# Space Strategies Center

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# SWAT

# Space Warfare Analysis Tools

## - Future Space Strategies -

### "The Mother of All Space Strategy Briefings"

**22 July, 2013**

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

# Outline (1)


① Why SWAT (24 Slides)

② SWAT Tools Summary (3 Slides)

③ Space Doctrine & Strategy (52 Slides)

- Space Principles of War (10 Slides)
- Space Escalation Ladder (2 Slides)
- Space Strategy Sequence (12 Slides)
- Space Strategy Tempo (5 Slides)
- Space Strategies (COA's) (14 Slides)
- Space Centers Of Gravity (9 Slides)
- Space INTEL Indicators (2 Slides)
- Space Objectives (2 Slides)

# Outline (2)

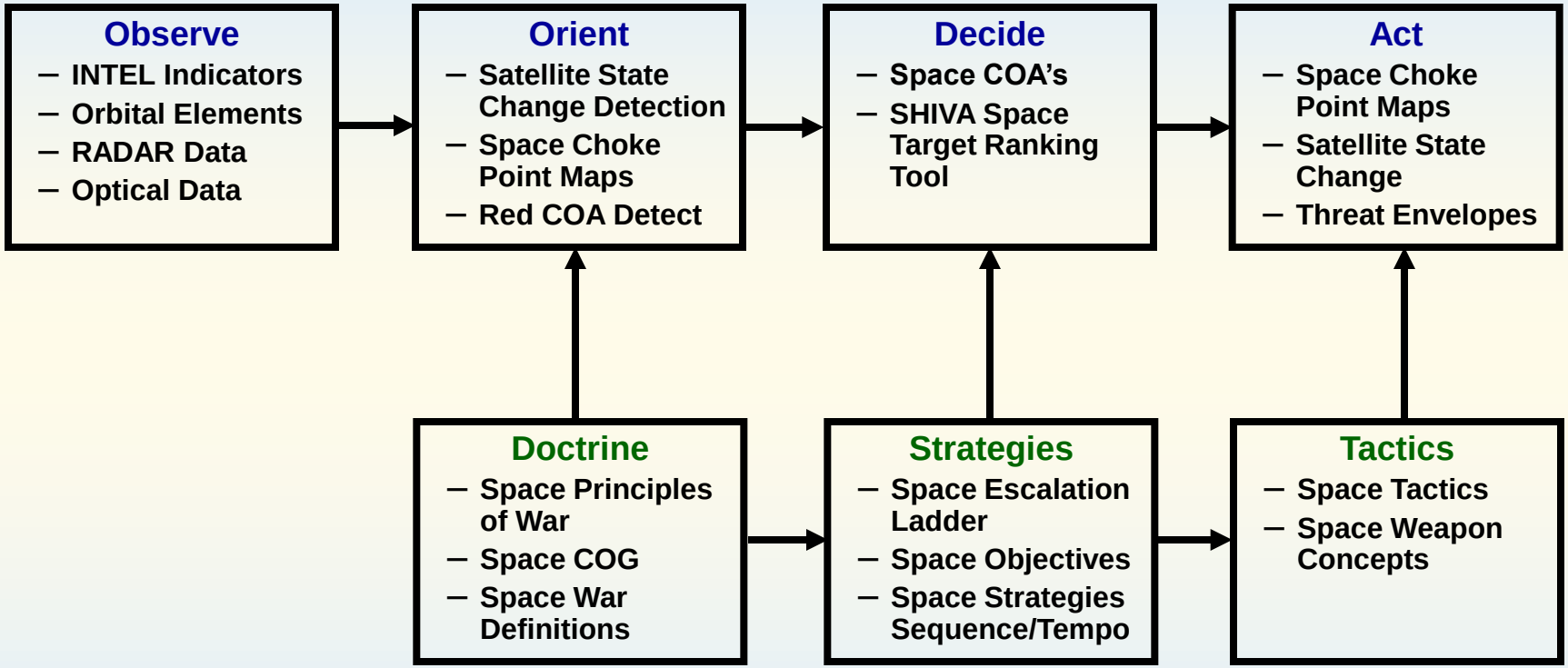
④ Space Warfare Definitions (5 Slides)

⑤ Satellite Attack Warning (SAW) Choke Point Displays (35 Slides)

⑥ Space Tactics (74 Slides)

This Brief Is an Encyclopedia for Space Warfare

# SWAT Logic Flow




**SWAT Products Listed Inside Boxes**

**SWAT Provides an Integrated Space Warfare Conceptual Framework**

# SWAT Purpose

- **Develop Original Space Warfare Doctrine, Strategies, Tactics, Concepts & Tools Supporting Future Combat Operations**
- **SWAT Will Support Answering the Following Questions:**
  - **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?**
  - **What Is Optimal Blue Response?**

**Provides a "Unified Field Theory" for Space Warfare**

# Why SWAT?

❶ Predict Space Attack

❷ Timely Attack Response

❸ Win Space Battle

**Predict Future Space Combat Principles**

# Source of Concepts

- Principal Investigator – (Dr. Strangelove of Space)
- 35 Years of Continuous Experience in Space Warfare
  - Space Command & Control (SPADOC 3+)
  - Space Surveillance (5 Architecture Studies)
  - Space Systems Survivability
  - Weapon Systems
  - Space Exercises (12)
- 800 Military History Books In Personal Collection
- Reviewed 55 Doctrine Docs, Joint Pubs, Air Force Glossaries, Air Force Instructions, Air Force Pamphlets, Army Field Manuals, National Defense University Handbook, & Multiservice Procedures
- Particular Interest In Translating Terrestrial Warfare Concepts to Space Operations – From Ancient Sumerian Warfare to the Future

# Fundamental Space Threats-1

- **World Has Not Yet Experienced a Full-Out Space War**
- **Difficult to Assess What the Likely Conditions, Battlefield Tempo, Strategies & Tactics Would Underlay a Future Space Conflict**

**Space Warfare Future is Unknown**

# Fundamental Space Threats-2

- **Despite Best Efforts at INTEL Collection, Many Historical Examples of Surprise Attack**
  - **Pearl Harbor**
  - **Battle of the Bulge (in Spite of 11,000 Ultra Message Decryptions Indicating Buildup of Major German Forces for Attack)**
  - **Yalu River in Korea**
  - **Most Israeli-Arab Conflicts**
- **Due to the Distances Involved in Space & Unmanned Nature of the Environment, Surprise Attacks in Space Can Only be Even More Difficult to Detect**

**Surprise Attacks In Space Will Occur**

# The Value of Surprise

- **National Defense University Study:**
  - **Analysis of 16 Major Conflicts in 20th Century**
  - **138 Cases of Surprise Attacks Assessed**

- **Study Results**
  - **Without Surprise - 1 : 1.7 Casualty Ratio**
  - **With Surprise - 1 : 14.5 Casualty Ratio**

# Fundamental Space Threats-3

- **Many New Weapon Technologies Provided Considerable Advantages to Their First User**
  - **Catapult vs. Greek Fortifications**
  - **Cannon vs. Castle Walls**
  - **Crossbow vs. Shield**
  - **Musket vs. Body Armor**
  - **Tank vs. Machine Gun**
  - **Shaped-Charge vs. Bunker**
  - **Airplane vs. Battleship**
- **More Than Likely the Side That First Employs Offensive Weapons Against Space Systems Will "Win" the Space War, & Unbalance US & Allied Use of Space Systems to Support the Terrestrial Battlefield, at Least Over the Short Duration of Any Probable Future Major Conflict.**

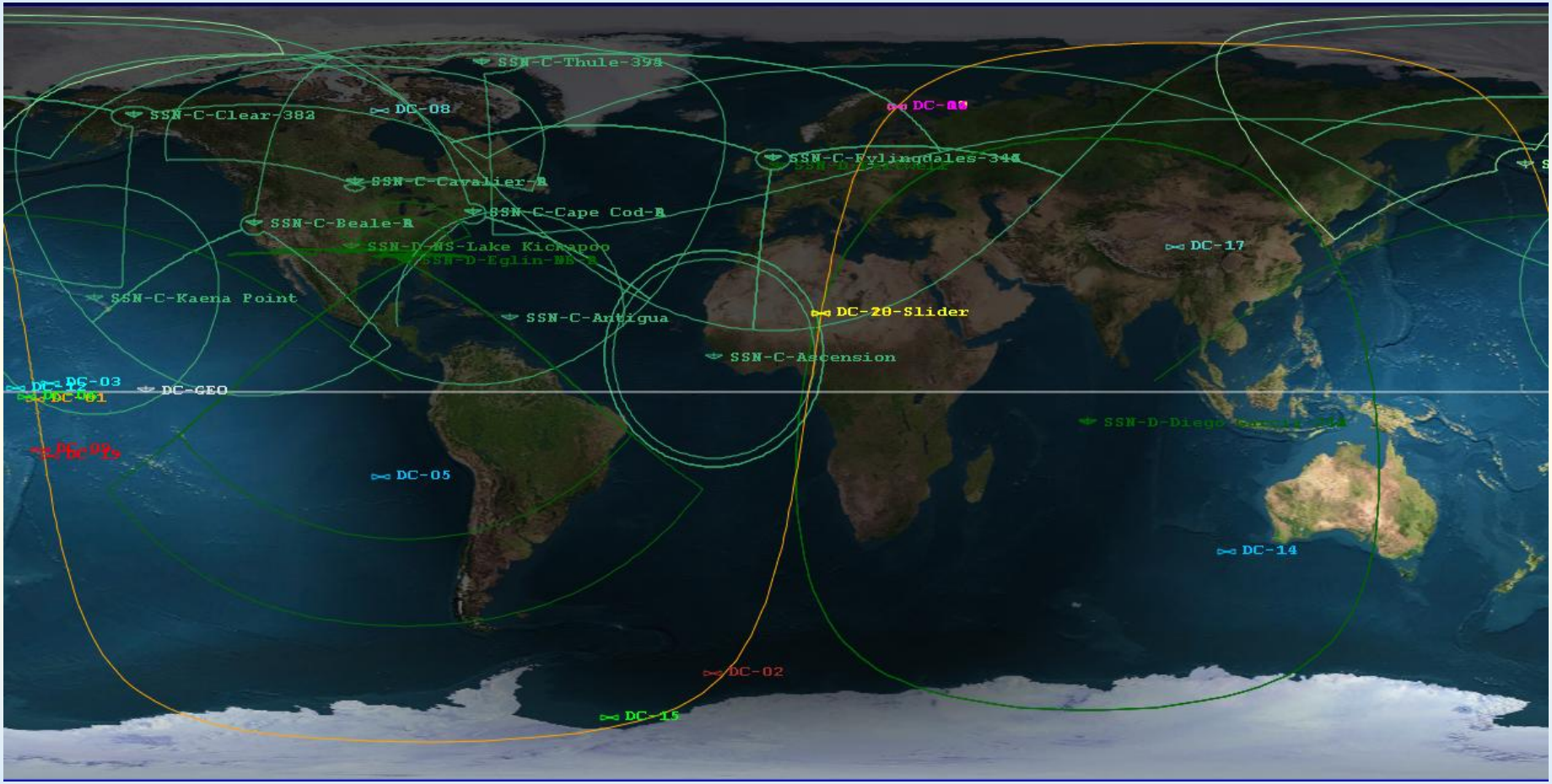
**Side That Attacks First In Space Will Win???**

# Fundamental Space Threats-4

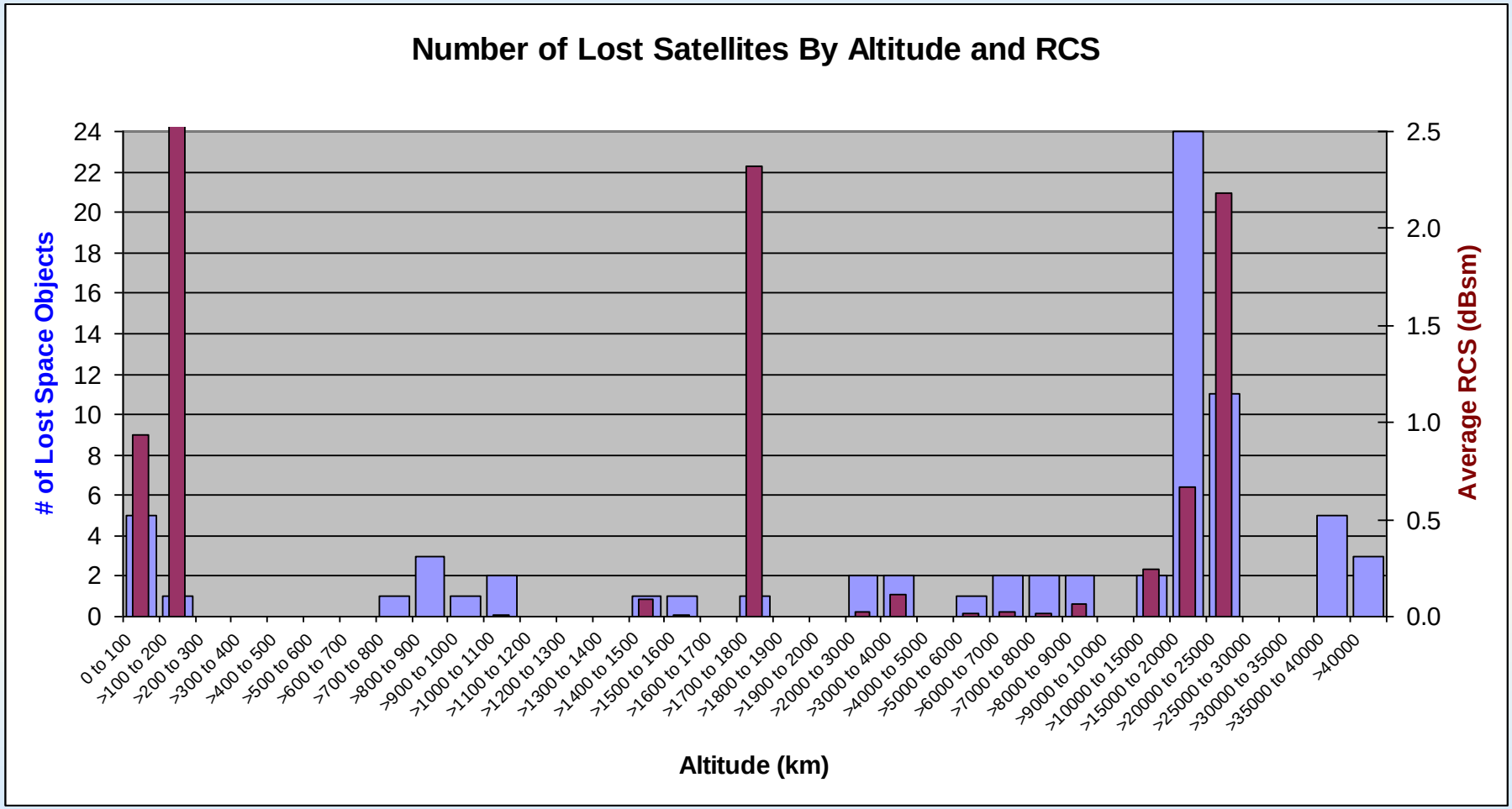
- **Space Objects Playing "Dead"**
  - **"Spent" Stages & Boosters**
    - **Large Volume Objects**
    - **Many Have Completed ½ of Hohmann Transfer**
    - **Natural Perturbations of Orbit Come "Close" (Low Delta-V & Transfer Time) to Many Critical US Satellites**
    - **These Space Objects Are Not Frequently Tracked**
      - **Can Be a Mother Ship for Space Mines that Maneuver Outside of Space Surveillance Coverage Zones**
      - **Low or No Space Surveillance Coverage: Southern Hemisphere; Poles; Equatorial LEO (Intersects All LEO Satellites)**

**Easy to Conduct Surprise Attacks In Space**

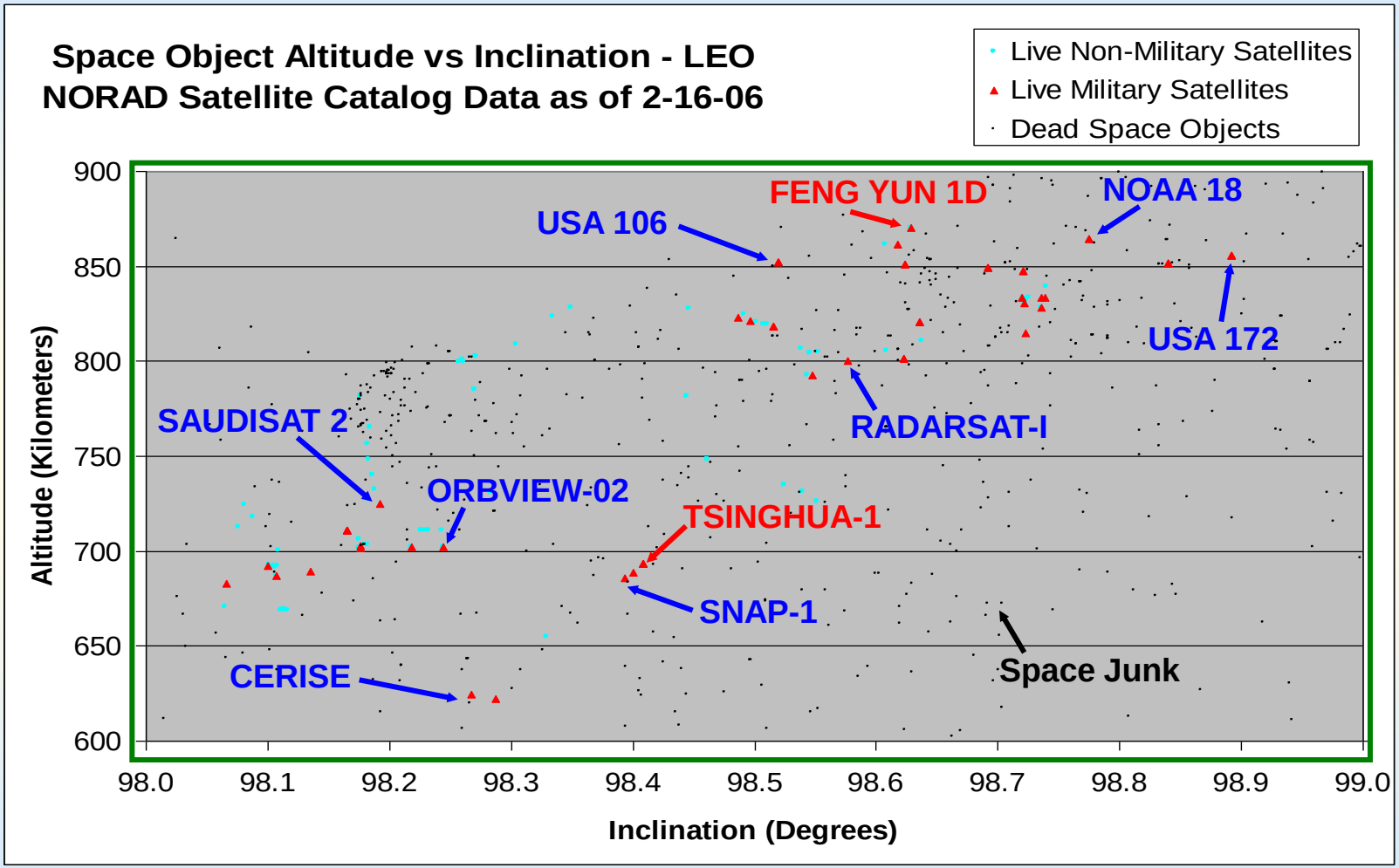
# Current Space Surveillance Network



# NORAD Catalog Missing Space Objects



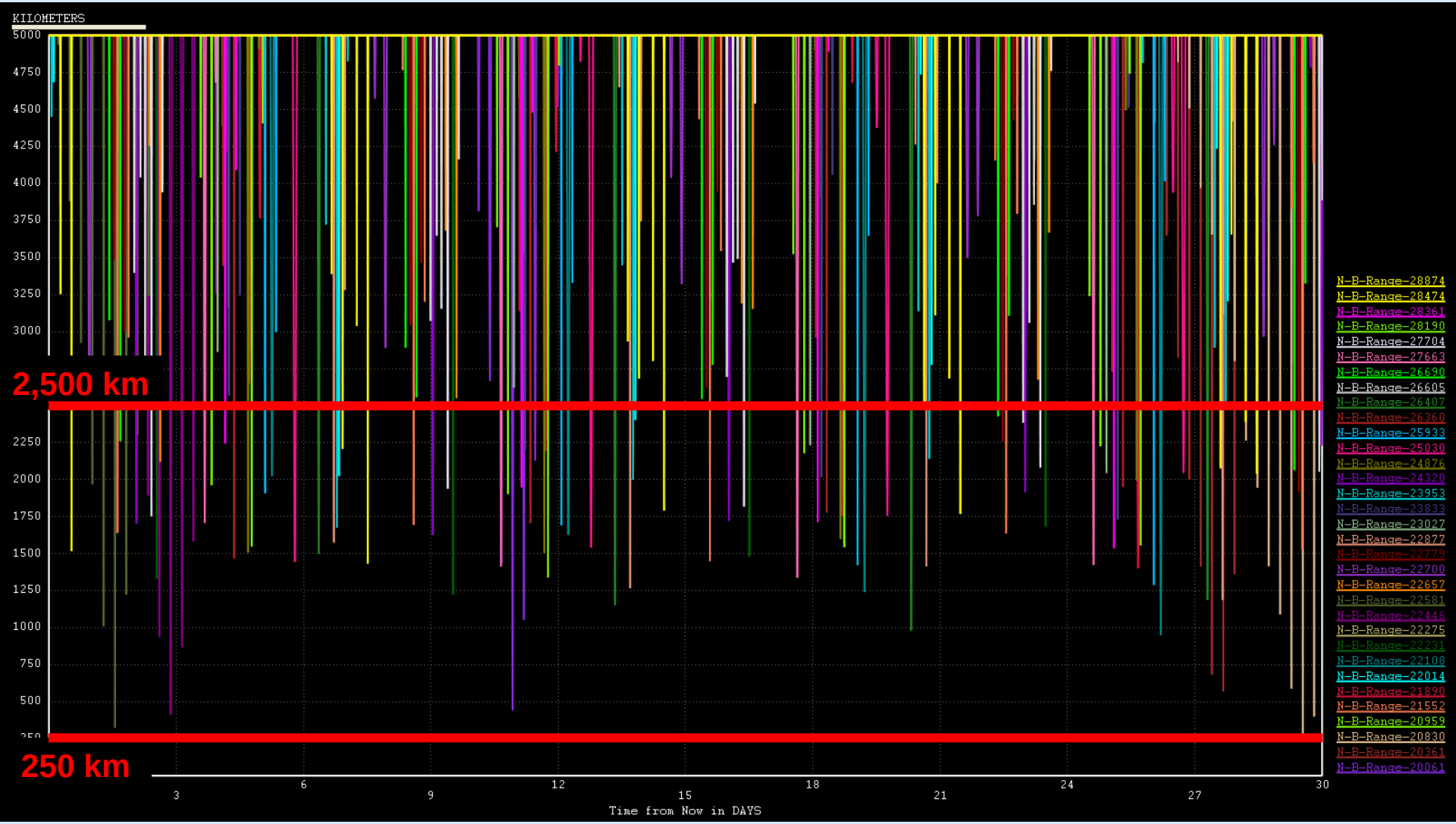
# Space Choke Points




Hohmann Maneuver Envelope at 100 M/Sec Delta-V

**There are Many Potential Sources of Attack**

# Beidou - MEO


KILOMETERS
5000
4750
4500
4250
4000
3750
3500
3250
3000
2,500 km
2250
2000
1750
1500
1250
1000
750
500
250 km
3
6
9
12
15
18
21
24
27
30
Time from Now in DAYS
N-B-Range-28874
N-B-Range-28474
N-B-Range-28361
N-B-Range-28190
N-B-Range-27704
N-B-Range-27663
N-B-Range-26690
N-B-Range-26605
N-B-Range-26407
N-B-Range-26360
N-B-Range-25933
N-B-Range-25030
N-B-Range-24876
N-B-Range-24320
N-B-Range-23953
N-B-Range-23833
N-B-Range-23027
N-B-Range-22877
N-B-Range-22773
N-B-Range-22700
N-B-Range-22657
N-B-Range-22581
N-B-Range-22446
N-B-Range-22275
N-B-Range-22231
N-B-Range-22108
N-B-Range-22014
N-B-Range-21890
N-B-Range-21552
N-B-Range-20959
N-B-Range-20830
N-B-Range-20361
N-B-Range-20061

# Paul's Favorite ASAT's (1)

- **Double The Trouble**
  - **Direct Ascent ASAT Has Two KKV's**
  - **2nd KKV Holds Back In Reserve In Case 1st KKV Fails**
  - **If 1st KKV Succeeds, 2nd KKV Hides In Debris Cloud for a Few Days, & Then Maneuvers Away When Over the Poles**

**Many Terrestrial Attacks Use Multiple Weapons Against the Same Target**

# Paul's Favorite ASAT's (2)

- **Hide & Seek**
  - Microsatellite ASAT Covertly Deployed From Multiple Payload Booster
  - ASAT Attaches Itself to Old Rocket Booster (1960's?) & Drifts With It for Years
  - When Natural Orbital Perturbations Bring Junk Booster Within Range, ASAT Maneuvers Close to Target
  - ASAT Uses Smart Attitude to Steer Away Solar Glints From Earth
  - Old Space Junk Not Tracked Often, and Is of Little Interest to Satellite Inspectors (Burns Up Too Much Fuel to Visit)

**Space Attack Will Come "Out of the Blue"**

# Paul's Favorite ASAT's (3)

- **Shot Out of the Blue**
  - **Region of Space Between Geosynchronous Orbit & the Moon Is Not Routinely Monitored (Lagrangian Points?)**
  - **At Very High Altitudes, Very Little Delta-V Required to Make Large Changes in Inclination / Altitude**
  - **Unobserved ASAT Forces Can Make a Surprise Attack on GEO Belt**

**He Who Controls the Lagrangian Points Rules the World?**

# Paul's Favorite ASAT's (4)

- **Equatorial Cutter**
  - **Region of Space at Low Inclinations and Low Altitude (LEO) Is Not Routinely Monitored**
  - **All LEO Satellites Pass Through This Region**
  - **ASAT System Based In This Region Has Access to Many LEO Satellites, But Is Not Easily Tracked (Never Passes Through Space Fence)**
  - **ASAT Uses Glancing Attack Methodology (Same As Iridium vs. COSMOS Collision)**

**He Who Controls the Equatorial Belt Rules the World?**

# Paul's Favorite ASAT's (5)

- **Space Flyer**
  - **Constantly Thrusting ASAT Confuses Space Surveillance Tracking Network**
  - **Difficult to Determine What It Is, Who Owns It, Where Did It Come From, Where Is It Going**
  - **GOCE Earth Resources Satellite Already In Orbit Will Be Continuously Thrusting for 20-30 Months**

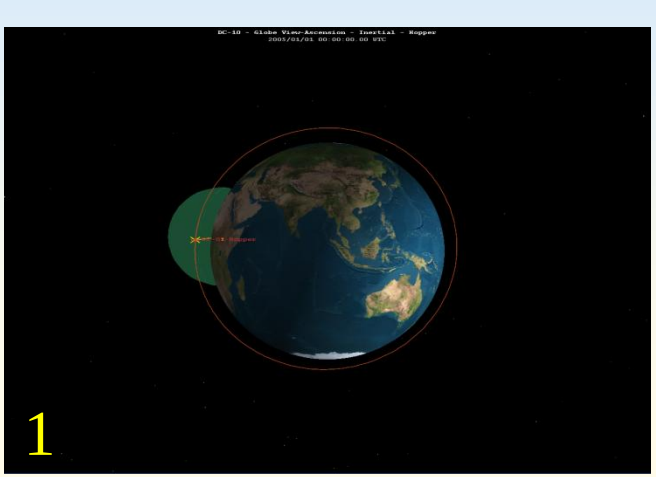
**Space Attacks Do Not Have to Follow Classical Orbital Dynamics**

# Paul's Favorite ASAT's (6)

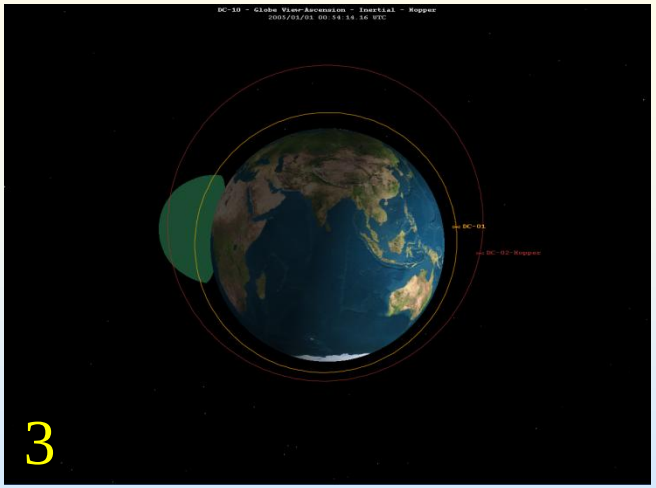
- **Pixie Dust**
  - **Electrostatically Charged Small Pieces of Fiber Optic Strands Are Sent Towards Target Satellite's Star Sensors**
  - **Satellite Attitude Algorithms Would Be Confused By Multiple Glints From Solar Reflections & May Tumble the Satellite**

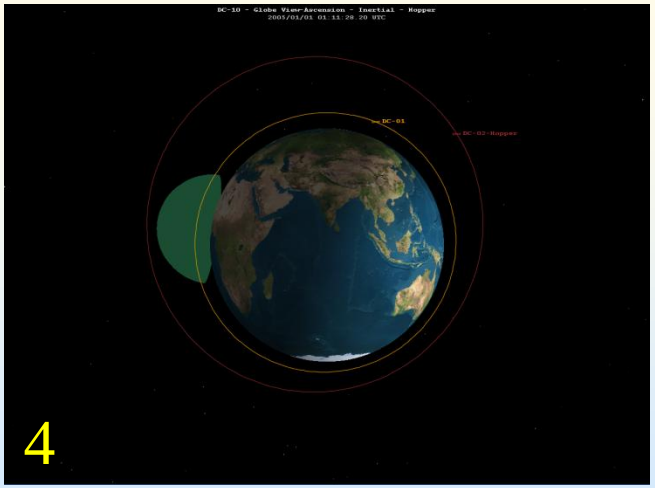
**Satellites Not Designed for Unusual Circumstances**

