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ISSUE 113 | 19 JAN 2025

ISR UNIVERSITY

SPACE FORCE ASSOCIATION

In This Issue

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Catalog

2025 SPACE COURSE CALENDAR

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TAKE YOUR UNDERSTANDING OF ORBITAL MECHANICS TO THE NEXT LEVEL AND SOLVE COMPLEX SPACE CHALLENGES WITH CONFIDENCE.

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STEP INTO STRATEGIC LEADERSHIP ROLES WITH THE ADVANCED SKILLS TO LEAD MULTI-DOMAIN SPACE OPERATIONS AT THE HIGHEST LEVEL.

'25 DATES

11 MAR '25 13 MAR '25 Offering SP900	17 MAR '25 11 MAY '25 Offering SP100, SP200, SP300, SP310	19 MAY '25 13 JULY '25 Offering SP100, SP200, SP300, SP310	
21 JULY '25 14 SEPT '25 Offering SP100, SP200, SP300, SP310	5 AUG '25 7 AUG '25 Offering SP900	22 SEPT '25 16 NOV '25 Offering SP100, SP200, SP300, SP310	

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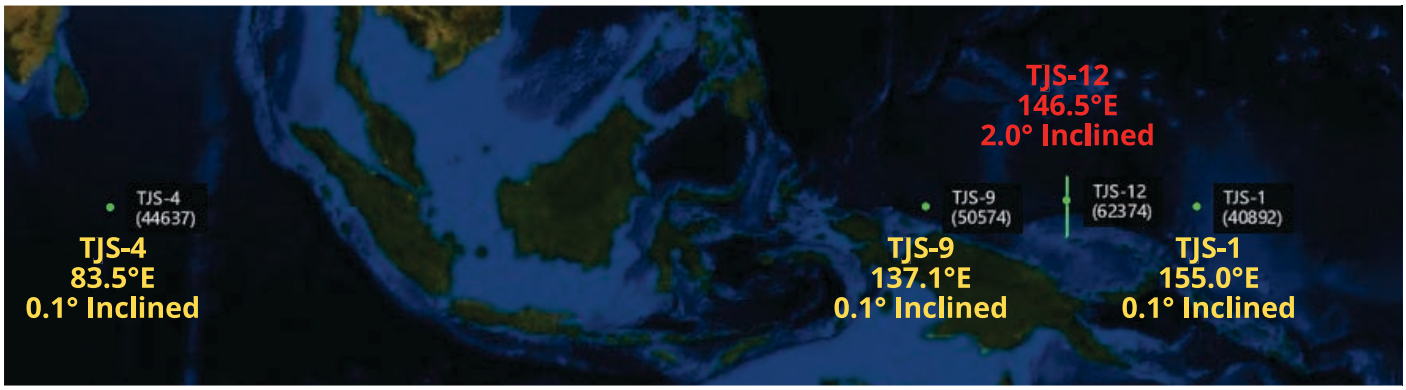
TJS-12 Update & a Theory

31 Dec: China placed its TJS-12 (62374) satellite, launched on 20 Dec 2024, into Geosynchronous Orbit (GEO) over the Earth at 146.5°E. TJS-12 is inclined 2.0°; higher than any of the other suspected TJS Missile Warning or SIGINT satellites. At its current location, TJS-12 is located 1.7° west of Gaofen-13 02 (55912), a Chinese GEO based imaging satellite launched in 2023. Interestingly, GF-13 02 maneuvered from its position at 146.6°E to 148.2°E in early October 2024. The relationship between TJS-12 and GF-13 02 has some similarities to that of TJS-11 (59020) and Yaogan-41 (58582).

- TJS-12 was first observed at 146.5°E and 2.0° inclination on 31 Dec 2024.
  - Per Orbital Focus other GEO satellites in the area are GF-13 02 at 148.2°E and Shiyan 9 (47851) at 149.0°E. Shiyan 9 is inclined 17.7°.
  - Coincidentally, SJ-23 (55131) was also in the area as it drifts east along the GEO belt. On 10 Jan 2025 SJ-23 was ~120km from TJS-12 with a solar phase angle of 124° making it favorable for imaging (see graphic next page).
  - TJS-12's GEO position, 146.5°E, was also the initial position for TJS-7 (49115) before it relocated to the western hemisphere. TJS-7 is now over the equator at 99.4°W which is due south of the state of Texas. However, China is actively maintaining TJS-7's inclination between 0.0 and 0.6°. The mission of TJS-7 remains unknown.
- Per Gunther's Space Page, TJS-12 is possibly associated with China's Qianshao-3 SIGINT constellation. TJS-12 may also be a GEO based missile warning satellite.
  - Gunther's lists TJS-1 (40892), 4 (44637), & 9 (40892) as being possible SIGINT satellites.
  - TJS-12 is situated between TJS-1 and TJS-9. It is 8.5° west of TJS-1 (155.0°E) and 9.4° east of TJS-9 (137.1°E).
  - TJS-12's 2.0° inclination is unique to this group of satellites. TJS-1, 4, & 9 inclinations are 0.1°.
- China's official launch statement noted TJS-12 was developed by SAST. This is significant in that SAST is believed to be the developer of the 4 TJS missile warning satellites China operates in GEO: TJS-2 (41911), TJS-5 (44978) & TJS-6 (47613).

At this time the mission of TJS-12 remains unknown. It is likely fulfilling either a SIGINT or Missile Warning function but other uses remain possible.



Possible Chinese GEO Based SIGINT Satellites (spaceaware.io)

Possible Chinese GEO Based Missile Warning Satellites (spaceaware.io)

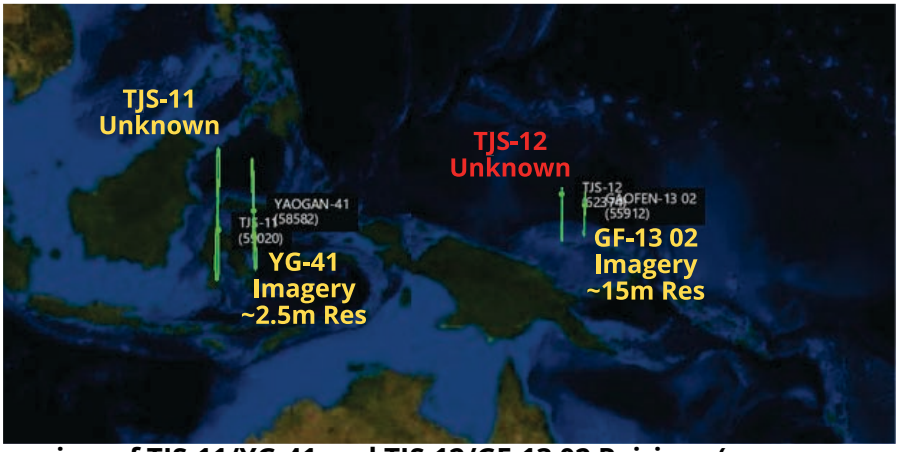
TJS-12 Update & a Theory (contd)

