

COMSPOC Corp

Preserve and protect space operations and the benefits of space

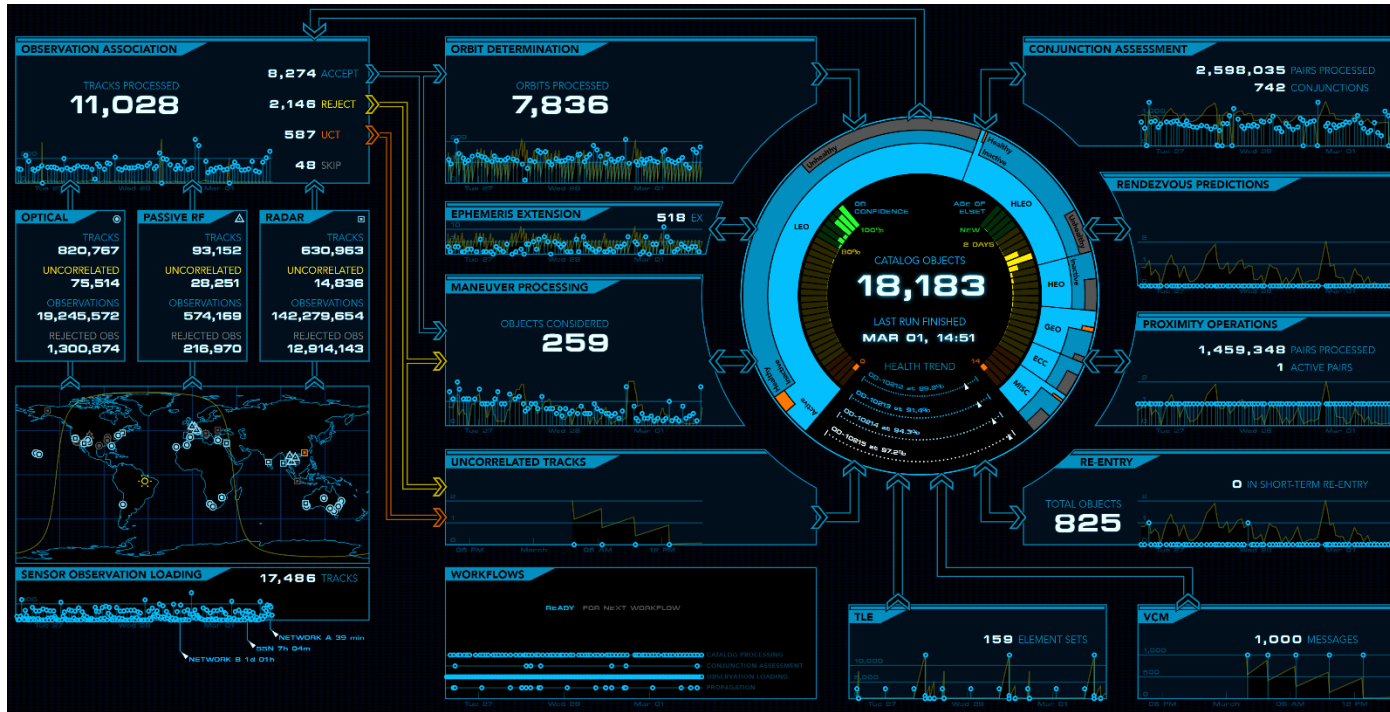
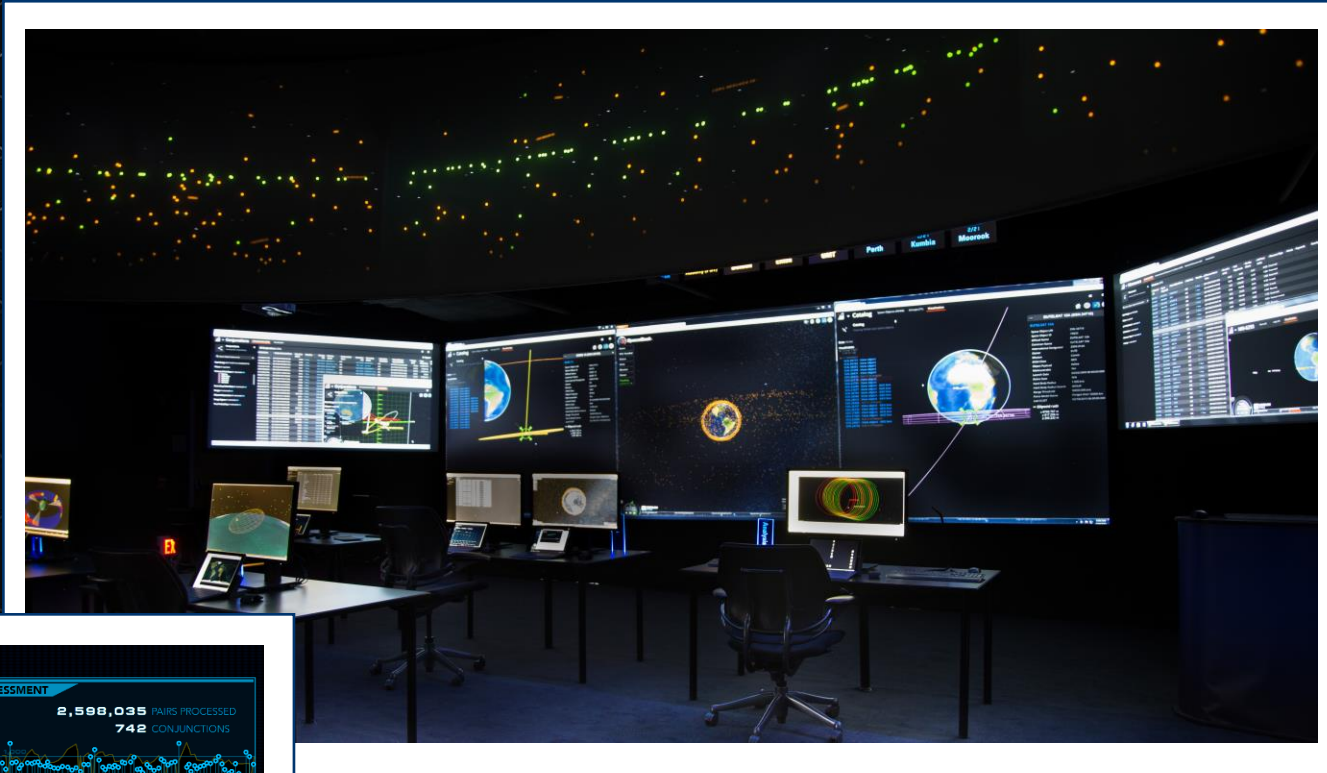
Jim Cooper
Lead, SSA Solutions
7 Jun 23



COMSPOC

Established 2014

www.comspoc.com



Unmatched Space Situational Awareness, Space Domain Awareness, and Space Traffic Management software and services to meet the current and emerging challenges of the space domain



COMSPOC

Protecting and characterizing the space domain
www.comspoc.com

Operations



Space Domain Awareness



Space Situational Awareness



Space Traffic Coordination & Mgmt.

