Space Security: Capabilities and Limits of Technical Solutions

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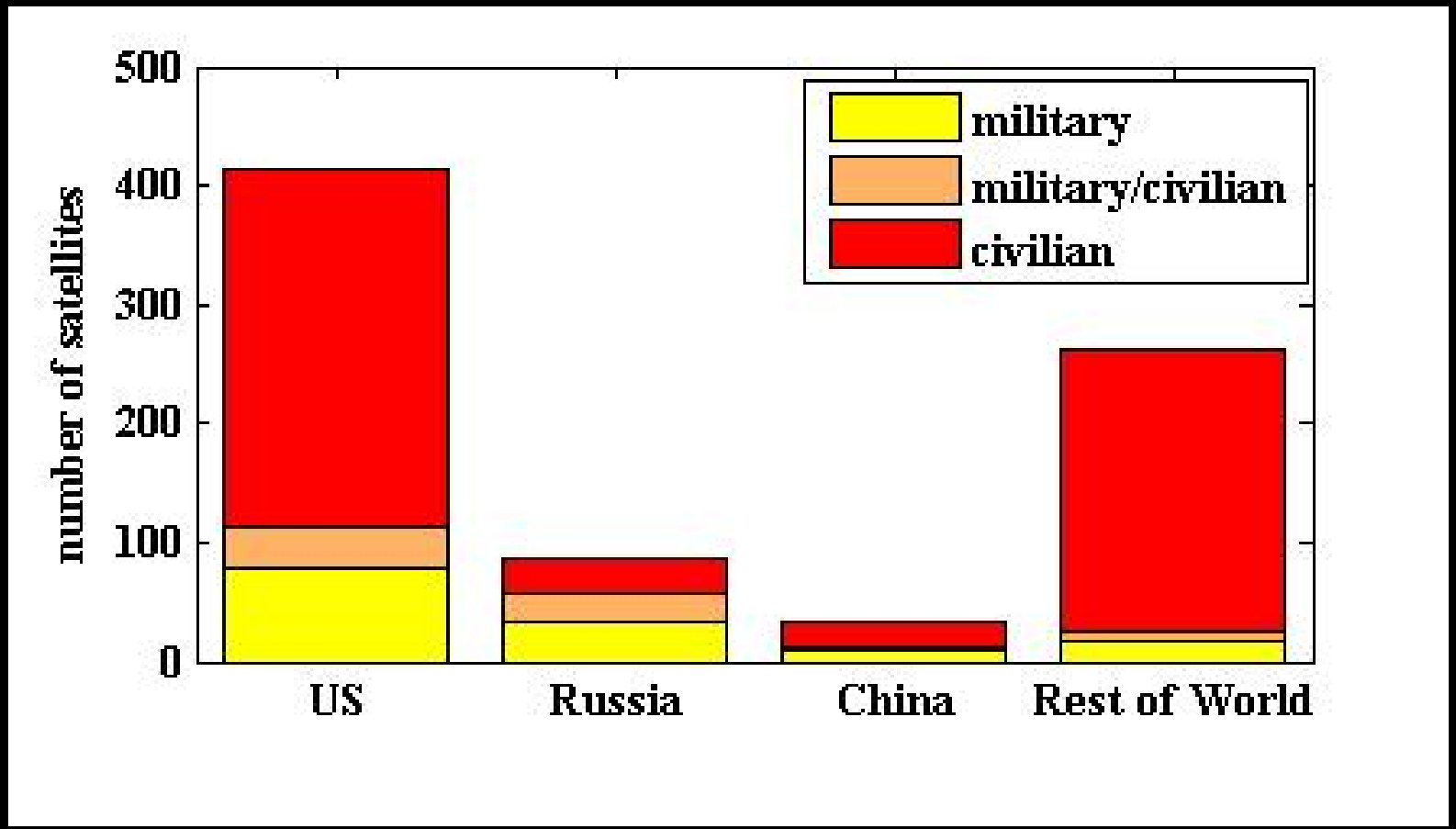
Union of Concerned Scientists
Citizens and Scientists for Environmental Solutions

War and Poverty, Peace and Prosperity, May 31, 2007

How is space used now?



