

SPACE SURVEILLANCE AND TRACKING

Problems, Solutions and Current Activities

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ESA SSA Programme

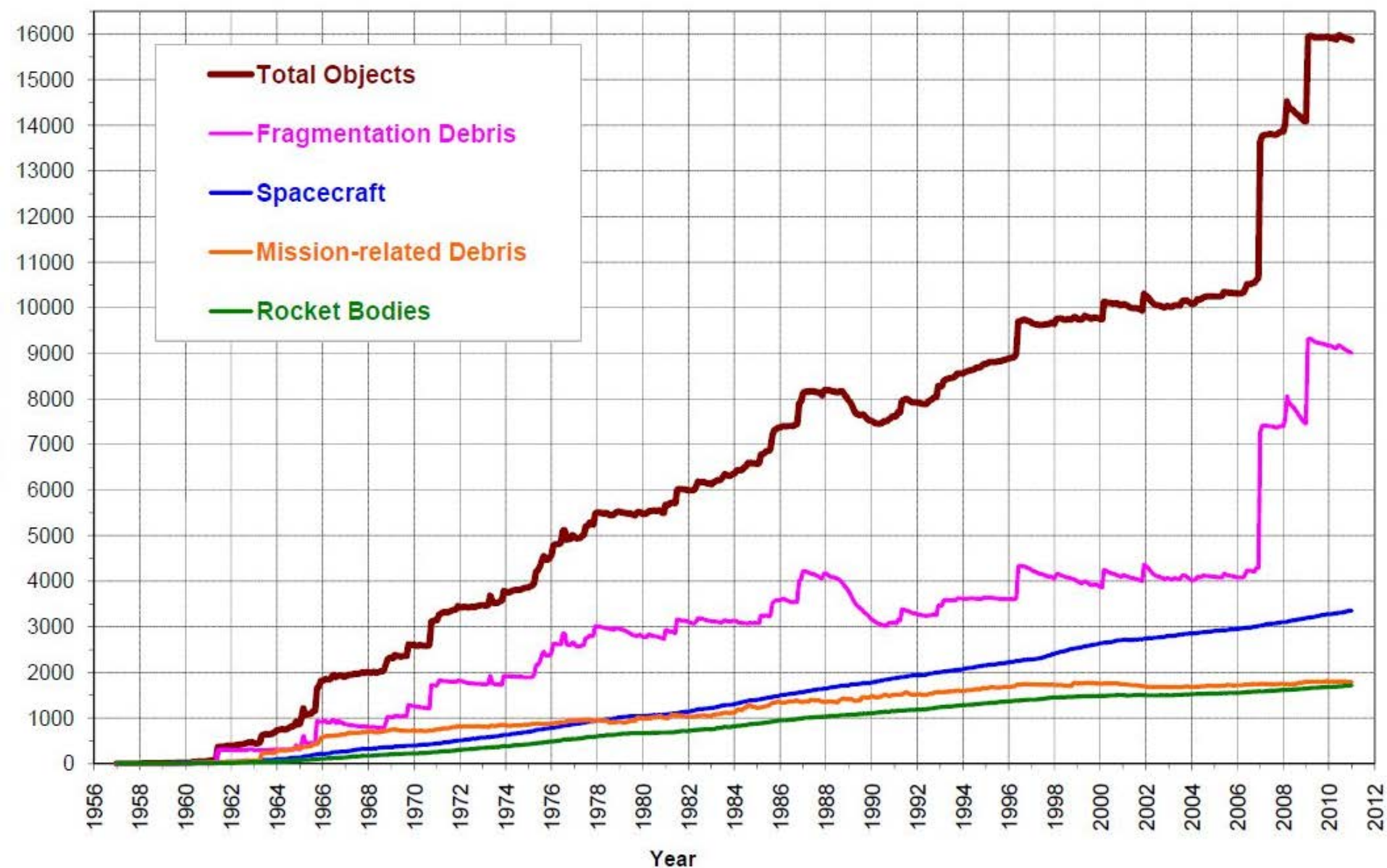


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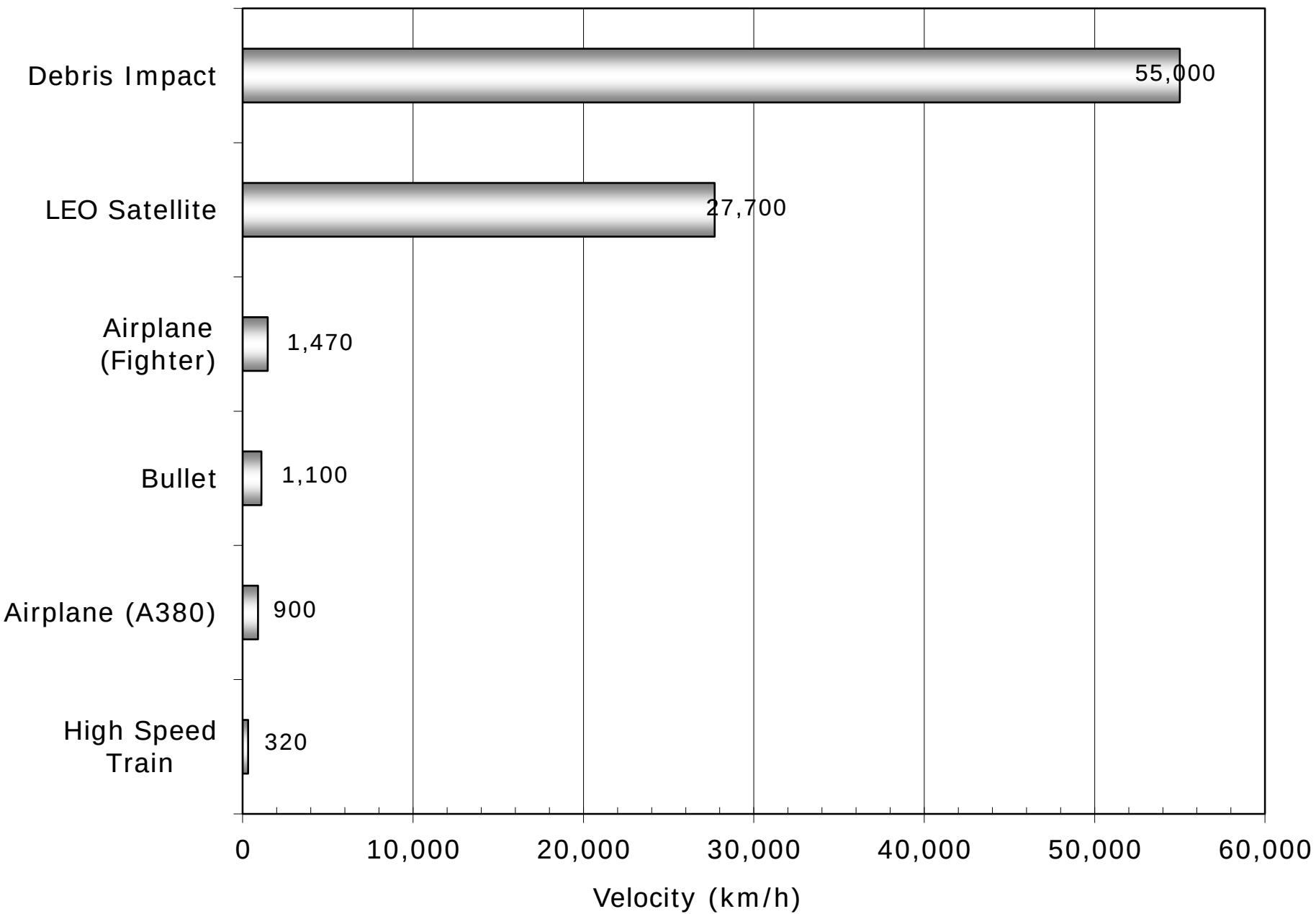
THE PROBLEM

