



# 2019 SPACE DEBRIS ACTIVITIES IN FRANCE : HIGHLIGHTS

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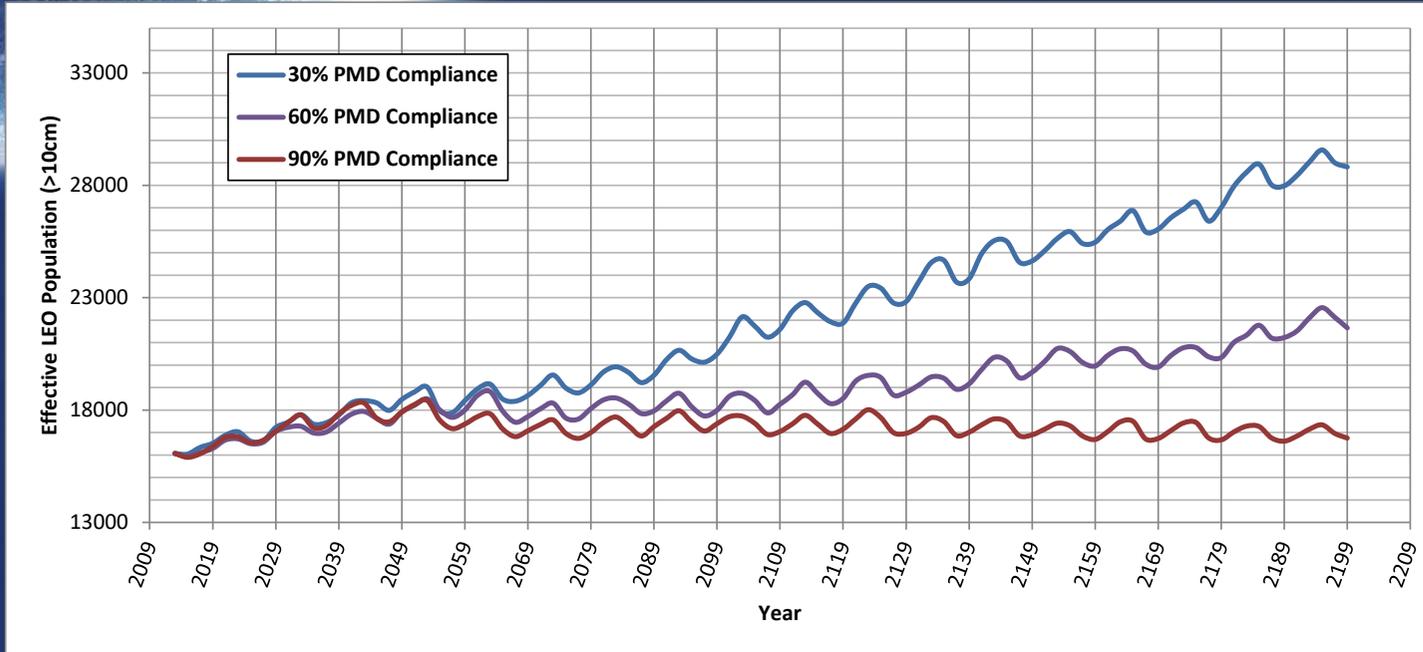
- Orbital Systems Directorate -



## Space Debris : a CNES top priority



# MITIGATION : Debris population increase is an issue



**90 % of satellite and rocket bodies which do not perform natural re-entry in less than 25 yrs should be deorbited**

Space debris evolution for the next 200 years vs Post mission disposal compliance

