# Lunar Heritage AFF

## 1AC

### 1AC: Plan

#### Plan - Private entities ought not appropriate lunar heritage sites in outer space.

* We will defend NASA’s interpretation of lunar heritage sites

Harrington 19, Andrea J. "Preserving Humanity's Heritage in Space: Fifty Years after Apollo 11 and beyond." J. Air L. & Com. 84 (2019): 299. (Associate Professor and Director of the Schriever Space Scholars at USAF Air Command and Staff College)//Elmer

The issue of humanity’s cultural heritage in space has arisen as one of many unanswered questions in space law, with no international agreements specifically addressing it. With the beginning of the space age fifty-six years ago and a series of remarkable achievements in space exploration behind us, it is necessary to determine what should be done regarding the “artifacts” of this exploration. NASA has promulgated their recommendations for spacefaring entities with the goal of protecting the lunar artifacts left behind by the Apollo missions.8 These recommendations establish “keep-out zones” of up to a four kilometer diameter with the aim of protecting the artifacts, particularly from dangerous, fastmoving particles that arise as a result of craft landings.9 Experience has shown that even artifacts that are sheltered by craters can be significantly sandblasted and pitted as a result of the moving particles.10 These recommendations, supposedly drafted in conformity with the Outer Space Treaty, however, are completely nonbinding.11 Legislation that has passed the U.S. Senate and is under consideration by the House of Representatives as of July 2019 would make these recommendations binding on U.S. entities seeking to land on the Moon.12 Accidental damage from unrelated missions, however, is only one of many threats to space artifacts. With the impending return to the Moon, it is likely that individuals and corporations will be looking to turn a profit from space heritage, without concern for the protection of such heritage. Tourists may disrupt sites with careless expeditions and landing sites may be desecrated so that the items can be sold. A Russian Lunakhod lunar rover has already been sold at auction to a private party, though it has not yet been moved from its original position on the Moon.13 While national heritage legislation can protect space artifacts from citizens of their own countries, there is currently no effective means in the present space law regime by which a country can protect its heritage from other countries.14 Both California and New Mexico have added Tranquility Base to their list of protected heritage sites.15 However, this solution, and those proposed in the bill put forth to the U.S. House of Representatives, only serve to restrict the activities of a small subset of the potential visitors to the Moon. Though the Senate bill calls for the President to initiate negotiations for a binding international agreement, there is still a long road from this bill to a potential agreement.16 A solution is needed to prevent the damage, destruction, loss, or private appropriation of our cultural heritage in space.

#### We’ll defend NASA’s list of Lunar Heritage Sites – insert Map below.

JPL 13 12-13-2013 "Lunar Heritage Sites" <https://moon.nasa.gov/resources/53/lunar-heritage-sites/> (Jet Propulsion Laboratory at CalTech)//Elmer

A picture containing dome

Description automatically generated

### 1AC: Lunar Heritage

#### The Advantage is Lunar Heritage:

#### Global Moon Rush by private actors is coming now.

Sample 19 Ian Sample 7-19-2019 “Apollo 11 site should be granted heritage status, says space agency boss” <https://www.theguardian.com/science/2019/jul/19/apollo-11-site-heritage-status-space-agency-moon> (PhD at Queens Mary College)//Elmer

But protecting lunar heritage may not be straightforward. On Earth, the United Nations Educational, Scientific and Cultural Organisation (Unesco) decides what deserves world heritage status from nominations sent by countries that claim ownership of the sites. Different rules apply in space. The UN’s outer space treaty, a keystone of space law, states that all countries are free to explore and use space, but warns it “is not subject to national appropriation by claim of sovereignty”. In other words, space is for all and owned by none. Wörner is not put off and sees no need for troublesome regulations. “My hope is that humanity is smart enough not to go back to this type of earthly protection. Just protect it. That’s enough. Just protect it and have everybody agree,” he said. A no-go zone of 50 metres around Tranquility base should do the job, he added. Martin Rees, the Cambridge cosmologist and astronomer royal, said there was a case for designating the sites so future generations and explorers were aware of their importance. “If there are any artefacts there, they shouldn’t be purloined,” he said. “Probably orbiting spacecraft will provide routine CCTV-style coverage which would prevent this from being done clandestinely.” Beyond the dust-covered hardware that stands motionless on the moon, Lord Rees suspects future activity could drive calls for broader lunar protection. The Apollo 17 astronaut and geologist Harrison Schmidt has advocated strip mining the moon for helium-3, a potential source of energy. The proposal, which Rees suggests has raised eyebrows in the community, could potentially provoke a backlash. “There might be pressure to preserve the more attractive moonscapes against such despoilation, and to try to enforce regulations as in the Antarctic,” he said. Fifty years on from Apollo 11, the moon is still a place to make statements. In January, the Chinese space agency became the first to land a probe on the far side. On Monday, India hopes to launch a robotic probe, the delayed Chandrayaan-2 lander that is bound for the unchartered lunar south pole. Far more is on the cards. Major space agencies, including ESA and Nasa, plan a “lunar gateway”, described by Wörner as a “bus stop to the moon and beyond”. His vision is for a “moon village”, but rather than a sprawl of domes, shops and a cosy pub, it is more an agreement between nations and industry to cooperate on lunar projects. The private sector is eager to be involved. Between now and 2024, at least five companies aim to launch lunar landers. In May, Nasa selected three companies to design, build and operate spacecraft that will ferry scientific experiments and technology packages to the moon. The coming flurry of activity may make protection more urgent. Michelle Hanlon, a space lawyer at the University of Mississippi, co-founded the non-profit organisation For all Moonkind to protect, preserve and memorialise human heritage on the moon. While she conceded that not all of the sites that bear evidence of human activity needed protection, she said many held invaluable scientific and archaeological data that we could not afford to lose. “These sites need to be protected from disruption if only for that reason,” she added. The protection should be far wider, and more formal, than Wörner calls for, Hanlon argues. “It is astounding to me that we wouldn’t protect the site of Luna 2, the very first object humans crashed on to another celestial body, and Luna 9, the very first object humans soft-landed on another celestial body,” she said. The Soviet Luna programme sent robotic craft to the moon between 1959 and 1976. “The director general has a much more optimistic view of human nature than I do,” Hanlon said. “I completely agree that the entities and nations headed back to the moon in the near future will take a commonsense approach and give due regard to the sites and artefacts. However, that is the near future. We have to be prepared for the company or nation that doesn’t care. Or worse, that seeks to return to the moon primarily to pillage for artefacts that will undoubtedly sell for tremendous amounts of money here on Earth.”

#### Corporate development, tourism, and looting will destroy scientifically rich Tranquility base artifacts.

Fessl 19 Sophie Fessl 7-10-2019 “Should the Moon Landing Site Be a National Historic Landmark?” <https://daily.jstor.org/should-the-moon-landing-site-be-a-national-historic-landmark/> (PhD King’s College London, BA Oxford)//Elmer

When Neil Armstrong set foot on the moon on July 20, 1969, the pictures sent to Earth captured a historical moment: It was the first time that any human set foot on another body in our solar system. Fifty years later, experts are debating how to preserve humankind’s first steps beyond Earth. Could a National Park on the moon be the solution to saving Armstrong’s bootprints for future archaeologists? Flags, rovers, laser-reflecting mirrors, footprint—these are just a few of the dozens of artifacts and features that bear witness to our exploration of the moon. Archaeologists argue that these objects are a record to trace the development of humans in space. “Surely, those footprints are as important as those left by hominids at Laetoli, Tanzania, in the story of human development,” the anthropologist P.J. Capelotti wrote in Archaeology. While the oldest then known examples of hominins walking on two feet were cemented in ash 3.6 million years ago, “those at Tranquility Base could be swept away with a casual brush of a space tourist’s hand.” Fragile Traces Just how fragile humankind’s lunar traces are was seen already during Apollo 12. On November 19, 1969, Charles “Pete” Conrad and Alan Bean manually landed their lunar module in the moon’s Ocean of Storms, 200 meters from the unmanned probe Surveyor 3, which was left sitting on the moon’s surface two years earlier, in 1967. The next day, Conrad and Bean hopped to Surveyor 3. As they approached the spacecraft, they were surprised: The spacecraft, originally bright white, had turned light brown. It was covered in a fine layer of moon dust, likely kicked up by their landing. Harsh ultraviolet light has likely bleached the U.S. flag bright white. Without Apollo 12 upsetting the moon dust, Surveyor 3 would likely have remained stark white. Unlike Earth, the moon has no wind that carries away the dust, no rain to corrode materials, and no plate tectonic activity to pull sites on the surface back into the moon. But the moon’s thin atmosphere also means that solar wind particles bombard the lunar surface, and harsh ultraviolet light has likely bleached the U.S. flag bright white. The astronauts’ first bootprints will likely be on the moon for a long time, and will almost certainly still be there when humans next visit—unless, by tragic coincidence, a meteorite hits them first. Had LunaCorp not abandoned the idea in the early 2000s, the company’s plan to send a robot to visit the most famous sites of moon exploration could have done a lot of damage. And with Jeff Bezos’ recent unveiling of a mock-up of the lunar lander Blue Moon, it is only a matter of time before corporate adventurers and space tourists reach the moon. Historians and archaeologists are keen to avoid lunar looting. Roger Launius, senior curator of space history at the National Air and Space Museum in Washington, D.C., warned: “What we don’t want to happen is what happened in Antarctica at Scott’s hut. People took souvenirs, and nothing was done to try to preserve those until fairly late in the game.” On the other hand, there is a legitimate scientific interest in investigating how the equipment that’s on the moon was affected by a decades-long stay there.

#### Private entities are a unique threat---universal rules key.

* Private Key Card – AT: Alt Causes
* AT: Unilat CP
* AT: Adv CP
* AT: Generic DA
* AT: OST DA
* Solvency Advocate

Hertzfeld and Pace 13 (, H. and Pace, S., 2013. International Cooperation on Human Lunar Heritage. [online] Cpb-us-e1.wpmucdn.com. Available at: <https://cpb-us-e1.wpmucdn.com/blogs.gwu.edu/dist/7/314/files/2018/10/Hertzfeld-and-Pace-International-Cooperation-on-Human-Lunar-Heritage-t984sx.pdf> [Accessed 18 January 2022] Dr. Hertzfeld is an expert in the economic, legal, and policy issues of space and advanced technological development. Dr. Hertzfeld holds a B.A. from the University of Pennsylvania, an M.A. from Washington University, and a Ph.D. degree in economics from Temple University. He also holds a J.D. degree from the George Washington University and is a member of the Bar in Pennsylvania and the District of Columbia. Dr. Hertzfeld joined the Space Policy Institute in 1992. His research projects have included studies on the privatization of the Space Shuttle, the economic benefits of NASA R&D expenditures, and the socioeconomic impacts of earth observation technologies. He teaches a course in Space Law and a course in microeconomics through the Economics Department at G.W. Dr. Hertzfeld has served as a Senior Economist and Policy Analyst at both NASA and the National Science Foundation, and has been a consultant to many U.S. and international organizations, including a recent project on space applications with the OECD. He is the co-editor of Space Economics (AIAA 1992). Selected other publications include a study of the issues for privatizing the Space Shuttle (2000), an analysis of the value of information from better weather forecasts, an analysis of sovereignty and property rights published in the Journal of International Law (University of Chicago, 2005), and an economic analysis of the space launch vehicle industry (2005). Dr. Hertzfeld has also edited and prepared a new edition of the Study Guide and Case Book for Managerial Economics (Sixth Edition, W.W. Norton & Co.). Dr. Scott N. Pace is the Deputy Assistant to the President and Executive Secretary of the National Space Council (NSpC). He joined the NSpC in August 2017. From 2008-2017, he was the Director of the Space Policy Institute and a Professor of the Practice of International Affairs at George Washington University’s Elliott School of International Affairs. From 2005-2008, he served as the Associate Administrator for Program Analysis and Evaluation at NASA. Prior to NASA, he was the Assistant Director for Space and Aeronautics in the White House Office of Science and Technology Policy. From 1993-2000, he worked for the RAND Corporation’s Science and Technology Policy Institute, and from 1990-1993, he served as the Deputy Director and Acting Director of the Office of Space Commerce, in the Office of the Deputy Secretary of the Department of Commerce. In 1980, he received a Bachelor of Science degree in Physics from Harvey Mudd College; in 1982, Masters degrees in Aeronautics & Astronautics and Technology & Policy from the Massachusetts Institute of Technology; and in 1989, a Doctorate in Policy Analysis from the RAND Graduate School.)-rahulpenu

