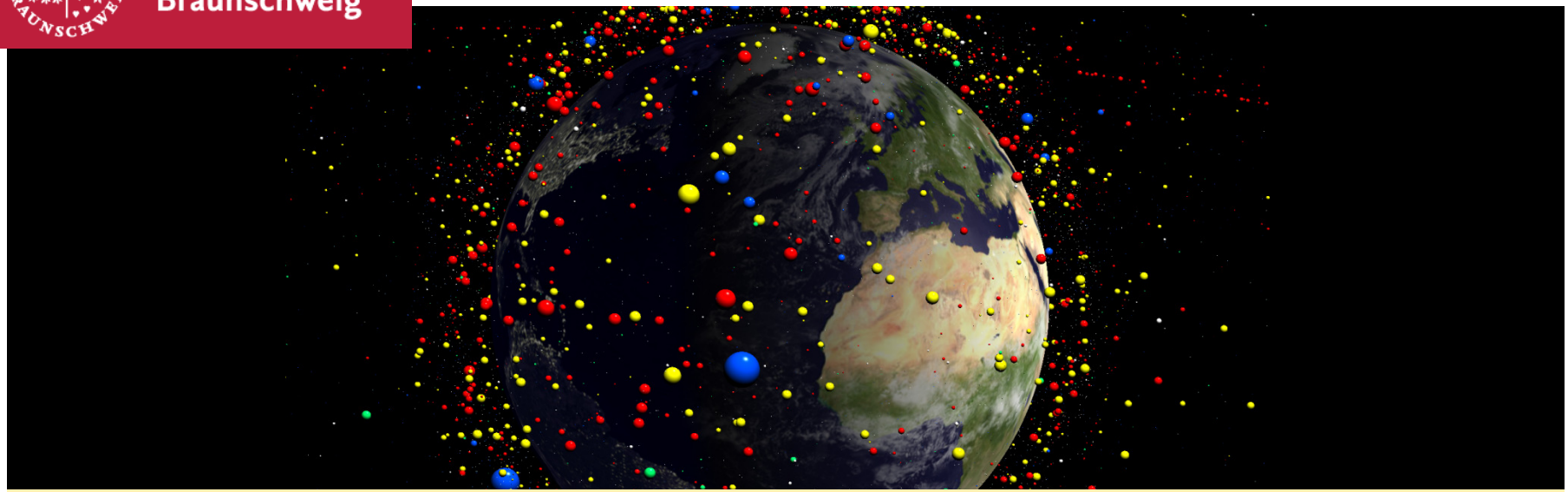
Technische Universität Braunschweig

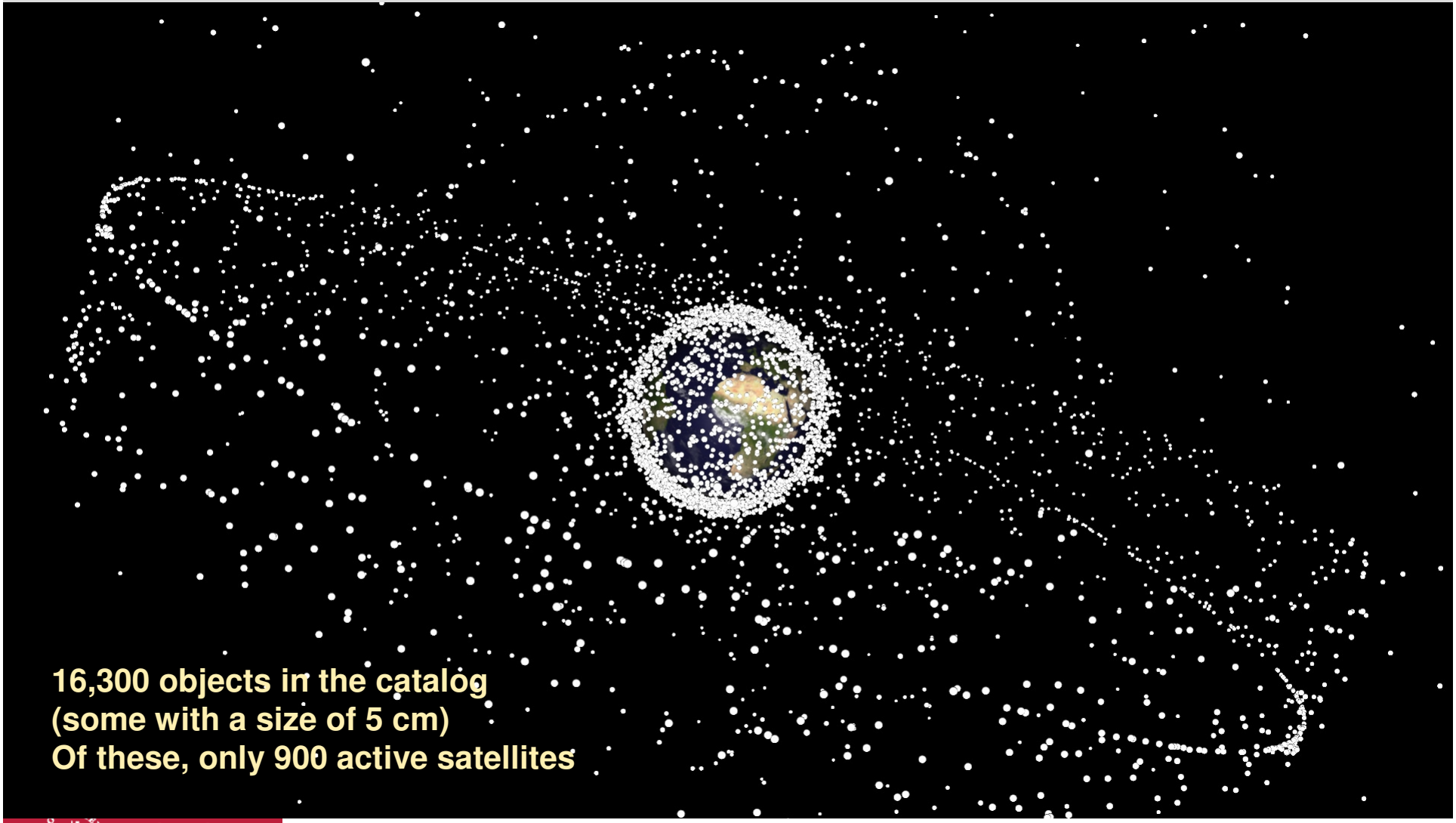
Institut für Luft- und Raumfahrtsysteme



