

Challenges Posed by Large Constellations

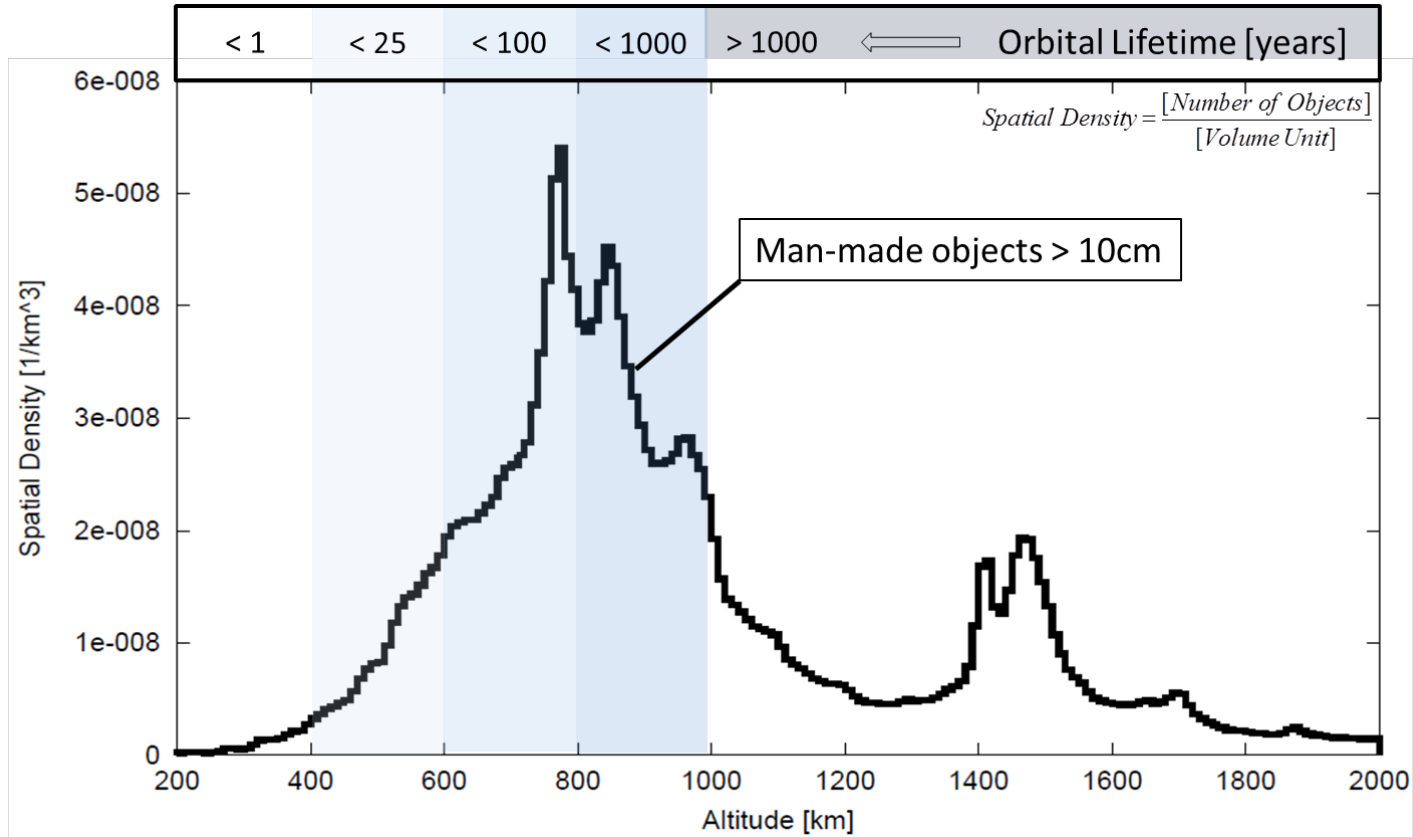
Holger Krag, Head of ESA's Space Debris Office

11/06/2019

Mega Constellations (> 10,000 LEO satellites)

Constellation	OneWeb	BOEING	SPACEX	SAMSUNG
Satellites	882	2960	7518	4600
Altitude	1200 km	1200 km	350 km	1400 km
Mass	150kg	> 100kg	390kg	< 200kg

