

Space Debris - *The prevention and removal of orbital debris*

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Abstract

The ever increasing popularity of space travel brings about important innovative discoveries, however the expanding presence of debris in space poses a threat to the security of Low Earth Orbits. This project aims to address the orbital debris problem through a multifaceted approach. The project will consider unique solutions for debris mitigation and removal, describe current policies that address de-orbiting satellites after their useful life and space traffic management. In addition, it addresses the problem from a technical standpoint including categorizing existing debris and current removal solutions, both successful and not. Through this project, we hope to enact positive change in local and national space law by proposing orbital debris mitigation and satellite removal policies to governing officials. On the technical side, we will brainstorm ideas for a debris removal concept based on our research of existing solutions, which will eventually lead to a working prototype of our design. Another product of this research is to provide an educational resource on the topic of space debris, bringing light to the problem. The collection of information is ongoing as we continue to learn about existing debris in space.

Purpose

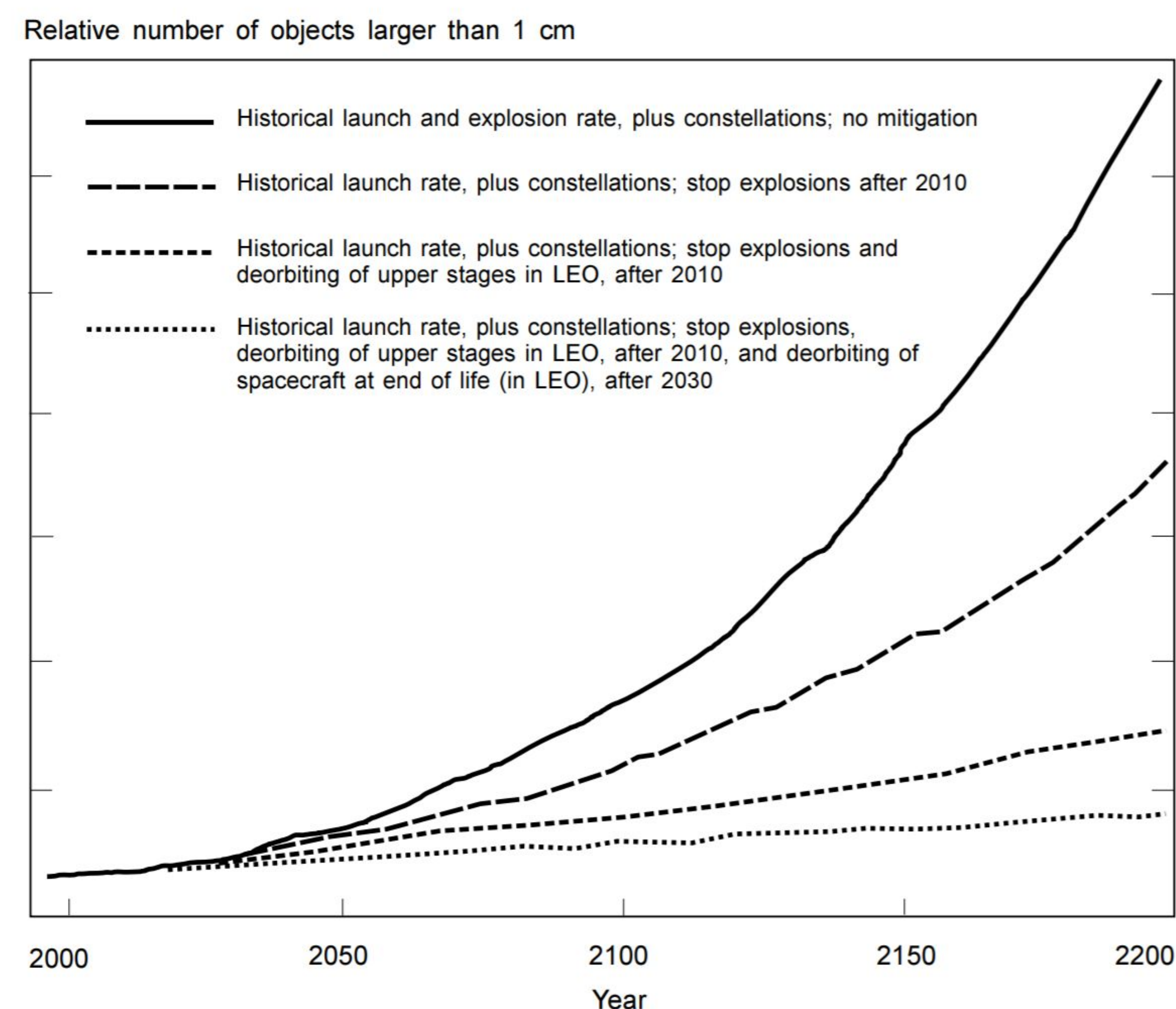
Space Debris is an increasing problem every day among the aerospace industry. There are roughly 35,200,000 pieces of debris 0.1-1 cm in size and 12,000 pieces 10 cm and larger in size. This amount will only increase as the space industry grows. With this amount of debris in orbit, the chances of collisions rise. While this may not seem like a pressing issue, it could have serious consequences for the space industry and the lives of astronauts on the International Space Station. These pieces of debris can travel up to 22,300 miles per hour. At these speeds,, orbital debris can cause major damage to satellites or other spacecraft in orbit. Another issue with the rise of space debris is that launching space vehicles becomes more complicated, because they now have to account for debris in orbit. While this appears to only be an issue for the space industry, space debris can also affect people's everyday lives. Many technologies that people rely on today use satellites to operate. If low earth orbit becomes inaccessible because of space debris, these technologies would no longer be available.