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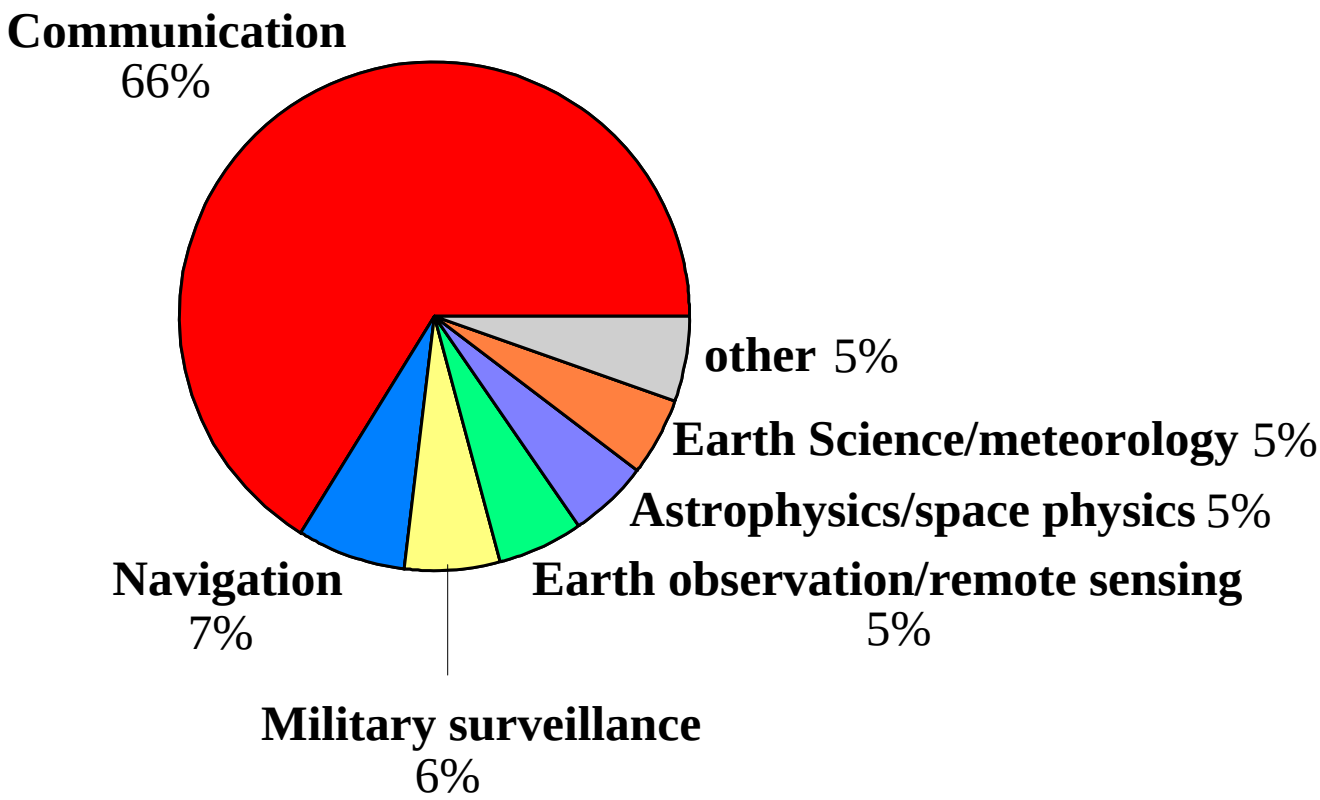

