



A discussion about debris in outer space by
Cassandra Fallscheer – RASC Star Party – 18 August 2012

SPACE JUNK



SPACE

IS

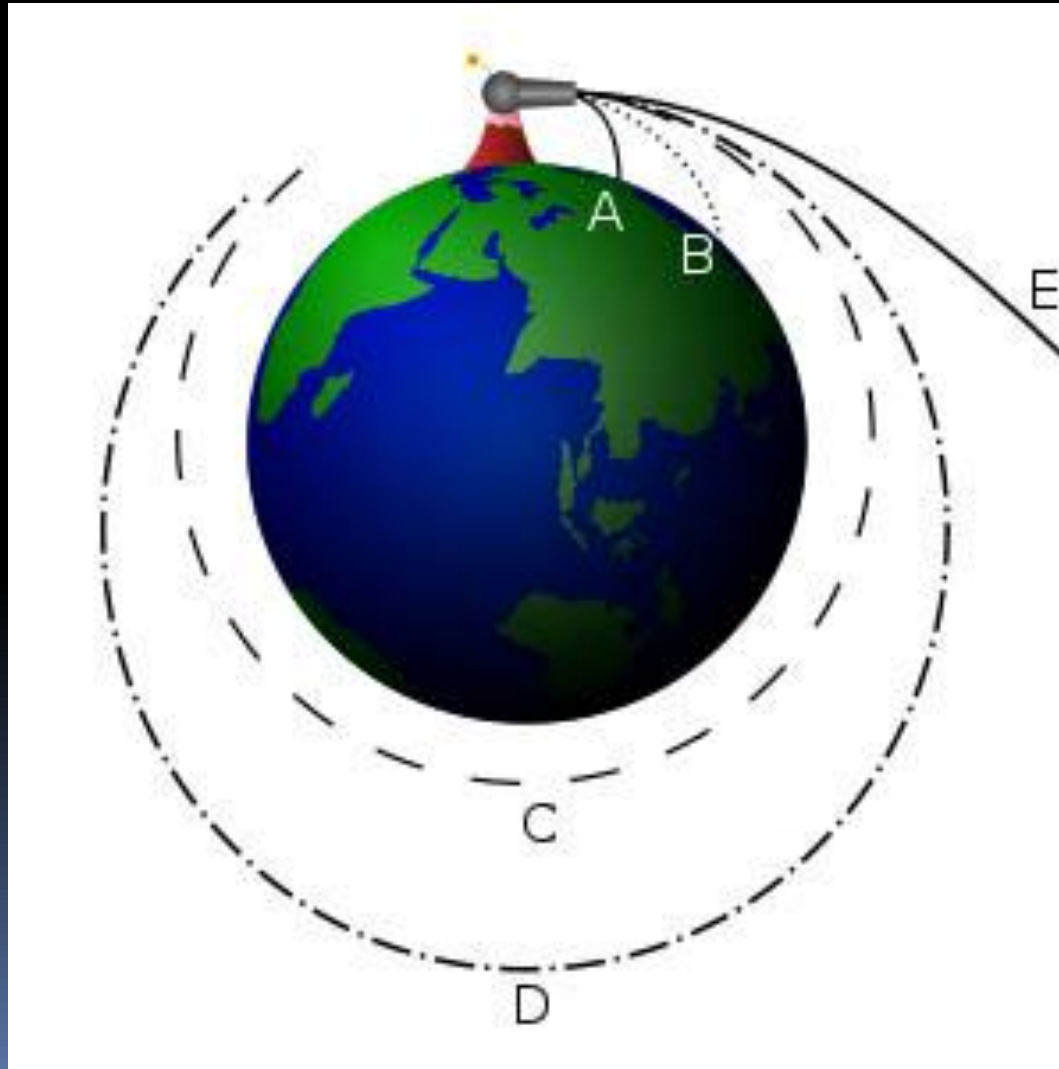
VAST!

BACK IN THE DAY...

- STUFF ORBITING EARTH LOOKED LIKE THIS:

