

SOURCES OF SPACE DEBRIS



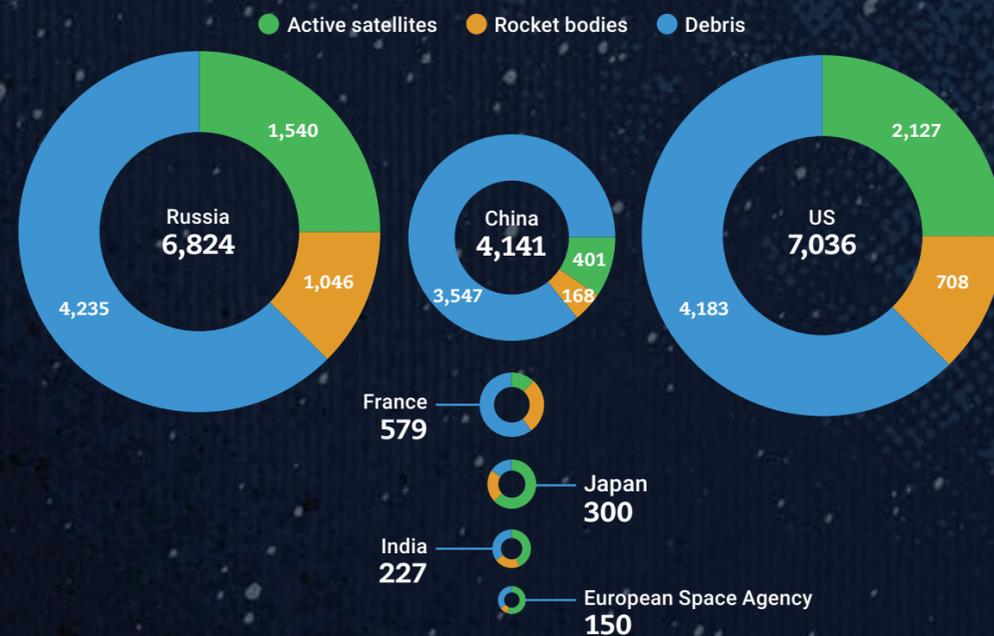
January 11, 2007 — China fires a surface-launched, medium-range missile at a defunct weather satellite. The test creates 3,300 pieces of debris larger than 10 centimeters in diameter and produces more than 200,000 debris particles as small as 1 centimeter. Those smaller pieces are still large enough to disable a spacecraft or penetrate the shields of the International Space Station.



February 10, 2009 — The defunct 950-kilogram Russian satellite known as Cosmos-2251 collides with and destroys a functioning U.S. Iridium commercial satellite, creating 2,000 large pieces of space debris and more than 100,000 smaller particles. Together, the Chinese anti-satellite test and the collision of the Russian and U.S. satellites increased the amount of debris in low Earth orbit by 60 percent.

ORIGINS OF SPACE DEBRIS

COUNTRIES WITH THE MOST STUFF IN SPACE AND WHAT IT IS



CLEANUP EFFORTS

Nations are teaming up to remove space debris from orbit. Researchers led by Guglielmo Aglietti, director of the Surrey Space Centre in the United Kingdom, have been developing methods to tether, harpoon or net space junk and bring it down to 200 kilometers above the surface to re-enter Earth's atmosphere and burn up. The RemoveDebris satellite carrying the leading wave of these experiments was deployed from the International Space Station in 2018.

Net experiment — A miniature satellite deploys a balloon to simulate space debris. From a short distance away, the RemoveDebris satellite captures the debris in a net and maneuvers the package into Earth's atmosphere so it will burn up.

Vision-based navigation — The RemoveDebris satellite conducts a series of maneuvers to obtain data and take images of another miniature satellite.

Harpoon and deployable target — A harpoon connected by a tether ejects from the RemoveDebris satellite platform at a low velocity to spear target panels released by a miniature satellite.

Drag sail — The RemoveDebris satellite deploys a large sail, which acts like an air brake. The drag sail brings the satellite from the relatively low orbital altitude of the space station into the planet's atmosphere to safely disintegrate.



NET EXPERIMENT



VISION-BASED NAVIGATION



HARPOON AND DEPLOYABLE TARGET



DRAG SAIL

Earth Observation Portal

DEBRIS IN SPACE



Thousands of pieces of space debris endanger active satellites, the International Space Station and other spacecraft. For an in-depth look at the dilemma, read "Space Debris: Working Together to Defend the Planet from Orbiting Objects" on **Page 30**.

WHAT IS SPACE DEBRIS?

Nonfunctional, human-made materials in orbit caused by everything from spent booster stages to satellite collisions and explosions.

73%

of tracked debris resides in low-Earth orbit
1,931 kilometers above our planet's surface.

HOW MUCH SPACE JUNK IS UP THERE?

More than

25,000

objects



larger than 10 centimeters in diameter in Earth's orbit are being tracked by the U.S. Space Surveillance Network.



900,000

objects

larger than 1 centimeter in diameter, or the size of a marble, are circulating in space.

128 million

objects

that measure smaller than a centimeter are orbiting the Earth.



WHY IT'S A SERIOUS PROBLEM

Traveling at such hypervelocities, any particle of space junk presents a considerable threat to space flight for any nation. And with more hardware flying around Earth's orbit, the potential of collisions between spacecraft and large orbital trash only continues to grow.

FASTER THAN THE SPEED OF SOUND

The speed of sound travels at approximately
1,236 kph on a normal day.

To remain in orbit, the fragments in space have to move along at least **20 times that speed** and can go to almost

28,968 kph

TOO CLOSE FOR COMFORT

About **1,000 times a day**, satellites and debris pass less than **8 kilometers** from each other. Considering how expansive space is, this distance is striking.

COLLISIONS & EXPLOSIONS INCREASE DEBRIS



More than **500** Estimated number of breakups, explosions, collisions or anomalous events each year.

8,800

metric tons

Total mass of all space objects in Earth's orbit.

