



2020 SPACE DEBRIS ACTIVITIES IN FRANCE : HIGHLIGHTS

58th STSC Session - COPUOS –2021

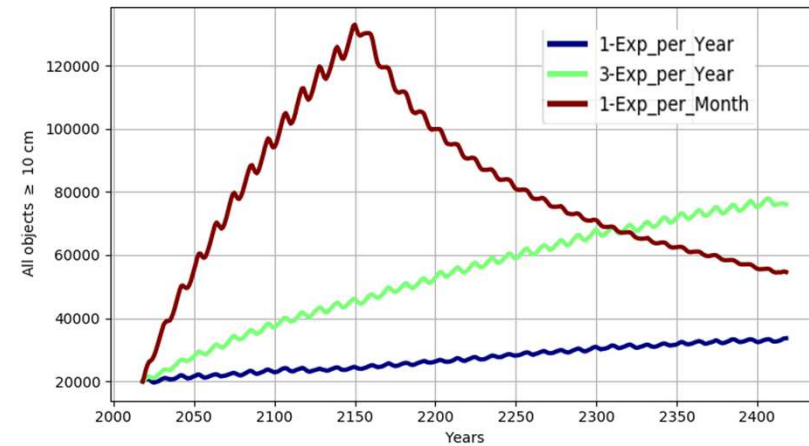
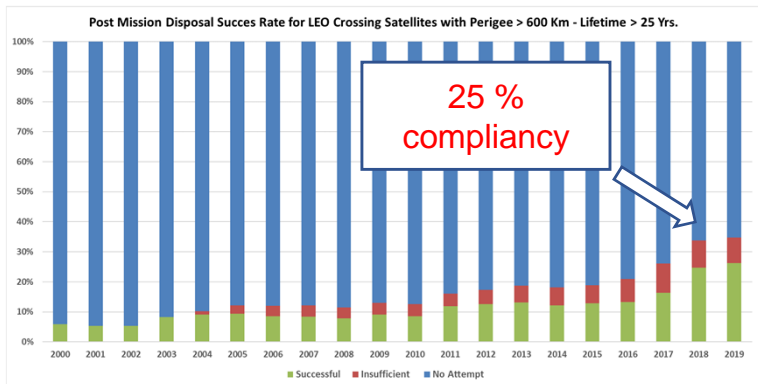
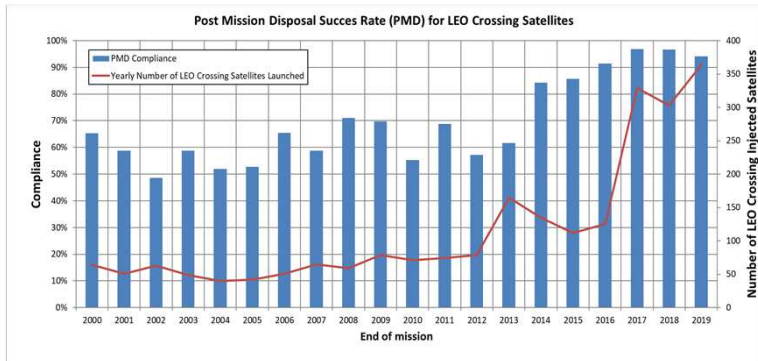
L. Francillout

Head of Space Safety Office

- Orbital Systems Directorate -



Debris proliferation diverges

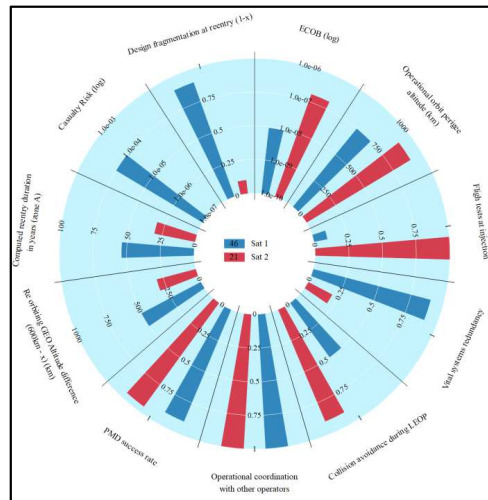


CNES studies on environment situation show :

