

PULSE

Population Update Framework for the Medium- and Long-term Space Environment Evolution

... towards a new MASTER Reference population of August 2024

André Horstmann

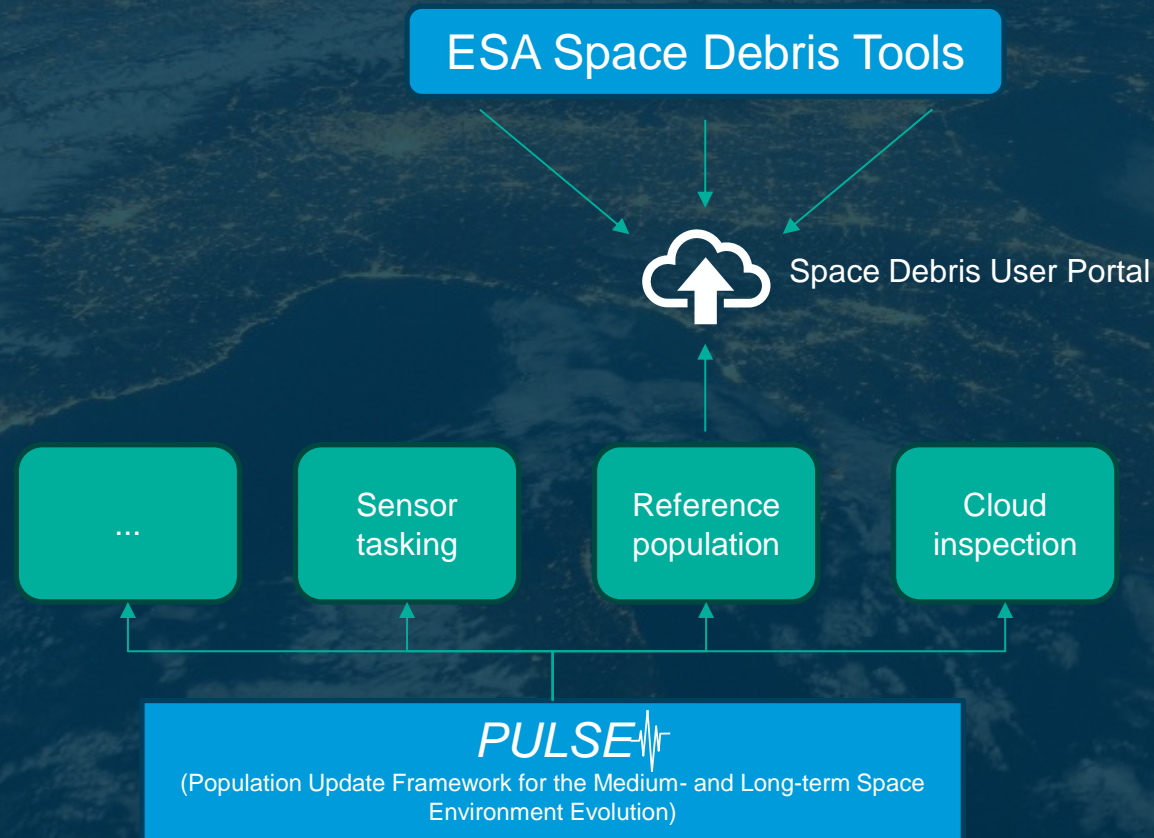
16/01/2025

1. What has been done so far?
2. How does the population look like in August 2024?
3. What are the upcoming plans?

What has been done so far?

(aka “What took you so long?”)

- Reference population release was always bound to new MASTER major release through industrial contracts
- Now: Population maintained independently of MASTER module by *PULSE*



