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CLEANING UP SPACE: THE MADRID PROTOCOL TO THE ANTARCTIC TREATY AS A MODEL FOR REGULATING ORBITAL DEBRIS

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INTRODUCTION

> *Space . . . is big. Really big. You just won't believe how vastly, hugely, mindbogglingly big it is. I mean, you may think it's a long way down the road to the chemist's, but that's just peanuts to space.*[1]

When they consider space at all, most people think of it as a vast other, something huge beyond Earth and beyond our environment. Huge though it may be, space is not separate from us and it is not outside of our influence. The space near Earth, the orbit, is different from any other place in the universe due to its proximity to our planet and the impact humans have on the area. Humanity needs to stop thinking of the planet's orbit as just a part of the vastness of space, and remember that it is, in fact, part of the environment—part of *our* environment.

Earth's orbit is a vital component of the overall environmental system of the planet, and it has become heavily polluted by debris.[2] The debris pollution in the orbit is a worsening problem, which is not adequately addressed by any extant regulations. To clean up this environmental disaster, the international community must shift its focus regarding the orbit from national and commercial interests to environmental considerations and adopt an enforceable environmental protocol. The best

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[1] DOUGLAS ADAMS, THE HITCHHIKER'S GUIDE TO THE GALAXY 69 (2007).

[2] Natalie Pusey, Note, *The Case for Preserving Nothing: The Need for a Global Response to the Space Debris Problem*, 21 COLO. J. INT'L ENVTL. L. & POL'Y 425 (2010) ("Like so many of Earth's delicate regions, Earth orbit has been greatly altered by human activity. For a variety of reasons, human exploration and the commercialization of space create litter, or debris, that pollutes Earth orbit.").

option for doing so is to create a new international treaty and governing body modeled largely on the Protocol on Environmental Protection to the Antarctic Treaty ("PEPAT").[3]

In Part I.A, this Note explains what Earth's orbit is and how it interacts with the terrestrial environment. It then discusses why it should be treated as a part of the environment and as a limited resource that must be carefully preserved and regulated. Looking at Earth's orbit as an environmental system, Part I.B.1 lays out the problem of orbital debris: what it is and what environmental problems it causes, including nuclear contamination of orbit and Earth, astronomical blinding, and that such debris is pollution in and of itself.

Part I.B.2 looks at orbital debris as a current and growing problem, as demonstrated by recent collisions between satellites and other events in the past decade that have created massive amounts of new debris. After outlining the present state of the debris field, and current predictions on how it will grow in the future, Part II addresses the current regulation of this debris. As it stands today, orbital debris is not well-regulated. Part II establishes that this is because the current regulations are non-binding and are not enforced in a practical way.[4] Even if they were binding and enforced, they would still be ineffective, because none of the existing regulations have provisions for cleaning up orbital debris.[5] Furthermore, some of the provisions in these regulations could actually act as roadblocks to removing debris from orbit. Finally, current regulations focus on the oversight of state actors,[6] even though private companies have an ever-increasing presence in space.[7]

Having established the existing problems, I propose a solution in Part III: a new regulation of orbit modeled on PEPAT. This Part briefly outlines the provisions of PEPAT, and then gives a breakdown of how PEPAT can be applied to orbit. This includes: which provisions would be effective, which should be dropped, and how parts of PEPAT can be adapted so that they either protect orbit specifically, or are more effective in general.

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[3] Although others have suggested importing aspects of the underlying structure of PEPAT, the Antarctic Treaty System, into orbit, this Note focuses specifically on how the PEPAT agreement could be a useful model for orbital regulations, rather than discussing the Antarctic Treaty as a whole.

[4] *See* Pusey, *supra* note 2, at 435.

[5] Brian Beck, *The Next, Small, Step for Mankind: Fixing the Inadequacies of the International Space Law Treaty Regime to Accommodate the Modern Space Flight Industry*, 19 ALB. L.J. SCI. & TECH. 1, 27 (2009).

[6] *Id.* at 7.

[7] *Id.* at 13.

I. THE ORBITAL ENVIRONMENT AND DEBRIS

A. What Is the Orbital Environment?

The environment discussed in this Note is not all of outer space, but is limited to the orbital area immediately surrounding Earth, which is commonly used for satellites.[8] There is no international consensus on where the atmosphere ends and space begins.[9] For the purposes of this Note, the definition of 100km above Earth's surface and upwards will be used, which is based on the lowest point at which an object can orbit Earth without propulsion systems.[10] The fact that there is confusion on this point demonstrates that the difference between Earth's atmosphere and the orbit is blurry, perhaps even entirely arbitrary. It is all part of the same interrelated environmental system, without a clear dividing line.[11]

Outer space as a whole should be viewed through the lens of environmental policy concerns, but Earth's orbit is of particular interest because it directly affects terrestrial environmental systems.[12] In addition, humanity is hardly cluttering up the rest of the solar system at this point, but Earth's orbit is a part of the space environment within our reach, and we are making a mess of it.

1. Orbit as a Limited Resource

Space is, as suggested by Douglas Adams, absolutely huge—which is why it can be so easy to forget that Earth's orbit is, in fact, a finite region of space. There are three primary levels of orbit used for satellites: Low Earth Orbit ("LEO"), Geosynchronous Earth Orbit ("GEO"), and Medium Earth Orbit ("MEO").[13] Of these, GEO is the most highly sought after real

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[8] MICHAEL W. TAYLOR, ORBITAL DEBRIS: TECHNICAL AND LEGAL ISSUES AND SOLUTIONS 7 (2006) ("For a variety of reasons, satellites tend to congregate in certain well-defined regions around the Earth. The mission of the satellite is probably the most important factor in determining the orbit. However, mass and fuel limitations, radiation levels, and orbital mechanics also play important roles. These factors have important consequences for the issue of orbital debris because the most useful orbits have also become the most congested.").
[9] *See* G.C.M. REIJNEN & W. DE GRAAFF, THE POLLUTION OF OUTER SPACE, IN PARTICULAR OF THE GEOSTATIONARY ORBIT 2 (1989).
[10] *Id.* at 3.
[11] David Enrico Reibel, *Environmental Regulation of Space Activity: The Case of Orbital Debris*, 10 STAN. ENVTL. L.J. 97 (1991) (emphasizing the importance of considering space as a part of Earth's environment).
[12] *See infra* Part I.B.1.
[13] TAYLOR, *supra* note 8, at 7–10.

estate, because "the [GEO] is composed of a set of vantage points around the Earth's equator from which satellites have the 'best seat' to communicate with the planet below."[14] The majority of satellites engaged in commercial communications are in GEO.[15]

GEO slots are currently regulated by the International Telecommunication Union ("ITU").[16] This began as a natural outgrowth from the organization's traditional duty of apportioning radio frequencies.[17] It now also distributes GEO slots to avoid both satellite collisions and satellite signal interference.[18] "The ITU does not have an environmental mission, but because overcrowding in GEO has a detrimental effect on telecommunications, it has promulgated provisions to address the creation of debris in GEO."[19]

There have been political efforts from developing countries to change the way GEO positions are determined, including a failed attempt by the infamous "Bogotá Eight" to claim GEO slots directly above their own nations as part of their sovereign territory.[20] In addition, the ITU system has been abused by some countries. In 1991, Tonga tried to obtain six slots in GEO, not so it could use them, but so it could rent or sell them by auction to other parties wanting to launch satellites into GEO.[21] Under international pressure, some of these slots were returned by Tonga, and the ITU now requires "that a majority of slots applied for be used directly by the requesting country."[22] These slots are valuable; they are worth enough money that countries squabble over and plot to get more of them because of their potential scarcity.[23] GEO is the best example of the true nature of orbit; it is not merely part of the mind-boggling hugeness of space, it is a limited resource intimately connected with Earth. There are only so many satellites that can fit around our planet.

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[14] Nima Nayebi, *The Geosynchronous Orbit and the Outer Limits of Westphalian Sovereignty*, 3 HASTINGS SCI. & TECH. L.J. 471, 472 (2011).
[15] *Satellite Quick Facts*, UNION OF CONCERNED SCIENTISTS, http://www.ucsusa.org/assets/documents/nwgs/quick-facts-and-analysis-4-13-09.pdf (last visited Jan. 29, 2013).
[16] Timothy G. Nelson, *The Moon Agreement and Private Enterprise: Lessons from Investment Law*, 17 ILSA J. INT'L & COMP. L. 393, 408 (2011).
[17] *Id.*
[18] *See id.*
[19] Pusey, *supra* note 2, at 428. These regulations include recommending that GEO satellites be moved into a "graveyard" orbit out of GEO before they become inoperable, to avoid overcrowding GEO with inoperable satellites. *Id.*
[20] Nayebi, *supra* note 14, at 487; *see also infra* Part II.B.2.
[21] Nelson, *supra* note 16, at 408.
[22] *Id.* at 409.
[23] *See id.* at 408.

