

GEOENGINEERING: ISSUES OF ACCOUNTABILITY IN INTERNATIONAL LAW

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*If we take an active role in managing the planet, we will replace mystery and beauty with lousy engineering.*¹

INTRODUCTION

In November 2009, the *Wall Street Journal* reported that China's Weather Modification Office started seeding clouds with silver iodide in an effort to counteract a lingering drought in Beijing.² Even though China intended this

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¹ JEFF GOODELL, HOW TO COOL THE PLANET: GEOENGINEERING AND THE AUDACIOUS QUEST TO FIX EARTH'S CLIMATE 218 (2010).

² Jason Dean, *Blizzard Renews Storm over China Making Snow*, WALL ST. J., Nov. 16, 2009, at A12; Clay Dillow, *China's Weather Manipulation Brings Crippling Snowstorm to Beijing*, POPULAR SCI. (Nov. 11, 2009), <http://www.popsoci.com/science/article/2009-11/chinas-weather-manipulation-brings-crippling-snowstorm-beijing> ("The Chinese government employs the controversial practice of cloud seeding in an attempt to force precipitation in and around Beijing.").

procedure to produce local rain, it instead accidentally produced snowfall, leading to the biggest blizzard in China in over five decades.³ This incidental, man-made blizzard caused over \$650 million worth of damage and forty deaths.⁴ Although unintended, this calamity stirred a controversial uproar over whether state actors have the right to modify the weather or manipulate the climate.⁵ The United Nations—along with many scholars opposed to environmental modification techniques—argued that the weather belongs to everyone, and because the environmental consequences can potentially be transnational, state actors should not tamper with it.⁶ Further, opponents of environmental modification techniques argue that this science is underdeveloped and stress the potential harm to our ecosystems if a drastic modification of the environment occurs.⁷

Although China has practiced only small-scale and temporary weather modification techniques, such as cloud seeding, its accidental blizzard exemplifies the exact problems that the international scientific community is currently debating about geoengineering. Geoengineering is commonly defined as the “deliberate large-scale intervention in the Earth’s climate system, in order to moderate global warming.”⁸ Instead of regional weather modification techniques—like cloud seeding in order to produce local rain—geoengineering’s effects go beyond state territories, and may encompass whole continents, or even hemispheres. Stated simply, geoengineering is a form of weather modification, but on a global or hemispheric scale. The two terms—weather modification and geoengineering—can seem interchangeable at times because both sciences involve environmental modification techniques and can cause devastating results. Nevertheless, this note distinguishes between the two sciences to

³ Dean, *supra* note 2.

⁴ *Id.*

⁵ *Id.* (“The weather belongs to everyone, not just to the Department of Artificial Interference with the Weather.”) (quoting a blogger from Shou.com); see Suvi Huttunen & Mikael Hildén, *Framing the Controversial: Geoengineering in Academic Literature*, 36 *SCI. COMM.* 3, 4 (2013) (“Geoengineering is novel and highly controversial.”); *Scientists ‘Cause’ Beijing Snow*, BBC NEWS (Nov. 2, 2009 2:59 PM), <http://news.bbc.co.uk/2/hi/asia-pacific/8337337.stm> (stating that scientists are skeptical of the effectiveness of cloud seeding).

⁶ See generally *Climate & Geoengineering*, ETC GRP., <http://www.etcgroup.org/issues/climate-geoengineering> (last visited May 27, 2015). Some of the main opponents of environmental modification techniques include the ETC group, which “calls for a ban” on geoengineering because it is a false solution to climate change. *Id.*

⁷ *WSF 2013: Geoengineering: Resisting Climate Manipulation*, ETC GRP. (Mar. 19, 2013), <http://www.etcgroup.org/content/wsf-2013-geoengineering-resisting-climate-manipulation>.

⁸ ROYAL SOC’Y, *GEOENGINEERING THE CLIMATE: SCIENCE, GOVERNANCE AND UNCERTAINTY*, at ix (2009), available at http://royalsociety.org/uploadedFiles/Royal_Society_Content/policy/publications/2009/8693.pdf; see also INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, IPCC EXPERT MEETING ON GEOENGINEERING, MEETING REPORT 2 (Ottmar Edenhofer et al. eds., 2012) [hereinafter IPCC MEETING REPORT], available at <http://www.ipcc-wg3.de/publications/supporting-material-1/EM-GeoE-Meeting-Report-final.pdf> (finding that the term “geoengineering” encompasses a “broad, and ill-defined, variety of concepts for intentionally modifying the Earth’s climate at the large scale”).

demonstrate geoengineering's potential for even greater disaster than weather modification.⁹

As demonstrated by the documentary *Owning the Weather*, many states, private corporations, and even individuals increasingly use weather modification techniques to combat global warming, but weather modification is just a limited, temporary fix.¹⁰ Although China's weather modification techniques are not as large-scale as geoengineering, the accidental Beijing disaster provides a glimpse of the catastrophes geoengineering could cause before legal regulatory mechanisms are set in place.

This issue of legal accountability for the potentially devastating effects of geoengineering is an important matter of debate for the international scientific community. For example, what would have happened if China's man-made blizzard had crossed into a neighboring country, killing civilians and causing millions of dollars in damage? Would it be considered an act of war? Would China be accountable for the destruction? Although it would have been logical to address these issues before states began practicing environmental modification techniques,¹¹ such discussion has not taken place.¹² International law has yet to catch up with this developing science. The Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques, also known as ENMOD,¹³ is the only international legal mechanism dealing with weather modification. Unfortunately, ENMOD is outdated in its failure to regulate peaceful environmental modification techniques and to hold state actors accountable for geoengineered weather.¹⁴ With no international legal agreement,¹⁵ state actors can perform this underdeveloped science, putting citizens' lives at risk without the fear of liability.

⁹ See *infra* note 11; see also IPCC MEETING REPORT, *supra* note 8 (“Geoengineering is different from weather modification . . . but the boundary can be fuzzy.”).

¹⁰ OWNING THE WEATHER (4th Row Films 2009).

¹¹ For purposes of this note, I use the term “environmental modification techniques” to encompass both geoengineering and weather modification. Although weather modification is small-scale compared to geoengineering, issues of accountability still must be addressed for both sciences.

¹² See Huttunen & Hildén, *supra* note 5, at 10 tbl.2 (“Geoengineering is essentially an governance issue, where the governance problems should be solved as soon as possible, before the technology is applicable.”).

¹³ Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques, *opened for signature* May 18, 1977, 31 U.S.T. 333, 1108 U.N.T.S. 151 [hereinafter ENMOD].

¹⁴ See generally Bidisha Banerjee, *ENMOD Squad: Could an Obscure Treaty Protect Developing Countries from Geoengineering Gone Wrong?*, SLATE (Sept. 23, 2010, 11:00 AM), http://www.slate.com/articles/technology/future_tense/2010/09/enmod_squad.html (finding that ENMOD would not cover geoengineering because of its peaceful purposes, “unless someone could prove hostile intent”).

¹⁵ See IPCC MEETING REPORT, *supra* note 8, at 34 (“To date there has been little comprehensive assessment of the international regulation of geoengineering. Indeed, absent from the current legal landscape is a single treaty or institution addressing all aspects of geoengineering; rather, the regulatory picture is a diverse and fragmented one both at the interna-

Something must be done to eliminate the current lack of international law to govern this potentially dangerous field of scientific study and practice.¹⁶ Geoengineering is no longer science fiction; it is being researched and developed now, while weather modification is already a common practice in the United States.¹⁷ Therefore, it is essential that international law catch up to the state-of-the-art technological developments of today before a geoengineered catastrophe occurs that, in comparison, makes the Beijing blizzard look like a fun snow day. Without any sufficient legal mechanisms or precedents specific to environmental modification techniques, there is no consensus on the issue of liability resulting from geoengineered weather. Consequently, this note asks: how can international law provide sufficient legal accountability in case of a catastrophic accident from geoengineering?

As this note shows through congressional hearings, newspaper articles, and international agreements, geoengineering and weather modification have been lingering matters in international law for several decades and will continue to be reviewed, researched, and developed in the years to come. This note examines how international law can provide legal accountability for geoengineering in the event of a catastrophic accident. First, Part I describes commonly proposed geoengineering techniques, coupled with the arguments for and against geoengineering. Second, Part II evaluates four case studies—including ENMOD—regarding relevant legal mechanisms to provide a legal precedent in international disputes, accountability, regulation, and enforcement. Finally, Part III interprets the evidence to assess the possible implications of international law on geoengineering.

I. GEOENGINEERING TECHNIQUES

To better recognize the catastrophic potential that geoengineering may have on the planet, it is imperative to understand the techniques used in its practice. However, before showcasing different geoengineering techniques and the scientific community's acceptance—or rejection—of these techniques, this

tional and national levels.”); *see also* KELSI BRACMORT & RICHARD K. LATTANZIO, CONG. RESEARCH SERV., R41371, *GEOENGINEERING: GOVERNANCE AND TECHNOLOGY POLICY* 39 (2013) (“[I]n the United States, there is limited federal involvement in, or oversight of, geoengineering.”).

¹⁶ *See* Huttunen & Hildén, *supra* note 5, at 9 (“[T]he mere existence of geoengineering options needs regulation, irrespective of its actual effects or effectiveness.”).

¹⁷ *OWNING THE WEATHER*, *supra* note 10. According to the documentary, there are more than fifty active weather modification programs in the United States alone. *Id.* Scientists are already developing one type of geoengineering—the use of sulfate aerosols. Jonathan Benson, *Scientist Terrified of Geoengineering Technology Being Developed under Guise of Halting Global Warming*, NAT. NEWS (Dec. 30, 2014), http://www.naturalnews.com/048147_geoengineering_global_warming_chemtrails.html. (stating that Dr. Matthew Watson of Bristol University is “working on a \$2.8 million [sulfate aerosol] project”). For a discussion of sulfate aerosols, *see infra* Part I(B).

note briefly discusses the practices of weather modification in order to substantiate the distinction between the two sciences.

