Space Strategies Center

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SSA-T

Space Situational Awareness Tools

- Wargaming Capabilities -

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

SSA-T Purpose

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

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

SSA-T Wargame Purpose

- Develop Future Space Warfare Theory, Doctrine, Strategies, Tactics, and Techniques that Enable Informed Decision Making by Space Control Warfighters
- Train Space Warfighters to Recognize Covert Attacks on Space Systems
- Train Space Warfighters On How to Defend Their Space Assets
- Train Space Warfighters to Fight and Win Space Wars
- Determine Required Future Technologies for Offensive and Defensive Space Weapon Systems
- Develop Procedures, Forms, Documentation and Organizational Relationships to Fight and Win Space Wars
- Provides a Basic Space Warfare Command and Control System
- Provides Space Weapons Employment Optimization Tools

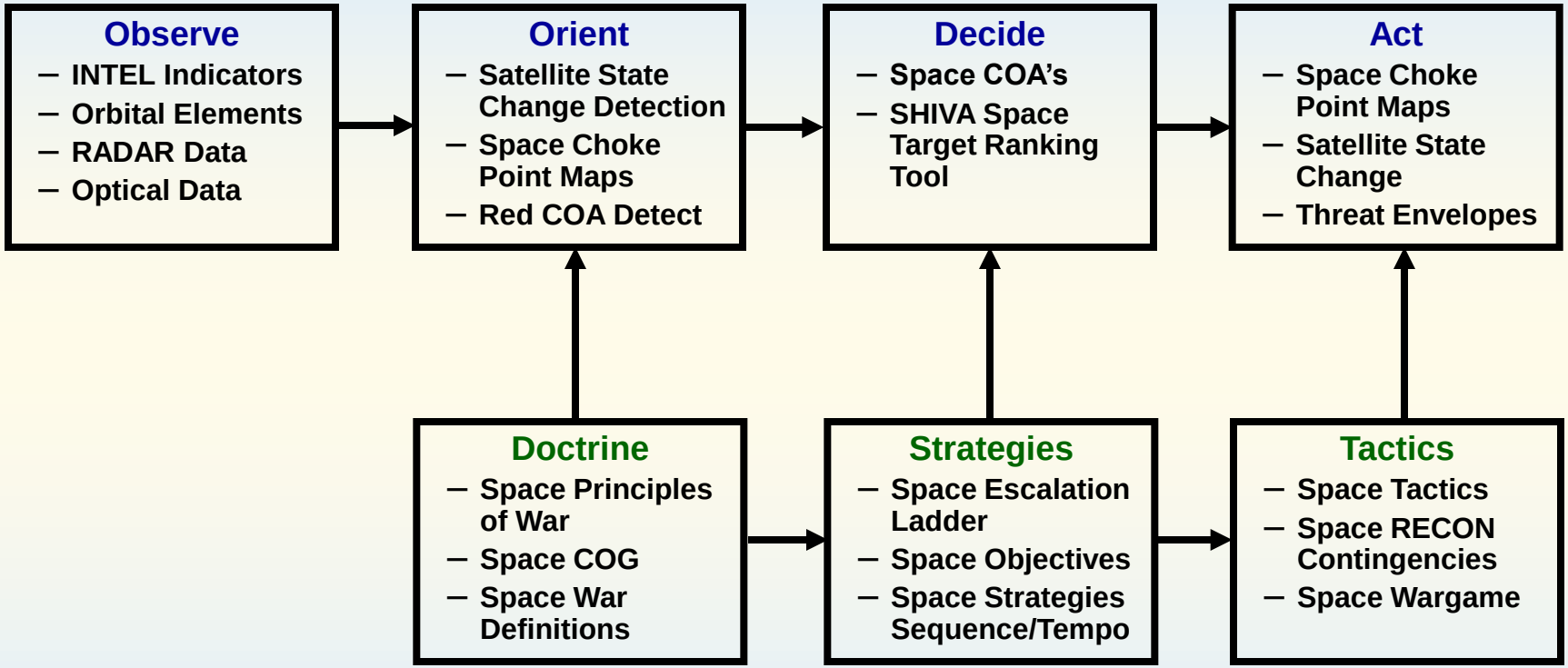
Space Wargame Trains our Future Space Warfighters

SSA-T Wargame Main Attributes

- Realistic VS Typical Consumer Space Video Game
- Heavily Operational Orientated
- Unusually Detailed with All Aspects of Space Warfare:
  - Obscure Battlefield (Many Unknowns) with Sensor Tasking & Search Optimization Tools
  - Uncertainty (Random Within Bounds) Capabilities
  - Ground, Air, Sea and Space Current & Future Systems
  - Varied Phenomenology Space Weapons
  - Space Courses Of Action (COA's) Development Tools with Formatted Message Generation
  - Unique Space Attack Warning (SAW) Visualization Screens

Most Complete Space Warfare Gaming Tools In Existence

SSA-T Process Flow



SSA-T Products Listed Inside Boxes

SSA-T Provides an Integrated Space Warfare Conceptual Framework

SSA-T Wargaming Process Flow (1)