Research and Standards Development



IMPORTANT
AFFILIATIONS



Featured Product Line



SSASUITE

Integrates all phases of space situational awareness, from initial observation collection and processing to actionable predictive analysis.



SOTA

Assesses space object's vulnerability to another's actions or events, decreasing satellite mission risk and increasing survivability against threats



SEG

Rapidly and accurately simulates space events for Test, Training, and Exercise (TTX).



ODSSA

Automatically characterizes non-cooperative maneuvers and allows analysts to examine and fix observation association problems.



AVOID

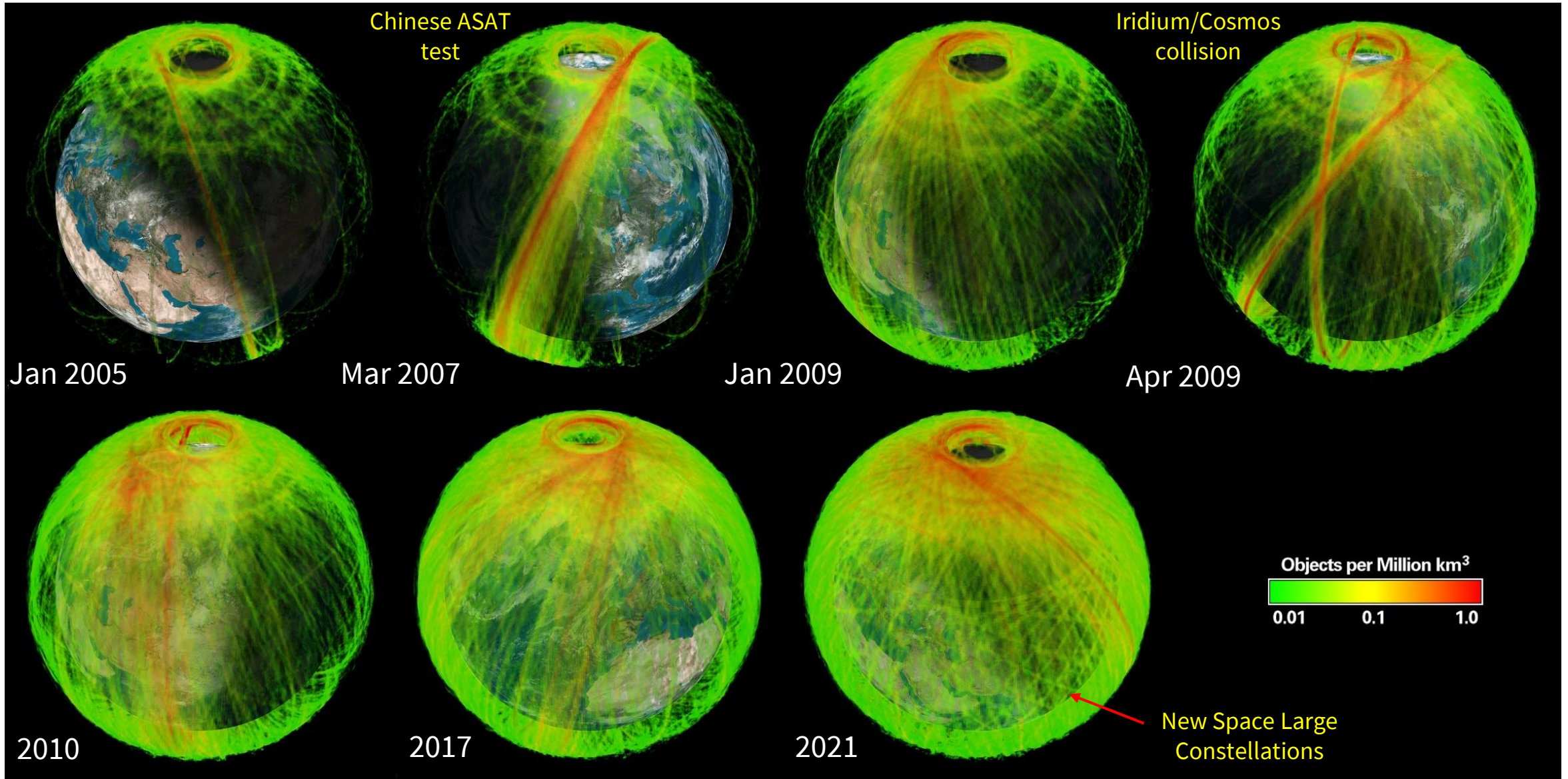
Analysis and Visualization for Orbit Insertion Deconfliction, providing Launch Collision Avoidance (LCOLA) support.

Congested, Contested Domain

New space and large constellations

Kinetic energy ASATs

There's a lot of "stuff" in space now! How did we get here?