A. *Weather Modification and the Rise of Geoengineering*

Weather modification techniques are regional and temporary modifications on a small-scale. Cloud seeding is a very common form of weather modification.¹⁸ Cloud seeding—as used in the Beijing blizzard tragedy—is the process of spreading dry ice or silver iodide in the upper parts of clouds to induce rain or snowfall; this can be done by machine, plane, or even rockets to disperse the dry ice, or more commonly, the silver iodide.¹⁹ The silver iodide dispersed into the clouds clings to water molecules making the water molecules heavier.²⁰ Consequently, these heavier water molecules will fall, turning into rain or snow.²¹ This same technique was used in an attempt to weaken the wrath of Hurricane Debbie in August of 1969.²² Although this experiment—called Project Stormfury—was not successful, it was a forerunner to modern geoengineering techniques.²³

Contrary to the regional, temporary, and small-scale effects of weather modification, geoengineering is the large-scale manipulation of the Earth's climate to counteract the effects of global warming.²⁴ Geoengineering is a hot topic because of the controversial issue of global warming, which estimates that Earth's temperature will “warm by 3 to 7 degrees Fahrenheit by the end of the century and forecast[s] a future of melting glaciers, rising seas, epic droughts, disease, and famine.”²⁵ However, those forecasts are already out-of-date.²⁶ Earth's temperature is actually rising faster than predicted, rendering the climate impact much more severe.²⁷ Instead of an increase of only three to seven degrees, scientists now predict that the United States' temperature could warm by as much as “15 degrees Fahrenheit by the end of the century.”²⁸ Conse-

¹⁸ See Virginia Simms, Comment, *Making the Rain: Cloud Seeding, the Imminent Freshwater Crisis, and International Law*, 44 INT'L LAW. 915, 916 (2010) (finding that over twenty-seven countries engage in cloud seeding).

¹⁹ *Id.* at 919.

²⁰ *Id.* at 918.

²¹ *Id.* at 919.

²² GOODELL, *supra* note 1, at 209; Jack Williams, *Cloud Seeding Experiment Almost Snarled Hurricane Camille Forecast*, WASH. POST (Aug. 27, 2013), <http://www.washingtonpost.com/blogs/capital-weather-gang/wp/2013/08/27/cloud-seeding-experiment-almost-snarled-hurricane-camille-forecast/>.

²³ See ELI KINTISCH, HACK THE PLANET: SCIENCE'S BEST HOPE—OR WORST NIGHTMARE—FOR AVERTING CLIMATE CATASTROPHE 87 (2010).

²⁴ See ROYAL SOC'Y, *supra* note 8.

²⁵ GOODELL, *supra* note 1, at 8 (referencing the Intergovernmental Panel on Climate Change's Report).

²⁶ *Id.*

²⁷ *Id.*

²⁸ *Id.* (indicating that the temperature increase may cause the sea levels to rise by as much as nine feet).

quently, “the public debate [has shifted] from how to stop global warming to how we can live with it.”²⁹ Hence, the idea of geoengineering became a possible solution to the global warming problem.

B. *Geoengineering*

Geoengineering proposals typically fall into two categories: carbon dioxide removal and solar radiation management.³⁰ Carbon dioxide removal, as its name implies, is the practice of removing carbon dioxide (“CO₂”) from the atmosphere.³¹ Essentially, geoengineers want to remove CO₂ because it heats the planet.³² When sunlight hits Earth, Earth reflects the heat energy from the sunlight back into space.³³ CO₂, however, absorbs the heat energy and then rereleases some of it back into the atmosphere.³⁴ Hence, CO₂ in the atmosphere heats up the planet, and the removal of CO₂ will cool the Earth’s temperatures.³⁵

CO₂ removal is an attractive option because of the high costs and politics involved with requiring large CO₂ emitters, such as coal plants, to filter their CO₂. Without having to use potentially dangerous geoengineering techniques, there are already “basic ways in which engineers could alter existing coal plants to grab their carbon dioxide.”³⁶ One of the main non-geoengineering techniques for reducing CO₂ is for coal plants to replace their air supply with pure oxygen in the boiler.³⁷ Although this technique makes the CO₂ easier to “grab,” it requires a large amount of energy and could cut “the efficiency of the coal plant by 36 percent.”³⁸ Alternatively, if coal plants added a CO₂ filter to their exhaust, it could be very effective.³⁹ However, CO₂ filters are expensive, with an estimation of a fifty to seventy dollar-per-ton increase of CO₂ that is filtered.⁴⁰ Although some countries may have the political willingness to adopt such an expensive program, the largest CO₂ emitters, such as China, the United States,

²⁹ *Id.* at 14.

³⁰ BRACMORT & LATTANZIO, *supra* note 15, at 2. For more information regarding geoengineering techniques, see IPCC, *supra* note 8; ROYAL SOC’Y, *supra* note 8, at 1.

³¹ BRACMORT & LATTANZIO, *supra* note 15, at 2.

³² *How Does Carbon Dioxide Cause Global Warming*, LANSING ST. J. (Aug. 31, 1994), http://www.pa.msu.edu/sciencet/ask_st/083194.html.

³³ *Id.*

³⁴ *Id.*

³⁵ BRACMORT & LATTANZIO, *supra* note 15, at 10.

³⁶ KINTISCH, *supra* note 23, at 110.

³⁷ *Id.*

³⁸ *Id.*

³⁹ *Id.*

⁴⁰ *Id.* (citing an MIT study that estimated the costs of adding filters to coal plants); see David Biello, *Can Captured Carbon Save Coal-Fired Power?*, SCI. AM. (May 17, 2009), <http://www.scientificamerican.com/article/can-captured-carbon-save/> (stating that the use of a \$100 million carbon capture and sequestration boiler at a power plant produces nine metric tons of CO₂ per hour, but recognizing that CO₂ can be compressed into liquid form and sold to other companies, such as carbonated beverage makers like Coca-Cola).

and India, would be unlikely to require such pricy business practices to save the environment.⁴¹ Consequently, geoengineering techniques become a viable option when large, polluting companies are unwilling to foot the bill themselves.

Even if large CO₂ emitters filtered their CO₂, carbon dioxide removal may still be necessary to cool the planet. Although carbon dioxide removal has not been scientifically proven as safe and effective, it is proposed as an emergency relief measure to prevent abrupt and severe climate change. Though the thought of going green and reducing CO₂ to save the planet is appealing, “[e]ven if we cut CO₂ pollution to zero tomorrow, the amount of CO₂ we have already pumped into the atmosphere will ensure that the climate will remain warm for centuries.”⁴² In fact, CO₂ can remain in the atmosphere for up to 100,000 years.⁴³ Thus, carbon dioxide removal has gained some popularity as a proposed application of geoengineering.

The other main geoengineering experiment—solar radiation management—is also a widely controversial subject. During the second of three congressional hearings on geoengineering in the House of Representatives’ Committee on Science and Technology in February of 2010, expert witness Dr. Philip Rasch defined solar radiation management as the process of “managing the amount of sunlight reaching the Earth’s surface.”⁴⁴ The purpose of solar radiation management is to reduce some of the global warming that is expected from the increasing amount of greenhouse gas concentrations.⁴⁵ However, solar radiation management will not be able to fix other problems related to the increasing amount of CO₂, such as the heightened acidity of the ocean, endangering marine life.⁴⁶

One particularly contentious geoengineering technique, which would fall under the category of solar radiation management, is the use of stratospheric sulfate aerosols. This method is based on the logic that when a volcano erupts, it naturally cools down the earth because of the injection of sulfur dioxide into the stratosphere.⁴⁷ The man-made replicas of this natural phenomenon are called sulfate aerosols, which “act like small reflectors that scatter sunlight.”⁴⁸ Some of the sunlight hitting the aerosol drops gets scattered down toward Earth

⁴¹ KINTISCH, *supra* note 23, at 110. “‘CCS is advancing slowly, due to high costs and lack of political and financial commitment.’” *‘Clean Coal’ Technologies, Carbon Capture & Sequestration*, WORLD NUCLEAR ASS’N, <http://www.world-nuclear.org/info/Energy-and-Environment/-Clean-Coal--Technologies/> (last updated Feb. 2015) (quoting the International Energy Association).

⁴² GOODELL, *supra* note 1, at 9.

⁴³ *Id.*

⁴⁴ *Geoengineering II: The Scientific Basis and Engineering Challenges: Hearing Before the H. Comm. on Sci. & Tech.*, 111th Cong. 1 (2010) (statement of Dr. Philip Rasch, Scientist, Pacific Northwest National Laboratory).

⁴⁵ BRACMORT & LATTANZIO, *supra* note 15, at 15.

⁴⁶ GOODELL, *supra* note 1, at 17.

⁴⁷ *Geoengineering II*, *supra* note 44, at 5.

⁴⁸ *Id.*

and some gets reflected back out of our atmosphere.⁴⁹ Consequently, Earth cools down.⁵⁰ “[S]cientists [have] estimated that geoengineering the upper atmosphere with this particular technique could cool Earth by as much as 4 °F in a few years.”⁵¹ Scientists have also proposed using the same method to adjust climates to taste, whereby everyone could enjoy the same Mediterranean climate.⁵² However, this lavish proposal was quickly abandoned after realizing that not all food supplies grow properly in a Mediterranean climate.⁵³

C. *Controversy in the Scientific Community*

Although these proposed geoengineering strategies might theoretically help counteract global warming, many respected, mainstream scientists have expressed doubt over the safety and effectiveness of geoengineering.⁵⁴ For example, Michael Oppenheimer, a climate scientist at Princeton, stated: “‘The fact that we’re even talking about it is a sign of desperation.’”⁵⁵ Further, John Holdren, Chief Science Advisor to President Barack Obama, opined: “‘The geoengineering approaches considered so far appear to be afflicted with some combination of high costs, low leverage, and a high likelihood of serious side effects.’”⁵⁶

In general, scientists’ doubts about geoengineering can be summed up in three main arguments.⁵⁷ First, many experts believe that “we are messing with a system we don’t understand.”⁵⁸ Earth’s climate is much more complex than we think. Scientists may understand the theories behind geoengineering, but the consequences are not always foreseeable. A prime example is the Beijing blizzard.⁵⁹ Chinese scientists may have understood the theory of cloud seeding; yet, they did not expect to create an uncontrollable blizzard that killed over forty people and caused more than \$650 million of damage.⁶⁰ Moreover, the Beijing blizzard was a simple case of cloud seeding—a localized, small-scale weather modification technique. If scientists cannot fully understand cloud seeding,

⁴⁹ *Id.*

⁵⁰ *Id.*

⁵¹ KINTISCH, *supra* note 23, at 7.

