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UK Space Agency

Outline

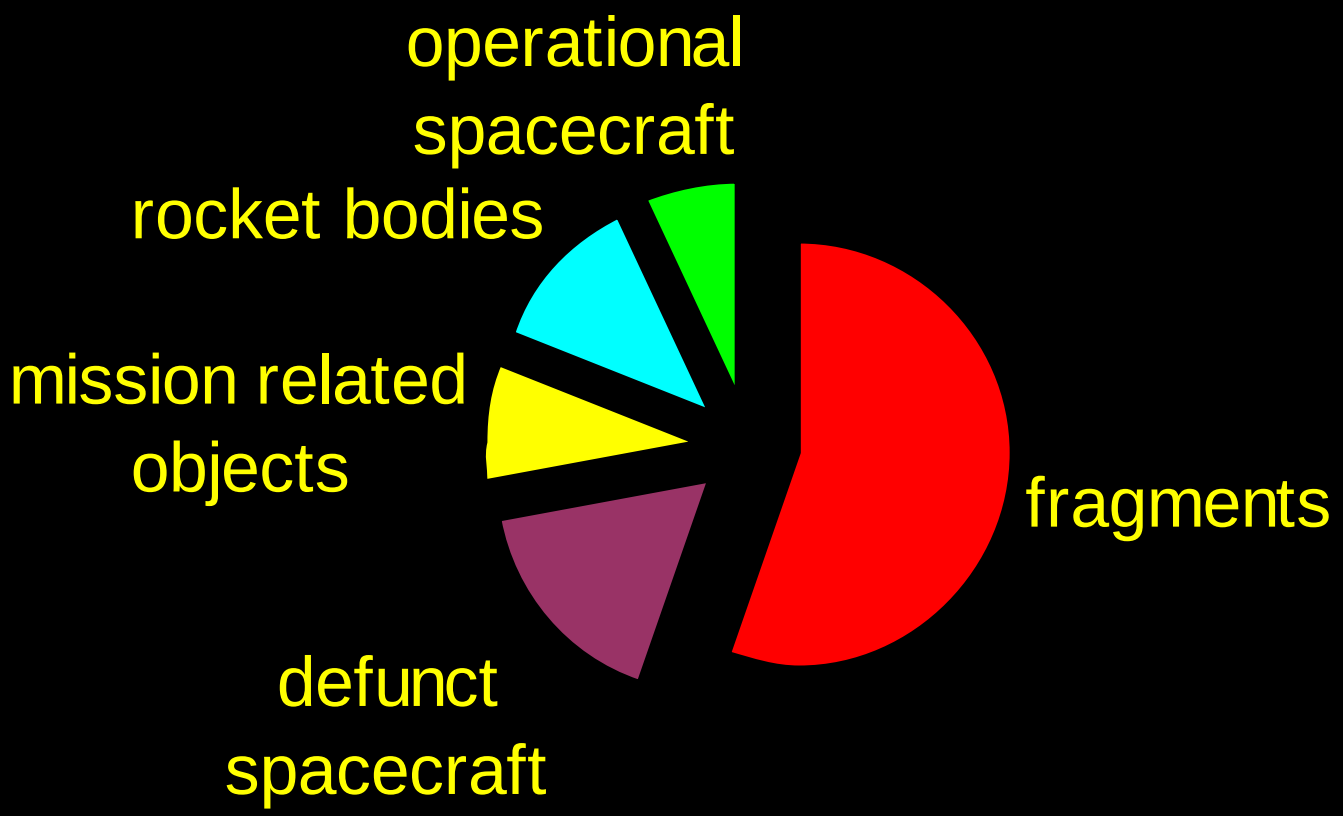
- What is in orbit around the Earth?
- How much space debris is there?
- What is the future for space debris?
- What is the solution to space debris?
- What lessons have we learnt?

WHAT IS IN ORBIT AROUND THE EARTH?