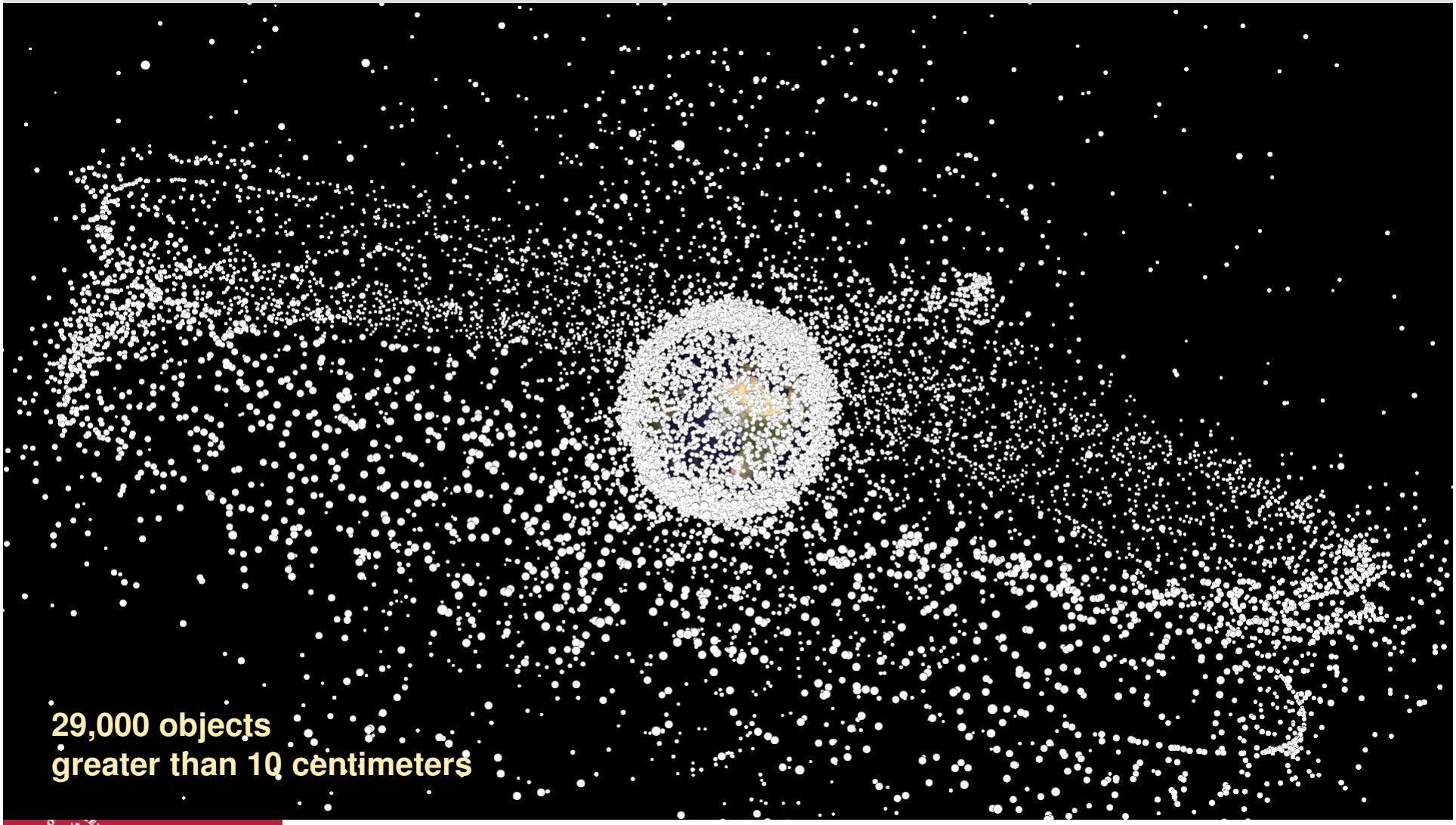
Space Debris – Current Situation

Dr.-Ing. Carsten Wiedemann, Prof. Dr.-Ing. Peter Vörsmann

