



Space Traffic Management Conference

2018 Seeking Sustainable Solutions

Jan 18th, 1:30 PM - 3:15 PM

Overview of the Orbital Debris Environment

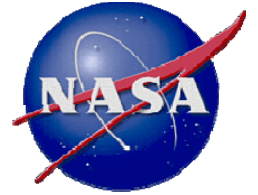
JC Liou

NASA, Chief Scientist for Orbital Debris

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Overview of the Orbital Debris Environment

J.-C. Liou, PhD

NASA Chief Scientist for Orbital Debris

2018 STM Conference

Embry-Riddle Aeronautical University, Daytona Beach, 18 January 2018



How Much Debris Is Currently in Earth Orbit?

**Baseball size or larger (≥ 10 cm): ~23,000
(tracked by the U.S. Space Surveillance Network)**



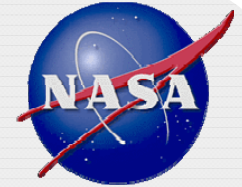
Marble size or larger (≥ 1 cm): ~500,000



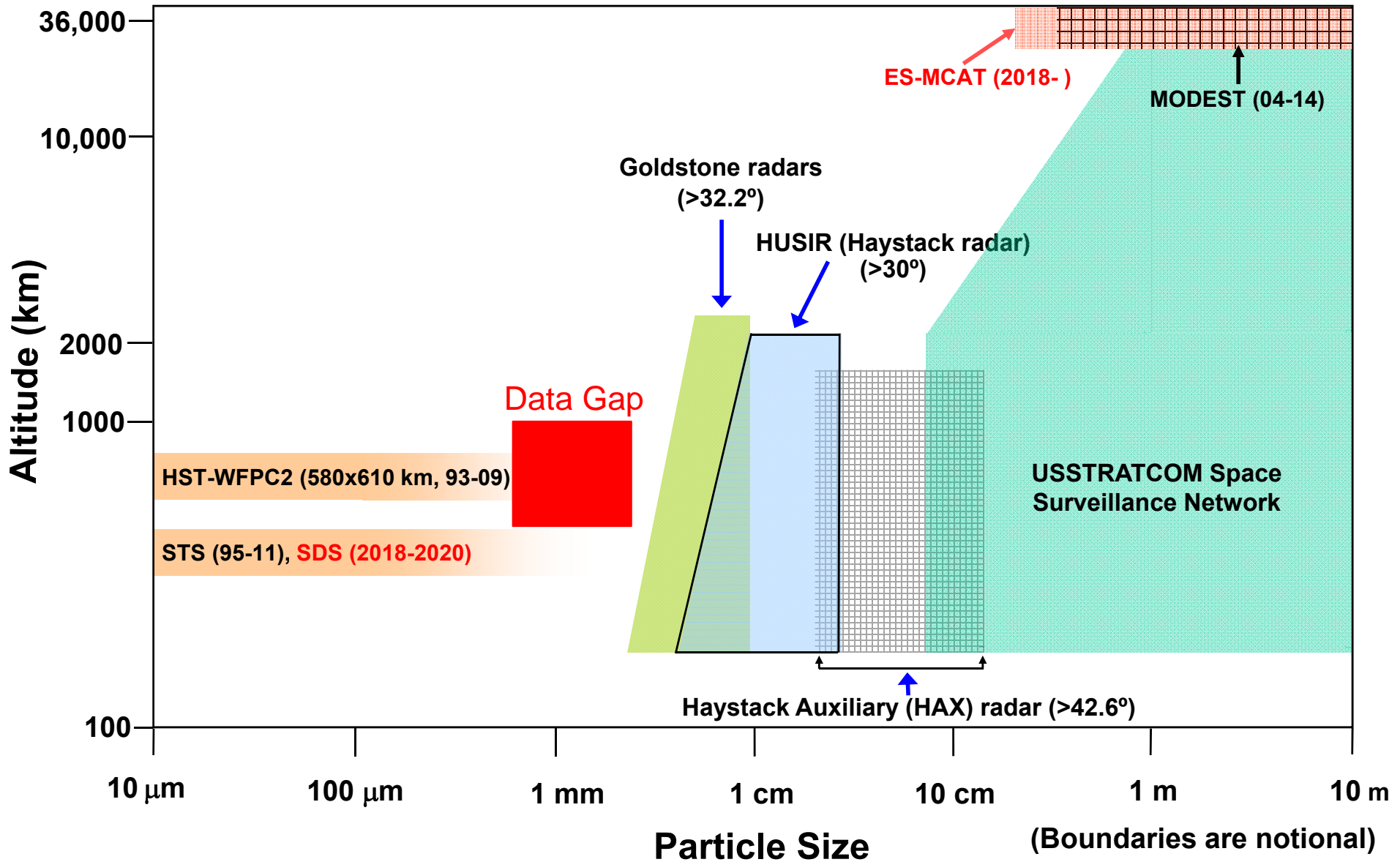
**Dot or larger (≥ 1 mm): >100,000,000
(a grain of salt)**

