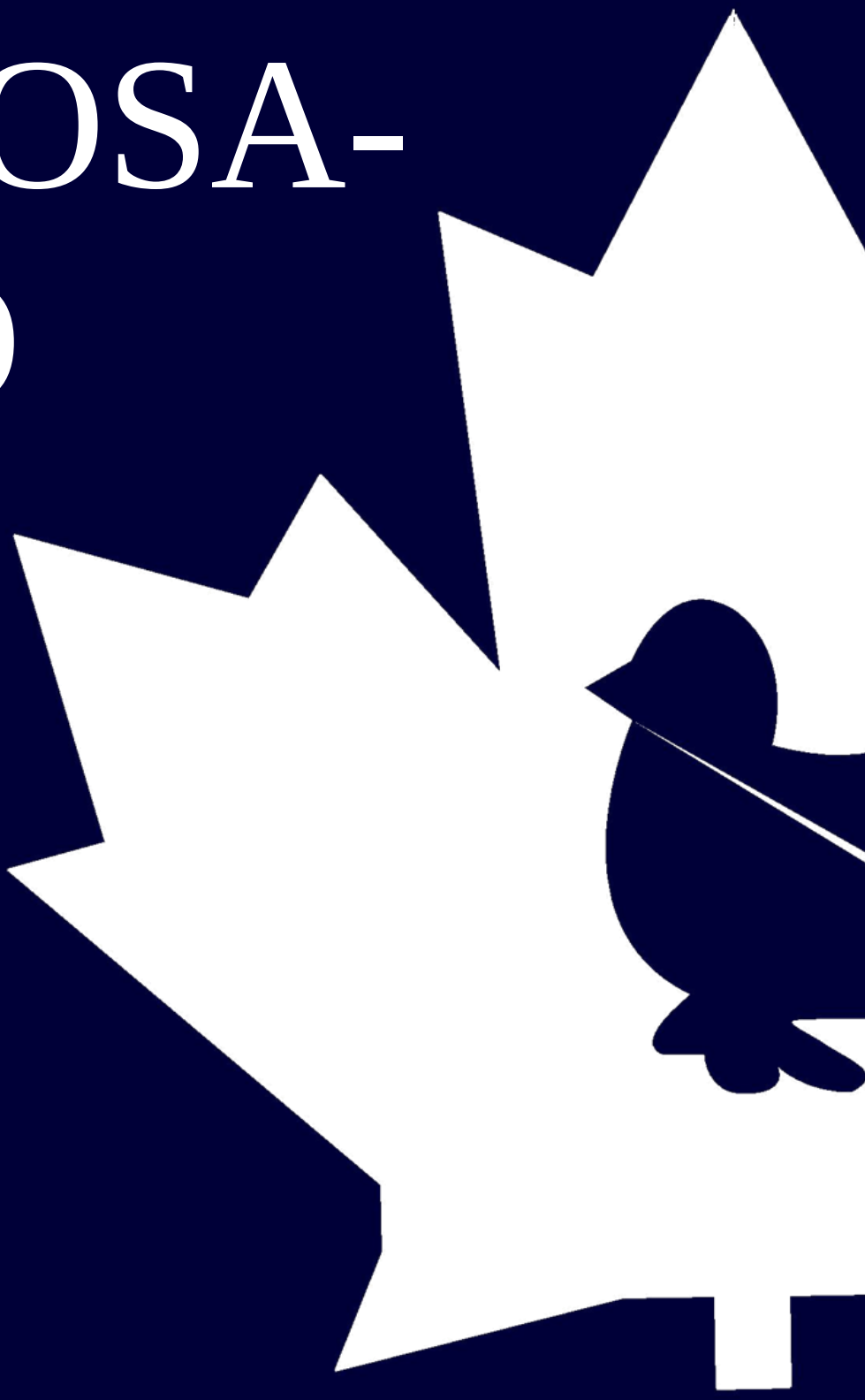
SECONDARY SCHOOLS' UNITED NATIONS SYMPOSIUM 2016

UNOOSA-ICAO



Chairs:
Samer Salameh
Nicholas D'Ascanio

Vice Chairs:
Julia Yingling
Hena Guha
Jacklyn Chan

NOVEMBER 10-13, 2016 | MONTRÉAL, QUÉBEC

Dear esteemed delegates,

Hello and welcome to the UNOOSA-ICAO Joint Session Committee at SSUNS 2016! Our names are **Nicholas D'Ascanio** and **Samer Salameh**, and it is our distinct honour to co-chair this exciting committee. Allow us to introduce ourselves individually:

Samer Salameh

Born in Canada and raised in Beirut, Lebanon, I am in my final year pursuing a Neuroscience major and an Economics minor with the goal of getting into medical school. As an avid follower of politics and international relations, Model United Nations has been a passion of mine since I started high school. I have participated in several conferences as a delegate, and chaired previously in both McMUN (our university conference) and SSUNS. Without needing to think twice, I can emphatically say that my all-time favorite spacecraft is none other than the Millenium Falcon from the *Star Wars* franchise.

Nicholas D'Ascanio

I hail from the sleepy town of London, Ontario, and am captivated by geopolitics, diplomacy, and international organisations. I'm in my fourth year here at McGill studying History and Political Science. I've been doing Model UN since high school. At McGill, I've chaired, vice-chaired, committee directed, went on a delegation trip in 2014, and was on the Secretariat for SSUNS 2014. I'll also be chairing for McMUN 2017 later this year. Ever since I was a wee lad, I've been obsessed with outer space. My favourite spaceship would have to be the *Discovery One* from 2001: A Space Odyssey. For me, this committee

is the perfect marriage between my interests in international politics and my obsession with all things extraterrestrial.

We are fortunate to be joined at the front of the room by our team of three brilliant Vice-Chairs, who have worked around the clock to draft the excellent background guide which you will now have the pleasure of reading. ***Julia Yingling*** is a third year Political Science Honours student from Connecticut who is minoring in Russian and International Development studies. When asked about her favorite spacecraft, Julia chose the Starship Enterprise from the *Star Trek* franchise as the one she prefers. Hailing from Hong Kong, ***Jacklyn Chan*** is entering her final year as a Joint Honours student in Philosophy and Political Science. When asked the same question, Jacklyn chose *Dragon*, a transporting spacecraft developed by *SpaceX*. Last but not least, ***Hena Guha*** is a second year Political Science Honours student with a double minor in Philosophy and English Literature. Born in Toronto, Ontario and raised in Moscow, Russia, Hena will have you know that her all-time favorite spacecraft is *Sputnik 2* (she even named her dog after the first animal to be launched into orbit: *Laika*!).

Air and space law is one of the hidden gems of international relations. There are no nations in space, and yet the interests of countries, corporations, and people are always at play. Advances in technology have paved the way for new endeavours such as asteroid mining and space tourism. At the same time, much of our life on Earth depends on the fair and efficient regulation of space. The modern world, from cell phones to the internet to GPS, depends on space infrastructure. The United Nations Office for Outer Space Agency

(UNOOSA) works to ensure that the existing laws that regulate the use of outer space are enforced to ensure that outer space stays "the common heritage of mankind." The International Civil Aviation Organization (ICAO) has also come intro increased prominence over the past few years. Air travel has become ubiquitous in the modern world. This has brought new challenges for the regulation of the civil aviation world. The disappearance of the Malaysian Airlines Flight MH370 is just one example of a high profile civil aviation issue the ICAO has had to grapple with.

We are lucky that the ICAO is headquartered right here in Montreal. We are even luckier that they have graciously allowed us to use their facilities for our committee. We will be spending at least one committee session in the actual ICAO building, debating in the same place where these debates have really happened. This is an amazing opportunity and we know you delegates will rise to the occasion.

Contrary to popular belief, being the best delegate has nothing to do with the number of draft resolutions you write or the number of times you raise your placard. Leadership and public speaking are essential, but a great delegate must also exemplify the spirit of MUN through *diplomacy* and *cooperation*. Furthermore, a great delegate must *stay in character*. In other words, be thorough in your research, understand your character's policies, and display a solid commitment towards those policies. I would also urge delegates to not rely solely on the background guide in order to achieve an optimal level of preparation. After all, we will be looking for speeches and draft resolutions that contain *substance* as well as style. As for my last piece of advice: dazzle us! This committee has a

large number of delegates, and it will be difficult to stand out. If you impress us, then we will certainly remember you!

We are eagerly waiting for SSUNS 2016 to begin so that we can meet all of you and enjoy this unique experience together. In the meantime, feel free to reach us on our committee email if you have any questions or concerns. Best of luck and see you soon!

Regards,

Samer Salameh and Nicholas D'Ascanio

Topic 1: The Environment and Space Activity

Introduction

Space exploration has continued to be considered a grey area in terms of laws and expectations. The fact that outer space is owned by no one specifically- but the human race as a whole, has proved to be cause a large dilemma when it comes to the environment. As human kind we are expected to not over-pollute the universe that we live in. Nevertheless, when making such an ambiguous statement, one must consider what truly defines 'destroying'. What is the difference between space exploration and space pollution? Where does the line begin? Who gets to draw this line? Who enforces it? As the concept of exploring outer space is an immensely new concept, it comes with many environmental questions to consider. Many of which will require a firm understanding of foreign and domestic policy. The impact of how outer space is used by man will decide under which circumstances generations after us will live.