- **Define / Review Future Space Warfare Terminology (Acronyms & Glossary)**
- **Define / Review Future Space Warfare Doctrine, Strategies, Tactics, Space Principles of War, Space Centers of Gravity, etc.**

Develop Space Warfare Basics

SSA-T Wargaming Process Flow (2)

- **Setup Wargame**
  - **Define Country Alignments**
    - **Blue**
    - **Red**
    - **Gray**
  - **Define Areas of Responsibility (AOR's)**
    - **Terrestrial**
    - **Orbital Regions**
  - **Set Country Space Budgets**
    - **Randomized Space Budgets Limit What Each Player Can Purchase In Space Systems & Weapons**

Define Wargame Parameters

SSA-T Wargaming Process Flow (3)

- **Chose Notional Future Space Systems**
  - **Define Space Support Systems**
    - **COMM**
    - **Imagery**
    - **NAV**
    - **Terrestrial Space Systems**
      - **Ground Fixed/Mobile**
      - **Aircraft**
      - **Ship**
      - **Submarine**
  - **Define Space Weapon Systems**
    - **Terrestrial Weapons Directed Towards Space**
    - **Space-to-Space Weapons**
    - **Space-to-Earth Weapons**

Develop Space Systems Used In Wargame

SSA-T Wargaming Process Flow (4)

- **Randomize Notional Space Systems**
  - **Randomize Military Value, Quantities, Costs, Characteristics, Locations, Orbits, Visibility to Red Sensors**
  - **Allows Randomized (Within User-Selected Min/Max Limits) Types, Quantities & Effectiveness for Those Systems Allocated by the computer to Each Side**
- **Select & Randomize the Probability Players Can View Individual INTEL Reports on Opposing Side Activities**
- **Chose Real Space Systems**
  - **Link Real Satellite Orbits (2 Line Element Sets) With Notional Future Satellites**

Make Sure Game Play Has Random Factors Within User Defined Min-Max Limits

SSA-T Wargaming Process Flow (5)

- **Chose Military Events**
  - **Set Degree With Which Each Side Has a Probability of Viewing His Opponent's Activities**
  - **Randomize (Within User Selected Min-Max Bounds) Military Events & Probabilities of Being Viewed**

Determine Wargame Player Events

SSA-T Wargaming Process Flow (6)

- **Execute Wargame**
  - Review Received Randomized INTEL Report Messages
  - Detect / Determine / Assess Opposing Side Space Courses Of Action (COA's)
    - Task / Optimize Space Situational Awareness (SSA) Sensor Collection Strategies / Allocations
    - Review Historical Satellite Reliability & Natural Outages Probabilities
    - Review Historical Satellite Uncorrelated Target (UCT) Rates
    - Run SSA-T State Change Tools to Automatically Detect Adversary Satellite Attitude Changes & Orbital Maneuvers
    - Review & Assess Satellite Attack Warning (SAW) Orbital Situation Maps
  - Develop Blue Space COA's & Military Objectives

Play Wargame

SSA-T Wargaming Process Flow (7)

- **Space Weaponeering Optimizations**
  - **Calculate All Possible Multiple Satellite Attacks Against Multiple Targets Within Military Objectives Time Constraints**
  - **Choose Those Satellite Attacks That Fulfill Military Objectives Within Rules Of Engagement (ROE) Constraints & Commander's Intent While Limiting Maneuvering Fuel Expended**
  - **Optimization Parameters:**
    - **Minimize Maneuvering Fuel**
    - **Minimize Transit Time**
    - **Minimize Sun Angles (Keep as Dark as Possible)**
    - **Maximize Overflights of Friendly Satellite Ground Stations / Sensors**
    - **Minimize Overflights of Adversary Satellite Ground Stations / Sensors**
    - **Align On-Target Times Within Military Objectives & Other Orbital Attacks (Maximize Shock Value & Overload Adversary Ground Controllers)**
    - **Assess Cost Exchange & Military Value Ratios**
    - **Assess Probabilities of Kill & Multiple Strike or Re-Strike Options**

Direct Wargame Weapons Fires

SSA-T Wargaming Process Flow (8)

- **Determine Weapons Effects, Conduct Additional Situational Assessment & Re-Target**