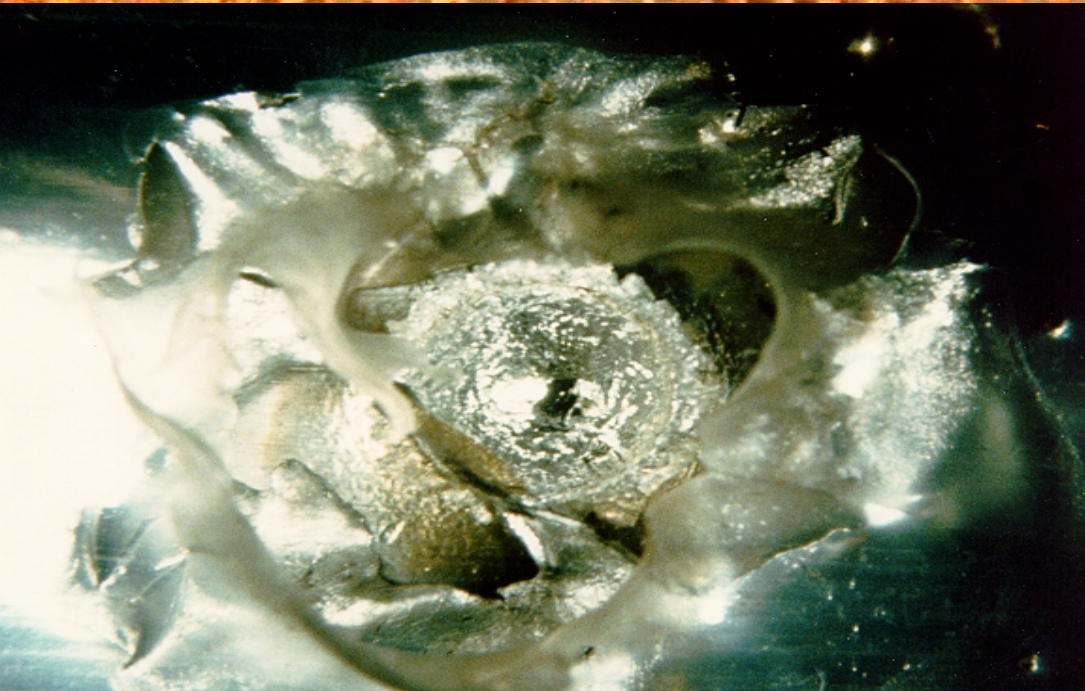
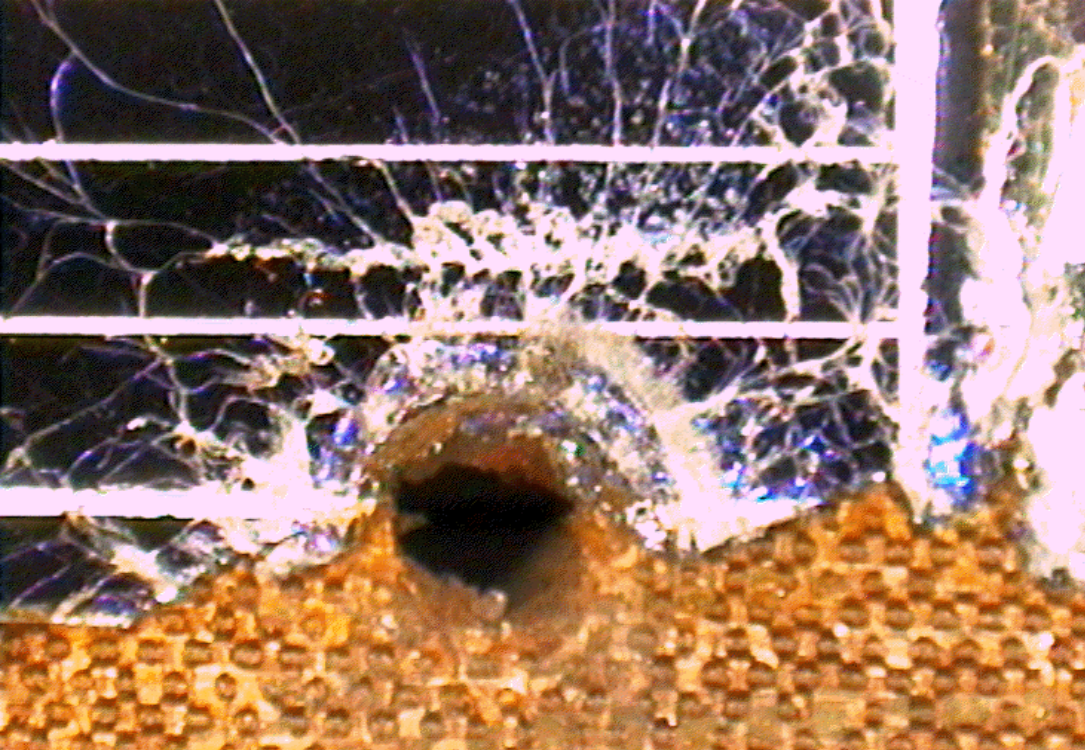


Monthly Number of Objects in Earth Orbit by Object Type



	size	number	% total mass
	> 10 cm	> 20.000	99,93
	1 – 10 cm	> 600.000	0,035
	< 1 cm	> 35.000.000	0,035
	total	> 35.000.000	> 6.000 toneladas







European Space Agency



esa

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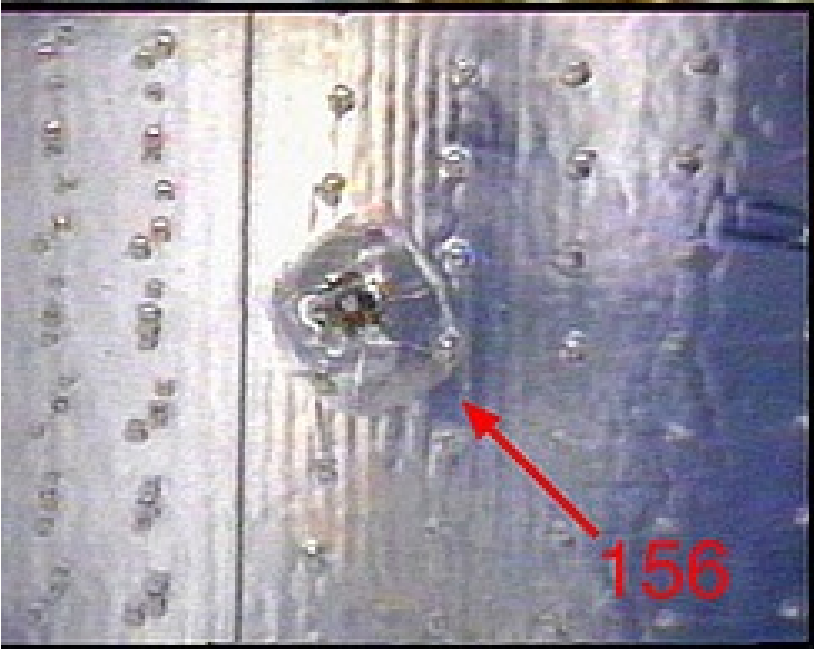