- Current IADC mitigation guidelines have a low rate of compliance (25%) worldwide typically for 25 years rule even if it tends to improve.
- If Space was no longer exploited, Kessler syndrome would finally start because of explosion of non depleted derelict
- If IADC recommendations were followed from now considering expected new space traffic and topology and an initial empty Space it would not be enough to avoid debris apparition and proliferation

France contributes to stop debris proliferation

Quantify criticality and outreach !



To develop environment index to measure :

- Space remaining capability
- Mission footprint

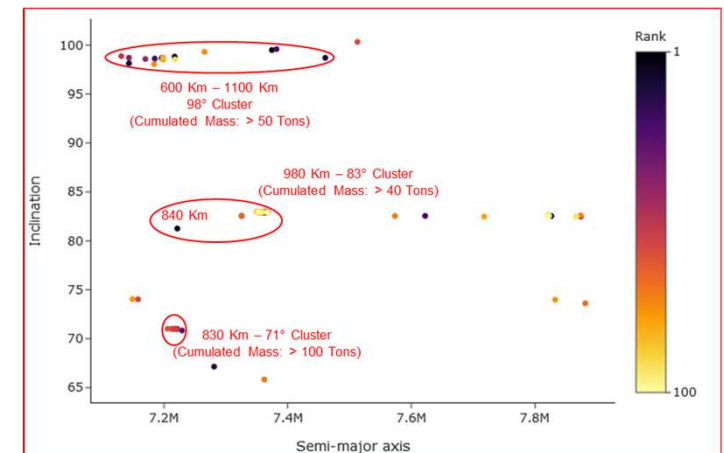
Stop traffic contribution !



Traffic must be managed through licencing and Coordination implementing :

- Traffic rules
- 0-debris Design & Operations

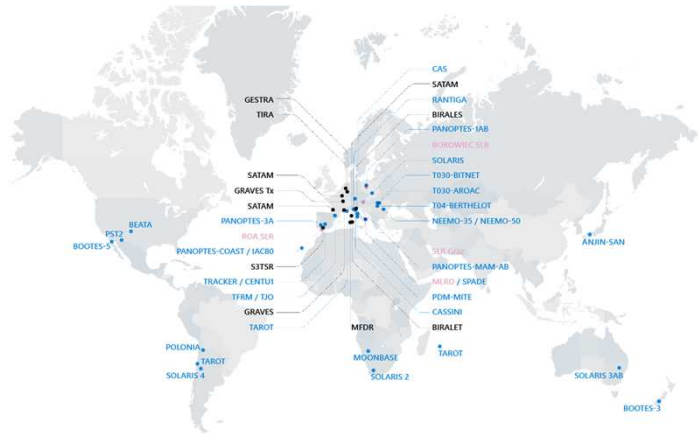
Remove massiv derelict !



CNES contribution to D. McKnight et al. Identifying the 50 Statistically Most Concerning Objects in LEO. Acta Astronautica, volume 181, April 2021, Pages 282-291
<https://doi.org/10.1016/j.actaastro.2021.01.021>