- Comparison between TJS-12 / GF-13 02 and TJS-11 / YG-41 "Pairings"

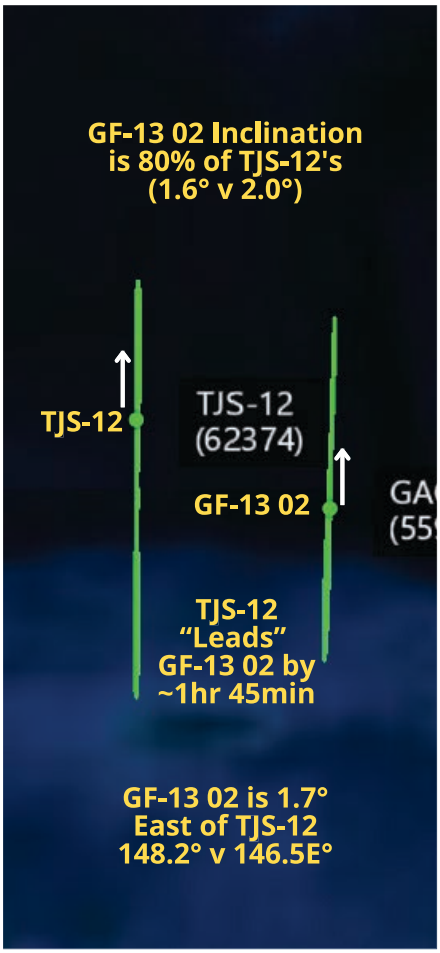
- Location
  - TJS-12 is at 146.5°E, GF-13 02 is at 148.2° a difference of 1.7.°
  - TJS-11 is at 120.3°E, YG-41 is at 123.1°E a difference of 2.8°.
- Inclination
  - GF-13 is inclined 1.6° or 80% of TJS-12 2.0° inclination.
  - YG-41 is inclined 4.2° or 84% of TJS-11 5.0° inclination.
- Phasing
  - TJS-12 "leads" GF-13 02 by about 1hr 45min.
  - YG-41 "leads" TJS-11 by about 1hr 06 min.

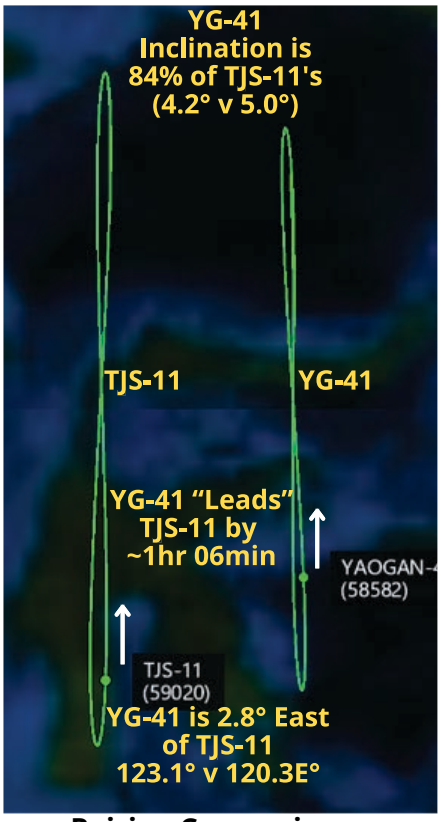
- Background

- GF-13 02 is one of China's GEO based imagery satellites and are believed to have a 15m resolution. China launched GF-13 02 on 17 Mar 2023. From Apr 2023 - Oct 2024 GF-13 02 was located at 146.7°E, very near where TJS-12 is now. **On ~8-9 Oct GF-13 02 decreased its SMA ~52km initiating an eastward drift. China relocated the satellite at 148.2°E on 13 Oct 2024 where it has remained.**
- YG-41 is also an imagery satellite (launched in late-2023) but has a better resolution than GF-13 02. China used its most powerful rocket, the LM-5, with an extended fairing to launch the satellite into GTO. Yaogan-41 is believed to have resolution down to around 2.5 meters and can likely see, identify and track car-sized objects throughout the entire Indo-Pacific region.
- The mission of TJS-11 remains unknown. Like YG-41, China used the LM-5 with extended fairing to launch the satellite. China released little information regarding the satellite's mission, stating it would be mainly used to carry out multi-band, high-speed satellite communication technology verification.



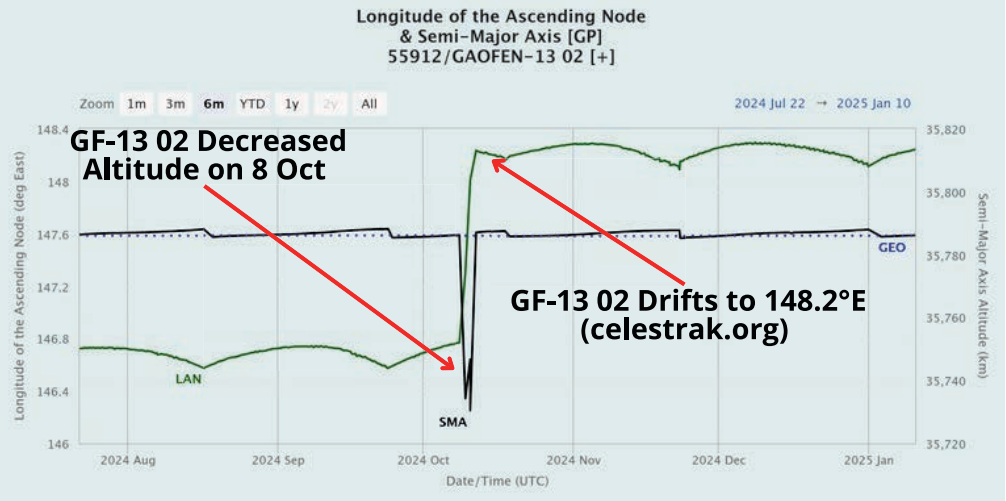
Overview of TJS-11/YG-41 and TJS-12/GF-13 02 Pairings (spaceaware.io)



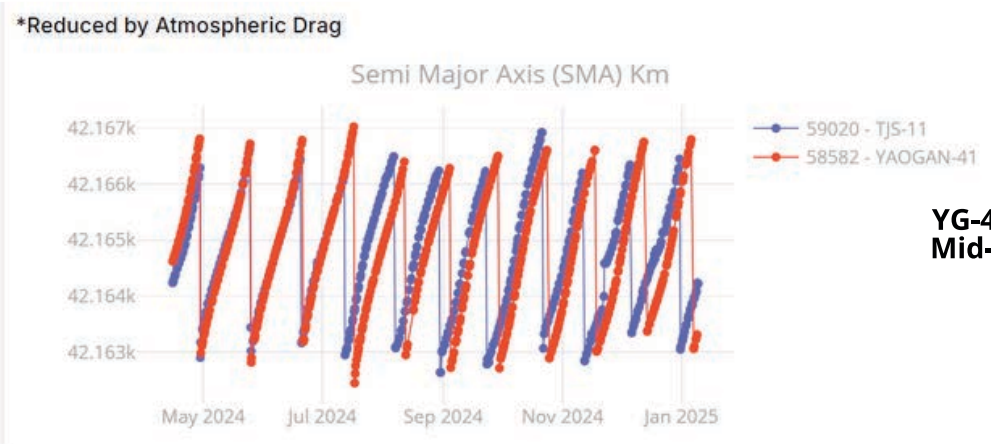


Pairing Comparison (spaceaware.io)