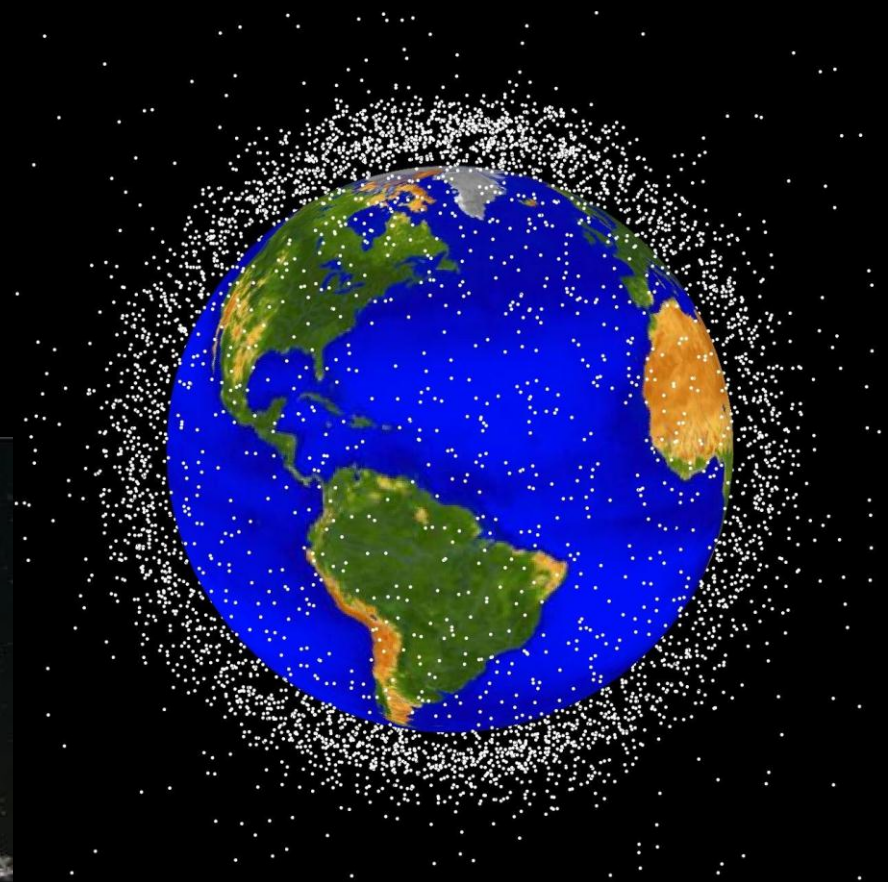


Falling around the Earth



Until it started looking like this

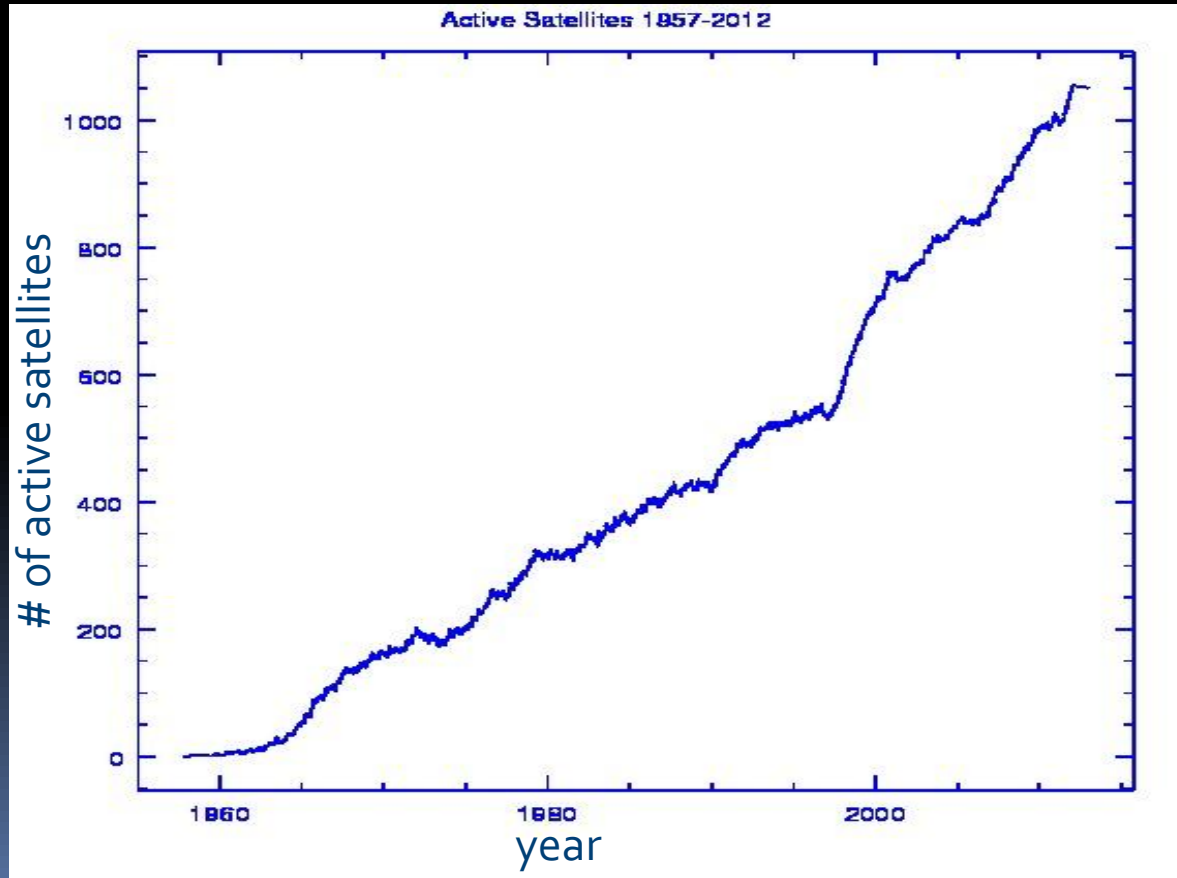
- Human-made space junk
- spent fuel containers
- rocket boosters
- defunct satellites



