



U.S. Space Debris Environment and Activity Updates

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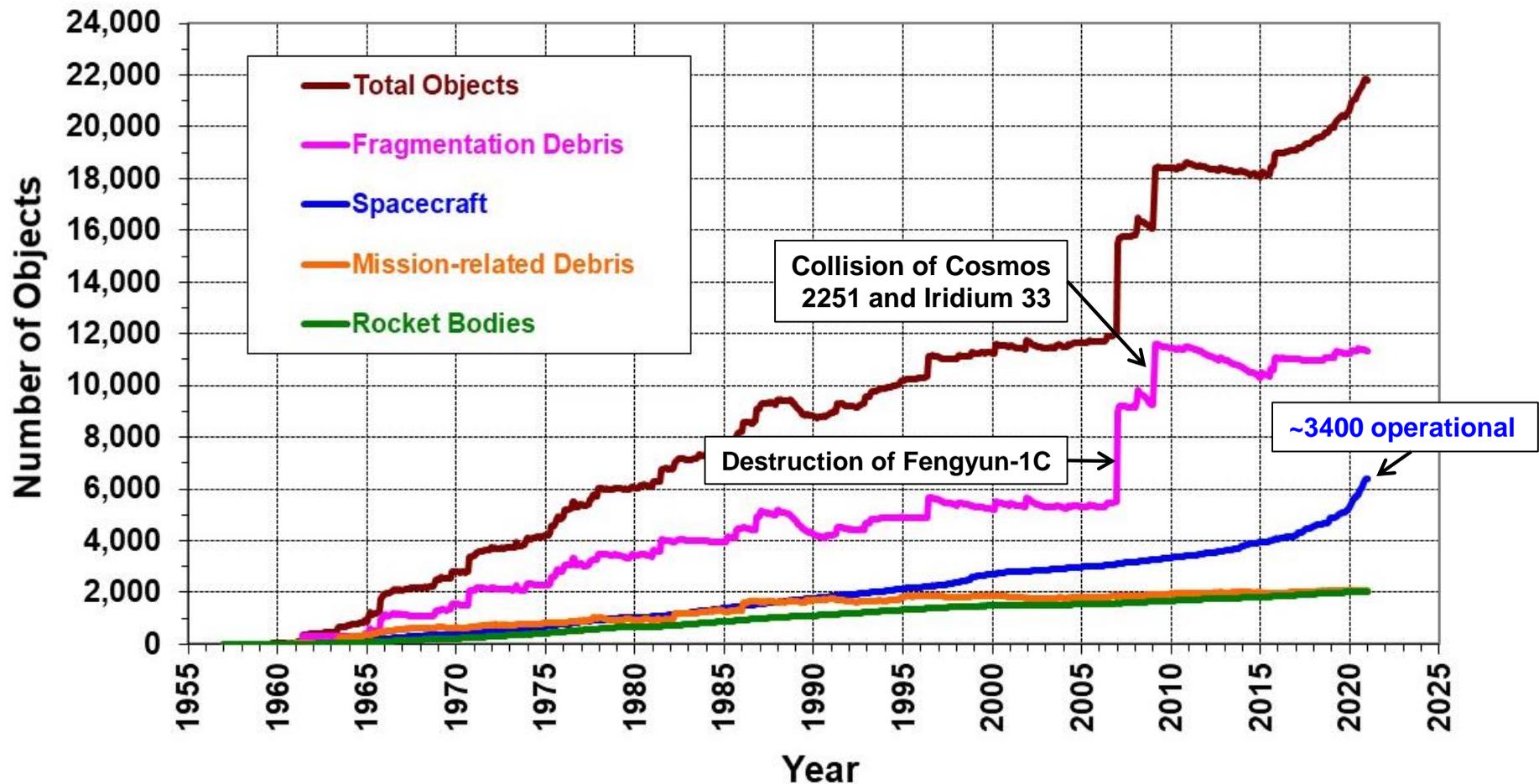
Presentation Outline

