

Space Weather & International Civil Space Situational Awareness

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NOAA Space Weather Week
28 April 2009

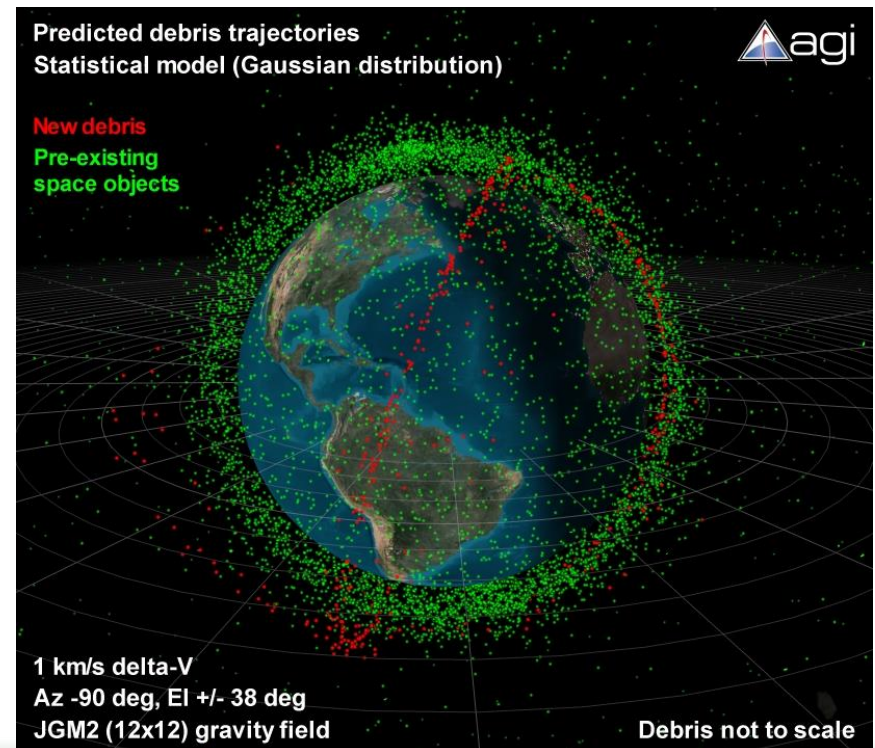
Space situational awareness (SSA) involves knowledge of:

- Where a satellite is at any given moment (positional data)
- What other human-made objects are around it (situational data)
- The space environment, including space weather.

Economic consequences of:

- Inadequate SSA data collection
- Poor data sharing
- Lack of international coordination

Costs can be significant to civil, military and commercial satellite operators.