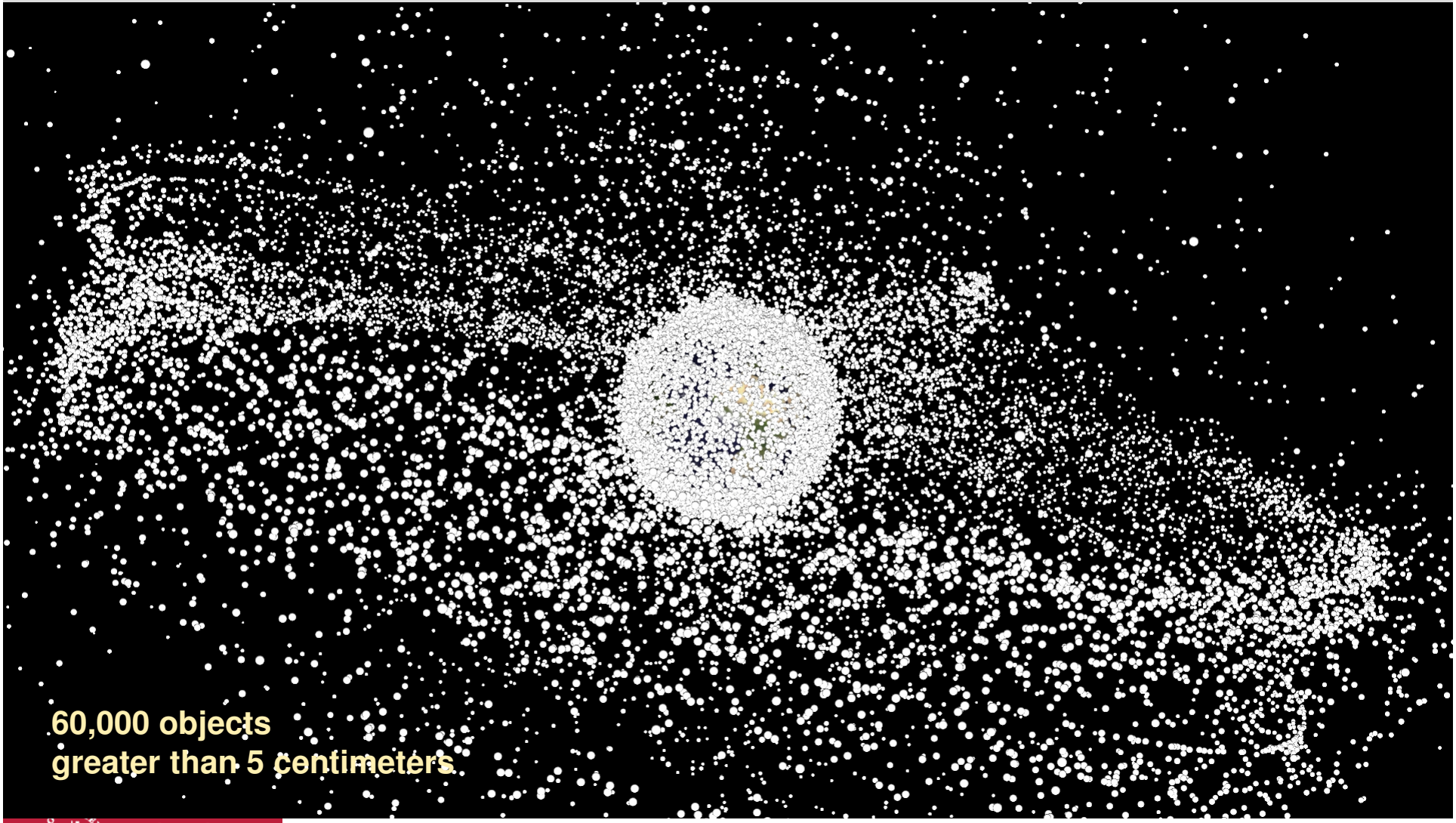
Catalog


16,300 objects in the catalog
(some with a size of 5 cm)
Of these, only 900 active satellites

