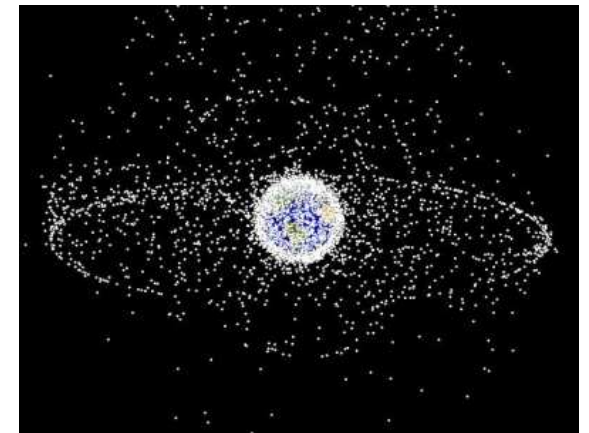


The Contribution of IAA Orbital Debris Initiatives Over the Last Twenty Years



Dr. Darren McKnight
Member
IAA Committee on Space Debris

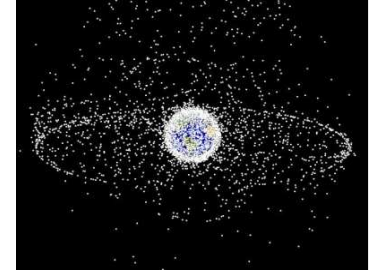


January 9-10, 2014

IAA Heads of Space Agencies Summit



ABSTRACT

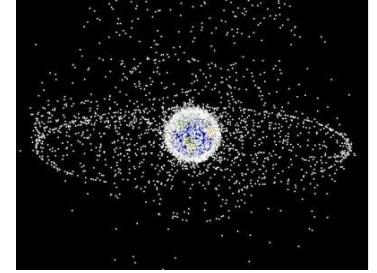


- Orbital debris (OD) is an increasing concern to...
 - Satellite operators, aerospace engineers, space lawyers, insurance underwriters, scientists, and policymakers worldwide.
- Events over the last two decades have amplified concerns that this environmental hazard will become a central issue in the decades to come.
- Published four documents as catalysts for forward-thinking technical and policy constructs to deal with the orbital debris problem.
- Each review provided a quality chronicle of this evolving space environmental hazard
 - **Recognition → Characterization → Mitigation → Remediation**