# MITIGATION : French Space Law limits debris proliferation

EUTELSAT  
GLOBALSTAR  
AIRBUS GEO  
CSUM  
CSUT  
ADS  
TAS  
UNSEENLABS  
CNES

1  
Mission  
extension

5  
Preliminary  
conformity

70  
satellites flying  
under FSOA licence

22  
upcoming  
submission

VEGA  
SOYUZ  
ARIANE 5

## Launchers

9  
Launch  
authorisations

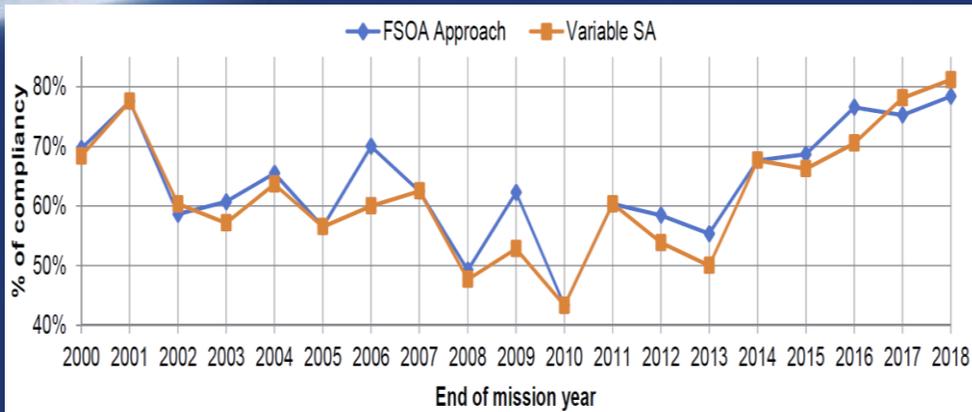
1  
End of Life

10  
New licences

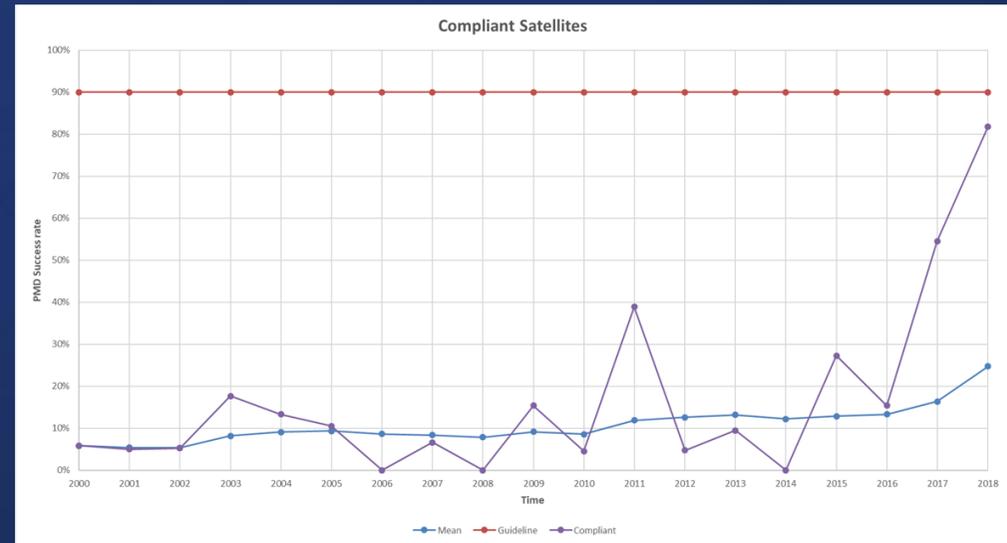
## Satellites

# MITIGATION : Compliancy to mitigation guideline is not reached

- French law technical regulation criteria
  - Leave LEO protected zone in less than 25 years after EOL
  - Free GEO protected zone during 100 Yrs after EOL