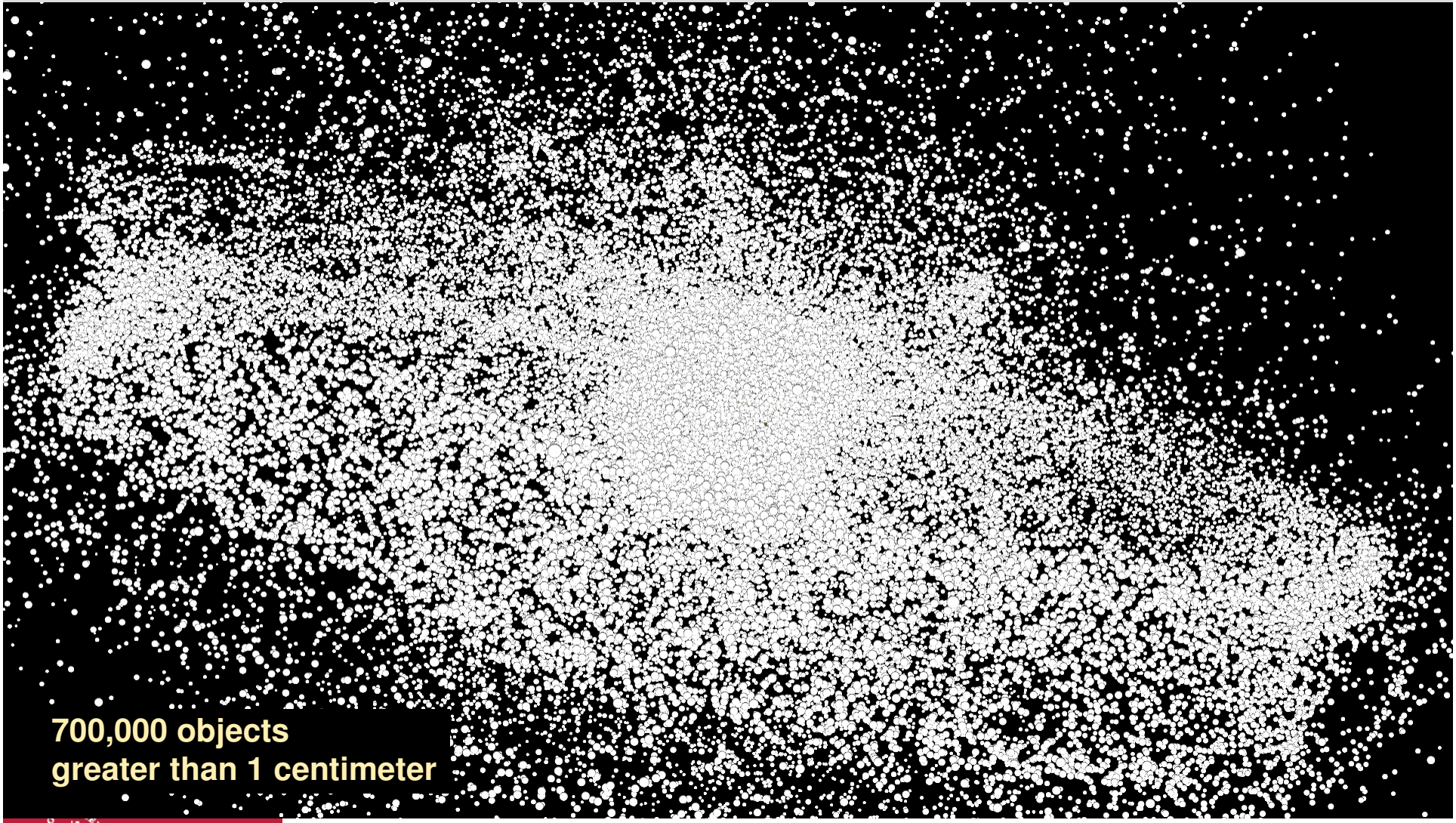
Objects greater than 10 cm



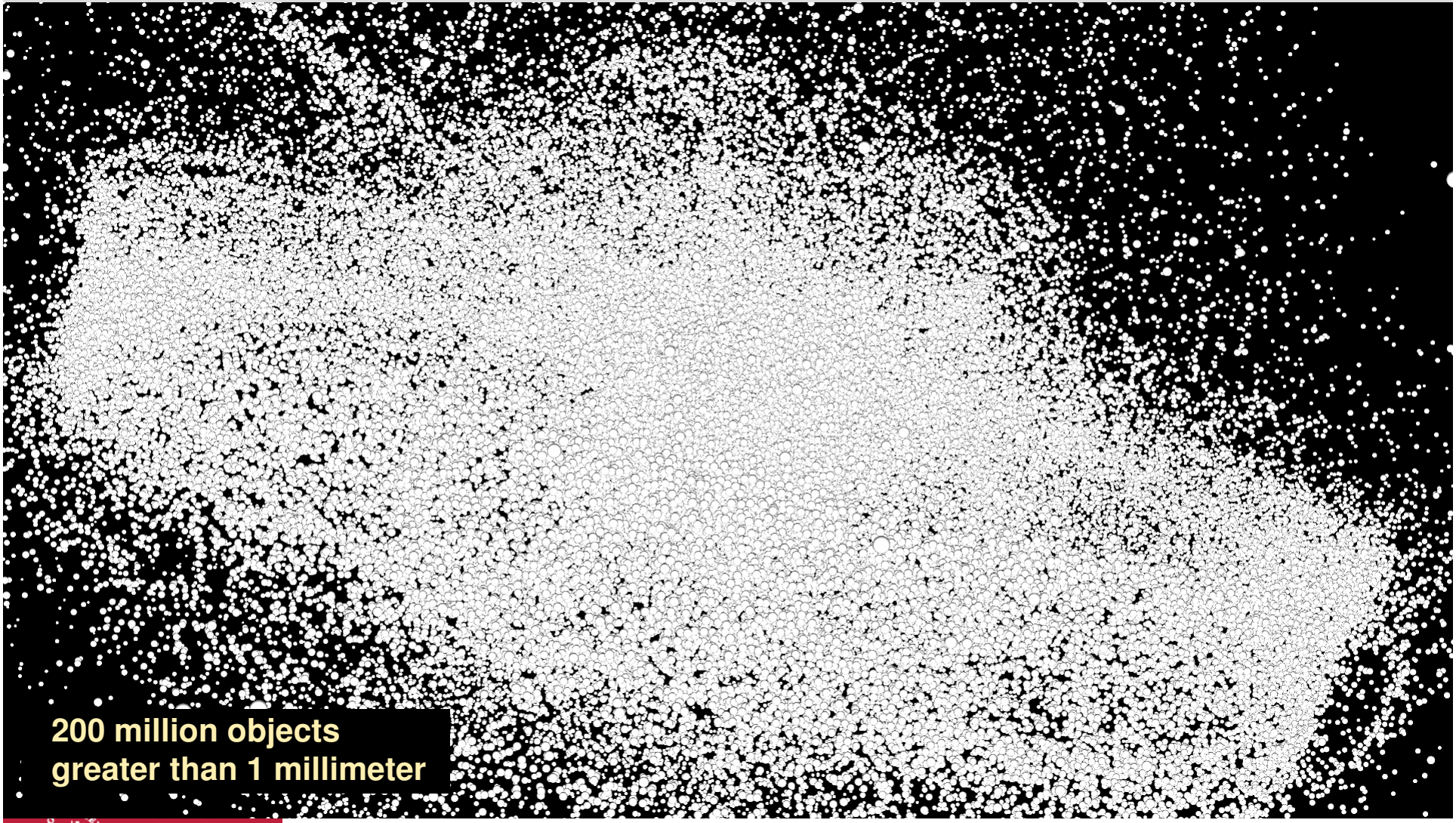