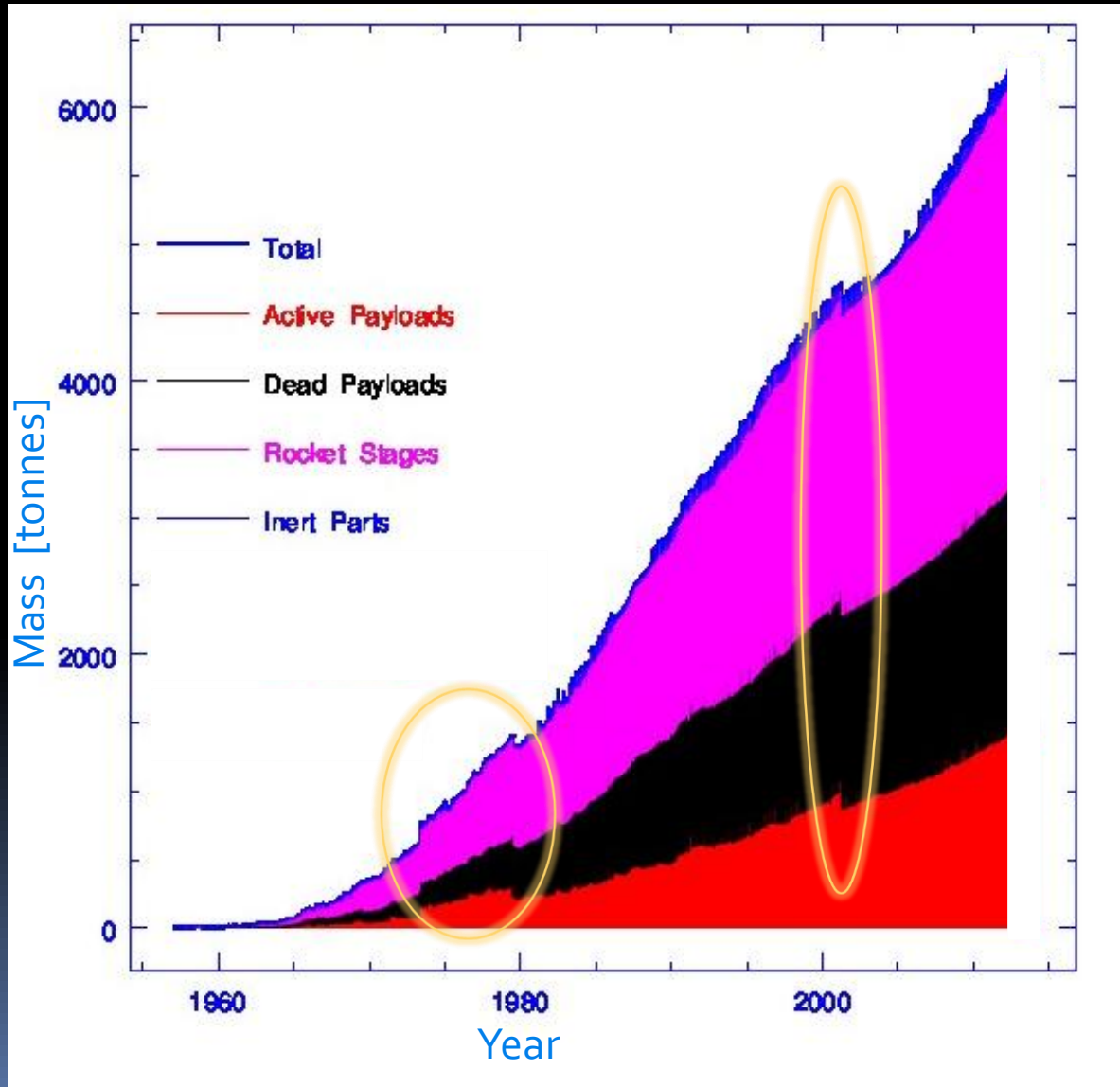
Then things started changing..