⁵² *Id.*

⁵³ *Id.*

⁵⁴ GOODELL, *supra* note 1, at 13.

⁵⁵ *Id.*

⁵⁶ *Id.*

⁵⁷ *Id.* at 18.

⁵⁸ *Id.*; *Climate Change FAQ*, SCRIPPS INST. OF OCEANOGRAPHY, http://aquarium.ucsd.edu/climate/Climate_Change_FAQ/ (last visited May 27, 2015) (“[W]e don’t yet fully understand the behavior of Earth’s complex climate system.”).

⁵⁹ Dean, *supra* note 2. *But see* GOODELL, *supra* note 1, at 41 (“The fact that even the best models can’t accurately predict next week’s weather is evidence of just how dynamic the system is. . . . Predicting weather and predicting climate are two different things. A system can be quite chaotic on a local or regional level, while much steadier on a global scale.”).

⁶⁰ Dean, *supra* note 2.

how can we have the confidence to let them manipulate the climate of an entire hemisphere, with the potential to cause catastrophic results that span not just countries, but continents?

Second, the mere fact of discussing geoengineering “distracts us from the urgent job of cutting greenhouse gas pollution.”⁶¹ The sad reality is that the world—particularly the United States—is having trouble going green.⁶² In fact, CO₂ emissions in the United States for 2013 actually increased due to higher costs of natural gas, “which prompted some utilities to switch back to a dirtier energy source—coal.”⁶³ The United States is the second-worst country for CO₂ emissions, but it is nipping at China’s heels.⁶⁴ Unfortunately, the United States and many other highly developed countries seem unlikely to reverse the trend anytime soon:

[I]f people believe there is a quick technological fix out there for global warming, they will ask why we should bother going through all the pain and struggle of reinventing the world’s energy systems. After all, who wants to pay higher electric bills, move to a smaller house, or give up their third TV if we can just throw some dust in the air and cool off the planet? This is a version of the classic “moral hazard” argument that economists use frequently to underscore why flood insurance encourages people to build homes in flood-prone locations, or why bank bailouts discourage investment firms from instituting real reforms. If someone else is going to cover the loss, it greatly lessens the urgency of taking responsibility for one’s own actions.⁶⁵

This moral hazard leads to the third argument against geoengineering, that it is “evidence of exactly the same kind of industrial thinking that cooked the planet in the first place.”⁶⁶ The root problem is that “Western civilization as we know it is unsustainable.”⁶⁷ The climatic footprint that an average family makes, with their SUVs, multiple TVs, and endless energy consumption, cannot be balanced out by recycling a few soda cans here and there. Hence, our lavish lifestyle “compels us to chase after a technological fix—a high-tech Band-Aid that will solve all our problems.”⁶⁸

Through a legal lens, geoengineering raises another shadow of doubt regarding accountability. Even if the international legal arena adopts a geoengineering treaty, how can one prove that a particular type of weather at a particular time was geoengineered? The problem is that modern science will allow us to engage in geoengineering, but not necessarily to measure its true impact:

⁶¹ GOODELL, *supra* note 1, at 19.

⁶² Sarah Wolfe, *Dirty Deeds: The World’s Biggest Polluters by Country*, GLOBALPOST (Jan. 14, 2014, 3:35 PM), <http://www.globalpost.com/dispatch/news/science/global-warming/140113/dirty-deeds-the-worlds-biggest-polluters-co2-emissions-country>.

⁶³ *Id.*

⁶⁴ *Id.*

⁶⁵ GOODELL, *supra* note 1, at 19–20.

⁶⁶ *Id.* at 20.

⁶⁷ *Id.* at 21.

⁶⁸ *Id.*

If we take an active role in managing the planet, we will replace mystery and beauty with lousy engineering. If it rains too little, we will curse the engineers at Climate Control Center. If it rains too much, we will curse them again. Once in a while, they will get it right, and once in a while, we will be grateful.⁶⁹

It is not difficult to see, then, how the floodgates of litigation might consequently be flung open. For example, people may start suing their governments regardless of whether geoengineering is actually responsible for certain changes in the weather: some may sue because the fog from sulfate aerosols depresses them; some may sue because their plants are not growing properly; and some may sue because the fog blocked their million-dollar ocean view. Regardless of the reason, if people believe the government is affecting the weather, then they may also believe the government is to blame whenever something goes wrong. Because it is not clear how to distinguish between geoengineered weather and naturally-occurring weather,⁷⁰ society's already underfunded judicial resources would be consumed by weather-related lawsuits.

Therefore, with these arguments in mind, and to ensure the safety and effectiveness of geoengineering practices, it is essential to establish a legal framework that provides sufficient legal accountability in the unfortunate event of a geoengineered catastrophe.

II. RESEARCH FINDINGS—CASE STUDIES

In order to answer the important research question—how can international law provide sufficient legal accountability in case of a catastrophic accident from geoengineering—this note uses four different case studies as the form of analysis. Due to the lack of international law regarding the specific issue of accountability for geoengineering practices, this note examines different bodies of international law and U.S. environmental practices in order to determine the best comparative framework for this narrow question.⁷¹ Even though they are distinct bodies of international law, the legal frameworks for arms control, intellectual property rights, and environmental law all have features applicable to an international agreement that could be used as a legal framework for geoengineering accountability.

For each of the four case studies, this note briefly discusses the basic principles of each international agreement or U.S. federal statute, before specifically focusing on the issue of accountability, regulation, and enforceability. For the first case study, in the field of arms control, this note investigates ENMOD

⁶⁹ *Id.* at 218.

⁷⁰ *See infra* Part II(B) (discussing the use of environmental impact assessments as a presumption of liability).

⁷¹ Examining different fields of law is a recommended practice for geoengineering due to the lack of applicable international law. *See* IPCC, *supra* note 8, at 34. (“[Geoengineering] relies on the flexible adaptation, or possible amendment, of existing treaty rules or the application of customary international law rules, seeking to employ the legal tools at hand to regulate geoengineering activities.”).

to showcase the only current legal framework for environmental modification techniques. Although ENMOD's prevention of hostile or military uses of environmental modification techniques does not regulate the use of peaceful weather modification or geoengineering,⁷² the examination of ENMOD shows the predicaments that the international arena faces when trying to create accountability for environmental modification techniques. The second case study, the National Environmental Policy Act, requires certain environmental impact assessments when a federal undertaking may significantly impact the environment. This Act provides the framework for how a geoengineering treaty should be regulated and how it can overcome the issue of proving environmental modification techniques actually caused the damaging weather or climate.

In the third case study, this note studies the Agreement on Trade Related Aspects of Intellectual Property Rights ("TRIPS Agreement") to analyze issues of legal accountability in international law regarding intellectual property. The TRIPS Agreement, administered by the World Trade Organization, offers dispute settlement strategies and levels of accountability for international violations of intellectual property rights. For the fourth case study, in the field of environmental law, the Montreal Protocol provides a legal framework for governmental liability and enforcement. Although the Montreal Protocol is not the most recent or relevant international agreement in global environmental governance, it is the most successful case of international environmental implementation.⁷³

A. Case Study: ENMOD

In order to explore the legal ramifications of ENMOD in the context of weather modification, it is imperative to establish the series of events that led to the creation of ENMOD. Hence, this section analyzes the history of weather modification leading to ENMOD before evaluating its legal implications with respect to weather modification and, possibly, geoengineering. As the only piece of international law dealing with any type of weather modification, ENMOD is the most relevant treaty to geoengineering.

Despite the fact that weather modification techniques were first officially performed in 1946 in the United States,⁷⁴ it was not until the Vietnam War ef-

⁷² Because of ENMOD's broad definition of environmental modification techniques, if geoengineering was used for hostile or military purposes, ENMOD may certainly be applicable. However, the definition of geoengineering—the large-scale manipulation of the Earth's climate to counteract global warming—makes clear that geoengineering is solely used for peaceful purposes. See ROYAL SOC'Y, *supra* note 8. If geoengineering was used for military or other hostile uses, it would not be considered geoengineering. Instead, it simply would be the large-scale manipulation of the Earth's climate for military and/or hostile purposes. Hence, the term geoengineering signifies that peaceful purposes are intended, which would eliminate ENMOD's applicability.

⁷³ Donald Kaniaru et al., *Strengthening the Montreal Protocol: Insurance Against Abrupt Climate Change*, 7 SUSTAINABLE DEV. L. & POL'Y 3, 4 (2007).

⁷⁴ GOODELL, *supra* note 1, at 171–72.

fort that this new science received international recognition. The Department of Defense (“DOD”) finally had to admit to its use of cloud seeding in North Vietnam from 1967–1972.⁷⁵ The Senate, as directed by Senator Claiborne Pell, then held a hearing regarding the United States’ use of weather modification for military purposes.⁷⁶ Colonel Ed Soyster, Chief Advisor to the committee hearing, explained that he, and many notable scientists, believed that cloud seeding was an acceptable tactic to use in warfare because it (supposedly) has no harmful effects to civilians.⁷⁷ He exemplified this belief by saying: “It is the consensus of the scientific community that the techniques employed could not be used to create large uncontrolled storm systems accidentally or purposely.”⁷⁸ During that same Congressional hearing, the DOD admitted to using cloud-seeding techniques in Vietnam for a period of about six years; however, the DOD denied the allegation that the United States military was responsible for the devastating floods that North Vietnam faced in 1971, which caused expansive civilian suffering.⁷⁹ A representative from the DOD claimed that those floods were caused by *natural* rainfall.⁸⁰

After Senator Pell, a strong advocate for banning weather modification, publicized the secret rainmaking program that the United States was using in North Vietnam, an international uproar began over the potential possibilities of weather modification.⁸¹ Senator Pell led the Senate to vote for a resolution that would urge the Administration to seek a treaty banning weather modification in warfare.⁸² As Senator Pell explained, these environmental weather modification techniques include, but are not limited to, melting polar ice, steering hurricanes, and the inducement of rainfall, earthquakes, and tidal waves.⁸³ As if the threat of Mother Nature as a weapon is not frightening enough, the United States had to worry about this science getting into the hands of a state actor with bad intentions or a lack of knowledge about the potential consequences of weather modification.

