COMMITTEE : Environment and Digital Technologies
ISSUE : How can we reduce environmental and light pollution caused by satellite constellations, while still keeping the benefits of global telecommunications networks ?
CHAIRS : Jade FONTAINE MORCELA, Valentin IFTENIE et Jawad ABOU-CHEDID

PRESENTATION OF THE CHAIR



Hello dear delegates !

My name is Jade Fontaine Morcela, I'm 16 years old, and I will have the pleasure of being your chair for FerMUN 2027, alongside Valentin Iftenie and Jawad Abou-Chedid.

I'm in the Excellence English section at the Lycée International de Ferney-Voltaire. I was born in Geneva, I'm French and Portuguese, and I live in France. In general, I love music, Formula One, and hanging out with my friends. I've been part of the MUN programme since last year, when I had the opportunity to be the delegate of Brazil in the Labour Rights committee.

This year, our committee will examine a major current issue: the deployment of satellite mega-constellations and the resulting consequences.

Satellite mega-constellations are now being deployed to provide global internet coverage, with communication capabilities that were not possible until now.

While these services meet a growing demand, the massive deployment of low-Earth-orbit satellites is not without consequences. The environment bears the brunt of them: atmospheric pollution from metal particles released when end-of-life satellites burn up on reentry, disruption of ecosystems and of animal species sensitive to natural light cycles, and growing demand for the natural resources needed to manufacture them.

This research report aims to provide an initial overview of the issues to be discussed at the upcoming conference. It outlines the current consequences of these satellite constellations, as well as foreseeable future developments.

Your mission will be to propose solutions that mitigate these environmental problems while preserving the benefits of global telecommunications networks.

My fellow presidents and I are very excited to see you all in January to debate this fascinating topic, which is so important for our future

Dear delegates,



My name is Jawad Abou-Chedid, I am 17 years old and I will have the pleasure of being your Chair for FerMun 2027, alongside Jade Fontaine Morcela and Valentin Iftenie. I am in the British section of the French International Baccalaureate (BFI) at the Lycée Français International Jacques Prévert in Accra, Ghana. Born in Lebanon, I am Lebanese and I live in Ghana. In general, I enjoy diplomacy, international relations and spending time with my friends. I also speak 5 languages: English, French, Lebanese, Spanish and Russian. A student in the MUN programme for two years, I had the opportunity to be the delegate of Ghana in the Youth Assembly committee at the last FERMUN conference, where I drafted a resolution on the challenges of multilateralism in the face of rising nationalism. This resolution was adopted by the committee and selected to be sent to the United Nations Headquarters in New York.

This year, our committee will examine a major current issue: the deployment of mega-constellations of satellites and the consequences that arise from it. Mega-constellations of satellites are now being deployed to provide global internet coverage and communication capabilities on a scale previously inaccessible.

While these services meet a growing demand, the deployment of such a large number of satellites in low orbit is not without consequence. The environment is directly affected, whether through air and atmospheric pollution from metallic particles released by the disintegration of satellites at the end of their life, the disruption of ecosystems and animal species sensitive to natural light cycles, or the growing exploitation of natural resources needed for their manufacture.

This report aims to give you an initial overview of the issues that will be debated at the next conference. You will find in it the current consequences of these satellite constellations, as well as the foreseeable developments for our future.

Your mission will therefore be to propose solutions to mitigate these environmental problems, while preserving the benefits brought by global telecommunications networks.

I look forward, along with the other Chairs, to meeting you in January to debate this fascinating and decisive subject for our future.

KEY WORDS

Pollution : Environmental degradation caused by substances (natural, chemical, or radioactive), waste (household or industrial), or various nuisances (noise, light, heat, biological, etc.). Although it may have a completely natural origin (volcanic eruption, for example), it is primarily linked to human activities.

Satellite constellation : A set of telecommunications satellites placed in circular polar orbits, in different planes, so as to cover the entire globe.

Global telecommunications networks : A set of systems enabling the transmission of information and the connection of places and people. These networks are essential to globalization, as they facilitate exchanges on a global scale.

Environment : The set of natural (physical, chemical, biological) and cultural or social elements surrounding a living being or a society, which influence its development and its needs.

Atmosphere : Earth's atmosphere is the gas layer surrounding the globe. It is composed of several layers : the troposphere, the stratosphere, the mesosphere, the thermosphere, and the exosphere (see atmosphere diagram on p.8). Earth's atmosphere influences numerous natural phenomena by modulating light, temperature, pressure, and climate : we call it "the atmospheric effect"

Ozone : Ozone is a gas naturally present in trace amounts in the atmosphere. Its role and impact on living things vary radically depending on its altitude : it protects the Earth in the stratosphere but irritates the respiratory tract and damages vegetation when found near the ground in the troposphere.