International Cooperation on Human Lunar Heritage The U.S. Apollo Space Program was a premier technological accomplishment of the 20th century. Preserving the six historic landing sites of the manned Apollo missions, as well as the mementos and equipment still on the Moon from those and other U.S. (e.g., Ranger and Surveyor) and Soviet Union (e.g., Luna) missions is important. Some of the instruments on the lunar surface are still active, monitored, and provide valuable scientifi c information. But recent government and **private**-**sector** **plans** to explore and potentially use lunar resources for commercial activity raise questions about the use of the Moon and potential accidental or purposeful threats to the historic sites and scientific equipment there. Although some steps to protect these sites have been proposed, we suggest a better way, drawing on international, not U.S. unilateral, recognition for the sites. Less than 2 years before the fi rst footsteps on the lunar surface on 20 July 1969 (see the image) , the United Nations Outer Space Treaty (OST) was drafted, ratifi ed, and came into force ( 1). Article II of the OST reinforced and formalized the international standard that outer space, the Moon, and other celestial bodies would not be subject to claims of sovereignty from any nation by any means, including appropriation. The OST prohibits ownership of territory or its appropriation by any state party to the treaty, which includes the United States, Russia, and 126 other nations. It does not prohibit the use of the Moon and its resources. In fact, the treaty emphasizes the importance of freedom of access to space for any nation and the importance of international cooperation in space exploration. These principles of the space treaties have enabled gains in science and technology and have contributed to international stability in space. New attention is being focused on the lunar surface. China has an active Moon exploration program and is considering sending astronauts (taikonauts) to the Moon. **Private** **firms** are contemplating robotic **missions** that could land in the vicinity of the historical sites of Apollo and other missions. Although we might assume the best of intentions for such missions, they could **irreparably** **disturb** the **traces** **of** the first **human** **visits** to another world. NASA has taken **steps** **to** **protect** the lunar landing **sites** and equipment and to initiate a process to create recognized norms of behavior. In July 2011, guidelines were issued for private companies competing in the Google Lunar X Prize that established detailed requirements for avoiding damage to U.S. government property on the Moon ( 2). H.R. 2617, The Apollo Lunar Landing Legacy Act, was introduced into the U.S. Congress on 8 July 2013 ( 3). In essence, it proposes to designate the Apollo landing sites and U.S. equipment on the Moon as a U.S. National Park with jurisdiction under the auspices of the U.S. Department of the Interior. Although the bill acknowledges treaty obligations of the United States, it would create, in effect, a unilateral U.S. action to control parts of the Moon. This would **create** a **direct** **conflict** **with** **i**nternational **law** and could be viewed as a **violation** **of** U.S. commitments under the **OST**. It would be an ineffective way of protecting historical U.S. sites, and it fails to address interests of other states that have visited and will likely visit the Moon. It is **legally** **flawed**, **unenforceable**, and **contradictory** **to** our national **space** **policy** and our international relations in space ( 4). There is a better way for the United States to protect its historic artifacts and equipment on the Moon. The fi rst step is to clearly distinguish between U.S. artifacts left on the Moon, such as fl ags and scientifi c equipment, and the territory they occupy. The second is to gain international, not unilateral, recognition for the sites upon which they rest. Aside from debris from crash landings (by Japan, India, China, and the European Space Agency), there are only two nations with “soft-landed” equipment on the lunar surface: the United States and Russia. China has plans to soft-land Chang’e 3 on the Moon in December 2013. All three nations (and any others wishing to participate) have much to gain and little or **nothing** **to** **lose** **from** a **multinational** **agreement** based on mutual respect and mutual protection of each other’s historical sites and equipment. Legal Issues Although ownership of planets, the Moon, and celestial bodies is prohibited, ownership of equipment launched into space remains with the nation or entity that launched the equipment, wherever that equipment is in the solar system. Under the OST, that nation is both responsible and liable for any harmful acts that equipment may create in space. There are no prescribed limits on time or the amount of damage a nation may have to pay. The U.S. government therefore still owns equipment it placed on the Moon. Ownership has the associated right of protecting the equipment, subject to using necessary and proportional means for protection. But, because no nation can claim ownership of the territory on which equipment rests, there is an open issue of how to control the spots on the Moon underneath that equipment, because the site is **integral** **to** the **historical** **signifi** **-** **cance**. In H.R. 2617, establishment of Apollo sites as a unit of the U.S. National Park System could be interpreted as a declaration of territorial sovereignty on the Moon, even though ensuing paragraphs specify the Park’s components as the “artifacts on the surface of the Moon” at those sites. This problem needs international legal clarifi cation, achievable via a formal agreement among those nations that have the technological ability to directly access the Moon ( 5). Section 6(a) raises another legal issue. The bill proposes that the Secretary of the Interior shall administer the park in accordance with laws generally applicable to U.S. National Parks. It also requires the Secretary to act in accordance with applicable international law and treaties. The U.S. National Park System Act states that the Parks are “managed for the benefi t and inspiration of all the people of the United States” ( 6). The OST clearly emphasizes that the exploration and use of space by nations is to benefi t all peoples. The laws and space policies of the United States have always emphasized peaceful uses of space and the benefi ts of space for humankind. It may not be possible to implement and execute provisions of this Bill without raising important and fundamental questions about these contradictions between the language of the treaty and the mandates of our National Park Service. A third legal issue is raised in section (6) (c)(2) that allows private donations and cooperative agreements to “provide visitors centers and administrative facilities within reasonable proximity to the Historical Park.” This **implies** **future** **private** **use** of the Moon **under** **rights** **granted** **by** the **U.S.** government. **Unilateral** **granting** **of** lunar territorial **rights** to private individuals and implicit sovereign protection of that territory **violates** the **OST**. Finally, section 8 of the bill requires the Secretary of the Interior to submit the Apollo 11 lunar landing site to the United Nations Educational, Scientifi c, and Cultural Organization (UNESCO) for designation as a World Heritage Site. This violates Article II of the OST. All current World Heritage Sites are located on sovereign territory of nations. The only exception is a separate treaty that allows UNESCO to designate underwater sites (such as sunken ships) as protected cultural sites ( 7). These designations are very limited, and although the convention has been ratifi ed by 43 nations, the United States, Russia, and China are not among them. Thus, any new treaty of this type specifi cally for outer space would have little chance of being ratifi ed by the major space-faring nations. A Proposal to Protect Lunar Sites Although a new U.N. treaty for space artifacts of signifi cant cultural and historic importance may be reasonable someday, this would start a very long process with unknown outcomes. Such a treaty could be delayed to a point beyond the time when nations and/or companies may be active on the Moon ( 8). Our suggested alternative is to create a bilateral agreement between the United States and Russia, offered as a multilateral agreement to other nations with artifacts on the Moon. This would be more legally expedient, politically sustainable, and would more likely meet and exceed the stated goals of the bill. It would also emphasize the important role of national laws to implement and enforce these international space agreements. **Any** **nation** **with** **assets** on the lunar surface will **endeavor** **to** **protect** those assets. This creates a situation where those nations have a **timely**, **current**, and **common** **interest** incorporating important implications for peaceful uses of outer space; **scientific** **research** and the advancement of **knowledge**; and **cultural** **and** **heritage** **value**, either presently or in the foreseeable future. The United States, Russia, and China all engage in multilateral cooperative space programs. They share many economic and trade dependencies adding to the international importance of promoting cooperation in space and commerce. In spite of today’s charged political environment, an **agreement** of the type we propose may still be possible to negotiate because it **focuses** **on** the **culture** **of** **space**, the use of space to benefit humankind, and the **archaeological** **record** of our civilization. It specifi cally would not touch sensitive issues of real property rights, export controls, human rights, or the weaponization of outer space. **Cooperation** on recognizing and protecting each other’s interests in historical sites and on equipment and artifacts also has no signifi cant security, prestige, or technological impediments. It reinforces the basic principles of the existing space treaties, avoids declarations of sovereignity on the Moon, and encourages multilateral cooperation resulting in a more stable and predictable environment for private activities on the Moon. The best mechanism for implementing a new agreement would be direct negotiations at highest levels of government in the United States, Russia, and China, with priority to include Russian sites in a proposal that protects U.S. sites. It could be included in meetings of heads of state of those nations, either jointly or sequentially among the three nations. Such an agreement could be executed in a relatively short period of time, setting precedents for peaceful and coordinated research, exploration, and exploitation of the Moon ( 9). An international agreement on lunar artifacts among the United States, Russia, and China would be a far superior and long-lasting solution than the unilateral U.S. proclamation in H.R. 2617. Enforcement of the agreement would be through each nation’s national laws, applying to those entities subject to the jurisdiction or control of the agreement members. Each nation’s property would be protected and preserved. Other nations should be free to join the agreement, and particularly encouraged to do so if they have the ability to access the Moon. An important result would be to develop a new level of trust among nations that could then lead to more **comprehensive** **future** cooperative agreements on **space**, **science**, **exploration**, **commerce**, **and** the use of the Moon and **other** **celestial** **bodies**.

#### Heritage Sites are critical for science research around Dust.

OSTP 18 Office of Science and Technology Policy March 2018 “PROTECTING & PRESERVING APOLLO PROGRAM LUNAR LANDING SITES & ARTIFACTS” (The Office of Science and Technology Policy is a department of the United States government, part of the Executive Office of the President, established by United States Congress on May 11, 1976, with a broad mandate to advise the President on the effects of science and technology on domestic and international affairs.)//Elmer

The Moon continues to hold great significance around the world. The successes of the Apollo missions still represent a profound human technological achievement almost 50 years later and continue to symbolize the pride of the only nation to send humans to an extraterrestrial body. The Apollo missions reflect the depth and scope of human imagination and the desire to push the boundaries of humankind’s existence. The Apollo landing sites and the accomplishments of our early space explorers energized our Nation's technological prowess, inspired generations of students, and greatly contributed to the worldwide scientific understanding of the Moon and our Solar System. Additionally, other countries have placed hardware on the Moon which undoubtedly has similar historic, cultural, and scientific value to their country and to humanity. Three Apollo sites remain scientifically active and all the landing sites provide the opportunity to learn about the changes associated with long-term exposure of human-created systems in the harsh lunar environment. These sites offer rich opportunities for biological, physical, and material sciences. Future visits to the Moon’s surface offer opportunities to study the effects of long-term exposure to the lunar environment on materials and articles, including food left behind, paint, nylon, rubber, and metals. Currently, very little data exist that describe what effect temperature extremes, lunar dust, micrometeoroids, solar radiation, etc. have on such man-made material, and no data exist for time frames approaching the five decades that have elapsed since the Apollo missions. While some of the hardware on the Moon was designed to remain operational for extended periods and successfully telemetered scientific data back to the Earth, much of what is there was designed only for use during the Apollo mission and then abandoned with no expectation of further survivability. How these artifacts and their constituent materials have survived and been altered while on the lunar surface is of great interest to engineers and scientists. The Apollo artifacts and the impact sites have the potential to provide unprecedented data if lunar missions to gather and not corrupt the data are developed. These data will be invaluable for helping to design future long-duration systems for operation on the lunar surface. NASA has formally evaluated the possible effects of the lunar environment and identified potential science opportunities. For example, using Apollo 15 as a representative landing site, the crew left 189 individually cataloged items on the lunar surface, including the descent stage of the Lunar Module, the Lunar Roving Vehicle, the Apollo Lunar Surface Experiments Package, and a wide variety of miscellaneous items that were offloaded by the astronauts to save weight prior to departure. The locations of many of these items are well documented, and numerous photographs are available to establish their appearance and condition at the time they were left behind.