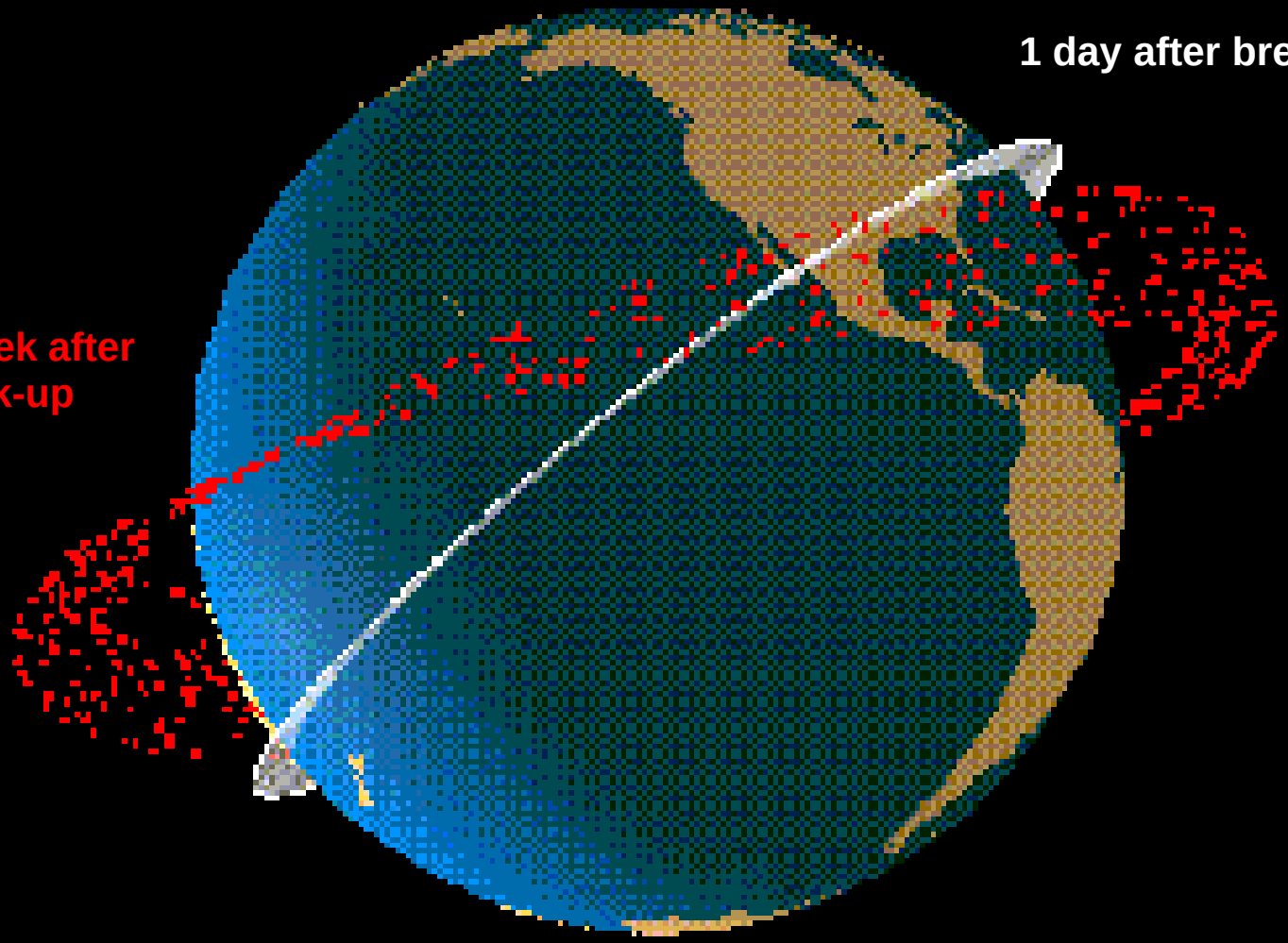
near-Earth satellite population reflects use of space

>16000 catalogued objects concentrated in distinct orbits with unique characteristics