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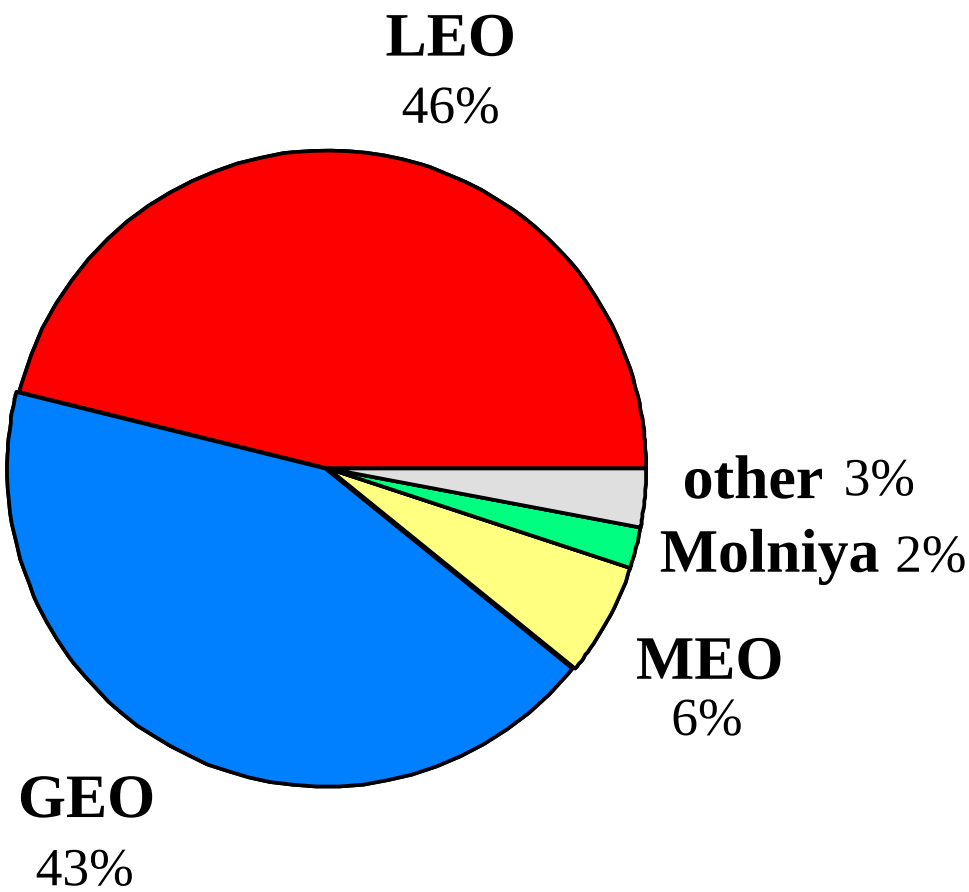
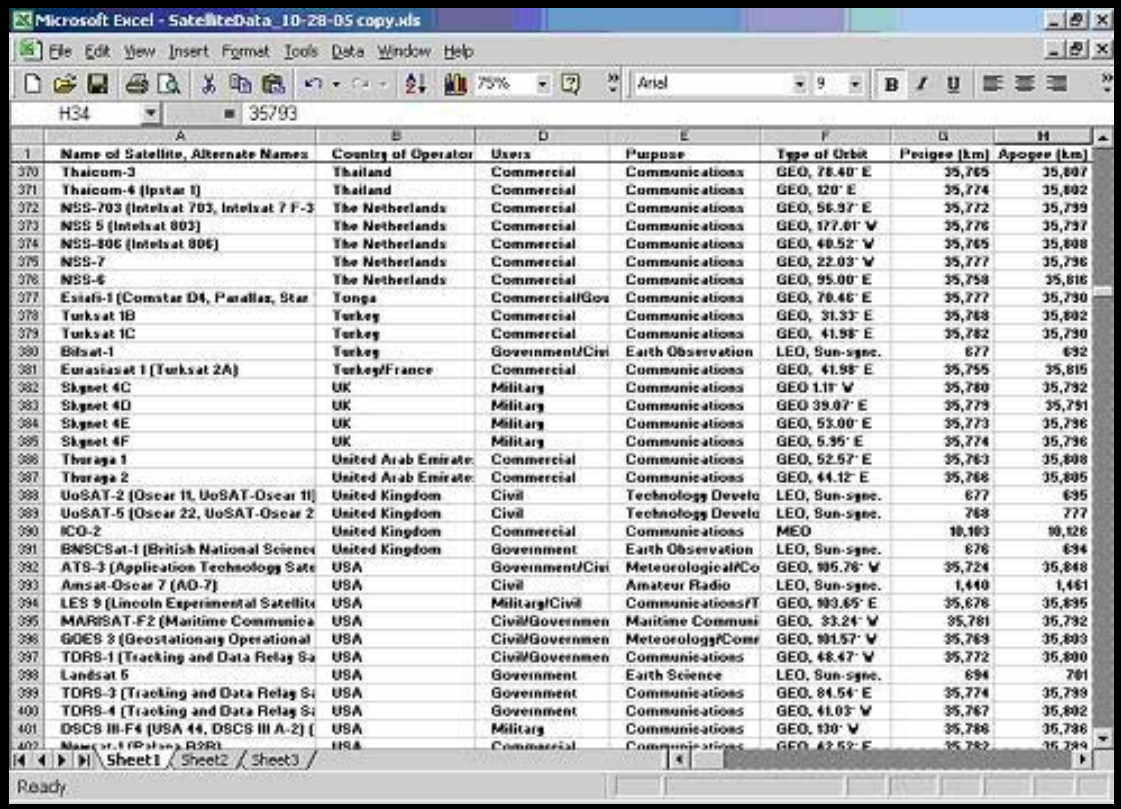