How does the population look like in August 2024

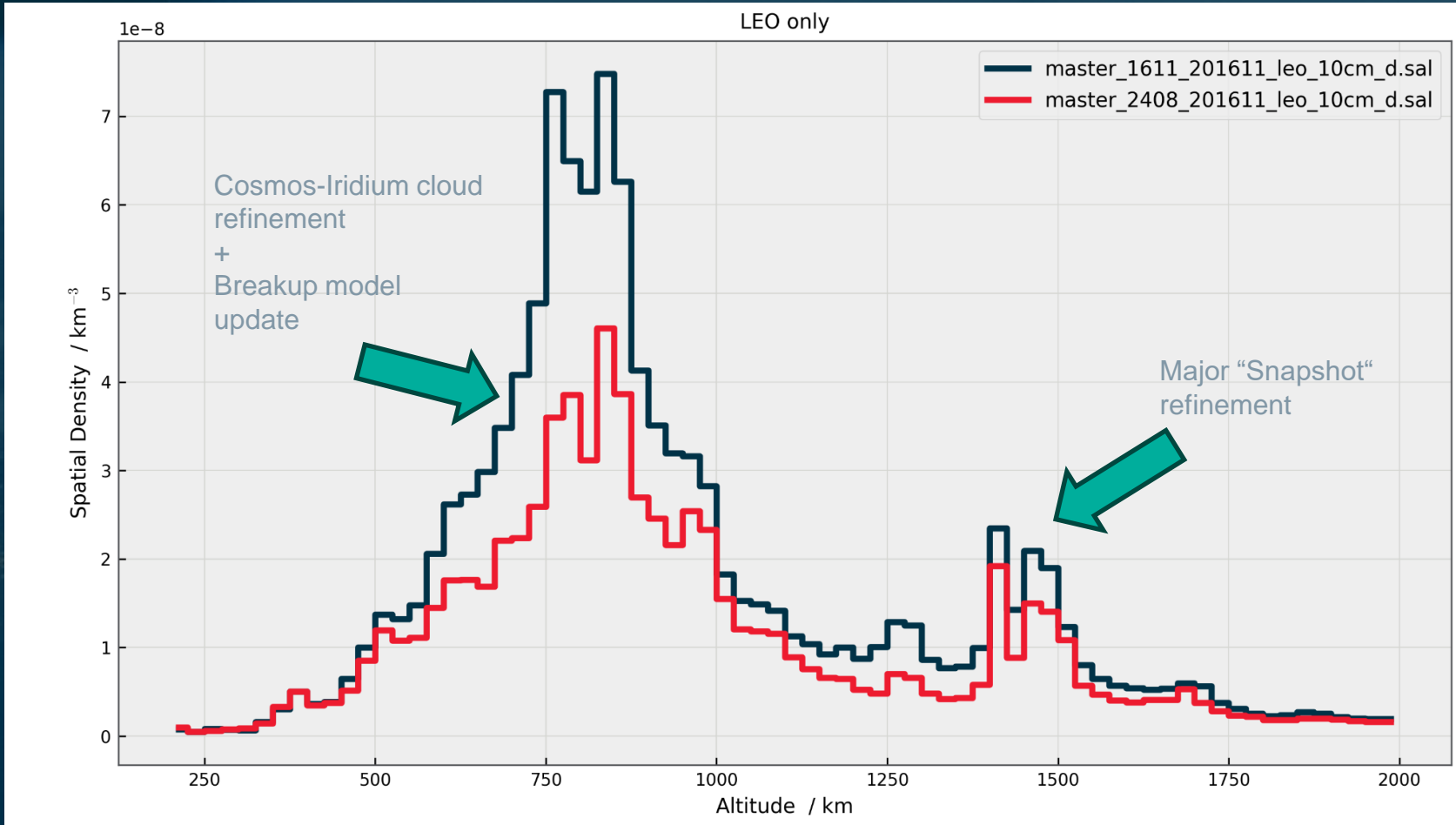


How does the population look like in August 2024



How does the population look like in August 2024

- A revisit of the Nov 2016 10cm-population (LEO), obtained with *PULSE*



LEO crossers @ 2016/11

2016/11 ref. Pop.:	26.046
2024/08 ref. Pop.:	18.897

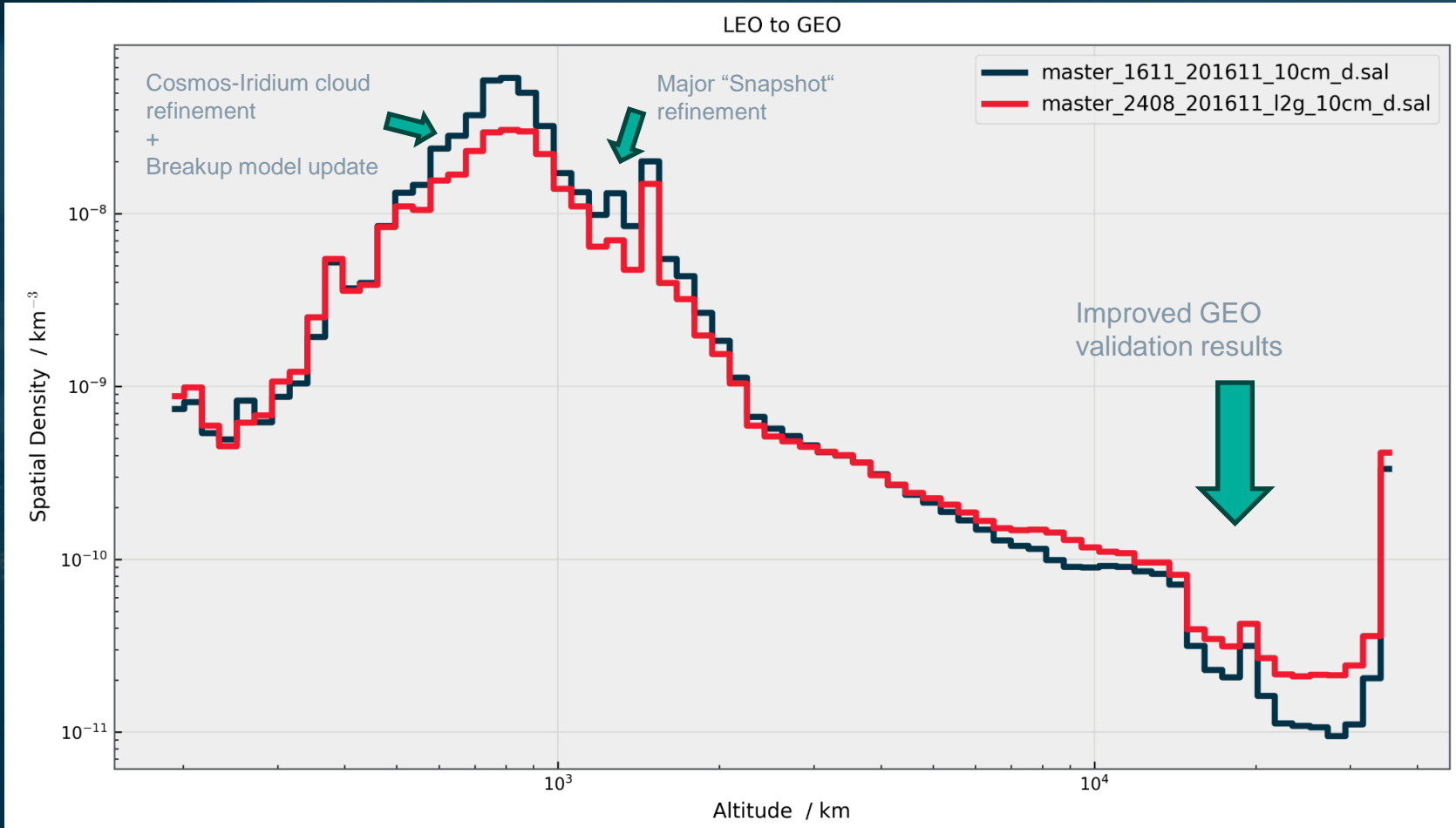
Rectifications:

- Less compensation factors for catalogue incompleteness (now using reported fragments)
- More data sources for fragments
- Breakup Model update