Determine Net Balance of Power in Space

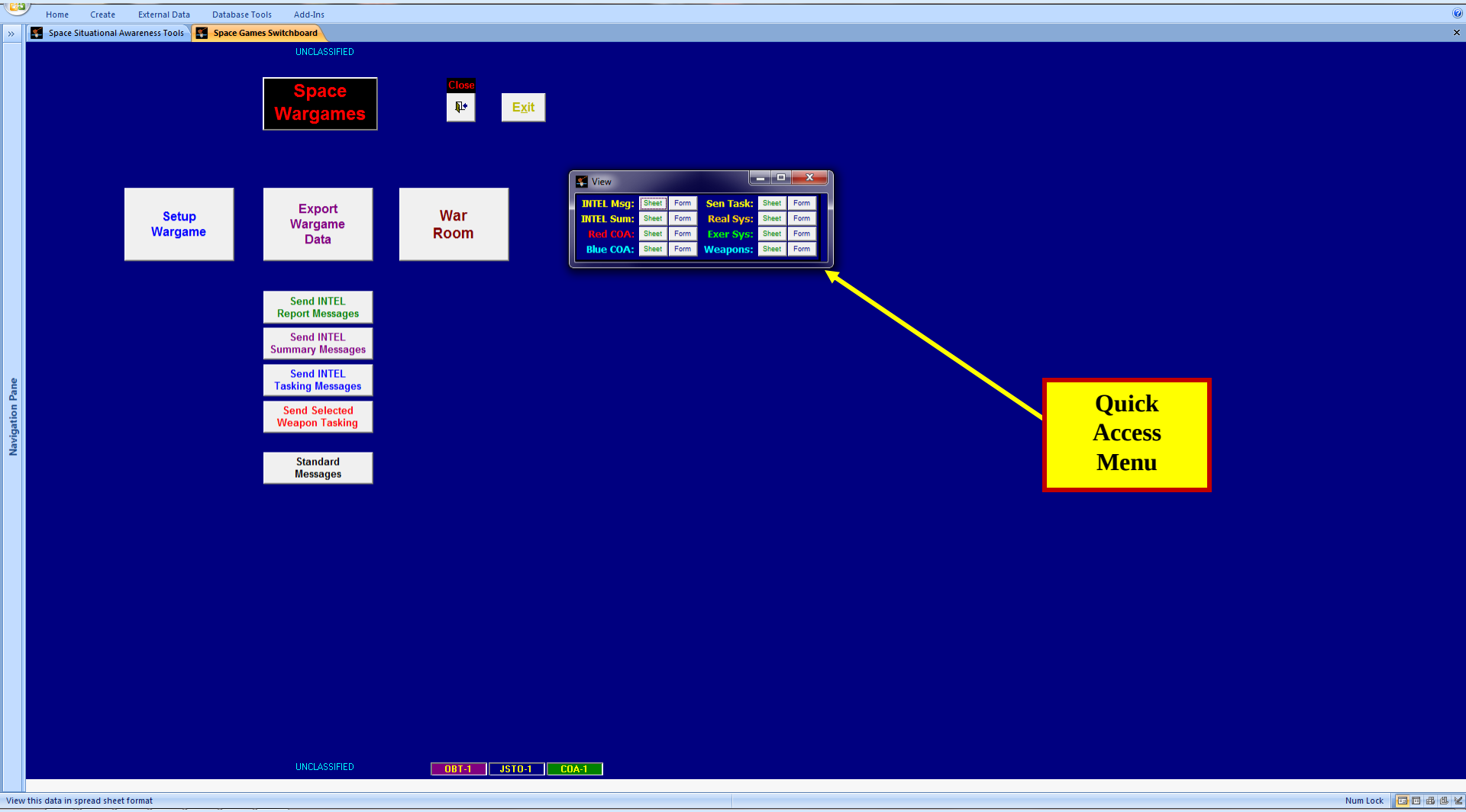
Main SSA-T Screen Shots

Actual SSA-T Wargame Menus

Main SSA-T Menu