UCS Database of Active Satellites

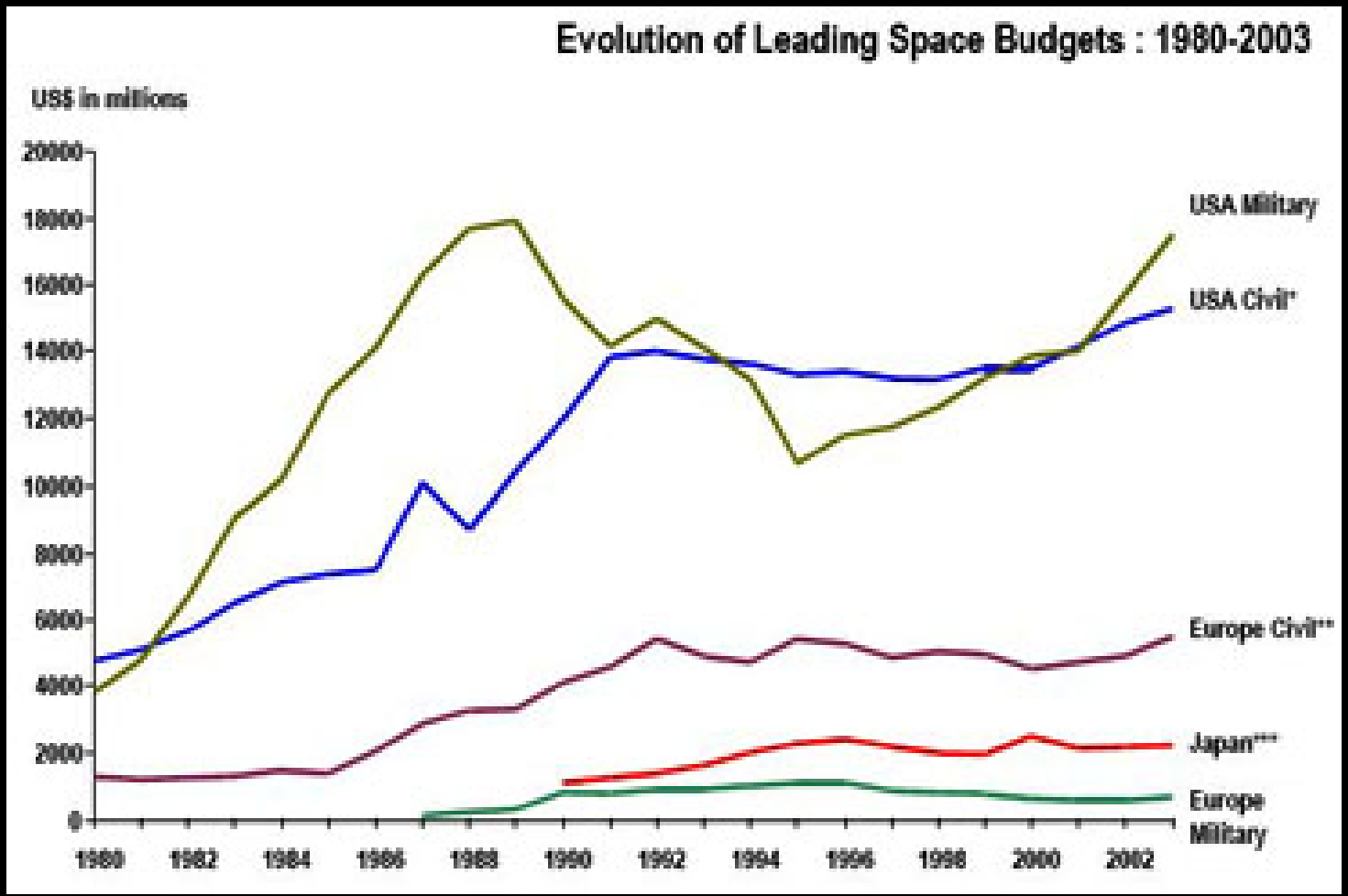
- Available at www.ucsusa.org/global_security/
- Data on over 800 satellites,
  updated quarterly