- 1957: Russia launched **Спутник-1**

<http://www.planet4589.org/space/log/stats.ht>



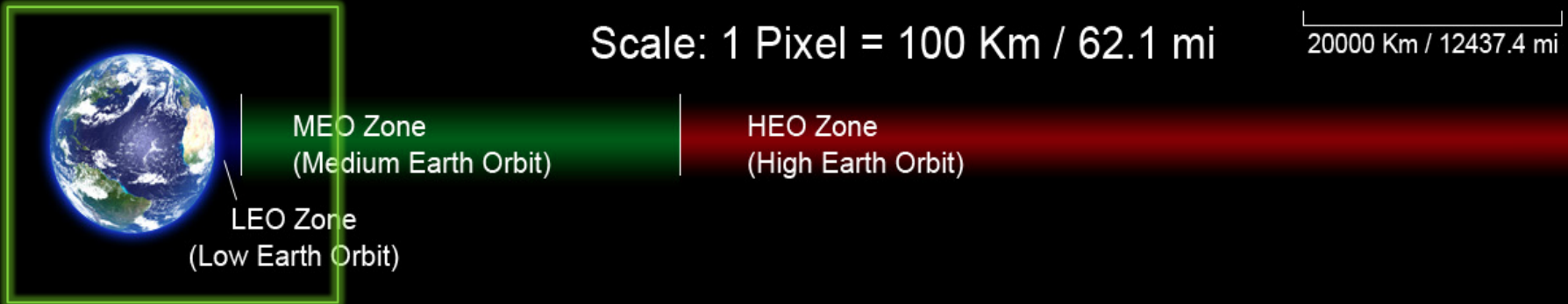
Mass of Stuff in Space



Skylab (1973-1979)
77 tonnes

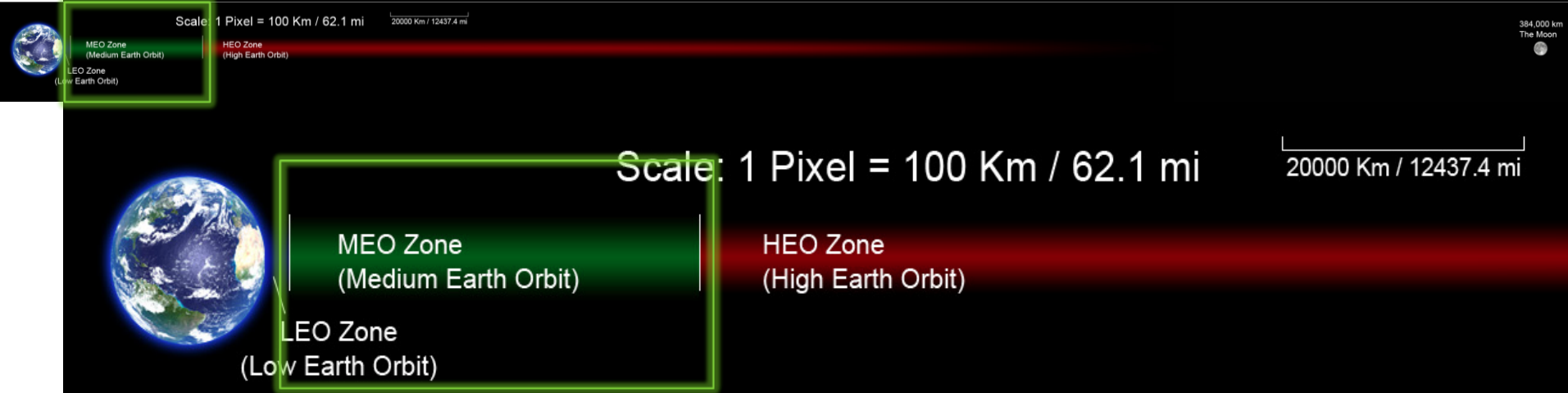
Mir (1986-2001)
130 tonnes

What's up there?



- Low Earth Orbit: 160 km to 2000 km
 - manned space stations
 - all human space flight (except lunar missions)
 - most science satellites (Hubble)
 - typically >300 km due to minimal atmospheric drag

What's up there?



- Medium Earth Orbit: 2000 km – 36,000 km
 - geosynchronous and semisynchronous satellites
 - communication (TV, internet, phone) (geo)
 - GPS (semi)
 - beyond Earth's atmosphere

What's up there?