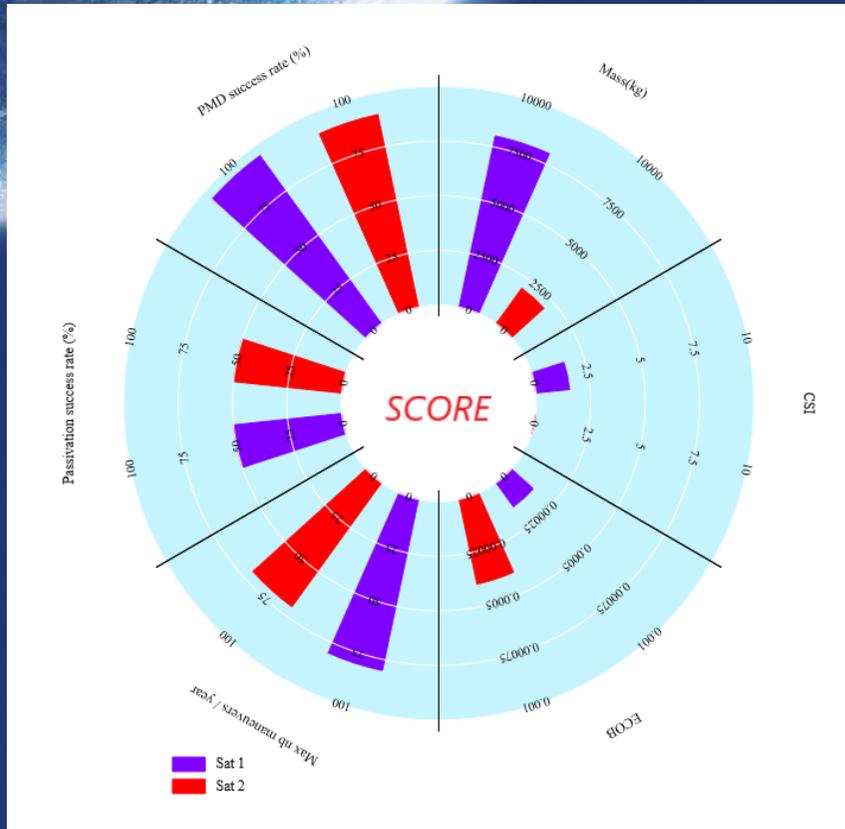


**80 % worldwide launchers compliant in 2018**



**30 % worldwide LEO satellite deorbited toward 25 years re-entry orbit since 2000**

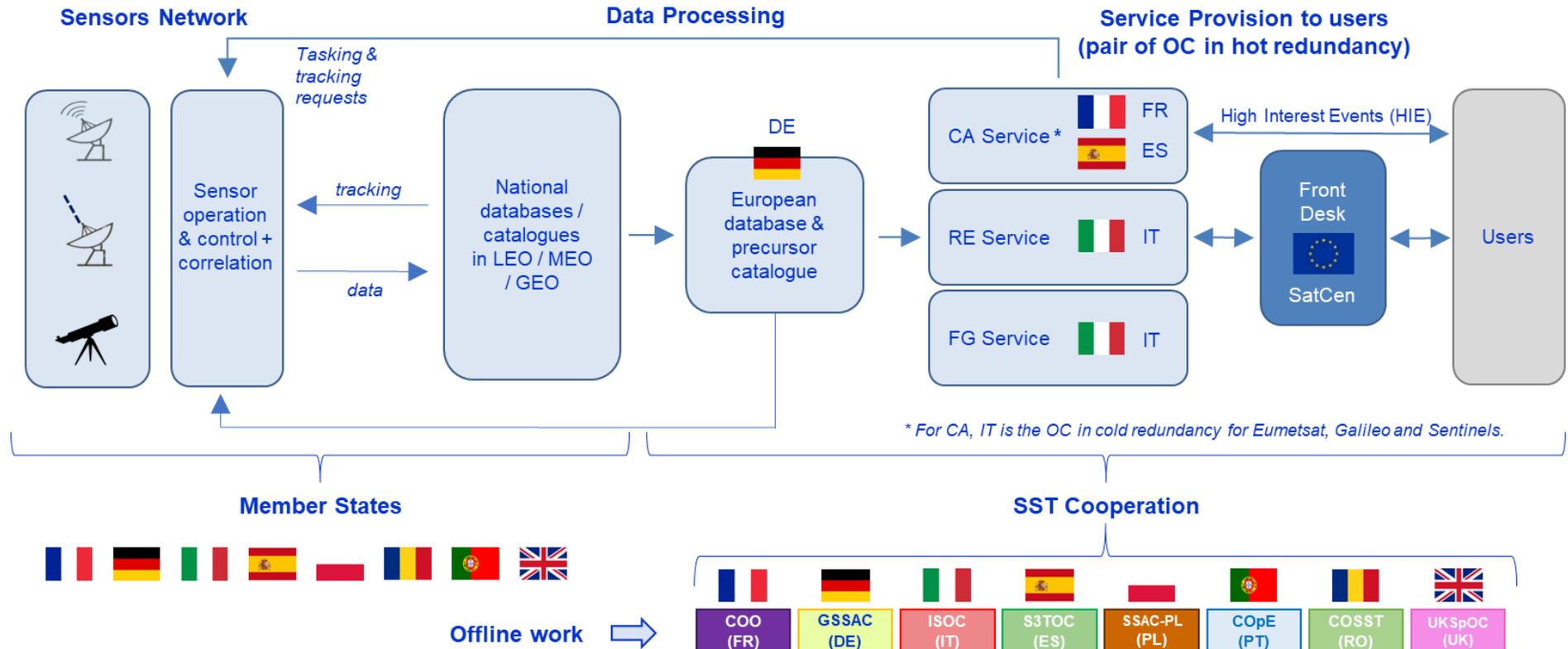
## MITIGATION : Environment Impact Evaluation