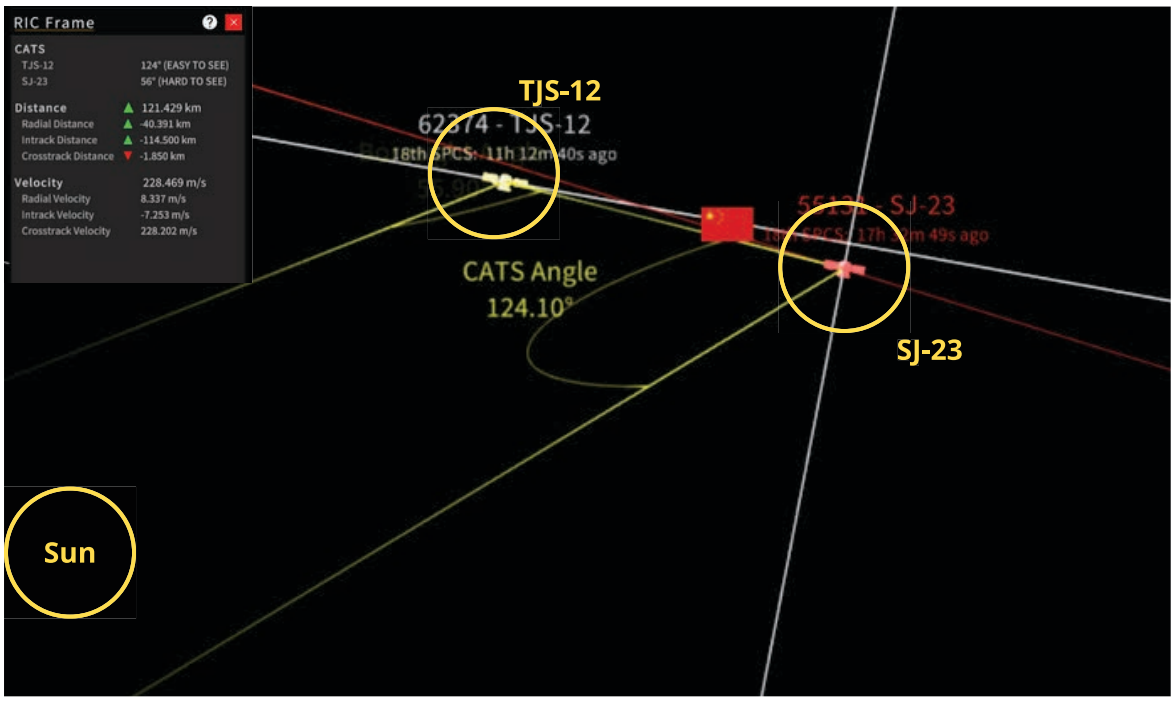
TJS-12 Update & a Theory (contd)



GF-13 02 Maneuvered 8-10 Oct 2024 & Relocated from 146.6°E to 148.2°E 71 days prior to TJS-12 Launch (celestrak.org)



YG-41 & TJS-11 Stationkeeping Mid-April 2024 - early-Jan 2025 (spacecockpit.com)



Curious Timing: SJ-23 ~121km from TJS-12 on 10 Jan 2025 13:09Z with favorable lighting conditions (spacecockpit.com)

Fill 'er Up? Shijian-25 Launched, Co-planar with Shijian-21

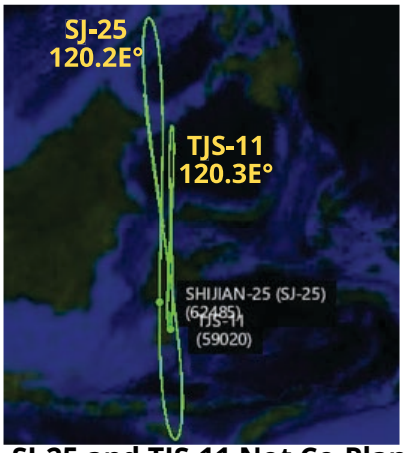
16 Jan 2025: On 6 Jan 2025 China launched a Long March-3B with the Shijian-25 (62485) satellite from Xichang. According to official sources, the satellite entered the planned orbit and will be "primarily used for the verification of satellite fuel replenishment and life extension service technologies". Most interesting is the fact that China placed SJ-25 into a co-planar orbit with Shijiian-21 (49330.) SAST is the manufacturer for both SJ-21 and SJ-25 satellites. SJ-21 may be the intended refueling customer. Launch Video.

- China maneuvered SJ-25 out of GTO on ~13 Jan 2025. China has placed the satellite at 120.2°E which is 0.1° west of TJS-11. SJ-21 is 28.6° away at 148.8°E.
- SJ-25's orbit is inclined 10.2° with a RAAN (orbit twist) value of 43.75°. SJ-21 is also inclined 10.2° and has nearly the exact same RAAN value of 43.745°.
- Recall that for two objects to be co-planar they must have the same inclination and RAAN. SJ-25 and SJ-21 meet this criteria. Also recall that changing inclination or RAAN requires significant energy/fuel.
- Why China initially located SJ-25 "near" TJS-11 is an open question. Examining their orbits, SJ-25 does not get closer than 450km from TJS-11. TJS-11 is inclined 5.0° with a RAAN of 322.3°...it is NOT co-planar with SJ-25.
- China can relocate SJ-25 to conduct proximity operations with SJ-21 using only 22-32m/sec of fuel. The exact fuel usage will depend on how quickly China moves SJ-25 to intercept SJ-21. Thanks to Bob Hall and the COMSPOC team for their analysis.

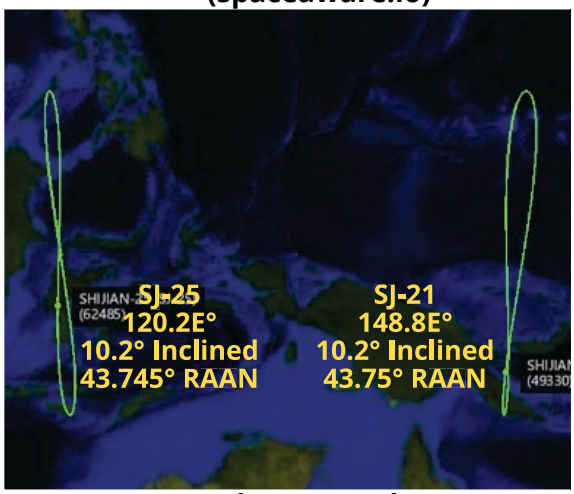
-Background on SJ-21

- SJ-21 launched on 24 Oct 2021. After launch China announced it was intended to perform debris mitigation experimentation.
- In late January 2022, SJ-21 docked/captured a defunct Chinese satellite to dragged it 300km out of geostationary orbit and into a "graveyard orbit." The test demonstrated capabilities only previously exhibited by the United States and may have been the first capture of a non-cooperative target in GEO. See COMSPOC Video & Exoanalytic Video.
- SJ-21's last maneuver occurred on ~10 Jul 2023 when it decreased its altitude ~64km. At the time its inclination was 9.2°. For the past 555 days SJ-21 has not maneuvered and its inclination naturally increased to 10.2°.