The “**New Space**” Era – With access comes complexity



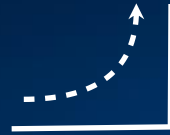
100,000+

New spacecraft applications filed for 2019-2029



42%

Of all payloads since 1957 have been launched within the past 5 years



6X

Objects/year over past 5 years compared to previous 50 years



15,000

Daily conjunctions within 10 km for all active LEO satellites

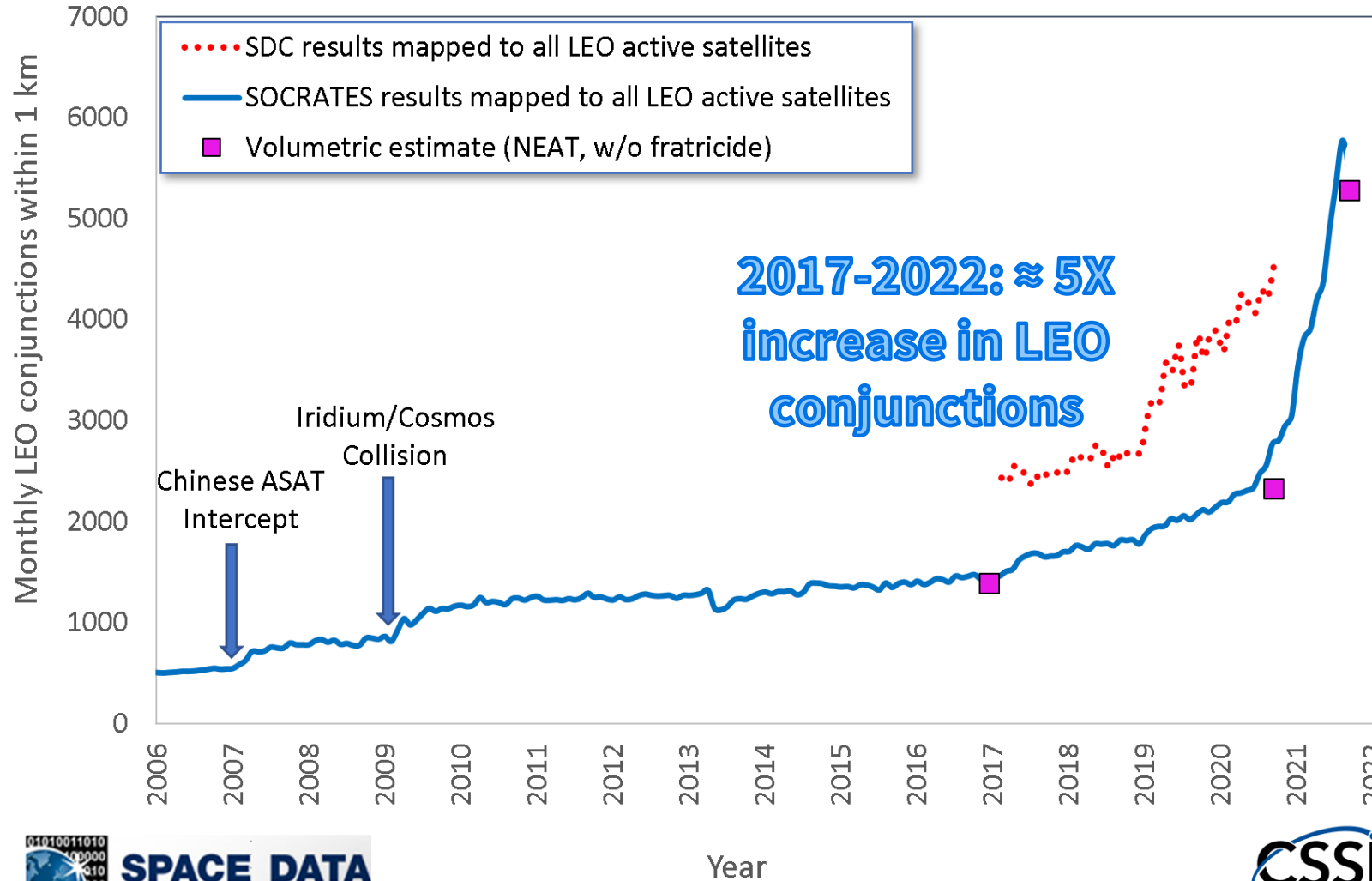
SPD-3 released Jun 2018



COMSPOC

Traffic and close conjunctions already increasing

Conjunction trend for active Low Earth Orbit (LEO) satellites



Average monthly conjunction rates surge from 2017 to 2020

Satellite operators are receiving warnings that their spacecraft are within 1 kilometer of another satellite or piece of tracked debris approximately twice as often as they did three years ago.

That was one of the key takeaways from data compiled for *SpaceNews* by Analytical Graphics Inc. (AGI), the Exton, Pennsylvania firm that hosts the Space Data Center, a platform that ingests information from Space Data Association satellite operators and compares it with commercial radar and telescope observations to assess conjunction risks and warn satellite operators. AGI also hosts Satellite Orbital Conjunction Reports Assessing Threatening Encounters in

potential collision risks since 2004.

In low Earth orbit, satellite operators typically evaluate the need for a collision avoidance maneuver when one of their satellites is expected to come within 1 kilometer of another object. Space Data Center and SOCRATES data indicate that in 2017, LEO spacecraft likely came within 1 kilometer of other objects an average of 2,000 times per month. Now, it's closer to 4,000 monthly conjunctions.

Those are averages. For some satellite operators, conjunction alerts may be increasing even faster. "As steep as this curve is, there are operators that are seeing even higher conjunction rates



