

OVERVIEW ON 2012 SPACE DEBRIS ACTIVITIES IN FRANCE

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21 September 2013

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- *Atmospheric reentries predictions*
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END OF LIFE OPERATIONS

LOW EARTH ORBIT:

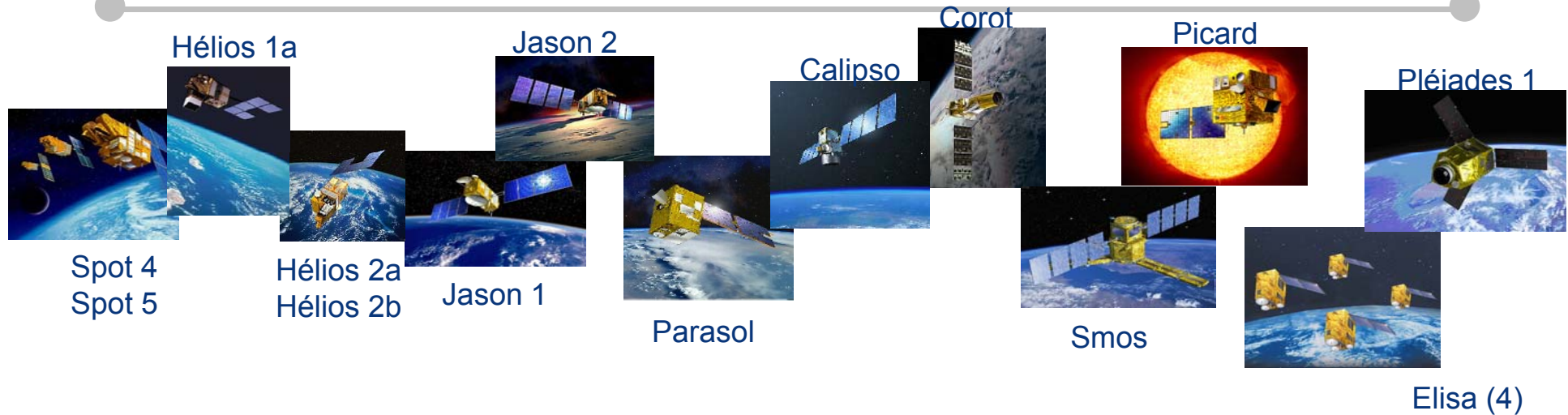
- **Helios 1A (18 February 2012)**
 - ◆ Remaining orbital lifetime about 18 years

GEOSTATIONARY ORBIT:

- **EUTELSAT 4A (23 February 2012)**
 - ◆ Graveyard orbit 500 km above GEO
- **Telecom 2D (18 November 2012)**
 - ◆ Graveyard orbit 450 km above GEO

→ compliance with French law and international recommendations

COLLISION RISK MONITORING



- **Operational service called CAESAR (Conjunction Analysis and Evaluation, Assessment and Recommendations)**

- ◆ Analysis of all CSMs available corresponding to a conjunction
- ◆ Risk evaluation and avoidance recommendations
- ◆ Use of tracking radars or telescopes when necessary

- **Open to:**

- ◆ Satellites controlled by CNES
- ◆ External customers (AstroTerra-Spot 6 for the time being)
- ◆ Additional customers expected in 2013

ATMOSPHERIC REENTRIES MONITORING

■ Objects monitored:

« French » objects that could fall on foreign countries (Launching State responsibility)

- satellites and launcher stages registered by France
- launcher stages registered by ESA

« foreign » objects that could fall on the national territory:

Potentially dangerous objects registered by other countries:

- Mass > 5T
- dangerous materials

■ Particular cases:

IADC or governmental requests

■ «debris » objects not considered



SPACE DEBRIS R/D ACTIVITIES

● ON-ORBIT SITUATION:

- ◆ Debris observation from space and ground
- ◆ Catalog management

● PROTECTION:

- ◆ Effect of debris impacts on satellites, protection
- ◆ Aero-thermodynamics models for reentry

● MITIGATION:

- ◆ Electric and fluidic passivation
- ◆ Reentry survivability

● REMEDIATION:

- ◆ Long term evolution of the space debris population
- ◆ Optimal orbital transfer for active debris removal missions

REGULATORY ACTIVITIES

- **French Space Act applicable since December 2010**
- **Technical compliance is checked by CNES before launch or critical operations**
- **Methods and tools are developed and proposed to support the implementation of the Technical Regulations:**
 - ◆ Fragmentation modeling during reentry: DEBRISK
 - ◆ Estimation of ground risk in case of reentry: ELECTRA
 - ◆ Determination of compliance with the 25-year rule: STELA
 - ◆ Long term stability of the GEO graveyard orbit
 - ◆ Collision risk during launch phase: ARCL

NATIONAL REGISTER OF SPACE OBJECTS

305 space objects, end 2012, in the French Register

- **191** launcher elements (LEO, MEO, GTO)

- **114** satellites:

operational satellites: **63**

LEO : 35

GEO: 28

inactive satellites: **51**

LEO : 24

GEO: 23

GTO: 4

MEETINGS AND WORKSHOPS

- **annual national meeting on space debris: Space Debris Synthesis Group**
 - ◆ 27 June 2013, CNES Toulouse
 - ◆ 80 participants: Administrations, Defence, Industry, Operators, Research, Insurance companies,...
 - ◆ Objective: to inform all partners about national space debris activities and international discussions (IADC, COPUOS, ISO)

- **5th satellites end of life workshop:**
 - ◆ 28 January 2014, CNES HQ, Paris
 - ◆ Participants: industry, operators, space agencies
 - ◆ Objectives:
 - » To inform operators and industry on regulatory issues and evolution
 - » To get feed-back from operators/industry in implementing the guidelines

MEETINGS AND WORKSHOPS

- **3rd European workshop on Space Debris Remediation:**
 - ◆ **16-18 June 2014, CNES HQ, Paris**
 - ◆ **Participants: industry, academics, laboratories, space agencies**
 - ◆ **Programme Committee: CNES, DLR, ESA-HQ, ESOC**
 - ◆ **To be contacted soon: NASA, JAXA, Roscosmos**
 - ◆ **Objectives:**
 - » **Follow-up of workshops held in 2010 and 2012**
 - » **More general than previous ADR thematics**