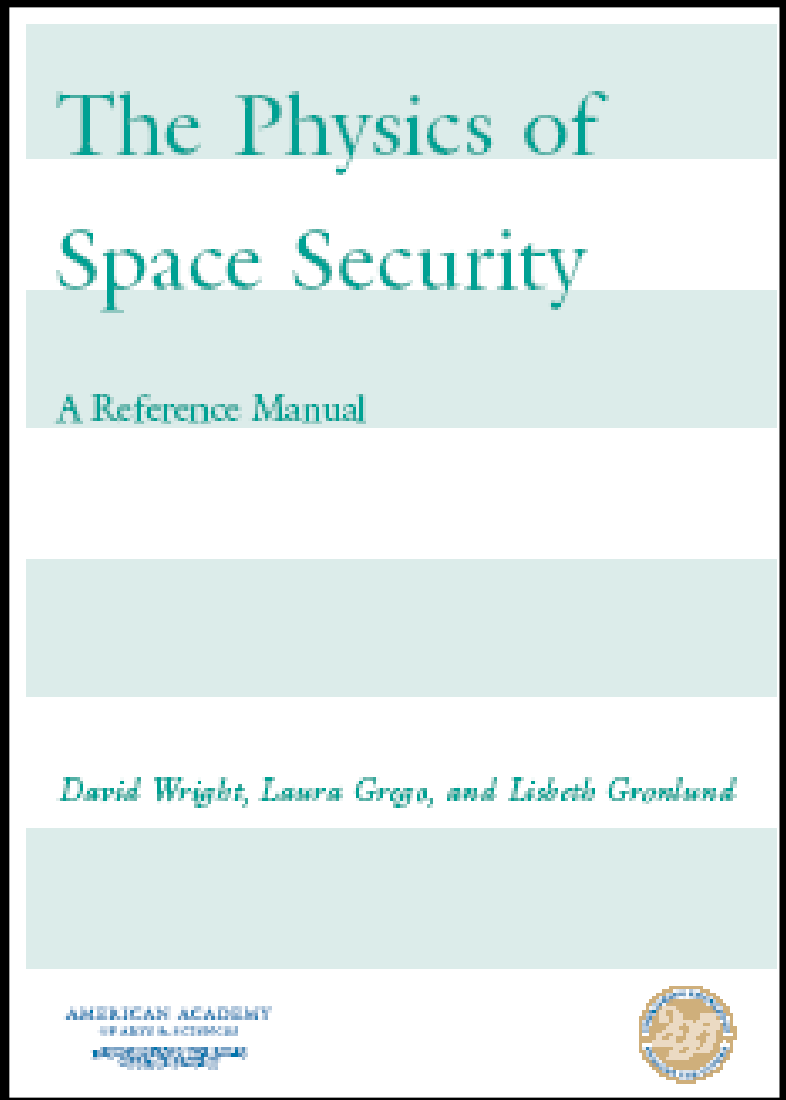


	Name of Satellite, Alternate Names	Country of Operator	Users	Purpose	Type of Orbit	Perigee (km)	Apogee (km)
370	Thaicom-3	Thailand	Commercial	Communications	GEO, 78.40° E	35,765	35,807
371	Thaicom-4 (Ipstar 1)	Thailand	Commercial	Communications	GEO, 120° E	35,774	35,802
372	NSS-703 (Intelsat 703, Intelsat 7 F-3	The Netherlands	Commercial	Communications	GEO, 56.97° E	35,772	35,799
373	NSS 5 (Intelsat 803)	The Netherlands	Commercial	Communications	GEO, 177.01° W	35,776	35,797
374	NSS-806 (Intelsat 806)	The Netherlands	Commercial	Communications	GEO, 40.52° W	35,765	35,808
375	NSS-7	The Netherlands	Commercial	Communications	GEO, 22.03° W	35,777	35,796
376	NSS-6	The Netherlands	Commercial	Communications	GEO, 95.00° E	35,758	35,816
377	Esiafi-1 (Comstar D4, Parallax, Star	Tonga	Commercial/Gov	Communications	GEO, 76.46° E	35,777	35,790
378	Turksat 1B	Turkey	Commercial	Communications	GEO, 31.33° E	35,768	35,802
379	Turksat 1C	Turkey	Commercial	Communications	GEO, 41.98° E	35,782	35,790
380	Bilsat-1	Turkey	Government/Civi	Earth Observation	LEO, Sun-sync.	677	692
381	Eurasiasat 1 (Turksat 2A)	Turkey/France	Commercial	Communications	GEO, 41.98° E	35,755	35,815
382	Skynet 4C	UK	Military	Communications	GEO 1.11° W	35,780	35,792
383	Skynet 4D	UK	Military	Communications	GEO 39.07° E	35,779	35,791
384	Skynet 4E	UK	Military	Communications	GEO, 53.00° E	35,773	35,796
385	Skynet 4F	UK	Military	Communications	GEO, 5.95° E	35,774	35,796
386	Thuraya 1	United Arab Emirate	Commercial	Communications	GEO, 52.57° E	35,763	35,808
387	Thuraya 2	United Arab Emirate	Commercial	Communications	GEO, 44.12° E	35,768	35,805
388	UoSAT-2 (Oscar 11, UoSAT-Oscar 11)	United Kingdom	Civil	Technology Develo	LEO, Sun-sync.	677	695
389	UoSAT-5 (Oscar 22, UoSAT-Oscar 2	United Kingdom	Civil	Technology Develo	LEO, Sun-sync.	768	777
390	ICO-2	United Kingdom	Commercial	Communications	MEO	10,103	10,126
391	BNSCSat-1 (British National Science	United Kingdom	Government	Earth Observation	LEO, Sun-sync.	676	694
392	ATS-3 (Application Technology Sate	USA	Government/Civi	Meteorological/Co	GEO, 105.76° W	35,724	35,848
393	Amsat-Oscar 7 (AO-7)	USA	Civil	Amateur Radio	LEO, Sun-sync.	1,440	1,461
394	LES 9 (Lincoln Experimental Satellite	USA	Military/Civil	Communications/T	GEO, 103.65° E	35,678	35,895
395	MARISAT-F2 (Maritime Communica	USA	Civil/Governmen	Maritime Communi	GEO, 33.24° W	35,781	35,792
396	GOES 3 (Geostationary Operational	USA	Civil/Governmen	Meteorology/Comr	GEO, 101.57° W	35,769	35,803
397	TDRS-1 (Tracking and Data Relay Sa	USA	Civil/Governmen	Communications	GEO, 48.47° W	35,772	35,800
398	Landsat 5	USA	Government	Earth Science	LEO, Sun-sync.	694	701
399	TDRS-3 (Tracking and Data Relay Sa	USA	Government	Communications	GEO, 84.54° E	35,774	35,799
400	TDRS-4 (Tracking and Data Relay Sa	USA	Government	Communications	GEO, 41.03° W	35,767	35,802
401	DSCS III-F4 (USA 44, DSCS III A-2) (	USA	Military	Communications	GEO, 130° W	35,788	35,786
402		USA					