UNISPACE

Ever since the commencement of Sputnik I in 1957, the United Nations has delegated immense importance to the advocacy of global participation in outer space. The benefits of space technology for socioeconomic development had become known all around the world. Obtaining this development required international cooperation in outer space. This cooperation was catalyzed by the United Nations- which created the

UNISPACE Conferences. These gatherings presented a platform on which a global dialogue on important issues related to space exploration and misuse, took place.

UNISPACE I was held for two weeks in August of 1968 and was the first of three global conferences on outer space. In addition to other concerns, the conference recommended the establishment of the UNOOSA Programme on Space Applications in 1971. This program enforced training and workshops using space technology in areas such as environmental monitoring, weather forecasting, geology, and agricultural and forestry development. UNISPACE II was held in 1982 and brought attention to concerns of how to prevent a global arms race in outer space. During a time period which had what seemed like exponential progress in space exploration and technology, UNISPACE III, held in 1999, created a framework for the peaceful uses of outer space in the 21st century. The conference was attended by 97 Member States, 9 UN specialized agencies and 15 international intergovernmental organizations. [1]

Figure 1: UNISPACE I

[1] Garcia-Yarnoz, Daniel. "Environment and Natural Resource: Work and Achievements." United Nations Office of Outer Space. Accessed September 05, 2016. http://www.unoosa.org/oosa/en/ourwork/psa/emnrm/index.html.

2018 will be the year that marks the 50th anniversary of the first UNISPACE conference on the Exploration and Peaceful Uses of Outer Space. It represents the efforts for a collective space community in providing guidance in the development of outer space activities and interactions. The next conference will be focused on 'space as a driver for socio-economic sustainable development'[2]. These conferences have provided a platform for global dialogue in issues related to commercial space activity and space exploration. Delegates should keep in mind the development concerns for the four main pillars of the conference[3]:

- Space Economy: space for the development of the economy
- Space Society: evolution of society and societal benefits stemming from space-related activities
- Space Accessibility: strengthening of national space infrastructures and capacity building
- Space Diplomacy: building partnerships and strengthening international cooperation in space activities

The UN accords a significant importance to the promotion of greater international collaboration in outer space. UNOOSA and UNISPACE will work together to advance these areas of the space industry in a sustainable and peaceful way. They rely on key corporate members in the industry, as well as government and international support. There,

[2] "UNISPACE+50," *UNOOSA*, 2016 http://www.unoosa.org/oosa/en/ourwork/unispaceplus50/index.html
[3] Ibid.

agreements can be made regarding space activity and conduct, as well as on trade partnerships and ventures.

Outer Space Treaty

The creation of the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies (unofficially known as the Outer Space Treaty) is a treaty that is considered to be the foundation of international space law. In 1967, the treaty was opened for signature in the United States, Soviet Union, and United Kingdom. The treaty clearly declares that no government may claim a celestial resource such as the Moon or any planets, and declares that they are the 'common heritage of mankind'. However, the state that launches a space object has jurisdiction and control over said object. In addition, this treaty ensures that the state is also liable for damages in space caused by this object[4].

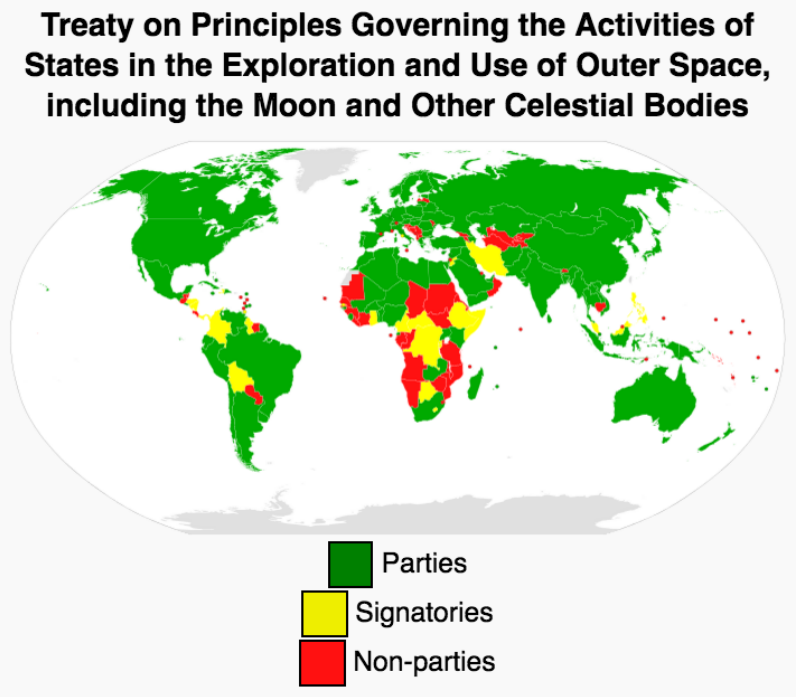


Figure 1: Global Overview of Status of Outer Space Treaty

[4] "Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies." Bureau of Public Affairs. Accessed September 05, 2016.

Even though the treaty had legitimate solutions to many intense issues, it was not a thorough resolution that contend3ed with all existing and perceptible aspects of space activities, nor did it include explanations of basic terms that were being used in the treaty. For example, terms like “exploration and use of outer space” and “orbit around the Earth” went undefined. Although efforts are being made to create treaties to protect outer space, it is important to note that for action to be taken, further detail and depth is required in these international agreements.[5]

Space Debris

Over 500,000 pieces of debris are monitored as they orbit the Earth. Most, if not all, travel at speeds up to 30,000 km/h – fast enough for to impair a satellite or a spacecraft.

The increasing population of debris is seen as a potential harm to all space vehicles but especially to the International Space Station and any spacecraft with humans aboard. NASA considers this issue to be of high urgency and therefore has a set of guidelines stating how to deal with a potential collision threat. These guidelines are part of a larger set of decision-making aids known as the flight rules. They specify when the anticipated proximity of a piece of debris escalates the probability of a collision enough such that evasive actions are required, and any other precautionary measures that need to be taken to assure that the safety of those involved is secured.

[5] "Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies." Bureau of Public Affairs. Accessed September 05, 2016.

Space debris includes both artificial (man-made) and natural (meteor) particles. Meteors orbit the sun, while other artificial debris usually orbits around the Earth. Artificial orbital debris includes any man-made object that is orbiting the Earth which is considered to no longer serve as a useful purpose. According to NASA, there are more than 20,000 pieces of debris larger than a softball that are currently orbiting the Earth, with millions of other pieces so miniscule that they cannot be tracked. Even debris as small as a paint fleck can damage a spacecraft when travelling at these high velocities, and a number of space shuttles' windows have needed to be replaced due to the damage caused by them. NASA's Chief Scientist of orbital debris, Nicholas Johnson, claims that "the greatest risk to space missions comes from non-trackable debris".[6]

There is a long history of accidents occurring due to space debris. In 1996, a French satellite was hit and impaired due to the debris of a French rocket that had exploded a decade earlier. On February 10th, 2009, an inoperative Russian satellite collided with and destroyed an operational U.S Iridium commercial satellite. The crash added more than 2,000 pieces of trackable debris to the rest of the space junk. In 2007, China's anti-satellite test, which used a missile to demolish an old weather satellite, increased to problem of space debris by another 3,000 trackable pieces. The amount of space debris grows more and more each year, creating more and more risk for satellites, rockets, and astronauts.

[6] Garcia, Mark. "Space Debris and Human Spacecraft." NASA. July 26, 2016. Accessed September 05, 2016. http://www.nasa.gov/mission_pages/station/news/orbital_debris.html.

The US Department of Defence retains a highly precise register on objects in the Earth's orbit that are larger than the size of a softball. Collision risks are separated into two diverse categories depending on the size of threat[7]:

- Objects larger than 10 cm – conjunction assessments and collision avoidance maneuvers are required to counter them
- Objects between 10 cm and 1cm – these are usually too small to track if not too large to shield against

Debris avoidance maneuvers are held when the probability of collision reaches limits set in the space station flight rules. If the probability of a crash is greater than 1 in 100,000 then a maneuver will be conducted, as long as it does not result in significant impact to the mission's original objective. If the probability is higher than 1 in 10,000, a maneuver will be administered as long as no additional risk will be added for crew members. The maneuvers usually are small and occur from one to several hours prior to the time of the conjunction. Avoidance maneuvers with a shuttle can be planned and conducted in a few hours. That being said, these maneuvers with the space stations require a total of 30 hours of planning and execution mainly due to the fact that it necessitates the use of Russian thrusters or the propulsion systems on either the docked Russian or European spacecraft.