#### Moon Dust Research key to Moon Basing.

Smith 19 Belinda Smith 7-18-2019 “Who protects Apollo sites when no-one owns the Moon?” <https://www.abc.net.au/news/science/2019-07-19/apollo-11-moon-landing-heritage-preservation-outer-space-treaty/11055458> (Strategic Communications Advisor at Department of Education and Training at University of Victoria)//Elmer

It's not just about history Alongside heritage value, the bits and pieces left on the Moon have enormous scientific significance. Take moon dust. It's a real problem for moon-bound equipment because it's made of fine, super sticky and highly abrasive grains, which have a habit of clogging instruments and spacesuits. But as Armstrong and Aldrin trotted across the surface, the footprints they left behind gave us valuable information into the properties of moon dust, Flinders University space archaeologist Alice Gorman said. "The ridges on the boots were meant to measure how far they sank into the dust. "Then they used the light contrast between the ridges to measure the reflectance properties of the dust." A boot print in grey dust. This iconic photo of Buzz Aldrin's footprint is also a science experiment. (Supplied: NASA) It's data like this that will help if we want a long-term base on the Moon — we need to know how our gear will stand up to lunar conditions. Apart from the sticky, gritty dust, the lunar surface is also peppered with meteorites and cosmic rays. So, Dr Gorman said, one of the very few reasons to revisit a moon site is to collect some of the equipment left behind and see how it fared. "What has happened to this material in 50 years of sitting on the lunar surface? "This is going to be really interesting scientific information because it will help planning for future missions and get an understanding of long-term conditions." And NASA has already done this. The Apollo 12 mission, which landed on the Moon four months after Apollo 11, collected parts from the 1967 Surveyor probe and brought them back to Earth. An astronaut standing next to a piece of equipment on the lunar surface Along with rocks and soil samples, Apollo 12 astronauts collected pieces of the Surveyor 3 probe for analysis back on Earth. (Supplied: NASA) Another reason to preserve the equipment left on the Moon is to prove we really went there, Professor Capelotti said. "There's a lot of people out there who still don't believe it happened. "The stuff on the Moon is a testament to what we did and when we did it."

#### Research for a moon base is coming now but preservation of the environment is key.

**Shekhtman 21** [Lonnie Shekhtman, Lonnie is a senior science writer for Nasa. She 1-26-2021, "NASA’s Artemis Base Camp on the Moon Will Need Light, Water, Elevation," <https://www.nasa.gov/feature/goddard/2021/nasa-s-artemis-base-camp-on-the-moon-will-need-light-water-elevation/> accessed 2/12/22] Adam

American astronauts in 2024 will take their first steps near the Moon’s South Pole: the land of extreme light, extreme darkness, and frozen water that could fuel NASA’s Artemis lunar base and the agency’s leap into deep space.

Scientists and engineers are helping NASA determine the precise location of the [Artemis Base Camp](https://www.nasa.gov/feature/nasa-outlines-lunar-surface-sustainability-concept) concept. Among the many things NASA must take into account in choosing a specific location are two key features: The site must bask in near continuous sunlight to power the base and moderate extreme temperature swings, and it must offer easy access to areas of complete darkness that hold water ice.

While the South Pole region has many well-illuminated areas, some parts see more or less light than others. Scientists have found that at some higher elevations, such as on crater rims, astronauts would see longer periods of light. But the bottoms of some deep craters are shrouded in near constant darkness, since sunlight at the South Pole strikes at such a low angle it only brushes their rims.

These unique lighting conditions have to do with the Moon’s tilt and with the topography of the South Pole region. Unlike Earth’s 23.5-degree tilt, the Moon is tilted only 1.5 degrees on its axis. As a result, neither of the Moon’s hemispheres tips noticeably toward or away from the Sun throughout the year as it does on Earth — a phenomenon that gives us sunnier and darker seasons here. This also means that the height of the Sun in the sky at the lunar poles doesn’t change much during the day. If a person were standing on a hilltop near the lunar South Pole during daylight hours, at any time of year, they would see the Sun moving across the horizon, skimming the surface like a flashlight laying on a table.

“It’s such a dramatic terrain down there,” said [W. Brent Garry](https://science.gsfc.nasa.gov/sed/bio/william.b.garry), a geologist at NASA’s Goddard Space Flight Center in Greenbelt, Maryland. Garry is working with engineers on a virtual reality tour of the Moon’s South Pole to help immerse astronauts, scientists, and mission planners in the exotic environment of that region as they prepare for a human return to the Moon.

While a base camp site will require lots of light, it is also important for astronauts to be able to take short trips into permanently dark craters. Scientists expect that these shadowed craters are home to reservoirs of frozen water that explorers could use for life support. “One idea is to set up camp in an illuminated zone and traverse into these craters, which are exceptionally cold,” said NASA Goddard planetary scientist [Daniel P. Moriarty](https://science.gsfc.nasa.gov/sed/bio/daniel.p.moriarty), who’s involved with NASA’s South Pole site analysis and planning team. Temperatures in some of the coldest craters can dip to about -391 degrees Fahrenheit (-235 degrees Celsius).

Initial plans include landing a spacecraft on a relatively flat part of a well-lit crater rim or a ridge. “You want to land in the flattest area possible, since you don’t want the landing vehicle to tip over,” Moriarty said.

The landing area, ideally, should be separated from other base camp features — such as the habitat or solar panels — by at least half a mile, or 1 kilometer. It also ought to be situated at a different elevation to prevent descending spacecraft from spraying high-speed debris at equipment or areas of scientific interest. Some scientists have estimated that as a spacecraft thrusts its engines for a soft landing, it could potentially spray nearly a million pounds, or hundreds of thousands of kilograms, of surface particles, water, and other gases across the surface.

“You want to take advantage of the landforms, such as hills, that can act as barriers to minimize the impact of contamination,” says [Ruthan Lewis](https://www.nasa.gov/nesc/academy/ruthan-lewis-bio" \t "_blank), a biomechanical and industrial engineer, architect, and a leader on NASA’s South Pole site analysis and planning team. “So, we’re looking at distances, elevations, and slopes in our planning.”

At the Moon, it’s critical to keep the area around the landing site and base camp as pristine as possible for scientists. For instance, among the many interesting features of the South Pole region is its location right between the Earth-facing side of the Moon, or the near side, and the side we never see from Earth, known as the far side.

These two hemispheres are geologically very different, with the far side more heavily cratered and its crust thicker than on the near side. Scientists don’t know why the two sides formed this way.

The Artemis Base Camp has to be on the Earth-facing side to make it easier for engineers to use radio waves to communicate with astronauts working on the Moon. But scientists expect that over billions of years of meteorite impacts to the Moon’s surface, rocks, and dust from each hemisphere were kicked up and strewn about the other, so it’s possible that astronauts could collect samples of the far side from their base camp on the near side.

#### Scenario 1 – Warming:

#### Lunar observatory solves warming adaptation.

Ding et al. 17 (, Y., Liu, G. and Guo, H., 2017. Moon-based Earth observation: scientific concept and potential applications. [online] Volume 11, 2018. Available at: <https://www.tandfonline.com/doi/full/10.1080/17538947.2017.1356879> [Accessed 22 January 2022] Yixing Ding - Institute of Remote Sensing and Digital Earth, Chinese Academy of Sciences, Beijing, People’s Republic of China Guang Liu - Institute of Remote Sensing and Digital Earth, Chinese Academy of Sciences, Beijing, People’s Republic of China Huadong Guo - Institute of Remote Sensing and Digital Earth, Chinese Academy of Sciences, Beijing, People’s Republic of China.)-rahulpenu