⁷⁵ *Briefing on Dep’t of Defense Weather Modification Activity: Hearing on Weather Modification Before the Subcomm. on Oceans & Int’l Env’t of the S. Comm. on Foreign Relations*, 93rd Cong. 88 (1974).

⁷⁶ *Id.* at 87.

⁷⁷ *Id.* at 87, 92–93.

⁷⁸ *Id.* at 93. Colonel Soyster explained that cloud seeding techniques were not overused; once they achieved the result they desired, they would shift locations. *Id.* Also, Soyster stated that cloud seeding was not used during tropical rainstorms or when large amounts of rainfall already existed. *Id.*

⁷⁹ *Id.* at 118.

⁸⁰ *Id.*

⁸¹ See Bernard Gwertzman, *A U.S.-Soviet Ban on Weather Use for War Is Near*, N.Y. TIMES, June 24, 1975, at 1.

⁸² *Id.* at 1, 7 (stating that when a resolution was brought to the Senate to urge the administration to ban weather modification techniques in warfare, it overwhelmingly passed 82–10).

⁸³ *Id.* at 7.

During this same era, the United States was in a cold war with Russia.⁸⁴ This context further fueled the fear that weather modification techniques were being developed for use against the United States. However, after the Soviet Communist Party Leader, Leonid Brezhnev, met with Senator Pell on his trip to Washington, D.C., he realized the possible hazards of the issue and later met with President Nixon to draft an agreement on banning weather modification techniques in warfare.⁸⁵ In their negotiations, the two leaders said that in an effort to “limit the potential danger to mankind from possible new means of warfare,” they decided the possibilities of an environmental warfare ban should be explored.⁸⁶ They also stated that weather modification might have “widespread, long-lasting, and severe effects harmful to human welfare,”⁸⁷ words which later became the basis for ENMOD. This similarity in language is due to the fact that the Soviet Union called for this ban at the United Nations’ General Assembly in 1976, which, as history has shown, led to ENMOD.⁸⁸

The ambiguity of whether rain—in general—was induced by cloud seeding was a contributing factor to the proposal of ENMOD. Even with the prohibition of military or any other hostile use of environmental modification techniques, there is still a question of how a state can be certain whether it is facing natural or induced weather. If a nation may avoid repercussions merely by claiming it had no part in weather modification, then the possibilities of weather modification being used as an untraceable weapon will increase.

Unfortunately, geoengineering, despite its catastrophic risks, is not currently considered to be a violation of ENMOD. As exemplified by its formal title—the Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques—ENMOD clearly establishes that weather modification can be practiced as long as it is not used as a weapon.⁸⁹ Indeed, Article One provides that parties are only prohibited from using these environmental techniques with “widespread, long-lasting or severe effects *as the means of destruction, damage or injury to any other State Party.*”⁹⁰

Scholar Lawrence Juda addresses the ambiguities and loopholes caused by including the threshold requirement that weather modification techniques are

⁸⁴ See generally Quintard Taylor, Jr., *United States History: Timeline: Cold War*, U. WASH. DEP’T HIST., http://faculty.washington.edu/qtaylor/a_us_history/cold_war_timeline.htm (last visited May 27, 2015) (stating that the Cold War lasted from 1945 to 1991).

⁸⁵ Gwertzman, *supra* note 81, at 1, 7.

⁸⁶ *Id.* at 1.

⁸⁷ *Id.*

⁸⁸ *Id.* For a history of the negotiations leading to ENMOD, see *Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques—Narrative*, U.S. DEP’T ST., <http://www.state.gov/t/isn/4783.htm> (last visited May 27, 2015).

⁸⁹ See ENMOD, *supra* note 13.

⁹⁰ *Id.* at art. I (emphasis added).

only prohibited if they have “widespread, long-lasting or severe effects.”⁹¹ State actors, as Juda explains, have the ability to use environmental modification techniques for hostile or military purposes as long as they do not meet the above criteria.⁹² Furthermore, Juda argues that the incorporation of the term “hostile use” in Article One was “questioned since damage to other states could result from the attempt to modify the environment for peaceful purposes such as through programs of precipitation enhancement.”⁹³ Consequently, Juda asks: “How is ‘hostile’ intent to be established?”⁹⁴ This question is still a matter of controversy, and it will surely be debated during the negotiation of any international agreement for geoengineering, especially regarding accountability for geoengineered catastrophes.

Although ENMOD addresses the potential risks of environmental modification techniques to human welfare, it still grants absolute freedom and provides zero regulation for the use of such techniques for peaceful purposes.⁹⁵ As stated in Article Three, a state has the right to participate in and facilitate, to the fullest possible extent, the science of environmental modification in accordance with international law.⁹⁶ One important aspect of Article Three is its explanation that environmental modification can be used for peaceful purposes with the intent of “preservation, improvement and peaceful utilization of the environment, with due consideration for the needs of the developing areas of the world.”⁹⁷ With the latter in mind, consider another example of China’s use of weather modification—rain prevention to make the weather more convenient during the 2008 Beijing Olympics.⁹⁸ It would be difficult to argue that China’s use of weather modification for the Olympics was done with the intent to preserve or improve the environment.⁹⁹ Hence, China’s practice of altering the climate was simply used as a tool for convenience, economics, and reputation, which arguably are not permissible purposes covered by ENMOD.

⁹¹ Lawrence Juda, *Negotiating a Treaty on Environmental Modification Warfare: The Convention on Environmental Warfare and Its Impact upon Arms Control Negotiations*, 32 INT’L ORG. 975, 980 (1978).

⁹² *Id.*

⁹³ *Id.*

⁹⁴ *Id.*

⁹⁵ See ENMOD, *supra* note 13, at art. III(1).

⁹⁶ *Id.* at art. III(2).

⁹⁷ *Id.* A question not addressed by ENMOD is the use of weather modification for recreational purposes and convenience, such as the Chinese did in the Beijing blizzard tragedy, to make farming possible during the drought, or the 2008 Beijing Olympics.

⁹⁸ Yu Zheng, *Beijing Uses High-Tech to Prevent Rain from Dampening Olympic Opening*, CHINA VIEW (July 28, 2008, 1:20 PM), http://news.xinhuanet.com/english/2008-07/28/content_8787101.htm (stating that in an effort to save the opening Olympic ceremony from rainfall, the Beijing Weather Engineering Office used satellite monitoring and cloud seeding); see also Barbara Demick, *China Plans to Halt Rain for Olympics*, L.A. TIMES, Jan. 31, 2008, at A3.

⁹⁹ See generally Yu Zheng, *supra* note 98 (stating that Beijing used cloud seeding to prevent rain during the Olympic opening).

Article Two of ENMOD defines the term “environmental modification techniques” to include the following: “[A]ny technique for changing—through the deliberate manipulation of natural processes—the dynamics, composition or structure of the Earth, including its biota, lithosphere, hydrosphere and atmosphere, or of outer space.”¹⁰⁰ Although this definition may encompass geoengineering techniques, at least in a legal and technical sense, ENMOD does not incorporate any legal framework for the issue of accountability in cases of environmental modification catastrophes, nor does it regulate the use of environmental modification techniques for peaceful purposes. Article Five of ENMOD describes the only part of the treaty regarding breach. Article Five states: “Any State Party to this Convention which has reason to believe that any other State Party is acting in breach of obligations deriving from the provisions of the Convention may lodge a complaint with the Security Council of the United Nations.”¹⁰¹ Furthermore, Article Five explains that the Security Council will investigate such a complaint.¹⁰² However, ENMOD does not specifically mention the examination of intent—whether for hostile and military purposes or peaceful purposes—and it similarly does not address accountability. Consequently, ENMOD is insufficient to provide the framework for legal accountability in cases of geoengineered catastrophes.

ENMOD does not regulate the use of environmental modification techniques for peaceful purposes. Instead, ENMOD simply states it does not “hinder the use of environmental modification techniques for peaceful purposes.”¹⁰³ By not hindering its use, while also not regulating it, state actors can practice “peaceful” environmental modification techniques in compliance with ENMOD, but without any oversight. It is, therefore, necessary to look at other areas of international law to develop a legal framework for the issues of accountability, regulation, and enforcement.

B. Case Study: National Environmental Policy Act

The Environmental Protection Agency, a U.S. federal agency, oversees the enforcement of the National Environmental Policy Act of 1969 (“NEPA”) through the Council on Environmental Quality.¹⁰⁴ NEPA “requires federal agencies to integrate environmental values into their decision making processes by considering the environmental impacts of their proposed actions and reasonable alternatives to those actions.”¹⁰⁵ To comply with NEPA, federal agencies

¹⁰⁰ ENMOD, *supra* note 13, at art. II.

¹⁰¹ *Id.* at art. V(3).

¹⁰² *Id.* at art. V(4).

¹⁰³ *Id.* at art. III(1).

¹⁰⁴ 42 U.S.C. § 4321 (2012); *National Environmental Policy Act: Basic Information*, U.S. ENVTL. PROTECTION AGENCY (last updated May 4, 2015), <http://www.epa.gov/compliance/basics/nepa.html> [hereinafter *NEPA: Basic Information*].