Based on explicit flight rules and exhaustive hazard analysis, NASA decides if a collision avoidance maneuver is needed. Nevertheless, despite its efforts of tracking the hazardous debris, it is difficult to presume that we are completely out of harm's way. It is

[7] Garcia, Mark. "Space Debris and Human Spacecraft." NASA. July 26, 2016. Accessed September 05, 2016. http://www.nasa.gov/mission_pages/station/news/orbital_debris.html.

important to recall that much of the space junk is hard to track and is therefore still considered to be a threat to extraterrestrial travel. [8]

Black Carbon

According to a study done by The Aerospace Corporation, if the industry of space transportation grows considerably in the upcoming years, either through an increase in space tourism or commercial space travel, emissions of black carbon (soot) from rocket launches could make a significant contribution to climate change.

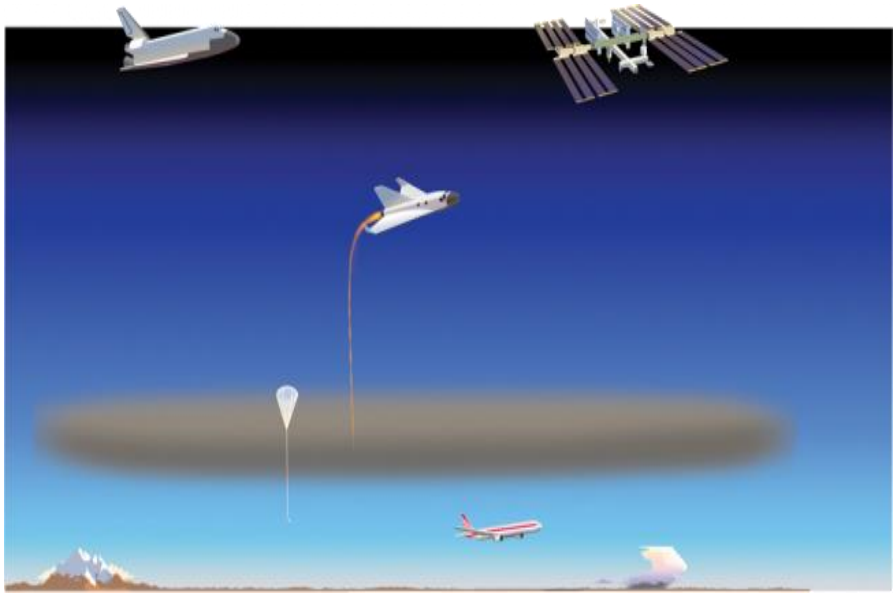


Figure 3: "A cloud of rocket soot may accumulate at about 25 miles over the Northern Hemisphere." (NASA)

Much like the way carbon dioxide and other greenhouse gases increase the overall temperature by absorbing the Earth's infrared light, black carbon particles absorb the sun's light[9], thereby increasing solar heating in the atmosphere. More thermal energy from particles heated by

[8] Garcia, Mark. "Space Debris and Human Spacecraft." NASA. July 26, 2016. Accessed September 05, 2016. http://www.nasa.gov/mission_pages/station/news/orbital_debris.html.

the sun can alter the general circulation of the aerospace, thereby causing changes in regional temperature, the ozone layer, and other atmospheric indicators.

Black carbon particles are considered to play a significant role in global climate change, possibly second solely to carbon dioxide in increasing the heat of the atmosphere.

Between 2009 and 2013, a group of thirty-one atmospheric scientists studied black carbon and eventually published a detailed report published in the Journal of Geophysical Research. One of the questions they asked dealt with how much extra energy was being stored in the atmosphere because of black carbon. They concluded that number was 1.1 watts (per square meter of the Earth's surface). Although this may seem like a small amount, carbon dioxide has only a slightly higher amount (1.56 watts per square meter), which means that reducing soot may be a potent method of reducing the Earth's temperature.[10] It is thus possible to imagine that reducing black carbon emissions is something that the international community will find easier to get behind, as it is easier to regulate while still being a significant factor behind climate change.[11]

[10] Zimmer, Carl. "Black Carbon and Warming: It's Worse than We Thought." Environment 360. January 17, 2013. Accessed September 05, 2016.
[11] Garcia, Mark. "Space Debris and Human Spacecraft." NASA. July 26, 2016. Accessed September 05, 2016. http://www.nasa.gov/mission_pages/station/news/orbital_debris.html.

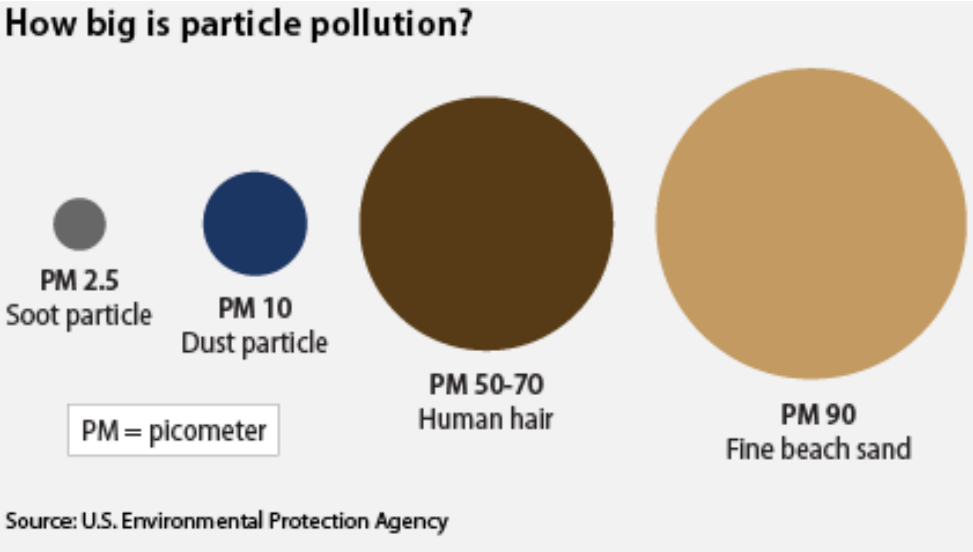


Figure 4: Scale of Various Particle Pollution

International Agreements:

Numerous international treaties have been instilled and aimed to protect the environment, including the 1987 Montreal Protocol on Substances That Deplete the Ozone Layer (Montreal Protocol), the 1979 Geneva Convention on Long-Range Trans-Boundary Air Pollution (the Air Pollution Conference), and the 1997 Kyoto Protocol to the United Nations Framework Convention on Climate Change (Kyoto Protocol).

When it comes to regulations, each space agency has its own set of policies. Under the China Environmental Protection Law for example, all institutions in China, including the launch industry, must enforce policies that promote environmental protections and must take effective measures to prevent and control environmental pollution.[12] As shown below, enforcement of these regulations as well as the treaties mentioned above are taken very

[12] Steeves Geoffrey. "EcoSpace Executive Summary." *EcoSpace Executive Summary*. Accessed September 05, 2016.

seriously. Furthermore, no nation has any jurisdiction in outer space, therefore any enforcement of statutes would have to be made upon international agreement. As stated in the Moon Treaty, the jurisdiction for all laws regarding extraterrestrial bodies are implemented by the international community. As a result, all activities must conform to international law including the United Nations Charter.[13]

Figure 5: Countries' Status on the Kyoto Protocol

Impacts

There are multiple societal benefits linked to new knowledge and technology from space exploration. Technologies created for the purpose of space exploration have added immense value to human life, and include everything from solar panels to water purification systems. Exploration will undeniably expand the resources that the Earth looks for in everyday life. It will continue to be a fundamental driver that opens up new sectors

[13] "Agreement Governing the Activities of States on the Moon and Other Celestial Bodies." United Nations Office for Outer Space Affairs. December 05, 1979. Accessed September 05, 2016.

of technology and science. This will give back to the Earth through new methods of power generation, recycling and waste management, and energy storage.[14] In addition, it is important to note that efforts are being made by NASA to find "habitable zones" in outer space, discoveries of which could lead to unimaginable changes in human civilization.[15] There are however many negative impacts from such exploration, with many of these attempts leading to further pollution of our environment as well as risking the lives of those involved in the mission.

Conclusion

In conclusion, it is important to recall both the negative and positive impacts of space activity to the environment. Outer space has brought the global community together to discover more about the universe we live in. Day-by-day, researchers from all over the world cooperate amongst each other to educate themselves and the public on what exactly lies beyond what we already know.

Questions to Consider

- **How do we regulate the resources required for the launch of rockets?**
- **What is "orbiting the earth" defined as and who gets to monitor/enforce it?**
- **What is the importance of a country having presence in outer space?**
- **In some foreseeable future space exploration will increase and many countries will have a footprint in outer space. How does this affect the power and influence countries have?**
- **How do we forge global consensus on regulating black carbon?**
- **How do we get rid of space debris orbiting our planet?**

[14] "Benefits Stemming from Space Exploration." International Space Exploration Coordination Group. September 2013. Accessed September 05, 2016.
[15] Phillips, Tony. "Earth-Size Planet Found In The 'Habitable Zone' of Another Star." NASA Science. April 17, 2014. Accessed September 05, 2016. http://science.nasa.gov/science-news/science-at-nasa/2014/17apr_firstearth/.

Bibliography

"Agreement Governing the Activities of States on the Moon and Other Celestial Bodies." United Nations Office for Outer Space Affairs. December 05, 1979. Accessed September 05, 2016.