CATEGORIES OF CATALOGUED OBJECTS

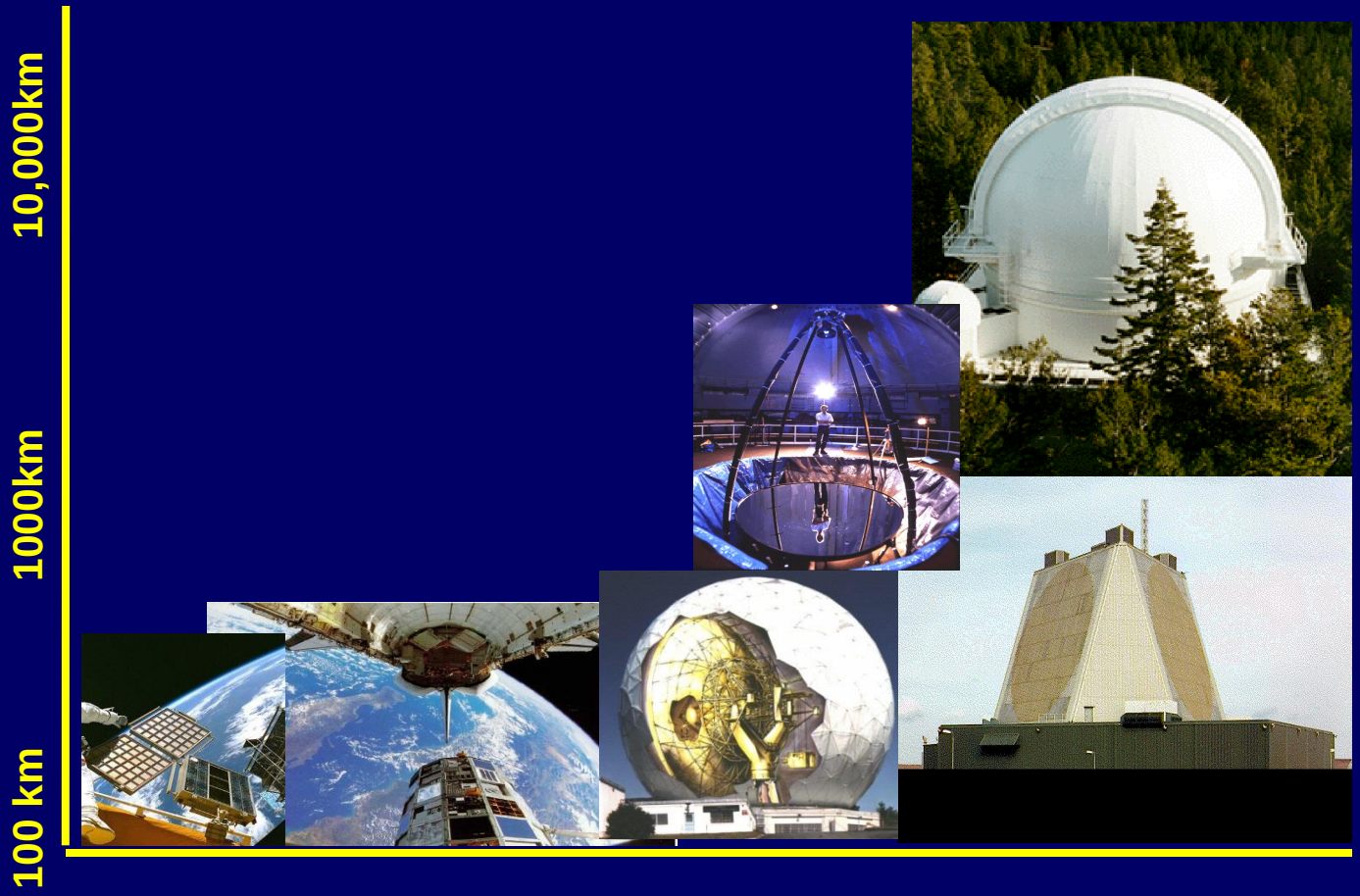


FRAGMENTS FROM BREAK-UP QUICKLY DISPERSE



HOW MUCH SPACE DEBRIS IS THERE?