SAST Refueling Satellite Rendering at the 2022 Zhuhai Airshow (nasaspaceflight.com)



SJ-25 and TJS-11 Not Co-Planar (spaceaware.io)



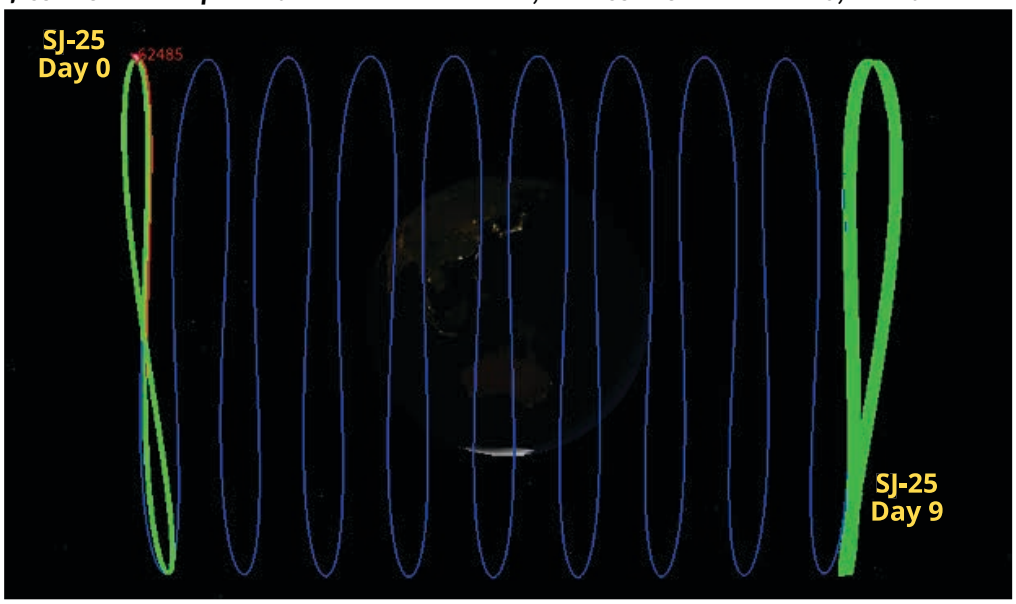
SJ-25 and SJ-21 Co-Planar (spaceaware.io)

Shijian-25 & Shijian-21 Contd

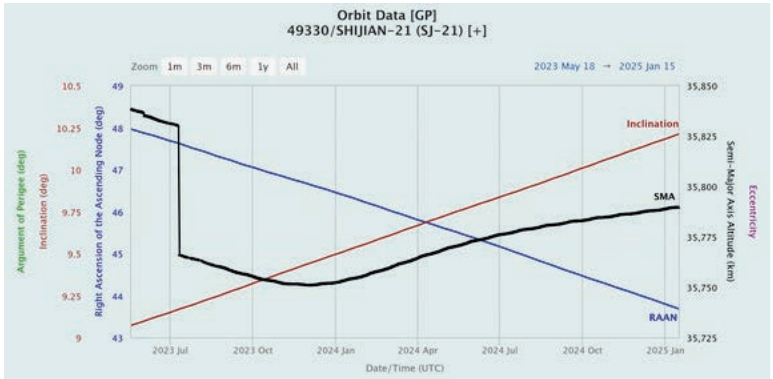
- Background on SJ-25: Per Andrew Jones:

- Shijian-25 was developed and manufactured by the Shanghai Academy of Spaceflight Technology (SAST), a major CASC subsidiary. The spacecraft will be used for "satellite fuel replenishment and life extension service technology verification," according to a SAST statement.
- The Shijian-25 mission suggests China is focusing on advancing capabilities for maintaining and prolonging the operational lifespan of satellites already in orbit. Such capabilities can reduce costs and improve sustainability in space operations.
- While the mission may be focused on extending the lifetime of a civilian satellite, the capabilities could, for example, be used in the future to support military satellites through on-orbit servicing. The People's Liberation Army is known to be working on the technology and training tools for on-orbit satellite refueling for both peacetime and wartime scenarios.

The fact SJ-25 is co-planar with SJ-21 strongly suggests SJ-21 is the intended refueling target. Both satellites were manufactured by the Shanghai Academy of Spaceflight Technology increasing the chances of collaboration between development/design teams. SJ-21 may have expended most of its onboard fuel during the debris mitigation demonstration and it may have been equipped for refueling in anticipation of SJ-25 development and launch. Time, and SJ-25 maneuvers, will tell.



COMSPOC Model of 9-10 day transfer of SJ-25 to SJ-21
Fuel Use Estimates for SJ-25 to RPO w SJ-21 Co-Planar
Arrival in 1 week ~32 m/sec
Arrival in 2 weeks ~22 m/sec
(COMSPOC Space Object Threat Assessment tool – SOTA)

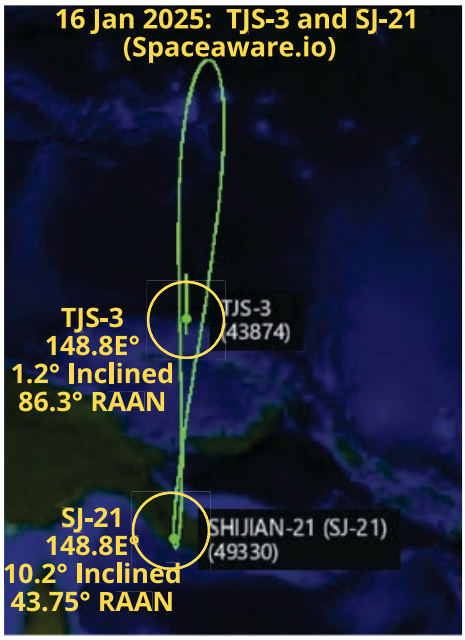


SJ-21 Altitude, Inclination & RAAN
May 2023-Jan 2025 (spaceaware.io)

SJ-21 Coin (@raz_liu via X)

