UNITED NATIONS ENVIRONMENT ASSEMBLY (UNEA)

STUDY GUIDE

Regulation of solar radiation modification and other geoengineering technologies under international environmental law.

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MUNIFL'26

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1. Letter from Secretary General

Dear Esteemed Delegates, Academic Team, Hardworking Organization Team, Advisors, Staff and Partners,

I would like to welcome all of you to the third official session of the Model United Nations of Izmir Science High School! I am Hazal KUŞ and I am more than proud to serve as your Secretary General in this amazing conference.

Our aim is to ensure that all of your needs are covered. While preparing for the conference, our executive, organization and academic teams worked really hard to provide you with everything and I would like to express my biggest appreciations to them for their efforts. We are sure that MUNIFL'26 will be the best conference you've ever been in!

During the conference, you will not only be a part of diplomacy and discussing current topics, but you will also engage in meaningful debates, exchange diverse perspectives, and develop critical thinking and communication skills. At the same time, you will create strong bonds with others, build lasting friendships, and gain unforgettable experiences that go beyond the formal sessions.

As the Secretary General of this conference, I suggest you to read your study guides properly and do research about your agenda item as it will make your experience even more productive. I hope you all will have a fantastic conference full of unforgettable memories.

Best Regards!

Hazal Kuş
Secretary General
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2. Letter from the Under-Secretary-General

Meritorious participants,

Welcome to the United Nations Environment Assembly (UNEA) and to our committee on geoengineering, one of the most controversial, darkest, and yet fascinating aspects of the climate crisis. I am Nisa İltekin, currently a 2nd year Industrial Engineering student at Bogazici University. I am proud to serve you as your Under-Secretary General. I believe this agenda item is far more niche, multifaceted, and boundary-pushing than typical MUN topics, at the intersection of international law, environmental engineering, and global ethics. I hope you share this excitement as you step into the committee room.

First, I must state that this Background Guide has been meticulously prepared to provide you with a comprehensive understanding of the fundamental framework, the daunting mechanisms behind these technologies, and the legal loopholes in the international arena. However, when it comes to generating resolutions, forming blocs, and managing crises, relying solely on this guide will not suffice. For example, let's say the country you represent is a fragile state that will suffer from regional climate changes or monsoon shifts caused by Solar Radiation Modification (SRM) applications; or, for purely political and ethical reasons, categorically opposes such radical geoengineering methods. This is precisely where you will need to delve into international academic papers, conduct in-depth, specific research, and most importantly, think strategically about this crisis in order to defend your country's interests and exploit those legal loopholes to your advantage.

My expectation is that you don't view this committee as just a weekend simulation. The effort and research you put into preparing for this committee will not only earn you a MUN certificate; it will also build your intellectual foundation in a visionary field where you can write academic papers, develop projects during your university life or career.

By the time you finish reading this guide, you will already have a complete grasp of the complex and weighty terminology of geoengineering. Immediately afterward, I strongly recommend that you review the resources and articles I have

carefully compiled in the "Further Reading" section to strengthen your arguments and broaden your horizons.

I look forward to sharing a table with you in this challenging and unforgettable committee where we will decide who will hold the thermostat of the global climate.

Before wrapping up, I would like to give my incredible thanks to the Secretariat and the whole MUNIFL team. Here is a fun fact: I graduated from Izmir Science High School at 2024 and I was once a part of this amazing club. I feel honored to be here, and I hope you will enjoy the conference experience as much as I will.

Best regards,

Nisa İltekin

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3. Introduction to UNEA

The United Nations Environment Assembly (UNEA) is the world's highest-level decision-making body on the environment, with a universal membership of all 193 UN Member States. UNEA meets biennially to set priorities for global environmental policies and develop international environmental law. *(International Institute for Sustainable Development, n.d.)*

The UN 2030 Agenda for Sustainable Development is implemented with the help of the Assembly, which also acts as a catalyst for intergovernmental environmental action. Additionally, UNEA is the United Nations Environment Programme's (UNEP) governing body.

Established following the Rio+20 Summit in 2012, this massive body is tasked with setting the global environmental agenda, developing strategic policies to address ecological crises, and coordinating the world's response to emerging environmental threats. UNEA functions as a kind of environmental parliament for the planet; it sets the norms of international environmental law and oversees the implementation of the Sustainable Development Goals. It is essential for the delegates to understand that this committee is not merely a platform for discussion, but rather an authority that charts the course of all global environmental policies, that this is a fundamental requirement for the committee's seriousness.

However, when the assembly's limits of authority and capacity are examined, a crucial soft law reality emerges. UNEA cannot make legally binding (which is called as hard law, we will discuss about this term in later chapters) decisions like the United Nations Security Council (UNSC) or impose economic/military sanctions on countries that do not comply with the rules. Resolutions and declarations adopted by UNEA provide a strong normative framework rather than directly imposing legal obligations on states. These decisions create peer pressure, lay the groundwork for future binding international treaties, and guide states' domestic legal systems. It is essential that delegates understand the assembly's non-enforceable but highly influential political nature throughout the committee; for the real diplomatic challenge is how a committee without "police power" will

persuade states to take joint action.

It is precisely because of this *governance vacuum* that the UNEA is the perfect arena to discuss risky geoengineering technologies, such as Solar Radiation Modification (SRM), which could change the fate of the planet and for which there is still no legal framework. Since there is no specific and binding international law governing these technologies, the UNEA's primary task is to build the much-needed global ethical and regulatory standards for their research, limitation, or application. In short, the UNEA does not dictate to states what to do; But by creating a shared climate conscience on behalf of all humanity, it erects an insurmountable diplomatic and scientific wall against states seeking to take unilateral steps.

4. Introduction to the Agenda Item: Regulating Solar Radiation Modification (SRM) and Geoengineering Technologies under International Environmental Law

The inadequacy of traditional emission reduction methods in combating climate change has brought humanity to the brink of radical and controversial technologies such as Solar Radiation Modification (SRM) and Geoengineering. I want to note that this agenda item is not merely a technical environmental engineering issue; it is also a massive crisis area where the fundamental pillars of international law (sovereignty, state responsibility, and binding force) are being tested. Instead of cleaning greenhouse gases from the atmosphere, SRM aims to “mask” global warming by reflecting sunlight back through methods such as spraying reflective particles (SAI) into the stratosphere or brightening clouds (MCB). On the other hand, while Carbon Dioxide Removal (CDR) technologies attempt to address the root of the problem, both approaches risk creating unpredictable butterfly effects on ecosystems. You need to rigorously analyze whether these interventions are merely technical band-aids or a planetary gamble, and address this process in all its dimensions.

In case if you did not understand anything from the agenda item, let’s dive deeper into what actually the SRM is. Solar Radiation Modification, or solar geoengineering, refers to proposed, large-scale techniques designed to temporarily

cool the Earth by reflecting a small percentage of sunlight back into space. The interest in SRM arises from ongoing global warming, increasing risks to both human and natural systems. *(NASA, 2019)*

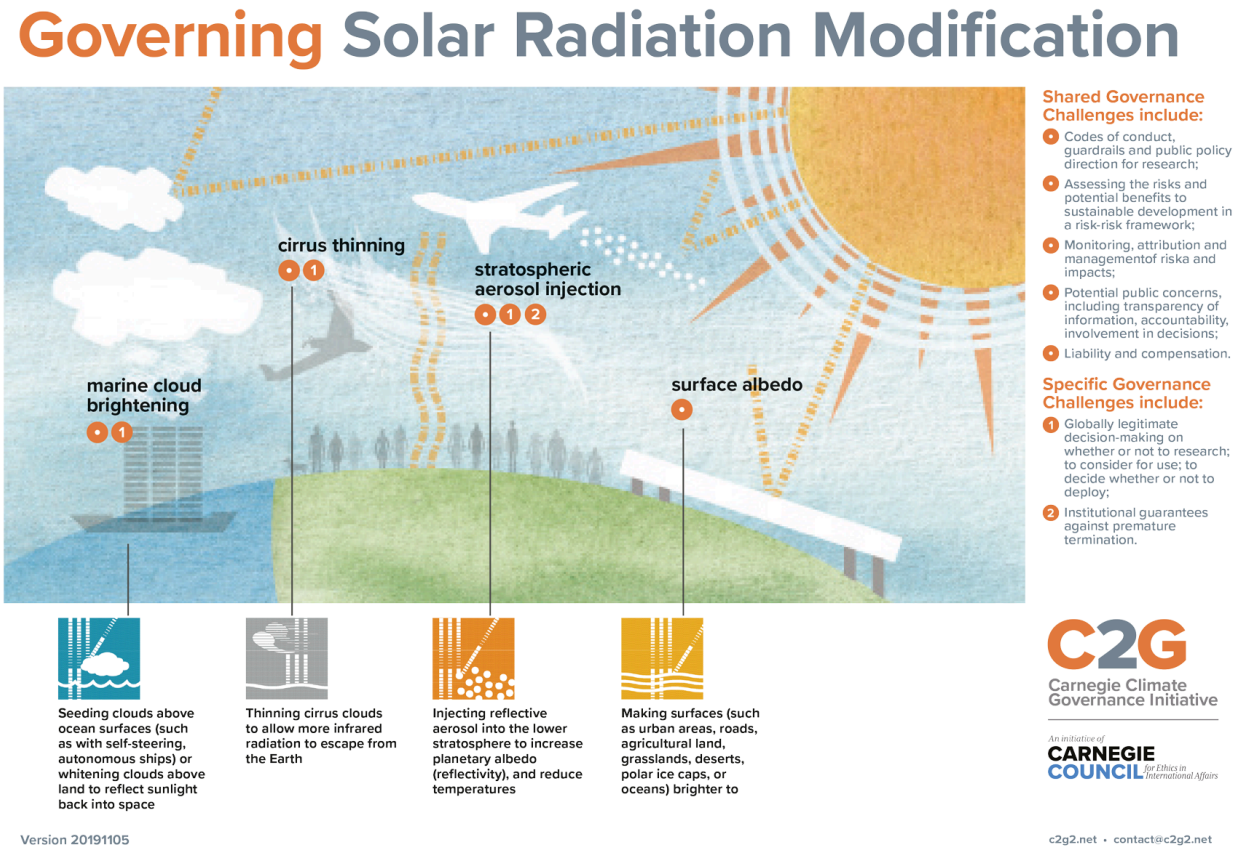
In principle, achieving net-zero emissions through emissions reductions and CDR could halt global warming. However, emissions reductions have consistently fallen short of targets, and large-scale CDR may not be feasible. The 2024 UN Environment Programme (UNEP) Emissions Gap Report said that current policies would likely lead to 3.1 °C global warming country's commitments and pledges to reduce emissions would likely lead to 1.9 °C warming. *(UNEP, 2024)*

The concept is based on artificially increasing the planet's *albedo* (reflectivity) capacity. Stratospheric Aerosol Injection (SAI), the most researched SRM method, mimics the natural cooling effect of large volcanic eruptions; sulfur dioxide (SO2), calcium carbonate, or specially designed nanoparticles are sprayed into the lower layers of the stratosphere (15-25 km altitude) using specially modified aircraft or high-altitude balloons. These particles transform into sulfate aerosols in the stratosphere, dispersing incoming solar radiation before it reaches the troposphere and the Earth's surface. Another important technique, Marine Cloud Brightening (MCB), aims to increase the density, lifespan, and reflectivity of marine stratocumulus clouds by spraying sea salt aerosols into the lower atmosphere above the ocean via autonomous ships. These particles act as cloud condensation nuclei (CCNs).