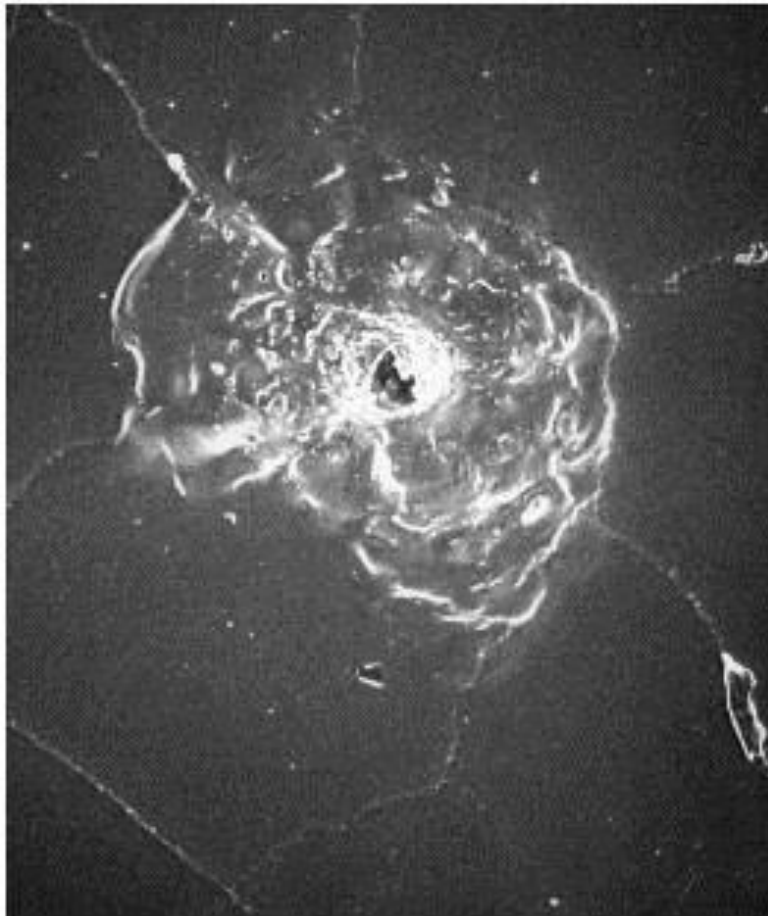


Shuttle & ISS Micrometeorite Damage

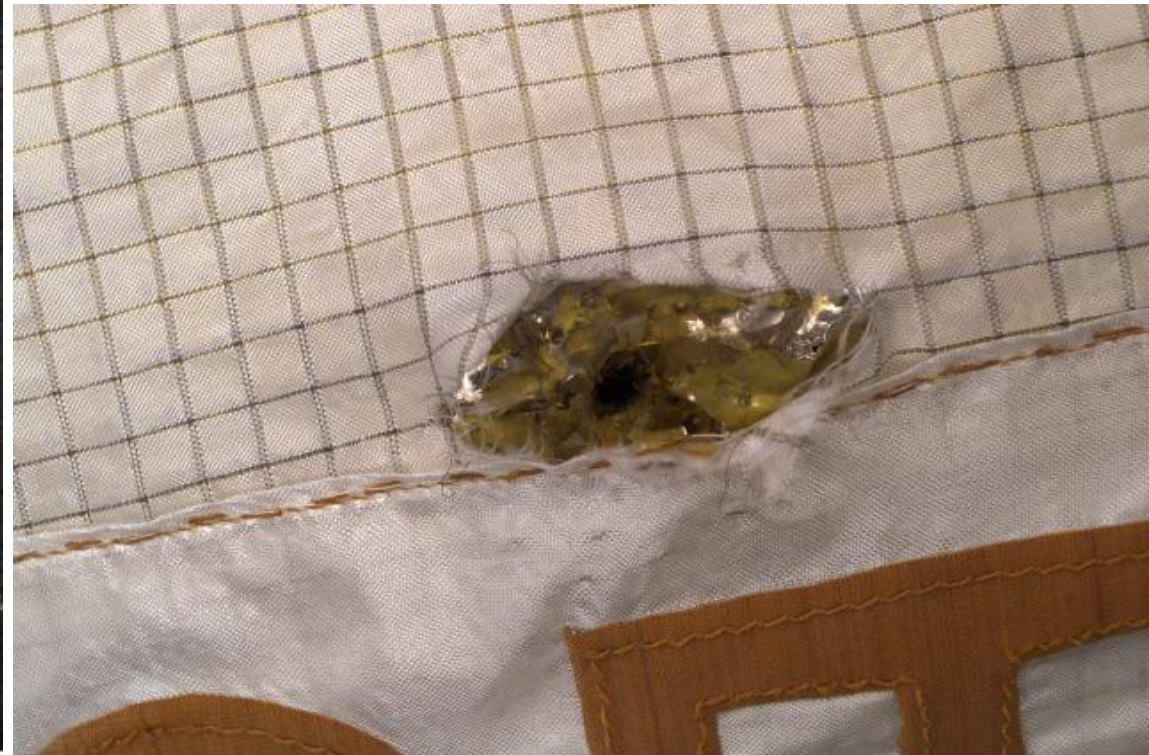
Promoting Cooperative Solutions for Space Security

International Space Station, June 2007 –

Micrometeoroid damage to a multi-layer insulation (MLI) protective blanket on the Zarya module.