# Avoid Space Radar - Hopper

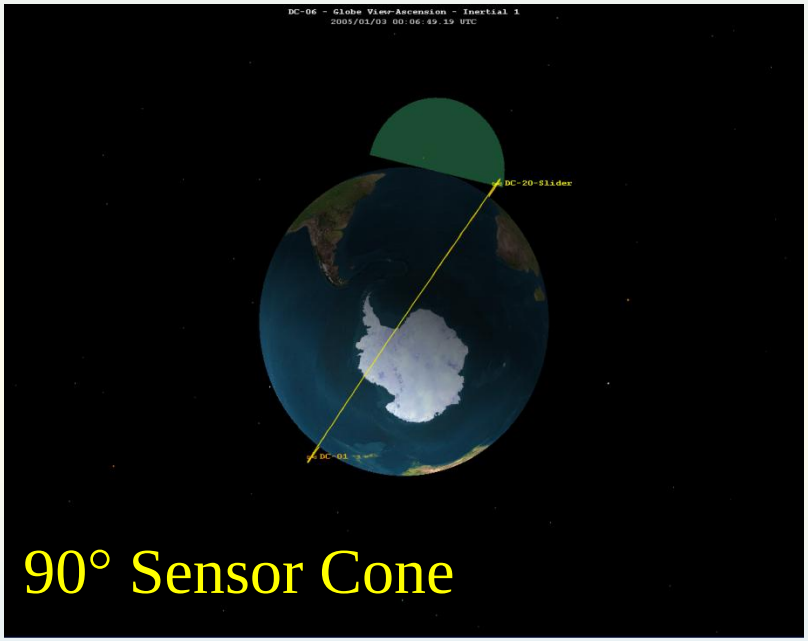




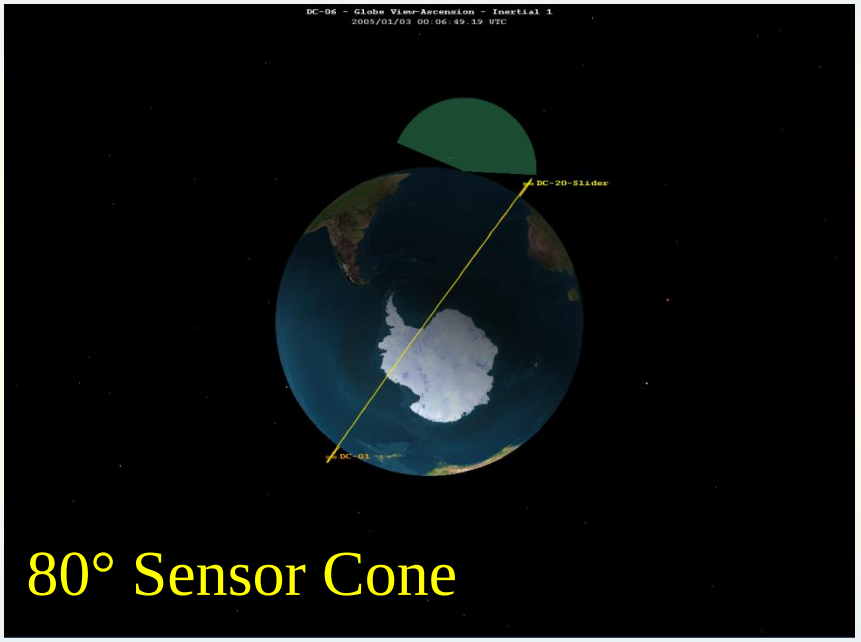


# Avoid Space Radar - Slider

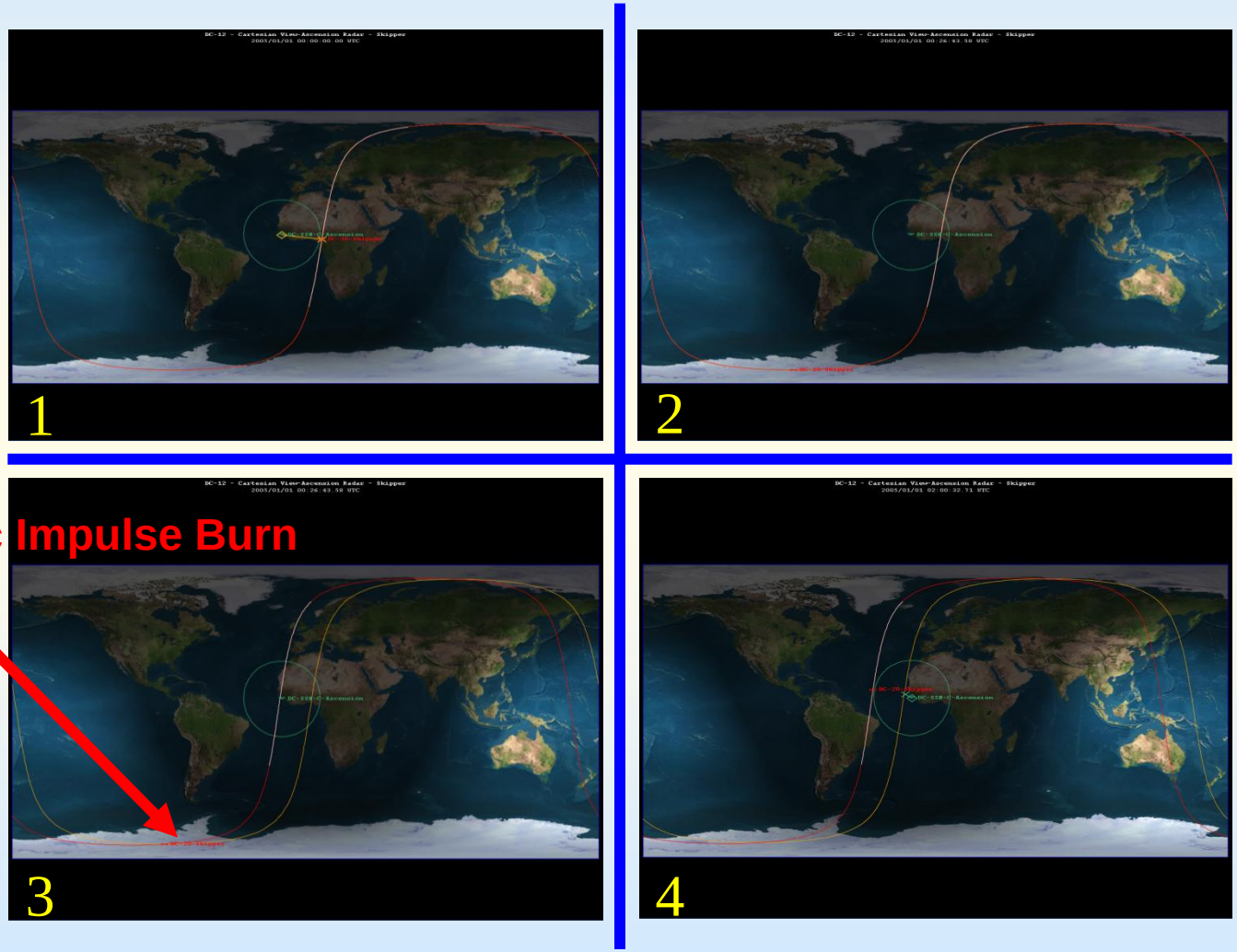



90° Sensor Cone

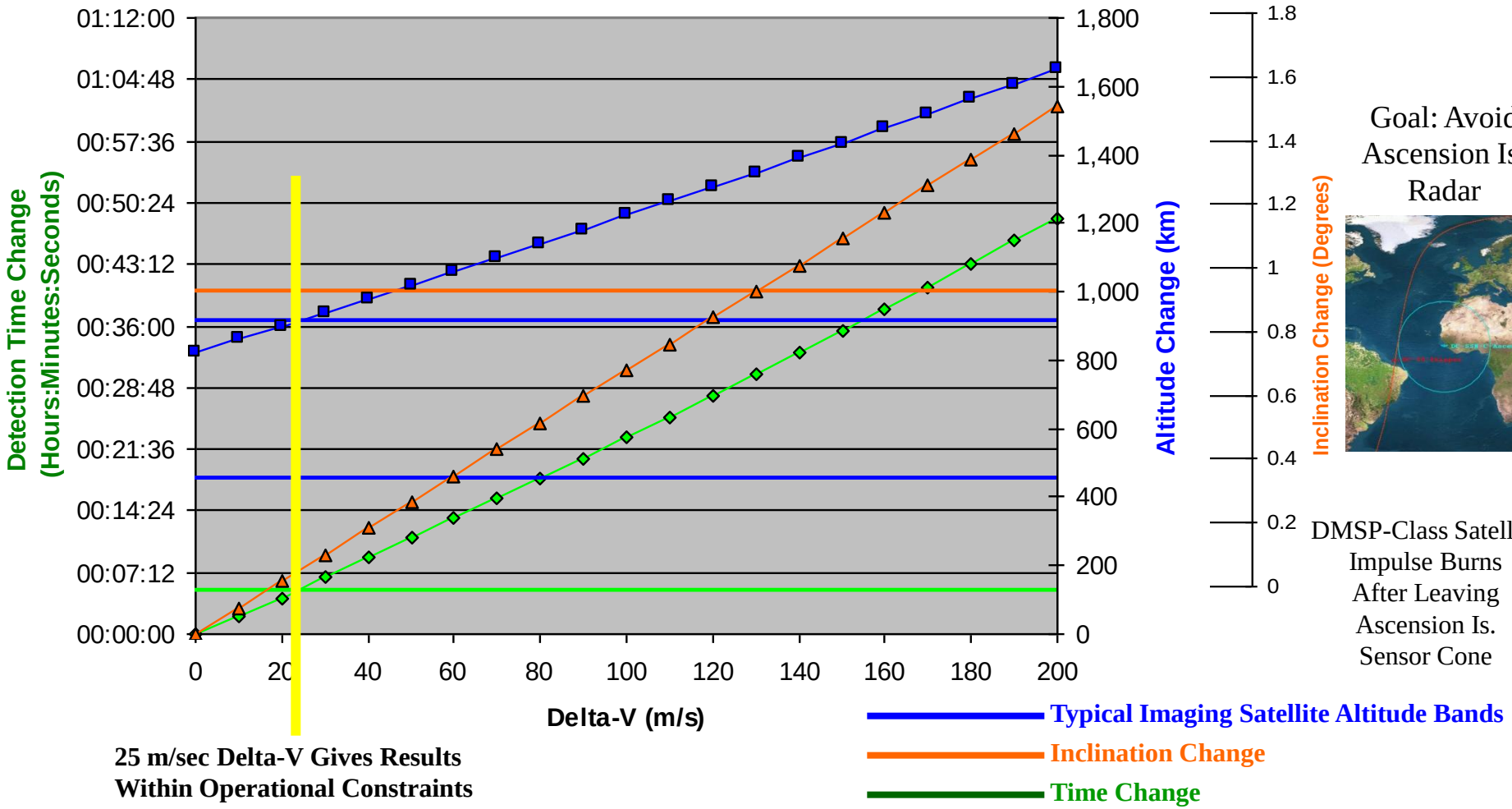



80° Sensor Cone

# Avoid Space Radar - Skipper

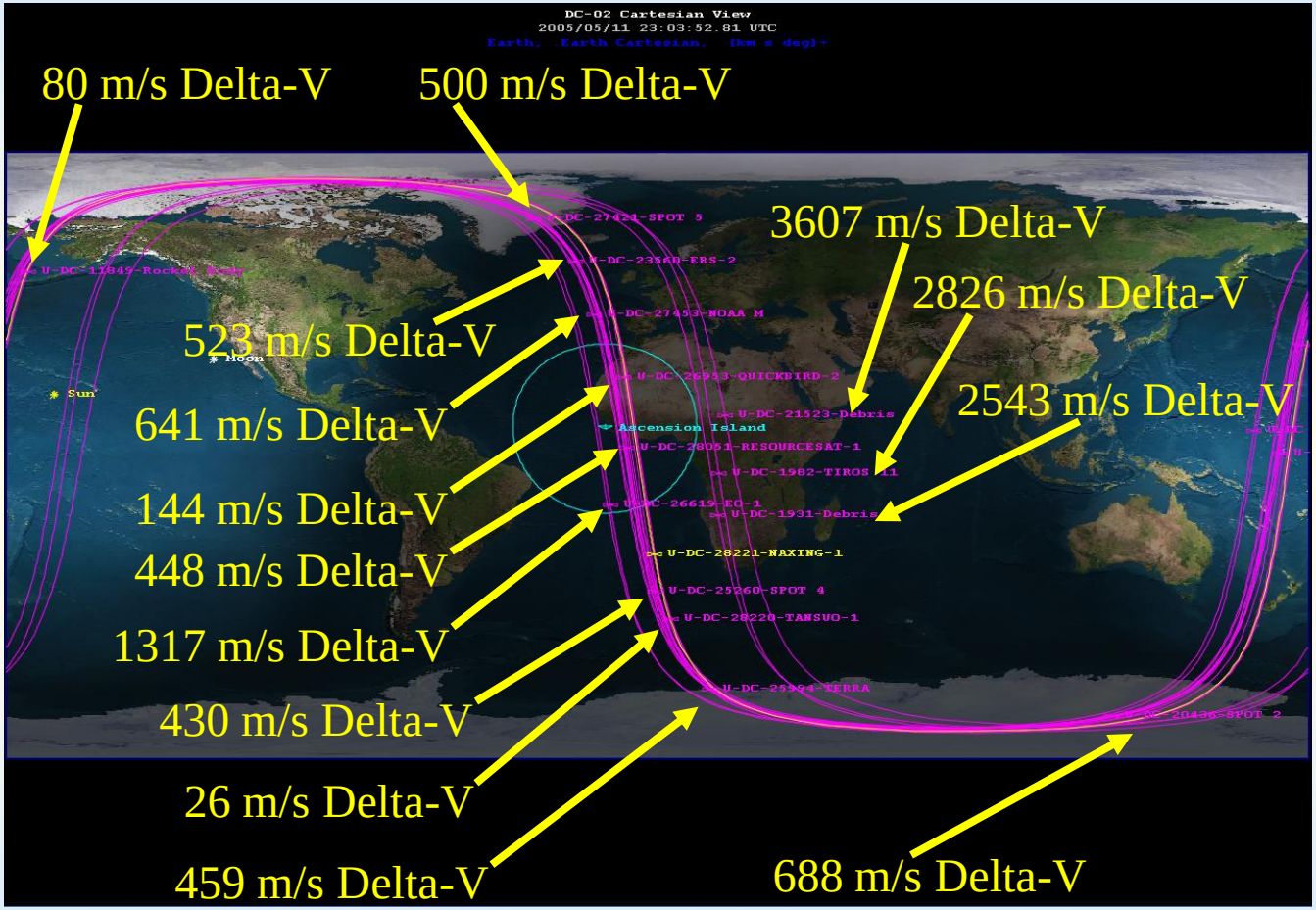


# One Impulse Maneuver Effects




**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**

# Issues of Space Grand Strategy

- Offense vs. Defense
- Whomever Attacks First Wins?
- Types of Defense
  - Passive
  - Active
  - Reconstitution
  - "The Best Defense Is an Offense"
- Regions of Space & Time That Must Be Defended at All Costs (Space Choke Points?)
- Many Small Satellites vs. Large Battle Stations

**Only Robust Space Wargaming Can Begin to Solve Some of These Issues**

# SWAT Tools

# 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 (5,000)**
- View **Resolution Requirements (Space NIIRS)**
- View **Sensor Requirements Tracking Software**

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

# SWAT Tools Developed (3)

- View **Space Blue COA Support**
  - View Space Strategies Checklist
  - 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

**SWAT Supports Timely & Decisive Blue Courses of Action Generation**

# Space Doctrine & Strategies

# 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**

# Principles of War by Country

## PRINCIPLES OF WAR

| *UNITED STATES* | *GREAT BRITAIN AUSTRALIA* | *FORMER SOVIET UNION "Principles of Military Art"* | *FRANCE* | *PEOPLE'S REPUBLIC OF CHINA* |
|---|---|---|---|---|
| Objective | Selection & Mainte-nance of Aim | | | Selection & Mainte-nance of Aim |
| Offensive | Offensive Action | | | Offensive Action |
| Mass | Concentration of Force | Massing & Correlation of Forces | Concentration of Effort | Concentration of Force |
| Economy of Force | Economy of Force | Economy, Sufficiency of Force | | |
| Maneuver | Flexibility | Initiative | | Initiative & Flexibility |
| Unity of Command | Cooperation | | | Coordination |
| Security | Security | | | Security |
| Surprise | Surprise | Surprise | Surprise | Surprise |
| Simplicity | | | | |
| | Maintenance of Morale | Mobility & Tempo, Simultaneous Attack on All Levels, Preservation of Combat Effectiveness, Interworking & Coordination | Liberty of Action | Morale, Mobility, Political Mobilization, Freedom of Action |

Adapted from JT Pub 1, FM 100-1, AFM 1-1, and FMFM 6-4

Figure D-1

# Space Principles of War (1)

- **Objective**
  - **Terrestrial:** *"Direct every military operation toward a clearly defined, decisive, and attainable objective with measurable effects"*
  - **Space:** Are your objectives to take out a satellite or a system capability that may be supported by both satellites and ground systems. Will taking out the satellite be decisive in denying that category of information. Does it have a measurable impact on the battlefield. Which military objectives does this system support. Is satisfaction of this objective achievable. Are there branches and sequels to space control operations plans if they fail or if they are successful.

# Space Principles of War (2)

- **Offensive**
  - **Terrestrial:** *"Seize, retain, and exploit the initiative"*
  - **Space:** Is there political will to start a space war at the beginning of conflict and seize the space initiative, or is taking out ground sites supporting space sufficient to achieve objectives. Are we setting the time, place and terms of the space battle. Does the battle tempo include space attacks on a continuing basis to keep the adversary off-balance. Can space weapons sustain continuous attacks. Is there a pre-approved ramp-up of space attack severity to exploit successes for further gain.

# Space Principles of War (3)

- **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 Principles of War (4)

- **Economy of Force**
  - **Terrestrial:** *"Employ all combat power available in the most effective way possible; allocate minimum essential combat power to secondary efforts"*
  - **Space:** Are all space control efforts and weapon systems integrated into one deployment/employment plan. Is the target list optimal with minimal weapons use. Are different phenomenology weapons use integrated. Are the results of space control decisive to the battlefield. Are all space control systems employed purposefully at all times of the conflict, even in delay, limited or deceptive kinds of attack that focus the adversary's attention away from the main space attack.

# Space Principles of War (5)

- **Maneuver**
  - **Terrestrial:** *"Place the enemy in a position of disadvantage through the flexible application of combat power"*
  - **Space:** Have space weapons been deployed in optimal positions and time-space phasing. What is the effect on the adversary of weapons use. Has the "high ground" of space above the battlefield been won. Are there critical orbits/time phasing/launch corridors/communications paths around the world contributing to the battlefield that need space superiority consideration. Has access to space been denied to the adversary & its allies, and optimized for blue side & allies. Has blue freedom of action been maximized while minimizing red freedom of action in space. Are points of application of space control weapons constantly shifted to confuse adversary response, and avoid predictable patterns of operation, for survivability reasons.

# Space Principles of War (6)

- **Unity of Command**
  - **Terrestrial:** *"For every objective, seek unity of command and unity of effort"*
  - **Space:** Have space control, info war, and air/ground attack plans been integrated with each other and with intelligence collection requirements. Does the "classic" target allocation process give sufficient consideration of space/info targets. Is there adequate space/info war delineation of chain of command and decision responsibility. Are space target lists traceable back to objectives (both red and blue). Do blue and red commanders appreciate the importance of space to their conduct of the war.

# Space Principles of War (7)

- **Security**
  - **Terrestrial:** *"Never permit the enemy to acquire unexpected advantage"*
  - **Space:** Are space forces, including weapon systems, survivable in the battlefield environment. Have OPSEC and fratricide concerns been met. Have blue space choke points (orbits/time phasing/launch corridors/communications paths), centers of gravity (TT&C and launch sites), logistics, and command structures been identified and protected. Does blue have alternative space-related sensor, processing, command, and communications paths. Are red space strategy, tactics, doctrine, organization, and intentions assessed.

# Space Principles of War (8)

- **Surprise**
  - **Terrestrial:** *"Strike the enemy at a time or place or in a manner for which he is unprepared"*
  - **Space:** Are space control weapons existence known to an adversary, or does he know they have been deployed to the theater, or do they have war operating modes to surprise the enemy by their use. Are there a series of surprise space control weapons that can be alternated in use to maintain cover. Is the use of these weapons detectable or attributable to a specific country by an adversary. Timing and tempo of space weapon use can surprise also, even if their existence is known. Threat of weapon use, even if does not exist, can effectively surprise.

# Space Principles of War (9)

- **Simplicity**
  - **Terrestrial:** *"Prepare clear, uncomplicated plans and concise orders to ensure thorough understanding"*
  - **Space:** How complex are space weapons, and are the effects of their use easily understandable by non-space blue and red commanders (do they know they've been hurt bad). Are there branches and sequels to space control operations if they fail or if they are successful.

# Other Considerations (1)

- Combined Arms
  - Space vs Terrestrial Attack
  - Delay vs Kill Effects
  - Deterrence vs Employment
  - Covert vs Overt Weapons
- Balance
  - Offense vs Defense

# Other Considerations (2)

- **Political Sensitivity**
  - **Laws of Armed Conflict**
  - **Space Treaties**
  - **Public Perception**
- **Rules of Engagement**
- **Space Includes Both Position (Orbits) and Time - Impacts Attack Tempo**
- **Space Attack Phase of Conflict**
  - ***Would space attack in the pre-conflict phase deter the start of the conflict***

# Gradations of Space Control

① **Deter**
- **Pre-Conflict**
- **Trans-Conflict**

② **Deceive**

③ **Deny**

④ **Disrupt**

⑤ **Degrade**

⑥ **Destroy**

# Space Conflict Levels

① Peacetime

② Crisis

③ Covert Military Actions

④ Overt Military Actions

⑤ Reconstruction/Reconstitution

# 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 Weapon; Treaty; Saber Rattling; Space Alliances |
| P.1.B.0 | Pre-Conflict | Phase 0: Pre-War Buildup (Shape) | 1st Wave Attacks Phase B | Persuade | 1st Wave Attacks Phase B - Pre-Conflict Persuade | Diplomatic Request; Economic Action; Legal Action; Administrative Action |
| P.1.C.0 | Pre-Conflict | Phase 0: Pre-War Buildup (Shape) | 1st Wave Attacks Phase C | Hide | 1st Wave Attacks Phase C - Pre-Conflict Hide | Camouflage; Stop Activities; Mobility |
| P.2.A.0 | Trans-Conflict | Phase I: Deployment / Deterrence (Deter) | 2nd Wave Attacks | Trans-Conflict Deter | 2nd Wave Attacks - Trans-Conflict Deter | Linked Attack; Demo Attack; Alternate Country Attack; Covert Attack |
| 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 |
| 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 |

**Space Actions May Be Conducted Pre-Conflict**

# Space Escalation Ladder (Cont.)

| WBS | Conflict Phase | Terrestrial Campaign Phase | Space Campaign Phase | Weapon Type | Space Campaign Phase Full Name | Weapon Category |
|---|---|---|---|---|---|---|
| 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 Civil Authority) | 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 Civil Authority) | 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 | 5th Wave Attacks - Space-Manned Permanent Kill | Degrade, Destroy |
| 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 Request; Economic Action; Legal Action; Administrative Action |

**Space Provides Finer Gradations & Thus Better Control During Conflict Escalation**

# Space Strategy Sequence

① Deter (Pre-Conflict)

② Persuade

③ Confuse

④ Deter (Trans-Conflict)

⑤ Protect

⑥ Deny Space Force Enhancement

⑦ Deny Space Support

⑧ Destroy Space Infrastructure

⑨ Space-Supported Reconstruction

# Space Strategy Sequence (1)

## ① Deter (Pre-Conflict)

- Overt Weapon
  - Demonstrated Capability
  - Can Be Secretly Linked To Covert
- Space Treaty Allows
  - Embargo Gray Country Space Support
    - Jam
    - Blind
  - Destruction of Threatening Space Systems
- Saber Rattling
- Space Mutual Defense Alliances

# Space Strategy Sequence (2)

② **Persuade**

- **—Diplomatic Request**
- **—Economic Action**
- **—Legal Action**
- **—Administrative Action**
  - **Turn-Off Own Systems**

# Space Strategy Sequence (3a)

## ③ Confuse

- **—Hide**
  - **Passive**
    - **—Camouflage**
    - **—Cease Activities When Sensor Is Overhead**
    - **—Move Out of the Way of Sensor**
  - **Active**
    - **—Jam**
    - **—Blind**

# Space Strategy Sequence (3b)

## ③ Confuse (Continued)

- Change Adversary Confidence
  - Covertly Disrupt Space Systems
    - Adversary Can't Trust the Reliability Or Validity of His Space Systems
- Change Adversary Perceptions
  - Make Blue Side Look Bigger Than They Are
    - Fake Forces
    - Blind Sensors Where No Forces Exist
  - Make Red Side Look Smaller Than They Are
    - Adversary Can't Determine Location & Status of His Own Forces
    - Convince Adversary Future Space or Terrestrial Weather Is Not Favorable for Attack

# Space Strategy Sequence (4a)

## ④ Deter (Trans-Conflict)

- **Linked Attack**
  - Declare That Use of Gray/Red Space Assets Will Precipitate Attack On Terrestrial Systems
- **Demo Attack**
  - Destroy Derelict Space System To Show Real Space Control Capability & Willingness To Use It
    - Covert Space Control Capability Can Actually Be Used To Cover for Weak Overt Capability

# Space Strategy Sequence (4b)

## ④ Deter (Trans-Conflict, Continued)

- **Alternate Country Attack**
  - Destroying Red Space Systems Deters Gray From Supporting Red
- **Covert Attack**
  - Red/Gray Space Systems Temporarily Stop Working, Even Though Blue Does Not Admit Attack, The Message Is Clear

# Space Strategy Sequence (5)

## ⑤ Protect

- —Passive
  - Harden
  - Maneuver
  - Hide
- —Active
  - Deny Adversary Space Control Capability
    - —Deny Terrestrial Space Control Capability
    - —Deny Space-Based Space Control Capability

# Space Strategy Sequence (6)

⑥ **Deny Space Force Enhancement**

- —Deny Imagery Info
- —Deny Weather Info
- —Deny Navigation Info
- —Deny Missile Warning Info
  - If Within Rules of Engagement
- —Deny Communications

# Space Strategy Sequence (7)

## ⑦ Deny Space Support

- —Deny Access To and From Space
  - Deny Space Launch
  - Deny Space De-Orbit/Retrieval
    - —Space Planes
    - —Film Capsule Return
    - —Hijacked Satellite Parts
    - —Astronaut Return

# Space Strategy Sequence (8a)

## ⑧ Destroy Space Infrastructure

- Set Back Adversary Space Capabilities For Years To Come (Watch Out For Poisonous Materials)
  - Large Earth Terminals & Antennas
  - Launch Pads & Space Plane Airfields
  - Space Production Facilities
    - Rocket Fuel Production
    - Satellite Construction
    - Missile Construction
  - Space Design Facilities & Personnel

# Space Strategy Sequence (8b)

- ⑧ **Destroy Space Infrastructure (Continued)**
  - **Critical Utilities Leading to Space Facilities**
    - **Electrical Transmission Towers**
    - **Pipelines**
    - **Roads, Bridges, Tunnels & Passes**

# Space Strategy Sequence (9)

⑨ **Space-Supported Reconstruction**

- **Employ Space Assets for Allied/Red Post-Conflict Rebuilding**
- **Clean Up Space Debris?**

# Space Control Tempo (1)

❶ **Determine Most Vulnerable Blue/Gray Assets - Protect These**

- **Satellites**
- **Satellite Control/Receiver Sites**
- **Satellite Tracking Sites**
- **Space Weapons**
- **Terrestrial Non-Space Linked To Space Assets**
  - **Communications**
  - **Command**

# Space Control Tempo (2)

❷ **Determine Most Threatening Red/Gray Assets**

- **Satellites**
- **Satellite Control/Receiver Sites**
- **Satellite Tracking Sites**
- **Space Weapons**
- **Terrestrial Non-Space Linked To Space Assets**
  - **Communications**
  - **Command**

# Space Control Tempo (3)

❸ **Deter Red & Gray Use of Space Assets**

- **Space Escalation Ladder Control**
  - **Pre-Conflict**
  - **Trans-Conflict**
- **Blue May Not Want to Escalate Space War All the Way**
  - **Blue May Have More Space Assets to Lose Than Red**
  - **Blue May Force Red to Use Gray Space Assets, Which Blue May Be Self-Deterred From Attacking**
  - **Blue May Be Monitoring Red/Gray Space Assets for INTEL**

# Space Control Tempo (4)

- ❹ **Fix Space Assets Into Quiescent State Until Satellite Killers Are In Theater, On-Line, Targets Are Within Range & Employment Authorized**
  - **Satellites Cannot Get New Tasking, Re-Configure Into War Reserve Modes, Or Maneuver to Orbits Advantageous on Battlefield**
    - **Confuse/Deny TT&C and Tasking of Satellites**
    - **Confuse/Deny Data Down-Linked From Satellites**
    - **Confuse/Deny Command Centers Requesting Satellite Info**
    - **Confuse/Deny Communications Between Command Centers & Space Centers**

# Space Control Tempo (5)

- ❺ Employ Degrade/Destroy Space Control Weapons Where Authorized (ROE)

# Space Strategies (1)

**Title:**
*Sweep The Skies*

**Action:**
Destroy all Red satellites whether military, civil, or commercial, in a synchronized simultaneous attack so that Red protective/reconstitution measures cannot be implemented in time.

**Desired Effect:**
One large synchronized blow keeps red off balance.

# Space Strategies (2)

**Title:**
*Sweep The Ground*

**Action:**
Destroy all prime Red space-related ground targets with a minimum of collateral damage.

**Desired Effect:**
With all ground sites destroyed, satellites cannot be tasked or download data. Probably a more politically acceptable solution, but space-related ground sites can be replaced easier than satellites after the war, and data from Gray satellite systems can still be downloaded outside of Red country and transmitted into theater.

# Space Strategies (3)

**Title:**
*Periodic Degrade*

**Action:**
Use degrade type of weapons whose attack cycles are timed to correspond with the reconstitution or replacement time of that target's capability.

**Desired Effect:**
As Red starts to bring on-line an alternate space capability, it is negated. This minimizes space weapons employment, but does not have as much shock value as a *Sweep The Skies* attack.

# Space Strategies (4)

**Title:**
*Rolling Disrupt*

**Action:**
Temporarily disrupt Gray space assets for small lengths of time, then move on to other Gray assets. Use low probability of detection and attribution weapons. This will give the impression of reliability issues with Gray equipment, not intentional attack, and decrease confidence in Gray systems, while also making Gray countries suspicious of Blue willingness to disrupt, but they would not be able to absolutely prove this. This may also confuse Gray countries as to Blue strategies and intent for that Gray country, and deter their support for Red side.

**Desired Effect:**
Keep Gray side guessing as to the ultimate fate of their space systems if they continue to support Red side.

# Space Strategies (5)

**Title:**
*Herd COMM*

**Action:**
Selectively destroy or temporarily disrupt specific Red space systems communications assets so that critical Red sensor and C4 info gets directed to known paths that can be monitored by Blue sensors.

**Desired Effect:**
Make Red more vulnerable to intelligence exploitation.

# Space Strategies (6)

**Title:**
*Funnel COMM*

**Action:**
Selectively disrupt select Red space systems communications assets so that critical Red sensor and C4 info gets directed to communications paths with low data rates, effectively delaying receipt of critical data beyond its useful life.

**Desired Effect:**
Delay receipt of critical info while conserving space control weapons employment.

# Space Strategies (7)

**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 (8)

**Title:**
*Herd Sensors*

**Action:**
Temporarily deny Red space sensors, or only certain sensors. This will blind them, until they are allowed to use them again when Blue side wants them to observe certain fake Blue force dispositions. This directs Red sensors to see only what Blue side wants them to see.

**Desired Effect:**
Control Red perception of Blue strengths and battlefield situation.

# Space Strategies (9)

**Title:**
*Hidden Disrupt*

**Action:**
Employ weapons with low probability of detection and attribution, to minimize world reaction to Blue side counter space. Temporarily disrupt spacecraft operations at random times.

**Desired Effect:**
Red side loses confidence in his space systems. He is constantly kept off-balance by repeated disruption of his space capabilities – timed within his decision cycle times. Political implications of space control need not be addressed.

# Space Strategies (10)

**Title:**
*Hidden Negate*

**Action:**
Employ weapons with low probability of detection and attribution, to minimize Red perception that Blue has begun counter space operations. Slowly increase tempo of Red satellite disruption, starting with minor anomalies easily attributable to natural causes, and building up to major problems. This will make the Red side lose confidence in the operation and data associated with this space system, and will make it less suspicious when the satellite system is finally negated.

**Desired Effect:**
Red probably hasn't used space systems in a real conflict before, and their decreasing reliability under combat stress might be understandable and acceptable to them.

# Other Space Strategies (1)

- Blind Blue capabilities to observe the terrestrial battlefield
- Blind Blue capabilities to support 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
- Spoof Blue capabilities to support 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 surprise attacks on Blue space systems

# Other Space Strategies (2)

- Conduct diplomatic offensive to restrict Blue ability to employ ASAT's
- Actively defend key launch corridors and orbits critical to Red conduct of war
- Mass Red ASAT forces against high value Blue targets
- Preposition Red space assets to maximize their effectiveness at the start of the conflict
- Red exploits Blue space systems to Red advantage
- 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
- Deny Blue ability to use commercial and Gray space assets

# Other Space Strategies (3)

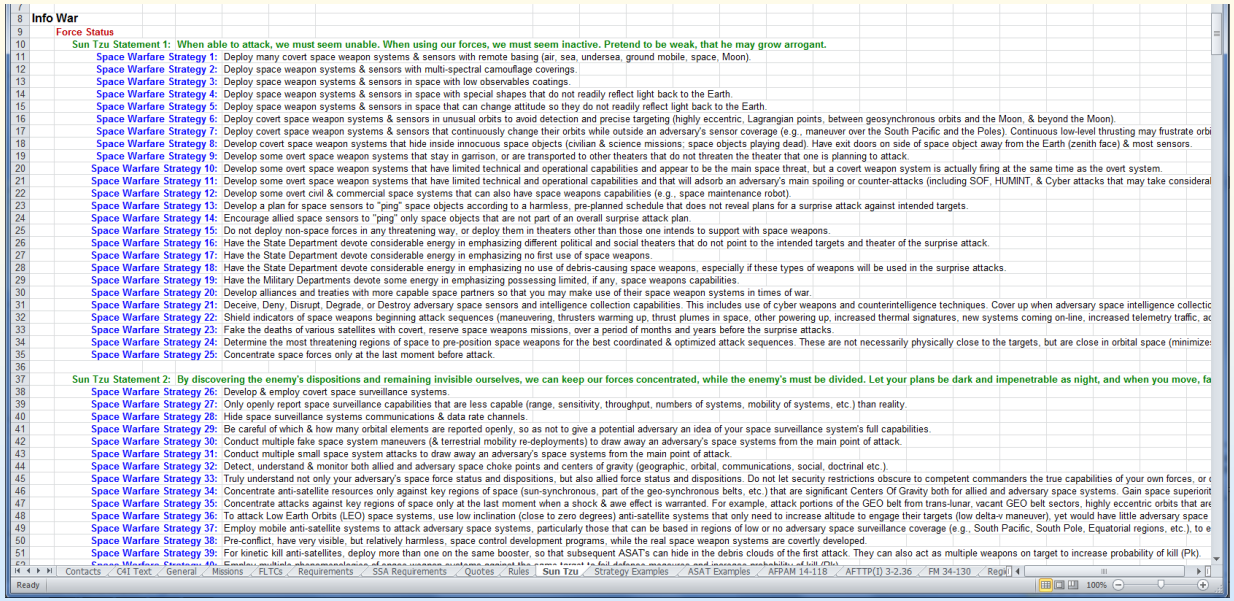
- Destroy Blue space infrastructure to have a long term impact on Blue space capabilities even after the war's end
- Disrupt Blue space attacks so they become uncoordinated
- Constantly shift points of application of space control weapons to confuse adversary response
- Cut off Blue access to satellites
- Herd Blue space communications paths to those that are more easily monitored by Red SIGINT assets
- Attack key Blue space personnel and technicians
- Allocate space defenses according to priority of space system defended
- Does Red conduct an active (attack ASAT's) or passive defense (satellite hardening)

# Other Space Strategies (4)

- Does Red conduct ASAT attacks over home territory
- What is Red attack priority timelines: terrestrial space systems or satellites first
- Disperse Red assets (maneuver satellites) just before launching first attack
- All-out first attack or gradual escalation of space attacks
- Is the strategy dependent upon a perception of the relative capability of the threat, for example, would Red do something different if the attacker were perceived to be stronger?
- Attach new ASAT to old space object that has been dead for a long time (1960's debris?). Maneuver this new "shield" along with your new ASAT. Drift with this debris, maybe making slight maneuvers until needed to attack with a major, final maneuver.

# 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**
  - **287 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(I) 3-2.36 | FM 34-130 | Regs

Ready

**War Is Eternal**

# Conclusions (1)

- **Future Space Planning Violates Most of the Rules of War**
  - **Space Control Concepts Have Not Been Fully Militarized**
  - **Political Sensitivity of Space Weapons Restricts Full Military Use Supporting the Battle Tempo**
  - **Senior Decision Makers Reluctant to Authorize Space Counterattacks If Attacker Is Not Verified**

# Conclusions (2)

- Space Does Not Fit Into Classic ATO (Air Tasking Order) Targeting Procedures & Concepts
  - Useful Pre-Conflict (Pre-ATO) To Confuse Red, Warn Gray & Show Resolve Without Affecting Public Emotions
  - Subtlety of Space Weapon Concepts (Jamming, Blinding, Spoofing) Does Not Fit Into ATO Concepts of Full Kill (Iron Bombs On Target)
    - Many Space Targets Are Offline From ATO Target Ranking (Most Space-Related Targets Are Not Attacked by Bombers)
    - No Satellite BE (Basic Encyclopedia) Numbers

# 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**

# 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. | Detect the presence of 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. | Detect the presence of 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. | Detect the presence of a 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 individual rail ties. | 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 vertical ribs on a radar antenna. | 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 internal fuel reserves by IR means. |

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

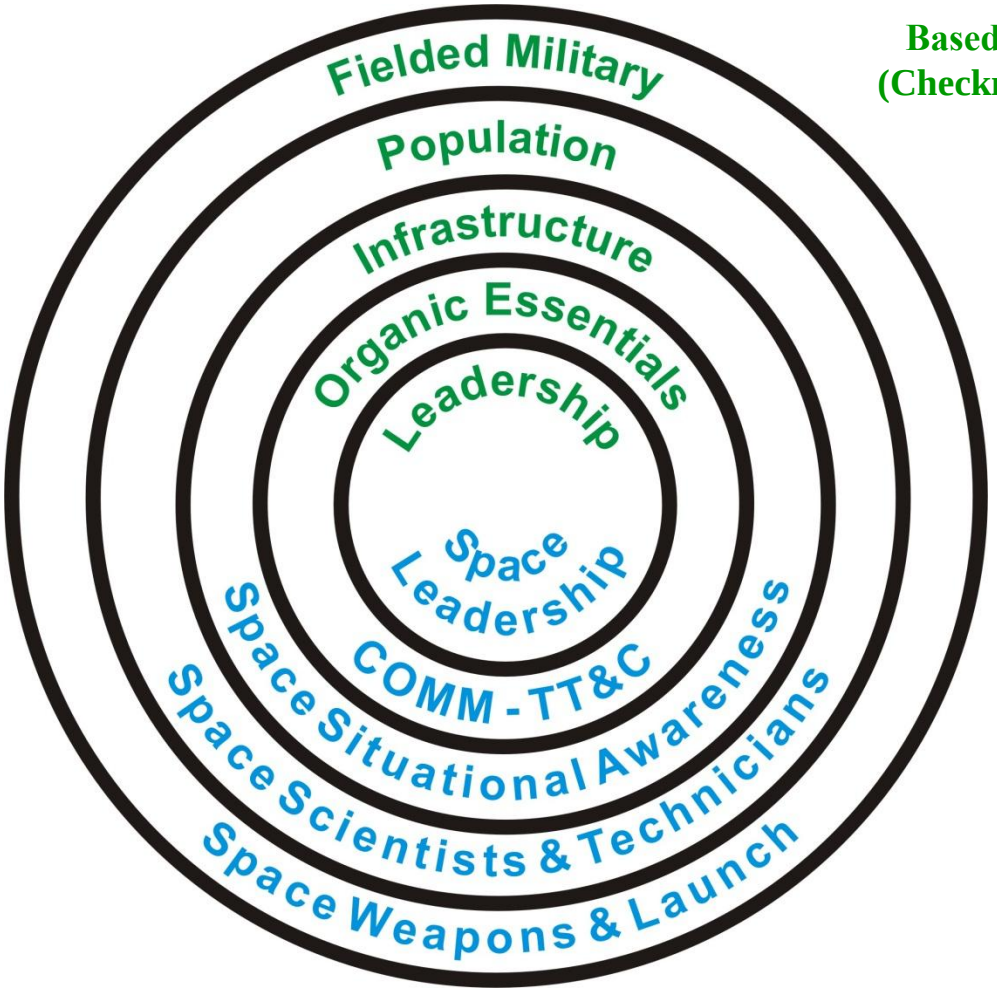
**Space NIIRS Based on Equivalent Terrestrial NIIRS Definitions**

# SSA Requirements Tracking


**SSA Requirements Linked to Military Requirements**

# 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**

# Space Centers Of Gravity - Strategic COG (1) -

- **Launch Corridors**
- GEO Belt Sectors
  - Above AO
  - Atlantic/Pacific COMM Relay Points
- **Sun-Synchronous LEO Orbits**
- **GEO Transfer Orbits**
- Earth-Lunar Orbits
- Space Launch Facilities
- Petrochemical Facilities Producing Rocket Fuel
- Terrestrial-Based Space Telemetry & Control Systems
- Space-Related Command Centers
- Space-Related Commanders

# Space Centers Of Gravity - Strategic COG (2) -

- Terrestrial-Based Space Weapon Systems
- Space-Based Space Weapon Systems
- Terrestrial-Based Space Surveillance Systems
- Space-Based Space Surveillance Systems
- Space Weather Systems
- Terrestrial-Based Satellite Heavy Communications Terminals
- Space Technicians
- Space Scientists
- Electric Grid Serving Ground Space Facilities
- Roads, Bridges, Tunnels & Passes Serving Ground Space Facilities
- Space Design & Manufacturing Facilities
- Space-Related INTEL Centers

# Space Centers Of Gravity - Strategic COG (3) -

- Leader's Confidence In Their New Space Technologies
- Blue & Red Side Political Will to Start & Continue a Space War
- Key Phases of the Battle
  - Pre-Conflict Use of Space War
  - Just Before Major Terrestrial Offenses
  - Just Before the End of the Conflict
- Space-Related Decision Cycle Times (OODA Loops)
- Knowledge Of Classified Space Systems Existence or War Reserve Modes
- Status of Space Forces
- Attack on Alternate Country Space Systems
- Blue May be Self-Deterred From Attacking Gray Space Systems
- Space Alliances & Treaties

# Space Centers Of Gravity - Strategic COG (4) -

- 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 & Time With Advantageous Solar Phase Angles
- Gravity Wells at GEO Disposal Orbits Where Dead Satellites Tend to Group
- Space Radiation Belts
- Times of High Solar Storm Activity
- Zones Outside a Satellite's or Constellation's Collective Sensors' Field Of Regard

# Space Centers Of Gravity - Strategic COG (5) -

- Times When Adversary Military Is Concentrating on In-theater Actions, & Is Less Aware of Space-related Actions on the Other Side of the Globe
- 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
- Other Satellites Being Launched on the Same Booster
- Manned Launch (Shuttle, Space Station) of Satellites
- Times When a Full Moon Degrades an Adversary's Ability to Optically Track Dim Space Objects From Terrestrial Locations

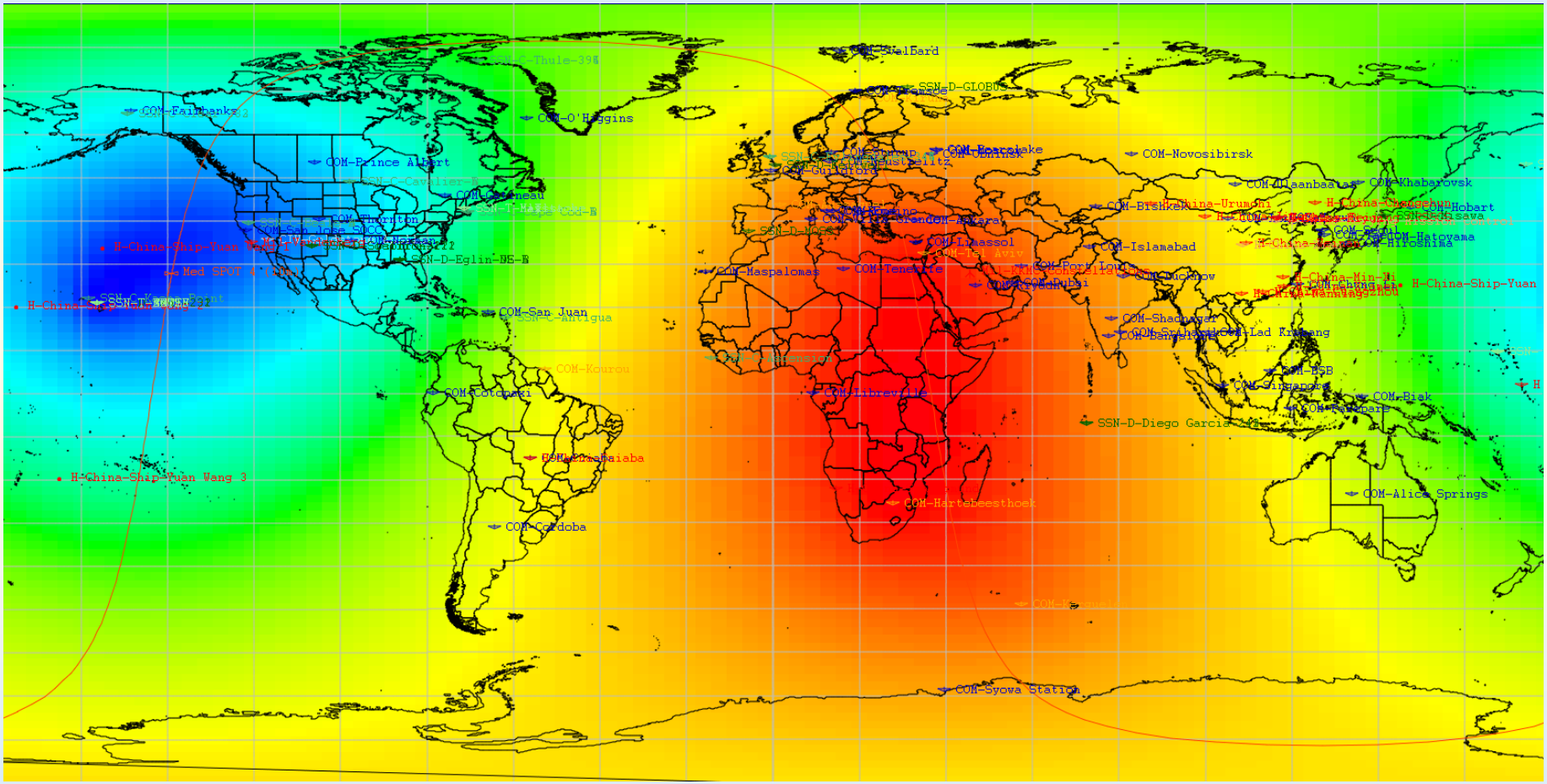
# Space Centers Of Gravity - Tactical COG (1) -