However, the most critical technical aspect of SRM is that it does not address the root cause of anthropogenic climate change; it has no effect on chemical problems such as ocean acidification because it does not reduce carbon concentration in the atmosphere. Furthermore, the application must be carried out continuously to maintain the artificial cooling effect of the system; if the injection is suddenly stopped due to any geopolitical or economic crisis, a devastating thermal rebound called a termination shock occurs, leading to a catastrophic increase in global temperatures at a rate that ecosystems cannot adapt to. So, it is quite

understandable that why today, in UNEA, we are talking about how to regulate SRMs (or is it actually possible to regulate? if yes, in what frame?)

There are also a lot of controversy on-going about the ethical aspect of SRMs. According to Ekaterina Zaharieva, European Commissioner for Startups, Research and Innovations, these technologies are still far from being mature and reliable. She stated that “Research must continue, but the opinion of the European Group on Ethics shows research must be rigorous and ethical, and it must take full account of the possible range of direct and indirect effects. It is also important that the scientific evidence on risks and opportunities of SRM research and deployment is periodically assessed.”



5. Introduction to the Topic

5.1. The Concept of a "*Planetary Thermostat*"

The concept of a "*Planetary Thermostat*" is based on the idea that humanity could artificially and centrally control Earth's climate system, much like adjusting the temperature of a house. With global warming approaching irreversible tipping points, geoengineering technologies like SRM have been put on the table as the control knobs for this hypothetical thermostat. However, Earth's atmosphere, ocean currents, and biosphere are a vast ecosystem interconnected by incredibly complex and non-linear links. Therefore, intervening in the stratosphere to lower the planet's average temperature by a few degrees is not simply an engineering optimization; a cooling action at one end of the world could create a massive butterfly effect, leading to the cessation of monsoon rains or deadly droughts at the other end. The most critical philosophical and legal dilemma that delegates must grasp here is this: If a thermostat is indeed built that can regulate the planet's temperature, who will decide on its setting? Will this unprecedented power be managed equitably on the international stage, or will it transform into a new climate imperialism that consolidates the economic and political hegemony of the Global North at the expense of the Global South's struggle for survival? This concept reveals that geoengineering is not only a technological salvation but also a global governance crisis that fundamentally undermines the principles of consent and state sovereignty.

5.2. Defining Geoengineering: The Divide Between SRM and CDR

Geoengineering is a massive, deliberate intervention in Earth's natural systems that arose as traditional emission mitigation and climate change adaptation policies proved insufficient to keep global warming within the 1.5°C limit. While often perceived as a single monolithic concept, this latest and most controversial line of defense for humanity is actually divided into two main factions that are diametrically opposed in terms of their technical mechanisms, ecological risk profiles, and international legal implications: SRM and CDR. For delegates at the UNEA to draft an effective resolution, it is absolutely essential that they fully

understand that these two technologies are too different to be equated.

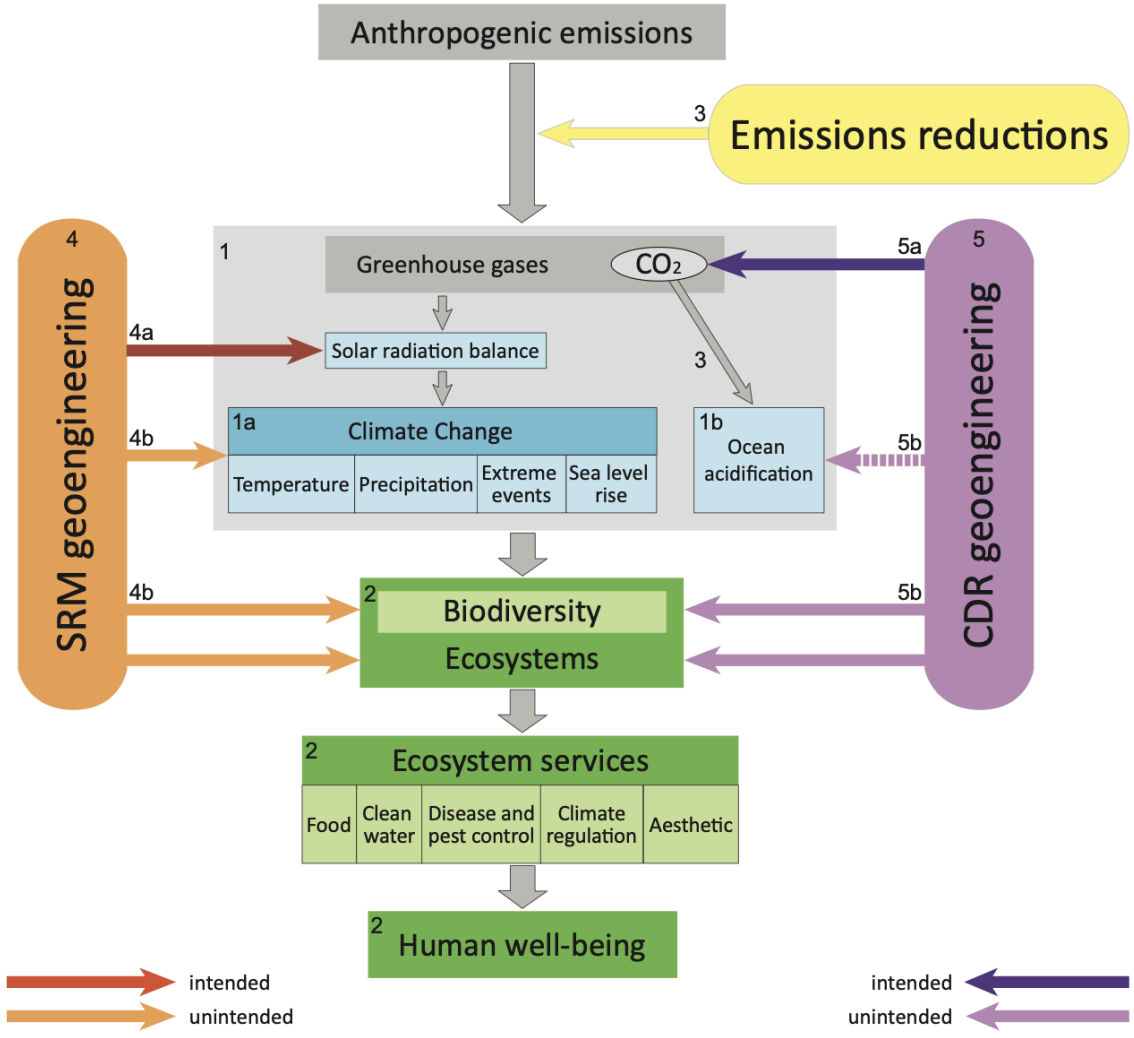
SRM is an immediate and aggressive intervention in the planet's thermodynamic equilibrium. The basic principle is to artificially cool the planet by increasing the Earth's "albedo" (reflectivity), reflecting short-wave solar radiation reaching the surface back into space. Methods like Stratospheric Aerosol Injection (SAI) or Ocean Cloud Brightening (MCB) have the capacity to reduce global temperatures in very short periods, such as months. However, the harsh reality that you should understand here is that SRM does not reduce the concentration of greenhouse gases in the atmosphere, which is the main cause of the climate crisis, in the slightest. It is merely a dangerous thermal illusion that masks warming and offers no solution to chemical catastrophes such as ocean acidification. Moreover, SRM is so cheap that a single state (rogue state) with the technological capacity can unilaterally initiate this action, disregarding international consent. Its greatest danger is the catastrophic "termination shock"; If this reflective shield is abruptly halted due to a geopolitical crisis, the masked warming will return with full force within weeks, triggering a mass extinction to which no ecosystem can adapt. Plus, based on some experiments, researchers underlined that although many SRM geoengineering schemes can act rapidly to reduce temperature anomalies caused by greenhouse gas emissions, controlling all climate parameters (e.g. precipitation, climatic extreme events) is not possible. (Zhang, 2014)

CDR, unlike SRM, attempts to address the ontological root of the problem by directly filtering excess carbon from the atmosphere and trapping it in geological or oceanic reservoirs in the long term. This approach, which includes Direct Air Capture (DAC) facilities, mass reforestation projects, or creating artificial algal blooms by dumping iron sulfate into the oceans (Ocean Fertilization), appears on paper to be a more "natural" and reliable treatment method. However, the biggest drawback of CDR is speed and scale. Significantly reducing global temperatures requires unimaginable amounts of energy, enormous budgets, and land use the size of entire continents. Furthermore, uncontrolled carbon sequestration in ocean ecosystems risks creating "hypoxic zones" that will completely suffocate marine life.

In conclusion, the biggest dilemma facing international environmental law in regulating these technologies lies in this duality. SRM is fast, inexpensive, and unilaterally applicable, but it is a ticking time bomb that immediately brings transboundary harm to the doorstep. CDR, on the other hand, is slow, extremely expensive, requires multilateral global cooperation, but offers a long-term solution. Trying to merge these two opposing forces under a single "geoengineering law" when drawing up an international regulatory framework would be legal suicide. Therefore, UNEA must establish a dual-track monitoring mechanism for both technologies, where risks, consent building, and responsibilities are assessed differently.

Addendum

The attached figure was inadvertently omitted from the second draft of the study (23 January, 2012).