Estimating the debris population



BAY 5


T180-2
T180-38
T180-5
T180-7
T180-40
T180-1
T180-3
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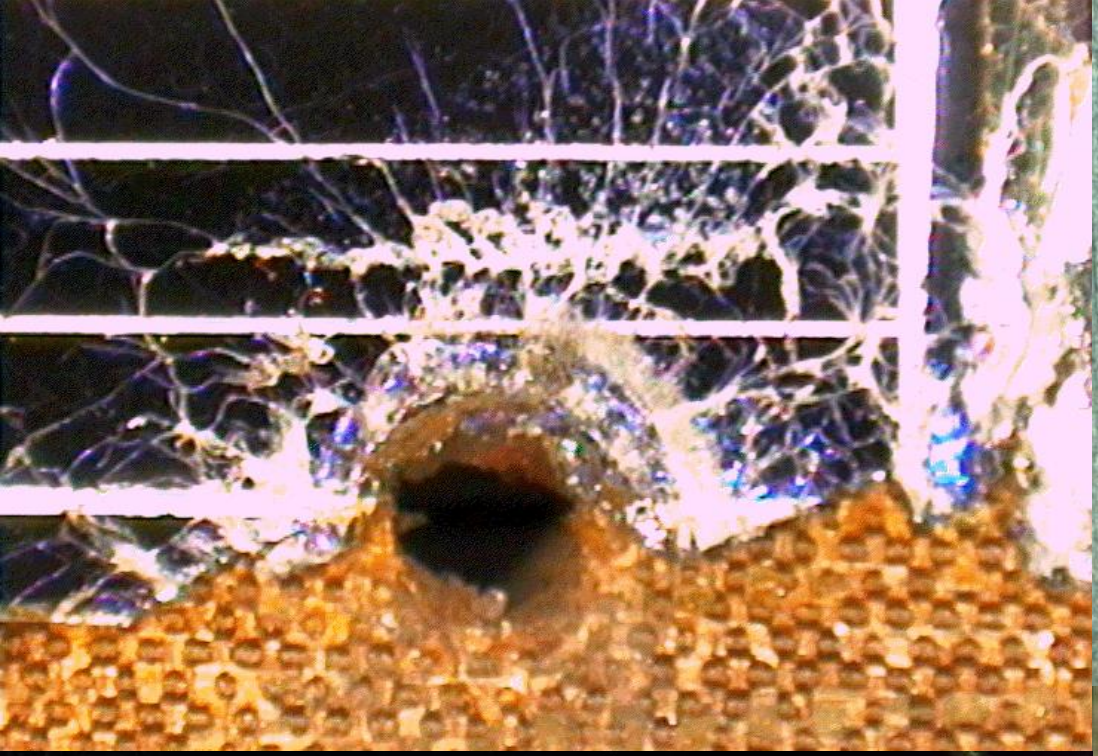
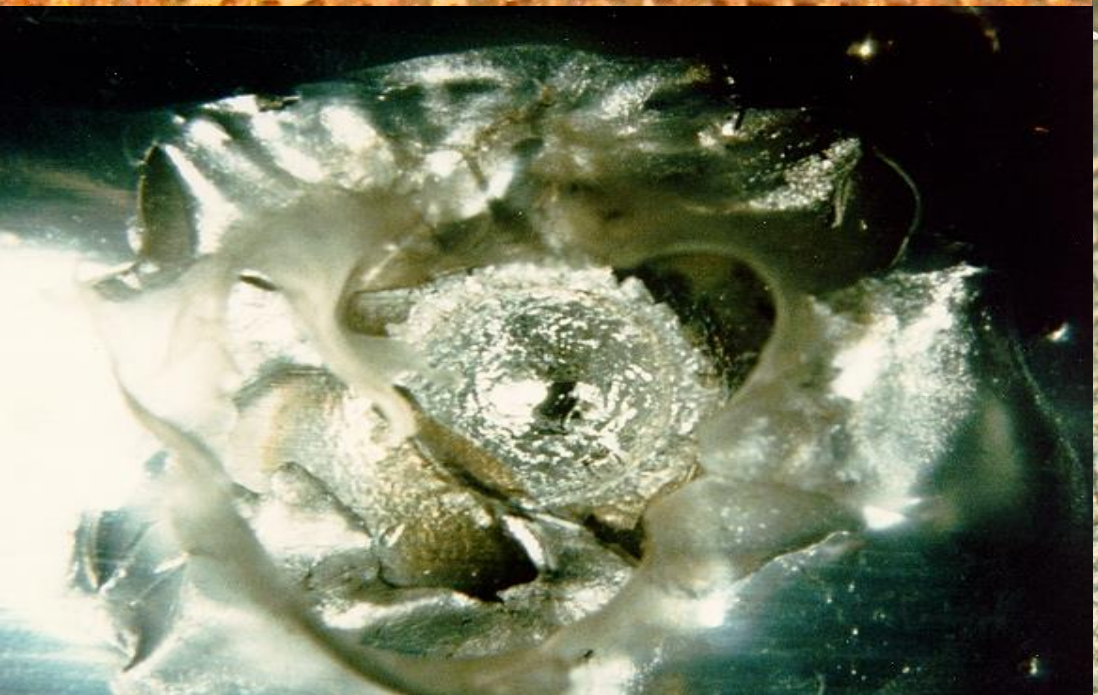
T180-68
T180-67
-V3
150
180