B. Orbital Debris: What It Is, Why It Is a Problem

Before the twentieth century, the near space surrounding Earth was a pristine environment.[24] Today, Earth is surrounded by an ever-growing cloud of garbage, and its orbit is heavily polluted by the mass of debris.[25] Pollution in orbit takes the form of orbital debris and the overcrowding of satellites.[26] "Orbital" or "space" debris is debris left over from objects launched into space,[27] and includes everything from derelict satellites to lost screwdrivers, and even golf balls.[28] Orbital debris is an ever-increasing problem, because as debris moves in orbit, pieces of it collide and break apart, creating more debris.[29] While there are several agencies worldwide with varying abilities in tracking space debris, "thus far, only the United States and Russia have systems that do systematic observation, as opposed to spot checks."[30] The United States Strategic Command tracks over 22,000 man-made orbiting objects, including satellites and debris.[31]

One of the primary sources of orbital debris is exploding rocket engines.[32] "Originally, these engines were jettisoned in orbit after launch,

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[24] *See* Jonathan Amos, *Space Debris: Time to Clean Up the Sky*, BBC NEWS (Sept. 2, 2011), http://www.bbc.co.uk/news/science-environment-14763668.

[25] *Id.*

[26] *Id.*

[27] NAT'L AERONAUTICS & SPACE ADMIN., NASA PROCEDURAL REQUIREMENTS FOR LIMITING ORBITAL DEBRIS (W/CHANGE 1—5/14/09) (2009), *available at* http://nodis3.gsfc.nasa.gov/displayDir.cfm?t=NPR&c=8715&s=6A ("Orbital debris is defined as any object placed in space . . . by humans that remains in orbit and no longer serves any useful function or purpose. Objects range from spacecraft to spent launch vehicle stages to components and also include materials, trash, refuse, fragments, or other objects which are overtly or inadvertently cast off or generated."); *see also* INT'L ACAD. OF ASTRONAUTICS, POSITION PAPER ON SPACE DEBRIS MITIGATION (2005), *available at* http://iaaweb.org/iaa/Studies/spacedebrismitigation.pdf (defining orbital/space debris as "all man[-]made objects including fragments and elements thereof, in Earth orbit or re-entering the atmosphere, that are non[-]functional.").

[28] Kelly Young, *Space Golf Shot Might Stay in Orbit for Years*, NEW SCIENTIST (Nov. 17, 2006), http://www.newscientist.com/article/dn10606-space-golf-shot-might-stay-in-orbit-for-years.html; *see also* TAYLOR, *supra* note 8, at 1, 15.

[29] *See* Reibel, *supra* note 11, at 108; *see also infra* Part I.B.2.

[30] Pusey, *supra* note 2, at 433; *see also* MARK WILLIAMSON, SPACE: THE FRAGILE FRONTIER 54 (2006).

[31] *USSTRATCOM Space Control and Space Surveillance*, U.S. STRATEGIC COMMAND, http://www.stratcom.mil/factsheets/USSTRATCOM_Space_Control_and_Space_Surveillance/ (last updated May 2012).

[32] DAVE BAIOCCHI & WILLIAM WELSER IV, NAT'L DEF. RESEARCH INST., CONFRONTING SPACE DEBRIS: STRATEGIES AND WARNINGS FROM COMPARABLE EXAMPLES INCLUDING DEEPWATER HORIZON 2, 17 (2010), *available at* http://www.rand.org/content/dam/rand/pubs/monographs/2010/RAND_MG1042.pdf.

and the remaining fuel expanded because of the thermal conditions. Under the right conditions, the pressure became too great, and the rocket body exploded."[33] Exploding rocket engines have become less of a problem since the 1990s, when they were redesigned to vent pressure through valves.[34] However, the already exploded rocket bodies continue to collide, and were the primary source of orbital debris through 2007.[35]

One need only read the news to see that orbital debris is a current and worsening problem.[36] Some of the worst instances of collisions involving or creating orbital debris have happened relatively recently.[37] There had never been a collision between two catalogued pieces of orbital debris until 1991.[38] In 1996, the first publicly documented collision involving two internationally catalogued space objects took place between a French military microsatellite and a European Space Association rocket body.[39] This collision resulted in debris breaking off from both objects, only one piece of which was large enough to be tracked.[40] This event is an example of the self-generating nature of debris. Collisions between debris and functioning satellites, apart from the monetary harm they may cause to the owners of satellites, cause environmental damage. Once damaged in a collision, a satellite can lose its ability to correct its orbit, and become another hazard in space, without any way to steer onto a better orbital path.[41] This greatly increases the chance of a damaged satellite careening into some other orbiting object, be it another satellite or a piece of debris, and continuing the cycle of debris generation.

There have been a number of collisions involving already existing debris. There was a debris-on-debris collision between tracked trash from the United States and China in January of 2005.[42] This, like the collisions

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[33] *Id.* at 2.
[34] *Id.*
[35] *Id.*
[36] *E.g.*, Amos, *supra* note 24.
[37] BAIOCCHI & WELSER, *supra* note 32, at 2.
[38] *See id.* at 26–27 ("In 1991, a non-functional Russian navigation satellite in LEO collided with a piece of debris that had previously detached from another Russian satellite. The impact created many new pieces of debris."). While this collision occurred in 1991, it was not identified until 2005. *Id.* at 27 n.136.
[39] Henry T. Scott, *Improving the Shield: Mitigating the Danger of Space Debris by Enforcing and Developing Already Existing Space Law*, 34 ANNALS OF AIR & SPACE LAW 719, 720 (2009).
[40] *Id.*
[41] *See Concern Over Space Debris*, THE BRUNEI TIMES (Sept. 28, 2011), http://www.bt.com.bn/editorial/2011/09/28/concern-over-space-debris.
[42] TAYLOR, *supra* note 8, at 27.

between satellites and debris, contributes to the self-sustaining cloud of space trash as the pieces break apart and cause more hazards.

1. Orbital Debris as an Environmental Problem

Orbital debris is garbage and a pollutant in and of itself. It is important not to lose track of that basic consideration; beyond any potential damage to Earth's surface, beyond any financial losses, orbital debris is, essentially, litter.[43] There are specific harms relating to this debris, however, that may drive the environmental damage it causes home.

a. Potential Nuclear Contamination of Earth's Surface

The man-made objects in orbit have the potential to harm terrestrial environmental systems, particularly when one considers the risks from nuclear waste in space. This danger was made apparent in 1978, when a Soviet satellite malfunctioned and fell to Earth, scattering radioactive debris over northern Canada.[44] Only about 0.1 percent of the satellite's power source was ever recovered.[45] There have been international efforts to limit the use of nuclear materials in orbit, the most significant of which is the Principles Relevant to the Use of Nuclear Power Sources In Outer Space, established by the United Nations Office for Outer Space Affairs ("UNOOSA").[46] These principles call for limitations on the use of nuclear materials in space, only allowing nuclear fuel for "those space missions which cannot be operated by non-nuclear energy sources in a reasonable way."[47] The protocol specifically protects both the terrestrial environment and the space environment.[48] However, the regulation is non-binding,[49] severely limiting its usefulness.