"Benefits Stemming from Space Exploration." International Space Exploration Coordination Group. September 2013. Accessed September 05, 2016.

Garcia, Mark. "Space Debris and Human Spacecraft." NASA. July 26, 2016. Accessed September 05, 2016. http://www.nasa.gov/mission_pages/station/news/orbital_debris.html.

Garcia-Yarnoz, Daniel. "Environment and Natural Resource: Work and Achievements." United Nations Office of Outer Space. Accessed September 05, 2016. http://www.unoosa.org/oosa/en/ourwork/psa/emnrm/index.html.

Phillips, Tony. "Earth-Size Planet Found In The 'Habitable Zone' of Another Star." NASA Science. April 17, 2014. Accessed September 05, 2016. http://science.nasa.gov/science-news/science-at-nasa/2014/17apr_firstearth/.

Steeves, Geoffrey. "EcoSpace Executive Summary." *EcoSpace Executive Summary*. Accessed September 05, 2016.

"Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies." Bureau of Public Affairs. Accessed September 05, 2016.

Zimmer, Carl. "Black Carbon and Warming: It's Worse than We Thought." Environment 360. January 17, 2013. Accessed September 05, 2016.

Topic 2: The militarization of space and international law

Figure 6: Global Overview of Status of Outer Space Treaty

Introduction

For thousands of years, people have gazed up at the night sky and wondered what was there. Many dreamed up fantastic scenarios of war and fighting carried out in outer space. Indeed, a decades-spanning blockbuster movie series has been based on the very concept. But with technological advances and the extension of modern warfare, interstate conflict beyond the Earth's atmosphere is no longer a fantasy resigned to a long time ago in a galaxy far away. Indeed, the Gulf War is already considered the first 'space war.'[16] Although the conflict was fought on the Earth's surface, and not far above, the level of reliance the military had on space assets to enable their strategy, communications, cooperation, and targeting meant that the conflict would have been dramatically different without space-based connections.[17]

[16] Dale Stephens and Cassandra Steer, "Conflicts in Space: International Humanitarian Law and Its Application to Space Warfare," *McGill Annals of Air and Space Law* 40 (2015): 2, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2722315.
[17] Ibid.

The militarization of space is a current and pressing issue that must be tackled by international cooperation, or space will continue towards becoming a highly concerning and volatile military flashpoint. As military expands into space, we must both think of the direct consequences of militarization and weaponization and the difficulties of the laws that govern interactions in space. An understanding of what exactly militarization and weaponization are is important, as is an understanding of the potential consequences. There have been a number of steps taken by the international community to regulate space expansion; however, it is futile to try and stop it. Indeed, "space superiority is the future of warfare."[18] Now, it is up to the ICAO and UNOOSA to find ways for responsible militarization.

Militarization of space

Militarization is the broad process of organizing an environment, process, or group – in this case, outer space – in such a way to enable military conflict. The militarization of space has in fact been progressing since the earliest development and launching of satellites into orbit in the 1950s, during the space race of the Cold War.[19] This is because even peaceful communication satellites have military applications that count, therefore, towards militarization. Armed forces all around the world utilize satellites widely, for purposes ranging from the peaceful navigation of a warship into a new harbour, to locating an enemy

[18] Dale Stephens and Cassandra Steer, "Conflicts in Space: International Humanitarian Law and Its Application to Space Warfare," *McGill Annals of Air and Space Law* 40 (2015): 4, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2722315.
[19] Stratfor, "The Real Danger from Space Weapons," February 22, 2016, https://www.stratfor.com/sample/thank-you/analysis/real-danger-space-weapons.

target for a weapons launch.[20] Satellites provide weather information, communication links that enable real time command and early warning systems, GPS for navigation, and surveillance.[21] All of these functions allow militaries to act faster and more efficiently in both peace and wartime, without actually deploying anything beyond satellites – relatively low effort for significant returns.

The weaponization of space, on the other hand, would be active deployment of weapons into outer space, whether they are intended for points on the ground or other space-based targets. As of yet, outer space is not yet truly weaponized, as there are currently no dedicated weapons in orbit.[22] However, a variety of countries have begun to develop offensive technology in recent years, mostly under the pretext of developing missile defense systems.[23] A common excuse

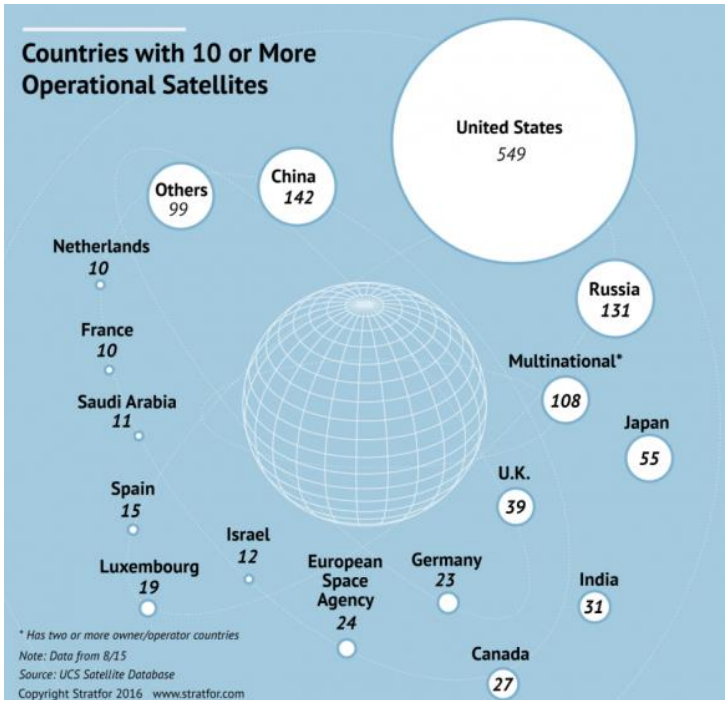


Figure 7 "The Real Danger from Space Weapons" (Source: Stratfor)

[20] Lee Billings, "War in Space May Be Closer Than Ever," *Scientific American*, August 10, 2015, http://www.scientificamerican.com/article/war-in-space-may-be-closer-than-ever/.
[21] Ibid.
[22] Stratfor, "The Real Danger from Space Weapons," February 22, 2016, https://www.stratfor.com/sample/thank-you/analysis/real-danger-space-weapons.
[23] Reaching Critical Will, "Outer Space: Militarization, weaponization, and the prevention of the arms race," http://www.reachingcriticalwill.org/resources/fact-sheets/critical-issues/5448-outer-space.

that the United States, China, and Russia have all cited is this exact defence.[24] The closest states have currently come to weaponization is anti-satellite technology.[25] Anti-satellite technology, or ASAT, can be done through many different techniques, from a full missile launch to simply something small enough to destabilize a satellite's orbit or jam its delicate transmission functions.[26] And although ASAT in itself is not deployed in space and is generally seen more as a method of deterring true space weaponization, they contribute to and may hide space defence programs.[27] Currently, China and the United States have functional ASAT programs, and Russia may be testing its own program under the guise of removing 'defective satellites'.[28]

The Challenges of Militarization

The technologies advancing the militarization and potential weaponization of space have come far in improving many aspects of civilian life. Satellites in particular are responsible for the internet, communications technology, and GPS – without them, we would not have many things, from accurate weather reports to Facebook. However, their military applications raise substantial concerns in a variety of areas, and the weaponization

[24] Reaching Critical Will, "Outer Space: Militarization, weaponization, and the prevention of the arms race," http://www.reachingcriticalwill.org/resources/fact-sheets/critical-issues/5448-outer-space.
[25] Ibid.
[26] Lee Billings, "War in Space May Be Closer Than Ever," *Scientific American*, August 10, 2015, http://www.scientificamerican.com/article/war-in-space-may-be-closer-than-ever/.
[27] Stratfor, "The Real Danger from Space Weapons," February 22, 2016, https://www.stratfor.com/sample/thank-you/analysis/real-danger-space-weapons.
[28] Lee Billings, "War in Space May Be Closer Than Ever," *Scientific American*, August 10, 2015, http://www.scientificamerican.com/article/war-in-space-may-be-closer-than-ever/.

of outer space is one of the most concerning issues facing the United Nations today for a wide variety of reasons.