→ No need for stronger scaling

How does the population look like in August 2024

- A revisit of the Nov 2016 10cm-population (FULL), obtained with *PULSE*

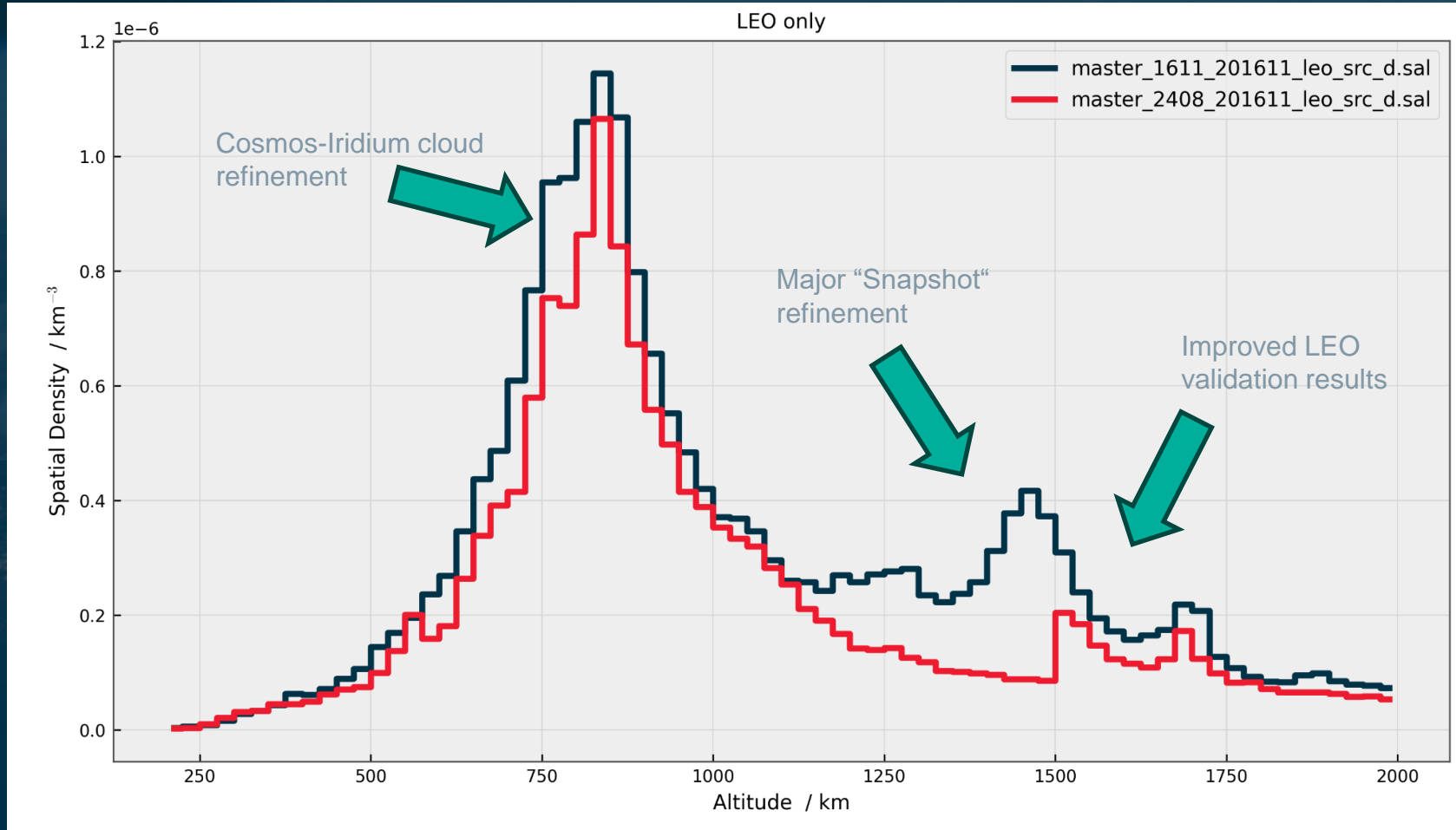


All objects @ 2016/11

2016/11 ref. Pop.:	34.017
2024/08 ref. Pop.:	34.410

How does the population look like in August 2024

- A revisit of the Nov 2016 1cm-population (LEO), obtained with *PULSE*

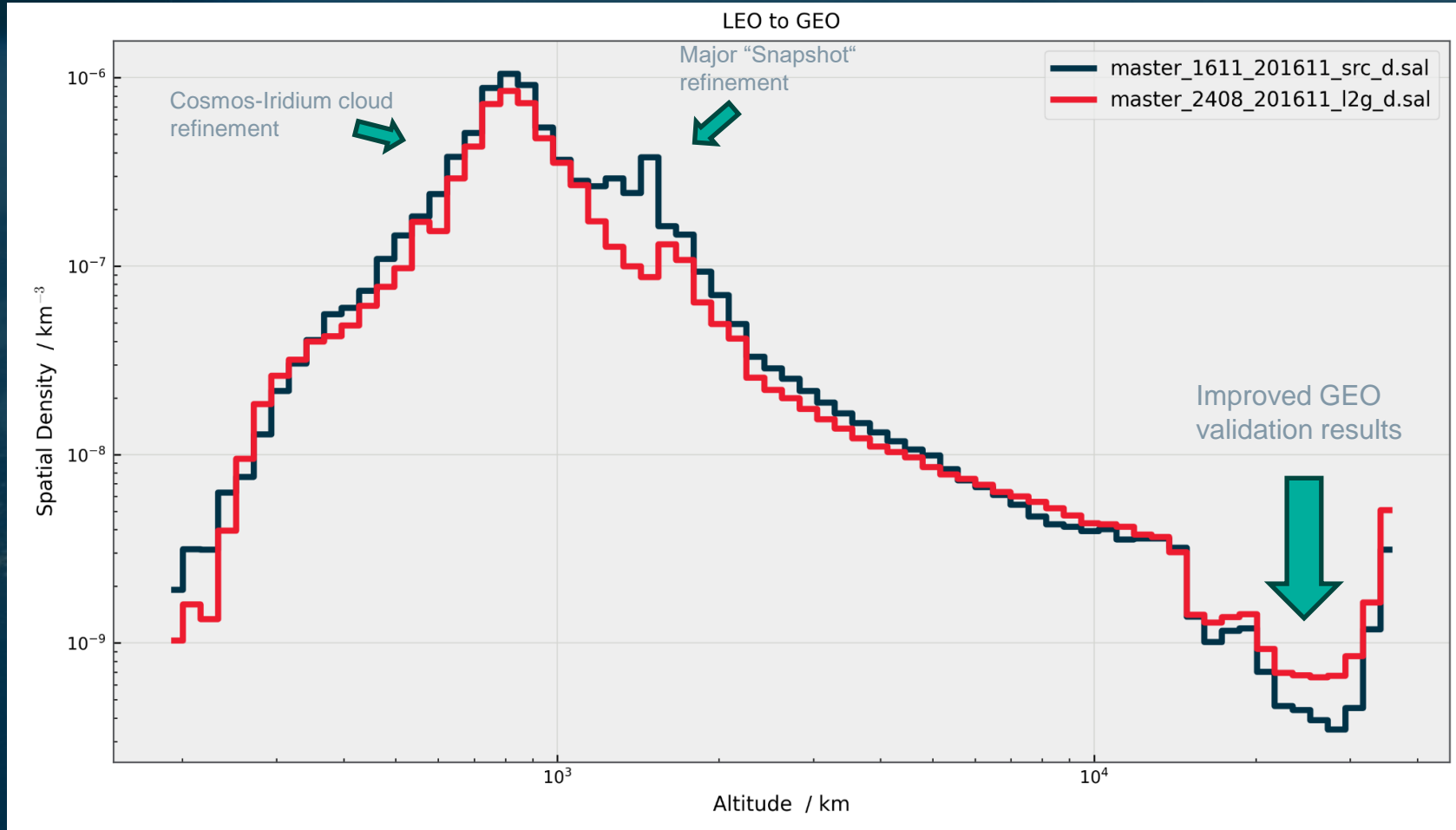