Natural resources : Sources of material and energy available in the natural environment in their primary form, prior to processing by human activity, that are economically accessible. A natural resource may be renewable on a human timescale (animal or plant biomass, water) or non-renewable (metal resources, minerals, fossil energy resources, uranium)

COPUOS (Committee on the Peaceful Uses of Outer Space) : This Committee was established by the General Assembly in 1959 to govern the exploitation and use of outer space for

the benefits of all humanity, for peace, security, and development. The Committee's mandate was to review international cooperation in the peaceful uses of outer space, study space-related activities that could be undertaken by the United Nations, encourage space research programs, and analyze legal issues arising from space exploration.

Low Earth Orbit (LEO) : Low Earth Orbit (LEO) is a type of Earth orbit located at an altitude between 350 and 1,400 kilometers. Low Earth Orbit is generally considered to extend from the atmosphere to the Van Allen belt.

International Space Governance : International space governance refers to the processes and standards that govern the use and exploration of outer space. This includes international cooperation, regulation, security, sustainability, and scientific advancements in this field.

OVERVIEW

Introduction :

Satellite constellations are experiencing unprecedented growth.

Since 2019, the number of satellites in Earth orbit has skyrocketed, reaching 15,000 today (Press article on the ESO study, July 2, 2026), primarily SpaceX's Starlink telecommunications satellites.

Their primary function is to provide high-speed Internet access on a global scale, particularly in rural, remote, or underserved areas lacking traditional terrestrial infrastructure such as fiber optics. They also ensure uninterrupted connectivity in the event of natural disasters or conflicts, when terrestrial networks are damaged, thereby addressing a critical challenge of digital inclusion for millions of people worldwide.
However, while useful, these constellations pose numerous challenges for the world of tomorrow.

First, we will begin by presenting the benefits of these constellations before addressing their harmful effects. Indeed, satellite constellations have an impact on the atmosphere and ozone chemistry due to debris emitted by end-of-life satellites and collisions, which can disrupt nocturnal animals and migratory birds.

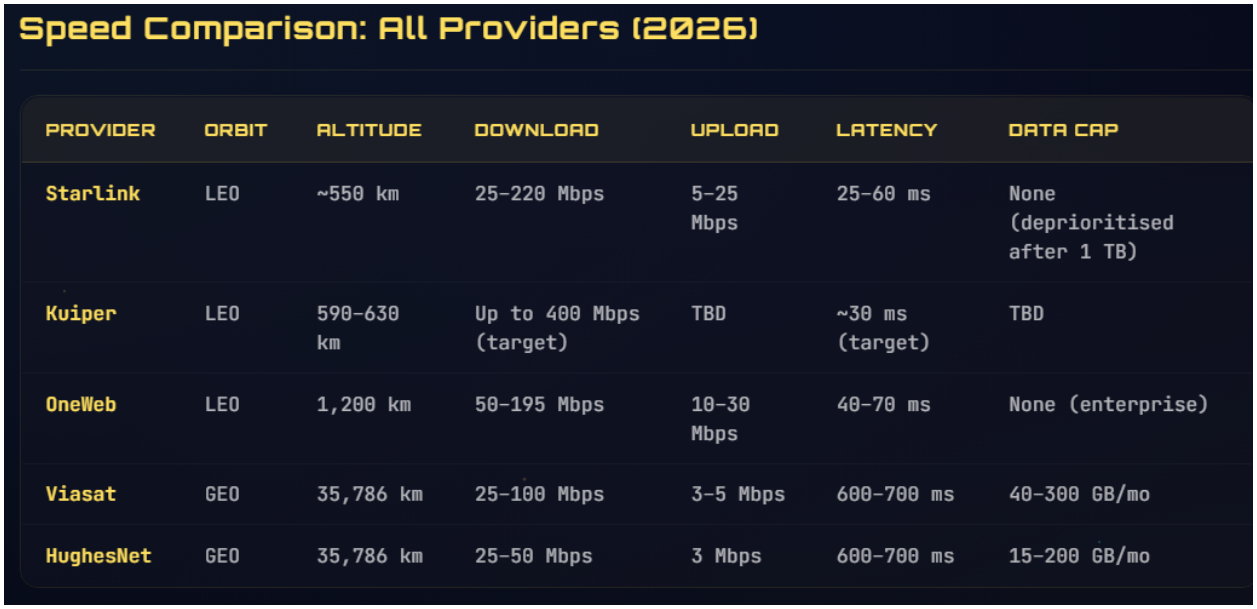
Furthermore, biodiversity is also threatened, particularly due to the mining of natural resources needed to manufacture these networks. Finally, the space debris they generate poses an additional risk to the environment and to science.

