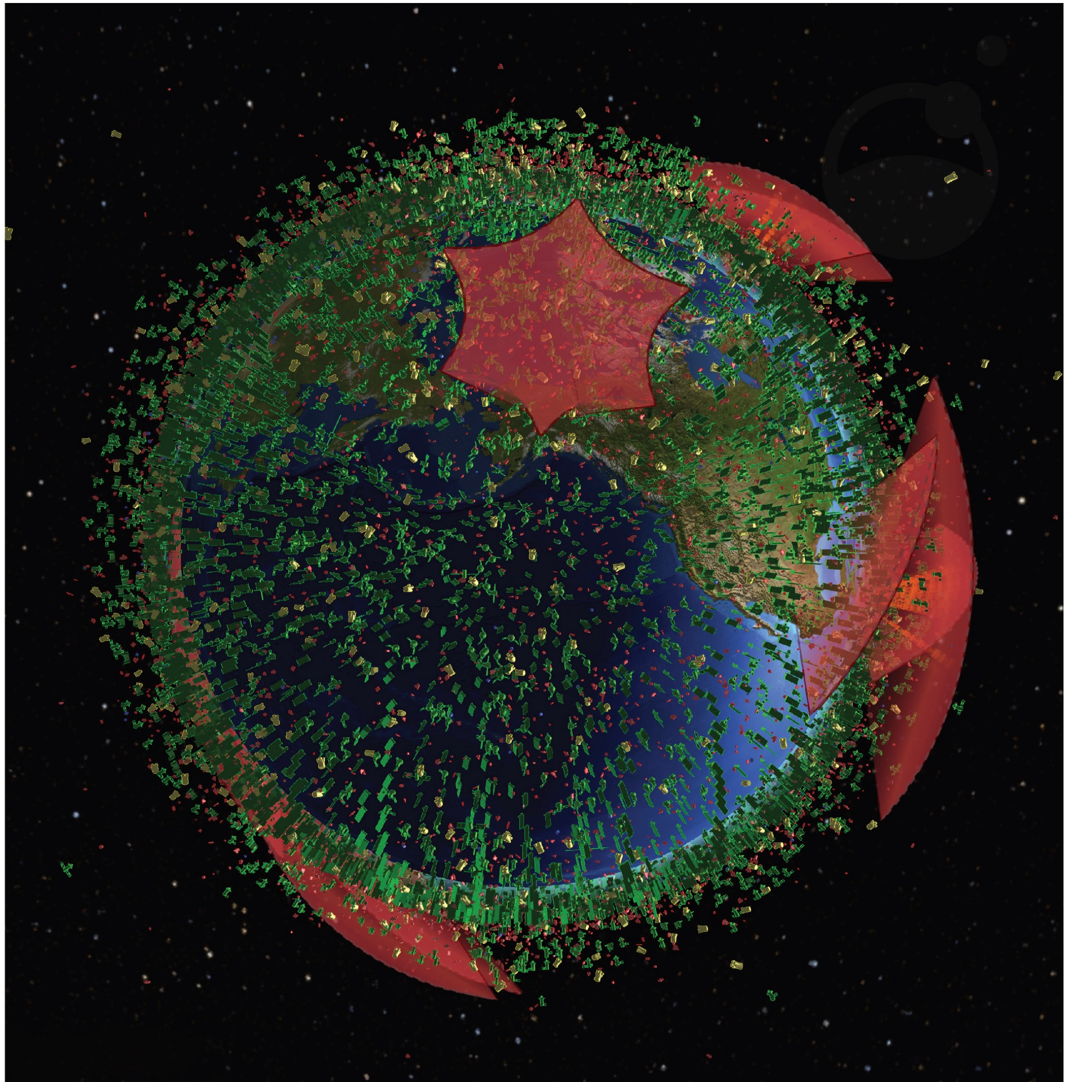
Operational Implementation of STM services

Clean Space Days – Oct 9th 2024

S. Delattre – Sr Space Domain Awareness Architect



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Summary

3.5. MINIMISE RISKS OF INTERNAL BREAK-UPS

To keep the probability of debris generation through collisions and break-ups below 1 in 1000 per object, it is essential to minimise the risk of internal break-ups during both the operational lifetime and post mission. Reliable passivation reduces the risk of in-orbit break-ups by depleting on-board sources of energy. While autonomous systems improve the likelihood of successful passivation, they also introduce new risks, such as premature activation, which must be managed. Solutions to address this issue include:

4.1. IMPROVE SPACE TRAFFIC COORDINATION AND INFORMATION SHARING

Improved STC [13] will help prevent collisions and reduce the occurrence of unnecessary collision avoidance manoeuvres.

4.2. IMPROVE SPACE SURVEILLANCE PERFORMANCE

Collision risk assessment is based on knowing the position and velocities of the objects involved. A reduction in uncertainty on these parameters will reduce the amount of false perceived risky close encounters, and hence reduce the burden on the operator. The capability to track smaller objects down to 5 cm in LEO and 20 cm in GEO will reduce the risk for catastrophic collisions in these orbital regions.

4.4. ROBUST TASKING OF TRACKING FOR LARGER CATALOGUES

With increasing amounts of debris and active spacecraft alike, current sensor networks can become overloaded leading to larger times between tracks and hence larger uncertainties on derived space surveillance products.