First and foremost are concerns about power imbalances between different countries and the chance of a resulting arms race. The militarization of space has increased the United States' dominance in the military arena the most, and further weaponization risks furthering military imbalances between the United States and the rest of the world.[29] Due to its enormous expenditures on military technology, the United States is well positioned to increase its lead beyond other countries, as research and advances in emerging technologies with the potential to one-up satellites and current ASAT are highly expensive and require budgetary expenses that many other nations are unwilling to commit to.[30] However, as the United States pulls ahead in technology and expands on existing space power imbalances, countries such as China and Russia that have traditionally posed a threat to American military supremacy will seek to expand their own ASAT and space weaponry programs.[31]

These power imbalances result in countries such as China and Russia being concerned by the further military advantage of the United States and the threat it causes. As their concern grows, it is likely that these nations will start or continue developing their own space based systems in order to counter American military power – the more one

[29] "Outer Space: Militarization, weaponization, and the prevention of the arms race."
[30] Stratfor, "The Real Danger from Space Weapons," February 22, 2016, https://www.stratfor.com/sample/thank-you/analysis/real-danger-space-weapons.
[31] Lee Billings, "War in Space May Be Closer Than Ever," *Scientific American*, August 10, 2015, http://www.scientificamerican.com/article/war-in-space-may-be-closer-than-ever/.

nation puts into its space program, the more concerned others become and they more they will in turn invest in their own.[32] This results in a potential arms race, reminiscent of the Cold War arms race, which becomes a self-fulfilling prophecy of proliferation.[33] And though today, China and Russia are the only true challengers to American space hegemony,[34] the threat of an arms race only grows as more and more possible as countries globalize and become interconnected. The more countries become dependent on space-based technology for their day-to-day functions, the more sensitive they will be to potential threats to their space infrastructures.[35] Unfortunately, even if arms races do not eventually result in armed conflict, they are long, involved, difficult to end, and waste massive amounts of resources.[36]

Another major concern regarding the militarization and weaponization of outer space lies with the massive increase of space debris that would come with active warfare being carried out in orbit. Space debris is already an issue facing space exploration, and the strategic targeting of, for instance, satellites during a space war would create unprecedented amounts of debris that would result in a chain reaction of continued destruction and proliferation of debris.[37] The proliferation of space debris is concerning

[32] Stratfor, "The Real Danger from Space Weapons," February 22, 2016, https://www.stratfor.com/sample/thank-you/analysis/real-danger-space-weapons.
[33] Anup Shah, "Militarization and Weaponization of Outer Space," *Global Issues*, January 21, 2007, http://www.globalissues.org/article/69/militarization-and-weaponization-of-outer-space.
[34] Lee Billings, "War in Space May Be Closer Than Ever," *Scientific American*, August 10, 2015, http://www.scientificamerican.com/article/war-in-space-may-be-closer-than-ever/.."
[35] Stratfor, "The Real Danger from Space Weapons," February 22, 2016, https://www.stratfor.com/sample/thank-you/analysis/real-danger-space-weapons.
[36] "Outer Space: Militarization, weaponization, and the prevention of the arms race."
[37] Lee Billings, "War in Space May Be Closer Than Ever," *Scientific American*, August 10, 2015, http://www.scientificamerican.com/article/war-in-space-may-be-closer-than-ever/.

because it may very quickly make space nearly unusable for both civil and commercial space infrastructure, and would result in the destruction of important civilian technologies currently in orbit.[38]

Existing Guidelines and International Law

The international community has long been concerned about the development of space weapons and the militarization of space. Even at the height of the Cold War, the United States and Russia took steps in their own domestic policies to not target the other country's satellites, as they realized that they would all be worse off as a whole.[39] This recognition allowed the passage of the UN Outer Space Treaty with cooperation from the major powers in 1967.[40] The Outer Space Treaty's main goal is to ensure the reservation of space for peaceful uses – however, even non-aggressive military usage of space can be considered peaceful. Clearly, these are lofty goals that even today are not strictly being adhered to. However, they do provide an important basis for considering how to approach militarization.

Unfortunately, countries are not always eager to work together on specific issues, despite the general consensus of the international community. In 2000, the United Nations had an exceptional show of unity with the passage of a resolution called the "Prevention of

[38] Stratfor, "The Real Danger from Space Weapons," February 22, 2016, https://www.stratfor.com/sample/thank-you/analysis/real-danger-space-weapons.
[39] Lee Billings, "War in Space May Be Closer Than Ever," *Scientific American,* August 10, 2015, http://www.scientificamerican.com/article/war-in-space-may-be-closer-than-ever/.
[40] Anup Shah, "Militarization and Weaponization of Outer Space," *Global Issues,* January 21, 2007, http://www.globalissues.org/article/69/militarization-and-weaponization-of-outer-space.

Outer Space Arms Race," passed with 163 votes in favour and only three abstentions.[41] However, only four years later the UN voiced concerns during a General Assembly session that space was moving increasingly towards militarization, disregarding previous resolutions and treaties such as the Outer Space Treaty.[42] A lack of cooperation between nations is certainly one of the issues facing the international community as it tries to address militarization and weaponization. For instance, discussions on a code of conduct for spacefaring nations petered out in July of 2015 due to opposition from countries including Russia, and China, but also newer developing states such as India, Brazil, and South Africa.[43] At the same time, other UN resolutions pursued by Russia and China in particular that would ban space weapons were rejected by the United States on the grounds that it had unclear definitions and a lack of enforcement mechanisms.[44]

International Humanitarian Law in Space

International law is a body of law governing the relations between states; likewise, space law is a sub body of law governing the interactions between countries in space. Space law touches upon a wide variety of topics, including environmental protection, dispute

[41] Anup Shah, "Militarization and Weaponization of Outer Space," *Global Issues*, January 21, 2007, http://www.globalissues.org/article/69/militarization-and-weaponization-of-outer-space.
[42] Ibid.
[43] Lee Billings, "War in Space May Be Closer Than Ever," *Scientific American*, August 10, 2015, http://www.scientificamerican.com/article/war-in-space-may-be-closer-than-ever/.
[44] Ibid.

settlement, astronaut rescue, and liability.[45] The fundamental goal of space law is to

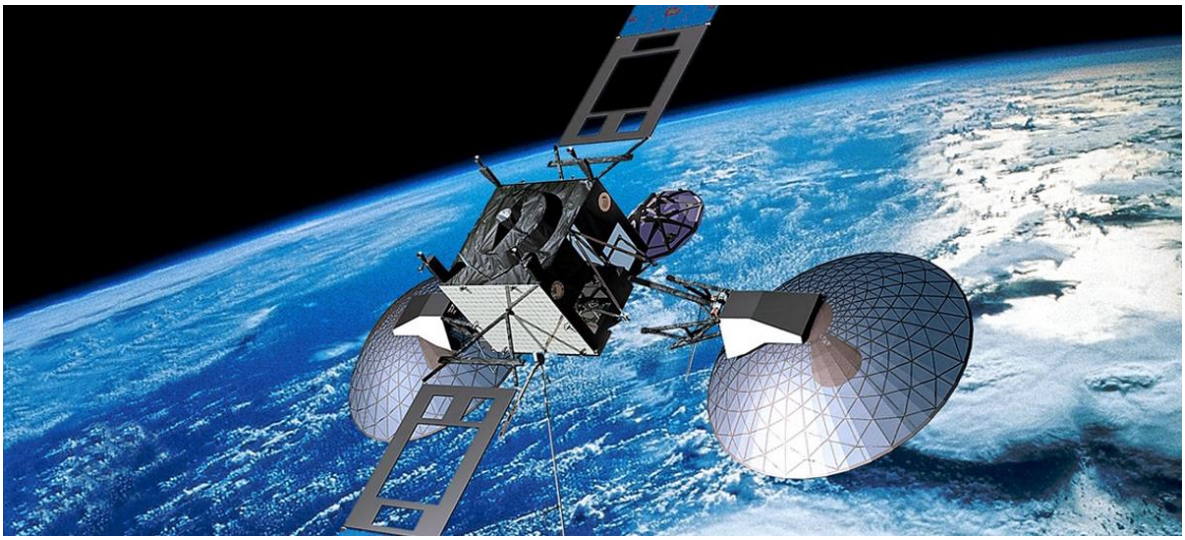


Figure 8: ASAT-Type Satellite

maintain "space as the province of all humankind, the freedom of exploration and use of outer space by all states without discrimination, and the principle of non-appropriation of outer space."[46] Like other sections of international law, space law is formed not from an official legislative system as domestic law is, but is a collection of international agreements, treaties, resolutions, norms, and customs that are recognized by the majority of nations as legitimate.[47] However, due to its relative recent development, space law has a limited amount of written law, treaties, and even customary laws, as so few countries have full-fledged space programs and therefore interest in developing space law.[48]

[45] UNOOSA, "Space Law," http://www.unoosa.org/oosa/en/ourwork/spacelaw/index.html.
[46] Ibid.
[47] Ibid.
[48] Lee Billings, "War in Space May Be Closer Than Ever," *Scientific American*, August 10, 2015, http://www.scientificamerican.com/article/war-in-space-may-be-closer-than-ever/.

During war on the ground, conflicts are governed by *jus in bello*, or international humanitarian law (IHL). Also known as the Laws of Armed Combat, IHL is fundamental in preventing modern warfare from becoming unnecessarily destructive and is intended to protect victims and bystanders to armed conflicts.[49] As warfare expands into space, it therefore stands to reason that IHL, an extremely important subset of international law, should expand as well and develop some type of humanitarian laws for space conflict.

