Premium

Isro brings down decommissioned weather satellite: What is a controlled re-entry? Why is it done?

Satellites are brought down to minimise the amount of space debris orbiting the earth. This debris pose risks to operating satellites and space craft, and have become a source of major concern for scientists.

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Megha-Tropiques-1 was developed as a joint mission by India and France to study the tropics' water cycle and energy exchanges. (Photo: ISRO)

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The Indian Space Research Organisation **brought down a satellite in a controlled manner** after its end of life, for the first time earlier this week. The weather satellite Megha Tropiques-1, which was developed as a joint mission by Indian and French space agencies, entered the atmosphere after the final two manoeuvres on Tuesday and burnt up over the Pacific Ocean.

How was the satellite brought down?

The Megha Tropiques satellite was launched aboard a **PSLV** by the space agency in 2011. And, although the planned mission life of the satellite was only three years, it continued providing data on water cycle and energy exchanges in the tropics for nearly a decade.

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With over 120kgs of fuel remaining in the satellite even after being decommissioned, the space agency determined that there was enough to attempt a controlled re-entry, where a series of 20 manoeuvres over eight months lowered the orbit of the satellite such that it re-entered the dense atmosphere on Tuesday and burned up.

This was the first time that the space agency attempted such a manoeuvre to clear out space debris despite the satellite not being built to do so. "The re-entry was not really planned as part of the mission; there was fuel left so Isro attempted it. Usually, satellites are left in their orbit and because of the gravitational pull of the earth, they come down to the atmosphere over years and years. When the satellites re-enter the atmosphere, the friction causes it to heat up to extreme high temperatures of thousands of degrees Celsius. Without a heat shield, 99% of a satellite gets burnt up whether in a controlled re-entry or an uncontrolled one," said Ajey Lele, senior fellow at Manohar Parrikar Institute for Defence Studies and Analyses.

Why did Isro attempt a controlled re-entry?

Other than extra fuel conveniently remaining in the satellite after the mission life ended, Isro attempted the control re-entry to demonstrate and understand the process of doing so.

With several space fairing nations and private entities launching satellites, mostly in low earth orbits, it has become imperative to keep the space clean. There are thousands of objects flying around in these orbits; not just old satellites and their parts but also last stages of the rockets that take them there. Moving at extremely high speeds, **even the smallest debris can destroy active satellites.**

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Scarier still is Kessler syndrome – a scenario where the amount of space debris reaches a point where they just create more with one collision triggering others.

This is the reason the **space debris** are monitored and sometimes satellites have to be moved from their way. Isro carried out 21 such collision course manoeuvres in 2022, as per minister of state for space Dr Jitendra Singh's reply in the parliament. In fact, the space agency set up a department last year to monitor the space debris and mitigate the risks posed.

The space agency was also following the guidelines of UN and the **Inter-Agency Space Debris Coordination Committee** (IADC) that say satellites should be deorbited after mission life – either through controlled entry over a safe impact zone as was attempted by Isro with Megh Tropiques-1, or by bringing it down to reduce the orbital lifetime (the time it would take for a satellite to drop from a particular orbit by itself) to less than 25 years.

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It is also recommended that in such cases stored fuel be removed from the spacecraft to ensure that there are no accidents that break up the satellite in space and create more debris. In the case of Megha Tropiques-1, the orbit of 867 km with 20 degree inclination meant an orbital lifetime of over 100 years. And, there was over 120 kg of fuel left over in the spacecraft.

What happens to satellites usually?

A controlled re-entry like the one attempted by **Isro** earlier this week is possible only for satellites in the low-earth orbit – at about 1,000 kms over the surface of the earth. These manoeuvres, however, are not usually attempted because fuel reserves have to be maintained in the satellite after mission life is over.

And, this is impossible for satellites placed in geo-stationary or geosynchronous orbit – where time taken by the satellite to orbit the earth matches Earth's rotation – because they are at altitudes of nearly 36,000 kms. "For attempting to bring down a

satellite from such as orbit, a huge fuel reserve would be needed. This will only make the satellite heavier and costlier at launch," said Lele.

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An official from Isro said, considering it takes debris from the low earth orbit 20 to 30 years to fall to the atmosphere naturally, it would take generations for those in geosynchronous or geo-stationary orbits to fall.

So, what happens to satellites in these higher orbits? "They are usually moved to what is known as graveyard orbit. Instead of bringing them down, they are shot upwards at the end of life," said Lele. The official from Isro added, "These orbits are like parking lots in space where all old satellites are put in. Sometimes a satellite might escape to deep space as well." A satellite escapes to deep space when its velocity increases enough to get away from the gravitational pull of the earth.

Have Isro satellites rained debris in the past?

Not really. "Almost 99.9 per cent of a satellite burns up in the atmosphere. We haven't seen really had instances of debris raining over inhabited areas," said the official from Isro. The satellites in low earth orbit are usually smaller and hence more likely to disintegrate complete when they enter the atmosphere.

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In addition, the official from Isro said, the space agency usually uses aluminium and composites to make the satellites. These materials have a lower burning point