¹⁰⁵ *National Environmental Policy Act (NEPA)*, U.S. ENVTL. PROTECTION AGENCY (last updated Feb. 3, 2015), <http://www.epa.gov/compliance/nepa/>.

are required to “prepare detailed statements assessing the environmental impact of and alternatives to major federal actions significantly affecting the environment,” which are commonly referred to as environmental impact statements.¹⁰⁶ Environmental impact statements must be made available to the public before any action is taken or any decisions are made.¹⁰⁷ Further, NEPA states that the purpose of the environmental impact statements is to provide high quality information that is central to the action in question and is based on “[a]ccurate scientific analysis, expert agency comments, and public scrutiny.”¹⁰⁸

The NEPA process—used to evaluate the potential environmental effects of a federal undertaking, along with its alternatives—has three levels of analysis: (1) categorical exclusions; (2) environmental assessments; and (3) environmental impact statements.¹⁰⁹ First, categorical exclusions, as its name implies, allows federal agencies to avoid the research and preparation of environmental assessments or environmental impact statements for certain undertakings.¹¹⁰ If the Council on Environmental Quality already has determined that a particular undertaking does not have significant environmental impact, it serves as a precedent for federal agencies to determine that it is normally excluded from environmental evaluation under NEPA.¹¹¹

The second and third levels of scrutiny under NEPA require research, thorough analysis, and written assessments to determine whether an environmental impact exists. Regarding environmental assessments, a federal agency is required to submit a written proposal that includes the following: “[t]he need for the proposal; [a]lternatives (when there is an unresolved conflict concerning alternative uses of available resources); [t]he environmental impacts of the proposed action and alternatives; [and a] listing of agencies and persons consulted.”¹¹² The purpose of the environmental assessment is to “determine whether or not a federal undertaking would *significantly* affect the environment.”¹¹³ If the proposed federal undertaking would not significantly affect the environment, the agency shall prepare a “finding of no significant impact.”¹¹⁴

¹⁰⁶ *NEPA: Basic Information*, *supra* note 104; *see also* 42 U.S.C. § 4332.

¹⁰⁷ 40 C.F.R. § 1500.1(b) (2014).

¹⁰⁸ *Id.*; *see also id.* § 1502.1 (“[Environmental impact statements] shall provide full and fair discussion of significant environmental impacts and shall inform decisionmakers and the public of the reasonable alternatives which would avoid or minimize adverse impacts or enhance the quality of the human environment. Agencies shall focus on significant environmental issues and alternatives and shall reduce paperwork and the accumulation of extraneous background data. Statements shall be concise, clear, and to the point, and shall be supported by evidence that the agency has made the necessary environmental analyses.”).

¹⁰⁹ *NEPA: Basic Information*, *supra* note 104.

¹¹⁰ *Id.*

¹¹¹ *Id.* For examples of federal undertakings that are categorically excluded by statute, *see* 23 C.F.R. § 771.117(c) (2014) (excluding undertakings, such as landscaping and the construction of pedestrian and bicycle lanes, paths, and facilities).

¹¹² *NEPA: Basic Information*, *supra* note 104; *see also* 40 C.F.R. § 1508.9(b).

¹¹³ *NEPA: Basic Information*, *supra* note 104 (emphasis added).

¹¹⁴ *Id.*

On the other hand, if an environmental assessment determines that the federal undertaking would significantly affect the environment, the federal agency must prepare an environmental impact statement, which is the third level of analysis under NEPA.¹¹⁵ Compared to the environmental assessment, an environmental impact statement is more detailed in relation to the proposed undertaking and possible alternatives.¹¹⁶ An environmental impact statement includes: “[d]iscussions of the purpose of and need for the action; [a]lternatives; [t]he affected environment; [t]he environmental consequences of the proposed action; [l]ists of preparers, agencies, organizations and persons to whom the statement is sent; [a]n index; [and an] appendix (if any).”¹¹⁷

One of the main benefits about the NEPA process is the transparency for the public. The NEPA process allows the public to comment on an agency’s NEPA documents, attend hearings or public meetings, and submit comments directly to the federal agency.¹¹⁸ Congress declared that one of the purposes of NEPA is to “encourage productive and enjoyable harmony between man and his environment; . . . [and] to enrich the understanding of the ecological systems and natural resources important to the Nation.”¹¹⁹ To achieve this connection between man and his environment, man must be allowed to play an active role in undertakings that may significantly impact the environment.

Environmental impact statements and assessments (collectively referred to as “Environmental Impact Assessments”) provide many benefits to the agency or developer.¹²⁰ In addition to Environmental Impact Assessments demonstrating due diligence to defend against a claim of negligence, Environmental Impact Assessments also “can lead to more environmentally sensitive development; to improved relations between the developer, the planning authority and the local communities; [and] to a smoother development consent process.”¹²¹

The NEPA process provides an applicable framework to a geoengineering treaty. Adopting the NEPA process would solve several issues. First, requiring Environmental Impact Assessments would regulate environmental modification techniques. Like the Environmental Protection Agency has the Council on Environmental Quality, an international body could be established to regulate the

¹¹⁵ 40 C.F.R. § 1501.4; *NEPA: Basic Information*, *supra* note 104. If an agency anticipates that its undertaking will significantly impact the environment, the agency can skip level two—filing an environmental assessment—and file an environmental impact statement. *Id.*

¹¹⁶ *NEPA: Basic Information*, *supra* note 104.

¹¹⁷ *Id.*

¹¹⁸ *Id.*; *Environmental Impact Statement (EIS) Database*, U.S. ENVTL. PROTECTION AGENCY (last updated Feb. 3, 2015), <http://www.epa.gov/compliance/nepa/eisdata.html> (“All EISs are filed with EPA, and EPA publishes a ‘Notice of Availability’ each week in the Federal Register. The ‘Notice of Availability’ is the start of the 45-day public comment period for Draft EISs. This notice is also the start of the 30-day ‘wait period’ for Final EISs, in which agencies are generally required to wait 30 days before making a decision on a proposed action.”).

¹¹⁹ 42 U.S.C. § 4321 (2012).

¹²⁰ JOHN GLASSON ET AL., *INTRODUCTION TO ENVIRONMENTAL IMPACT ASSESSMENT* 7 (4th ed., 2012).

¹²¹ *Id.*

Environmental Impact Assessments. This note will refer to such potential international agency as CENMOD,¹²² which would have current information on all proposed and practiced geoengineering or weather modification techniques. Further, by adopting the three-tiered level of analysis for environmental modification undertakings, CENMOD could categorically exclude certain types of small-scale environmental modification techniques. For example, scientists could determine a safe and effective amount of silver iodide to disperse among clouds per square mile. If farmers desired to cloud seed their own land, there would be no need to go through the Environmental Impact Assessments as long as the proposal fell within a certain threshold category. On the other hand, a country could skip the second tier of the analysis and issue an environmental impact statement if it knew that its proposal would have a significant impact on the environment, just like federal agencies do under NEPA.¹²³

Regulation of environmental modification techniques—geoengineering and weather modification—is imperative to ensure the health of the environment. By requiring state actors to submit Environmental Impact Assessments, CENMOD, using a panel of experts, could oversee the frequency of environmental modification techniques. Due to the underdeveloped nature of geoengineering, the long-term effects of proposed geoengineering techniques on the environment, such as using sulfate aerosols, is unclear. CENMOD could establish regulations to ensure that state actors were not damaging the health of the environment, the eco-systems, or the world's population.¹²⁴

Also, the requirement that Environmental Impact Assessments be published for the public should be incorporated into a geoengineering treaty.¹²⁵ For example, if the United States wanted to practice geoengineering, its environmental impact statement may include the possible impact on neighboring countries, such as Canada and Mexico. The United States would submit its report to CENMOD to ensure that it would be publicly available to all countries.

A further issue that the NEPA process would help solve is the issue of proving whether a state actor using environmental modification techniques caused any particular climatic effect. One of the largest hurdles in a geoengineering treaty is the ability for a state actor to prove that the damage it suffered from some type of weather or climate change is the result of another state actor's use of geoengineering or weather modification, instead of simply Mother

¹²² Following the popular acronym of "ENMOD," I propose that this international governing body be nicknamed: "CENMOD"—Council on Environmental Modification.

¹²³ *NEPA: Basic Information*, *supra* note 104.

¹²⁴ For example, if a state actor decided to use sulfate aerosols to cool itself down, CENMOD may have regulations on the use of the sulfate aerosols: how high must the aerosols be dispersed to avoid it affecting the environment below; what measurement of sulfate aerosols is safe; how often can sulfate aerosols be dispersed; can every state actor simultaneously disperse sulfate aerosols or do state actors need to take turns?

¹²⁵ *NEPA: Basic Information*, *supra* note 104.

Nature.¹²⁶ Environmental Impact Assessments can help solve that issue because they would provide for a public record of a state actor's use of environmental modification techniques. If a state actor encountered an unusual weather or climate pattern that caused damage, such as the Beijing blizzard, it could investigate Environmental Impact Assessments filed with CENMOD. The damaged state actor could then use the Environmental Impact Assessments as a presumption of liability in a dispute settlement mechanism. Therefore, the adoption of the NEPA process not only provides for safer environmental practices, but also the requirement of state actors submitting Environmental Impact Assessments as a form of regulation would facilitate CENMOD to provide sufficient legal accountability in cases of catastrophe or damage.

C. Case Study: TRIPS Agreement

The Agreement on Trade Related Aspects of Intellectual Property Rights, referred to as the TRIPS Agreement, is an international agreement administered by the World Trade Organization ("WTO").¹²⁷ This Agreement deals with the minimum standards for many forms of intellectual property regulations for WTO member states.¹²⁸ Due to its strict regulations and the creation of the Dispute Settlement Body,¹²⁹ the TRIPS Agreement provides an example of the possible legal framework for an international geoengineering agreement. Furthermore, the TRIPS Agreement incorporates a strictly enforced framework for accountability from violations of intellectual property rights.¹³⁰ In order to showcase the applicability of the TRIPS Agreement to a potential geoengineering agreement, this section first examines key articles of the TRIPS Agreement, while detailing the process of the Dispute Settlement Body.

The TRIPS Agreement was negotiated at the end of the Uruguay Round of the General Agreements on Tariffs and Trade ("GATT") in 1994.¹³¹ GATT became the basis for the establishment of the World Trade Organization.¹³² The TRIPS Agreement is a compulsory requirement of WTO membership.¹³³ Con-

¹²⁶ *Scientists 'Cause' Beijing Snow*, *supra* note 5 ("Even if it is theoretically possible, one of the problems for proponents has been to demonstrate that a rainfall or snowfall was caused by the seeding or simply occurred spontaneously.").

