National Aeronautics and Space Administration


# USA Space Debris Environment and Policy Updates in 2005

**Presentation to the 43rd Session of the**
**Scientific and Technical Subcommittee**
**Committee on the Peaceful Uses of Outer Space**
**United Nations**

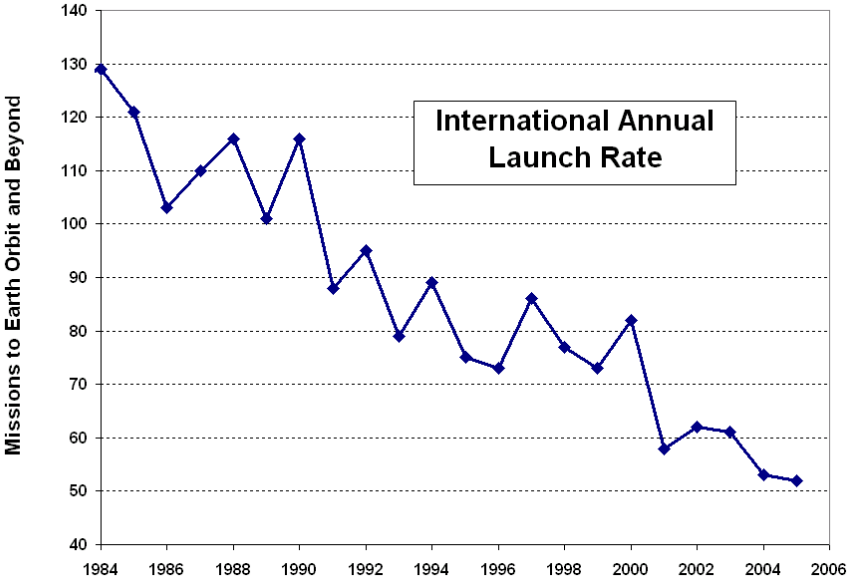
**20 February – 3 March 2006**

# Presentation Outline

- **Satellite Traffic in 2005**
- **Retirement of USA Spacecraft**
- **USA Collision and Collision Avoidance Maneuver**
- **Satellite Fragmentations in 2005**
- **USA Space Debris Experiment for ISS**
- **Space Debris Evolutionary Study**

# Satellite Traffic in 2005

- **The number of world-wide space launches in 2005 to reach Earth orbit or beyond was 52:**
  - Russian Federation 23
  - USA 12
  - China 5
  - France 5
  - Japan 2
  - India 1
  - SeaLaunch 4




- **Cataloged Objects in Earth Orbit:**

| | Total | USA |
|---|---|---|
| **1 January 2005** | **9464** | **3888** |
| **1 January 2006** | **9430** | **3881** |

# Disposal of USA Geosynchronous Satellites in 2005


- **Two USA commercial GEO spacecraft (SBS 4 and SATCOM C1) and three US Government spacecraft of the DSCS series were decommissioned in 2005 and placed in disposal orbits at least 300 km above GEO.**

- **One USA commercial GEO spacecraft (Galaxy 5) and one USA Government GEO spacecraft of the DSCS series were decommissioned in 2005 and placed into disposal orbits with mean altitudes of approximately 270 km above GEO.**

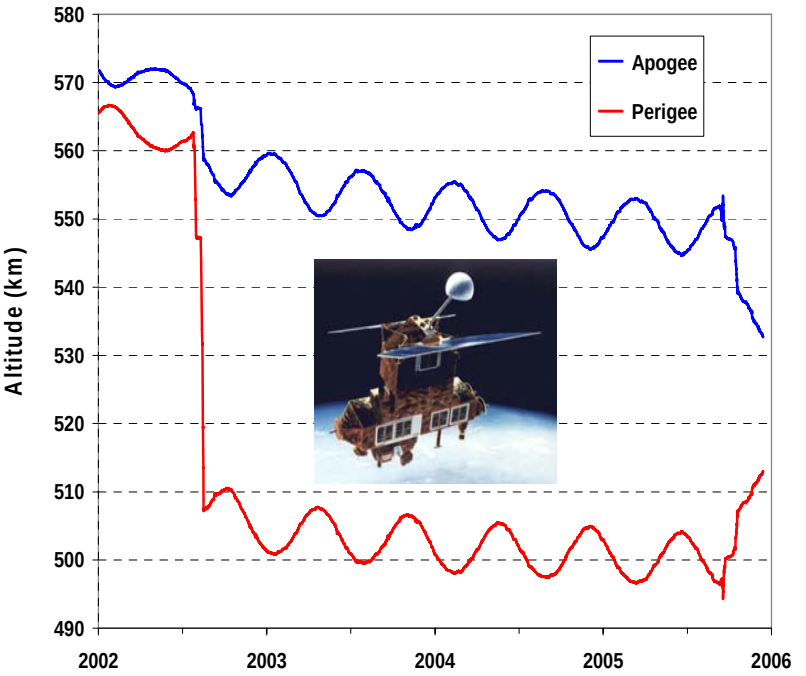
  – Both spacecraft were 13 or more years old, *i.e.*, they were launched six or more years prior to the IADC GEO spacecraft disposal recommendation of 1997