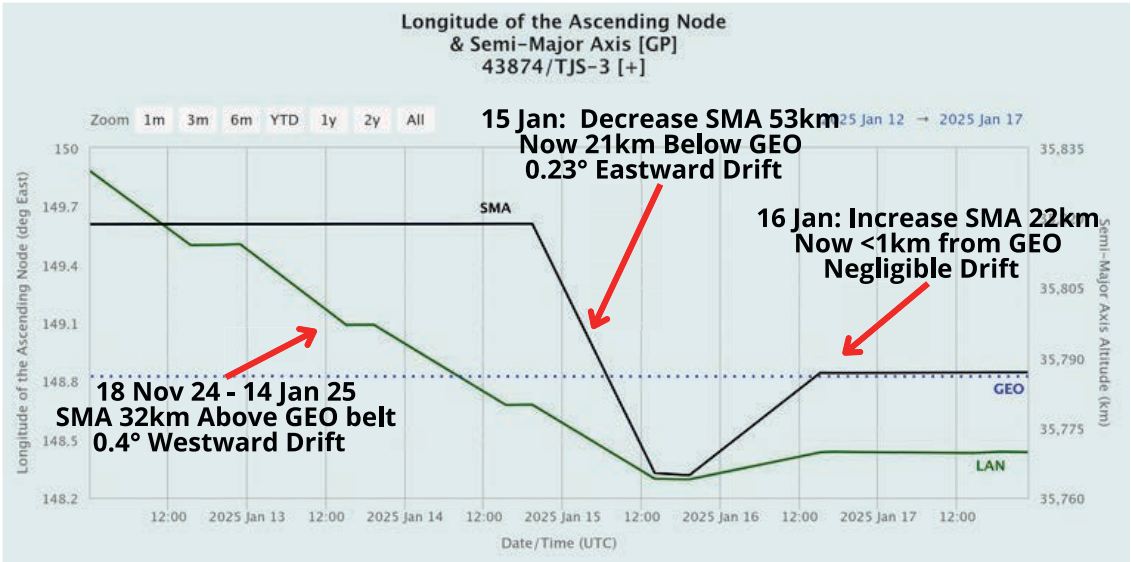
The SJ-25 Plot Thickens: Enter TJS-3

18 Jan: TJS-3 conducted a series of maneuvers resulting in its positioning in the neighborhood of SJ-21 at 148°E. While the TJS-3 has a different inclination and RAAN than SJ-21 (it is NOT co-planar) its positioning could be in preparation to support a re-fueling demonstration involving SJ-25 and SJ-21.



- Here is a brief timeline of TJS-3 maneuvers:
  - Our last look at TJS-3 was in mid-November 2024 when it had apparently completed a 1 year test with TJS-10 (58204). Up until this point TJS-3 had maintained its location at 173°E for 6 months.
  - On 18 November 2024, TJS-3 increased its SMA (altitude) to ~32km above the GEO belt and initiated a ~0.4° per day westward drift.
  - TJS-3 maintained this orbital profile until it reached 148.7°E on 13 January 2025.
  - From 14-15 January, Chinese space operators reduced the satellites altitude ~53km reversing the satellite's westward drift.
  - On 16 January, China raised TJS-3's altitude 21.9km placing the satellite onto the GEO belt pausing its drift at ~148.26°E. TJS-3 has remained at this altitude through 18 January.
  - At its current altitude TJS-3 has a negligible drift of 0.005° west per day.
  - As of 18 January, TJS-3 was located at 148.4°E and SJ-21 was located at 148.7°E.
- TJS-3 is NOT co-planar with SJ-25 & SJ-21.
  - TJS-3 has an inclination of 1.2° and a RAAN of 86.3°...neither value matches that of SJ-21 or SJ-25 which are both inclined 10.2° with a RAAN value of 43.75°.
  - In their current orbits the point of closest approach between TJS-3 and SJ-21 is ~300km.

TJS-3 Background: China launched TJS-3 on 24 Dec 2018 (thanks guys) and immediately engaged in unusual behavior for geostationary satellites. It performed several RPO events with its Apogee Kick Motor (see COMSPOC video) and has been rumored to be a GEO "inspector sat." See review of TJS-3 and other Chinese proximity operations in this excellent SWF overview.

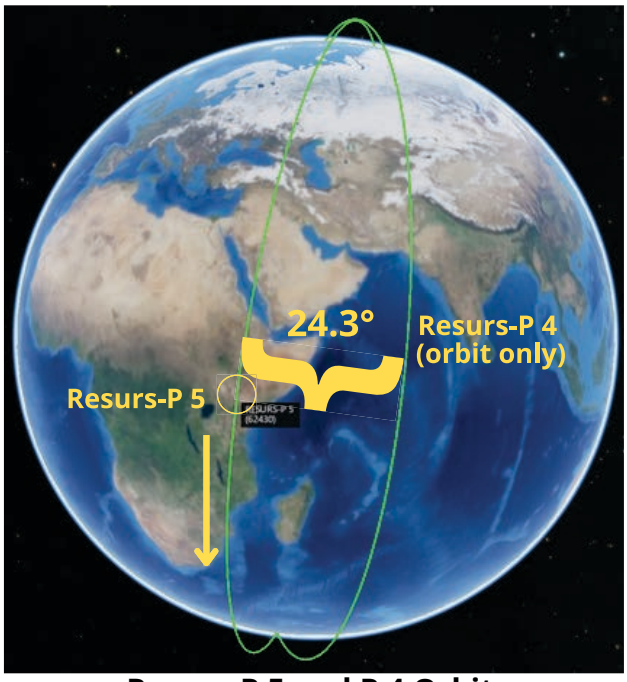


12 -17 Jan 2025: TJS-3 Altitude (Black) and Longitude Location (Green) (celestrak.org)

Russia launches Resurs-P 5

25 Dec: Russia launched a Soyuz-2-1b from Baikonur with the fifth and final Resurs-P earth observation satellite. Resurs-P 5's (62430) initial orbit was 287x467km with a 97.3° inclination. About 5 days after launch Russia completed the circularization maneuver to raise its perigee and the satellite is now in a sun-synchronous 411x467km orbit (inclination remains at 97.3°). This launch occurred ~9 months after Russia launched Resurs-P4 (59371) also from Baikonur. Launch Video.

- The two satellites are both inclined 97.3° but are not co-planar as Resurs-P 5 RAAN is offset ~24.3° west of Resurs-P 4.
- Resurs-P 5's orbit was lower than that of P 4 with an SMA of 443km. P 4's initial SMA after orbit circularization was 470.6km. On 5-6 Jan Russia raised P 5's SMA to ~470km.
- Resurs-P 4 did not conduct any orbit raising maneuvers in its first 9 months on orbit and its SMA declined to 456.6km. However, 2 days following the Resurs-P 5 launch Russia did raise P 4's SMA to near its original value of 470.4km.
-From Bart Hendrycx:
  - Resurs-P N°5 is a virtual carbon copy of its predecessor (Resrus-P 4). The two satellites were ordered together by Roscosmos in December 2016. The presentation contains lots of information on the satellite bus and the optical payloads and also sums up the modifications introduced after Resurs-P N°3.
- Both Resurs-P 4 and P 5 have an expected maximum resolution of 1.0m.
- Western sanctions appear to have significantly delayed Resurs-P 4 and 5 as #4 was originally scheduled to be launched in 2018 and #5 in 2019, but both were postponed due to the unavailability of certain components.
-Resurs-P 4 & 5 are the only operational Resurs-P satellites. Per Russianspaceweb.com "Resurs-P2 failed prematurely in 2017, while Resurs-P3 was seriously crippled by technical problems in the same year. The original Resurs-P1 lasted the longest, before going out of business in the Fall of 2021, thus leaving Roskosmos and its customers without a spacecraft in this class."
- Russia intentionally de-orbited Resurs-P no3 in October 2023. It had been paired with the experimental Russian satellite, Kosmos-2562 fromOct 2022 - Jul 2023.