- **Earth Satellite Population (1957-2020)**
- **Satellite Fragmentation in 2020**
- **Collision Avoidance Maneuvers**
- **Highlights of U.S. Orbital Debris Activities**
- **The 2020 National Space Policy**



Evolution of the Cataloged Satellite Population

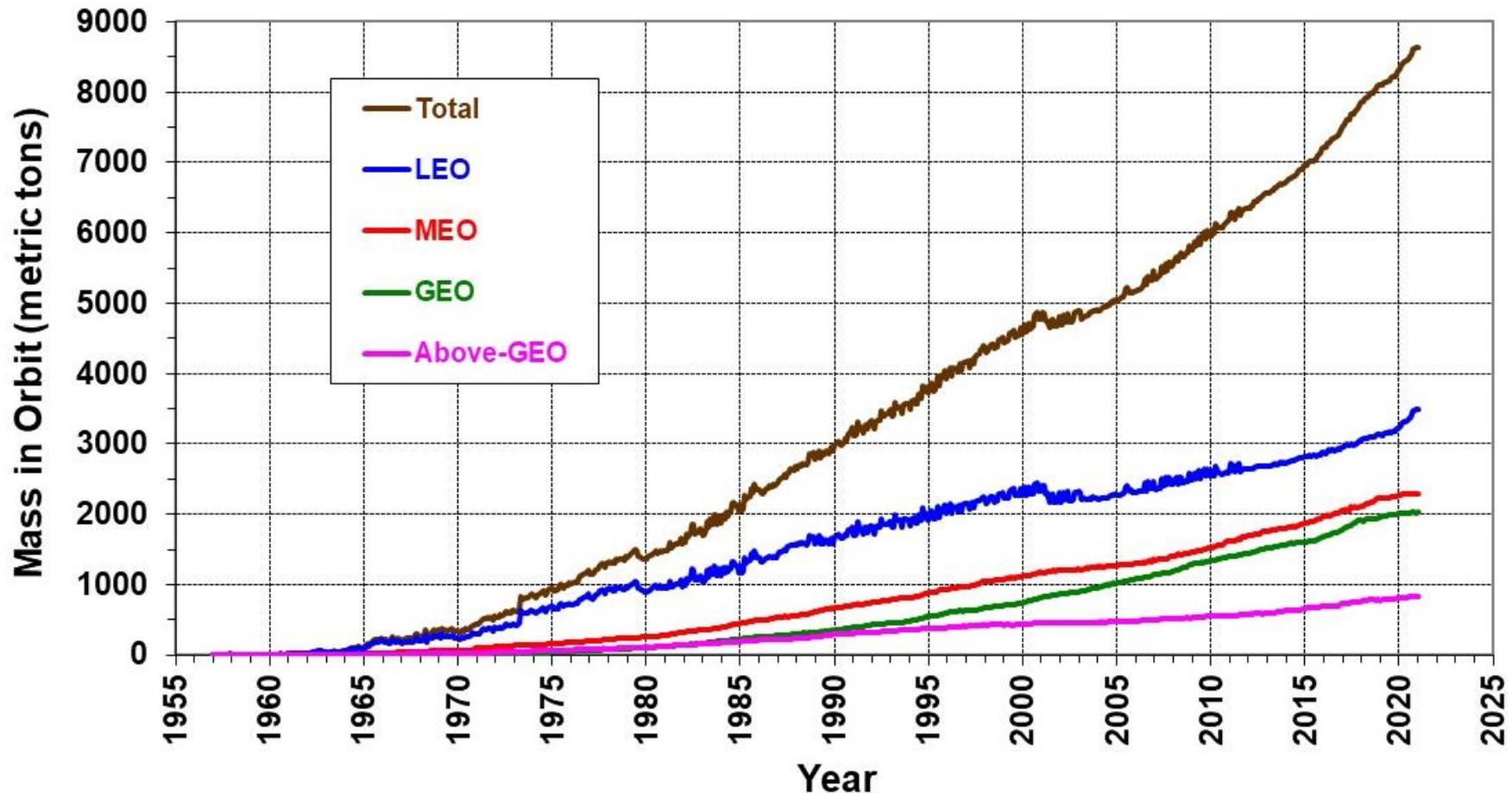
- According to the U.S. Satellite Catalog, the number of 10 cm and larger objects in Earth orbit continued to increase in 2020