- **Two USA GEO spacecraft (INTELSAT 804 and UFO 3) suffered catastrophic failures in GEO and could not be transferred to disposal orbits.**

# Disposal of NASA LEO Spacecraft in 2005

## Earth Radiation Budget Experiment (ERBS) [1984-108B]

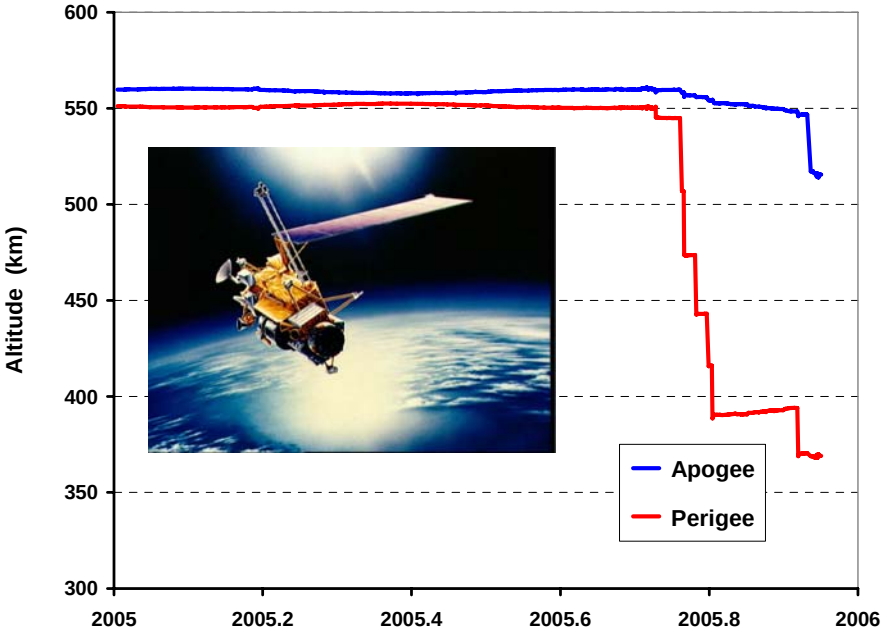
- Operated near 600 km for almost 18 years
- Perigee lowered more than 50 km in 2002 to ensure orbital reentry in less than 25 years after end of mission
- Support system degradation prevented further reduction in perigee in 2005; however, all residual propellant was expended during maneuvers in September and October
- Remaining orbital lifetime is expected to be less than 17 years



# Disposal of NASA LEO Spacecraft in 2005 (continued)

## Upper Atmosphere Research Satellite (UARS) [1991-063B]

- Operated between 550 and 600 km for 14 years
- During October and December 2005 all residual propellant was expended in a series of 8 maneuvers
- Mean orbital altitude was reduced more than 100 km
- Remaining orbital lifetime is expected to be less than 5 years

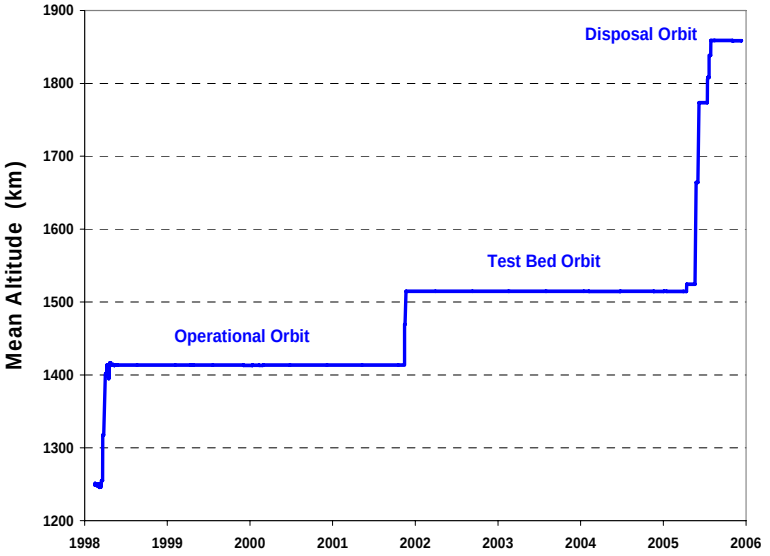


# Disposal of Globalstar Spacecraft

- **The Globalstar commercial communications network consists of 48 primary spacecraft in orbits near 1415 km altitude. The spacecraft were designed in the early 1990's before disposal recommendations for LEO satellites.**