Government spending on space

US military space spending is 95% of worldwide total





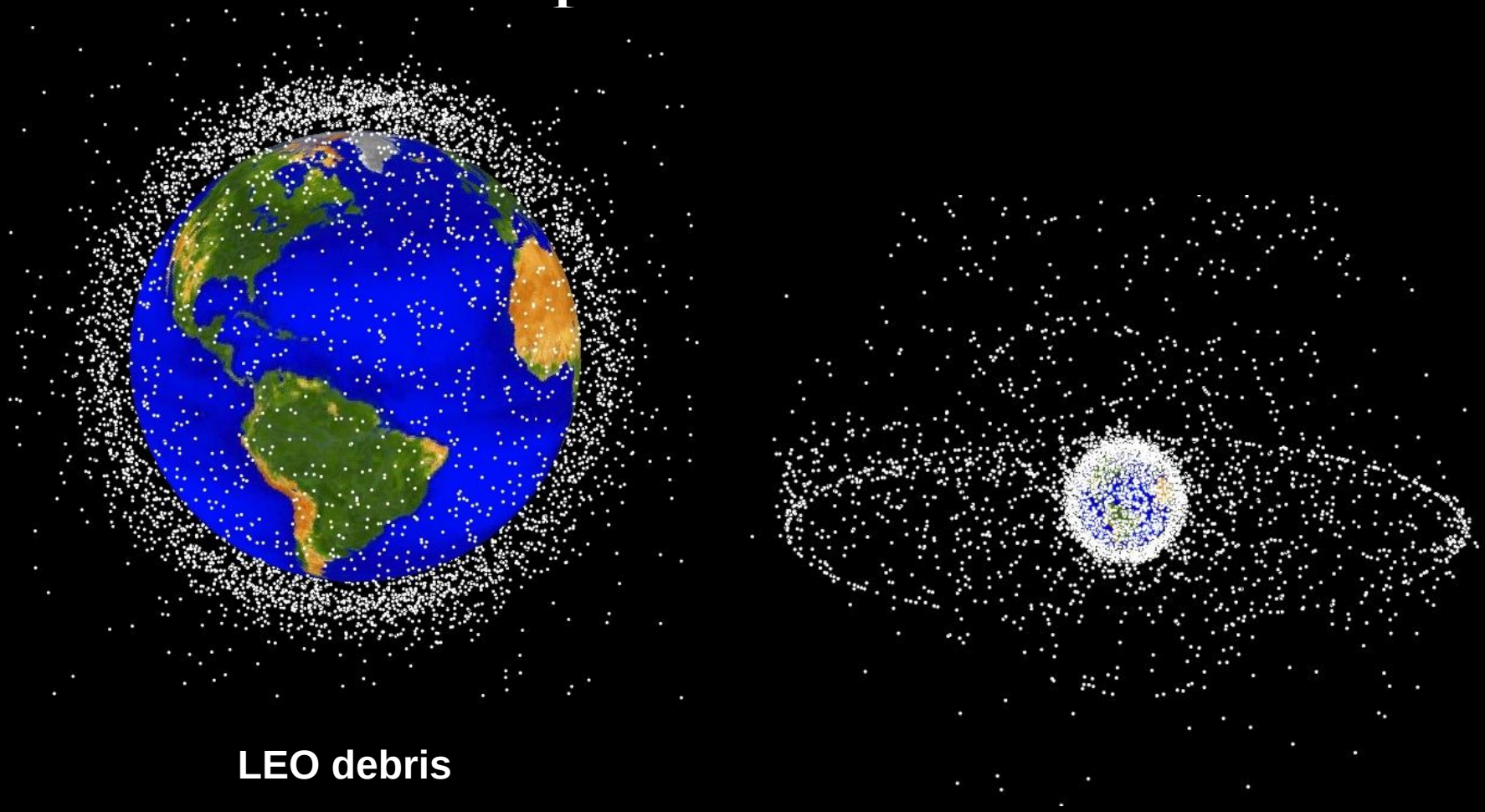
The Physics of Space Security

-David Wright, Laura Grego, Lisbeth Gronlund

Published by:

American Academy of Arts and Sciences (May 2005)