Resurs-P 5 and P 4 Orbits (spaceaware.io)

Комплекс широкозахватной мультиспектральной аппаратуры (КШМСА) КА «Ресурс-П» №4 разрабатывается филиалом АО «РКЦ «Прогресс» – НПП «ОПТЭКС» и состоит из двух ШМСА-ВР.

ШМСА-ВР

Наименование характеристики	ШМСА-ВР	
	Панхром. канал	Мультиспектр. канал
Полоса захвата, км	97,2	
Разрешающая способность комплекса (проекция пиксела), м	11,9	23,8
Спектральные диапазоны, мкм	0,43÷0,70	0,43÷0,51 0,51÷0,58 0,60÷0,70 0,70÷0,90 0,80÷0,90
Фокусное расстояние объектива, мм	200	
Размер фоточувствительного элемента ОЭП, мкм²	5×5	10×10
Количество фоточувствительных элементов в строке ОЭП	8160	4080
Разрядность аналого-цифрового преобразователя, бит/пиксель	12	

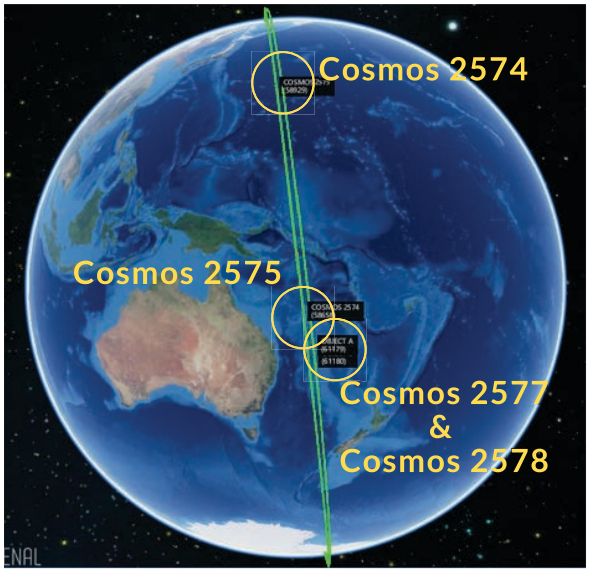
Заимствуется с КА «Ресурс-П» №3 с доработкой в части замены аппаратуры ШМСА-СР на аппаратуру ШМСА-ВР.

Press Packet Slides of Satellite and Sensors (nasaspaceflight.com)

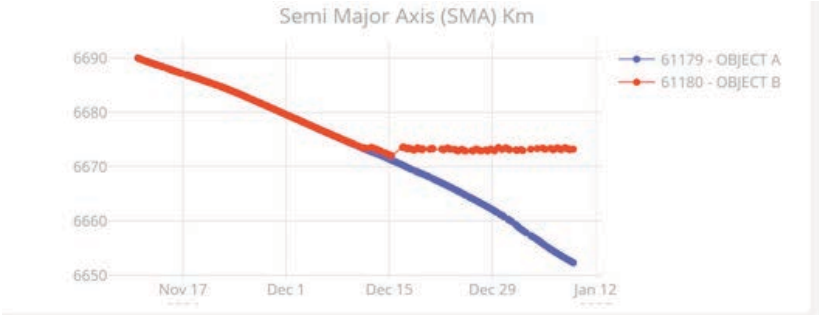
Russia: VLEO Update

Russia's Cosmos 2577 (still unnamed in Spacetrack.org catalog but probably 61179) may have experienced an on-orbit failure as the satellite appears to be no longer performing maneuvers to maintain its altitude. By contrast, Cosmos 2578 (also unnamed but likely 61180) continues to maneuver regularly. As a result the two spacecraft have begun to diverge. For the first several weeks the two satellites orbited relatively close to one another, however this appears to have changed in mid-December.

- Russia launched Cosmos 2577 and 2578 on 17 Sep 2024 from Plesetsk on an Angara 1.2. Russia placed both satellites into a sun synchronous orbit which is typical for imagery satellites. Both are operating at a low altitude of 339x322km and inclination 96.77°.
- Cosmos 2577/2578 are nearly co-planar with Cosmos 2574 (58658) and Cosmos 2575 (58929).
  - Cosmos-2574 may be an EO MKA or Razbeg imagery satellite. EO MKA / Razbeg imagery satellites are believed to be a small optical reconnaissance satellites (~150 kg) built by VNIIEM. Expected ground resolution is 0.9m.
- Per Bart Hendrickx, " until mid-December, when Kosmos-2578 started performing regular burns to maintain a mean altitude just under 300 km. Kosmos-2577's orbit, however, has continued to decay and the satellite is now flying more than 10 km below Kosmos-2578 (278x289 km vs. 290x301 km). Possibly, some kind of on-board failure is preventing it from countering its orbital decay, but it's too early to draw any definitive conclusions. The first three satellites believed to have belonged to this series (Kosmos-2551, 2555, 2560) showed similar behavior, re-entering only months after launch without having made any obvious maneuvers. It's not known if this was intended or not.



Orbital Comparison Between
Cosmos 2574 / 2575
Cosmos 2577 / 2578
(spaceaware.io)



Graph comparing SMA (altitude) of Cosmos 2577 (purple) & Cosmos 2578 (red) between 9 Nov 2024 to 9 Jan 2025 (spacecockpit.com)

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CSP2 Certification Exam

Certified Space Professional 3 (CSP-3)
SP300 - Adversary Space Capabilities I
SP310 - Adversary Space Capabilities II

Certified Space Professional Executive (CSP-E)
SP900 - The Space Domain & National Security Executive Seminar

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SP102 - Introduction to Space
SP103 - Math for Space
SP201 - Space Race 2.0
SP202 - Advanced OrbitalMechanics
SP203 - Joint Planning Process
SP204 - Space Surveillance Network/Object Surveillance & ID
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SP302 - Cyberspace
SP303 - Anti-Satellite Weapons

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SP440 - Space ISR
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SP470 - Space Acquisitions
SP480 - Intelligence Support to Space

Analytic Thought
AW100 - Foundations of Analytic Writing
AW200 - Analytical Writing
AW300 - Collaborative Analytical Writing
CT100 - Foundations of Critical Thinking & Structured Analysis
CT200 - Critical Thinking for Analysts
CT300 - Advanced Critical Thinking for Analysts
CT500 - Leading Critical Thinkers
CT600 - Critical Thinking for Learning Professionals
CT700 - Critical Thinking for Executives
DA100 - Foundations of Data Analytics
DA200 - The Art & Science of Data Analytics