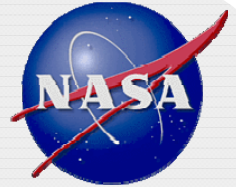


- Due to high impact speed in space (~10 km/sec in LEO), even sub-millimeter debris pose a realistic threat to human spaceflight and robotic missions
 - 10 km/sec = 36,000 km per hour (the speed of a bullet ~2,500 km per hour)
- **Mission-ending threat is dominated by small (millimeter-sized) debris impacts**
- Total mass: >7600 tons LEO-to-GEO (~2700 tons in LEO)

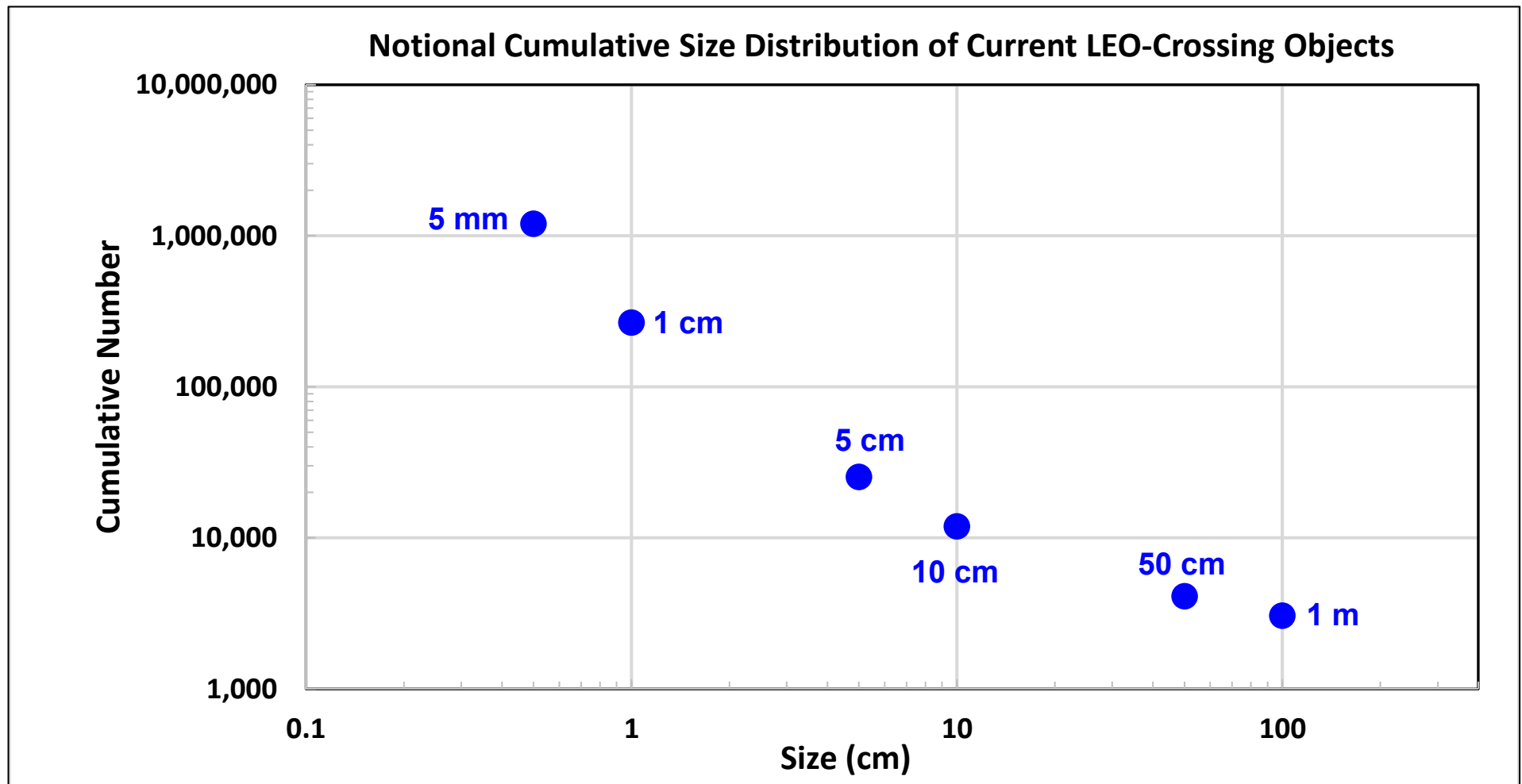


NASA and USSTRATCOM SSA Coverage

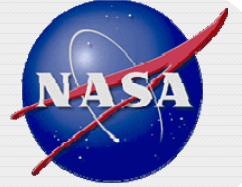




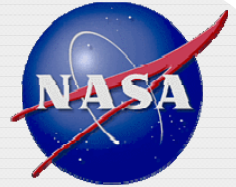