Existing Solutions

While space debris may pose a future threat, it is not a new one, and several organizations in the past have created and tested designs to help remove and prevent orbital debris.

- **Mitigation:** Many modern satellites have debris monitoring software so they can maneuver out of the way to avoid collisions. Space X's Starlink Satellites feature this technology and are also programmed to undergo a de-orbit maneuver where they will burn up in the atmosphere after their useful life. Satellite servicing such as Northrop Grumman's Mission Extension Vehicle is another concept that can extend a satellite's useful life through in space repairs.
- **Capture:** Some private and government organizations have developed devices to catch and remove orbital debris such as harpoons, nets, solar sails, robotic arms, tethering systems, and more. The European Space Agency's (ESA) Clearspace-1 will attach to and manually de-orbit decommissioned satellites.

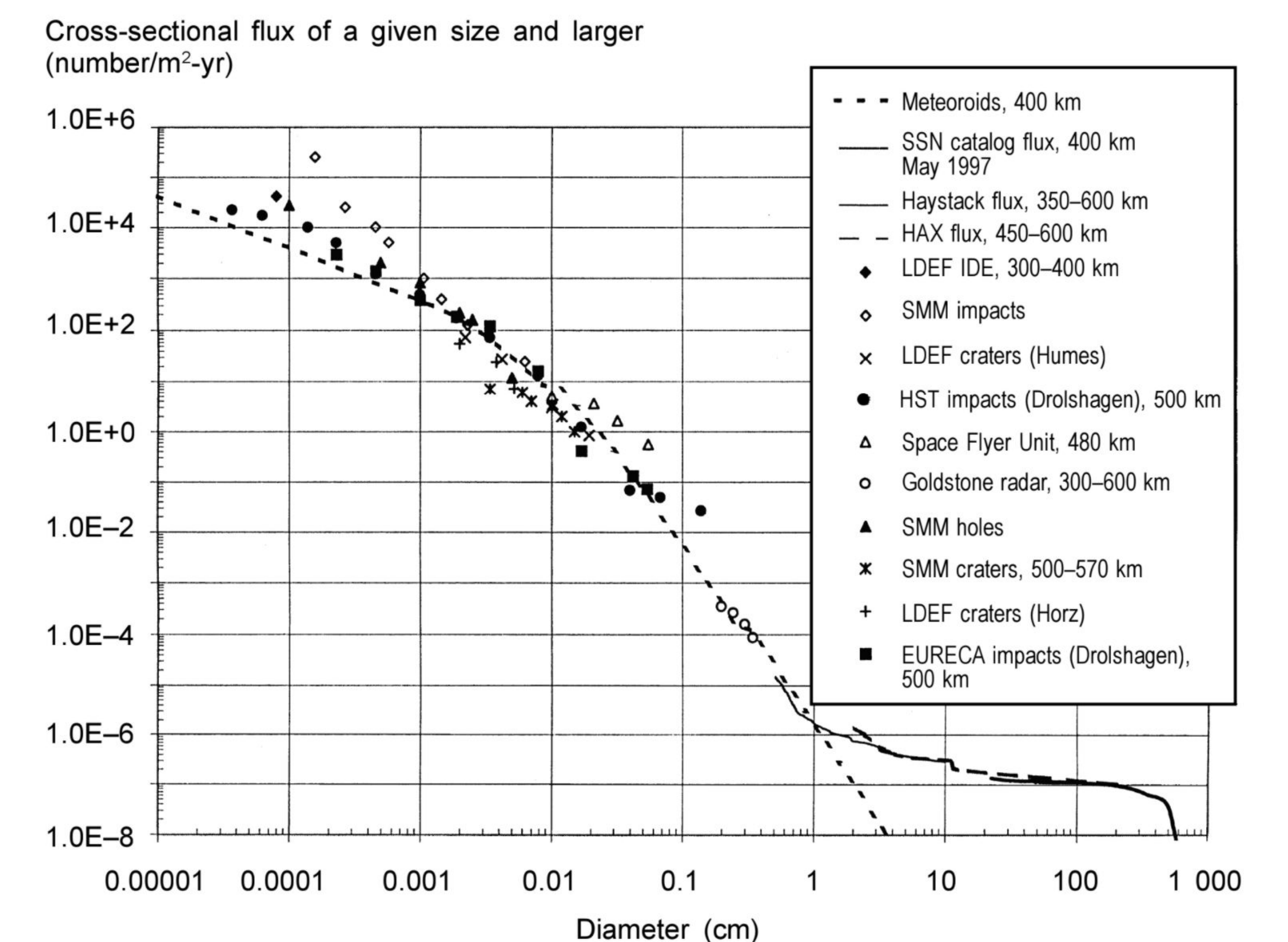
Figure IX. Trends in population of space debris particles larger than 1 centimetre in low Earth orbit for different scenarios, 2000-2200



(UN. Committee on the Peaceful Uses of Outer Space. Scientific and Technical Subcommittee, 1999, p. 12)

Background Image Source: NASA

Figure I. Approximate measured debris flux in low Earth orbit, by object size



(UN. Committee on the Peaceful Uses of Outer Space. Scientific and Technical Subcommittee, 1999, p. 39)

Policies/Legislation

In 1979, the United States' National Aeronautics and Space Administration (NASA) created the NASA Orbital Debris Program. The program looks for ways to mitigate debris in LEO. In 2002, The ESA Space Debris Mitigation Handbook was made to provide technical information in support of the ESA's debris mitigation standards. Agencies and countries have made policies and laws that target mitigation of debris but there are no international laws and space laws to clean up space. Aerospace companies and agencies have taken initiative to create their own ideas to combat the issue technologically, but the lack of international law means this process could take years before an affordable and accessible solution is found. Our project aims to tackle the lack of space debris policy by reaching out to government officials, informing them of the problem, our ideas for policy solutions, and explaining why their participation is critical to cleaning up space before it is no longer accessible.

Acknowledgments

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