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150

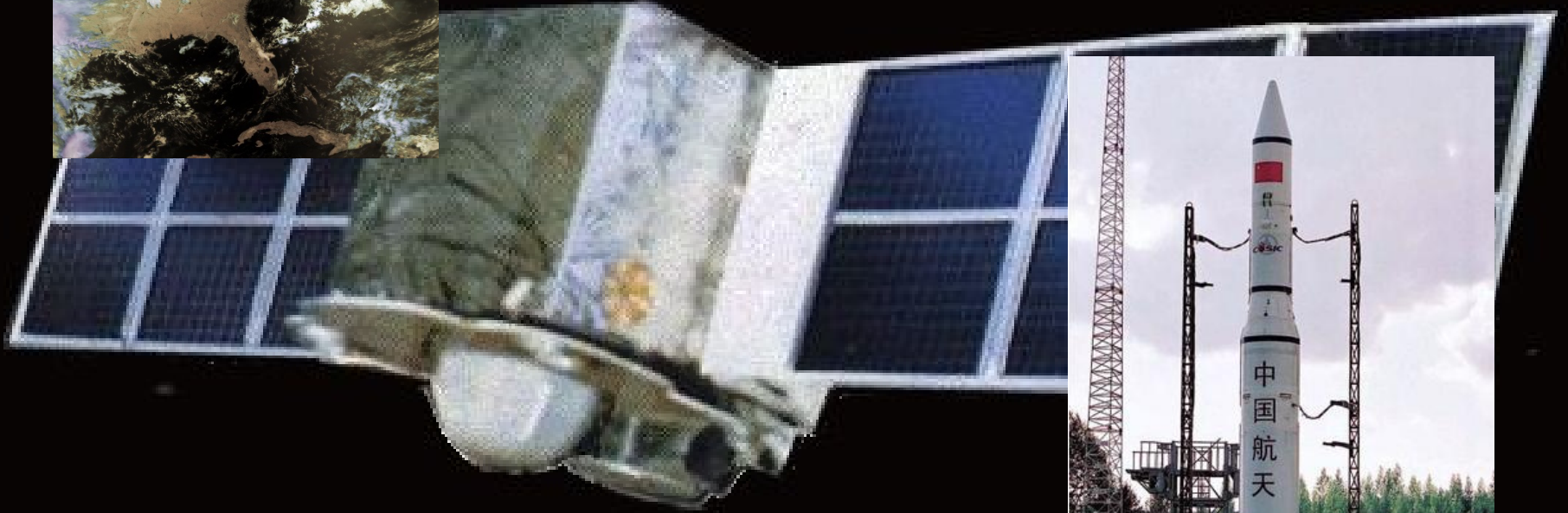
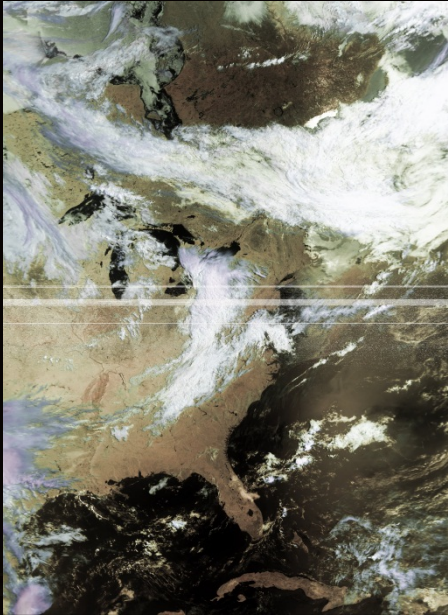
-V3