- Space Tactics, Techniques & Procedures
- Initial Satellite Checkout After Launch or Orbital Insertion
- GEO Satellites Changing Orbital Position
- Periods of Solar Eclipse for Satellites
- Periods When a Satellite Has a Low Battery Charge
- 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

# Space Centers Of Gravity - Tactical COG (2) -

- Near a Satellite's Thrusters
- Near a Satellite's High Power Antennas
- Anti-Satellite Launch/Attack Rate
- Just After Loss of Contact With Adversary Satellite Ground Controllers
- Just After Loss of Contact With Adversary Space Surveillance Assets
- Times of Cloud Cover/Weather/Natural Disasters for Terrestrial-Based Space Weapons Systems
- Times of Cloud Cover/Weather/Natural Disasters for Terrestrial-Based Space Surveillance Systems
- Times When the Satellite Passes Through Space Radiation Belts
- Communications or Telemetry Frequencies That Can be Jammed or Spoofed

# Example Attack Locations Optimized for Space Surveillance




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

# Example Space INTEL 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 Details

| | |
|---|---|
| 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 |

# Example Red National Military Space Objectives

- Deny Blue Ability to Use Space as a Force Multiplier of the Terrestrial Battlespace
- Gain & Maintain Red Space Superiority
- Seize & Retain the Initiative in Space Warfare
- Show the World Red Technical & Military Capabilities
- Show Resolve to Inhibit Blue Military Actions
- Take Revenge Upon Blue by Destroying Space Assets
- Assure Red Access to Space
- Deny Blue Ability to Attack Red Space Systems
- Suppress Blue National Capacity to Wage Space War
- Verify International Space Agreements
- Control Space Escalation Ladder

# Example Red Space Campaign 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 |

⋮

**SWAT Has Space Objectives for Both Red & Blue Sides**

# Space Warfare Definitions

# Space Defense Definitions (1)

- **Space Sovereignty - A nation's inherent right to exercise absolute control and authority over the orbital space near its satellites. Also see Space Sovereignty Mission.**
- **Space Sovereignty Mission - The integrated tasks of surveillance and control, the execution of which enforces a nation's authority over the orbital space near its satellites.**
- **Space Control Operations - The employment of space forces, supported by air, ground and naval forces, as appropriate, to achieve military objectives in vital areas of concern to space systems. Such operations include destruction of enemy in-space assets, space-related ground systems and surface-to-space forces (launch), interdiction of enemy space operations, protection of vital space lines of communication (links from ground to space to ground), and the establishment of local military superiority in areas of space operations.**

**Definitions Derived from Joint Pub 3-01.1 Modified for Space Control**

# Space Defense Definitions (2)

- **Space Autonomous Operation - In space defense, the mode of operation assumed by a space system after it has lost all communications with human controllers. The space system assumes full responsibility for control of weapons and engagement of hostile targets, based in accordance with on-board surveillance and weapon system control logic. This automatic state may occur on a regular basis due to orbital movements outside regions of ground coverage and control.**
- **Space Positive Control - A method of space control which relies on positive identification, tracking, and situation assessment of spacecraft within a Space Defense Area, conducted with electronic means by an agency having the authority and responsibility therein.**
- **Space Weapons Free - In space defense, a weapon control order imposing a status whereby weapons systems may be fired at any target in orbital space of defined altitude and inclination, not positively recognized as friendly.**
- **Space Weapons Hold - In space defense, a weapon control order imposing a status whereby weapons systems may only be fired in self defense or in response to a formal order.**
- **Space Weapons Tight - In space defense, a weapon control order imposing a status whereby weapons systems may be fired only at targets recognized as hostile.**

**Definitions Derived from Joint Pub 3-01.1 Modified for Space Control**

# Space Defense Definitions (3)

- Active Space Defense - Direct defensive action taken to destroy, nullify, or reduce the effectiveness of hostile space actions. It includes the use of anti-satellite weapon systems, defensive counter space weapons, electronic warfare, and other available weapons not primarily used in a space defense role. See also Space Defense.
- Passive Space Defense - All measures, other than Active Space Defense, taken to reduce the probability of and to minimize the effects of damage to space systems caused by hostile action without the intention of taking the initiative. These measures include camouflage, deception, dispersion, and the use of protective construction and design. See also Space Defense.
- Space Centralized Control - In space defense, the control mode whereby a higher echelon makes direct target assignments to fire units.
- Space Decentralized Control - In space defense, the normal mode whereby a higher echelon monitors unit actions, making direct target assignments to units only when necessary to ensure proper fire distribution or to prevent engagement of friendly spacecraft. See also Centralized Control.
- Broadcast-Controlled Space Interception - An interception in which the interceptor is given a continuous broadcast of information concerning the space defense situation and effects interception without further control.
- Close-Controlled Space Interception - An interception in which the interceptor is continuously controlled to a position from which the target is within local sensor range.

**Definitions Derived from Joint Pub 3-01.1 Modified for Space Control**

# Space Defense Definitions (4)

- **Suppression of Adversary Counterspace Capabilities - Suppression that neutralizes or negates an adversary offensive counterspace system through deception, denial, disruption, degradation, and/or destruction. These operations can target ground, air, missile, or space threats in response to an attack or threat of attack. (AFDD 2-2.1)**
- **Space Control Sector - A sub element of the space control area, established to facilitate the control of the overall orbit. Space control sector boundaries normally coincide with space defense organization subdivision boundaries. Space control sectors are designated in accordance with procedures and guidance contained in the space control plan in consideration of Service component and allied space control capabilities and requirements.**
- **Space Deconfliction In The Combat Zone - A process used to increase combat effectiveness by promoting the safe, efficient, and flexible use of space systems. Space Deconfliction is provided in order to prevent fratricide, enhance space defense operations, and permit greater flexibility of operations. Space Deconfliction does not infringe on the authority vested in commanders to approve, disapprove, or deny combat operations. Also called combat space deconfliction; space deconfliction.**
- **Space Point Defense - The defense or protection of special vital elements, orbital positions (geosynchronous slots, and advantageous orbits, such as sun-synchronous) and installations; e.g., command and control facilities, space launch facilities, Tracking, Telemetry and Control facilities, space surveillance sensors, and high-value satellites.**

**Definitions Derived from Joint Pub 3-01.1 Modified for Space Control**

# Space Defense Definitions (5)

- Space Defense Operations Area - An area and the orbital space around it within which procedures are established to minimize mutual interference between space defense and other operations; it may include designation of one or more of the following: Space Defense Action Area, Space Defense Area; Space Defense Identification Zone, and, or firepower umbrella.
- Space Defense Action Area - An orbit and the space around it within which friendly spacecraft or surface-to-space weapons are normally given precedence in operations except under specified conditions.
- Space Defense Area - 1.) A specifically defined orbit for which space defense must be planned and provided. 2.) An orbit and a region surrounding it of defined dimensions designated by the appropriate agency within which the ready control of spaceborne vehicles is required in the interest of national security during an space defense emergency.
- Space Defense Region - An orbital subdivision of a Space Defense Area.
- Space Defense Sector - An orbital subdivision of a Space Defense Region.
- Space Defense Division - A geographic subdivision of a Space Defense Region.
- Space Defense Identification Zone (SDIZ) - Orbital space of defined parameters within which the ready identification, location, and control of spaceborne vehicles is required.
- Space Defense Battle Zone - A volume of space surrounding a space defense fire unit or defended area, extending to a specified orbital altitude and inclination, in which the fire unit commander will engage and destroy targets not identified as friendly under criteria established by higher headquarters. In other words, this would be a free-fire zone around a defended satellite.

**Definitions Derived from Joint Pub 3-01.1 Modified for Space Control**

# Space Defense Definitions (6)

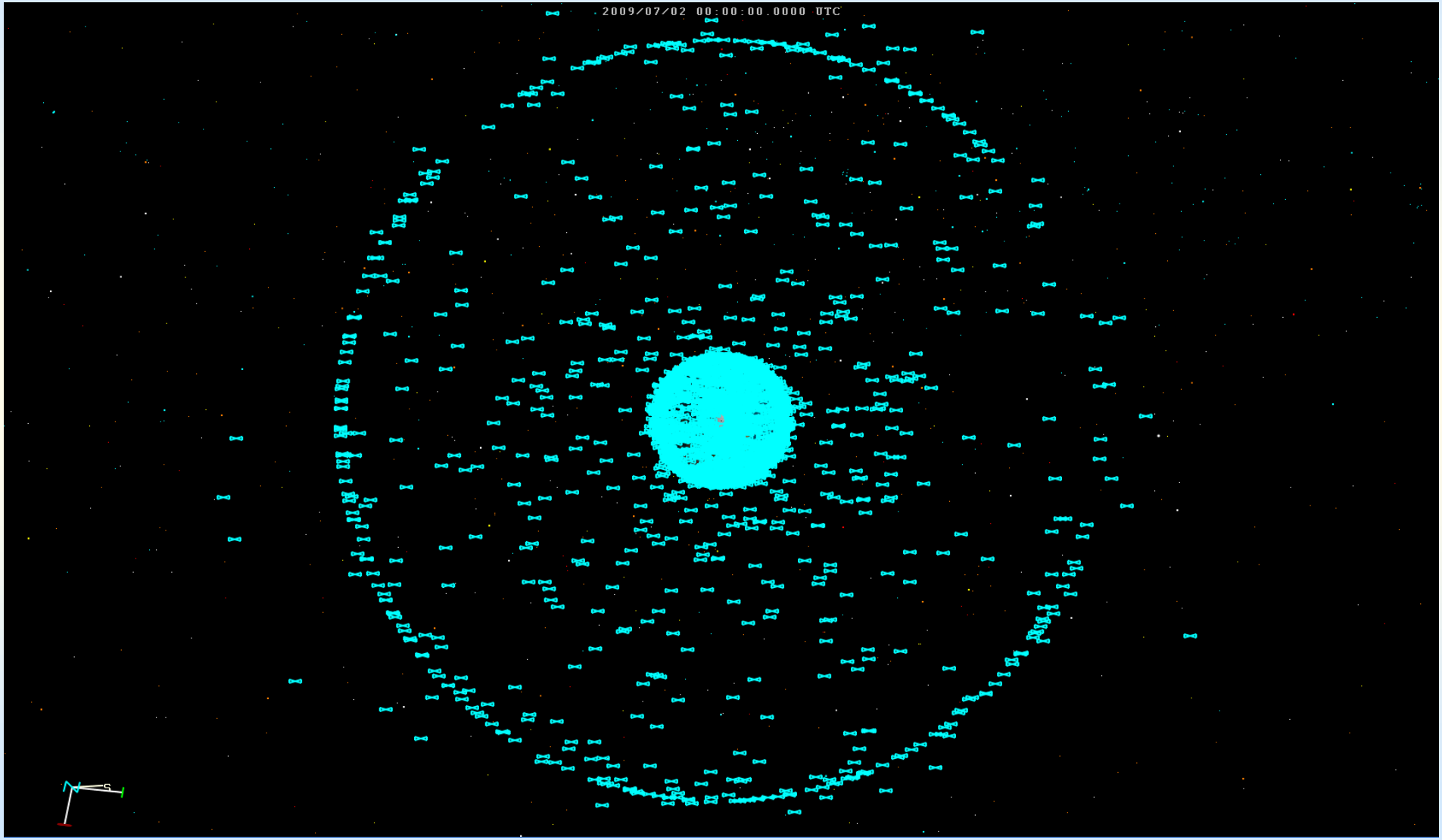
- **Space Weapon Engagement Zone (SWEZ) - In space defense, orbital space of defined altitude and inclination within which the responsibility for engagement of space threats normally rests with a particular weapon system.**
- **Direct-Ascent Engagement Zone (DAEZ) - In space defense, that orbital space of defined altitude and inclination within which the responsibility for engagement of space threats normally rests with a direct-ascent anti-satellite system of terrestrial launch origin.**
- **Directed Energy Engagement Zone (DEEZ) - In space defense, that orbital space of defined altitude and inclination within which the responsibility for engagement of space threats normally rests with a directed energy (laser or microwave) ASAT or electronic warfare system of terrestrial location.**
- **Electronic Warfare Engagement Zone (EWEZ) - In space defense, that orbital space of defined altitude and inclination within which the responsibility for engagement of space threats normally rests with an electronic warfare system of terrestrial location.**
- **Close Attack Engagement Zone (CAEZ) - In space defense, that orbital space of defined altitude and inclination within which the responsibility for engagement of space threats normally rests with an ASAT system that is stationed within 10 kilometers of its target.**
- **Long Range Engagement Zone (LREZ) - In space defense, that orbital space of defined altitude and inclination within which the responsibility for engagement of space threats normally rests with long range space defense weapons, that are space-based, but are normally stationed at more than 10 kilometers from its target.**
- **Joint Engagement Zone (JEZ) - In space defense, that orbital space of defined altitude and inclination within which multiple space defense systems (from both terrestrial and space-based locations) are simultaneously employed to engage space targets.**