4. Scientific goal of moon-based earth observation A basic question for moon-based Earth observation is, ‘What to see?’ According to the characteristics of moon-based Earth observation, the phenomena suitable for Moon-based Earth observation may have at least one of the following features: long-lasting, related to Sun–Earth–Moon motion, requires stable baseline observation, large-scale and describes multiple parameters. In the following sections, we will present several observation objectives to discuss in detail. 4.1. Solid earth dynamics Solid Earth tides, continental plate movement and glacier isostatic adjustment (GIA) are three typical large-scale solid Earth movements (Jiang et al. 2016), the measurement of which is a basic task of geodesy. For a uniform layered Earth, accurately predicting tidal movement can be done theoretically, but complex ocean tides and the inelasticity and heterogeneity of Earth’s interior material make the solid tide of the real Earth difficult to research theoretically. For GIA studies, prior knowledge about ancient ice cover evolution and a large amount of observational data are needed. Plate tectonics theory is a quantitative description of Earth plate movement (Ni et al. 2016). It may well explain the movement of most oceanic plates, but still have some problems to explain the mechanism of strong continental earthquakes, large-scale continental deformation, as well as the movements of other oceanic plates (Bird 2003). Accurately **measuring** solid **Earth** **dynamics** is **beneficial** **to** **understanding** solid Earth **tides**, **continental** **plate** **movement** and **GIA**, and provides further support for geodynamics and seismology. Devices such as a superconducting gravimeter and global navigation satellite system are currently used to measure small deformations of solid Earth, but these point-by-point methods are spatially limited to certain regions. Spaceborne InSAR measures deformation continuously, but the swath is not wide enough for mapping large-scale solid Earth movement. The Moon is a vast and stable platform that can provide sufficiently long and stable baseline interferometry. Its movement is easier to predict and the time interval of repeat-pass interferometry could be reduced to one day (Fornaro et al. 2010). In addition, the Moon is one of the main sources of tides on the Earth; so if we compare two measurements at different times, the lunar tide portion can be subtracted, leaving only the solar tide portion. After proper processing, it may help us learn more about the interior structure of Earth’s crust. To measure the large-scale deformation, a Moon-based repeat-pass InSAR system needs to be carefully designed. Except for the general SAR parameters, the critical baseline is a key factor that impacts its performance. The critical baseline Bc leading to a complete spatial decorrelation is given by Bc = BlDem tan ui c . (7) In this equation, the incidence angle ui is related to the observational geometry, while l and B are optional. When the bandwidth is 100 MHz and the incidence angle is 25°, the critical baselines are 14,000, 3300 and 1770 km at the L-band, C-band and X-band, respectively. In order to keep the correlation between two repeat passes, a practical baseline must be smaller than Bc. Therefore, from a practical point of view, the L-band is better than the C-band or X-band. Figure 4 shows the simulation results of one-day interval interferometry, but the side-looking constraints are not involved. In this case, the temporal decorrelation is highly reduced. It is obvious that the interferometric area is larger in the L-band than in X-band. Meanwhile, when the declination of the Moon is near the extremes, the interferometric area becomes larger. When the declination of the Moon is near the equatorial plane, one-day interval repeat-pass interferometry is not feasible, but a half month or one month interval repeat-pass interferometry is available. The magnitude of the solid Earth motion is not large. For example, the typical solid Earth tide amplitude is dozens of centimetres in one day. A resolution of hundreds of metres or even coarser will be enough if the wave is stably scattered. 4.2. Energy budget of earth Fundamentally, **climate** **change** **depends** **on** Earth’s **radiation** **balance**. **Observation** **of** both the solar **radiation** **and** Earth’s **reflection** and emission will **depend** **on** **accurate** **measurement** with space technology. Since the late 1970s, the United States and Europe have launched a number of missions to measure solar and terrestrial radiation, such as NASA’s Active Cavity Radiometer Irradiance Monitor Series programme (ACRIM1, 1980–1989; ACRIM2, 1991–2001; ACRIM3, 2000–present), Earth Radiation Budget Experiment (ERBE, 1984–1994), Clouds and Earth’s Radiant Energy System (CERES, 1997–present), Solar Radiation and Climate Experiment (SORCE, 2003–present) and the French Megha-Tropiques satellite on the Scanner for Radiation Budget (ScaRaB, 2011–present). These missions have greatly improved our understanding of Earth’s energy system. The Deep Space Climate Observatory (DSCOVR), placed at the earth–Sun first Lagrangian point, has been designed to measure the outgoing radiation of the sunlit Earth disk with a constant look angle. But in the outgoing radiation, the reflected shortwave **radiation** is **highly** **affected** **by** **albedo** **and** **atmospheric** **conditions**, showing obvious anisotropy. **Lack** **of** **sampling** in space and time is **vulnerable** **to** **uncertainties**. The **lunar** **observatory** **provides** **large**-**scale** **observation** **with** continuously **changing** **angles**, enabling it to calibrate the **data** of satellites in different orbits at different times. Its most important property is that it can provide a **very** **long**-**term** time series from a single orbit platform. In a year, the time series covers all local times, all seasons (different weather pattern) and all Earth phases for all underlying surfaces (Pallé and Goode 2009; Karalidi et al. 2012). The diversity of the **surface**-**weatherphase** combination is beneficial to improving the quality of global energy budget data and to the study of regional energy redistribution and its multi-layer coupling effects. The Moon-based data will also provide a direct connection between the data from space technology and the data from ground-based earthshine measurement series, which span almost one hundred years. The system design can consult the DSCOVR satellite, a radiometer measuring irradiance of the Earth phase and an imaging camera taking images of the Earth phase for various Earth sciences purposes. In order to take into account the needs of observing the Earth’s environmental elements, 1 km spatial resolution and 20–30 channels of the camera are suggested. 4.3. Earth’s environmental elements Vegetation is an important part of the global carbon pool and a key element of global carbon cycle. Most vegetation is distributed in middle- and low-latitude regions. A Moon-based optical camera can image global **vegetation** almost every day. SAR maps not only the horizontal distribution of vegetation, but also extracts forest morphological structure through tomography. The Moon provides multi-baseline **accessibility** within a single pass to eliminate the tomographic temporal decorrelation, but the imaging temporal decorrelation within a long synthetic aperture time hampers the focusing of forest. Therefore, to validate the feasibility of Moon-based **3D** **mapping** of forest, more imaging methods for unstable scatterer, for example, the time reversal imaging method (Jin and Moura 2007), need to be tested and new methods are also expected. Glaciers are sensitive variables of climate change. The monitoring of glacier area, surface velocity and mass balance plays an important role in understanding the status of glaciers and their response to global change. Remote sensing techniques, such as optical sensors, SAR and altimeter data, provide regular observations of key glacial parameters. A lunar platform would provide continuous three- or four-day temporal coverage per month at the polar regions, but the observation incidence angle would typically be larger than 40° (see Figure 5) due to the relatively small inclination angle of the lunar orbit. For the High Asia area, the average coverage is about 4 h per day with proper incidence angle. The challenges may be the cost of high-resolution mapping for the optical sensor, and the layover problem (Tilley and Bonwit 1989) in heavy gradient area for SAR. Moon-based altimetry faces the same problems as LiDAR mentioned before, and is not recommended. An **atmospheric** **observatory** on the Moon can be used to evaluate the cloud fraction in an unambiguous manner, **determine** the **composition** in terms **of** the major **trace** **gas** and aerosols (Hamill 2016), and shed light on the relationship between lunar phases and **cloudiness** or **precipitation**. Particularly, the Moon offers a good place for **occultation** observation, which means observing the light or microwave changes emitted by stars or satellites when they are obstructed by atmosphere around the Earth. The Global Ozone Monitoring by Occultation of Stars (GOMOS) instrument on board the Envisat satellite is a typical system using the stellar occultation measurement principle in monitoring ozone and other trace gases in Earth’s stratosphere (Kyrola et al. 2004). Moon-based occultation was proposed in Link (1969), and was considered promising in Moon-based Earth atmosphere monitoring (Hamill 2007, 2016; Guo et al. 2014). The advantage of Moon-based occultation is that a star descends several times slower through the atmosphere than when viewed from a LEO satellite. This helps by increasing the SNR and resolution to some extent, but the practical performance also relies on the system design and the probability of finding an appropriate occultation geometry. 4.4. Earth-space environment Observing the environment of outer space surrounding Earth requires much larger FOV than only observing the solid Earth. The Moon is an ideal place to monitor the interaction between the solar wind and the magnetosphere. Moon-based observation combined with high near-polar Earth orbit or Molniya orbit observations can help us construct the three-dimensional structure of the magnetosphere by X-ray and EUV remote imaging. Images in all meridian planes of the whole plasma layer have already been captured by the EUV camera on the Chang’e 3 lander. Some initial results reflect the basic features of the plasmasphere, and also verified the accessibility of high-quality data of magnetosphere from the Moon (Feng et al. 2014). 5. Conclusion In this paper, we propose the Moon as a platform for Earth observation with long-term, dynamic capabilities, mainly focusing on large-scale geoscience phenomena. The characteristics of a lunar platform, the sensors and the scientific objectives of Moon-based Earth observation are discussed in detail. A lunar platform could observe Earth in quite a different way, and give a long-lasting disk view, a stable baseline and a unique perspective. The proposed sensors include some optical sensors and SAR. LiDAR, altimeters and scatterometers may not be functional on the lunar surface mainly because of the long viewing distance, and Moon-based radiometers may not be necessary if spaceborne radiometers are effective enough. Though the cost is not discussed in this paper, a Moon-based SAR would be extremely expensive and face too many specific technical difficulties to be implemented at the present time. On the contrary, passive optical sensors, such as spectrographs and panchromatic cameras, are much easier to realize. The scientific objectives of Moon-based Earth observation include measuring solid Earth dynamics and the global energy budget, and monitoring Earth’s environment and the surrounding environment of outer space. Moon-based Earth observation will be effective in measuring solid Earth tides, detecting outgoing radiation, and monitoring the magnetosphere and some of Earth’s environmental elements. Finally, we suggest that numerical simulations are indispensable to validate the proposals and to address specific problems.

#### Moon Base is the only option and outweighs Satellites.

Ding et al. 17 (, Y., Liu, G. and Guo, H., 2017. Moon-based Earth observation: scientific concept and potential applications. [online] Volume 11, 2018. Available at: <https://www.tandfonline.com/doi/full/10.1080/17538947.2017.1356879> [Accessed 22 January 2022] Yixing Ding - Institute of Remote Sensing and Digital Earth, Chinese Academy of Sciences, Beijing, People’s Republic of China Guang Liu - Institute of Remote Sensing and Digital Earth, Chinese Academy of Sciences, Beijing, People’s Republic of China Huadong Guo - Institute of Remote Sensing and Digital Earth, Chinese Academy of Sciences, Beijing, People’s Republic of China.)

There are several characteristics of Moon-based Earth observation as listed below. (1) Longevity The life cycle of artificial satellites is generally several years, while the Moon has already existed for billions of years, and will not go extinct in the foreseeable future. It is a longstanding, essentially permanent platform. The revisit cycle is quite different from LEO satellite. Except for the polar regions, the revisit period is one day, the same as Earth’s rotation period. The revisit period in the same geometric condition is one month, the same as the moon’s revolution period. The temporal sampling of the lunar platform is not systematically biased. It covers all local times in a month and all seasons in a year. This will be very useful for long-term time series analysis in climate change research. Furthermore, the lunar platform can also provide time series data to calibrate the remote sensing data from other platforms. (2) Integrity The whole Earth disk facing the Moon, both the sunlit portion and dark portion, is always observable from the near side of the Moon, with a field angle of only about 2°. This allows an observer on the Moon to view the whole Earth disk at any given time and Earth’s entire surface in a day, both in dark and sunlit conditions. (3) Stability Studies show that the lunar crust lacks plate tectonics; so the quantity and degree of moonquake activities are much less than earthquakes (Jaumann et al. 2012). Compared to satellite platforms, the Moon has vast spaces on which to install a set of sensors to form a long, stable baseline of large observational networks for precise measurement. Moon also moves stably, which enables repeat-pass interferometry. (4) Uniqueness Moon exerts influences on precipitation, ice nuclei concentrations, diurnal pressure changes, hurricanes, cloudiness, thunderstorm and surface temperature (Balling and Cerveny 1995). The tidal force of the Moon is also considered as a trigger of earthquakes (Cochran et al. 2004) and a resource generating internal waves (Simmons et al. 2004). For those Moon-related terrestrial phenomena, the lunar platform provides such a unique perspective that any place on the Earth can be continuously monitored at different Moon–Earth phase angles each day. A Moon-based sensor can dynamically trace the whole process covering their occurrence, development and dissipation. It will help the understanding of the relationship between the tidal phases and the evolution of the phenomena. 3. Sensors for moon-based earth observation For most of the history of lunar exploration, the United States, China and Japan have been taking a few pictures of Earth with cameras both on the lunar surface and in lunar orbit. This proved that it is possible to observe Earth utilizing Moon-based optical sensors. However, except for observing Earth’s magnetosphere, these photos had no specific scientific objective. Few works about the sensors for Moon-based Earth observation have been published by previous missions. So, in this section we discuss the feasibility and the key parameters of various traditional remote sensors, including both the optical sensors and the microwave sensors. 3.1. Optical sensors for moon-based earth observation One important parameter of most remote sensing systems is the spatial resolution. The detection range of Moon-based optical sensors is much further than spaceborne sensors. The diffraction limited resolution of optical sensors r is given by = 1.22lR/d, (1) where l is the wavelength, d the telescopic aperture and R the distance from the sensor to the target. In the visible band, the limiting resolution is 0.17–0.36 km, when d is 1 m. In short, if the telescopic aperture is 0.5 m, the spatial resolution can be less than 1 km in the visible band and several kilometres in the near-infrared and thermal infrared bands, which satisfies the needs of climatologic models and global mapping for oceans, clouds and land use (Ding, Guo and Liu 2014). LiDAR is an example of an active sensor. To place a LiDAR on the Moon, many technological challenges must be taken into consideration, such as the echo power, the size of the laser beam on earth’s surface and the coverage performance. If the scattering solid angle of a homogeneous scatterer is p, the received power of this system falls within the square of the distance from LiDAR to scatterer R (Wagner et al. 2006): Pr = PtrD2 r 4R2 , (2) where the received power and transmitted power is Pr and Pt, Dr the receiving aperture and r the reflectivity. The power needed for Moon-based LiDAR would be a hundred thousand times greater than that of satellite-based LiDAR, which is at the megawatt level. The footprint of the laser beam on Earth’s surface is proportional to the laser divergence angle. Under a divergence of 0.1 m/rad, the beam of Moon-based LiDAR would be 36–40 km, two orders of magnitude larger than the beam width of spaceborne LiDAR. Such a large beam would stretch the length of the echo signal and complicate its waveform, and will lead to a difficulty to determine the exact echo position of the target in measuring the altitude of sea surface and the thickness of vegetation.