Objects greater than 5 cm



Objects greater than 1 cm

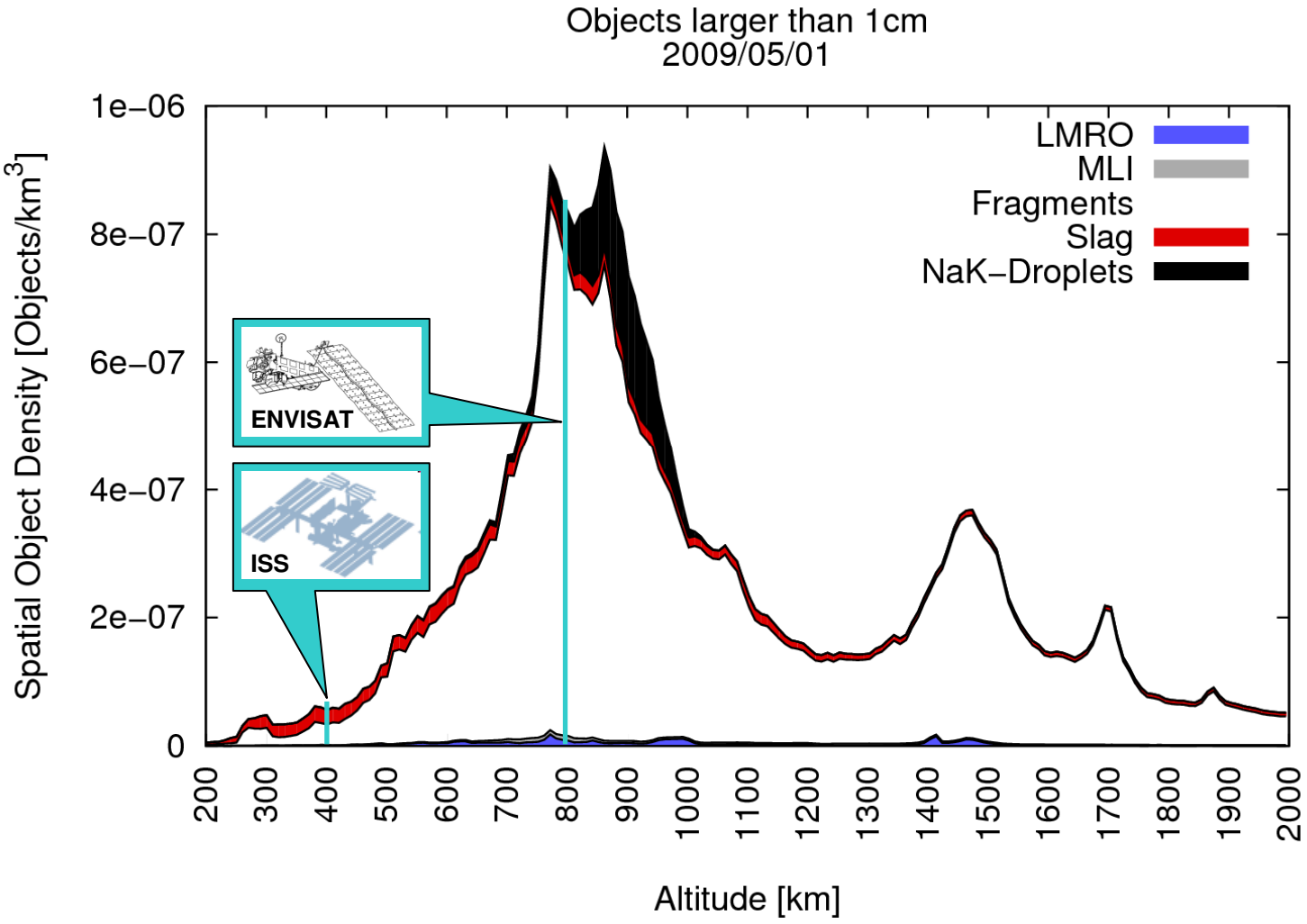


Objects greater than 1 mm