Mass in Near-Earth Space Continued to Increase

- **The total mass of material exceeded 8700 metric tons in 2020**
 - About 3500 tons of material was in low Earth orbit (LEO, the region below 2000 km altitude)

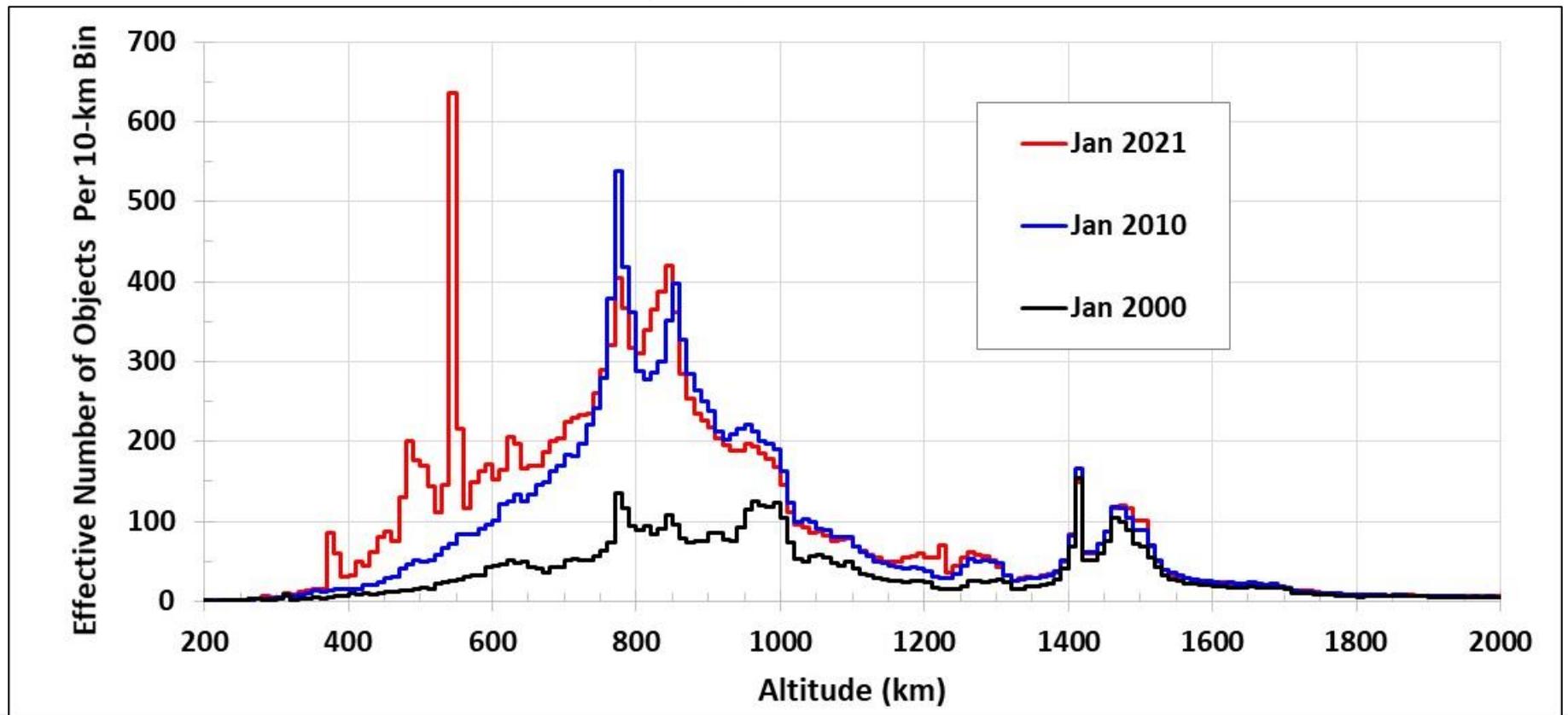




Low Earth Orbit (LEO) Environment

- From the year 2000 to 2021

- **The LEO cataloged objects have significantly increased in 20 years**
 - 2000 to 2010: The Fengyun-1C anti-satellite (ASAT) test and the collision between Iridium 33 and Cosmos 2251 drove most of the increase
 - 2010 to 2021: Proliferation of CubeSats and deployments of large constellations were primarily responsible for the increase below ~700 km





Satellite Fragmentation During 2020

- **The U.S. Space Surveillance Network (SSN) detected five satellite fragmentations during 2020. The five breakups generated**
 - more than 600 fragments large enough to be cataloged by the SSN and
 - hundreds of thousands of additional debris too small to be tracked by the SSN but large enough to threaten human spaceflight and robotic missions.

Common Name	International Designator	Perigee Altitude (km)	Apogee Altitude (km)	Debris Cataloged	Cataloged Debris Still On-Orbit ¹
Cosmos 2535 spacecraft	2019-039A	604	618	26	13
SL-14 Tsyklon 3rd stage	1991-056A	1,186	1,206	112	108
SL-23 Zenit Fregat tank	2011-037B	422	3,606	325	309
H-2A fairing cover	2018-084C	595	643	87	28
Resurs-O1 spacecraft	1994-074A	633	660	72	72

¹As of 1 February 2021



International Space Station and NASA Robotic Spacecraft Collision Avoidance Maneuvers

- **NASA has established conjunction assessment processes for its human spaceflight and robotic missions to avoid accidental collisions with objects tracked by the SSN**
 - NASA also assists other U.S. government spacecraft owners with conjunction assessments and subsequent maneuvers
- **The International Space Station (ISS) conducted three debris collision avoidance maneuvers in 2020**
 - The avoided objects included a fragment generated from the 2007 Fengyun-1C ASAT test, a fragment from the explosion of a SOZ ullage motor in 2003, and a fragment generated from the breakup of an H-1A fairing cover in 2020