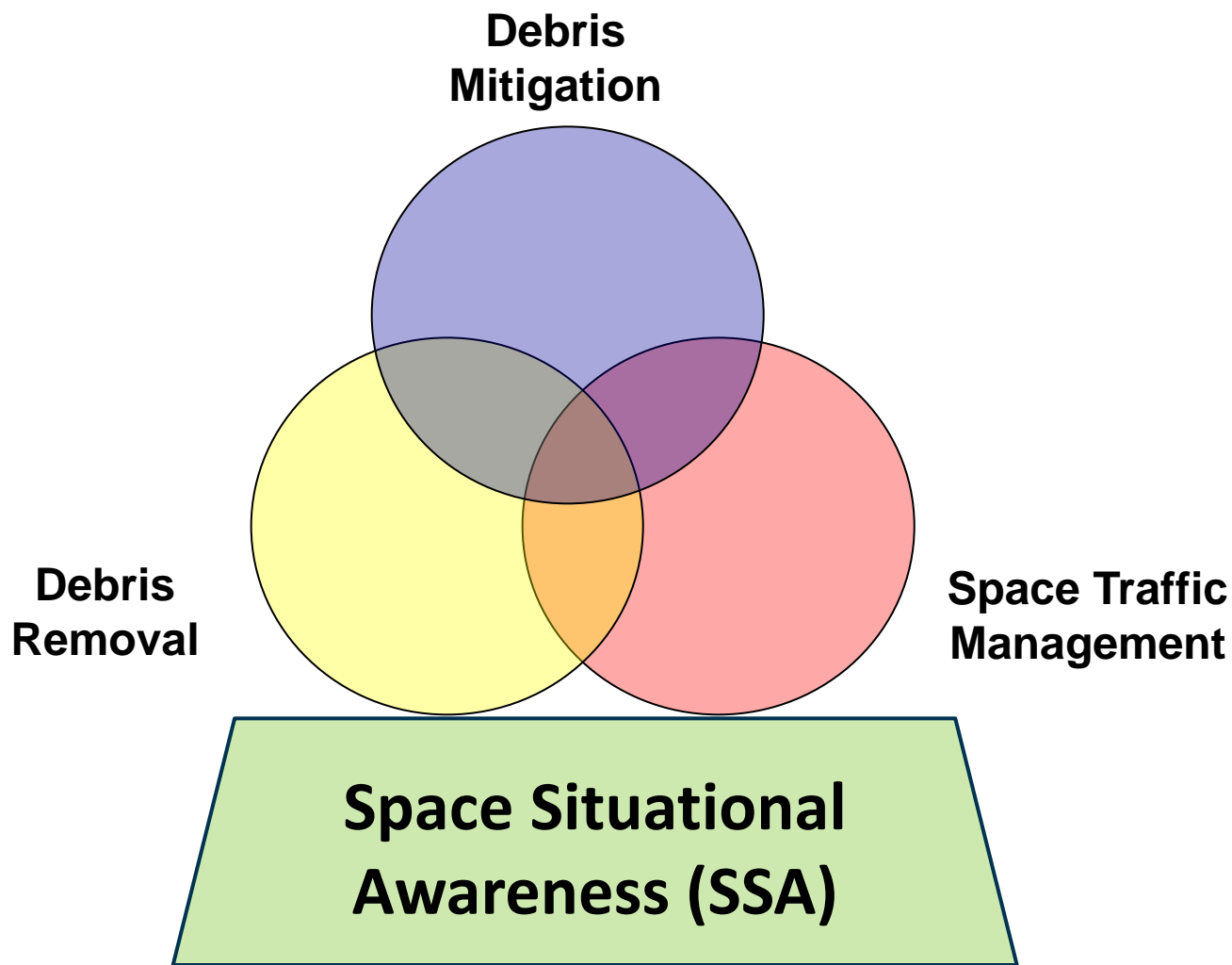


Space Shuttle Endeavour, December 2000
– Micrometeoroid damage to window



ISS015ED0854





To provide **all** space actors access to the tools needed for safe and sustainable activity in Earth orbit