- High Earth Orbit: 36,000 km
 - intense radiation
 - weather satellites


THEN THINGS GOT CROWDED

- People wanted to use
 - satellite phones
 - GPS

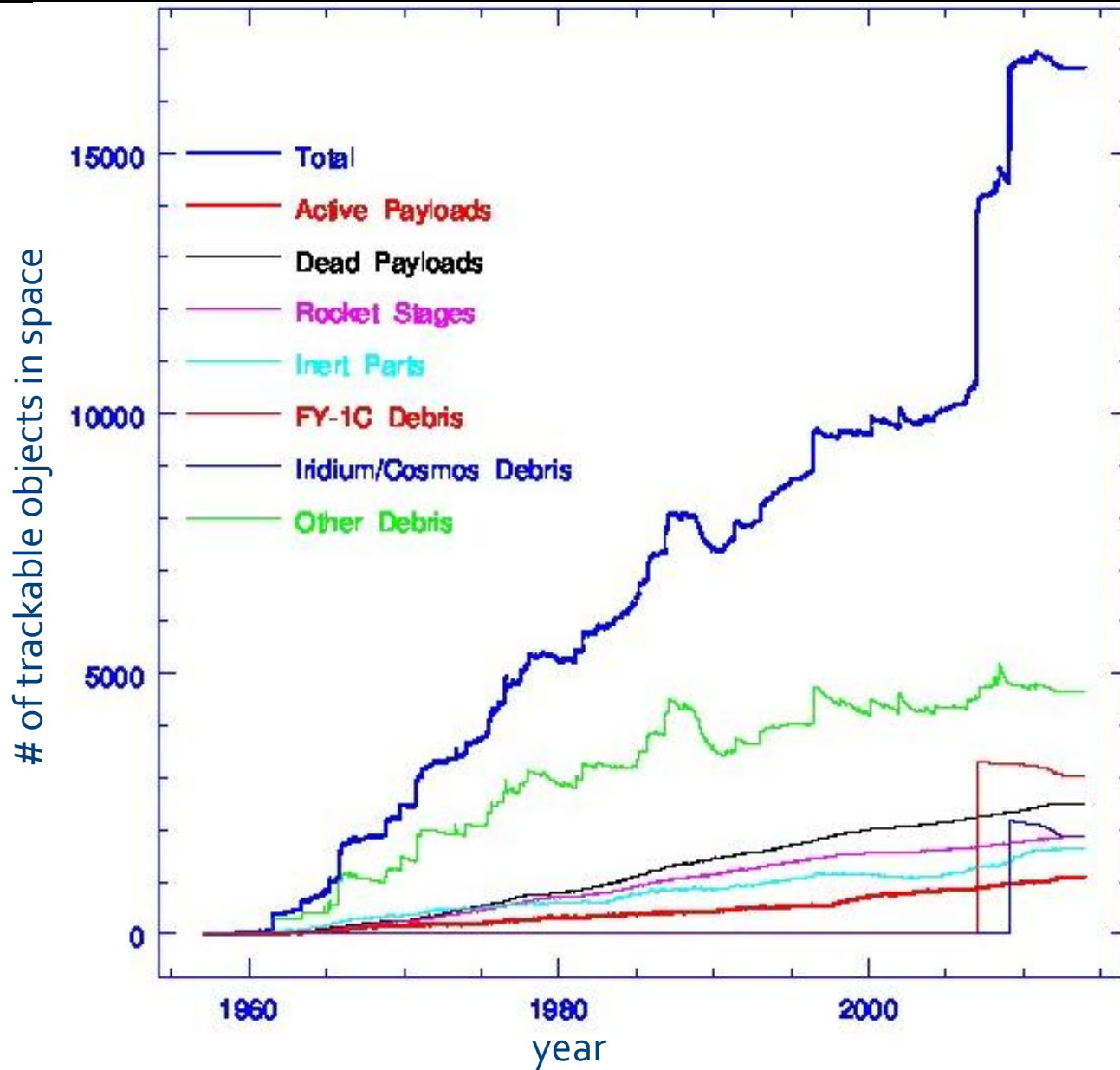




Especially when the Chinese decided they wanted to show the world their might

- 2007 the Chinese successfully tested an anti-satellite missile
 - Over 2000 pieces of large space junk created when they blew up their zombie FY-1C satellite, some of which created danger to the ISS
- 

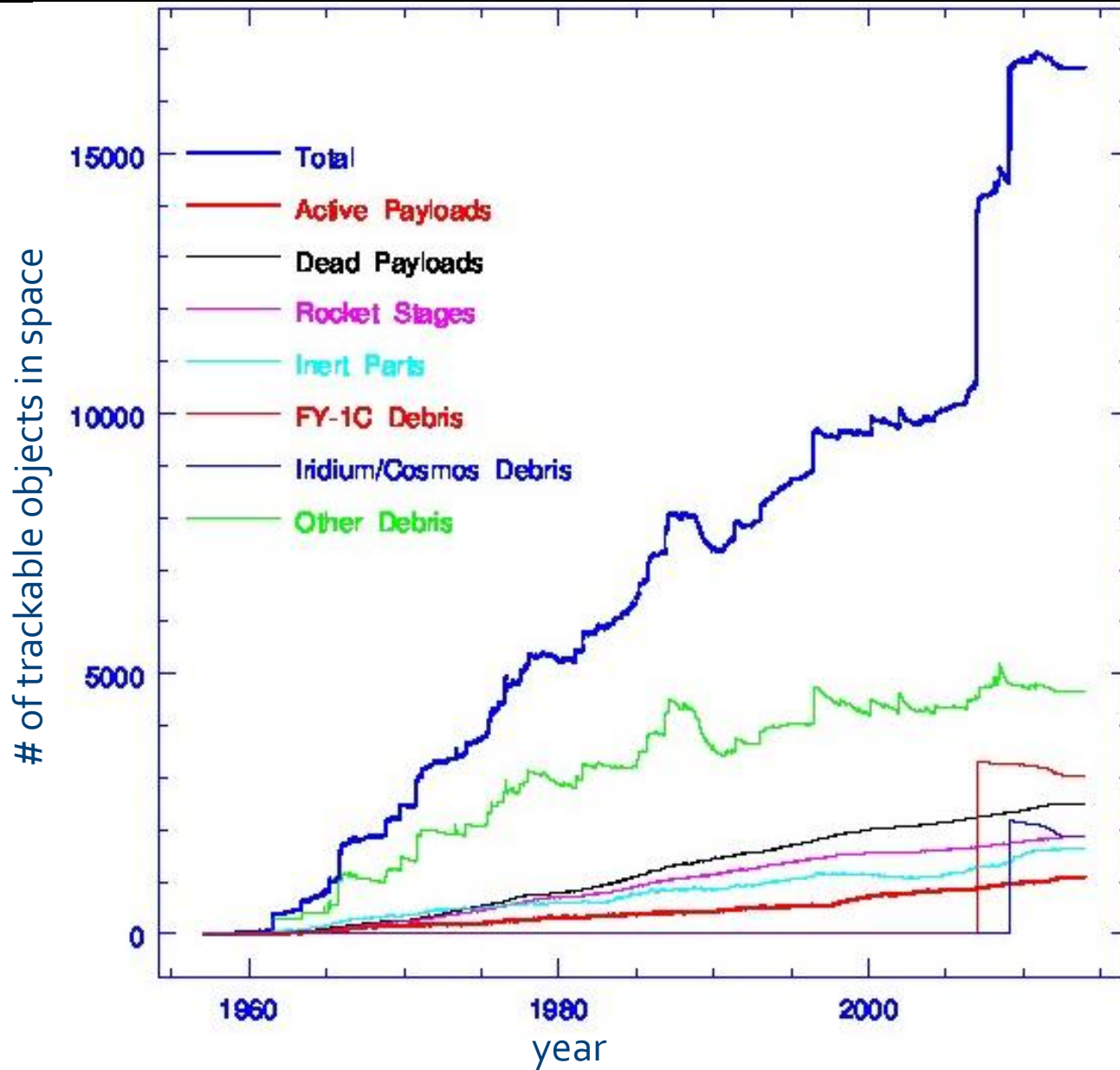
Junk in space



And then, the unthinkable happened

- In 2009, Iridium-33 and Kosmos-2251 collided
- Difficult to predict...models at the time indicated they would 'only' come within 600m of each other
- This event created ~1000 pieces of large space junk
- International good Samaritan practice now calls for the de-orbiting of satellites once they are retired

Junk in space



And then, the unthinkable happened



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And then, the unthinkable happened

Predicted debris trajectories
Statistical model (modified Evolve)