Estimated Debris Population

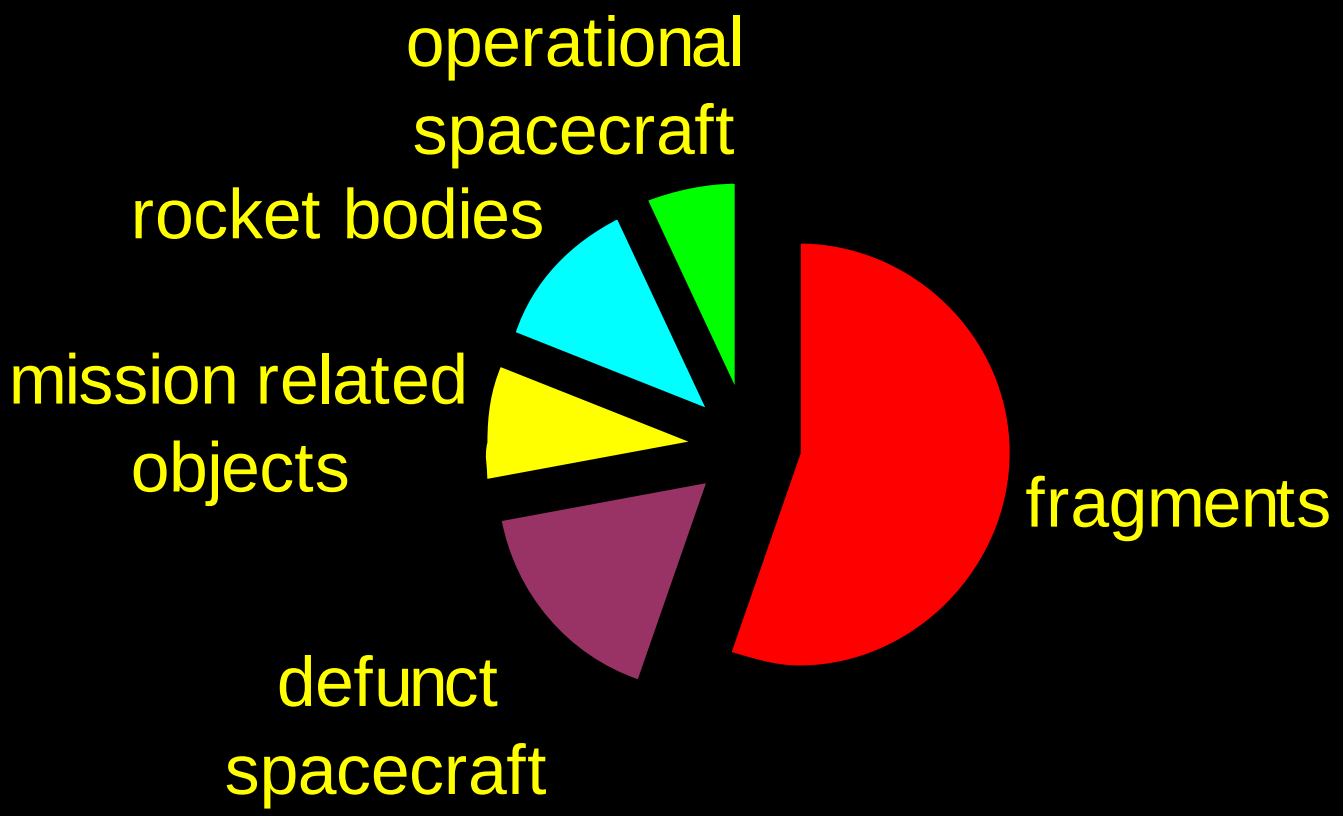
Size	Number	% Mass
>10 cm	>20000	99.93
1-10 cm	>500,000	0.035
<1 cm	>50,000,000	0.035
Total	>50,000,000	>5,000 tonnes