#### Adaptation solves Climate Change’s worst effects – it’s the Silver Bullet.

Rood and Gibbons 21 Richard B. Rood and Elizabeth Gibbons 9-11-2021 "After a summer of weather horrors, adapting to climate change is an imperative" <https://archive.is/VKac8#selection-391.0-413.1> (Richard B. (Ricky) Rood is a professor of climate and space sciences and engineering at the University of Michigan. Elizabeth (Beth) Gibbons is executive director of the American Society of Adaptation Professionals.)//Elmer

This summer, the extraordinary heat in the Pacific Northwest, floods across the Northern Hemisphere and Hurricane Ida’s swath across the country have awakened more people to the dangers of climate change. As professionals working on climate change, we receive many requests for comments and interviews. More telling, perhaps, have been panic-tinged personal letters from family and friends as well as colleagues working in the field awakening to the real-world consequences of our warming climate. Public messaging on climate change is dominated by the discussion of reducing carbon dioxide emissions to limit the warming and to stop the “worst effects” of climate change. This is the mitigation of global warming. Headlines range from declarations of climate despair to the measured voices of those who insist that there is still the time and wherewithal to limit warming to the goals aspired to by the United Nations. Amid this cacophony of mitigation panic and sought-after patience is another discussion that has been going on for more than a decade. Namely, that we are not likely to meet emission-reduction goals such as those of the Paris agreement. This is complemented by the fact that we live in a rapidly changing climate, rapid change will continue, and we are not going back to the climate of our childhoods. When we consider how we will address our climate future, it is worth considering our past behavior and choices. We have had the ability and the roadmap to make major strides in reducing carbon dioxide emissions and mitigating climate change for many years. In many cases, these mitigation tactics are “no regrets,” with very quick monetary payback for expenditures — the insulation of houses and choosing fuel-efficient vehicles, for example. Yet we have not taken these steps at the scales that are required for effective intervention. Mitigation is one response, but adaptation can be framed as the other response. Adaptation is responding to the effects of warming or perhaps coping with the consequences of the warming Earth. With the public conversation focusing overwhelmingly on mitigation, adaptation has been a neglected topic. Compared with mitigation, adaptation is relatively easy. Effective mitigation requires changing human behavior, ingrained geopolitical and economic power structures, and built infrastructure on a global scale. It requires convincing people to invest for the common good of other people, often decades into the future. At its simplest, adaptation can be carried out by an individual. You can sell the house next to the ocean and move to northern Michigan. You can reinforce your roof and put your oceanside house on stilts. There is a concrete value proposition. Although adaptation can be carried out by individuals, it is better and certainly more equitable to plan on the larger scales of a community, a city or a region. As the geographical scale increases and more individuals, organizations and local governments are involved, it does get more difficult. However, the threats to life, property and the local environment often serve as motivation to challenge the barriers of cooperation and shared beneficial outcomes. For example, a region threatened by rising seas is motivated to come together to find solution strategies. Indeed such efforts are underway, for example, in the Southeast Florida climate compact, the Puget Sound climate collaborative, and efforts across Southeast Virginia’s Hampton Roads region. When a region successfully implements adaptation plans, communities are likely to have wins when the next storm is not as destructive and costly. These wins help people cope with global warming and realize some ability to take control of what has been often stated as an existential threat. There have been those calling for adaptation policy for many years. However, it has been difficult to get adaptation on the policy agenda. This is ascribed to many reasons, including the persistent, spurious argument that if we talk of adaptation, then we will decide that we do not need to mitigate our emissions. However, we are at the point that, even if we were to meet all of the emission reduction goals of the United Nations’ Paris agreement, adaptation will still be required. In the end, the most important aspect of adaptation is fundamentally human. If individuals and communities can see adaptation as a way of sustaining their well-being in the face of rapidly changing weather, then it is a step of moving past the narrative that we must, between now and 2030, solve an existential threat to our survival. We can see successful adaptation strategies spreading, scaling, and bringing planetary warming into the mind-set and the behavior of more and more people. We must entrain dealing with the weather of a warming Earth into all that we do. And that, we assert, will make the need for mitigation more real and urgent.

#### Missing Data holds back Adaptation efforts.

Barrios et Al 18, Alonso, Guillermo Trincado, and René Garreaud. "Alternative approaches for estimating missing climate data: application to monthly precipitation records in South-Central Chile." Forest Ecosystems 5.1 (2018): 1-10. (Graduate School, Faculty of Forest Sciences and Natural Resources)

The effects of climate on natural resources have become highly relevant (Cannell et al. 1995). In forestry, there is an increasing interest to study the influence of climate on forest productivity (Álvarez et al. 2013), forest hydrology (Dai et al. 2011), soil water availability (Ge et al. 2013), and wood quality (Xu et al. 2013). Nowadays, climate data are also required for parameterizing process-based simulators of tree growth (Sands and Landsberg 2002) and for studying forest water balance (Huber and Trecaman 2002), phenology processes (Caveside et al. 2005) and to carry out pest and disease research (Ahumada et al. 2013). To perform these studies, complete and homogenous climate data that covers a sufficiently long period of time is required (Teegavarapu 2012; Khosravi et al. 2015). Climate data often have missing information that limits their use (Alfaro and Pacheco 2000). Missing values in climate series affects parameter estimation when applying regression and multivariate analysis techniques (Ramos-Calzado et al. 2008). In most cases, some techniques must be applied to estimate missing data. In forestry, there are few studies that have compared the accuracy of different approaches. Furthermore, factors that might affect their precision have not been studied in detail. The simplest approach for imputing missing values involves the data being filled-in. The main limitation is that these approaches are suitable for small gaps and can only be applied to climate variables with a high degree of autocorrelation (Khosravi et al. 2015), which is not the case for annual mean temperatures or precipitation values. A more common approach to complete missing data is to use information from neighboring meteorological stations (Vasiliev 1996), using techniques such as inverse distance weighting (IDW). Nonetheless, horizontal distance is not a measure of spatial autocorrelation (e.g., Ahrens 2006; Ramos-Calzado et al. 2008), especially when the region contains prominent topographic features or major water bodies. Indeed, two relatively close stations can feature substantial differences in their mean climate and climate variability if they are located at opposite sides of a mountain range. Spatial correlations could be quantified by calculating the correlation coefficient between time series obtained at different locations. Teegavarapu and Chandramouli (2005) found that replacing distances with correlation coefficients as weights improved estimation of missing precipitation data. The resulting method is known as a coefficient of correlation weighting (CCW), reported by Teegavarapu (2009).

#### That causes extinction.

Sears 21 (, N., 2021. Great Powers, Polarity, and Existential Threats to Humanity: An Analysis of the Distribution of the Forces of Total Destruction in International Security. [online] ResearchGate. Available at: <https://www.researchgate.net/publication/350500094> [Accessed 22 November 2021] Nathan Alexander Sears is a PhD Candidate in Political Science at The University of Toronto. Before beginning his PhD, he was a Professor of International Relations at the Universidad de Las Américas, Quito. His research focuses on international security and the existential threats to humanity posed by nuclear weapons, climate change, biotechnology, and artificial intelligence. His PhD dissertation is entitled, “International Politics in the Age of Existential Threats”)-re-cut rahulpenu

Climate Change Humanity faces existential risks from the large-scale destruction of Earth’s natural environment making the planet less hospitable for humankind (Wallace-Wells 2019). The decline of some of Earth’s natural systems may already exceed the “planetary boundaries” that represent a “safe operating space for humanity” (Rockstrom et al. 2009). Humanity has become one of the driving forces behind Earth’s climate system (Crutzen 2002). The major anthropogenic drivers of climate change are the burning of fossil fuels (e.g., coal, oil, and gas), combined with the degradation of Earth’s natural systems for absorbing carbon dioxide, such as deforestation for agriculture (e.g., livestock and monocultures) and resource extraction (e.g., mining and oil), and the warming of the oceans (Kump et al. 2003). While humanity has influenced Earth’s climate since at least the Industrial Revolution, the dramatic increase in greenhouse gas emissions since the mid-twentieth century—the “Great Acceleration” (Steffen et al. 2007; 2015; McNeill & Engelke 2016)— is responsible for contemporary climate change, which has reached approximately 1°C above preindustrial levels (IPCC 2018). Climate change could become an existential threat to humanity if the planet’s climate reaches a “Hothouse Earth” state (Ripple et al. 2020). What are the dangers? There are two mechanisms of climate change that threaten humankind. The direct threat is extreme heat. While human societies possesses some capacity for adaptation and resilience to climate change, the physiological response of humans to heat stress imposes physical limits—with a hard limit at roughly 35°C wet-bulb temperature (Sherwood et al. 2010). A rise in global average temperatures by 3–4°C would increase the risk of heat stress, while 7°C could render some regions uninhabitable, and 11–12°C would leave much of the planet too hot for human habitation (Sherwood et al. 2010). The indirect effects of climate change could include, inter alia, rising sea levels affecting coastal regions (e.g., Miami and Shanghai), or even swallowing entire countries (e.g., Bangladesh and the Maldives); extreme and unpredictable weather and natural disasters (e.g., hurricanes and forest fires); environmental pressures on water and food scarcity (e.g., droughts from less-dispersed rainfall, and lower wheat-yields at higher temperatures); the possible inception of new bacteria and viruses; and, of course, large-scale human migration (World Bank 2012; Wallace-Well 2019; Richards, Lupton & Allywood 2001). While it is difficult to determine the existential implications of extreme environmental conditions, there are historic precedents for the collapse of human societies under environmental pressures (Diamond 2005). Earth’s “big five” mass extinction events have been linked to dramatic shifts in Earth’s climate (Ward 2008; Payne & Clapham 2012; Kolbert 2014; Brannen 2017), and a Hothouse Earth climate would represent terra incognita for humanity. Thus, the assumption here is that a Hothouse Earth climate could pose an existential threat to the habitability of the planet for humanity (Steffen et al. 2018., 5). At what point could climate change cross the threshold of an existential threat to humankind? The complexity of Earth’s natural systems makes it extremely difficult to give a precise figure (Rockstrom et al. 2009; ). However, much of the concern about climate change is over the danger of crossing “tipping points,” whereby positive feedback loops in Earth’s climate system could lead to potentially irreversible and self-reinforcing “runaway” climate change. For example, the melting of Arctic “permafrost” could produce additional warming, as glacial retreat reduces the refractory effect of the ice and releases huge quantities of methane currently trapped beneath it. A recent study suggests that a “planetary threshold” could exist at global average temperature of 2°C above preindustrial levels (Steffen et al. 2018; also IPCC 2018). Therefore, the analysis here takes the 2°C rise in global average temperatures as representing the lower-boundary of an existential threat to humanity, with higher temperatures increasing the risk of runaway climate change leading to a Hothouse Earth. The Paris Agreement on Climate Change set the goal of limiting the increase in global average temperatures to “well below” 2°C and to pursue efforts to limit the increase to 1.5°C. If the Paris Agreement goals are met, then nations would likely keep climate change below the threshold of an existential threat to humanity. According to Climate Action Tracker (2020), however, current policies of states are expected to produce global average temperatures of 2.9°C above preindustrial levels by 2100 (range between +2.1 and +3.9°C), while if states succeed in meeting their pledges and targets, global average temperatures are still projected to increase by 2.6°C (range between +2.1 and +3.3°C). Thus, while the Paris Agreements sets a goal 6 that would reduce the existential risk of climate change, the actual policies of states could easily cross the threshold that would constitute an existential threat to humanity (CAT 2020).