▲agi

Iridium mass 900kg
Cosmos mass 685kg
30% impact overlap

Debris not to scale



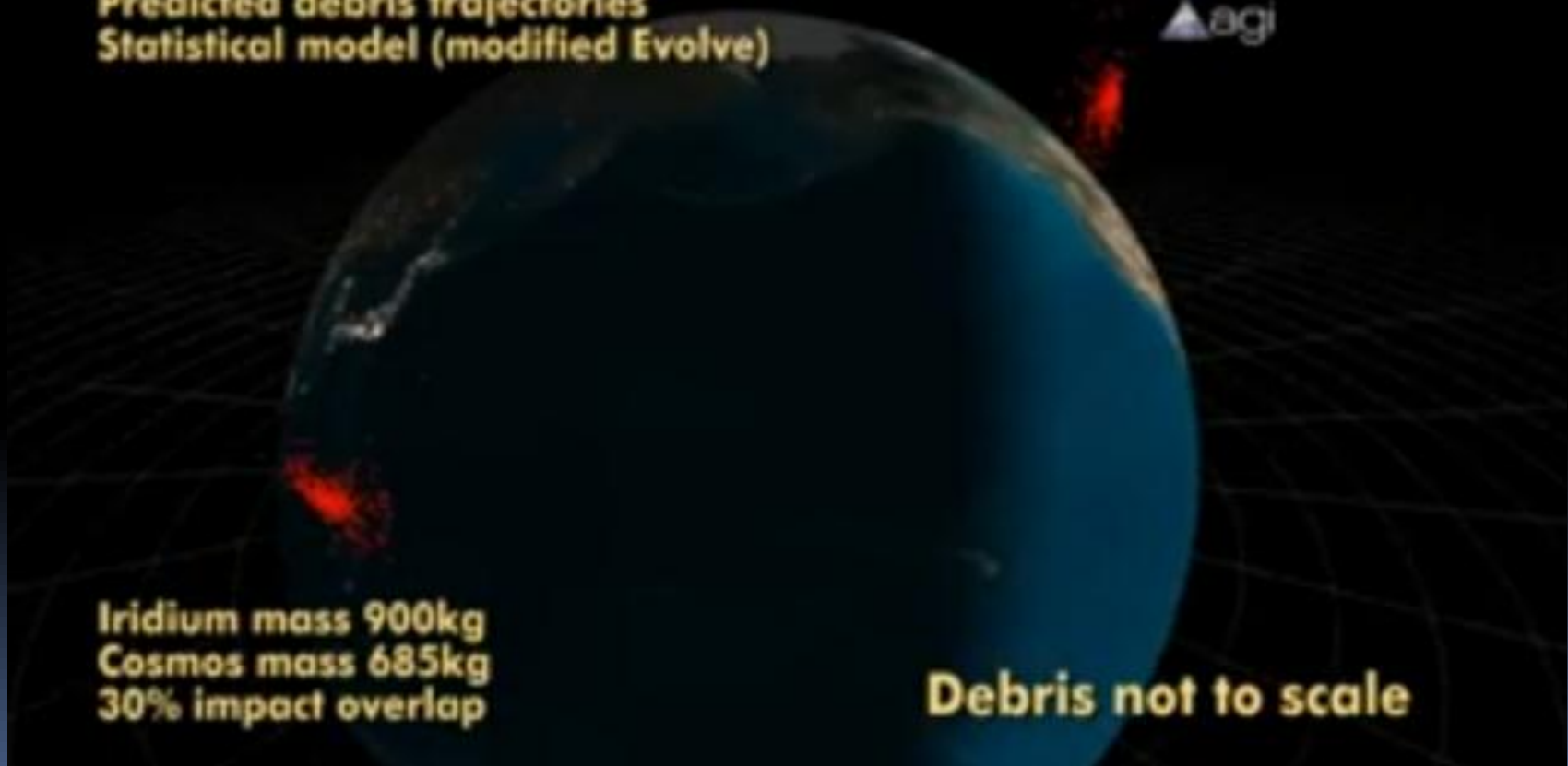
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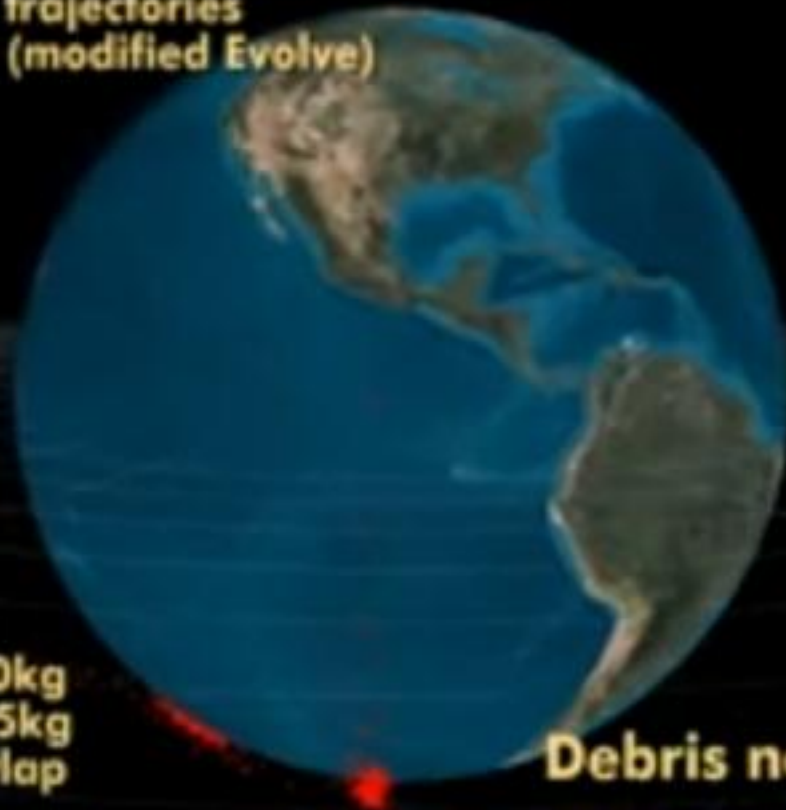
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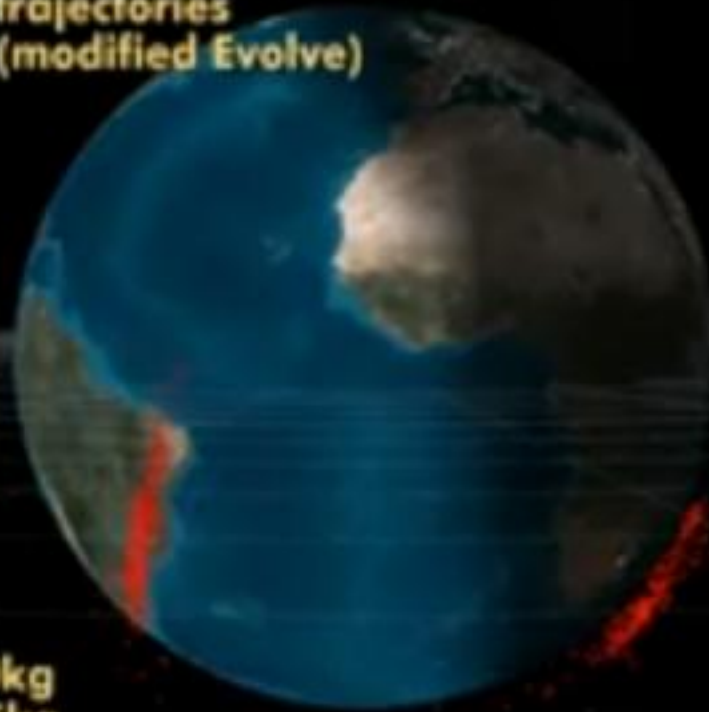
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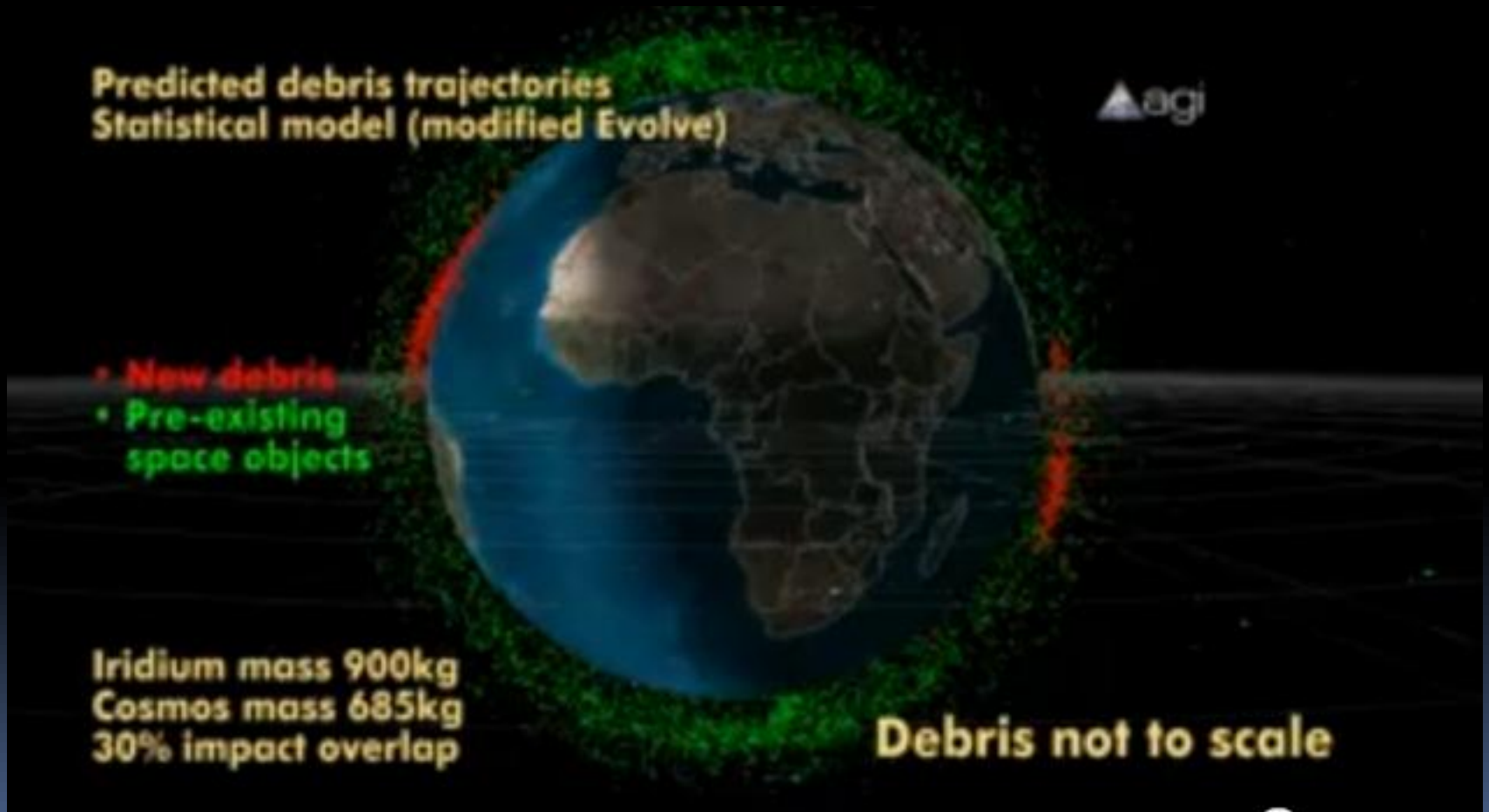