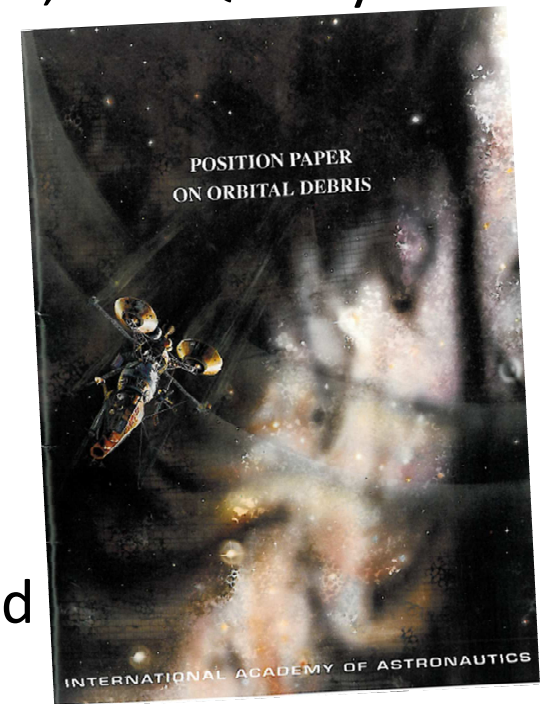


1993 IAA Position Paper

Recognition



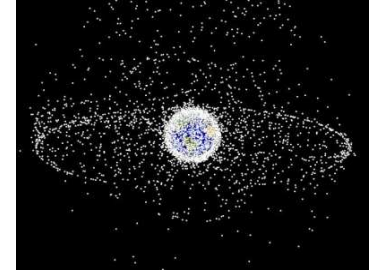
- Compiled by the Ad Hoc Expert Group of the IAA
 - Component of IAC Committee on Safety, Rescue, and Quality
- *Debris scorecard at time of this report:*
 - *~7,700 cataloged objects in orbit*
 - *~120 breakups on orbit to date*
 - *Author statistics: 13 authors from 6 countries*
- Precursor to...
 - Inter-Agency Space Debris Coordination Committee (IADC) formed (1993)
 - NASA Safety Standard 1740.14 – Guidelines and Assessment Procedures for Limiting OD (1995)
 - NASDA STD-18, Space Debris Mitigation Standard (1996)
 - CNES Space Debris Mitigation Standard (1999)