### 1AC – Framework

#### Pleasure and pain are intrinsic value and disvalue – everything else regresses – robust neuroscience.

Blum et al. 18

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**Pleasure** is not only one of the three primary reward functions but it also **defines reward.** As homeostasis explains the functions of only a limited number of rewards, the principal reason why particular stimuli, objects, events, situations, and activities are rewarding may be due to pleasure. This applies first of all to sex and to the primary homeostatic rewards of food and liquid and extends to money, taste, beauty, social encounters and nonmaterial, internally set, and intrinsic rewards. Pleasure, as the primary effect of rewards, drives the prime reward functions of learning, approach behavior, and decision making and provides the **basis for hedonic theories** of reward function. We are attracted by most rewards and exert intense efforts to obtain them, just because they are enjoyable [10]. Pleasure is a passive reaction that derives from the experience or prediction of reward and may lead to a long-lasting state of happiness. The word happiness is difficult to define. In fact, just obtaining physical pleasure may not be enough. One key to happiness involves a network of good friends. However, it is not obvious how the higher forms of satisfaction and pleasure are related to an ice cream cone, or to your team winning a sporting event. Recent multidisciplinary research, using both humans and detailed invasive brain analysis of animals has discovered some critical ways that the brain processes pleasure [14]. Pleasure as a hallmark of reward is sufficient for defining a reward, but it may not be necessary. A reward may generate positive learning and approach behavior simply because it contains substances that are essential for body function. When we are hungry, we may eat bad and unpleasant meals. A monkey who receives hundreds of small drops of water every morning in the laboratory is unlikely to feel a rush of pleasure every time it gets the 0.1 ml. Nevertheless, with these precautions in mind, we may define any stimulus, object, event, activity, or situation that has the potential to produce pleasure as a reward. In the context of reward deficiency or for disorders of addiction, homeostasis pursues pharmacological treatments: drugs to treat drug addiction, obesity, and other compulsive behaviors. The theory of allostasis suggests broader approaches - such as re-expanding the range of possible pleasures and providing opportunities to expend effort in their pursuit. [15]. It is noteworthy, the first animal studies eliciting approach behavior by electrical brain stimulation interpreted their findings as a discovery of the brain’s pleasure centers [16] which were later partly associated with midbrain dopamine neurons [17–19] despite the notorious difficulties of identifying emotions in animals. Evolutionary theories of pleasure: The love connection BO:D Charles Darwin and other biological scientists that have examined the biological evolution and its basic principles found various mechanisms that steer behavior and biological development. Besides their theory on natural selection, it was particularly the sexual selection process that gained significance in the latter context over the last century, especially when it comes to the question of what makes us “what we are,” i.e., human. However, the capacity to sexually select and evolve is not at all a human accomplishment alone or a sign of our uniqueness; yet, we humans, as it seems, are ingenious in fooling ourselves and others–when we are in love or desperately search for it. It is well established that modern biological theory conjectures that **organisms are** the **result of evolutionary competition.** In fact, Richard Dawkins stresses gene survival and propagation as the basic mechanism of life [20]. Only genes that lead to the fittest phenotype will make it. It is noteworthy that the phenotype is selected based on behavior that maximizes gene propagation. To do so, the phenotype must survive and generate offspring, and be better at it than its competitors. Thus, the ultimate, distal function of rewards is to increase evolutionary fitness by ensuring the survival of the organism and reproduction. It is agreed that learning, approach, economic decisions, and positive emotions are the proximal functions through which phenotypes obtain other necessary nutrients for survival, mating, and care for offspring. Behavioral reward functions have evolved to help individuals to survive and propagate their genes. Apparently, people need to live well and long enough to reproduce. Most would agree that homo-sapiens do so by ingesting the substances that make their bodies function properly. For this reason, foods and drinks are rewards. Additional rewards, including those used for economic exchanges, ensure sufficient palatable food and drink supply. Mating and gene propagation is supported by powerful sexual attraction. Additional properties, like body form, augment the chance to mate and nourish and defend offspring and are therefore also rewards. Care for offspring until they can reproduce themselves helps gene propagation and is rewarding; otherwise, many believe mating is useless. According to David E Comings, as any small edge will ultimately result in evolutionary advantage [21], additional reward mechanisms like novelty seeking and exploration widen the spectrum of available rewards and thus enhance the chance for survival, reproduction, and ultimate gene propagation. These functions may help us to obtain the benefits of distant rewards that are determined by our own interests and not immediately available in the environment. Thus the distal reward function in gene propagation and evolutionary fitness defines the proximal reward functions that we see in everyday behavior. That is why foods, drinks, mates, and offspring are rewarding. There have been theories linking pleasure as a required component of health benefits salutogenesis, (salugenesis). In essence, under these terms, pleasure is described as a state or feeling of happiness and satisfaction resulting from an experience that one enjoys. Regarding pleasure, it is a double-edged sword, on the one hand, it promotes positive feelings (like mindfulness) and even better cognition, possibly through the release of dopamine [22]. But on the other hand, pleasure simultaneously encourages addiction and other negative behaviors, i.e., motivational toxicity. It is a complex neurobiological phenomenon, relying on reward circuitry or limbic activity. It is important to realize that through the “Brain Reward Cascade” (BRC) endorphin and endogenous morphinergic mechanisms may play a role [23]. While natural rewards are essential for survival and appetitive motivation leading to beneficial biological behaviors like eating, sex, and reproduction, crucial social interactions seem to further facilitate the positive effects exerted by pleasurable experiences. Indeed, experimentation with addictive drugs is capable of directly acting on reward pathways and causing deterioration of these systems promoting hypodopaminergia [24]. Most would agree that pleasurable activities can stimulate personal growth and may help to induce healthy behavioral changes, including stress management [25]. The work of Esch and Stefano [26] concerning the link between compassion and love implicate the brain reward system, and pleasure induction suggests that social contact in general, i.e., love, attachment, and compassion, can be highly effective in stress reduction, survival, and overall health. Understanding the role of neurotransmission and pleasurable states both positive and negative have been adequately studied over many decades [26–37], but comparative anatomical and neurobiological function between animals and homo sapiens appear to be required and seem to be in an infancy stage. Finding happiness is different between apes and humans As stated earlier in this expert opinion one key to happiness involves a network of good friends [38]. However, it is not entirely clear exactly how the higher forms of satisfaction and pleasure are related to a sugar rush, winning a sports event or even sky diving, all of which augment dopamine release at the reward brain site. Recent multidisciplinary research, using both humans and detailed invasive brain analysis of animals has discovered some critical ways that the brain processes pleasure. Remarkably, there are pathways for ordinary liking and pleasure, which are limited in scope as described above in this commentary. However, there are **many brain regions**, often termed hot and cold spots, that significantly **modulate** (increase or decrease) our **pleasure or** even **produce the opposite** of pleasure— that is disgust and fear [39]. One specific region of the nucleus accumbens is organized like a computer keyboard, with particular stimulus triggers in rows— producing an increase and decrease of pleasure and disgust. Moreover, the cortex has unique roles in the cognitive evaluation of our feelings of pleasure [40]. Importantly, the interplay of these multiple triggers and the higher brain centers in the prefrontal cortex are very intricate and are just being uncovered. Desire and reward centers It is surprising that many different sources of pleasure activate the same circuits between the mesocorticolimbic regions (Figure 1). Reward and desire are two aspects pleasure induction and have a very widespread, large circuit. Some part of this circuit distinguishes between desire and dread. The so-called pleasure circuitry called “REWARD” involves a well-known dopamine pathway in the mesolimbic system that can influence both pleasure and motivation. In simplest terms, the well-established mesolimbic system is a dopamine circuit for reward. It starts in the ventral tegmental area (VTA) of the midbrain and travels to the nucleus accumbens (Figure 2). It is the cornerstone target to all addictions. The VTA is encompassed with neurons using glutamate, GABA, and dopamine. The nucleus accumbens (NAc) is located within the ventral striatum and is divided into two sub-regions—the motor and limbic regions associated with its core and shell, respectively. The NAc has spiny neurons that receive dopamine from the VTA and glutamate (a dopamine driver) from the hippocampus, amygdala and medial prefrontal cortex. Subsequently, the NAc projects GABA signals to an area termed the ventral pallidum (VP). The region is a relay station in the limbic loop of the basal ganglia, critical for motivation, behavior, emotions and the “Feel Good” response. This defined system of the brain is involved in all addictions –substance, and non –substance related. In 1995, our laboratory coined the term “Reward Deficiency Syndrome” (RDS) to describe genetic and epigenetic induced hypodopaminergia in the “Brain Reward Cascade” that contribute to addiction and compulsive behaviors [3,6,41]. Furthermore, ordinary “liking” of something, or pure pleasure, is represented by small regions mainly in the limbic system (old reptilian part of the brain). These may be part of larger neural circuits. In Latin, hedus is the term for “sweet”; and in Greek, hodone is the term for “pleasure.” Thus, the word Hedonic is now referring to various subcomponents of pleasure: some associated with purely sensory and others with more complex emotions involving morals, aesthetics, and social interactions. The capacity to have pleasure is part of being healthy and may even extend life, especially if linked to optimism as a dopaminergic response [42]. Psychiatric illness often includes symptoms of an abnormal inability to experience pleasure, referred to as anhedonia. A negative feeling state is called dysphoria, which can consist of many emotions such as pain, depression, anxiety, fear, and disgust. Previously many scientists used animal research to uncover the complex mechanisms of pleasure, liking, motivation and even emotions like panic and fear, as discussed above [43]. However, as a significant amount of related research about the specific brain regions of pleasure/reward circuitry has been derived from invasive studies of animals, these cannot be directly compared with subjective states experienced by humans. In an attempt to resolve the controversy regarding the causal contributions of mesolimbic dopamine systems to reward, we have previously evaluated the three-main competing explanatory categories: “liking,” “learning,” and “wanting” [3]. That is, dopamine may mediate (a) liking: the hedonic impact of reward, (b) learning: learned predictions about rewarding effects, or (c) wanting: the pursuit of rewards by attributing incentive salience to reward-related stimuli [44]. We have evaluated these hypotheses, especially as they relate to the RDS, and we find that the incentive salience or “wanting” hypothesis of dopaminergic functioning is supported by a majority of the scientific evidence. Various neuroimaging studies have shown that anticipated behaviors such as sex and gaming, delicious foods and drugs of abuse all affect brain regions associated with reward networks, and may not be unidirectional. Drugs of abuse enhance dopamine signaling which sensitizes mesolimbic brain mechanisms that apparently evolved explicitly to attribute incentive salience to various rewards [45]. Addictive substances are voluntarily self-administered, and they enhance (directly or indirectly) dopaminergic synaptic function in the NAc. This activation of the brain reward networks (producing the ecstatic “high” that users seek). Although these circuits were initially thought to encode a set point of hedonic tone, it is now being considered to be far more complicated in function, also encoding attention, reward expectancy, disconfirmation of reward expectancy, and incentive motivation [46]. The argument about addiction as a disease may be confused with a predisposition to substance and nonsubstance rewards relative to the extreme effect of drugs of abuse on brain neurochemistry. The former sets up an individual to be at high risk through both genetic polymorphisms in reward genes as well as harmful epigenetic insult. Some Psychologists, even with all the data, still infer that addiction is not a disease [47]. Elevated stress levels, together with polymorphisms (genetic variations) of various dopaminergic genes and the genes related to other neurotransmitters (and their genetic variants), and may have an additive effect on vulnerability to various addictions [48]. In this regard, Vanyukov, et al. [48] suggested based on review that whereas the gateway hypothesis does not specify mechanistic connections between “stages,” and does not extend to the risks for addictions the concept of common liability to addictions may be more parsimonious. The latter theory is grounded in genetic theory and supported by data identifying common sources of variation in the risk for specific addictions (e.g., RDS). This commonality has identifiable neurobiological substrate and plausible evolutionary explanations. Over many years the controversy of dopamine involvement in especially “pleasure” has led to confusion concerning separating motivation from actual pleasure (wanting versus liking) [49]. We take the position that animal studies cannot provide real clinical information as described by self-reports in humans. As mentioned earlier and in the abstract, on November 23rd, 2017, evidence for our concerns was discovered [50] In essence, although nonhuman primate brains are similar to our own, the disparity between other primates and those of human cognitive abilities tells us that surface similarity is not the whole story. Sousa et al. [50] small case found various differentially expressed genes, to associate with pleasure related systems. Furthermore, the dopaminergic interneurons located in the human neocortex were absent from the neocortex of nonhuman African apes. Such differences in neuronal transcriptional programs may underlie a variety of neurodevelopmental disorders. In simpler terms, the system controls the production of dopamine, a chemical messenger that plays a significant role in pleasure and rewards. The senior author, Dr. Nenad Sestan from Yale, stated: “Humans have evolved a dopamine system that is different than the one in chimpanzees.” This may explain why the behavior of humans is so unique from that of non-human primates, even though our brains are so surprisingly similar, Sestan said: “It might also shed light on why people are vulnerable to mental disorders such as autism (possibly even addiction).” Remarkably, this research finding emerged from an extensive, multicenter collaboration to compare the brains across several species. These researchers examined 247 specimens of neural tissue from six humans, five chimpanzees, and five macaque monkeys. Moreover, these investigators analyzed which genes were turned on or off in 16 regions of the brain. While the differences among species were subtle, **there was** a **remarkable contrast in** the **neocortices**, specifically in an area of the brain that is much more developed in humans than in chimpanzees. In fact, these researchers found that a gene called tyrosine hydroxylase (TH) for the enzyme, responsible for the production of dopamine, was expressed in the neocortex of humans, but not chimpanzees. As discussed earlier, dopamine is best known for its essential role within the brain’s reward system; the very system that responds to everything from sex, to gambling, to food, and to addictive drugs. However, dopamine also assists in regulating emotional responses, memory, and movement. Notably, abnormal dopamine levels have been linked to disorders including Parkinson’s, schizophrenia and spectrum disorders such as autism and addiction or RDS. Nora Volkow, the director of NIDA, pointed out that one alluring possibility is that the neurotransmitter dopamine plays a substantial role in humans’ ability to pursue various rewards that are perhaps months or even years away in the future. This same idea has been suggested by Dr. Robert Sapolsky, a professor of biology and neurology at Stanford University. Dr. Sapolsky cited evidence that dopamine levels rise dramatically in humans when we anticipate potential rewards that are uncertain and even far off in our futures, such as retirement or even the possible alterlife. This may explain what often motivates people to work for things that have no apparent short-term benefit [51]. In similar work, Volkow and Bale [52] proposed a model in which dopamine can favor NOW processes through phasic signaling in reward circuits or LATER processes through tonic signaling in control circuits. Specifically, they suggest that through its modulation of the orbitofrontal cortex, which processes salience attribution, dopamine also enables shilting from NOW to LATER, while its modulation of the insula, which processes interoceptive information, influences the probability of selecting NOW versus LATER actions based on an individual’s physiological state. This hypothesis further supports the concept that disruptions along these circuits contribute to diverse pathologies, including obesity and addiction or RDS.