➤ Sensor Data

- Orbits and locations of objects
- Solar activity
- Atmospheric density

➤ Analytical capacity

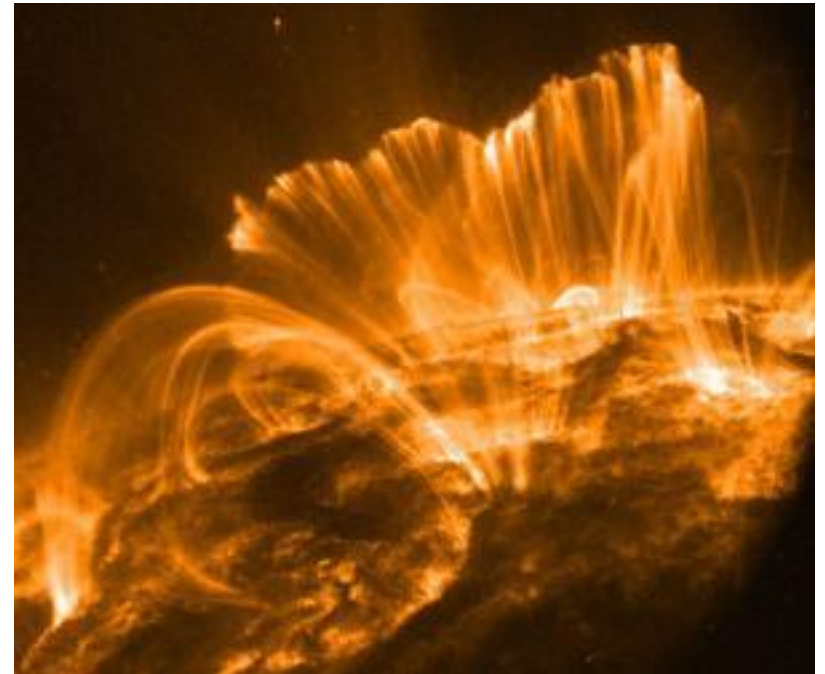
- Conjunction Assessment (predicted close approach between two objects)
- Collision Avoidance (maneuvering to mitigate high risk conjunctions)
- Space weather predictions
- Anomaly resolution

Civil SSA is interested in:

- Location of an object in Earth orbit
- Point of contact for that object
- Space Weather

Military SSA is interested in more data:

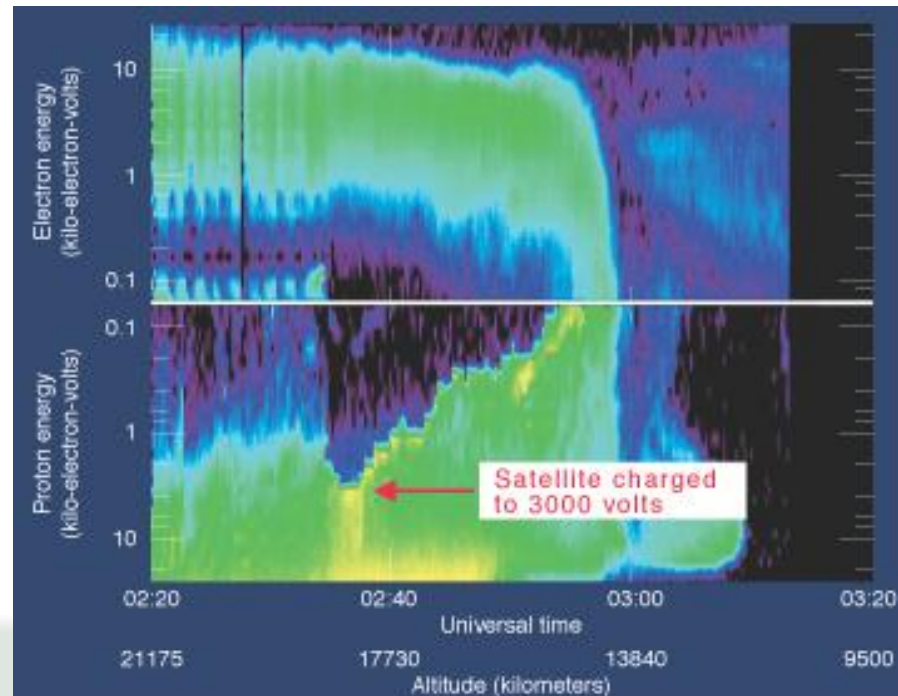
- What the function of an object is
- What the intention of an object is
- Capabilities and limitations of an object



Sharing data on space weather is an
essential part of ICSSA

Space weather events such as solar flares or coronal mass ejections may negatively affect the utility of in-space assets.

- Thermal expansion of Earth's atmosphere increases drag on objects in low earth orbit, cleaning up some low-flying orbital debris but also shortening the working lifespan of functional satellites.
- Surface charging, electrostatic discharge, and other risks to onboard electronics from solar protons and other energetic charged particles.
- Degraded solar panels, power loss
- Phantom commands, data corruption



Ground stations may also suffer from adverse effects of space weather events.