- **Development of this index shall take into account**
  - The specificity of New Space
  - PF/PL design (Orbit control capability, D4D, shielding, ADR ready...)
  - Mission design (controlled reentry, operational orbit, ground segment redundancy ...)
- **An iterative process is necessary to converge towards a good proxy of both environmental health and operators' awareness of the situation**

# SURVEILLANCE : Involvement in EUSST services

- ❖ CNES provides operational collision assessment service through EUSST



## SURVEILLANCE : collision risk monitoring

- ❖ CNES operational service is called **CAESAR** (Conjunction Analysis and Evaluation, Assessment and Recommendations) :

- 116 satellites worldwide use CAESAR through EU-SST services

	LEO 2019	MEO 2019	GEO 2019
Satellites monitored	32	30	54
Close approach alert (communication to users)	45	2	14
Successful additional tracking request	10	0	9
Effective collision avoidance maneuvers	12	0	5*



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

- ❖ Improving conjunction analysis methods
  - Improvement of collision probability algorithms
  - Improvement of cataloguing algorithms

# SURVEILLANCE : 2019 Re-entries followed by France

## French objects

Re-entry date	Norad	International	Name	Launch	Incl. (deg.)	Radius (m) / Mass (t)
04/02/2019	N42707	1998-067LQ	Xcubesat	20/11/1998	51.62	0.2 / 0.1
24/02/2019	N24715	1997-002C	Ariane 44L R/B	30/01/1997	7.26	9.5 / 1.8
10/03/2019	N40616	2015-022D	Ariane 5 Deb (Sylda)	26/04/2015	5.64	5.4 / 0.4
07/05/2019	N38743	2012-043D	Ariane 5 Deb (Sylda)	02/08/2012	5.78	5.6 / 0.4
15/06/2019	N40335	2014-078D	Ariane 5 Deb (Sylda)	06/12/2014	6.38	5.4 / 0.4

**5 French objects**

**12 foreign objects**

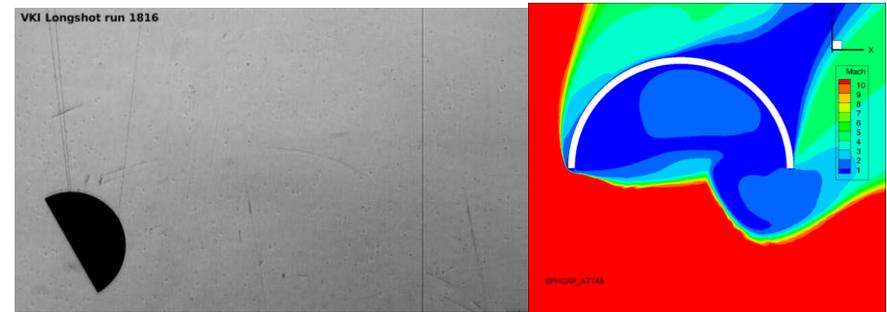
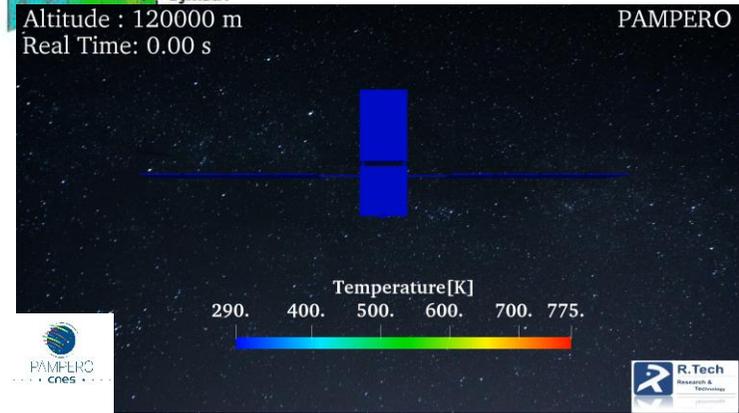
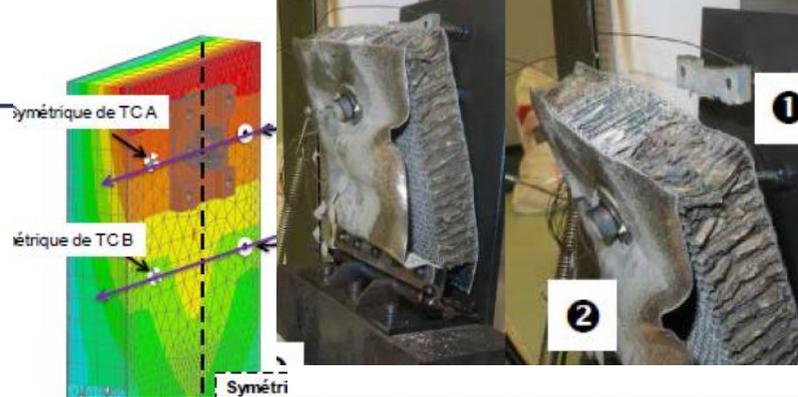
## Foreign objects