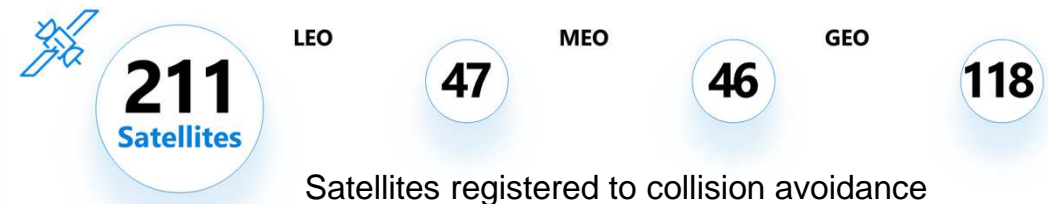
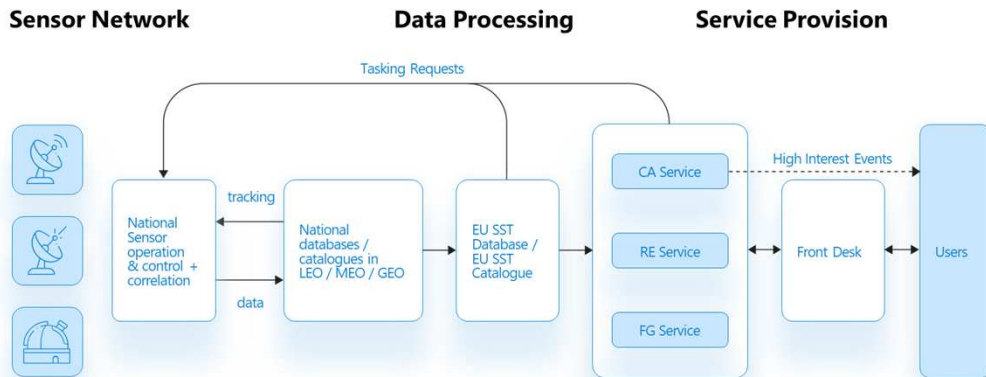
SURVEILLANCE : France involved in EUSST

❖ CNES provides operational collision assessment service through EUSST



| | LEO | MEO | GEO |
|--|-----|-----|-----|
| Satellites monitored | 47 | 46 | 118 |
| 2020 Close approach alert (communication to users) | 47 | 0 | 16 |
| 2020 Successful additional tracking request | 10 | 0 | 9 |
| 2020 Effective collision avoidance maneuvers | 11 | 0 | 5* |

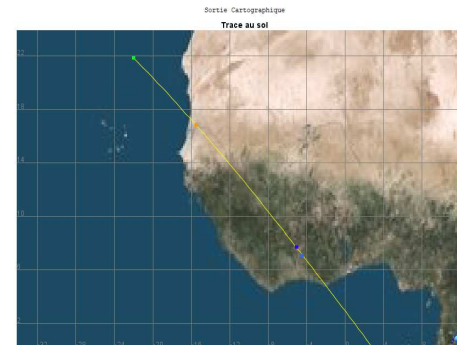
* for GEO s/c, all collisions avoidance maneuvers were managed through a modification of the station-keeping maneuver plan



SURVEILLANCE : France monitor French object re-entries and foreign object which Could fall down on french territory