180





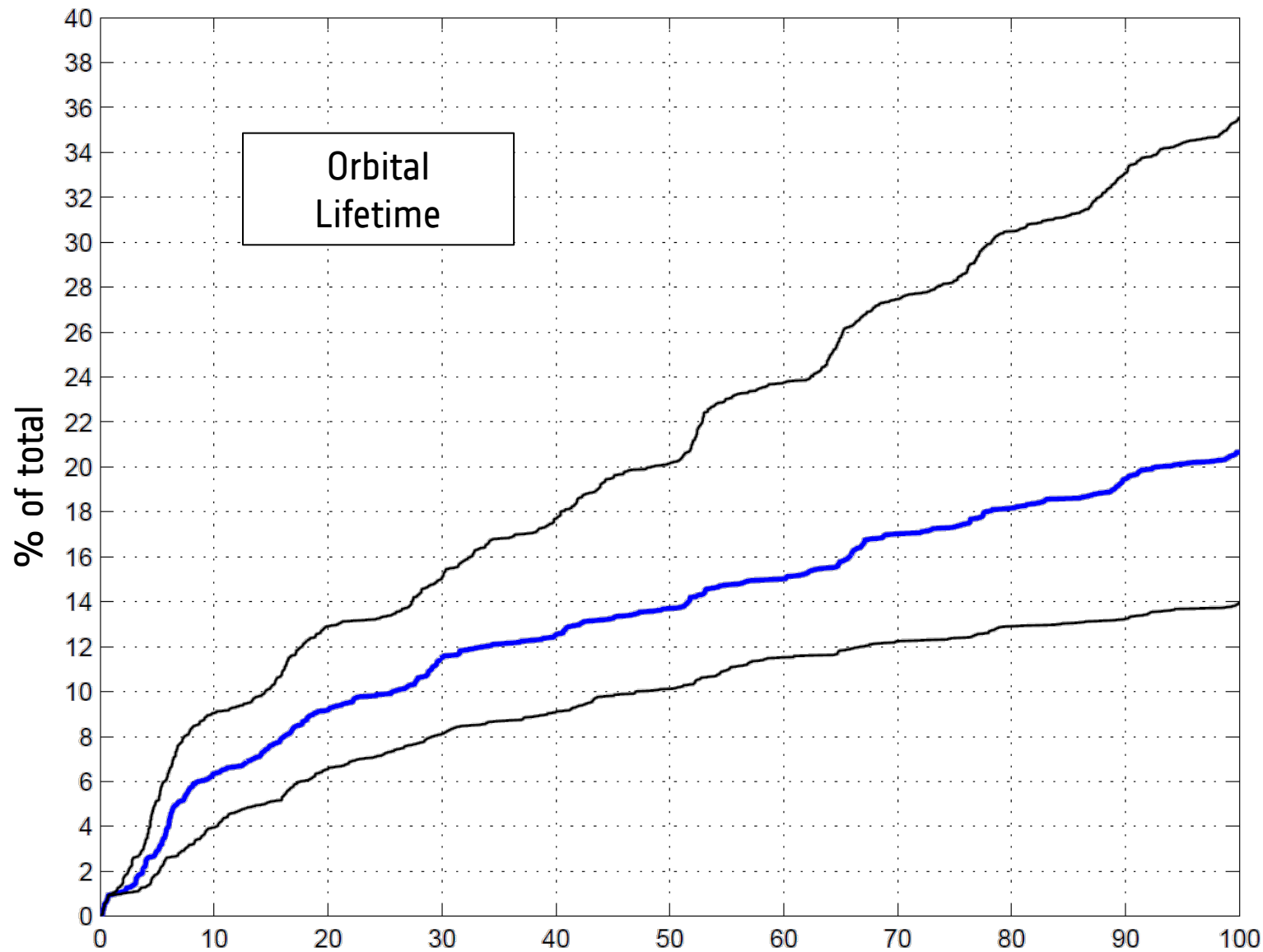
European Space Agency



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Xichang



Years since 11 January 2011

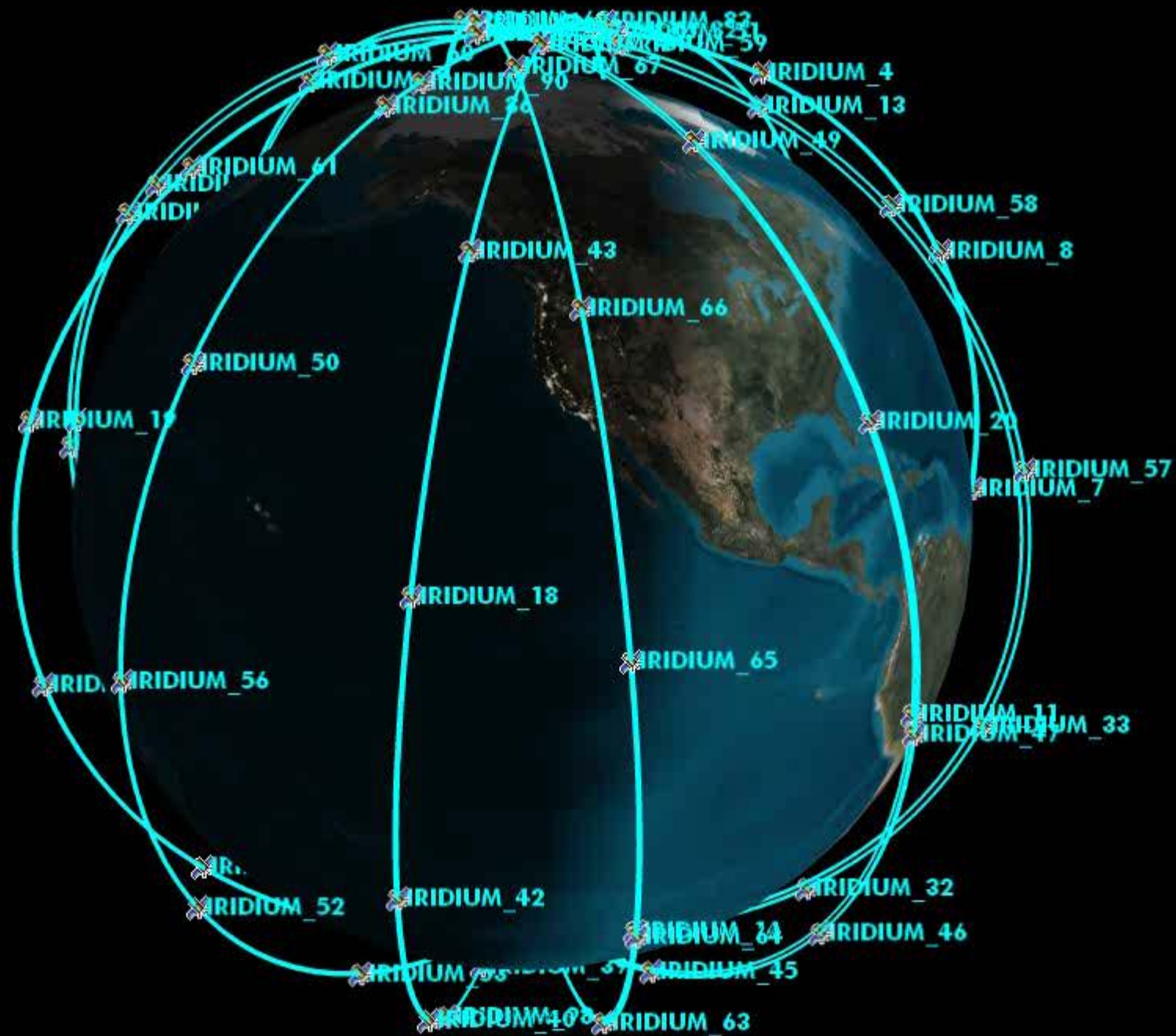
Source: CelesTrak/CSSI