Making space debris catalogues and services available to other space actors or the public is a simple route to share knowledge of the space debris population and cross-validate models and measurements of space debris. Solutions to address this issue include:

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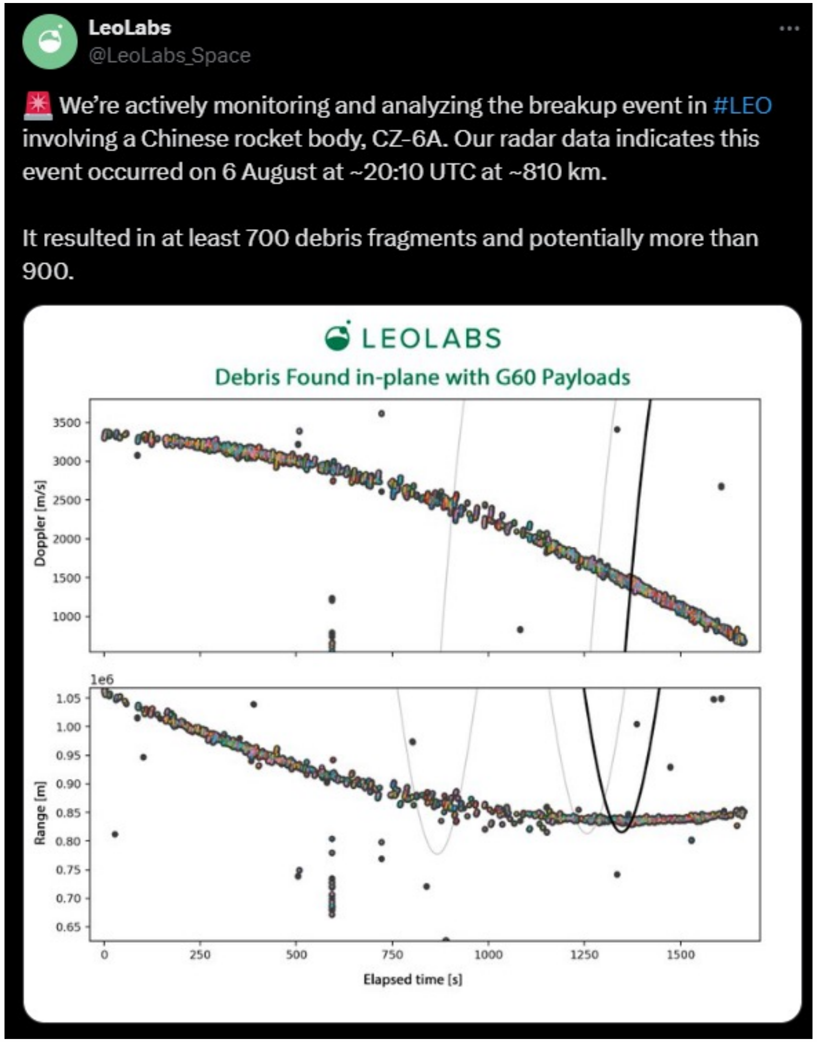
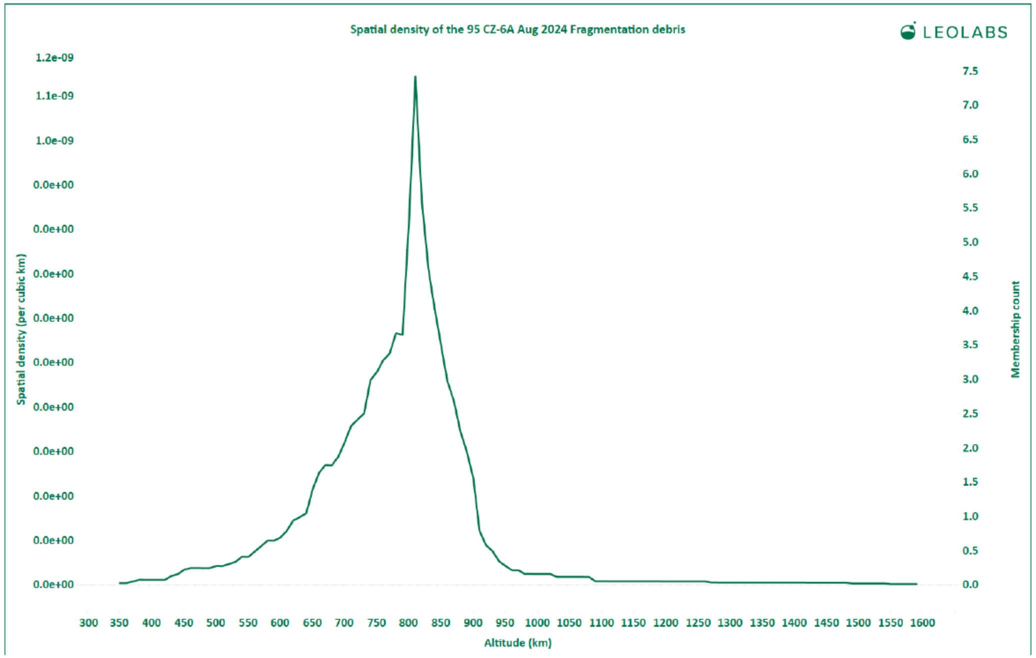