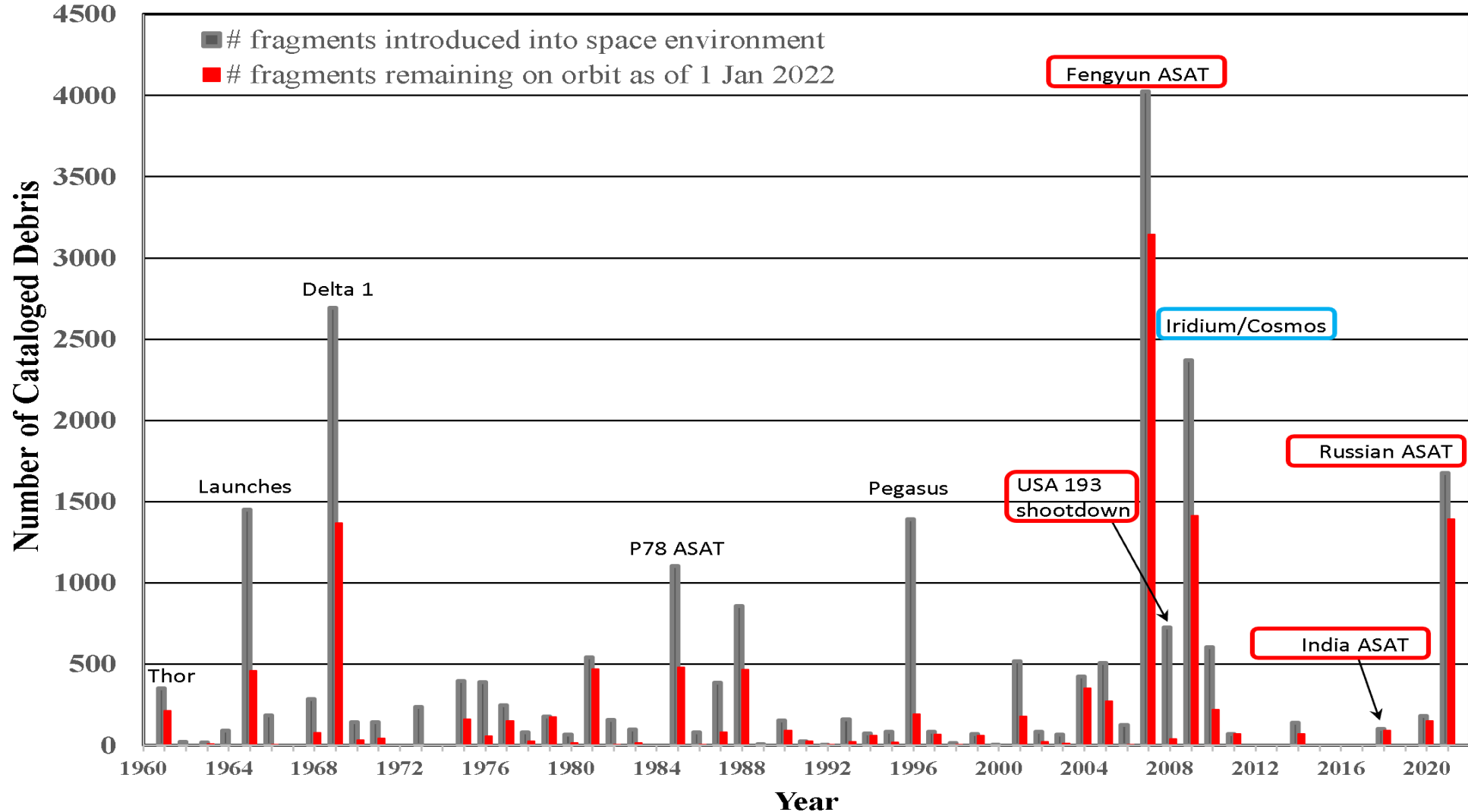
Russia ASAT

https://comspoc.blob.core.windows.net/public/Russian_ASAT_Test_COMSPOC_Modeling_.mp4

Major debris-generating events in space era

Debris fragments introduced annually, 1960 - 2021

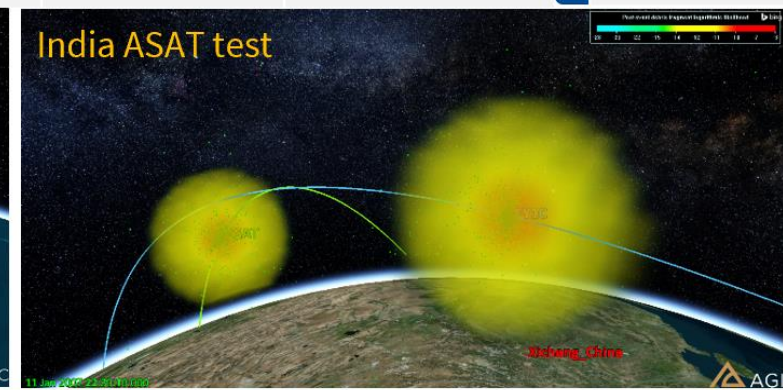
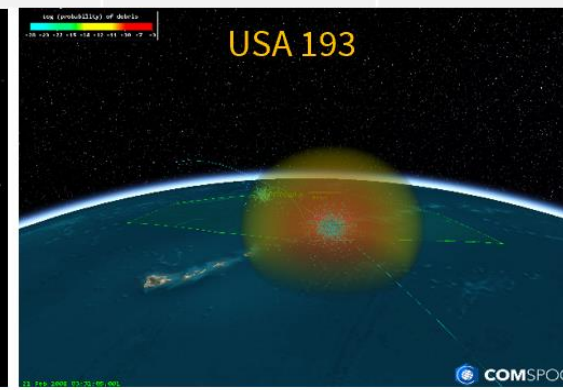
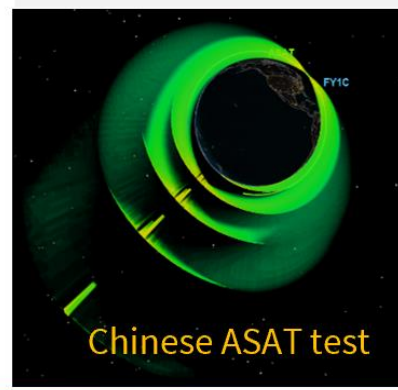
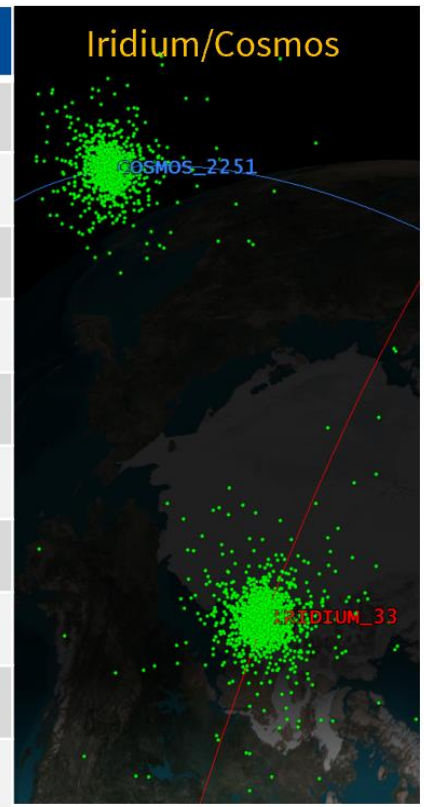
Note: Labeled peaks denote major (but not only) debris source that year



