Space Strategies Center

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SWAT

Space Warfare Analysis Tools

- Summary -

22 July, 2013

"You may not be interested in war …
but war is interested in you."
(Leon Trotsky)

SWAT Purpose

- **Develop Space Warfare Theory, Doctrine, Strategies, Tactics, Techniques & Tools that Enable Informed Decision Making by Space Control Warfighters:**
  - **Will Space Systems be Under Attack In the Near Future?**
  - **Are Space Systems Currently Under Attack?**
  - **Who Is Attacking?**
  - **What is the Adversary Attack Strategy?**
  - **What Damage Has Been Caused to Military Capabilities?**
  - **What Is Optimal Blue Military/Diplomatic/Economic Response?**

Provides a "Unified Field Theory" for Space Situational Awareness (SSA) & Satellite Attack Warning (SAW)

SWAT Tools Developed (1)

- View **Automatic Space Object Mission ID**
- View **Auto Space Object State Change Detection**
- View **Automatic Red Space COA ID**
- View **Space Choke Point Maps (SAW – Satellite Attack Warning)**

Anticipate What an Adversary's Next Move Is

SWAT Tools Developed (2)

- View **SSA Requirements (1,900)**
- View **Space INTEL Indicators List (6,000)**
- View **Auto INTEL Message Generation**
- View **Resolution Requirements (Space NIIRS)**
- View **Sensor Requirements Tasking Optimization Software, Plus Reconnaissance Contingency Checklists**

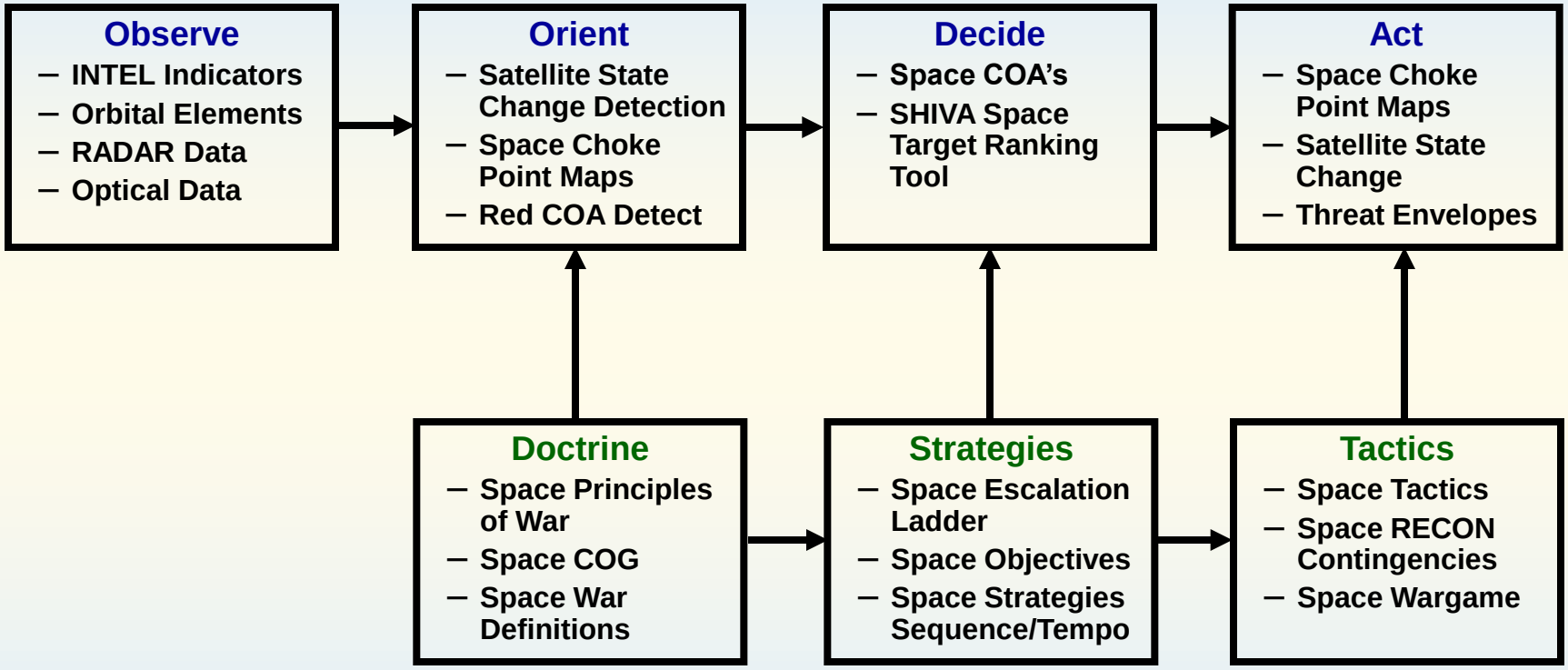
Determine What We Know & Don't Know About an Adversary

SWAT Tools Developed (3)

- View **Space Blue COA Support**
  - View Space Strategies Checklist (Based on Sun Tzu)
  - View Space Principles of War Checklist
  - View Space Military Objectives Database (5,000 Objectives)
  - View Space Centers of Gravity Checklist
  - View Space Escalation Ladder
  - View Auto Joint Space & Ground Target Prioritization
  - View Information Targets Ranking
- View **Space Control Scenario**
  - View Automatic Space Scenario Generation Tool & Space Game (In Work)

SWAT Supports Timely & Decisive Blue Courses of Action Generation

SWAT Process Flow



SWAT Products Listed Inside Boxes

SWAT Provides an Integrated Space Warfare Conceptual Framework

Space Object State Change Algorithms

SWAT State Change Parameters Analyzed (26 Total)

Physical Characteristics

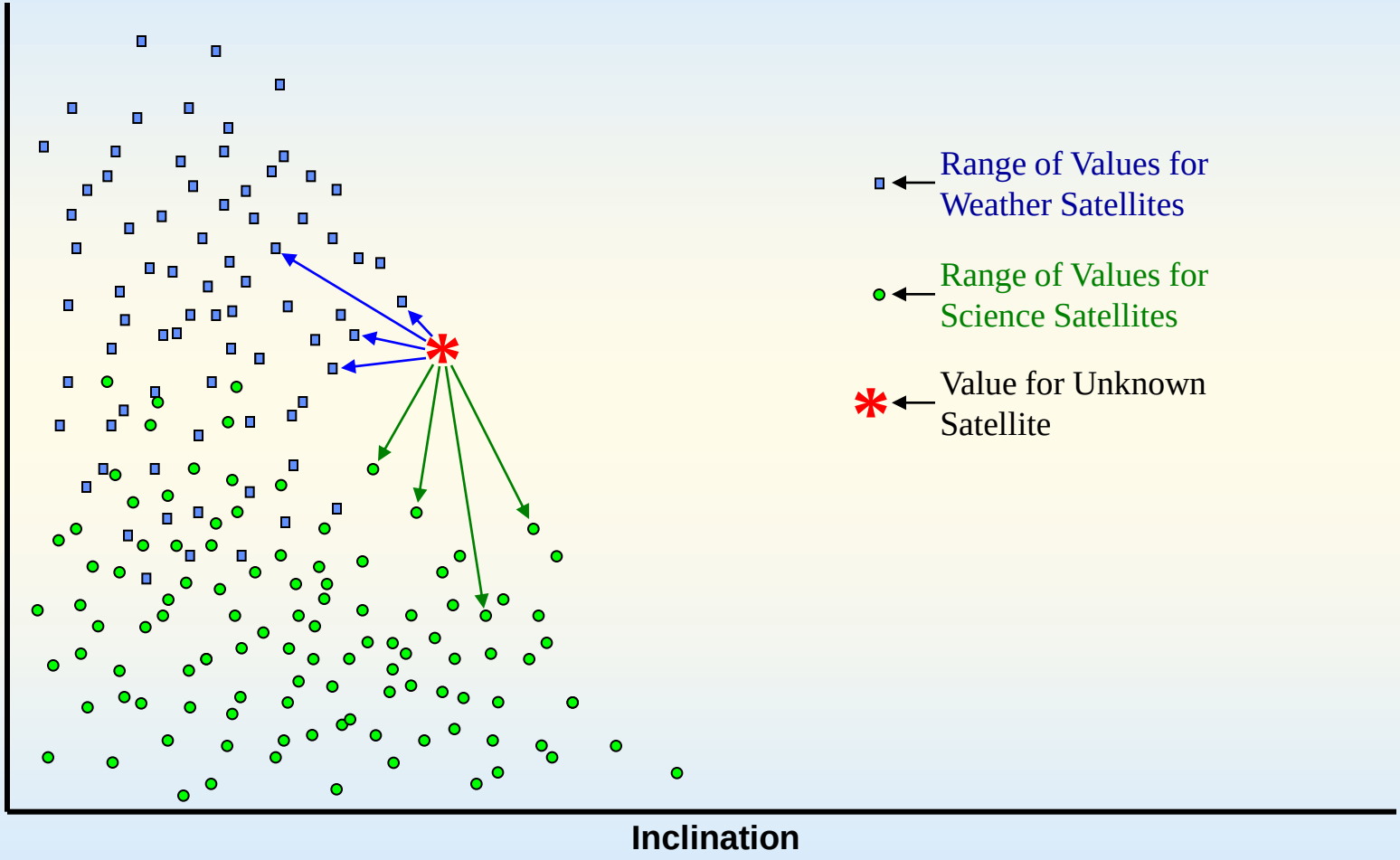
- Radar Cross Section (RCS)
- Optical Cross Section
- Flashing or Not
- Flash Period
- Stabilization Type (Spinning or 3-Axis)
- Object Shape (Sphere, Cylinder, Box)
- Length
- Width
- Height
- Mass
- Spin Rate
- Delta-V
- Satellite Position (Geosynchronous)
- Beginning of Life On-Board Power
- Major COMM Antennas & COMM Signals
- Major Optics On-Board
- Retro Reflectors On-Board

Orbital Characteristics

- Inclination
- Eccentricity
- Mean Motion
- Mean Anomaly
- RAN
- Argument of Perigee
- BStar
- 1st Mean
- 2nd Mean

SWAT Assesses State Changes Beyond Orbital Characteristics

SWAT Automatic Space Object State Change Algorithm



Unknown Space Objects Compared to Those of Known Mission Characteristics

Data Correction & Segmenting

- **Correct Mission Designations**
  - **e.g.: “Science” vs. “Scientific” Missions**
- **Correct Data Values**
  - **e.g.: Zero vs. Null Data**
    - **Change Zero Values to Null for Mass**
    - **Change Null Values to Zero for Spin**
- **Segment Missions**
    - **By Satellite Status (Dead vs. Live)**
    - **By Space Object Orbital Location**

SWAT Databases

- Space Objects: 37,932 Records
  - Also Includes Decayed Objects
- Orbital Elements: 5.3 Million Records
  - 15 Months of Data Internal to SWAT
  - All Orbital Data Since 1957 In External Archives
- RADAR Cross Sections: 1.5 Million Records
  - All RCS's for All Space Objects Since 1957
- Satellite Characteristics History: 7.5 Million Records
  - Almost 3 Years History for All Space Objects (Live & Dead)
- Optical Visual Magnitude & Flash Rate: 73 Thousand
- Space Acronyms: 35,542 Records

Orbital Location Segmenting

Region	Region Definition
SDR GEO	Space Defense Region Geosynchronous
SDR GEO ASIA	Space Defense Region Geosynchronous over Asia
SDR GEO EU	Space Defense Region Geosynchronous over Europe
SDR GEO ME	Space Defense Region Geosynchronous over the Middle East
SDR GEO US	Space Defense Region Geosynchronous over the United States
SDR GEO-G-A	Space Defense Region Graveyard Orbit Above Geosynchronous
SDR GEO-G-B	Space Defense Region Graveyard Orbit Below Geosynchronous
SDR GEO-I	Space Defense Region Geosynchronous Inclined
SDR HEO	Space Defense Region Above Geosynchronous (High Earth Orbit)
SDR LEO-E	Space Defense Region Low Earth Orbit Highly Eccentric
SDR LEO-H	Space Defense Region Low Earth Orbit - High (>600 and <5,000 km)
SDR LEO-L	Space Defense Region Low Earth Orbit - Low (<=500 km)
SDR LEO-M	Space Defense Region Low Earth Orbit - Medium (>500 and <=600 km)
SDR LEO-R	Space Defense Region Low Earth Orbit Retrograde
SDR LEO-S	Space Defense Region Low Earth Orbit Sun-Synchronous
SDR MEO	Space Defense Region Medium Earth Orbit (>=5,000 and <25,000 km)
SDR MOLY	Space Defense Region Molniya
SDR NOE	Space Defense Region No Orbital Elements

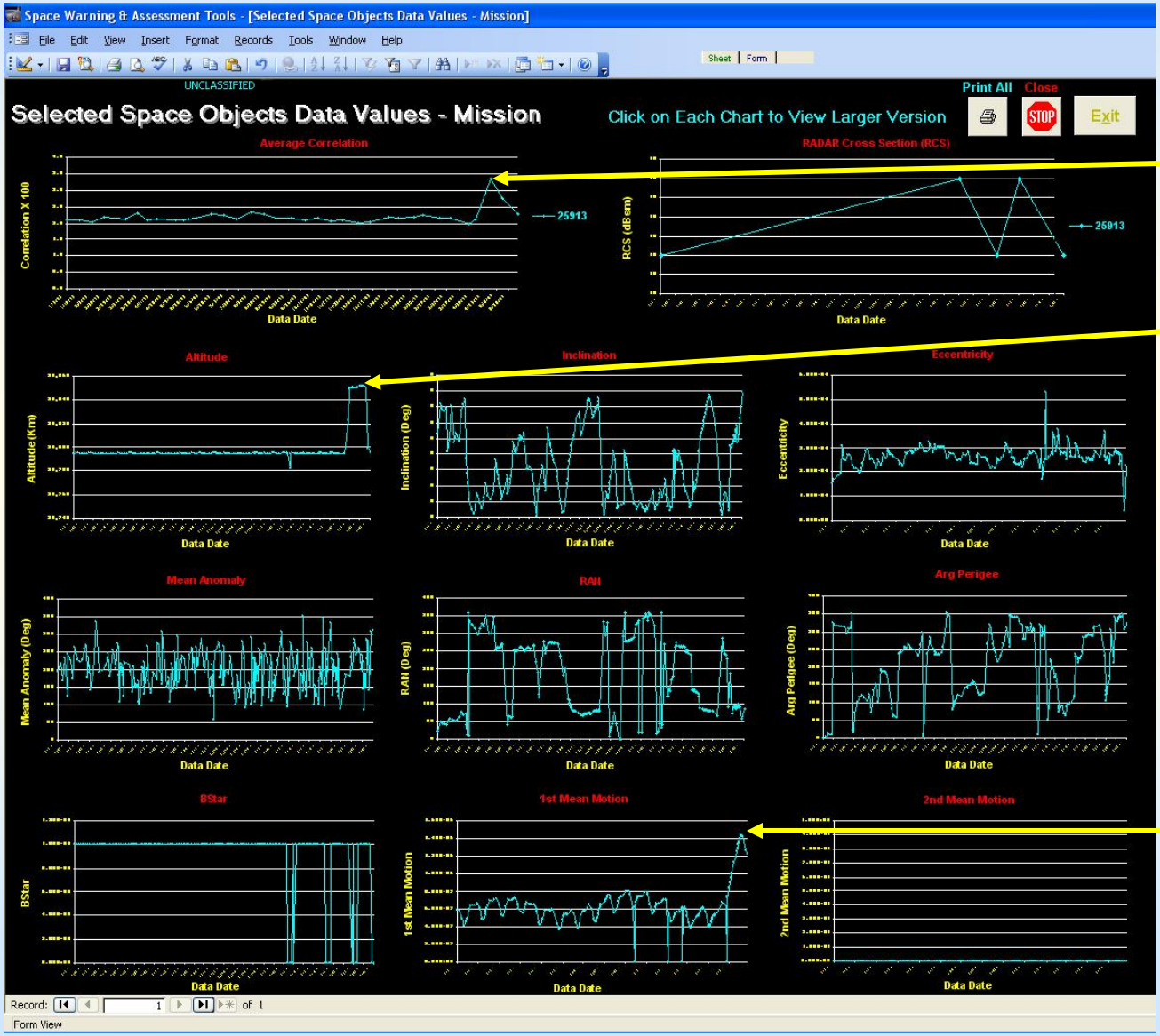
SWAT Correlation Types

- **Current Correlations**
  - **All Objects (Dead & Live) Against All Objects for Current Analysis Date**
- **Historical Correlations**
  - **All Objects (Dead & Live) Against All Objects for Current & Past Dates (6,056,355 records)**
- **Self Correlations**
  - **All Objects (Dead & Live) Against Their Own Historical Characteristics**

Example State Changes

- GPS
- ECHOSTAR 5
- MOLNIYA
- Beidou MEO
- Beidou GEO
- SJ’s

ECHOSTAR 5 Maneuver

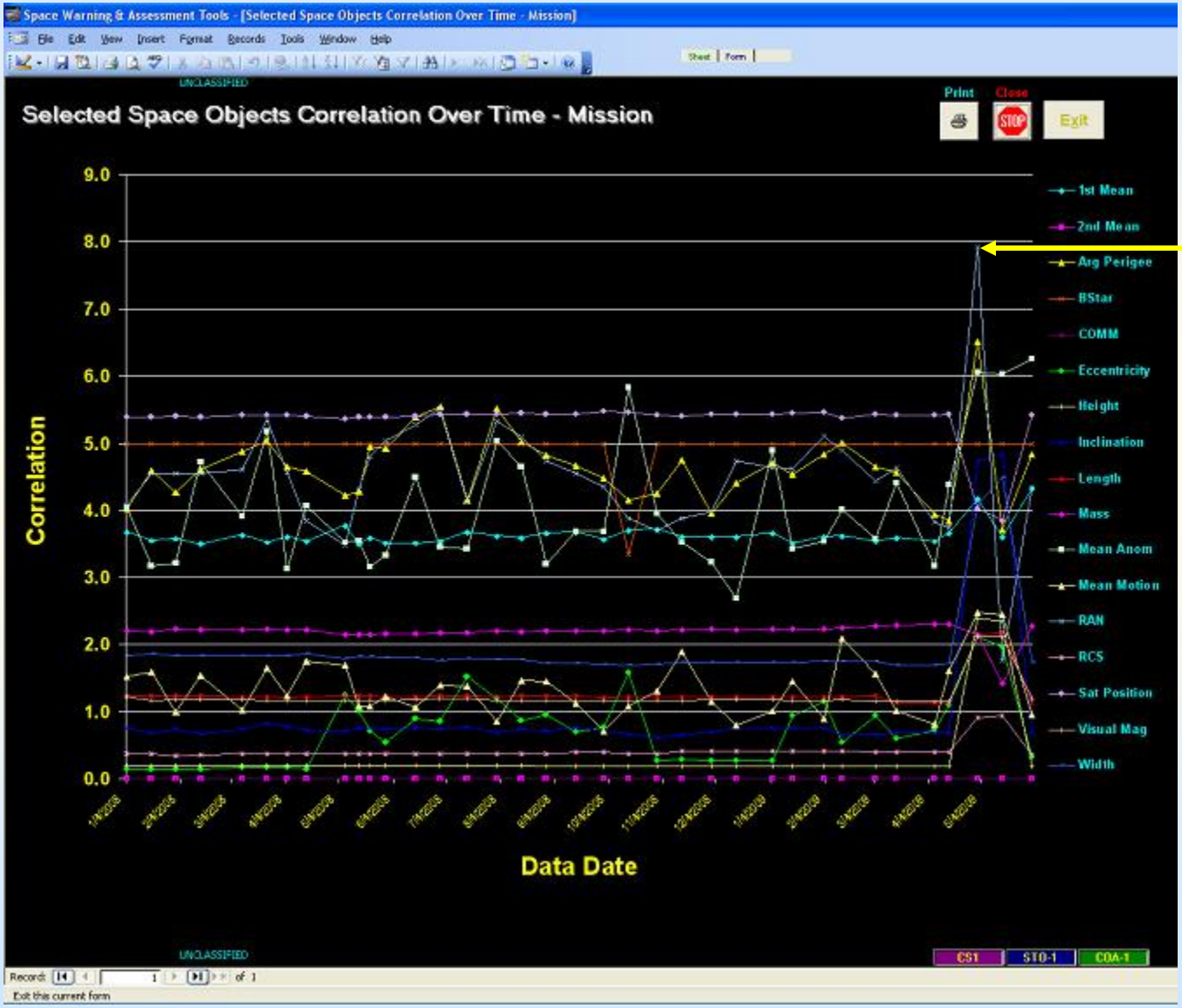


Orbital Maneuver Detected In State Change Algorithms

Orbital Maneuver (57 km)

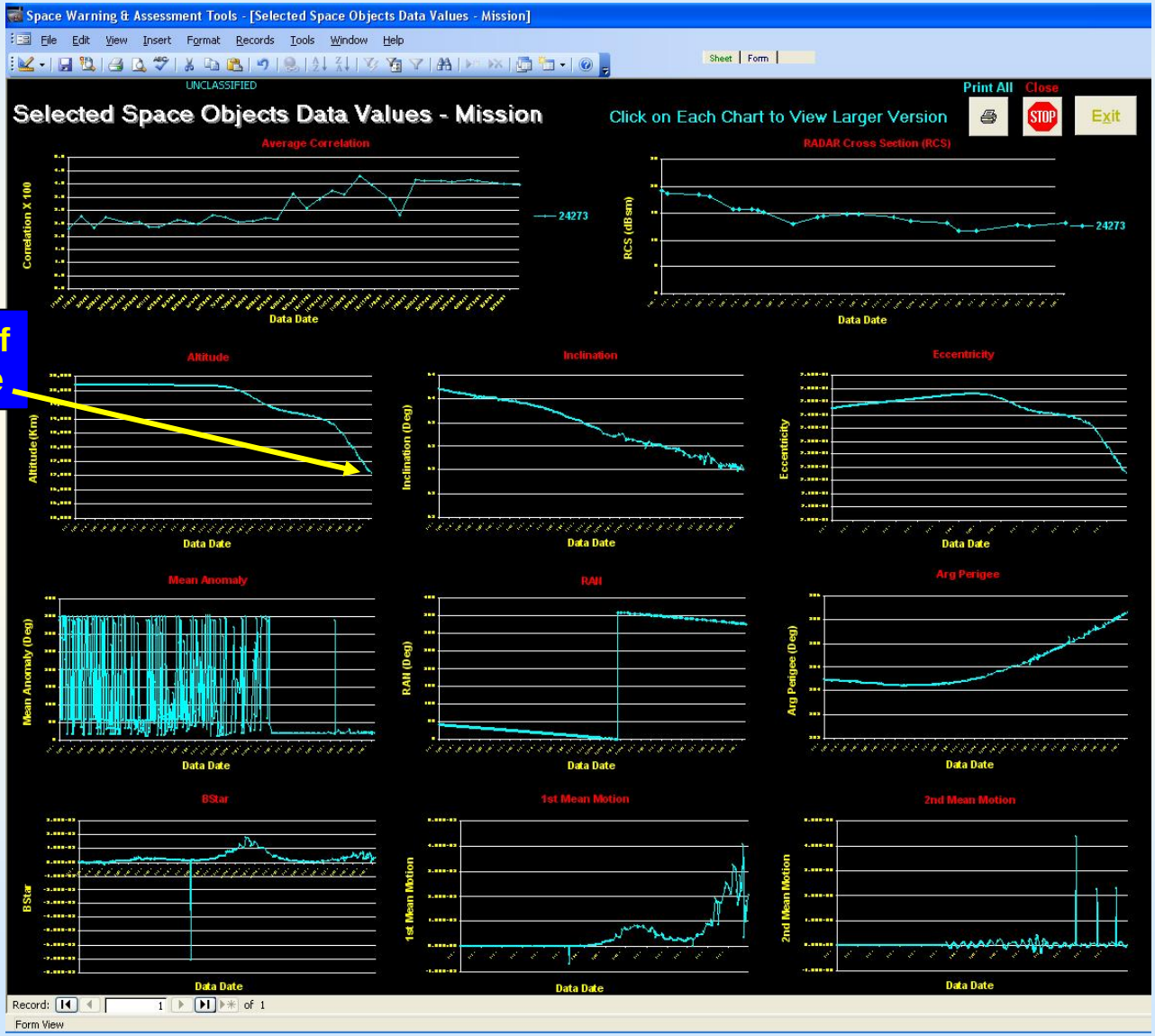
1st Derivative of Altitude

ECHOSTAR 5 Correlations



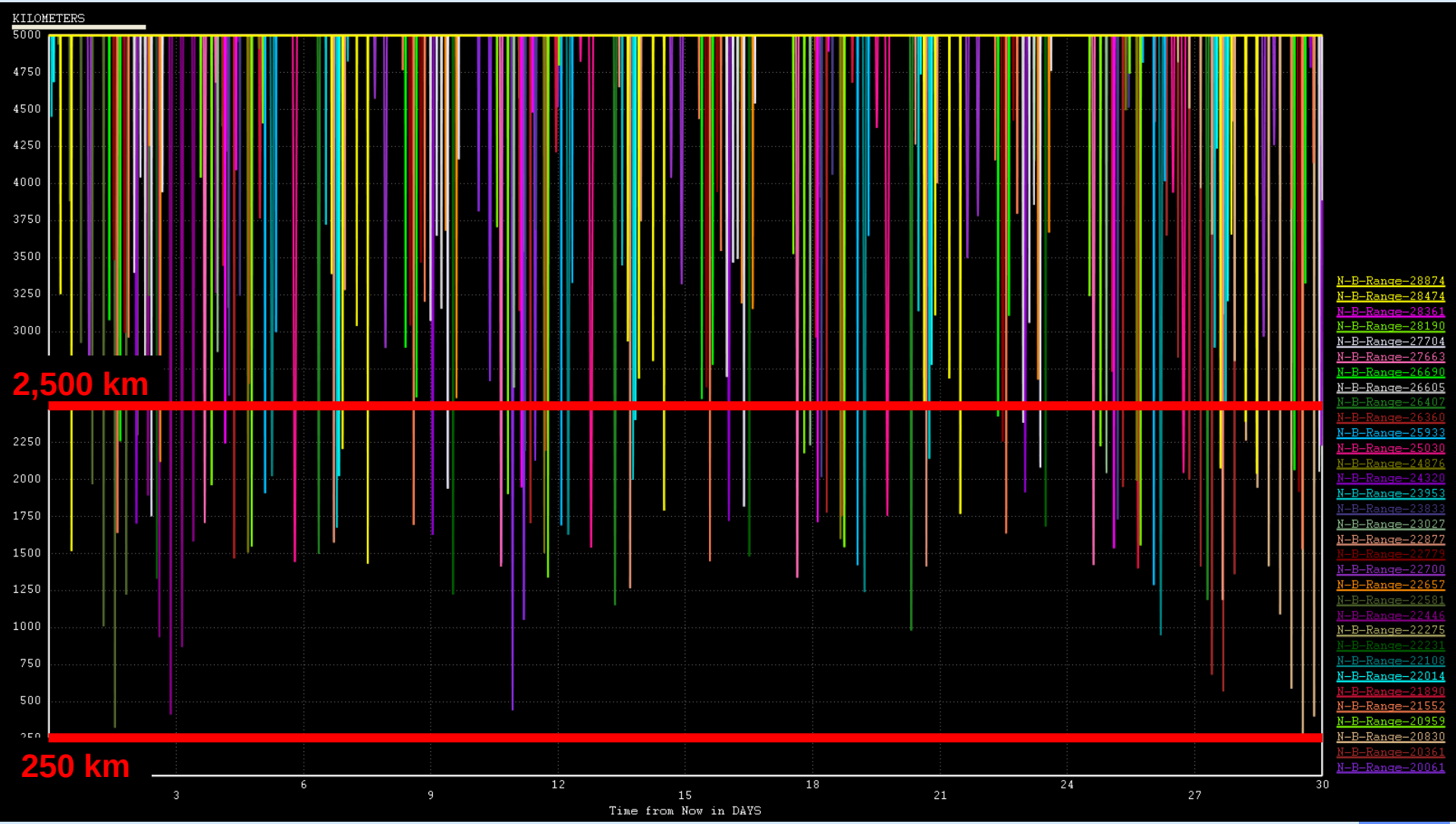
Orbital Maneuver Affected RAN, Arg Perigee, Mean Anomaly, Sat Position, Inclination, Eccentricity, Mean Motion, RCS, and Visual Mag Correlations Against Other GEO Satellites.