CZ-6A Rocket Body Explosion

August 6th 2024



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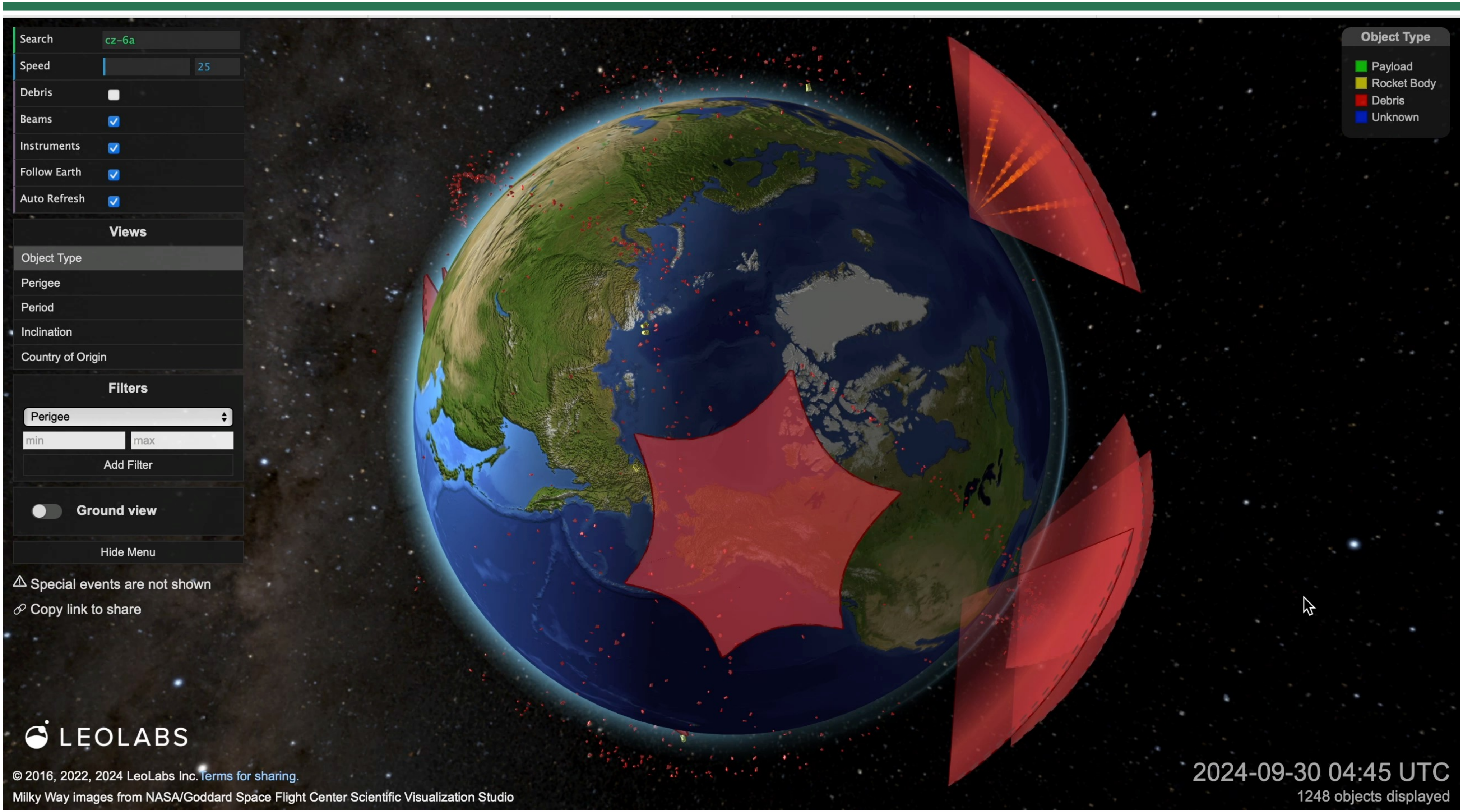