This report therefore aims to examine these various issues in order to identify solutions that reconcile the benefits of global telecommunications networks with the preservation of our environment.

I. A Tool for Global Connectivity: Satellite Constellations

Several operators share the largest existing mega-constellations, including SpaceX with the Starlink constellation in the United States, Amazon with the Kuiper constellation, also in the United States, and Eutelsat with the OneWeb constellation in the United Kingdom.

For example, Starlink reduces latency, the transmission delay in computer communications, from 600 ms (geostationary orbit) to approximately 20 ms, thanks to its low Earth orbit, which is faster than other high-speed Internet technologies, as shown in the table below. This reduction therefore optimizes application performance, improves the user experience, and enhances operational efficiency.



Speed Comparison: All Providers (2026)

PROVIDER	ORBIT	ALTITUDE	DOWNLOAD	UPLOAD	LATENCY	DATA CAP
Starlink	LEO	~550 km	25–220 Mbps	5–25 Mbps	25–60 ms	None (deprioritised after 1 TB)
Kuiper	LEO	590–630 km	Up to 400 Mbps (target)	TBD	~30 ms (target)	TBD
OneWeb	LEO	1,200 km	50–195 Mbps	10–30 Mbps	40–70 ms	None (enterprise)
Viasat	GEO	35,786 km	25–100 Mbps	3–5 Mbps	600–700 ms	40–300 GB/mo
HughesNet	GEO	35,786 km	25–50 Mbps	3 Mbps	600–700 ms	15–200 GB/mo

(OrbitalRadar)

According to a 2021 FCC report (p. 20), approximately 14.5 million Americans lacked access to high-speed internet in 2021—a need that these constellations aim to address.

Today, these constellations serve purposes that go far beyond simple residential Internet access. In the maritime sector, Starlink already equips more than 150,000 vessels (fishing, merchant marine, cruise ships, and recreational boats). In aviation, major airlines such as United, Southwest, Alaska Airlines, and Air Canada are equipping their aircraft to offer in-flight Wi-Fi. These networks also play a central role in crisis management by enabling the rapid deployment of antennas in areas affected by hurricanes, earthquakes, or floods, thereby maintaining connectivity for emergency responders and allowing affected populations to contact their loved ones. Added to this are military and security applications, as well as direct mobile connectivity ("Direct-to-Cell"), which, since 2025, has allowed standard smartphones to connect directly to satellites without an antenna or special equipment.

(See MacGeneration and The Global Statistics)

We therefore could not completely do without it given the current state of global infrastructure: approximately 2.9 billion people remained offline in 2026, a large portion of whom lived in areas where the deployment of fiber or terrestrial mobile networks would remain economically unprofitable for traditional operators. As indicated in the article "Starlink Statistics 2026: Subscribers, Revenue, Speed, and Constellation Data" published by Axis Intelligence in 2026, satellite constellations currently represent the fastest solution to deploy in these areas, unlike fiber, which requires extensive and costly infrastructure work.

In 2026, growth remains extremely rapid: Starlink reports more than 12 million customers in over 160 countries as of June 2026, up from just 9 million in February of that same year. SpaceX entered 35 new markets in 2025 alone, with growth now driven primarily by emerging markets (Brazil, Nigeria, the Philippines, Indonesia, Malaysia) rather than by rural areas in the United States that are already saturated. (See Wikipedia and Axis Intelligence)

Halting the deployment of these constellations could potentially deprive hundreds of millions of people of access to basic connectivity, even as bandwidth needs increase with the widespread adoption of remote work, telemedicine, and distance learning. It is this dilemma—between real social benefits and growing environmental costs—that justifies a regulatory approach rather than an outright halt, and which will be explored further in the remainder of this report.

However, while useful, these constellations present numerous challenges for the world of tomorrow.

II. At the Heart of the Atmosphere: Between Chemical Reactions and Collisions

A. An increasingly crowded space: the risk of collision

The more satellites there are, the greater the risk of a cascade of collisions, and this cascade (the Kessler syndrome) could become self-sustaining; it means that it could continue even if all action were halted.

For example, SpaceX's Starlink constellation had to perform approximately 300,000 anti-collision maneuvers in 2025 alone, a 50% increase from 2024, according to a FodNews article on the 2026 ESO report, illustrating just how congested low Earth orbit has become as the constellation grows.