MOLNIYA Decay



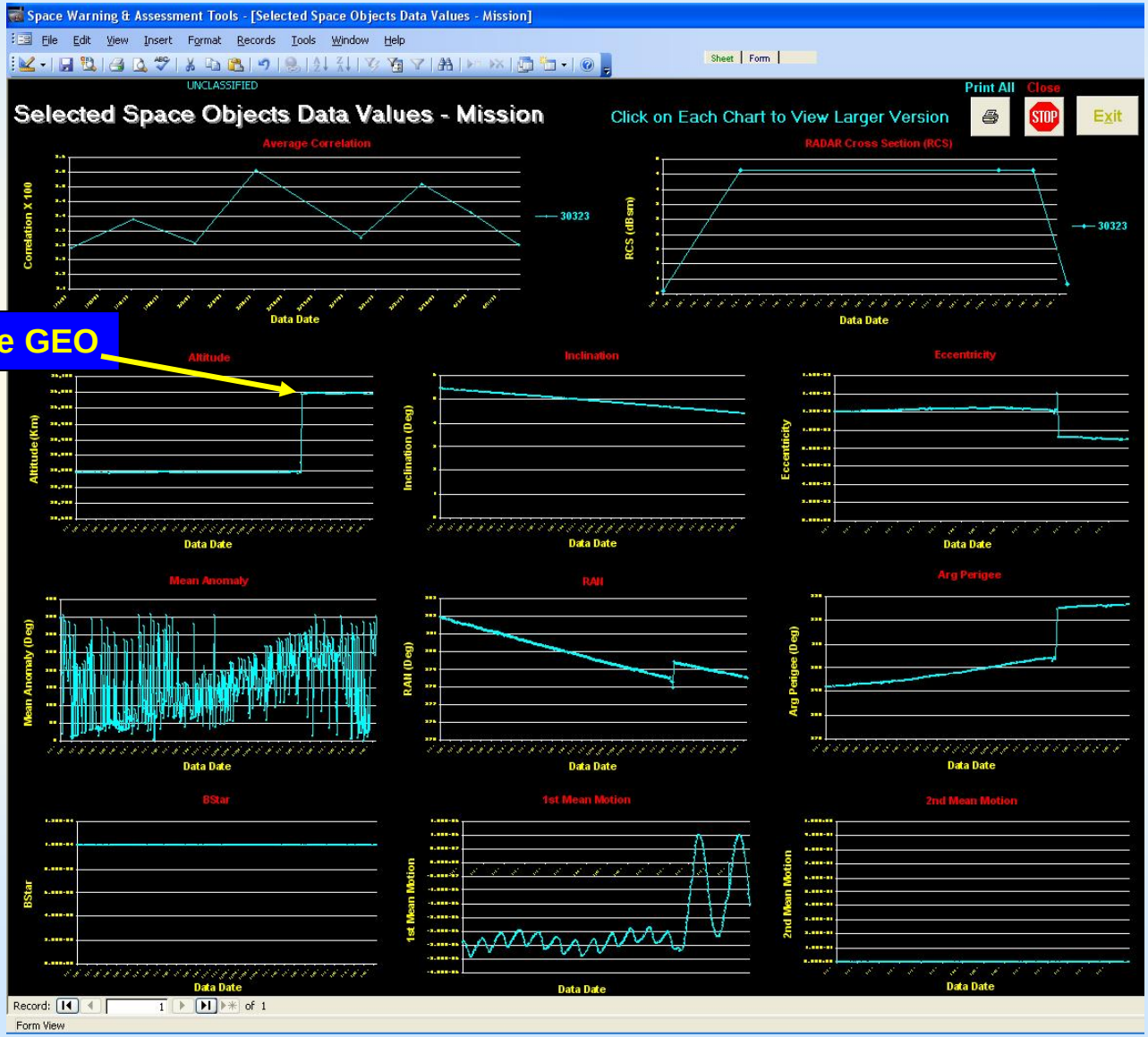
3,097 Km Loss of Average Altitude

Beidou - MEO

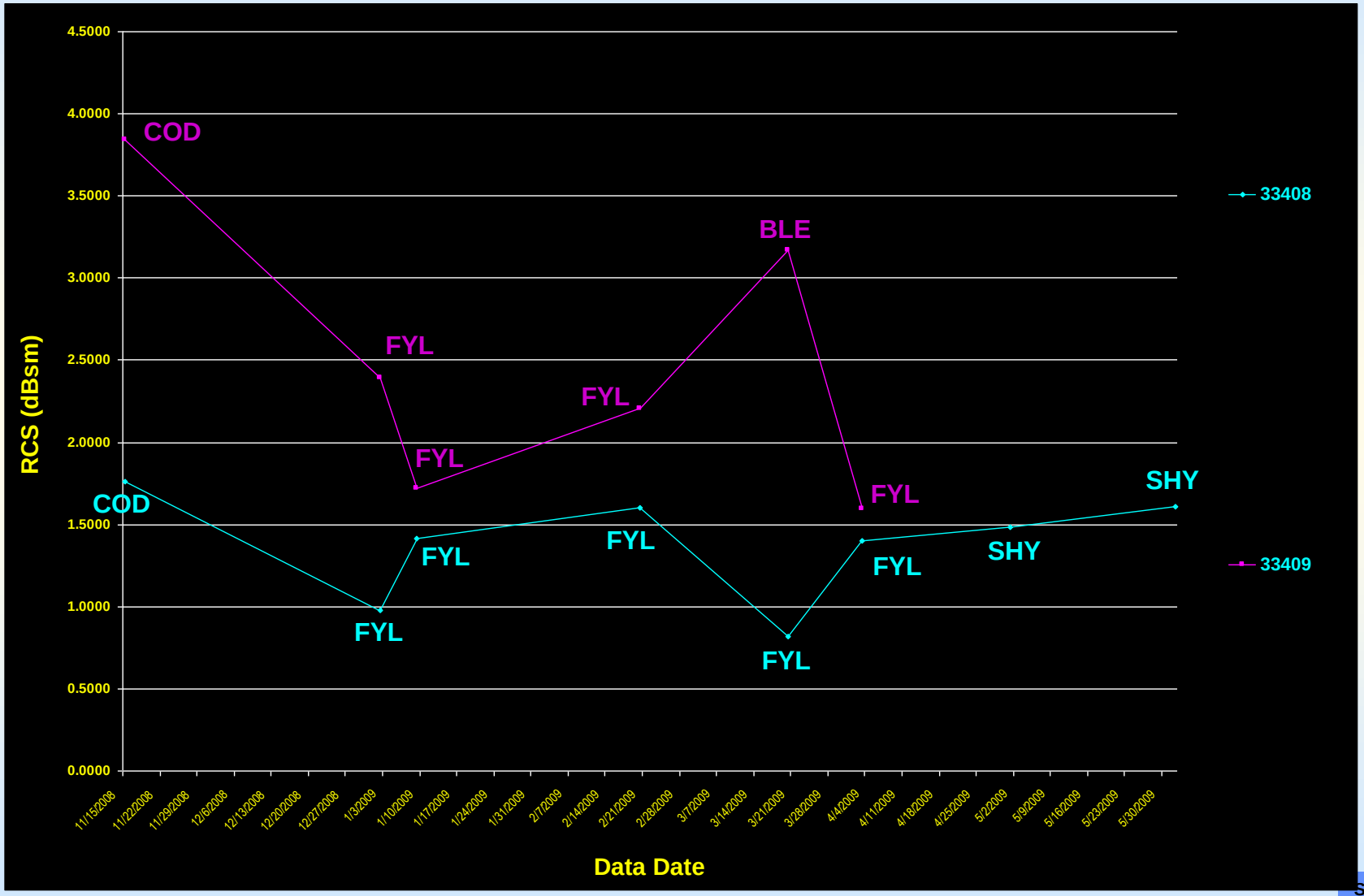


SWAT 1
SWAT 2
SWAT 3

Beidou - GEO Maneuver

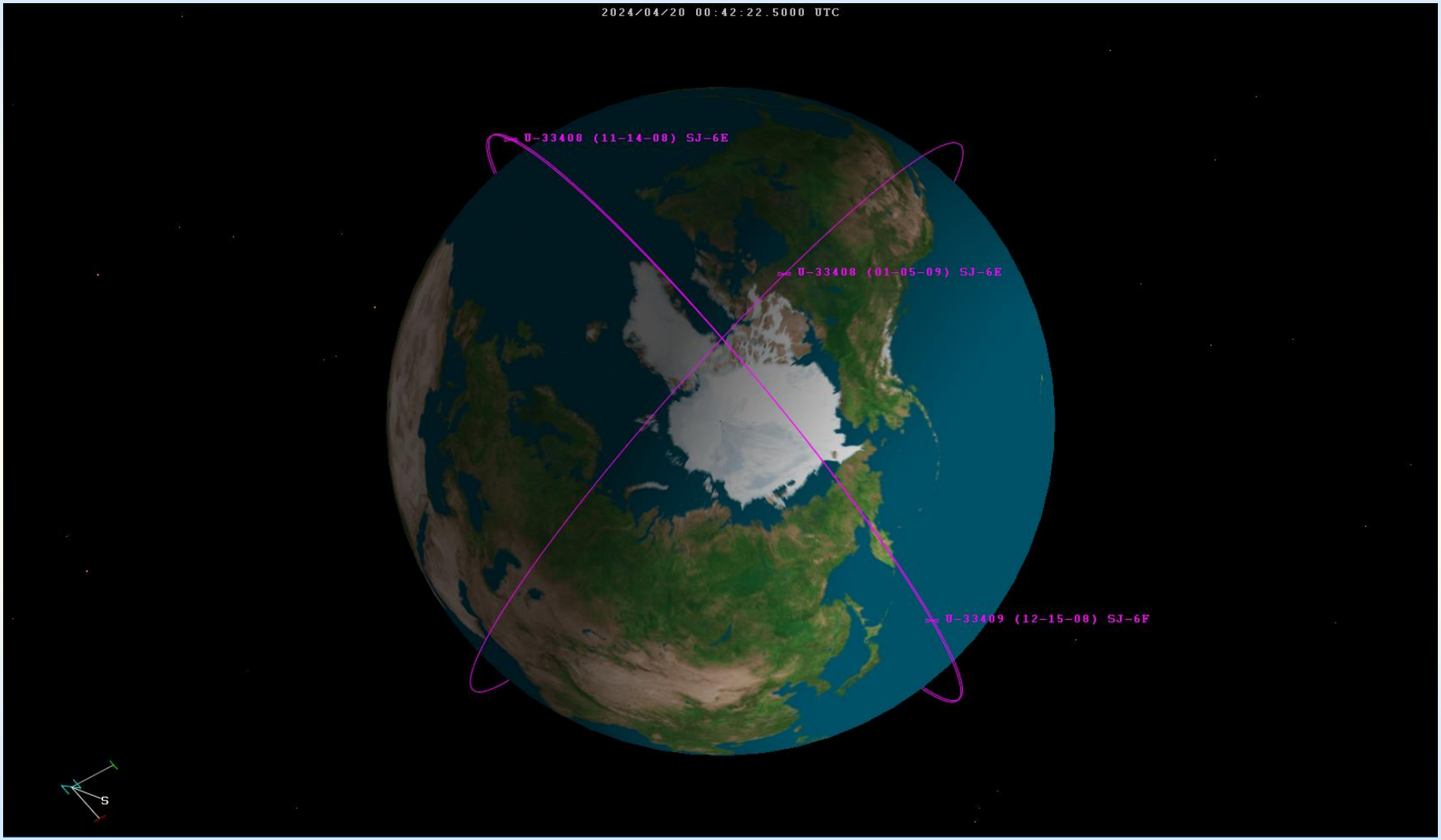


SJ's



SWAT 1
SWAT 2
SWAT 3

SJ's Orbits


2024/04/20 00:42:22.5000 UTC
U-33408 (11-14-08) SJ-6E
U-33408 (01-05-09) SJ-6E
U-33409 (12-15-08) SJ-6F
S

What Makes SWAT State Change Algorithms Different

- **SWAT Assesses All Space Objects**
  - **Particular Emphasis On Potentially Threatening Space Objects Playing "Dead"**
- **SWAT Analyzes 26 Characteristics of Space Objects Simultaneously**
  - **Assessments Go Beyond Orbital Elements Alone**
  - **Simultaneous Changes (e.g. Maneuver & RCS) Increase State Change Scores**
- **SWAT Compares Each Space Object To All Other Space Objects of Same Mission**
  - **Discovers Unusual Characteristics Out of Norm**

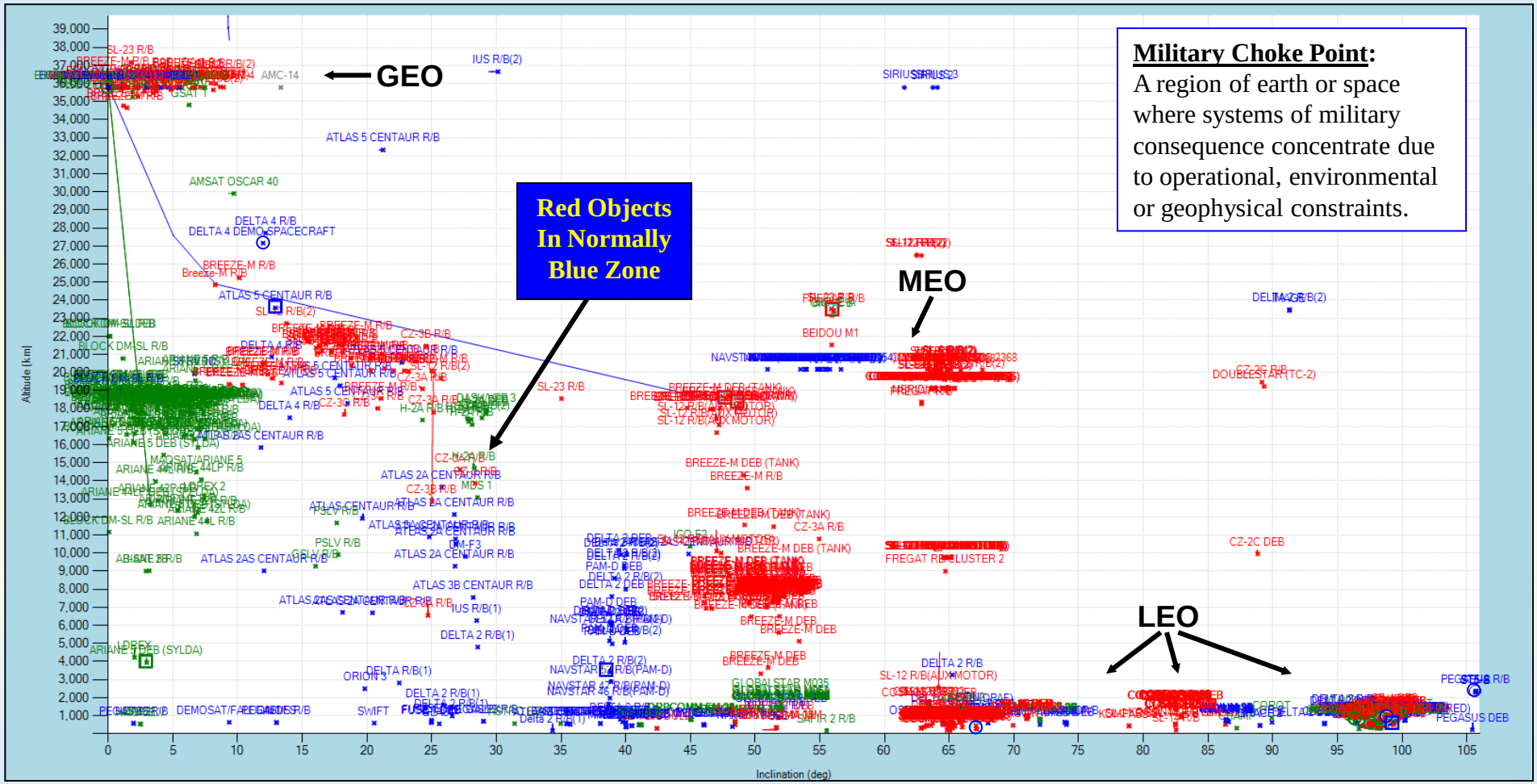
SWAT State Change Benefits

- Filters 11,496 Space Objects Down to Top 10-20 With Most Activity for More Detailed Assessment by Other Space INTEL Assets
- Possible Discovery of Hidden Adversary Intent
- May Indicate Dying or Dead Satellites Before JSpOC Assessment
- Helps Evaluate Friendly Satellite Cover Stories
- AFRL Success – Working Now & Ready for Operational Evaluation

SWAT Determines If Space Systems Have Changed State – Could Signal an ASAT Attack

SWAT 1
SWAT 2
SWAT 3

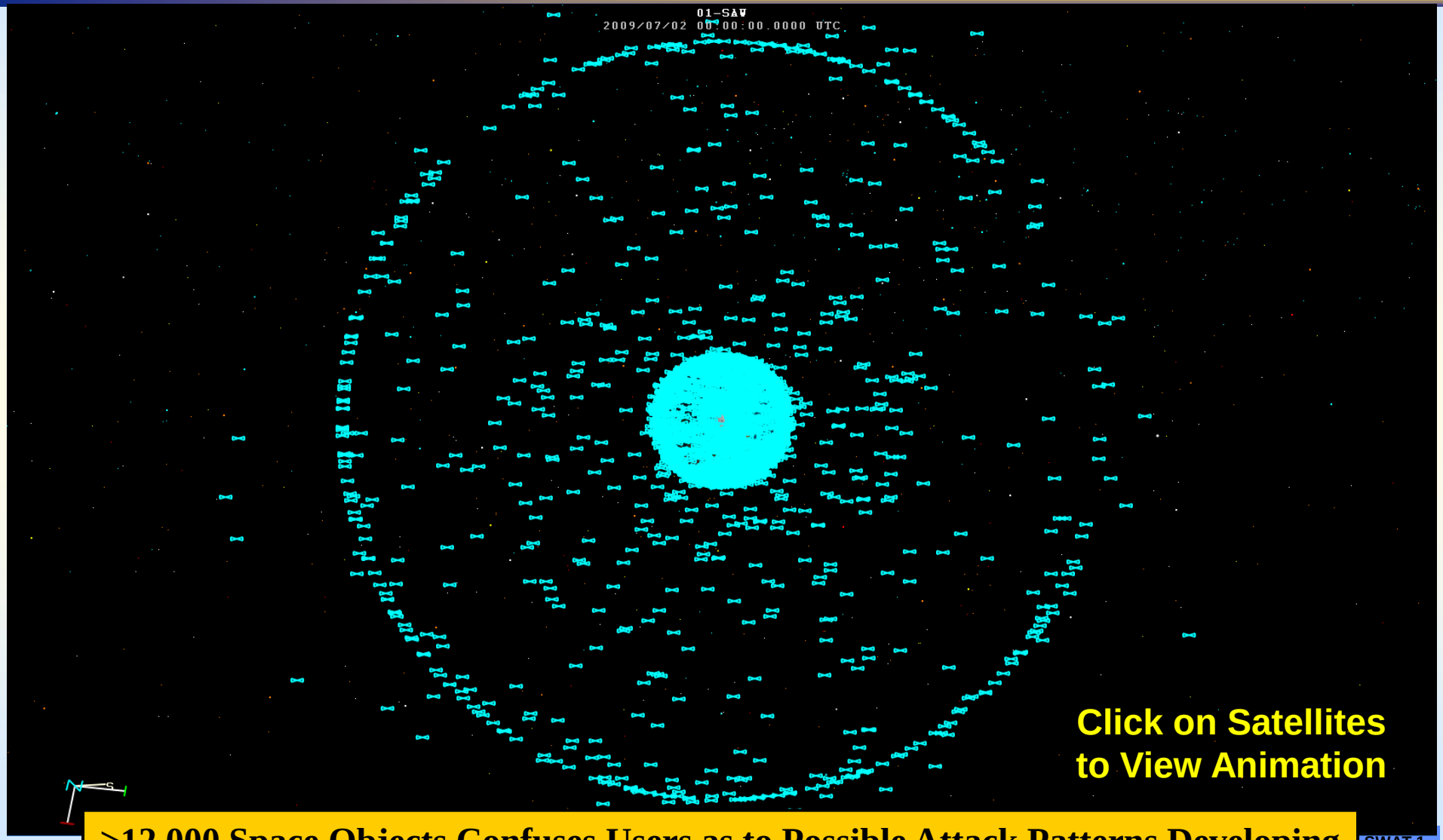
Satellite Attack Warning (SAW) – All Altitudes



Space Has Choke Points As In Terrestrial Systems – They're Just Not Stationary

SWAT 1
SWAT 2
SWAT 3

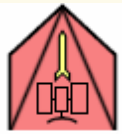
Traditional Orbital View



>12,000 Space Objects Confuses Users as to Possible Attack Patterns Developing

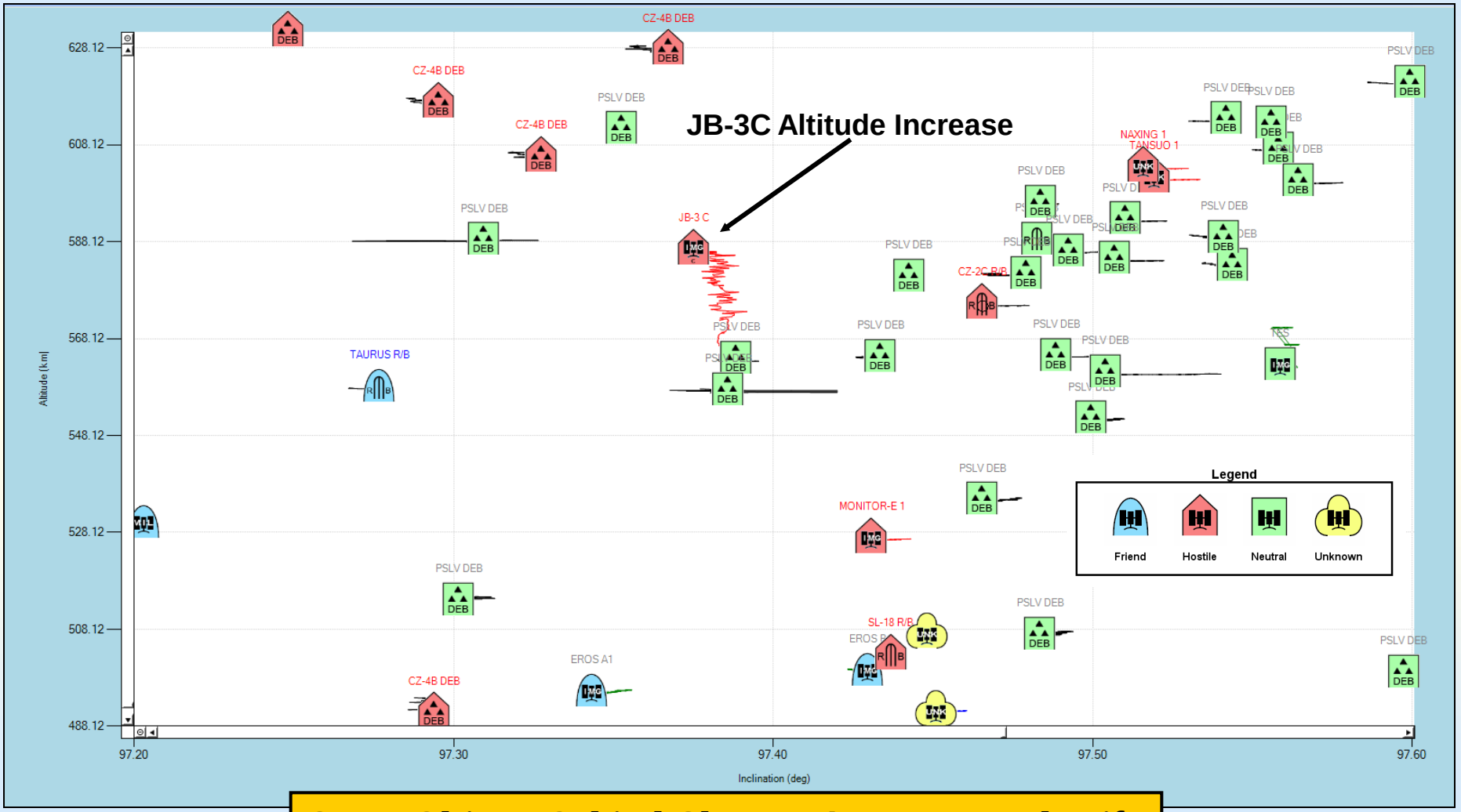
SAW – Icons

- Based on Mil-Std-2525B
- 220 New Space Icons

Friend	Adversary	Neutral	Unknown
			
			
			

Make SAW Maps Similar to Terrestrial Situation Maps

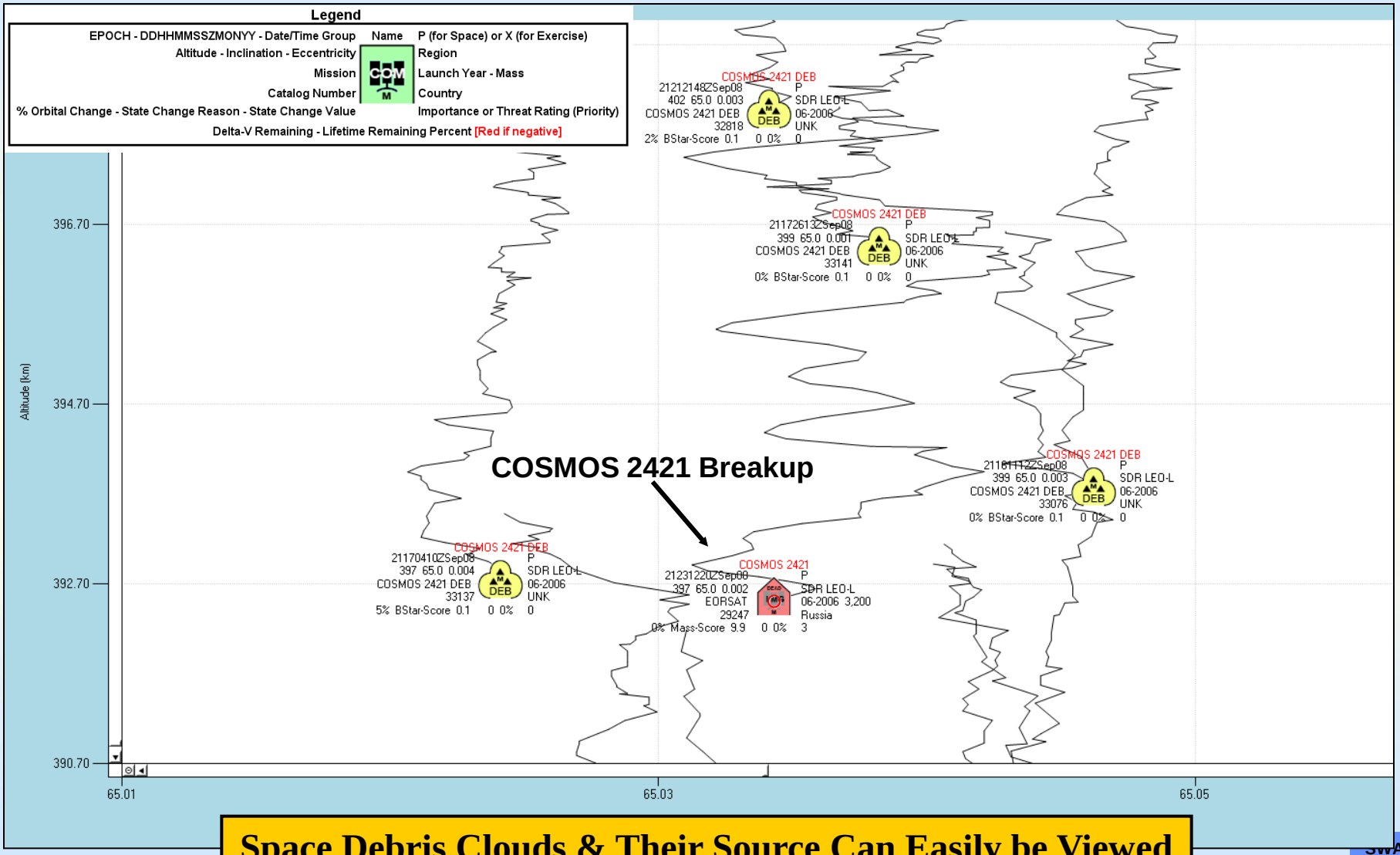
SAW – View 1



Space Objects Orbital Changes Are Easy to Identify

SWAT 1
SWAT 2
SWAT 3

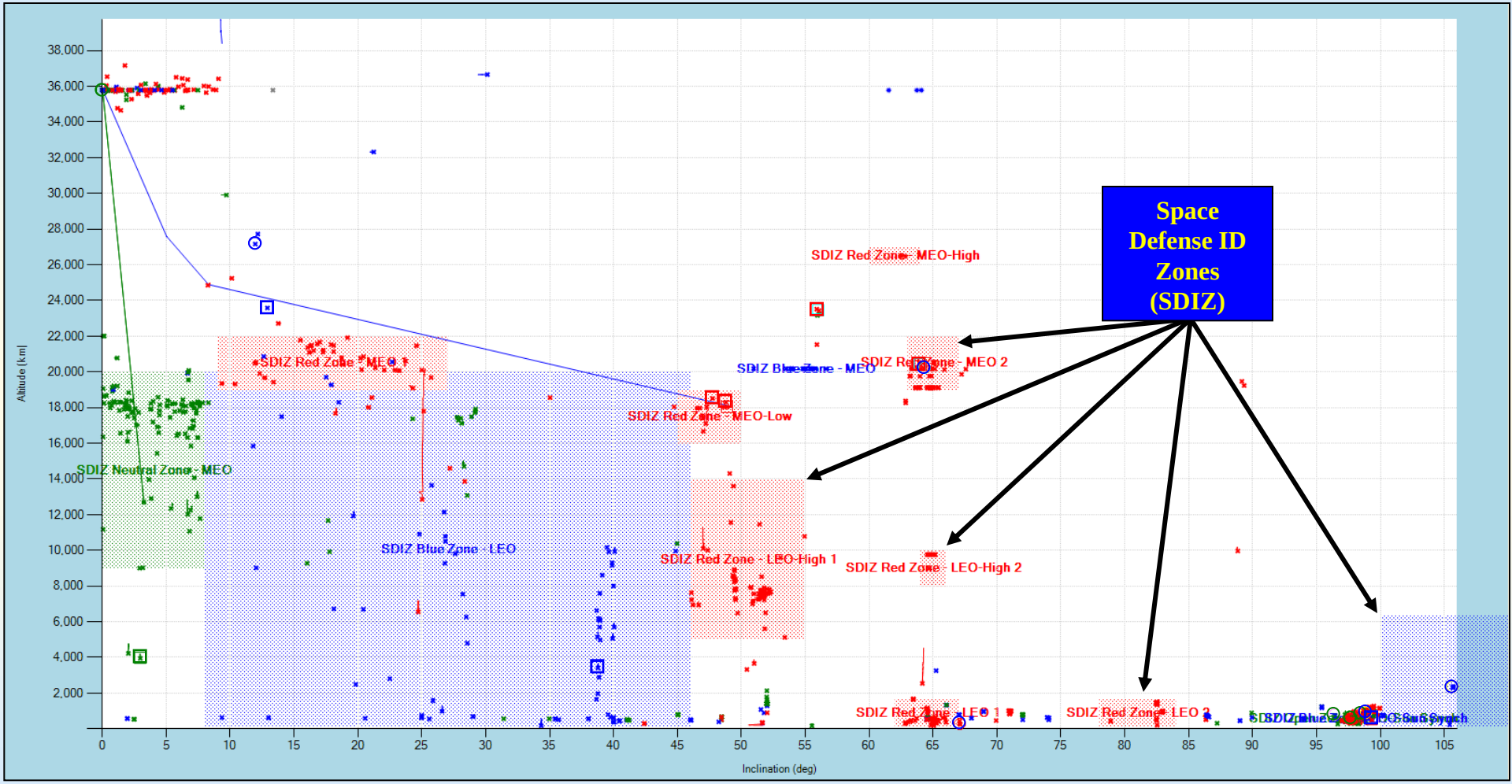
SAW – View 2



Space Debris Clouds & Their Source Can Easily be Viewed

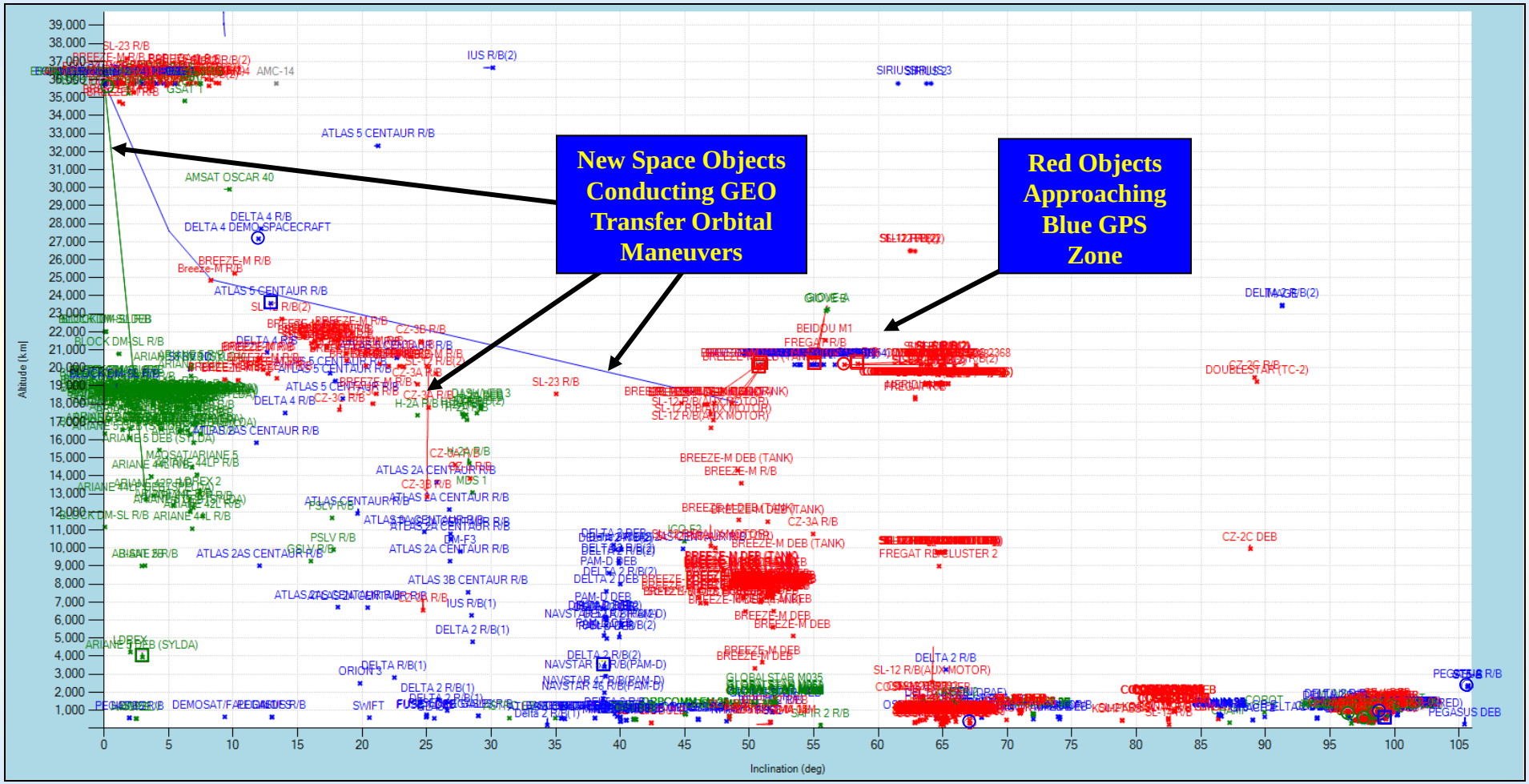
SWAT 1
SWAT 2
SWAT 3

SAW – SDIZ



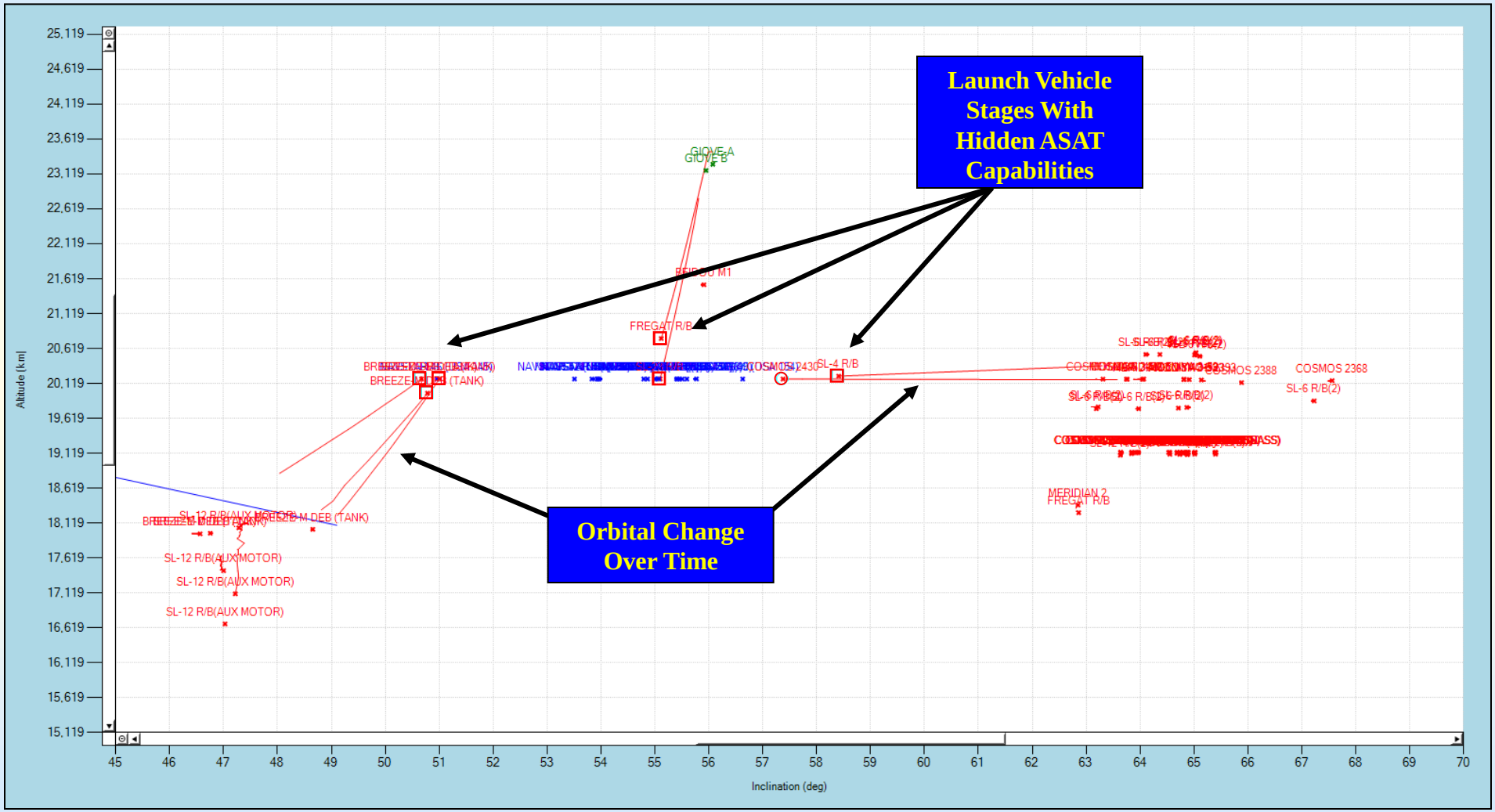
SSA Detection Zones Help Partial Out Operational Responsibility