Comparison of major fragmentation events since 2000

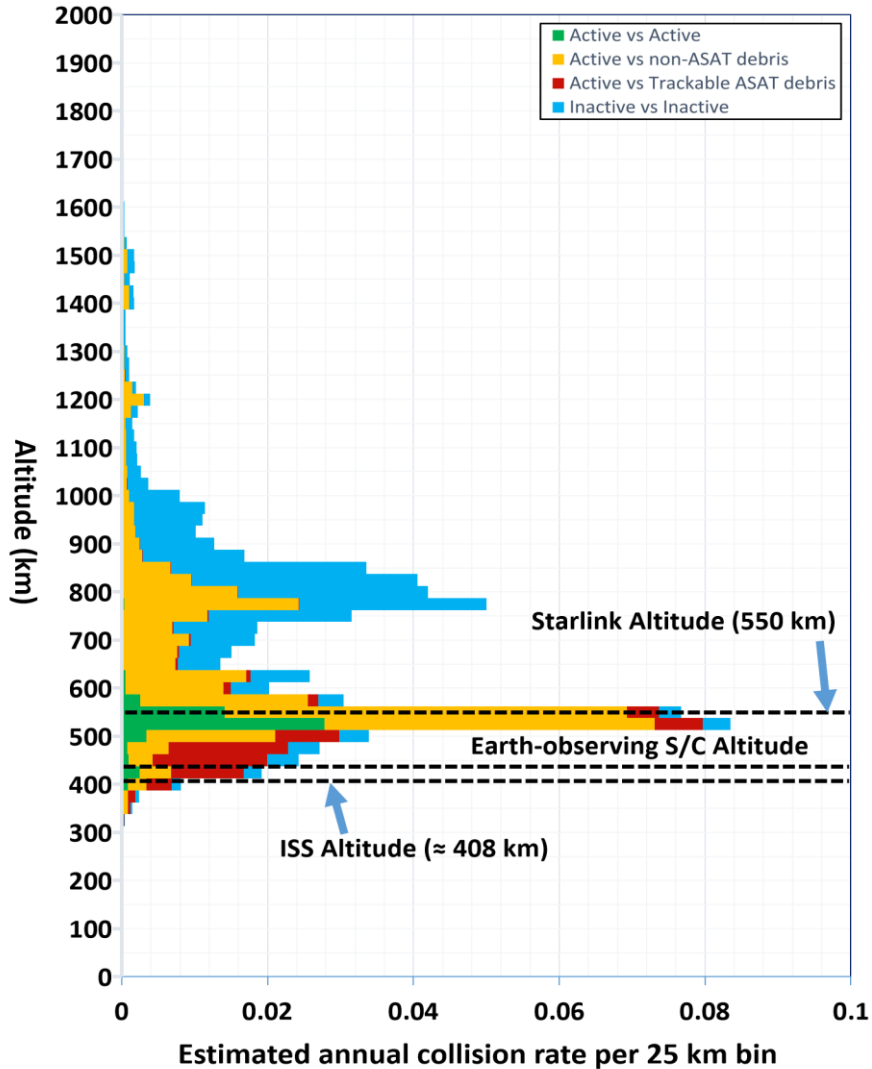
NOTE: $J/kg = \frac{1}{2} \frac{m_{interceptor}}{m_{target}} \Delta V_{intercept}^2$

Category	Chinese ASAT	USA 193	Indian ASAT	Russian ASAT	Iridium/Cosmos collision
Date	11 Jan 2007	21 Feb 2008	27 Mar 2019	15 Nov 2021	10 Feb 2009
Altitude (km)	856	246	282	461	769
Velocity (hypervelocity ~ > ≈ 6)	14.8 km/s	8.49 km/s	9.4 km/s	4.6 km/s	11.6 km/s
≈ kJ/kg (catastrophic ≈ >40)	15,000-35,000	1,500 – 2,500	6,000	500 – 1,000	51,500
Debris tracked by SSN	3,532	174	129	1,604 (so far)	2,369
Simulated trackable* debris	3,007	452	936	1,246	2,651
Simulated Lethal Non-Track	34,733	3728	10,439	16,386	7,883
80 th percentile lifetime (yrs)	63	0.03	0.05	1.5	56
“RSO-years” (trackable)	130,347	13	65	2,098	108,230
“RSO-years” (LNT)	1,225,972	94	784	16,464	257,442