This creates an imbalance of interests. Countries that already have mega-constellations (the United States with SpaceX, the United Kingdom with Amazon's Kuiper and Eutelsat's OneWeb,

and China with CTC-1, CTC-2, and Guowang) are more interested in flexible rules that allow them to continue deploying rapidly without constraints; countries without their own constellations (the majority) face the risk of collisions and orbital congestion without reaping the same economic benefits. This phenomenon illustrates a typical case where the speed of action gives certain actors the power to unilaterally define the standards applicable to all, at the cost of growing inequalities.

B. Pollution from end-of-life constellations

Ozone, a gas composed of three oxygen atoms, occurs naturally in our atmosphere. However, when its concentration becomes too high in the lower layers of the atmosphere, it can pose a threat to living organisms : this is known as ozone pollution.

This pollution can occur, in particular, when aluminum from end-of-life satellites reacts with oxygen upon reentry into the atmosphere, specifically as the satellite passes through the mesosphere, creating aluminum oxides that catalyze the activation of chlorine. This activation of chlorine is dangerous because it then becomes reactive enough to destroy stratospheric ozone, which contributes to the thinning of the ozone layer and increases exposure to harmful UV rays. This additional UV radiation can damage cells and DNA, increase the risk of skin cancer and cataracts, and disrupt ecosystems, as noted by UNEP in its article "Ozone and You."

Low-Earth Orbit (LEO) satellites typically operate at altitudes between 500 and 2,000 km, well above the mesosphere. They pass through this layer only during atmospheric reentry at the end of their operational life. This ozone layer is located in the stratosphere (at an altitude of approximately 15 to 50 km), which explains why the particles released during reentry can descend and interact with stratospheric ozone.

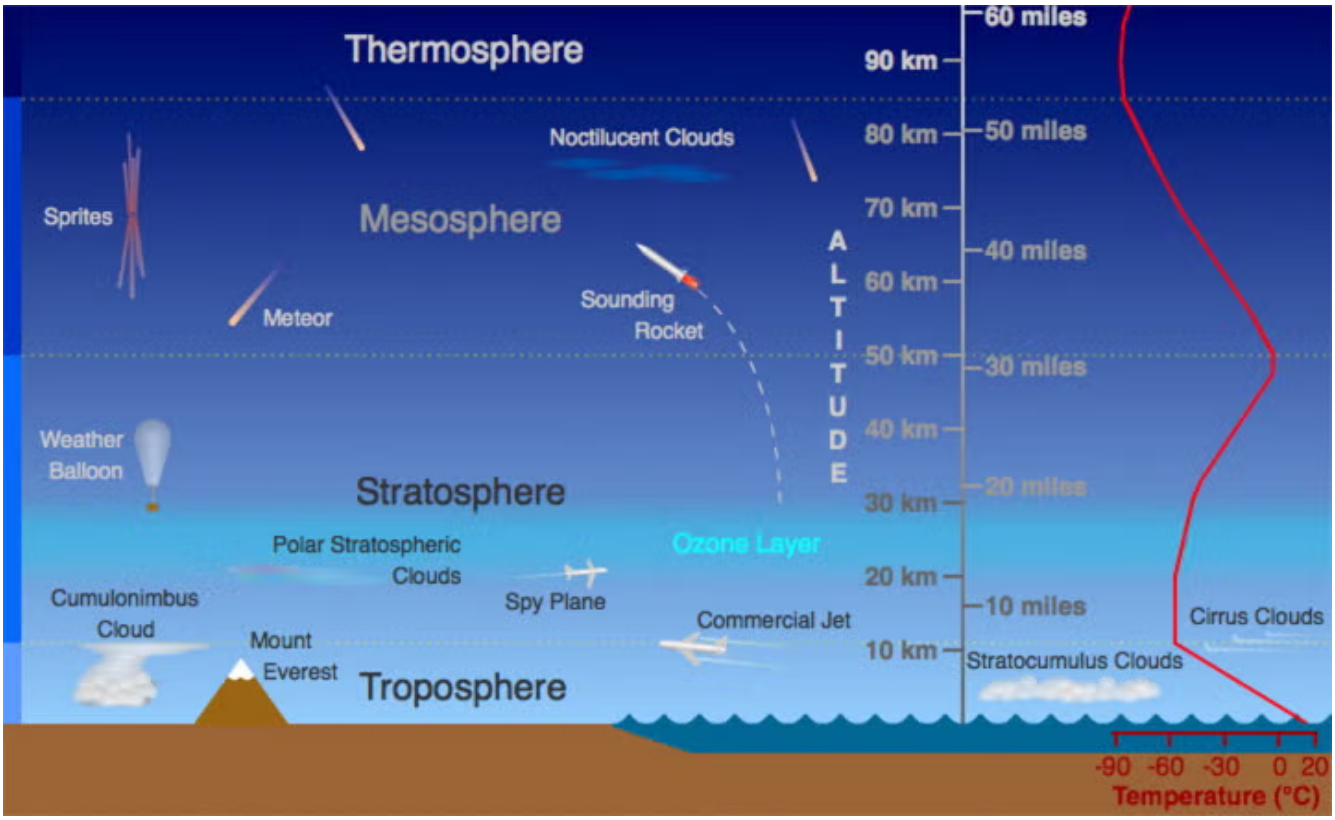
A typical 250-kg satellite generates about 30 kg of aluminum oxide nanoparticles as it breaks up—particles that can persist in the atmosphere for decades. In 2022, all satellites re-entering the atmosphere generated approximately 17 metric tons of these compounds; mega-constellation scenarios project more than 360 metric tons per year, which could lead to significant ozone depletion.

