Threats to Space Systems: Risks to Stability and Sustainability

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About Secure World Foundation

- **SWF** is a *private operating foundation* that promotes cooperative solutions for space sustainability

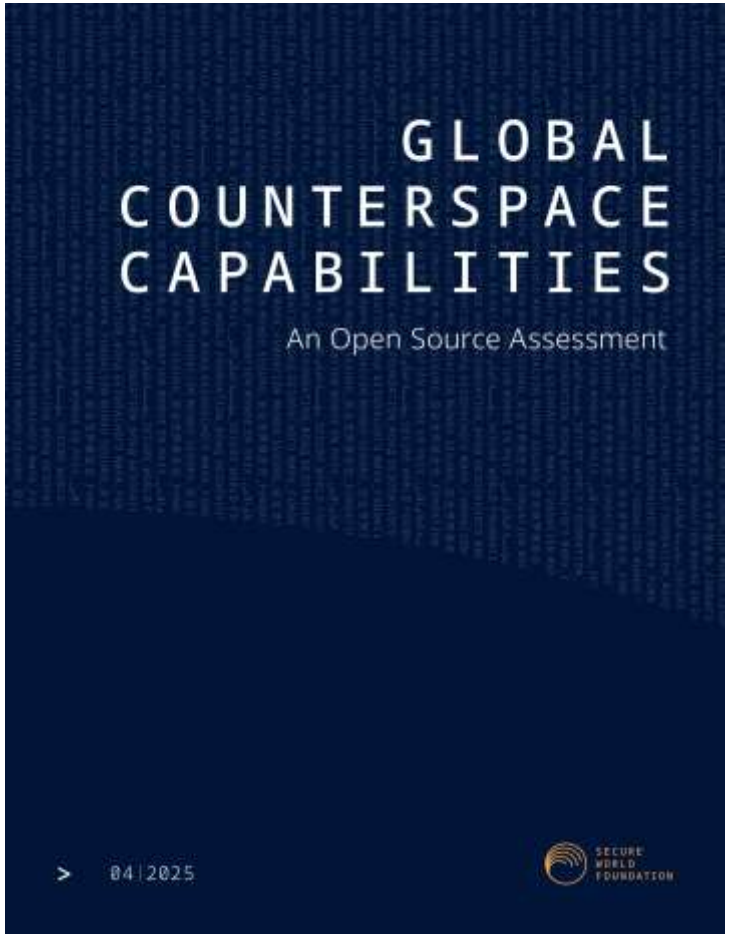
- **Our vision:** the secure, sustainable, and peaceful uses of outer space that contribute to global stability on Earth

- **Our mission:** work with governments, industry, international organizations, and civil society to develop and promote ideas and actions to achieve *the secure, sustainable, and peaceful uses of outer space* benefiting Earth and all its peoples

- Existence of counterspace capabilities is not new, but the circumstances surrounding them are

- Significant R&D/testing of a wide range of destructive & non-destructive counterspace capabilities by multiple countries

- ***Only non-destructive capabilities are actively being used in current military operations***



https://swfound.org/counterspace

Counterspace Capabilities

Co-orbital: systems that are placed into orbit and then maneuver to approach the target to attack it by various means, including destructive and non-destructive

Direct-Ascent: systems that use ground, air-, or sea-launched missiles with interceptors that are used to kinetically destroy satellites through force of impact, but are not placed into orbit themselves

Directed Energy: systems that use focused energy, such as laser, particle, or microwave beams to interfere or destroy space systems

Electronic Warfare: systems that use radiofrequency energy to interfere with or jam the communications to or from satellites

Cyber: systems that use software and network techniques to compromise, control, interfere, or destroy computer systems

Space Situational Awareness: knowledge about the space environment and human space activities that enables both offensive and defense counterspace operations

2025 Global Assessment

	US	RUSSIA	CHINA	INDIA	AUS.	FRANCE	IRAN	ISRAEL	JAPAN	N. KOREA	S. KOREA	UK
LEO Co-Orbital	■	▲	▲	●	●	■	●	●	●	●	●	●
MEO/GEO Co-Orbital	■	■	■	●	●	■	●	●	●	●	●	●
LEO Direct Ascent	■	▲	▲	■	●	●	●	●	●	●	●	●
MEO/GEO Direct Ascent	■	■	■	●	●	●	●	●	●	●	●	●
Directed Energy	■	■	■	●	●	■	●	●	●	●	●	●
Electronic Warfare	▲	▲	▲	■	■	■	■	▲	■	■	●	●
Space Situational Awareness	▲	▲	▲	■	■	■	■	■	■	■	■	■