Search
cz-6a
Speed
25
Debris
Beams
Instruments
Follow Earth
Auto Refresh
Views
Object Type
Perigee
Period
Inclination
Country of Origin
Filters
Perigee
min
max
Add Filter
Ground view
Hide Menu
Special events are not shown
Copy link to share
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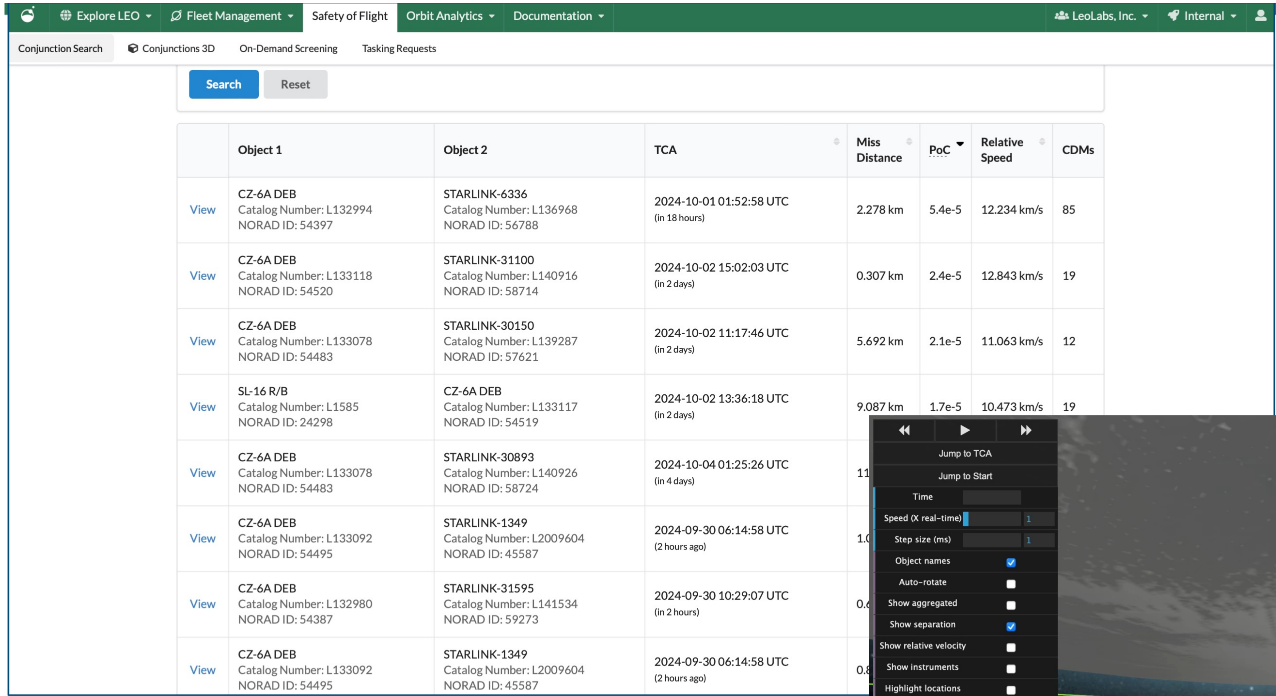
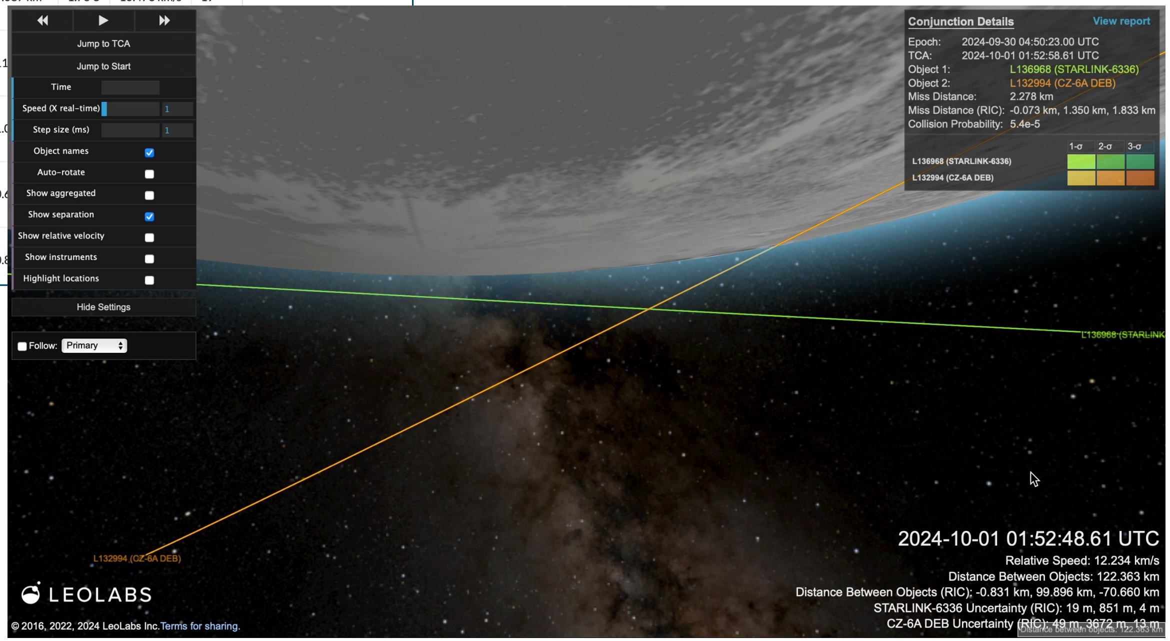
Milky Way images from NASA/Goddard Space Flight Center Scientific Visualization Studio
Object Type
Payload
Rocket Body
Debris
Unknown
2024-09-30 04:45 UTC
1248 objects displayed

CZ-6A CDMs extract on Sept 30th



	Object 1	Object 2	TCA	Miss Distance	PoC	Relative Speed	CDMs
View	CZ-6A DEB Catalog Number: L132994 NORAD ID: 54397	STARLINK-6336 Catalog Number: L136968 NORAD ID: 56788	2024-10-01 01:52:58 UTC (in 18 hours)	2.278 km	5.4e-5	12.234 km/s	85
View	CZ-6A DEB Catalog Number: L133118 NORAD ID: 54520	STARLINK-31100 Catalog Number: L140916 NORAD ID: 58714	2024-10-02 15:02:03 UTC (in 2 days)	0.307 km	2.4e-5	12.843 km/s	19
View	CZ-6A DEB Catalog Number: L133078 NORAD ID: 54483	STARLINK-30150 Catalog Number: L139287 NORAD ID: 57621	2024-10-02 11:17:46 UTC (in 2 days)	5.692 km	2.1e-5	11.063 km/s	12
View	SL-16 R/B Catalog Number: L1585 NORAD ID: 24298	CZ-6A DEB Catalog Number: L133117 NORAD ID: 54519	2024-10-02 13:36:18 UTC (in 2 days)	9.087 km	1.7e-5	10.473 km/s	19
View	CZ-6A DEB Catalog Number: L133078 NORAD ID: 54483	STARLINK-30893 Catalog Number: L140926 NORAD ID: 58724	2024-10-04 01:25:26 UTC (in 4 days)	11			
View	CZ-6A DEB Catalog Number: L133092 NORAD ID: 54495	STARLINK-1349 Catalog Number: L2009604 NORAD ID: 45587	2024-09-30 06:14:58 UTC (2 hours ago)	1.0			
View	CZ-6A DEB Catalog Number: L132980 NORAD ID: 54387	STARLINK-31595 Catalog Number: L141534 NORAD ID: 59273	2024-09-30 10:29:07 UTC (in 2 hours)	0.6			
View	CZ-6A DEB Catalog Number: L133092 NORAD ID: 54495	STARLINK-1349 Catalog Number: L2009604 NORAD ID: 45587	2024-09-30 06:14:58 UTC (2 hours ago)	0.8			