Cyber
CYBER900 - Cyber Security Strategy
ENG200 - English for Cyber

Faculty Development
FD600 - Facilitation for Learning Professionals
CT600 - Critical Thinking for Learning Professionals

ISR - Analysis
PED100 - Intelligence Planning Cycle
EM110 - Electromagnetic Spectrum Fundamentals
IADS100 - IADS Foundations
IADS200 - Rethinking IADS
IADS310 - Advanced IADS Analysis

ISR - Targeting
TGT110 - Fundamentals of Targeting
TGT210 - Target Development I
TGT211 - Target Development II
TGT212 - Target Capabilities Analysis
TGT213 - Target Force Assignments
TGT214 - Mission Planning & Force Execution
TGT215 - Combat Assessment
TGT310 - Weaponeering and Collateral Damage Assessment
TGT311 - HVI Target Development
TGT312 - Precision Point Mensuration
TGT315 - Targeting Professional

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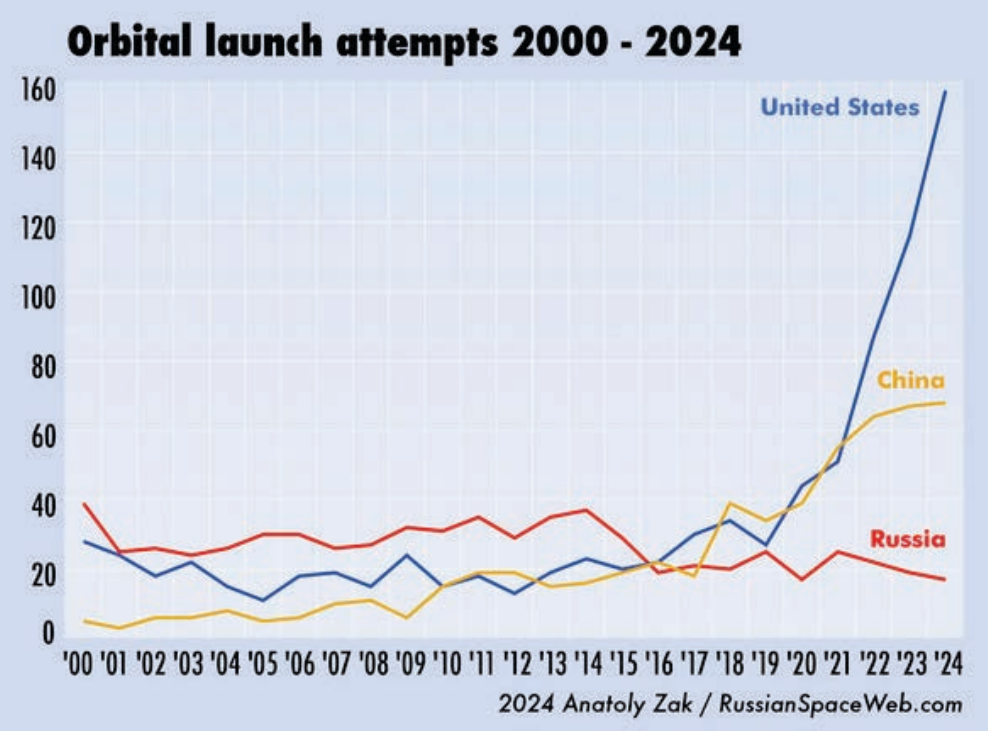
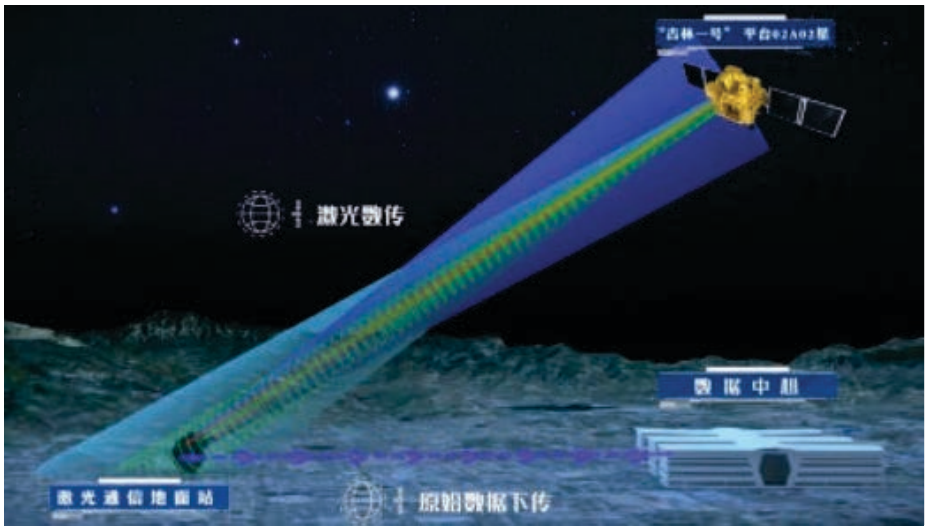
Pics o' the week!

Ground Based Observations of YG-36 03A/B/C and YG-36 04A/B/C. YAOGAN 36-04 seems to have the same pattern as YAOGAN 36-03 with the Trail1 satellite being significantly dimmer than the Lead or Trail2 satellites. Courtesy S2A Systems. (Roger Spinner <roger.spinner@s2a-systems.com>)



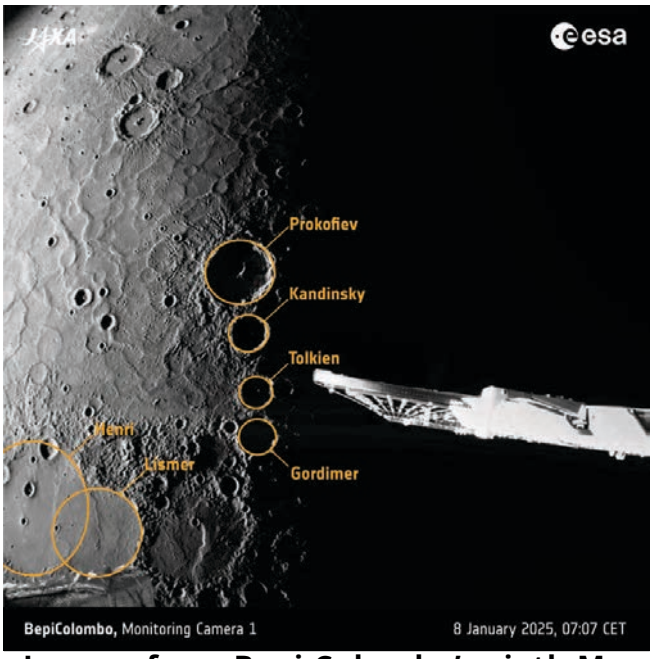
Russian annual launch rate fell to its lowest level in the 21st century with 17 missions in 2024 (@RussianSpaceWeb via X)