6. History of the Topic

6.1. Early Climate Intervention Theories

The idea of humanity interfering with climate systems dates back long before the technological crises of the 21st century, to that primal and ontological desire of humankind to dominate nature. Beginning with pseudoscientific attempts at rainmakers in the late 19th century, these gave way to genuine laboratory experiments in the 1940s with the development of atmospheric physics. The first successful *cloud seeding* in 1946, achieved by General Electric laboratories' scientists Vincent Schaefer and Bernard Vonnegut by injecting dry ice and silver iodide into clouds, is considered the beginning of modern weather modification. However, this scientific breakthrough was quickly seen as a military opportunity rather than an ecological awakening, and was rapidly weaponized in the paranoid climate of the Cold War. The highly secretive military operation conducted by the United States during the Vietnam War, known in history as *Operation Popeye* (1967-1972), is the first concrete evidence of the dark side of geoengineering. In this operation, the US military aimed to artificially prolong and intensify the monsoon rains along the Ho Chi Minh Trail, thereby burying the Viet Cong's logistical networks in mud and paralyzing their military supply routes. This brutal demonstration of how weather could be used as a weapon of mass destruction or tactical warfare caused widespread outrage in the international community and ultimately initiated the famous legal panic that led to the signing of the ENMOD Treaty (Prohibition of the Military Uses of Environmental Modification Techniques) in 1977.

The evolution of the idea of regional weather control (weather modification) into a planetary-scale climate intervention (climate modification/geoengineering) dates back to the mid-1960s. During the period when the first serious warnings were issued about the greenhouse effect created by carbon dioxide emissions in the atmosphere, surprisingly, "reducing emissions" was not the first solution that came to mind. The first high-level government report highlighting the danger of global

warming, presented to US President Lyndon B. Johnson in 1965, made no mention of restricting fossil fuel use; instead, it suggested increasing the Earth's albedo capacity by dumping massive amounts of reflective particles onto the oceans. This historical irony is also the origin of the *Moral Hazard* argument, which forms the heart of today's geoengineering debates. Global North countries, at the height of their technological optimism, have always tended to prefer tampering with the planet's thermodynamic balance to emission reductions, in order to maintain the status quo and their fossil fuel-based economic growth. The fundamental reality that delegates must confront in the UNEA committee is this: the deep global distrust of technologies like SRM and the justified paranoia of the Global South today are rooted in a militaristic and hegemonic history that views nature as a battlefield and an engineering plaything. This historical baggage clearly demonstrates how any new step taken without establishing a binding international legal mechanism could irreversibly undermine interstate trust.

6.2. The Evolution of Geoengineering in IPCC Reports

The Intergovernmental Panel on Climate Change (IPCC) reports form the scientific backbone of global climate policies and international environmental law. The evolution of the geoengineering concept in these authoritative texts is not simply a technological development, but a tragic chronology of the international community's systematic failure to meet its emission reduction commitments. In early assessments, for example, the Fourth Assessment Report (AR4) published in 2007, geoengineering was largely viewed as science fiction fantasy or a marginal, dangerous, and speculative idea not worth considering; it only found a place in a few paragraphs of the thousands-of-pages report in a skeptical tone. However, the depletion of the global carbon budget much faster than predicted officially shattered this scientific taboo with the Fifth Assessment Report (AR5) published in 2013. AR5 formally incorporated the concepts of SRM and CDR into climate modeling for the first time; However, it has been made clear to global policymakers, in bold letters, that SRM cannot stop ocean acidification and that a system shutdown would create a devastating termination shock. The delegates' understanding of this historic

turning point is vital for the committee's progress, because for the first time the scientific community has officially documented the existence of Plan B scenarios, despite their enormous risks.

The real paradigm shift occurred with the famous “Special Report on Global Warming of 1.5°C” (SR15) of 2018 and the Sixth Assessment Report (AR6) published in 2021-2022. In these latest reports, the IPCC explicitly declared the bitter truth that international law and states have avoided hearing for years: achieving the 1.5°C or 2°C targets solely through emissions reduction is now mathematically impossible, and therefore the mass deployment of CDR technologies is no longer an option, but an existential necessity. However, the same IPCC has continued to use extremely distant, alarming, and cautionary language regarding SRM. While the AR6 report acknowledges that SRM has the potential to lower global temperatures very rapidly, it strongly emphasizes the transboundary harm, ethical crises, and, most importantly, the enormous "governance deficit" that this technology will create. The highest authority in science confirms the technological capacity of SRM but formally declares that current international law lacks the enforcement mechanisms to govern this technology.

7. Current Situation: Technical Realities & Ecological Risks

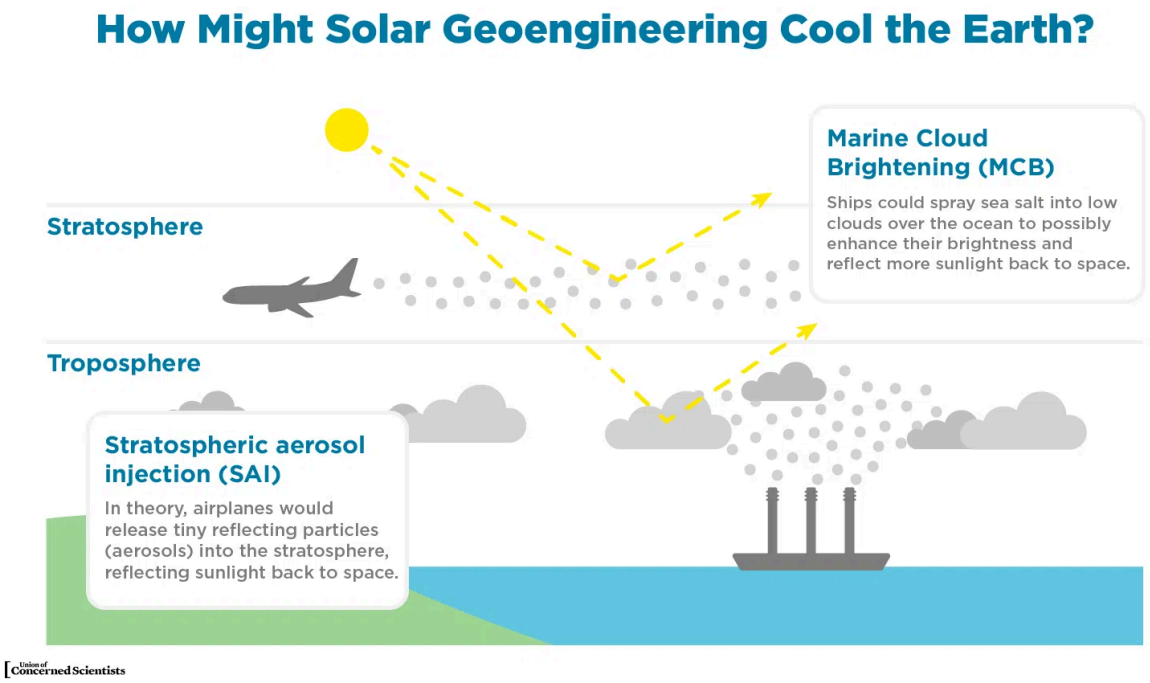
7.1. Solar Radiation Modification (SRM): Masking the Warming

7.1.1. Stratospheric Aerosol Injection (SAI) and the Risk of Ozone Depletion

Stratospheric Aerosol Injection is a technique which aims at increasing the backscattering of solar radiation directly back into the space to cool Earth's climate by injecting Aerosols in the Earth’s stratosphere. (European Space Agency, n.d.)

Stratospheric Aerosol Injection (SAI) is the most debated geoengineering method under the SRM umbrella, technologically closest to achieving the same feasibility but also possessing the most lethal side effects. Its basic principle is to artificially and continuously replicate the natural global cooling effect created by the 1991 Pinatubo volcanic eruption. Through specially designed high-altitude aircraft or stratospheric balloons, millions of tons of sulfur dioxide (SO2) or similar

sulfate-based reflective particles are sprayed 15 to 25 kilometers into the atmosphere. These particles spread throughout the stratosphere, reflecting short-wave radiation from the Sun back into space like a giant mirror, masking the temperature increase on the Earth's surface in a very short time. However, this mechanical intervention represents a massive ecological gamble that fundamentally alters atmospheric chemistry. The most critical and potentially catastrophic side effect of SAI is its devastating chemical impact on the Ozone Layer, our shield protecting the Earth from the sun's harmful rays. Sulfate aerosols injected into the stratosphere not only reflect sunlight but also create perfect surface areas for man-made chemicals (especially chlorofluorocarbon gases used in the past) such as chlorine and bromine, which have been suspended in the atmosphere for decades, to react. This catalytic effect causes ozone molecules (O3) to break down at an unprecedented rate, and the ozone hole, particularly over Antarctica and the Arctic, to reach deadly levels again, or even become permanent. The thinning of the ozone layer means a dramatic increase in deadly ultraviolet (especially UV-B)



radiation reaching the Earth's surface. This risks triggering global epidemics of skin cancer, cataracts, and immune system collapse in human populations. Worse, increased UV radiation breaks down the DNA of phytoplankton, the ocean's primary

carbon sink and food source, leading to the complete collapse of marine ecosystems and a global decline in terrestrial agricultural yields. In short, SAI is a dangerous treatment that poisons the biosphere with radiation while simultaneously cooling down the fire of global warming. The diplomatic crisis in the committee begins right here: If a unilateral SAI operation launched by a state or coalition to lower temperatures punctures the ozone layer thousands of kilometers away on another continent, destroying crops and human health, how will existing international environmental law compensate for this "transboundary harm"? There is currently no binding mechanism to solve this devastating equation or prosecute the violators.

7.1.2. Marine Cloud Brightening (MCB) and Regional Weather Disruption

Marine Cloud Brightening (MCB), unlike SAI's global and stratospheric approach, is a highly regionally applicable but equally unstable SRM technique that focuses directly on the lower atmosphere (troposphere) above the oceans. Its basic mechanism involves continuously spraying seawater, drawn from the ocean surface via a fleet of specially designed autonomous ships, into low-lying stratocumulus clouds in the sky as microscopic salt particles (aerosols). These sea salt particles act as *cloud condensation nuclei* (CCNs) in the atmosphere, increasing the number of water droplets within the clouds, making them denser, whiter, and therefore much more capable of reflecting sunlight (albedo). Although it is presented as an innocent and *environmentally friendly* intervention on paper because only natural seawater is used in the process, MCB's ability to cool only certain regions of the oceans constitutes its greatest ecological danger. The Earth's climate system is a vast network of pressure and wind that operates based on thermal gradients (temperature differences) between hot and cold regions. Artificially and abruptly cooling a region of the ocean using MCB drastically disrupts these thermal balances, creating a devastating "butterfly effect" in atmospheric circulation. Modeling shows that regional application of MCB could disrupt the cycles of critical ocean-atmosphere phenomena such as El Niño and La Niña, and even shift the

course of monsoon rains in South America, Africa, and Asia, vital to the agricultural production of billions of people. The most serious legal crisis facing the delegates on the UNEA committee arises at this point: What if a developed Global North country launches a massive MCB operation in the Pacific to save its coral reefs or protect itself from heatwaves, and this regional cooling leads to unprecedented drought in Sub-Saharan Africa or floods in India? The MCB has the potential to transform the climate crisis into a spiral of "climate theft" or "weather warfare" between states. The fact that there is no international court or binding law regulating consent mechanisms or determining the cost of these transboundary harms makes the MCB a ticking time bomb for international diplomacy.