LEO crossers @ 2016/11

2016/11 ref. Pop.: 657.454
2024/08 ref. Pop.: 482.535

How does the population look like in August 2024

- A revisit of the Nov 2016 1cm-population (FULL), obtained with *PULSE*



All objects @ 2016/11

2016/11 ref. Pop.: 912.000

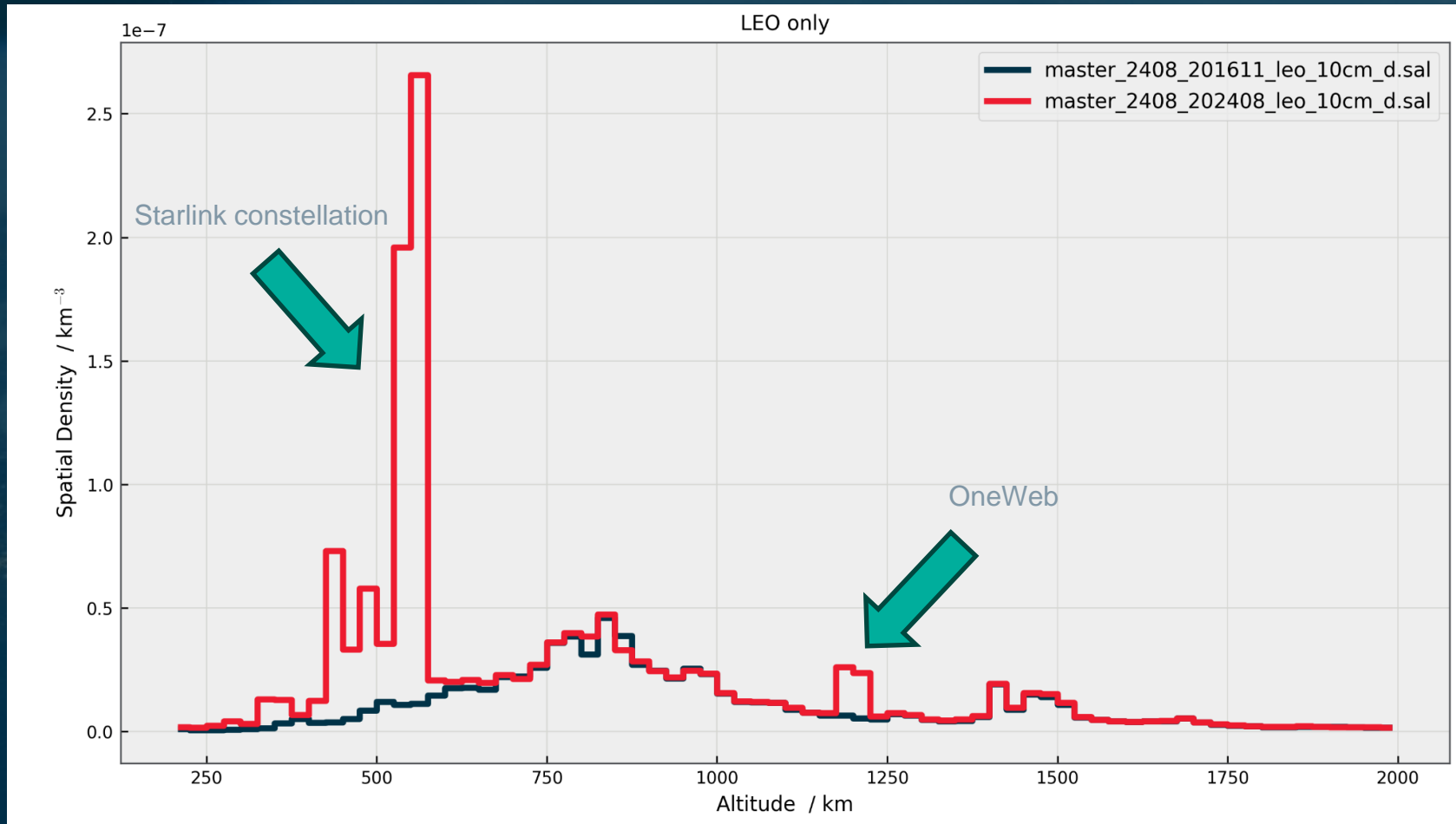
2024/08 ref. Pop.: 1.018.204

How does the population look like in August 2024



How does the population look like in August 2024