Risk from Small and Large Debris



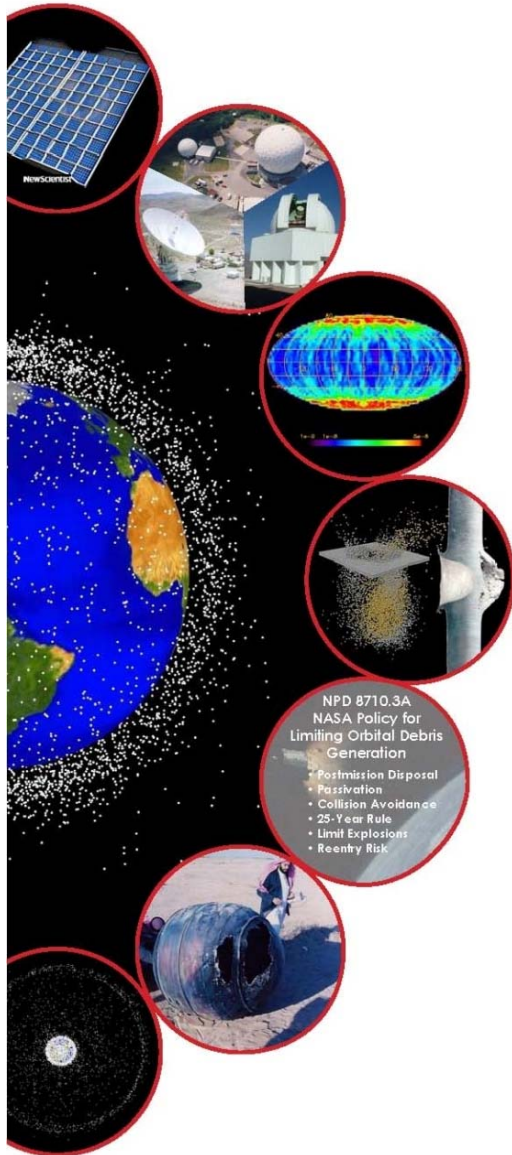
- **Mission-ending threat is dominated by small debris impacts**
 - Current conjunction assessments and collision avoidance maneuvers against the tracked objects (which are typically 10 cm and larger) only address a small fraction (<1%) of the mission-ending risk from orbital debris



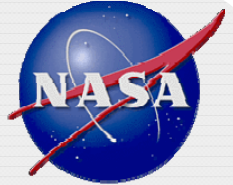
Backup Charts



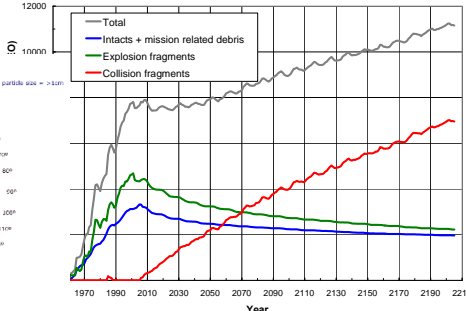
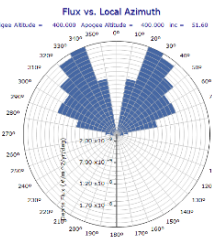
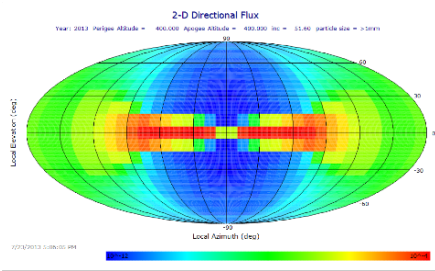
NASA Orbital Debris Program Office (ODPO)