7.1.3. The Nightmare Scenario: “Termination Shock”

The most apocalyptic and intractable risk inherent in SRM technologies, particularly Stratospheric Aerosol Injection (SAI), is the scenario known in the literature as the "Termination Shock." SRM does not reduce greenhouse gas concentrations in the atmosphere; it only temporarily masks the warming effect created by these gases with an artificial reflective shield. If this shield suddenly collapses decades after the system's implementation—which could happen suddenly as a result of a global war, economic depression, cyberattack, geopolitical dispute, or infrastructure sabotage—all that masked warming will hit the Earth with full force in just a few months or years, instead of being spread over decades. This unprecedented and sudden thermal rebound in the climate system will cause temperatures to skyrocket at an unprecedented rate, breaking through threshold values. The biosphere, forests, ocean currents, and agricultural ecosystems have zero chance of evolutionarily adapting to such a rapid temperature increase. This would mean an inevitable mass extinction and the collapse of the global food chain. The real legal and philosophical horror that delegates must confront in the committee hall is this: once the SRM is initiated, humanity will be condemned to operate this system flawlessly for hundreds of years, without a single day's interruption. This leaves the fate of the planet at the mercy of a handful of technological hegemons or unstable coalitions controlling the system, plunging the

entire world into an unending hostage crisis. The absence of any binding mechanism in international law to guarantee this "necessary continuity" transforms the Termination Shock scenario from a mere theoretical ecological risk into a global time bomb with the pin pulled.

7.2. Carbon Dioxide Removal (CDR): Vacuuming the Atmosphere

7.2.1. Ocean Fertilization, Phytoplankton Blooms, and Hypoxic (Dead) Zones

Ocean fertilization, in its simplest form, is the process of artificially greening the water by dumping a massive amount of "agricultural pesticide" or "vitamin" into the middle of the ocean. It is one of the most talked-about methods of CDR technologies.

In some areas of the oceans (especially the Southern Ocean), the water contains abundant sunlight and nutrients such as nitrogen and phosphorus, which are necessary for photosynthesis. However, just like plants on land, phytoplankton, the microscopic plants in the ocean, need the element "iron" to grow. Because there is no iron, these areas are like biological deserts; phytoplankton cannot multiply. At this point, scientists or geoengineering companies say: "If we dump tons of iron sulfate powder into these areas by ships, we will have fertilized the water." As soon as the iron mixes with the water, the phytoplankton absorb this vitamin and begin to multiply at an incredible rate. This is called an "algal bloom" (phytoplankton bloom). That area of the ocean turns a vibrant green, visible even from space. This enormous army of phytoplankton absorbs carbon dioxide (CO2) from the atmosphere like sponges while photosynthesizing. Phytoplankton have a very short lifespan (a few weeks). When they die, they sink like snowflakes to the dark depths of the ocean, to the "abyssal" regions, along with the carbon they have trapped inside (this is called marine snow). Thus, the carbon that causes warming in the atmosphere is buried (sequestered) at the bottom of the ocean for hundreds or even thousands of years. In short, the plan on paper is: Drop an anchor into the sea -> Phytoplankton multiply -> They absorb carbon from the air -> They die and sink to the bottom -> The climate crisis is solved. However, as mentioned in the previous

text, this system has a huge cost: creating "Dead Zones". To understand this concept, we need to understand algal blooms and eutrophication, which is a process of algal blooms.

Algal blooms can be characterized as the accumulation of excess nitrogen and phosphorus in seepage water from non-point agricultural practices, surface runoff, and solid waste dumps, rivers, lakes, coastal areas, estuaries, and dam reservoirs, due to the rich nutrients found in untreated or inadequately treated wastewater discharge, resulting in the accumulation and uncontrolled proliferation of algae. Autotrophic organisms (phytoplankton), sometimes known as blue-green algae or cyanobacteria, obtain their nutrients through photosynthesis. Although they are single-celled, their rapid reproduction allows them to grow in colonies visible to the naked eye. Phytoplankton cause most cases of eutrophication (Eren, Z. 2021).

The other category of algae is known as macroalgae, which are multicellular eukaryotic algae. Algae are living organisms that do not resemble plants in terms of roots, stems, and leaves, and are generally quite common in aquatic environments (Eren, Z. 2021: 205). Macroalgae, such as "sea lettuce," can undergo eutrophication due to excessive nutrient accumulation, just like microalgae. This ecological phenomenon, also known as an algal bloom, becomes a greater threat, especially in regions where climatic and geographical features are conducive to rapid growth, due to their rapid population development and visibility to the naked eye. The biggest effect of eutrophication is the reduction of oxygen levels in the aquatic ecosystem (hypoxia). Organisms that consume more oxygen than is produced during nighttime hours when photosynthesis cannot occur reduce the oxygen level in the ecosystem. Hypoxia causes the mass death of organisms living in the aquatic environment.

In addition, photoautotrophic organisms begin to accumulate on the water surface to be exposed to more sunlight. This prevents sunlight from reaching below the water surface, and leads to the death of sessile photoautotrophic organisms due to insufficient sunlight.

Increased nutrient levels damage coral reefs by promoting algal growth in coral larvae; dying phytoplankton begin to release toxic substances. Then, changes in the species composition and biomass of the aquatic community living below the water surface eventually lead to a decrease in species diversity and the disruption of the biological ecosystem.

Although there are many reasons for the emergence of the eutrophication problem, exponential increases in human factors have led to a series of chain reactions. Among the different human factors causing this interaction are increased urbanization, unnecessary water use in housing, regulation of wetlands, and commercial, agricultural, and manufacturing activities. These elements cause shallow lakes to become loaded with nutrients such as nitrogen and phosphorus, and salt, leading to the problem. Eutrophication in shallow lakes disrupts the ecological balance by degrading water quality and endangering the lives of aquatic plants, predatory fish, and water birds. The consequences of eutrophication are due to the increase in average temperatures.

Especially during the summer months, it includes blue-green algae or algal blooms, surface vegetation, and a concentration of benthic macrophytes in a single location.

Organic and inorganic nitrogen and phosphorus compounds are transported to lakes by streams. Depending on how much sunlight enters the lake water, microscopic floating algae use carbon, phosphate, and nitrogen from the water to complete photosynthesis. Other consumers of aquatic life, such as fish, benefit from these. These processes gradually increase the concentration of dissolved organic carbon, phosphorus, and nitrogen in the water.

7.2.2. Direct Air Capture (DAC) and Massive Energy Trade-offs

Direct Air Capture (DAC), one of the most popular and technologically advanced methods under the umbrella of CDR, initially appears to be the miraculous and perfect solution to the climate crisis. Unlike SRM technologies or

Ocean Fertilization, it does not have immediate and devastating ecological side effects such as depleting the ozone layer or poisoning marine ecosystems. DAC plants are designed as "artificial forests" that vacuum air from the atmosphere with massive industrial fans, separate the carbon dioxide (CO_2) within it using special chemical filters, and then liquefy this gas, trapping it underground in geological formations such as basalt rocks for thousands of years. However, the enormous and daunting drawback of this technology is not ecological, but thermodynamic and economic. Carbon dioxide in the atmosphere is an extremely dilute gas, present in the air at only 0.04% (approximately 420 ppm) despite all the crises created by emissions. This process, akin to finding a needle in a haystack, requires unimaginable amounts of energy (especially high temperatures ranging from 100°C to 900°C) during the separation phase of chemical filters. This is where the dilemma known as the "Massive Energy Trade-off" begins: To create a planetary cooling effect, thousands of these massive plants would need to be built worldwide. If the enormous energy required to operate these plants is derived from fossil fuels, the system will produce far more carbon than it removes from the atmosphere. If the plants are powered entirely by renewable energy sources such as solar or wind power, humanity's limited and valuable green energy capacity would be thrown into a massive black hole to feed DAC plants instead of being used to shut down still-operating coal power plants. The real political crisis that delegates must confront in the committee is the "moral hazard" and inequality that DAC technology will create on the international stage. DAC is an astronomically expensive technology, requiring trillions of dollars in budgets for its construction and operation. This cost breakdown means that only the wealthy Global North states and giant tech companies will have access to this system. Unless you equip it with a binding enforcement mechanism under international law, developed countries will invest in DAC technology to buy themselves a "climate absolution card" rather than endure the painful and economically slowing policies of converting their industries to green energy. In this scenario, while fossil fuel lobbies continue to pollute the air, wealthy states will vacuum their emissions from the atmosphere and claim to have achieved their "net-zero" targets, while the Global South will be forced to endure the

consequences of this hypocritical carbon market and extreme climate events, in which it has no say. The UNEA must urgently put regulations on the table to prevent this technology from becoming merely a license for the wealthy to legally pollute the environment.

8. The Legal Dilemma: Absence of Enforcement Mechanisms

8.1. The Tragedy of the Commons and the Free-Rider Problem in the Atmosphere

William Nordhaus's 2015 article[1], "Climate Clubs: Overcoming Free-riding in International Climate Policy," published in the American Economic Review, is a revolutionary study that attributes the failure of international climate agreements not to political reluctance, but to the flawed incentive structure of the system, and is particularly well-suited for examination under this heading. Nordhaus begins his analysis by defining the economic nature of global warming, primarily by addressing the Collapse of the Current System and the Problem of "Free-riding." According to him, combating climate change is, in its purest form, a global public good problem. Of course, by the nature of public goods, everyone (countries and their populations) will benefit from its production (i.e., the reduction of carbon emissions), but there is a problem: the cost will inevitably be borne only by those who take action. This situation gives rise to the "free-riding" problem in international relations and game theory. To elaborate on this problem, existing regimes like the Kyoto Protocol and the Paris Agreement are doomed to fail because they are based on voluntarism and lack a mechanism to penalize non-participants or those who fail to fulfill their commitments. (Note: For those wondering why there shouldn't be penalty mechanisms, please continue reading! You will find the answer.) A country can benefit from this improvement without incurring any cost while other countries reduce their emissions (free-riding).

