



Space Debris

For Prelims: [Space Debris](#), [Indian Space Research Organization](#), **China's Long March 5B rocket**, **Kessler Syndrome**, [Project NETRA](#), **Inter-Agency Space Debris Coordination Committee**.

For Mains: Challenges in Managing Space Debris and Way Forward.

[Source: IE](#)

Why in News?

Recently, [ISRO's \(Indian Space Research Organization\)](#) Rocket Debris was found on the shores of Western Australia.

- In November 2022, large fragments of [China's Long March 5B rocket](#) plunged uncontrolled into the south-central [Pacific Ocean](#). These fragments were stages of the rocket used to deliver the third and final module of the Tiangong space station.
- In **May 2021**, a large chunk of a **25-tonne Chinese rocket** fell into the [Indian Ocean](#).

What is Space Debris?

- **About:**
 - Space debris refers to **man-made objects in Earth's orbit** that no longer serve a useful purpose.
 - This includes **defunct satellites, spent rocket stages**, and fragments of debris from collisions or other events.
- **Threats from Space Debris:**
 - **Threat to Marine Life:**
 - Even when falling into the oceans, which is more likely since 70% of the earth's surface is ocean, **large objects can be a threat to marine life**, and a source of pollution.
 - **Threat for Operational Satellites:**
 - The floating space debris is a potential hazard for operational satellites and colliding with them can leave the satellites dysfunctional.
 - This overpopulation of space with objects and debris is referred to as **Kessler Syndrome**.
 - **Reduction of Orbital Slots:**
 - The accumulation of space debris in specific orbital regions can limit the availability of desirable orbital slots for future missions.
 - **Space Situational Awareness:**
 - The increasing amount of space debris makes it more challenging for satellite operators and space agencies to accurately track and predict the orbits of objects in space.

What are the Challenges in Tackling Space Activities?

- **More Satellite Launches by Various Countries:**
 - Countries like the **United States, China, India, and Japan** are actively engaged in space activities, including manned missions, lunar exploration, and resource exploitation.
 - Satellite launches have exponentially **increased in the past decade**, with 210 launches in 2013, 600 in 2019, 1,200 in 2020, and 2,470 in 2022.
 - Valuable metals in asteroids and planets have **attracted international interest in the absence of an agreed international framework** on space resource exploration that poses challenges in dealing with space activities.
- **Coordination and Space Traffic Management:**
 - The current coordination of space traffic is fragmented, **with different countries and regional entities employing varying standards** and practices.
 - This **lack of coordination** can lead to potential **collisions and accidents in space**, posing risks to operational spacecraft and increasing space debris.
- **Technological Challenges:**
 - Developing and deploying space missions requires cutting-edge technology, which can be expensive and prone to technical failures. Space agencies and private companies must address these challenges to ensure the success of their missions.
- **Geopolitical Tensions:**
 - As more countries become spacefaring nations, **there is potential for geopolitical tensions** in outer space.
 - Competing interests and territorial claims can create diplomatic challenges and hinder international cooperation.

What are the Initiatives to Deal with Space Debris?

- **India:**
 - In 2022, ISRO set up the **System for Safe and Sustainable Operations Management (IS 4 OM)** to continually monitor objects posing collision threats, predict the evolution of space debris, and mitigate the risk posed by space debris.
 - ISRO also carried out 21 collision avoidance manoeuvres of Indian operational space assets in 2022 to avoid collisions with other space objects.
 - ISRO has also set up a Centre for Space Debris Research to monitor and mitigate the threat of space debris.
 - **'Project NETRA'** is also an early warning system in space to detect debris and other hazards to Indian satellites.
- **Global:**
 - The **Inter-Agency Space Debris Coordination Committee (IADC)**, an international governmental forum, was established in 1993 to coordinate efforts between spacefaring nations to address the issue of space debris.
 - The **United Nations** has established the Committee on the Peaceful Uses of Outer Space (COPUOS) to develop guidelines for the long-term sustainability of outer space activities, including the mitigation of space debris.
 - The European Space Agency (ESA) has launched the Clean Space initiative, aimed at reducing the amount of space debris and promoting sustainable space activities.

What are the UN's Five Treaties to Deal with Space Activities?

- **The Outer Space Treaty 1967:**
 - Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies.
- **Rescue Agreement 1968:**
 - Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space.
- **Liability Convention 1972:**
 - It deals mainly with **damage caused by space objects to other space assets**, but it also applies to damage caused by **falling objects on earth**.
 - The Convention makes the **launching country "absolutely liable"** to pay **compensation for any damage** caused by its space object on the earth or to a flight in

air. The country where the junk falls **can stake a claim for compensation** if it has been damaged by the falling object.

- **The Registration Convention 1976:**
 - Convention on Registration of Objects Launched into Outer Space.
- **The Moon Agreement 1979:**
 - Agreement Governing the Activities of States on the **Moon and Other Celestial Bodies.**
 - India is a signatory to all five of these treaties but has ratified only four. India did not ratify the Moon agreement.

Way Forward

- Improving the ability to track and **monitor space debris can help mitigate the risks** it poses to operational satellites and human space missions.
- Using **reusable launch vehicles instead of single-use rockets** can help reduce the number of new debris generated from launches.
- Using more durable materials and designing satellites for eventual de-orbiting can reduce the number of debris generated in the long term.

UPSC Civil Services Examination, Previous Year Question (PYQ)

Q. International civil aviation laws provide all countries complete and exclusive sovereignty over the airspace above their territory. What do you understand by 'airspace'? What are the implications of these laws on the space above this airspace? Discuss the challenges which this poses and suggest ways to contain the threat. (2014)

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