The foundation of IHL is the four Geneva Conventions of 1949 and two following protocols added in 1977; these conventions and protocols are recognized widely enough to commonly be considered customary international law.[50] IHL revolves around three main principles that structure and underpin laws: distinction, necessity, and proportionality. The principle of distinction is the most fundamental, and creates defined, strict categories for civilians and combatants.[51] Civilians and civilian property are not to be targeted.[52] In this vein, the principle of military necessity provides some exception: every action taken during combat should have some sort of military necessity in order to avoid random acts of violence.[53] The principle of necessity can occasionally allow for the targeting of civilians. To balance the principle of necessity, the principle of proportionality is intended to avoid

[49] Dale Stephens and Cassandra Steer, "Conflicts in Space: International Humanitarian Law and Its Application to Space Warfare," *McGill Annals of Air and Space Law* 40 (2015): 10, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2722315.
[50] Ibid, 8.
[51] Marco Sassòli, et al., "How Does Law Protect in War?" *International Committee of the Red Cross*, last updated April 20, 2016, https://www.icrc.org/casebook/index.jsp.
[52] Ibid.
[53] Ibid.

unnecessary suffering on the part of both innocents and combatants; therefore, even if civilians are targeted, it must be done with the minimal amount of impact.[54] IHL as a whole does not outlaw war or violence; rather, it attempts to balance legitimate military strategy with the protection of civilian populations.

Unfortunately, adapting IHL into the space context is not a straightforward transfer of principles. Due to the highly categorical nature of IHL, it is difficult to fully define where space and the various people and objects in space fit into existing IHL protocol.[55] Although initially applying the principles of distinction, military necessity, and proportionality to situations in outer space may seem straightforward, there are in fact many layers of complications.

Consider the case of the principle of distinction applied in space. This is unlikely to be a huge issue at any given time due to the small amount of humans in space. However, it becomes complicated when differentiating between military and civilian astronauts. Initially this seems straightforward – military astronauts can be seen as combatants, and civilian as civilian. However, under the Outer Space Treaty astronauts, including military astronauts, are classified as envoys of humankind.[56] Under the 1968 Rescue Agreement, astronauts are entitled to protection, aid, and assistance at all times, whereas under IHL one might assume that this would only apply to civilian astronauts.[57] Would space IHL classify

[54] Dale Stephens and Cassandra Steer, "Conflicts in Space: International Humanitarian Law and Its Application to Space Warfare," *McGill Annals of Air and Space Law* 40 (2015): 13, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2722315.
[55] Ibid, 8.
[56] Ibid, 15.
[57] UNOOSA, "Space Law," http://www.unoosa.org/oosa/en/ourwork/spacelaw/index.html

astronauts differently at different times, or consider more specific categories? Furthermore, there is a lot of overlap between military and civilian uses of property in space. For instance, the destruction of a doomed military satellite would not only create debris, potentially harming nearby civilian satellites, but would not clearly be defined as either military or civilian, as it performs a variety of functions.[58] This substantial overlap makes the principle of military necessity much harder to balance with the principle of distinction.

The principle of proportionality can be similarly confusing to apply to situations in space. For instance, does the potential targeting of space-based objects, instead of targets on earth, successfully minimize human suffering? Initially, one might say yes, as the fact that destruction is taking place in orbit means that direct loss of life is highly unlikely.[59] However, it is extremely probable that destroying a satellite's military functions, for instance, means the destruction of any civilian functions as well. Consider therefore that the destruction of these civilian functions can have a dramatic impact on health services, energy production, and transportation safety, creating communication failures and other issues that can certainly cause human suffering and loss of life.[60] So is it better to target a satellite to take out the navigation for a civilian ship transporting supplies for a military – and potentially innumerable other civilian navigation systems, potentially resulting in

[58] Dale Stephens and Cassandra Steer, "Conflicts in Space: International Humanitarian Law and Its Application to Space Warfare," *McGill Annals of Air and Space Law* 40 (2015): 28, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2722315.
[59] Ibid, 24.
[60] Ibid.

danger for a civilian ship – or targeting the ship directly and causing direct loss of civilian life? There is no sure answer as of now.

Despite the lack of treaty laws that apply to the specificities of IHL in space, there are still plenty of customary laws that can be applied to space.[61] The challenge, of course, is to ensure that they are properly and thoughtfully enacted. And even in situations where they may not be an applicable law, international courts tend to search for other sources for guidance, as opposed to simply ignoring the issue. This is known as the Martens Clause, and prescribes that "in cases not covered by treaties and traditional customary international law, civilians and combatants remain under the protection and authority of the principles of international law derived from established custom, from the principles of humanity and from the dictates of public conscience."[62] International courts such as the ICJ assimilate outside legal principles to "fill apparent voids, especially in the context of armed force;"[63] that is to say, just because there is no explicit written law about IHL in space does not mean states are free to militarize and weaponized without consideration for the principles of IHL.

Conclusion

Space is one of the new frontiers nations develop technologies for, and is in fact one of the least militarized areas known. Nonetheless, in the interests of their own security,

[61] Dale Stephens and Cassandra Steer, "Conflicts in Space: International Humanitarian Law and Its Application to Space Warfare," *McGill Annals of Air and Space Law* 40 (2015): 11, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2722315.
[62] Marco Sassòli, et al., "How Does Law Protect in War?" *International Committee of the Red Cross*, last updated April 20, 2016, https://www.icrc.org/casebook/index.jsp.
[63] Dale Stephens and Cassandra Steer, "Conflicts in Space: International Humanitarian Law and Its Application to Space Warfare," *McGill Annals of Air and Space Law* 40 (2015): 10, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2722315.

countries most likely will be reluctant to stop developing technologies such as ASAT to counter space-based military assets and finding ways to deploy their own weapons into space. For the continued peaceful and fair use of space as a commons available to all – as was intended under the Outer Space Treaty – the UNOOSA-ICAO joint session must bring together the international community to discuss and consider issues related both to militarization of space and ways to maintain law and order in the face of potential weaponization and conflict in our skies.

Questions to Consider:

- **How do we prevent a space arms race?**
- **What steps can the international community take to expand IHL to space? What factors will it have to consider?**
- **How can the imbalance in space technologies between countries be narrowed?**

Bibliography

Billings, Lee. "War in Space May Be Closer Than Ever." *Scientific American*. August 10, 2015. http://www.scientificamerican.com/article/war-in-space-may-be-closer-than-ever/.

Reaching Critical Will. "Outer Space: Militarization, weaponization, and the prevention of the arms race." http://www.reachingcriticalwill.org/resources/fact-sheets/critical-issues/5448-outer-space.

Sassòli, Marco, et al. "How Does Law Protect in War?" *International Committee of the Red Cross*. Last updated April 20, 2016. https://www.icrc.org/casebook/index.jsp.

Shah, Anup. "Militarization and weaponization of outer space." *Global Issues*. January 21, 2007. http://www.globalissues.org/article/69/militarization-and-weaponization-of-outer-space.

Stephens, Dale, and Cassandra Steer. "Conflicts in Space: International Humanitarian Law and Its Application to Space Warfare." *McGill Annals of Air and Space Law* 40 (2015): 1-33. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2722315.

Stratfor. "The Real Danger from Space Weapons." February 22, 2016. https://www.stratfor.com/analysis/real-danger-space-weapons.

UNOOSA. "Space Law." http://www.unoosa.org/oosa/en/ourwork/spacelaw/index.html.

Topic 3: Space Commercialization

Introduction

With emerging space technology and increase aerospace activity, we are seeing a rapid commercialization of the space industry. There will be new business opportunities, research initiatives, and the expansion and development of space tourism. The advancing industry will begin to see greater market demands for aerospace production and services, which will require understanding and investment to meet those demands.

Delegates should consider the aims, regulations, and impacts of these activities to discuss how one can best facilitate safe, ethical, and orderly development of the industry. This committee aims to explore international regulatory regimes and new emerging frontiers for space activities, and propose new initiatives to develop or improve commercial space activities. This includes areas including but not limited to planetary resourcing, asteroid mining, commercialized sub-orbital flights, national space programs and other international cooperatives. It is important to consider the consequences and implications commercialization will have upon international space law. How should private aerospace research be regulated? What about the cooperation between governments on a national

scale? Such discussion will allow us to provide and develop the legal framework and regulatory guidelines in face of international commercial activity.