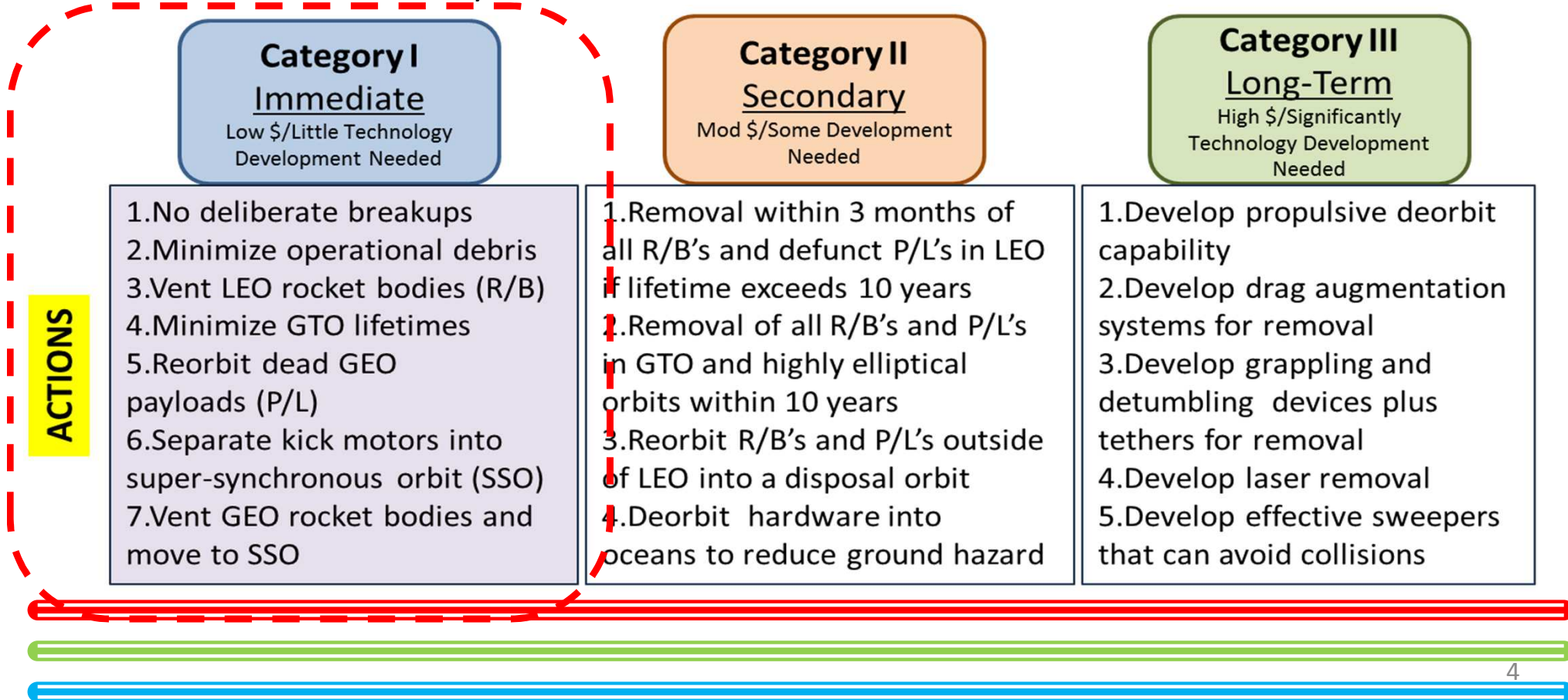


1993 IAA Position Paper

Recommended Actions



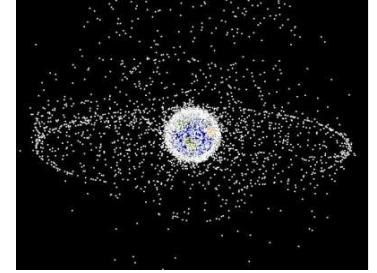
- Three families of options:
 - Category I: should do immediately - require minimal technology development or cost
 - Category II: consider later - require moderate technology development and/or cost
 - Category III: consider later - require significant technology and cost
 - Technical feasibility and cost-effectiveness were unclear.





2001 IAA Position Paper

Characterization



- Update of 1993 IAA Position Paper
 - Updated by Space Debris Subcommittee of the IAA
- *Debris scorecard at time of this report:*
 - *~8,700 cataloged objects in orbit*
 - *~160 breakups on orbit to date*
 - *Author statistics: 26 authors - 9 countries*
- Update takes into account:
 - New results of space debris research
 - Evolving space debris environment
 - International policy developments

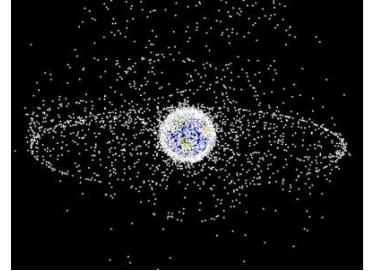
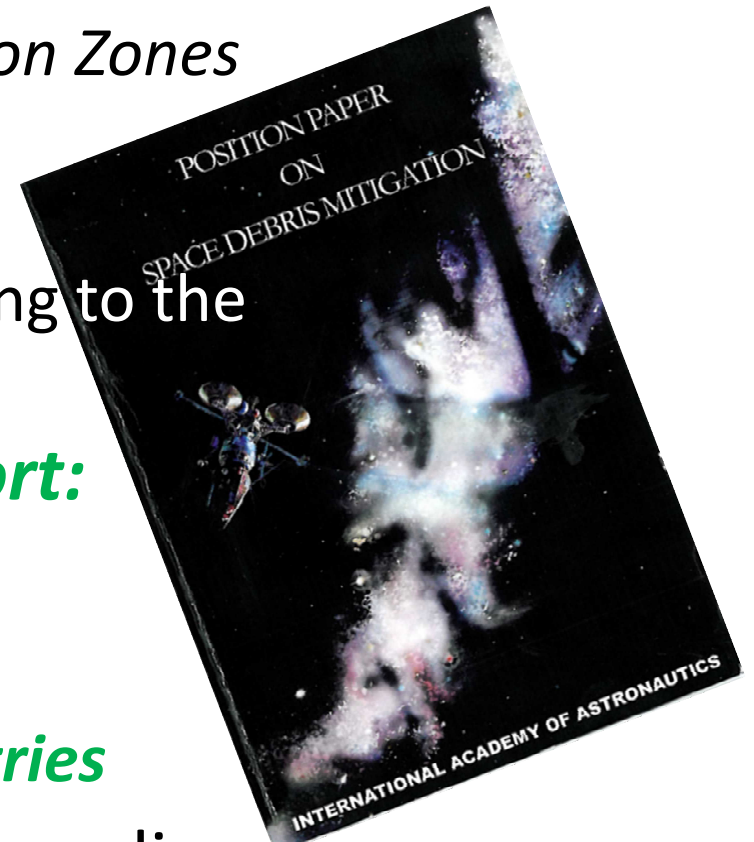