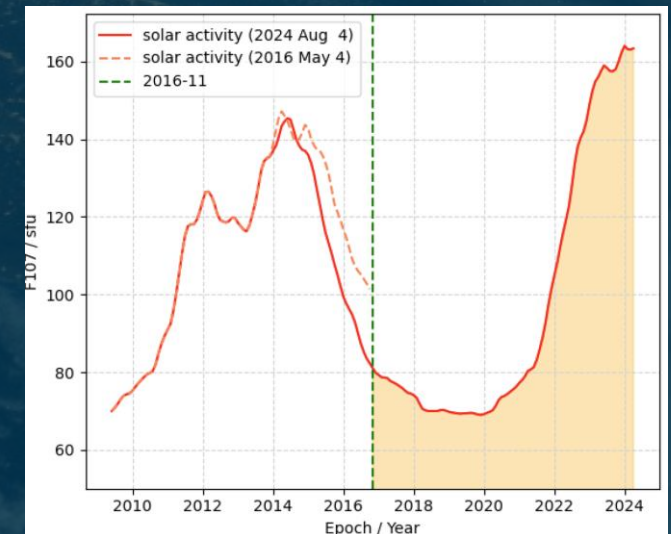
- Now: 10cm Population (LEO) evolution from 2016/11 to 2024/08 (approx. 8 years)



LEO crossers @ 2024/08

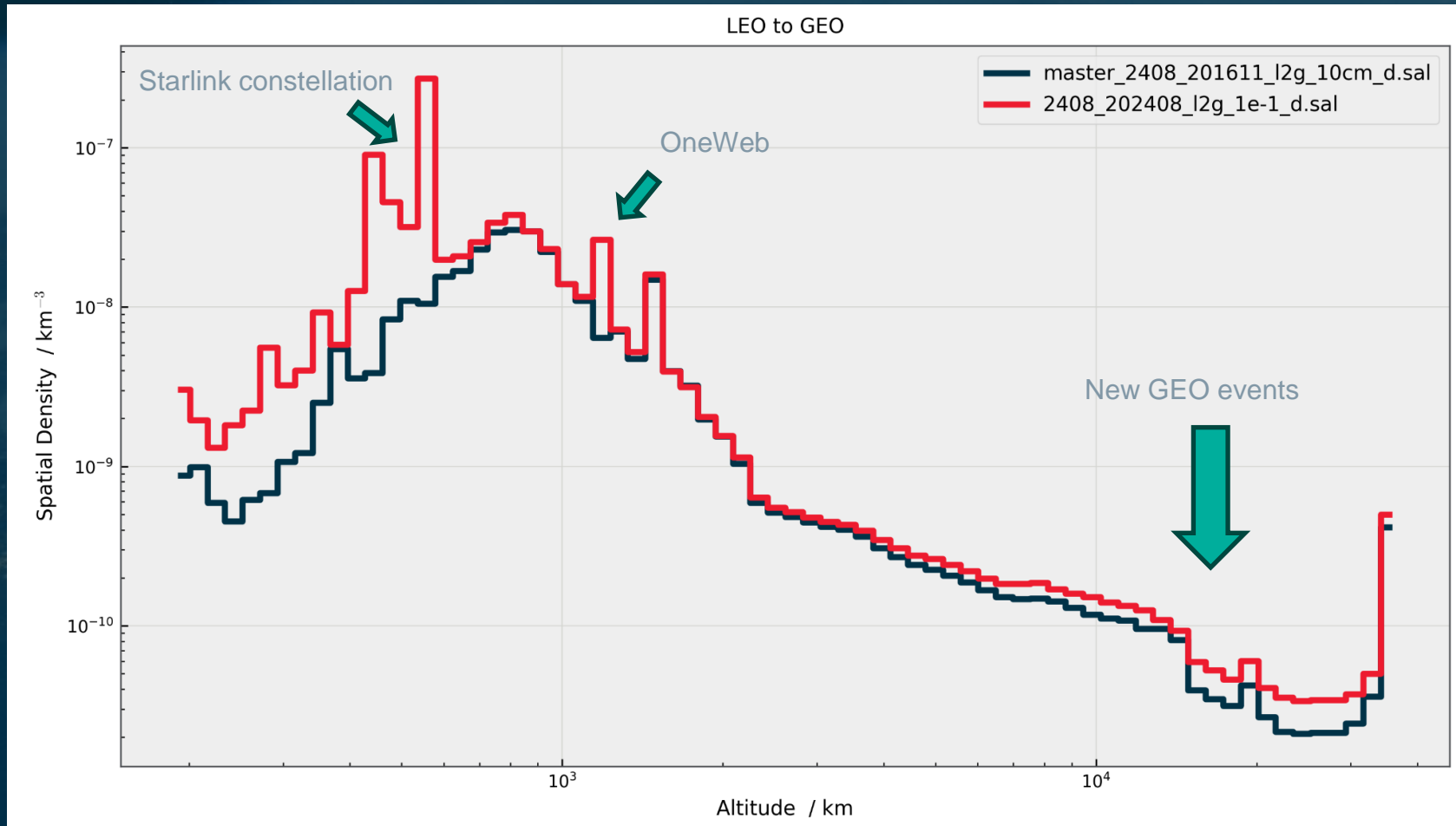
2024/08 ref. Pop.: 28.865

11.9 % are Starlink: 3.452



How does the population look like in August 2024

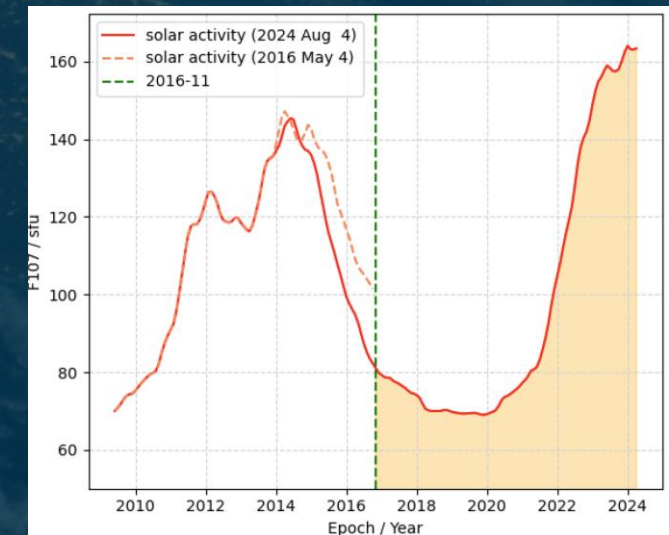
- Now: 10cm Population (FULL) evolution from 2016/11 to 2024/08 (approx. 8 years)