#### Thus, the standard is maximizing expected well-being or act hedonistic util. Prefer additionally –

#### 1] Death is bad and outweighs – a) agents can’t act if they fear for their bodily security which constrains every ethical theory, b) it destroys the subject itself – kills any ability to achieve value in ethics since life is a prerequisite which means it’s a side constraint since we can’t reach the end goal of ethics without life

#### 2] Actor spec—governments must use util because they don’t have intentions and are constantly dealing with tradeoffs—outweighs since different agents have different obligations—takes out calc indicts since they are empirically denied.

#### Extinction first –

#### 1 – Forecloses future improvement – we can never improve society because our impact is irreversible

#### 2 – Turns suffering – mass death causes suffering because people can’t get access to resources and basic necessities

#### 3 – Moral obligation – allowing people to die is unethical and should be prevented because it creates ethics towards other people

#### 4 – Objectivity – body count is the most objective way to calculate impacts because comparing suffering is unethical

#### 5 – Moral uncertainty – if we’re unsure about which interpretation of the world is true – we ought to preserve the world to keep debating about it

### 1AC – Method

#### The 1AC foreclosed a chance to develop skills of space policy literacy - space scenario planning can develop emancipatory skills, combat inequality, and fracture expertism in space activities - without stifling the 1AC’s radical energies.

Weeks, 12—Adjunct Professor of International Relations Online Program, Webster University (Edythe, “OUTER SPACE DEVELOPMENT: THE SOLUTION FOR GLOBAL INEQUALITY,” *Outer Space Development, International Relations and Space Law: A Method for Elucidating Seeds*, Chapter 7, pg 171-174, dml)

This is the time to discuss equality. Once societies in outer space are established it will be too late. The first wave of outer space development in the last half of the 20th century changed the world. This process included establishing a satellite telecommunications infrastructure in the geostationary orbit along with the globalization of new high-tech products and services. The retirement of the NASA space shuttle program symbolized the start of the second wave of outer space development, which is likely to be propelled by the privatization of space tourism and space mining. This type of space industrialization will undoubtedly result in extreme wealth for a few who know what is happening, while those who have no knowledge will be left behind. Decision makers, scholars, trouble-shooters, and others worry constantly about existing inequality gaps, lack of development, poverty, and economic hardship. This chapter suggests a method for preventative maintenance prior to humankind’s next development project. It argues that education, information, and sharing knowledge can become tools for generating perpetual equality as we embark on our journey to colonize the final frontier. Those historically disenfranchised can gain a fresh advantage through preparation and education to develop an expertise aimed at providing valuable knowledge useful for space endeavors. In addition, in these times of crashing economies, job loss, high unemployment rates, and school system failures, people are searching for ways to create prosperous futures for themselves and their families. Outer space could prove to be a way for many to find their answer. Newly Emerging Trends Relevant for Outer Space Development The passage of the NASA Authorization Act of 2010 demonstrates a willingness by the U.S. to fund a stepped-up phase of space activities. During bad economic times, this Act provides $58,400,000,000 for various space-related programs from 2011 to 2013. In 2010/2011, media reports constantly alerted the general public to be ready for the retirement of the NASA Space Shuttle program. This initiative complemented the New Vision for U.S. Space Exploration Policy (2004), as well as various other laws and policies initiated by the United States and discussed in previous chapters. When read together, it is fair to assume the newly emerging space industries will be related to achieving advanced space transportation systems, private spacecraft development, commercial space habitats, space stations, space settlements, commercial space mining, spacecraft trajectory optimization techniques for landing on near-Earth asteroids, commercial spaceport construction, interplanetary telecommunications, and space exploration missions. The thing for teachers, students, and members of the general public to do in order to prepare to take advantage of these linked opportunities is to imagine how these goals are likely to play out, and what types of goods, services, and skill-sets will be needed. Education as the Solution Outer space development historically has been the purview of skilled professionals in the science, technology, engineering, and math (STEM) fields. The STEM-oriented opportunities for those proficient in physics, astrophysics, space medicine, engineering, calculus, etc., have always been limited to a few select students. But now global society is calling for something, more since the STEM fields have failed to attract diverse people on an equal footing.186 A bridge can be created by using social and behavioral sciences curricula, thereby to attract people from a wider range of backgrounds to learn about outer space development and newly emerging industries. New education paradigms can help ensure equity and enable wider citizen participation throughout the international community. Curricula using the new paradigm can be used to motivate and inspire a new generation of scholars who can play a key role in the process of outer space development. In effect, an educational system that unleashes human creativity and curiosity will empower students with the knowledge and competencies not only for the second wave of outer space development, but also for the global engagement necessary for the 21st century and beyond (Weeks and Tamashiro, 2011). It is never too early to begin cultivating a person’s intellectual and academic talents. Most children are naturally curious. As part of the curriculum, students of all ages can be shown how to do research, how to write a research paper, to compile and present data, perform critical analytical thinking, and to anticipate and develop relevant skill-sets for newly emerging industry trends. Learning these skills will enable more people to develop an expertise aimed at supplying talent that will be in demand as future industries emerge. This can change people’s lives. Students can learn how to anticipate and prepare for future emerging industries while they are at the K-12 level. Students can also learn at young ages how to get recognized by publishers, editors, the mass media, and others. In situations where the resources necessary for teaching science are unavailable, space studies can be introduced through the social and behavioral sciences and the arts. For many years, space studies has remained the exclusive purview of engineers, scientists, and technology experts. However, there is room at the table for social and behavioral sciences students to join in and develop a specialty area of expertise. Key actors within the outer space development community have expressed an interest in advancing space studies to a broader audience. Orchestrating such a process carries with it the power to improve international relations, education, inspiration, dreams, and creativity, and to boost the global economy by creating a myriad of new jobs and degree programs. We can open an additional door to allow a broader range of knowledge into the minds of more people by introducing outer space development studies through the social and behavioral sciences (Hammond and Weeks, 2011). Unlike engineering, an interdisciplinary social and behavioral sciences lens enables us to interpret the meaning behind sets and patterns of human behaviors—this includes the behavior of individuals, institutions, groups, presidents, members of congress, business and other organizations, mass media, international organizations, and lawmakers. Humankind can progress beyond the “STEMs = space studies” model by including, encouraging, involving, and preparing a new breed of social and behavioral sciences geniuses. These would be people who are naturals in international relations, conflict resolution, and peace studies, as well as versed in international law, politics, social psychology, critical analysis, discourse analysis, international communication, artistic architecture, race and ethnic studies, gender studies, religious studies, economics, finance, business and entrepreneurship, history, and political economy, while also being concerned with inequality gaps, oppression, subjugation, revolts, uprisings, revolutions, and various other social and behavioral phenomena. People who understand the issues concerning human beings now have a way of participating in future emerging space industries. The audience of learners scheduled to receive cutting-edge knowledge of fields relevant for outer space development will be expanded by online learning techniques and sharing of information through the open-source technologies of the Internet. Shaping Ideology Imagine teaching students about the newly emerging trends related to outer space development. This would give students permission to envision and carve out their role in designing future space societies. Students from all disciplines can be taught to see what’s coming next by learning to research and interpret economic policies, laws, and international relations. This will enable them to detect newly emerging industries and to anticipate the elements likely to be in demand. Students can then shape their skill-sets and prepare to satisfy these emerging needs. Students can be taught to perform this type of interdisciplinary analysis and to research combined dynamics—government hearings and transcripts, policy statements and speeches, laws, economic initiatives, and international treaties. They can also be taught to combine this type of primary data with theoretical understandings of historical, ideological, institutional, political, economic, psychological, and structural phenomena.