2005 IAA Position Paper SG 5.1 on Space Debris **Mitigation**

Implementing Zero Debris Creation Zones

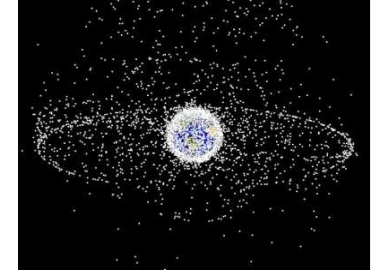
- Focus on debris mitigation
 - Aerospace community must stop adding to the existing debris population
- ***Debris scorecard at time of this report:***
 - ***~10,300 cataloged objects in orbit***
 - ***~180 breakups on orbit to date***
 - ***Author statistics: 22 authors - 8 countries***
- Outline operational procedures for compliance with evolving space debris mitigation guidelines



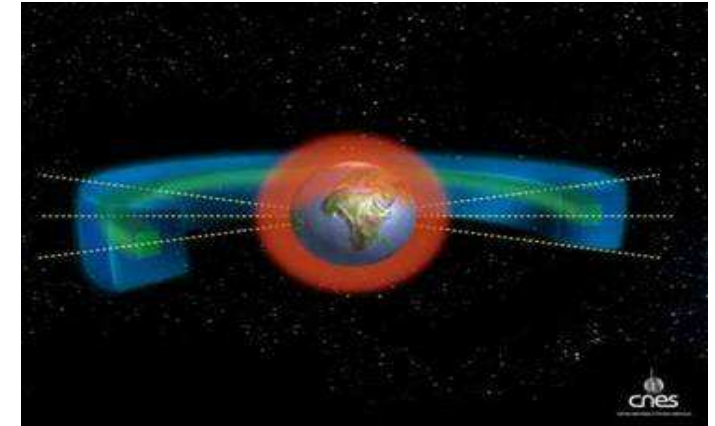


2005 IAA Position Paper

Recommendations



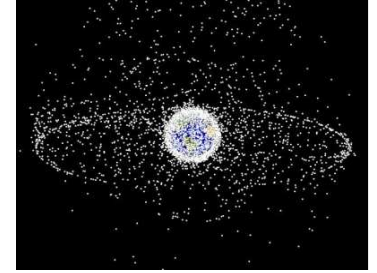
- Proposed two space regimes to protect through zero debris creation mandates
 - LEO: Up to 2000km
 - GEO: ± 200 km altitude and $\pm 15^\circ$ latitude



Debris Mitigation Guidelines	Hardware Design	Mission Operations
Spacecraft	<i>Minimize debris releases</i> <i>Eliminate energy sources (after use)</i> <i>Remove from orbit</i>	
Launchers		



2013 IAA Cosmic Study SG 5.5 on Space Debris Environment **Remediation**

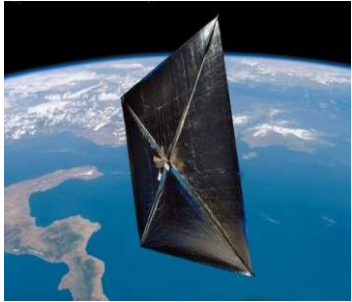


- Debris mitigation guidelines will not be sufficient to control growth of orbital debris
 - Must actively remove massive derelict objects
- **Debris scorecard at time of this report:**
 - ~16,600 cataloged objects in orbit
 - ~210 breakups on orbit to date
 - **Author statistics: 26 authors - 11 countries**
- Wide variety of technologies are under consideration for the challenging mission of active debris removal (ADR)