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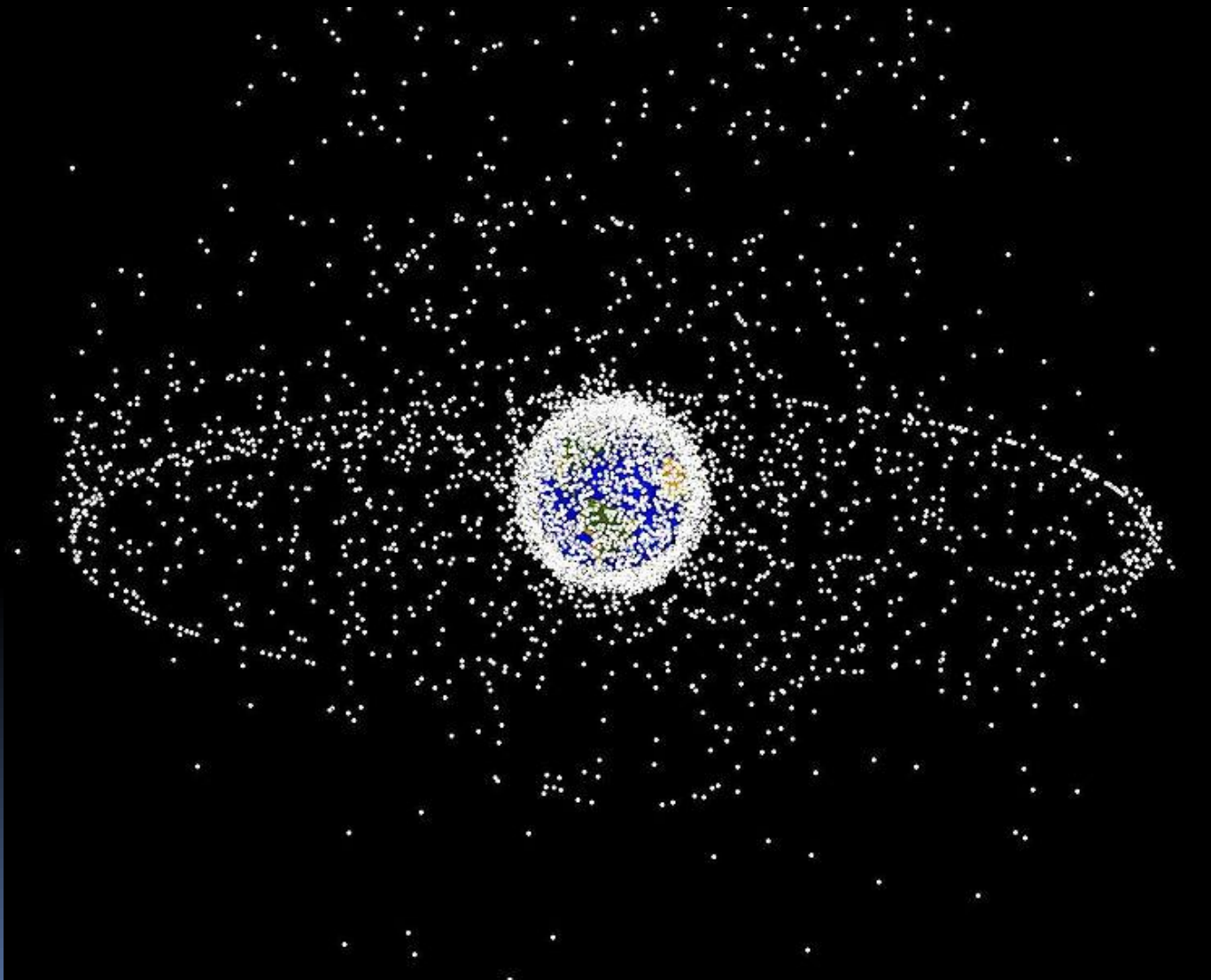
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DISTRIBUTION OF JUNK IN SPACE



COSMIC RECYCLING PROGRAM

- Reduce:
 - late 80's boosters designed not to explode
 - each impact sprays debris, each piece causing potential for further collisions
- Recycle: hypothetical
 - provide satellites with enough fuel to de-orbit
 - shoot small pieces with laser to de-orbit
- Prevention likely more effective than cure

Something to Ponder

- A 1 kg object directly impacting a 1000kg satellite would break it into numerous pieces, many of which larger than 1 kg
- So now we have to think about getting them down again
- We may be launching our dreams, but the cluttered room won't clean itself while we're dreaming