Space Debris



LEO debris

Roughly half of current space debris is in LEO (< 2,000 km altitude)

Current Orbital Debris Population in Low Earth Orbit (LEO)

	Debris size		
	1 mm to 1 cm	1 cm to 10 cm	> 10 cm
Total debris in LEO before Chinese test	140 million	180,000	9,700

Orbital Debris Created by the Breakup of a 10-ton Satellite

	Debris size		
	1 mm to 1 cm	1 cm to 10 cm	> 10 cm
Total debris in LEO before Chinese test	140 million	180,000	9,700
Debris from the breakup of a 10-ton satellite	14 million	250,000	5,000

The catastrophic breakup of even a single massive satellite would dramatically increase the amount of debris currently in orbit.

Debris Evolution from ASAT

Figure 2. Cloud of debris of size greater than 10 cm after 15 minutes.

Figure 3. Debris cloud after 10 days.

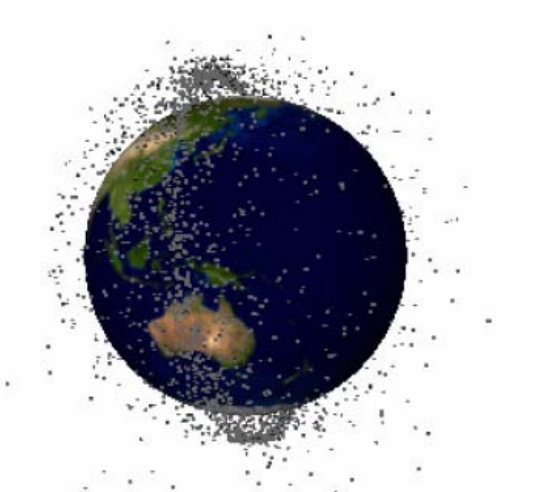


Figure 4: Debris cloud after 6 months.

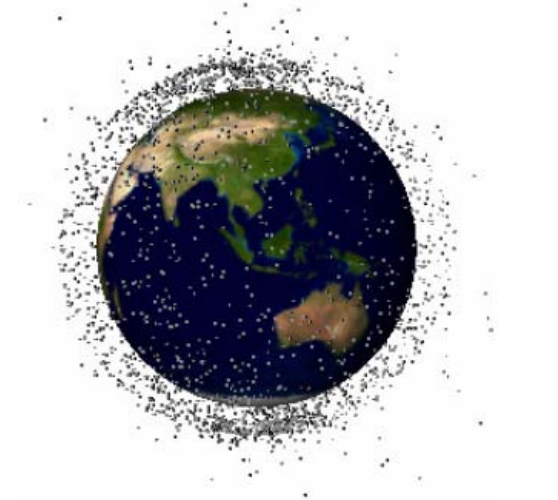
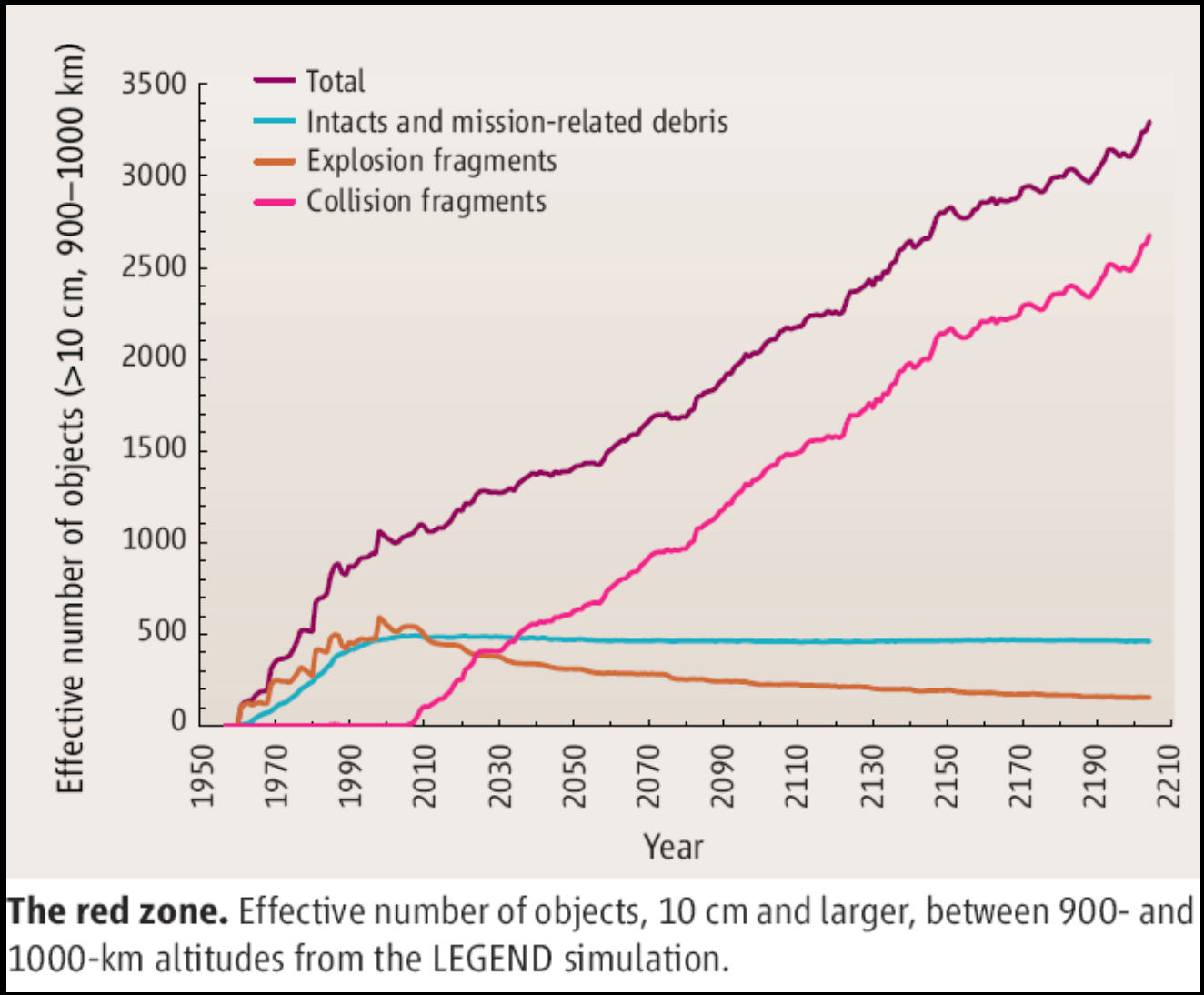