**Definitions Derived from Joint Pub 3-01.1 Modified for Space Control**

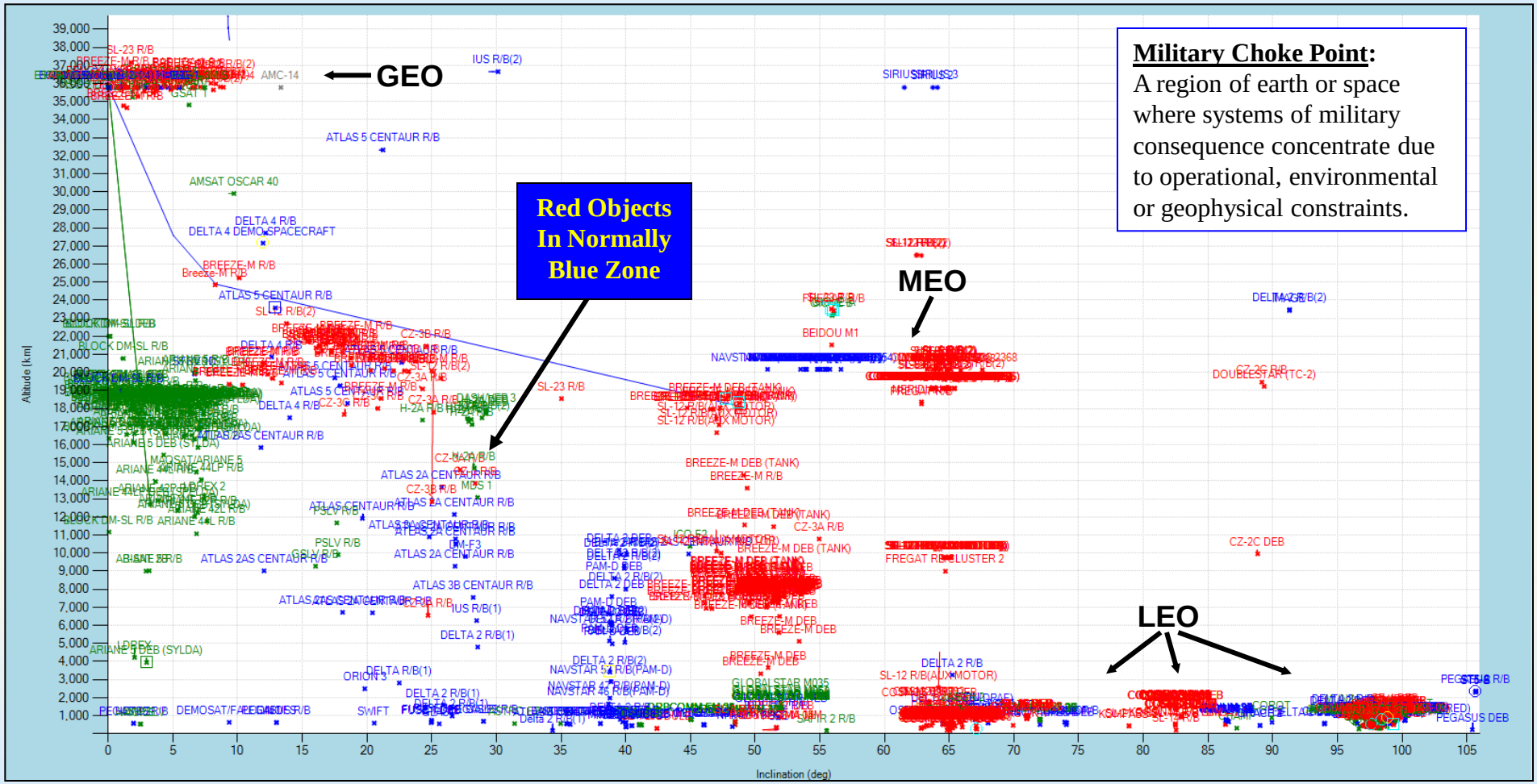
# Space Choke Point Displays

## - Satellite Attack Warning (SAW) -

# Traditional Orbital View



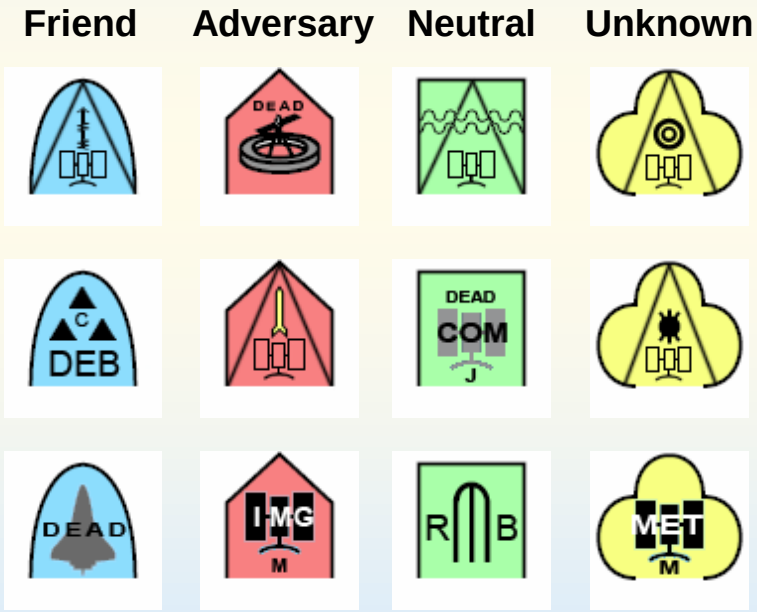
# SAW – All Altitudes




**Space Has Choke Points As In Terrestrial Systems – They Just Are Not Stationary**

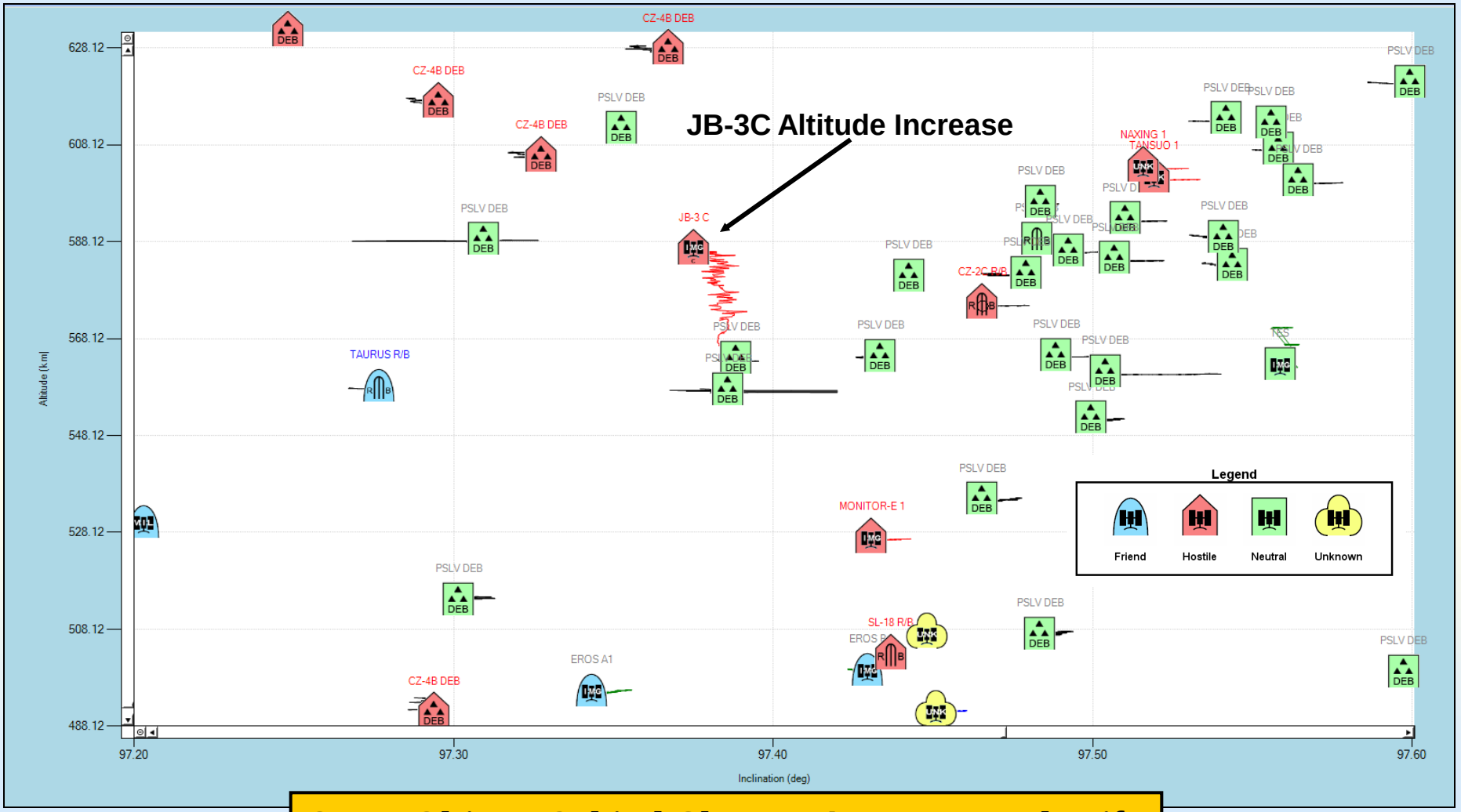
# SAW – Icons

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



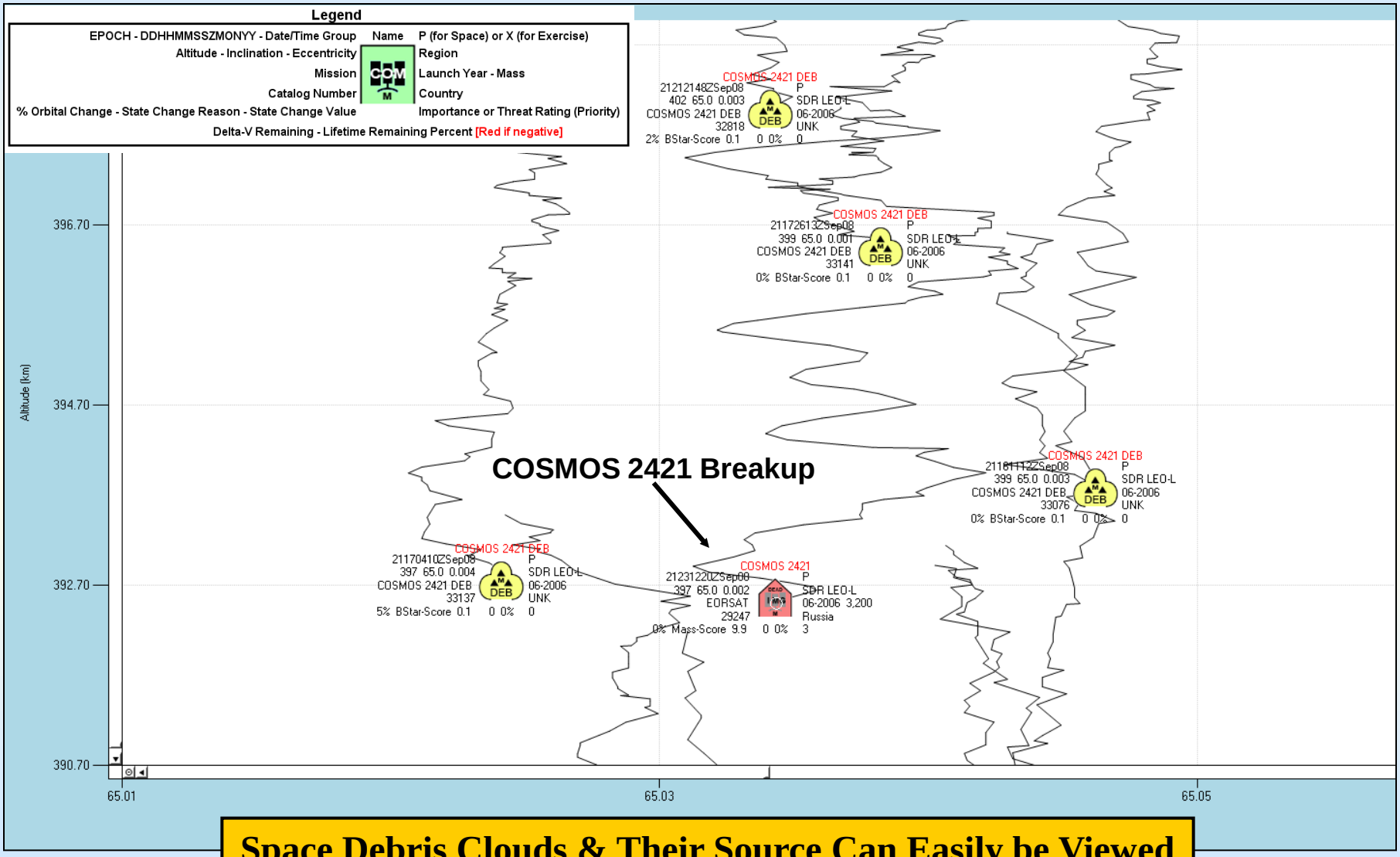

**Make SAW Maps Similar to Terrestrial Situation Maps**

# SAW – View 1



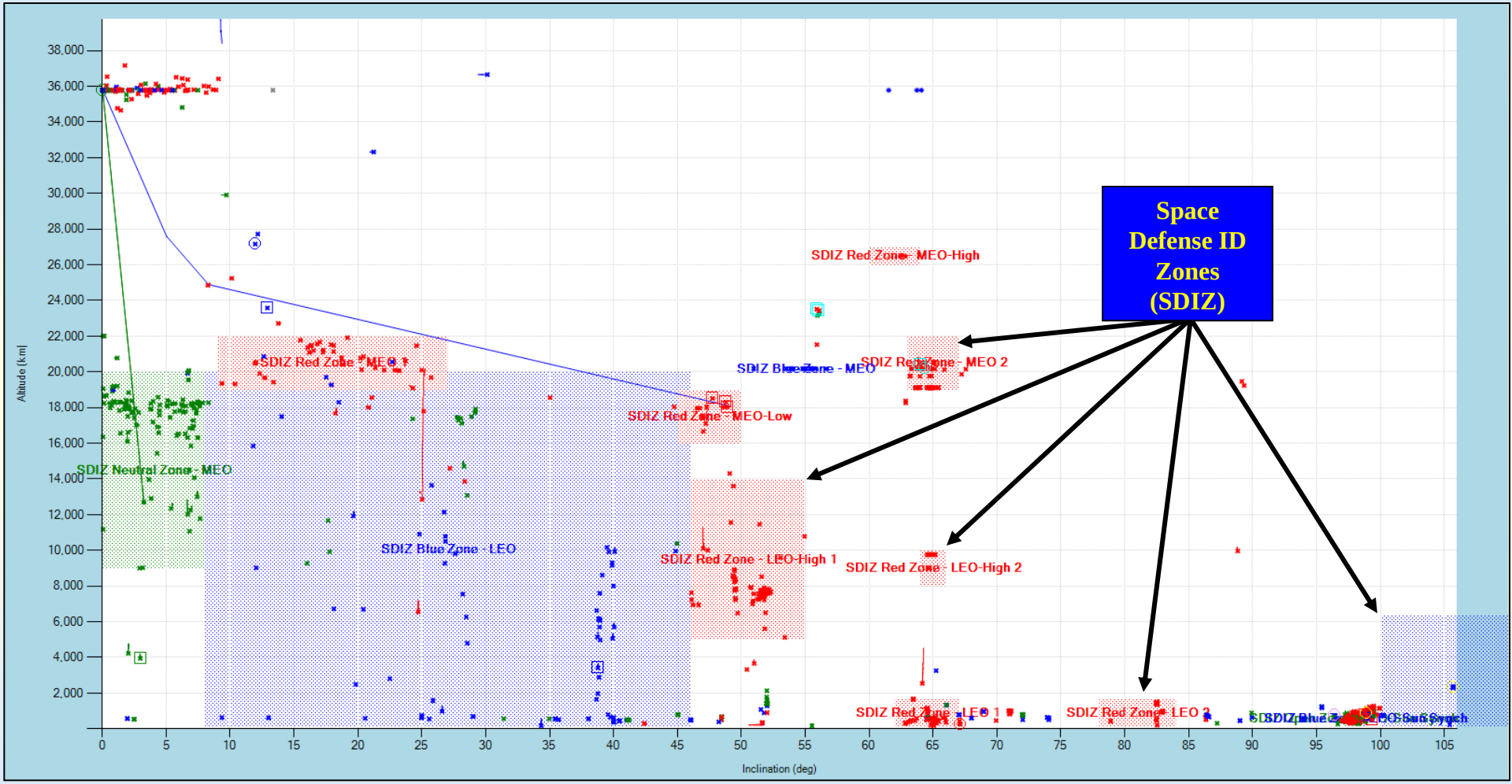

**Space Objects Orbital Changes Are Easy to Identify**

# SAW – View 2



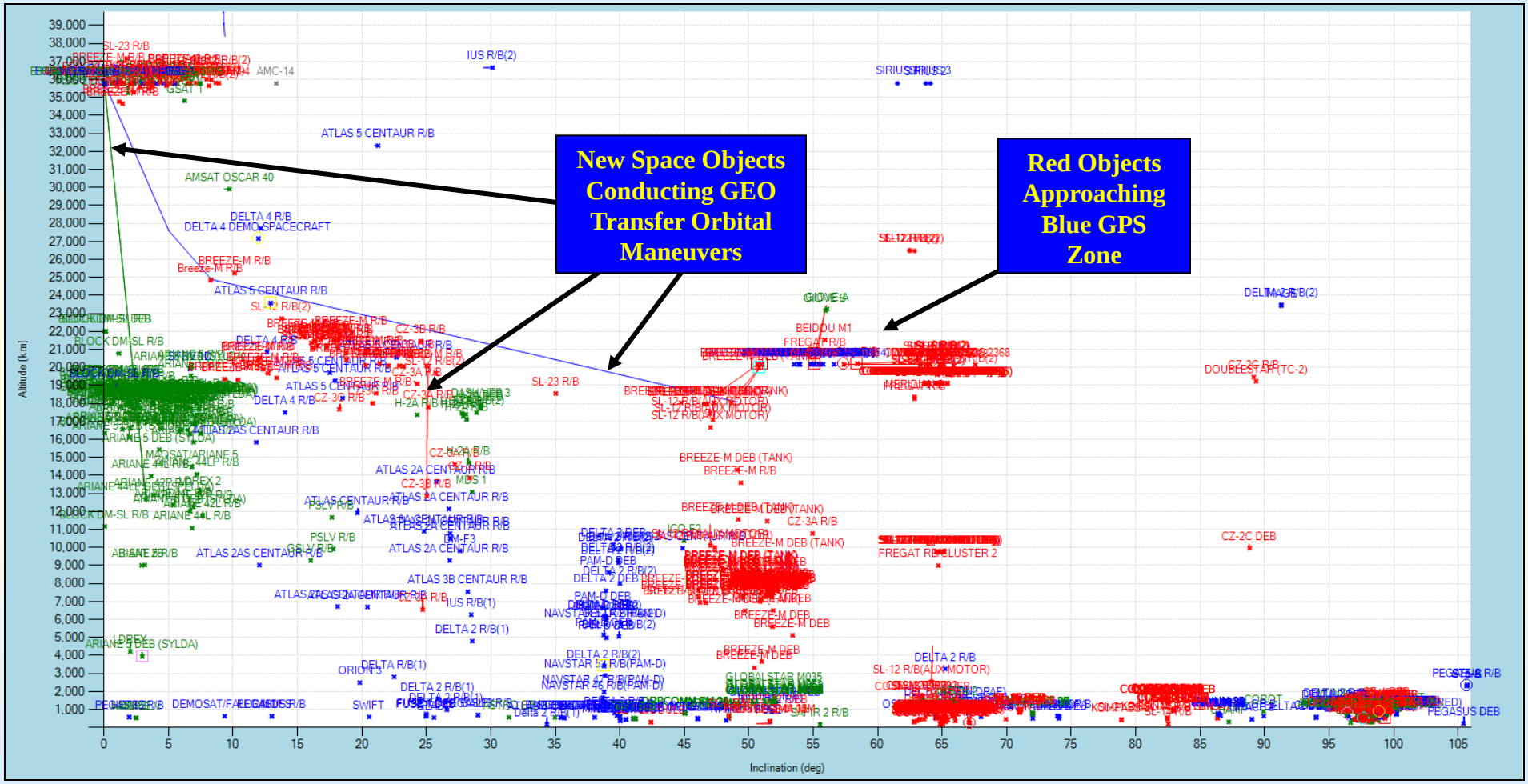

**Space Debris Clouds & Their Source Can Easily be Viewed**

# SAW – SDIZ



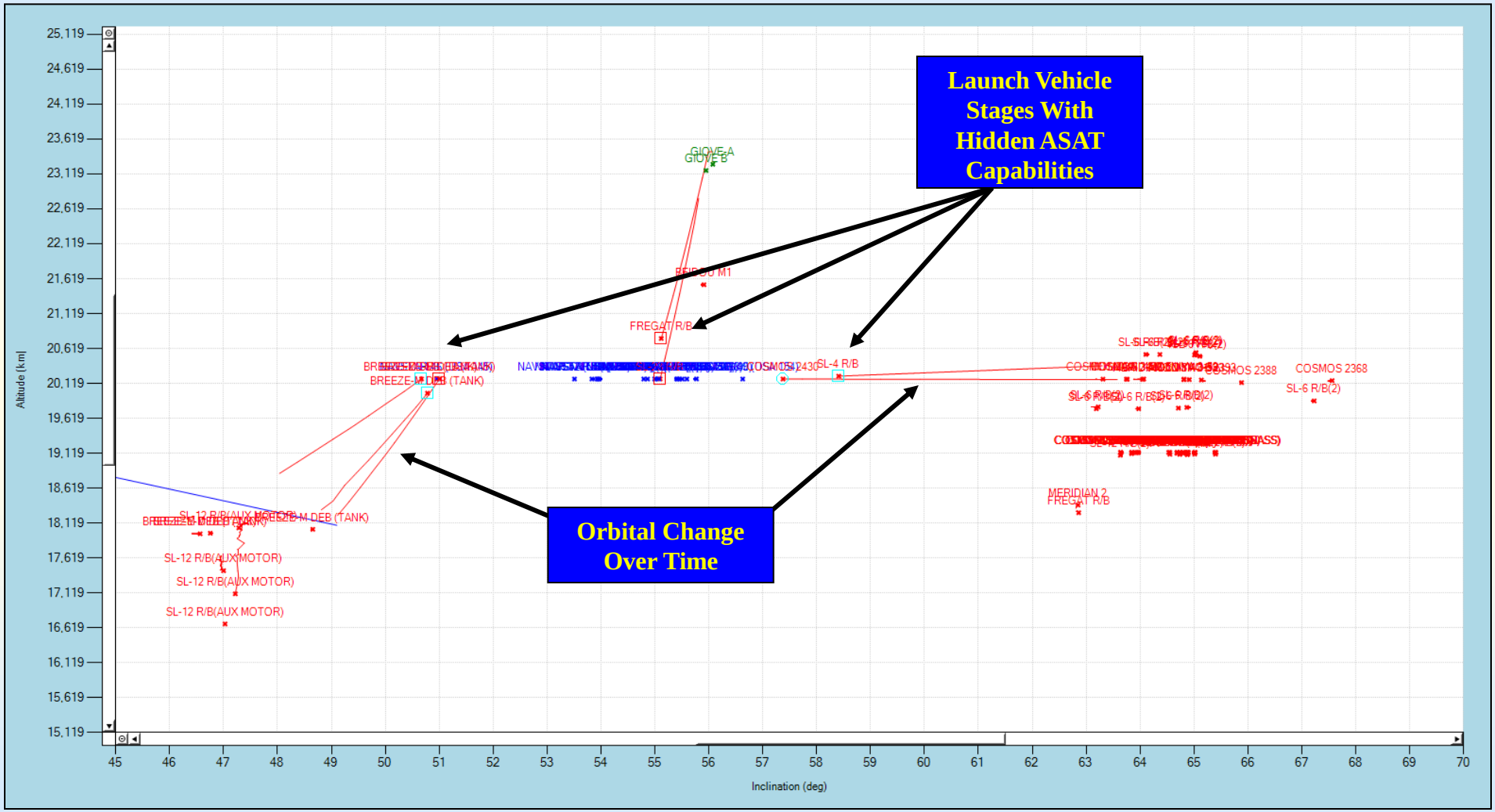

**SSA Detection Zones Help Partial Out Operational Responsibility**

# SAW – Simulated Attack Against GPS



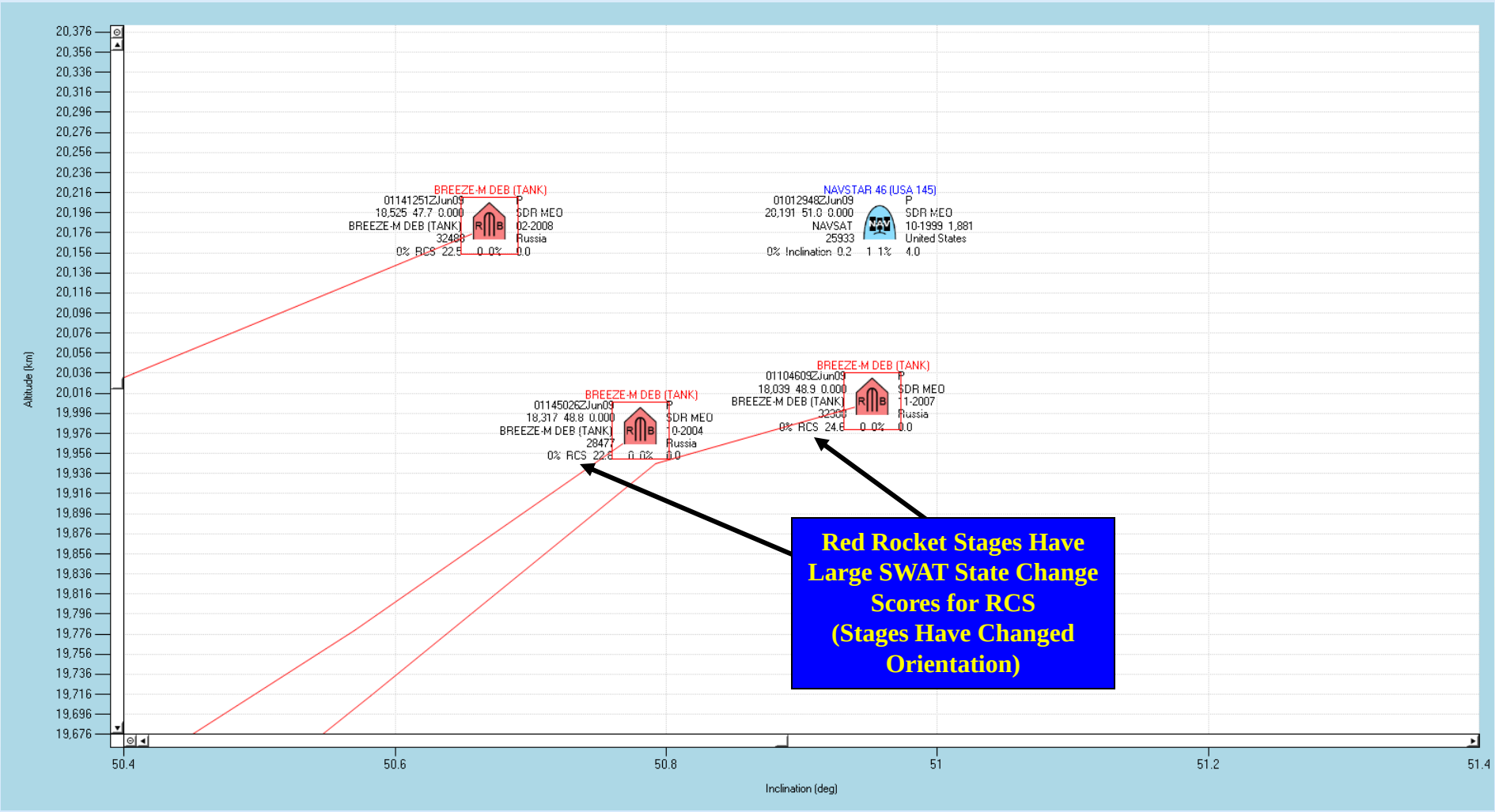

**Space Debris Clouds & Their Sources Can Easily be Viewed**

# SAW – "Dead" Stages as ASATS



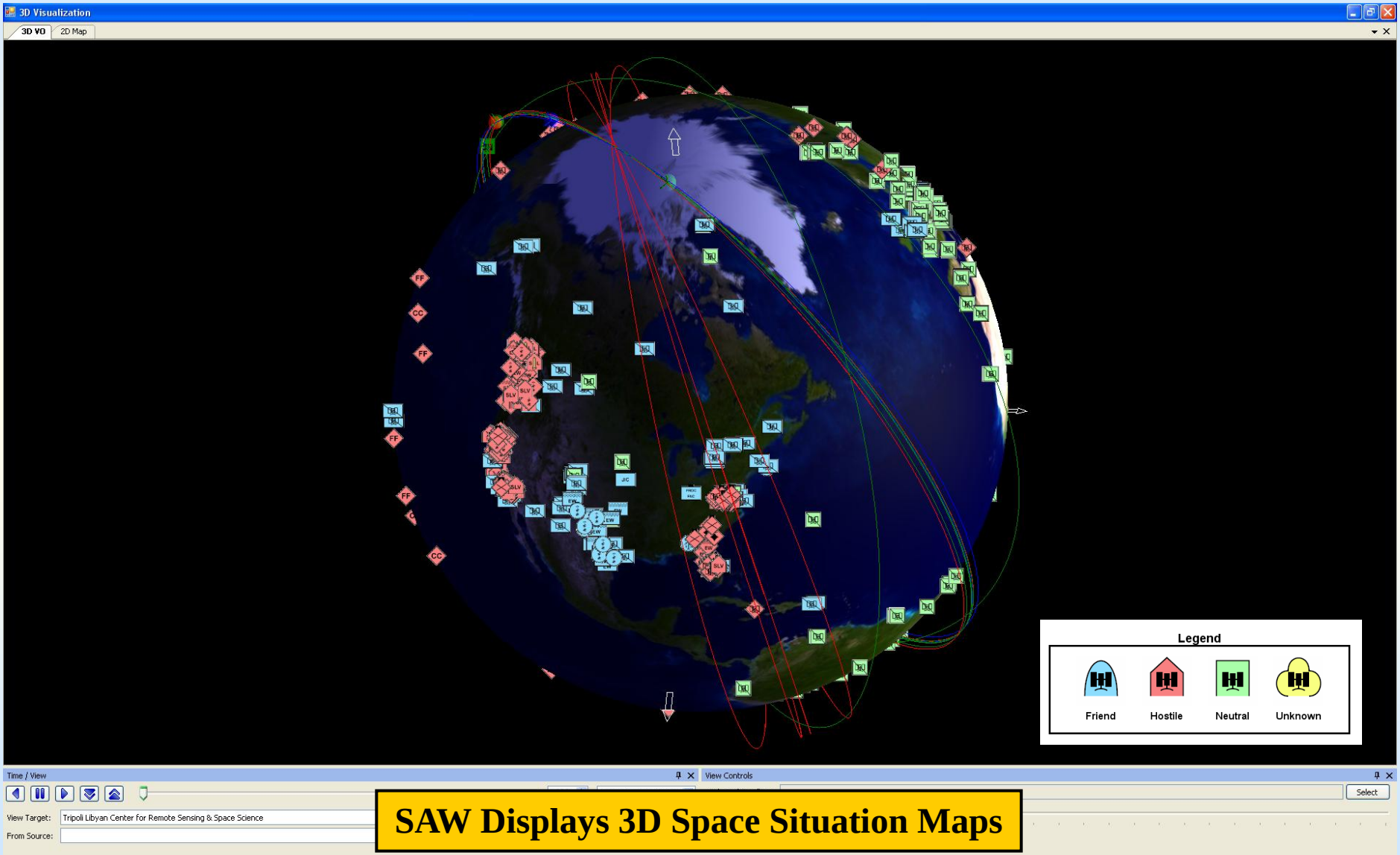

**Simultaneous Attack Maneuvers Can Easily be Detected**

# SAW – Multiple Attacks Against One GPS



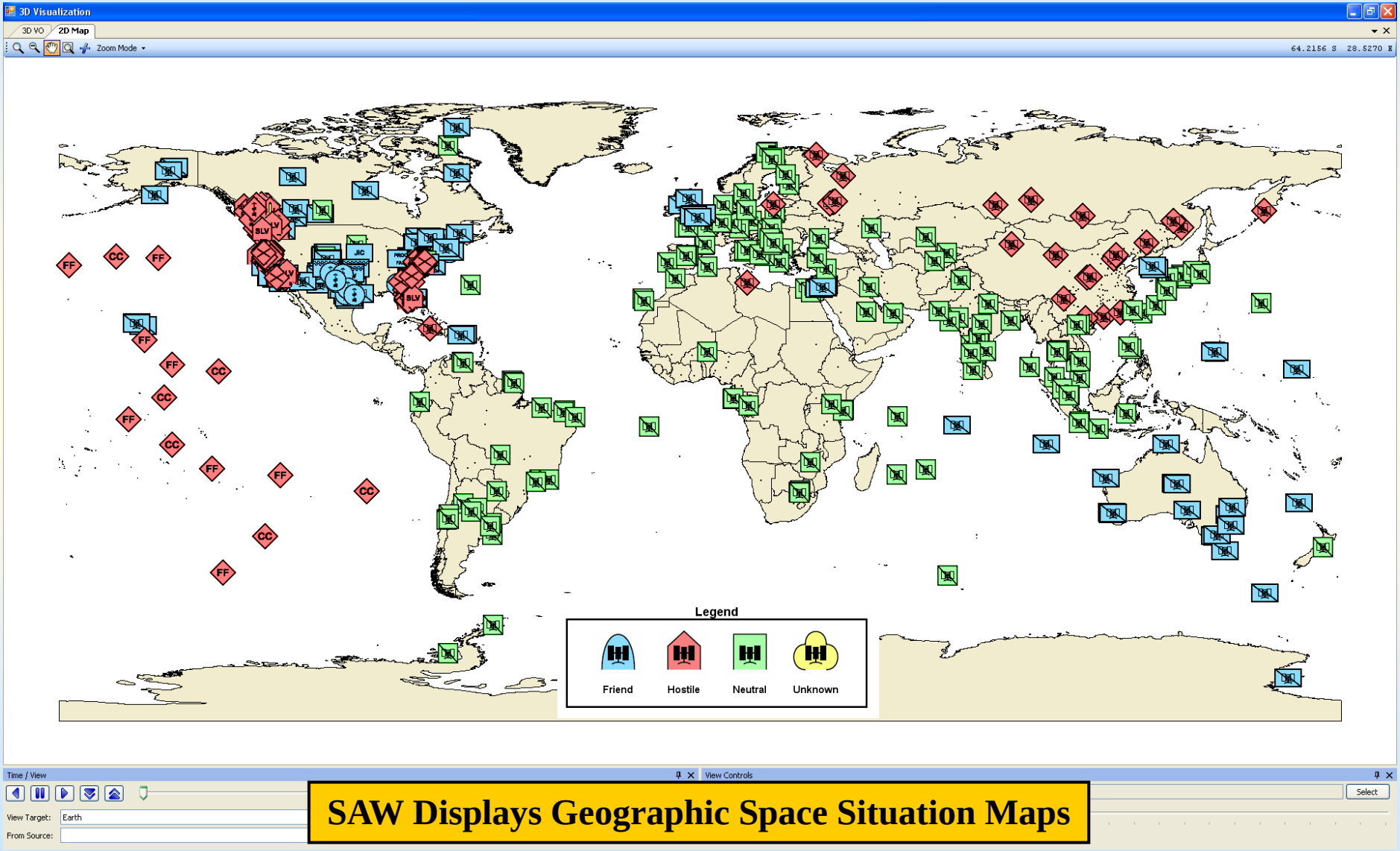

**Space Objects Playing Dead Can be Detected With Unusual Movements**

# SAW – 3D View




**SAW Displays 3D Space Situation Maps**

# SAW – Flat Map View




**SAW Displays Geographic Space Situation Maps**

# Other Potential Displays

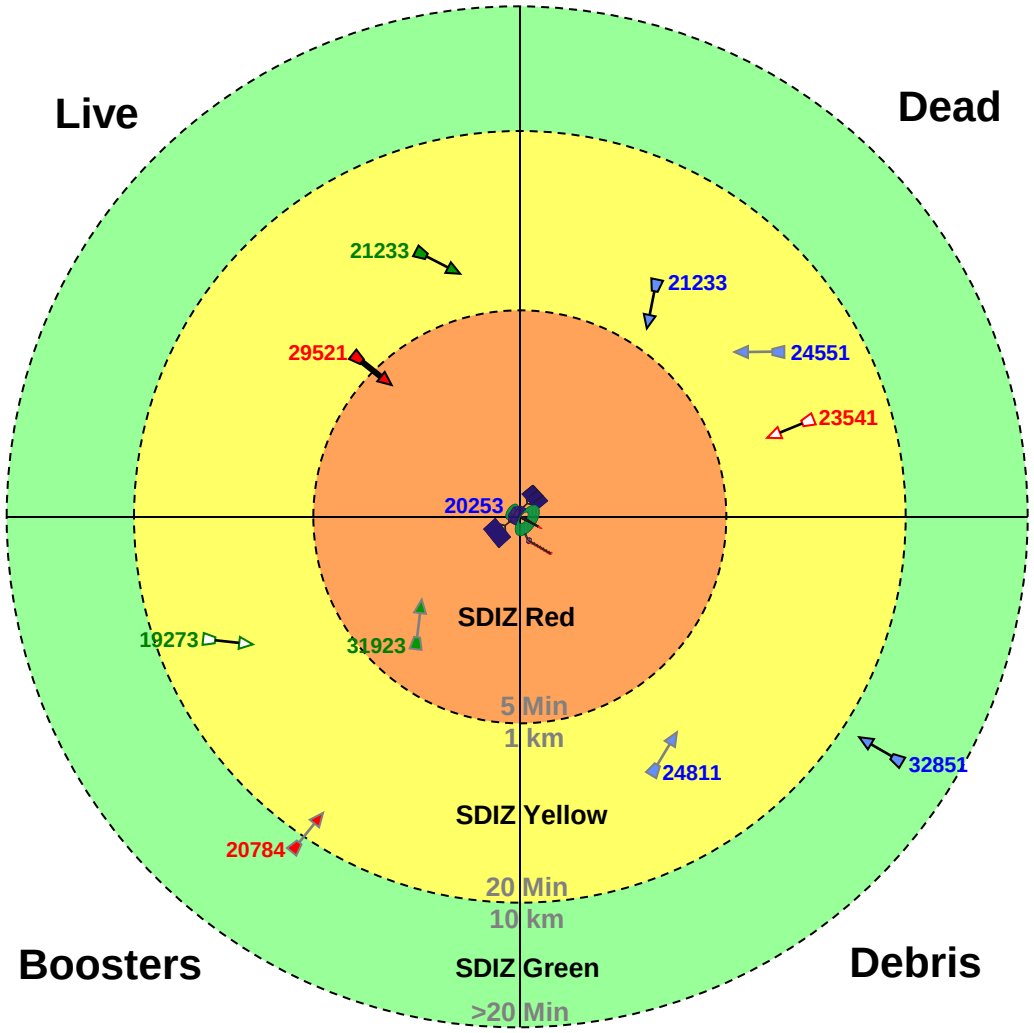
# SWAT Display Requirements (1)

- Delta-V Potential (Estimated From Mass & Orbital Lifetime)
  - Direct Burn
  - Hohmann Transfer
  - Other?
- Time to Intercept (Or Range)
  - Real (Current Orbital Parameters)
  - Potential (Estimated Delta-V)
  - Increasing or Decreasing Range to Target

# SWAT Display Requirements (2)

- **Type of Intercept**
  - Rendezvous
  - Flyby / Impact
- **Country of Origin**
- **Space Object Status**
  - Live
  - Dead (Once was Live)
  - Booster
  - Debris
- **INTEL Threat Assessment Ranking**

# Threat Assessment Chart (TAC)




SDIZ = Space Defense Identification Zone

Time to Target by Direct Burn
Threat Assessment (Line Thickness)
Time to Target by Hohmann Transfer

Object Pointed at Target
= Orbit Is Decreasing Range

Object Pointed Away From Target
= Orbit Is Increasing Range

Arrow Open (Unfilled)
= Maneuver to Proximity Ops

Arrow Solid (Filled)
= Maneuver to Impact / Flyby

Arrow Full Color
= Currently Detected Maneuver

Arrow Grayed Out
= Potential Maneuver

Arrow Blue
= US / Allied Countries Space Objects

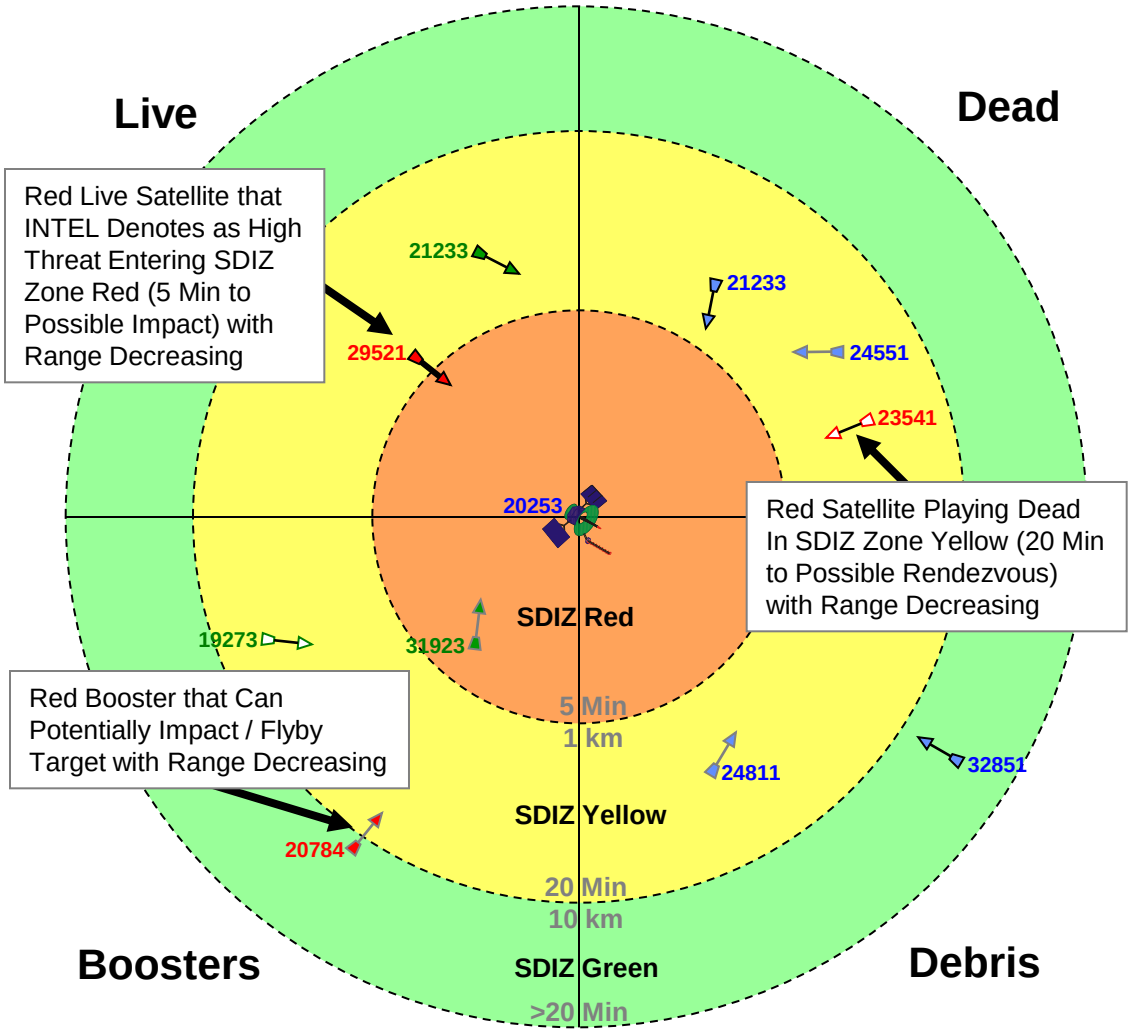
Arrow Green
= Neutral Countries Space Objects

Arrow Red
= Red Countries Space Objects

Flashing Arrow Red
= Red Country Space Object Entering SDIZ Red Zone and Range to Potential Target is Decreasing

**One View to Determine Space-to-Space Attack**

# TAC Chart Explained

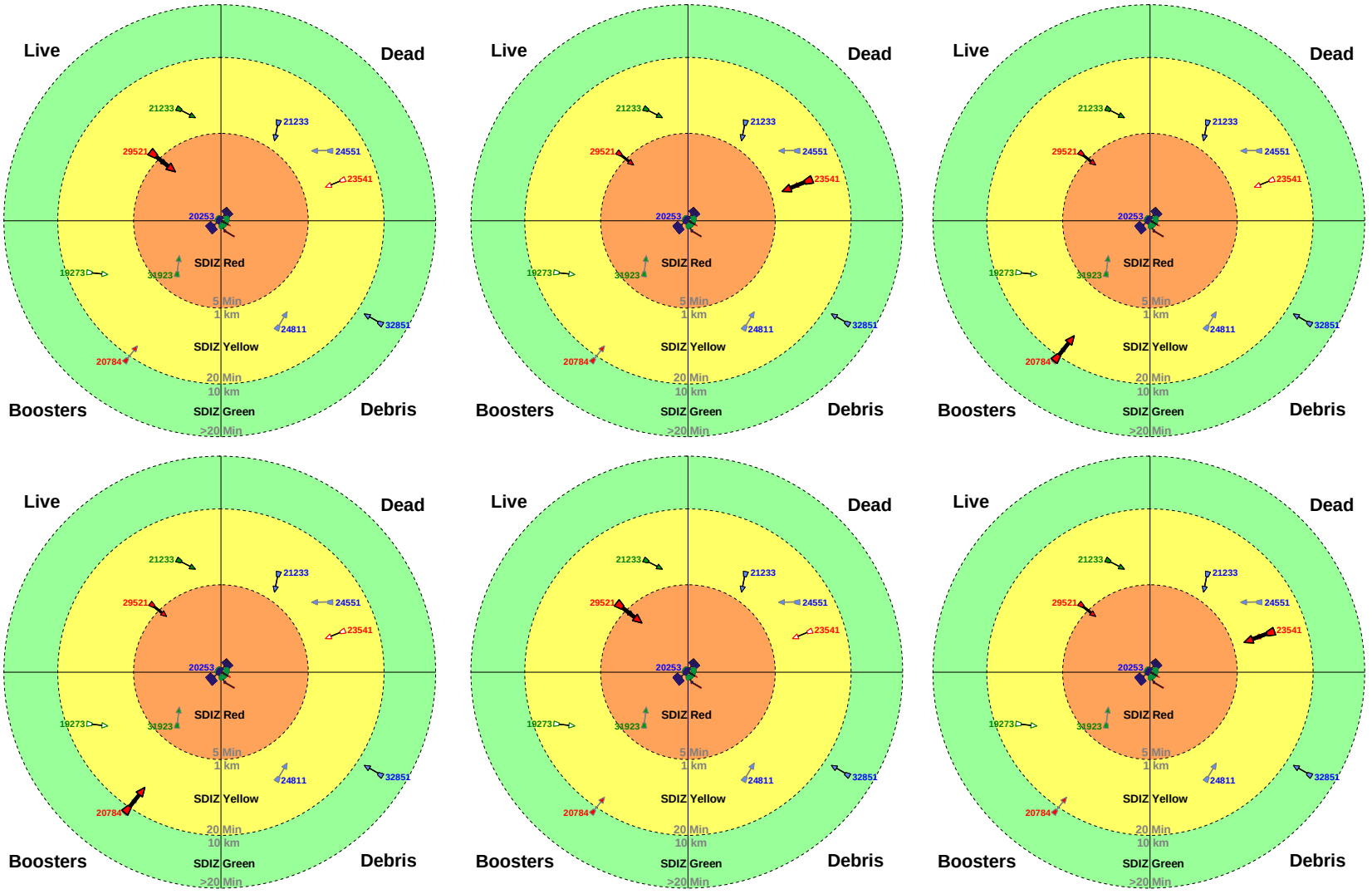



SDIZ = Space Defense Identification Zone

- Time to Target by Direct Burn
- Threat Level (Line Thickness)
- Time to Target by Hohmann Transfer
- Object Pointed at Target = Orbit Is Decreasing Range
- Object Pointed Away From Target = Orbit Is Increasing Range
- Arrow Open (Unfilled) = Maneuver to Proximity Ops
- Arrow Solid (Filled) = Maneuver to Impact / Flyby
- Arrow Full Color = Currently Detected Maneuver
- Arrow Grayed Out = Potential Maneuver
- Arrow Blue = US / Allied Countries Space Objects
- Arrow Green = Neutral Countries Space Objects
- Arrow Red = Red Countries Space Objects
- Flashing Arrow Red = Red Country Space Object Entering SDIZ Red Zone and Range to Potential Target is Decreasing

**Different Space Attack Possibilities Immediately Recognizable**

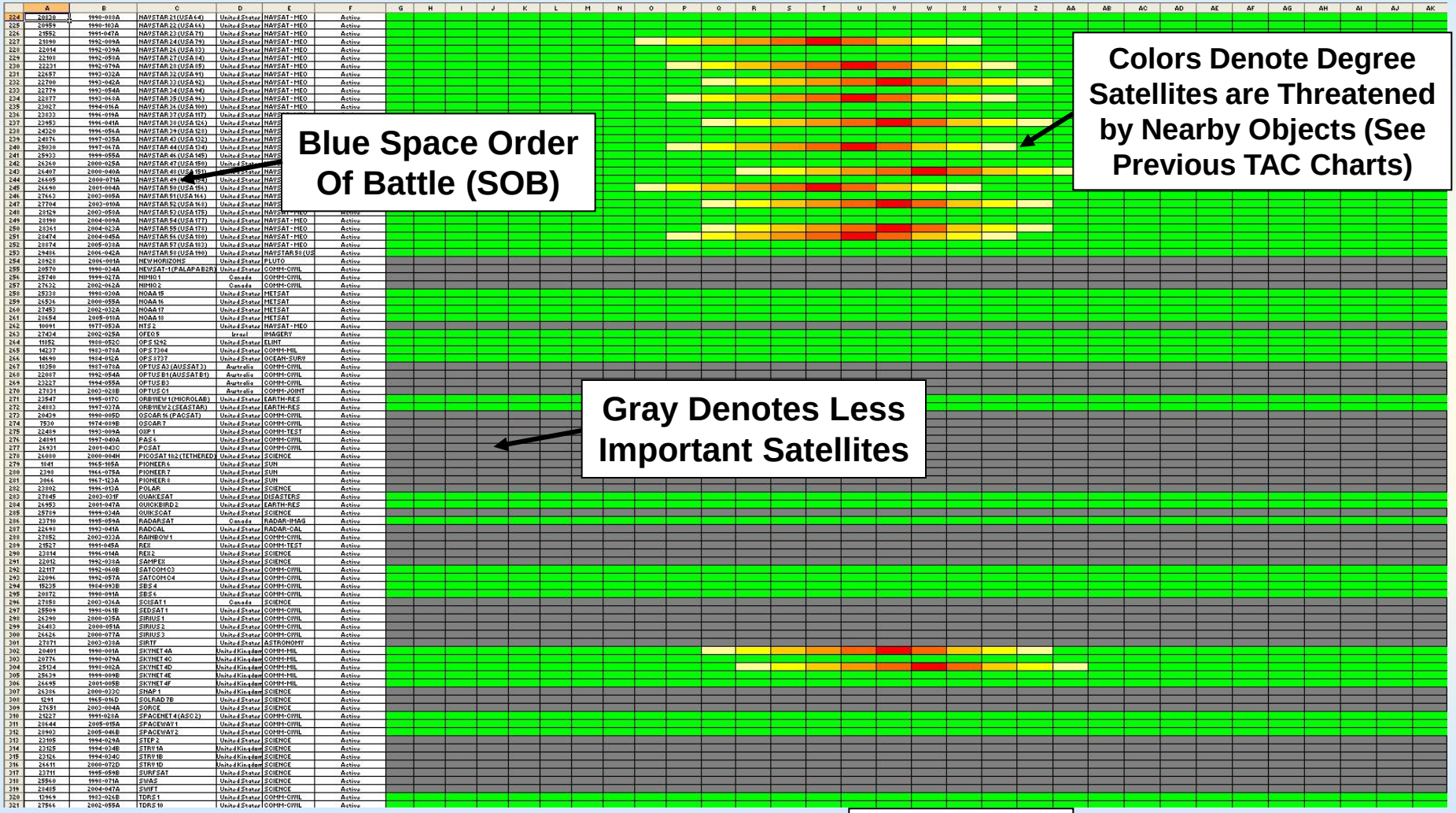
# Multiple TAC Charts Can Predict Simultaneous Space Attack



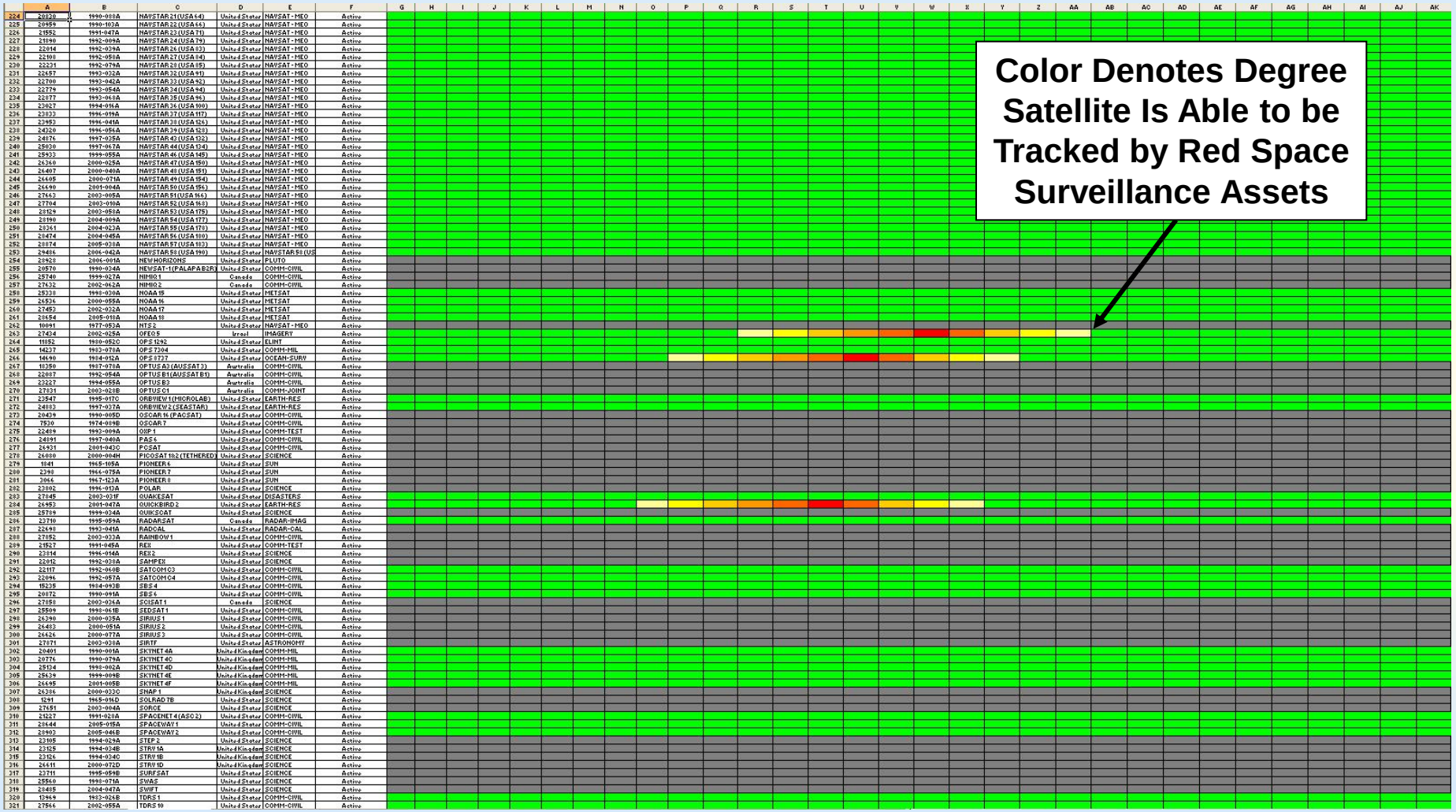

**Large Space Attacks May Provide Indications & Warning of Impending Terrestrial Assault**

# Threat Assessment Summary (TAS)

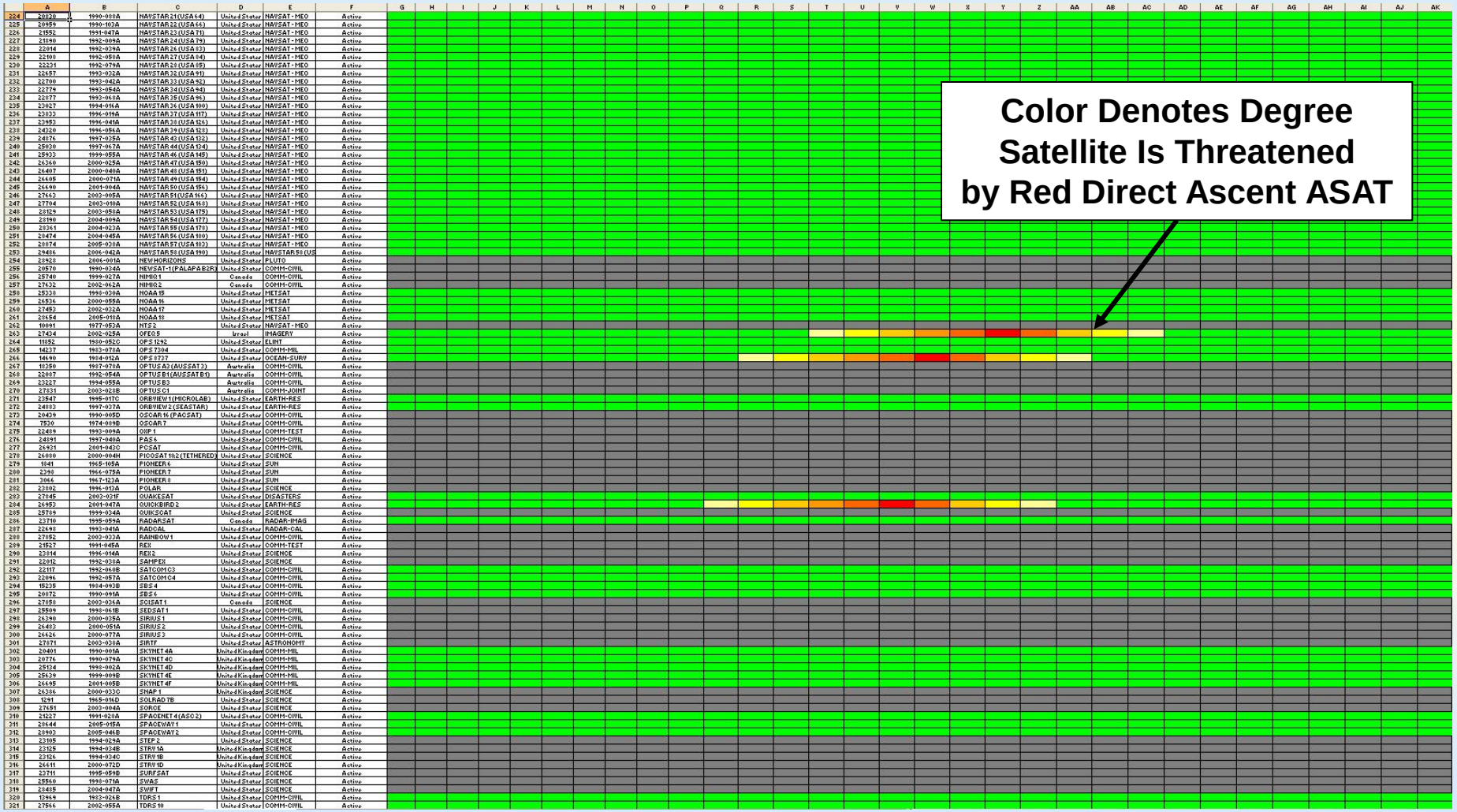
## - Nearby Space Objects Potential Maneuvers -