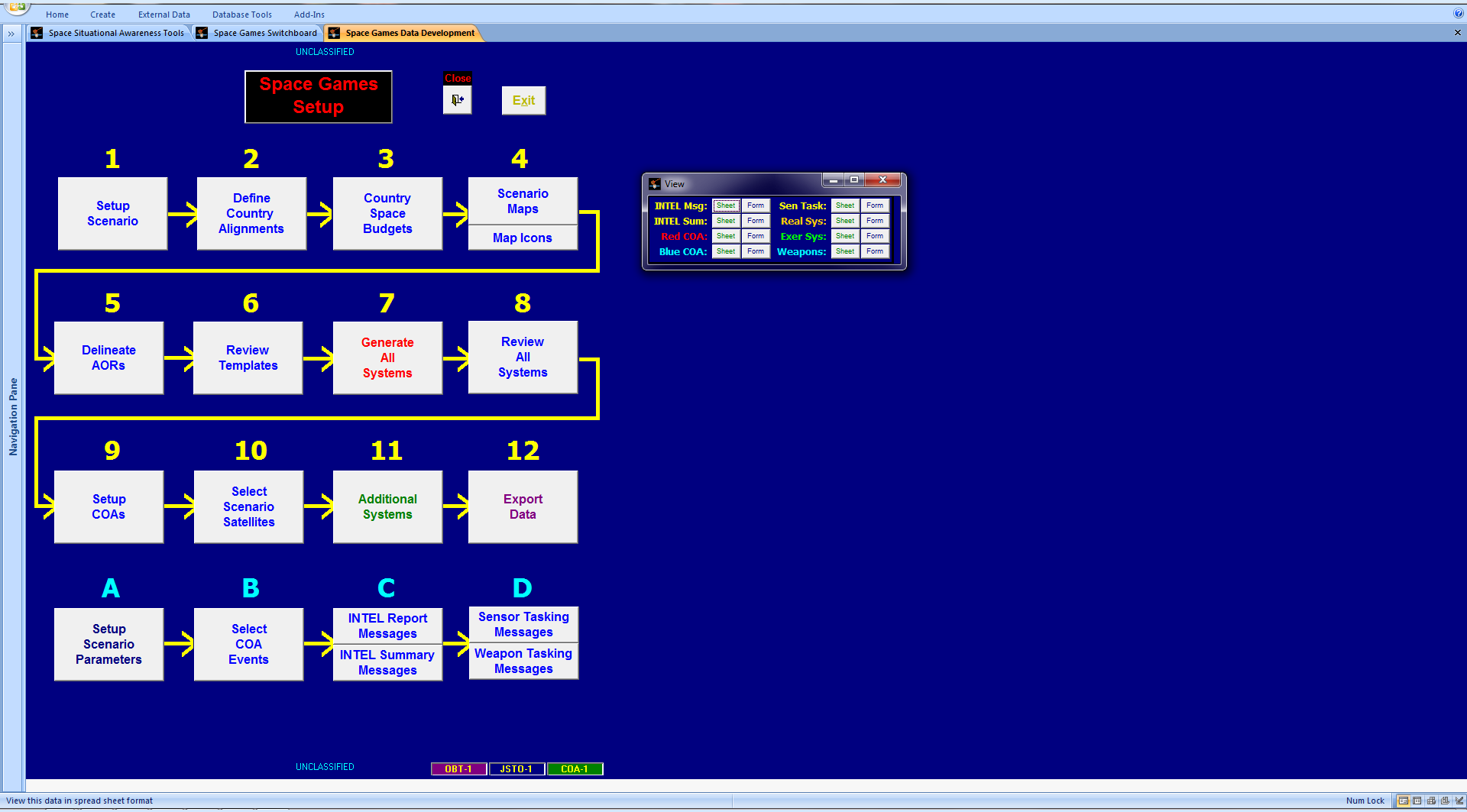
Main SSA-T Overall Menu

Main SSA-T Wargaming Menu



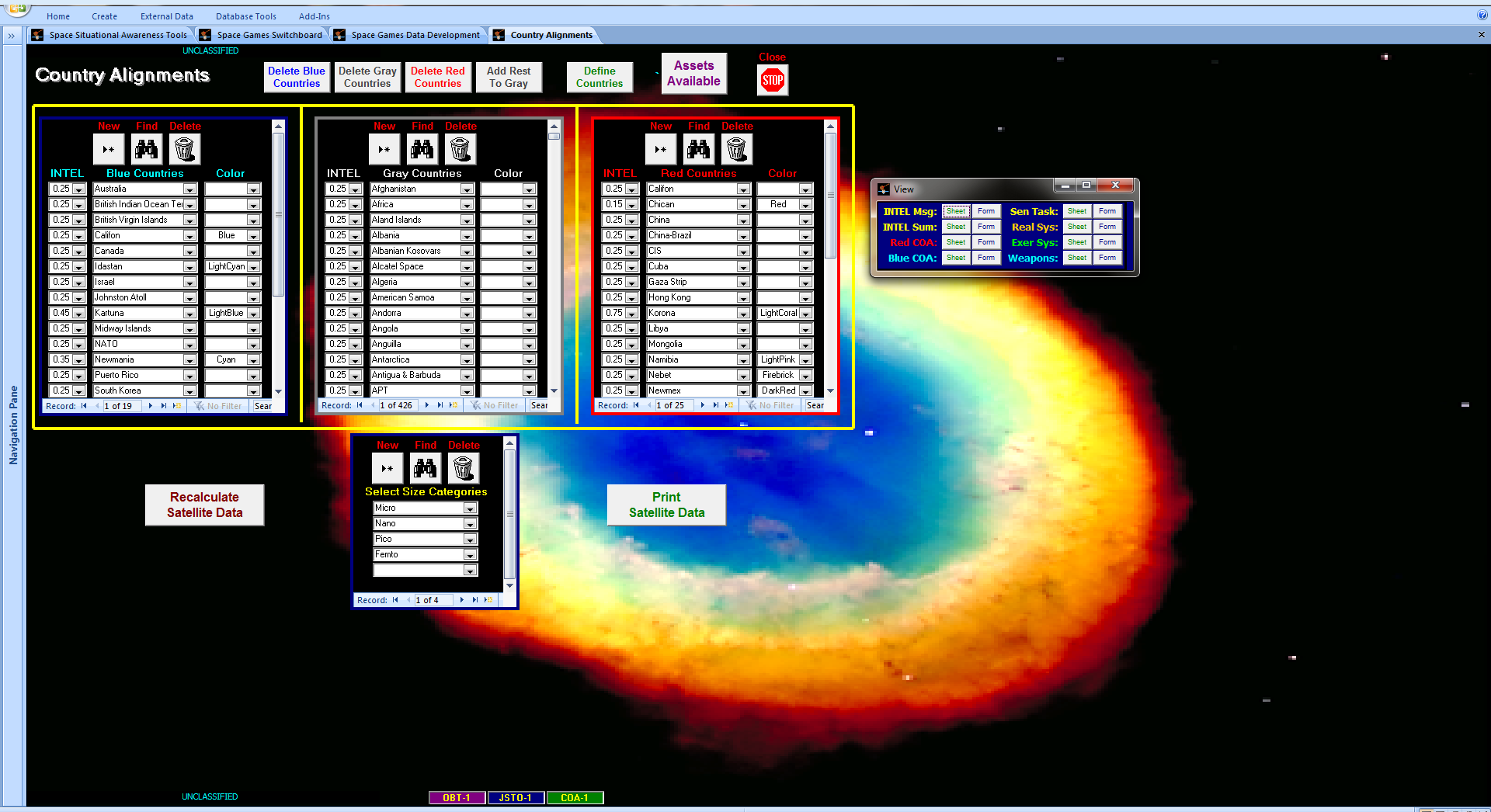
Gateway to User Setup & Execution Screens