A more recent study confirms and updates these figures: by 2024, the amount of aluminum oxides injected into the mesosphere by human-made objects in low Earth orbit had more than tripled since 2016, with launch vehicles (rocket stages) now contributing more to this pollution than the satellites themselves. In March 2026, an analysis confirmed that by 2022, the total amount of aluminum generated by satellite re-entries had already reached 41.7 metric tons—about 30% more than what the planet naturally receives from space debris—a figure considered modest compared

to the current trajectory, with more than 9,000 Starlink satellites in orbit by early 2026. Even more recently, a groundbreaking study published in February 2026 by the Leibniz Institute for Atmospheric Physics (Germany) succeeded, for the first time, in linking a specific atmospheric reentry event to a pollution plume directly detected in the atmosphere. (See ScienceDirect, September 2025, and FODNews, March 2026)

A more recent study by NOAA (2025) estimates that the number of satellites in low Earth orbit could exceed 60,000 by 2040, and that these aluminum particles could alter the speed of the polar vortex, warm certain parts of the mesosphere by up to 1.5°C, and affect the ozone layer

To better understand at what altitude these phenomena occur, here is a diagram of the different



layers of the atmosphere created by the University Corporation for Atmospheric Research :

III. Endangered Animal Species and the Importance of Darkness

A. Disturbance of Nocturnal Animals and Migratory Birds

Many species of nocturnal migratory birds, such as the indigo bunting and the European robin, use the position of the stars to navigate during their journeys, particularly when the Earth's

magnetic field is insufficient to guide them. However, artificial light emitted by satellites can be mistaken for these stellar landmarks, causing disorientation, premature migration, or even collisions with illuminated structures, as highlighted in the IJRASET (2024) article (International Journal for Research in Applied Science and Engineering Technology).

This finding is officially recognized at the intergovernmental level by the CMS (United Nations Convention on Migratory Species), which states that artificial light disrupts essential wildlife behaviors and ecological processes, potentially hindering the recovery of threatened species and compromising the ability of migratory species to undertake the long-distance journeys essential to their life cycles. Artificial light also affects insects, which are a primary food source for many migratory species. Since 2020, this issue has been addressed by an official resolution adopted at CMS COP13 (Gandhinagar, India), supplemented by international guidelines specifically dedicated to reducing light pollution for migratory species.

B. Preserving the night: an essential need for life

Beyond just navigation, exposure to artificial light at night more broadly disrupts the biological rhythms of living organisms. In particular, it reduces the production of melatonin, a hormone that regulates not only sleep but also immune functions and seasonal reproduction, with cascading effects already documented in birds, reptiles, and mammals. (See the April 2023 article in ScienceDirect)

This finding is consistent with that of the NPS (National Park Service, a U.S. federal agency), which confirms that a naturally dark environment is a vital resource for all living organisms, just like sleep: no species can truly function without it.

This urgency is also highlighted by the IUCN (International Union for Conservation of Nature), the world's leading authority on the state of nature. According to a study published in the journal *Science* that it cites, the number of stars visible in the night sky decreased by 7 to 10 percent per year between 2011 and 2022. While this trend is currently driven primarily by ground-based lighting, it illustrates the rapid pace at which natural darkness continues to recede globally, a phenomenon now compounded by the growth of mega-constellations. Indeed, while satellites contribute to light pollution, there are also terrestrial sources that contribute to it, such as public streetlights, buildings, industrial and port areas, and transportation infrastructure (airports, etc.).