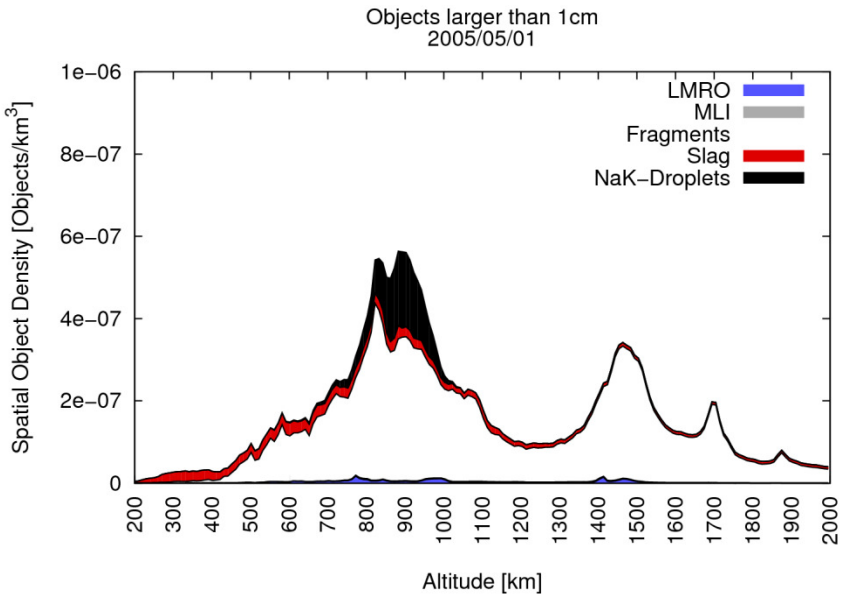
Objects greater than one tenth of a millimeter

Spatial Density (2009)