¹²⁷ See Agreement on Trade-Related Aspects of Intellectual Property Rights, Apr. 15, 1994, Marrakesh Agreement Establishing the World Trade Organization, Annex 1C, 1869 U.N.T.S. 299, 300 [hereinafter TRIPS Agreement].

¹²⁸ *Id.*

¹²⁹ *Id.* at art. 64.

¹³⁰ See *id.* at art. 41.

¹³¹ *Understanding the WTO: The Agreements*, WORLD TRADE ORG., http://www.wto.org/english/thewto_e/whatis_e/tif_e/agrm7_e.htm (last visited May 27, 2015).

¹³² Kenneth W. Abbott & Duncan Snidal, *Hard and Soft Law in International Governance*, 54 INT'L ORG. 421, 436 (2000) ("Over time, GATT developed into the WTO as states learned the advantages of harder legalization in governing international trade.").

¹³³ TRIPS Agreement, *supra* note 127, at art. 1(1). Article 1 requires WTO members to "give effect to the provisions of this Agreement." *Id.*

sequently, countries that seek to acquire easy access to the international markets through the WTO must ratify the strict intellectual property laws mandated by TRIPS. The TRIPS Agreement created the Dispute Settlement Body that the member governments must use when a dispute arises.¹³⁴ Prior to the Dispute Settlement Body, international intellectual property law “did not provide any practical means of recourse, at the multilateral level, to a government that believed that another government was not living up to its obligations.”¹³⁵

A dispute occurs “when a member government believes another member government is violating a WTO agreement. The complaining member must submit a ‘request for consultations’ identifying the agreements it believes are being violated.”¹³⁶ The first stage of the Dispute Settlement Body process is the consultation stage.¹³⁷ The consultation stage is an alternative dispute resolution process that allows up to sixty days for the countries to settle the claim—either on their own or in mediation with the WTO director-general.¹³⁸ If the consultations are unsuccessful, the “complaining country can ask for a panel to be appointed.”¹³⁹ Once a request for a panel is filed, it can take up to forty-five days for the Dispute Settlement Body to appoint a panel, and up to six months for the panel to issue its report.¹⁴⁰

The panel stage consists of written arguments, oral arguments, and preliminary reports between the countries and the panel.¹⁴¹ The first requirement in the panel stage involves each country with an interest in the dispute “present[ing] its case in writing to the panel.”¹⁴² Then, the panel will hold its first hearing, in which each interested country will argue its case.¹⁴³ After having the opportunity to hear each country’s arguments, the countries may “submit written rebuttals and present oral arguments at the panel’s second meeting.”¹⁴⁴ If one country’s case involves “scientific or other technical matters, the panel may

¹³⁴ *Id.* at art. 64(1). The Dispute Settlement Body is “[m]ade up of all member governments, usually represented by ambassadors or equivalent.” *Dispute Settlement*, WORLD TRADE ORG., https://www.wto.org/english/tratop_e/dispu_e/dispu_e.htm (last visited May 27, 2015).

¹³⁵ Matthijs Geuze & Hannu Wager, *WTO Dispute Settlement Practice Relating to the TRIPS Agreement*, 2 J. INT’L ECON. L. 347, 347 (1999).

¹³⁶ *Dispute Settlement: The Disputes*, WORLD TRADE ORG., http://www.wto.org/english/tratop_e/dispu_e/dispu_agreements_index_e.htm?id=A26 (last visited May 27, 2015).

¹³⁷ *Understanding the WTO: Settling Disputes*, WORLD TRADE ORG., https://www.wto.org/english/thewto_e/whatis_e/tif_e/disp1_e.htm (last visited May 27, 2015).

¹³⁸ *Id.*

¹³⁹ *Id.* The Dispute Settlement Body, at its discretion, may establish a panel, which “help[s] the Dispute Settlement Body make rulings or recommendations.” *Id.* However, the Dispute Settlement Body can accept the panel’s report, or reject it with a consensus of the Dispute Settlement Body. *Id.* “Panels consist of three (possibly five) experts from different countries who examine the evidence and decide who is right and who is wrong.” *Id.*

¹⁴⁰ *Id.* The responding country is allowed to block the creation of the panel one time. *Id.*

¹⁴¹ *Id.*

¹⁴² *Id.*

¹⁴³ *Id.*

¹⁴⁴ *Id.*

consult experts or appoint an expert review group to prepare an advisory report.”¹⁴⁵ The panel then submits drafts and interim reports of the facts and arguments involved, along with its findings and conclusions.¹⁴⁶ Each country in the dispute has an opportunity to review the drafts, interim reports, and final report; if necessary, the panel can hold additional meetings with the interested countries.¹⁴⁷ Once the panel releases its final report to all WTO members, it becomes a “ruling” of the Dispute Settlement Body within sixty days, unless a consensus of the Dispute Settlement Body rejects the panel’s final report.¹⁴⁸

The “Dispute Settlement Body is available as an ultimate arbiter.”¹⁴⁹ In cases of damages done to the rightful intellectual property holder, the WTO has the judicial authority to order the infringer to pay adequate compensation and expenses, which may include attorney’s fees.¹⁵⁰ This compensation can also apply retrospectively to the damages incurred during unintentional infringement.¹⁵¹ The infringing country must follow the recommendations of the panel’s report. If it cannot comply, it must state its intention to the Dispute Settlement Body and explain any reasons of impracticability or needing a longer period of time to comply. If this occurs, then the complaining country can request permission from the Disputed Settlement Body to retaliate.¹⁵² Among other things, retaliation can involve “suspend[ing] concessions or other obligations” and/or raising import duties.¹⁵³

The TRIPS Agreement provides the international arena with an efficient legal framework that encompasses the issue of accountability for violations. This framework can be analogously applied to geoengineering and its potential for catastrophe. Similar to the TRIPS Agreement’s use of the WTO’s Dispute Settlement Body, international disputes regarding geoengineering may call for some sort of dispute settlement body within CENMOD. To be useful, it would need to be strict and have greater enforcement power than a mere complaint and investigation system.

The Dispute Settlement Body’s process will be beneficial for a geoengineering treaty because of its alternative dispute resolution requirement¹⁵⁴ and

¹⁴⁵ *Id.*

¹⁴⁶ *Id.*

¹⁴⁷ *Id.*

¹⁴⁸ *Id.*

¹⁴⁹ Webster D. McBride, *GI Joe? Coffee, Location, and Regulatory Accountability*, 85 N.Y.U. L. REV. 2138, 2158 (2010).

¹⁵⁰ TRIPS Agreement, *supra* note 127, at art. 45.

¹⁵¹ *Id.*

¹⁵² *Understanding the WTO*, *supra* note 137.

¹⁵³ *Id.* (“In principle, the retaliation should be in the same sector as the dispute. If this is not practical or if it would not be effective, it can be in a different sector of the same agreement. In turn, if this is not effective or practicable and if the circumstances are not serious enough, the action can be taken under another agreement.”).

¹⁵⁴ The alternative dispute resolution process of the “consultation” stage of the Dispute Settlement Body allows most claims to be settled without the use of panels. Geuze & Wager, *supra* note 135, at 375 (“Most disputes about matters of compliance with the requirements of

its use of panels and experts on issues of science and technology. Because geoengineering and all environmental modification techniques are difficult to prove, a panel of three to five different experts—including geoengineers, climatologists, scientists, and lawyers—from different countries will allow for expertise that surpasses the typical judicial tribunal. Moreover, the continual exchange between arguments, drafts, interim reports, and final reports allows countries to ensure that the panel correctly understands their arguments and the science supporting them.

Although the TRIPS Agreement involves intellectual property, it provides a great example of the structure that a geoengineering treaty may encompass. The use of the Dispute Settlement Body is the most important tool for any potential geoengineering treaty because inquiry without any means for enforcement or repercussions will fail to produce any real results. By adding the principles of the TRIPS Agreement to ENMOD, ENMOD would progress toward becoming a more appropriate international treaty to address the issue of accountability for geoengineered catastrophes.

D. Case Study: Montreal Protocol

The Montreal Protocol, officially known as the Montreal Protocol on Substances that Deplete the Ozone Layer, came into effect when signed on September 16, 1987.¹⁵⁵ Although there are more recent or relevant international agreements in global environmental governance,¹⁵⁶ the Montreal Protocol is the most successful case of international environmental implementation.¹⁵⁷ Consequently, the Montreal Protocol—considered a historic event for a range of reasons¹⁵⁸—offers two main elements that could be incorporated into a geoengineering treaty. First, it is the first treaty that adopted the “precautionary approach,” meaning governments implement substantial measures for environmental protection before complete knowledge about the threat has been proven.¹⁵⁹ Second, the Montreal Protocol is the first environmental treaty in which state actors consensually incorporated a “formal noncompliance procedure.”¹⁶⁰ This noncompliance procedure offers positive and negative incentives through

the TRIPS Agreement are resolved in bilateral consultations between the Members concerned, either in Geneva or in capitals, without invoking the dispute settlement procedures in the [Dispute Settlement Body].”).

¹⁵⁵ Montreal Protocol on Substances that Deplete the Ozone Layer, Sept. 16, 1987, 1522 U.N.T.S. 3 [hereinafter Montreal Protocol].

¹⁵⁶ See generally Kyoto Protocol to the United Nations Framework Convention on Climate Change, Dec. 11, 1997, 2303 U.N.T.S. 162 (entered into force Feb. 16, 2005).

¹⁵⁷ Kaniaru et al., *supra* note 73.

¹⁵⁸ Shinya Murase et al., *Compliance-Control in Respect of the Montreal Protocol*, 89 AM. SOC'Y INT'L L. 206, 206 (1995).

¹⁵⁹ *Id.*; see also *Brief Primer on the Montreal Protocol*, UN ENV'T PROGRAMME, http://ozone.unep.org/Publications/MP_Brief_Primer_on_MP-E.pdf (last visited May 27, 2015).