IV. Conquering space, at the expense of Earth?

A. From Earth to Space: The Environmental Cost of Satellites

The manufacture of tens of thousands of satellites requires large quantities of metals such as aluminum, copper, and rare earth elements, the extraction of which has a direct impact on terrestrial ecosystems.

According to an official 2025 report by the UNEP (United Nations Environment Programme), global mining output has increased fivefold since 1970, and demand for critical minerals such as nickel, cobalt, graphite, and rare earth elements rose by 8 to 15 percent in 2023 alone : a trend that the production of mega-constellations is further accelerating.

Most mining takes place in African countries such as the Democratic Republic of the Congo (DRC) for cobalt (essential for batteries and heat-resistant superalloys), Guinea for bauxite and aluminum (the primary material for lightweight satellite structures), South Africa and Zimbabwe for platinum and platinum group metals (used in electronic components and sensors), and Rwanda for tantalum (coltan) (crucial for capacitors in miniature circuit boards), as indicated in this European Parliament report.

This mining activity is not without consequences for biodiversity : it involves land clearing, the use of toxic chemicals, and the production of large quantities of waste, which can lead to significant habitat loss, water contamination, air and soil pollution, all of which also affect human lives. (See the article "Mapping the Impact and Conflicts of Rare-Earth Elements 2023").

B. A carbon footprint right from the start

Beyond their manufacture, the launch of these satellites itself has a direct impact on the atmosphere: according to a 2022 study by NOAA (the U.S. National Oceanic and Atmospheric Administration), rockets emit black carbon directly into the stratosphere, where these particles accumulate and absorb solar radiation, warming the surrounding air : a phenomenon that is accelerating as the space industry grows.

In an official technical report from October 2024, NASA confirms that by 2040, the total global flux of particles emitted by launches and atmospheric re-entries (black carbon and metal oxides) will be comparable to the natural background flux caused by meteorites, a sign that stratospheric pollution is now on the same order of magnitude as the natural phenomena themselves.

V. Space Debris: A Risk That Goes Beyond the Environment

A. When Space Becomes a Dump

According to the ESA's official 2025 report, approximately 40,000 objects are now being tracked in orbit, including about 11,000 active satellites, but the actual number of debris pieces larger than 1 cm (large enough to cause catastrophic damage) is estimated to be more than 1.2 million.

At an altitude of 550 km—the thermosphere—the ESA has now observed that the density of debris is on the same order of magnitude as the density of active satellites themselves. Entire satellites or rocket stages are now entering the atmosphere an average of more than three times a day.

According to a NASA report cited by CNN in 2022, despite atmospheric disintegration, the risk of debris falling to Earth is ever-present. There are at least 26,000 pieces of space debris the size of a softball or larger, capable of destroying a satellite upon impact, and more than 500,000 pieces the size of a marble that could damage a spacecraft; while the majority of objects disintegrate upon re-entry into the atmosphere, the re-entry of larger objects (entire satellites, rocket stages) must be precisely planned by space agencies to prevent them from crashing into populated areas.

A "space graveyard" in the South Pacific has existed since 1971, where more than 263 spacecraft have been intentionally deorbited. This area is centered on Point Nemo, the spot on Earth farthest from any inhabited land. This practice aims to reduce the risk to populations, but shifts the problem to the ocean, as this Space Daily article explains, citing the 2021 GESAMP report.

Currently, there is still no specific binding legislation governing marine pollution caused by space debris (see the 2022 Ocean Vision article).

B. A Scientific Challenge: Astronomy Faces a Growing Threat

In addition to the environmental concerns posed by satellites, there is also a scientific challenge. A passing satellite leaves a trail of light that obscures the objects being observed. Up to "28% of the field of view" of the Very Large Telescope could be lost in an image taken two hours after nightfall when the entire SpaceX constellation is in the sky.

To give you an idea of what this looks like, here is an image showing satellites crossing the night sky over the Atacama Desert in northern Chile in just one hour. It is a composite of a time-lapse

video taken on October 15, 2025, about two hours after sunset. In this image, we can see that the bright trails in the sky obscure the view of the stars.

Photograph of the night sky showing satellites passing overhead over the northern part of the Atacama Desert in Chile over the course of an hour



(ESO, 2026)

According to the ESO : the stakes are almost existential once the number of satellites exceeds 100,000 (below the threshold of visibility to the naked eye), the very ability to conduct ground-based optical astronomy from Earth would be compromised.