- **Disposal orbits 100 km above the operational orbits were originally envisioned. However, in October 2005 Globalstar LLC declared to the USA Federal Communications Commission its intent to dispose of Globalstar vehicles in orbits as high as 2000 km, in accordance with current USA disposal options.**

- **One of the first group of four spacecraft was transferred to a disposal orbit near 1900 km in 2005. Two other spacecraft in a temporary post-mission test orbit are expected to reach 2000 km.**




**Globalstar M002**

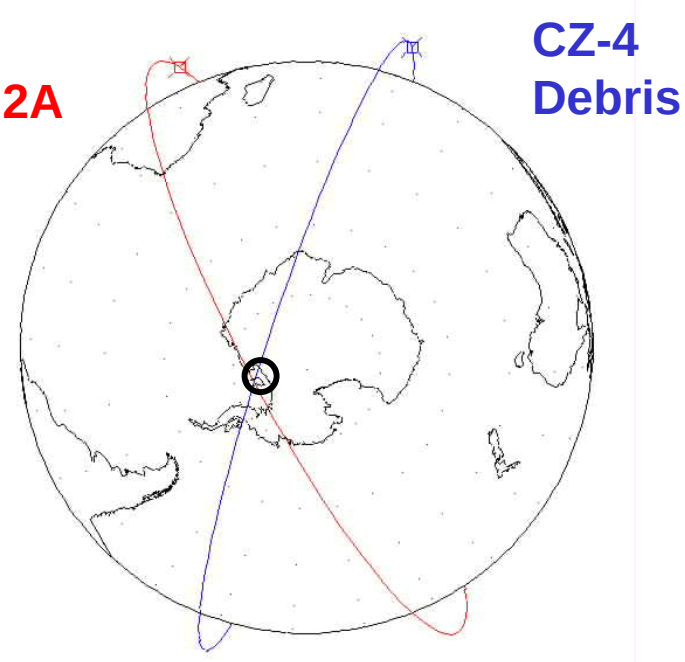
# Third Known Accidental Collision

- **The third known accidental collision in low Earth orbit between cataloged satellites occurred on 17 January 2005.**

- **The collision involved a 31-year-old USA Thor Burner 2A orbital stage (1974-015B) and fragmentation debris from a Chinese CZ-4 orbital stage (1999-057C), which broke-up in March 2000.**

- **Both satellites were in similar retrograde orbits with apogees near 900 km, where the collision occurred.**

- **Fortunately, only three new debris, from the USA orbital stage, are large enough to have been detected.**



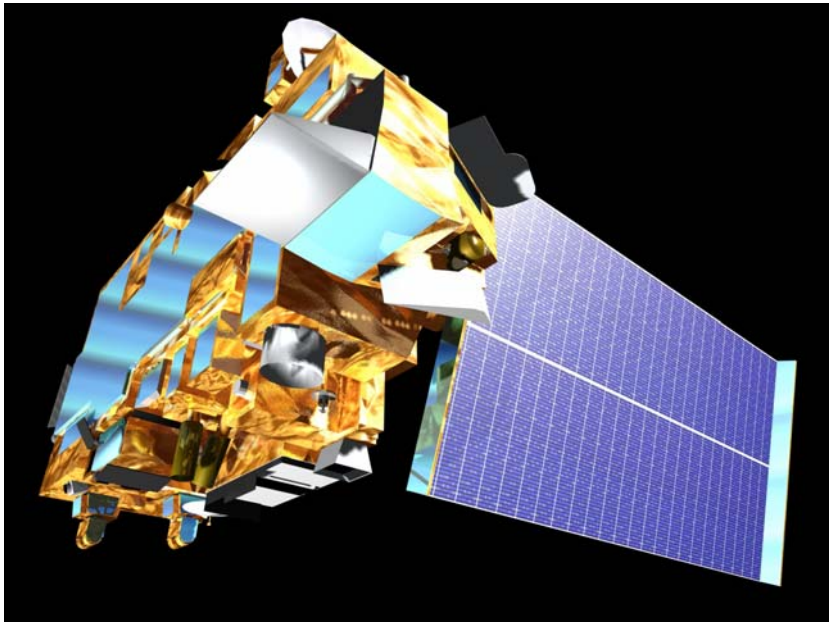
# USA Collision Avoidance Maneuver

- **Terra (1999-068A) is the flagship of NASA's Earth Observing System (EOS), residing in a sun-synchronous orbit at an altitude of 705 km.**