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[43] Pusey, *supra* note 2, at 425.
[44] COMM. FOR THE ASSESSMENT OF NASA'S ORBITAL DEBRIS PROGRAMS, NAT'L RESEARCH COUNCIL, LIMITING FUTURE COLLISION RISK TO SPACECRAFT: AN ASSESSMENT OF NASA'S METEOROID AND ORBITAL DEBRIS PROGRAMS 61 (2011), *available at* http://www.nap.edu/catalog.php?record_id=13244 [hereinafter ASSESSMENT]; *see also infra* Part II.A.2.a for a discussion of the legal fallout from this incident.
[45] *See* ASSESSMENT, *supra* note 44.
[46] Principles Relevant to the Use of Nuclear Power Sources in Outer Space, G.A. Res. 47/68, U.N. Doc. A/RES/47/68 (Feb. 23, 1993), *available at* http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/47/68&Lang=E&Area=RESOLUTION.
[47] *Id.* at Principle 3.
[48] *Id.*
[49] J-A. van Wyk, *Overview of the Implementation Status of the Five United Nations Treaties on Outer Space in African Countries*, 12 AFRICAN SKIES/CIEUX AFRICAINS 90, 91 (2008), *available at* http://www.saao.ac.za/~wgssa/archive/as12/van_wyk.pdf.

b. Astronomical Blinding

Visual pollution is one effect of orbital debris which impacts the environment in a way that human beings can see from Earth, and therefore perhaps better appreciate. Space debris can interfere with satellite observations of outer space and it "can also obscure ground-based astronomical observation."[50] This means that debris in orbit is diminishing humanity's view of the stars in the same way as atmospheric pollution and light pollution.

Aside from the aesthetic loss, the debris also harms scientific research; orbital debris "can either decrease the quality of, or completely negate, many hours of observations."[51] Orbital debris has become a physical and visual barrier between Earth and the rest of the universe. This is pollution on a massive scale, and the problem is only getting worse.

2. Current and Future State of Orbital Debris

Since 2007, the greatest contributors to orbital debris were two major collisions. The first was an attempt by the Chinese government to destroy one of its old satellites with an anti-satellite missile in 2007.[52] The attempt, far from successfully removing the satellite from orbit, massively increased the amount of debris by adding "2,606 [sic.] trackable objects to the U.S. space catalog as of June 2010" and an estimated "35,000–500,000 smaller, untrackable pieces of debris."[53] The methods used by China did not conform with any international agreements on the removal of satellites.[54]

The second collision event took place in 2009, when "an active Iridium communications satellite" collided with a non-functioning Russian communication satellite, creating 1658 pieces of trackable orbital debris.[55] As the number of defunct satellites and the amount of debris in orbit increases, these kinds of collisions will also be on the rise, creating a cycle of increasing orbital debris.[56] In discussing orbital debris, environmental issues and the potential problem of debris colliding with active operations in space are one and the same; any danger to satellites from orbital debris means the potential creation of even more orbital debris, and therefore, more pollution.

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[50] Pusey, *supra* note 2, at 431.
[51] TAYLOR, *supra* note 8, at 33.
[52] BAIOCCHI & WELSER, *supra* note 32, at 2.
[53] *Id.*
[54] Scott, *supra* note 39, at 758.
[55] BAIOCCHI & WELSER, *supra* note 32, at 2.
[56] Reibel, *supra* note 11, at 108.

Unfortunately, without an international system in place for debris removal, more nations may follow China's lead in attempting debris and satellite removal unilaterally. There are no binding international agreements on how satellites are to be retired,[57] which means that there is nothing stopping another disastrous attempt from being tried by another government. This event created more orbital debris than any other single event,[58] and yet there is no system in place to keep history from repeating itself.

According to Henry Scott's article on orbital debris, "[a]n increase in the quantity of space debris, even in the absence of new launches *and* with complete international compliance with *all* existing debris mitigation guidelines, is inevitable."[59] In fact, a 2006 report by NASA scientists found that beyond 2055, the debris population in LEO will increase dramatically, largely due to debris-on-debris collisions,[60] such as the collision between the U.S. and Russian satellites in 2009, and the Chinese missile launch in 2007. The pollution that exists right now will have environmental repercussions stretching well into the future, including an inevitable increase in the amount of debris forty-some years from now. This pollution has become a gift for our grandchildren, and one that we cannot take back. One scholar stated that "[o]rbital debris in GEO is estimated to last anywhere from a million to 10 million years."[61] This means that we cannot wait for debris in the GEO to come back to Earth through natural orbital degradation, it must be actively removed at some point, or it will continue to pollute the GEO and endanger satellites, potentially creating more debris for millions of years.

The NASA study points to two things: first, action must be taken as soon as possible, to avoid an even greater environmental disaster than already predicted.[62] Second, it suggests the urgency of creating a new plan; current regulations, if followed, will not stop the increase of debris, so alternatives must be explored to try and avoid the looming threat.[63] The scientific and international community has not yet agreed upon a plan to remove

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[57] *See* Scott, *supra* note 39, at 758.
[58] John Matson, *U.S. Taking Initial Steps to Grapple with Space Debris Problem*, SCI. AM. (Aug. 31, 2011), http://www.scientificamerican.com/article.cfm?id=orbital-debris-space-fence.
[59] Scott, *supra* note 39, at 727 (emphasis in original).
[60] J.-C. Liou & N. L. Johnson, *Risks in Space from Orbiting Debris*, 311 SCIENCE 340 (2006), *available at* http://www.sciencemag.org/content/311/5759/340.full.pdf.
[61] TAYLOR, *supra* note 8, at 10.
[62] Liou & Johnson, *supra* note 60, at 340.
[63] *Id.*

debris that is technologically viable;[64] but current regulations prevent any future technological advance in debris removal from being effectively implemented.[65] Therefore, orbit regulation needs to change in order to create an environment in which mitigation and removal of orbital debris is politically and legally possible.

II. POLLUTION IN ORBIT IS POORLY REGULATED

A. International Regulations

In studying the regulation of outer space, one must remember that "space law, as it now exists, is not an independent legal system. It is merely a functional classification of those rules of international law and of municipal law."[66] There are several international regulations that govern the use of space.[67] However, the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, more commonly known as the Outer Space Treaty of 1967 ("OST"),[68] the Convention for International Liability for Damage Caused by Space Objects of 1972 ("ILD"),[69] and the Convention on Registration of Objects Launched into Outer Space ("Registration Convention") are the most directly applicable to orbital debris.[70] As will be discussed with regard to individual treaties, all of these regulations have flaws which prevent the environment of Earth's orbit from being protected or "cleaned up" effectively.[71] None of these regulations create both a duty to remove

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[64] TAYLOR, *supra* note 8, at 79 ("Currently, there are no economically or technically feasible ways to remove debris from space.").
[65] *See infra* Part II.
[66] BIN CHENG, STUDIES IN INTERNATIONAL SPACE LAW 383 (1997).
[67] For a list of the U.N.-developed multilateral treaties, see U.N., UNITED NATIONS TREATIES AND PRINCIPLES ON OUTER SPACE (2002), *available at* http://www.unoosa.org/pdf/publications/STSPACE11E.pdf.
[68] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, Jan. 27, 1967, 18 U.S.T. 2410, 610 U.N.T.S. 205, *available at* http://www.unoosa.org/pdf/publications/STSPACE11E.pdf [hereinafter OST].
[69] Convention on International Liability for Damage Caused by Space Objects, Mar. 29, 1972, 24.2 U.S.T. 2389, 961 U.N.T.S. 187, *available at* http://www.unoosa.org/pdf/publications/STSPACE11E.pdf [hereinafter ILD].
[70] Convention on Registration of Objects Launched into Outer Space, Jan. 14, 1975, 1023 U.N.T.S. 15, *available at* http://www.unoosa.org/pdf/publications/STSPACE11E.pdf [hereinafter Registration Convention].
[71] TAYLOR, *supra* note 8, at 79–80.

orbital debris and an effective policy for how to do so. In addition, these guidelines are non-binding and thus essentially unenforced.[72] Finally, none of these guidelines effectively consider regulation of non-governmental parties.[73] Current regulations are state-centric, which does not work well with the modern trend towards private enterprise in space.[74]

1. The OST

The OST is not an environmentally minded treaty. Its focus is on the exploration of space "for the benefit and in the interests of all countries,"[75] the "use of outer space for peaceful purposes,"[76] and "freedom of scientific investigation in outer space."[77] The word "environment" is used only once, and only in reference to *Earth*'s environment; signing nations are expected to conduct studies in such a way as to avoid "adverse changes in the environment of the Earth resulting from the introduction of extraterrestrial matter."[78] Parties to the treaty are also expected to avoid "potentially harmful interference with activities of other States Parties."[79]

Even though the OST does not actively consider the orbital environment, it does have a theoretical impact on orbital debris. The OST declares that state parties are internationally responsible for the activities in space carried out by "governmental agencies or by non-governmental entities,"[80] and that both the launching State and the State from which a space object is launched are liable for any damage caused by the object or its component parts to another State Party "on the Earth, in air space or in outer space."[81] It further declares that objects launched into outer space, and their component parts, belong at all times to the State on whose registry the object is carried.[82] Finally, parties who believe that some aspect of their activities in space might cause harm to another party or to the "peaceful exploration and use of outer space" must "undertake appropriate international consultations before proceeding."[83]