William Nordhaus's 2015 article[2], "Climate Clubs: Overcoming Free-riding in

[1] For further information regarding the article, see the link below
https://www.aeaweb.org/articles?id=10.1257/aer.15000001
[2] For further information regarding the article, see the link below
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8.2. Trade Measures as Enforcement Tools in Climate Governance

According to Nordhaus's models, the "individual rational strategy" for each country in this structure is not to cooperate; this creates a Nash Equilibrium where the worst-case scenario (high global warming) occurs. (For further reading, https://en.wikipedia.org/wiki/Nash_equilibrium) So what is the proposed solution? That's exactly where, Nordhaus, at a theoretical level, proposed the "climate club" model as a solution to this issue. To break this vicious cycle, Nordhaus suggests the "Climate Club" concept, which facilitates a shift from voluntary participation to a "strategic incentive" model. A club is an excludable structure where the benefits it provides to its members outweigh the cost of being left out. Nordhaus's proposed Climate Club has two main pillars. The first is a "target carbon price" (e.g., $50 per ton) that club members determine internally. Whether members use a carbon tax or

an emissions trading system (cap-and-trade) to reach this price, the important thing is that they bear the cost of emission reduction. This is the "entry fee" of the club. However, the truly revolutionary part of the system is the second pillar, the "exclusionary mechanism," which keeps members in the club while penalizing non-members. This is the most striking part of the article, and it sheds light on the “enforcement” debate, the answer to which will be sought in this committee.

Nordhaus mathematically proves that the club cannot be stable without sanctions applied to non-participants (the mathematical proof will be discussed in the annex). However, the penalty he proposes is not a complex system based on the carbon content of specific products (such as a carbon footprint tax), as such taxes are very difficult to calculate and prone to misinformation. Instead, Nordhaus proposes a “Uniform Tariff” to be applied to all products imported from non-participants (for example, a low but effective rate like 2%; such approaches are highly open to discussion and encouraged in this committee). This method is strategic rather than targeted: the aim is to inflict enough damage on the non-participant country's economy that it would prefer to join the club and bear the cost of carbon reduction. In other words, the cost of staying outside (loss of trade) should be higher than the cost of joining (carbon tax). To test his theory, Nordhaus conducts simulations on 15 different regions of the world using DICE and RICE (Regional Integrated Climate-Economy) models. The results are striking: In scenarios without an enforcement mechanism (similar to the current Paris Agreement), global emission reductions remain minimal and coalitions quickly disintegrate. However, in scenarios where a relatively low tariff of 2% is applied to non-members, the “Climate Club” achieves high participation rates. Large economies like China, the European Union and the United States of America[3], prefer to join the club and reduce emissions rather than risk a trade war. This model proves that even without a "central authority" or “climate police” in international law,

[3] The United States has chosen to withdraw from all climate laws, including the Paris Agreement, by January 8, 2026, and President Trump has made some rather sensational statements on this matter. https://www.bbc.com/news/articles/cp80ln97py5o The United States has displayed quite contrasting stances on this issue over approximately the last four presidential terms. For more reading on this topic, you can visit this link: https://en.wikipedia.org/wiki/United_States_and_the_Paris_Agreement#Second_withdrawal

a strong enforcement mechanism can be created by using trade policies as leverage, thereby ensuring a cooperative balance. In summary, the article argues that combating climate change is not merely a matter of environmental science or moral responsibility; it is fundamentally a problem of “restructuring incentives.” Unless unsecured (powerless) agreements are replaced by “club” structures strengthened by trade sanctions, halting global warming is impossible.

However, there is another major problem here, and this is the crucial point where the issue will be discussed: climate club approaches, which have come to the fore in recent years in international climate governance, particularly the theoretical framework developed by William Nordhaus and related tools such as the Carbon Border Adjustment Mechanism (CBAM), aim to overcome the free-riding problem in global emission reduction. These approaches aim to expand carbon pricing through international trading mechanisms and to internalize the cost of carbon on a global scale.

Nonetheless, the design of these mechanisms without considering global economic and technological inequalities creates serious justice problems, especially for developing and least developed countries. Although CBAM and similar arrangements ostensibly serve environmental goals, in practice they reinforce the capital, technology, and institutional capacity advantages of developed economies. While developed countries have access to the financial resources and low-carbon production technologies that can finance the green transition, developing countries often experience such arrangements as an additional trade barrier. This situation leads to carbon pricing functioning less as an environmental tool and more as a new competitive filter in global trade. Particularly noteworthy in this context is the disproportionate negative impact on countries with low emission levels. For example, countries like South Sudan exhibit low carbon emissions in terms of SDG 13 (Climate Action) under the Sustainable Development Goals; however, this is a result of limited industrial capacity and widespread poverty, rather than a conscious success in climate policy. Despite this, lacking the technical and financial capacity to comply with carbon standards, these countries face a greater risk of exclusion from the global trading system. Thus, low emissions are effectively penalized with

economic exclusion.

8.3. The "Bindingness" Debate: Hard Law vs. Soft Law in Climate Governance

In addition to formal treaties, global climate governance heavily relies on soft law instruments and voluntary commitments. Soft law refers to non-binding agreements, resolutions, or principles that, while not legally enforceable, shape state behavior and expectations. In the climate context, soft-law arrangements have been used to complement or pave the way for hard-law treaties. A prime example is the 2009 Copenhagen Accord, essentially a political declaration wherein countries outlined voluntary climate actions for 2020 (Patt et al., 2022, p. 1461). The Accord was not legally binding and set no enforceable emission targets, yet over 140 countries (accounting for more than 80% of global emissions) associated themselves with it and submitted pledges. These pledges (ranging from economy-wide emission targets by developed nations to goals like improving carbon intensity or reducing deforestation by developing nations) were purely voluntary. Nevertheless, the Copenhagen Accord's bottom-up pledge approach significantly influenced subsequent negotiations. At COP16 in Cancun (2010), parties formally adopted the Cancun Agreements, which incorporated the Copenhagen pledges into the UNFCCC framework. Although still non-binding, this move gave the voluntary commitments official recognition under the UN process. The Cancun Agreements were viewed as an interim solution through 2020, bridging the gap between Kyoto's first period and the new Paris regime.

Soft law in climate governance also encompasses the myriad of conference decisions, declarations, and initiatives that guide implementation and encourage greater ambition. COP decisions (apart from adopting treaties) are typically not treaties themselves but carry political weight. For instance, the COP21 decision adopting the Paris Agreement (Decision 1/CP.21) contains important but non-binding provisions, urging countries to pursue efforts for the 1.5°C limit and signaling intent on climate finance and adaptation. Similarly, the annual COP cover decisions (such as the Glasgow Climate Pact at COP26 in 2021) are essentially soft

law instruments: they express consensus political commitments like accelerating the phase-down of unabated coal power, without creating new legal obligations on parties. These instruments rely on peer pressure and global public scrutiny rather than formal enforcement. They can influence national policies by articulating normative expectations. For example, even though the long-standing pledge by developed countries to mobilize $100 billion per year for developing nations by 2020 was not a binding treaty obligation, it was reiterated in UNFCCC decisions and thus became a benchmark against which countries' performance is judged. The repeated affirmation of this goal in soft-law form (from Copenhagen/Cancun through Paris decisions) put pressure on donor countries to demonstrate progress, illustrating how soft commitments can have practical impact.

Voluntary commitments by non-state actors and coalitions also form part of the soft-law landscape in climate governance. The UNFCCC recognizes and encourages efforts by cities, regions, businesses, and civil society through initiatives like the Global Climate Action Portal (NAZCA), where thousands of pledges (e.g. on achieving net-zero emissions or 100% renewable energy) are recorded. These are not governed by international law, but they contribute to global climate objectives and create accountability through transparency. Furthermore, clubs and partnerships outside the UNFCCC, such as the Climate and Clean Air Coalition or the Powering Past Coal Alliance, operate via voluntary commitments among subsets of countries and organizations. While not legally binding, they often spur faster action and can be incubators for norms later adopted universally. Scholars note that such transnational climate initiatives exemplify soft governance: they fill gaps left by intergovernmental agreements and can increase ambition by creating forums for like-minded actors.

In summary, soft law instruments (from COP decisions and political accords to voluntary multi-stakeholder initiatives) play a strategic role in global climate governance. They allow for flexibility and broad participation, enabling progress even when consensus for hard law is elusive. However, their non binding nature means they rely on transparency, goodwill, and normative pressure. The climate

regime's experience (e.g. with the Copenhagen/Cancun pledges) shows that voluntary commitments can mobilize action and prepare the ground for stronger agreements. The Paris Agreement itself can be seen as a blend of hard and soft elements: the treaty is binding in form, but the stringency and enforcement of countries' contributions are largely voluntary, backed by soft pressure. Thus, soft law and voluntary commitments complement formal treaties, aiming to boost ambition and implementation in the absence of a global enforcement authority.

8.4. Existing Compliance and Monitoring Mechanisms

Ensuring that countries honor their climate commitments is a core challenge of global climate governance. Without a world government or "climate police" , compliance relies on monitoring, transparency, and peer accountability rather than coercive enforcement (Gillenwater, 2010). Over time, the climate regime has developed a complex system of reporting and review to track implementation. Under the UNFCCC, all parties submit periodic national communications and GHG inventory reports (Annex I countries annually, others biennially or as agreed) detailing emissions and policies (Gillenwater, 2010). The Kyoto Protocol significantly strengthened monitoring with rigorous accounting rules and expert review processes. Annex I parties had to maintain national systems for estimating emissions, and their inventories underwent review by teams of international experts to ensure accuracy (Gillenwater, 2010). Kyoto also introduced flexible mechanisms (emissions trading, Clean Development Mechanism, Joint Implementation), which came with their own oversight and verification procedures, linking compliance to carbon market eligibility (Gillenwater, 2010). The culmination of Kyoto's monitoring was the true-up period at the end of the commitment period: each party's total emissions were compared against its assigned amount (allowances plus credits) to determine compliance (Gillenwater, 2010).