SAW – Simulated Attack Against GPS



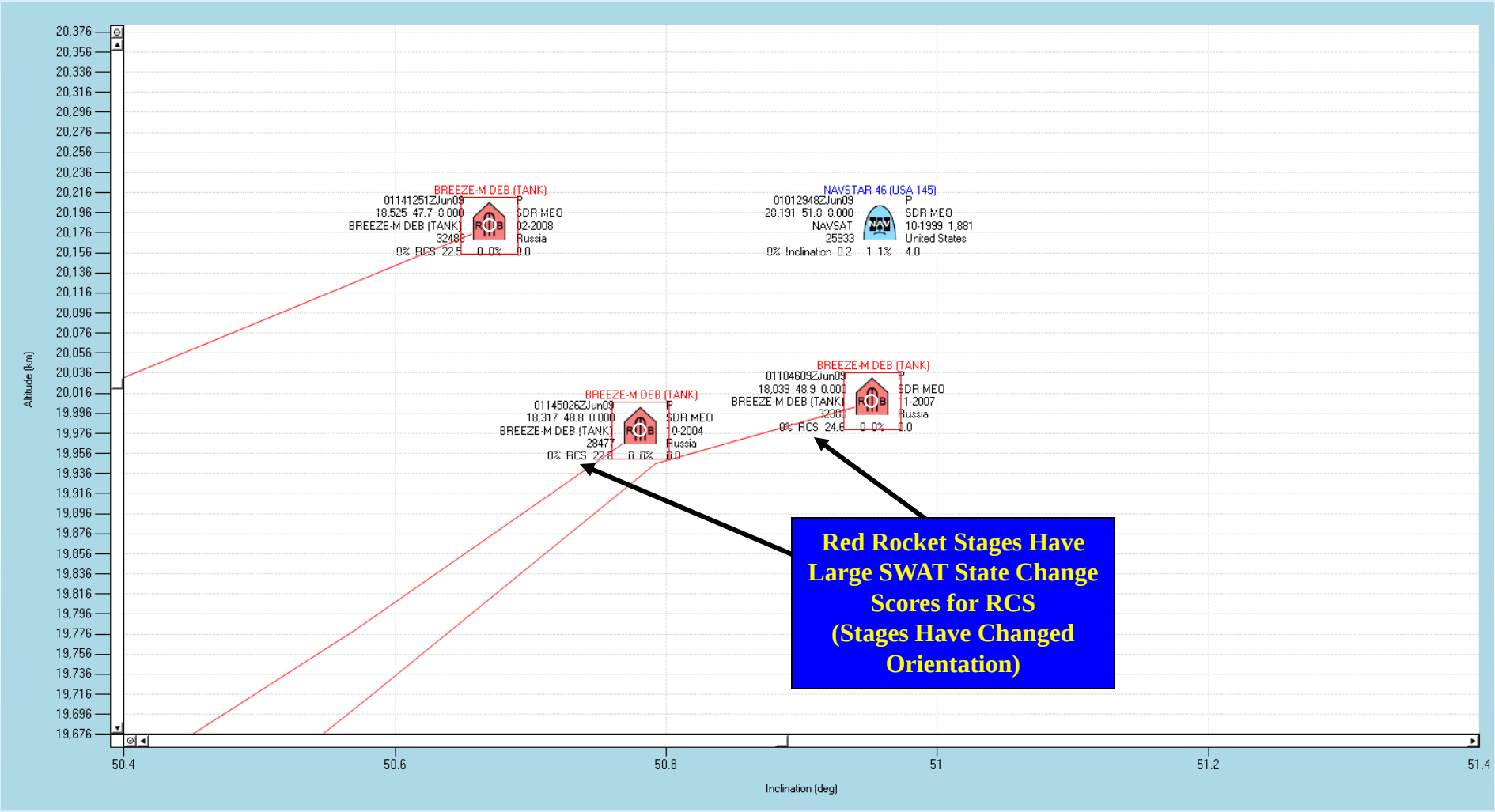
Major Maneuvers of Space Objects are Easily Visualized

SAW – "Dead" Stages as ASATS



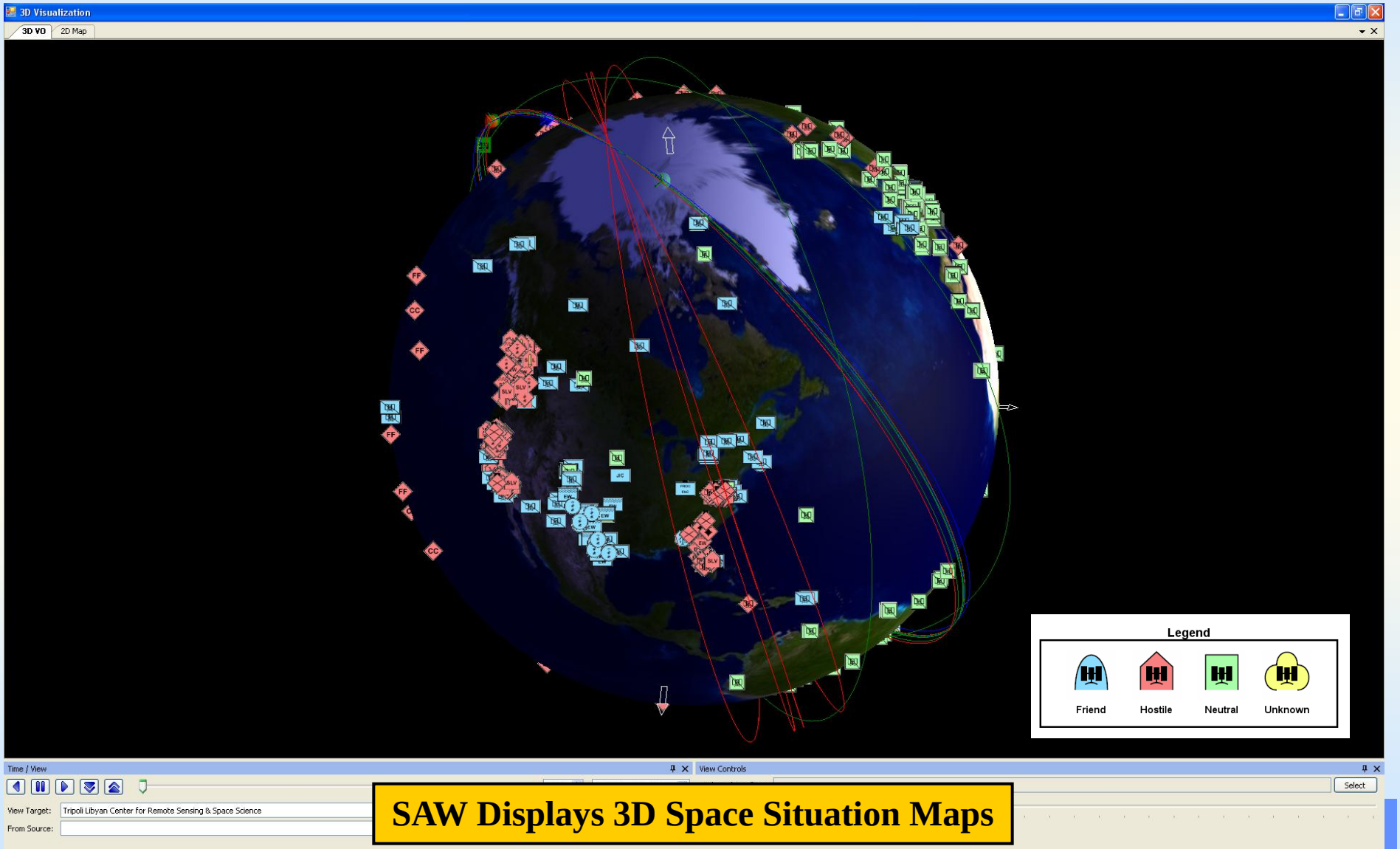
Simultaneous Attack Maneuvers Can Easily be Detected

SAW – Multiple Attacks Against One GPS



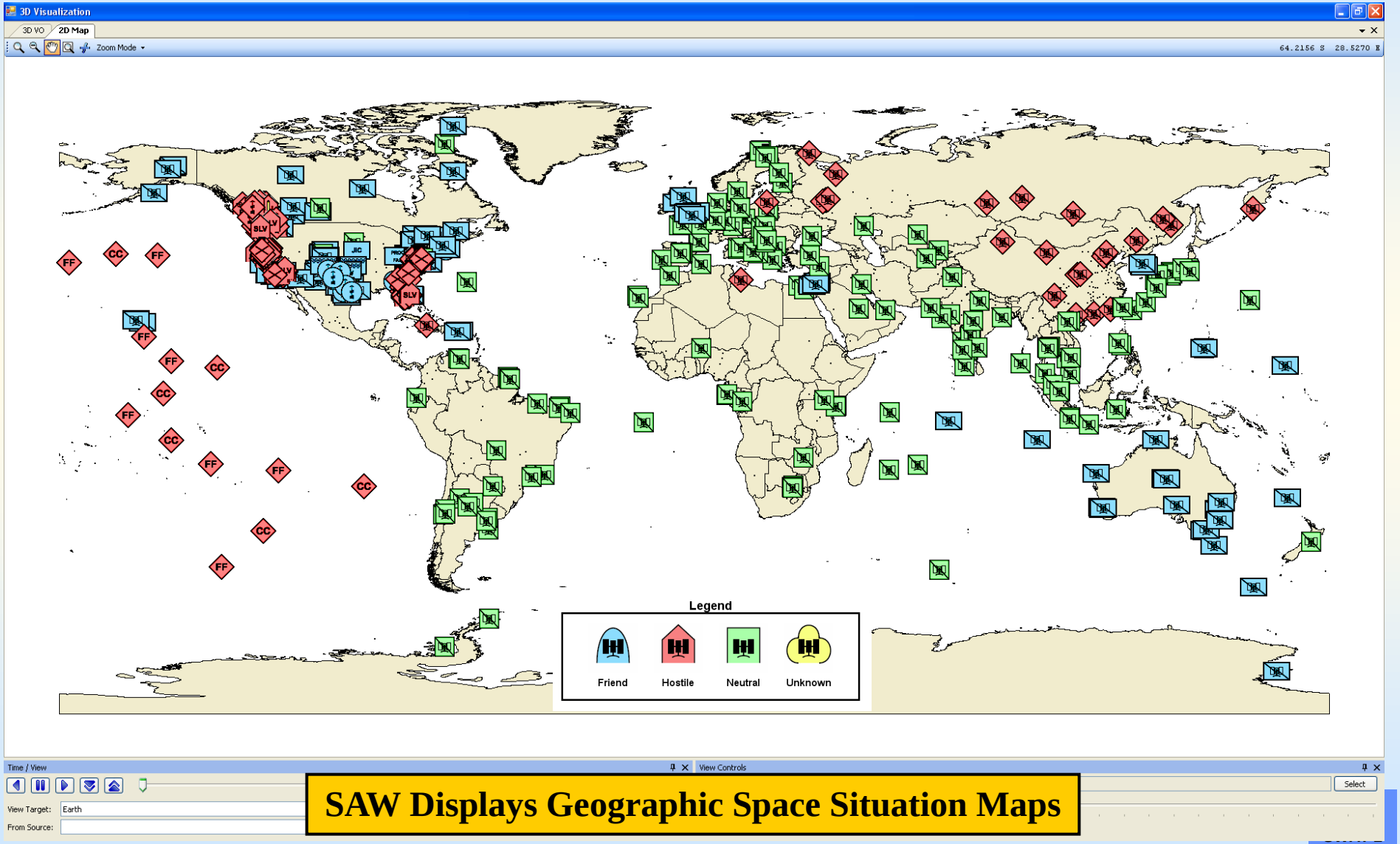
Space Objects Playing Dead Can be Detected With Unusual Movements

SAW – 3D View



SAW Displays 3D Space Situation Maps

SAW – Flat Map View



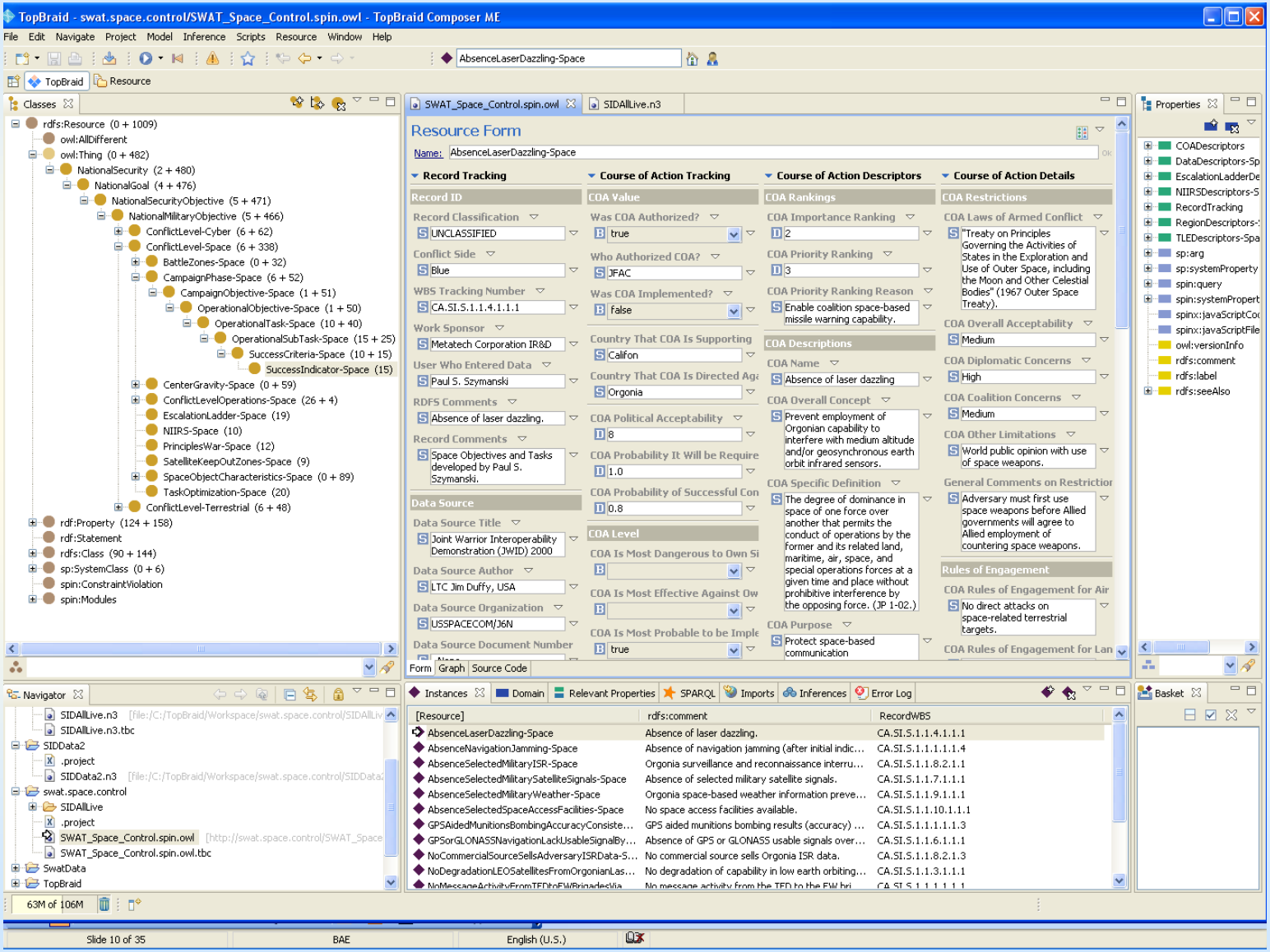
SAW Displays Geographic Space Situation Maps

Space Web Ontology

Space Ontology

- 1,009 Objects: Classes, Properties, Instances
- Most Classes Have Documented Instances
- Classes:
  - Military Objectives & Tasks (8 Levels)
  - Conflict Levels
  - Campaign Phases
  - Success Criteria
  - Success Indicators
  - Space Battle Zones
  - Space Centers Of Gravity
  - Space Principles of War
  - Space Escalation Ladder
  - Space NIIRS
  - Satellite Keep-Out Zones

Space Ontology Example



BACKUP

“It is not the object of war to annihilate those who have given provocation for it, but to cause them to mend their ways.”
- Polybius, History (2nd century B.C.) -

Principles of War

- Objective
- Offensive
- Mass
- Economy of Force
- Maneuver
- Unity of Command
- Security
- Surprise
- Simplicity

Principles of War Equally Applicable to Space & Terrestrial Warfare

Space Principles of War Example

- Mass
  - **Terrestrial:** *"Mass the effects of overwhelming combat power at the decisive place and time"*
  - **Space:** Are there sufficient weapons to achieve continuous, or sustained space control. Can the adversary re-configure to avoid attack. Are the space weapons overwhelming to the military function they are trying to deny. Is there political will to implement massed space attack. Can space weapons get into position at the decisive place and time. Do we know the decisive place and time for space weapons application. Can space weapons be synchronized for employment simultaneously.

Space Strategy Planning Has Not Had the Benefit of a Long History

Space Strategies Example

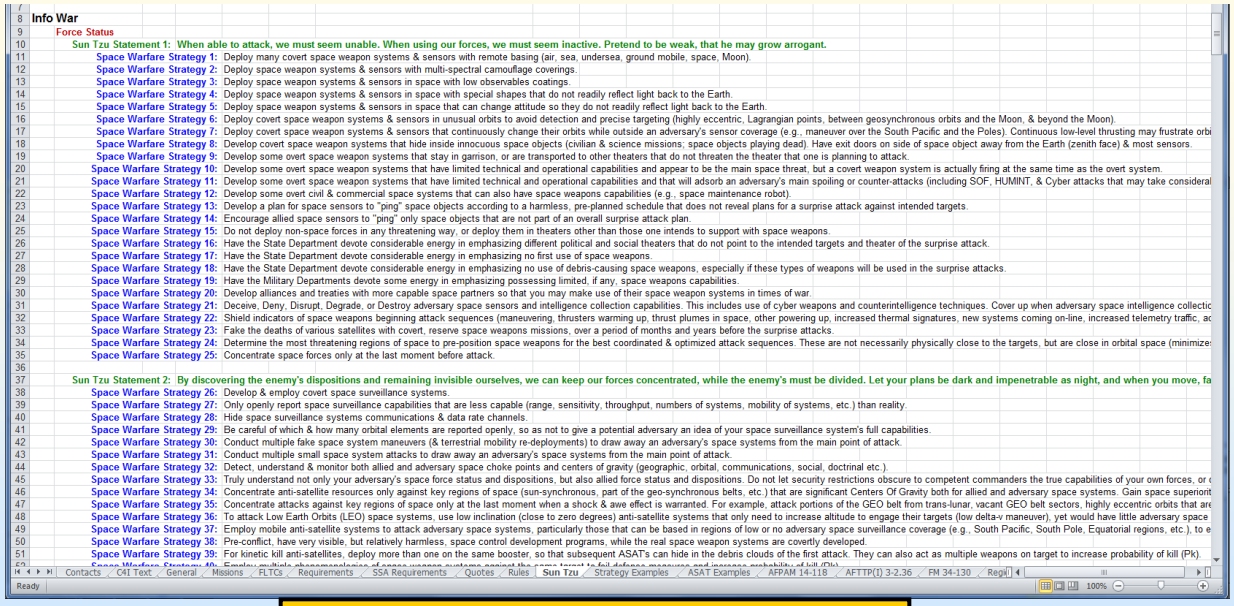
Title:
Herd Space Personnel

Action:
Destroy all Red space-related ground targets, except purposely lightly damage one ground center. Assume that key space support personnel will converge to this lightly damaged site to conduct repairs. 12 hours later, use anti-personnel weapons at this site, with destroy weapons 2 hours later.

Desired Effect:
Destroys Red country's most import space asset: key technically trained space personnel. Also sends message to international community that foreign personnel supporting Red space efforts will be at risk.

Space Strategies Derived From Sun Tzu

- **Sun Tzu's "The Art of War" (544 BC – 496 BC) Used to Derive Modern Space Strategies**
- **Analysis In Progress**
  - **453 Space Warfare Strategies Already Derived**
  - **Only 1/3 the Way Through Sun Tzu's Teachings**

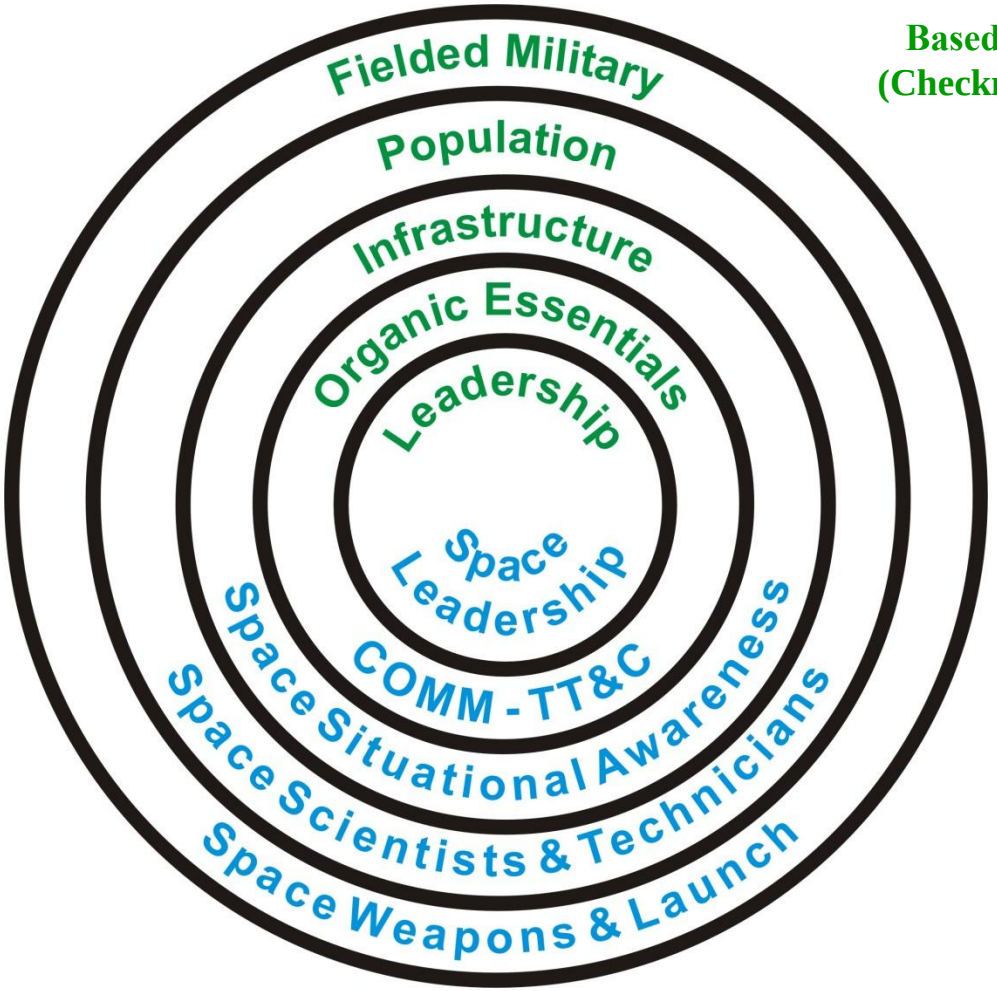


Info War
Force Status
Sun Tzu Statement 1: When able to attack, we must seem unable. When using our forces, we must seem inactive. Pretend to be weak, that he may grow arrogant.
Space Warfare Strategy 1: Deploy many covert space weapon systems & sensors with remote basing (air, sea, undersea, ground mobile, space, Moon).
Space Warfare Strategy 2: Deploy space weapon systems & sensors with multi-spectral camouflage coverings.
Space Warfare Strategy 3: Deploy space weapon systems & sensors in space with low observables coatings.
Space Warfare Strategy 4: Deploy space weapon systems & sensors in space with special shapes that do not readily reflect light back to the Earth.
Space Warfare Strategy 5: Deploy space weapon systems & sensors in space that can change attitude so they do not readily reflect light back to the Earth.
Space Warfare Strategy 6: Deploy covert space weapon systems & sensors in unusual orbits to avoid detection and precise targeting (highly eccentric, Lagrangian points, between geosynchronous orbits and the Moon, & beyond the Moon).
Space Warfare Strategy 7: Deploy covert space weapon systems & sensors that continuously change their orbits while outside an adversary's sensor coverage (e.g., maneuver over the South Pacific and the Poles). Continuous low-level thrusting may frustrate orbi
Space Warfare Strategy 8: Develop covert space weapon systems that hide inside innocuous space objects (civilian & science missions; space objects playing dead). Have exit doors on side of space object away from the Earth (zenith face) & most sensors.
Space Warfare Strategy 9: Develop some overt space weapon systems that stay in garrison, or are transported to other theaters that do not threaten the theater that one is planning to attack.
Space Warfare Strategy 10: Develop some overt space weapon systems that have limited technical and operational capabilities and appear to be the main space threat, but a covert weapon system is actually firing at the same time as the overt system.
Space Warfare Strategy 11: Develop some overt space weapon systems that have limited technical and operational capabilities and that will adsorb an adversary's main spoiling or counter-attacks (including SOF, HUMINT, & Cyber attacks that may take considera
Space Warfare Strategy 12: Develop some overt civil & commercial space systems that can also have space weapons capabilities (e.g., space maintenance robot).
Space Warfare Strategy 13: Develop a plan for space sensors to "ping" space objects according to a harmless, pre-planned schedule that does not reveal plans for a surprise attack against intended targets.
Space Warfare Strategy 14: Encourage allied space sensors to "ping" only space objects that are not part of an overall surprise attack plan.
Space Warfare Strategy 15: Do not deploy non-space forces in any threatening way, or deploy them in theaters other than those one intends to support with space weapons.
Space Warfare Strategy 16: Have the State Department devote considerable energy in emphasizing different political and social theaters that do not point to the intended targets and theater of the surprise attack.
Space Warfare Strategy 17: Have the State Department devote considerable energy in emphasizing no first use of space weapons.
Space Warfare Strategy 18: Have the State Department devote considerable energy in emphasizing no use of debris-causing space weapons, especially if these types of weapons will be used in the surprise attacks.
Space Warfare Strategy 19: Have the Military Departments devote some energy in emphasizing possessing limited, if any, space weapons capabilities.
Space Warfare Strategy 20: Develop alliances and treaties with more capable space partners so that you may make use of their space weapon systems in times of war.
Space Warfare Strategy 21: Deceive, Deny, Disrupt, Degrade, or Destroy adversary space sensors and intelligence collection capabilities. This includes use of cyber weapons and counterintelligence techniques. Cover up when adversary space intelligence collectio
Space Warfare Strategy 22: Shield indicators of space weapons beginning attack sequences (maneuvering, thrusters warming up, thrust plumes in space, other powering up, increased thermal signatures, new systems coming on-line, increased telemetry traffic, ac
Space Warfare Strategy 23: Fake the deaths of various satellites with covert, reserve space weapons missions, over a period of months and years before the surprise attacks.
Space Warfare Strategy 24: Determine the most threatening regions of space to pre-position space weapons for the best coordinated & optimized attack sequences. These are not necessarily physically close to the targets, but are close in orbital space (minimize
Space Warfare Strategy 25: Concentrate space forces only at the last moment before attack.
Sun Tzu Statement 2: By discovering the enemy's dispositions and remaining invisible ourselves, we can keep our forces concentrated, while the enemy's must be divided. Let your plans be dark and impenetrable as night, and when you move, fa
Space Warfare Strategy 26: Develop & employ covert space surveillance systems.
Space Warfare Strategy 27: Only openly report space surveillance capabilities that are less capable (range, sensitivity, throughput, numbers of systems, mobility of systems, etc.) than reality.
Space Warfare Strategy 28: Hide space surveillance systems communications & data rate channels.
Space Warfare Strategy 29: Be careful of which & how many orbital elements are reported openly, so as not to give a potential adversary an idea of your space surveillance system's full capabilities.
Space Warfare Strategy 30: Conduct multiple fake space system maneuvers (& terrestrial mobility re-deployments) to draw away an adversary's space systems from the main point of attack.
Space Warfare Strategy 31: Conduct multiple small space system attacks to draw away an adversary's space systems from the main point of attack.
Space Warfare Strategy 32: Detect, understand & monitor both allied and adversary space choke points and centers of gravity (geographic, orbital, communications, social, doctrinal etc.).
Space Warfare Strategy 33: Truly understand not only your adversary's space force status and dispositions, but also allied force status and dispositions. Do not let security restrictions obscure to competent commanders the true capabilities of your own forces, or
Space Warfare Strategy 34: Concentrate anti-satellite resources only against key regions of space (sun-synchronous, part of the geo-synchronous belts, etc.) that are significant Centers Of Gravity both for allied and adversary space systems. Gain space superiorit
Space Warfare Strategy 35: Concentrate attacks against key regions of space only at the last moment when a shock & awe effect is warranted. For example, attack portions of the GEO belt from trans-lunar, vacant GEO belt sectors, highly eccentric orbits that are
Space Warfare Strategy 36: To attack Low Earth Orbits (LEO) space systems, use low inclination (close to zero degrees) anti-satellite systems that only need to increase altitude to engage their targets (low delta-v maneuver), yet would have little adversary space
Space Warfare Strategy 37: Employ mobile anti-satellite systems to attack adversary space systems, particularly those that can be based in regions of low or no adversary space surveillance coverage (e.g., South Pacific, South Pole, Equatorial regions, etc.), to e
Space Warfare Strategy 38: Pre-conflict, have very visible, but relatively harmless, space control development programs, while the real space weapon systems are covertly developed.
Space Warfare Strategy 39: For kinetic kill anti-satellites, deploy more than one on the same booster, so that subsequent ASAT's can hide in the debris clouds of the first attack. They can also act as multiple weapons on target to increase probability of kill (Pk).
Contacts | C4I Text | General | Missions | FLTCs | Requirements | SSA Requirements | Quotes | Rules | Sun Tzu | Strategy Examples | ASAT Examples | AFPAM 14-118 | AFTTP(1) 3-2.36 | FM 34-130 | Regi
Ready