Beyond scientific curiosity, it has practical applications such as the detection of asteroids that could pose a threat to Earth, technological innovations (optical sensors, imaging) that are being applied to medicine and telecommunications, and reference points useful for navigation.

It also answers fundamental questions about our origins and our place in the universe, while representing a colossal scientific investment that has already been made—one that a gradual deterioration of the night sky would render partially useless.

Finally, the starry sky is a shared cultural heritage recognized by UNESCO (see the article "International Workshop and Expert Meeting on Starling Reserves and World Heritage held in

Fuerteventura, Spain"" March 16, 2009). The risk posed by satellite constellations is not the sudden extinction of astronomy, but a gradual erosion of its ability to detect the faintest and rarest phenomena—which are often the most scientifically interesting.

RELEVANT UN TREATIES AND MAJOR EVENTS

January 27, 1967

Signed on January 27 1967 and entering into force on October 10 1967, in the midst of the Cold War, the Outer Space Treaty laid the foundation for international space law by prohibiting the national appropriation of outer space, guaranteeing its peaceful use, and establishing the responsibility of states for their space activities. (UNOOSA)

March 29, 1972

Signed on March 29, 1972, and entering into force on September 1 of that same year, the Convention on International Liability for Damage Caused by Space Objects established a legal framework defining the liability of States in the event of damage related to space objects and debris. (UNOOSA)

November 13, 1979

Adopted on November 13, 1979, and entering into force on July 15, 2021, the Geneva Convention on Long-Range Transboundary Air Pollution established a treaty that regulates air pollution crossing national borders, with a definition broad enough to potentially include emissions from space activities.
(UNECE)

June 8, 2017

The ESO supported the International Astronomical Union (IAU) in submitting a document to COPUOS, raising the issue of dark sky protection and recommending that the IAU and the United Nations Office for Outer Space Affairs (UNOOSA) organize an international conference. (UNOOSA)

09/2017

In September 2017, the Inter-Agency Space Debris Coordination Committee (IADC) published the "Statement on Large Constellations of Satellites in Low Earth Orbit," which proposes additional measures to ensure that mega-constellations comply with space debris mitigation guidelines. (IADC)

October 28, 2019 – November 22, 2019

This resolution was subsequently revised at the 2023 World Radiocommunication Conference. The version currently in force is therefore Resolution 35, and the ITU has added a multi-stage monitoring system (M0, M1, M2, M3) to verify that operators are meeting their satellite deployment milestones. This milestone-based approach is intended to help "regulate" the over-deployment of satellites to some extent. (ITU)

February 22, 2020

From February 15 to 22, 2020, the Convention on Migratory Species (CMS) convened to adopt a resolution on light pollution. This UN resolution officially recognizes that artificial light disrupts migratory species and calls on states to reduce its impact. (CMS)

September 10, 2021

The 2021 GESAMP report was prepared by a group of scientists jointly commissioned by several UN agencies, in which they acknowledge for the first time that deorbited spacecraft are an emerging source of ocean debris. (GESAMP)

October 9, 2025

This UN (UNEP) report warns of the social and environmental impacts of the surge in demand for minerals needed for modern technologies, including mining related to satellite manufacturing. (UNEP)

POSSIBLE SOLUTIONS

The deployment of mega-satellite constellations is currently creating growing tension between the need for global connectivity and the preservation of the environment, biodiversity, and the night sky. The projected trajectory (up to 1.7 million satellites) risks exacerbating this tension if no action is taken.

But potential solutions exist at several levels:

1. Mandatory technical standards imposed on operators

➔ **Anti-reflective coatings and devices**. The use of dark coatings or deployable sunshades, such as the "VisorSat" developed by Starlink, would reduce the reflectivity of satellites, thereby limiting the nighttime light pollution they cause, which disturbs wildlife.

➔ **Limiting pollutants at the end of a satellite's life**. Regulate the metal alloys used in satellite manufacturing (particularly aluminum) to reduce the formation of metal oxides and polluting particles during atmospheric reentry.

➔ **Mandatory sharing of position data.** Requiring the real-time dissemination of orbital ephemerides would help reduce the risk of collisions between satellites, thereby limiting the creation of new space debris.

2. Strengthening Environmental Scientific Research

➔ **More accurate atmospheric simulation models.** Develop models capable of measuring the cumulative impact of satellite re-entry on the ozone layer and stratospheric chemistry, similar to the work already conducted by NOAA and NASA on this topic.

➔ **Biodiversity impact studies**. Fund independent research on the effects of light pollution and mining related to satellite constellations on terrestrial and marine ecosystems—an area that remains poorly documented, according to the 2021 GESAMP report.