# Threat Assessment Summary (TAS) - Surveillance -



# Threat Assessment Summary (TAS)
# - Direct Ascent ASAT -




| | A | B | C | D | E | F |
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| 225 | 20959 | 1990-103A | NAVSTAR 22 (USA 66) | United States | NAVSAT-MEO | Active |
| 226 | 21552 | 1991-047A | NAVSTAR 23 (USA 71) | United States | NAVSAT-MEO | Active |
| 227 | 21890 | 1992-009A | NAVSTAR 24 (USA 79) | United States | NAVSAT-MEO | Active |
| 228 | 22014 | 1992-039A | NAVSTAR 26 (USA 83) | United States | NAVSAT-MEO | Active |
| 229 | 22108 | 1992-058A | NAVSTAR 27 (USA 84) | United States | NAVSAT-MEO | Active |
| 230 | 22231 | 1992-079A | NAVSTAR 28 (USA 85) | United States | NAVSAT-MEO | Active |
| 231 | 22657 | 1993-032A | NAVSTAR 32 (USA 91) | United States | NAVSAT-MEO | Active |
| 232 | 22700 | 1993-042A | NAVSTAR 33 (USA 92) | United States | NAVSAT-MEO | Active |
| 233 | 22779 | 1993-054A | NAVSTAR 34 (USA 94) | United States | NAVSAT-MEO | Active |
| 234 | 22877 | 1993-068A | NAVSTAR 35 (USA 96) | United States | NAVSAT-MEO | Active |
| 235 | 23027 | 1994-016A | NAVSTAR 36 (USA 100) | United States | NAVSAT-MEO | Active |
| 236 | 23833 | 1996-019A | NAVSTAR 37 (USA 117) | United States | NAVSAT-MEO | Active |
| 237 | 23953 | 1996-041A | NAVSTAR 38 (USA 126) | United States | NAVSAT-MEO | Active |
| 238 | 24320 | 1996-056A | NAVSTAR 39 (USA 128) | United States | NAVSAT-MEO | Active |
| 239 | 24876 | 1997-035A | NAVSTAR 43 (USA 132) | United States | NAVSAT-MEO | Active |
| 240 | 25030 | 1997-067A | NAVSTAR 44 (USA 134) | United States | NAVSAT-MEO | Active |
| 241 | 25933 | 1999-055A | NAVSTAR 46 (USA 145) | United States | NAVSAT-MEO | Active |
| 242 | 26360 | 2000-025A | NAVSTAR 47 (USA 150) | United States | NAVSAT-MEO | Active |
| 243 | 26407 | 2000-040A | NAVSTAR 48 (USA 151) | United States | NAVSAT-MEO | Active |
| 244 | 26605 | 2000-071A | NAVSTAR 49 (USA 154) | United States | NAVSAT-MEO | Active |
| 245 | 26690 | 2001-004A | NAVSTAR 50 (USA 156) | United States | NAVSAT-MEO | Active |
| 246 | 27663 | 2002-005A | NAVSTAR 51 (USA 166) | United States | NAVSAT-MEO | Active |
| 247 | 27704 | 2002-019A | NAVSTAR 52 (USA 168) | United States | NAVSAT-MEO | Active |
| 248 | 28129 | 2003-058A | NAVSTAR 53 (USA 175) | United States | NAVSAT-MEO | Active |
| 249 | 28190 | 2004-009A | NAVSTAR 54 (USA 177) | United States | NAVSAT-MEO | Active |
| 250 | 28361 | 2004-023A | NAVSTAR 55 (USA 178) | United States | NAVSAT-MEO | Active |
| 251 | 28474 | 2004-045A | NAVSTAR 56 (USA 180) | United States | NAVSAT-MEO | Active |
| 252 | 28874 | 2005-038A | NAVSTAR 57 (USA 183) | United States | NAVSAT-MEO | Active |
| 253 | 29486 | 2006-042A | NAVSTAR 58 (USA 190) | United States | NAVSTAR 58 (US | Active |
| 254 | 28928 | 2006-001A | NEW HORIZONS | United States | PLUTO | Active |
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| 257 | 27632 | 2002-062A | NIMIQ 2 | Canada | COMM-CIVIL | Active |
| 258 | 25338 | 1998-020A | NOAA 15 | United States | METSAT | Active |
| 259 | 26526 | 2000-055A | NOAA 16 | United States | METSAT | Active |
| 260 | 27453 | 2002-032A | NOAA 17 | United States | METSAT | Active |
| 261 | 28654 | 2005-018A | NOAA 18 | United States | METSAT | Active |
| 262 | 10691 | 1977-053A | NTS 2 | United States | NAVSAT-MEO | Active |
| 263 | 27434 | 2002-025A | OFEQ 5 | Israel | IMAGERY | Active |
| 264 | 11852 | 1980-052C | OPS 1292 | United States | ELINT | Active |
| 265 | 14237 | 1983-078A | OPS 7204 | United States | COMM-MIL | Active |
| 266 | 14690 | 1984-012A | OPS 8737 | United States | OCEAN-SURV | Active |
| 267 | 18350 | 1987-078A | OPTUS A2 (AUSSAT 3) | Australia | COMM-CIVIL | Active |
| 268 | 22087 | 1992-054A | OPTUS B1 (AUSSAT B1) | Australia | COMM-CIVIL | Active |
| 269 | 23227 | 1994-055A | OPTUS B3 | Australia | COMM-CIVIL | Active |
| 270 | 27631 | 2002-028B | OPTUS C1 | Australia | COMM-JOINT | Active |
| 271 | 23547 | 1995-017C | ORBVIEW 1 (MICROLAB) | United States | EARTH-RES | Active |
| 272 | 24883 | 1997-037A | ORBVIEW 2 (SEASTAR) | United States | EARTH-RES | Active |
| 273 | 20439 | 1990-005D | OSCAR 16 (PACSAT) | United States | COMM-CIVIL | Active |
| 274 | 7530 | 1974-089B | OSCAR 7 | United States | COMM-CIVIL | Active |
| 275 | 22489 | 1993-009A | OXP 1 | United States | COMM-TEST | Active |
| 276 | 24891 | 1997-040A | PAS 6 | United States | COMM-CIVIL | Active |
| 277 | 24931 | 2001-042C | PCSAT | United States | COMM-CIVIL | Active |
| 278 | 26880 | 2000-044H | PICOSAT 182 (TETHERED) | United States | SCIENCE | Active |
| 279 | 1841 | 1965-105A | PIONEER 6 | United States | SUN | Active |
| 280 | 2398 | 1966-075A | PIONEER 7 | United States | SUN | Active |
| 281 | 3066 | 1967-122A | PIONEER 8 | United States | SUN | Active |
| 282 | 23802 | 1996-013A | POLAR | United States | SCIENCE | Active |
| 283 | 27845 | 2003-031F | QUAKESAT | United States | DISASTERS | Active |
| 284 | 26953 | 2001-047A | QUICKBIRD 2 | United States | EARTH-RES | Active |
| 285 | 25729 | 1999-034A | QUIKSCAT | United States | SCIENCE | Active |
| 286 | 23710 | 1995-059A | RADARSAT | Canada | RADAR-IMAG | Active |
| 287 | 22698 | 1993-041A | RADCAL | United States | RADAR-CAL | Active |
| 288 | 27592 | 2002-033A | RAINBOW 1 | United States | COMM-CIVIL | Active |
| 289 | 21527 | 1991-045A | REX | United States | COMM-TEST | Active |
| 290 | 23814 | 1996-014A | REX 2 | United States | SCIENCE | Active |
| 291 | 22012 | 1992-038A | SAMPEX | United States | SCIENCE | Active |
| 292 | 22117 | 1992-060B | SATCOM C3 | United States | COMM-CIVIL | Active |
| 293 | 22096 | 1992-057A | SATCOM C4 | United States | COMM-CIVIL | Active |
| 294 | 15235 | 1984-093B | SBS 4 | United States | COMM-CIVIL | Active |
| 295 | 20872 | 1990-091A | SBS 6 | United States | COMM-CIVIL | Active |
| 296 | 27589 | 2002-034A | SCISAT 1 | Canada | SCIENCE | Active |
| 297 | 25909 | 1998-061B | SEDSAT 1 | United States | COMM-CIVIL | Active |
| 298 | 26390 | 2000-035A | SIRIUS 1 | United States | COMM-CIVIL | Active |
| 299 | 26493 | 2000-051A | SIRIUS 2 | United States | COMM-CIVIL | Active |
| 300 | 26626 | 2000-077A | SIRIUS 3 | United States | COMM-CIVIL | Active |
| 301 | 27671 | 2003-038A | SIRTF | United States | ASTRONOMY | Active |
| 302 | 20401 | 1990-001A | SKYNET 4A | United Kingdom | COMM-MIL | Active |
| 303 | 20776 | 1990-079A | SKYNET 4C | United Kingdom | COMM-MIL | Active |
| 304 | 25134 | 1998-002A | SKYNET 4D | United Kingdom | COMM-MIL | Active |
| 305 | 25639 | 1999-009B | SKYNET 4E | United Kingdom | COMM-MIL | Active |
| 306 | 26695 | 2001-005B | SKYNET 4F | United Kingdom | COMM-MIL | Active |
| 307 | 26386 | 2000-033C | SNAP 1 | United Kingdom | SCIENCE | Active |
| 308 | 1291 | 1965-015D | SOLRAD 7B | United States | SCIENCE | Active |
| 309 | 27651 | 2003-004A | SORCE | United States | SCIENCE | Active |
| 310 | 21227 | 1991-028A | SPACENET 4 (ASC 2) | United States | COMM-CIVIL | Active |
| 311 | 28644 | 2005-015A | SPACEWAY 1 | United States | COMM-CIVIL | Active |
| 312 | 28903 | 2005-046B | SPACEWAY 2 | United States | COMM-CIVIL | Active |
| 313 | 23105 | 1994-029A | STEP 2 | United States | SCIENCE | Active |
| 314 | 23125 | 1994-034B | STRV 1A | United Kingdom | SCIENCE | Active |
| 315 | 23126 | 1994-034C | STRV 1B | United Kingdom | SCIENCE | Active |
| 316 | 26411 | 2000-072D | STRV 1D | United Kingdom | SCIENCE | Active |
| 317 | 23711 | 1995-059B | SURFSAT | United States | SCIENCE | Active |
| 318 | 25560 | 1998-071A | SWAS | United States | SCIENCE | Active |
| 319 | 28485 | 2004-047A | SWIFT | United States | SCIENCE | Active |
| 320 | 13969 | 1983-024B | TDRS 1 | United States | COMM-CIVIL | Active |
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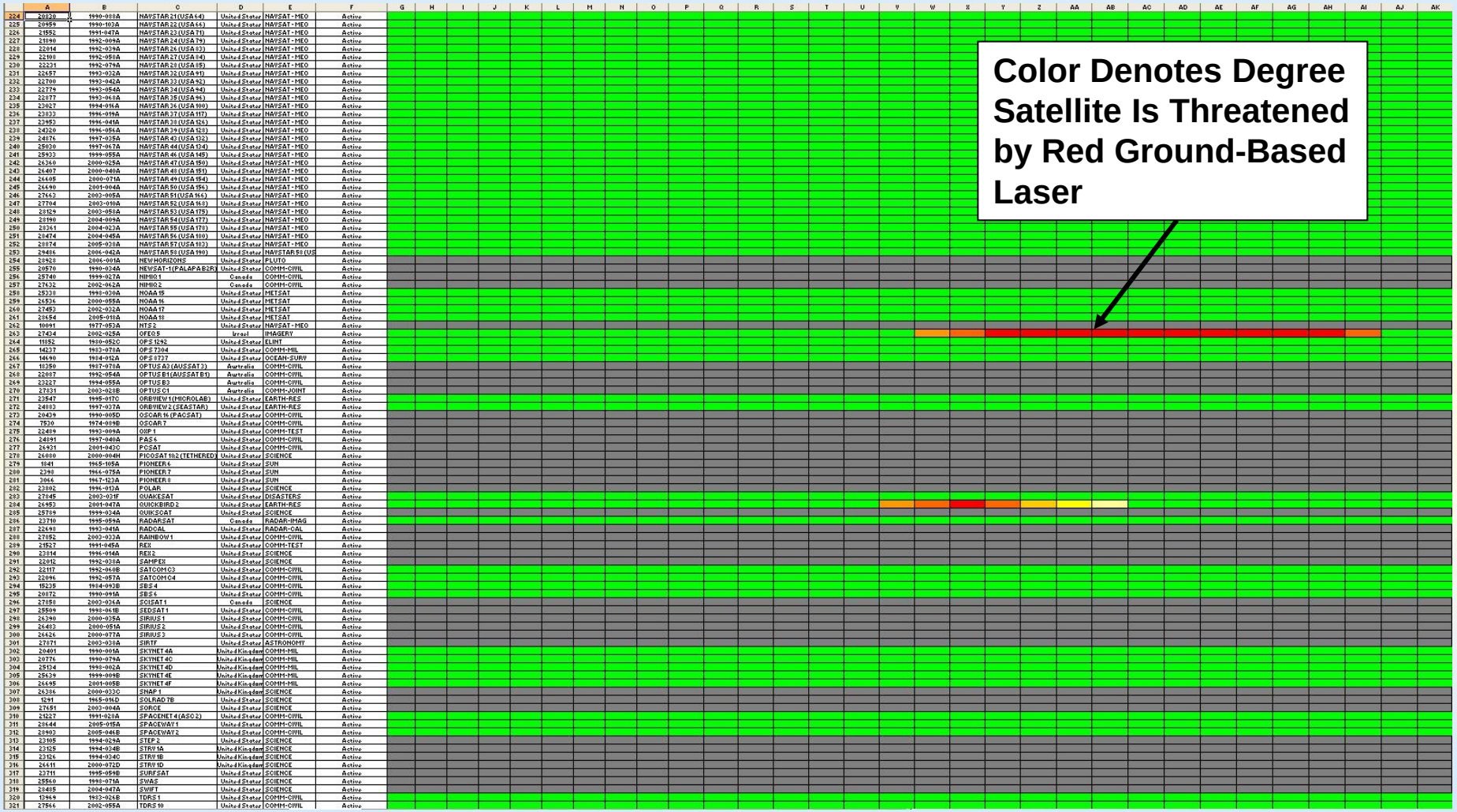
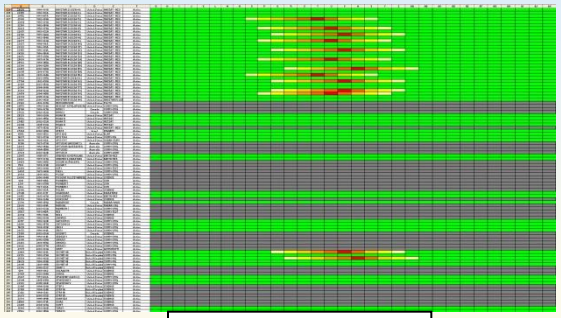
# Threat Assessment Summary (TAS) - Ground-Based Laser -



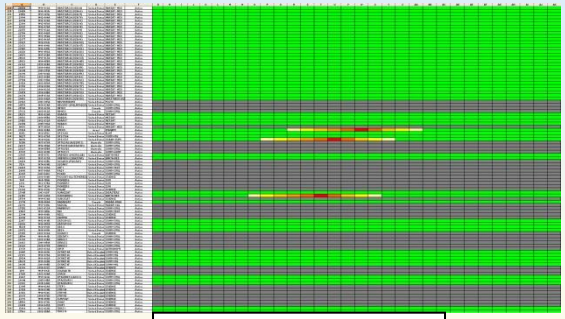

| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 224 | 20830 | 1990-033A | NAVSTAR 21 (USA 64) | United States | NAVSAT-MEO | Active |
| 225 | 20959 | 1990-103A | NAVSTAR 22 (USA 66) | United States | NAVSAT-MEO | Active |
| 226 | 21552 | 1991-047A | NAVSTAR 23 (USA 71) | United States | NAVSAT-MEO | Active |
| 227 | 21890 | 1992-009A | NAVSTAR 24 (USA 79) | United States | NAVSAT-MEO | Active |
| 228 | 22014 | 1992-039A | NAVSTAR 26 (USA 83) | United States | NAVSAT-MEO | Active |
| 229 | 22108 | 1992-058A | NAVSTAR 27 (USA 84) | United States | NAVSAT-MEO | Active |
| 230 | 22231 | 1992-079A | NAVSTAR 28 (USA 85) | United States | NAVSAT-MEO | Active |
| 231 | 22657 | 1993-032A | NAVSTAR 32 (USA 91) | United States | NAVSAT-MEO | Active |
| 232 | 22700 | 1993-042A | NAVSTAR 33 (USA 92) | United States | NAVSAT-MEO | Active |
| 233 | 22779 | 1993-054A | NAVSTAR 34 (USA 94) | United States | NAVSAT-MEO | Active |
| 234 | 22877 | 1993-068A | NAVSTAR 35 (USA 96) | United States | NAVSAT-MEO | Active |
| 235 | 23027 | 1994-016A | NAVSTAR 36 (USA 100) | United States | NAVSAT-MEO | Active |
| 236 | 23833 | 1996-019A | NAVSTAR 37 (USA 117) | United States | NAVSAT-MEO | Active |
| 237 | 23953 | 1996-041A | NAVSTAR 38 (USA 126) | United States | NAVSAT-MEO | Active |
| 238 | 24320 | 1996-056A | NAVSTAR 39 (USA 128) | United States | NAVSAT-MEO | Active |
| 239 | 24876 | 1997-035A | NAVSTAR 43 (USA 132) | United States | NAVSAT-MEO | Active |
| 240 | 25030 | 1997-067A | NAVSTAR 44 (USA 134) | United States | NAVSAT-MEO | Active |
| 241 | 25933 | 1999-055A | NAVSTAR 46 (USA 145) | United States | NAVSAT-MEO | Active |
| 242 | 26360 | 2000-025A | NAVSTAR 47 (USA 150) | United States | NAVSAT-MEO | Active |
| 243 | 26407 | 2000-040A | NAVSTAR 48 (USA 151) | United States | NAVSAT-MEO | Active |
| 244 | 26605 | 2000-071A | NAVSTAR 49 (USA 154) | United States | NAVSAT-MEO | Active |
| 245 | 26690 | 2001-004A | NAVSTAR 50 (USA 156) | United States | NAVSAT-MEO | Active |
| 246 | 27663 | 2002-005A | NAVSTAR 51 (USA 166) | United States | NAVSAT-MEO | Active |
| 247 | 27704 | 2002-019A | NAVSTAR 52 (USA 168) | United States | NAVSAT-MEO | Active |
| 248 | 28129 | 2003-058A | NAVSTAR 53 (USA 175) | United States | NAVSAT-MEO | Active |
| 249 | 28190 | 2004-009A | NAVSTAR 54 (USA 177) | United States | NAVSAT-MEO | Active |
| 250 | 28361 | 2004-023A | NAVSTAR 55 (USA 178) | United States | NAVSAT-MEO | Active |
| 251 | 28474 | 2004-045A | NAVSTAR 56 (USA 180) | United States | NAVSAT-MEO | Active |
| 252 | 28874 | 2005-038A | NAVSTAR 57 (USA 183) | United States | NAVSAT-MEO | Active |
| 253 | 29486 | 2006-042A | NAVSTAR 58 (USA 190) | United States | NAVSTAR 58 (US | Active |
| 254 | 28928 | 2006-001A | NEW HORIZONS | United States | PLUTO | Active |
| 255 | 20570 | 1990-034A | NEWSAT-1 (PALAPA B2R) | United States | COMM-CIVIL | Active |
| 256 | 25740 | 1999-027A | NIMIQ 1 | Canada | COMM-CIVIL | Active |
| 257 | 27632 | 2002-062A | NIMIQ 2 | Canada | COMM-CIVIL | Active |
| 258 | 25338 | 1998-020A | NOAA 15 | United States | METSAT | Active |
| 259 | 26526 | 2000-055A | NOAA 16 | United States | METSAT | Active |
| 260 | 27453 | 2002-032A | NOAA 17 | United States | METSAT | Active |
| 261 | 28654 | 2005-018A | NOAA 18 | United States | METSAT | Active |
| 262 | 10691 | 1977-053A | NTS 2 | United States | NAVSAT-MEO | Active |
| 263 | 27434 | 2002-025A | OFEQ 5 | Israel | IMAGERY | Active |
| 264 | 11852 | 1980-052C | OPS 1292 | United States | ELINT | Active |
| 265 | 14237 | 1983-078A | OPS 7204 | United States | COMM-MIL | Active |
| 266 | 14690 | 1984-012A | OPS 8737 | United States | OCEAN-SURV | Active |
| 267 | 18350 | 1987-078A | OPTUS A2 (AUSSAT 3) | Australia | COMM-CIVIL | Active |
| 268 | 22087 | 1992-054A | OPTUS B1 (AUSSAT B1) | Australia | COMM-CIVIL | Active |
| 269 | 23227 | 1994-055A | OPTUS B3 | Australia | COMM-CIVIL | Active |
| 270 | 27631 | 2002-028B | OPTUS C1 | Australia | COMM-JOINT | Active |
| 271 | 23547 | 1995-017C | ORBVIEW 1 (MICROLAB) | United States | EARTH-RES | Active |
| 272 | 24883 | 1997-037A | ORBVIEW 2 (SEASTAR) | United States | EARTH-RES | Active |
| 273 | 20439 | 1990-005D | OSCAR 16 (PACSAT) | United States | COMM-CIVIL | Active |
| 274 | 7530 | 1974-089B | OSCAR 7 | United States | COMM-CIVIL | Active |
| 275 | 22489 | 1993-009A | OXP 1 | United States | COMM-TEST | Active |
| 276 | 24891 | 1997-040A | PAS 6 | United States | COMM-CIVIL | Active |
| 277 | 24931 | 2001-042C | PCSAT | United States | COMM-CIVIL | Active |
| 278 | 26880 | 2000-004H | PICOSAT 1&2 (TETHERED) | United States | SCIENCE | Active |
| 279 | 1841 | 1965-105A | PIONEER 6 | United States | SUN | Active |
| 280 | 2398 | 1966-075A | PIONEER 7 | United States | SUN | Active |
| 281 | 3966 | 1967-122A | PIONEER 8 | United States | SUN | Active |
| 282 | 23802 | 1996-013A | POLAR | United States | SCIENCE | Active |
| 283 | 27845 | 2003-031F | QUAKESAT | United States | DISASTERS | Active |
| 284 | 26953 | 2001-047A | QUICKBIRD 2 | United States | EARTH-RES | Active |
| 285 | 25729 | 1999-034A | QUIKSCAT | United States | SCIENCE | Active |
| 286 | 23710 | 1995-059A | RADARSAT | Canada | RADAR-IMAG | Active |
| 287 | 22698 | 1993-041A | RADCAL | United States | RADAR-CAL | Active |
| 288 | 27592 | 2002-032A | RAINBOW 1 | United States | COMM-CIVIL | Active |
| 289 | 21527 | 1991-045A | REX | United States | COMM-TEST | Active |
| 290 | 23814 | 1996-014A | REX 2 | United States | SCIENCE | Active |
| 291 | 22012 | 1992-038A | SAMPEX | United States | SCIENCE | Active |
| 292 | 22117 | 1992-060B | SATCOM C3 | United States | COMM-CIVIL | Active |
| 293 | 22096 | 1992-057A | SATCOM C4 | United States | COMM-CIVIL | Active |
| 294 | 15235 | 1984-093B | SBS 4 | United States | COMM-CIVIL | Active |
| 295 | 20872 | 1990-091A | SBS 6 | United States | COMM-CIVIL | Active |
| 296 | 27589 | 2002-034A | SCISAT 1 | Canada | SCIENCE | Active |
| 297 | 25909 | 1998-061B | SEDSAT 1 | United States | COMM-CIVIL | Active |
| 298 | 26390 | 2000-035A | SIRIUS 1 | United States | COMM-CIVIL | Active |
| 299 | 26483 | 2000-051A | SIRIUS 2 | United States | COMM-CIVIL | Active |
| 300 | 26626 | 2000-077A | SIRIUS 3 | United States | COMM-CIVIL | Active |
| 301 | 27671 | 2003-038A | SIRTF | United States | ASTRONOMY | Active |
| 302 | 20401 | 1990-001A | SKYNET 4A | United Kingdom | COMM-MIL | Active |
| 303 | 20776 | 1990-079A | SKYNET 4C | United Kingdom | COMM-MIL | Active |
| 304 | 25134 | 1998-002A | SKYNET 4D | United Kingdom | COMM-MIL | Active |
| 305 | 25639 | 1999-009B | SKYNET 4E | United Kingdom | COMM-MIL | Active |
| 306 | 26695 | 2001-005B | SKYNET 4F | United Kingdom | COMM-MIL | Active |
| 307 | 26386 | 2000-033C | SNAP 1 | United Kingdom | SCIENCE | Active |
| 308 | 1291 | 1965-015D | SOLRAD 7B | United States | SCIENCE | Active |
| 309 | 27651 | 2003-004A | SORCE | United States | SCIENCE | Active |
| 310 | 21227 | 1991-028A | SPACENET 4 (ASC 2) | United States | COMM-CIVIL | Active |
| 311 | 28644 | 2005-015A | SPACEWAY 1 | United States | COMM-CIVIL | Active |
| 312 | 28903 | 2005-046B | SPACEWAY 2 | United States | COMM-CIVIL | Active |
| 313 | 23105 | 1994-029A | STEP 2 | United States | SCIENCE | Active |
| 314 | 23125 | 1994-034B | STRV 1A | United Kingdom | SCIENCE | Active |
| 315 | 23126 | 1994-034C | STRV 1B | United Kingdom | SCIENCE | Active |
| 316 | 26411 | 2000-072D | STRV 1D | United Kingdom | SCIENCE | Active |
| 317 | 23711 | 1995-059B | SURFSAT | United States | SCIENCE | Active |
| 318 | 25560 | 1998-071A | SWAS | United States | SCIENCE | Active |
| 319 | 28485 | 2004-047A | SWIFT | United States | SCIENCE | Active |
| 320 | 13969 | 1983-024B | TDRS 1 | United States | COMM-CIVIL | Active |
| 321 | 27566 | 2002-055A | TDRS 10 | United States | COMM-CIVIL | Active |

# Threat Assessment Summary (TAS) - Attack Potential Summary Inputs -



Maneuvers

+



Surveillance

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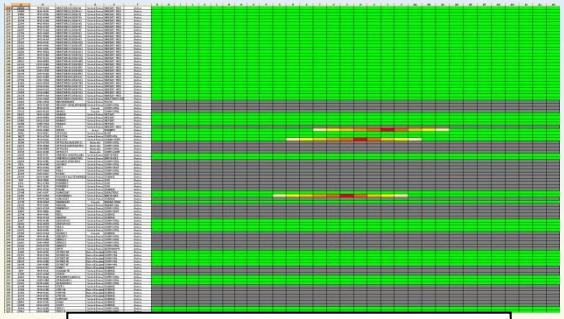

Direct Ascent ASAT

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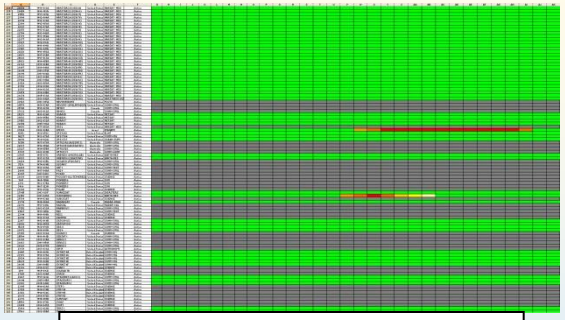
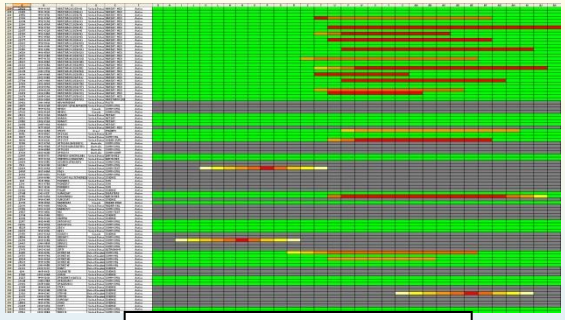


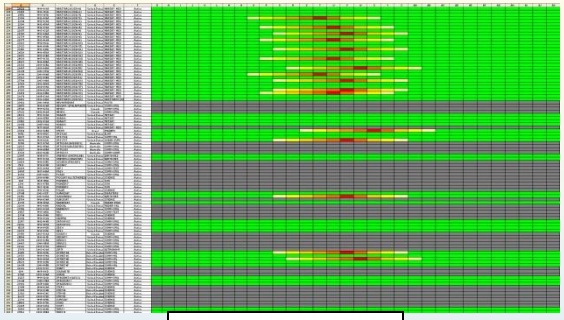
Ground-Based ASAT

+



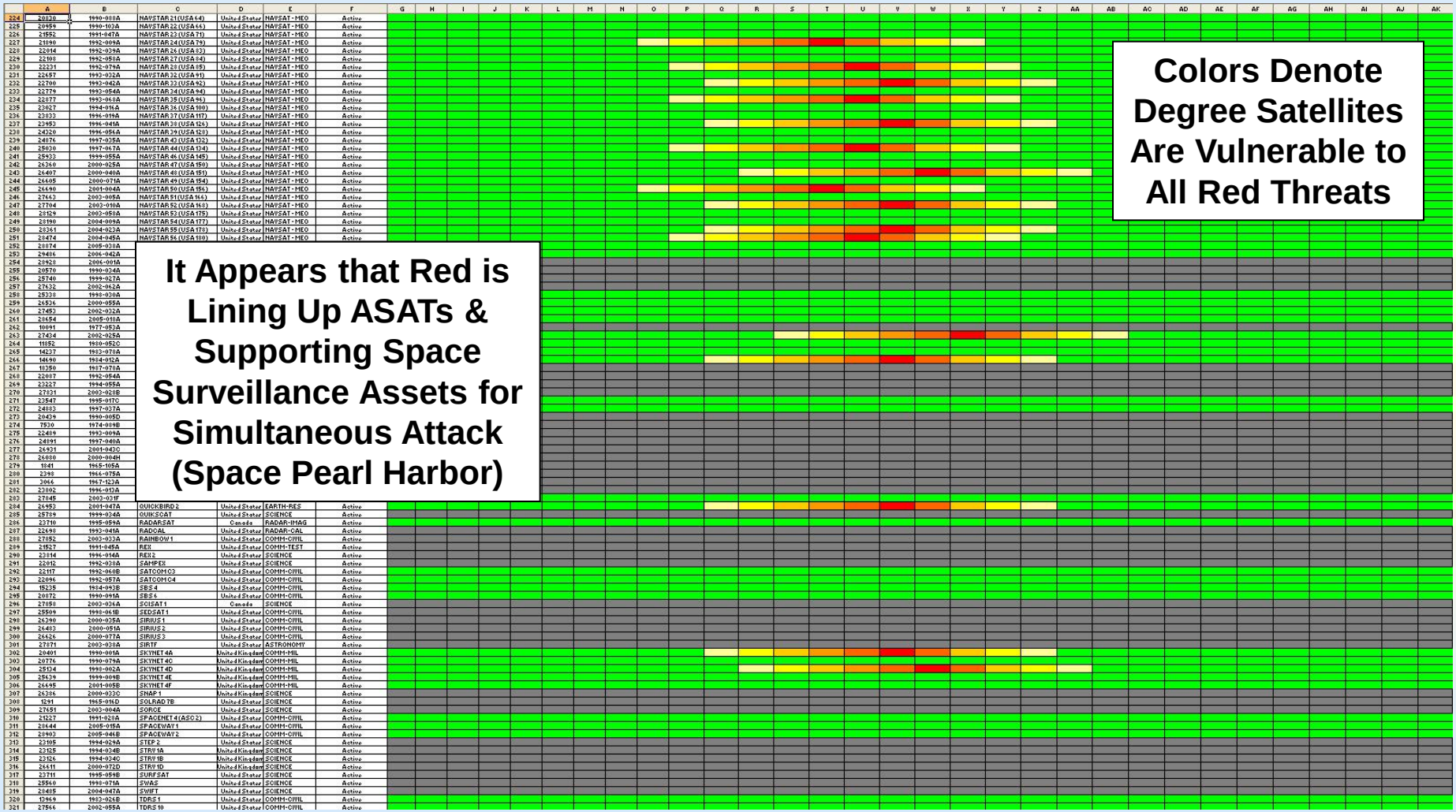
Satellite Status

=



Summary

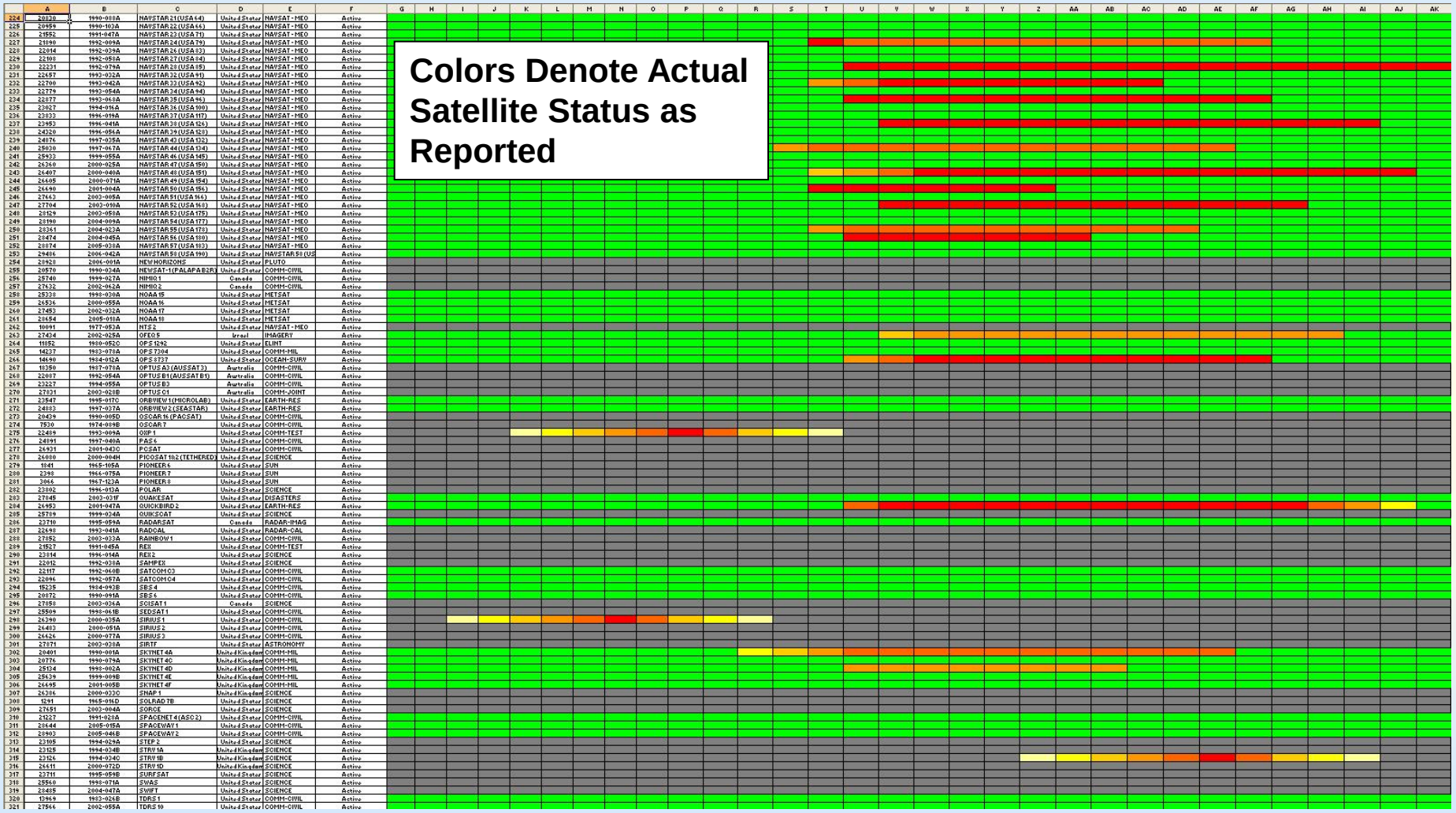
# Threat Assessment Summary (TAS) - Attack Potential Summary -



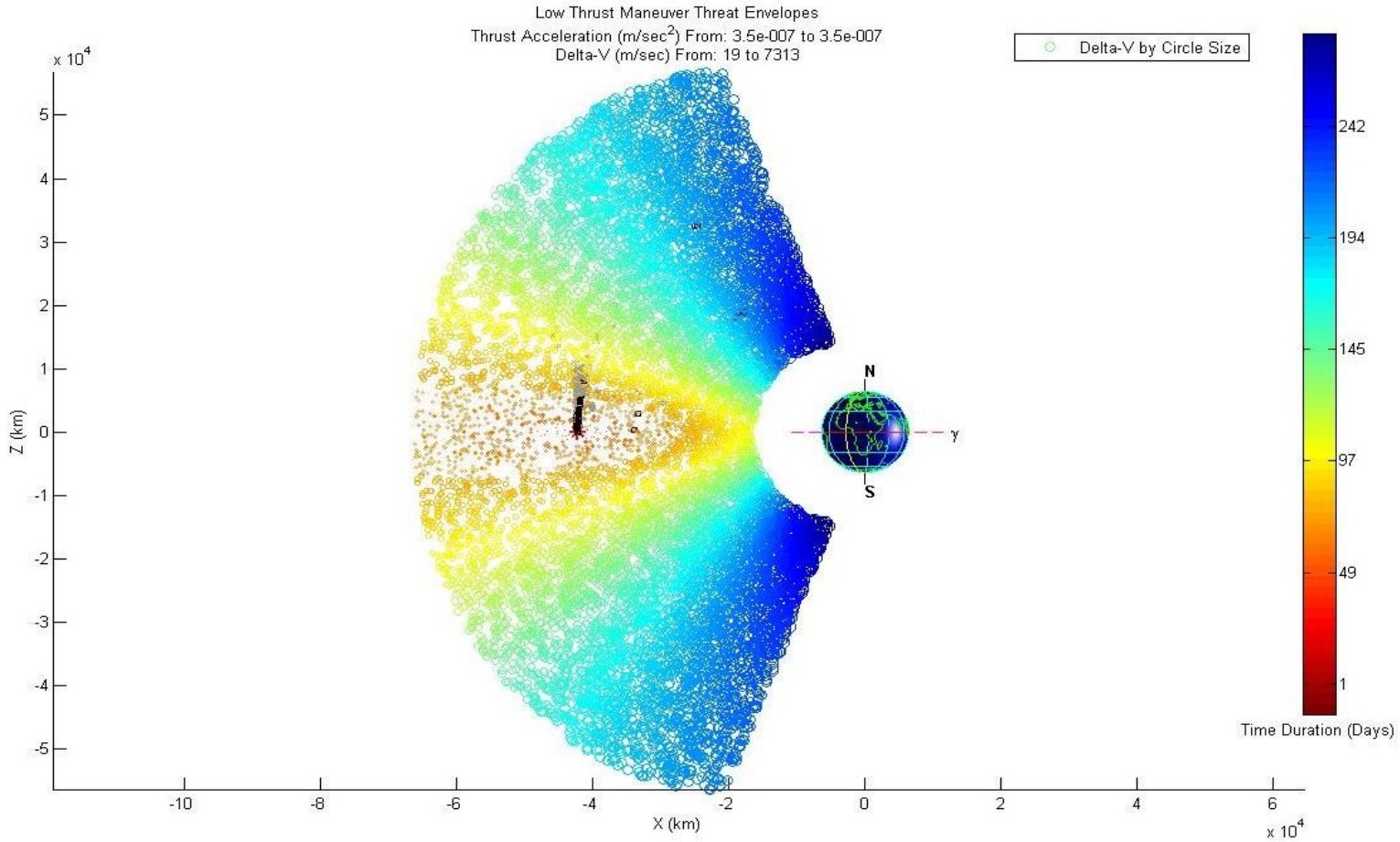
**Colors Denote Degree Satellites Are Vulnerable to All Red Threats**

**It Appears that Red is Lining Up ASATs & Supporting Space Surveillance Assets for Simultaneous Attack (Space Pearl Harbor)**