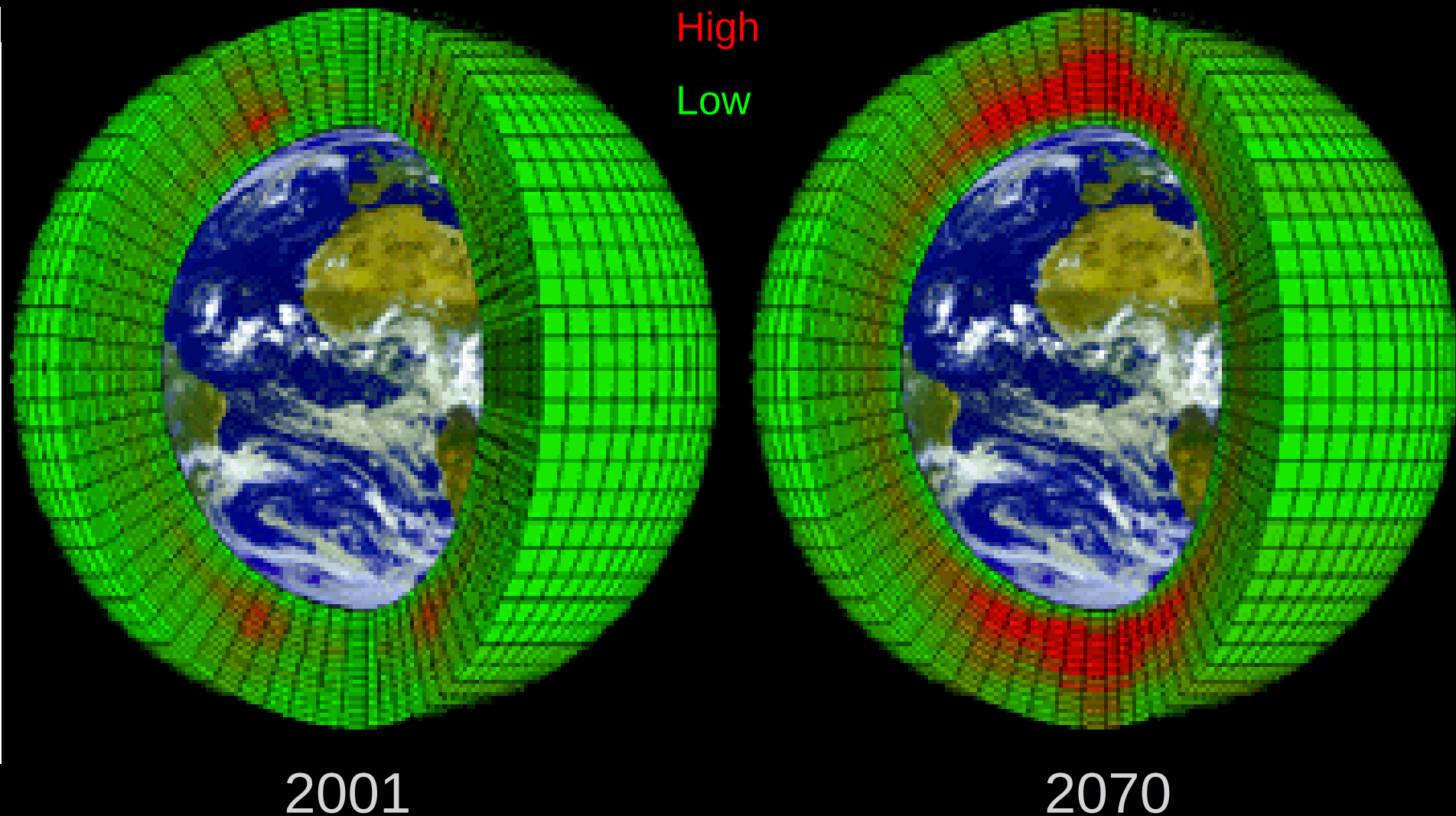


Image: Stefano Tartarotti

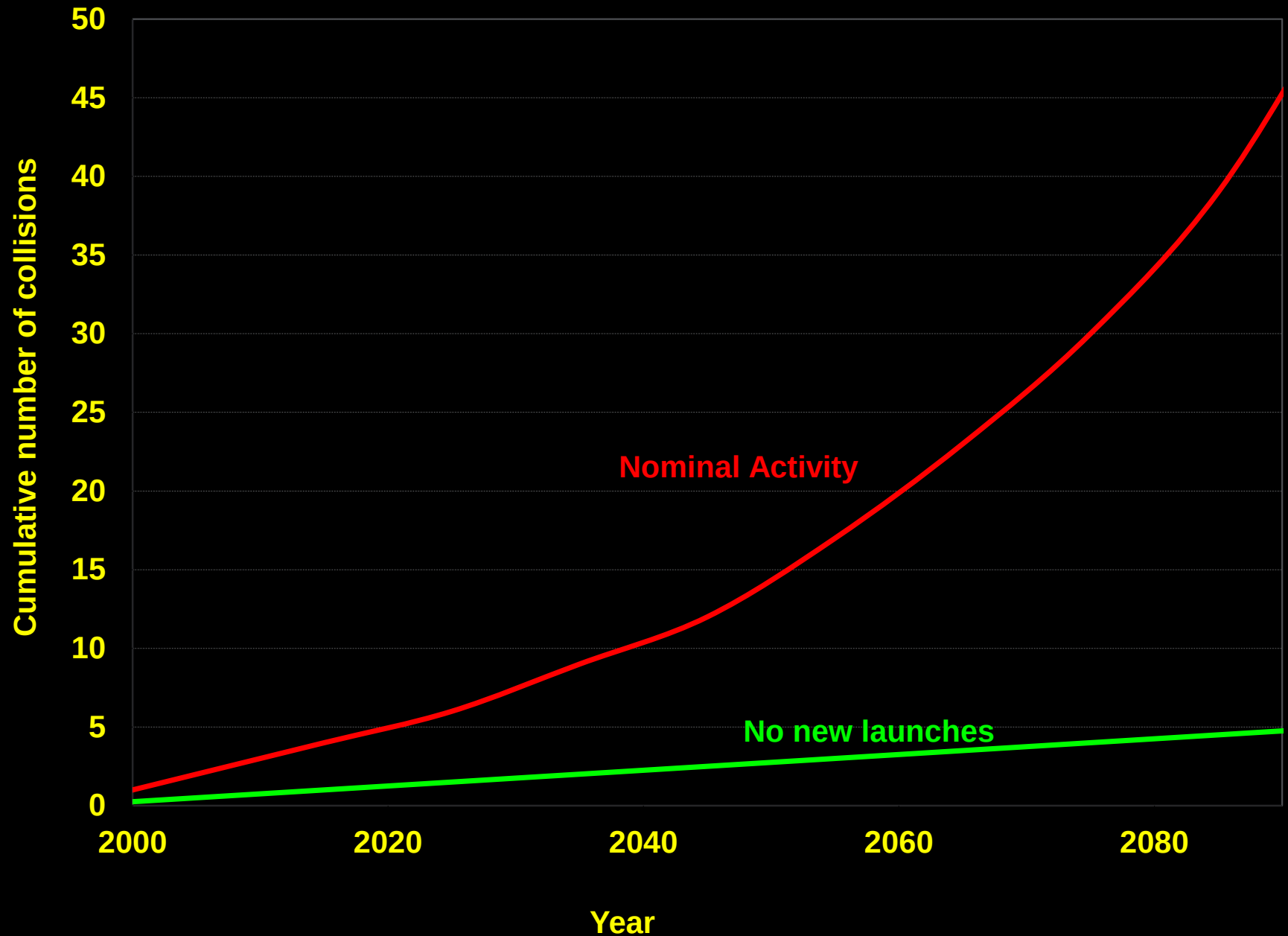
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12/03/09 00:54:01 0404.6



Future Collision Prediction





SOLUTIONS

LEO
(< 2.000 km)