Setup Space Wargame Menu



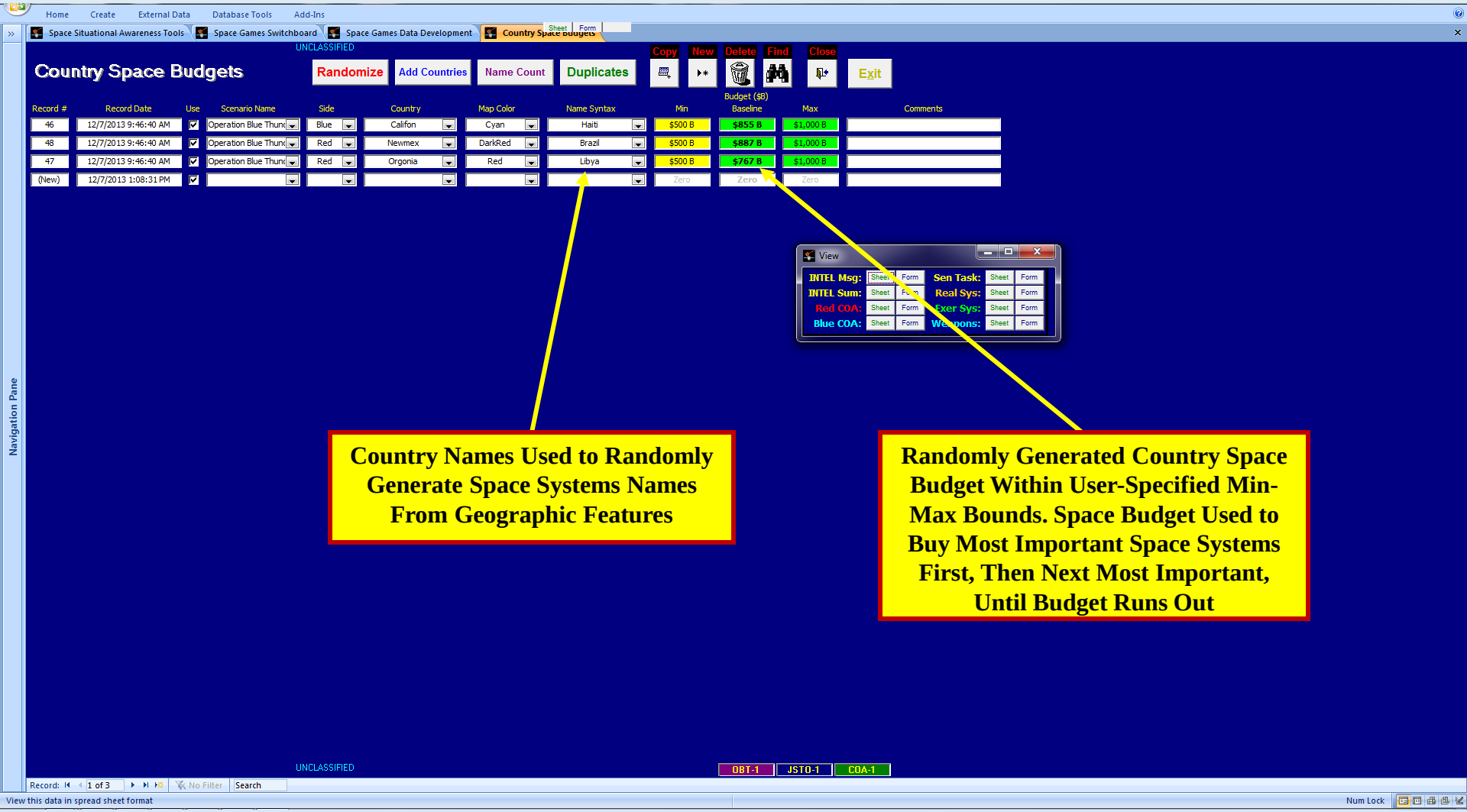
Setup Space Wargame Before Game Execution

Designate Wargame Country Alignments



Designate Which Countries are Allied (Blue), Adversary (Red) or Neutral (Gray)