Re-entry date	Norad	International	Name	Launch	Incl. (deg.)	Radius (m) / Mass (t)
05/02/2019	N43667	2018-083F	CZ-2C R/B (PRC)	29/10/2018	97.6	7.8 / 5.0
17/03/2019	N44070	2019-013B	SL-4 R/B (CIS)	14/03/2019	51.6	NC / NC
07/04/2019	N44111	2019-019B	SL-4 R/B (CIS)	04/04/2019	51.6	NC / NC
30/04/2019	N43532	2018-056D	CZ-2C R/B (PRC)	09/07/2018	98.0	7.8 / 5.0
15/05/2019	N43033	2017-076B	SL-4 R/B (CIS)	02/12/2017	67.1	5.0 / 2.4
20/07/2019	N43583	2018-062C	CZ-3B R/B (PRC)	29/07/2018	54.6	9.2 / 2.1
24/07/2019	N44438	2019-041B	SL-4 R/B (CIS)	20/07/2019	51.6	5.0 / 2.4
04/08/2019	N44456	2019-047B	SL-4 R/B (CIS)	31/07/2019	51.6	5.0 / 2.4
04/10/2019	N41325	2016-006C	CZ-3C R/B (PRC)	01/02/2016	54.6	8.9 / 2.8
16/10/2019	N44442	2019-042B	GSLV R/B (IND)	22/07/2019	21.4	9.8 / 5.3
28/10/2019	N43709	2018-093D	CZ-3B R/B (PRC)	18/11/2018	54.7	9.2 / 2.1
31/12/2019	N26476	2000-048A	DM-F3 (US)	23/08/2000	27.2	1.7 / 4.4

# TECHNOLOGY : Tech4SpaceCare

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

- ❖ Fragmentation : Mechanical & Thermal joints experimental & numerical tests
- ❖ Mechanical stress : Implementation and adaptation of PAMPERO software for mechanical computation in complex vehicle
- ❖ Wind tunnel : Wind tunnel test for complex shape knowledge improvement and implementation in DEBRISK
- ❖ D4D : Investigation of termite technology for help destruction during reentry



## COOPERATION

- France actively supports international groups in charge of establishing best practices, guidelines and standards :
  - ❖ ECSS
  - ❖ ISO
  - ❖ UN COPUOS
  - ❖ IADC
  - ❖ ...
- France advises states which aim to promote a space law by sharing its experience and feedback
- Cooperation frameworks on surveillance and technology blocks

## Workshops organisation

- International Conjunction Assessment Workshop, CNES HQ – Paris, June 26-28, 2019
- 8th Workshop on Satellite End Of Life & Sustainable Technologies - CNES HQ - Paris, Jan 22-23, 2020

### Coming soon

- 6th European Workshop on Space Debris Modeling and Remediation - CNES HQ - Paris, June 15-17, 2020

## 38th IADC Meeting – 6-10 april 2020 - Toulouse