Methods of War Are Eternal

Space Centers of Gravity Model

Based On Col John Warden's (Checkmate) 5-Ring COG Model



Space Equivalent 5-Ring COG Model

Space Systems Strategic Targeting Is Similar to Terrestrial Targeting Strategies

Example Space Centers of Gravity

Launch corridors
GEO belt sectors
Sun-Synchronous LEO orbits
GEO satellites changing orbital position
Space-related command centers / commanders / INTEL Centers
Space surveillance systems
Space technicians / scientists
Electric grid serving ground space facilities
Space design and manufacturing facilities
Leader's confidence in their new space technologies
Blue and Red side political will to start and continue a space war
Space-related decision cycle times (OODA loops)
Low delta-v/transit time points in space to reach High Value Targets
Points in space with high/low coverage from space surveillance assets
Regions of space and time with advantageous solar phase angles
Times of high solar storm activity
On-orbit spares or launch replenishment or ability to reconstitute space capability with terrestrial systems
Antipodal nodes 180 degrees from launch sites around the world
Manned launch (Shuttle, Space Station) of satellites
Initial satellite checkout after launch or orbital insertion
Periods of solar eclipse / low battery charge for satellites
Approach trajectories outside the field of regard of the target's on-board sensors
Approach trajectories when the Sun/Moon/Earth is in the background of a target's sensors
Approach trajectories outside normally employed orbits
Near a satellite's thrusters
Near a satellite's high power antennas
Just after loss of contact with adversary satellite ground controllers / space surveillance assets

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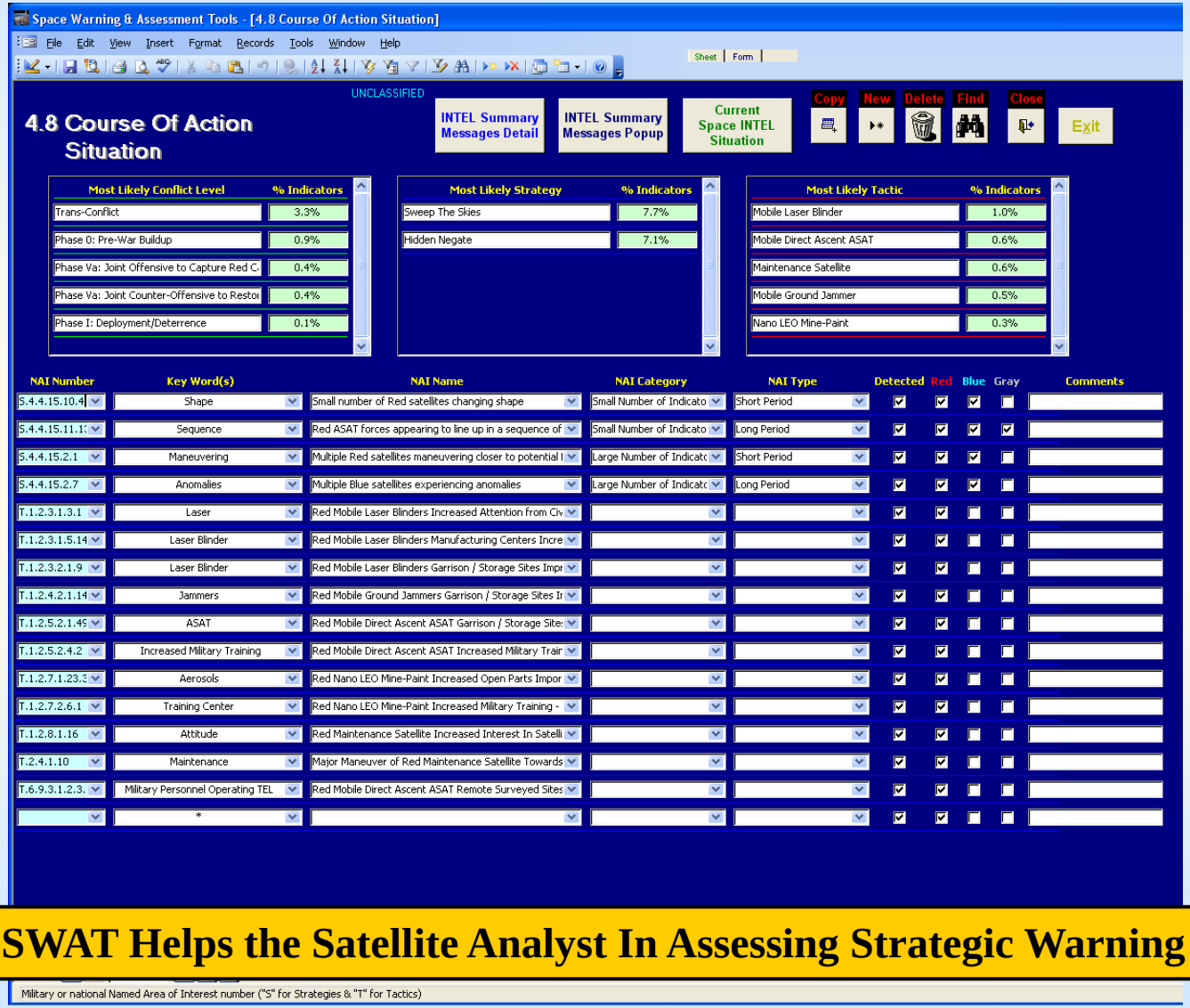
SWAT Has Extensive Space Centers of Gravity Checklists

SWAT Automatic Determination of Red Space Attack Strategies

- **Database of Possible Red Space Attack Strategies are Linked to Checklist of INTEL Indicators of Space Systems Activities**
- **Most Probable Red Space Strategy Is Determined Based On Currently Observed INTEL Indications of Space Activities**
- **SWAT Automatically Increases Space INTEL Collection Priorities In IPB Tasking Forms Based On Probable Red Actions**

SWAT Helps the Satellite Analyst Determine If Space Systems Are Under Attack

SWAT Auto Attack Assessment



SWAT Helps the Satellite Analyst In Assessing Strategic Warning

SWAT 1
SWAT 2
SWAT 3

Example Space Objectives

⋮ ← 5,000 Other Space Objectives

Blind Blue capabilities to observe the terrestrial battlefield
Blind Blue capabilities to observe space from terrestrial sensors
Blind Blue capabilities to observe space from space-based sensors
Spoof Blue capabilities to observe the battlefield
Deny Blue ability to launch new satellites
Destroy some Blue space capability as a warning to Gray space systems support to Blue
Wear down Blue Defensive Counter-Space capabilities by instigating multiple false alarm attacks
Attack Blue satellites before the start of the terrestrial conflict
Spoof Blue perceptions of Red space strengths
Conduct diplomatic offensive to restrict Blue ability to employ ASAT's
Actively defend key launch corridors and orbits critical to Red conduct of war
Preposition Red space assets to maximize their effectiveness at the start of the conflict
Disrupt Blue command and control capabilities for space systems
Embargo Blue access to space systems
Prevent Blue ability to service or re-fuel on-orbit satellites
Develop propaganda campaign against Blue use of ASAT's
Shape and delay Blue plans for space warfare
Deny Blue ability to achieve Space Situational Awareness
Disrupt Blue space attacks so they become uncoordinated
Constantly shift points of application of space control weapons to confuse adversary response
Herd Blue space communications paths to those that are more easily monitored by Red SIGINT assets
Attack key Blue space personnel and technicians
Disperse Red assets (maneuver satellites) just before launching first attack

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SWAT Has Space Objectives for Both Red & Blue Sides

Example Space COA Indicators

Are a small number of Blue and Gray satellites experiencing anomalies over a long time period
Are a small number of Blue and Gray satellites losing contact with terrestrial controllers
Are a small number of new Red satellites appearing in orbit
Are a small number of Red satellites changing orientation
Are a small number of Red satellites changing shape
Are a small number of Red satellites changing thermal signatures
Are a small number of Red satellites concentrating towards potential Blue and Gray satellites
Are Red ASAT forces appearing to line up in a sequence of timed attacks against Blue and Gray assets
Are Red forces capable of attacking space-related terrestrial sites in Blue countries appearing to line up in a sequence of timed attacks
Are Red SIGINT assets appearing to line up in a sequence of timed operations against Blue and Gray Communications assets
Are there indications of Red aircraft activities that appear to concentrate on space-related terrestrial sites around the world
Are there indications of Red missile activities that appear to concentrate on space-related terrestrial sites around the world
Are there a small number of new satellite launches from Red facilities

Many Insignificant Space Indicators May Add Up to Predicting a Major Attack

INTEL Indicators Example

1.2.5.1.5.21	Chicanean Yuan Hsi Mobile Direct Ascent ASAT Manufacturing Centers Increased Wear On Roads at Sites
1.2.5.1.5.22	Chicanean Yuan Hsi Mobile Direct Ascent ASAT Manufacturing Centers Improved / New Roads at Sites
1.2.5.1.5.23	Chicanean Yuan Hsi Mobile Direct Ascent ASAT Manufacturing Centers Improved / New Parking at Sites
1.2.5.1.5.24	Chicanean Yuan Hsi Mobile Direct Ascent ASAT Manufacturing Centers Improved / New Railroad Tracks at Sites
1.2.5.1.5.25	Chicanean Yuan Hsi Mobile Direct Ascent ASAT Manufacturing Centers Improved / New Railroad Sidings at Sites
1.2.5.1.5.26	Chicanean Yuan Hsi Mobile Direct Ascent ASAT Manufacturing Centers Increased Disturbed Vegetation / Soil at Sites
1.2.5.1.5.27	Chicanean Yuan Hsi Mobile Direct Ascent ASAT Manufacturing Centers Different Communications Patterns To / From Sites
1.2.5.1.5.27.1	Chicanean Yuan Hsi Mobile Direct Ascent ASAT Manufacturing Centers Increased Communications Traffic To / From Sites
1.2.5.1.5.27.2	Chicanean Yuan Hsi Mobile Direct Ascent ASAT Manufacturing Centers Decreased (More Attempts to Hide) Communications Traffic To / From Sites
1.2.5.1.5.27.3	Chicanean Yuan Hsi Mobile Direct Ascent ASAT Manufacturing Centers No Net Increase or Decrease of Communications Traffic To / From Sites, But Changed Patterns
1.2.5.1.5.27.4	Chicanean Yuan Hsi Mobile Direct Ascent ASAT Manufacturing Centers Increased Encrypted Communications Traffic To / From Sites
1.2.5.1.5.28	Chicanean Yuan Hsi Mobile Direct Ascent ASAT Manufacturing Centers Increased Hours / New Shifts for Personnel at Sites
1.2.5.1.5.29	Chicanean Yuan Hsi Mobile Direct Ascent ASAT Manufacturing Centers Increased Number of Scientists & Engineers at Sites
1.2.5.1.5.30	Chicanean Yuan Hsi Mobile Direct Ascent ASAT Manufacturing Centers Increased Number of Military Personnel at Sites
1.2.5.1.5.31	Chicanean Yuan Hsi Mobile Direct Ascent ASAT Manufacturing Centers Increased Number of Military Personnel of Higher Ranks at Sites
1.2.5.1.5.32	Chicanean Yuan Hsi Mobile Direct Ascent ASAT Manufacturing Centers Increased Number of Foreign Personnel at Sites
1.2.5.1.5.33	Chicanean Yuan Hsi Mobile Direct Ascent ASAT Manufacturing Centers Increased Number of VIPs at Sites
1.2.5.1.5.34	Chicanean Yuan Hsi Mobile Direct Ascent ASAT Manufacturing Centers Increased Housing Demand In Local Area
1.2.5.1.5.35	Chicanean Yuan Hsi Mobile Direct Ascent ASAT Manufacturing Centers New / Expanded / Improved Housing Built On-Site
1.2.5.1.5.36	Chicanean Yuan Hsi Mobile Direct Ascent ASAT Manufacturing Centers New / Expanded / Improved Recreational Facilities On-Site
1.2.5.1.5.37	Chicanean Yuan Hsi Mobile Direct Ascent ASAT Manufacturing Centers Increased Food Intake
1.2.5.1.5.38	Chicanean Yuan Hsi Mobile Direct Ascent ASAT Manufacturing Centers Increased Power Consumption
1.2.5.1.5.39	Chicanean Yuan Hsi Mobile Direct Ascent ASAT Manufacturing Centers Increased Water Consumption
1.2.5.1.5.40	Chicanean Yuan Hsi Mobile Direct Ascent ASAT Manufacturing Centers Increased Sewer Outake
1.2.5.1.5.41	Chicanean Yuan Hsi Mobile Direct Ascent ASAT Manufacturing Centers Increased Refuse Outake
1.2.5.1.5.42	Chicanean Yuan Hsi Mobile Direct Ascent ASAT Manufacturing Centers Increased Smoke Plumes from Sites
1.2.5.1.5.43	Chicanean Yuan Hsi Mobile Direct Ascent ASAT Manufacturing Centers Increased Chemical Contamination at Sites
1.2.5.1.5.44	Chicanean Yuan Hsi Mobile Direct Ascent ASAT Manufacturing Centers New or Increased Settling / Effluents Ponds at Sites
1.2.5.1.5.45	Chicanean Yuan Hsi Mobile Direct Ascent ASAT Manufacturing Centers Increased Use of Data Processing Assets at Site
1.2.5.1.5.46	Chicanean Yuan Hsi Mobile Direct Ascent ASAT Manufacturing Centers Increased / Different Patterns of Thermal Images
1.2.5.1.5.47	Chicanean Yuan Hsi Mobile Direct Ascent ASAT Manufacturing Centers Increased Number of Large Mobile Vehicles with Erection Gantries at Sites
1.2.5.1.5.48	Chicanean Yuan Hsi Mobile Direct Ascent ASAT Manufacturing Centers Increased Number of Mobile Vehicles with Cooling at Sites
1.2.5.1.5.49	Chicanean Yuan Hsi Mobile Direct Ascent ASAT Manufacturing Centers Increased Number of Chemical Support Equipment at Sites
1.2.5.1.5.50	Chicanean Yuan Hsi Mobile Direct Ascent ASAT Manufacturing Centers Increased Number of Optical Test Equipment at Sites
1.2.5.1.5.51	Chicanean Yuan Hsi Mobile Direct Ascent ASAT Manufacturing Centers Increased Number of RF Test Equipment at Sites
1.2.5.1.5.52	Chicanean Yuan Hsi Mobile Direct Ascent ASAT Manufacturing Centers Increased Number of Electrical Test Equipment at Sites
1.2.5.1.5.53	Chicanean Yuan Hsi Mobile Direct Ascent ASAT Manufacturing Centers Increased Number of Optical Test Stands at Sites
1.2.5.1.5.54	Chicanean Yuan Hsi Mobile Direct Ascent ASAT Manufacturing Centers Increased Number of RF Test Stands at Sites
1.2.5.1.5.55	Chicanean Yuan Hsi Mobile Direct Ascent ASAT Manufacturing Centers Increased Number of Large Mobile Vehicle Storage Sheds at Sites
1.2.5.1.5.56	Chicanean Yuan Hsi Mobile Direct Ascent ASAT Manufacturing Centers Increased Security at Sites

Space Escalation Ladder

WBS	Conflict Phase	Terrestrial Campaign Phase	Space Campaign Phase	Weapon Type	Space Campaign Phase Full Name	Weapon Category
P.1.A.0	Pre-Conflict	Phase 0: Pre-War Buildup (Shape)	1st Wave Attacks Phase A	Pre-Conflict Deter	1st Wave Attacks Phase A - Pre-Conflict Deter	Overt Weapons Testing & Deployment; Treaties; Saber Rattling; Space Alliances; Normal Space Surveillance, Tracking & Reconnaissance Activities
P.1.B.0	Pre-Conflict	Phase 0: Pre-War Buildup (Shape)	1st Wave Attacks Phase B	Persuade; Spying; Propaganda; Avoidance Maneuvering; Increased Space Surveillance & Close Satellite Inspections	1st Wave Attacks Phase B - Pre-Conflict Persuade	Diplomatic Requests & Démarches; Economic Actions; Embargos; Legal Actions; Administrative Actions; Transmitting Propaganda Broadcasts; Jamming Propaganda Broadcasts; Increased Spying & Surveillance; Unusual Increases in Space Surveillance and Tracking Activities; Satellite Close Inspectors; Threaten Allies of Your Adversaries; Maneuver to Avoid Attacks
P.1.C.0	Pre-Conflict	Phase 0: Pre-War Buildup (Shape)	1st Wave Attacks Phase C	Hide; Covert; Cyber; Political Disruptions; Mobilize Forces; Increase Military Alert Level; Threatening Satellite Maneuvers; Increase Space Radiation; Initiate Satellite Defensive Measures; Employ Nation's Astronauts on International Space Station for Military Uses	1st Wave Attacks Phase C - Pre-Conflict Hide	Camouflage; Stop Activities; Mobility; Covert Technology Developments; Small Covert Attacks; Cyber Attacks; Provocative but False Attacks; Covert Actions in Violation of International Treaties; Cutoff Diplomatic Relations; Inspire Social Disruptions and Agitation; Employ Lethal Force Against Your Own Citizens; Mobilize Forces; Increase Military Alert Level (DEFCON); Maneuver Close Enough to Adversary Satellites to Purposely Appear as a Threat; Reveal Covert Programs to Appear Threatening; Enter Into War-Reserve Modes (Hide) for Critical Satellites; Hide Senior Leadership; Increase Radiation Environment in Orbits Used by Adversaries; Initiate Satellite Defensive Measures; Employ Nation's Astronauts on International Space Station for Military Reconnaissance and Surveillance
P.2.A.0	Trans-Conflict	Phase I: Deployment / Deterrence (Deter)	2nd Wave Attacks	Trans-Conflict Deter	2nd Wave Attacks - Trans-Conflict Deter	Linked Attacks; Demo Attacks; Alternate Country Attacks; Blockades; Major Covert Attacks; Terrorist Attacks; Summarily Execute Saboteurs; Seize & Sequester Suspected Terrorists; Alert Anti-Satellite Systems; Arm Satellite Self-Defense Mechanisms; Alert Anti-Missile Defenses; Alert Anti-Aircraft Defenses; Arm Allied Astronauts on International Space Station

Space Actions May Be Conducted Pre-Conflict

SWAT 1
SWAT 2
SWAT 3

Space Escalation Ladder (Cont.)

WBS	Conflict Phase	Terrestrial Campaign Phase	Space Campaign Phase	Weapon Type	Space Campaign Phase Full Name	Weapon Category
P.3.A.1	Trans-Conflict	Phase II: Halt Incursion (Seize Initiative)	3rd Wave Attacks Phase A1 – Gnd Based	From Terrestrial Partial Temporary Kill	3rd Wave Attacks Phase A1 – Terrestrial-to-Space Partial Temporary Effects	Delay, Deny, Covertly Assassinate Adversary Diplomatic Ambassador
P.3.A.2	Trans-Conflict	Phase II: Halt Incursion (Seize Initiative)	3rd Wave Attacks Phase A2 – Gnd Based	From Terrestrial Total Temporary Kill	3rd Wave Attacks Phase A2 – Terrestrial-to-Space Total Temporary Effects	Disrupt
P.3.B.1	Trans-Conflict	Phase III: Air Counter-Offensive (Dominate)	3rd Wave Attacks Phase B1 – Space Based	From Space Partial Temporary Kill	3rd Wave Attacks Phase B1 – Space-to-Space Partial Temporary Effects	Delay, Deny
P.3.B.2	Trans-Conflict	Phase III: Air Counter-Offensive (Dominate)	3rd Wave Attacks Phase B2 – Space Based	From Space Total Temporary Kill	3rd Wave Attacks Phase B2 – Space-to-Space Total Temporary Effects	Disrupt
P.4.A.1	Trans-Conflict	Phase IV: Joint Counter-Offensive to Restore Friendly Pre-Conflict Status (Stabilize Borders)	4th Wave Attacks Phase A1 – Gnd Based	From Terrestrial Partial Permanent Kill	4th Wave Attacks Phase A1 – Terrestrial-to-Space Partial Permanent Kill	Degrade
P.4.A.2	Trans-Conflict	Phase IV: Joint Counter-Offensive to Restore Friendly Pre-Conflict Status (Stabilize Borders)	4th Wave Attacks Phase A2 – Gnd Based	From Terrestrial Total Permanent Kill	4th Wave Attacks Phase A2 – Terrestrial-to-Space Total Permanent Kill	Destroy
P.4.B.1	Trans-Conflict	Phase V: Joint Counter-Offensive to Capture Adversary Capitol (Enable New	4th Wave Attacks Phase B1 – Space Based	From Space Partial Permanent Kill	4th Wave Attacks Phase B1 – Space-to-Space Partial Permanent Kill	Degrade
P.4.B.2	Trans-Conflict	Phase V: Joint Counter-Offensive to Capture Adversary Capitol (Enable New	4th Wave Attacks Phase B2 – Space Based	From Space Total Permanent Kill	4th Wave Attacks Phase B2 – Space-to-Space Total Permanent Kill	Destroy
P.5.A.0	Trans-Conflict	Phase VI: Defend Against Adversary Counter-Attacks Against Friendly Homeland (Defend Friendly Citizens)	5th Wave Attacks	Space-Manned Permanent Kill: Kill Adversary Astronauts	5th Wave Attacks - Space-Manned Permanent Kill	Degrade, Destroy: Kill Adversary Astronauts on International Space Station
P.6.A.0	Trans-Conflict	Phase VI: Defend Against Adversary Counter-Attacks Against Friendly Homeland (Defend Friendly Citizens)	6th Wave Attacks	Space-to-Earth Permanent Kill	6th Wave Attacks - Space-to-Earth Permanent Kill	Degrade, Destroy
P.7.A.0	Trans-Conflict	Phase VII: Defend Against Adversary Use of Nuclear Weapons in Space (Defend Friendly Military)	7th Wave Attacks	NBC Use - Space	7th Wave Attacks - NBC Use - Space	Degrade, Destroy
P.8.A.0	Trans-Conflict	Phase VIII: Defend Against Adversary Use of NBC Against Friendly Military Targets (Defend Friendly Military)	8th Wave Attacks; Phase A – Military Targets	NBC Use - Space & Terrestrial	8th Wave Attacks Phase A – NBC Use - Space & Terrestrial - Military Targets	Degrade, Destroy
P.8.B.0	Trans-Conflict	Phase IX: Defend Against Adversary Use of NBC Against All Friendly Targets (Defend Friendly Military & Civilians)	8th Wave Attacks; Phase B – Civilian Targets	NBC Use - Space & Terrestrial	8th Wave Attacks Phase B – NBC Use - Space & Terrestrial - Civilian Targets	Degrade, Destroy
P.9.A.0	Post-Conflict	Phase X: Post-Hostilities (Reconstruction & Stabilization)	9th Wave Attacks	Post-Conflict Deter	9th Wave Attacks - Post-Conflict Deter	Diplomatic Requests; Economic Actions; Legal Actions; Administrative Actions; Jamming Propaganda Broadcasts

Space Provides Finer Gradations & Thus Better Control During Conflict Escalation

COA Reactions Example

Time Sequence	Category	Actor	Target	Escalation Ladder	Probability of Occurrence	WBS	Action	Reaction
35	Satellites	Califon	Newmex	**P.4.A.1**	8	N.S.R.3		**Newmex Bicudo Large LEO Photo Satellite is permanently partially blinded when over flying the disputed oil fields**
35A	Political	Newmex	Califon	**P.1.C.0**	1	N.S.R.3.0		Do nothing to increase escalation ladder
35B	INTEL	Newmex	Califon	**P.1.A.0**	10	N.S.R.3.1		Determine if degradation is caused by natural events, equipment failure or human actions, whether intentional or unintentional
35C	Forces	Newmex	Califon	**P.1.C.0**	9	N.S.R.3.2		Increase military alert level (DEFCON)
35D	Ground Stations	Newmex	Califon	**P.1.A.0**	9	N.S.R.3.3		Contact other Newmexian space-related ground facilities to determine if multiple ground outage incidents are occurring
35E	Satellites	Newmex	Califon	**P.1.A.0**	9	N.S.R.3.4		Contact other Newmexian TTC ground facilities to determine if multiple satellite outage incidents are occurring
35F	Satellites	Newmex	Califon	**P.1.A.0**	9	N.S.R.3.5		Check with Newmexian supreme military command to determine if other military incidents are occurring to Newmexian and allied forces
35I	Space Surveillance	Newmex	Califon	**P.1.B.0**	10	N.S.R.3.8		Increase surveillance and tracking for new and suspicious space objects
35J	Satellites	Newmex	Califon	**P.1.B.0**	10	N.S.R.3.9		Increase mission identification and country of origin determination for new and suspicious space objects (Space Object Identification - SOI)
35K	Satellites	Newmex	Califon	**P.1.B.0**	10	N.S.R.3.10		Increase signals intelligence collection on new and suspicious space objects
35L	Satellites	Orgonia	Califon	**P.1.B.0**	10	N.S.R.3.11		Maneuver Orgonian Abragh Nano LEO Inspector Satellite close to Newmex Bicudo Large LEO Photo Satellite for close inspection to help determine origin of mission degradations
35M	Satellites	Newmex	Califon	**P.1.B.0**	9	N.S.R.3.12		Increase satellite imagery, OPIR and RADAR surveillance and signals intelligence collection of Newmexian border areas
35N	Satellites	Newmex	Califon	**P.1.B.0**	8	N.S.R.3.13		Increase satellite imagery, OPIR and RADAR surveillance and signals intelligence collection of Newmexian internal areas
35O	Satellites	Newmex	Califon	**P.1.B.0**	10	N.S.R.3.14		Increase satellite imagery, OPIR and RADAR surveillance and signals intelligence collection of internal Califon activities
35P	Satellites	Newmex	Califon	**P.1.B.0**	9	N.S.R.3.15		Increase satellite imagery, OPIR and RADAR surveillance and signals intelligence collection of Califon **allied** activities
35Q	Forces	Newmex	Califon	**P.1.A.0**	9	N.S.R.3.16		Increase critical infrastructures defenses and surveillance
35AG	Political	Newmex	Califon	**P.1.C.0**	5	N.S.R.3.32		Cutoff diplomatic relations with Califon
35AP	Political	Newmex	Califon	**P.1.B.0**	9	N.S.R.3.41		Increase world attention to the problems of orbital space debris in order to slow down Califon's launching of new satellites
35BB	Political	Newmex	Califon	**P.1.A.0**	10	N.S.R.3.53		Engage in negotiations for space treaties and mutual defense pacts with other countries to increase space defense protection
35BC	Political	Newmex	Califon	**P.1.A.0**	10	N.S.R.3.54		Publically declare that any use of space weapons against Newmexian satellites will have a corresponding attack on the aggressor's space facilities associated with this attack, whether they be research centers, launch facilities, space surveillance sites, or command and control centers
35BD	Political	Newmex	Califon	**P.1.B.0**	9	N.S.R.3.55		Publically declare that any use of space weapons against Newmexian satellites will have a corresponding attack on the aggressor's **and their allies** space facilities associated with this attack, whether they be research centers, launch facilities, space surveillance sites, or command and control centers
35BE	Forces	Newmex	Califon	**P.1.C.0**	8	N.S.R.3.56		Initiate multiple false starts, threatening space and terrestrial maneuvers, etc. to induce your adversaries to begin constant satellite maneuvering, so as to waste their on-board fuel reserves before actual conflict starts
35BF	Forces	Newmex	Califon	**P.1.C.0**	8	N.S.R.3.57		Initiate random military orders, communications traffic, re-deployments and satellite maneuvers to confuse potential adversaries of your immediate plans and goals
35BG	Forces	Newmex	Califon	**P.1.C.0**	7	N.S.R.3.58		Launch or maneuver a new mysterious satellite that comes close to critical Califon satellites, to make Califon pause in its military execution plans, to show resolve, and as a warning to Califon to back down
35BH	ASAT	Newmex	Califon	**P.1.B.0**	10	N.S.R.3.59		Jam Califon propaganda broadcasts from their communications satellites directed at Newmexian dissidents
35BI	ASAT	Newmex	Califon	**P.1.C.0**	10	N.S.R.3.60		Initiate operational deployment of Newmexian Anti-Satellite (ASAT) systems

COA Reactions Example (Cont.)