Estimated Debris Population

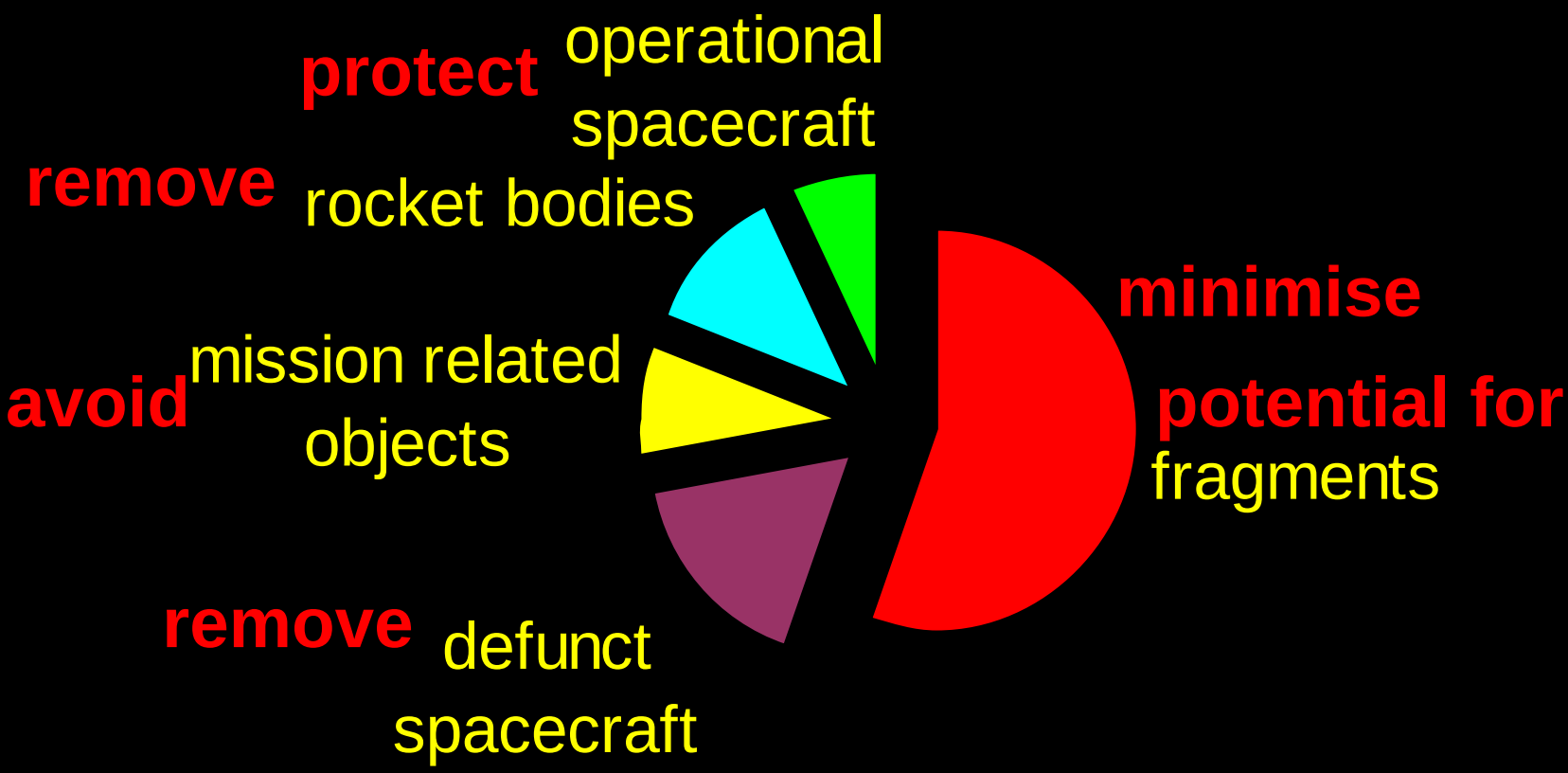
	Size	Number	% Mass
<10% active	>10 cm	>20000	99.93
	1-10 cm	>500,000	0.035
	<1 cm	>50,000,000	0.035
	Total	>50,000,000	>5,000 tonnes

WHAT IS THE SOLUTION TO SPACE DEBRIS?