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[72] *See* Pusey, *supra* note 2, at 435.
[73] *See* Beck, *supra* note 5, at 12–15.
[74] *See id.* at 12.
[75] OST, *supra* note 68, art. I.
[76] *Id.* Preamble.
[77] *Id.* art. I.
[78] *Id.* art. IX.
[79] *Id.*
[80] *Id.* art. VI.
[81] OST, *supra* note 68, art. VII.
[82] *Id.* art. VIII.
[83] *Id.* art. IX.

a. Why the OST Regulations Are Ineffective for Solving the Orbital Debris Problem

In spite of the OST's utter lack of concern for outer space as a part of the environment, the treaty still addresses major concerns of orbital debris regulation: who is responsible for orbital debris and how to prevent the creation of more orbital debris. However, the OST does not address these concerns in a manner that is in any way practicable. Declaring that the launching state and the state from which the object launches are ultimately liable sounds sufficient, but in reality, it is largely unenforceable. If the collision is between two satellites, for instance, these provisions can be useful. For example, in February 2009 a Russian satellite collided with an American satellite.[84] Scientists determined that neither nation was at fault,[85] so the OST was not invoked. If it had been invoked, however, at the very least what nations were involved in determining fault would have been obvious—Russia and the United States. But that collision also created over 1600 pieces of orbital debris.[86] Which pieces of debris came from which satellite? How could a ragged bit of Russian metal hurtling through orbit be differentiated from a ragged bit of American metal? What if some of the debris resulting from this collision next collides with and damages a French communications satellite? The idea that each State will "own" or "be liable for" the component parts of each launched object is laughable—debris cannot always be traced back to a specific launched object. Furthermore, even if neither country was at fault, these regulations do not address who may complain for the damage done to the orbital environment itself, as opposed to a satellite, since environmental damage is only addressed regarding the terrestrial environment.

Additionally, the OST does not take into account the current state of orbital use. When it was written, orbit was the domain of State actors.[87] As time has passed, however, the presence of private companies in space has only increased.[88] Private corporations have owned satellites for years,[89]

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[84] Pusey, *supra* note 2, at 430; *see also supra* Part I.B.2.
[85] William Harwood, *U.S. and Russian Satellites Collide*, CBS NEWS (Feb. 12, 2009, 4:33 PM), http://www.cbsnews.com/stories/2009/02/11/tech/main4792976.shtml.
[86] BAIOCCHI & WELSER, *supra* note 32, at 2.
[87] *See* Beck, *supra* note 5, at 7.
[88] Frank J. Balsamello, Note, *When You Wish Upon a Falling Billboard: Advertising in an Age of Space Tourism*, 98 GEO. L.J. 1769, 1776 (2010).
[89] *Satellite Timeline*, SOC'Y OF SATELLITE PROF'LS INT'L, http://www.sathistory.com/ (last visited Jan. 29, 2013) (showing a timeline of satellite activity, including the growth of private satellite ownership).

and in 2004 the X-Prize, a non-profit foundation, paid out a $10 million prize for the first private spacecraft to travel into sub-orbit twice within the same week.[90] Currently, Virgin Galactic is attempting to become the first private company to offer flights into space.[91] As private companies become more and more involved in space, the need to directly regulate their orbital activities increases.[92] But the OST only regulates these companies *through* State parties and does not allow private corporations as parties to the treaty;[93] this is a fundamental weakness.

Beyond being ineffective, this treaty might actually hinder efforts to remove orbital debris. The OST definition of ownership means that a State launching something into orbit retains property rights in perpetuity, down to the component parts.[94] This stance did not create a good background for reducing orbital debris because it did not have an ending point for ownership. Presumably, a party may want to retain ownership over a slightly damaged satellite that can be salvaged in some way, but how damaged can a satellite be and still retain its property status? At what point might a satellite be considered "abandoned" and therefore something that a third party could dispose of for the common good? Following the logic of the OST, that point can never be reached.

As for mitigating the creation of orbital debris, a similar problem exists. The treaty could be interpreted as offering a solution, mandating that States concerned that their activities will harm other parties or the peaceful exploration of space must consult the international community.[95] Orbital debris should fit the bill for this requirement; it is a dangerous element for all parties with activities in space, and it clearly interferes with space exploration and scientific study.[96] Therefore, following the language of the OST, each nation that launches a satellite should be consulting with other nations to figure out the best way to avoid creating more orbital debris, for instance, with proper placement of the satellite or by making sure there is a plan for removing the satellite from orbit once it ceases to function. The OST's potential plan has clearly failed; the OST was signed

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[90] Rosanna Sattler, *Transporting a Legal System for Property Rights: From the Earth to the Stars*, 6 CHI. J. INT'L L. 23, 24–25 (2005).
[91] *Virgin Galactic Announced*, VIRGIN GALACTIC (Sept. 27, 2004), http://www.virgingalactic.com/news/item/virgin-galactic-announced/.
[92] *See generally* TAYLOR, *supra* note 8, at 42 (explaining the importance of regulating the liability of non-governmental entities in space).
[93] OST, *supra* note 68, art. VI.
[94] *Id.* art. VIII.
[95] *Id.* art. IX.
[96] *See, e.g.*, TAYLOR, *supra* note 8, at 32; *see also supra* Part I.B.

in 1967, and the amount of debris in orbit has only increased in the decades since its signing.[97]

2. The ILD and the Registration Convention

The ILD attempts to set up the rules for liability for damage caused by space objects,[98] while the Registration Convention established how the identity of the responsible party for each space object is to be tracked.[99] These conventions, while not effective on the whole, do take a step in the right direction in that they recognize non-governmental organizations who accept its tenets as parties under the convention, unlike the OST.[100]

a. Why the ILD and Registration Convention Are Ineffective for Solving the Orbital Debris Problem

Unfortunately, property rights in space became an even greater problem for removing debris from orbit with the signing of the ILD and Registration Convention. The ILD asks parties to determine who owns any "space object" before taking action on it, and the drafters define "space object" as "component parts of a space object as well as its launch vehicle and parts thereof."[101] This is a broad definition, which appears to encompass any sort of orbital debris.

Orbital debris have been produced by many different countries.[102] As Michael Taylor put it, "[t]o have any noticeable effect on the quantity of debris, a group of States undertaking such an endeavor would need to be able to remove any debris, not just debris for which that group of States was a launching State."[103] This means that when the technology to successfully remove orbital debris becomes available, under current regulations it cannot be used by any organization to clean up orbit without determining the ownership of each and every piece, according to the commonly accepted reading of this convention.[104]

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[97] *See* Amos, *supra* note 24.
[98] ILD, *supra* note 69, art. II.
[99] Registration Convention, *supra* note 70, arts. I–IV.
[100] ILD, *supra* note 69, art. XXII; *see also* Registration Convention, *supra* note 70, art. VII.
[101] ILD, *supra* note 69, art. I.
[102] Matson, *supra* note 58 ("[O]f the catalogued debris now in orbit, 37 percent is Russian or Soviet in origin, 29 percent is American and 28 percent is Chinese.").
[103] TAYLOR, *supra* note 8, at 79–80.
[104] *Id.* at 80.