Time Sequence	Category	Actor	Target	Escalation Ladder	Probability of Occurrence	WBS	Action	Reaction
35BJ	ASAT	Newmex	Califon	P.3.A.1	8	N.S.R.3.61		Attack Califon Darapi Large LEO Photo Satellite with a Lagoa Mobile Ground Jammer-RF that temporarily denies Califon access to its intelligence collection capabilities, to show resolve and as a warning to Califon to back down
35BK	ASAT	Newmex	Califon	P.4.A.2	6	N.S.R.3.62		Attack Califon Darapi Large LEO Photo Satellite with an Ouro Space Launch ASAT Ground Mobile Missile that permanently destroys it, to show resolve and as a warning to Califon to back down
35BL	ASAT	Orgonia	Califon	P.3.A.2	9	N.S.R.3.63		Attack Califon Darapi Large LEO Photo Satellite with an Orgonian Dimbabah Nano LEO Mine-Paint that temporarily denies Califon access to its intelligence collection capabilities (covers lenses with temporary paint), to show resolve and as a warning to Califon to back down
35BM	Cyber	Newmex	Califon	P.2.A.0	9	N.S.R.3.64		Attack Califon Jeanton Large Ground Fixed Command Center with a cyber attack that temporarily disables its ability to command forces, to show resolve and as a warning to Califon to back down
35BN	Forces	Newmex	Califon	P.3.A.2	5	N.S.R.3.65		Attack Califon Jeanton Large Ground Fixed Command Center with Newmexian Irece SOF forces that permanently disables its ability to command forces, to show resolve and as a warning to Califon to back down
35BO	Forces	Newmex	Califon	P.2.A.0	5	N.S.R.3.66		Attack a Califon terrestrial system of similar military and economic value to deter Califon from further aggression
35BP	Forces	Newmex	Califon	P.1.C.0	10	N.S.R.3.67		Attack by cyber means the Califon facility that caused the Newmex Bicudo Large LEO Photo Satellite to be temporarily or permanently damaged
35BQ	Forces	Newmex	Califon	P.2.A.0	5	N.S.R.3.68		Attack by Newmexian Irece SOF forces the Califon facility that caused the Newmex Bicudo Large LEO Photo Satellite to be temporarily or permanently damaged
35BR	Forces	Newmex	Califon	P.4.A.2	3	N.S.R.3.69		Attack by the Newmexian Air Force Califon's facility that caused the Newmex Bicudo Large LEO Photo Satellite to be temporarily or permanently damaged
35BY	Industrial	Newmex	Califon	P.1.A.0	10	N.S.R.3.76		Prepare any remaining satellite launch facilities for rapid reaction capabilities enabling quick satellite launches
35BZ	Satellites	Newmex	Califon	P.1.A.0	9	N.S.R.3.77		Increase on-orbit spares for critical satellites
35CA	Satellites	Newmex	Califon	P.1.A.0	9	N.S.R.3.78		Increase on-orbit satellite decoys to confuse Califon and its allies' space surveillance networks
35CB	Satellites	Newmex	Califon	P.1.C.0	8	N.S.R.3.79		Initiate war-reserve modes for critical Newmexian satellite assets that begin to maneuver and reduce RADAR and optical signatures to avoid Califon and its allies' space surveillance networks
35CC	Satellites	Newmex	Califon	P.1.C.0	9	N.S.R.3.80		Recharge Newmexian satellite batteries on-orbit
35CD	Satellites	Newmex	Califon	P.1.C.0	9	N.S.R.3.81		Refuel Newmexian satellites on-orbit
35CE	Satellites	Newmex	Califon	P.1.C.0	9	N.S.R.3.82		Refuel Newmexian space support sites backup generators
35CF	Satellites	Newmex	Califon	P.1.C.0	9	N.S.R.3.83		Maneuver Newmexian space weapons (space-based and terrestrial-based) into optimized offensive and defensive positions
35CG	Satellites	Newmex	Califon	P.1.C.0	9	N.S.R.3.84		Deploy Newmexian space support assets (space-based and terrestrial-based) into optimized offensive and defensive support positions
35CH	Satellites	Newmex	Califon	P.1.C.0	9	N.S.R.3.85		Maneuver and deploy space control assets that later enable sealing off the Earth from adversary satellites, in order to fix these adversary space assets into a steady state that cannot be changed from the ground. This would including positioning for jamming, spoofing and cyber attacks, along with denying an adversary the ability to launch new satellites
35CI	Launch	Newmex	Orgonia	P.1.A.0	8	N.S.R.3.86		Request Orgonia provide satellite launch support from its Nuwayr Space Launch Ground Mobile Systems for Newmexian satellites
35CJ	Forces	Newmex	Califon	P.1.A.0	10	N.S.R.3.87		Explore non-space mission replacements for reduced satellite capabilities
35CP	Forces	Newmex	Califon	P.1.C.0	9	N.S.R.3.93		Increase surveillance, protection and defenses of space systems terrestrial terminals, command and control sites, space sensor sites, launch sites, space weapons marshaling areas, research centers and factories
35CQ	Environmental	Space	Space	P.1.B.0	9	N.S.R.3.94		Increase surveillance of solar events to better determine if potential satellite outages are caused by natural or human intents
35CR	Forces	Newmex	Califon	P.1.C.0	10	N.S.R.3.95		Determine if Califon and/or their allies have terrestrial forces maneuvering or deploying to operational locations and appear to be pre-positioning for attack
35CS	Satellites	Newmex	Califon	P.1.C.0	10	N.S.R.3.96		Command critical Newmexian satellites to initiate defensive measures (spinning, close shutters, increased heat transfer, etc.)
35CT	Satellites	Newmex	Califon	P.1.B.0	9	N.S.R.3.97		Maneuver critical Newmexian satellites beyond the range of potential threats
35CU	Satellites	Newmex	Newmex	P.1.A.0	10	N.S.R.3.98		Conduct a full battery of diagnostic testing on Newmexian satellites to determine if intermittent failures are a possibility
35CV	Launch	Newmex	Califon	P.1.A.0	9	N.S.R.3.99		If critical Newmexian satellites are permanently damaged, then launch other satellites with similar capabilities
35CW	Forces	Newmex	Newmex	P.1.A.0	10	N.S.R.3.100		Determine the effects on the overall space system mission of any space systems degradations
35CX	Forces	Newmex	Newmex	P.1.A.0	10	N.S.R.3.101		Modify previously planned space strategies and tactics due to current adversary and their allies' actions
35CY	Satellites	Newmex	Califon	P.1.A.0	10	N.S.R.3.102		Increase training for satellite operators that allows them to recognize intentional attacks and respond promptly

SWAT 1
SWAT 2
SWAT 3

SSA Requirements Study

- **Reviewed Doctrine Docs, Joint Pubs, Air Force Glossaries, Air Force Instructions, Air Force Pamphlets, Army Field Manuals, National Defense University Handbook, and Multiservice Procedures**
  - **55 Total Documents Analyzed**
- **Terrestrial Intelligence Preparation of the Battlespace (IPB) Principles Extrapolated to Space**
  - **~1,900 Different Space Control / SSA Requirements**

SWAT Baselines Space Control/SSA Requirements From Fundamental Military Doctrine

Example SSA Requirements Matrix

Is the weapon system preparing/powering up for use?

INTEL Derived From	INTEL Requirements	INTEL Indicators	Resolution Requirements	Space NIIRS	Detection Means	Technologies
Basic Characterization	**Satellite Current Orientation Attitude**	Satellite Current Cross Section	1.2 - 2.5	4	Imagery or RADAR	Optical or RADAR
Basic Characterization	Satellite Has Changed Attitude From Spinning or 3-Axis Stability	Satellite Cross Section Change	2.5 - 4.5	3	Optical or RADAR Cross Section	Optical or RADAR
Detailed Characterization	Satellite Current Weapons Suite Pointing Direction	Satellite Weapons Suite Image	0.20 - 0.40	7	Imagery	Optical
Exquisite Characterization	Satellite Delta-V Remaining Capability	Satellite Telemetry Indicates Propulsion Tank Fluid Level	N/A	N/A	RF Signal Monitoring	RF Receivers
		Satellite Propulsion Tank Thermal Image	0.20 - 0.40	7	Imagery	Optical-IR
Exquisite Characterization	**Satellite Propulsion Tank Fluid Status**	Satellite Telemetry Indicates Propulsion Tank Fluid Status	N/A	N/A	RF Signal Monitoring	RF Receivers
		Satellite Propulsion Tank Thermal Image	0.20 - 0.40	7	Imagery	Optical-IR
Exquisite Characterization	Satellite Current On-Board Processor State	Satellite Telemetry Indicates On-Board Processor State	N/A	N/A	RF Signal Monitoring	RF Receivers
Exquisite Characterization	Satellite Propulsion Tank Internal Pressure	Satellite Telemetry Indicates Propulsion Tank Internal Pressure	N/A	N/A	RF Signal Monitoring	RF Receivers
Detailed Characterization	Satellite Current Detailed Thermal Signature	Satellite Thermal Image	0.20 - 0.40	7	Imagery	Optical-IR

← 1,900 Other SSA Requirements

SSA Requirements Linked to Sensor Resolutions

SSA Requirements Tracking

NIIRS Space Equivalents Defined

NIIRS Rating	GRD (m)	Terrestrial Examples	Space Equivalent Examples
0		Interpretability of the imagery is precluded by obscuration, degradation, or very poor resolution	Satellite features in shadow
1	9	Detect the presence of aircraft dispersal parking areas.	Characterize very large (e.g., International Space Station) space object.
2	4.5 - 9.0	Detect the presence of large (e.g., Boeing 737, 747, Airbus A-300, MD-80) aircraft.	Characterize large (e.g., GEO Communications satellite) space object.
3	2.5 - 4.5	Detect medium-sized aircraft (e.g., F-15). Identify an ORBITA site on the basis of a 12 meter dish antenna normally mounted on a circular building.	Characterize medium (e.g., DMSP) space object.
4	1.2 - 2.5	Identify the wing configuration of small fighter aircraft (e.g., F- 16). Detect large (e.g., greater than 10 meter diameter) environmental domes at an electronics facility.	Detect if large (e.g., TDRS) solar panel has deployed.
5	0.75 - 1.2	Distinguish between single-tail (e.g., F-16) and twin-tailed (e.g., F-15) fighters. Detect automobile in a parking lot. Identify the metal lattice structure of large (e.g. approximately 75 meter) radio relay towers.	Determine large (e.g., TDRS) solar panel design configuration. Determine satellite attitude/spin rate. Determine if satellite has broken up into large pieces.
6	0.40 - 0.75	Detect wing-mounted stores (i.e., ASM, bombs) protruding from the wings of large bombers (e.g., B-52). Identify the spare tire on a medium-sized truck.	Determine existence of medium-sized (TDRS SGL Antenna) satellite antennas.
7	0.20 - 0.40	Identify antenna dishes (less than 3 meters in diameter) on a radio relay tower. Identify individual 55-gallon drums. Detect small marine mammals (e.g., harbor seals) on sand/gravel beaches. Identify ports, ladders, vents on electronics vans. Identify ind	Determine attitude of medium-sized (TDRS SGL Antenna) satellite antennas. Determine large area degradation of solar panel optical quality.
8	0.10 - 0.20	Identify the rivet lines on bomber aircraft. Detect horn-shaped and W-shaped antennas mounted atop BACKTRAP and BACKNET radars. Identify windshield wipers on a vehicle. Identify limbs (e.g., arms, legs) on an individual. Identify individual horizontal and	Determine medium-sized (TDRS SGL Antenna) satellite antenna damage.
9	<0.10	Identify screws and bolts on missile components. Detect individual spikes in railroad ties. Identify individual rungs on bulkhead mounted ladders. Identify vehicle registration numbers (VRN) on trucks.	Detect orbital thruster damage. Detect if optical covers have been removed.

Similar to AFRL SORS (Space Object Rating Scale) NIIRS = National Imagery Interpretability Rating Scale

Space NIIRS Based on Equivalent Terrestrial NIIRS Definitions

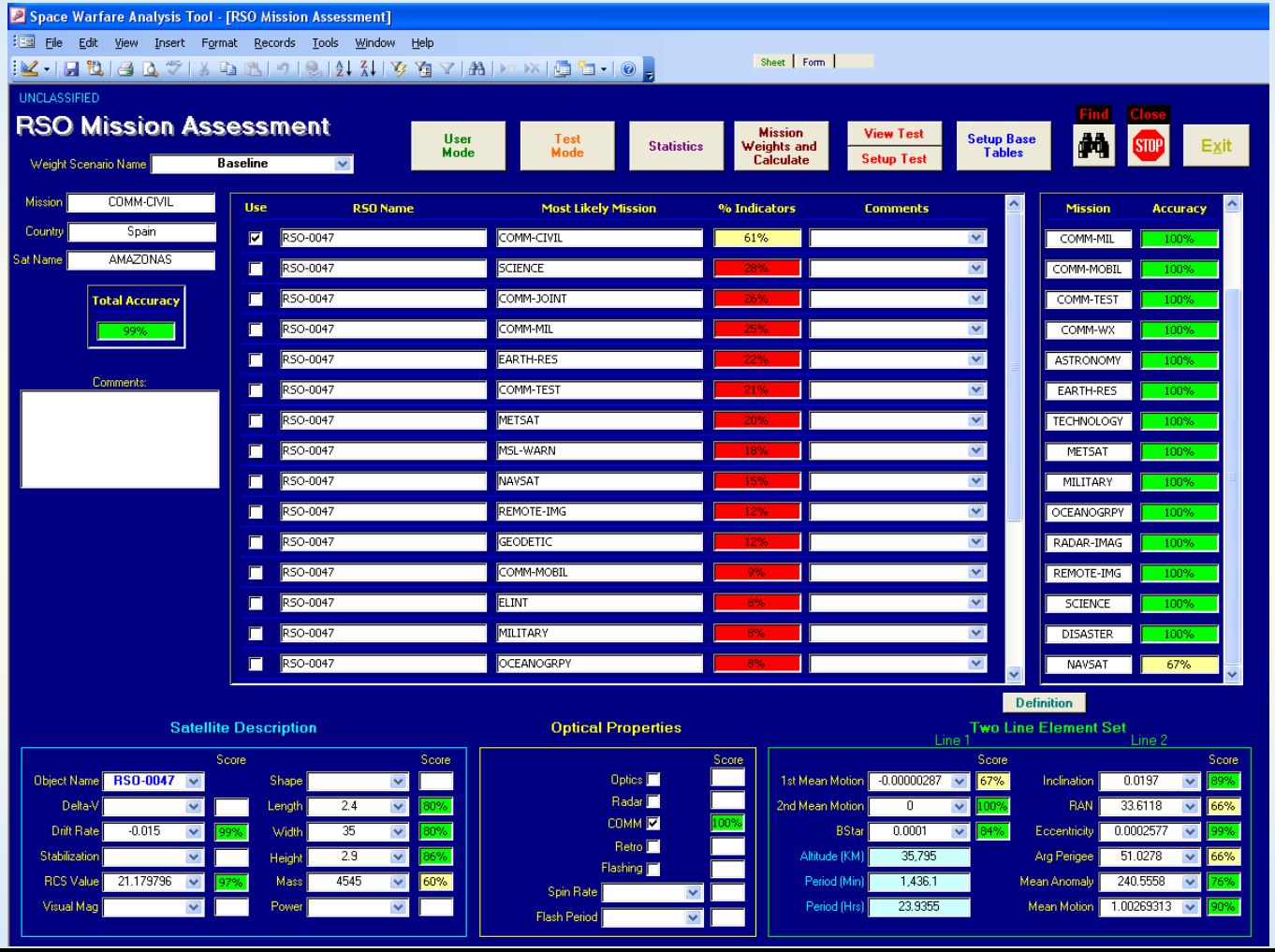
SWAT 1
SWAT 2
SWAT 3

SWAT Automatic Space Object Classification

- Unknown Space Object Characteristics Compared to Selected Space Objects In SID + SPARKS Databases
- 98% of the Time the Correct Mission for the Unknown Object is Within the Top 3 Choices SWAT Automatically Makes
- SWAT Has Corrected NORAD Satellite Catalog Mistakes In Mission Assessments

SWAT Helps the Satellite Analyst In Determining Surveillance Tasking Priorities

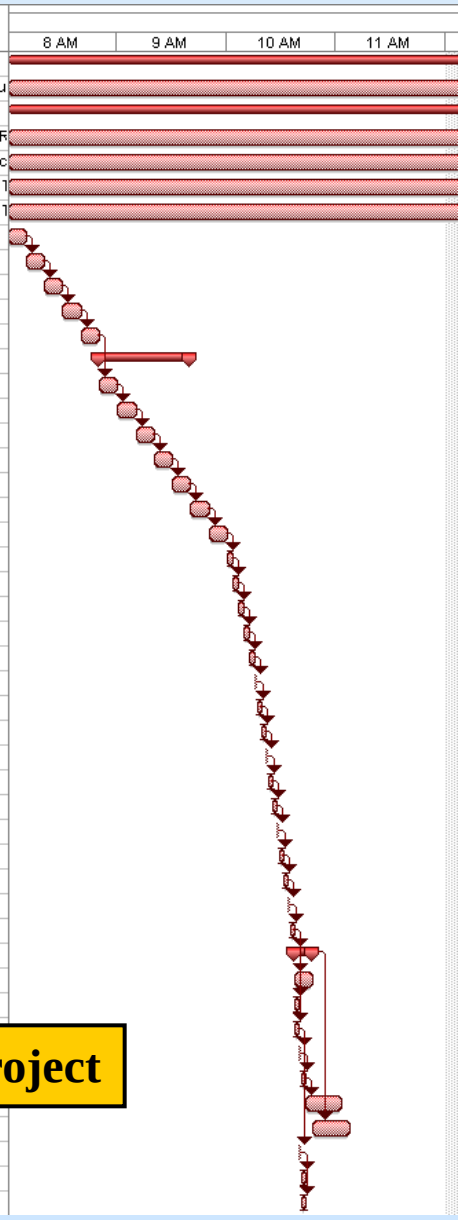
SWAT Auto Space Object ID



SWAT Helps the Satellite Analyst In Narrowing Choices for New Space Objects ID

Scenario Partial Example 1

Weapon	INTEL Type 1	INTEL Type 2	WBS Code	Name
Mobile Direct Ascent ASAT	**IMINT**	**SIGINT**	**8**	**Koronean Tubul Mobile DA ASAT Attack Against Newmanian Goy En LEO Photo Satellite - Launch Situation**
Mobile Direct Ascent ASAT	IMINT	SIGINT	8.1	Koronean Tubul Mobile DA ASAT Attack Against Newmanian Goy En LEO Photo Satellite - Launch Profile Does Not Look Like IRBM Surface-to-Surface Lau
Mobile Direct Ascent ASAT	**MASINT**		**8.2**	**Koronean Tubul Mobile DA ASAT Attack Against Newmanian Goy En LEO Photo Satellite - No Detrimental Weather Conditions for Launch**
Mobile Direct Ascent ASAT	MASINT		8.2.1	Koronean Tubul Mobile DA ASAT Attack Against Newmanian Goy En LEO Photo Satellite - No Detrimental Weather Conditions for Launch - No Heavy R
Mobile Direct Ascent ASAT	MASINT		8.2.2	Koronean Tubul Mobile DA ASAT Attack Against Newmanian Goy En LEO Photo Satellite - No Detrimental Weather Conditions for Launch - Low Chanc
Mobile Direct Ascent ASAT	MASINT		8.3	Koronean Tubul Mobile DA ASAT Attack Against Newmanian Goy En LEO Photo Satellite - Newmanian Satellite Approaching from Over the Horizon Within T
Mobile Direct Ascent ASAT	MASINT		8.4	Koronean Tubul Mobile DA ASAT Attack Against Newmanian Goy En LEO Photo Satellite - Newmanian Satellite Approaching from Over the Horizon Within T
Mobile Direct Ascent ASAT	IMINT		8.5	Koronean Tubul Mobile DA ASAT Attack Against Newmanian Goy En LEO Photo Satellite - TEL Removed from Shelter / Camouflage
Mobile Direct Ascent ASAT	IMINT		8.6	Koronean Tubul Mobile DA ASAT Attack Against Newmanian Goy En LEO Photo Satellite - Vehicle Chucks / Levelers / Stabilizers Extended
Mobile Direct Ascent ASAT	IMINT		8.7	Koronean Tubul Mobile DA ASAT Attack Against Newmanian Goy En LEO Photo Satellite - Missile Seals Removed
Mobile Direct Ascent ASAT	IMINT		8.8	Koronean Tubul Mobile DA ASAT Attack Against Newmanian Goy En LEO Photo Satellite - TEL Erects Missile
Mobile Direct Ascent ASAT	IMINT		8.9	Koronean Tubul Mobile DA ASAT Attack Against Newmanian Goy En LEO Photo Satellite - TEL Moves Away from Missile
Mobile Direct Ascent ASAT	**ELINT**	**COMINT**	**8.10**	**Koronean Tubul Mobile DA ASAT Attack Against Newmanian Goy En LEO Photo Satellite - Final Checks & Tests**
Mobile Direct Ascent ASAT	ELINT	COMINT	8.10.1	Koronean Tubul Mobile DA ASAT Attack Against Newmanian Goy En LEO Photo Satellite - Test Missile Sub-Systems
Mobile Direct Ascent ASAT	ELINT		8.10.2	Koronean Tubul Mobile DA ASAT Attack Against Newmanian Goy En LEO Photo Satellite - Test Launch Control Vehicle to Missile COMM
Mobile Direct Ascent ASAT	COMINT		8.10.3	Koronean Tubul Mobile DA ASAT Attack Against Newmanian Goy En LEO Photo Satellite - Test Space Center to Launch Control Vehicle COMM
Mobile Direct Ascent ASAT	COMINT		8.10.4	Koronean Tubul Mobile DA ASAT Attack Against Newmanian Goy En LEO Photo Satellite - Test Command Center to Space Center COMM
Mobile Direct Ascent ASAT	IMINT	SIGINT	8.10.5	Koronean Tubul Mobile DA ASAT Attack Against Newmanian Goy En LEO Photo Satellite - Launch Rehearsal
Mobile Direct Ascent ASAT	FISINT	TELINT	8.11	Koronean Tubul Mobile DA ASAT Attack Against Newmanian Goy En LEO Photo Satellite - Calibrate Inertial Guidance System
Mobile Direct Ascent ASAT	COMINT		8.12	Koronean Tubul Mobile DA ASAT Attack Against Newmanian Goy En LEO Photo Satellite - Receive Final Target Orbital Elements
Mobile Direct Ascent ASAT	FISINT	TELINT	8.13	Koronean Tubul Mobile DA ASAT Attack Against Newmanian Goy En LEO Photo Satellite - Upload Final Target Orbital Elements
Mobile Direct Ascent ASAT	IMINT	MASINT	8.14	Koronean Tubul Mobile DA ASAT Attack Against Newmanian Goy En LEO Photo Satellite - Top-Off Seeker Coolant
Mobile Direct Ascent ASAT	FISINT	TELINT	8.15	Koronean Tubul Mobile DA ASAT Attack Against Newmanian Goy En LEO Photo Satellite - Arm Batteries
Mobile Direct Ascent ASAT	IMINT	FISINT	8.16	Koronean Tubul Mobile DA ASAT Attack Against Newmanian Goy En LEO Photo Satellite - Missile Hard-Point Attachments Released
Mobile Direct Ascent ASAT	FISINT	TELINT	8.17	Koronean Tubul Mobile DA ASAT Attack Against Newmanian Goy En LEO Photo Satellite - Booster Separation Squibs Armed
Mobile Direct Ascent ASAT	HUMINT	COMINT	8.18	Koronean Tubul Mobile DA ASAT Attack Against Newmanian Goy En LEO Photo Satellite - Countdown Sequence Initiated
Mobile Direct Ascent ASAT	FISINT	TELINT	8.19	Koronean Tubul Mobile DA ASAT Attack Against Newmanian Goy En LEO Photo Satellite - Missile Functions Transferred to Internal Power
Mobile Direct Ascent ASAT	COMINT	HUMINT	8.20	Koronean Tubul Mobile DA ASAT Attack Against Newmanian Goy En LEO Photo Satellite - Authenticated Launch Codes Received
Mobile Direct Ascent ASAT	ELINT	HUMINT	8.21	Koronean Tubul Mobile DA ASAT Attack Against Newmanian Goy En LEO Photo Satellite - Missile Officer Selects Missile from Battery
Mobile Direct Ascent ASAT	ELINT	HUMINT	8.22	Koronean Tubul Mobile DA ASAT Attack Against Newmanian Goy En LEO Photo Satellite - Missile Officer Inserts Key Into Launch Control Console
Mobile Direct Ascent ASAT	ELINT	HUMINT	8.23	Koronean Tubul Mobile DA ASAT Attack Against Newmanian Goy En LEO Photo Satellite - Missile Officer Lifts Cover from Launch Switch
Mobile Direct Ascent ASAT	ELINT	HUMINT	8.24	Koronean Tubul Mobile DA ASAT Attack Against Newmanian Goy En LEO Photo Satellite - Missile Officer Operates Launch Switch
Mobile Direct Ascent ASAT	IMINT	MASINT	8.25	Koronean Tubul Mobile DA ASAT Attack Against Newmanian Goy En LEO Photo Satellite - Missile Engine Started
Mobile Direct Ascent ASAT	FISINT	TELINT	8.26	Koronean Tubul Mobile DA ASAT Attack Against Newmanian Goy En LEO Photo Satellite - Begin Thrust Chamber Pressure Buildup
Mobile Direct Ascent ASAT	IMINT	MASINT	8.27	Koronean Tubul Mobile DA ASAT Attack Against Newmanian Goy En LEO Photo Satellite - Hold-Down-Bolts Fired
Mobile Direct Ascent ASAT	IMINT	MASINT	8.28	Koronean Tubul Mobile DA ASAT Attack Against Newmanian Goy En LEO Photo Satellite - Umbilicals Released
Mobile Direct Ascent ASAT	**IMINT**	**MASINT**	**8.29**	**Koronean Tubul Mobile DA ASAT Attack Against Newmanian Goy En LEO Photo Satellite - Missile Launch**
Mobile Direct Ascent ASAT	IMINT	MASINT	8.29.1	Koronean Tubul Mobile DA ASAT Attack Against Newmanian Goy En LEO Photo Satellite - Missile Launch - Plume Present
Mobile Direct Ascent ASAT	MASINT		8.29.2	Koronean Tubul Mobile DA ASAT Attack Against Newmanian Goy En LEO Photo Satellite - Missile Launch - Loud Auditory Signal
Mobile Direct Ascent ASAT	IMINT	MASI		
Mobile Direct Ascent ASAT	IMINT	MASI		
Mobile Direct Ascent ASAT	IMINT	MASI		
Mobile Direct Ascent ASAT	MASINT			
Mobile Direct Ascent ASAT	FISINT	TELINT	8.33	Koronean Tubul Mobile DA ASAT Attack Against Newmanian Goy En LEO Photo Satellite - Missile Telemetry Data Links Increased Bandwidth
Mobile Direct Ascent ASAT	MASINT		8.34	Koronean Tubul Mobile DA ASAT Attack Against Newmanian Goy En LEO Photo Satellite - Missile Flies Through Atmosphere
Mobile Direct Ascent ASAT	FISINT	TELINT	8.35	Koronean Tubul Mobile DA ASAT Attack Against Newmanian Goy En LEO Photo Satellite - Site Personnel Staring Up at the Sky
Mobile Direct Ascent ASAT	FISINT	TELINT	8.36	Koronean Tubul Mobile DA ASAT Attack Against Newmanian Goy En LEO Photo Satellite - Missile First Stage Shutdown



Battle in the Blue Scenario Time Lines in Microsoft Project

Scenario Partial Example 2

US Tactical Objective S2-8. Deny North Korea space-based surveillance and reconnaissance information

Purpose: Deny North Korea ability to gather information on coalition forces using space-based assets

Success Criterion:

S2-8.1: North Korea unable to receive space-based surveillance and reconnaissance information

Concept: Increase time and resources required for North Korea to gather information on coalition strength and force disposition

Tactical Tasks:

S2-8.1.1: Prevent North Korea forces from gathering ISR information using indigenous space-based assets

Concept: Eliminate North Korea surveillance and reconnaissance assets affecting the Coalition operations

Success Indicator:

IND: North Korea surveillance and reconnaissance interrupted

IND: Coalition space-based surveillance and reconnaissance capability remains uninterrupted

S 2-8.1.2: Prevent North Korea forces from acquiring third- party/commercial ISR information

Concept: Deny North Korea ability to purchase/obtain ISR data from third-party/Commercial sources

Deny third party capability to image selected protected areas

Success Indicator:

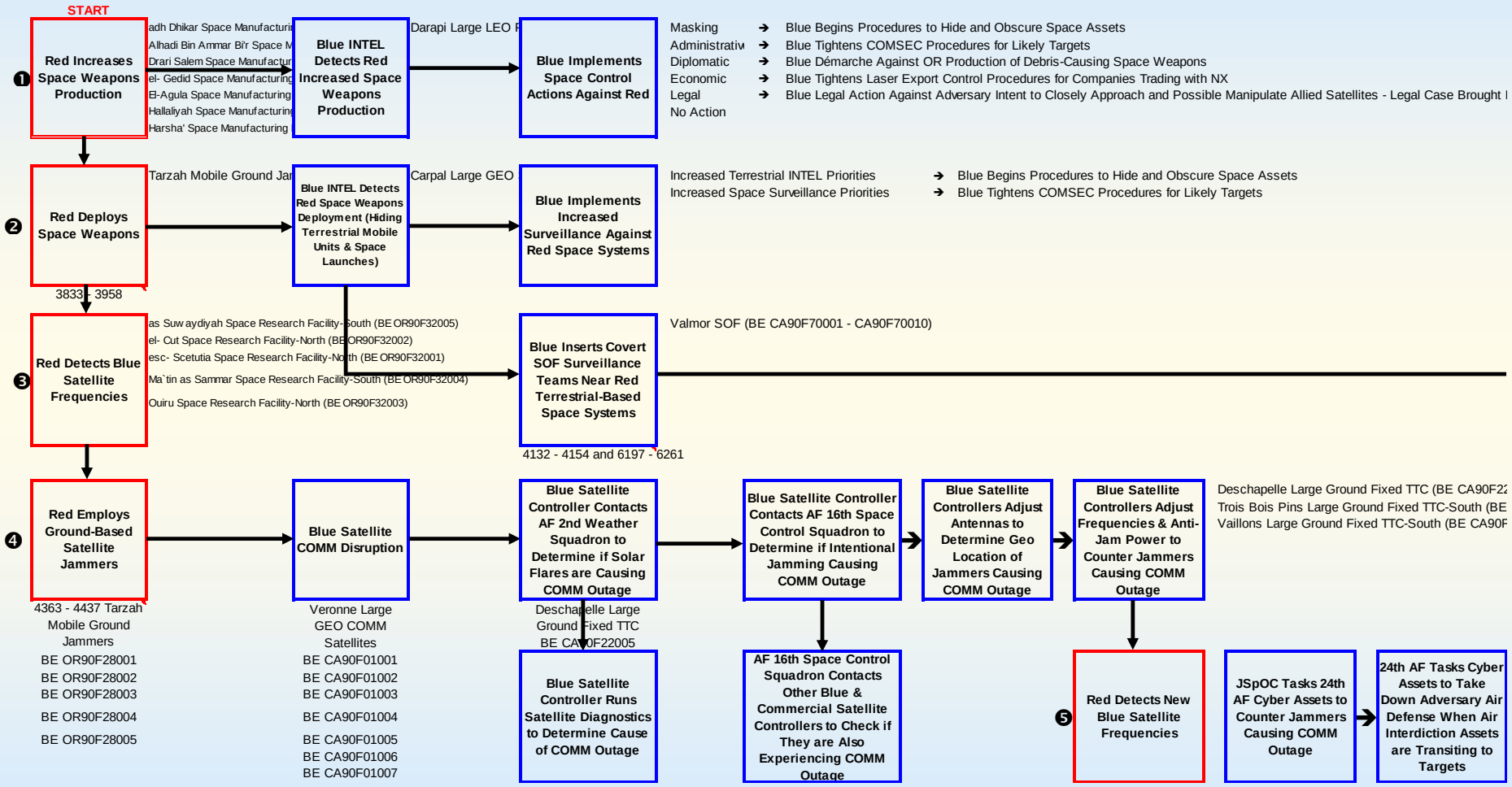
IND: No commercial source sells North Korea ISR data