Set Country Space Budgets

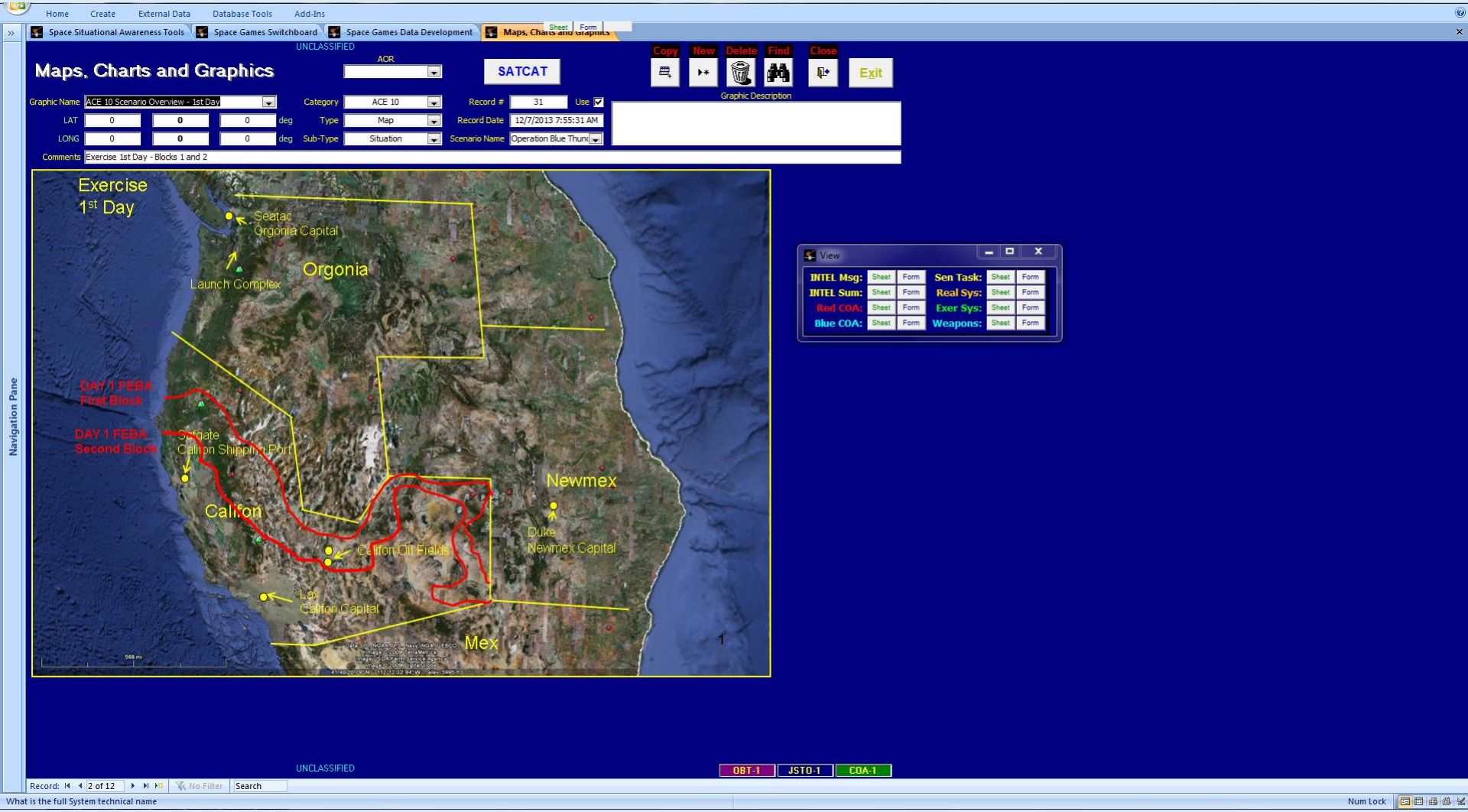


Country Names Used to Randomly Generate Space Systems Names From Geographic Features

Randomly Generated Country Space Budget Within User-Specified Min-Max Bounds. Space Budget Used to Buy Most Important Space Systems First, Then Next Most Important, Until Budget Runs Out