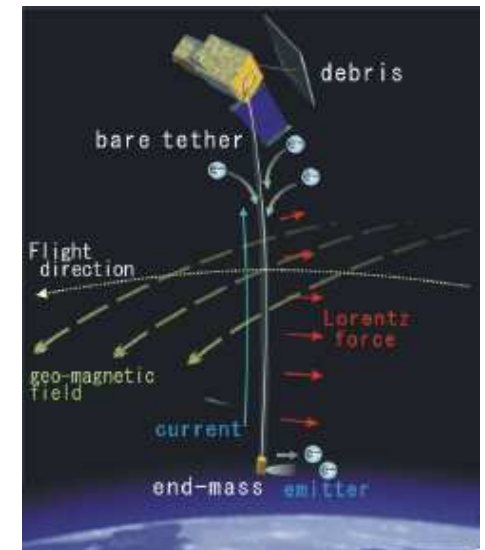
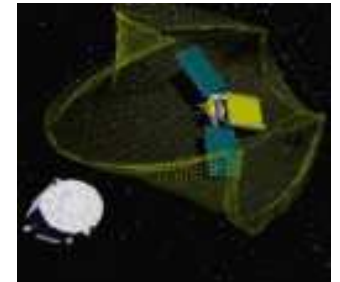
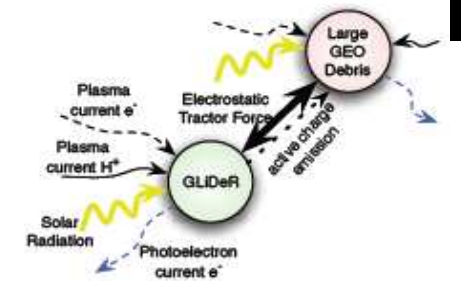
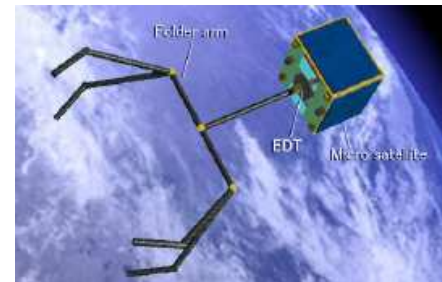


2013 IAA Cosmic Study

Key Findings

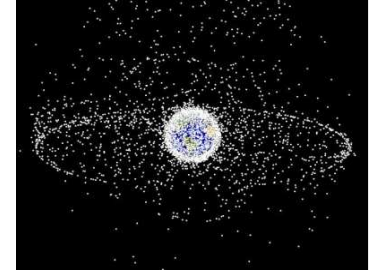


- Remove massive objects in cluttered orbits
- LEO – removal; GEO – move up
 - Must grapple, (possibly) despin, and move/remove
- Propulsive tug is only proven removal technology
 - Many other promising options in research and development





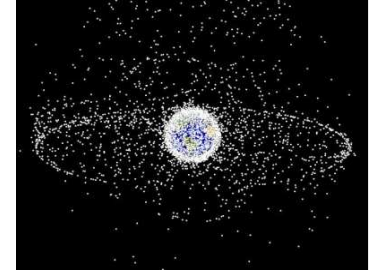
2014 IAA SG 5.10 on OD Removal: Policy, Legal, and Economic Considerations



- Build upon technical framework of the 2013 IAA Cosmic Study on Space Debris Environment Remediation to determine operational issues to fielding ADR options
 - Policy: Is it a space commons or alternative venue for international politics?
 - Legal: What is debris and who defines remaining utility of an object?
 - Economic: Is active debris removal cost-effective?



IAA Permanent Committee on Space Debris



- Scope
 - Coordination of all activities related to space debris within the Academy
 - Symposium A6 of IAC has consistently been one of the top three symposia in attendance and papers presented
 - Coordination of the Academy participation in conferences dedicated to Space Debris
 - For example, ESA Darmstadt Conference
 - Dissemination of information among the members of the Technical Committee
- Membership
 - 43 members from 12 countries