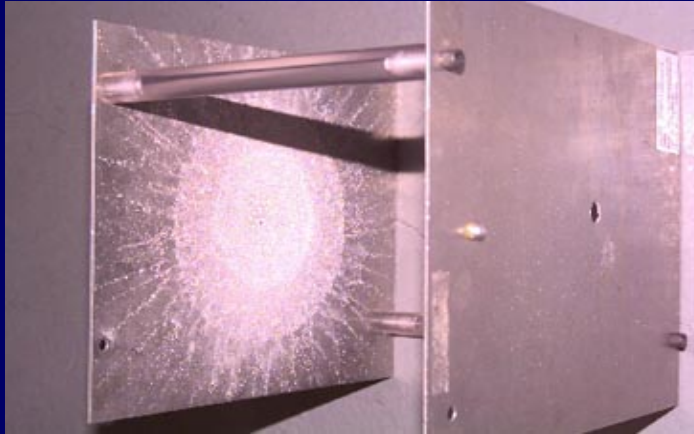
GEO

V 503

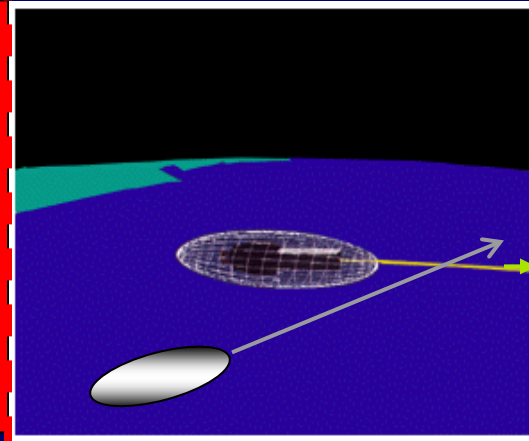
00:43:14.10

Current Solution

Shields



Avoidance



1 μ m

10 μ m

100 μ m

1mm

1cm

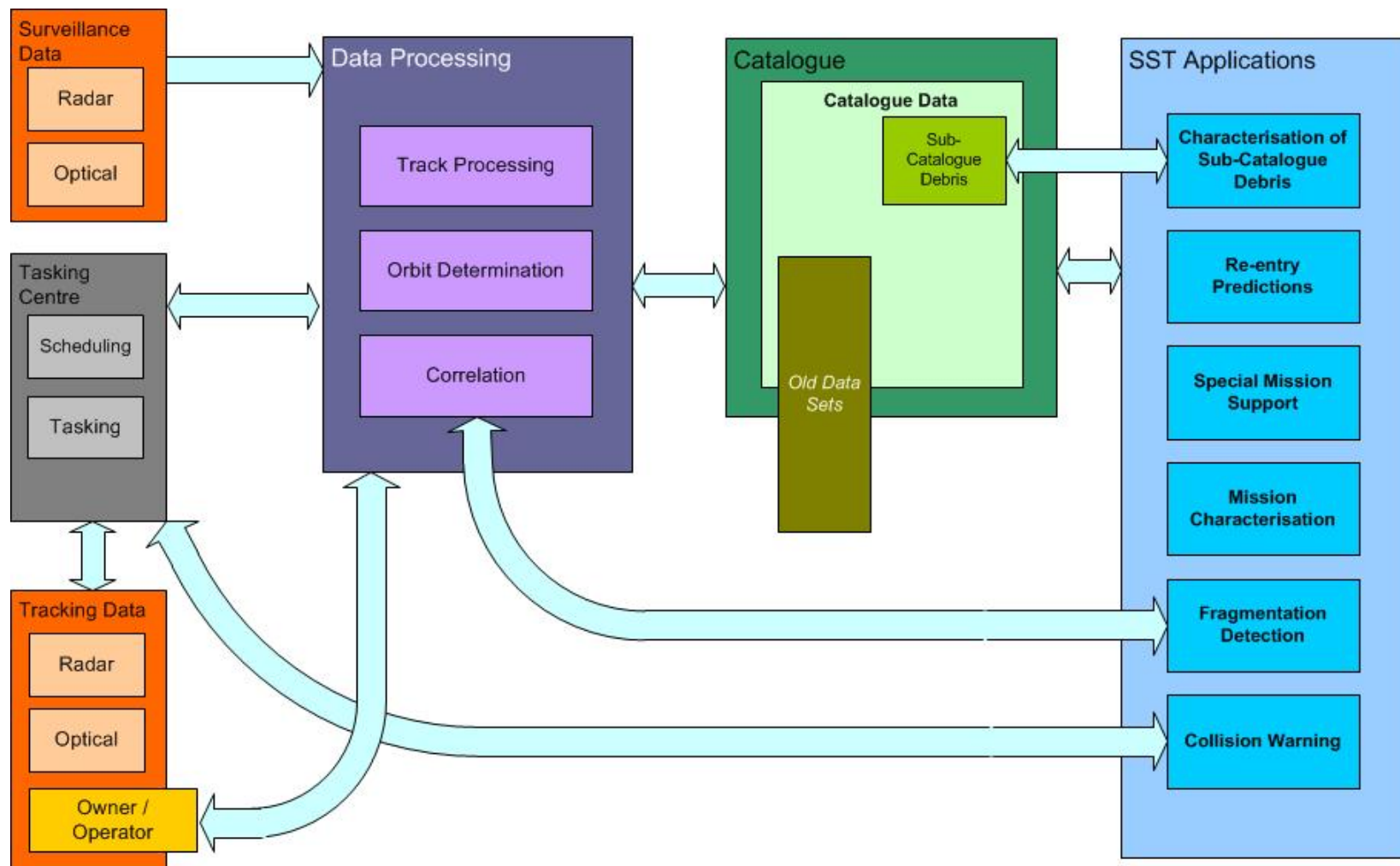
10cm

1m

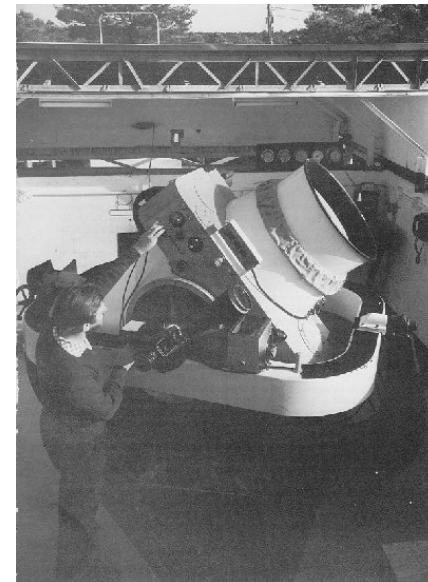
10m

SST

COMPONENTS OF AN SST SYSTEM



- First US system started in 1957
 - Sputnik 1 launched Oct '57
 - Baker-Nunn cameras tracked Sputnik 1 (deployed 1956)
 - Sputnik 2 first concerted tracking campaign (Nov '57)
 - 150 cooperating sensors by 1960



- Russian system started in parallel to US efforts
 - Baseline missile defence
 - Combined optical/radar system
 - First radar system: Dnestr (Hen House) deployed in 1960
 - Okno optical systems deployed in 1971
 - Krona radar system developed in late '70s



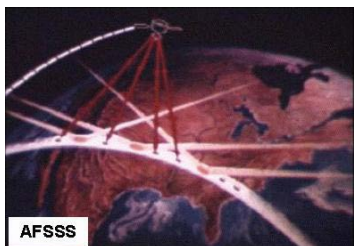
CURRENT CAPABILITIES USA



Eglin Radar



Moron (MOSS)



AFSSS



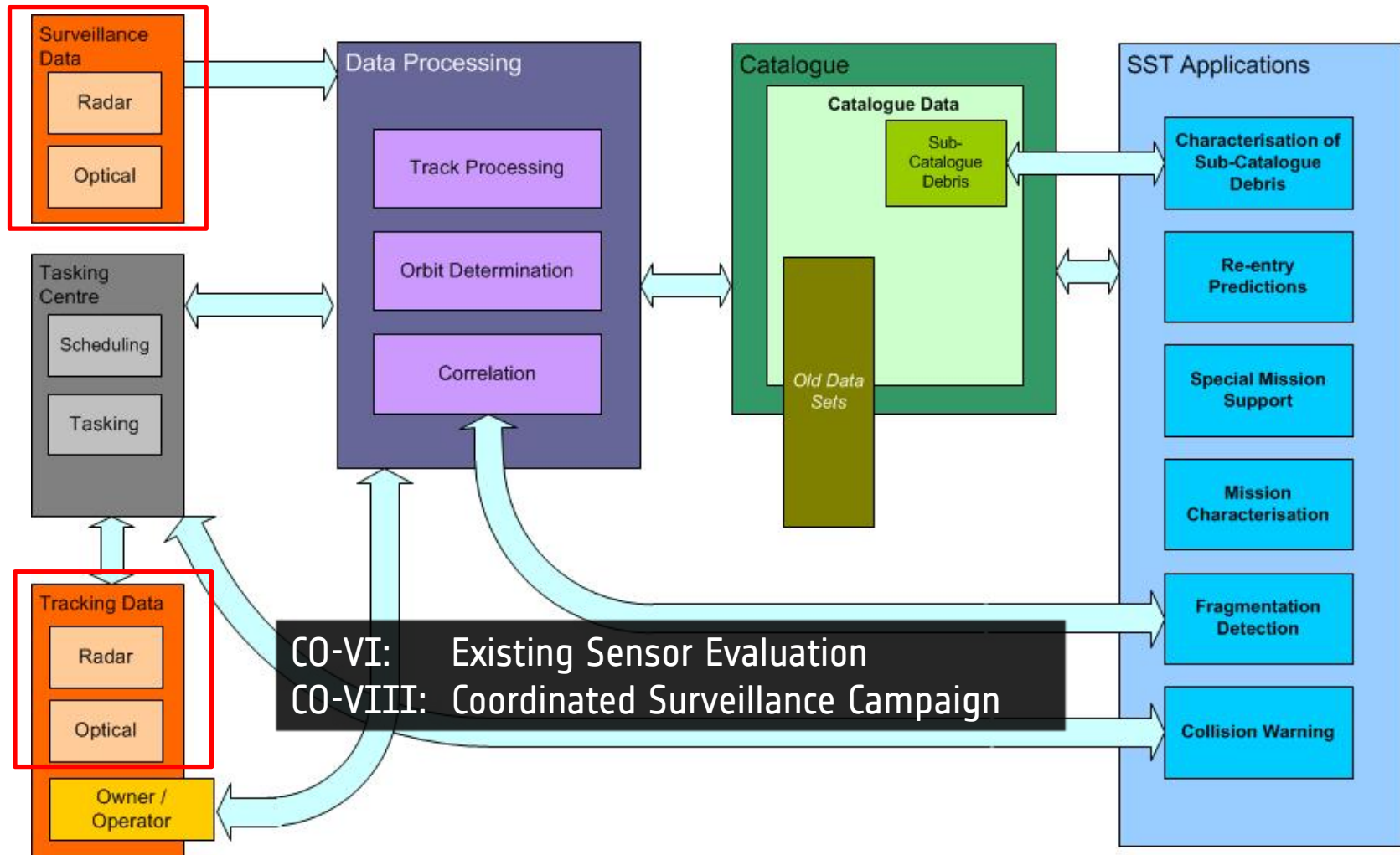
GEODSS



Globus II

PREPARATORY PROGRAMME WORK

Sensor Evaluation



Evaluated Sensors



Optical (Surveillance)

- La Sagra (E)
- Tarot (F)
- TFRM (E)
- Starbrook (UK)
- Zimmerwald (CH)

Optical (Tracking)

- OGS (ESA)
- La Sagra (E)
- Starbrook (UK)
- Zimmerwald (CH)