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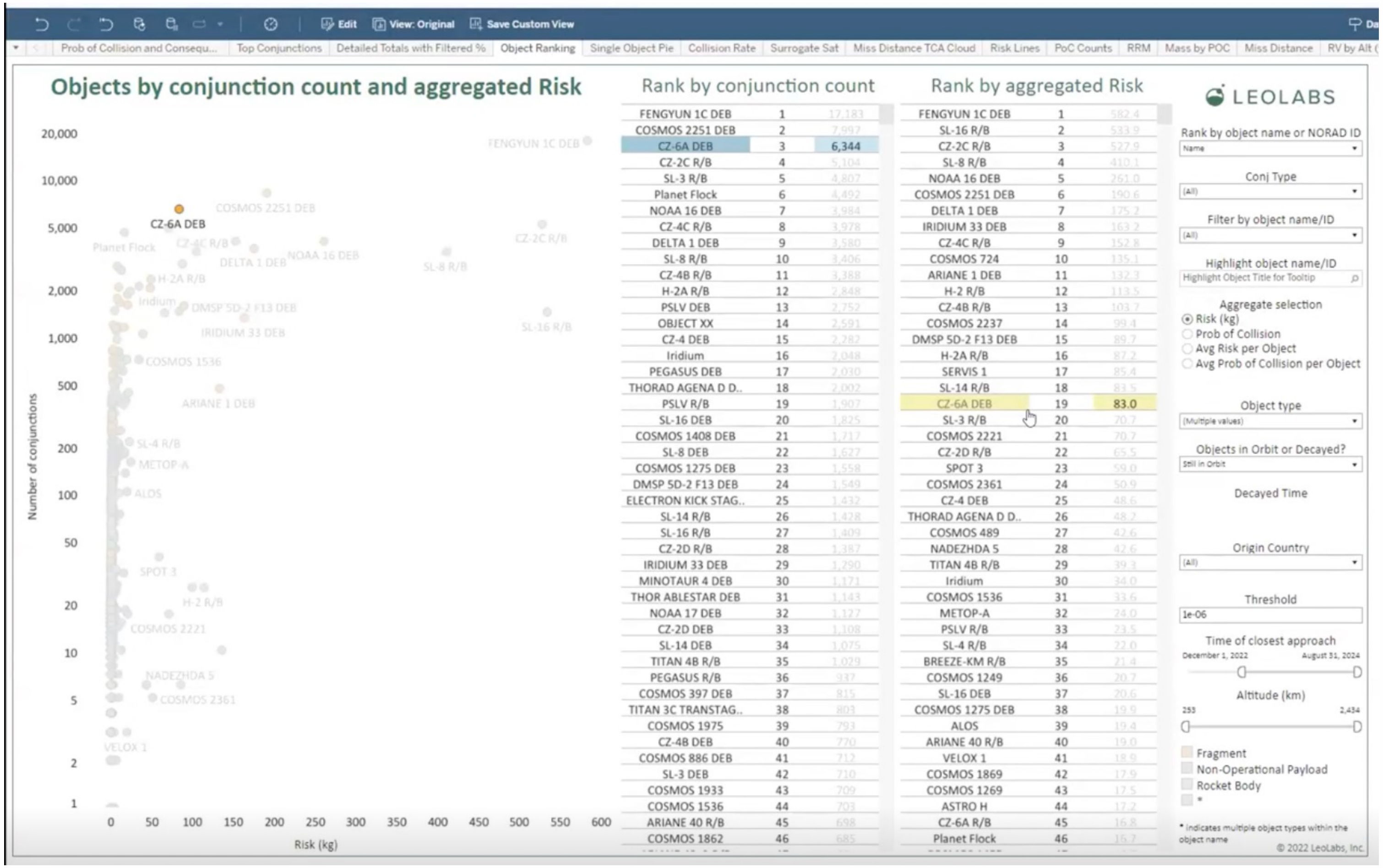

Since Dec 2022, 15% of conjunctions with Pc > 1e-06 involved CZ-6A

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Leolabs Catalog: foundational for SSA