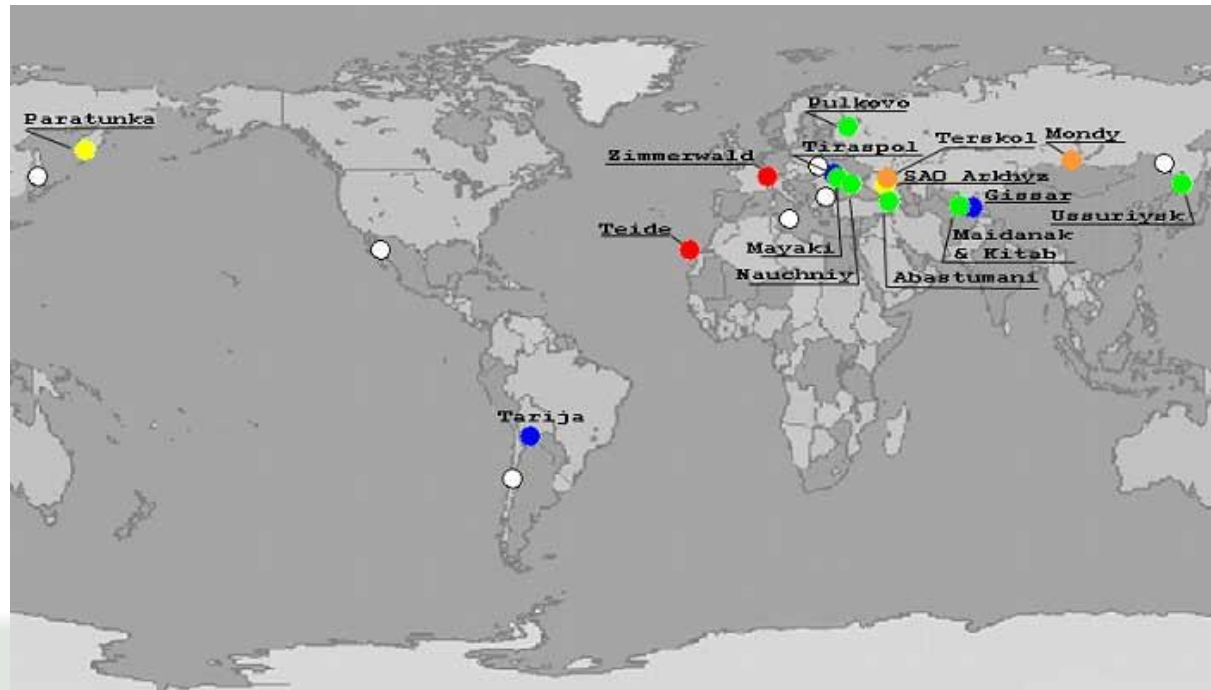
- Navigational data such as GPS signals may be corrupted, leading to signal timing and position errors.
- Ionization effects in Earth's atmosphere leading to communications data scatter, interruption or loss.



More ground stations lead to more coverage and more capability to correct errors in satellite tracking.

SSA data is provided to international satellite operators by:

- U.S. Department of Defense through its Commercial and Foreign Entities Support Program (raw data comes from Joint Space Operations Center)
- Data shared by the operators themselves for satellites in geosynchronous orbit through participation in SOCRATES-GEO.
- Scientific institutions participating in the International Scientific Optical Network (ISON), a network of 25 optical telescopes located at 18 facilities.



Space Surveillance Network

Worldwide Network of 20 Optical and Radar (Mechanical & Phased Array) Sensor Sites



SOCRATES-GEO project of Center for Space Standards and Innovation (CSSI)

- Partnership between CSSI and several commercial GEO operators to pool data and provide analytical services
- Provides close approach warning and collision avoidance services to the commercial operators
 - As of June 2008, more than 100 satellites among six global participants: Intelsat, Inmarsat, EchoStar, SES (Astra, New Skies, & Americom), NOAA, Star One
 - More than 25 percent of all active payloads in GEO

SOCRATES-GEO Search Results

Search parameters:

- Name(s): INSAT-1B
- Order by Minimum Range
- Return first 25 items

Data current as of 2009 Feb 02 13:00 UTC

Computation Interval: Start = 2009 Feb 02 13:00:00.000, Stop = 2009 Feb 09 13:00:00.000

Computation Threshold: 50.0 km

Considering: 751 Primaries, 1,292 Secondaries (1,030 Conjunctions)

[See notes at bottom of page for data field descriptions](#)

[Bookmark this search \(INSAT-1B\)](#)