The National Research Council's recent report on NASA's orbital debris program set out the difficulty that the current treaty system creates regarding the removal of orbital debris, stating that it would involve "crossing a crucial national and international legal threshold."[105] Thanks to the extant treaty system, the report notes that "[n]o state has the legal authority to remove a debris object from space without the express consent of the object's state of registry."[106] This means that any state wishing to implement large-scale debris removal would have to engage in formal diplomacy to gain the consent of the nation who owns the registry of a given piece of debris.[107] The ILD and the Registration Convention, far from helping to clean up orbit, have made the work of reducing orbital pollution even more difficult. The ILD has been ratified by eighty-eight states and signed by an additional twenty-three states.[108]

Beyond this, the ILD declares that launching states alone are liable for damage caused by objects launched into space.[109] For damage on Earth or to an aircraft, the liability is absolute, while if damage is to another state's space object, the launching state is only liable if it was at fault.[110] Meanwhile, the Registration Convention requires all launching states to maintain a registry of space objects it launches, which is then passed along to the United Nations so the object can be registered there as well.[111] For multistate launches, the parties must decide amongst themselves who is to carry the registry and be responsible for the space object.[112] This means that the same problems noted under the OST[113] persist with these regulations—private companies are not directly liable for their actions in space, even though private space activity is on the rise.[114]

The liability system has been successfully implemented—for damage done on Earth. As mentioned earlier, in 1978, a Soviet satellite crash-landed in Canada.[115] Canada brought suit against the Soviet Union under

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[105] ASSESSMENT, *supra* note 44, at 83–84.
[106] *Id.* at 84.
[107] *See id.*
[108] *Status of International Agreements Relating to Activities in Outer Space*, U.N. OFFICE FOR OUTER SPACE AFFAIRS, http://www.oosa.unvienna.org/oosa/en/SpaceLaw/treatystatus/index.html (last visited Jan. 29, 2013).
[109] ILD, *supra* note 69, arts. II–III. For a general discussion on the roadblocks created by the ILD liability situation, see TAYLOR, *supra* note 8, at 90.
[110] ILD, *supra* note 69, arts. II–III.
[111] Registration Convention, *supra* note 70, arts. II(1), III.
[112] *Id.* art. II(2).
[113] *See supra* Part II.A.1.a.
[114] Balsamello, *supra* note 88, at 1775.
[115] ASSESSMENT, *supra* note 44, at 61.

the ILD, and in 1981 the U.S.S.R. settled, paying the Canadian government $3 million.[116] The ILD system was effective in this case. However, this success is because this was a case involving *terrestrial* damage. The ILD establishes absolute liability for damage caused on Earth.[117] Unfortunately, for damage caused in orbit, the ILD uses a fault-based system of liability.[118]

The ILD and the Registration Convention attempt to set up a framework in which states can enforce a safe orbital environment by suing countries that are "at fault," but the system is untenable. David Tan summarized the problems nicely: "[t]he specificity of damage, the requirement of fault, and the difficulty of identification all contribute to the impotence of the Liability Convention and the Registration Convention in the protection of the outer-space environment from debris pollution."[119] There are simply too many pieces that need to come together to enforce these conventions with regards to orbital debris. According to the Space Frontier Foundation, "only the United States routinely registers all stages of a launch; most countries merely register the launch vehicle and the payload(s). Most important, there is no penalty for not registering with the U.N."[120] The only solution offered by the Registration Convention for unidentified space debris is that the State Party that is concerned can request assistance and other State Parties to the Convention are to assist in identifying it.[121] It is hard to imagine that this system will be practical in any way if a nation's satellite is damaged by orbital debris from an unknown source.

This is not a reasonable solution to the problem of orbital debris. This is not even a reasonable solution for how liability systems should work in orbit. After all, how does one determine "fault" in orbit? Unless dealing with GEO slots, which are determined by the ITU,[122] orbit is something of a free-for-all, so there are no reliable standards for where a space object should be located to avoid fault in the case of a collision.[123]

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[116] *Id.*
[117] ILD, *supra* note 69, art. II.
[118] *Id.* art. III.
[119] David Tan, *Towards a New Regime for the Protection of Outer Space as the "Province of All Mankind,"* 25 YALE J. INT'L L. 145, 168 (2000).
[120] JAMES DUNSTAN & BOB WERB, SPACE FRONTIER FOUND., LEGAL AND ECONOMICS IMPLICATIONS OF ORBITAL DEBRIS REMOVAL: COMMENTS OF THE SPACE FRONTIER FOUNDATION 5 (2009), *available at* http://www.scribd.com/doc/23379988/Legal-and-Economics-Implications-of-Orbital-Debris-Removal.
[121] Registration Convention, *supra* note 70, art. VI.
[122] Nelson, *supra* note 16, at 407.
[123] *See* Harwood, *supra* note 85 ("We don't have an air traffic controller in space. There is no universal way of knowing what's coming in your direction.").

Even worse, these regulations are not environmentally minded. There is no liability under the ILD without damage, and "'damage' means loss of life, personal injury or other impairment of health; or loss of or damage to property."[124] As pointed out by David Tan, the ILD "does not cover indirect damage or non-physical damage," which means "it does not deal with environmental dangers created by space activities."[125] This means that even if a State was concerned with the environmental impact of orbital debris, it would have no recourse through this system.[126] Moreover, this system does not address the removal of debris, only the assigning of liability, so even if it worked perfectly, it would still not be a solution to the problem at hand.

3. Inter-Agency Space Debris Coordination Committee and the United Nations Committee on the Peaceful Uses of Outer Space Regulations

A major effort at orbital debris mitigation is the Inter-Agency Space Debris Coordination Committee ("IADC"), an organization that is made up of twelve space agencies.[127] The scope of the IADC's goals is "(1) limitation of debris released during normal operations, (2) minimization of the potential for on-orbit breakups, (3) post-mission disposal, and (4) prevention of on-orbit collisions."[128] Meanwhile, the United Nations Committee on the Peaceful Uses of Outer Space ("UNCOPUOS") has guidelines modeled after the IADC's.[129] UNCOPUOS guidelines are "very similar, but are not identical, to the IADC guidelines,"[130] and UNCOPUOS looks to "(1) curtailment and mitigation of space debris generation for the near term, and (2) long-term debris mitigation."[131]

It is of course a good thing for reducing orbital debris levels that these two sets of guidelines exist, but their effectiveness should not be overstated. The UNCOPUOS guidelines are not binding on states.[132] The IADC guidelines are limited in that they apply only to missions begun after the

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[124] ILD, *supra* note 69, art. I.
[125] Tan, *supra* note 119, at 168.
[126] *See* TAYLOR, *supra* note 8, at 76.
[127] For a list of members, see INTER-AGENCY SPACE DEBRIS COORDINATION COMMITTEE, http://www.iadc-online.org/index.cgi?item=home (last visited Jan. 29, 2013).
[128] ASSESSMENT, *supra* note 44, at 80.
[129] *Id.*
[130] *Id.*
[131] *Id.*
[132] *Id.*

guidelines came into effect, but only "if possible" to current operations.[133] Also, only space agencies are members, excluding all other government agencies and private corporations.[134] The greatest weakness of these guidelines as they relate to reducing orbital debris, however, is that they do not address the rules for removing currently existing debris.

B. Domestic Efforts at Regulation of Orbital Debris

1. Regulations Affecting Orbital Debris in the United States

There are several domestic regulations in the United States that address, or at least potentially address, the mitigation of orbital debris. Since 1969, the National Environmental Policy Act ("NEPA") has required that federal agencies create a report on the potential environmental impact of major federal actions.[135] However, "[s]everal United States government agencies have determined as a legal matter that activities involving outer space do not fall under the purview of the Act."[136] NASA has regulations that apply within the United States to any governmental and non-governmental space activities, and it uses these regulations to enforce the NEPA policy for any activities which could have a significant environmental impact on Earth.[137] However, "NASA's environmental regulations do not appear to apply to activities in the 'global commons' of outer space,"[138] and so are only at issue when activities affect the terrestrial environment.

Relating to mitigating orbital debris, NASA is a proponent of the "25-year rule," which "seeks to restrict the post-operational life of objects in space to no more than 25 years."[139] The 25-year rule has been adopted by some international organizations, such as the European Space Agency ("ESA"),[140] but it is not uniformly followed even within the United States. The standard is often given waivers within NASA,[141] and the rule is not, in fact, a rule under federal law.[142] This means that other federal agencies do not have to follow the 25-year rule at all.

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[133] *Id.*
[134] INTER-AGENCY SPACE DEBRIS COORDINATION COMMITTEE, *supra* note 127.
[135] 42 U.S.C. § 4332 (2006).
[136] Irene Atney-Yurdin, *Space Debris Legal Research Guide*, 3 PACE Y.B. INT'L L. 167, 172 (1991).
[137] *Id.* at 173.
[138] *Id.*
[139] ASSESSMENT, *supra* note 44, at 77.
[140] *Id.* at 58.
[141] *Id.* at 77–78.
[142] *Id.* at 77.