| Re-entry date | Norad | International | Name | Launch | Incl. | Radius (m) / Mass (t) |
|---------------|--------|---------------|-----------------|------------|-------|-----------------------|
| 21/01/2020 | N41912 | 2017-001B | CZ-3B R/B | 05/01/2017 | 26.97 | 9,2m / 2,1T |
| 05/03/2020 | N45242 | 2020-012BS | FALCON 9 R/B | 17/02/2020 | 52.99 | 12,5m / 4,3T |
| 21/03/2020 | N41902 | 2016-081E | CZ-2D R/B | 21/12/2016 | 97.84 | 5,9m / 4T |
| 20/04/2020 | N42800 | 2017-037C | SL-4 R/B | 23/06/2017 | 98.02 | 4,1m / 2,7T |
| 11/05/2020 | N45601 | 2020-027C | CZ-5B R/B | 05/05/2020 | 41.01 | 15,5m / ~17 T |
| 04/07/2020 | N44210 | 2019-024D | CZ-4C R/B | 29/04/2020 | 97.46 | 2,25m / 1T |
| 18/07/2020 | N44799 | 2019-079C | SL-4 R/B | 25/11/2019 | 97.88 | 4,1m / 2,7T |
| 31/08/2020 | N39482 | 2013-075B | CZ-3B R/B | 20/12/2013 | 23.95 | 9,9m / 2,8T |
| 22/09/2020 | N44545 | 2019-061D | CZ-3B R/B | 22/09/2019 | 54.80 | 9,9m / 2,8T |
| 02/10/2020 | N21941 | 1992-021C | ARIANE 44L+ R/B | 15/04/1992 | 3.97 | 8,2m / 1,7T |
| 16/10/2020 | N43230 | 2018-023C | FALCON 9 R/B | 06/03/2018 | 26.74 | 12,5m / 4,3T |
| 25/10/2020 | N33415 | 2008-055B | CZ-3B R/B | 29/10/2008 | 23.68 | 9,9m / 2,8T |
| 28/10/2020 | N41195 | 2015-083B | CZ-3B R/B | 28/12/2015 | 22.59 | 9,9m / 2,8T |
| 30/10/2020 | 46669 | 2020-070BS | FALCON 9 R/B | 06/10/2020 | 52.98 | 12,5m / 4,3T |
| 16/11/2020 | 46803 | 2020-074BS | FALCON 9 R/B | 24/10/2020 | 53.04 | 12,5m / 4,3T |
| 12/12/2020 | 38015 | 2011-077B | CZ-3B R/B | 19/12/2011 | 23.46 | 9,9m / 2,8T |
| 26/12/2020 | 43588 | 2018-064B | FALCON 9 R/B | 07/08/2020 | 26.81 | 12,5m / 4,3T |
| 02/01/2021 | 46611 | 2020-071B | CZ-3B R/B | 11/10/2020 | 28.21 | 9,9m / 2,8T |

18 foreign objects in 2020



9 French objects in 2020

| Re-entry date | Norad | International | Name | Launch | Incl. | Radius (m) / Mass (t) |
|---------------|--------|---------------|----------------------|------------|-------|-----------------------|
| 14/01/2020 | N35945 | 2009-054D | ARIANE 5 DEB (SYLDA) | 30/09/2009 | 3.21 | 4,7m / 0,44 T |
| 22/01/2020 | N44602 | 2016-004C | ARIANE 5 DEB | 27/01/2016 | 1.37 | NC / NC |
| 14/02/2020 | N36584 | 2010-021D | ARIANE 5 DEB (SYLDA) | 14/02/2020 | 2.82 | 4,7m / 0,44 T |
| 20/02/2020 | N40943 | 2015-054D | ARIANE 5 DEB (SYLDA) | 30/09/2015 | 6.33 | 4,7m / 0,44 T |
| 03/05/2020 | N28905 | 2005-046D | ARIANE 5 DEB (SYLDA) | 03/05/2005 | 6.95 | 4,7m / 0,44 T |
| 02/06/2020 | N17199 | 1986-019BB | ARIANE 1 DEB | 22/02/1986 | 98.63 | NC / NC |
| 29/09/2020 | N41906 | 2016-082D | ARIANE 5 DEB (SYLDA) | 21/12/2016 | 6.13 | 4,7m / 0,44 T |
| 02/10/2020 | N21941 | 1992-021C | ARIANE 44L+ R/B | 15/04/1992 | 3.97 | 8,2m / 1,7T |
| 06/11/2020 | N23232 | 1991-015H | ARIANE 44LP DEB | 02/03/1991 | 6.96 | NC / NC |

MITIGATION : France is active in standards and guideline setting fora

- France actively supports international groups in charge of establishing best practices, guidelines and standards :
 - ❖ ECSS : CNES has setup and conducts a STM mirror group and participate to debris mirror group
 - ❖ ISO : active participation to TC20/SC14 WG3 (system & operations) & WG7 (debris mitigation)
 - ❖ UN COPUOS : participation to LTS working groups
 - ❖ IADC : France chaired IADC in 2020 and engaged action for regular IADC public environment report dedicated to quantify criticality of debris proliferation