All objects @ 2024/08

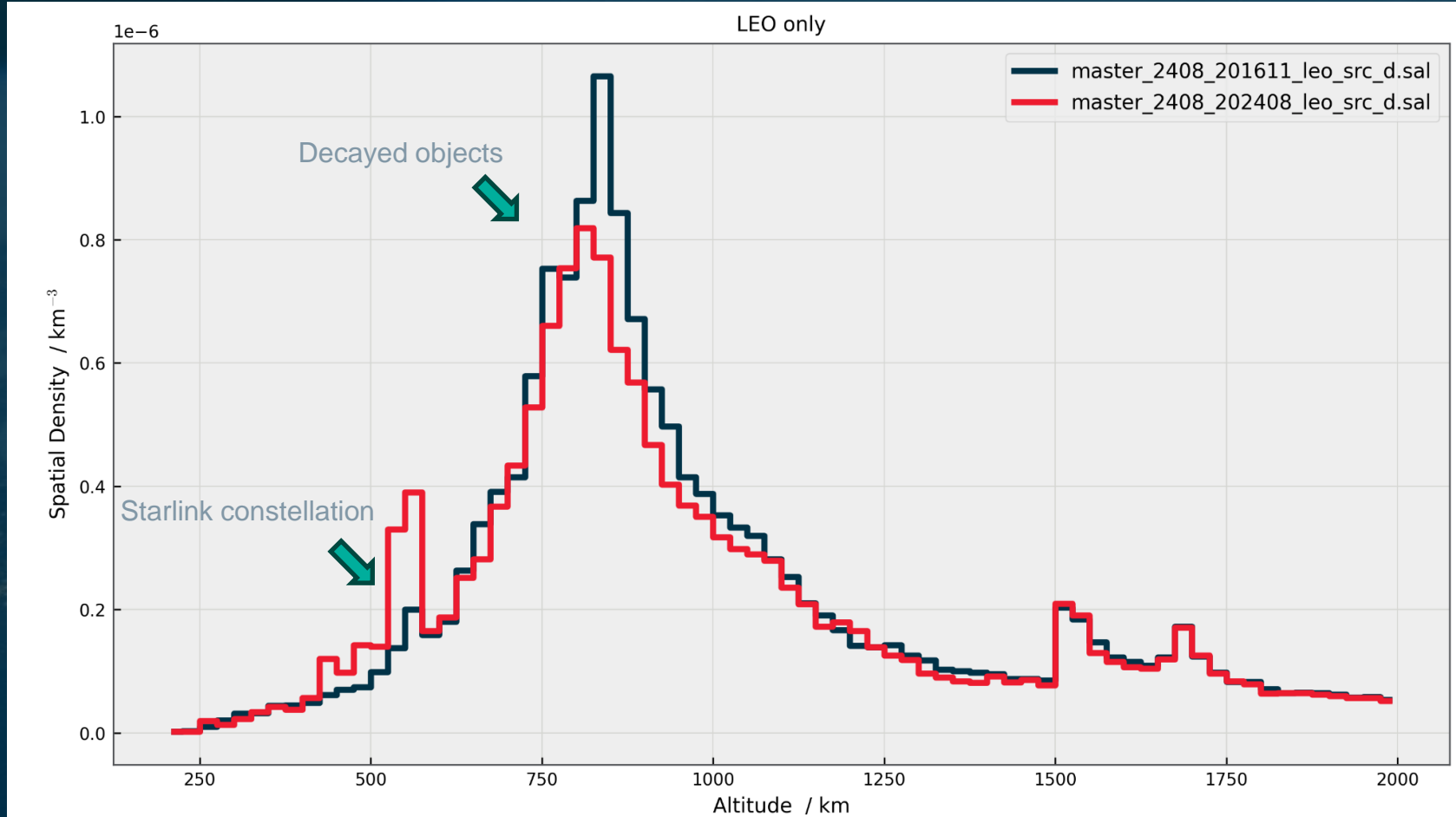
2024/08 ref. Pop.: 54.097

6.3 % are Starlink: 3.452



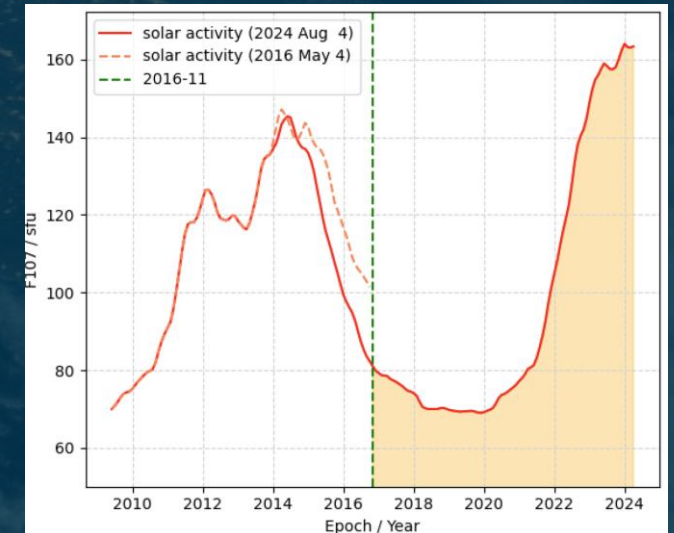
How does the population look like in August 2024

- Now: 1cm Population (LEO) evolution from 2016/11 to 2024/08 (approx. 8 years)