2. The Essential Problem with Domestic Regulations

Of course, other space-using countries have their own national laws regarding the use of orbit and orbital debris.[143] But the domestic efforts from any one nation, including the United States, cannot be effective in dealing with an environment that so many nations impact. Space travel is inherently international,[144] as the international community made clear in response to the Bogotá Eight.[145] The Bogotá Eight was a group of eight South and Central American countries who attempted to claim sovereign rights over GEO slots directly above their nations.[146] These nations released the Bogotá Declaration of 1976, which asserted that any nation wishing to place a satellite in one of these GEO slots must get the permission of the Bogotá Declaration nation over which the slot lay.[147] The Outer Space Legal Subcommittee found "that claims of sovereignty over the [GEO] or any other part of outer space are incompatible with the express and implied spirit of the Outer Space Treaty and should be dismissed."[148] International law has dominated in orbit,[149] and the consensus seems to be that it should continue to do so.

Whether an "orbital slot" is above a particular nation in GEO is indeterminable because objects in orbit move, collide, and interact with one another. A nation cannot put an object into space without at least a possibility that it could come into contact with an object from another nation. Even if one nation is able to limit its creation of orbital debris, that is a drop in the bucket. In a world where Chinese satellite demolition tests create massive amounts of debris,[150] and where Russian and American

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[143] For a database of domestic laws from United Nations Member States, see *Browse Legislative Texts*, U.N. OFFICE FOR OUTER SPACE AFFAIRS, http://www.unoosa.org/oosaddb/browse_all_js.jsp?dims=COUNTRY_CODE (last visited Jan. 29, 2013).

[144] *See, e.g.*, Beck, *supra* note 5, at 30. "In an area that is inherently international in nature as outer space travel, it is unacceptable to expect domestic tort laws to control issues of liability and regulation over commercial spacecraft." *Id.* International space law has traditionally taken the stance that orbit, and beyond, is not something that can be owned or controlled by individual nations. "The exploration and use of outer space, including the moon and other celestial bodies, shall be carried out for the benefit and in the interests of all countries." OST, *supra* note 68, art. I. "*Recognizing* the common interest of all mankind in the progress of the exploration and use of outer space for peaceful purposes." ILD, *supra* note 69, Preamble (emphasis in original).

[145] *See* Nayebi, *supra* note 14, at 489.

[146] *Id.* at 488.

[147] *Id.*

[148] *Id.* at 489.

[149] *Id.* at 471–72.

[150] BAIOCCHI & WELSER, *supra* note 32, at 2.

satellites collide,[151] no nation can eliminate the problem of orbital debris on its own.

III. A PEPAT-BASED TREATY FOR REGULATING ORBIT

In looking for a new way to regulate and protect the unique environment of Earth orbit, there is no need to reinvent the wheel. The broad outlines of a viable alternative can be found in PEPAT, which has successfully organized the international community around a set of standards for protecting a massive, environmentally threatened area.[152]

A. Similarities Between Orbit and Antarctica

The environmental policy concerns surrounding Earth's orbit are similar to those surrounding the Antarctic. Both are large regions that have a connection to the well-being of other parts of Earth's environment, both experience competing claims from different nations, and both have governmental and non-governmental groups with economic or political investments.[153] Space law was defined by the Cold War, later international tension, and disagreement over a massive area to which many countries believe they have a right.[154] This is much like the diplomatic situation that created the Antarctic Treaty, the underlying structure of PEPAT.[155]

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[151] Pusey, *supra* note 2, at 430.

[152] For a recent overview of the effectiveness of PEPAT, see R. ROURA ET AL., ANTARCTIC TREATY CONSULTATIVE MEETING, THE ANTARCTIC ENVIRONMENTAL PROTOCOL, 1991–2011 (2011), *available at* http://asoc.org/storage/documents/Meetings/ATCM/XXXIV/The_Antarctic_Environmental_Protocol_1991-2011.pdf (explaining that although PEPAT has not had perfect results, the treaty is vast in scope and has only been in effect for fourteen years). The finding of the committee was that, "[o]n the whole, inspections reported progress in many aspects of implementing the Protocol since 1998—such as waste management—but it is apparent that some aspects are taking a long time to be implemented." *Id.* at 4. One of the primary goals of PEPAT was to block proposals from New Zealand that mining be allowed in Antarctica, and it is a positive sign of the effectiveness of this system that PEPAT's ban on mining is still respected. Mark Horstman, *Call to Strengthen Antarctic Mining Ban*, ABC SCI. (Oct. 4, 2011), http://www.abc.net.au/science/articles/2011/10/04/3332124.htm.

[153] Margaret S. Race, *Policies for Scientific Exploration and Environmental Protection: Comparison of the Antarctic and Outer Space Treaties*, *in* SCIENCE DIPLOMACY: ANTARCTICA, SCIENCE AND THE GOVERNANCE OF INTERNATIONAL SPACES 143, 144 (Paul A. Berkman et al. eds., 2011).

[154] *See id.*

[155] Donald Rothwell, *The Antarctic Treaty: 1961–1991 and Beyond*, 14 SIDNEY L. REV. 62, 62 (1992) ("By the late 1940s sovereignty claims in Antarctica had been asserted by Argentina, Australia, Chile, France, New Zealand, Norway and the United Kingdom. . . . With the two

B. Brief Outline of PEPAT

PEPAT exists under the overarching Antarctic Treaty System ("ATS").[156] This system came into being with the Antarctic Treaty, which was ratified in June of 1961.[157] The countries which initially ratified ATS were the twelve that were "then active in Antarctic science."[158] There are currently forty-six nations under the Antarctic Treaty, which accounts for approximately eighty percent of the world's population.[159] These countries meet annually to decide the rules that govern the Antarctic, and have created three currently used international agreements, including PEPAT.[160]

PEPAT was largely the result of the efforts of Australia, France, Italy, and Belgium to create an international agreement that would provide environmental protection in Antarctica.[161] Although PEPAT was agreed to in 1991, it did not come into effect until 1998,[162] a subject which will be returned to in Part III.E.2.

Unlike the regulations on space, as one commentator noted before the treaty was ratified, "PEPAT is a legally binding instrument: once it enters into force there are no more uncertainties about its legal status."[163] PEPAT's basic goal, as outlined in the treaty, is that "activities in the Antarctic Treaty area shall be planned and conducted so as to limit adverse impacts on the Antarctic environment and dependent and associated ecosystems."[164] In furtherance of this goal, PEPAT requires that parties

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major Cold War protagonists, the United States and Soviet Union, having substantial historical and scientific interests in Antarctica . . . there was a growing fear that Antarctic sovereignty and the strategic and scientific importance of the continent could result in a conflict which would result in the world's greatest natural laboratory being permanently damaged.").

[156] *The Antarctic Treaty—Background Information*, NATURAL ENV'T RESEARCH COUNCIL, http://www.antarctica.ac.uk/about_antarctica/geopolitical/treaty/index.php (last visited Jan. 29, 2013).

[157] *Id.*

[158] *Id.*

[159] *Id.*

[160] *Id.* The other two agreements are the Convention for the Conservation of Antarctic Seals (1972) and the Convention on the Conservation of Antarctic Marine Living Resources (1980). *Id.*

[161] Australian Antarctic Div., *The Treaty: An Historical Outline*, AUSTRALIAN GOV'T, http://www.antarctica.gov.au/antarctic-law-and-treaty/our-treaty-obligations/history (last visited Jan. 29, 2013).

[162] *Id.*

[163] Laura Pineschi, *The Madrid Protocol on the Protection of the Antarctic Environment and its Effectiveness*, *in* INTERNATIONAL LAW FOR ANTARCTICA 263 (Francesco Francioni & Tullio Scovazzi eds., 1996).

[164] Protocol on Environmental Protection to the Antarctic Treaty, art. 3(2)(a), Oct. 4, 1991, 30 I.L.M. 1455 [hereinafter PEPAT].

to the treaty conduct environmental impact studies.[165] This requirement applies to governmental and non-governmental activities.[166]

C. PEPAT's Structure and Effective Regulation of Orbit

1. Different Parties at Different Levels

Although PEPAT only officially recognizes States as parties, it does acknowledge the activities of nations and private parties,[167] which is an important consideration for orbit. Current international regulations are largely focused on nation states, rather than private corporations,[168] despite the fact that private corporate action in space is a growing issue.[169] PEPAT organizes parties to the treaty on two levels: there are Consultative Parties and there are Observers.[170] While all parties participate in discussions and attend meetings, only the Consultative Parties vote on passing regulations.[171] Consultative Parties are those who have sufficient involvement in Antarctica.[172] This is yet another situation in which Antarctica is like orbit—it is a region which every nation on Earth has a relevant interest in, yet only a handful of countries and private parties actually have a physical presence there. Should a dispute arise between any two parties, there are dispute settlement procedures, which are further discussed in Part III.C.2.