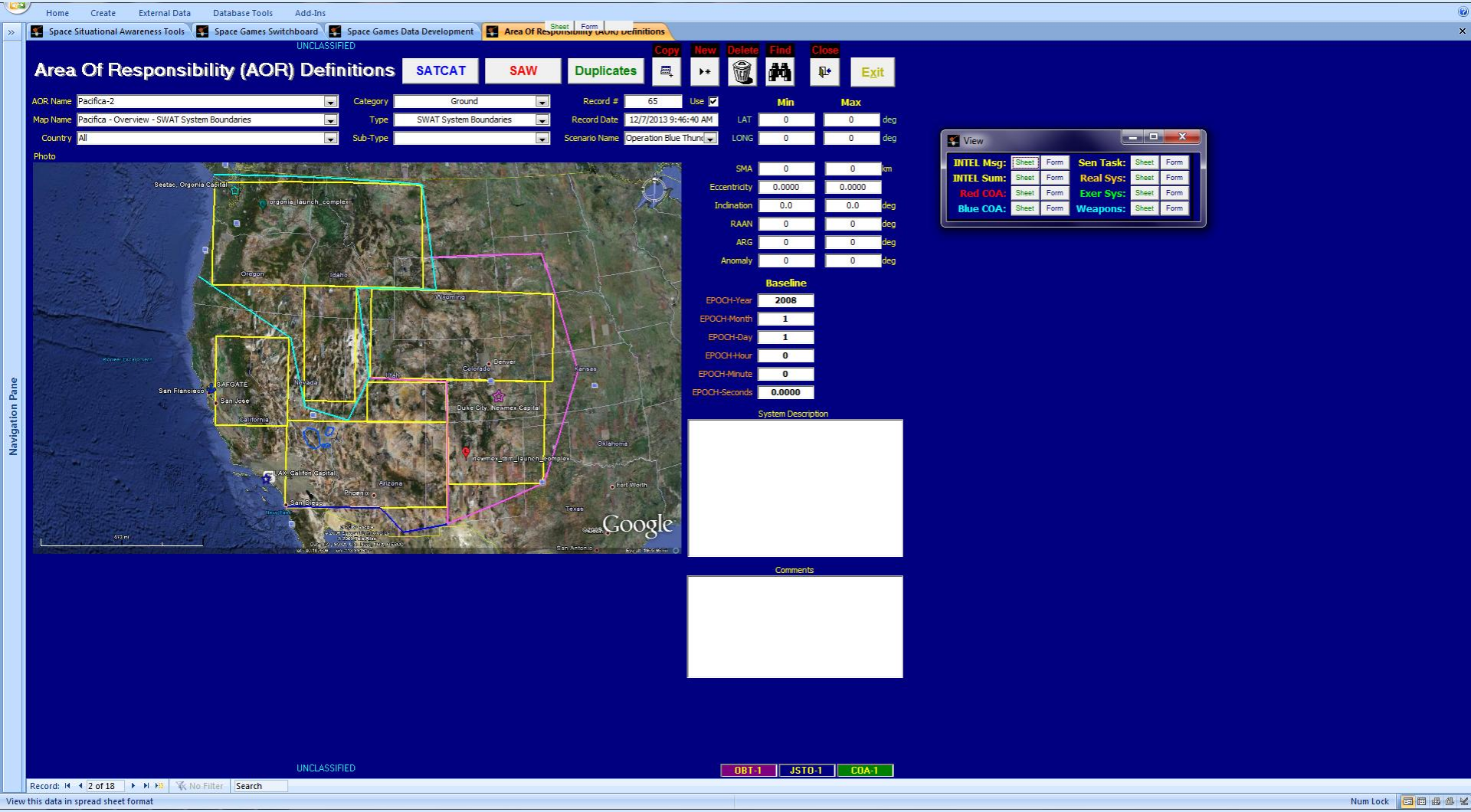
These Parameters Allow Random Game Play With Un-Equal Sides