LEGEND: NONE ● SOME ■ SIGNIFICANT ▲ UNCERTAIN ? NO DATA –

ASAT Tests by Year (2025)

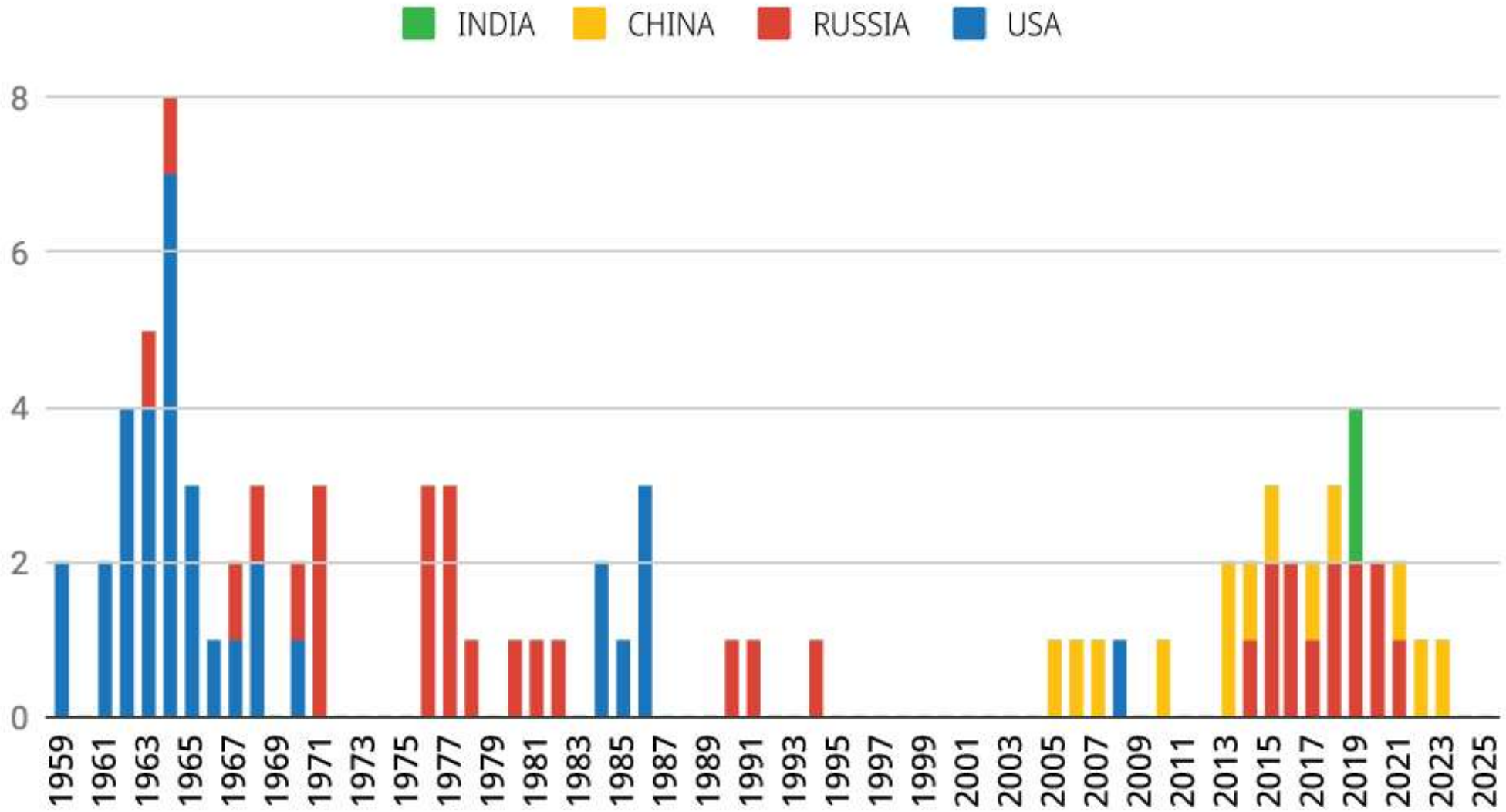


TABLE 5-1 – ORBITAL DEBRIS CREATED BY ASAT TESTS IN SPACE

DATE	COUNTRY	ASAT SYSTEM	TARGET	INTERCEPT ALTITUDE	TRACKED DEBRIS	DEBRIS STILL ON ORBIT	TOTAL DEBRIS LIFESPAN
Oct. 20, 1968	Russia	IS	Cosmos 248		252	73	50+ years
Oct. 23, 1970	Russia	IS	Cosmos 373		147	33	50+ years
Feb. 25, 1971	Russia	IS	Cosmos 394		117	44	50+ years
Dec. 3, 1971	Russia	IS	Cosmos 459		28	0	3.3 years
Dec. 17, 1976	Russia	IS	Cosmos 880		127	56	45+ years
May 19, 1978	Russia	IS-M	Cosmos 970		71	64	40+ years
Apr. 18, 1980	Russia	IS-M	Cosmos 1171		47	5	40+ years
Jun. 18, 1982	Russia	IS-M	Cosmos 1375		63	59	40+ years
Sept. 13, 1985	US	ASM-135	Solwind	530 km	285	0	18+ years
Sept. 5, 1986	US	Delta 180 PAS	Delta 2 R/B		13	0	< 1 year
Dec. 26, 1994	Russia	Naryad-V?	Unknown		26	23	30+ years
Jan. 11, 2007	China	SC-19	FengYun 1C	880 km	3533	2535	15+ years
Feb. 20, 2008	US	SM-3	USA 193	220 km	175	0	1+ year
Mar. 27, 2019	India	PDV-MK II	Microsat-R	300 km	130	0	3+ years
Aug.-Dec. 2019	Russia	Cosmos 2535	Cosmos 2536		30	16	<1 year
Nov. 15, 2021	Russia	Nudol	Cosmos 1408	470 km	1807	12	3+ years
				Total	**6851**	**2920**	

RPOs and effects on space security

- Rendezvous and proximity operations (RPOs): potential for (inadvertent) escalation
  - Unclear as to intention, hence SWF's inclusion of it as a co-orbital counterspace capability

- Not as easy to make hard and fast requirements about
  - Other domains can make rules about how close is too close, but due to orbital dynamics, this doesn't always translate into space issues

- Different risk assessments by different actors in space

- Very few hard "rules" about what is and isn't allowed
  - Helpful to have an understanding about what types of RPOs various actors deem concerning, possible situations where notifications could be given and how to go about doing this