These PEPAT provisions would be a useful tool to import into an orbital environmental protocol. Parties actively sending objects into orbit would be Consultative Parties, who could make decisions to amend the protocol, while any other party who wishes to sign on would be an Observer and unable to amend the protocol unless their status were changed. This would solve the current problem plaguing attempts to regulate space—which is that true international consensus on controversial environmental issues is next to impossible if every single country has equal say. This is part of the reason UNCOPUOS efforts to effectively regulate orbit through the treaties previously discussed have failed; it requires consensus from all

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[165] *Id.* art. 8.
[166] *Id.* art. 8(2).
[167] *Id.* arts. 3(2), 15(1)(a).
[168] *See, e.g.*, OST, *supra* note 68, art. VI ("States Parties to the Treaty shall bear international responsibility for national activities in outer space . . . whether such activities are carried on by governmental agencies or by non-governmental entities.").
[169] Beck, *supra* note 5, at 1.
[170] Sattler, *supra* note 90, at 32.
[171] *Id.*
[172] *Id.*

participating nations to address the problem of orbital debris.[173] The ATS, on the other hand, "has successfully squelched potential territorial disputes, ensured the peaceful use of the area, encouraged the proliferation of scientific research, and made strides in protecting the fragile environment."[174]

By following the PEPAT example and breaking away from the extreme view in which all nations get equal say in how space is used, whether or not they are using it,[175] the international community can become an effective, active decision-making body in how it regulates orbit. Overhauling the rules for orbit to enforce reducing the creation of orbital debris and laying the groundwork for removing orbital debris will be a feasible project if the body attempting this project has input from all interested nations, but vests its power in those who are actually putting things into orbit.

2. Settlement of Disputes

Unlike current regulations, PEPAT requires mandatory dispute settlement.[176] PEPAT allows parties to choose the International Court of Justice ("ICJ") by consensus, with an alternative Arbitral Tribunal as the default choice.[177] Such flexibility is essential for dealing with parties that do not always recognize the ICJ, like the United States.[178] The Outer Space Treaty only asks for "international cooperation and consultation,"[179] and the Liability Convention's only addition to this is that if the parties involved do not have diplomatic channels, the dispute may be presented to the U.N. Secretary General or third party states.[180] Without enforcement, environmental impact studies are useless.[181]

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[173] Balsamello, *supra* note 88, at 1786–87.
[174] Lynn M. Fountain, *Creating Momentum in Space: Ending the Paralysis Produced by the "Common Heritage of Mankind" Doctrine*, 35 CONN. L. REV. 1753, 1771 (2003).
[175] OST, *supra* note 68, art. I.
[176] PEPAT, *supra* note 164, art. 18.
[177] *Id.* art. 19.
[178] Sean Murphy, *The United States and the International Court of Justice: Coping with Antinomies*, *in* THE SWORD AND THE SCALES: THE UNITED STATES AND INTERNATIONAL COURTS AND TRIBUNALS 46, 46 (Cesare Romano ed., 2009) ("[T]he United States has never been willing to submit itself to the plenary authority of the [International Court of Justice], and has typically reacted negatively to decisions by the Court that are adverse to U.S. interests. . . . [The U.S.] withdrew from the Court's compulsory jurisdiction in 1986, and recently terminated its acceptance of the Court's jurisdiction.").
[179] Balsamello, *supra* note 88, at 1787.
[180] *Id.* at 1788.
[181] *See* TAYLOR, *supra* note 8, at 91 ("In order for an environmental impact analysis to have any meaning, there must be an enforcement mechanism, otherwise it is self-policing and will be ineffective.").

Moreover, neither the OST nor the ILD properly addresses how to punish a violating party for environmental damage that does not directly harm a particular party. The arbitration system of PEPAT, however, addresses these concerns. Having a real regulatory system would give international space law some teeth, and create a system which can enforce its regulations.[182]

D. Aspects of PEPAT That Will Translate Well to Orbit

The stated concerns of PEPAT have equivalents for orbit. The focuses of PEPAT are essentially the same as the needed focus in orbit. For instance, PEPAT is concerned with intrinsic natural beauty[183] and scientific research,[184] which can both be translated into the issues of astronomical blinding and scientific research in orbit.

1. The PEPAT Model and Orbital Debris

a. Tracking and Identifying Debris for Removal

Provisions requiring parties to take charge of waste, like the one contained in PEPAT,[185] would dovetail well with existing programs to track debris. The waste provision could be adapted to require parties to "claim" all waste, and any unclaimed debris would then be removable by any nation. This would circumvent the Liability Convention, which implies that debris may not be removed unless the party who "owns" it has consented.[186]

PEPAT requires parties to clean up all waste from activities in Antarctica.[187] This is a rule that could be directly translated to activities in orbit, once the technology for removing such debris is sufficiently developed. Merely mitigating the creation of debris is not enough; orbital debris must someday be actively removed.[188] While the technology does not currently exist to remove orbital debris,[189] a PEPAT-based treaty could be designed so that when this technology is developed, the treaty will work

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[182] DUNSTAN & WERB, *supra* note 120, at 5 (explaining that many states do not routinely follow the Registration Convention).
[183] PEPAT, *supra* note 164, art. 3(1).
[184] *Id.*
[185] *Id.* Annex III.
[186] OST, *supra* note 68, art. VIII.
[187] PEPAT, *supra* note 164, Annex III.
[188] *See supra* Part I.B.2.
[189] TAYLOR, *supra* note 8, at 79–80.

as a legal framework for the effort to remove the debris, rather than being a roadblock like current international space law.[190]

b. Mitigating Debris Creation

Under PEPAT, all parties must create environmental impact assessments before engaging in major activities in Antarctica.[191] Those studies are then inspected by members of PEPAT and the organizing body, which determine the appropriateness of the action.[192] For a PEPAT-based treaty, environmental impact studies would require parties to determine the potential harm of launching a space object, including potential debris creation and the plan for retiring the satellite from orbit at the end of its operating lifetime.

PEPAT members have the right to inspect one another's facilities.[193] For the new protocol, this would involve both inspections of launch sites and materials, and the use of existing debris tracking systems. Under PEPAT, nations regularly make use of their right of inspection, so if similar powers and attitudes are enforced in relation to activities in orbit, the international community would become self-policing.[194] In conjunction with dispute settlement procedures,[195] this would solve one of the major problems with the current system of space treaties: the lack of enforcement mechanisms.[196] Rather than merely requesting states to register objects or trying to deal with the later liability problems, a PEPAT-based treaty would work from the beginning of orbital projects, with states monitoring one another from the outset with the power to challenge any party that does not comply with the treaty.

c. Liability for Environmental Damage

The current orbital regulations regarding liability are woefully inadequate because they established a standard of fault-based liability

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[190] *Supra* Part II.A.1.a (discussing how the OST is a roadblock to removing orbital debris).
[191] PEPAT, *supra* note 164, art. 8.
[192] *Id.* Annex I, art. 3.
[193] Australian Antarctic Div., *Inspections Under the Antarctic Treaty and Its Protocol on Environmental Protection*, AUSTRALIAN GOV'T, http://www.antarctica.gov.au/antarctic-law-and-treaty/treaty-inspections (last modified July 14, 2005).
[194] *See id.* Since 1963, Australia has used its rights for inspection eight times, with two of those inspections occurring within the past few years. *Id.*
[195] *See supra* Part III.C.2.
[196] *See* Pusey, *supra* note 2, at 434.

that does not take into account environmental damage.[197] Under the proposed system, the rules for liability could follow PEPAT's environmentally minded, practical structure. As under PEPAT, there could be three layers of responsibility in avoiding environmental damage liability: the duty to take preventative measures to avoid environmental damage, the duty to establish a contingency plan should environmentally adverse incidents occur, and the duty to take response action to environmental emergencies.[198] Further, as in PEPAT, liability would exist for *environmental* damage, and the liability would be strict, with multiple parties held jointly and severally liable.[199] This system would require measures for preventing environmental damage in the first place. Furthermore, should environmental damage occur, it would establish a system for dealing with it, both in a physical sense (as technology improves, removing orbital debris) and in an economic sense. These rules would make the economic risk of environmental damage a true impetus for actors in space to pursue environmentally sound policy.