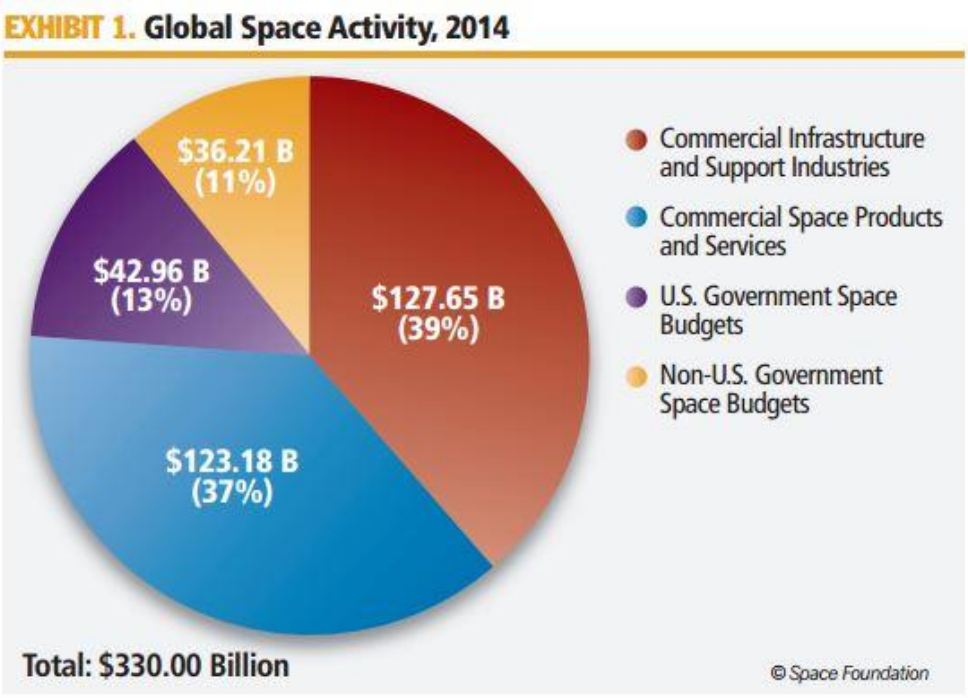


Figure 9: Global Space Activity (Source: Space Foundation)

Commercial Space Activity

Commercial space activity first began with the commercialization of the space transport industry. There was, and remains, a large interest towards the development of aerospace transport, specifically on the use of satellites. The commercial use of space is largely the provision of goods and services through the use of equipment in outer space. As of now, the industry is worth an estimate of $323 billion[64]. The industry is largely

[64] "Commercial Space Activities*", SpacePolicy Online*, 2015, http://www.spacepolicyonline.com/commercial.

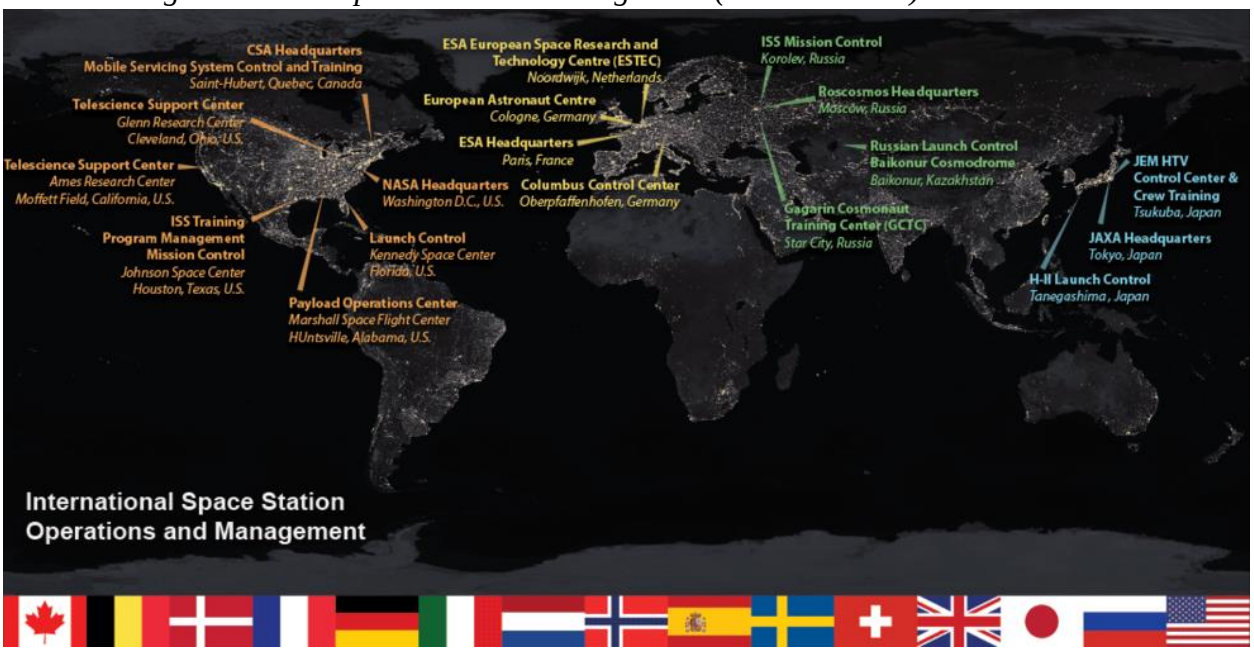
composed of government space budgets and international projects, commercial space products and services, as well as commercial infrastructure support and transport. Space activity is complex and relies on global investments, partnerships and technology. The commercial space industry is unique because it is intertwined with international space research and government-led projects. With it comes the development of projects and services that directly benefit humanity on Earth.

The extensive advancement of international aerospace activity brings implications for national/international regulations and policies. Many of these policies are supported by inter-governmental and international organizations with a focus on international cooperation and technological advancement. It leads to new developments in creating stable and effective policies that can support commercial trade in outer space.

International Space Station (ISS)

The ISS is the largest international scientific/engineering project in history. The ISS brings together scientists and engineers to create the largest research facility in orbit, to become a stepping-stone for space exploration and other aerospace activities. It is the largest structure to be put in space, and serves as an international platform for aerospace research. It involves the international partnership of several principal national space agencies, including the United States, Russia, Europe, Japan and Canada. The ISS receives support and operations management from over 15 national and private space stations. Led by the US, the joint ownership and use of the space facility is established by

Figure 10: ISS Operations and Management (Source: NASA)



intergovernmental contracts and agreements. Each partner in the ISS has the responsibility to handle its hardware and programs in their respective areas. These agreements also call for a joint cooperation in operating, maintaining and developing the International Space Station with support of national facilities on Earth[65].

The station has been occupied continuously since 2000, and is a facility that is suitable to test sub-orbital and orbital spacecraft, as well as equipment for missions to the Moon and Mars. Commercial transportation flights have made several missions there. It also allows members of partner stations and participating crews to conduct field experiments and research in the station.

[65] NASA. (n.d.). "International Cooperation." Retrieved September 12, 2016, from https://www.nasa.gov/mission_pages/station/cooperation/index.html

Space Products and Services

Space Tourism

Mankind has finally reached a stage where commercial aircrafts and technology are being developed and produced to meet commercial demands of entering space. As such, there is a new and increasing demand for regular civilians to visit space, just for fun, with several companies already launching sub-orbit flights that allow passengers to experience zero gravity for themselves. More ambitious companies, such as Richard Branson's Virgin Galactic, are in the midst of planning more ambitious trips to outer space, but nothing concrete has yet to be established. The UNOOSA body needs to make sure that these space missions are highly regulated, as any error can be fatal to the passengers involved.

International 'Moon Village'

The European Space Agency (ESA) has been pushing its plans forward to create a permanent human outpost 'village' on the moon. A 'moon village', it aims to be a centre for scientific research, business and possibly space tourism as the ESA predicts that the moon will become the next destination beyond sub-orbital space flights for ordinary people.

It is an interesting concept and initiative as it suggests that lunar exploration will be achievable within the next decade, as these projects start to take form. This idea grasps the potential for the moon to be a sustainable location to continue human surface-exploration and venture into areas unknown to humans on Earth. The ESA's moon village

vision is still relatively vague concept for now, but it provides a realistic vision for the future could look like.

Spaceport America: Space Tourism Launch Site

Figure 11: Bird's Eye View of Spaceport America (Source: Spaceport America)

Spaceport America is an aircraft launching facility in New Mexico dedicated to commercial spaceflight, and is used by several private aerospace and commercial flight companies. One of the main commercial anchors said to be operating the spaceport is Virgin Galactic, one of the first companies to introduce and establish space tourism as an opportunity for people to go into space. It aims to offer sub-orbital space flights to paying customers for prices as low as 200,000 USD (reportedly)[66]. It is also an extremely new

[66] Howell, Elizabeth "Spaceport America: Space Tourism Launch Site", *Space.com,* published March 21st, 2016 http://www.space.com/19258-spaceport-america.html

frontier; with more and more companies entering the industry, many are still aiming blindly into methods not previously tested.

However, it has run into issues insofar that both Spaceport America and Virgin Galactic have postponed launch dates continuously. Originally funded by the government of New Mexico, it is becoming a problem for taxpayers to fund a $250 million USD spaceport that is only partially used. There are also safety concerns, especially after the 2014 crash of the *VSS Enterprise*, a Virgin Galactic spaceflight vehicle. The *Enterprise* broke up in-flight, killing one pilot and seriously injuring another. This points to the need of more regulation for space tourism and space commercial flights in general, something this body can accomplish.

Emerging Frontiers:

The development of commercial infrastructure and mechanisms in outer space has led to the emergence of new industries. These technologies and developments aim to contribute to the collective goal of advancing space technology and the outer space community. What is important is the way this committee can find new ways and projects to facilitate these areas where they need international support and a legal infrastructure to work with. Furthermore, these new industries will bring up new policy areas for improvement and development of a regulatory practice that can support new technologies in outer space. It also invites the creation and development of a newer, comprehensive legal framework created for and by the international community. This will require an unprecedented level of cooperation amongst the international community to accomplish.