#### Legal reform is possible.

Hanna, 18—teaches courses in Aboriginal law and Indigenous laws methodology at the University of Victoria (Alan, “SPACES FOR SHARING: SEARCHING FOR INDIGENOUS LAW ON THE CANADIAN LEGAL LANDSCAPE,” University of British Columbia Law Review. 51.1 (Jan. 2018): p105, dml)

Substantive meaning in Indigenous laws will come from substantive change. According to Canadian legal scholar, Robert Samek, meaningful and effective legal reform requires serious commitment to effect proper social change:

Changing the letter of the law does not of itself cure one social ill. It merely changes the scenery on the stage; the play still goes on. [T]he greatest illusion of all is to think of the present as fixed, as a piece of machinery which can be kept going forever by replacing a few parts here and there, and patching up the test. Any social fabric can only take so much patchwork. Beneath every reforming patch yawns a tear. (173)

Significant change comes from legal reform, rather than tweaking an already archaic, inflexible, dilapidated system that has too many patches. The question is whether people are capable of change that will align contemporary society with the values and beliefs Canadians hold of ourselves. In the Tsilhqot'in BCSC trial decision, Vickers J contemplated what the consequence might be if the Crown suddenly admitted the Tsilhqot'in had existed on their territory for 200 years: "the real question to be answered . . . concerned the consequences that would follow such an admission." (174) Would the result be consequential? If so, for whom? Does doing nothing not continue the consequence of colonization on First Nations and their citizens, as Vickers J held: "[a]s a consequence of colonization and government policy, Tsilhqot'in people can no longer live on the land as their forefathers did"? (175)

So what of change ? What does it mean to reform Canada's legal system so Indigenous laws can participate in a meaningful way ? This is the topic of another paper. However, acknowledging the squatter state's unlawful presence and authority on the land would be a signal toward seeking meaningful reconciliation. Rejecting the suffocating and untenable test for title in BC is a starting point (a test Canada would fail). (176) Accept that BC is unceded Indigenous territoty, meaning Aboriginal title is everywhere and unextinguished--de facto title. This would require giving meaning to shared or joint jurisdiction in a manner that First Nations propose, according to their legal processes. Begin meaningful consultations with First Nations to develop legislation that sets out how to proceed when wanting to enter First Nations' territories through a process that includes respect, reciprocity, relationality, consent, and sharing. This would be a place to start.

The prospect of Nisga'a being granted limited governing powers was considered by some to potentially cause "a profound constitutional upheaval," which we now know simply was not true. (177) Initiating significant change that serves to decolonize the state and its practices will be significant, but the world will not end, the economy will not collapse, people will not be run off the lands, although the humility in accepting these possibilities is a part of what seeking true reconciliation requires. Much harm has been done for a very long time. Change will not be simple or easy, but the results will provide its own reward (e.g. strengthened values and beliefs, strengthened economy, enriched and more sustainable environmental practices, respectful relationships).

#### 300 years of history proves.

NoiseCat 17 (Julian Brave - enrolled member of the Canim Lake Band Tsq'escen in British Columbia where he was nominated to run for Chief in 2014 AND a graduate of Columbia University and the University of Oxford, “When the Indians Defeat the Cowboys,” 1/15/17, https://www.jacobinmag.com/2017/01/standing-rock-indigenous-american-progress/)

Consider, for example, the most cited work in the fields of settler colonial and indigenous studies: “Settler Colonialism and the Elimination of the Native,” a 2006 essay by the late radical Australian anthropologist Patrick Wolfe. In a clever turn of phrase, repeated today like a Feuerbach Thesis for indigenous radicals and scholars, Wolfe described the invasion of indigenous lands as “a structure not an event.” His argument was that settler colonialism — a form of colonialism where colonists come to stay, as in the United States, Canada, Australia, New Zealand, South Africa, Palestine, and some Pacific Islands — requires the elimination of Native people and societies to access and occupy their land. As Wolfe put it, “Settler colonialism destroys to replace.” Wolfe’s theory of settler colonialism emerged out of the ongoing “History Wars” in Australia, a public, battle-hardened, and career-defining debate over whether Australia’s treatment of Aborigines should be considered genocide. For decades, specialists have squabbled over the numbers massacred at places like Tasman and Slaughterhouse Creek. These debates remain passionate and deeply controversial. They are tied to political battles over land rights, reconciliation, constitutional recognition, mass incarceration, racism, and Aboriginal treaties. But while his contemporaries tried to win the History Wars by appealing to documents, figures, and definitions, Wolfe sought to reframe the debate. He shifted the focus from determining the point at which butcheries become genocide to the “logic” of eliminating indigenous people over centuries and around the world. Settler colonialism, he argued, is a structural phenomenon that plays an ongoing and central role in shaping the modern world. Wolfe’s was a brilliant intervention. In the jargon-riddled field of postcolonial studies, he homed in on the empires, colonies, states, and territories of ongoing settlement and indigenous dispossession. His theory traveled well. For indigenous scholars and activists from the United States to Palestine and Canada to New Zealand, “settler colonialism” became the dominant framework for understanding ongoing Fourth World struggles. But Wolfe’s theory ran into a rather significant problem — reality. If settler societies like Australia, Canada, New Zealand, and the United States are structurally dependent upon the elimination of the Native, how do we explain the survival, resilience, and resurgence of that same Native? How do we explain the global emergence of policies of indigenous self-determination, recognition, and land rights in various forms? Are these policies lipstick on the same colonial pig? Are indigenous people permanently cast in cameo roles — their victories small exceptions that prove the rule? How do we explain Standing Rock? Wolfe’s theory, however popular and illuminating, is in a sense, a gussied-up version of the inevitable victory of Cowboys over Indians — a reworking of Victorian ideology as critical theory. The indigenous story unfolding before us demands more. Explaining Standing Rock The Cowboy is supposed to be everything the Indian is not. While the Indian is depicted as a tragic vanquished trope, the Cowboy is a handsome, swaggering, and triumphant trickster. While the Indian retreats into the wild, the Cowboy hunts down his enemies to settle old scores. While the Indian is at best a noble savage and at worst a villain, the Cowboy is a cultural icon and hero. And, while the Indian is a loser, the Cowboy is a winner. At Standing Rock, generations of myth and folk wisdom proved wrong. As Bill McKibben put it in the Guardian, the Standing Rock movement “is a break in that long-running story, a new chapter.” In a moment when the Left is struggling in the face of a globalizing free market and an ascendant right, indigenous victory stands as both a surprising puzzle and an intriguing promise. It begs the rarely considered question: why have indigenous people been able to secure a stunning victory while even the most successful movements of late have faltered? And what can other movements learn from Indians? Various voices have risen to offer answers. Writing in the Nation, Audrea Lim argues that Standing Rock shows a multiracial coalition united against neoliberalism and white supremacy can win in the heartland. McKibben and Naomi Klein tout the power of direct action and praise indigenous organizers for catalyzing nonviolent mass resistance. In the New Yorker, novelist Louise Erdrich suggests that Standing Rock prevailed because it offered the world an emotionally, historically, and environmentally compelling story rooted in faith. “Every time the water protectors showed the fortitude of staying on message and advancing through prayer and ceremony, they gave the rest of the world a template for resistance,” Erdrich concludes. All of these analyses are accurate, but their individual and collective explanations for the Standing Rock victory are insufficient. They fail to ask key questions about the when, where, how, and who. They do not explain what made this movement and moment different. And perhaps most importantly, in their haste to explain a seemingly improbable and episodic victory, these writers miss the remarkable big picture. Outflanking Corporate Globalization Since the 1970s, unions, public goods, social welfare, and other essential building blocks of social democracy have been beaten back by the free market consensus. Yet over these same decades, indigenous rights to land, jurisdiction, and sovereignty have gained ground. At the same time workers lost their unions, the environment was winning a union of its own. That union takes the form of indigenous rights. Credit for these often-overlooked indigenous victories belongs to the indigenous movements that unswervingly pushed for similar goals across decades and even centuries: return of indigenous lands, restoration of indigenous sovereignties, and dignity for indigenous peoples. From the time their lands were seized in the nineteenth century and even before, indigenous people came together, forming tribal, intertribal, regional, and national coalitions and organizations. They pressured states and empires built on lands taken from them to recognize their demands. They stood strong against obstinate and repressive governments determined to claim their remaining territories and assimilate their people into the laboring class. They remained resolute. As the Chiefs of the Syilx, Nlaka’pamux, and Secwepemc nations wrote in a petition to then–Canadian prime minister Wilfrid Laurier in 1910: So long as what we consider justice is withheld from us, so long will dissatisfaction and unrest exist among us, and we will continue to struggle to better ourselves. For the accomplishment of this end we and other Indian tribes of this country are now uniting and we ask the help of yourself and government in this fight for our rights. In moments of global political and economic crisis like the 1880s, 1930s, 1940s, 1970s, and now 2010s, state policies toward indigenous people worldwide often shifted. During the 1880s and 1940s, the United States applied assimilationist pressure on indigenous communities, with disastrous consequences. In the 1880s allotment and privatization policies under the Dawes Act of 1887 splintered indigenous lands and communities and brought poverty and political, social, and cultural erosion. In the 1940s, termination policies designed to eliminate tribes and assimilate Native laborers further devastated indigenous communities. Children were taken from their families and placed in abusive residential schools. Workers were displaced from their homelands and dropped into poverty and homelessness in urban ghettos. Indigenous people, particularly indigenous women, were subjected to sexual violence, sterilization, and medical experimentation. Yet the stubborn dream of indigenous resurgence endured. And crises sometimes ushered in marginal progress. In the 1930s, Franklin Delano Roosevelt’s so-called “Indian New Deal” afforded tribes greater control over their lands and resources and restored a measure of sovereignty and self-determination. The 1960s and 70s saw the rise of the Red Power movement, a momentous breakthrough that pushed the US and Canadian states to adopt policies based on recognition instead of assimilation. The contemporaneous Maori Renaissance in Aotearoa/New Zealand and Aboriginal land rights movement in Australia won similar gains. These movements often found unlikely allies in neoconservatives, neoliberals, and their predecessors who, beginning in the 1970s and especially from the 1980s onwards, saw indigenous self-determination and autonomy as an opportunity to scale back social welfare spending and reduce indigenous dependence on the government. It was Richard Nixon who inaugurated the current era of indigenous self-determination. He outlined his commitment to the policy in a special message to Congress on July 8, 1970: This, then, must be the goal of any new national policy toward the Indian people: to strengthen the Indian’s sense of autonomy without threatening his sense of community. We must assure the Indian that he can assume control of his own life without being separated involuntarily from the tribal group. And we must make it clear that Indians can become independent of Federal control