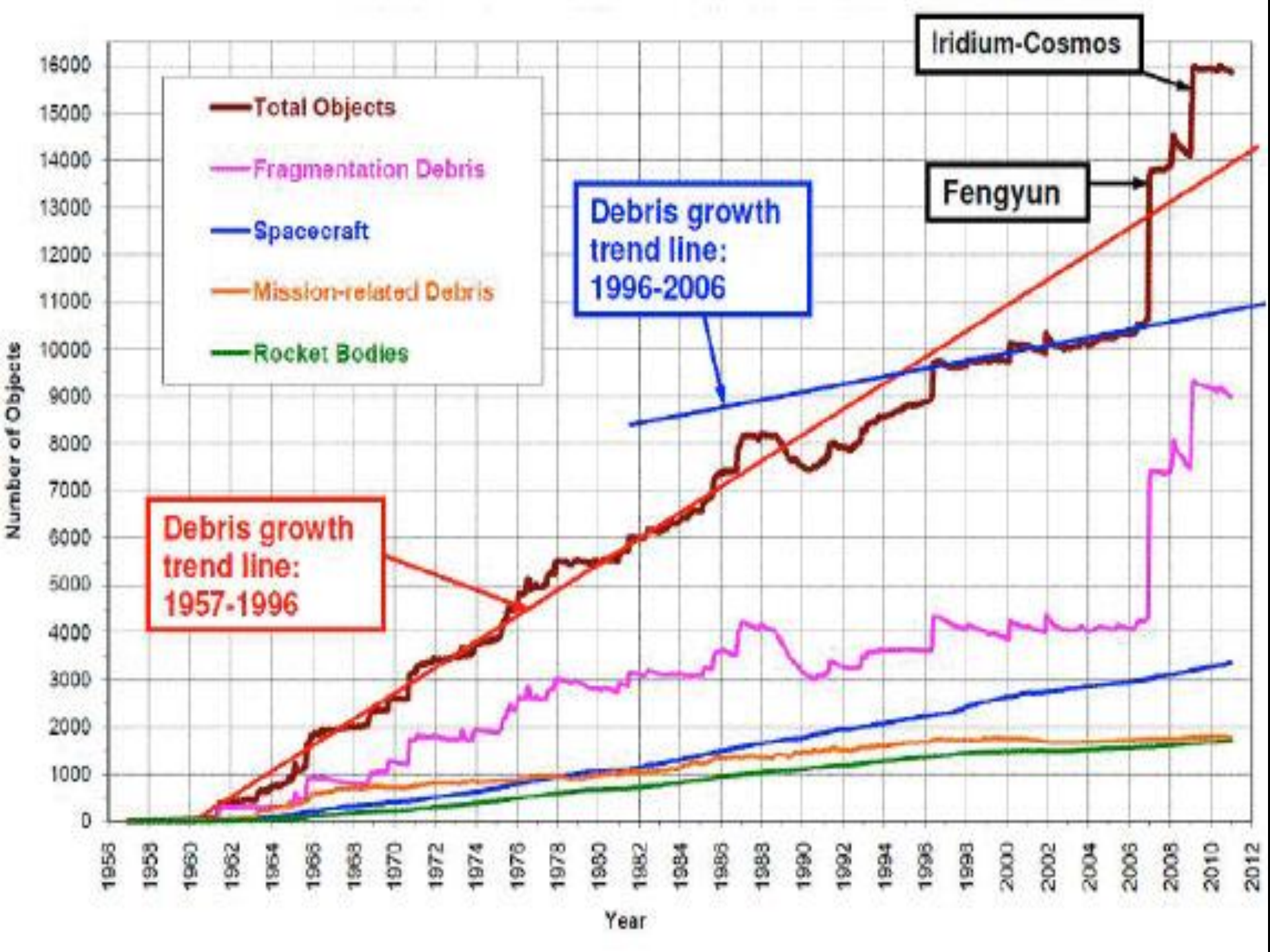
MITIGATION OBJECTIVES



MITIGATION OBJECTIVES




V 503
00:43:14.10
V 503
00:43:14.10

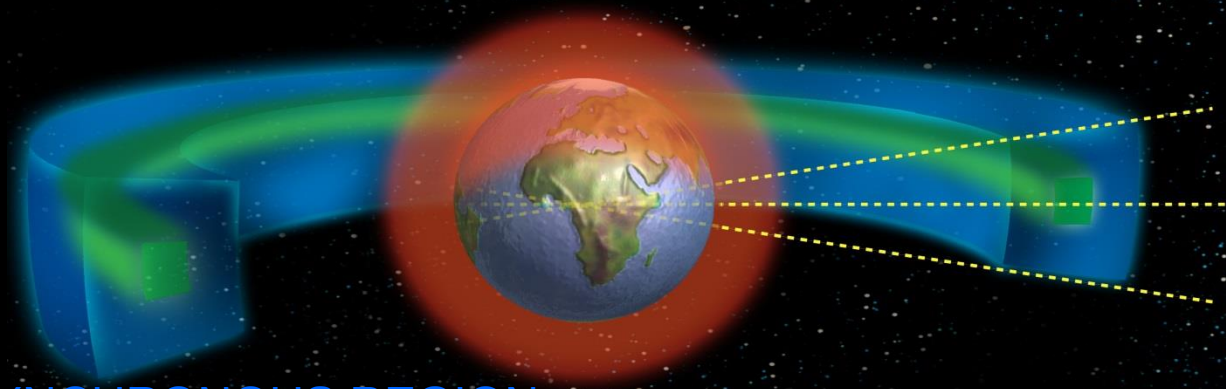

Iridium-Cosmos
Fengyun
Total Objects
Fragmentation Debris
Spacecraft
Mission-related Debris
Rocket Bodies
Debris growth trend line: 1996-2006
Debris growth trend line: 1957-1996
Number of Objects
Year
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
11000
12000
13000
14000
15000
16000
1957
1958
1960
1962
1964
1966
1968
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012

Debris Mitigation

- Managing the debris environment does work
- Requires information of orbital population
- Need to share experience between operators
- Effectiveness of measures can be demonstrated
- Need comprehensive implementation to be effective
- Increasing reflected in national legislation
- Regulators need to assess compliance

Definition of Protected Regions

- **Activities in space should recognise the unique nature of 2 regions in space:**