Spatial Density

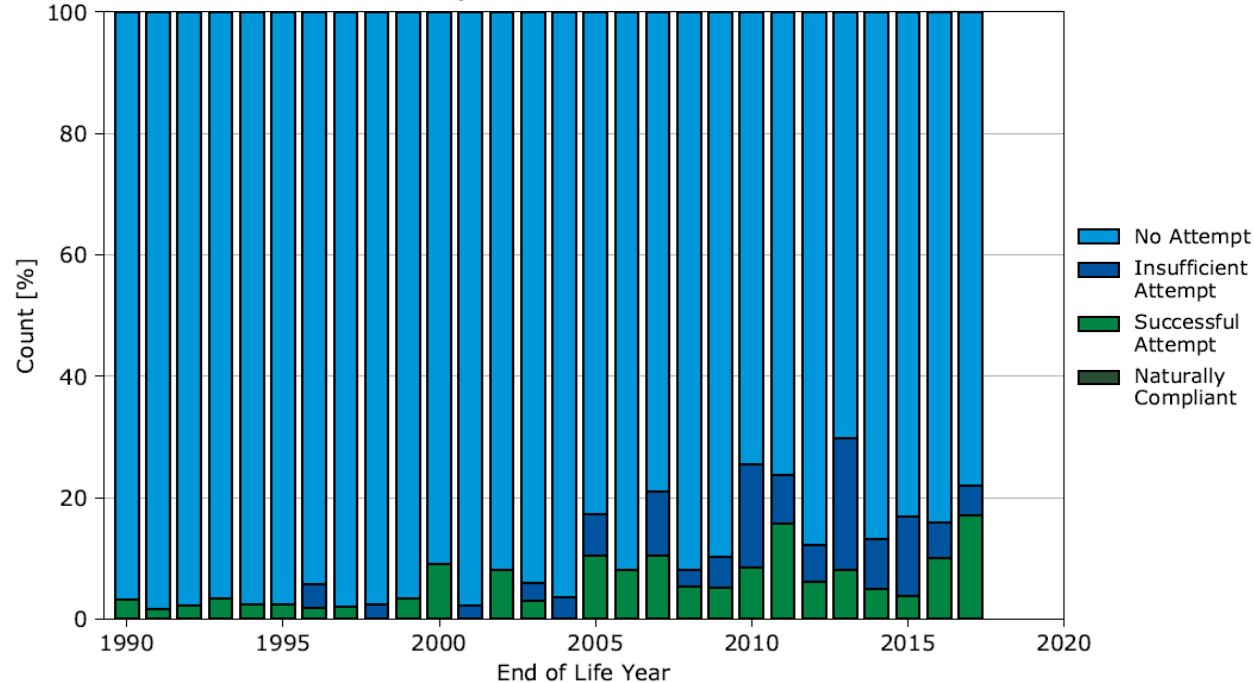


- Public Report on the global level of adherence to international Space Debris Mitigation Guidelines