LeoLabs System Metrics

Full transparency on LeoLabs system speed, accuracy, and quantity of data

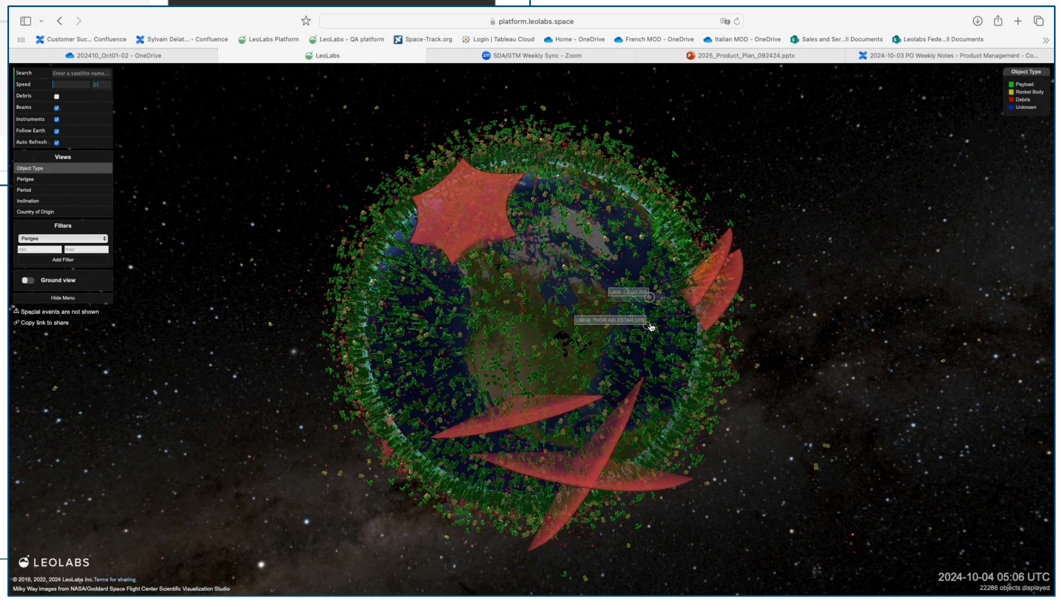
Key Performance Indicators
9/4/2024 - 10/4/2024

LATENCY TIME - RADAR PASS TO STATE VECTOR 4 MIN	ACCURACY VS TRUTH DATA DIFFERENCE BETWEEN LEOLABS & TRUTH DATA 56 METERS	PRECISION OF STATE VECTORS RMS UNCERTAINTY 18 METERS
RADAR PASSES 2,653,117	MEASUREMENTS 45,364,995	OBJECTS 22,465
STATE VECTORS 2,586,241	OPERATIONAL EPHEMERIS SCREENINGS 954,723	