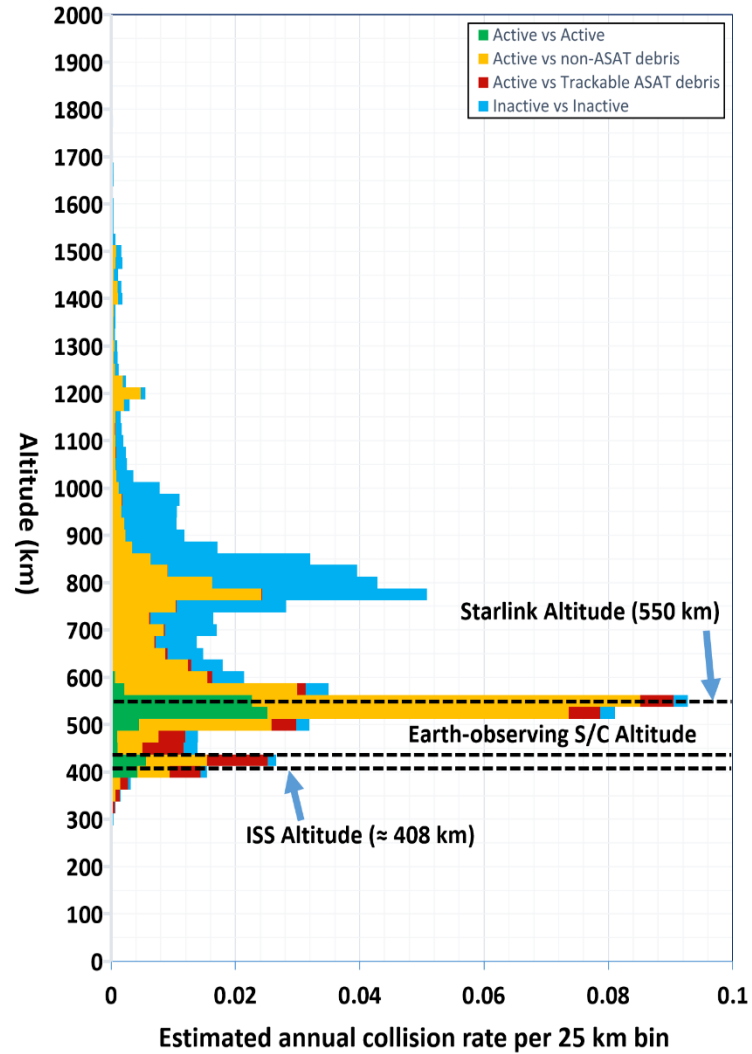


Annual collision risk during “tenure” of Russian ASAT Debris

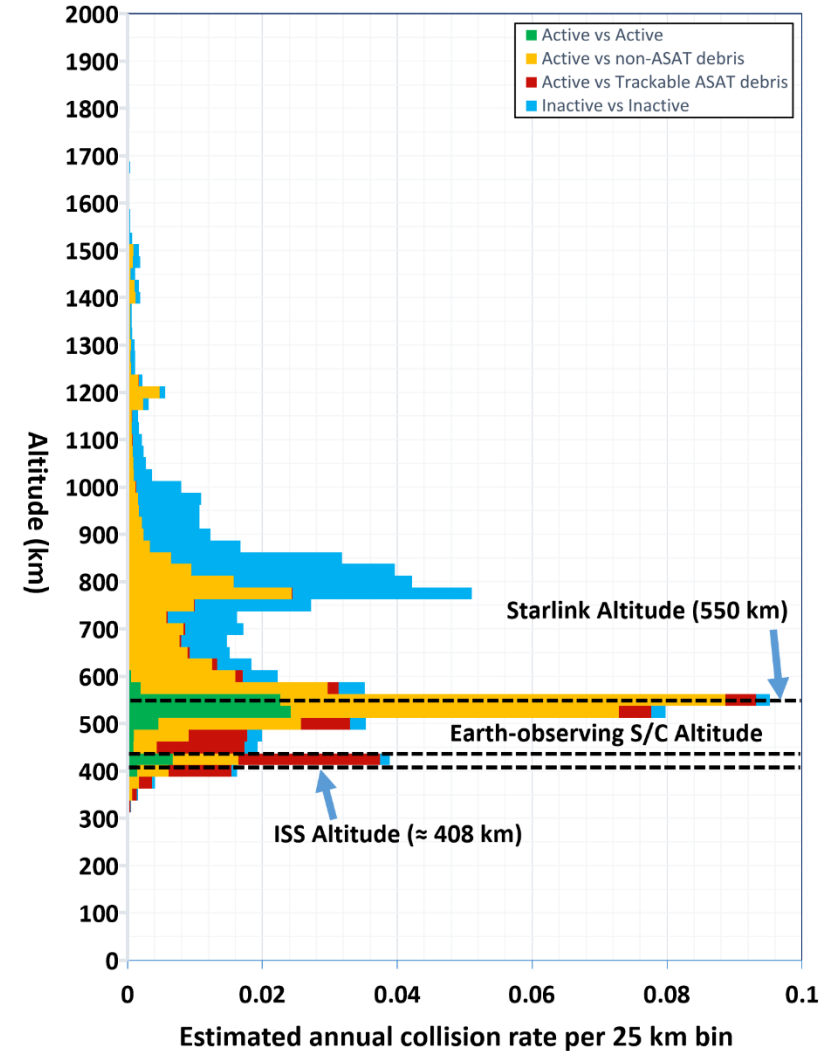
Annual collision risk by RSO type: 24 Jan 2022



Annual collision risk by RSO type: 30 Jul 2022



Annual collision risk by RSO type: 8 Aug 2022

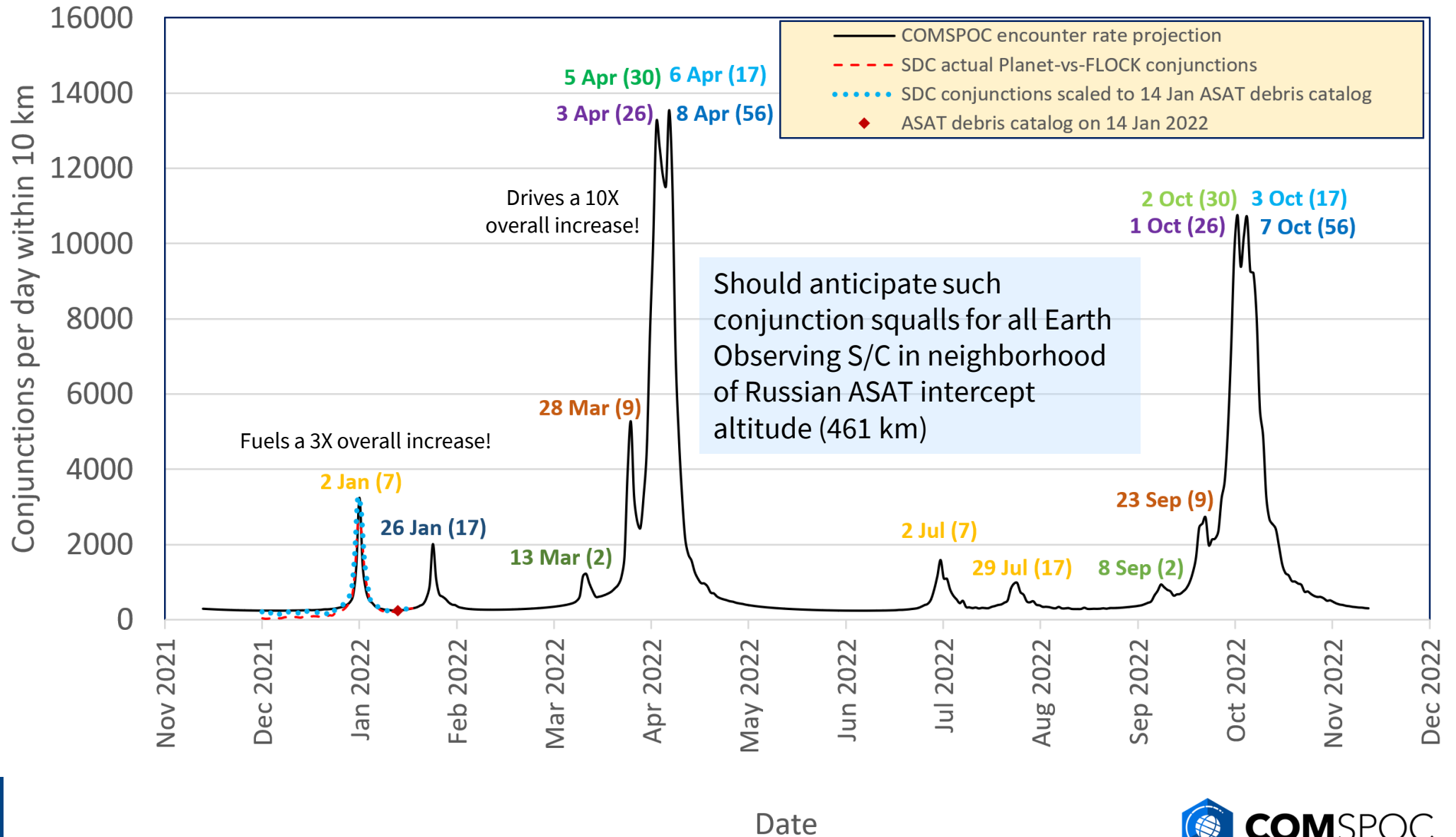


Planet Flock conjunctions w/ASAT debris

<https://comspoc.blob.core.windows.net/public/Planet-Flock-conjunctions-w-Russia-ASAT.wmv>