LOW EARTH ORBIT REGION

Earth surface up to 2000 km

GEOSYNCHRONOUS REGION

Geostationary altitude +/- 200 km

Equatorial latitude +/- 15 deg

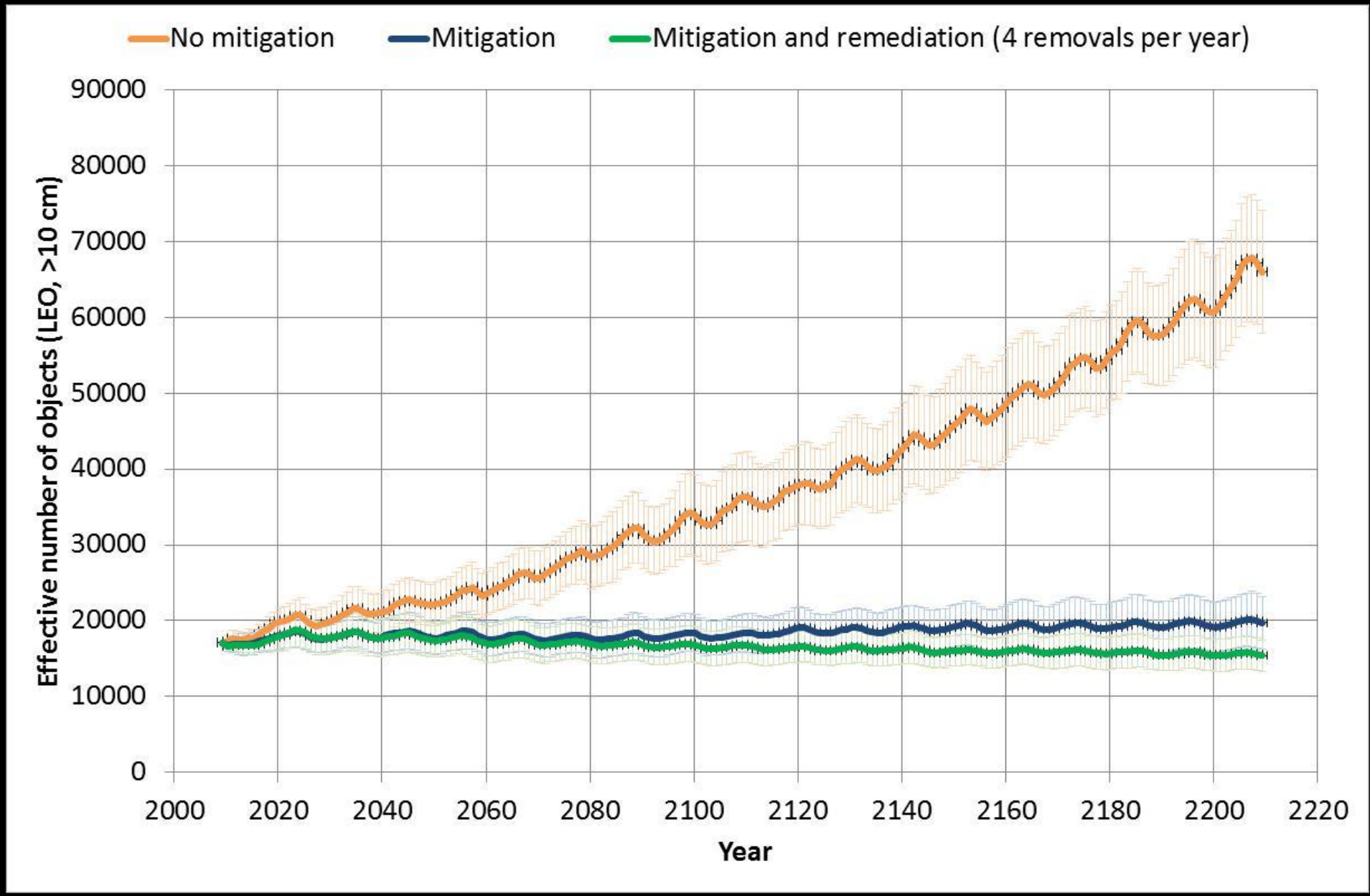
cnes

CENTRE NATIONAL D'ETUDES SPATIALES

GEO EOL Disposal

COMPLIANT?	2006	2007	2008	2009	2010	2011	2012	2013	TOTAL
NO	10	2	5	9	5	3	5	5	44
YES	9	11	6	12	11	12	10	15	86
ANNUAL	19	13	11	21	16	15	15	20	130

Source: H. Lewis, University of Southampton



Lessons Learnt

- Need to focus efforts on “cause” rather than just “effect”
- As environment deteriorates, cost impacts will increase significantly for all users of space
  - Loss of systems
  - Loss of fuel budget and lifetime due to increased manoeuvres
  - Increased demands of space surveillance
- Active management will be necessary
- Best practice needs to become <u>common</u> practice