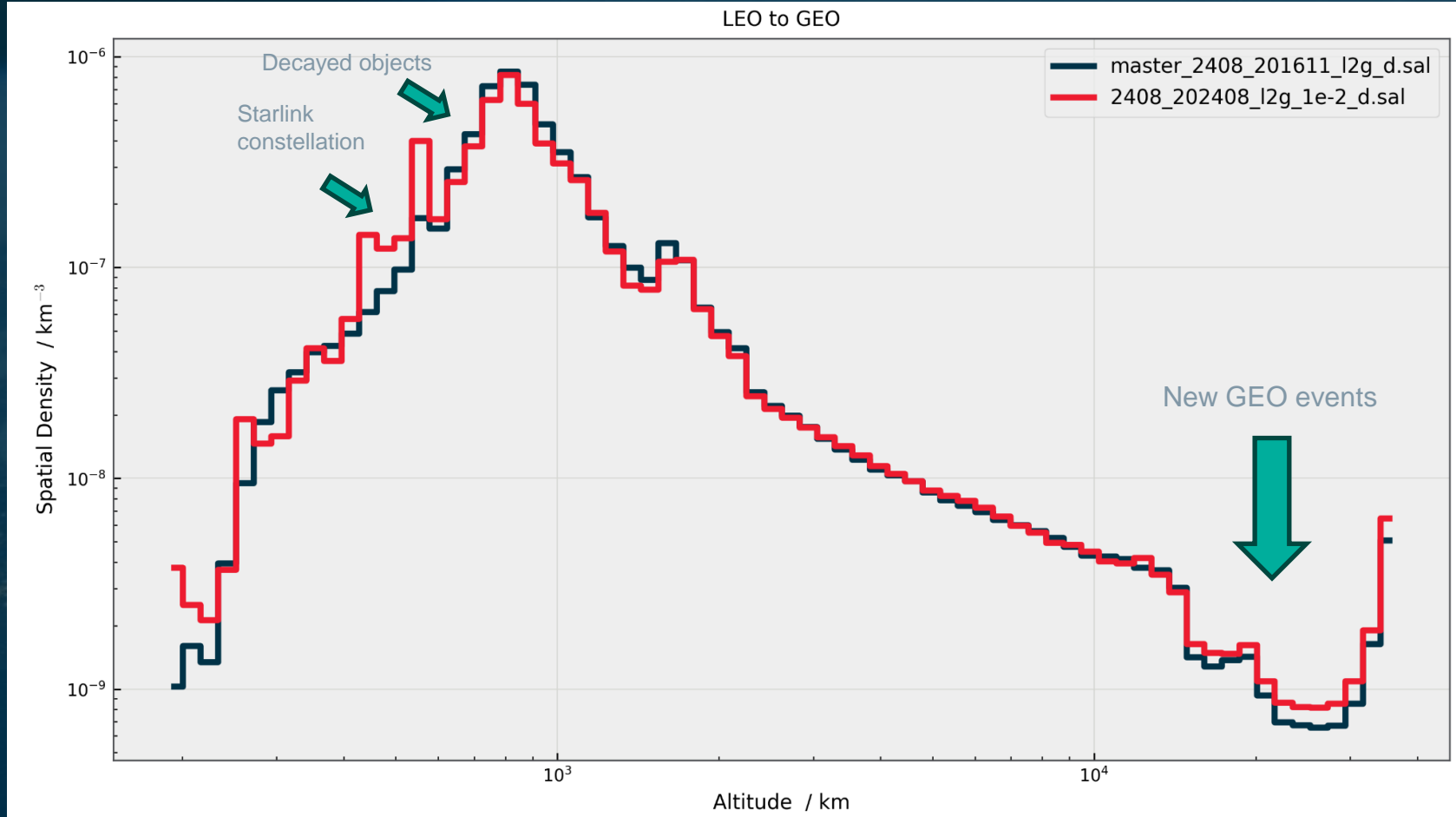
LEO crossers @ 2024/08

2024/08 ref. Pop.: 453.700



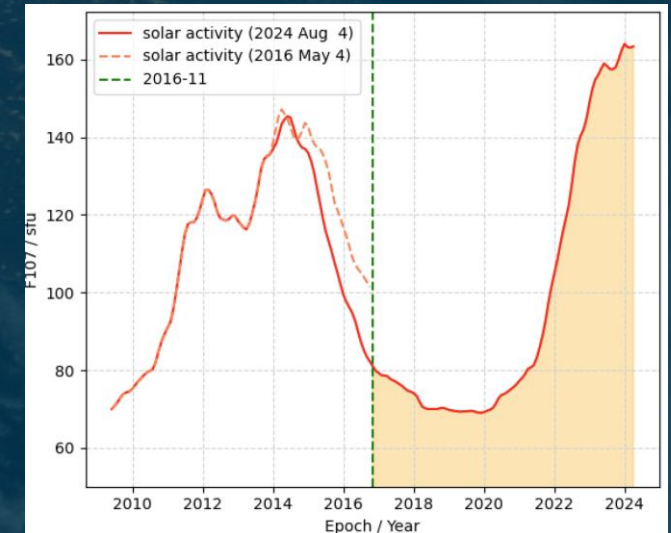
How does the population look like in August 2024

- Now: 1cm Population (FULL) evolution from 2016/11 to 2024/08 (approx. 8 years)