- **In October 2005 a routine conjunction assessment indicated that a piece of mission-related debris (1983-063C) from a 1983 USA mission would come close to Terra six days later.**

- **Further analysis indicated a miss distance of less than 50 meters and a risk of collision in excess of 1 in 100 at a relative velocity of ~12 km/s.**

- **A collision avoidance maneuver was performed two days before the conjunction.**



# Satellite Fragmentations in 2005


- **In addition to the collision involving the Thor Burner 2A orbital stage, only four other minor satellite fragmentations were detected by the USA Space Surveillance Network in 2005:**
  - Cosmos 2224 ullage motor (1992-088F) broke-up in April, producing a small number of short-lived debris
  - Cosmos 2392 ullage motor (2002-037E) broke-up in June, producing sixty cataloged debris, of which 82% had reentered by the beginning of 2006
  - Nadezhda 2 orbital stage (1990-017B) appears to have been struck by a small, untracked object in June; one piece of debris was created in an orbit near 1000 km
  - Meteor 2-17 (1988-005A) released a single piece of debris in June near 950 km; the cause of the event is unknown, but possibly related to vehicle degradation
- **Overall, very few long-lived fragmentation debris were created during 2005.**

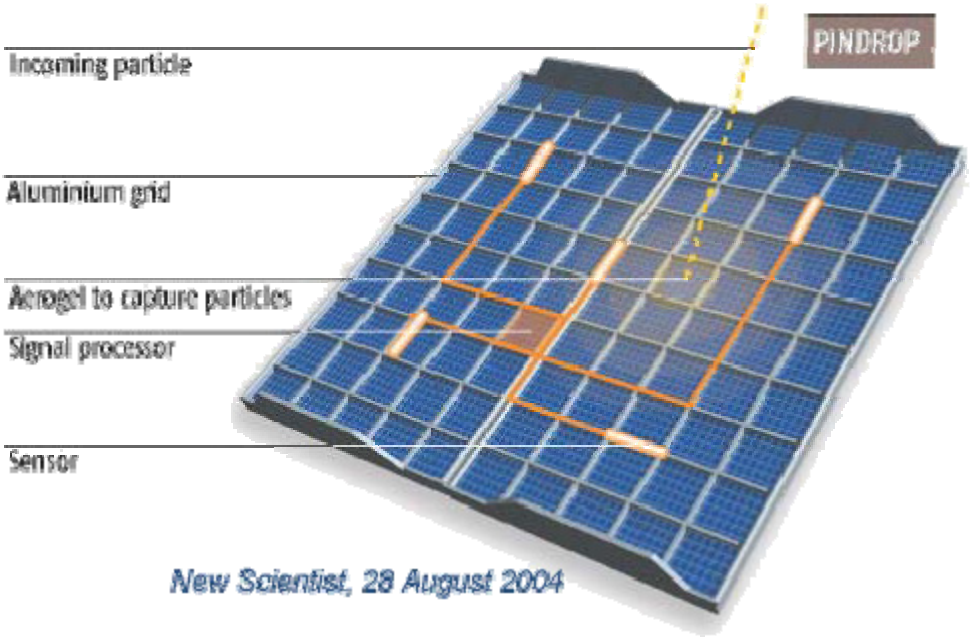
# USA Space Debris Experiment for ISS

- **In 2005 the USA approved a major new space debris experiment for the International Space Station.**

- **The purpose of the Large Area Debris Collector (LAD-C) will be to characterize the space debris environment with emphasis on particles 0.1 to 1.0 mm, which historically have been hard to detect.**

- **The experiment will employ both acoustic sensors and aerogel capture medium in a collecting area of 10 square meters.**

- **LAD-C is scheduled for launch in 2007 and will be retrieved after an exposure of at least one year.**




**Single LAD-C Panel**

# Space Debris Evolutionary Study

- **During 2005 NASA investigated the stability of the current satellite population in low Earth orbit using the LEGEND long-term evolutionary model.**

- **The objective was to determine the likely change of the satellite population assuming no new launches after 1 January 2005, no further disposal maneuvers, and a natural reduction in satellite explosions.**

- **The study indicated that the current number of objects larger than 10 cm would remain relatively constant for the next 50 years as the reentry of existing satellites would be off-set by the creation of new debris from accidental collisions.**

- **After about 50 years, the satellite population would begin to increase again as the accumulation of collision debris continues and the rate of reentries of existing satellites declines.**

# Space Debris Evolutionary Study (continued)