025a). The Global North still dominates in research funding and it retains the most research capacity. However, as we have also shown here, SRM discussions are now being increasingly shaped by experts and policymakers in the Global South and Southern countries have driven key diplomatic outcomes. The SRM landscape has changed significantly across the past decade in this respect.

A growing network of experts from the Global South are actively engaged in research and international discussion on SRM. This is due in large part to the efforts of NGOs such as the Degrees Initiative and DSG to build expertise and foundational knowledge in the Global South and support Southern SRM experts as they, for example, participate in international assessments on SRM and author authoritative reports; form networks to coordinate research; contribute to societal debates; and initiate dialogue with policymakers. These trends have been illustrated in our preliminary analysis of the novel set of empirical indicators of growing Global South engagement in SRM research and politics. We also demonstrated how the indicators enable future research tracking developments across time to evaluate how anticipatory diplomacy is being realized in practice, including across countries and regions. More specific quantitative indicators could be developed to measure progress across the various types of activities. The ongoing activity we highlight raises questions about the different forms Global South engagement can take, and the different impacts this activity may have on research and policy.

Moreover, we have also shown across our detailed case studies of Global South involvement in SRM diplomatic venues how some countries in the Global South have been instrumental in recent international diplomatic discussions and (non) decisions on SRM, and how these international fora are emerging as sites for anticipatory diplomacy around SRM. While these negotiations have been explored to various degrees in previous research, to our knowledge we are the first to focus on the varying roles

Global South actors and North–South politics played in driving outcomes across cases. Our analysis highlights two overarching conclusions, each of which sheds new light on previously unappreciated features of SRM diplomacy and has important implications for research and debate.

First, we concluded that Global South engagement is growing but continues to face challenges stemming from disparities in funding, vulnerability, and research capacity as well as a gap between growing regional expertise and decision-making. This means that simplistic descriptions of the Global South as lacking expertise and agency on SRM are outdated, and nuanced discussions and research that acknowledges and explores both growing engagement and entrenched challenges, disparities, and constraints are needed.

Second, we concluded that SRM is not a simple North–South issue, as countries in the Global South are taking on varying roles and positions on SRM that do not neatly follow a North–South divide. This means that, centrally, broad characterizations of the Global South as either in favor of or opposed to SRM obscure a more complex reality, and greater attention is needed towards emerging South–South and North–North contestation and dueling North–South coalitions spanning a spectrum of positions on key issues. Research that explores potential scenarios of minilateral North–South deployment coalitions is warranted.

Altogether, these insights challenge existing narratives and framings of SRM politics and diplomacy premised on either a North–South divide, or a monolithic or uninvolved Global South. In contrast, our analysis suggests the need for a novel narrative of SRM international politics and diplomacy premised on recognition of growing expertise and the multiple and increasingly diverse and influential roles and positions being taken on by countries and other actors in the Global South.

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## Data availability statement

The data that supports the findings of this study are openly available in the supplementary files of this article.

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