3. Better coordination among institutions

➔ **Forums for dialogue between public and private stakeholders.** Encouraging the creation of venues where governments and private operators can meet would help foster the development of solutions that are better suited to everyone's needs.

➔ **Closer coordination among existing bodies.** The ITU (which manages the radio spectrum and the pace of deployment) and COPUOS (which oversees space debris reduction and states' environmental responsibilities) currently operate in too siloed a manner; closer coordination between these two institutions would allow for more consistent regulation of the overall environmental impact.

4. Balanced regulations that also recognize the benefits

➔ **Geographical prioritization of connectivity**. The creation of priority satellite connectivity zones in the most isolated regions would address the real need for digital connectivity, while focusing regulatory efforts on ecologically sensitive areas (nature reserves, migration corridors, marine protected areas).

➔ **Monitoring the pace of deployment.** It is crucial to track changes in the number of satellites launched to prevent an imbalance between the benefits of connectivity and cumulative environmental degradation.

➔ **Accelerated deorbiting at the end of a satellite's life.** Some projects are advocating for a deorbiting standard of 5 years rather than 25 years, in order to reduce the accumulation of inactive debris in low Earth orbit—a measure that limits both the risk of collision and the amount of material that will eventually burn up in the atmosphere.

5. Responsible Management of Resources and Mining

➔ **Responsible sourcing standards.** Draw on UNEP's recommendations on responsible financing for critical minerals to regulate the extraction of metals needed to manufacture satellites.

➔ **A regulatory framework for ocean deorbiting.** Develop specific international rules for the South Pacific "space graveyard" area—which, according to Ocean Vision Legal, currently lacks a binding legal framework—in order to better assess and limit marine contamination.

Points for your delegation to consider:

1. Should we prioritize binding technical standards imposed on operators, or a framework of voluntary incentives accompanied by enhanced oversight?
2. Should we regulate the design and manufacture of satellites (brightness, materials, in-orbit lifespan)?
3. Should we regulate the deployment of satellite constellations? Only in certain orbital zones or near ecologically sensitive areas (nature reserves, migration corridors, marine protected areas)?
4. Who should bear the financial responsibility for mitigation measures: private operators, the governments that authorize them, or a shared international fund?
5. Should there be a temporary moratorium on new deployments while binding international standards are established?
6. Is the “first come, first served” principle, as applied to frequencies and orbits, compatible with the equitable management of a global resource shared among all states?
7. Does your country have a commercial space industry to protect, or major astronomical infrastructure to preserve? And how does this position influence your negotiating strategy?
8. Does your country rely on satellite constellations to bridge a connectivity gap, or does it already have sufficient terrestrial infrastructure (fiber, mobile networks) to do without this type of solution?
9. Is your country directly exposed to the environmental consequences of space debris (nearby ocean re-entry zones, flight paths over its territory during atmospheric re-entry)?

BIBLIOGRAPHY

1. Institutional Reports and Official Documents

ESA — Space Environment Report 2025 : ESA
UNEP (PNUE) — Ozone and You : https://ozone.unep.org/ozone-and-you
CMS — A CMS report stating that artificial light disrupts wildlife and biodiversity: CMS
UNESCO — Astronomie et héritage du monde : UNESCO
Diagram of the atmosphere by the University Corporation for Atmospheric Research : Diagram
Satellite constellation as defined by the International Astronomical Union (IAU) : iauarchive.eso.org Mineral Resource Extraction and the Energy Transition by UNEP: https://www.unep.org/

2. Scientific articles (academic preprints)

Report to the ESO Council — *"A Report on the Impact of Satellite Constellations"* (2020) : arxiv.org
IJRASET article on collisions and migration: : www.ijraset.com
ScienceDirect article : www.sciencedirect.com
Orbital Radar article about the differents satellites : orbitalradar.com
Light Pollution According to the IUCN (IUCN) : iucn.org

3. News Articles

FodNews article on the ESO report : fodnews.com
Gizmodo — *"ESO study finds that no more than 100,000 satellites should orbit Earth" :* gizmodo.com

4. videos for further understanding

- PBS NewsHour: “How light pollution is making it increasingly difficult to see the stars” : https://www.pbs.org/newshour/show/how-light-pollution-is-making-it-increasingly-difficult-to-see-the-stars
- Satellite constellations' threat to astronomy can get much worse : ESO youtube
- "The Dark Side of Bright Nights: How Artificial Light Transforms Biodiversity" (documentaire, juin 2026) : https://www.youtube.com/watch?v=E5wil6PM9iU