- **During 2020 NASA also executed or assisted in the execution of 12 collision avoidance maneuvers by robotic spacecraft**





Highlights of U.S. Orbital Debris Activities

- **Release of “*National Orbital Debris Research and Development Plan*” by the National Science & Technology Council**
 - A national plan of research and development in support of managing risks posed by orbital debris to space missions
- **Release of “*Spacecraft Conjunction Assessment and Collision Avoidance Best Practices*” by NASA**
 - Information sharing on best practices for coordinating in-orbit activity in a safe and responsible manner for a sustainable space environment
- **The U.S. Space Force’s Space Fence achieving initial operational capability**
 - Revolutionary space situational awareness improvements to object tracking and conjunction assessments
- **Release of updated Debris Assessment Software (DAS) by NASA**
 - A tool used by satellite owners and operators to assess mission compliance with orbital debris mitigation guidelines and best practices



U.S. National Space Policy

- **Orbital debris mitigation has been included in every U.S. National Space Policy since 1988 (1988, 1989, 1996, 2006, 2010, and 2020)**
 - The latest National Space Policy released in December 2020 continued the tradition to focus on limiting the generation of new debris:

“Preserve the Space Environment. To preserve the space environment for responsible, peaceful, and safe use, and with a focus on minimizing space debris the United States shall...

 - *Limit the creation of new debris, consistent with mission requirements and cost effectiveness, during the procurement and operation of spacecraft, launch services, and conduct of tests and experiments in space by following and periodically updating the United States Government Orbital Debris Mitigation Standard Practices...*
 - *Pursue research and development of technologies and techniques to characterize and to mitigate risks from orbital debris, reduce hazards, and increase understanding of the current and future debris environment;*
 - *Evaluate and pursue, in coordination with allies and partners, active debris removal as a potential long-term approach to ensure the safety of flight in key orbital regimes...*”