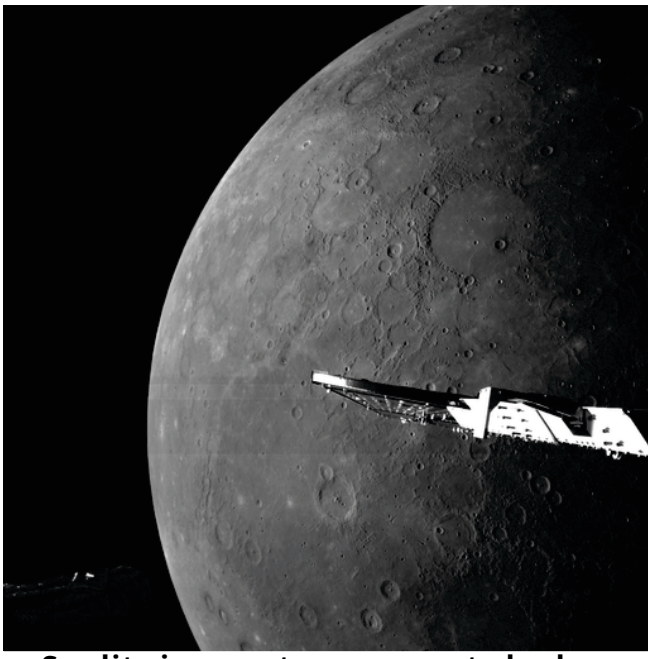


CGSTL completed a 100 Gbps laser communications test using a vehicle-mounted antenna on Earth, and the Jilin-1 02A02 satellite on-orbit. For CGSTL, this will be important for downlinking huge amounts of remote sensing data being generated by their Jilin-1 constellation of ~140 satellites.

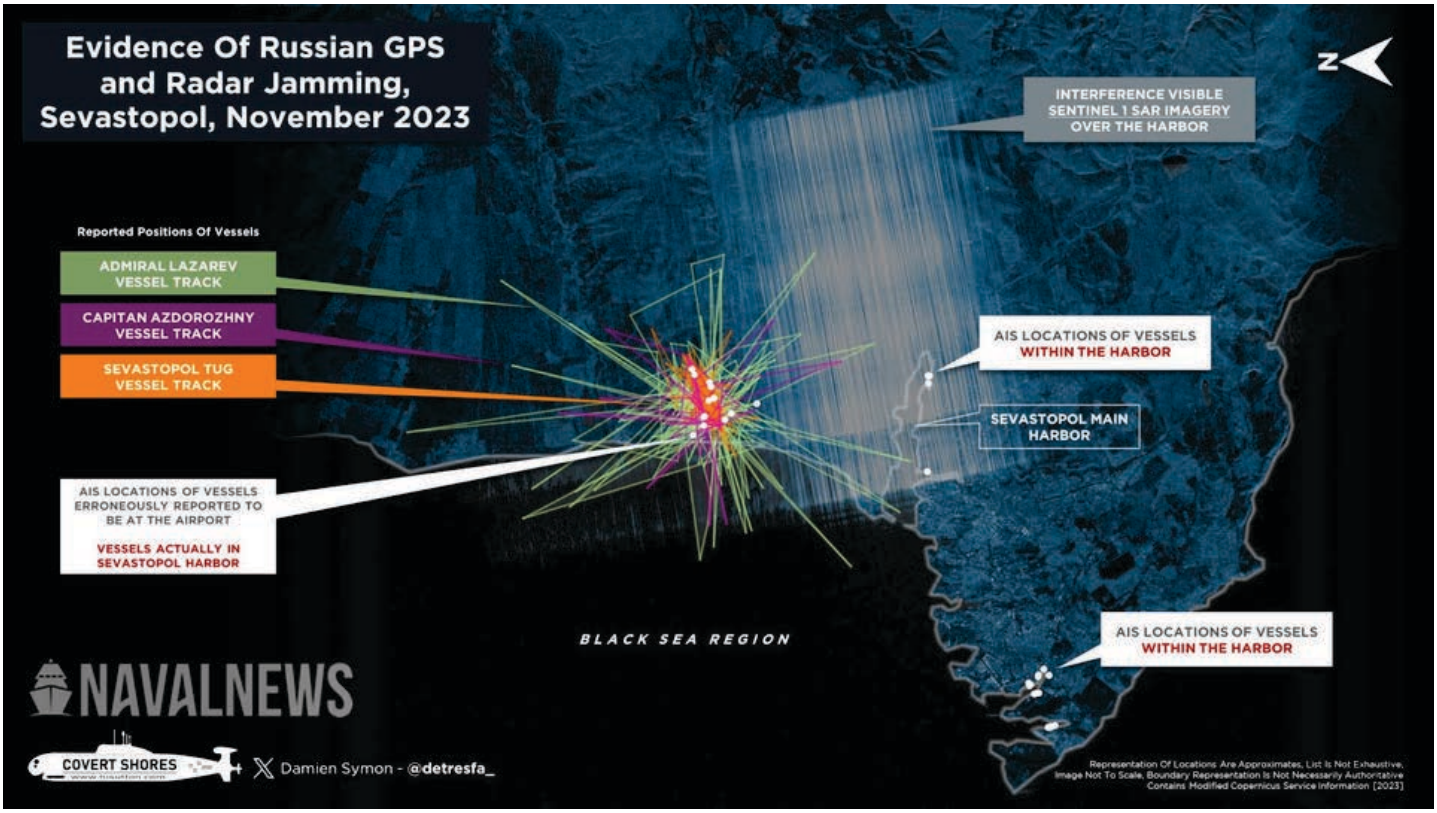
Blaine Curcio, China Space Monitor <chinaspacemonitor@substack.com>

Roskosmos publishes first photo from newly launched Resurs-P5 satellite. Image is of Los Angeles International Airport (LAX). (@RussianSpaceWeb via X)





Images from Bepi Colombo's sixth Mercury flyby. Sunlit rims cast permanent shadows on the floor of several craters seen here, making them some of the coldest places in the Solar System, despite Mercury being the closest planet to the Sun!
(@BepiColombo via X)



Example of SAR Jamming of Sentinel 1 attempt to image Sevastopol.
GPS Jamming also depicted.

Photo by Naval News (counteroffensive.pro)

Rough Month Here in Southern California.
Shortwave infrared image Pacific Palisades and Eaton fires from Maxar.
(Michael Sheetz via LinkedIn)

WHO WE ARE

Integrity ISR employs a diverse group of former military service members, national security experts, and academic professionals to deliver innovative C4ISR, Space & Cyber solutions.

WHAT WE DO

Integrity ISR offers a wide-range of services for multi-domain C4ISR, Space & Cyber strategy, training and operations - enabling operations in any domain under any conditions, from permissive to highly contested and denied environments.

WHY WE DO IT

Our number one priority is to strengthen US national security - increasing US readiness and lethality, building C4ISR, Space & Cyber capabilities for the US and our allies, and fostering increased interoperability for tomorrow's coalition.

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