Space Debris

Published On: 11-04-2024

Why is in news? "Another milestone": ISRO rocket accomplishes zero orbital debris mission

ISRO on 8th April, 2024 said its **Polar Satellite Launch Vehicle (PSLV)** has accomplished zero orbital debris mission, and described it "another milestone". This was achieved on March 21, when the **PSLV Orbital Experimental Module-3 (POEM-3)** met its "fiery end" through a re-entry into the Earth's atmosphere.

About POEM-3:

It was launched on January 1, 2024 POEM-3 utilized the **spent PS4 stage of the PSLV-C58 vehicle**, which initially launched XPoSat.

It is a **three-axis-altitude controlled platform** with power generation and tele-command & telemetry capabilities, for supporting Payloads.

The XPoSat mission aimed to **leave no debris in space**, demonstrating ISRO's commitment to responsible space practices.

The stage was **deorbited from 650 km to 350 km**, which facilitated its early re-entry, and was passivated to remove residual propellants to minimise any accidental break-up risks.

Upon deployment into its orbit at **650 km**, POEM-3 was maneuvered to a 350 km circular orbit to minimize orbit decay time after the experiment's completion.

After completing 400 orbits, POEM-3 **re-entered Earth's atmosphere after 73 days** in space.

POEM-3 was configured with a **total of nine different experimental payloads** to carry out technology demonstrations and scientific experiments on the newly developed indigenous systems.

Out of these, **six payloads** were delivered by **Non-Government Entities** (NGEs) through Indian National Space Promotion and Authorization Centre (IN' SPACe).

Through the POEM, which serves as a very cost-effective platform for carrying out **short-duration space-borne experiments**, ISRO has opened up new vistas for academia, startups, and NGEs to experiment with their new payloads.

This novel opportunity has been **effectively utilised** by numerous startups, universities, and NGEs for carrying out experiments in space, which included electric thrusters, satellite dispensers, and star-tracking.

POEM also **incorporates new features** such as total avionics in single-chain configuration, industrial-grade components in avionics packages including Mission Management Computer, standard interfaces for electric power, telemetry & telecommand, and new in-orbit navigation algorithms making use of rate-gyro, sun sensor, and magnetometer.

Significance:

With the rise in the number of satellites in orbit around the earth, space debris has become a pressing issue.

POEM-3's controlled re-entry into Earth's atmosphere **effectively mitigated the risk of space debris** by **ensuring the safe disposal** of the fourth stage of the PSLV rocket.

The experiments conducted on POEM-3 showcased advancements in areas such as power generation, navigation, and scientific research in the space environment.

By re-entering Earth's atmosphere, POEM-3 **minimized the accumulation of space debris** in low Earth orbit, contributing to the preservation of the space environment.

ISRO's meticulous tracking of POEM-3 **during its re-entry phase ensured the safety of terrestrial assets and populations** by monitoring the trajectory of the descending module.