- Generated from Surveillance Data

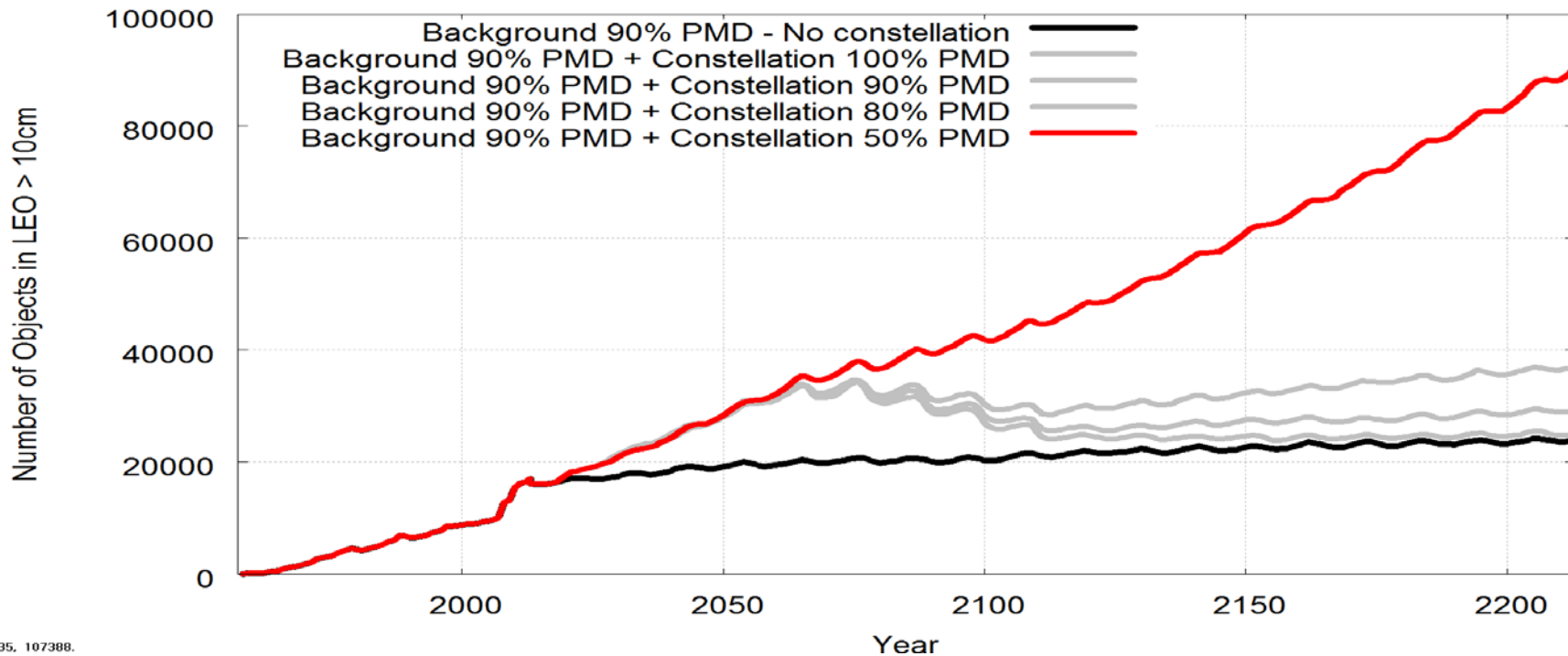
- https://www.sdo.esoc.esa.int/environment_report/Space_Environment_Report_latest.pdf

Statistics on the success-rate of Post Mission Disposal Manoeuvres



(Preliminary results)

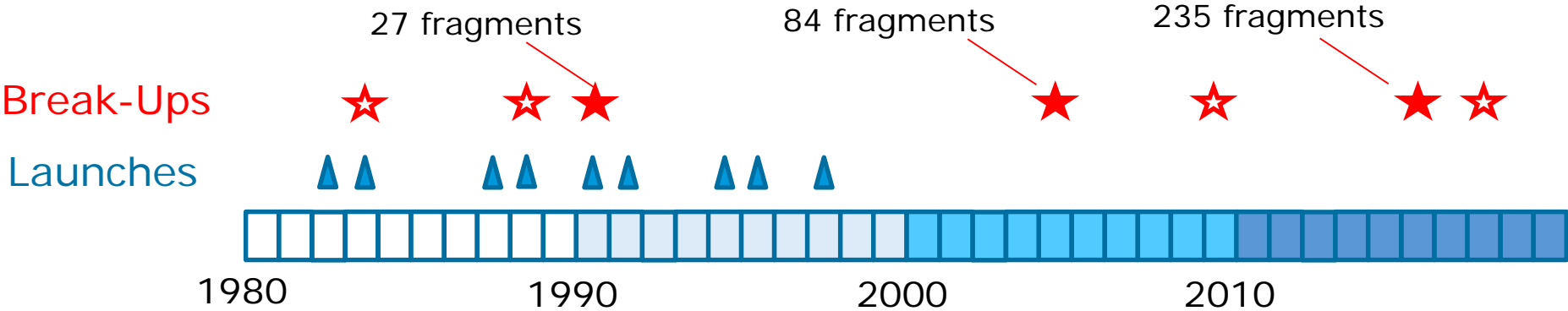
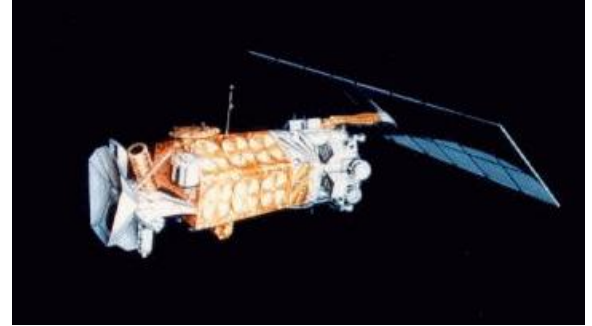
Environmental Effects of a Large Constellation