Radar (Surveillance)

- EISCAT (FI, N, SE)
- Medicina (I)

Radar (Tracking)

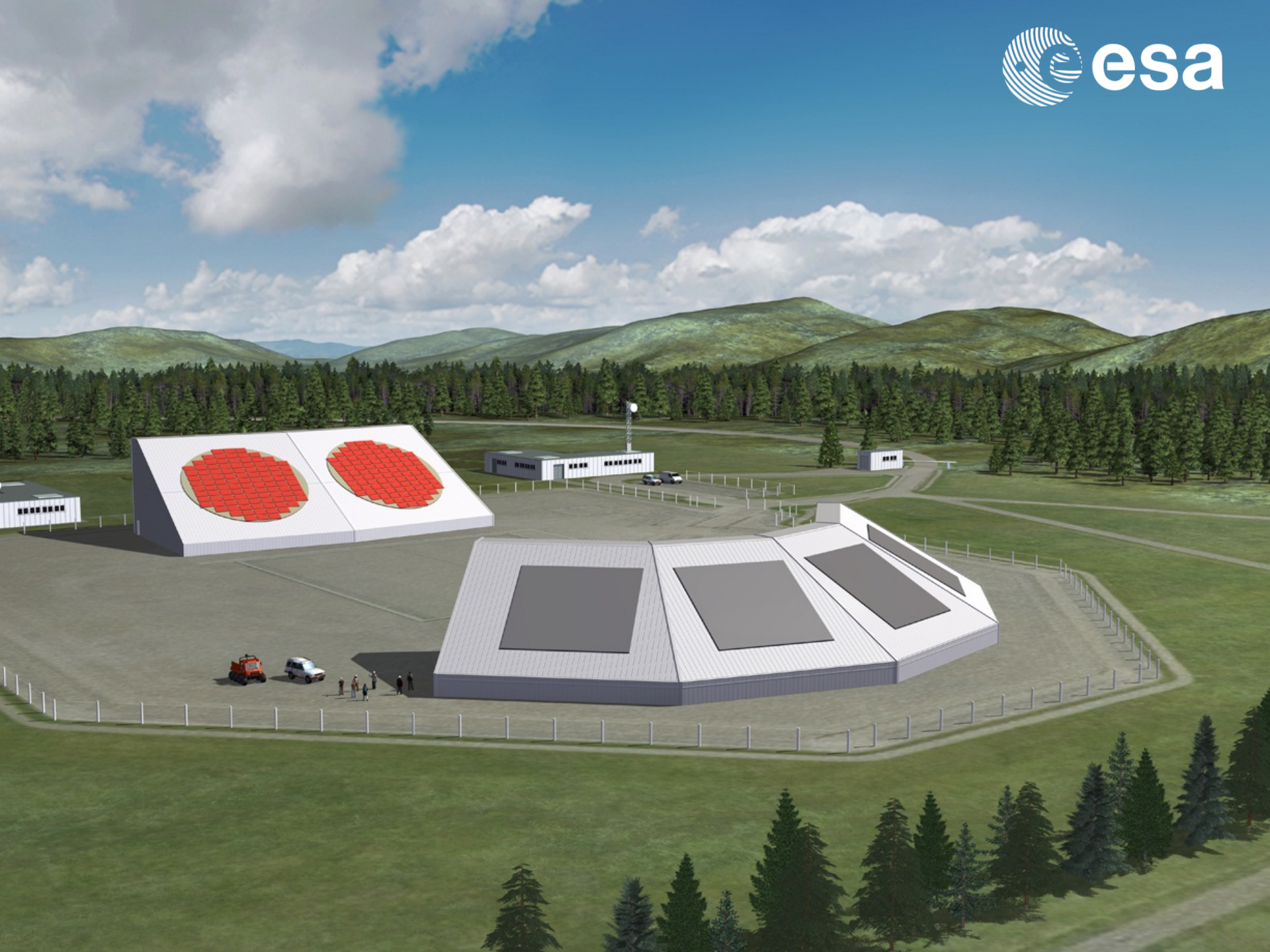
- Chilbolton (UK)
- EISCAT (FI, N, SE)
- Medicina (I)
- Monge (F)

Other

- Graz (A)
- Laser Ranging

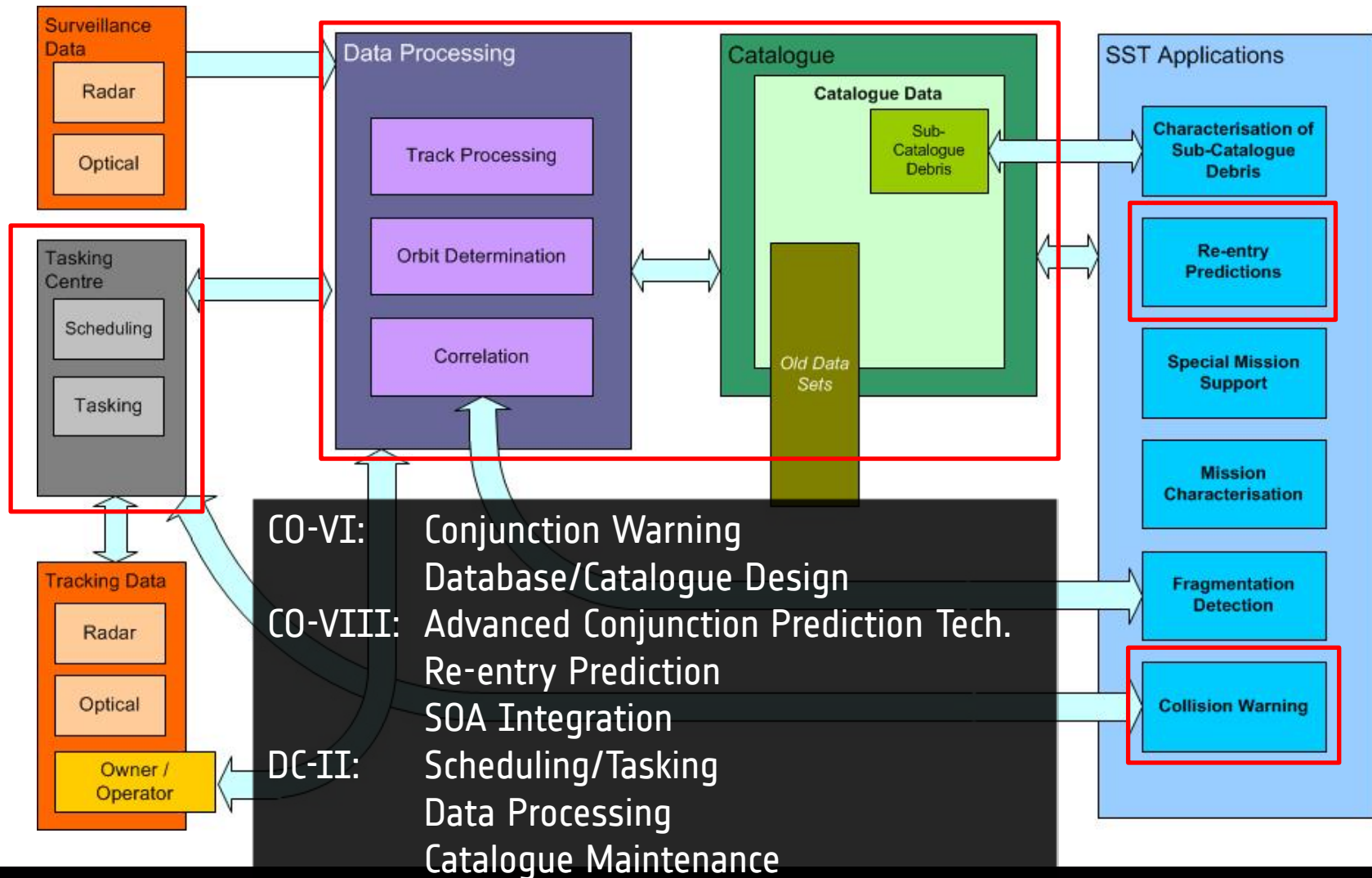






PREPARATORY PROGRAMME WORK

Systems and Applications



- Collision Warning
- Sensors Network
 - Optical Sensors
 - Radar Sensors
 - Webcams
- Analysis Centres
- Administration**
 - Objects
 - Objects
 - Services
 - Conjunction prediction analysis
 - Re-entry prediction analysis scenarios
 - Maintenance and monitoring
 - Maintenance and monitoring
- Service management**
 - Conjunction prediction service
 - Alerts
 - Execute Run
 - Business process monitoring
 - Contact