# Threat Assessment Summary (TAS) - Actual Satellite Status -

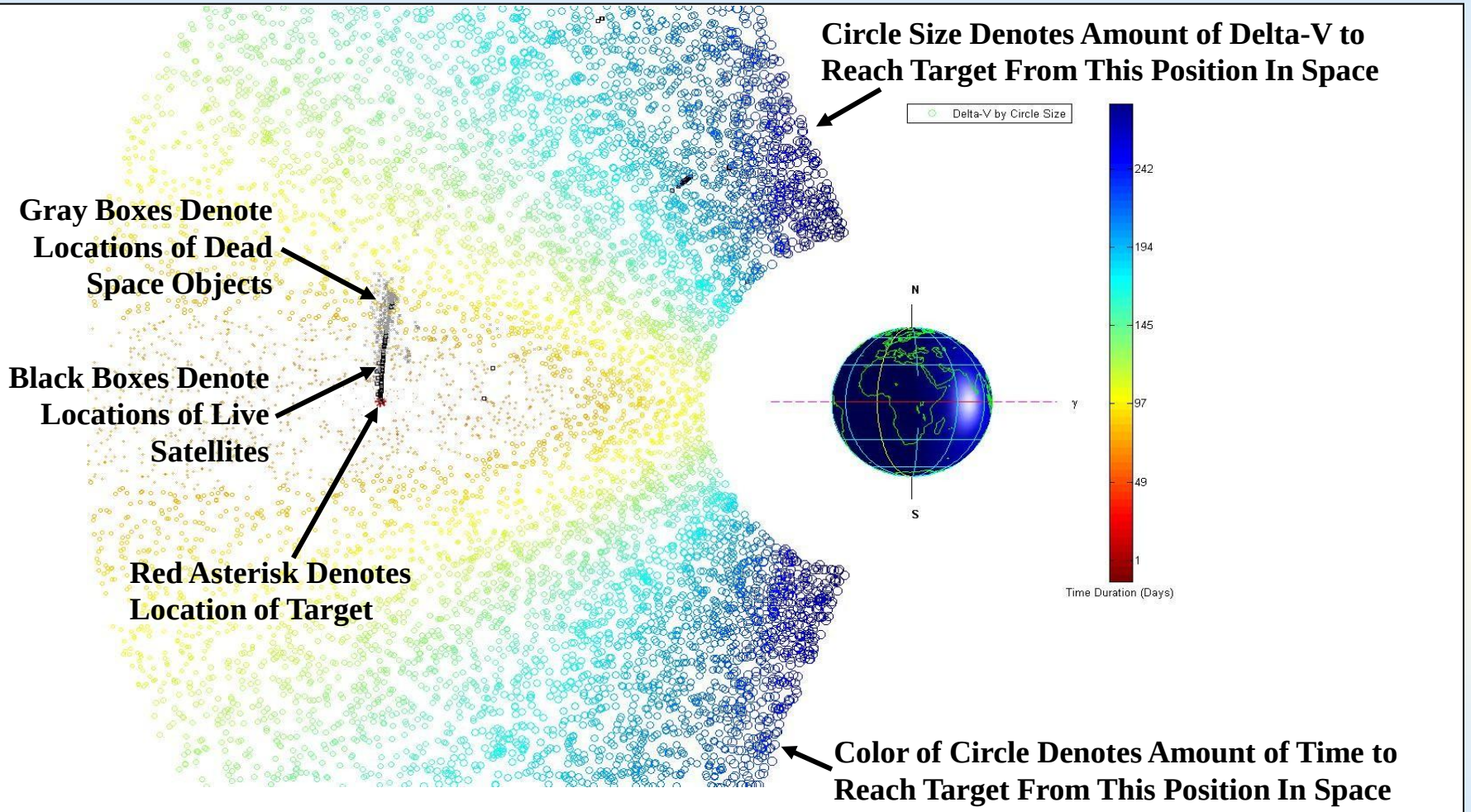


# Threat Envelope Chart (TEC) View 1



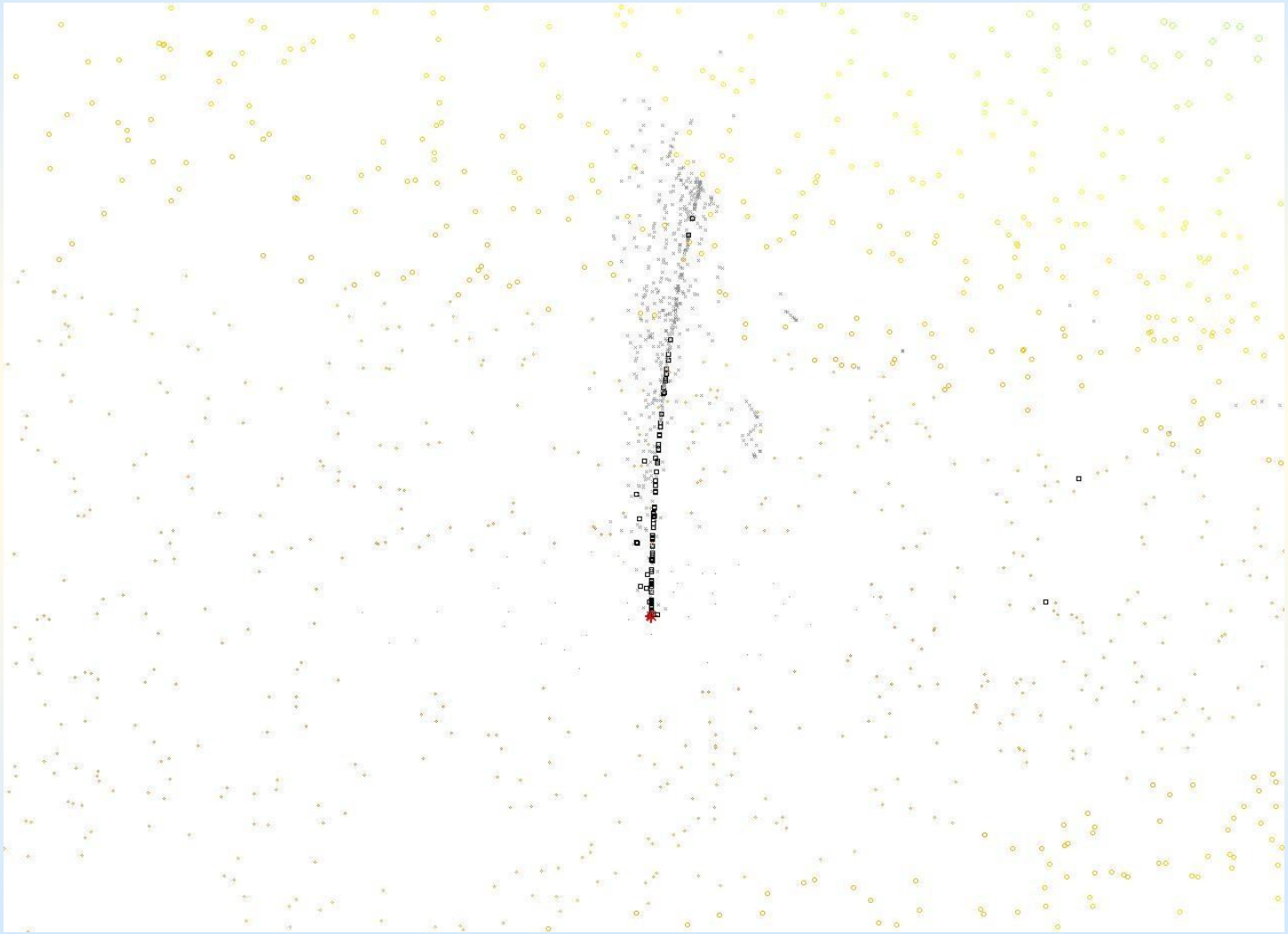

**Some Orbits are Easier to Maneuver to Than Others**

# Example Threat Envelope View 2




**Some Regions of Space May be More Threatening than Others**

# Example Threat Envelope View 3



# State Change Algorithms

# SWAT State Change Parameters Analyzed (26 Total)

## Physical Characteristics

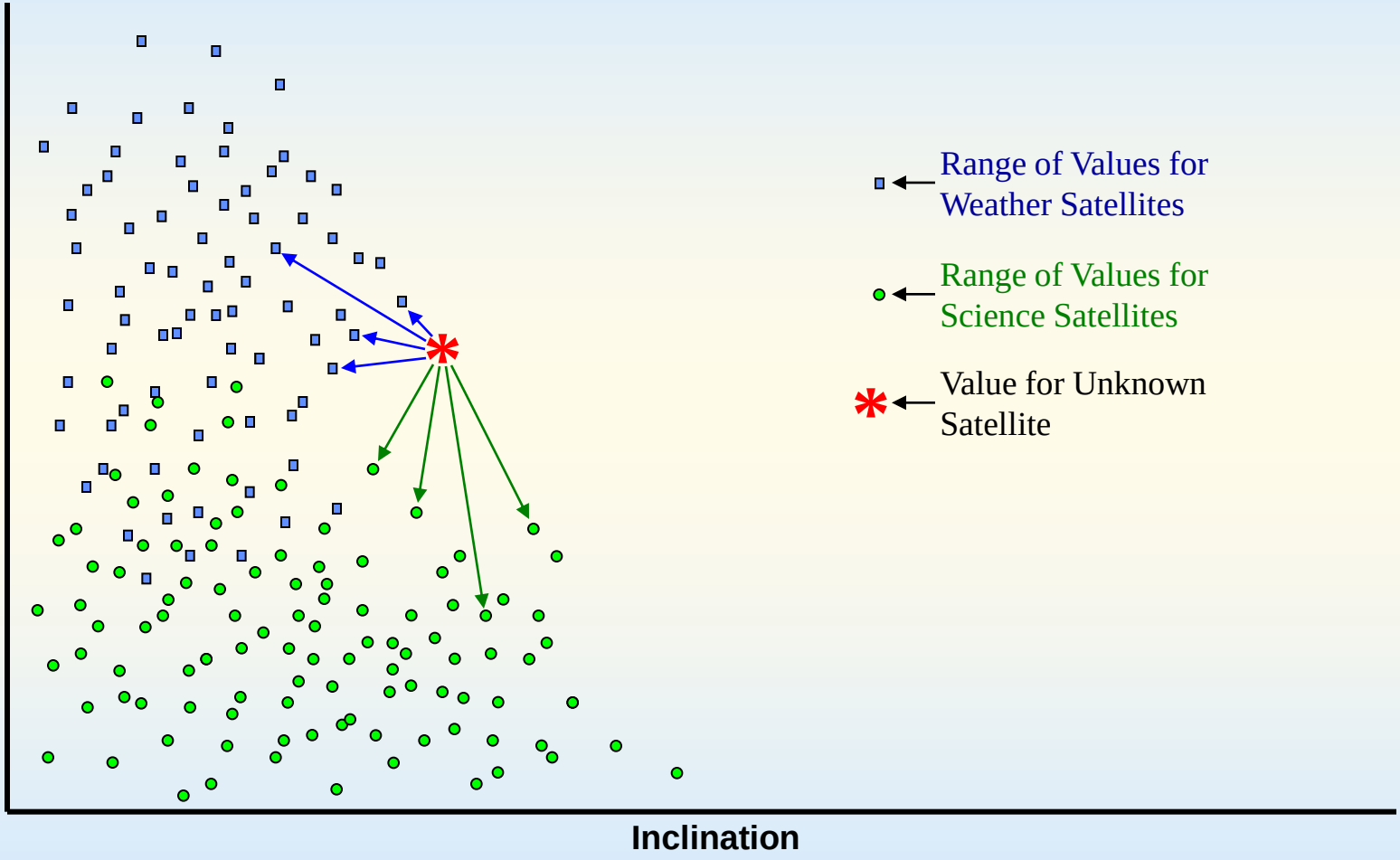
- Radar Cross Section (RCS)
- Optical Cross Section
- Flashing or Not
- Flash Period
- Stabilization Type (Spinning or 3-Axis)
- Object Shape (Sphere, Cylinder, Box)
- Length
- Width
- Height
- Mass
- Spin Rate
- Delta-V
- Satellite Position (Geosynchronous)
- Beginning of Life On-Board Power
- Major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

# 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 |

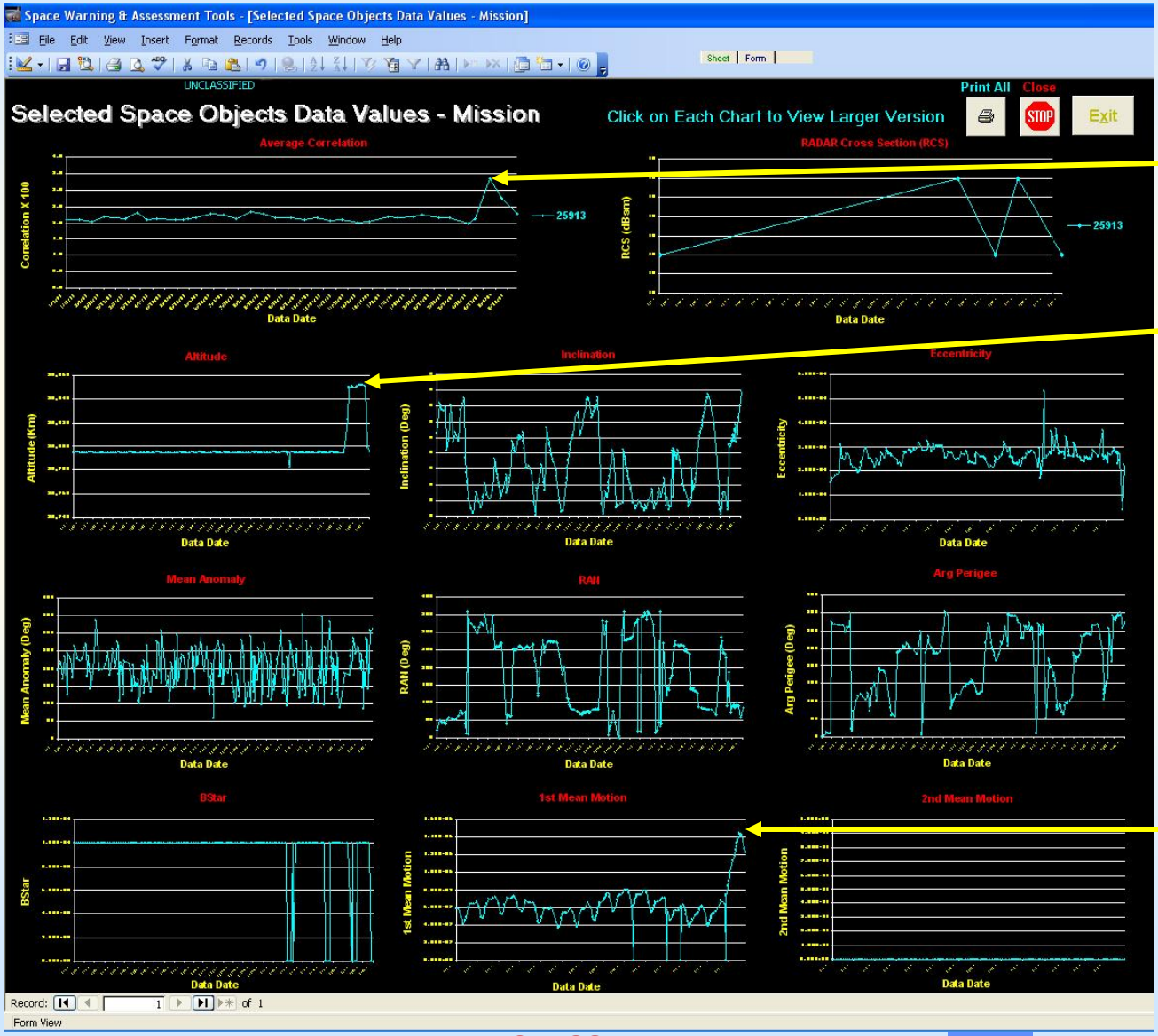
# SWAT Correlation Types

- **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 (4,117,708 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

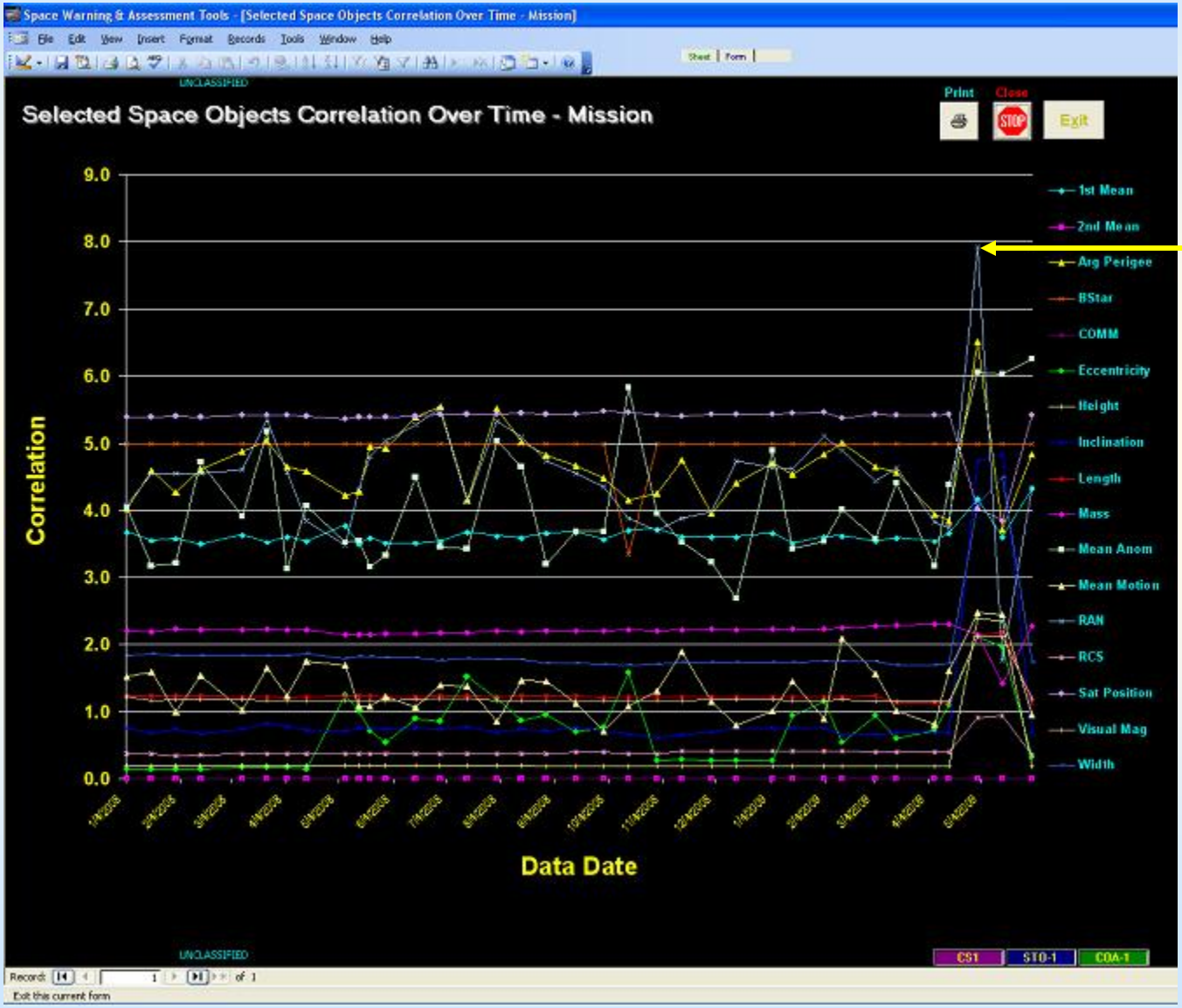



**Orbital Maneuver Detected In State Change Algorithms**

**Orbital Maneuver (57 km)**

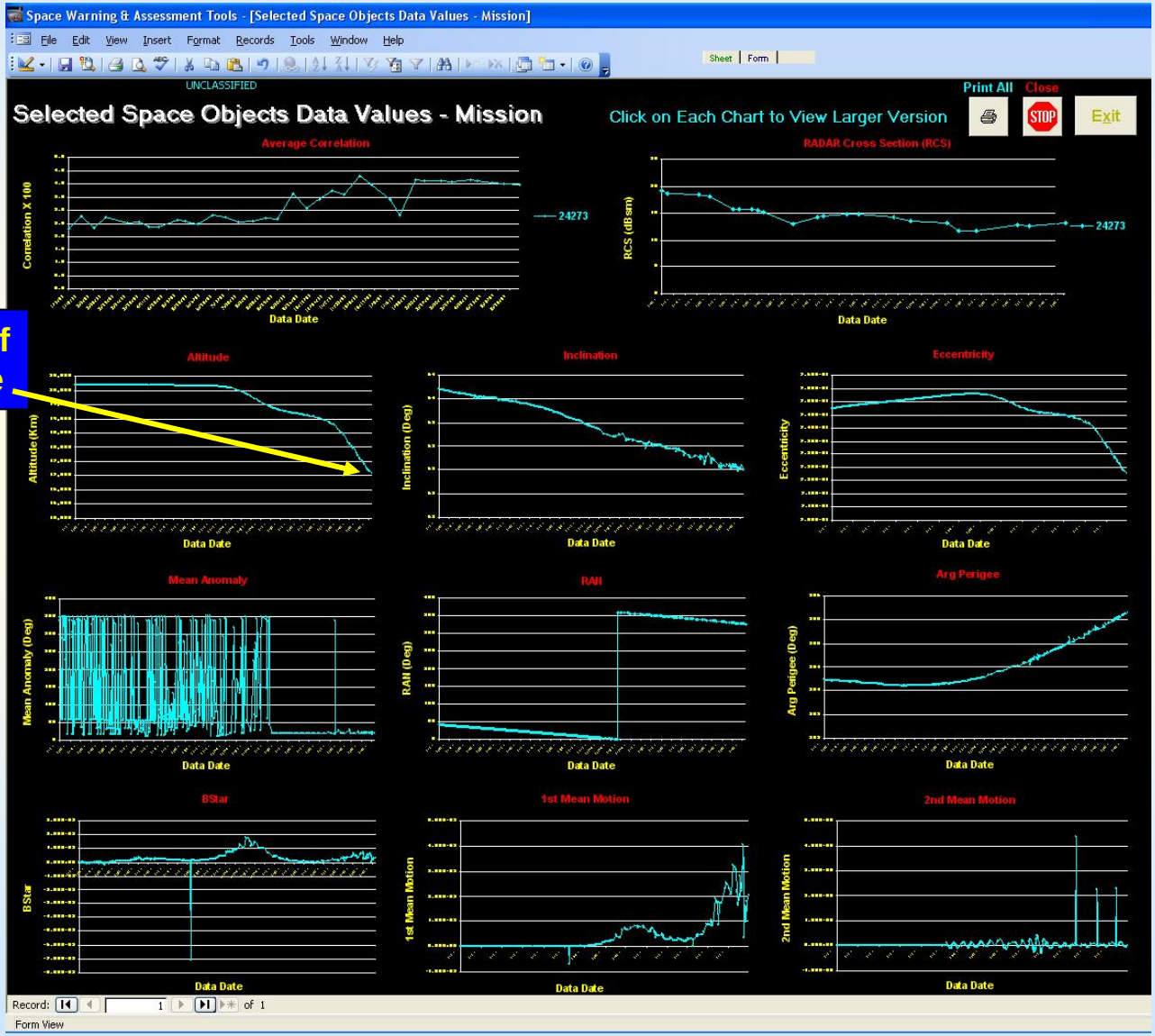
**1st Derivative of Altitude**

# ECHOSTAR 5 Correlations



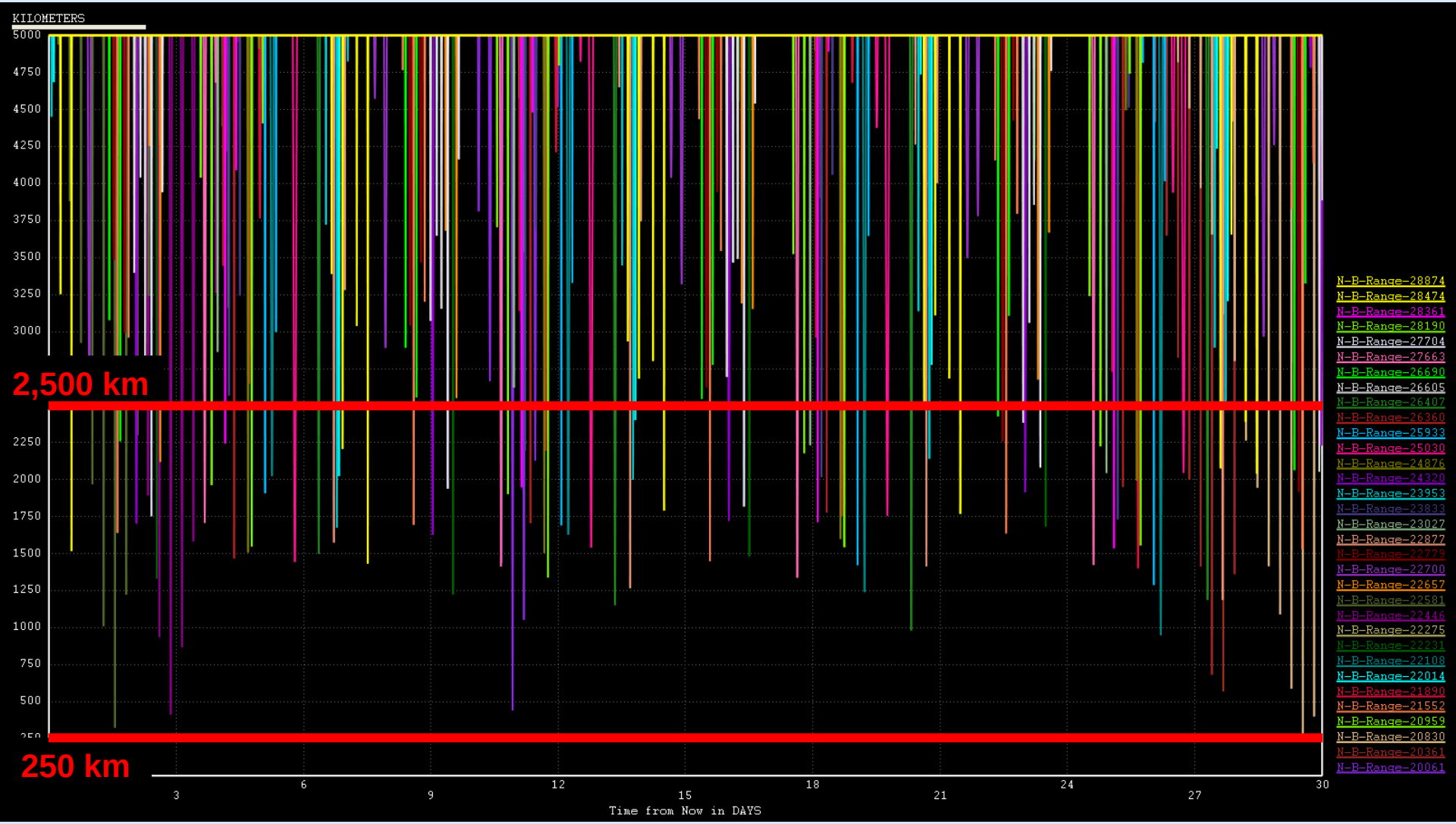

**Orbital Maneuver Affected RAN, Arg Perigee, Mean Anomaly, Sat Position, Inclination, Eccentricity, Mean Motion, RCS, and Visual Mag Correlations Against Other GEO Satellites.**

# MOLNIYA Decay

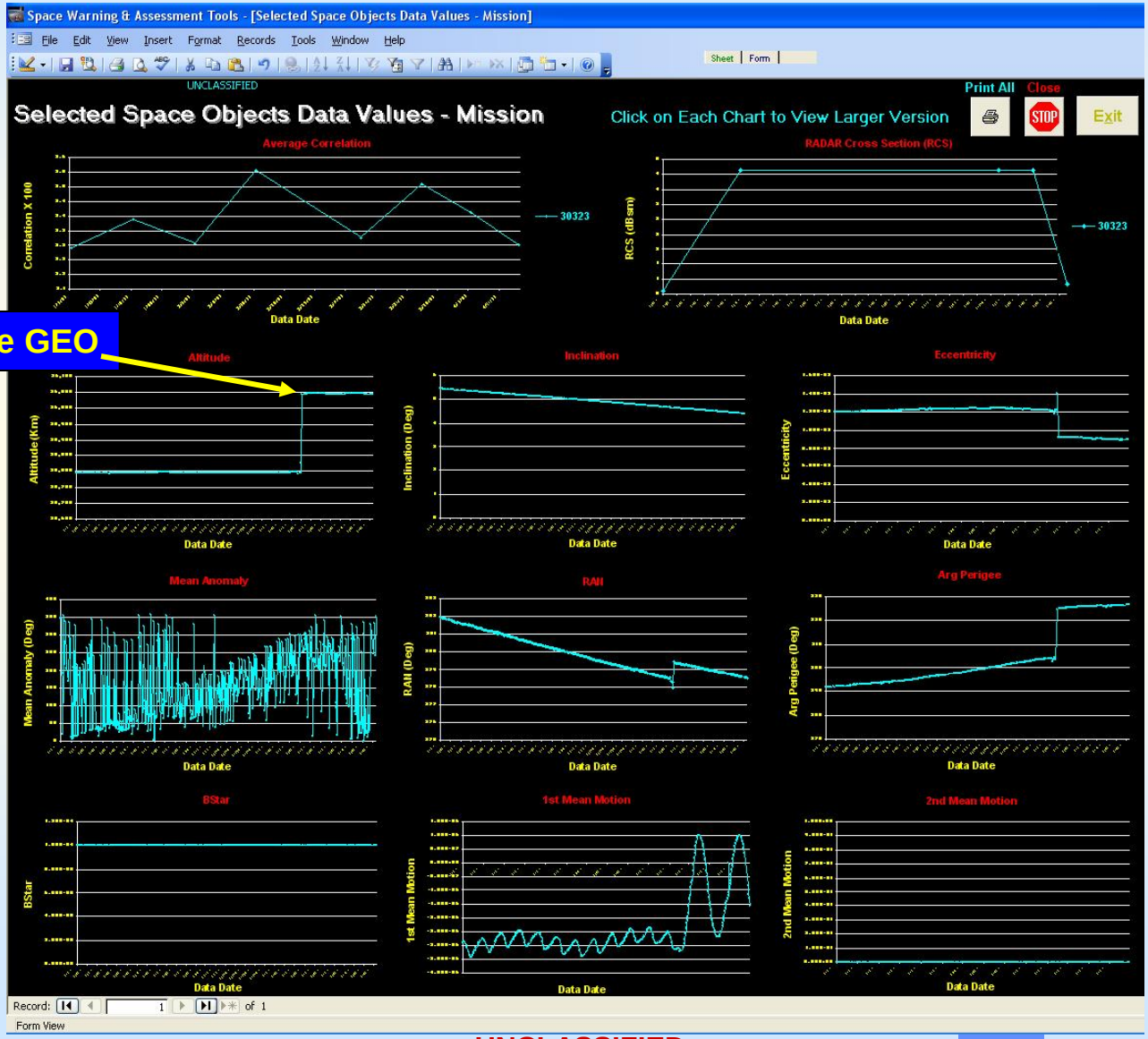



**3,097 Km Loss of Average Altitude**

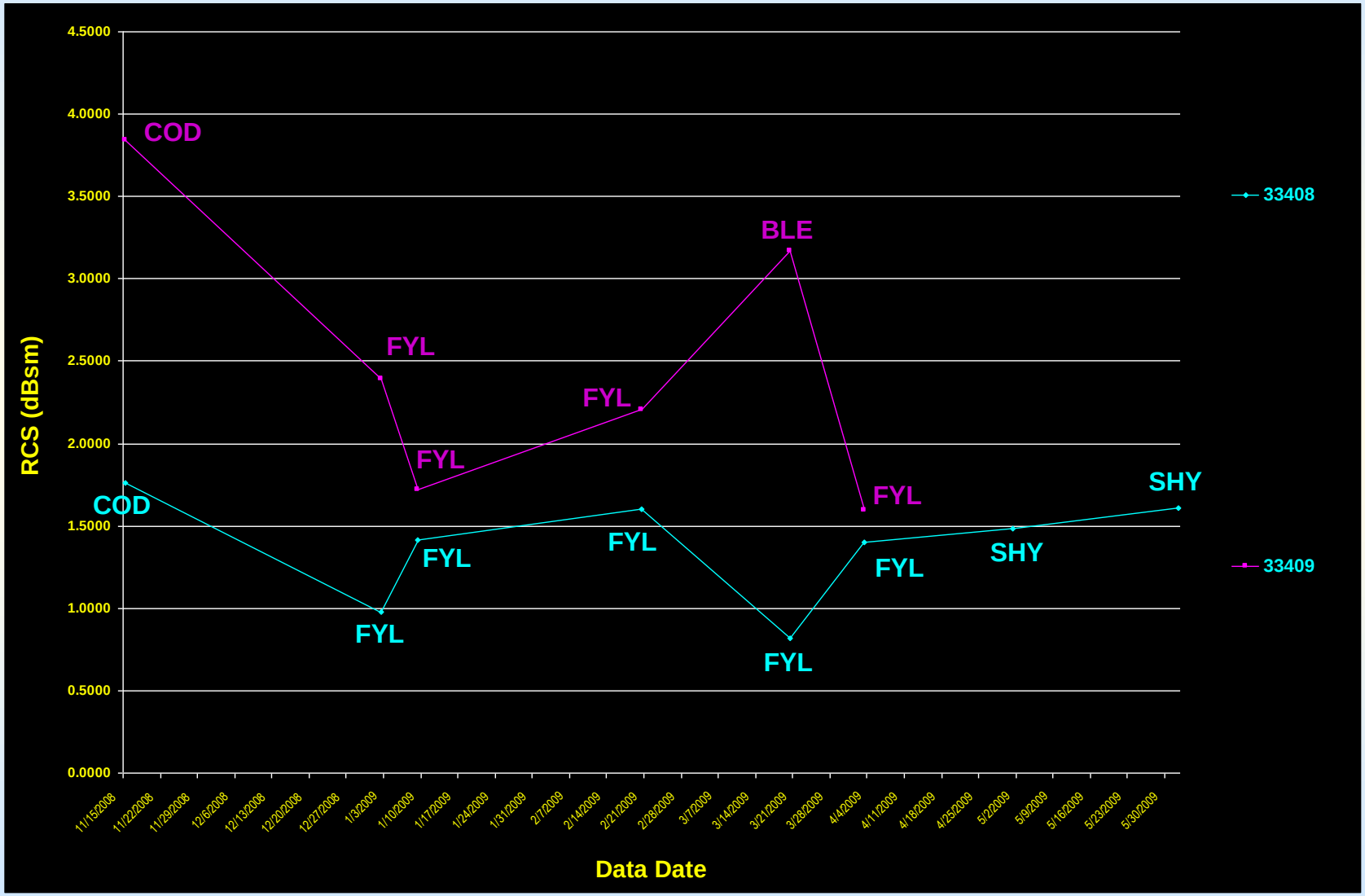
# Beidou - MEO


KILOMETERS
5000
4750
4500
4250
4000
3750
3500
3250
3000
2,500 km
2250
2000
1750
1500
1250
1000
750
500
250 km
3
6
9
12
15
18
21
24
27
30
Time from Now in DAYS
N-B-Range-28874
N-B-Range-28474
N-B-Range-28361
N-B-Range-28190
N-B-Range-27704
N-B-Range-27663
N-B-Range-26690
N-B-Range-26605
N-B-Range-26407
N-B-Range-26360
N-B-Range-25933
N-B-Range-25030
N-B-Range-24876
N-B-Range-24320
N-B-Range-23953
N-B-Range-23833
N-B-Range-23027
N-B-Range-22877
N-B-Range-22773
N-B-Range-22700
N-B-Range-22657
N-B-Range-22581
N-B-Range-22446
N-B-Range-22275
N-B-Range-22231
N-B-Range-22108
N-B-Range-22014
N-B-Range-21890
N-B-Range-21552
N-B-Range-20959
N-B-Range-20830
N-B-Range-20361
N-B-Range-20061

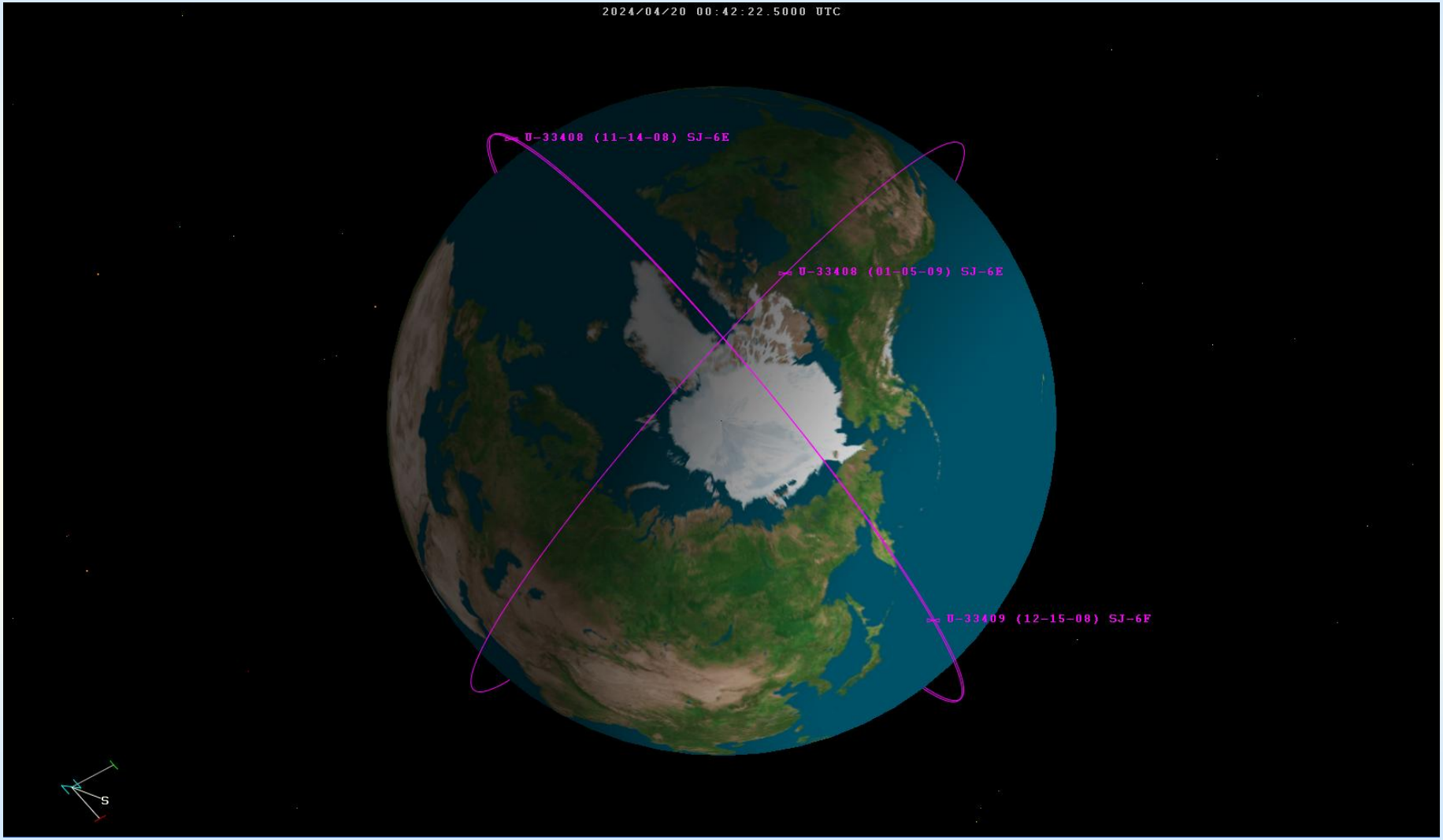
# Beidou - GEO Maneuver



# SJ's


RCS (dBsm)
4.5000
4.0000
3.5000
3.0000
2.5000
2.0000
1.5000
1.0000
0.5000
0.0000
COD
FYL
FYL
FYL
BLE
FYL
COD
FYL
FYL
FYL
FYL
SHY
SHY
33408
33409
11/15/2008
11/22/2008
11/29/2008
12/6/2008
12/13/2008
12/20/2008
12/27/2008
1/3/2009
1/10/2009
1/17/2009
1/24/2009
1/31/2009
2/7/2009
2/14/2009
2/21/2009
2/28/2009
3/7/2009
3/14/2009
3/21/2009
3/28/2009
4/4/2009
4/11/2009
4/18/2009
4/25/2009
5/2/2009
5/9/2009
5/16/2009
5/23/2009
5/30/2009
Data Date

# 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

# Space Tactics

## Space Segment COA #1 – Ground Based Laser (GBL)

OBJECTIVES –

1) Deny access to battlefield by blinding EO sensors
2) Degrade EO sensors by damaging parts of the focal plane
3) Degrade mission by damaging parts of the solar array
4) Destroy mission by damaging optics

Probability of Deployment (2025) – HIGH

Security – Within national borders / HIGH

Surprise – Quick ramp-up under cover before employment / HIGH

Uses -
1) Peacetime
2) Crisis
3) Overt Military

Strategies -
1) Periodic Degrade
2) Herd Sensors
3) Hidden Negate

Range – LEO

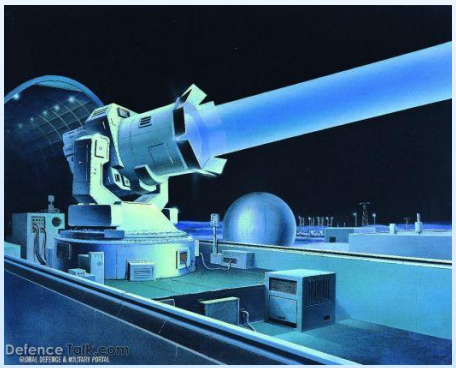
Availability – High for first use, significant recharge time needed for next event.

| INDICATORS | Long-Term | Short-Term |
|---|---|---|
| Preliminary | Fuels delivery to site | Remove optical covers |
| Time of Engagement | Sensor data degradation | Solar array thermistors |
| Post-Battle | Sensor data degradation | Various housekeeping thermistors |

## MASS / ECONOMY / MANUEVER

POOR –

1) Expensive per site cost. Significant continuous personnel requirements. Short runtimes for chemical systems.
2) Extensive space segment intelligence needed for subtle/low power effects.
3) Very complex power source and optics.
4) Limited targeting angles



# Space Segment COA #2 – Direct Ascent KEW

OBJECTIVES –
1) Destroy mission by using a ground-to-space missile/homing warhead

Range – LEO
Availability – High

| INDICATORS | Long-Term | Short-Term |
|---|---|---|
| Preliminary | Launch site preparations or ground/sea units moving to launch position | High use of orbit determination assets for accurate targeting |
| Time of Engagement | Increased optical/radar signatures | Loss of telemetry |
| Post-Battle | Debris cloud detection and spread | N/A |

## SYSTEM PROVEN IN TESTS

Security – Within national borders or placed with large forces / HIGH to GOOD

Surprise – Can require full launch site support or stored with other large tactical missiles / HIGH to POOR

Uses - 1) Crisis
2) Overt Military

Strategies - 1) Sweep the Skies
2) Herd Sensors

SEVERE POLITICAL REACTIONS ALREADY SEEN

## MASS / ECONOMY / MANUEVER

GOOD –
1) Reasonable per unit cost. Existing support personnel for usual missile support. Existing missile production can be used.