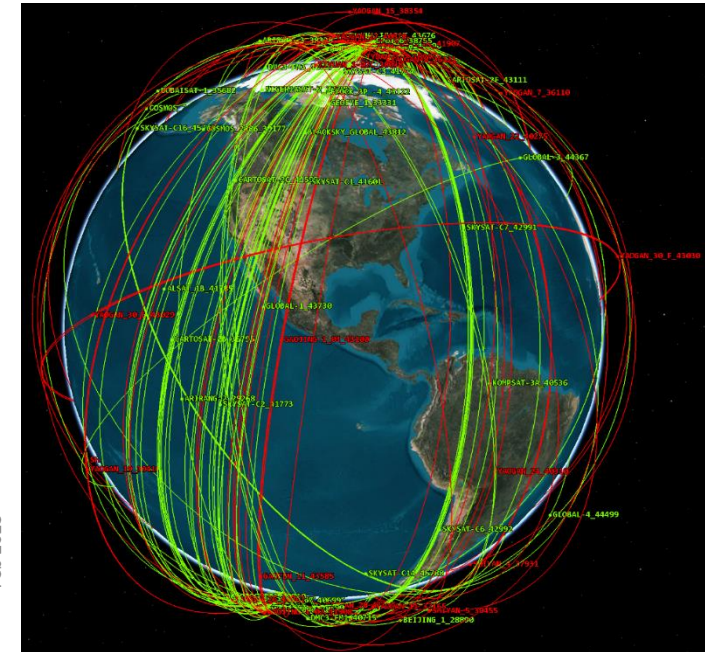
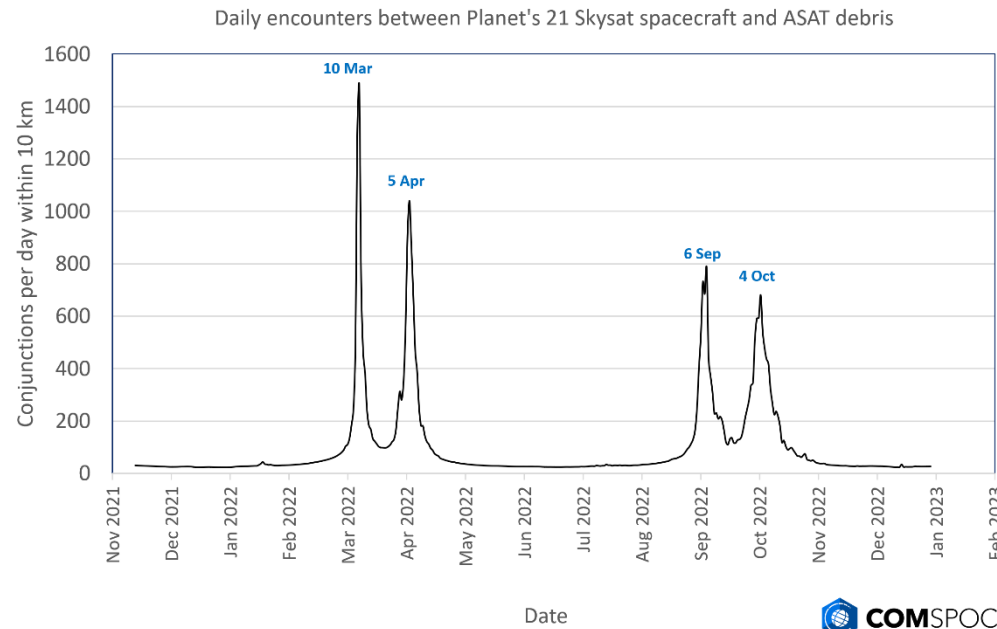
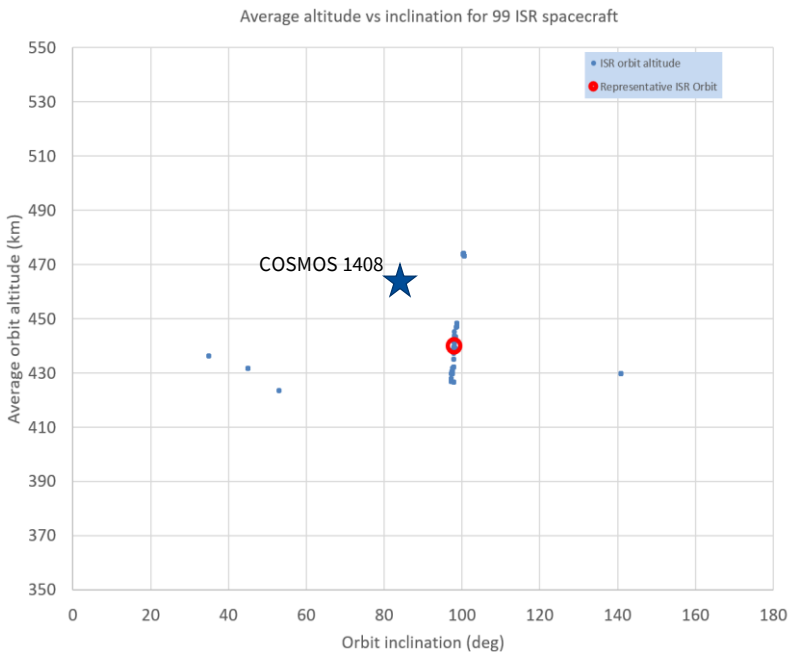
ASAT debris causing “Conjunction Squalls”

Daily encounters between Planet's 168 FLOCK spacecraft and ASAT debris



Other Earth observing spacecraft similarly at risk

- Earth Observing S/C tend to be Sun synch ($i \approx 98^\circ$) at ≈ 440 km
 - All will experience Russian ASAT conjunction squalls
 - Planet's SkySat constellation experienced four of them in 2022
 - Are Earth observing satellite operators and SSA centers aware and prepared?
- Fragmentation-based conjunction squall peaks disperse after several years



Who was affected?

- All Earth Observing systems using sun-synchronous orbits adversely affected.
 - “Conjunction squalls” may overload flight safety systems and spacecraft operators.
 - CubeSat Earth observing constellations face greatest increase in warnings (e.g., < 10 km miss)
 - Larger Earth observing spacecraft will likely face greatest actual risk due to spacecraft size
- Other operators affected (ISS experiencing $\approx 33\%$ increase in conjunctions; Starlink)

This afternoon, the International Space Station's [Progress 81](#) thrusters fired for 4 minutes, 34 seconds in a Avoidance Maneuver (PDAM) to provide the complex and extra measure of distance away from the predicted Russian Cosmos 1408 debris.