2076.35, 107388.

Late Effect of Design Flaws

- DMSP (Defence Meteorological Satellite Programme)
- Series 5D-2 (9 spacecraft, 7 broken-up)
- Battery fault

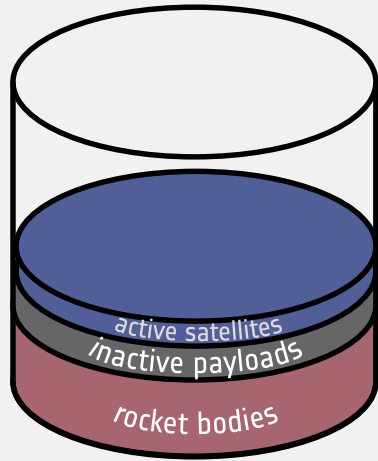


Impact on Astronomical Observations

- AAS Position Statement

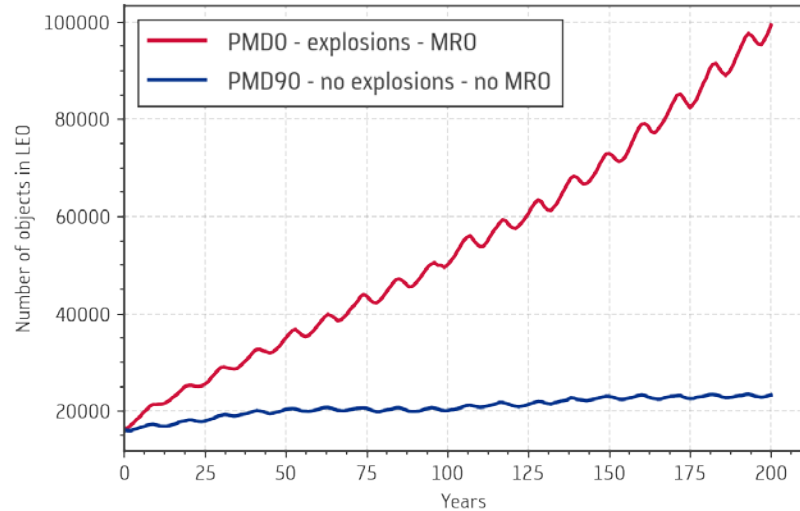


Space as a
shared resource

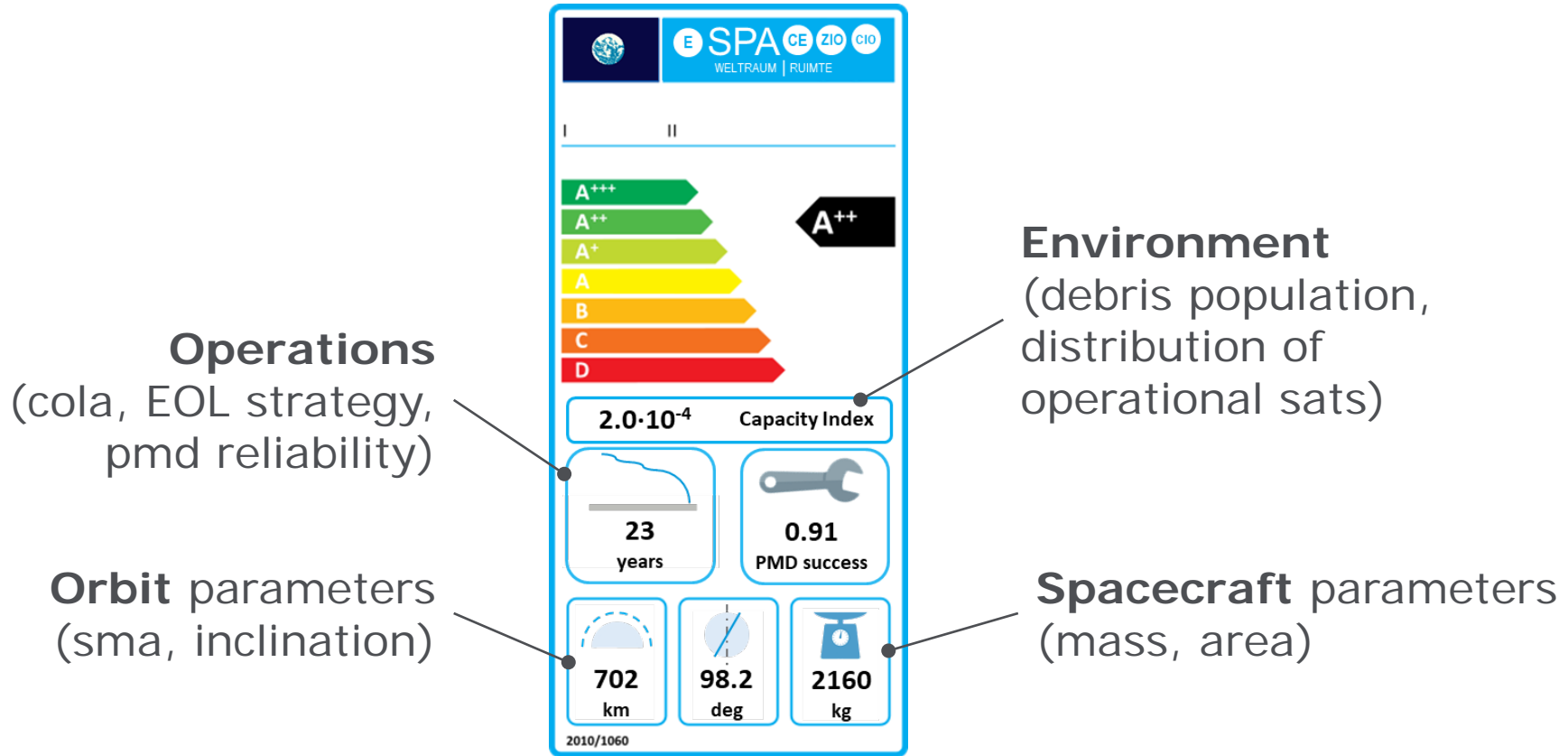


Capacity: typology & orbital regimes of artificial space objects compatible with a **stable evolution** of the environment