2) Little intelligence required past orbit parameters.

3) Proven technologies.

4) Many targeting opportunities

# Space Segment COA #3 – Co-Orbital KEW

OBJECTIVES –
1) Destroy mission by using a satellite-mounted HEE warhead

System may have been completely tested in orbit during 1980s

Security – Within national borders at launch. May be stealthy to avoid detection / HIGH

Surprise – Maneuvers can take a long time. Allows detection and avoidance if radars can detect the object / FAIR

Uses -
1) Crisis
2) Overt Military

Strategies -
1) Periodic Degrade
2) Herd Sensors
3) Herd Comm

Range – Booster-Dependent
Availability – Moderate

| INDICATORS | Long-Term | Short-Term |
|---|---|---|
| Preliminary | Launch site preparations or ground/sea units moving to launch position | Launch into particular inclinations and altitudes |
| Time of Engagement | Increased optical/radar signatures | Loss of telemetry or anomalous behaviors |
| Post-Battle | Debris cloud detection and spread or rapid degradation of bus/payload | N/A |

## MASS / ECONOMY / MANUEVER

FAIR –
1) Complete to-orbit launch system needed. Existing support personnel for usual launch activities can be used. Existing booster production can be used.

2) Little intelligence required past orbit parameters.

3) Proven technologies.

4) Typical orbital constraints apply

# Space Segment COA #4 – Space-Based Laser (SBL)

OBJECTIVES –

1) Destroy mission by inflicting severe damage on solar array, payload, thermal control components, and/or structure
2) Degrade mission by inflicting controlled amounts of damage on solar array and/or payload
3) Deny access to the battlefield by blinding EO payload or forcing an avoidance maneuver
4) Disrupt satellite operation with high thermal loads on external surfaces (especially radiators)

Range – Booster-Dependent / Propulsion Subsystem Dependent

Availability – Moderate

| INDICATORS | Long-Term | Short-Term |
|---|---|---|
| Preliminary | Orbital maneuvers to position for engagement | TLM indicates activation of payload (warm-up) |
| Time of Engagement | N/A | Temperature rise in several TLM channels |
| Post-Battle | Loss of payload and bus functions. Possible loss of earth/star lock in ACS | Component temperatures above acceptable or qualification limits |

Prob. of Deployment (2025) - MODERATE

Security – Must be negated with another ASAT weapon / MODERATE

Surprise – Maneuvers can take a long time / POOR

Uses -
1) Crisis
2) Overt Military

Strategies -
1) Sweep the Skies (?)
2) Periodic Degrade
3) Rolling Disrupt
4) Herd Sensors

## MASS / ECONOMY / MANUEVER

POOR –

1) Large to-orbit launch system needed. Existing support personnel for usual launch activities can be used. High per-unit payload cost. Fuels limit run times.

2) Some S&T intelligence required past orbit parameters.

3) Most basic technologies proven

4) Typical orbital constraints apply

# Space Segment COA #5 – Space-Base High Power RF Weapon

OBJECTIVES –
1) Destroy mission by inflicting severe damage on RF apertures and electronics
2) Deny access to the battlefield by blinding RF payload or forcing an avoidance maneuver
3) Disrupt satellite operation with RF jamming
4) Deny communication over wide ground segment

Range – Booster-Dependent / Propulsion Subsystem Dependent

Availability – Moderate

| INDICATORS | Long-Term | Short-Term |
|---|---|---|
| Preliminary | Orbital maneuvers to position for engagement | TLM indicates activation of payload (warm-up) |
| Time of Engagement | N/A | Noise increase in many comm channels |
| Post-Battle | Loss of payload and bus functions. Numerous SEUs detected | Massive loss of bus functions if central processor is affected. |

Prob. of Deployment (2025) - MODERATE

Security – Must be negated with another ASAT weapon / MODERATE

Surprise – Maneuvers can take a long time / POOR

Uses -
1) Peacetime
2) Crisis
3) Overt Military

Strategies -
1) Periodic Degrade
2) Rolling Disrupt
3) Herd Sensors
4) Herd Comm

## MASS / ECONOMY / MANUEVER

POOR –

1) Large to-orbit launch system needed. Existing support personnel for usual launch activities can be used. High per-unit payload cost.

2) Some S&T intelligence required past orbit parameters.

3) Most basic technologies proven

4) Typical orbital constraints apply

# Space Segment COA #6 – Ground Based RF Hijack System

OBJECTIVES –
1) Deny use of the satellite by introducing new commands or software to stop normal operations.
2) Destroy satellite by introducing software to negate critical housekeeping functions or activate EOL functions

Range – Unlimited
Availability – Moderate

| INDICATORS | Long-Term | Short-Term |
|---|---|---|
| Preliminary | Comm traffic indicating possible use of system | Comm traffic indicating possible use of system |
| Time of Engagement | Central processor executing unplanned commands | Unexpected command verification messages |
| Post-Battle | Loss of payload and bus functions. No response to new commands | Normal payload and bus functions stop. |

Prob. of Deployment (2025) - MODERATE

Security – Within national borders / HIGH

Surprise – Not expected to work / HIGH

Uses -
1) Peacetime
2) Crisis
3) Overt Military
4) Covert Military

Strategies -
1) Sweep the Skies (?)
2) Periodic Degrade
3) Herd Sensors
4) Herd Comm

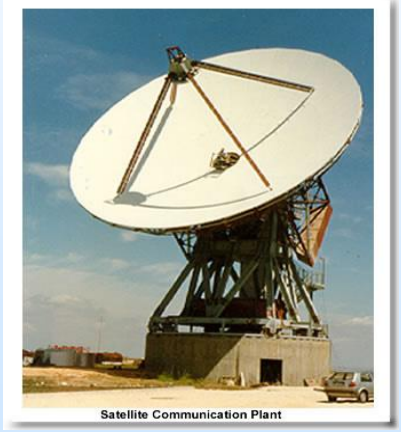
## MASS / ECONOMY / MANUEVER

POOR –
1) Inexpensive system. Existing ground segments can be used.

2) Perfect S&T intelligence needed for TT&C and Comm subsystems.

3) No new technology needed.

4) Numerous sites required for coordinated attacks.


Satellite Communication Plant

# Space Segment COA #7 – Permanent Paint Mine

OBJECTIVES –
1) Destroy mission by blinding EO sensors or ACS sensors.
2) Degrade EO and ACS sensors by controlled contamination of optics.
3) Degrade mission by decreasing solar array output.
4) Degrade mission by changing radiator thermal characteristics.

Range – Unlimited
Availability – High

| INDICATORS | Long-Term | Short-Term |
|---|---|---|
| Preliminary | Unidentified launch | Comm traffic indicating possible use of system |
| Time of Engagement | Degradation of payload data despite no error flags | Rapid, but not instantaneous change in electrical power. Loss of ACS lock. |
| Post-Battle | Degradation of payload data despite no error flags. Temperatures rise above limits. | ACS mode changes. Component temperatures increase. |

Prob. of Deployment (2025) - HIGH

Security – Very small objects to find / HIGH

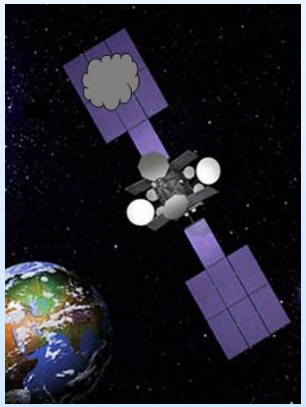
Surprise – SAME / HIGH

Uses -
1) Peacetime
2) Crisis
3) Overt Military
4) Covert Military

Strategies -
1) Sweep the Skies
2) Periodic Degrade
3) Herd Sensors
4) Hidden Disrupt

## MASS / ECONOMY / MANUEVER

FAIR –
1) Inexpensive system. Existing launch facilities can be used. Small boosters will suffice.
2) Moderate S&T intelligence needed to locate certain components.
3) May need system with intelligent targeting.
4) Many units needed for reliability.



# Space Segment COA #8 – Sublimating Paint Mine

OBJECTIVES –
1) Deny mission by blinding EO sensors or ACS sensors temporarily.
2) Deny mission by temporary reduction of available electric power.
3) Deny mission by forcing a change in ACS mode.

Range – Unlimited
Availability – High

| INDICATORS | Long-Term | Short-Term |
|---|---|---|
| Preliminary | Unidentified launch | Comm traffic indicating possible use of system |
| Time of Engagement | Degradation of payload data despite no error flags | Rapid, but not instantaneous change in electrical power. Loss of ACS lock. |
| Post-Battle | Recovery of payload data and/or power. Operators able to recover ACS. | ACS mode changes |

Prob. of Deployment (2025) - HIGH

Security – Very small objects to find / HIGH

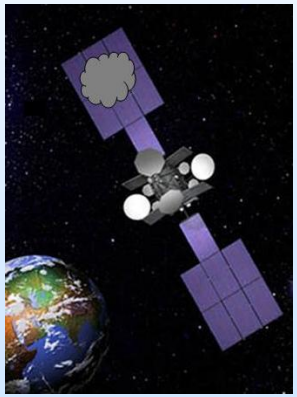
Surprise – SAME / HIGH

Uses - 1) Peacetime
2) Crisis

Strategies - 1) Herd Sensors
2) Hidden Disrupt

## MASS / ECONOMY / MANUEVER

FAIR –
1) Inexpensive system. Existing launch facilities can be used. Small boosters will suffice.
2) Moderate S&T intelligence needed to locate certain components.
3) May need system with intelligent targeting.
4) Many units needed for reliability.



# Space Segment COA #9 – Communication Jamming

OBJECTIVES –
1) Deny mission by jamming RF payloads.
2) Deny mission by jamming command and TLM channels.

Range – Limited by Antenna Size
Availability – High

| INDICATORS | Long-Term | Short-Term |
|---|---|---|
| Preliminary | N/A | Comm traffic indicating possible use of system |
| Time of Engagement | Loss or degradation of com channels | Loss or degradation of com channels |
| Post-Battle | N/A | Recovery of Comm channels |

## Proven System

Security – Systems need to be deployed in several places for maximum effects / LOW

Surprise – Systems may not be distinguishable from common deployed Comm equipment / LOW

Uses -
1) Peacetime
2) Crisis
3) Overt Military

Strategies -
1) Herd Comm
2) Rolling Disrupt

## MASS / ECONOMY / MANUEVER

FAIR –
1) Inexpensive system. No space segment items required.

2) Moderate S&T intelligence needed to identify channels and apertures.

3) Intel needs may increase to confirm effects.

4) Many units needed for reliability.

# Space Segment COA #10 – Solar Reflector

OBJECTIVES –
1) Deny mission by creating adverse thermal environment.
2) Deny mission by forcing operators to shut down equipment or maneuver.

Prob. Of Deployment (2025) - HIGH

Security – Large Sail Structure easy to find with ground-based optics and radar / LOW

Surprise – Cannot be maneuvered rapidly / LOW

Uses -
1) Peacetime
2) Crisis
3) Overt Military
4) Covert Military

Strategies -
1) Herd Comm
2) Herd Sensors
3) Hidden Disrupt

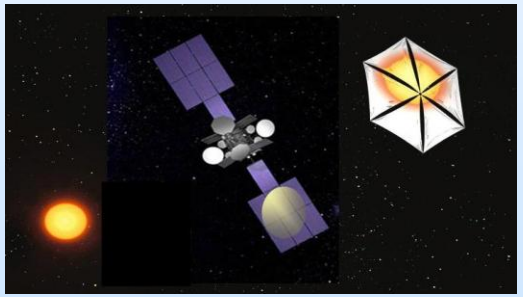
Range – Booster-Limited
Availability – High

| INDICATORS | Long-Term | Short-Term |
|---|---|---|
| Preliminary | Movement of objects detected by orbit determination assets | Comm traffic indicating possible use of system |
| Time of Engagement | Temperature increase in internal components | Increase in EPS shunt currents followed by slow decrease. Increase in temperature of external components |
| Post-Battle | N/A | Temperatures decrease to nominal levels |

## MASS / ECONOMY / MANUEVER

GOOD –
1) Inexpensive system based on solar sail technology. Existing launch facilities can be used.

2) Low S&T intelligence requirements.



# Space Segment COA #11 – Solar Blocker

OBJECTIVES –
1) Deny mission by decreasing available solar array output.
2) Deny mission by creating adverse thermal environment.
3) Deny mission by creating unbalanced torques on satellites with large appendages

Prob. Of Deployment (2025) - HIGH

Security – Large Sail Structure easy to find with ground-based optics and radar / LOW

Surprise – Cannot be maneuvered rapidly / LOW

Uses -
1) Peacetime
2) Crisis
3) Overt Military
4) Covert Military

Strategies -
1) Herd Comm
2) Herd Sensors
3) Hidden Disrupt

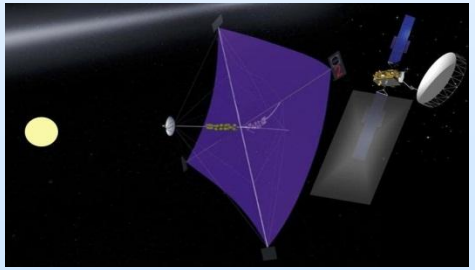
Range – Booster-Limited
Availability – High

| INDICATORS | Long-Term | Short-Term |
|---|---|---|
| Preliminary | Movement of objects detected by orbit determination assets | Comm traffic indicating possible use of system |
| Time of Engagement | Temperature decrease in internal components. Increasing motion from induced nutation. Change in ACS modes. | Decrease in EPS shunt currents. Decrease in temperature of external components |
| Post-Battle | Recovery of attitude control through normal progression of modes | Temperatures increase to nominal levels |

## MASS / ECONOMY / MANUEVER

GOOD –
1) Inexpensive system based on solar sail technology. Existing launch facilities can be used.

2) Low S&T intelligence requirements.



# Space Segment COA #12 – Sticky Sheet Mine

OBJECTIVES –
1) Destroy mission by covering sensor EO apertures.
2) Destroy or mission by decreasing emissivity of thermal radiators
3) Degrade mission by changing patterns of various antennas

Prob. Of Deployment (2025) - HIGH

Security – Can be a small and difficult to find in orbit / HIGH

Surprise – SAME / HIGH

Uses -
1) Clear the Skies (?)
2) Crisis
3) Overt Military
4) Covert Military

Strategies -
1) Sweep the Skies
2) Herd Comm
3) Herd Sensors
4) Hidden Disrupt
5) Rolling Disrupt
6) Periodic Negate

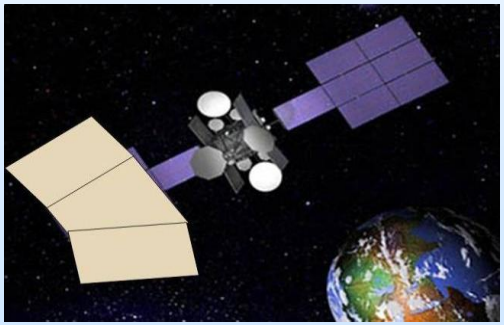
Range – Booster-Limited
Availability – High

| INDICATORS | Long-Term | Short-Term |
|---|---|---|
| Preliminary | Unidentified Launch | Comm traffic indicating possible use of system |
| Time of Engagement | Loss of EO payload data. Change in RF ground footprint. | Growing object detected in payload FOV |
| Post-Battle | Temperatures above operational or qualification levels | Temperatures increase |

## MASS / ECONOMY / MANUEVER

GOOD –
1) Inexpensive system based on solar sail technology with less structure. Existing launch facilities can be used.

2) Low S&T intelligence requirements.



# Space Segment COA #13 – Parasite Mass

OBJECTIVES –
1) Degrade or Destroy mission by confusing ACS with changes in inertia matrix.

Prob. Of Deployment (2025) - HIGH

Security – Can be a small and difficult to find in orbit / HIGH

Surprise – SAME / HIGH

Uses -
1) Clear the Skies (?)
2) Crisis
3) Overt Military
4) Covert Military

Strategies -
1) Sweep the Skies
2) Herd Comm
3) Herd Sensors
4) Hidden Disrupt
5) Rolling Disrupt
6) Periodic Negate

Range – Booster-Limited
Availability – High

| INDICATORS | Long-Term | Short-Term |
|---|---|---|
| Preliminary | Unidentified Launch | Comm traffic indicating possible use of system |
| Time of Engagement | N/A | Initial attachment detected by IMU |
| Post-Battle | Unable to maintain earth/star lock in ACS | Unusual motions during rate damping |

## MASS / ECONOMY / MANUEVER

FAIR –
1) Reliable attachment device must be developed.

2) Moderate S&T intelligence requirements.

3) Operators may be able to reprogram ACS to negate effect.

# Space Segment COA #14 – Javelin KEW

OBJECTIVES –
1) Destroy mission by negating specific components.

Prob. Of Deployment (2025) - LOW

Security – Can be a small and difficult to find in orbit / HIGH

Surprise – SAME / HIGH

Uses -
1) Clear the Skies (?)
2) Crisis
3) Covert Military

Strategies -
1) Sweep the Skies
2) Herd Comm
3) Herd Sensors
4) Hidden Disrupt
5) Rolling Disrupt
6) Periodic Negate

Range – Booster-Limited
Availability – High

| INDICATORS | Long-Term | Short-Term |
|---|---|---|
| Preliminary | Unidentified Launch | Comm traffic indicating possible use of system |
| Time of Engagement | N/A | Immediate TLM indicating component has stopped functioning |
| Post-Battle | N/A | Unusual motions |

## MASS / ECONOMY / MANUEVER

POOR –
1) Precise tracking and targeting required. May need intelligent targeting system.

2) High S&T intelligence requirements for identifying aimpoints.

3) Residual motion may lead to attribution

# Space Segment COA #16 – Solvent Grenade

OBJECTIVES –
1) Destroy mission by blinding EO sensors or ACS sensors.
2) Degrade EO and ACS sensors by controlled contamination of optics.
3) Degrade mission by decreasing solar array output.
4) Degrade mission by changing radiator thermal characteristics.

Range – Booster-Limited
Availability – High

| INDICATORS | Long-Term | Short-Term |
|---|---|---|
| Preliminary | Unidentified Launch | Comm traffic indicating possible use of system |
| Time of Engagement | N/A | Immediate TLM indicating component has stopped functioning |
| Post-Battle | N/A | Unusual motions |

Prob. of Deployment (2025) - MODERATE

Security – Very small objects to find / HIGH

Surprise – SAME / HIGH

Uses -
1) Peacetime
2) Crisis
3) Overt Military
4) Covert Military

Strategies -
1) Sweep the Skies
2) Periodic Degrade
3) Herd Sensors
4) Hidden Disrupt

## MASS / ECONOMY / MANUEVER

FAIR –
1) Inexpensive system. Existing launch facilities can be used. Small boosters will suffice.

2) Moderate S&T intelligence needed to locate certain components.

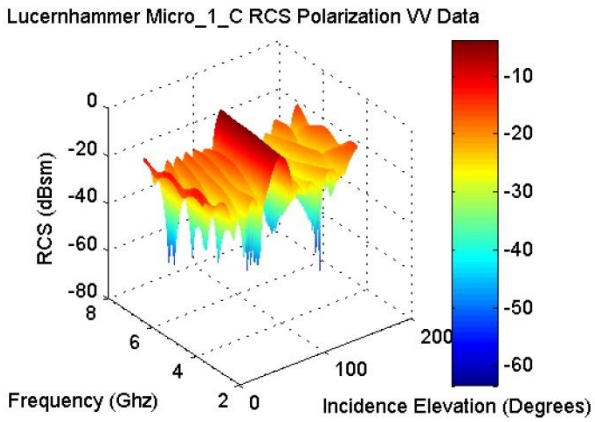
3) May need system with intelligent targeting.

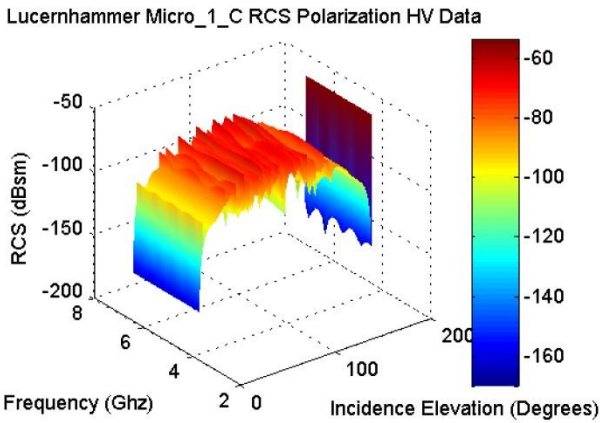
4) Many units needed for reliability.

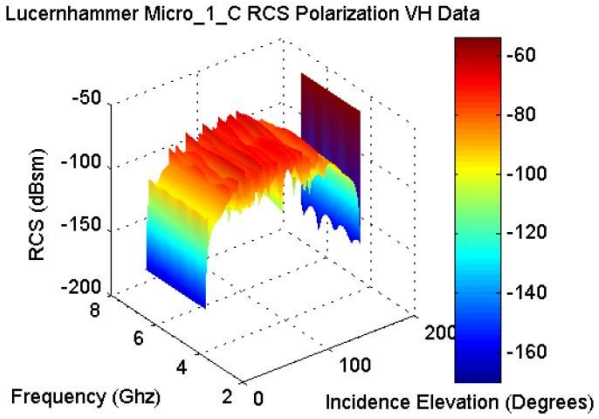
5) Residual motions can lead to attribution

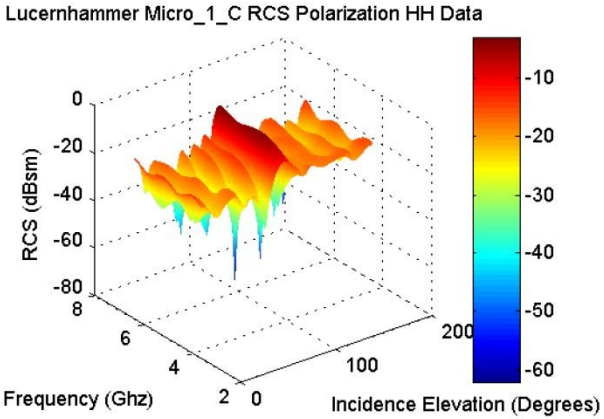
# BACKUP

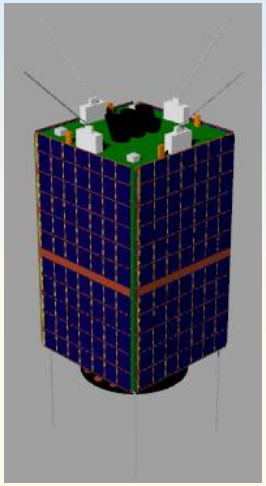
# Example SWAT Satellite RADAR Cross Section



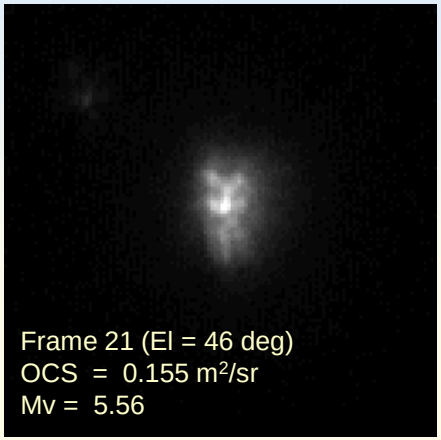



**Satellite Model Used In Calculations**

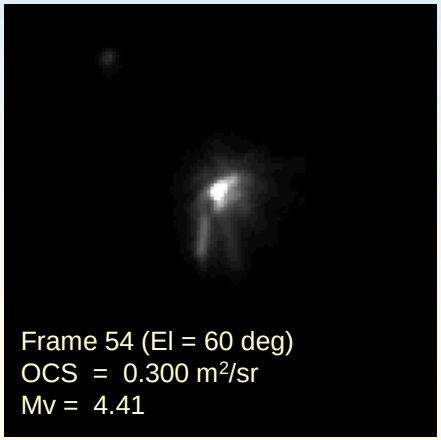
**Radar Cross Section Calculations Can be Performed on SatAC Models**

# Example Satellite Optical Cross Section

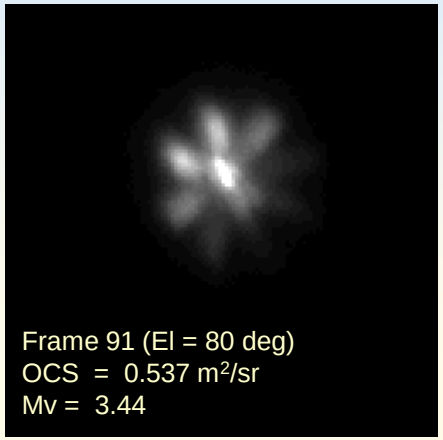
## SOR Field Data from JD 104, 2000



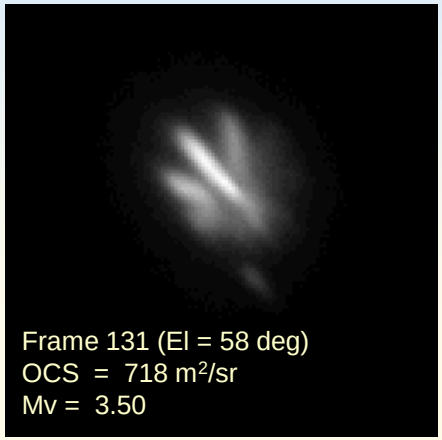
Frame 21 (El = 46 deg)
OCS = 0.155 $m^2$/sr
Mv = 5.56



Frame 54 (El = 60 deg)
OCS = 0.300 $m^2$/sr
Mv = 4.41

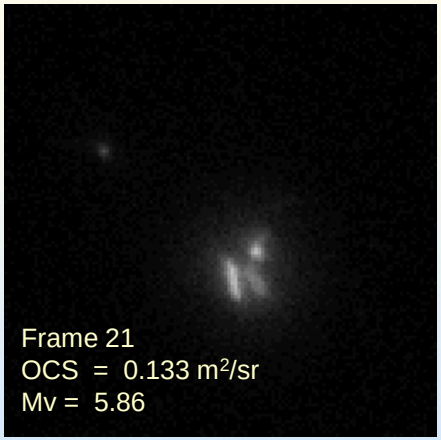


Frame 91 (El = 80 deg)
OCS = 0.537 $m^2$/sr
Mv = 3.44

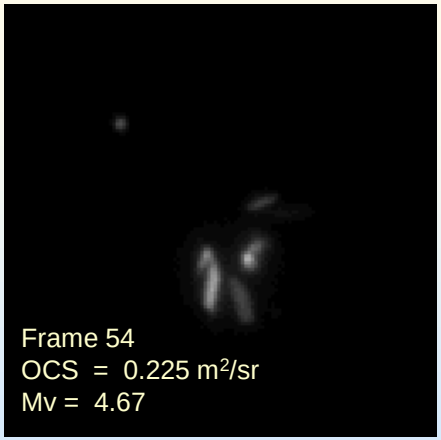


Frame 131 (El = 58 deg)
OCS = 718 $m^2$/sr
Mv = 3.50

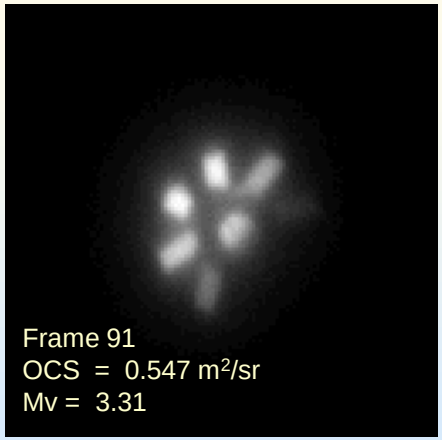
## TASAT Simulation w/ pose (11, -15, -1)



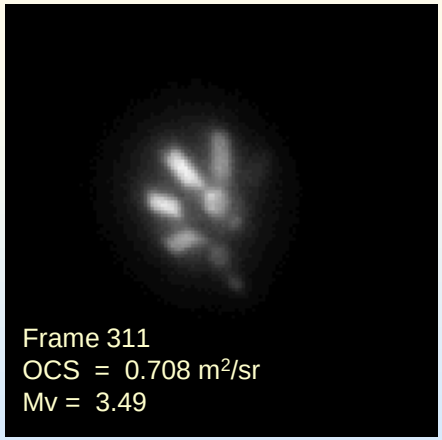
Frame 21
OCS = 0.133 $m^2$/sr
Mv = 5.86



Frame 54
OCS = 0.225 $m^2$/sr
Mv = 4.67

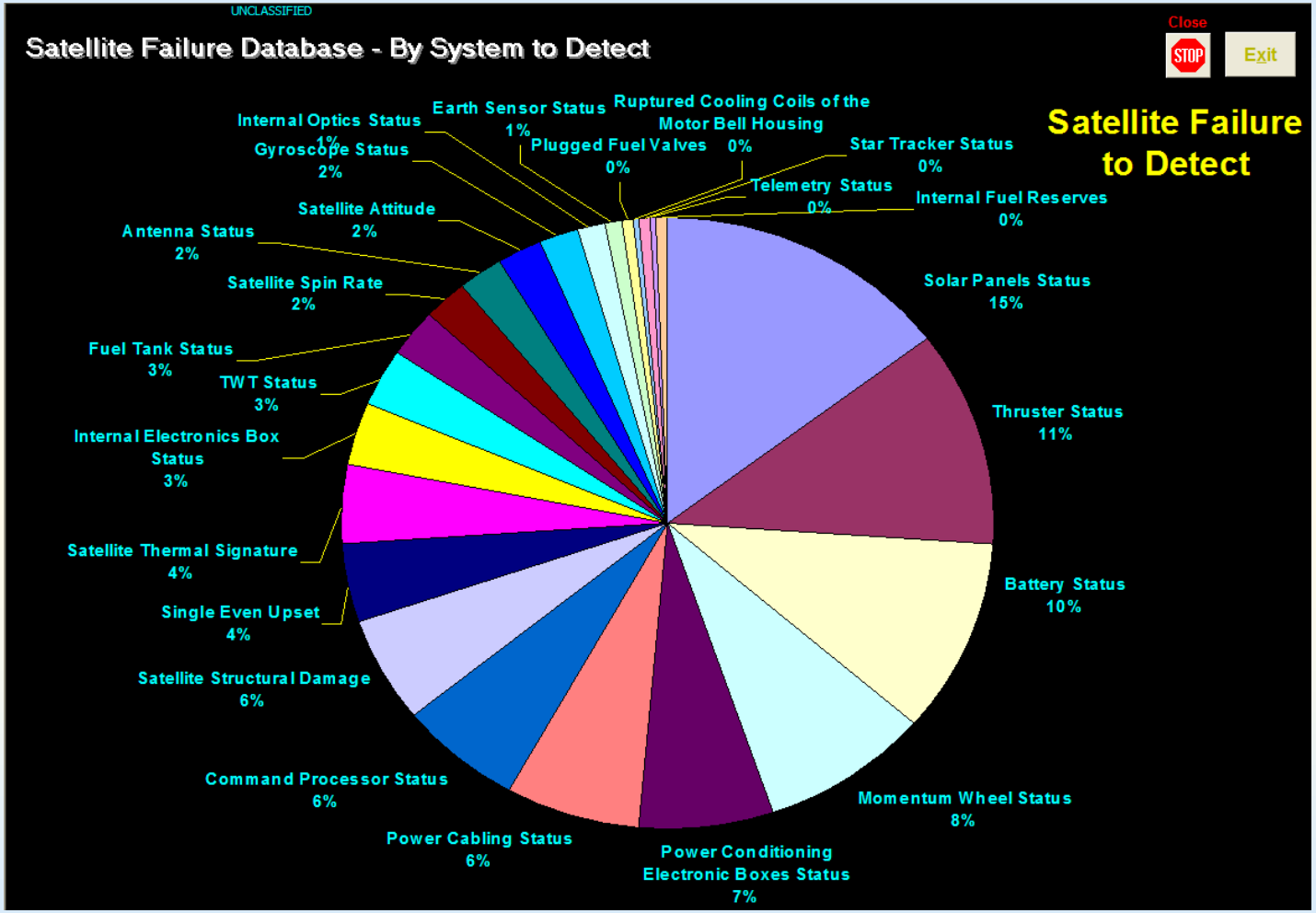


Frame 91
OCS = 0.547 $m^2$/sr
Mv = 3.31



Frame 311
OCS = 0.708 $m^2$/sr
Mv = 3.49

# Satellite Failures Database




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

# 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

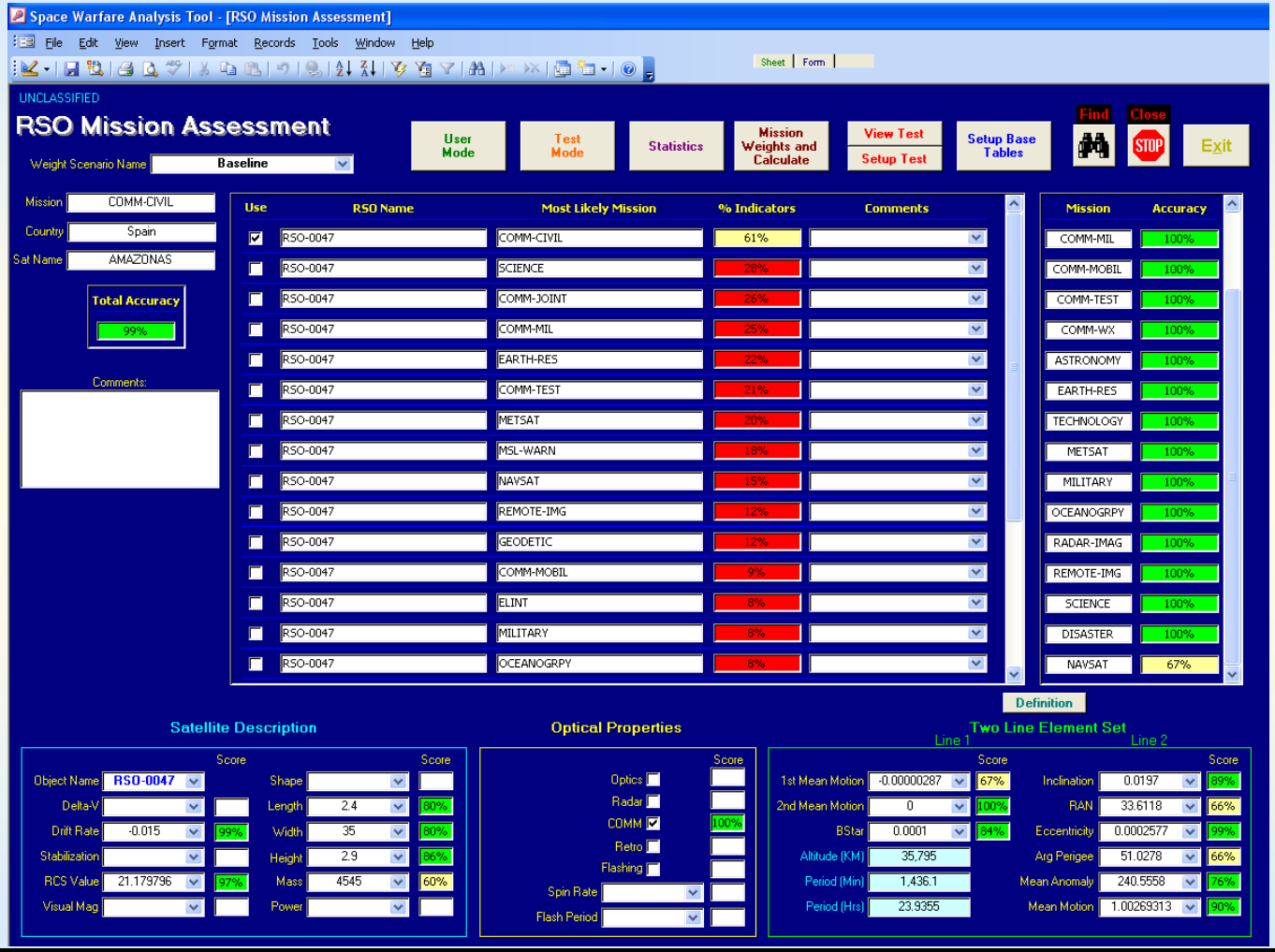
**Tool Development Focused On Satisfying War-Winning Requirements**