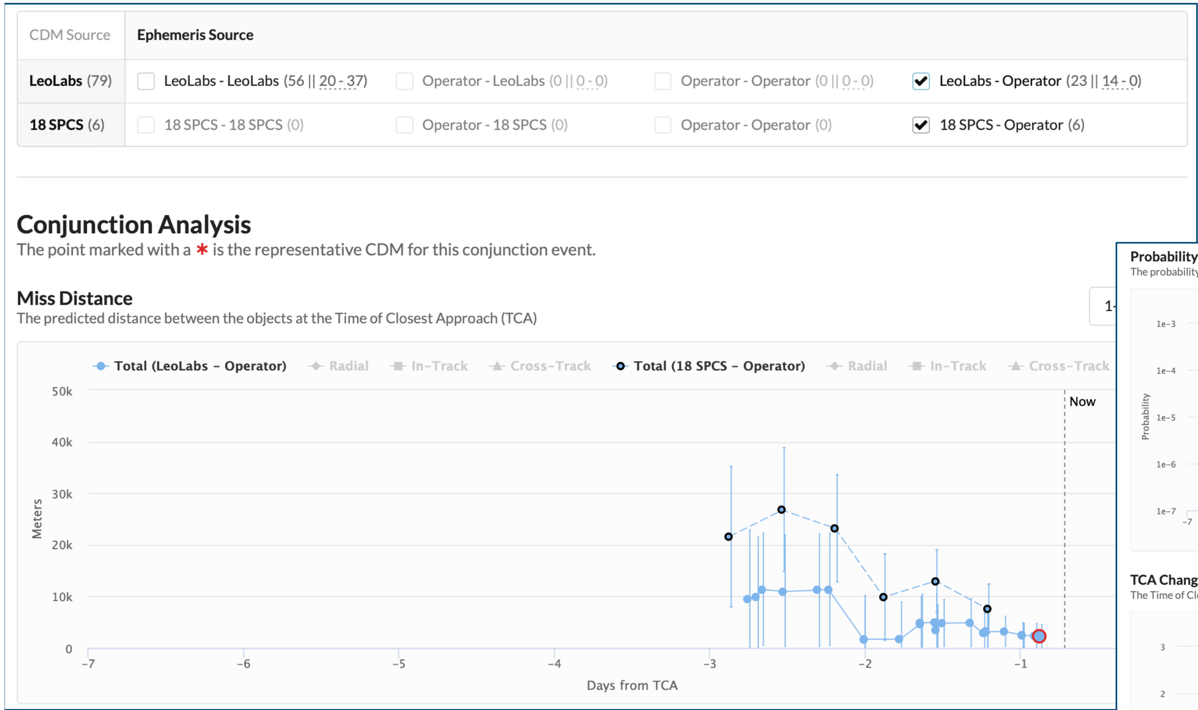
Livestream Counter
All time

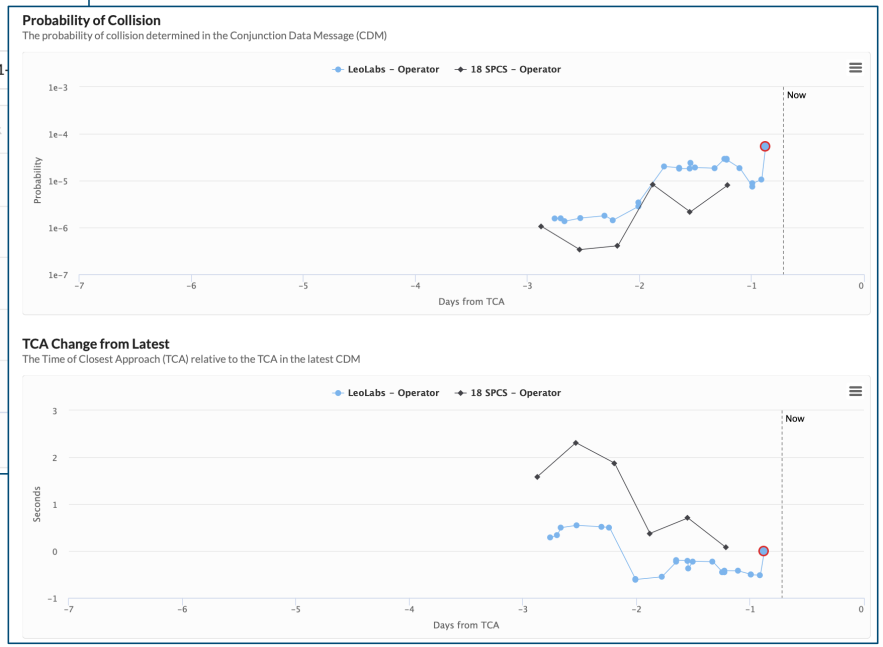
MEASUREMENTS
1,709,686,872

STATE VECTORS
81,445,961



STM and information sharing





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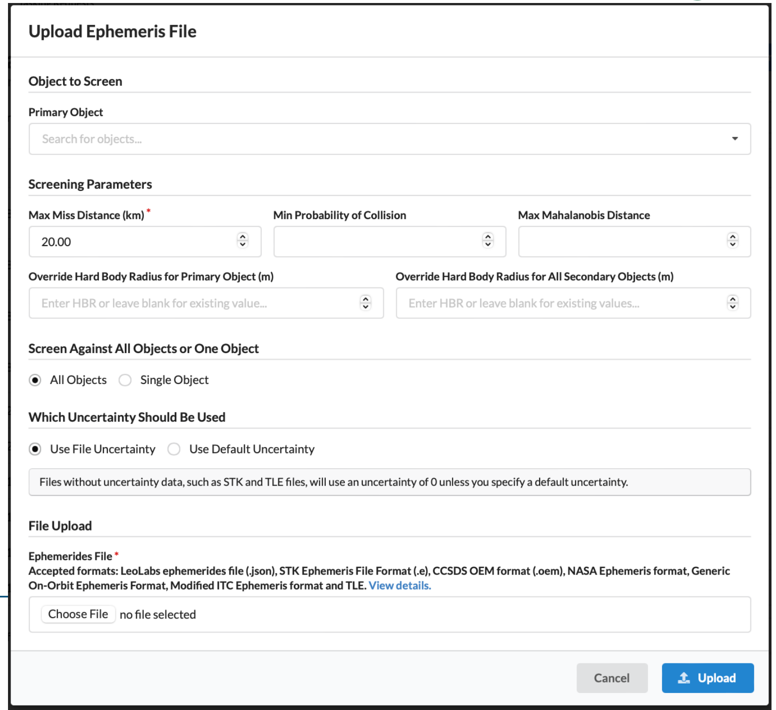
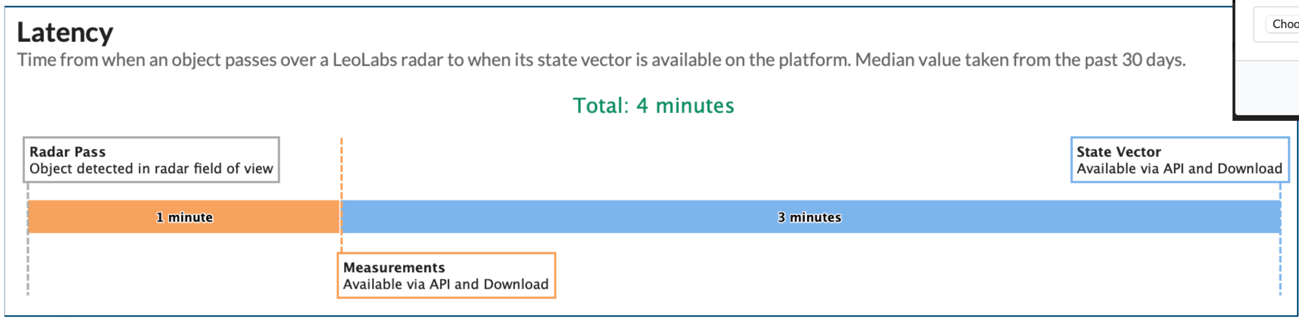
STM and improved Space Traffic Coordination : latency