France has translated international guidelines and standards in its regulation : French Space law

MITIGATION : French Space Law has demonstrated its efficiency for 10 years

EUTELSAT
GLOBALSTAR
AIRBUS GEO
CSUM
CSUT
ADS
TAS
UNSEENLABS
CNES

8
Transferts

76
in flight satellites

113

Satellites granted
licence since 2011

30
Disposals

7
imminent
launches

2020 highlights :

- 11 new licences in 2020
- Successful disposal of EUTELSAT E12WB to graveyard orbit
- End of transient regime : full application of technical regulation : **100 % compliancy of French operators and manufacturers**



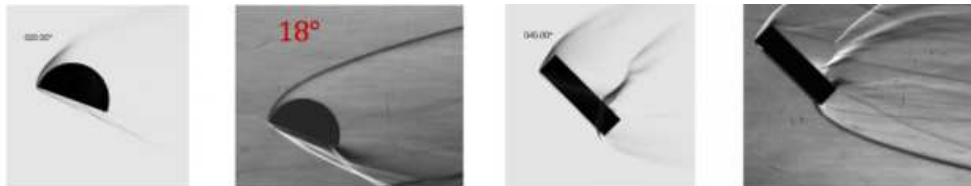
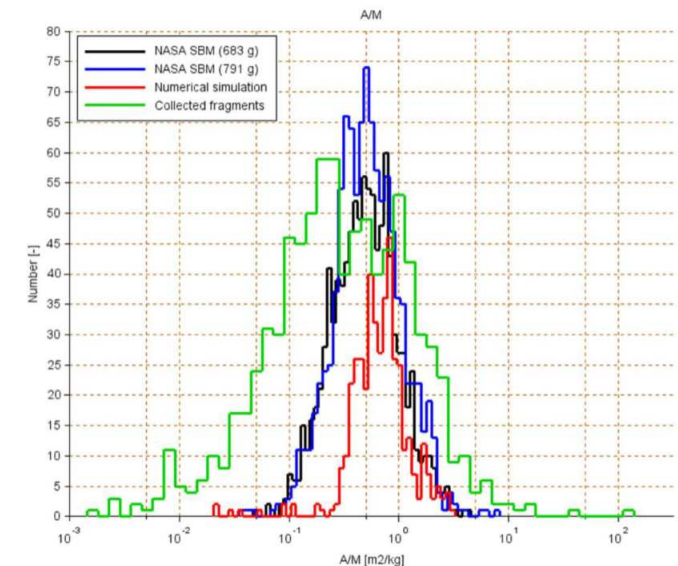
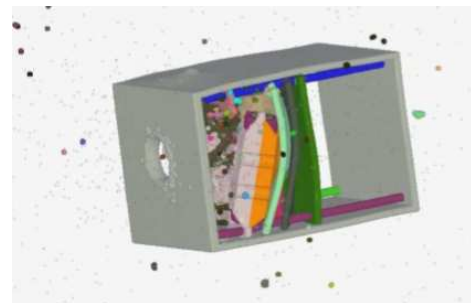
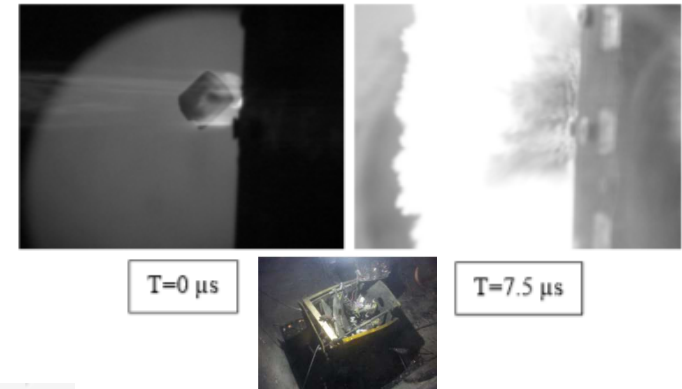
French Space Law new rulemaking in progress (objective 2022)