IND: Third parties unable to pass ISR data to North Korea

IND: Third party unable to collect ISR data over selected protected area

Space Objectives Available Also

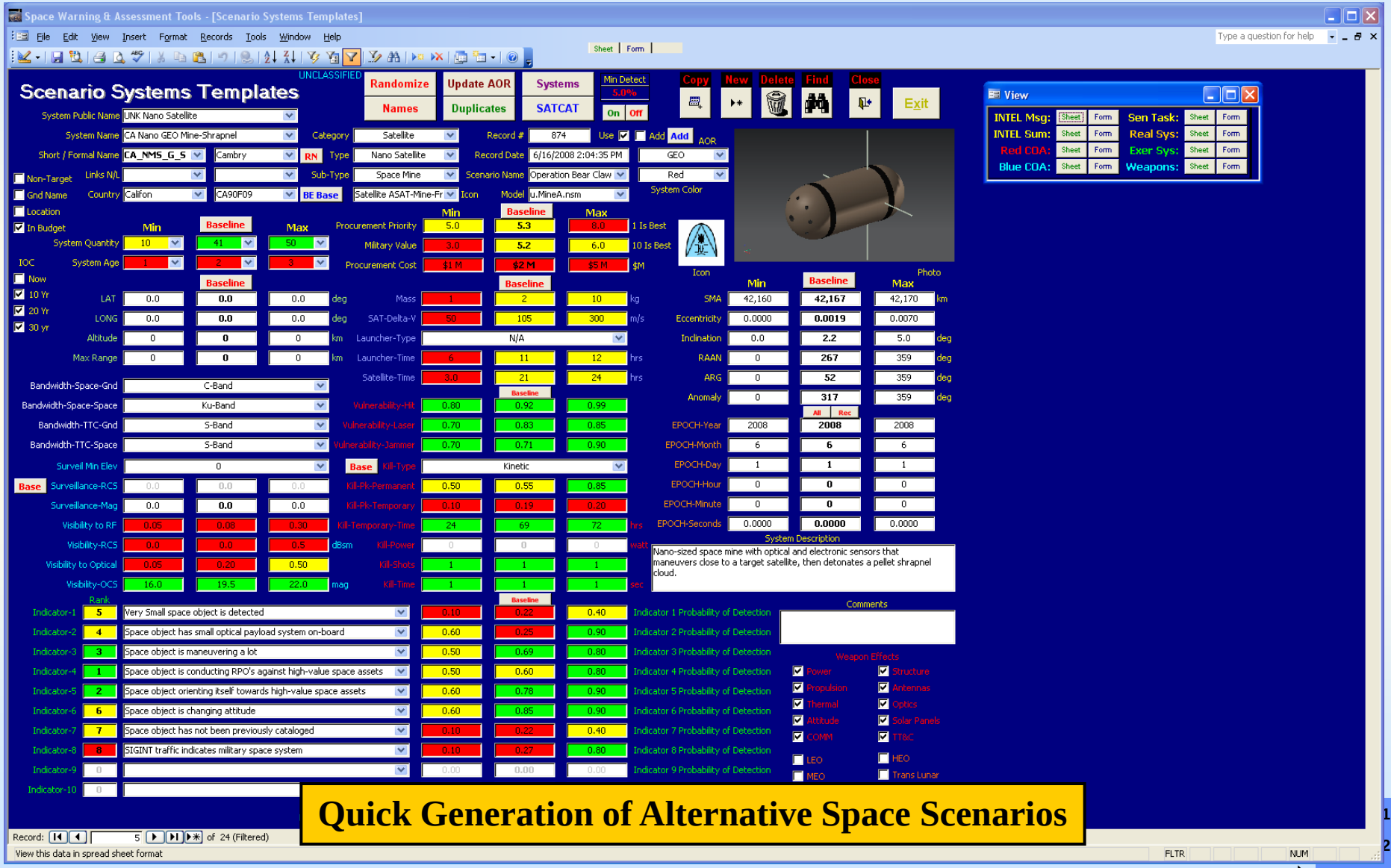
Scenario Partial Example 3



Detailed Space Control Scenario Available for Analyses

SWAT 1
SWAT 2
SWAT 3

Auto Space Scenario Generation Tool

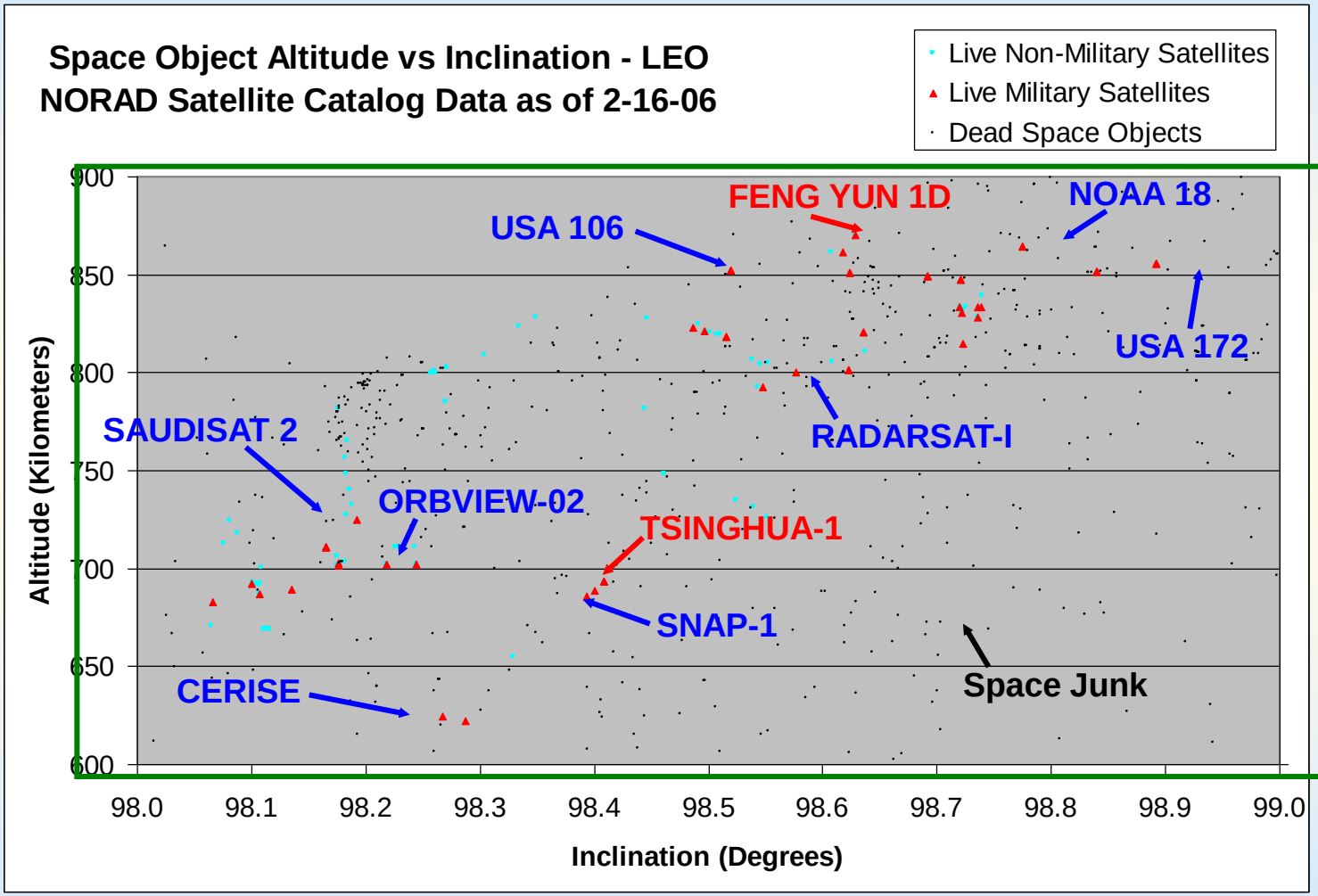


Example Space INTEL Message

```
FM: SATAC //
TO: USAF AFMC AFRL/RDTE //
INFO: USAF AFMC AFRL/RIEA //
UNCLASS //
EXER / Operation Bear Claw //
SWAT T.2.4.1.7.5.6.9 / INTSUM / SATAC / 11155335ZMay10 //
NA / FM 15153618ZMay10 TO 15155255ZMay10 / High Confidence //
Maneuver //
UNITID/ATK: UNK Nano Satellite (85) / BEN: UNK / CTY: UNK / MSN: UNK //
AOR: SDR LEO-S / LOC: NA //
EPOCH: 08153.00000000 / SMA: 7360.64060211182 / ECC: 3.42001691657305E-03 / INC: 99.1599548578262 //
RAN: 349.577767577191 / ARG: 30.6482817736223 / ANOM: 351.45193870978 //
UNITID/TGT: UNK Large Satellite (443) / BEN: UNK / CTY: UNK / MSN: UNK //
AOR: SDR LEO-S / LOC: NA //
EPOCH: 08153.00000000 / SMA: 7346.96979999542 / ECC: 1.30284271150827E-03 / INC: 98.4710093259811 //
RAN: 28.6831902525877 / ARG: 322.748763662227 / ANOM: 140.650247049581 //
GENTEXT: Mutiple space objects are maneuvering in space, some towards critical blue satellites. //
EST CONFLICT LVL: Phase 0: Pre-War Buildup / CONFID: Low //
EST RED STRATEGY: UNK / CONFID: Low //
EST RED TACTIC: Mobile Laser Blinder / CONFID: Low //
REF1: T.2.4.1.7.5.6.9  /  REF2: T.2.4.1.8.5.1.4  /  REF3: T.2.4.1.9.5.3.1 //
```

INTEL Messages Automatically Generated & E-Mailed

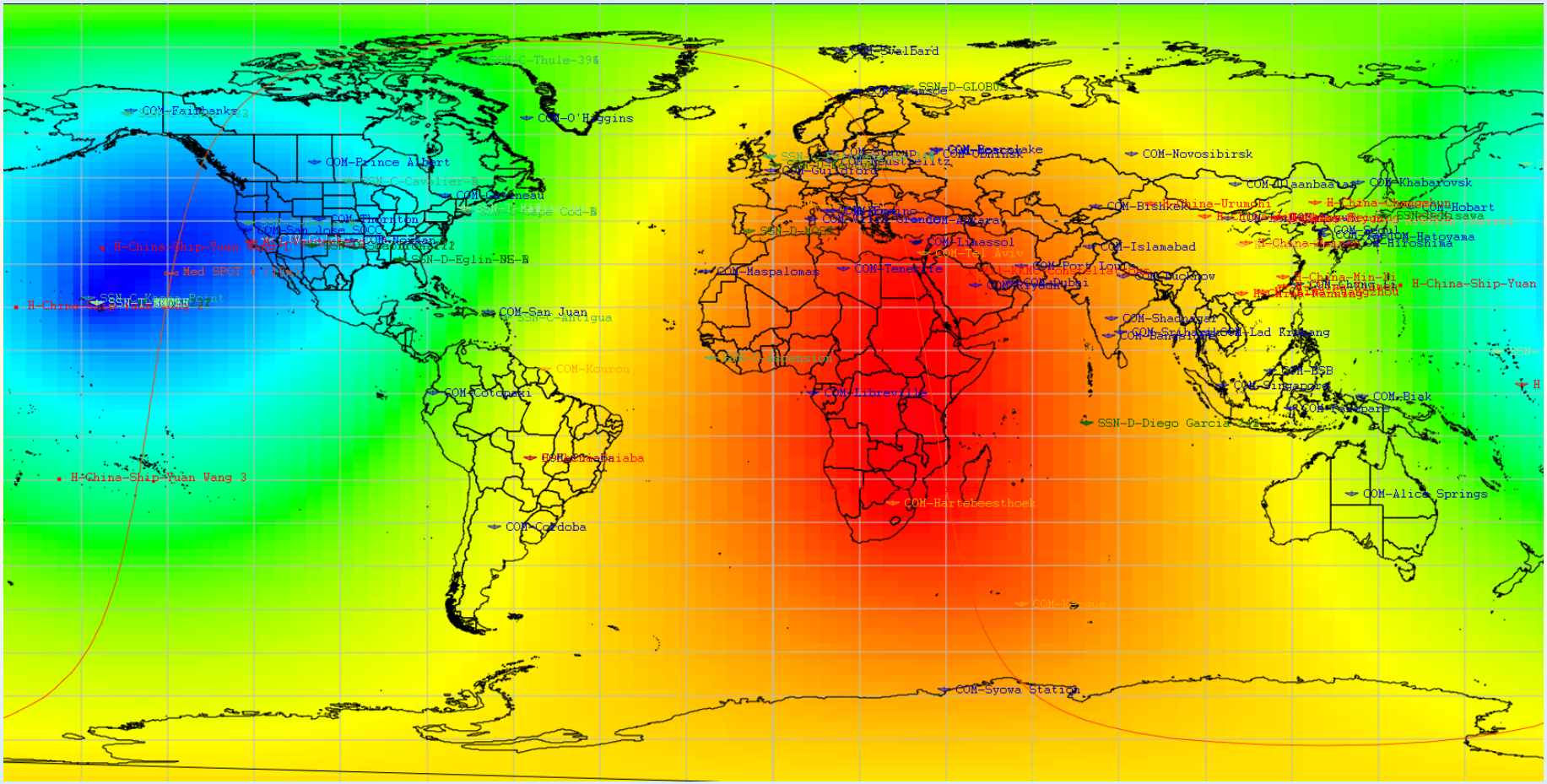
Space Choke Points



Hohmann Maneuver Envelope at 100 M/Sec Delta-V

There are Many Potential Sources of Attack

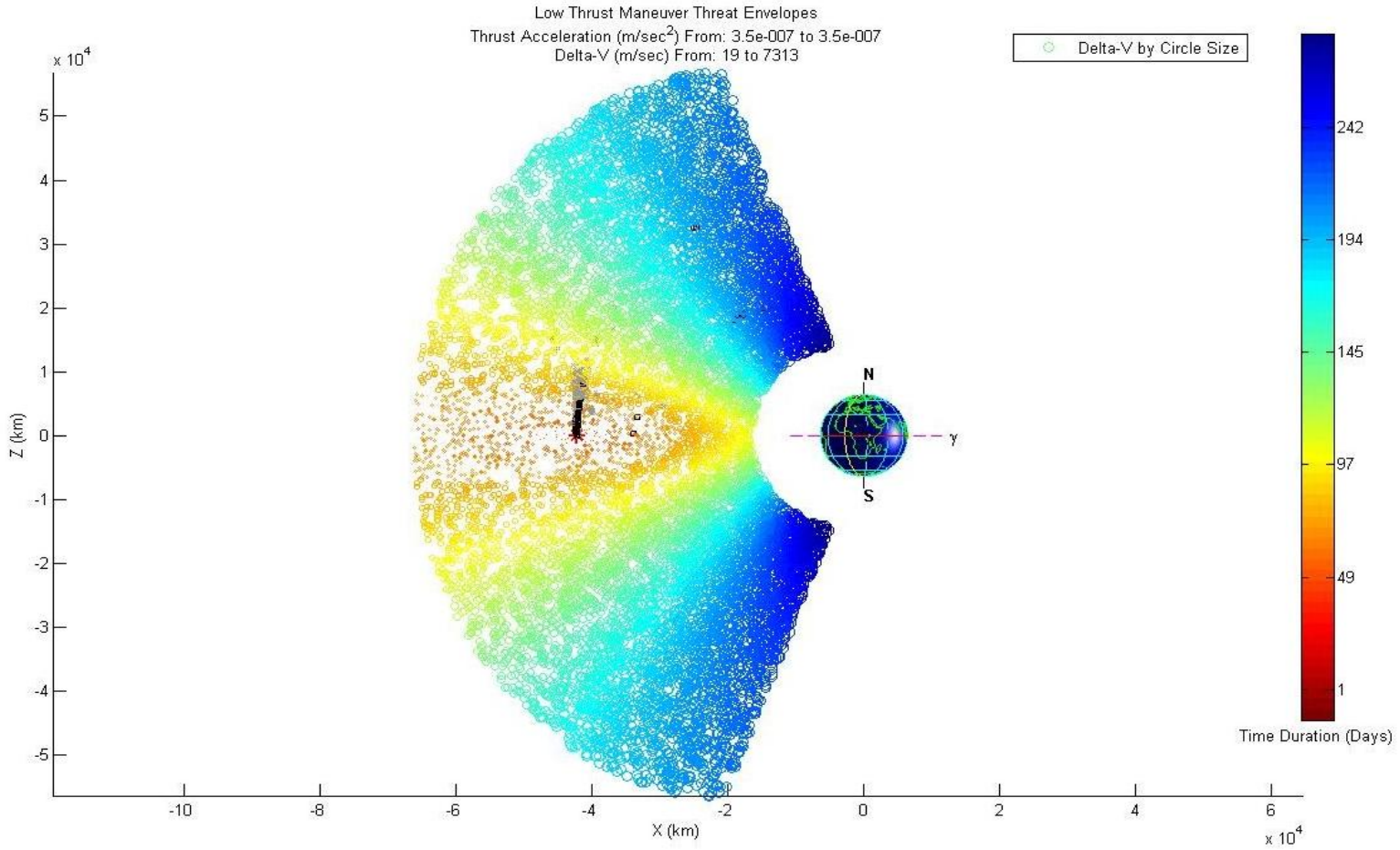
Example Attack Locations Optimized for Space Surveillance



Some Parts of a Satellite's Orbit May Be More Vulnerable than Others

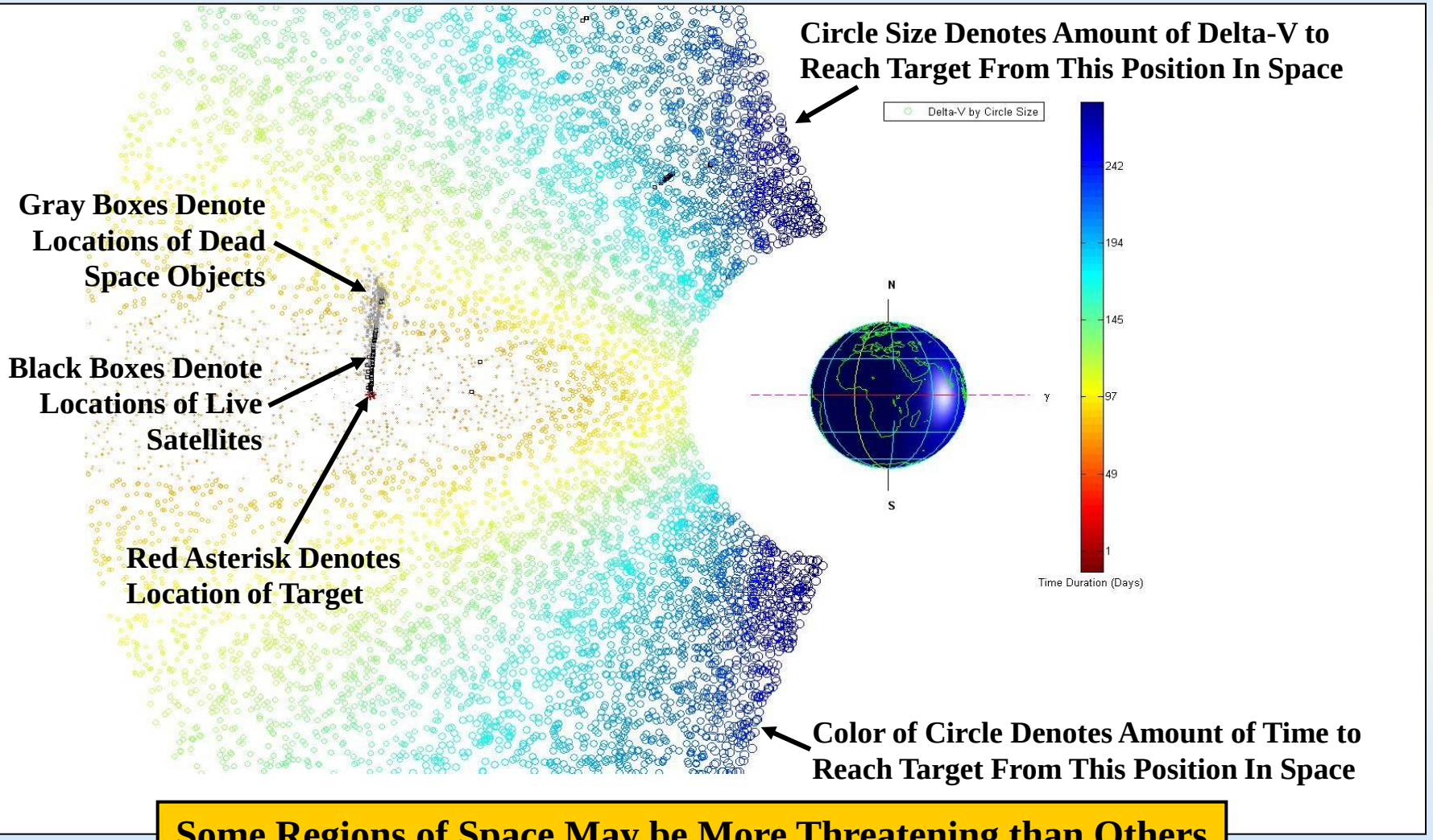
SWAT 1
SWAT 2
SWAT 3

Example Threat Envelope View 1



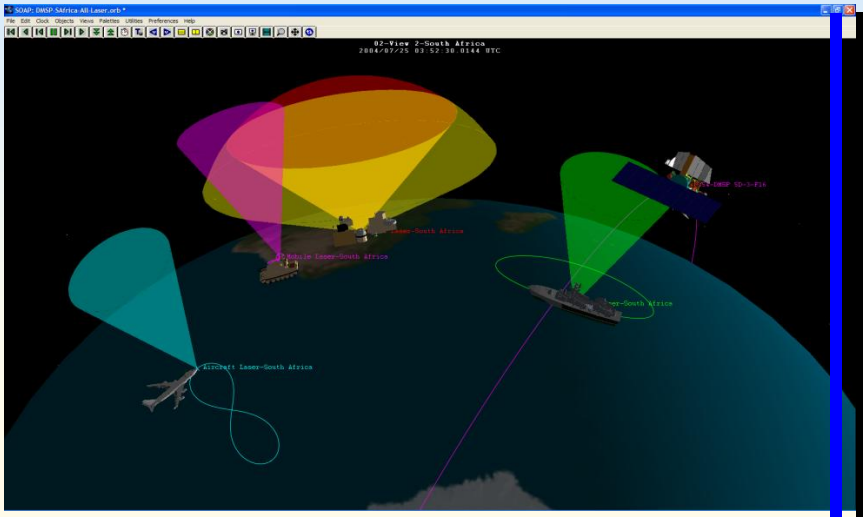
Some Orbits are Easier to Maneuver to Than Others

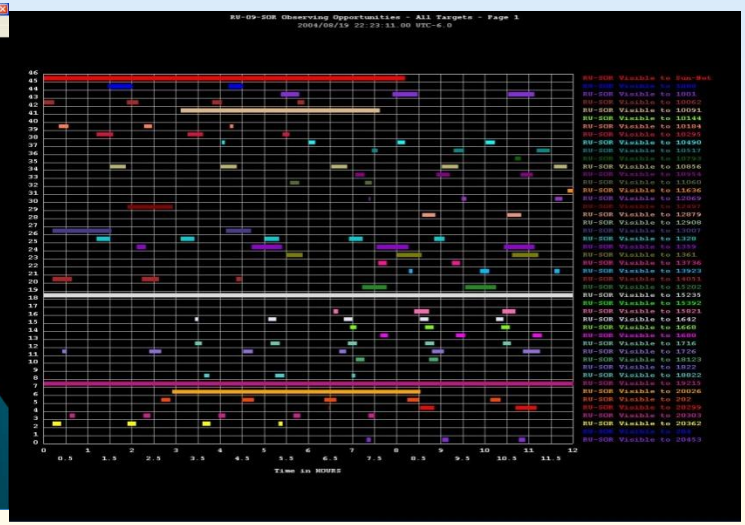
Example Threat Envelope View 2

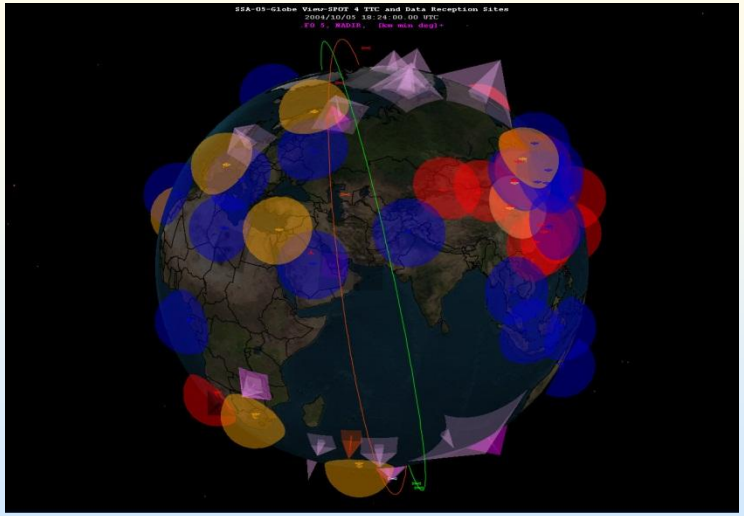


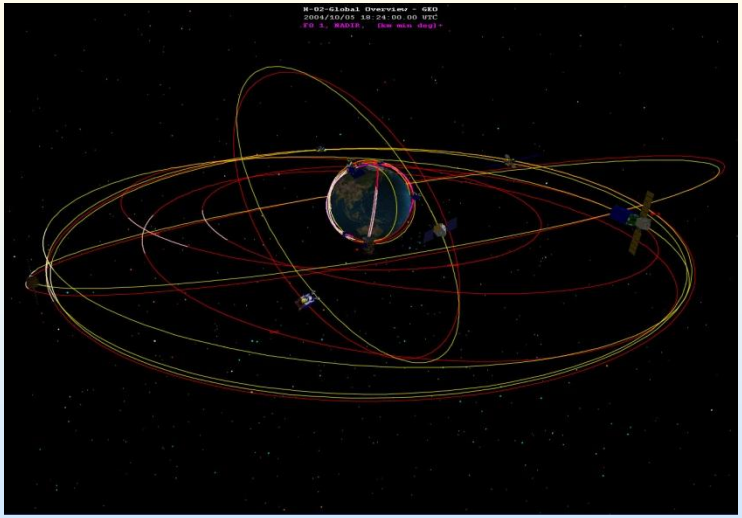
Some Regions of Space May be More Threatening than Others