The Kyoto compliance mechanism was, on paper, one of the most comprehensive in international environmental law. It featured a bifurcated Compliance Committee with a Facilitative Branch (to advise and assist parties in

implementation) and an Enforcement Branch (to determine non-compliance and apply consequences). If a country failed to meet its Kyoto emissions target, the Enforcement Branch could declare it non-compliant and invoke penalties. The main consequences were: suspension of eligibility to participate in emissions trading and other mechanism activities, and a requirement to make up the excess emissions in the next period with a 1.3 multiplier penalty. While these measures sounded strict, their real world efficacy was limited. For one, the second commitment period (2013-2020) saw fewer participants and was not ratified by some major parties, undermining the penalty of carrying over excess obligations. Moreover, as noted, a party could withdraw from the Protocol entirely to avoid compliance consequences, an option several took. No international court or police could compel a sovereign state to cut emissions or pay fines. In practice, Kyoto's enforcement branch never had to impose harsh penalties : by 2015 it found most parties in compliance (with generous use of carbon credits). Observers conclude that Kyoto's enforcement system provided only weak incentives for compliance, its true impact was more about transparency and political accountability than punishment.

The Paris Agreement takes a different approach, emphasizing transparency and facilitation over sanctions. Given that Paris relies on self-determined pledges (NDCs) rather than internationally assigned targets, its focus is on holding countries accountable to their own commitments through monitoring and review. The backbone of this is the Enhanced Transparency Framework (ETF) (Article 13 of Paris), which compels all parties to report detailed information on GHG emissions and progress toward their NDCs on a regular cycle. Starting in 2024, both developed and developing countries (with flexibility for least developed countries and small island states) must submit Biennial Transparency Reports with economy-wide emission inventories and tracking of NDC implementation. These reports undergo Technical Expert Review by international teams, which check the data and provide feedback. Additionally, there is a Facilitative, Multilateral Consideration of Progress, a form of peer review where countries discuss each other's performance in implementing NDCs. The ETF builds on prior UNFCCC MRV

(measurement, reporting, verification) systems but extends them to all parties and is more rigorous in terms of the scope of information. Through transparency, the Paris system aims to create reputational incentives: countries that fall behind their pledges can face international scrutiny and pressure to adjust policies.

In lieu of an enforcement branch, the Paris Agreement established an Implementation and Compliance Committee (Article 15) (the PAICC) which began operating in 2019. This committee is expert-based, facilitative, and non-punitive by design. It cannot impose sanctions or resolve disputes, but it can examine cases where a party may be struggling to fulfill its obligations and recommend steps to improve compliance. For instance, the committee can be triggered if a country fails to submit an NDC or required report on time. In such situations, the PAICC will engage with the party, identify the challenges, and offer assistance or recommendations, always paying particular attention to national capabilities and circumstances. The logic is that by treating compliance as a matter of facilitation (capacity-building, transparency, encouragement) rather than punishment, even reluctant parties will remain engaged rather than defy the system outright. This reflects a recognition of state sovereignty and the political reality that harsh enforcement is infeasible. As a result, current compliance mechanisms in climate governance are essentially cooperative: they aim to build trust and confidence that all are doing their part, rather than to coerce unwilling governments.

Finally, it's worth noting the role of global stocktaking and peer pressure as meta-level monitoring tools. The Paris Agreement's Global Stocktake (GST), first scheduled for 2023, assesses collective progress towards the long-term goals on mitigation, adaptation, and support. While it does not judge individual countries, the GST's findings (e.g. a gap between aggregated NDCs and the 1.5°C path) are expected to inform and morally pressure governments to enhance their next NDCs. Outside the UN process, independent assessment initiatives (such as the UNEP Emissions Gap Reports, Climate Action Tracker, etc.) also monitor and publicize how current policies and pledges compare to the Paris goals. This public transparency complements official mechanisms and can galvanize domestic

accountability, citizens and media can hold their governments to account for promises made on the international stage. To keep it short for this part, today's climate governance relies on a web of monitoring and compliance mechanisms that favor sunshine over sanctions: thorough reporting requirements, technical reviews, peer dialogues, facilitative committees, and periodic collective assessments. These tools seek to ensure that countries stay on track and progressively ratchet up action, even in the absence of binding enforcement, reflecting the delicate balance between international oversight and national sovereignty in the climate regime.

8.5. The Foundations and Limits of Obligation in International Climate Law

The global climate crisis and other environmental problems are common threats that transcend state borders and affect all of humanity. In order to combat these threats, numerous international environmental agreements have been concluded. As an example, global climate treaties such as the Paris Climate Agreement mentioned above call on states to reduce their greenhouse gas emissions. However, as is frequently observed in practice, whether such agreements are genuinely binding remains highly controversial, and this constitutes a significant part of the issue we are examining under Agenda Item A. States often act reluctantly in fulfilling their commitments, and when they fail to comply with these agreements, there is no effective enforcement or sanctioning mechanism they face. This situation may raise questions for some and may lead others to propose solutions such as "then let us prepare sanction packages" or "establish climate courts." Yet, there are certain reasons why there is no global climate police or supranational authority overseeing the enforcement of international law. To express the problem more clearly by turning it into a question: why does international climate law, and international environmental law more broadly, have such weak binding force in practice? Why is it that deterrent sanctions cannot be effectively triggered when rules are violated?

The answers to these questions are embedded in the philosophy and structure of international law. The differences between international law and

domestic law; state sovereignty; the principle of auto-limitation; the formation of international legal rules through consensus (unanimity or general agreement); the rule of *pacta sunt servanda* (agreements must be kept); and the concept of soft law all help explain why climate agreements often lack sufficient binding force (Note: due to the very nature of international law, there are of course multiple perspectives on why and to what extent something can be binding, and as you become familiar with these views, you will be able to conduct more effective debates within the committee). In addition, the fact that international law operates through states themselves, the concept of state personality in international law, the monist–dualist distinction, and the approaches of jurists such as Alfred Verdross also shed light on this issue.

8.6. State Sovereignty, State Personality, and the Theory of Auto-Limitation

The most fundamental characteristic of international law is the absence of a central legislator or enforcement body. Based on the principle of sovereign equality, states voluntarily create and agree to abide by the rules of international law. This is explained by the theory of auto-limitation, which we will discuss in more detail below. In other words, "*States are bound by the rules of international law because they have demonstrated the will to comply with those rules.*"

Moreover, the concept of state personality, which we will frequently refer to later, expresses that states are independent and equal subjects (legal persons) in international law. Each state claims absolute sovereignty over its territory and people. Therefore, international law is based on the principle of the sovereignty and equality of states; there is no superior authority above states to set rules for them (Güneş, A. M. , 2012). In other words, since there is no supranational government or global police force in the world, it is the states themselves that make the rules of international law and are obliged to abide by them.

This situation has also given rise to the question "Is international law… truly a law?", a problem that has preoccupied legal theorists since the nineteenth century.

Moreover, the following statement (or similar ones) frequently encountered in visual and written media with regard to international law (particularly public international law) can be subjected to criticism: “Does international law even exist to be applied?” (Reçber, 2020). For example, the English jurist John Austin regarded international law not as ‘law’ in the true sense, but rather as positive practices that states choose to observe, since it lacks a coercive sanctioning power and a superior authority. International lawyers, however, responded to this problem through various theories, such as the auto-limitation thesis put forward by thinkers like Georg Jellinek, the Vereinbarung (agreement) theory, and Anzilotti’s voluntarist approach. If you look into these theories, you will see that they are classified under voluntarist theories concerning the foundation of international law. Alongside these, there also exist natural law and objectivist theories, which may be briefly recommended for further exploration by those interested.

Returning to the concept of self-limitation, according to Jellinek, a sovereign state can be subject to law even in the absence of a superior authority; because the state can limit itself by deciding, through its own will, to respect the international legal order (Aguila & de Bellis, 2021). A sovereign state is bound only by the rules it willingly agrees to follow. This concept of state consent and self-limitation is the cornerstone of the binding nature of the international legal order (Aguila & de Bellis, 2021). International norms are valid because states agree to bind themselves to them.

The theory of auto-limitation shapes both the formation and application of international law. The rule-making process in international law largely relies on the consent of states. Treaties between states are the most fundamental sources because they explicitly reflect this consent. For a rule to be considered international law, it generally requires the explicit or implicit approval of states (for example, in international customary law, it requires broad and consistent application, *opinio juris*). Treaties, customs, and general principles, which are among the sources of international law, are in fact always the product of the agreement of states. Therefore, the process of creating new rules in the international community is

carried out with the common balance of 193 states: there is a constant search for consensus and compromise for the broadest possible participation. Diplomacy faces the dilemma of, on the one hand, creating rules with broad participation encompassing all states, and on the other hand, keeping the content of the rules at the lowest common denominator acceptable to everyone. In this context, Jellinek's theory can be summarized as: there is no international law without the consent of states. (Aguila & de Bellis, 2021)

Because states voluntarily enter into international obligations, they also have the freedom to withdraw from them. This weakens the enforceability of commitments that are not supported by sanctions, as seen in the international climate regime. For example, states party to the 2015 Paris Climate Agreement submit their self-determined climate targets through Nationally Determined Contributions (NDCs); however, there are no punitive sanctions for failing to meet these targets. Article 15 of the Paris Agreement states that the adaptation mechanism will be conducted by a "*transparent, non-adversarial and non-punitive*" expert committee. This design demonstrates a facilitative approach to the implementation of the agreement, but also reveals that the agreement does not contain binding sanctions in case of non-compliance.

Indeed, the US announced its intention to withdraw from the Paris Agreement in 2017 (during the Trump administration), officially left the agreement in 2020, and returned in 2021 with the new administration without facing any sanctions. This situation has shown that even a country that is one of the largest emitters can withdraw from an international climate agreement without facing legal sanctions, for economic or political reasons. As a natural consequence of the principle of auto-limitation, a state can voluntarily absolve itself from a rule it has bound itself to. Similarly, Canada, realizing that it could not meet the binding emission targets stipulated in the 1997 Kyoto Protocol, withdrew from the protocol in 2011, thus freeing itself from its obligations.

Also, the Kyoto Protocol envisioned a stricter compliance mechanism compared to the Paris Agreement; for example, it stipulated that countries that

failed to meet their targets would face heavier reductions and certain sanctions in the following period. However, Canada managed to avoid financial or legal penalties by withdrawing just before the end of the protocol's first commitment period. This event highlighted that states can find ways to circumvent even international climate law and the vacuum created by the lack of enforcement.

Consequently, the principles of voluntariness and sovereign equality, which form the normative basis of international law, limit the binding capacity of the climate regime. Because states “recognize no authority over themselves other than their own decisions,” compliance, even in a global issue like climate change, ultimately rests on the will of the state. This philosophical and structural reality explains why climate agreements often contain “soft law” provisions, a distinction we will discuss later. Without a central global enforcement mechanism, international climate law largely relies on the conscience, reputational concerns, and mutual self-interest of states.