Action	NORAD Catalog Number	Name	Days Since Epoch	Max Probability	Dilution Threshold (km)	Min Range (km)	Relative Velocity (km/sec)
				Start (UTC)	TCA (UTC)	Stop (UTC)	
Analysis	14318	INSAT-1B	6.484	1.224E-06	8.140	11.512	0.684
	23842	ASTRA 1F	1.731	2009 Feb 04 03:31:29.815	2009 Feb 04 03:32:40.961	2009 Feb 04 03:33:52.107	
Analysis	14318	INSAT-1B	6.485	7.818E-07	8.447	11.946	0.687
	31306	ASTRA 1L	1.732	2009 Feb 04 03:32:31.003	2009 Feb 04 03:33:41.678	2009 Feb 04 03:34:52.352	

SWF organized panel session at 3rd International Association for the Advancement of Space Safety (IAASS) Conference in October 2008

- Focused on technical requirements and feasibility of international civil SSA
- Involved technical experts from US, Europe, Russia, China
- Concluded that while there were technical hurdles to discuss, such a system is technically feasible.

- SSA requires a geographically distributed network for sensors to track satellites
- Building a geographically distributed network is expensive
- Owner-operator positional data is a critical supplement to third-party sensing

Many States and commercial operators working together can provide sensor coverage over the entire Earth for little cost to each

Each participant in the system chooses which data they provide

- All participants have access to all the shared data
- Each participant is able to use the data in their own analysis
- All participants have access to analytical support from data clearing house

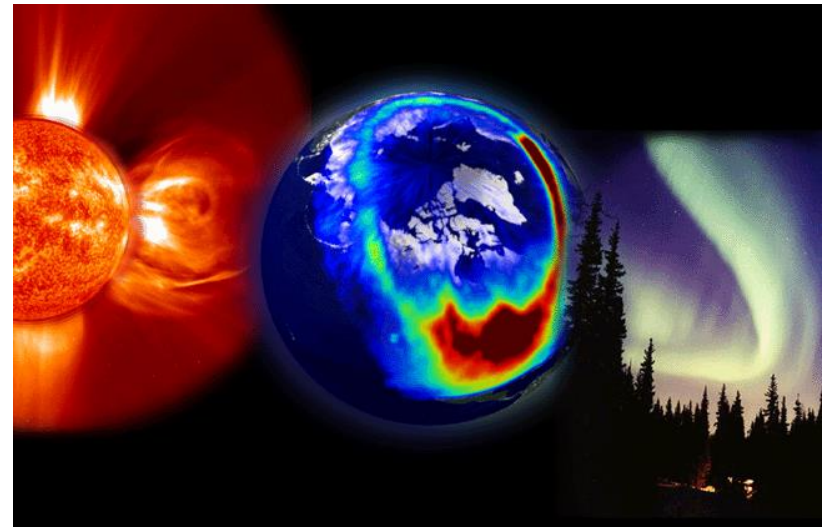
Balance of data security and dissemination

Benefits of ICSSA include:

- Provide the basic data necessary for all space actors to make educated, safe, and efficient decisions
- Increase international awareness and understanding of space sustainability
- Increase cooperation and transparency between States on space activities
- Potential verification mechanism for “code of conduct” / “rules of the road”

Space weather is one of three integral components of ICSSA along with **surveying/tracking** human-made objects in space and **identifying** owners. Knowledge of the natural space environment near Earth is a vital aspect of any successful SSA program.

Space weather data analysis may serve as a **confidence and security building measure** to international agreements.



An effective SSA system provides users with verifiable, dependable, accurate and timely information in order to:

- Support safe and secured operation of space assets and related services;
- Assist risk management (on orbit and during re-entry) and liability assessment;
- Identify non-compliance with relevant international treaties and recommendations.

Too many satellites are operated in a vacuum of information about their environment.

- Collisions are no longer theory and will happen again

States that have the information to prevent collisions do not have the immediate resources to screen all objects for possible collisions.

- The US is not and cannot be the sole source of positional data for civil/commercial satellites.

Many States, working together in a voluntary partnership with commercial partners, could provide the necessary data to all actors.

- This information could not only mitigate future collisions but enhance cooperation, transparency and for future space governance issues.

Secure World Foundation encourages development of an international civil SSA system.

- Governance, security and user-oriented issues must be addressed as well as a comprehensive scheme for funding and operating the system.

Essential technical elements of ICSSA already exist
and there is demonstrated need.
What remains is political will to act.

**Thank you for your time.
Questions?**

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