ASAT Range / Access Assessments



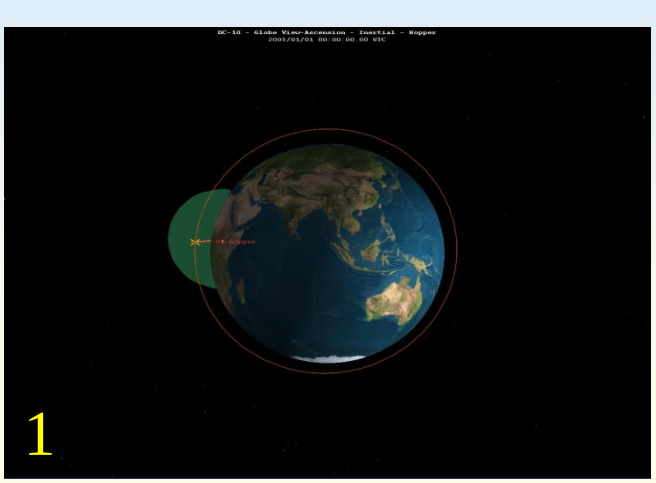


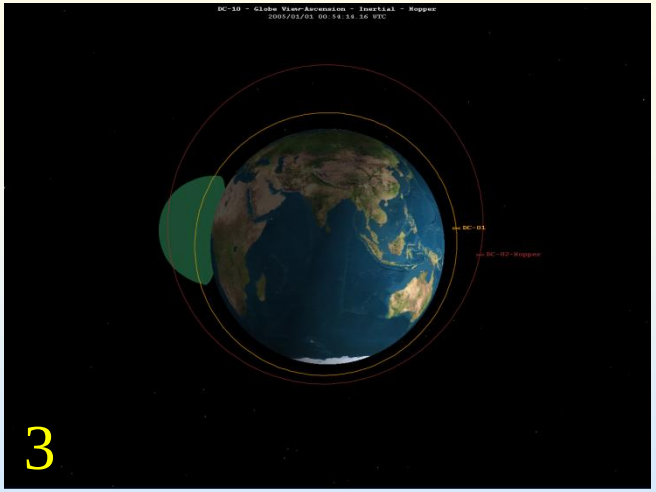


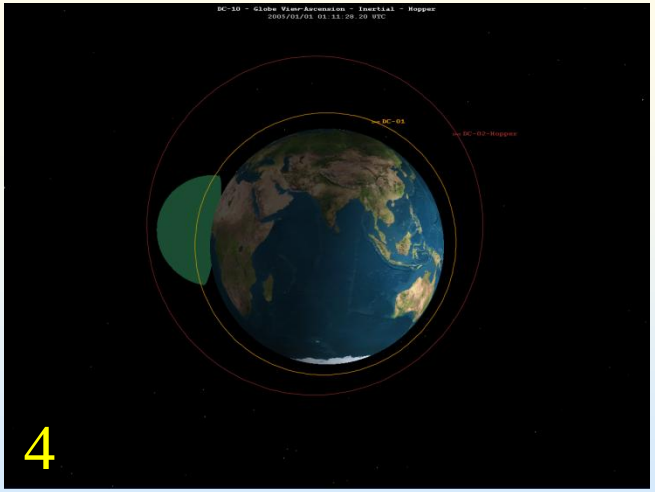


SWAT 1
SWAT 2
SWAT 3

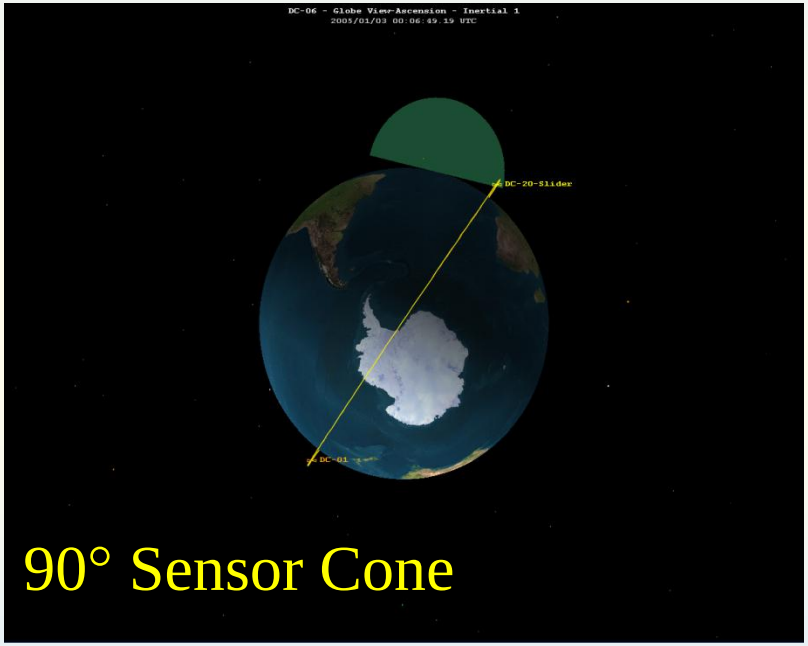
Avoid Space Radar - Hopper



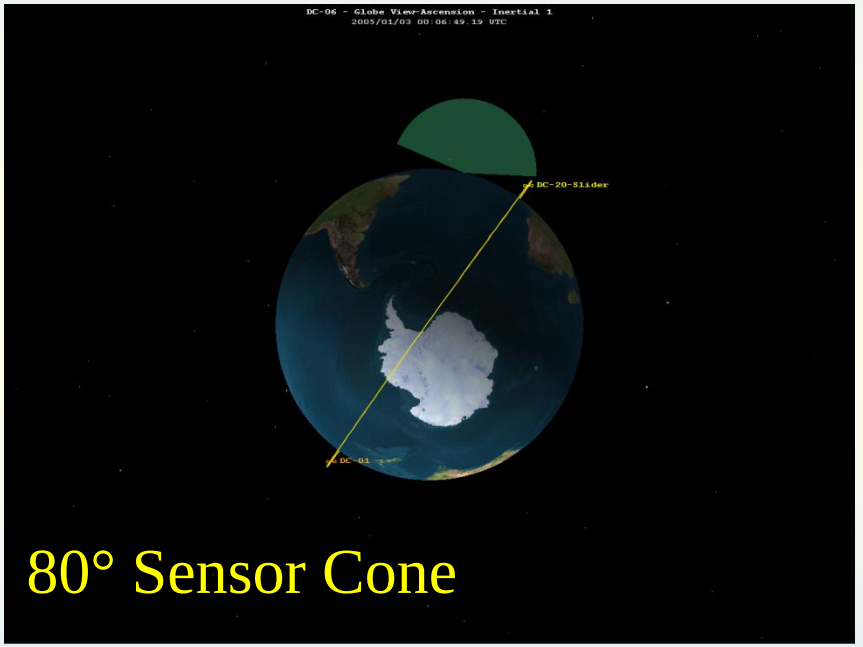




Avoid Space Radar - Slider

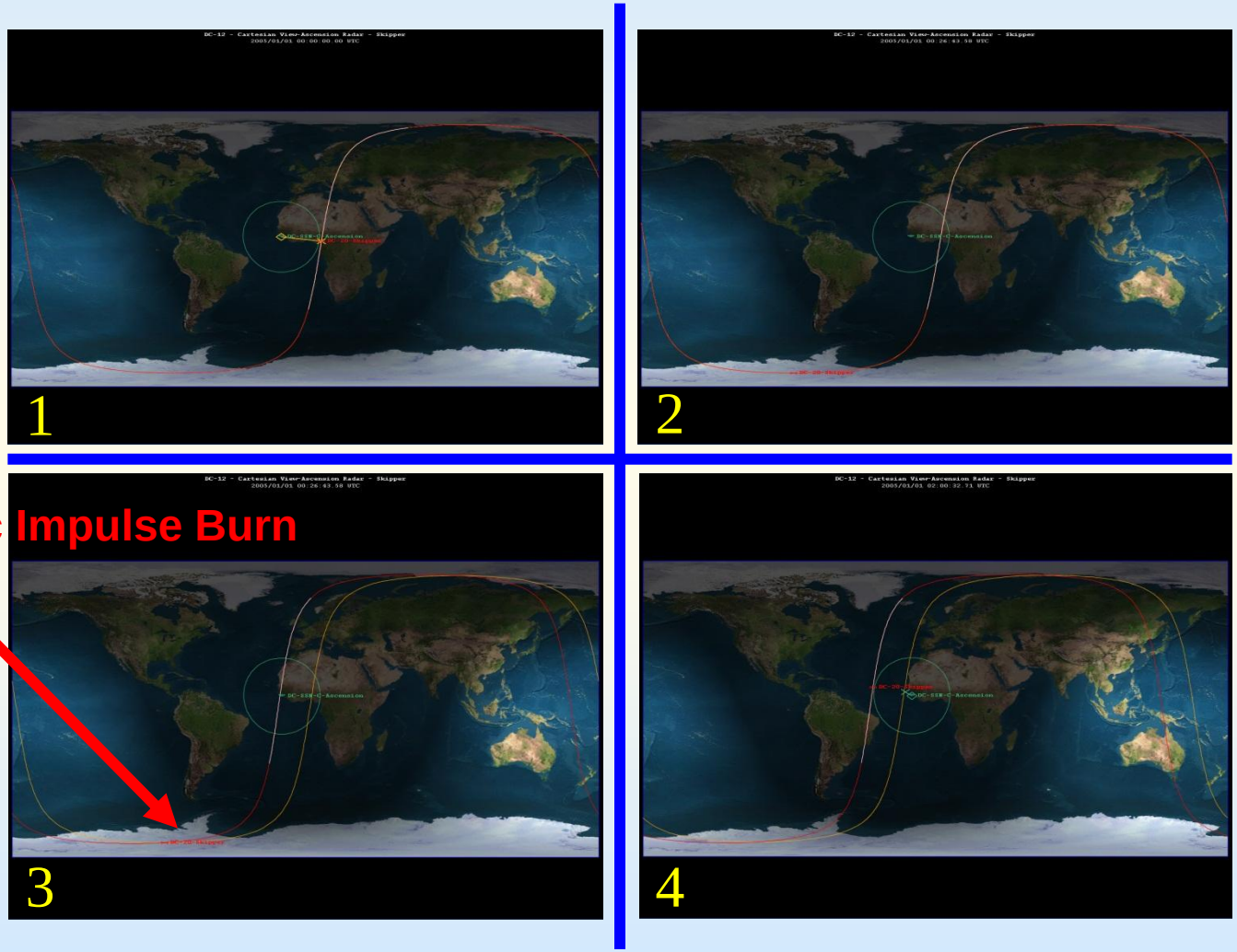


90° Sensor Cone

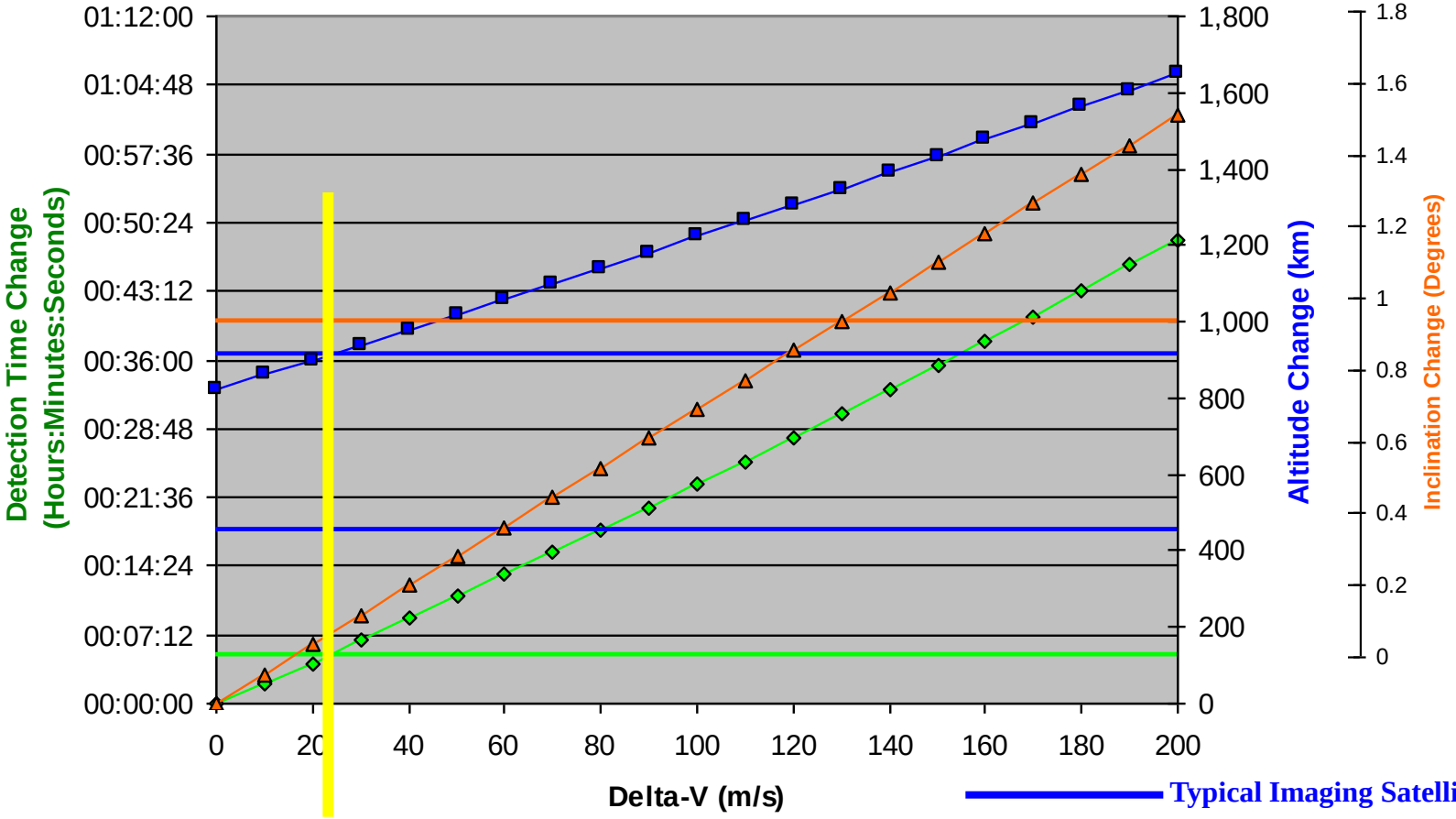


80° Sensor Cone

Avoid Space Radar - Skipper



One Impulse Maneuver Effects



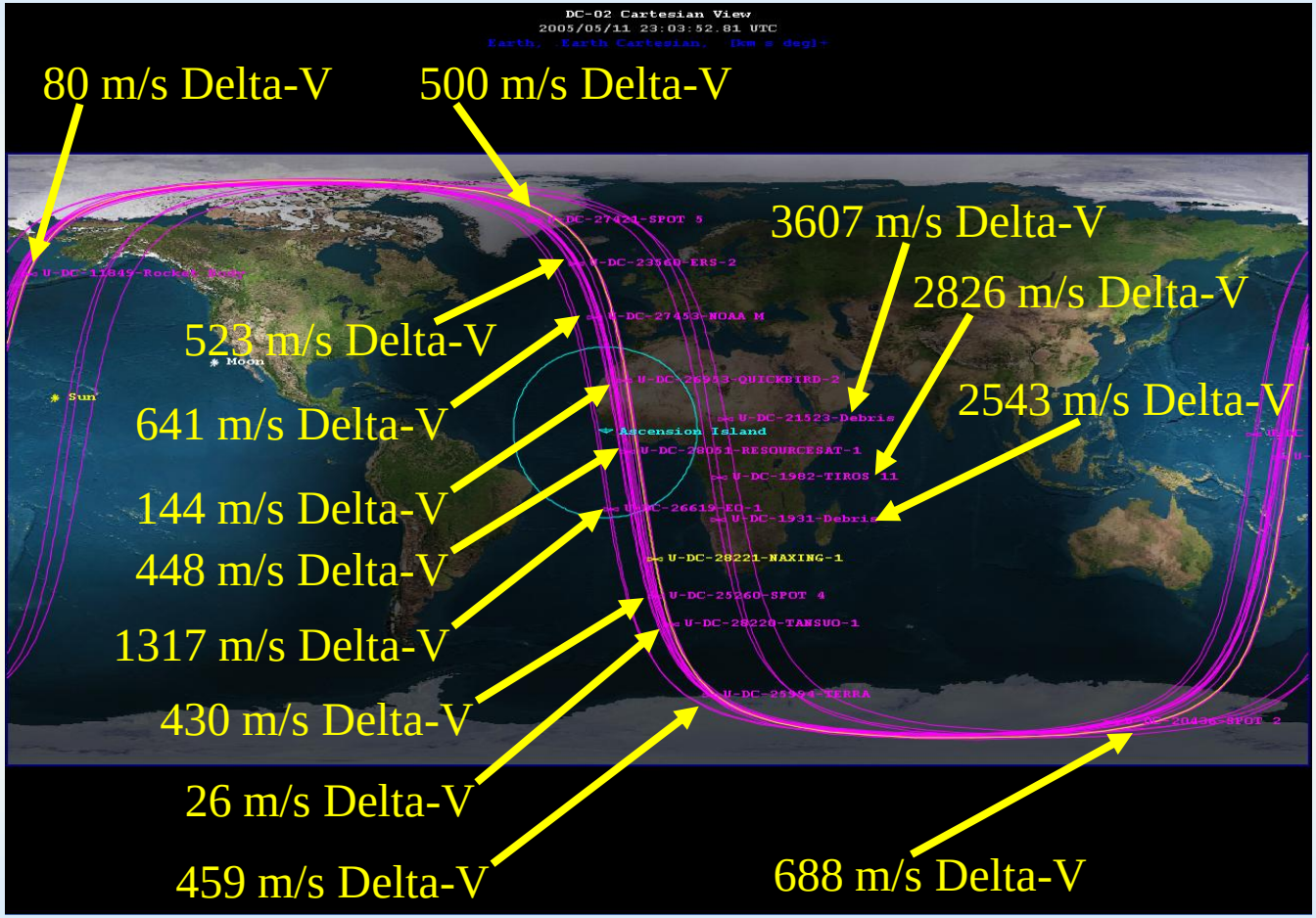
25 m/sec Delta-V Gives Results Within Operational Constraints

Goal: Avoid Ascension Is. Radar

DMSP-Class Satellite Impulse Burns After Leaving Ascension Is. Sensor Cone

Small Maneuvers Can Confuse NORAD Space Object Tracking

Hide Satellite Among Others

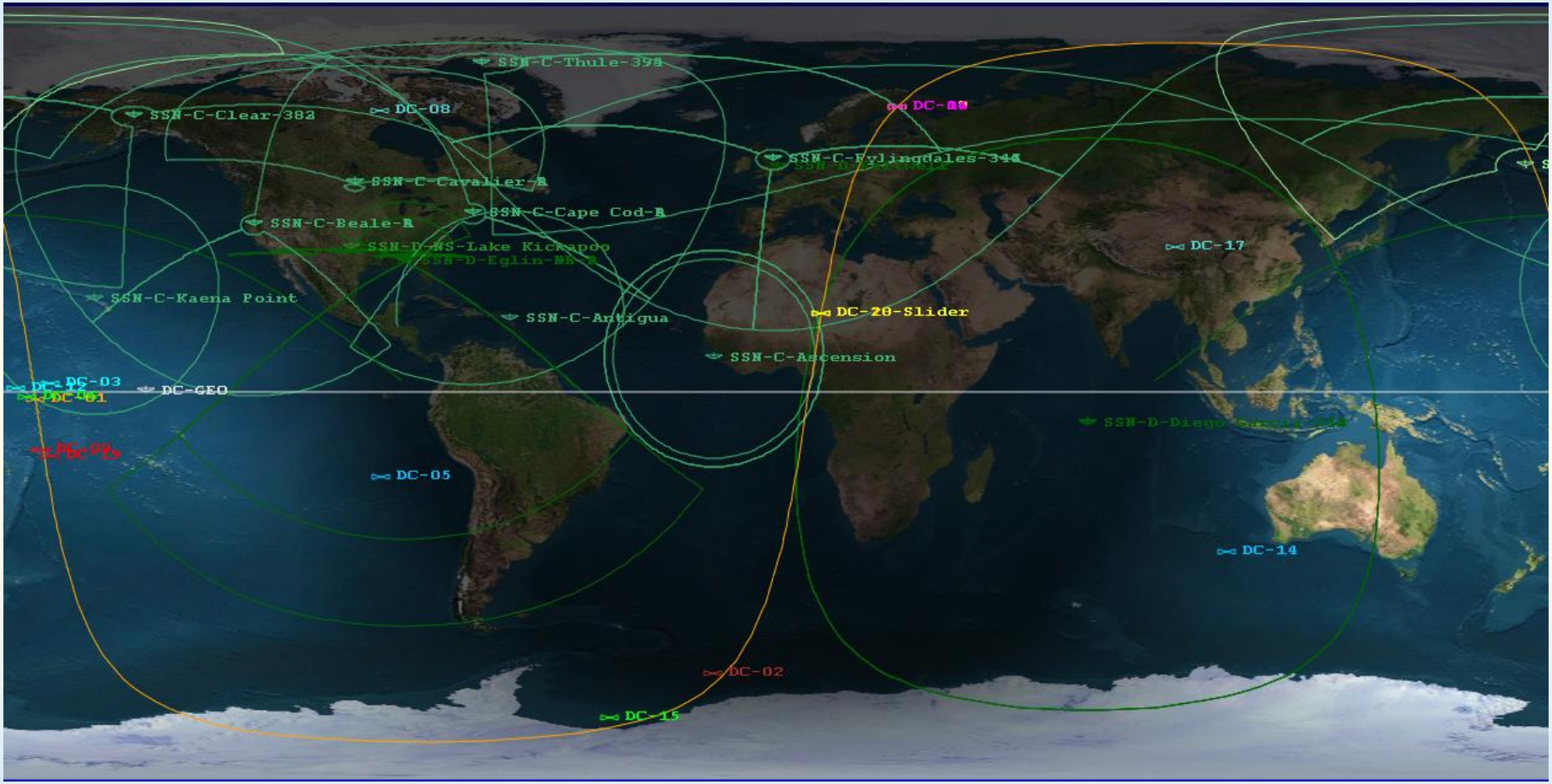


Goal: Appear Like Nearby Satellite

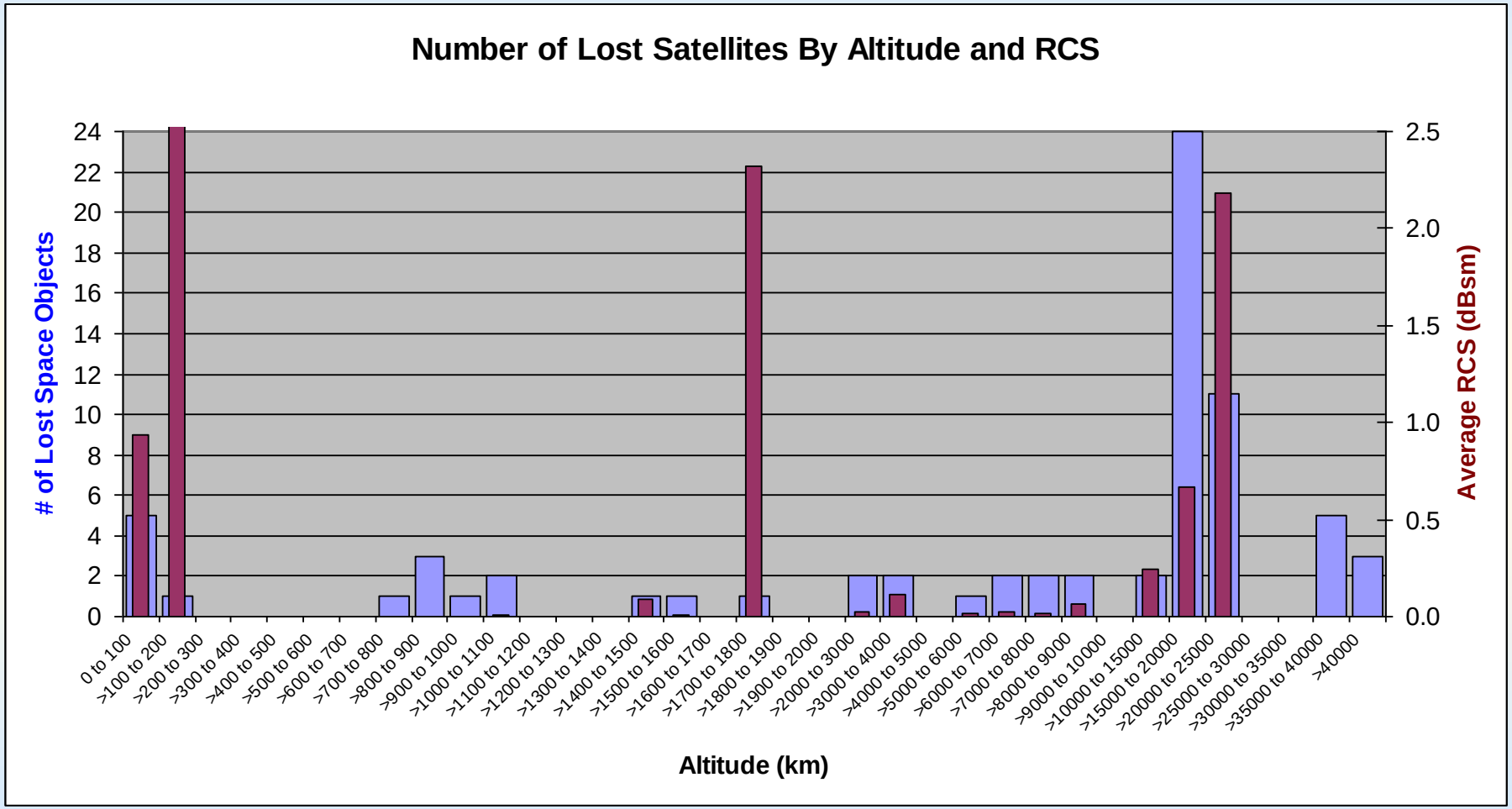
Delta-V Required for 2-Burn Hohmann Transfer Rendezvous

Satellites Can Maneuver to Confuse Targeting Assets

Space Surveillance Network



JSpOC Catalog Missing Space Objects



Optical Data Impact

- **Optical Data Formatted & Imported**
  - SOR Color Photometry GEO Catalog
  - Maui Russian Data
  - Belgian Astronomical Association Flashing Space Objects
- **State Change Analysis Runs (22 Time Periods)**
  - With Optical Data - 39 Hours Total Processing Time
  - Without Optical Data - 29 Hours Total Processing Time
- **Optical Data Had a Significant Impact on State Change Rankings**
  - 33% of Space Object Change Scores Increased (Increased State Change Detected)
  - 50% of Space Object Change Scores Decreased
    - Addition of Optical Data Helped Stabilized Erratic Data?
  - 17% of Space Object Change Scores Unchanged

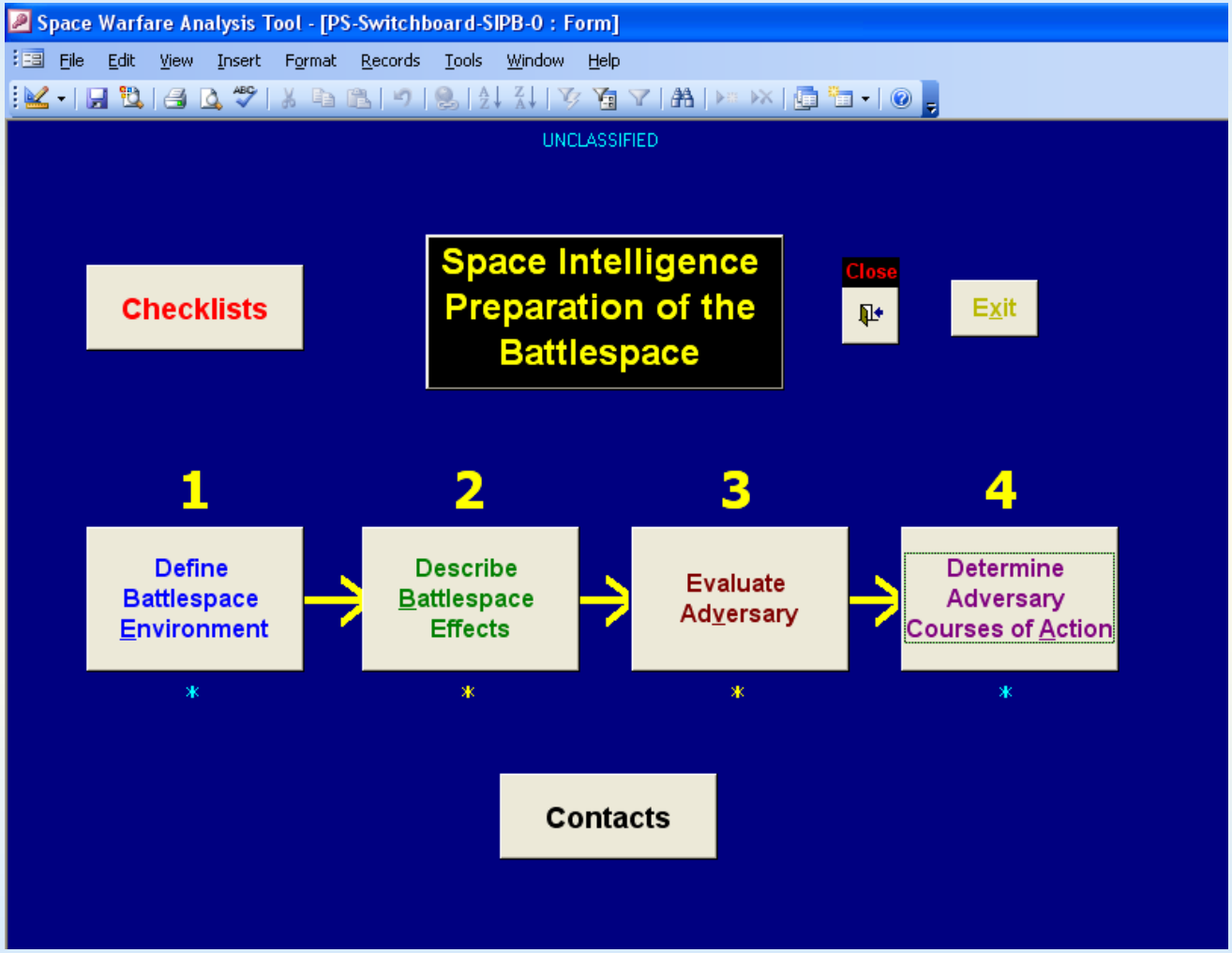
Example Optical State Changes - 1

SATCAT No	SatName	Mission	Country	Orbit	Comments
15774	SL-12 R/B(AUX MOTOR)	Rocket Body	Russia	SDR LEO-H	Flash Period (5.7) significantly less than other SL-12 R/B(AUX MOTOR) SSN: 15338 (15)
25415	ORBCOMM FM 19	COMM-MOBIL	ORBCOMM	SDR LEO-H	Visual Magnitude much dimmer (9) than other satellites of its class (Iridium - 6.5 ; GLOBALSTAR - 5.5)
25116	ORBCOMM FM 9	COMM-MOBIL	ORBCOMM	SDR LEO-H	Visual Magnitude much dimmer (9) than other satellites of its class (Iridium - 6.5 ; GLOBALSTAR - 5.5)
16191	**METEOR 3-1**	**METSAT**	**Russia**	**SDR LEO-H**	**Visual Magnitude much dimmer (6.7) than most other satellites of its class (5.3 - 5.8) [possibly because it is a new model; METEOR 3 vs. METEOR 1 or 2]**
15930	COSMOS 1670	RORSAT	Russia	SDR LEO-H	Visual Magnitude slightly brighter (6) than other satellites of its class (5.6)
11084	**COSMOS 1045**	**OCEANOGRPY**	**Russia**	**SDR LEO-H**	**Visual Magnitude slightly dimmer (6) than five other satellites of its class (5.5); note object is extremely stable in its orbit**
11671	COSMOS 1151	ELINT	Russia	SDR LEO-L	Visual Magnitude slightly dimmer (5.5) than most other satellites of its class (5.2 - 5.4)
25396	TMSAT	EARTH-RES	Thailand	SDR LEO-S	Visual Magnitude much dimmer (9) than other satellites of its class (4.5 - 6.9)
17199	ARIANE 1 DEB	ARIANE 1 DEB	France	SDR LEO-S	Flash Period much higher than other ARIANE 1 DEB
27430	**HAIYANG 1**	**METSAT**	**China**	**SDR LEO-S**	**Flash Period more than doubles on 6/16/2008**
21935	**SL-12 DEB**	**SL-12 DEB**	**Russia**	**SDR MEO**	**Radical change in Flash Period**
13080	COSMOS 1341	MSL-WARN	Russia	SDR MEO	Visual Magnitude slightly dimmer (5.5) than most other satellites of its class (1 - 5). Flash Period much lower (3.4) than others of its class (7 - 47)
21855	COSMOS 2179 (GLONASS)	NAVSAT	Russia	SDR MEO	Visual Magnitude very much dimmer (10.9) than other satellites of its class (1.5 - 3)

Example Optical State Changes - 2

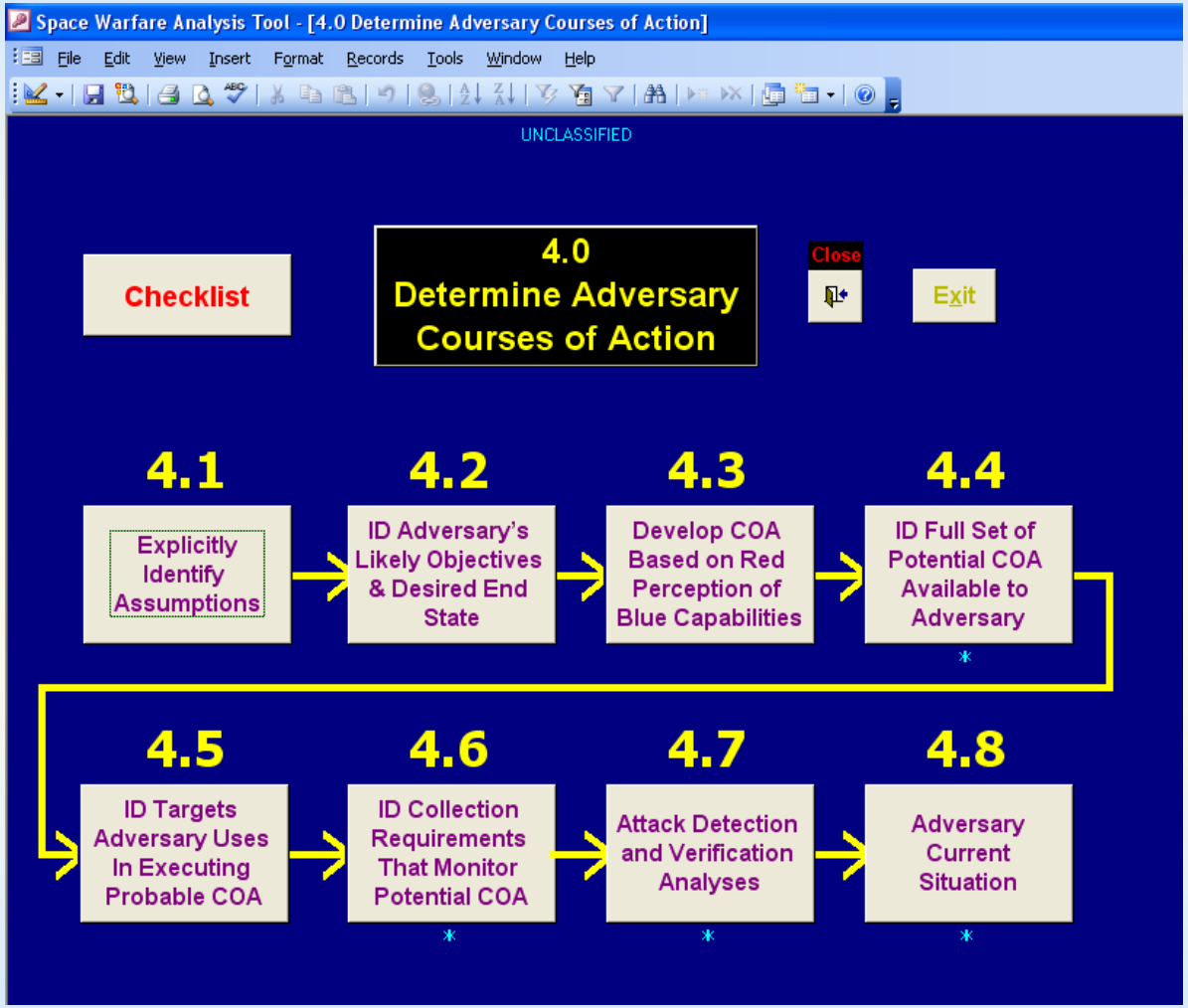
SATCAT No	SatName	Mission	Country	Orbit	Comments
17083	GORIZONT 13	COMM-CIVIL	Russia	SDR GEO	Along with GORIZONT 7, GORIZONT 13 is the dimmest GORIZONT in the sky (13) vs. visual magnitude of 6 for other GORIZONT's
16667	COSMOS 1738	COMM-CIVIL	Russia	SDR GEO	Visual Magnitude slightly dimmer (13.2) than many other satellites of its class (5.5 - 12.5)
16650	BRAZILSAT 2	COMM-CIVIL	Brazil	SDR GEO	Visual Magnitude much brighter (1 - flash) than other satellites of its class (4 - 14)
23267	COSMOS 2291	COMM-MIL	Russia	SDR GEO	Visual Magnitude much brighter (6) than other satellites of its class - US (11 - 11.6)
20523	INTELSAT 603	COMM-CIVIL	INTELSAT	SDR GEO	Along with 21653 (INTELSAT 605) Visual Magnitude much brighter (3) than other satellites of its class (6 - 14.7). At the time, the Intelsat 6 series were the largest commercial spacecraft ever built.
15946	RADUGA 16	COMM-CIVIL	Russia	SDR GEO	Visual Magnitude slightly dimmer (13.8) than many other satellites of its class (5.5 - 13.2)
26069	COSMOS 2369	ELINT	Russia	SDR LEO	Along with 28352 (another ELINT) Visual Magnitude slightly brighter (4.5) than most other satellites of its class (5 - 5.6)
15398	COSMOS 1610	NAVSAT	Russia	SDR LEO	Visual Magnitude slightly brighter (4) than other satellites of its class (5 - 10)
22971	SL-14 R/B	SL-14 R/B	Russia	SDR LEO	Visual Magnitude much dimmer (9.8) than other satellites of its class (5 - 6.5)
11165	COSMOS 1066	METSAT	Russia	SDR LEO	Visual Magnitude slightly dimmer (6.7) than other satellites of its class (5.3 - 6.4)