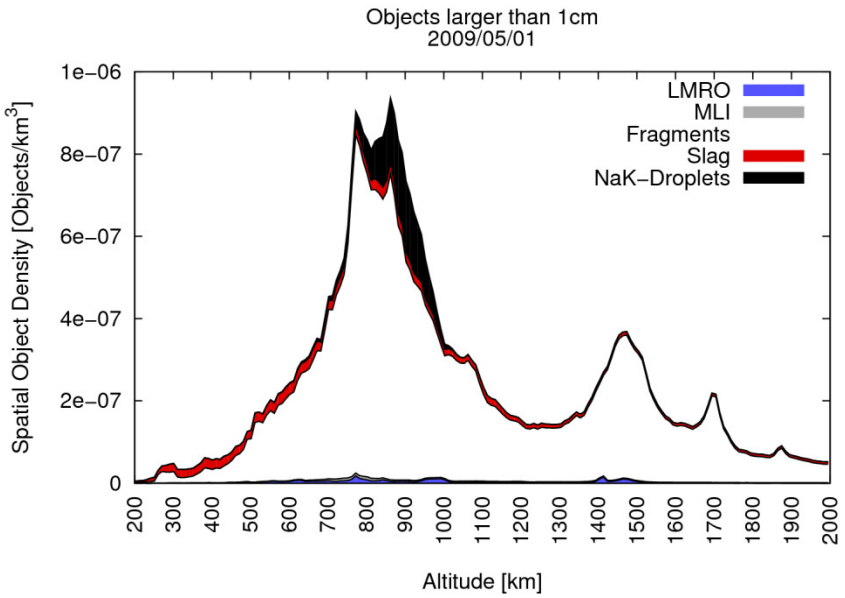


Spatial Density

Spatial density of debris larger than one centimeter according to MASTER-2009



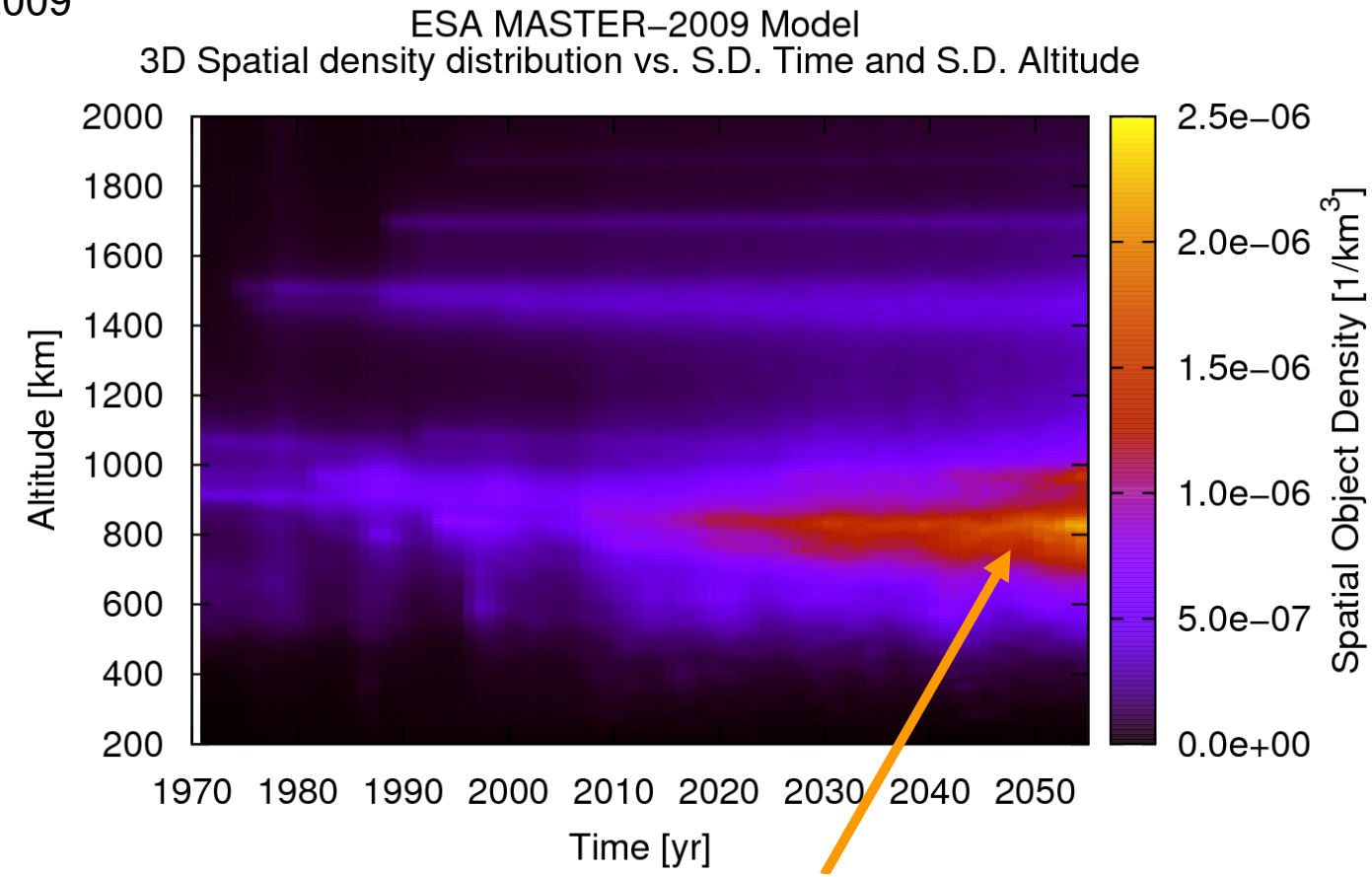
2005



2009

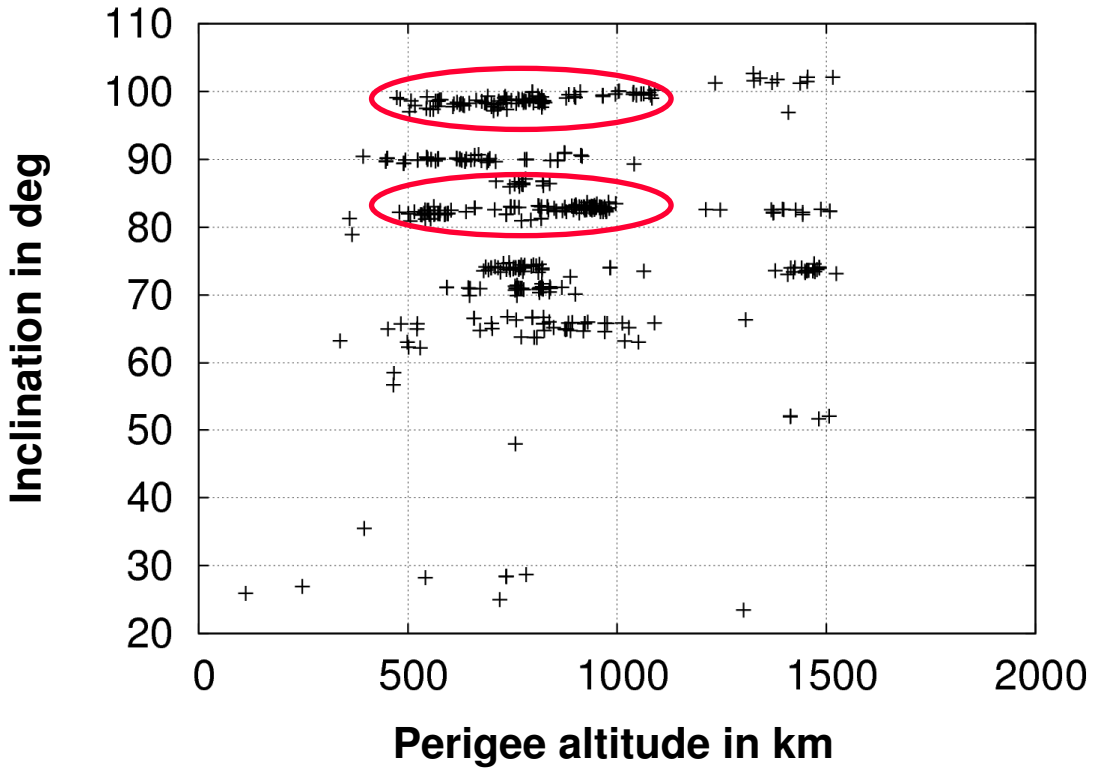
Instability of the LEO Population

Spatial density of objects larger than one centimeter versus time on LEO according to MASTER-2009



Increasing threat for the orbits used by Earth observation satellites

Which satellites are most likely to collide?



Collisions will mainly occur between sun-synchronous satellites (i ≈ 98°) and objects at i ≈ 82°. Basically head-on collisions with twice the orbital velocity!

Conclusions

Orbital region of special interest: 800 km altitude

- high number of space debris
- high collision velocity
- high probability of catastrophic collisions

Collisional cascading (Kessler Syndrom) will start in 800 km.

It may be necessary to remove existing objects actively.

Scientific/technical challenges

- identification of long-living risk objects (potential collision partners)
- prioritization of risk objects for active removal
- active removal (de-orbiter rendevouz and docking with risk object)

Legal challenges

- new satellites and rocket stages: implementation of an obligation for immediate de-orbiting at EOL?
- old satellites and rocket stages:
  - can risk objects be removed by a third party?
  - can someone be held responsible for a collision?