- Streaming CDM service that provides a 24/7 screening of uploaded O/O ephemeris
- On-demand screening against LeoLabs catalog and results back in less than ~5 mn
- Average S/V generation : 4 mn





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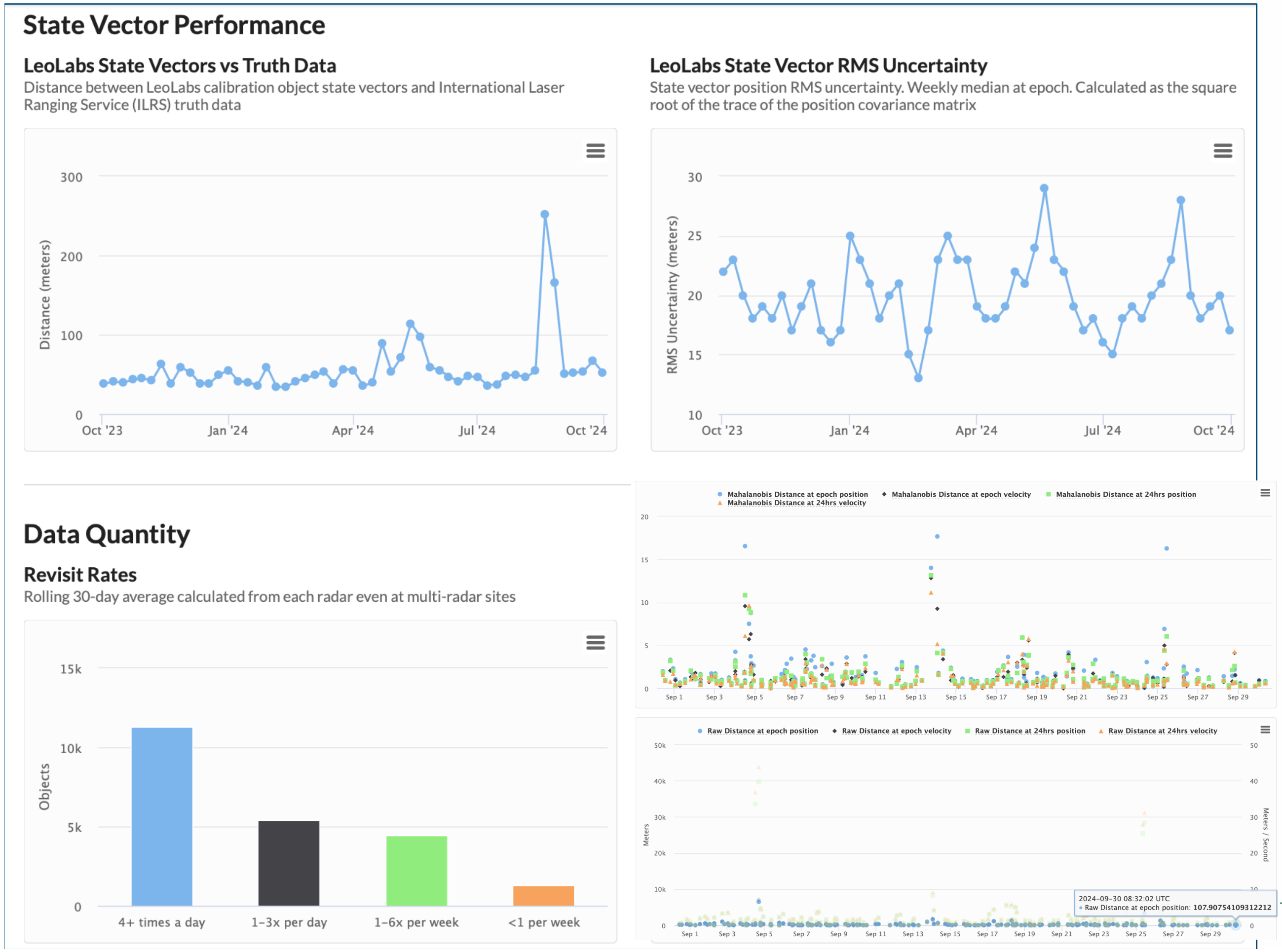
STM and performance : accuracy & transparency



- **Accuracy monitored and shared with operators**
- **Accuracy against truth data (ILRS) and self consistency**
- **High revisit rate for OD quality and operations timeliness**
- **Propagation accuracy shared with operators**

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Towards 2030 Zero Debris Charter's objectives

5. Access to timely and accurate data on space objects down to a size of 5 cm or smaller in low Earth orbit and 20 cm or smaller in geostationary Earth orbit should be improved to enhance decision making capabilities for collision avoidance.

- **Leolabs is expanding its radar network with next-generation UHF and S-band radars.**
  - **Increased capability in VLEO**
  - **Increased visibility of small objects**
  - **Increase detection capability (Launches, break-up events)**

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Towards 2030 Zero Debris Charter's objectives

4. Routine and transparent information sharing should be facilitated and active participation in strengthening global space traffic coordination mechanisms should be encouraged.

- **75% of the operational satellites in LEO are supported by LeoLabs services**
- **Active participation in Space Traffic Management processes definition**
- **Supports the U.S. Office of Space Commerce's Consolidated Pathfinder Project for its Traffic Coordination System for Space (TraCSS).**
- **Technical discussions with EUSST**

TRACSS

EU SST
Space Surveillance and Tracking

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THANK YOU.

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For more information, contact:

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