¹⁶⁰ Murase et al., *supra* note 158.

the use of the Multilateral Fund and trade restrictions, respectively. The Montreal Protocol's precautionary principle and noncompliance procedure provide another basis for an international treaty vis-à-vis legal accountability of geoen-gineering.

The precautionary principle is applicable “[w]hen human activities may lead to morally unacceptable harm that is scientifically plausible but uncertain, actions shall be taken to avoid or diminish that harm.”¹⁶¹ However, “a mere fantasy or crude speculation that an activity or new technology causes harm is not enough to trigger the [precautionary principle].”¹⁶² To recommend precautionary intervention, there must be judgments based on scientific analysis that give rise to “reasonable grounds for concern.”¹⁶³ Essentially, “this principle says that, rather than await certainty, regulators should act in anticipation of environmental harm to ensure that this harm does not occur.”¹⁶⁴ The Montreal Protocol acted in anticipation of the environmental damage from ozone-depleting substances because “[t]he science of ozone depletion was uncertain when the Montreal Protocol was negotiated in 1987.”¹⁶⁵

The Montreal Protocol's noncompliance procedure has proven to be successful because it applies a combination of positive and negative incentives.¹⁶⁶ First, the Montreal Protocol uses positive incentives through the use of the Multilateral Fund.¹⁶⁷ Second, the Montreal Protocol uses negative incentives from the threat of trade restrictions to ensure compliance.¹⁶⁸ Regarding the positive incentives, the noncompliance procedure has a dual standard for different state actors depending on whether it is a wealthy, industrialized state or a developing country.¹⁶⁹ The Montreal Protocol recognizes that the “commitments of developing states are often contingent on their receipt of adequate resources to fulfill those commitments.”¹⁷⁰ Consequently, the noncompliance procedure provides two resources to help developing nations: (1) a grace period for the state actor to provide enough time to acquire the financial and technological resources to meet its obligations; and (2) a Multilateral Fund to which wealthier

¹⁶¹ WORLD COMM'N ON THE ETHICS OF SCIENTIFIC KNOWLEDGE & TECH., U.N. EDUC., SCIENTIFIC & CULTURAL ORG., THE PRECAUTIONARY PRINCIPLE 14 box 2 (2005).

¹⁶² *Id.* at 50.

¹⁶³ Charles Weiss, *Defining Precaution*, 49 ENVIRONMENT 33, 34 (2007) (reviewing WORLD COMM'N ON THE ETHICS OF SCIENTIFIC KNOWLEDGE & TECH., U.N. EDUC., SCIENTIFIC & CULTURAL ORG., THE PRECAUTIONARY PRINCIPLE (2005)).

¹⁶⁴ Daniel Bodansky, *Scientific Uncertainty and the Precautionary Principle*, 33 ENVIRONMENT 4, 4 (1991).

¹⁶⁵ *Atmospheric Pressure: Why Some Environmental Agreements Work and Others Don't*, ECONOMIST (Apr. 17, 2003), <http://www.economist.com/node/1715055>.

¹⁶⁶ Scott Barrett & Robert Stavins, *Increasing Participation and Compliance in International Climate Change Agreements*, 3 INT'L ENVTL. AGREEMENTS: POL. L. & ECON. 349, 360–66 (2003) (discussing the positive and negative incentives of the Montreal Protocol).

¹⁶⁷ *Id.* at 361.

¹⁶⁸ *Id.* at 365.

¹⁶⁹ See Montreal Protocol, *supra* note 155, at art. 5.

¹⁷⁰ SEAN D. MURPHY, PRINCIPLES OF INTERNATIONAL LAW 162 (2006).

states contribute to help developing nations to reduce their emissions.¹⁷¹ On the other hand, industrialized nations must report to the Protocol Implementation committee if they cannot meet their emission obligations.¹⁷² Otherwise, the Montreal Protocol encourages whistleblowing on noncompliant states.¹⁷³

Whether self-reported or reported by another party for noncompliance, the implementation committee works with the noncompliant developing nation by encouraging wealthier states to provide financial, technological, or other resources to achieve compliance through the Multilateral Fund.¹⁷⁴ Hence, the industrialized countries pay the incremental costs of implementing the Montreal Protocol. The Montreal Protocol did not just encourage countries to reduce their own emissions, but it also encouraged industrialized countries to pay developing countries through the Multilateral Fund to reduce those countries' emissions as well.¹⁷⁵ Similar to the emission reductions, the contributions to the Multilateral Fund are an obligation for certain state actors that have surpassed a threshold level of consumption of ozone-depleting substances.¹⁷⁶

Instead of solely using positive, financial incentives to increase compliance with emission reductions, the Montreal Protocol used a credible threat of restricting trade regarding chlorofluorocarbons ("CFCs"), a known ozone-depleting substance, and products containing CFCs.¹⁷⁷ Although trade has not actually been restricted, the "belief that trade would be restricted if countries failed to participate had the effect of promoting participation."¹⁷⁸ Negative incentives, such as trade restrictions, are justifiable for the Montreal Protocol:

The justification for using trade restrictions also depends on the perceived fairness of an international treaty. No country could gain from ozone depletion, and the countries that would gain the least from ozone protection—developing countries—were compensated for participating in the Montreal Protocol. This made the threat to impose restrictions appear to be fair.¹⁷⁹

Although the damage caused by CFCs to the ozone layer has a detrimental effect on the entire planet, several countries did not see any type of benefit, only economic difficulties, if they were to ratify the Montreal Protocol. Nevertheless, the incentives set forth by the Montreal Protocol, coupled with the non-

¹⁷¹ *Id.*

¹⁷² *Id.*

¹⁷³ *Id.*

¹⁷⁴ *Id.* at 162–63.

¹⁷⁵ See Barrett & Stavins, *supra* note 166, at 361.

¹⁷⁶ Contributing countries are any country that is not considered an "Article 5" country. *Multilateral Fund for the Implementation of the Montreal Protocol*, MULTILATERAL FUND, <http://www.multilateralfund.org/default.aspx> (last visited May 27, 2015). Article 5 countries are determined if their annual level of consumption of ozone-depleting substances is "less than 0.3 kilograms per capita to comply with the control measures of the Protocol." *Id.*

¹⁷⁷ Barrett & Stavins, *supra* note 166, at 365; see also Montreal Protocol, *supra* note 155, at art. 4.

¹⁷⁸ Barrett & Stavins, *supra* note 166, at 365.

¹⁷⁹ *Id.* at 366.

compliance procedures, have been successful.¹⁸⁰ Specifically, the noncompliance procedure that threatens trade sanctions, while also providing community support through the Multilateral Fund, has proven to be effective.¹⁸¹ Having phased out almost one hundred ozone-depleting substances by nearly 100 percent in industrialized countries and at least 50–75 percent in developing countries, the Montreal Protocol is commonly considered one of the world’s most successful multilateral environmental agreements.¹⁸² These statistics place the ozone layer on a path to recovery later this century.¹⁸³ The great success of the Montreal Protocol can be attributed to the protocol’s “evolutionary process,” which has been adjusted repeatedly over its “nearly twenty year history to reflect current developments in scientific understanding and technological capabilities.”¹⁸⁴ To maintain the most efficient and contemporary environmental treaty, as showcased by the Montreal Protocol’s success, it is imperative to continually adapt to the changes in science, technology, and the climate.

This evolutionary process, along with the pioneering efforts to enforce compliance, make the Montreal Protocol a stellar example of the legal framework that could be adopted—at least partially—in an international geoengineering treaty. Adopted from the Montreal Protocol, the precautionary principle¹⁸⁵ needs to be applied to geoengineering because it provides a cautious approach to an underdeveloped technology with the potential for hemispheric catastrophe. As the popular adage goes, “hope for the best, prepare for the worst.” Essentially, the precautionary principle adopts an assumption into the treaty that the worst possibility could develop when practicing geoengineering. Similar to the Montreal Protocol, where the science of ozone depletion was uncertain during its negotiation, here, the science of geoengineering is also uncertain. Nevertheless, it does not follow that the potential liabilities of geoengineering catastrophes also need to be uncertain. Instead, state actors should have a clear understanding of the potential risks and liabilities associated with practicing environmental modification techniques.

¹⁸⁰ *Brief Primer on the Montreal Protocol*, *supra* note 159 (“In 2009, the Montreal Protocol became the first treaty in history to achieve universal ratification with 196 governments (Parties).”).

¹⁸¹ See Kaniaru et al., *supra* note 73.

¹⁸² Kaniaru et al., *supra* note 73, at 3; Mario Molina & Durwood Zaelke, Editorial, *A Climate Success Story to Build on*, INT’L HERALD TRIB., Sept. 26, 2012, at 6 (finding that the Montreal Protocol is twenty times more successful than the Kyoto Protocol).

¹⁸³ Kaniaru et al., *supra* note 73, at 3.

¹⁸⁴ *Id.* at 4; *Brief Primer on the Montreal Protocol*, *supra* note 159 (“The Protocol includes an adjustment provision that enables the Parties to respond to evolving science and accelerate the phase-out of agreed ozone depleting substances without going through the lengthy formal process of national ratification. . . . The Protocol has been adjusted six times and amended four times since its initial adoption in 1987.”).

¹⁸⁵ *Atmospheric Pressure*, *supra* note 165 (stating that “[t]he science of ozone depletion was uncertain when the Montreal Protocol was negotiated in 1987”); see *supra* text accompanying notes 159–65.

Just as the Montreal Protocol set up a Multilateral Fund to ensure compliance among developing states,¹⁸⁶ a geoengineering treaty needs to set up a comparable fund to maintain a balanced level of geoengineering practices between industrialized and developing nations. This fund would guarantee that wealthier states, which can afford expensive geoengineering techniques, would not be able to manipulate the climate to benefit them, while potentially worsening the climate in a developing country. For example, the shifting of a monsoon to increase rainfall in an industrialized country may devastate the agricultural practices of a developing country. Further, industrialized nations could subsidize the costs associated with the research and preparation of Environmental Impact Assessments to ensure that developing countries are following the regulations of CENMOD and as a positive incentive to developing countries that cannot afford the costs associated with the Environmental Impact Assessments. Part of the reason that the Montreal Protocol has been so successful was its low cost to all state actors.¹⁸⁷ Therefore, a geoengineering treaty would need to ensure that the burden on state actors is relatively low, so that those who ratify the treaty do not suffer as a consequence.