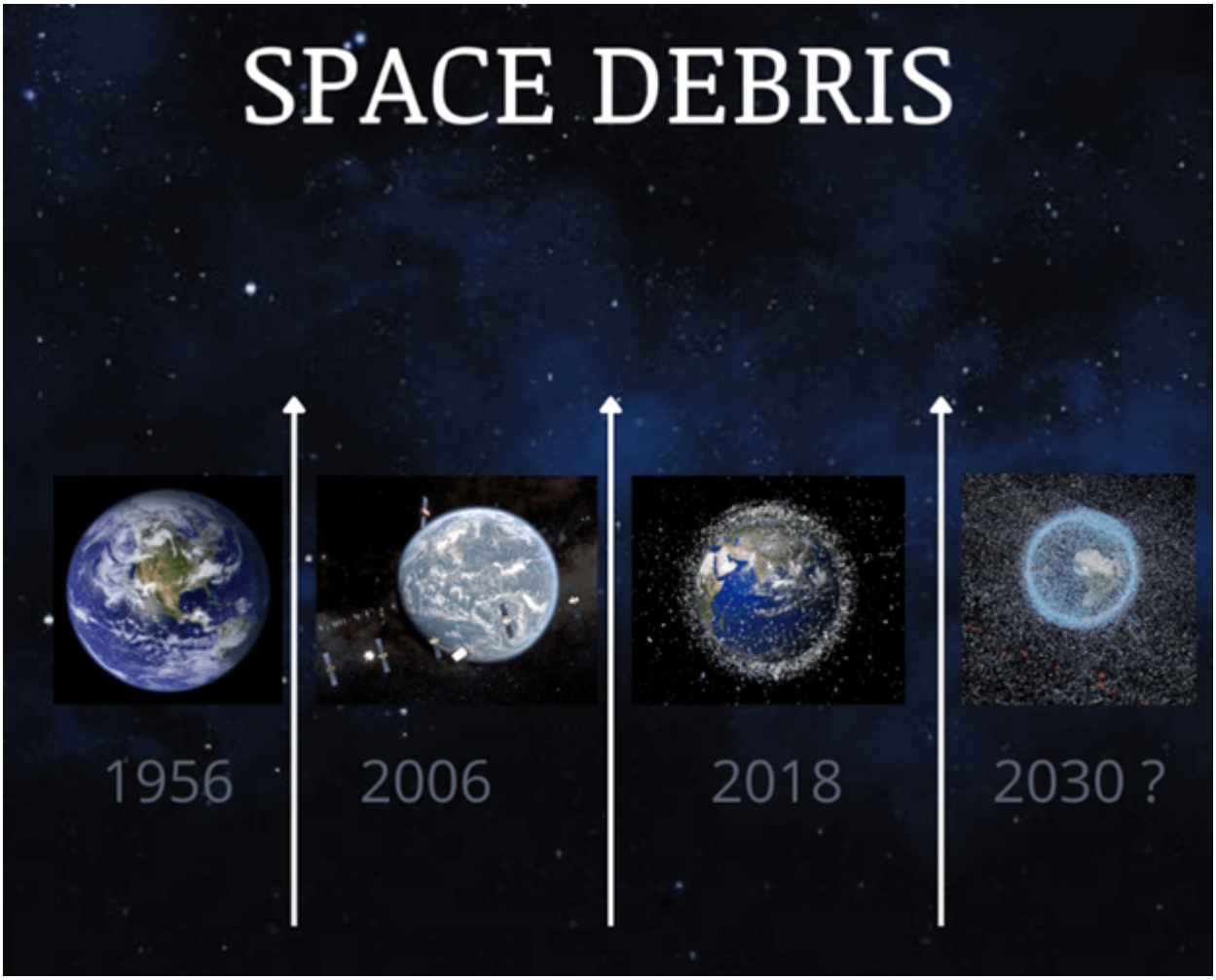
By effectively disposing of spent rocket stages and conducting controlled re-entries, ISRO's initiatives **help mitigate the risks associated with space debris collisions and orbital congestion.**

The insights gained from POEM-3's mission outcomes are valuable for international space agencies and organizations engaged in similar endeavours.

Space debris:

It is also known as **space junk**, refers to any **non-functional or discarded human-made objects** in space, including defunct satellites, spent rocket stages, fragments from previous collisions, and paint flecks.

These objects of space debris remain in various orbits around Earth and pose potential threats to operational satellites and space missions.



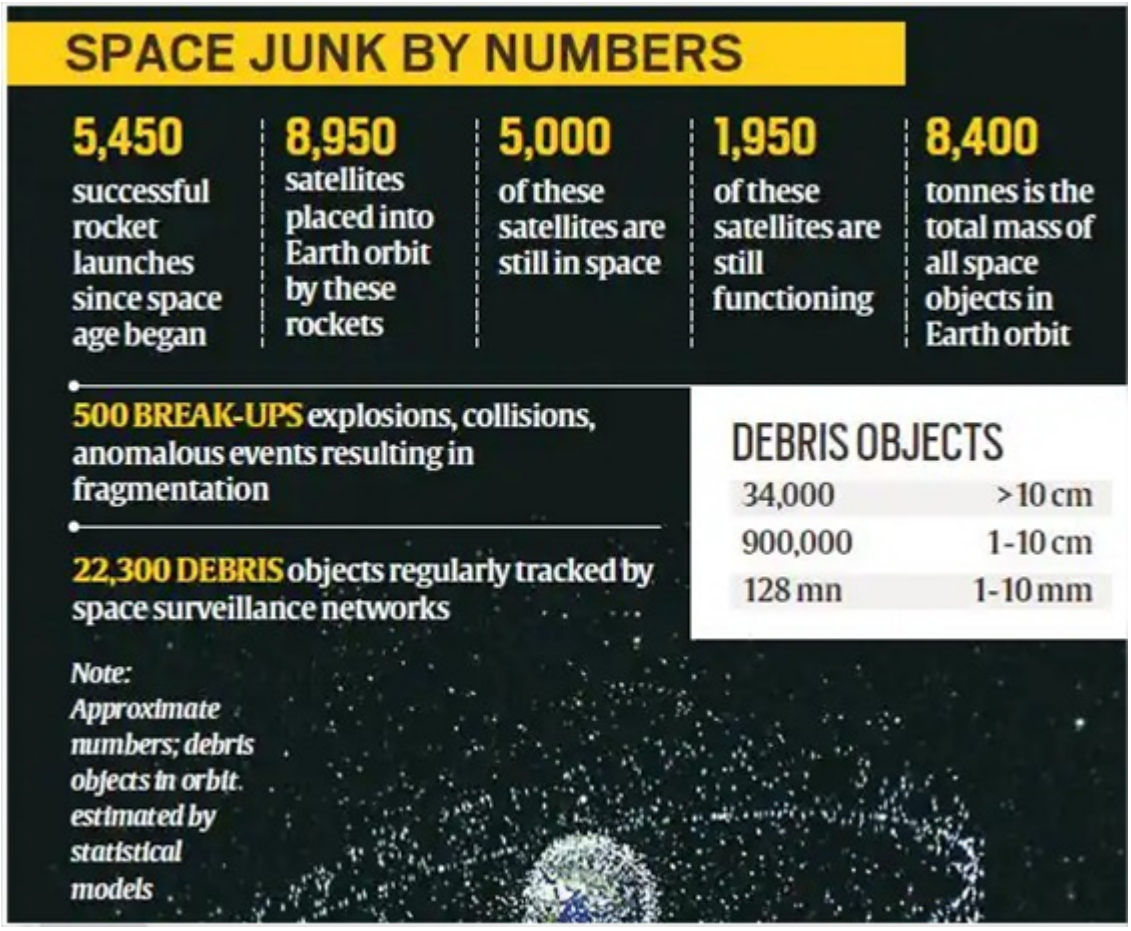
Current Status of Space Debris:

As per **ESA's Space Environment Report 2022,** over 30,000 pieces of space debris have been recorded and are being tracked on a regular basis by space surveillance networks.

It is estimated that there are **approximately 200,000 pieces** of micro debris ranging in size from **1 to 10 cm**, with millions **more smaller than 1 cm**.

There were approximately **6,718 active satellites orbiting the Earth in 2022**, an increase of nearly 2,000 satellites in just one year.

According to NASA, the number of satellites orbiting Earth is **expected to reach 60,000 by 2030**, up from the current 9,000, and the amount of untracked debris is a cause for concern.



Impacts of Space Debris:

Space debris can **collide with operational satellites and spacecraft**, causing damage or destruction.

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.

A major collision between large objects could trigger a chain reaction known as the **Kessler Syndrome**, where the resulting debris creates more collisions.

Space debris poses a **risk to crewed spacecraft and astronauts** on the International Space Station (ISS) and other future crewed missions.

When larger objects or satellites **re-enter the Earth's atmosphere**, some parts may survive the **heat of re-entry and reach the surface**. While most of the Earth's surface is water, there is still a risk of debris hitting populated areas.

The issue of space debris **raises important economic and political questions**, such as how to allocate the costs of removing debris and who should be responsible for its removal.

Regulations to deal with space junk:

Outer Space treaty, 1967: India is a signatory to this treaty which tells that States shall be liable for the damage caused by their space objects.

Liability Convention, 1972: It is the convention on International Liability for Damage Caused by Space Objects.

It deals with- Damage caused by space objects to other space assets, Damage caused by falling objects on earth.

It 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.

International Space Law points that if a satellite becomes dysfunctional, then the satellite should deorbit and its re-entry into the earth should be carried.

Various Initiatives to mitigate the Space Debris Issue:

Project NETRA:

It is **ISRO’s** initiative for **early warning system** in space to detect debris and hazards to the Indian satellites.

It can spot, track and catalogue objects as small as 10 cm, up to a range of 3,400 km and equal to a space orbit of around 2,000 km.

IS 4 OM:

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.

Space Debris Mitigation Guidelines:

It was established in 2002 by the Inter-Agency Space Debris Coordination Committee (IADC) and endorsed by the United Nations in 2007.

Inter-Agency Space Debris Coordination Committee (IADC):

It was established in 1993.

It is an international governmental forum, to coordinate efforts between spacefaring nations to address the issue of space debris.

Zero Debris Charter:

It was adopted by the **European Space Agency** (ESA) with the goal of achieving zero space debris by 2030.

NASA’s Orbital Debris Program:

NASA’s initiative since 1979, focusing on reducing orbital debris creation, tracking existing debris, and exploring debris removal technologies.

Space Force Tracking System:

It was implemented by the **U.S. Space Force** to monitor space debris and assess collision risks in low Earth orbit (LEO).

Chinese Debris Removal Initiatives:

China’s efforts include deploying spacecraft for debris removal with innovative technologies like solar sails.

Japanese CRD2 Demonstration:

It is partnership between Japan’s Aerospace Exploration Agency (JAXA) and Astroscale to develop debris removal technologies.

Conclusion:

ISRO said it will continue its commitment to providing a cost-effective orbital experiment platform, as the growing menace due to space debris, especially with multiple small satellite constellations coming up, poses a significant threat to space activities, including satellite launches, human spaceflight, and space exploration missions.

ISRO, being a responsible space agency, is committed to mitigating this threat through the development and implementation of advanced debris tracking systems, space-object deorbiting technologies, and responsible satellite deployment practices, thus safeguarding orbital environments for present and future space endeavours.