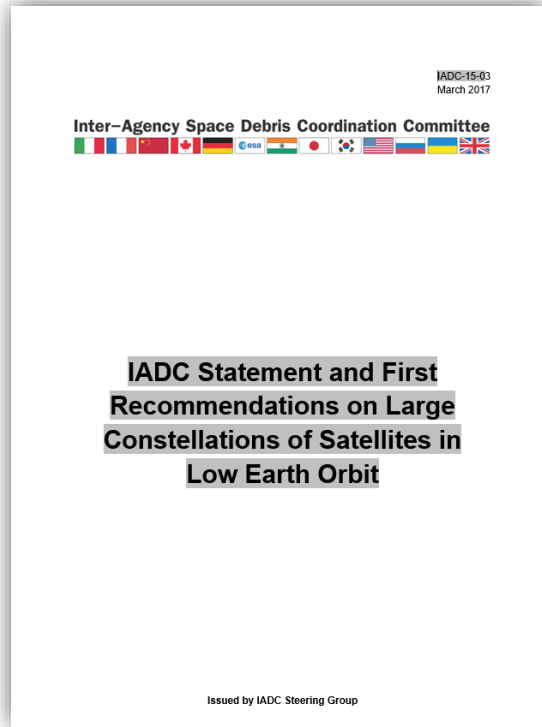
► Krag et al., 1th ICSSA, 2017



Impact of a mission on the space environment



Existing Work on Large Constellations



Development of technologies to prevent the creation of future debris

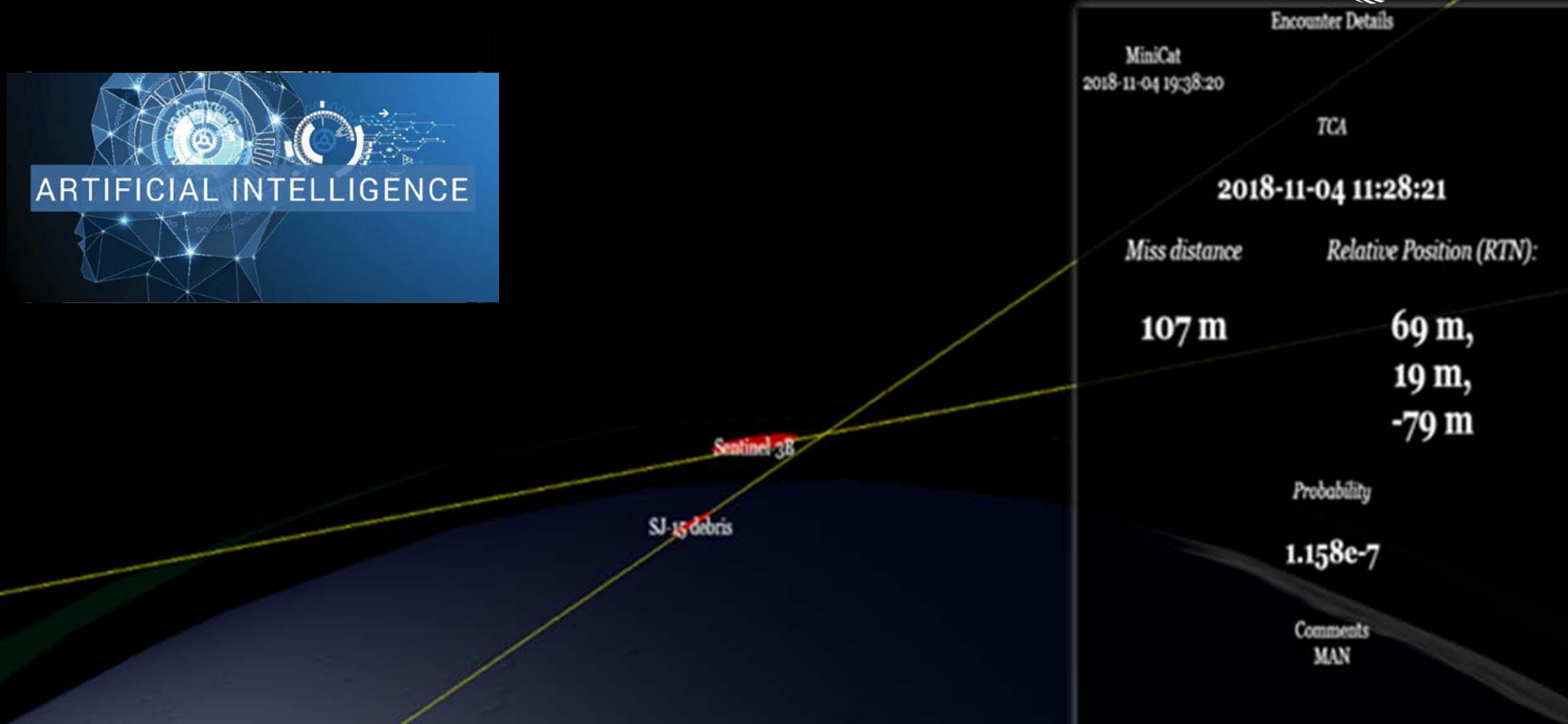


Altitude (Km) :



European Space Agency

Automated Collision Avoidance



Encounter Details	
MiniCat	
2018-11-04 19:38:20	
TCA	
2018-11-04 11:28:21	
Miss distance	Relative Position (RTN):
107 m	69 m, 19 m, -79 m
Probability	
1.158e-7	
Comments	
MAN	



Manoeuvre Coordination

*Warning /
notification*

*Decision
distribution*

*Orbit information
distribution*

*Avoidance strategy
coordination*