Asteroid Mining/Planetary Resources

Planetary resourcing is new aerospace sub-industry that is emerging as a top contender for future energy resources. It looks into the exploitation of asteroid resources in space that could be used to power energy on earth. Asteroids pass significantly closer to the Earth than the Moon, and are dense in resources that can be used for energy on Earth[67]. The two leading companies in this industry, Planetary Resources and Deep Space Industries, claim that utilizing these resources will create a market for H20 and minerals/metals in the energy sector. It is still an emerging technology and will require significant investments and time until we can see a successful experiment and mission in space regarding these activities.

The initiatives regarding the extraction of space materials are directed towards creating technology that can sustainably and efficiently extract valuable metals such as platinum.

Policy Implications

However, with all of these fields, there are international legal frameworks at play. With the signing of the Outer Space Treaty (OST) in 1967, the moon, asteroids, and other celestial bodies "is not subject to national appropriation by claims of sovereignty"[68]. While this was signed in the context of the Cold War arms race, this may be an obstacle for businesses looking towards asteroid mining as a new resource industry. The United States

[68] Rob Davies, "Asteroid Mining could be space's new frontier" *The Guardian,* last updated February 6th 2016 https://www.theguardian.com/business/2016/feb/06/asteroid-mining-space-minerals-legal-issues

of America, with the passing of the 2015 SPACE Act has allowed companies to "possess, own, transport and sell" extra-terrestrial resources for profit without violating United States law[69]. While the passing of this bill is positive for prospective companies in the aerospace industry, it still direct violates the OST treaty. It may call for an international agreement for countries to allow the free use and extraction of extra-terrestrial material without claiming sovereignty over any area, but it will only benefit those who have the means to access it.

On the other hand, there are governments that have allocated budgets on the development of this particular industry, with the hopes that it can soon draw up regulatory frameworks for this industry area. The government of Luxembourg, for example, has shown interests in the technology that extracts resources from asteroids. Secondly, private companies such as Deep Space Industries, as well as its rival Planetary Resources have plans to continue their exploration into asteroids by sending satellites to prospect for materials.

Even with significant international cooperation efforts on aerospace activities, the commercialization of the industry creates questions on who gets to profit on these activities. Whether or not space objects can be claimed or limited by national entities will determine the rapid development of the asteroid mining industry. This industry can lead to new opportunities for business and growth in the economy, as well as enhancing aerospace research through private investments of asteroid mining technology. Private research may

[69] Ibid.

also be beneficial for the aerospace scientific community as well, as commercial missions can explore new areas of outer space that have been limited by national or international interests.

SpaceX and Rocket Landings

Space Exploration Technologies Corporation Ltd, otherwise known as SpaceX, is a private aerospace manufacturer and space transport services company. One of the leading corporations driving space research and technology, it has demonstrated itself to be the leading innovators of the aerospace industry. In particular, it has utilized research and design in landing successful rockets post-launch on Earth. SpaceX is a key player in the industry as their technological advantages guide the development and dynamic of aerospace research.

On April 8th 2016, SpaceX successfully landed its Falcon 9 rocket on a drone ship after it had been launched into space. It has previously also shown success in landing the Falcon 9 on the ground post-launch as well. These are milestones in the aerospace industry as it demonstrates the potential of reusable rockets for science research and space exploration efforts. It is an important feat because rockets are relied on to launch materials into space, such as satellites or supplies for the ISS. The production of rockets costs over $60 million USD, and cannot be used again. With the development of reusable rockets, the SpaceX proves that it can potentially recover and reuse rockets. This encourages more opportunities for space exploration and to bring more materials and equipment in space

without the traditional costly price tag. SpaceX's method would only need to account for the costs of replacement parts and for the rocket to be re-fueled again.

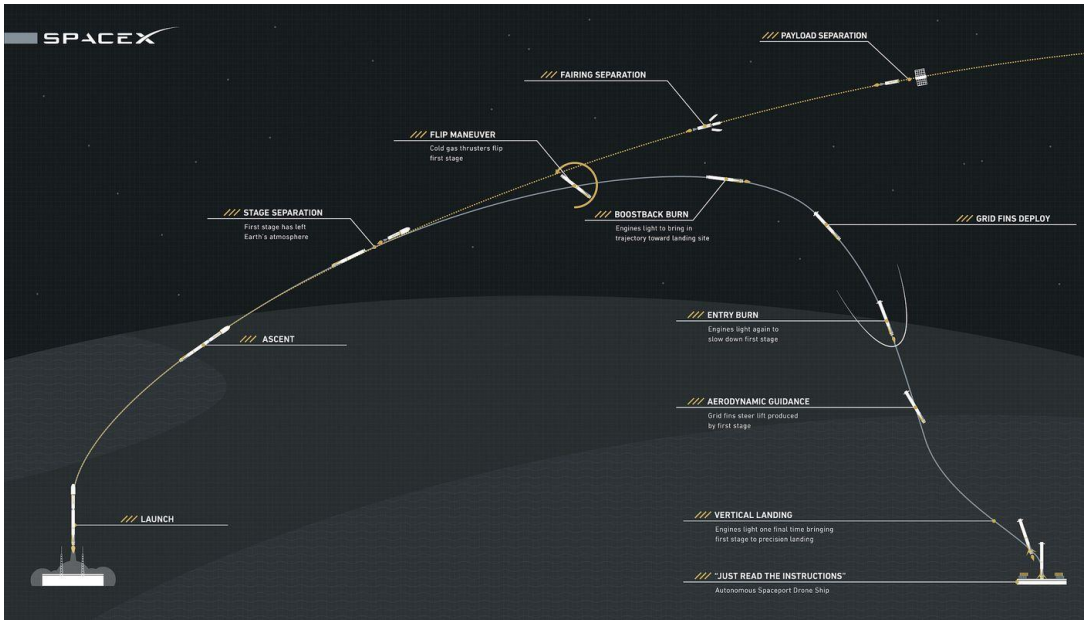


Figure 12: Falcon 9 Flight Path (Source: SpaceX)

The Falcon 9 landing on a drone ship is also a special achievement for SpaceX, and important one as over two thirds of their landings would be made in the ocean, as oceans occupy most of the Earth's surface. Ocean landings are fundamental to enhancing the technologies of space transport and equipment because it significantly saves the amount of fuel that the rocket requires upon making a landing once it has been launched into space.[70] Ground landings for rockets post-launch require more fuel to guide the rocket to turn back and towards the ground target, whereas ocean landings utilize autonomous drone ships that

[70] Loren Grush, "SpaceX successfully lands Falcon 9 rocket", *The Verge* http://www.theverge.com/2016/7/18/12208560/spacex-falcon-9-ground-landing-success

will adjust to the rocket's speed and 'catch' the rocket as it lands more naturally on its way back to Earth. It reduces the distance the rocket would have to travel, making it easier for it to land whilst reducing usage of fuel. The success of these landings make SpaceX a leading company to guide advancing aerospace activities by making them less costly and more efficient.

Commercial Space Activity and Outer Space Policies and Regulations

The commercialization of outer space activities has led to the creation of policies and resolutions designed to effectively manage commercial activity in outer space.

US Congress Bill: SPACE 2015 (Spurring Private Aerospace Competitiveness and Entrepreneurship Act of 2015)

With reference to the difficulties posed by the Outer Space Treaty, the US government has taken initiatives to update its space laws. On November 25th 2015, the United States government passed a commercial space bill to allow citizens the right to pursue space exploration and exploitation of extraterrestrial material resources. The bill declares that the US will not assert its sovereignty over territory or resources in space[71]- with an argument that it recognizes national ownership of space resources is an act of sovereignty, which violates the Outer Space Treaty. Putting the new changes in practice may still cause complications with the OST. However, it reflects the start of new changes

[71] H.R.2262 - U.S. Commercial Space Launch Competitiveness Act, *Congress Gov* https://www.congress.gov/bill/114th-congress/house-bill/2262

in response to the commercial of aerospace activity. It aims to create for stable and consistent regulatory practices to encourage the private sector to develop. It may even facilitate better opportunities for research with private financial investments or national cooperatives.

Questions to Consider:

- **How do we ensure that regulators ensure safe and orderly development of aerospace activities?**
- **How can we support and promote more sustainable aerospace practices especially on an international scale?**
- **How can we regulate the space tourism industry as it is quickly emerging?**
- **What is the extent of which we should limit or allow the commercial exploration and development of aerospace material for space tourism/travel? Are there any risks pre-development?**
- **Are there any security issues with the commercial use of aerospace research and technology?**
- **How much should we be really investing in aerospace? National or private or both?**

Bibliography:

Dunbar, B. (2012, November 19). NASA Space Act Agreement. Retrieved September 12, 2016, from http://www.nasa.gov/open/space-act.html.

Howell, E. (2016, March 21). Spaceport America: Space Tourism Launch Site. Retrieved September 12, 2016, from http://www.space.com/19258-spaceport-america.html.

NASA. (n.d.). International Cooperation. Retrieved September 12, 2016, from https://www.nasa.gov/mission_pages/station/cooperation/index.html.

President Obama Signs Bill Recognizing Asteroid Resource Property Rights into Law. (2015, November 15). Retrieved September 12, 2016, from http://www.planetaryresources.com/2015/11/president-obama-signs-bill-recognizing-asteroid-resource-property-rights-into-law/.