- In Orbit servicing
- Nanosatellites
- Large constellations
- Spaceports
- Micro-launchers

TECHNOLOGY : Tech4SpaceCare

Tech4SpaceCare Initiative aiming to develop technological elements for orbital systems to ensure the sustainable use of space and the safety of space operations

- **Battery Passivation study : good passivation practices**
- **Impact of new version of Master environment model on EOL reliability**
- **On ground HVI on a nanosatellite**
 - Impact Test
 - Fragments Recovery and Characterization
 - Impact numeric simulations
- **Improvement of re-entry safety tools (DEBRISK V3)**



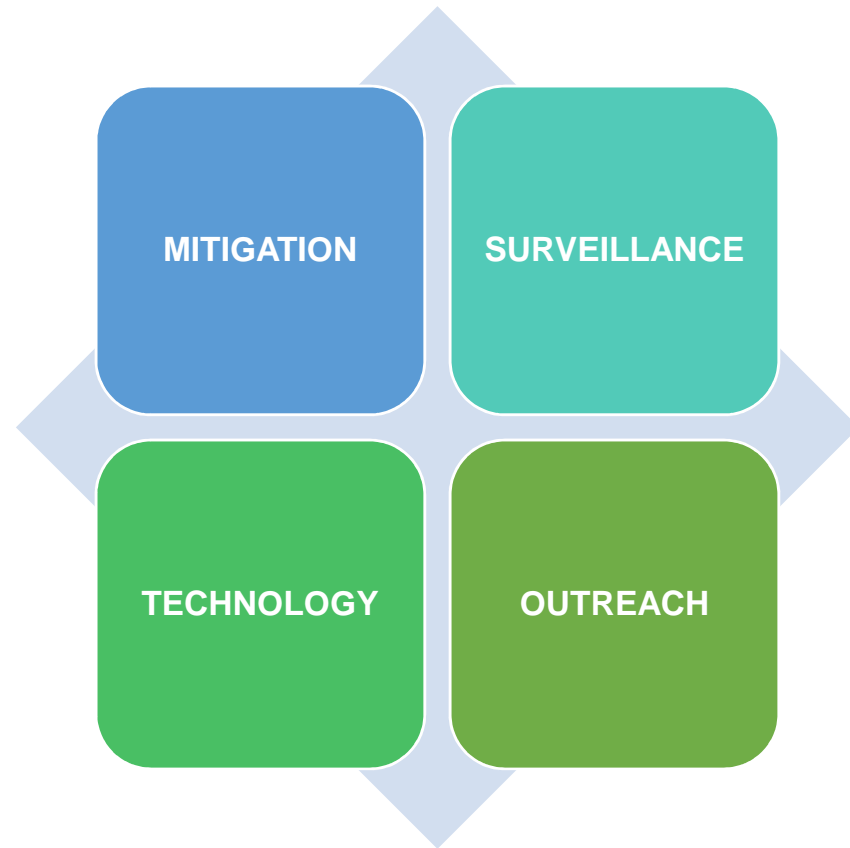
Number of debris vs density
Test results vs numerical sim vs models

OUTREACH

- **Publication in international Conferences**
- **CNES deeply involved in IAF debris and STM group**
- Learning sessions to operators, industrial, universities on debris & regulation
- CNES launched **Collective For Space Care** in 2015
- **Workshops organisation**
 - 9th Workshop on Satellite End Of Life & Sustainable Technologies - CNES HQ - Paris, Jan 22-23, 2022
 - International Conjunction Assessment Workshop, CNES HQ – Paris
 - European Workshop on Space Debris Modeling and Remediation - CNES HQ - Paris



Space Debris : a CNES top priority



Thank you for your attention