2. PEPAT and Tourism

One booming industry in Antarctica is tourism,[200] and this is also an emerging issue in space.[201] There are now private companies launching reusable manned spacecraft,[202] and as technology improves, the possibilities for space tourism will only increase. As Brian Beck said after noting that existing regulations of orbit do not in any way regulate tourism, "[t]he treaty regime cannot accommodate a booming private space flight industry, the emerging space tourism market."[203]

For Antarctica, PEPAT has strictly limited commercial development in some areas (e.g., mining), while continuing to allow it in others (such as

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[197] *See supra* Part II.A.2.a.
[198] PEPAT, *supra* note 164, Annex VI, arts. 3–5.
[199] *Id.* Annex VI, art. 6.
[200] *Human Impacts on Antarctica and Threats to the Environment—Tourism*, COOL ANTARCTICA, http://www.coolantarctica.com/Antarctica%20fact%20file/science/threats_tourism.htm (last visited Jan. 29, 2013).
[201] John Adolph, *The Recent Boom in Private Space Development and the Necessity of an International Framework Embracing Private Property Rights to Encourage Investment*, 40 INT'L LAW. 961, 962 (2006) ("Until recently, the idea of private citizens in space existed only in the imaginations of science fiction writers. Today, entrepreneurs form companies and organizations to develop space business opportunities ranging from satellite deployment to tourism to space mining.").
[202] *Id.* at 975.
[203] Beck, *supra* note 5, at 4.

tourism).[204] The treaty has attempted to regulate how commercial development progresses, as well as international attitudes towards the development of the Antarctic. This must be done in orbit as well. The new orbital regulations should look to how PEPAT directly addresses tourism, unlike any of the current space regulations. As in PEPAT, the tourism industry could be included as something that parties must submit environmental impact reports on.[205] The proposed system will also include private companies as parties.[206] Therefore, environmental protocols dealing with tourism will be more effective under the proposed system, since this system will directly address private tourism companies.

E. Significantly Amending Some Aspects of PEPAT for Orbit

1. Articles That Strictly Ban Activities

Some articles from PEPAT need to be substantially altered to better fit the environment in question, or left out altogether. The Antarctic is home to a complex ecosystem of plants and animals, but the only living creatures in orbit are the ones that we put up there. All parts of the PEPAT regulations that deal with flora, fauna, mining and the ocean are inapplicable, or should be significantly altered.

For instance, under PEPAT, zones within Antarctica can be "designated as an Antarctic Specially Protected Area or an Antarctic Specially Managed Area. Activities in those Areas shall be prohibited, restricted or managed in accordance with Management Plans."[207] Specially Protected Areas ("SPAs") under PEPAT are normally given more protections, as they are often the "only known habitat of any species"[208] or "examples of outstanding geological, glaciological or geomorphological features,"[209] or other such zones which are especially valuable or delicate. Orbit is less fragile than the Antarctic, because it has no wildlife. Orbital protocol should therefore be less strict and friendlier to commercial interests, like telecommunications, and therefore the idea of SPAs should be inversed for orbit.

SPAs under the proposed treaty would essentially be a photo negative of those in PEPAT. The most immediate concern for modern nations

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[204] PEPAT, *supra* note 164, art. 7; *id.* Annex III, art. 1.
[205] *Id.* art. 3(4).
[206] *See infra* Part III.E.2.
[207] *Id.* Annex V, art. 2.
[208] *Id.* art. 3(2)(d).
[209] *Id.* art. 3(2)(f).

is the highly in-demand zone that is GEO. This part of orbit could be a kind of SPA under the proposed system. Rather than having smaller zones with more restrictions as in PEPAT, GEO would be a smaller zone within the given area with *fewer* restrictions. The heavy use of GEO is the only way to support modern telecommunications, and so environmental concerns will need to be a bit more relaxed for modern society to function and for states and private companies to willingly sign on to the treaty. The debris mitigation standards of the ITU may even be used by the new treaty for GEO only.[210]

2. Structural and Enforcement Concerns

It took PEPAT seven years from when it was first written to actually come into force, and the nations that signed on earlier had no obligations under PEPAT until it was ratified.[211] Orbital debris is an increasing environmental danger,[212] and action should be taken sooner, rather than later, to avoid another incident like China's disastrous attempt to "retire" a satellite.[213] Therefore, while PEPAT *allowed* for provisional application by signing members before it was ratified,[214] this orbital environmental protocol could *require* signatories to independently implement the protocol to the extent feasible until its entry into force. This would promote environmental action even while the regulations were being set up. Such a system would be a double-edged sword, however. The upside is that it might help to improve the mitigation of the creation of orbital debris as soon as possible. The downside is that mandatory enforcement from the signing date could scare off parties who might otherwise be willing to sign on.[215]

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[210] *See* Nayebi, *supra* note 14, at 4–5.
[211] R. ROURA ET AL., *supra* note 152, at 3.
[212] *See supra* Part I.B.1.
[213] *Supra* Part I.B.2.
[214] Pineschi, *supra* note 163, at 265–66.
[215] There will be a number of practical concerns related to creating a new international system for this proposed treaty. Although the practical political maneuvering that will be necessary is beyond the scope of this note, that it is possible can be seen by the fact that such things have been done in the past. The ATS offers an example of a large, international treaty regime developed to regulate an area under competing territorial claims. Barbara Heim, *Exploring the Last Frontiers for Mineral Resources: A Comparison of International Law Regarding the Deep Seabed, Outer Space and Antarctica*, 23 VAND. J. TRANSNAT'L L. 819, 839 (1990). PEPAT itself, while not a free-standing system, shows that environmentally focused, international protocols can be created in the modern world. R. ROURA ET AL., *supra* note 152, at 3.

There are three major structural differences between PEPAT and an ideal treaty regulating orbit. One issue is that PEPAT exists as a subset of a larger treaty system, the ATS, and the proposed orbit treaty would be free standing. This means that the proposed treaty would have to be more extensive than PEPAT, because it would be establishing the protocol not just for reporting to some greater treaty body, but for running its own internal system for oversight, meetings, amending the protocol, etc.

Another structural concern is that the Committee for Environmental Protection ("CEP") for PEPAT is purely advisory.[216] CEP is designed to advise parties on their environmental protection measures on issues such as "the effectiveness of measures taken pursuant to this Protocol"[217] and "the need to update, strengthen or otherwise improve such measures."[218] This advisory function would still be part of the role of the proposed committee, but not the only role. As a free-standing treaty, a similar committee for orbit could have a more active power to control how debris is removed from orbit and how members mitigate debris creation.

While less state-centric than the extant orbital regulations, PEPAT is still generally aimed at nations, not private companies. PEPAT is enforced against non-governmental activities,[219] but it still discusses "State" actors.[220] The proposed treaty should allow for private companies to sign on as parties to the treaty, bound to its regulations in the same way that state parties would be. This would ensure that companies involved in space travel do not get away with activities that nations could not, particularly companies that are internationally based, and therefore difficult to regulate through the actions of any single state.

Current orbital regulations are lacking two important things: environmental focus and teeth. A free standing system which is modeled on the effective and environmentally sound aspects of PEPAT, while taking a stronger stance on certain issues, such as holding private corporations environmentally accountable, is a solution to both of these problems.

CONCLUSION

Space is big, so big that it is hard to comprehend. But there was a point in human history when Earth seemed just as huge and infinite.

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[216] PEPAT, *supra* note 164, art. 12.
[217] *Id.* art. 12(a).
[218] *Id.* art. 12(b).
[219] *Id.* art. 15(a).
[220] *Id.* art. 21.

Before modern communication networks and transportation, for an average person, a nation on the other side of the world may as well have been on another planet. Now we travel, trade, and communicate with people the world over, and we have become aware of Earth as an interconnected environmental system.[221] Earth has shrunk as human perception has grown, and that expanding perception must take into account the space directly surrounding our planet. Earth's orbit is part of its environment, a part that has become terribly polluted.[222] The international community needs to shift its focus in regulating orbit to take environmental concerns into account. A new protocol is needed, and PEPAT offers a well-suited model for a new regulatory system. By investing the international community's efforts on creating a new, PEPAT-based system, the disaster of orbital debris can be confronted, mitigated, and, as technology improves, cleaned up.

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[221] Alan Sitkin & Nick Bowen, *International Business—Extension Material*, *in* INTERNATIONAL BUSINESS: CHALLENGES AND CHOICES, *available at* http://www.oup.com/uk/orc/bin/9780199533916/01student/exmaterial/page_74.htm.
[222] Amos, *supra* note 24.