SWAT Space IPB User Interface Example 1



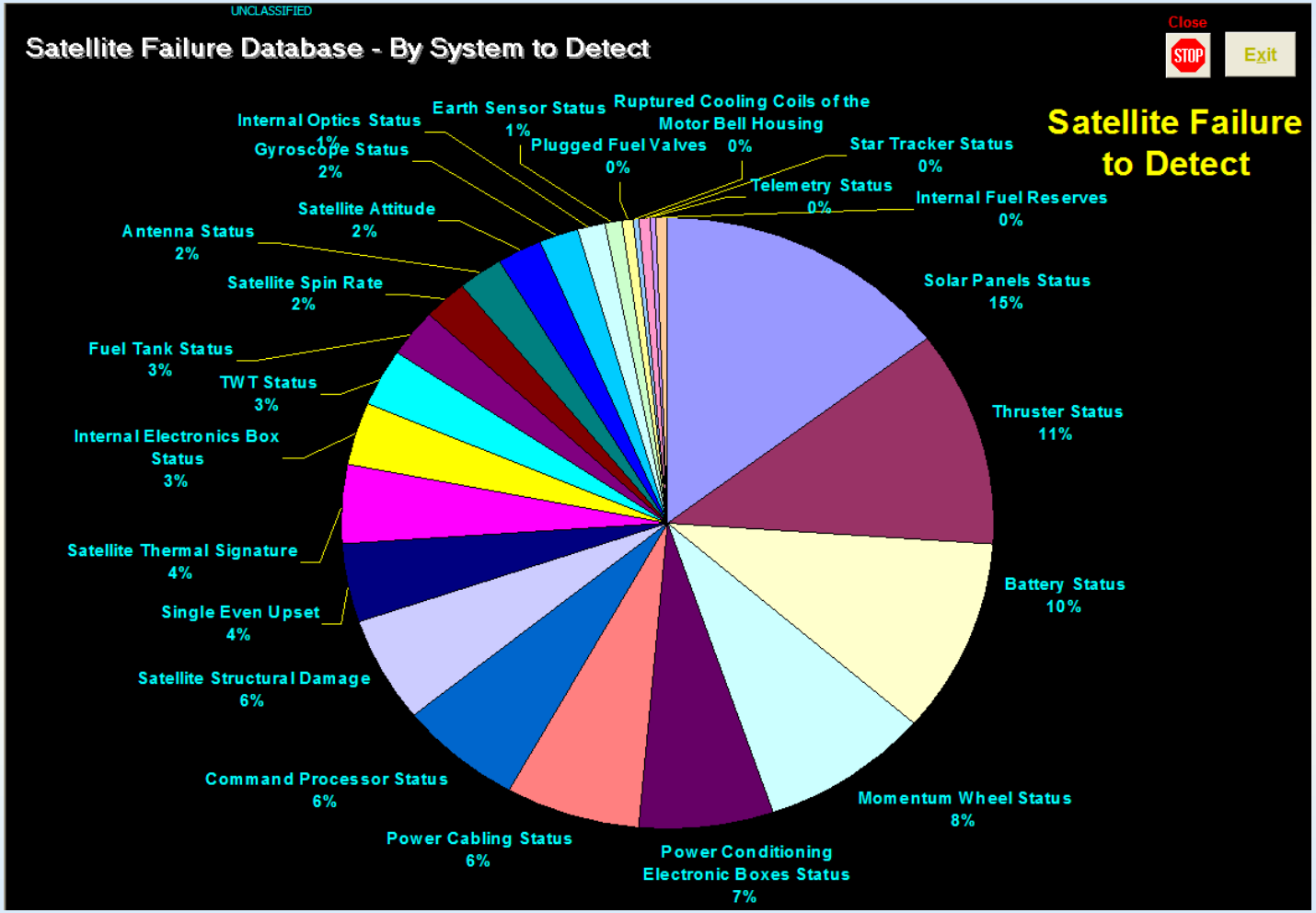
SWAT Space IPB Major Steps Based on Joint Doctrine

SWAT Space IPB User Interface Example 2



SWAT Space IPB Sub-Steps For Determining Red COA

Satellite Failures Database



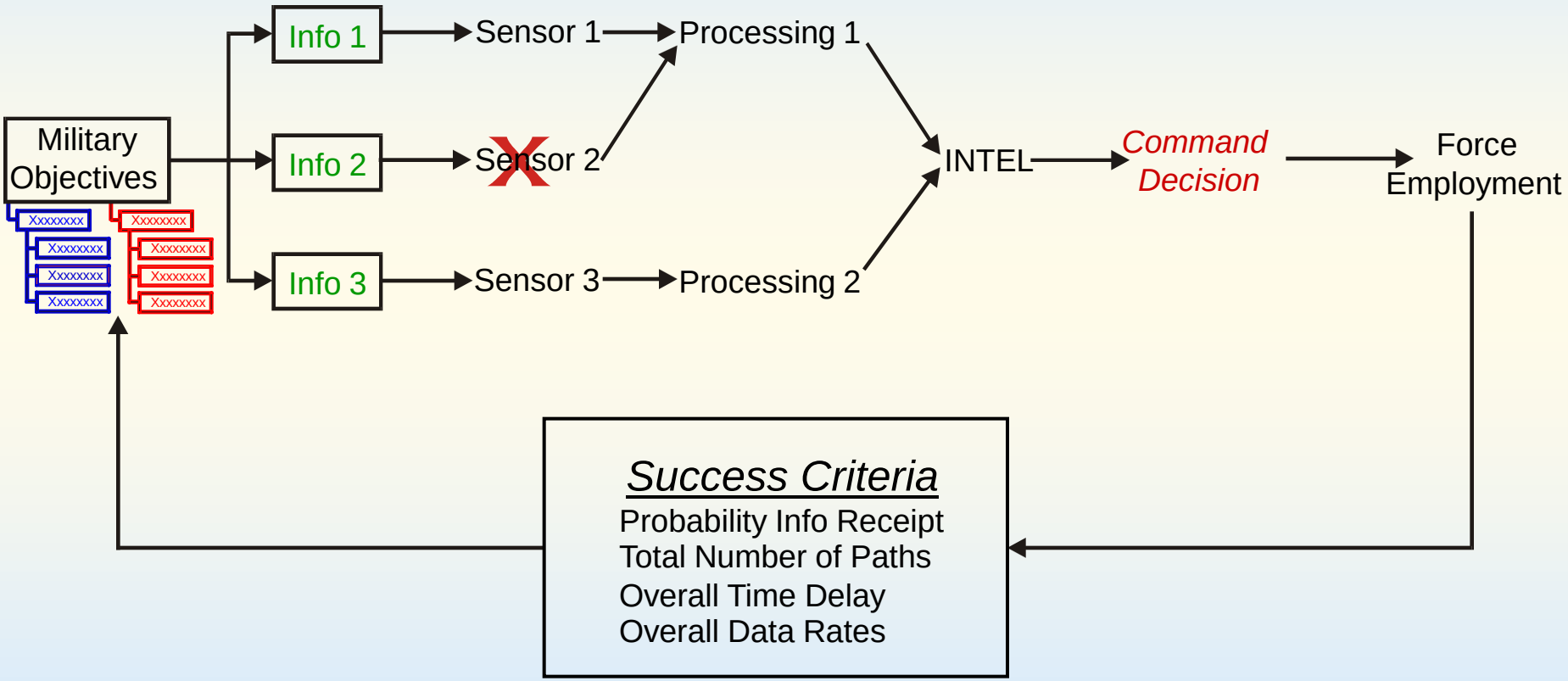
Satellite Failures Data Help Space Analyst Determine If Natural or Man-Made Attack

Space Info Choke Points Network Analyses

- **SHIVA (Space Highest Information Value Assessment)**
  - **AFRL (Phillips Site) Concept Development**
  - **SWC (SIDC) Support**
  - **PC-Based In Microsoft Access**
  - **Performs Links & Nodes Network Analysis Showing Value of Information to the Warfighter**
  - **Can Conduct Red Or Blue Targeting/Vulnerability Analyses**
  - **Algorithms & Software Validated by RAND**

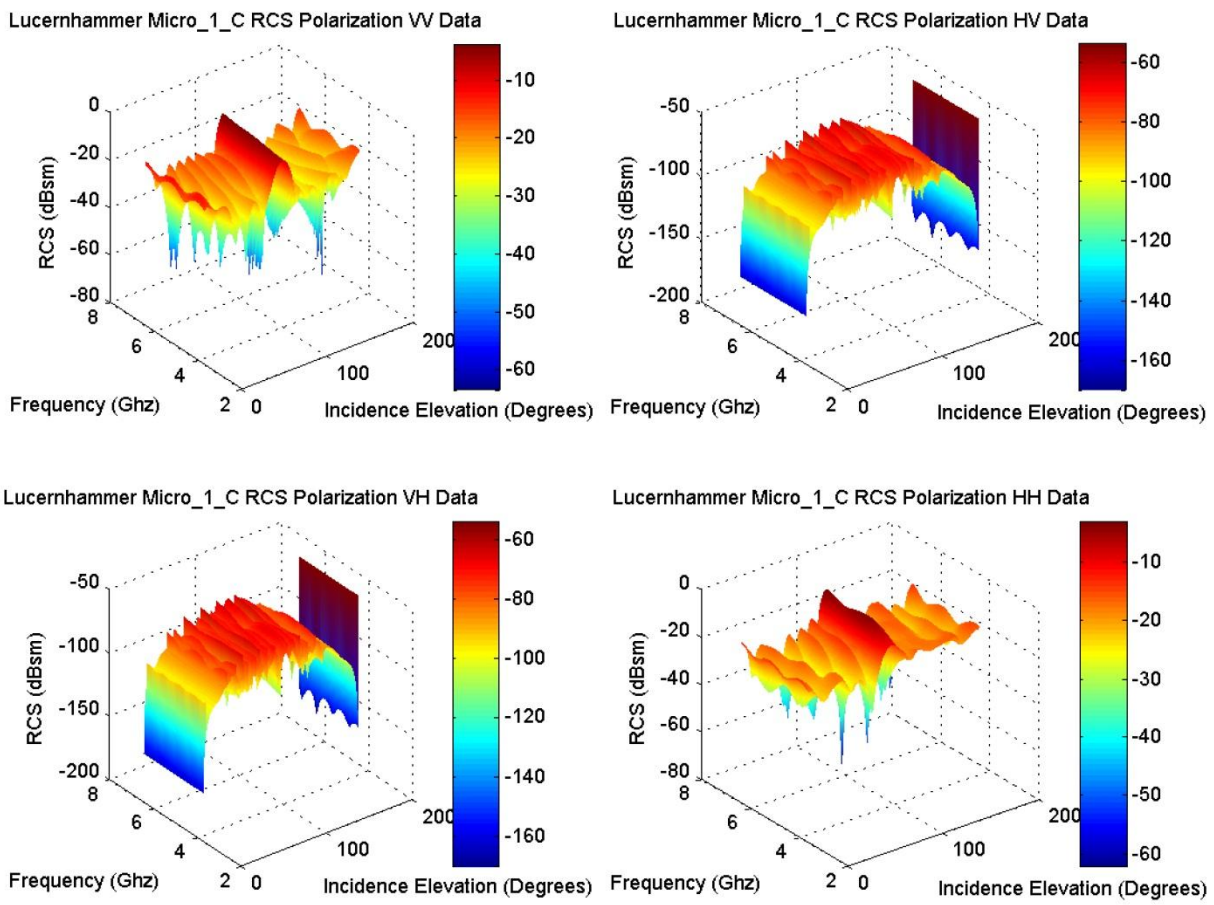
SHIVA Can Show the Value of Space Systems

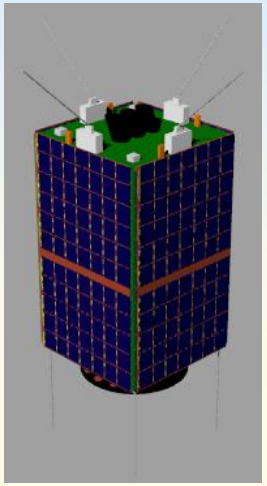
SHIVA Methodology



SHIVA Calculates All Possible Paths Between Sensors and Shooters

Example SWAT Satellite RADAR Cross Section



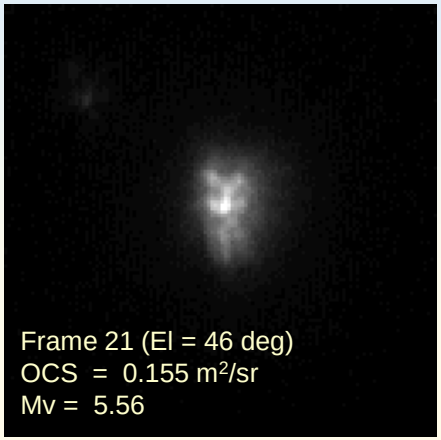


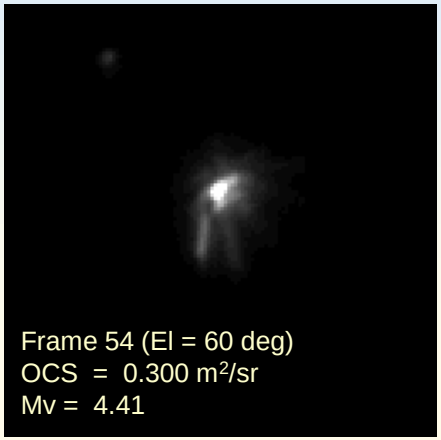
Satellite Model Used In Calculations

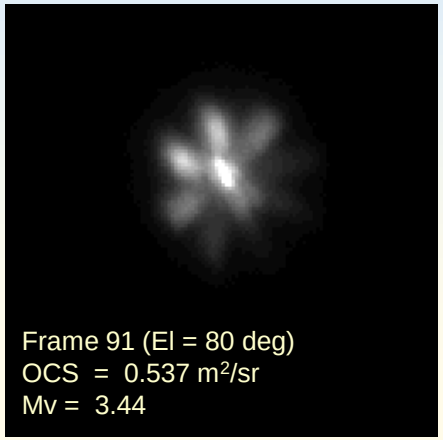
Radar Cross Section Calculations Can be Performed on SatAC Models

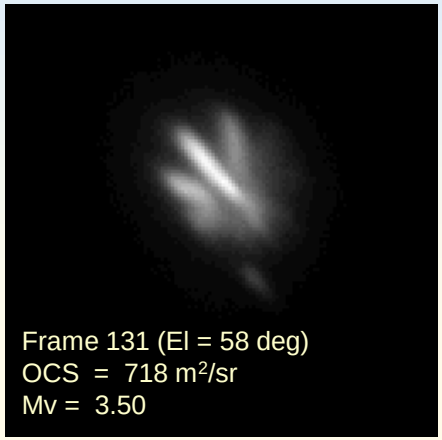
Example Satellite Optical Cross Section

SOR Field Data from JD 104, 2000

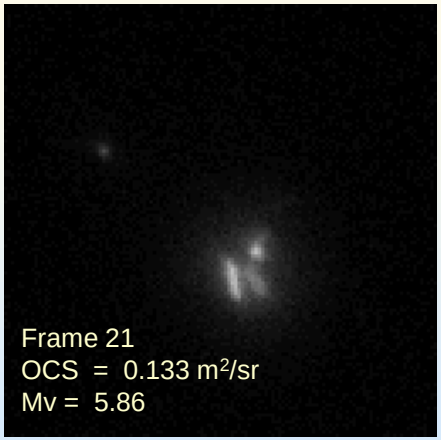


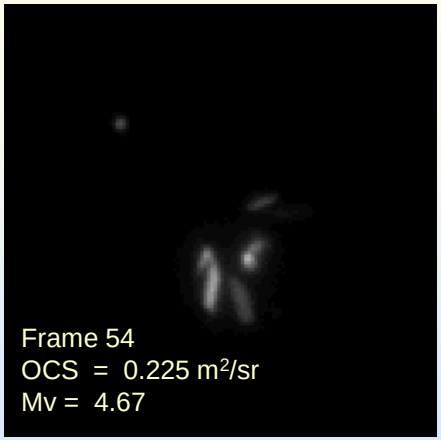


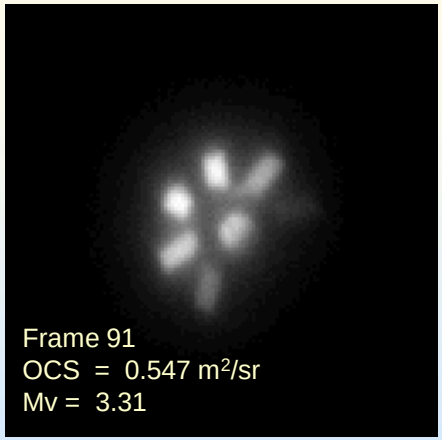


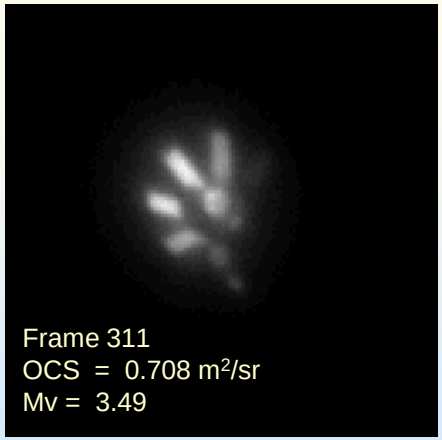


TASAT Simulation w/ pose (11, -15, -1)

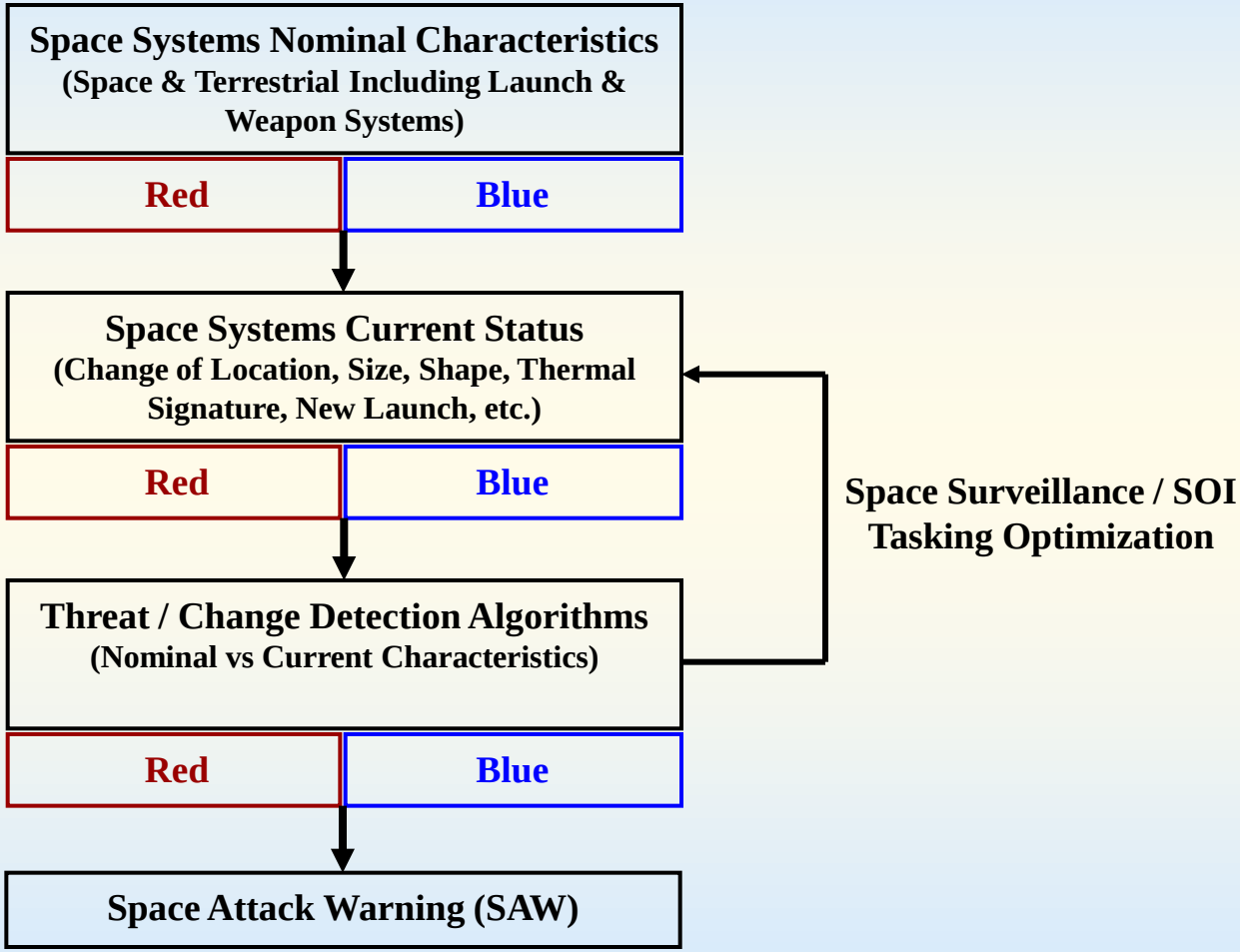






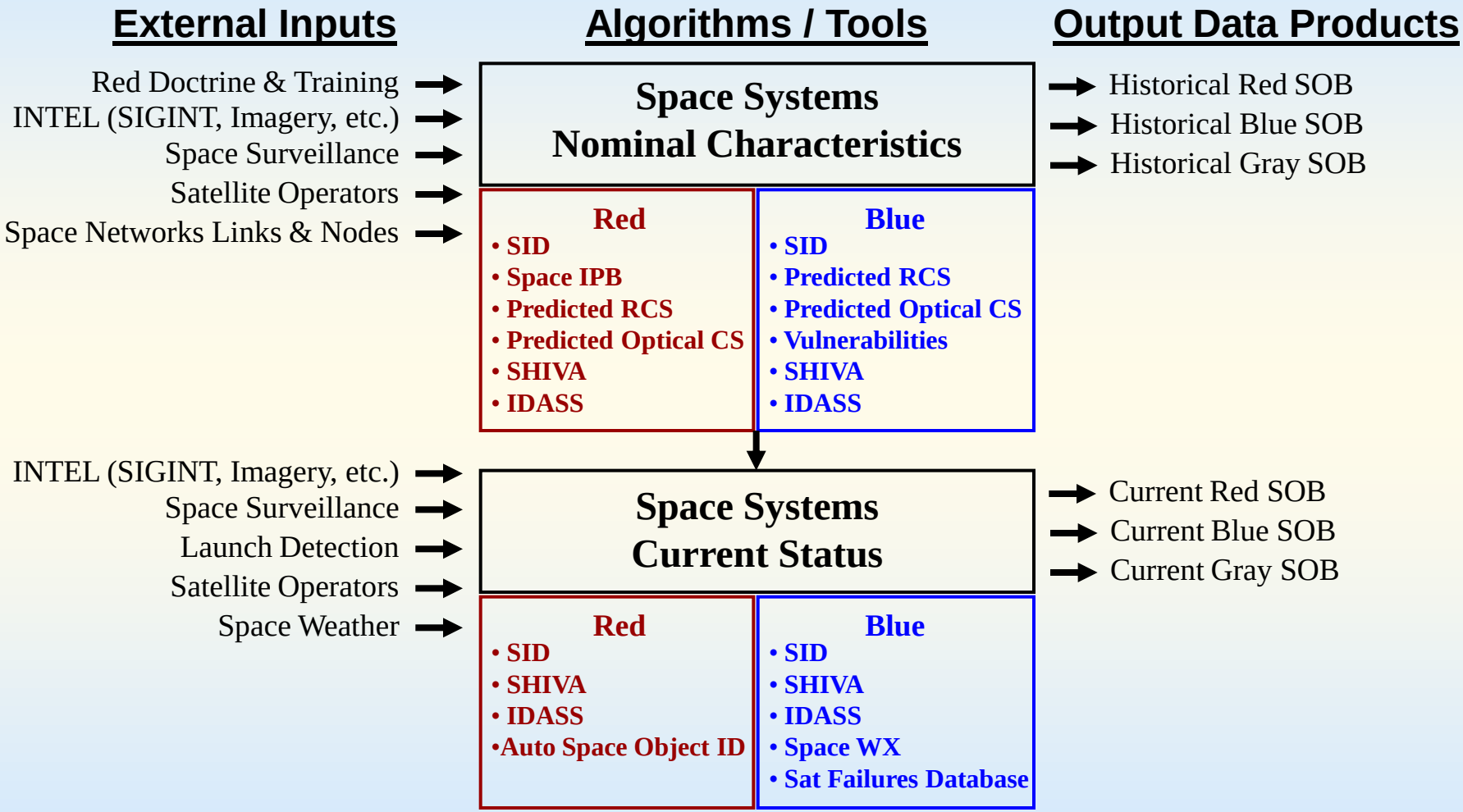


SSA & SAW Integrated Concept

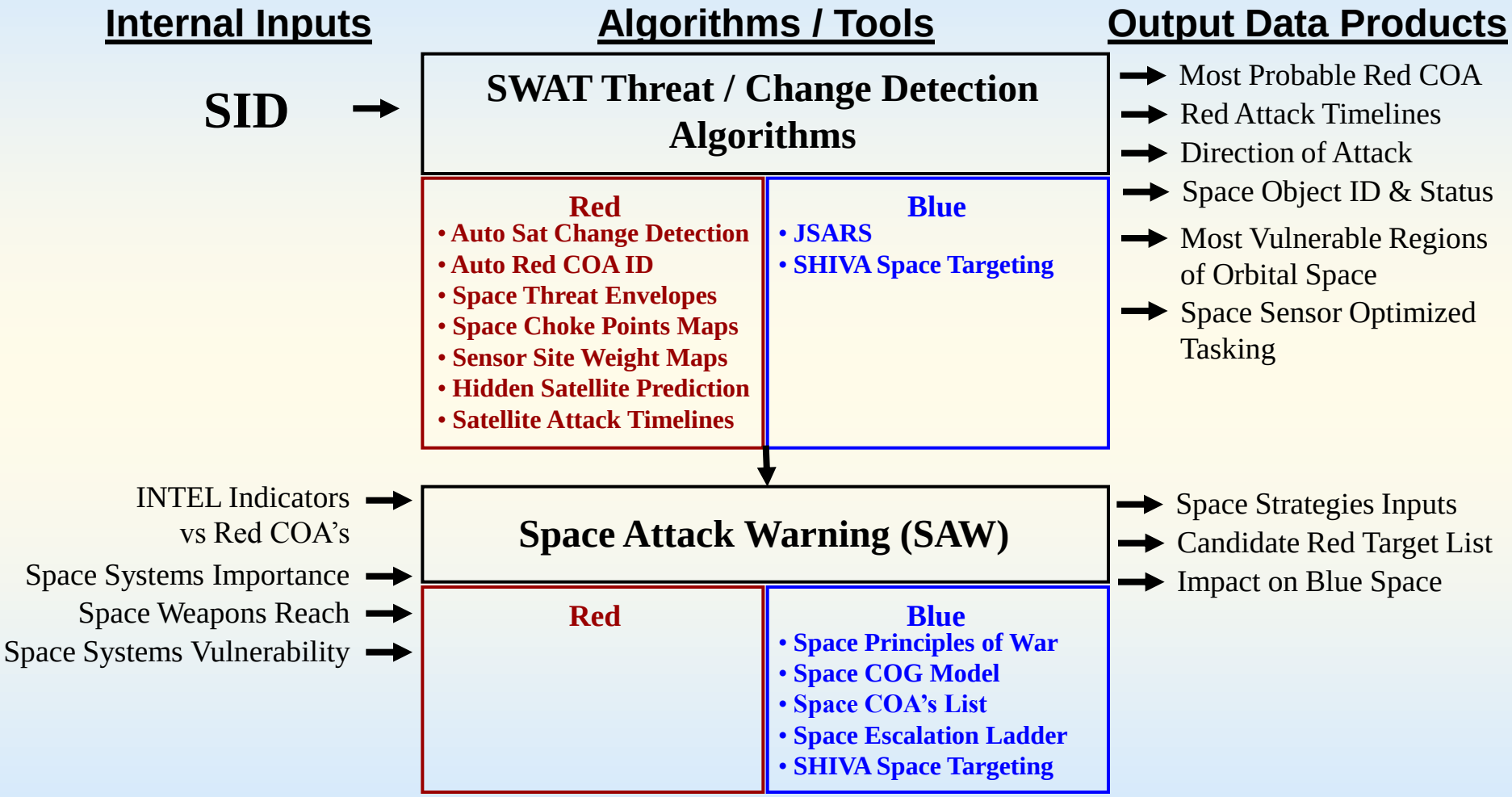


Predict an Adversary's Intentions & Next Moves Against Space Systems

SSA & SAW Detail 1



SSA & SAW Detail 2



Space Object Change Detection Critical for Attack Warning

Focused Long Term Challenges Linkages

FLTC's

Space Tools →

Space Control Tools / Algorithms

Number	Focused Long Term Challenges	Auto Space Object Classification	Auto Red COA ID	Space IPB Generation Support	Satellite Database & Statistics	Satellite Failures Database	Space INTEL Tasking Prioritization	Space Blue COA Generator	Space Control Scenario
FLTC #1	**Anticipatory Command, Control and Intelligence (C2I)**								
PS 1.1	Discover Threatening Systems & Objects	X	X	X	X	X	X		
TC 1.1.4	Define the behavior of potential threat entities	X	X	X	X	X	X		X
TC 1.1.5	Assessment of both current and most likely future situations	X	X	X	X	X	X		X
PS 1.2	Predict Adversary Behaviors	X	X	X	X	X	X		X
TC 1.2.1	Development of expected futures, their impacts and potential threats	X	X	X	X	X	X		X
TC 1.2.2	Identifying decision/leverage points for center of gravity analysis		X	X	X	X	X	X	X
TC 1.2.3	Generating and evaluating outcomes		X	X	X	X	X	X	X
TC 1.2.4	Visualization methods of adversary models of future states		X	X					
TC 1.2.5	Ensuring awareness of adversary deceptive behaviors	X	X	X	X	X	X		X
PS 1.3	Perform Near Real-Time Decision Management	X	X	X	X	X	X	X	
TC 1.3.1	Generating multiple courses of action		X	X			X	X	
TC 1.3.5	Generate nondeterministic, nonlinear causal linkages under ambiguous conditions	X	X	X	X	X	X	X	
TC 1.3.9	Develop automated target development and weaponeering tools	X	X	X	X	X	X	X	
FLTC #2	**Unprecedented Proactive Intelligence, Surveillance and Reconnaissance (ISR)**								
PS 2.3	Assure Closed-Loop C2ISR Sensing and Processing (anticipatory)	X	X	X	X	X	X		
TC 2.3.1	Accurately detecting all space objects	X	X	X	X	X	X		
TC 2.3.4	Exquisitely characterizing all high-value objects for vulnerability assessment	X	X	X	X	X	X	X	
PS 2.6	Provide Comprehensive Space Situational Awareness	X	X	X	X	X	X		
TC 2.6.2	Timely understanding of newly launched space objects & change/threat detection	X	X	X	X	X	X		
TC 2.6.3	Comprehensively characterizing and assessing all space objects	X	X	X	X	X	X		
TC 2.6.5	Collaborative tools for integration of multisensor space object recognition	X	X	X	X	X	X		
FLTC #5	**Assured Operations in High-Threat Environments**								
PS 5.2	Detect and Defeat Threats Through Defenses	X	X	X	X	X	X		
TC 5.2.2	Identifying, characterizing, and reporting all spacecraft threats and/or attacks	X	X	X	X	X	X		

PS = Problem Statement

TC = Technology Challenge

Tool Development Focused On Satisfying War-Winning Requirements

Proposed SWAT Future Developments

- **Evolve Most Threatening Regions of Space Displays (SAW)**
  - Develop Delta-V vs. Transit Time Maps
  - Display Non-RPO Attack Modes (Iridium 33 vs. Cosmos 2251)
  - ✓IMPACT: Increased Ability to Predict Space Attacks, & Help Prevent Terrestrial War; Also, Better Optimized Tasking of INTEL Sensors
- **Expand SWAT Space Game Developments**
  - Develop Lists of Best Red Space Attack Strategies Assuming Certain Types of Weapon Systems
  - Determine the INTEL Indicators of These Types of Attacks
  - ✓IMPACT: Increased Ability to Predict Red Space Intentions, & Help Prevent Terrestrial War; Also, Better Optimized Tasking of INTEL Sensors
- **Auto Space Missile Launch Identification**
  - Adapt Proven SWAT State Change Algorithms to Automatically Predict Satellite Launch Times & Missions Using SIGINT Data
  - ✓IMPACT: Automated Space Launch Typing Allows Faster Threat Mitigation Timelines Translating to Better War-Winning Space Strategies

Small Investment Leveraged Into War-Winning Space Control / SSA Battle Management