Figure 5: Debris cloud after 3 years.

Includes “J2” and “J4” terms to describe non-sphericity of earth

200-year Debris Evolution in 900-1,000 km band



The red zone. Effective number of objects, 10 cm and larger, between 900- and 1000-km altitudes from the LEGEND simulation.

(Liou-Johnson, *Science*, Jan 2006)

Proposed New Military Missions for Space

- Attacks on ground targets
- Ballistic missile defense
- Defense of satellites
- Attacks on satellites

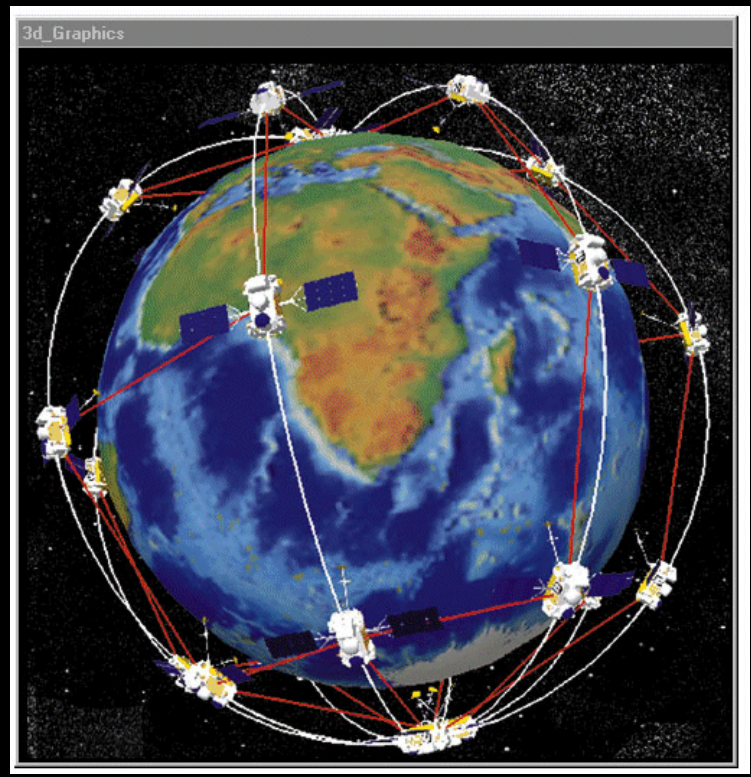
Space-based ground attacks

•Performs “Global Strike” mission outlined in Nuclear Posture Review

•Fast response time requires a constellation of satellites; orbital period in LEO is ~90 min

•For an attack that requires a response time of under an hour, need tens of satellites

•Ground-based alternatives many tens of times less expensive



Ballistic Missile Defense

•Response time required is ten times shorter than ground attack

•Requires hundreds to thousands of satellites in constellation

•Can be locally overwhelmed by launch of several ICBMs, or can have a “hole” punched through by shorter range missiles, rendering the defense ineffective.