    - RPOs that could increase the risk of misunderstanding and miscalculation are on the agenda to be discussed at the 3rd session of the OEWG (July 2026) and the 6th session (end of 2027)
  - Coming storm: very large constellations

Very large constellations and strategic stability

- Make up most of the current and future satellites in orbit
  - SpaceX's Starlink: 9100, 15,000 planned (+ 30,000 more?)
  - China: Guowang: roughly around 104, 13,000 planned
  - China: Thousand Sails (Qianfan) around 108, 15,000 planned
- Possibility for an incident between two operators to escalate to the point where it affects strategic stability
- Concern about these constellations hampering access to certain orbits; seeing effectively spectrum grab
  - Carrying capacity not as helpful a metric for this – risk tolerance is what guides this
- Need for operator to operator dialogue
  - Need for rules of the road: right of way, ways to quickly communicate amongst actors

SSA as a transparency mechanism

- Space situational awareness (SSA): monitor and characterize the space environment and human activities
  - Key factor in verifying activities in orbit and limiting how escalatory they are perceived
  - Can help establish what is anomalous behavior

- SSA is helpful for identifying certain kinds of threats in orbit but not all
  - Strongest in terms of helping determine whether or not an action occurred in orbit
  - Does not help in identifying *why* an action occurred

- No single universally agreed-upon pool of SSA data/catalogue
  - More catalogues means more options for objective confirmation of activities (and this is where the commercial sector fits in) but also more room for different assessments
  - Complicated by different maturity of users of SSA data plus hazards like space weather

- Part of democratization of space and evolution for how certain capabilities have proliferated beyond the major space powers

- Sharing information about SSA capabilities, data-sharing policies can also be a TCBM

Questions?

Thanks.

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