So we can, and should, ask the question, “Why isn’t there a mechanism for geoengineering or anything related to climate problems that works equally for every state here today?” Of course, the answer to the question of whether there is a way to create such a mechanism, given how international law has been shaped until today, can also be found. But before asking that question, it's important to understand why climate laws have never been 100% binding, and why enforcement and litigation mechanisms in international law are also structured according to the auto-limitation approach. International justice is often voluntary: States, by virtue of their sovereignty, are not obliged to recognize the compulsory jurisdiction of an international court. For example, the jurisdiction of the International Court of Justice only comes into play with the consent of the states; no state can be forcibly brought before the Court in a case it does not want. Similarly, there is no single central enforcement body in international law; there is no authority that can enforce compliance with the rules from a single source. The task of punishing a state that commits a wrongful act is essentially left to other states, which are the subjects of international law. Interstate sanctions (e.g., diplomatic initiatives, economic

embargoes, or retaliatory measures) are only implemented through the individual or collective will of states. This structural situation has led to international law being characterized as a unique and not yet fully developed legal system due to the lack of a central authority.

In summary, within the international legal order, states occupy a dual position as both law-makers and subjects of law. This dual role renders the binding force of international rules internally dependent on state consent. The sovereign legal personality of the state and the principle of auto-limitation provide a key to understanding why international rules (including those of international climate law) cannot be fully enforced in practice: without state consent, no rule can be established, nor can it be effectively implemented. Indeed, a legal person is one to whom a given legal order grants rights and imposes obligations. If a state possesses supreme authority that lies beyond all forms of control, this gives rise to the notion that the state stands outside and above the legal system of which it is supposedly a part. In such a case, the state cannot be regarded as a legal person (Reçber, 2020). In this sense, if we accept the state as a legal person, we must also acknowledge that the state's sovereignty and authority are limited by the legal order within which it exists (Çelik, 1984).

In other words, as a summary of the summary, it can be said that the most fundamental characteristic of international law is the absence of a centralized legislative or enforcement authority. States, based on the principle of sovereign equality, create and agree to abide by the rules of international law of their own free will. This stems from the thesis of self-limitation.

8.7. The Role of Domestic Legal Systems in Implementing International Climate Obligations

Up to this point, we have said that international law can be binding only insofar as states choose to remain faithful to agreements because they believe it serves their interests and we have noted that this is referred to as the auto-limitation theory. But is there truly no way for the rules of international climate law to be

effectively implemented in practice? One of the factors that directly affects this issue is how these rules are reflected in domestic legal systems. At this point, we encounter the monist-dualist distinction in international legal theory. This distinction represents two different approaches to the nature of the relationship between international law and national law: monism and dualism.

According to monism, national law and international law are parts of a single whole; the legal order is singular. In monist systems, when a state ratifies an international treaty, that treaty directly becomes part of domestic law. In other words, international norms automatically become applicable in national law. In some monist interpretations, international law is even hierarchically superior and prevails over national law in case of conflict. Countries like the Netherlands can be given as examples of monist structures: in this country, ratified treaties have the force of national legislation, and if they conflict with domestic law, the treaty provisions take precedence (Santos, 2023). In such a system, the terms of a climate agreement could be directly implemented domestically, and citizens or NGOs could challenge the state in national courts, alleging that the state is failing to fulfill its international climate obligations.

Dualism views national and international law as entirely separate systems. In a dualist system, an international agreement must first be transformed in order to have effect under domestic law. That is, unless Parliament or the competent authority incorporates the provisions of that agreement into domestic law, it cannot be directly enforced by individuals and courts. The United Kingdom typically adopts a dualist approach: even if the government is a party to an international agreement, the provisions of the agreement will not directly create rights or obligations within the country unless Parliament enacts the necessary domestic legislation (Santos, 2023). In this case, international law continues to exist at the interstate level, but it does not transform into a concrete legal rule that citizens can demand from the state.

The monist or dualist approach is a critical factor in determining the binding nature of international climate law at the national level. If a country has a monist

structure, environmental agreements it signs automatically become part of its domestic law, allowing its citizens to hold their government accountable in their own courts. A striking example of this is the climate case known as the Urgenda case in the Netherlands. A Dutch NGO (Urgenda Foundation)[4] filed a lawsuit alleging that the government was failing to meet its targets for reducing greenhouse gas emissions; in its rulings in 2015 and 2018, the Dutch courts condemned the government to take stronger measures to reduce emissions. The court decisions also took into account the Netherlands' obligations under the European Convention on Human Rights regarding the right to life and its international climate commitments. This decision is the first instance in the world where a government was compelled by a court ruling regarding its climate targets, and it was made possible thanks to the monist structure of the Netherlands (the Dutch constitution stipulates the direct enforceability of international agreements in domestic law). Similarly, in its decision of January 31, 2020, the French Constitutional Council stated that the ban on the export of pesticides produced in France to third countries was constitutional, based on the concept of “common heritage of humanity” in the preamble of the French Environmental Charter. In this decision, the Council emphasized that national activities for environmental protection must also take into account their impact outside the country (Aguila & de Bellis, 2021). This approach demonstrates that a national judicial body is acting from a perspective that considers the global public interest.

In dualistic systems, the effectiveness of international climate agreements in domestic law depends on the political authorities taking action. For example, in countries like Turkey (which adopts a hybrid model but where the dualistic aspect predominates in practice), the Paris Agreement needs to be ratified by parliament and then implemented through concrete policies in national legislation. If the government does not make the necessary legal and administrative arrangements, it becomes difficult to file a lawsuit based on the Paris Agreement in domestic law. Indeed, in some countries, even though governments have ratified international

[4]Further discussion of the case is available at the following link: https://www.climatecasechart.com/document/urgenda-foundation-v-state-of-the-netherlands_3297

commitments, delays in implementation can occur; targets may remain on paper because domestic legal steps are not completed. The criticized aspect of the dualistic approach is that it allows states to be “two-faced”: while gaining prestige by signing the agreement in the international arena, it is possible to delay or limit its implementation domestically.

On the other hand, even a monistic system is not a complete solution; because when some international agreements do not have sufficiently clear and precise provisions, judicial bodies may hesitate to apply them. Since framework texts such as the Paris Agreement do not directly say “make reductions at this level,” the application of these texts by courts becomes a matter of interpretation, even in monistic countries. Nevertheless, in monistic systems, since international law is accepted as a superior set of norms, there is more internal control pressure on the state to comply with its commitments. In dualistic systems, international law can easily be disregarded by politics, since it is generally not possible for citizens to claim rights based on an agreement that does not have a counterpart in domestic law.

In conclusion, for international climate law rules to be effective in real life, they need to be binding not only at the international level but also at the national level. This is possible only if constitutional and legal regulations support international environmental obligations. Some countries have strengthened the enforceability of international commitments in domestic law by adding the “right to a healthy environment” to their constitutions or by making the fight against climate change a legal obligation. For example, the UK's Climate Change Act of 2008 imposed legally binding carbon emission budget targets on the British government, creating a kind of domestic legal compulsion. Such steps can partially compensate for the enforcement gap at the international level.

8.8. Rule-Making by Consensus: The Problem of the Lowest Common Denominator and Soft Law

As mentioned above, the creation of international legal rules largely depends

on the consensus (unanimity or at least general agreement) of states. This is particularly evident in the field of environment and climate. In comprehensive environmental agreements concerning all states, it has generally only been possible to establish rules that are soft enough or general enough to be acceptable to everyone. In negotiations conducted within the framework of the United Nations, a paradoxical picture emerges: “ambitious but soft” vs. “binding but narrow”: either ambitious and advanced goals are set but are not legally binding (for example, texts such as the UN Biodiversity Aichi Targets or the Paris Agreement fall into this category), or legally binding agreements are made but are limited to very technical and narrow issues (for example, specific issues such as the transport of hazardous waste or the protection of the ozone layer) (Aguila & de Bellis, 2021). Indeed, observers have frequently noted that states often fail to agree on environmental norms that are both ambitious and coercive (Aguila & de Bellis, 2021). This is a structural problem of global environmental governance: rules that everyone can agree on are generally only at the level of a minimum common denominator, while advanced commitments remain in the form of voluntary agreements or soft law.

Soft law, in international law literature, refers to texts that are not legally binding but carry political or moral weight. Declarations, conference resolutions, guidelines, and action plans are generally considered soft law. The 1972 Stockholm Declaration and the 1992 Rio Declaration are examples of soft law in the environmental field. For instance, the Rio Declaration contains 27 principles on environment and development; while these principles are not legally binding, some are confirmed by existing international customary law, and others contribute to the development of customary law. In other words, although the Rio Declaration does not impose directly enforceable legal obligations, it defines the rights and responsibilities of states regarding environmental protection and imposes at least a political obligation on them. Similarly, comprehensive action plans such as Agenda 21, while not containing legal obligations, set out a set of policies that states are expected to adhere to.

States have consciously preferred to keep many environmental commitments

at the soft law level, as they will not evolve into binding agreements. The reason is clear: the preservation of sovereignty and the need for flexibility. A binding international rule restricts a state's future freedom of action and, if not complied with, can lead to consequences such as loss of prestige or political backlash. States unwilling to take these risks tend to pursue ambitious environmental targets "voluntarily, not legally." For example, this dynamic can be clearly seen in climate change negotiations: the 1997 Kyoto Protocol was a relatively strict agreement that set binding emission targets for industrialized countries; however, its impact remained limited due to the non-participation of major actors such as the US and the failure of some countries to fulfill their obligations. The 2015 Paris Agreement, designed after these experiences, followed a completely different strategy: by adopting a hybrid legal form, it created a framework that was both flexible enough for all countries to participate in and open to raising targets in the long term (Paris Agreement). Technically, the Paris Agreement has the status of a treaty, meaning it imposes certain legal obligations on its parties; However, the nature of these obligations is unusual. Each state submits its own national contribution targets (NDCs) and updates these targets and provides progress reports every five years. The agreement requires all parties to comply with these processes, but it does not impose a binding dictate on how much each state should reduce emissions. In other words, states' emission reduction commitments (NDCs) are not directly binding under international law; the Paris system primarily seeks to ensure accountability through transparency and monitoring (Paris Agreement). Indeed, as the UN Legal Counsel has emphasized, since the Paris Agreement does not make the parties' NDCs legally binding, it relies on transparency rather than legal coercion to ensure accountability (Paris Agreement). Therefore, the success of the Paris Agreement depends on the parties implementing their self-set targets in good faith and on the effectiveness of international pressure mechanisms (meetings, review processes, civil society pressure, etc.).