16 Jun 2022



30 Apr

The ESA satellite in question was Sentinel-1A, an Earth observation satellite launched in 2014. The space agency wrote in a tweet: "On Monday, for the first time, we performed a set of manoeuvres to avoid a high-risk collision with space debris created in the Cosmos 1408"

18 May 2022

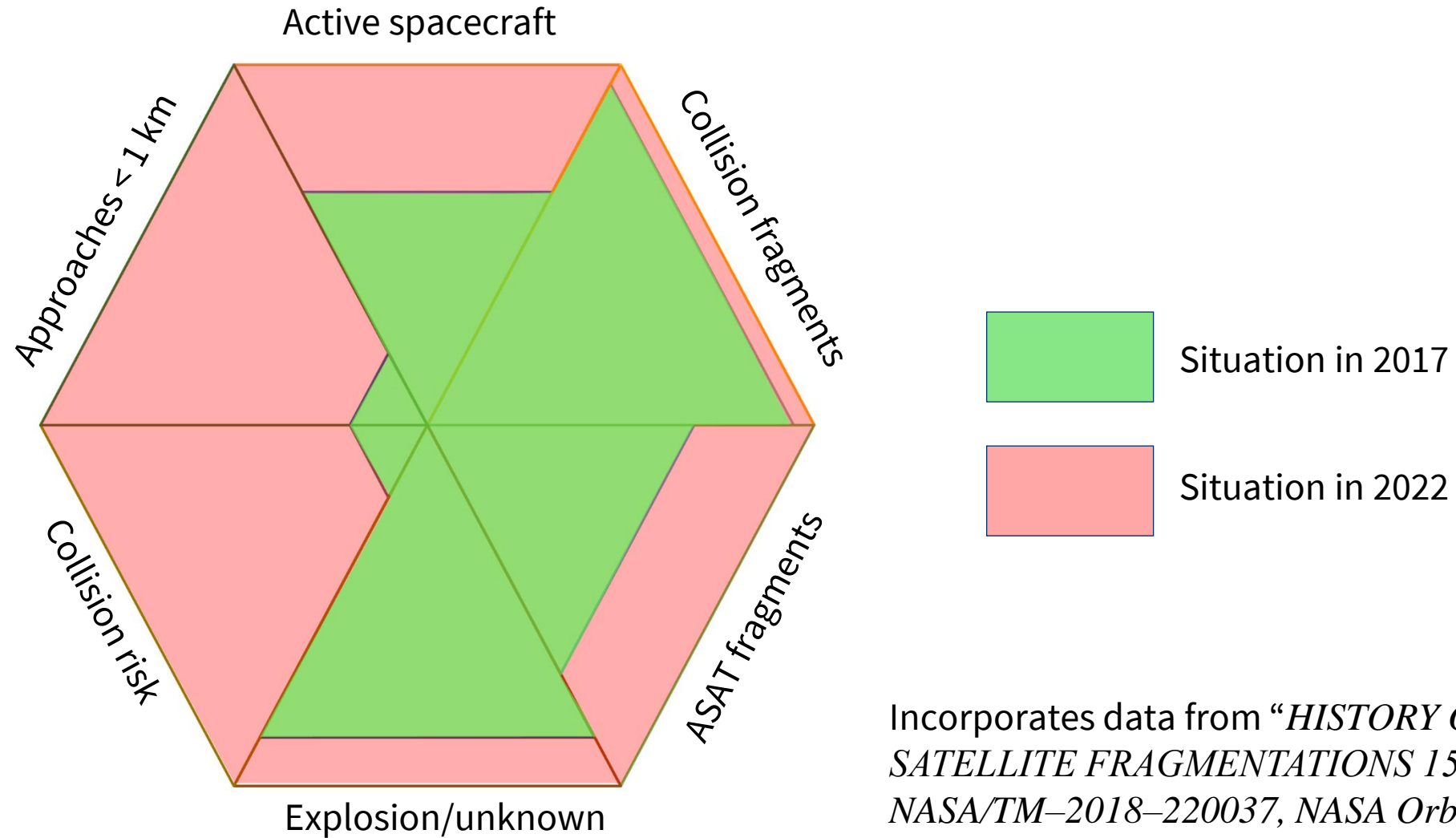
On Monday, for the first time, we performed a set of manoeuvres to avoid a high-risk collision w. #SpaceDebris created in the #Cosmos1408 anti-satellite test last year. This was a difficult #CollisionAvoidance manoeuvre. 🌞🌞 to our #Sentinel1A Control Team & Space Debris Office

Space debris from a Russian anti-satellite missile test came within 47 miles of knocking out China's Tsinghua University satellite this week, Beijing

China reportedly downed its own defunct intelligence satellite November 15. The test in Russia's 'anti-satellite test' almost hit a Chinese satellite on Tuesday. Space agencies need to clear Earth's orbit of space junk to prevent collisions

CHADWICK FOR MAILONLINE 9:51, 21 January 2022 | UPDATED: 10:39, 21 January 2022

Increases in space population and operational risk



Incorporates data from “*HISTORY OF ON-ORBIT SATELLITE FRAGMENTATIONS 15th Edition*”, NASA/TM–2018–220037, NASA Orbital Debris Program Office, 4 July 2018 and COMSPOC research

Conclusions

- We all need to care about and ensure space sustainability
- ASAT tests are a pressing threat to security and sustainability
 - U.S. unilaterally committed to a moratorium on destructive direct ascent anti-satellite missile tests
 - Asks other nations to commit to help establish this as an international norm
 - Subsequently joined by Canada, New Zealand, Japan, Germany, United Kingdom, South Korea, Australis, Switzerland and France
 - UN Open Ended Working Group on Space, as well as this year's UN General Assembly meeting, are opportunities to solidify this norm
- Space operations adherence to best practices, norms of behavior, data exchange standards, transparency, and UN and ISO guidelines and treaties is also extremely important
 - Resources: UN, IADC, ISO, CCSDS, NASA, 18SDS, SSC, SWF, CSF, AIA, SIA...



SPACENEWS

Canada joins U.S. in ASAT testing ban

by Jeff Foust — May 9, 2022



WASHINGTON — The Canadian government announced May 9 that it is joining the United States in banning tests of destructive direct-ascent antisatellite weapons as a step toward norms of responsible behavior in space.