# 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



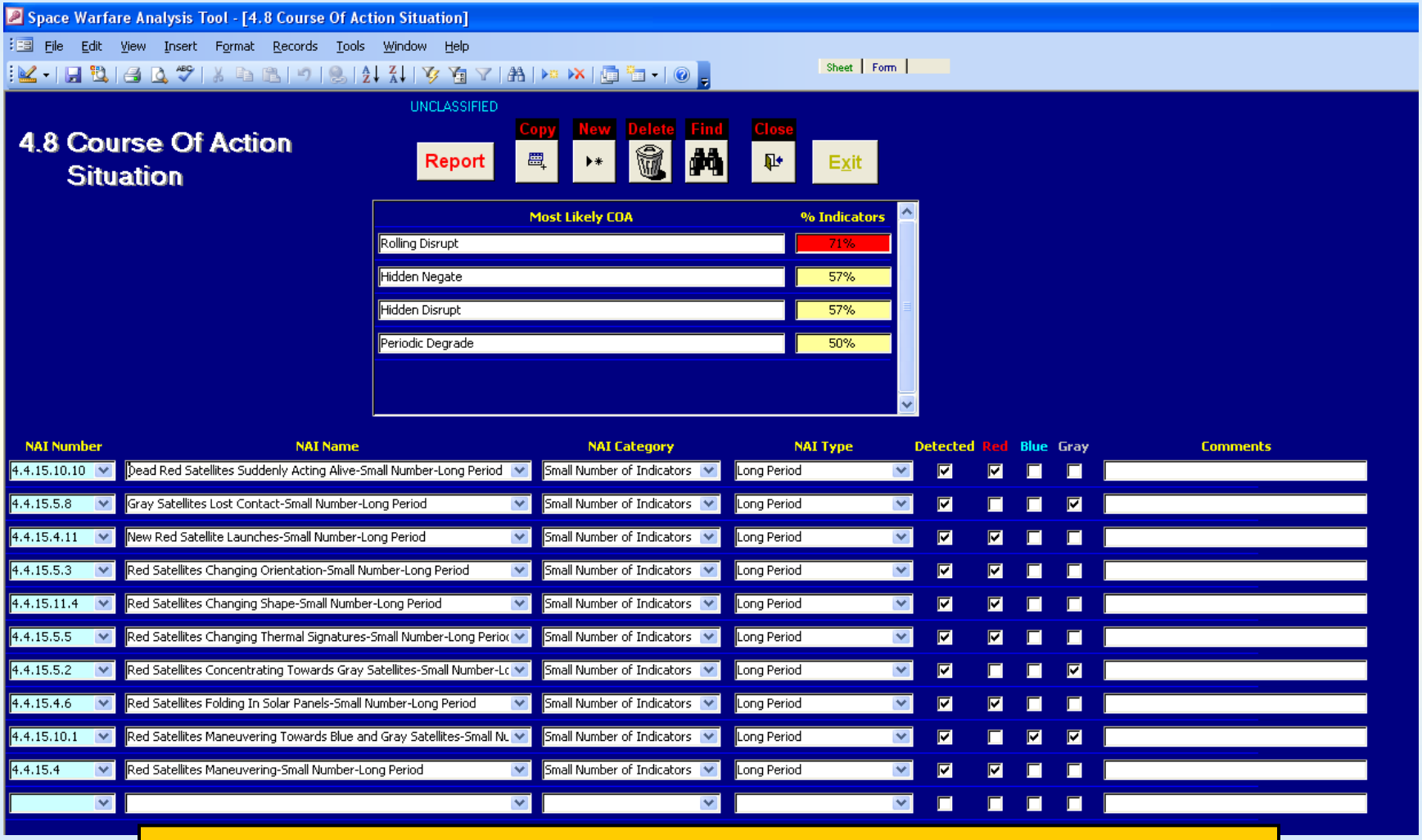

**SWAT Helps the Satellite Analyst In Narrowing Choices for New Space Objects ID**

# 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

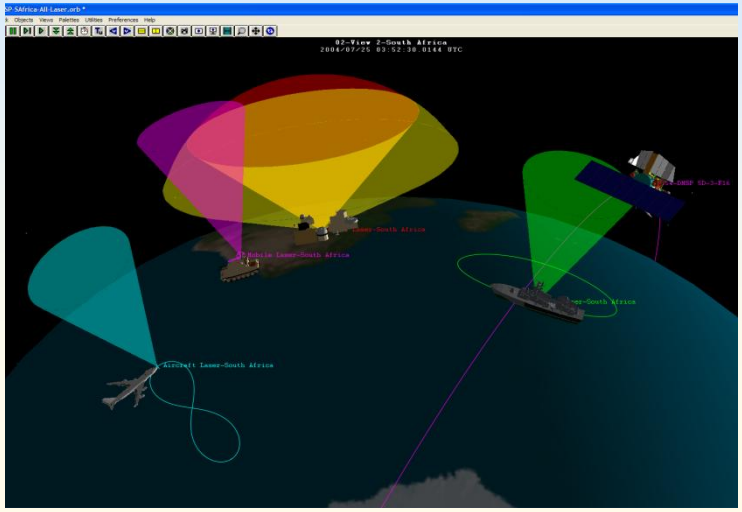
**SWAT Helps the Satellite Analyst Determine If Space Systems Are Under Attack**

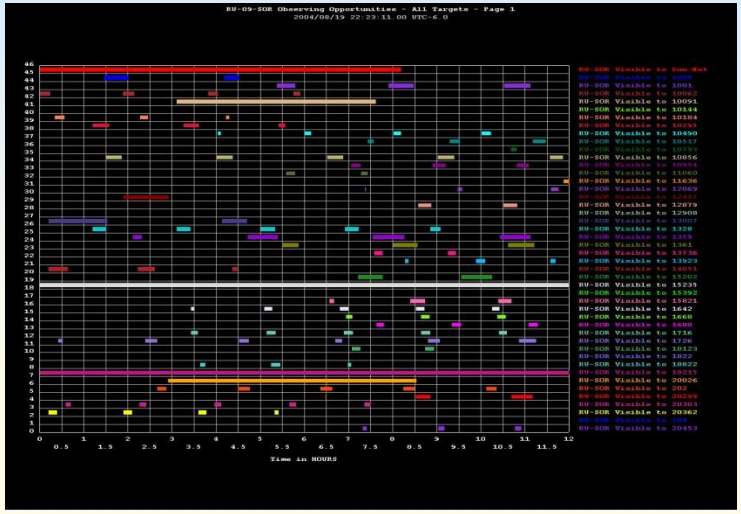
# SWAT Auto Attack Assessment

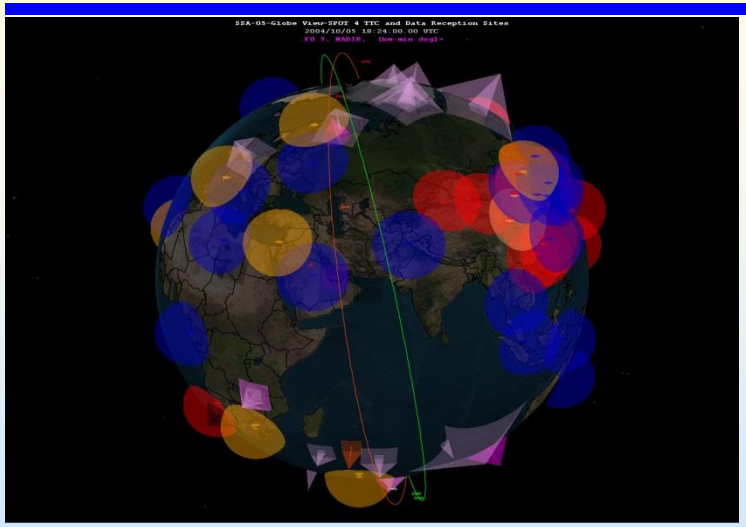


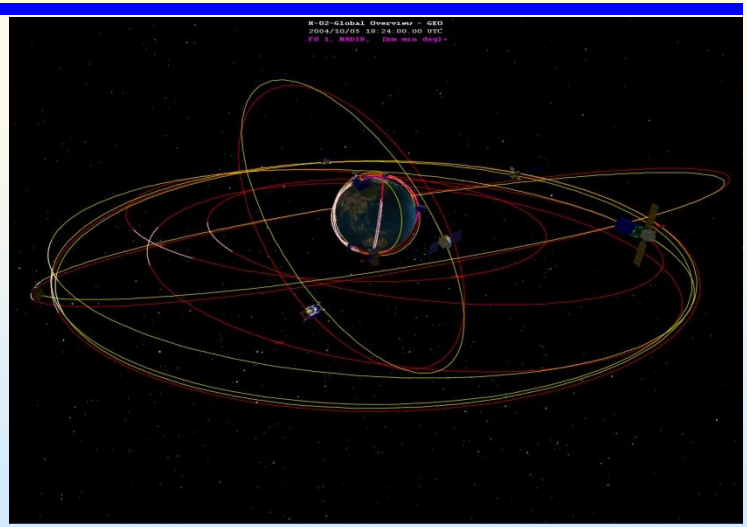

**SWAT Helps the Satellite Analyst In Assessing Strategic Warning**

# ASAT Range / Access Assessments



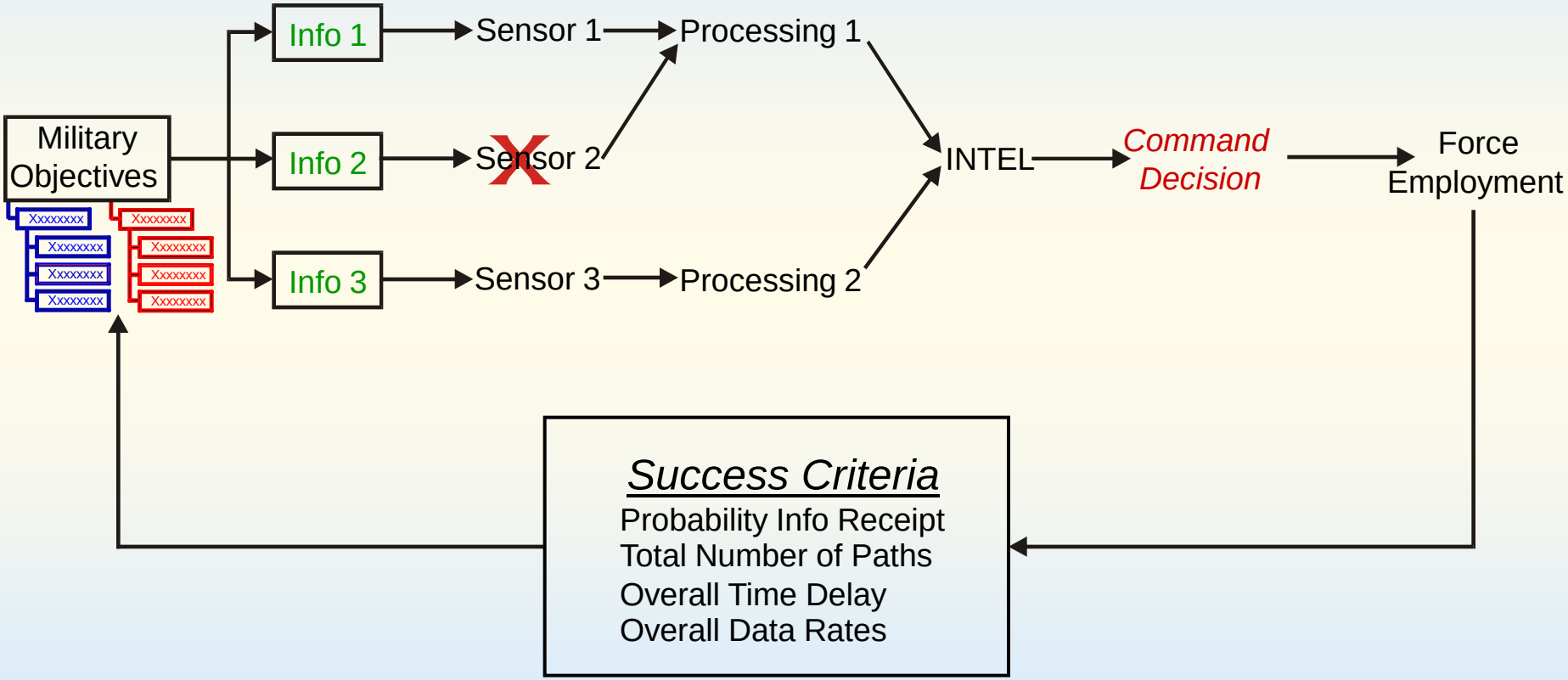



# Space Info Choke Points Network Analyses

- **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**

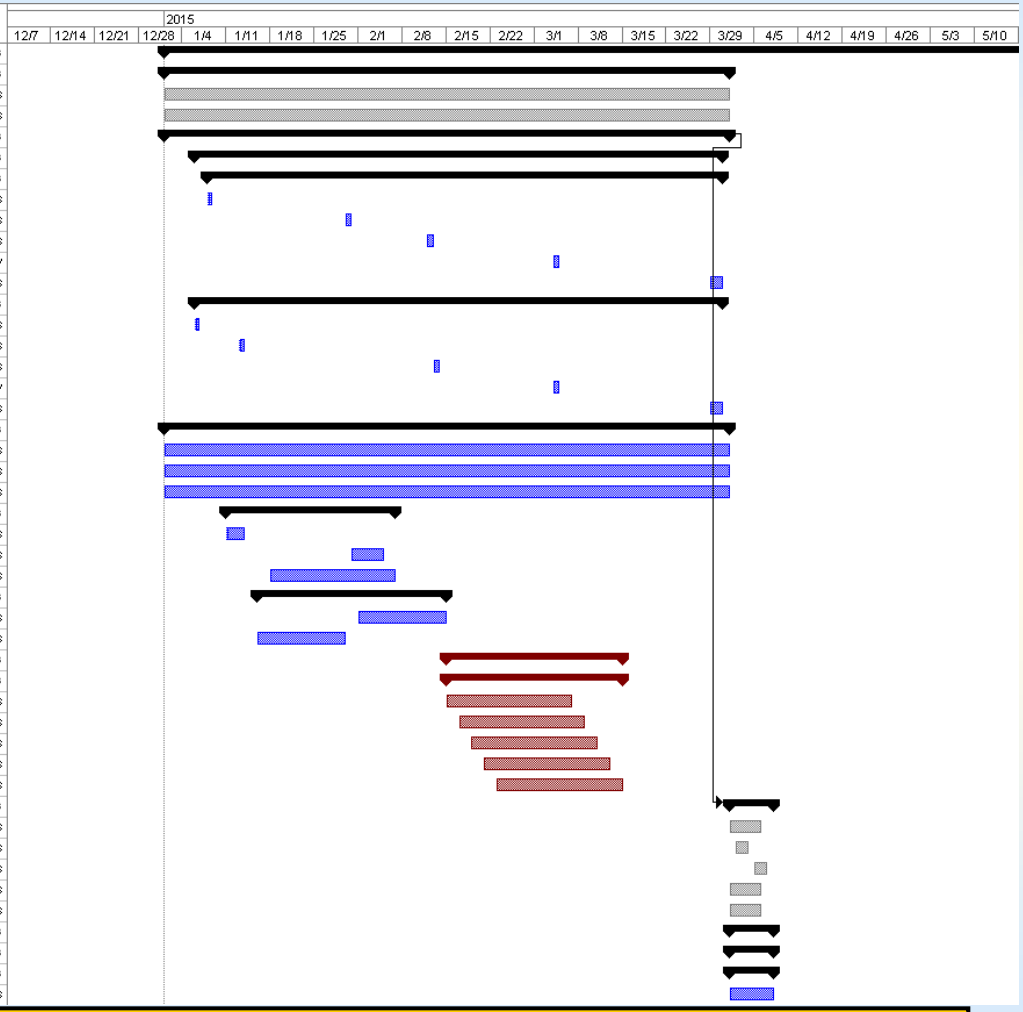
# SHIVA Methodology




**SHIVA Calculates All Possible Paths Between Sensors and Shooters**

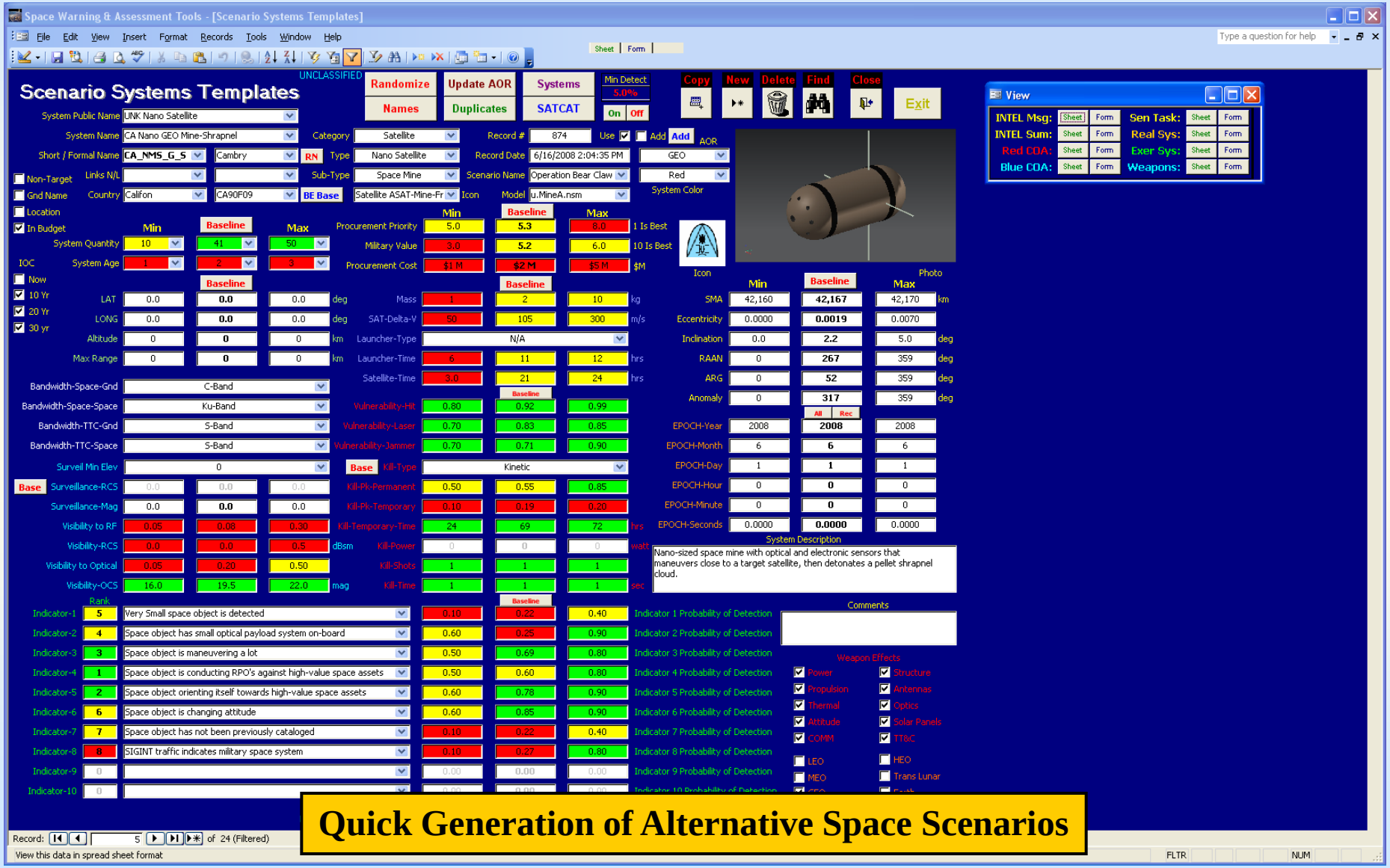
# Scenario Partial Example

| ID | Task Name | Duration |
|---|---|---|
| 1 | **Campaign Phases** | **357 days** |
| 2 | **Phase I: Deployment/Deterrence** | **90 days** |
| 3 | Naval Show of Force | 90 days |
| 4 | Air Show of Force | 90 days |
| 5 | **US Space Superiority** | **90 days** |
| 6 | **Discourage Attack & Show Resolve by Denying/Disrupting Space Assets Supporting North Korea** | **84 days** |
| 7 | **Disrupt Adversary Space Imagery Assets** | **82 days** |
| 8 | Random Imagery Satellite Disruption Attack 1 Against Chinese FSW 3-3 (2004-039A) | 0.25 days |
| 9 | Random Imagery Satellite Disruption Attack 2 Against Chinese FSW 3-3 (2004-039A) | 0.5 days |
| 10 | Random Imagery Satellite Disruption Attack 3 Against Chinese FSW 3-3 (2004-039A) | 0.75 days |
| 11 | Random Imagery Satellite Disruption Attack 4 Against Chinese FSW 3-3 (2004-039A) | 1 day |
| 12 | Random Imagery Satellite Disruption Attack 5 Against Chinese FSW 3-3 (2004-039A) | 2 days |
| 13 | **Disrupt Adversary Space COMM Assets** | **84 days** |
| 14 | Random COMM Satellite Disruption Attack 1 Against Chinese ZHONGXING-20 (2003-052A) | 0.25 days |
| 15 | Random COMM Satellite Disruption Attack 2 Against Chinese ZHONGXING-20 (2003-052A) | 0.5 days |
| 16 | Random COMM Satellite Disruption Attack 3 Against Chinese ZHONGXING-20 (2003-052A) | 0.75 days |
| 17 | Random COMM Satellite Disruption Attack 4 Against Chinese ZHONGXING-20 (2003-052A) | 1 day |
| 18 | Random COMM Satellite Disruption Attack 5 Against Chinese ZHONGXING-20 (2003-052A) | 2 days |
| 19 | **Protect Blue Space Assets From Adversary Attack** | **90 days** |
| 20 | Monitor Status of Blue Space Assets | 90 days |
| 21 | Protect On-Orbit Blue Space Assets | 90 days |
| 22 | Service Degraded Blue Space Assets | 90 days |
| 23 | **Minor Optimization of Satellite Orbits to Support NE Asia Theater** | **27 days** |
| 24 | Minor Maneuver of INTEL Satellite Orbits to Support NE Asia Theater | 3 days |
| 25 | Minor Maneuver of SBR Satellite Orbits to Support NE Asia Theater | 5 days |
| 26 | Minor Maneuver of Satellite Inspector Orbits to Observe Threat Orbital Corridors | 20 days |
| 27 | **Start Preparations to Move Terrestrial-Based Space Control Weapons Into Theater** | **30 days** |
| 28 | Mobile Satellite Laser Blinder Transportation Preparations | 14 days |
| 29 | Mobile Satellite COMM Jammer Transportation Preparations | 14 days |
| 30 | **Chinese Space Superiority** | **28 days** |
| 31 | **Major Optimization of Chinese ASAT Orbits to Counter US Space Assets** | **28 days** |
| 32 | Major Maneuver of Chinese Microsat-1 Towards MILSTAR 2-04 (2003-012A) | 20 days |
| 33 | Major Maneuver of Chinese Microsat-2 Towards UFO-10 (1999-063A) | 20 days |
| 34 | Major Maneuver of Chinese Microsat-3 Towards LEASAT F5 (1990-002B) | 20 days |
| 35 | Major Maneuver of Chinese Picosat-1 Towards DMSP 5D-3-F16 (2003-048A) | 20 days |
| 36 | Major Maneuver of Chinese Picosat-2 Towards NOSS 06 (1984-012A) | 20 days |
| 37 | **Phase II: Halt Incursion** | **7 days** |
| 38 | Attack 1st/2nd Echelon | 5 days |
| 39 | Support JFLCC | 2 days |
| 40 | Operational Reserve | 2 days |
| 41 | Air Superiority | 5 days |
| 42 | Information Dominance | 5 days |
| 43 | **US Space Superiority** | **7 days** |
| 44 | **Deny/Disrupt Space Assets Supporting North Korea** | **7 days** |
| 45 | **Disrupt/Degrade Space Imagery Assets Supporting North Korea** | **7 days** |
| 46 | Imagery Satellite Disruption Attack Against Chinese FSW 3-2 (2004-033A) | 7 days |




**Scenario Time Lines in Microsoft Project – Requires Orbital Simulations for Details**

# Auto Space Scenario Tool




**Quick Generation of Alternative Space Scenarios**

# Scenario Partial Example 1

**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:***

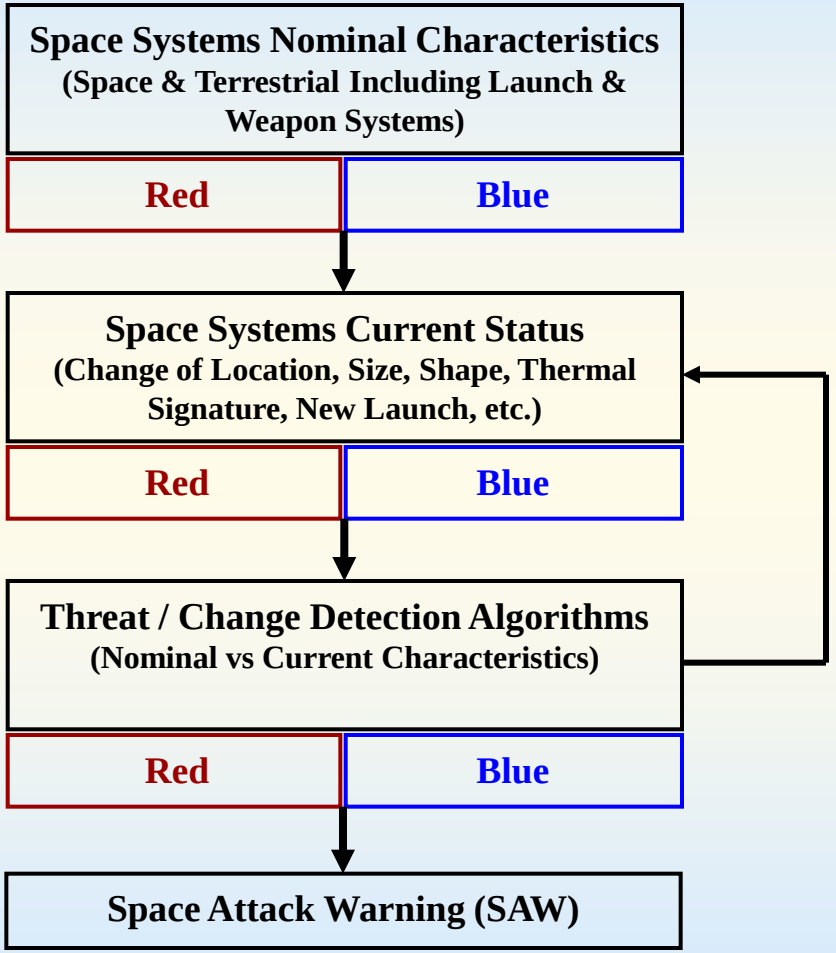
IND: No commercial source sells North Korea ISR data

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

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

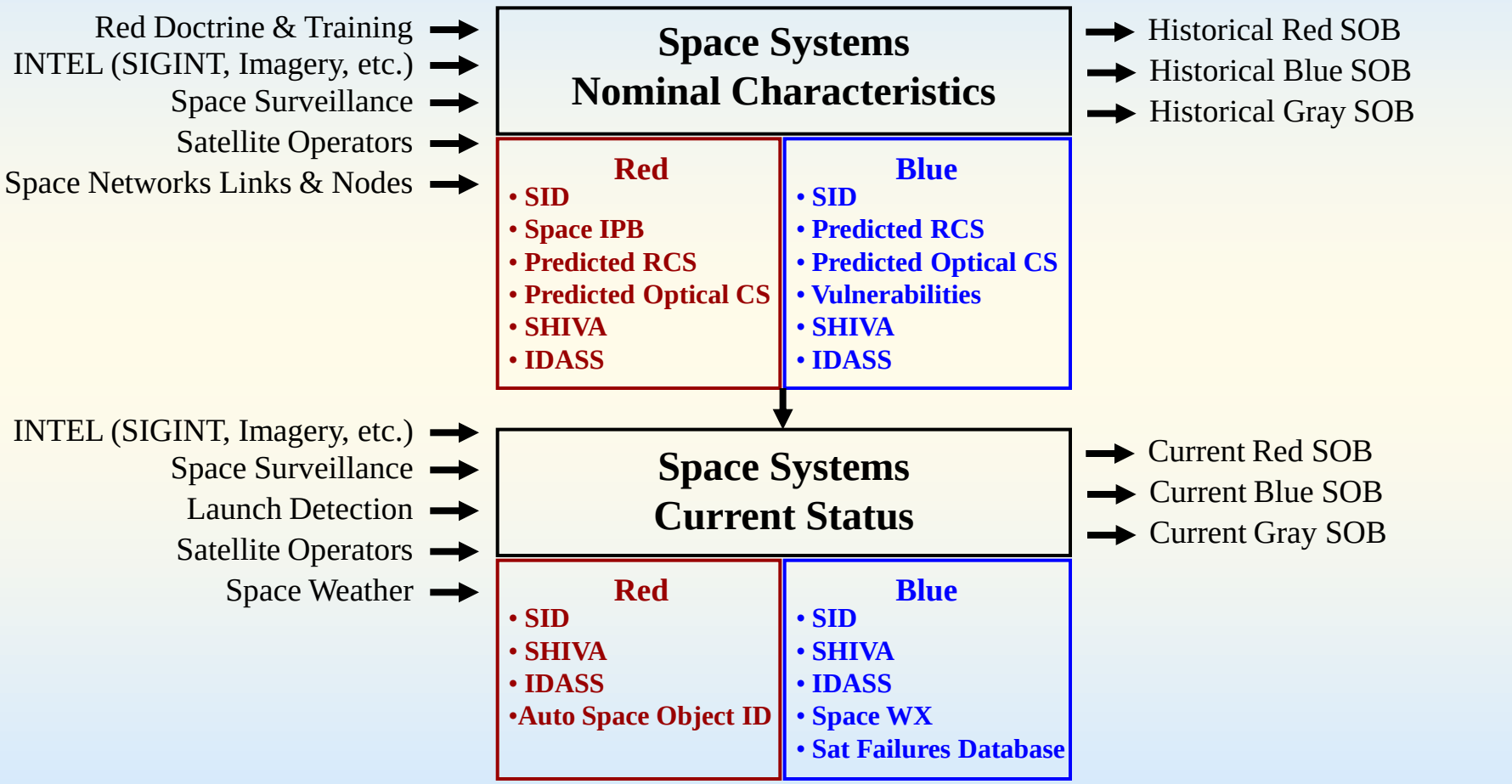
**Detailed Space Control Scenario Available for Analyses**

# SSA & SAW Integrated Concept



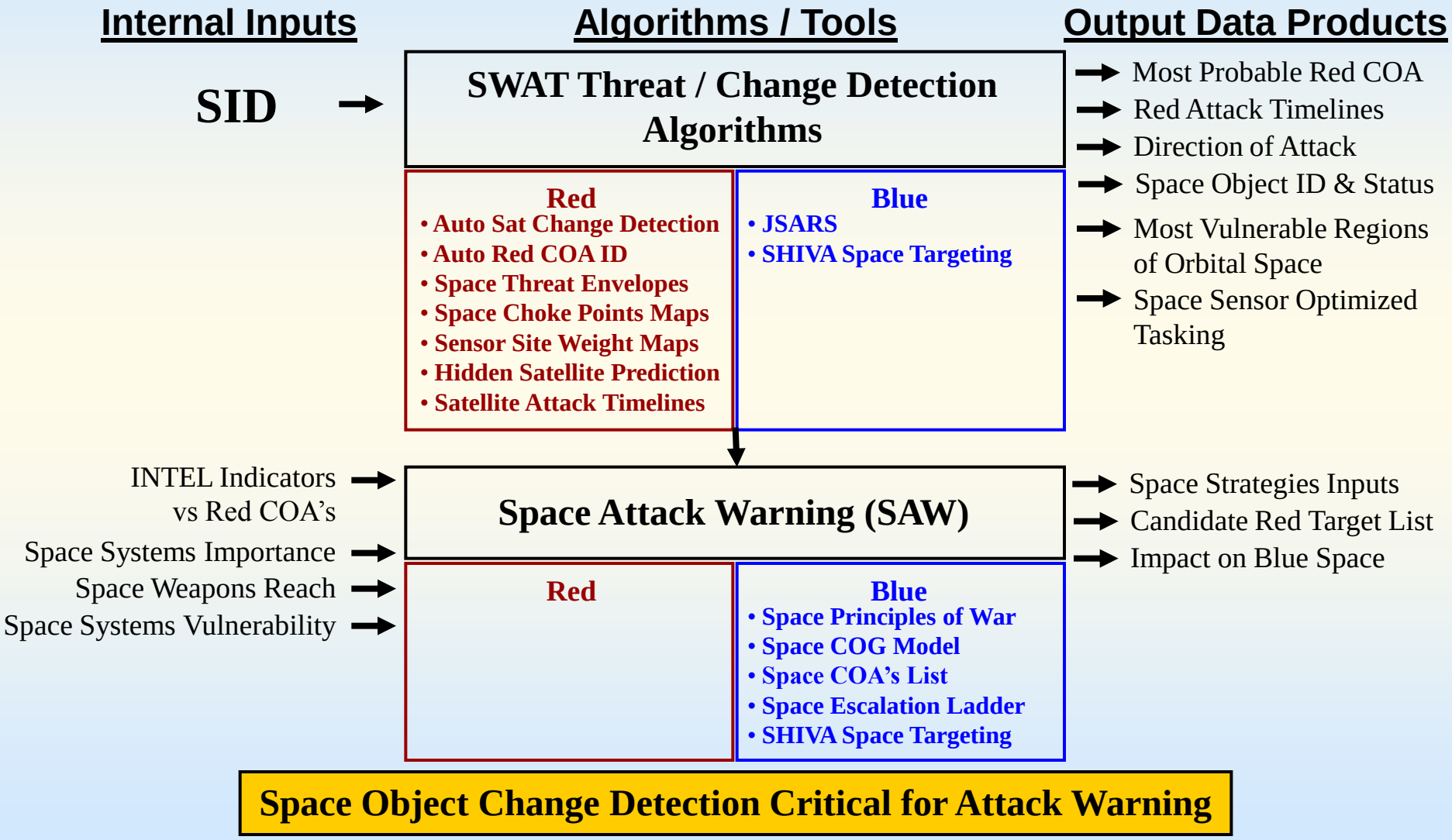

**Predict an Adversary's Intentions & Next Moves Against Space Systems**

# SSA & SAW Detail 1




**Space Characteristics Databases Critical for Attack Detection**

# SSA & SAW Detail 2



# Contacts

| Name | Organization | Telephone |
|---|---|---|
| Mike Carlson, Capt, USAF | Satellite Assessment Center AFRL/RDTE | Com: (505) 846-4786 DSN: 246-4786 |
| Paul Szymanski | Metatech Corporation | (505) 314-1381 |
| Chris Jones | Metatech Corporation | (505) 314-1355 |

**"Vision without action is daydream. Action without vision is nightmare" (Old Japanese Proverb)**

# Contents of DVD Handout

- This Briefing (SWAT-Future Space Strategies-09.ppt)
- SWAT Details Brief (SWAT-Summary-09.ppt)
- SWAT Summary Brief (SWAT-General Brief.pptx)
- SWAT 1 Chart (SWAT 1 Chart.ppt)
- Space BMC3 Requirements (Space BMC3 Requirements 1-Pictures.ppt)
- Space BMC3 Measures (Space BMC3 Measures.ppt)
- Space Threat Envelopes (Threat Envelope.ppt)
- Space Target Ranking Tool (SHIVA Introduction-2008.ppt)
- Space Target Ranking Tool 1 Chart (SHIVA 1 Page Description.ppt)
- SWAT Space Wargame Auto Scenario Generation Tool (SWAT-Space Wargame.ppt)
- Space Scenario (Battle in the Blue Space Scenario.ppt)
- Satellite Design Course (Satellites for Newbies-Print Version.ppt)
- SSA Requirements (SSA-Requirements.ppt)
- Space IPB, SSA Requirements & Strategies Lists (SSA-Requirements-Details.xls)
- JSpOC Characteristics (U JSpOC CTA.PDF)
- Metatech-SatAC Resumes of Support Personnel
- Attack Detection Diagram (Attack Detection.jpg)
- Space Screen Saver / Desktop Photos – 443 Photos
- Space Pictures – 34,316 Pictures
- Space Control Papers – 332 Papers
- Space Icons (Inspired by MIL-STD-2525B) – 550 Icon Files

Blue = Prime Documents