Target and chaser trajectories on Earth map. Please roll the mouse wheel forward/backwards to zoom in/out, double click in the divider to reset zoom

Conjunction at 2013/01/25 03:38:26 of 9801700002, 1998-017B, - and 9205300001, 1992-053A, -

11 before Conjunction

space situational awareness

Space Debris
Spacecraft Operations

can check the results that have raised alerts according to the pre e the report, and click on an alert icon to see the alert messages

Target	Chaser	Result Date
9801700002	9205300001	2013-01-21 15:40:53
9801700002	9205300001	2013-01-21 15:40:53

Item 1..2 of 2

Report
2D Map
2D Graphs
3D Graphs
CC

space situational awareness

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ESA SSA SST SWE NEO Space Debris Spacecraft Operations
21-Jan-2013

- SST Precursor Services
 - Collision Warning
 - Sensors Network
 - Optical Sensors
 - Radar Sensors
 - Webcams
 - Analysis Centres
- Administration**
 - Objects
 - Objects
 - Services
 - Conjunction prediction analysis
 - Re-entry prediction analysis scenarios
 - Maintenance and monitoring
 - Maintenance and monitoring
- Service management**
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 - Business process monitoring

3D Orbit Track and Foot Print

Object ID: 2
 Re-entry Date: 2012-08-14T02:13:7.14Z
 Calculation Date: 2013-01-18T15:31:43.00Z

Download Plot as PNG
Download Plot as JPG

Re-entry Prediction Service / Conjunction Prediction Service

- Re-entry Prediction Analysis
- System Monitoring and Maintenance
- Business Process Monitoring
- Objects
- State vectors
- Analysis results
- Re-entry results
- Request temporary
- Upload GPR
- Re-entry Analysis

Business Process Monitoring

Requests list:

Request id	Request time	Start time	Result time	Priority	User name	Select ALL e...	Errors
1191	2013/01/21-15:42:14.945	2013/01/21-15:42:59.000	2013/01/21-15:42:59.000	5			

Output:

- [Analysis results] Results
- [State vectors] State vectors
- [Object] Objects
- [Re-entry results] Altitude evolution versus time

Altitude (km) vs Time (Seconds)

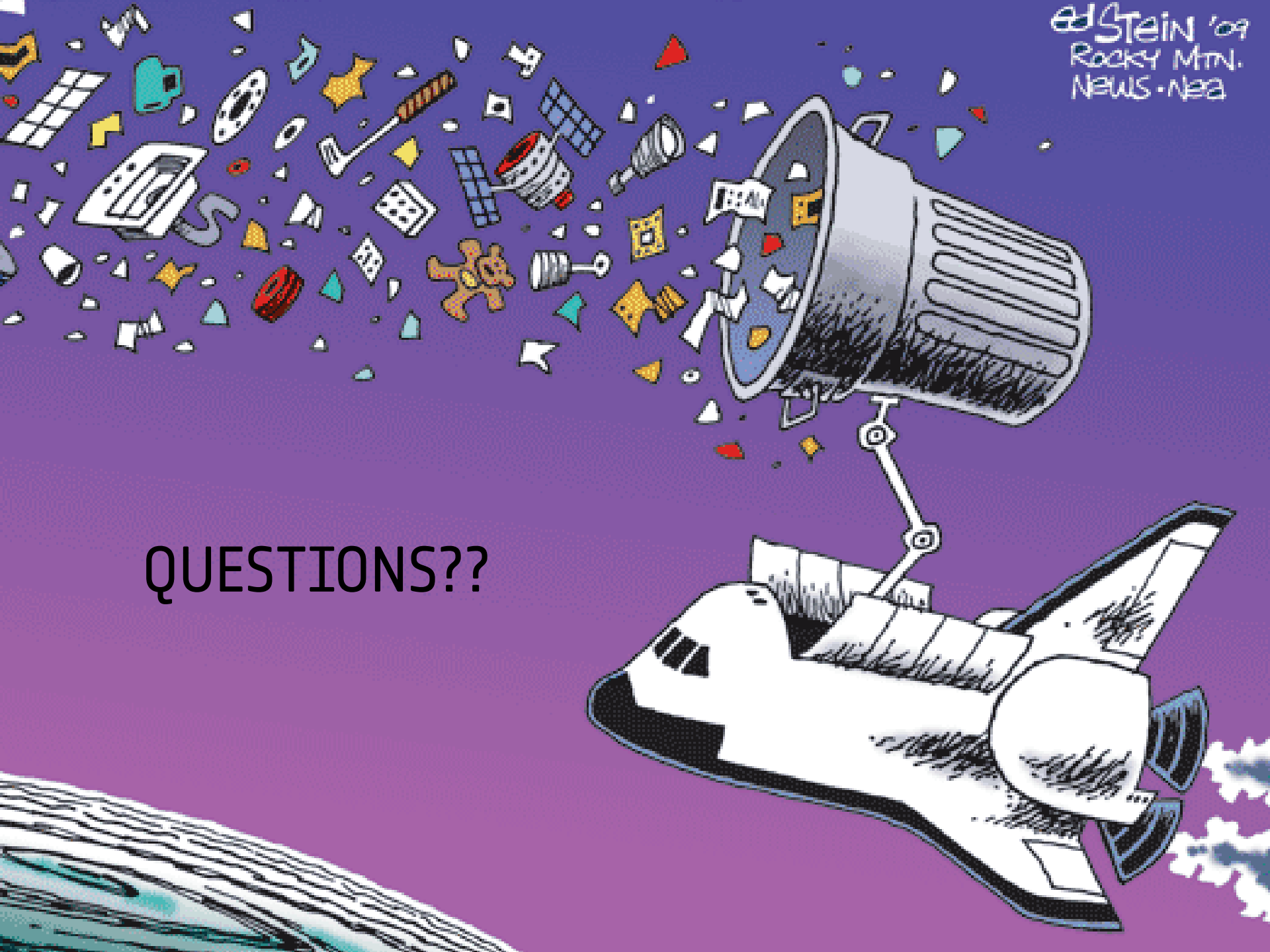
FUTURE PERSPECTIVES

Goals



- Evaluation of sensors from new participating Member States
- Investigate technology/experiences/developments from new participating Member States
- Research high-performance technologies
- Consolidate reference models
 - » *benchmark developments, testing tools, performance compliance*
- Refine data processing chain algorithms / technologies
 - » *observations, data fusion, orbit determination, correlation, propagation, cataloguing*
- Improve current application design (deployment approach, reliability)
 - » *Evolve system to future CO-II architecture*
- Add additional applications (fragmentation, mission support)
 - » *In accordance to the MRD / CRD*
- Investigate novel debris detection systems (such as laser ranging)
- Ensure compliant/efficient security systems for dual-use

QUESTIONS??





Thank you

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programme: www.esa.int/ss
 sst.ssa.esa.int

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