- **The ODPO is the only organization in the U.S. Government conducting a full range of research on orbital debris**
 - This unique NASA capability was established at JSC in 1979 (D. Kessler, J. Loftus, B. Cour-Palais, *etc.*)
 - ODPO's roles and responsibilities are defined in NASA Procedural Requirements NPR 8715.6B
- **ODPO provides technical and policy level support to NASA HQ, OSTP, and other U.S. Government and commercial organizations**
- **ODPO represents the U.S. Government in international fora (IADC, United Nations, *etc.*)**
- **ODPO is recognized as a pioneer and leader in environment definition and modeling, and in mitigation policy development**



End-to-End Orbital Debris Activities at ODPO



Mission Risk Assessments

**NASA space assets
(ISS, Orion, robotic missions, etc.)
Reentry**

Measurements

**Radar
Optical
In-situ
Laboratory**

Modeling

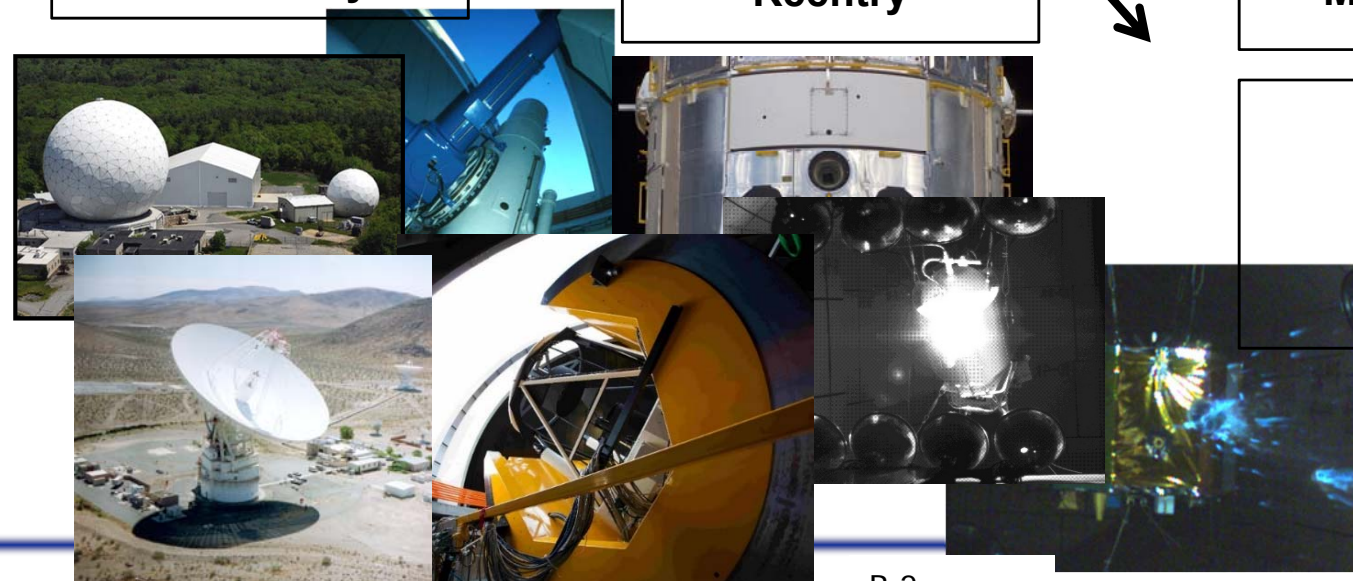
**Breakup
Engineering
Evolutionary
Reentry**

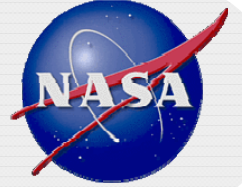
Environment Management

**Mitigation
Remediation
Policy
Mission Requirements**

Coordination

**U.S. Government
IADC, ISO
United Nations**





Distribution of the Cataloged Objects in LEO