All objects @ 2024/08

2024/08 ref. Pop.: 1.247.475



How does the population look like in August 2024



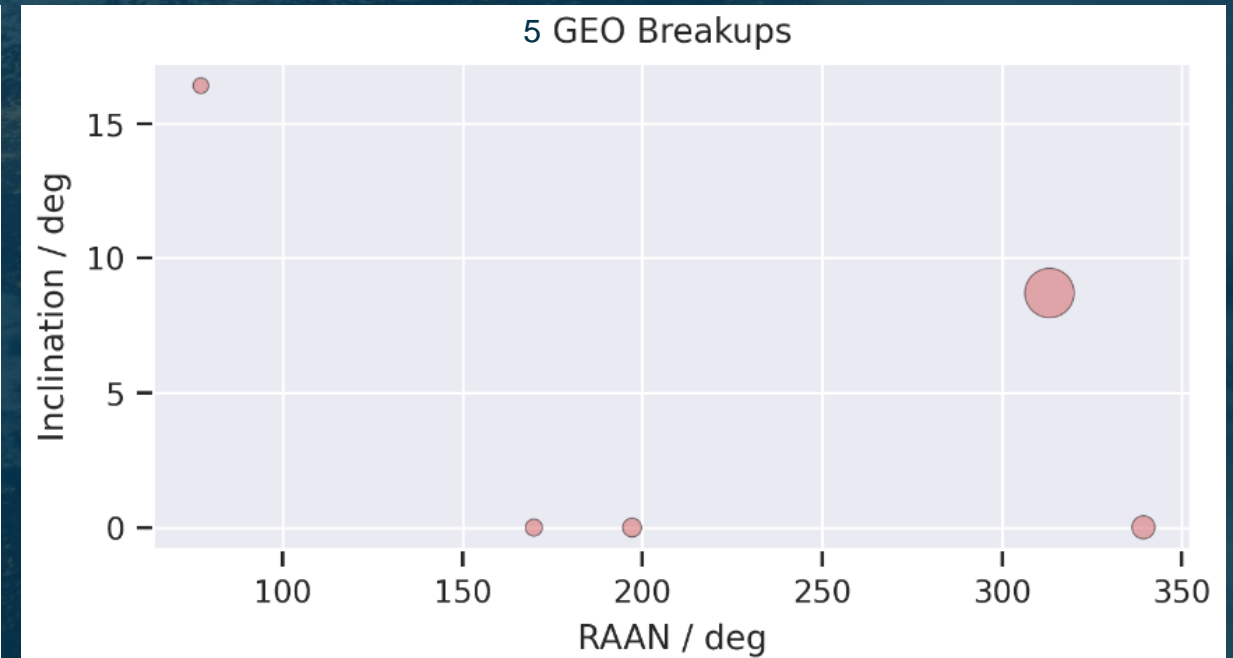
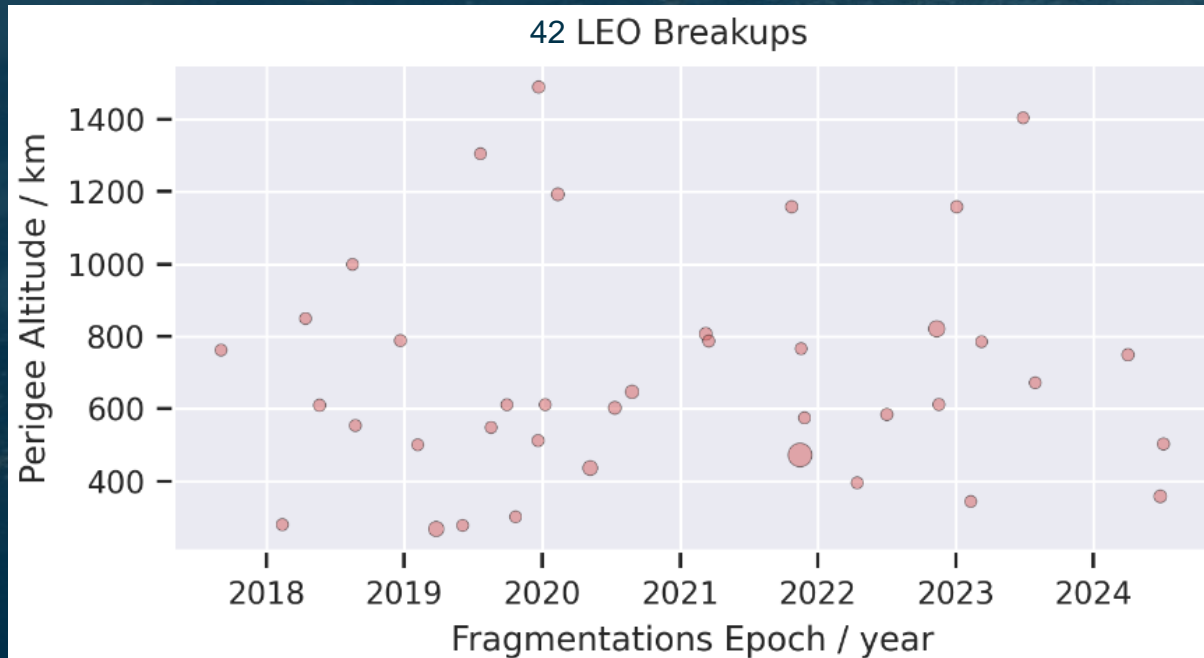
- What happened between 1st Nov 2016 and 1st August 2024?



How does the population look like in August 2024

- What happened between 1st Nov 2016 and 1st August 2024?

Total of 47 new events during last 8 years
→ Mean of 5.25 / year



New EISCAT measurements:
2018, 2022, 2024

New SDT measurements:
2016, 2017, 2019, 2020, 2021, 2022, 2023, (2024)

How does the population look like in August 2024

- What happened between 1st August 2024 and now?
- 3 Events

LEO fragmentation

L-15 / YF-115 (#60397, 2024-140U) – *Chinese R/B*
06/08/2024
805 km x 863 km x 89 deg
700 reported fragments by SSN

GEO fragmentation

Intelsat-33e (#41748, 2016-053B) – *US ComSat*
19/10/2024
35.798 km x 35.782 km x 0.018 deg
19 reported fragments by SSN
500 reported fragments by ExoAnalytic (d>10cm)

LEO fragmentation

DMSP-5D2 F14 (#24753, 1997-012A) – *US Weather Sat*
19/12/2024
844 km x 831 km x 89 deg
>50 reported fragments by LEOLABS

Will be included in 2025 population, after sufficient validation data has been acquired.

Download population (coming soon)

- ✓ Reference population: up to 01/08/2024
- ✓ Compatible with MASTER 8.0.0+ (CLI/API)
- ... Future reference population, up to 01/08/2074 (ETA end of Q1)



<https://sdup.esoc.esa.int/master/downloads>

Contact

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@ 08/2024	# > 10 cm	# > 1 cm
LEO	29.000	453.000
Total	54.000	1.250.000

What is next?

- Finish PULSE implementation
- Publish new reference populations **annually** (incl. validation report)
- Upgrading the MASTER model and PULSE within industrial contract:
 - Discrimination between non-/manoeuvrable payloads
 - Augment population with material and shape information
 - Several performance optimisations