The soft law approach has led to the emergence of many important principles in the environmental field: principles such as "sustainable development," "common

but differentiated responsibilities," "precautionary principle," and "polluter pays principle" were first expressed in soft law documents, and some have gradually become customary law. However, the weakness of soft law is that it does not have direct sanctions for non-compliance. International legal mechanisms cannot be activated against a state that does not comply with a declaration; at most, political criticism can be directed. This leads states to prefer soft law to avoid environmental obligations that involve serious restrictions. For example, the United Nations General Assembly debated for a long time proposals for a comprehensive and binding World Environmental Agreement, but ultimately settled for publishing a "Political Declaration" on the environment in 2022 (Aguila & de Bellis, 2021). In other words, the idea of creating a binding "global environmental constitution" has been replaced by declarations of good faith that have no legal value due to the reservations of powerful states.

As a result of this situation, international climate law in practice consists largely of voluntary or soft commitments. Texts setting ambitious targets mostly remain advisory; legally binding agreements are either narrow in scope (e.g., limited to specific pollutants) or insufficiently substantiated. This demonstrates that the "least common denominator" rule applies to the collective action of states. The part that everyone can agree on, unfortunately, falls short of what the planet needs.

9. Case Studies

9.1. The LOHAFEX Experiment (Ocean Fertilization)

The LOHAFEX experiment, jointly conducted in 2009 by the Indian Council for Scientific and Industrial Research (CSIR) and Germany's Alfred Wegener Institute (AWI), is one of the most concrete and shocking examples of the "governance gap" and lack of legal enforcement in international environmental law. The project aimed to trigger a massive artificial phytoplankton bloom by dumping 6 tons of iron sulfate into the international waters of the Southern Ocean (the open sea, not subject to the jurisdiction of any state) and trapping atmospheric carbon on the seabed. However, this operation went down in history not as a scientific breakthrough, but for the

diplomatic and legal crisis it created. Although the United Nations Convention on Biological Diversity (CBD) had declared a de facto moratorium (temporary ban) against ocean fertilization shortly before the operation (this moratorium will be discussed in later sections), the LOHAFEX team circumvented this decision by using the legitimate scientific research exception. Despite intense protests from international NGOs and even attempts by the German Ministry of Environment to halt the project, the experiment was carried out thanks to the initiative of the German Ministry of Science. The most ironic scientific aspect is that the artificially triggered algal bloom was rapidly consumed by other marine life (copepods); in other words, despite the shock inflicted on the ecosystem, the targeted carbon absorption was completely unsuccessful. The most critical fact that delegates to the UNEA committee should consider when examining this case is this: without a binding international police force or enforcement mechanism to punish violations, global moratoriums and "soft law" decisions are treated as mere recommendations by states or independent institutions. On the other hand, binding states to something and imposing sanctions against their will is also impossible, as described in previous sections. The LOHAFEX case has proven how dangerous a legal loophole the guise of "scientific research" creates to legitimize transboundary interventions in geoengineering. This case is a perfect precedent demonstrating that relying solely on "good faith science" is not enough to protect global commons such as the atmosphere and the high seas; there is an urgent need for a brand new, strict, unambiguous, and legally binding treaty.

(Those who wish to learn more about the LOHAFEX case can use this link:https://en.wikipedia.org/wiki/LOHAFEX)

9.2. The SCoPEx Project (SAI) and its Controversial Cancellation

The Stratospheric Controlled Disturbance Experiment (SCoPEx), conducted by Harvard University, has gone down in history as the highest-profile and most controversial academic initiative to take SRM technologies out of computer simulations and test them in the real-world atmosphere. The project's original goal

was to release just a few kilograms of calcium carbonate dust into the stratosphere (approximately 20 km high) using a high-altitude balloon and measure the distribution of these particles and their effects on atmospheric chemistry with specialized sensors. From a scientific and ecological perspective, the likelihood of such a small-scale intervention causing physical harm to the planet was practically zero; the environmental impact of the experiment was even less than the footprint of a commercial aircraft flight. However, SCoPEx became the center of a global diplomatic crisis not because of its technical risks, but because of the enormous ontological and political breaking point it represented. When the Kiruna space station in Sweden was chosen for the project's test flight in 2021, an unprecedented civil resistance erupted in the history of international environmental law. The Sami people (Saami Council), the indigenous inhabitants of the region, and international environmental organizations vehemently opposed the experiment, launching a global campaign to halt the project. The Sami and activists based their argument on the *Slippery Slope* theory: they believed that conducting this experiment would normalize SRM technologies and legitimize future massive and destructive operations, acting like a Trojan Horse. Furthermore, they argued that the first physical step in a technology that could profoundly impact the entire planet's climate, taken by an elite university in the Global North without any democratic consent from the Global South or indigenous peoples, constituted unacceptable *climate colonialism* and the construction of hegemony. Following months of intense public pressure, moral debates, and local resistance, Harvard University was forced to first suspend the flight in Sweden and ultimately, on the recommendation of an independent advisory board, announced the complete cancellation of the SCoPEx project in early 2024. The most crucial diplomatic lesson you should draw from this case is this: what halted the SCoPEx project was not a binding international law, a UN Security Council resolution, or a formal international enforcement mechanism; it was because such a mechanism to govern geoengineering simply does not currently exist. The project was cancelled solely due to pressure from civil society and the lack of a social license to operate within the existing governance vacuum. The SCoPEx case is the most perfect example proving how blurred the boundaries

between geoengineering research and actual geoengineering deployments are in the current legal framework, and that there is an urgent need for a binding international oversight body to define limits on scientific research.

10. UN Involvement & International Frameworks

10.1. Convention on Biological Diversity (CBD) 2010 Moratorium

The historic decision (Decision X/33) taken by the parties to the Convention on Biological Diversity (CBD) in Japan in 2010 is the most comprehensive normative step taken to date in the international arena against geoengineering technologies. The decision demands a de facto moratorium on all climate-related geoengineering activities until sufficient scientific basis and transparent risk assessments are carried out, on the grounds that massive interventions in climate systems can have unpredictable and devastating effects on biodiversity. While at first glance this text is presented as an impenetrable global shield protecting the Earth's atmosphere and oceans, an examination through the lens of international environmental law reveals it to be extremely fragile and full of loopholes. Above all, this moratorium is not a legally binding prohibition (hard law), but a "soft law" instrument relying on the consent and good faith of states. The text's greatest weakness is that it lacks any international power to stop, prosecute, or impose economic/political sanctions on any state or entity that violates the decision and launches a unilateral SRM operation.

Furthermore, the CBD moratorium has placed a ticking time bomb at the very heart of the system by exempting small-scale scientific research from this restriction. As we have seen in cases of ocean fertilization, the guise of scientific research has become a massive legal loophole allowing states and profit-driven private companies to circumvent this moratorium. In an area where the lines between research and actual deployment are so blurred, a moratorium based solely on peer pressure cannot prevent catastrophes. The painful reality that delegates on the UNEA committee must face is this: the only barrier protecting the planet from a unilaterally initiated geoengineering crisis today is this 2010 piece of paper, easily

breached by the word "research," and lacking any enforcement power. The diplomats' main task is to formulate how to transform this weak moratorium into a rigorous international protocol that is deterrent, binding, and capable of enforcing transboundary harm compensation in cases of breach.

10.2. ENMOD Convention (Prohibition of Hostile Use of Environmental Modification)

The Convention on the Prohibition of Military or Any Other Hostile Uses of Environmental Modification Techniques (ENMOD) was signed in 1977 as a direct result of Cold War paranoia and, in particular, the US weather modification operations (Operation Popeye) in the Vietnam War. This international treaty explicitly prohibits interfering with the planet's natural dynamics (weather, fault lines, ocean currents) and transforming these systems into weapons of mass destruction that create widespread, long-lasting or violent effects. However, at the heart of the current geoengineering regulation crisis, and likely to fuel diplomatic conflicts within the UNEA committee, lies the enormous legal loophole: the treaty only restricts hostile and military intentions. SRM technologies are entirely exempt from ENMOD's jurisdiction because they are presented by states and corporations with a peaceful and salvific motive, such as slowing global warming. In other words, if a state sprays aerosols into the stratosphere to cool the world, and this action causes drought on another continent by interrupting monsoon rains, it is not considered a technical violation under ENMOD as long as the intent behind the intervention is claimed to be peaceful. The reality that you all must confront at this stage is that the most specific treaty on climate intervention in international environmental law is actually an outdated fossil. This obsolete system, focused on intent, is completely incapable of controlling the action itself and the transboundary harm it creates. This convention demonstrates how states can bypass international consent under the guise of saving the world, while proving the urgent need for a binding mechanism (enforcement) based not on intent, but on the resulting harm and the obligation to take precautions.

10.3. The Role of UNEA in Global Governance

The United Nations Environment Assembly, with the universal participation of 193 member states, is the highest-level and legitimate decision-making body that charts the course of global environmental policies. However, when it comes to radical technologies that could fundamentally alter the planet's thermodynamic balance, such as geoengineering, the assembly's role in global governance falls into a colossal legal paradox. Resolutions and declarations adopted by the UNEA are, by their nature, “soft law”; that is, unlike UNSC resolutions, they are not texts that directly bind states and automatically trigger economic or diplomatic sanctions (enforcement) in case of violation. Lacking a strong "global police" or judicial mechanism, the assembly's real power lies in its capacity to establish the diplomatic framework that shapes the future boundaries of international law through "norm-building," peer pressure, and binding international treaties. In the dark "governance vacuum" surrounding geoengineering, the lack of any binding agreements transforms the UNEA from a mere platform for discussion into humanity's most critical and urgent line of defense against unilateral climate catastrophes.

Preventing SRM and CDR projects from turning into an uncontrolled scientific race or "climate colonialism" is the UNEA's greatest historical mission. The Assembly's task here is not merely to list the ecological risks of the technology; it is to adapt traditional legal concepts such as consent building, transboundary harm, and state liability to the geoengineering era. The UNEA is obligated to draw the red lines that will prevent the Global North, which holds technological and financial power, from turning the Global South into a laboratory for a climate experiment without consent, under the guise of "saving the world." The real equation the delegates need to solve in the committee room is how to use UNEA’s “advisory” authority to deter unilateral (rogue) interventions. The goal is to design the architecture of an international scientific oversight body that can stop private companies or autonomous states exploiting legal loopholes, and to prepare these flexible declarations to evolve into a binding, hard law protocol that can prosecute

violators in the future.

11. Questions to be Addressed

1. What kind of oversight mechanism should be established to prevent technologies powerful enough to control the planet's “thermostat,” such as Solar Radiation Management (SRM), from being implemented unilaterally by a single state or private company without seeking international consent?
2.

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