A geoengineering treaty would be beneficial to industrialized nations. Similar to the Montreal Protocol's goal of recycling ozone-depleting substances—which affect the atmosphere, thus affecting all state actors—geoengineering also has the ability to affect many state actors. Just as many state actors felt it was necessary to ratify ENMOD¹⁸⁸ to prevent environmental modification techniques from being used as a weapon, state actors should ratify a geoengineering treaty to make sure that the treaty's regulation, accountability, and enforcement would safeguard against negligent practices of environmental modification techniques. Even if a state actor has peaceful intentions, environmental modification techniques used negligently could cause the same results as if those techniques were used with hostile intentions. Consequently, it should be the goal of all state actors to have an agreement that provides regulation, accountability, and enforcement in case of a geoengineering catastrophe.

¹⁸⁶ With the procedural mechanisms in place that allow a state to either self-report the state's anticipated noncompliance or report the noncompliance of other states, the Montreal Protocol provides a checks-and-balances system that encourages obedience. See HARRO VAN ASSELT ET AL., ASSESSMENT AND REVIEW UNDER A 2015 CLIMATE CHANGE AGREEMENT 129 (2015). Furthermore, because wealthier states are obliged to pay into the Multilateral Fund, these wealthier states put pressure on developing countries to reduce their emissions. See Barrett & Stavins, *supra* note 166, at 361. This pressure, along with the threat of trade restrictions, politically and economically forces compliance among state actors. These same mechanisms should be used for geoengineering to ensure that noncompliance comes with a price no state actor wants to pay.

¹⁸⁷ *Atmospheric Pressure*, *supra* note 165 (stating that “the costs of implementing the protocol were relatively low”).

¹⁸⁸ Seventy-six state actors are parties to ENMOD. *Status of the Treaty—ENMOD*, UN OFF. FOR DISARMAMENT AFF., <http://disarmament.un.org/treaties/t/enmod> (last visited May 27, 2015).

In order to adapt to the technological advances that will occur as time progresses, a geoengineering treaty should mimic the Montreal Protocol's continual conventions and adjustments. This evolutionary process will not only make the treaty continually fresh, but its constant conventions and adjustments will serve as an enforcement reminder to state actors that the treaty still exists and must be complied with. Moreover, Article 9 of the Montreal Protocol provides for the "exchange of information," which is used to help developing countries with research, development, and public awareness.¹⁸⁹ This concept of technology transfer may be implemented for geoengineering practices. If other countries at least have the knowledge of the full capabilities of geoengineering, those countries can make informed decisions in the international arena.

The Montreal Protocol provides an excellent example of enforcement for an international environmental treaty. Combining these fundamental principles from the Montreal Protocol to the foundation built from ENMOD with the proposed additions from the TRIPS Agreement and NEPA, a cohesive structure for an international geoengineering treaty can be designed.

III. IMPLICATIONS

By incorporating the applicable elements from ENMOD, NEPA, the TRIPS Agreement, and the Montreal Protocol, this note examines how a state actor would be held accountable for a geoengineering catastrophe. Using the Beijing blizzard calamity as a base hypothetical,¹⁹⁰ but changing the location to the country of Alpha, this note next analyzes how Beta—a neighboring country to Alpha—would seek redress for the \$650 million in damage and forty deaths the Alpha blizzard caused from crossing into Beta.¹⁹¹

Under this note's proposed geoengineering treaty (referred to in this section as "Treaty"), let's rewind to Alpha's decision to cloud seed. Assuming Alpha ratified the Treaty, the regulation requirements, taken from NEPA, would mandate that Alpha determine whether cloud seeding would be categorically excluded or would require an Environmental Impact Assessment. At this point, CENMOD is a newly developed council and has not set any precedent for categorical exclusions. Therefore, Alpha would be required to submit an environmental assessment.¹⁹² This environmental assessment would need to include: Alpha's need for the proposal, which in this case would be its lingering drought; any alternatives; the environmental impact of Alpha's cloud seeding

¹⁸⁹ Montreal Protocol, *supra* note 155, at art. 9.

¹⁹⁰ Although the Beijing blizzard was caused by cloud seeding—a form of weather modification—instead of geoengineering, it is one of the only environmental modification disasters known to the public. This hypothetical provides a realistic idea of the issue of accountability for environmental modification techniques, as the damage caused by the Beijing blizzard is the same used in the hypothetical.

¹⁹¹ See *supra* notes 2–4 and accompanying text.

¹⁹² See *supra* Part II(B).

plan; and a list of agencies or persons consulted.¹⁹³ In this environmental assessment, Alpha would include the dates of the proposed cloud seeding plan (in this case, November 2009), the location, the amount of silver iodide involved, and the method of disbursement. After research and preparation of its environmental assessment, Alpha determined that the proposed cloud seeding would not significantly affect the environment. Consequently, it filed a “finding of no significant impact” with CENMOD.¹⁹⁴

CENMOD reviewed its Environmental Impact Assessments in that region to determine that no other environmental modification practices would conflict with Alpha’s proposed plan. CENMOD published the environmental assessment on its website—available to the public in September 2009.¹⁹⁵ Starting in November 2009, Alpha began its cloud seeding plan. It dispersed the predetermined amount of silver iodide into the clouds in an effort to produce rain.¹⁹⁶ However, Alpha’s continual disbursement of silver iodide, coupled with existing weather patterns, led to a blizzard that crossed into the country of Beta. The blizzard caused a total of \$650 million in damage and killed forty Beta citizens.

The Beta Ministry of Natural Resources and Environment, aware of Alpha’s plan because of CENMOD’s publication, reviewed Alpha’s environmental assessment to determine whether there may be a link between the blizzard and Alpha’s cloud seeding. Determined that Alpha was responsible for the damage from the blizzard and the death of its citizens, Beta filed a “request for consultations” with the Dispute Settlement Body of CENMOD. Within the sixty-day time period for consultations, the parties’ discussions were unproductive. The parties, therefore, requested the WTO director-general to serve as a mediator for the parties. Nevertheless, the parties could not reach a settlement.¹⁹⁷

The parties moved forward through the Dispute Settlement Body by requesting a panel. Within forty-five days, CENMOD’s Dispute Settlement Body appointed a panel of five experts, comprised of scientists and lawyers. The experts were on a list of pre-qualified panelists from different countries, and Beta

¹⁹³ For information about the requirements under NEPA for environmental assessments, see 40 C.F.R. § 1508.9(b) (2014).

¹⁹⁴ For more information about “findings of no significant impact,” see *NEPA: Basic Information*, *supra* note 104.

¹⁹⁵ Although NEPA’s public-comment process is reserved for environmental impact statements—not environmental assessments—CENMOD should publish environmental assessments for purposes of demonstrating a presumption of liability in case of allegations involving environmental modification techniques. However, CENMOD can choose to reserve the forty-five-day public-comment process to environmental impact statements, similar to NEPA. See *supra* note 118.

¹⁹⁶ See *supra* Part I(A).

¹⁹⁷ Although most consultations are successful, see *supra* note 154, for purposes of demonstrating the dispute settlement process, the parties do not reach an agreement.

had an opportunity to block the appointment of any expert.¹⁹⁸ Once CENMOD's Dispute Settlement Body finalized the panel, the parties submitted written arguments supporting their positions. At the first hearing, Beta argued that Alpha's environmental assessment demonstrates its use of cloud seeding, which should serve as a presumption of liability. Because of the timing and location of Alpha's cloud seeding operation, the panel agreed with Beta regarding a presumption of liability and shifted the burden of proof to Alpha to demonstrate that it is not liable for the damage its cloud seeding operation caused.

At the following hearings, Alpha presented expert reports on issues of causation and climatology. Nevertheless, the panel ruled in favor of Beta, awarding it \$500 million for the physical damage it sustained and as compensation to the families of the victims. The Dispute Settlement Body—through a consensus—rejected the panel's award because it believed that Alpha had exercised due diligence in the filing of its environmental assessment. However, recognizing that Beta suffered damage (whether caused 100 percent by Alpha's cloud seeding, or whether Alpha's cloud seeding only exacerbated an existing blizzard), the Dispute Settlement Body lowered the award amount to \$250 million. Under the threat of trade restrictions if Alpha did not comply with the Dispute Settlement Body's ruling, Alpha compensated Beta.

Although this hypothetical situation is simplistic, it provides a glimpse into the framework of the Treaty. In this hypothetical, Alpha was an industrialized nation. However, if it were a developing country, Alpha could have used the Multilateral Fund to receive a grant for the preparation of its environmental assessment. Moreover, the Multilateral Fund could also serve as a subsidy for the Dispute Settlement Body's award to Beta. In an effort to discourage negligence by state actors and ensure repercussions, CENMOD should only subsidize liability awards if a state actor followed its due diligence throughout the preparation and execution of the environmental modification plan. Otherwise, if Alpha acted recklessly, the threat of trade sanctions would incentivize Alpha to comply with the Dispute Settlement Body's ruling.

CONCLUSION

As there is no precedent for the issue of legal accountability for geoengineered catastrophes, or for environmental modification techniques in general, policymakers must use various fields of international law to find standards to apply to geoengineering. As the only international treaty addressing environmental modification techniques, ENMOD serves as the foundation for a geoengineering treaty. The Montreal Protocol has demonstrated that the field of international environmental governance is the most effective and applicable field of international law to provide a sufficient legal framework for geoengineering regarding enforcement. The TRIPS Agreement provides fundamental principles that should be adopted for a geoengineering treaty—particularly, the Dispute

¹⁹⁸ See *supra* notes 139–40.

Settlement Body. NEPA provides the framework for regulation of environmental modification techniques through the use of Environmental Impact Assessments. All together, ENMOD, the TRIPS Agreement, NEPA, and the Montreal Protocol contain valuable principles that can be applied to geoengineering and provide the basis for an international geoengineering treaty that would provide sufficient legal accountability in the event of a geoengineering catastrophe.