View Situation Maps



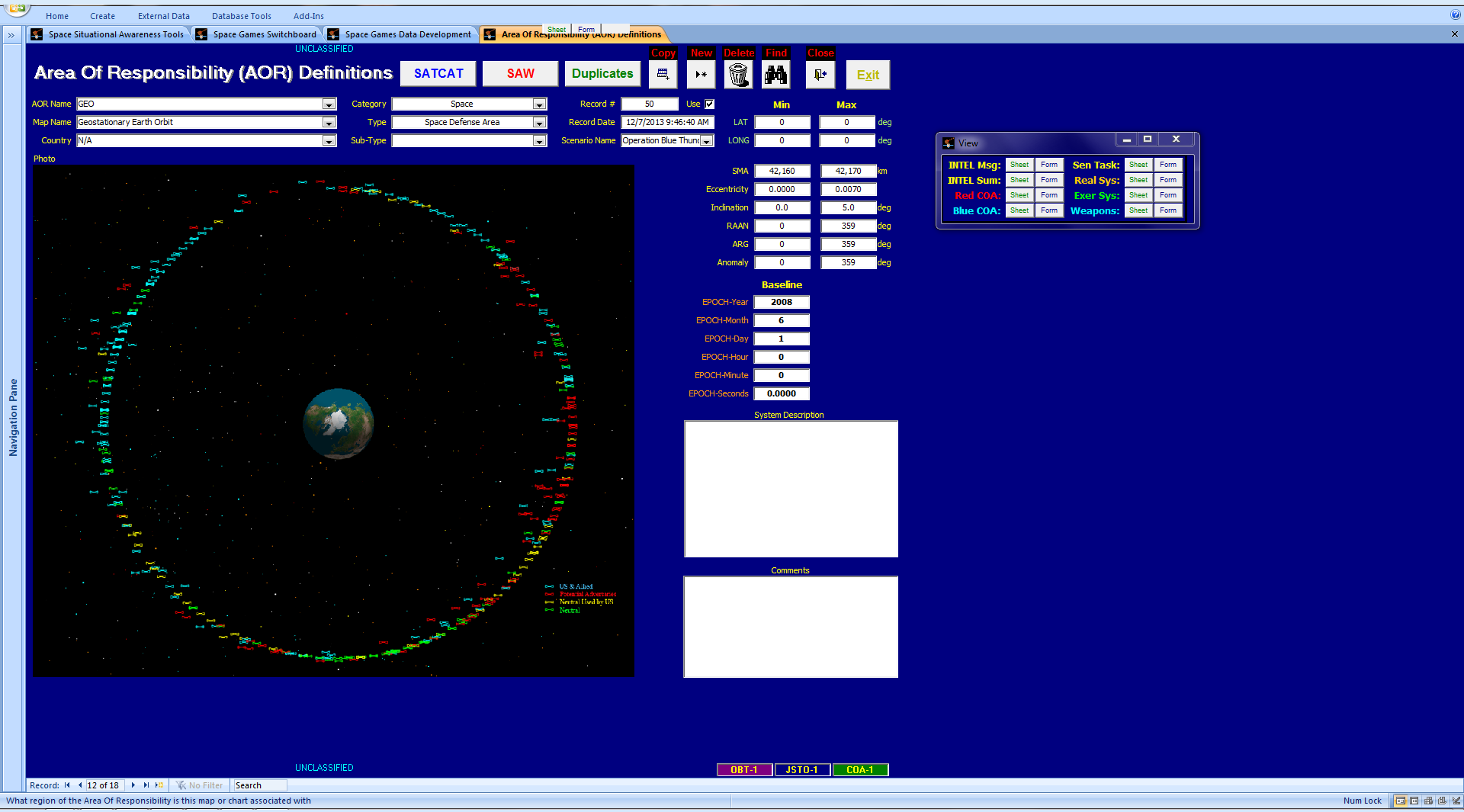
Terrestrial Game Maps

View Wargame Terrestrial Boundary Maps



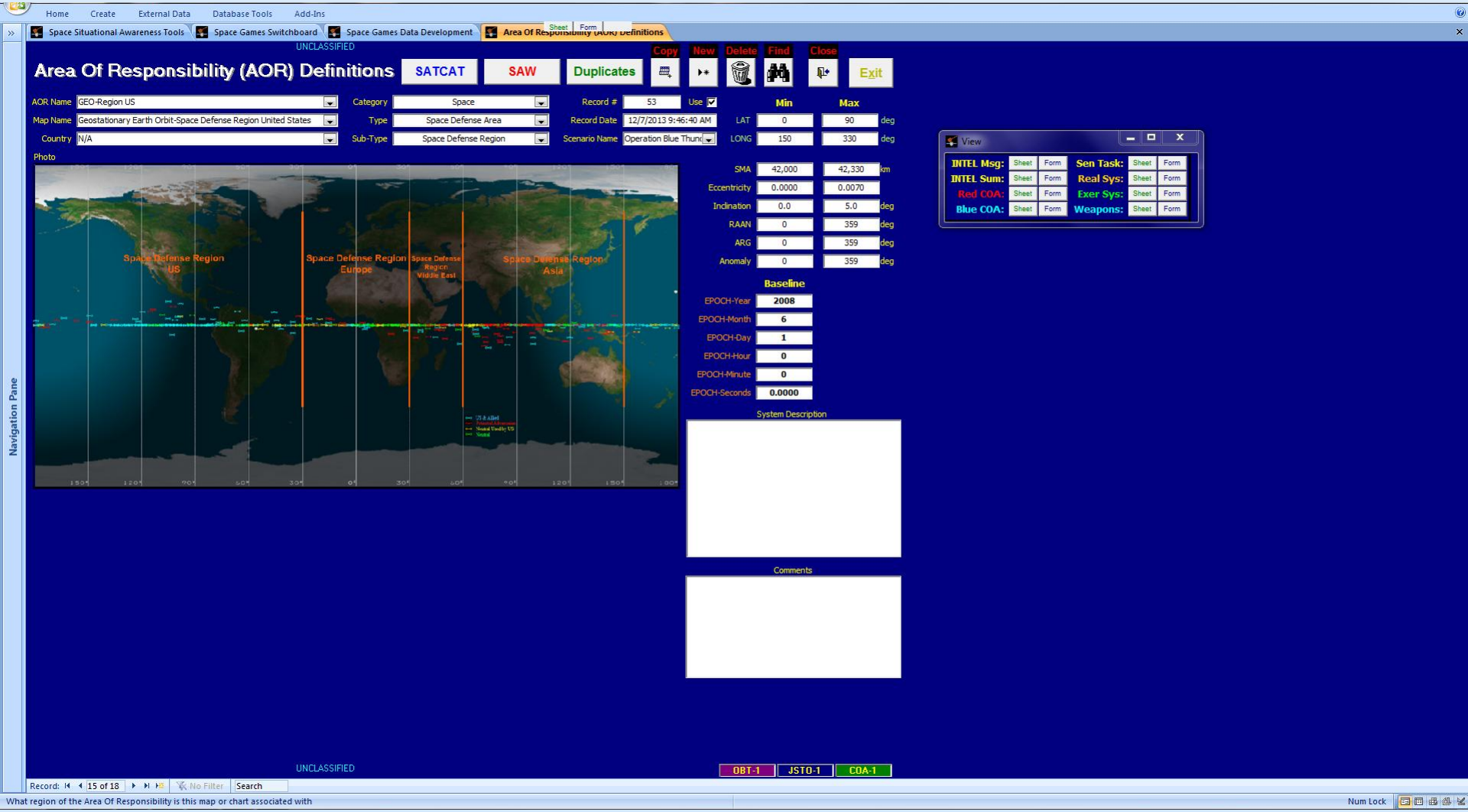
Terrestrial Game Areas Of Responsibility (AOR's)

View Wargame Space Boundary Maps (1)



Space Orbital Divisions

View Wargame Space Boundary Maps (2)

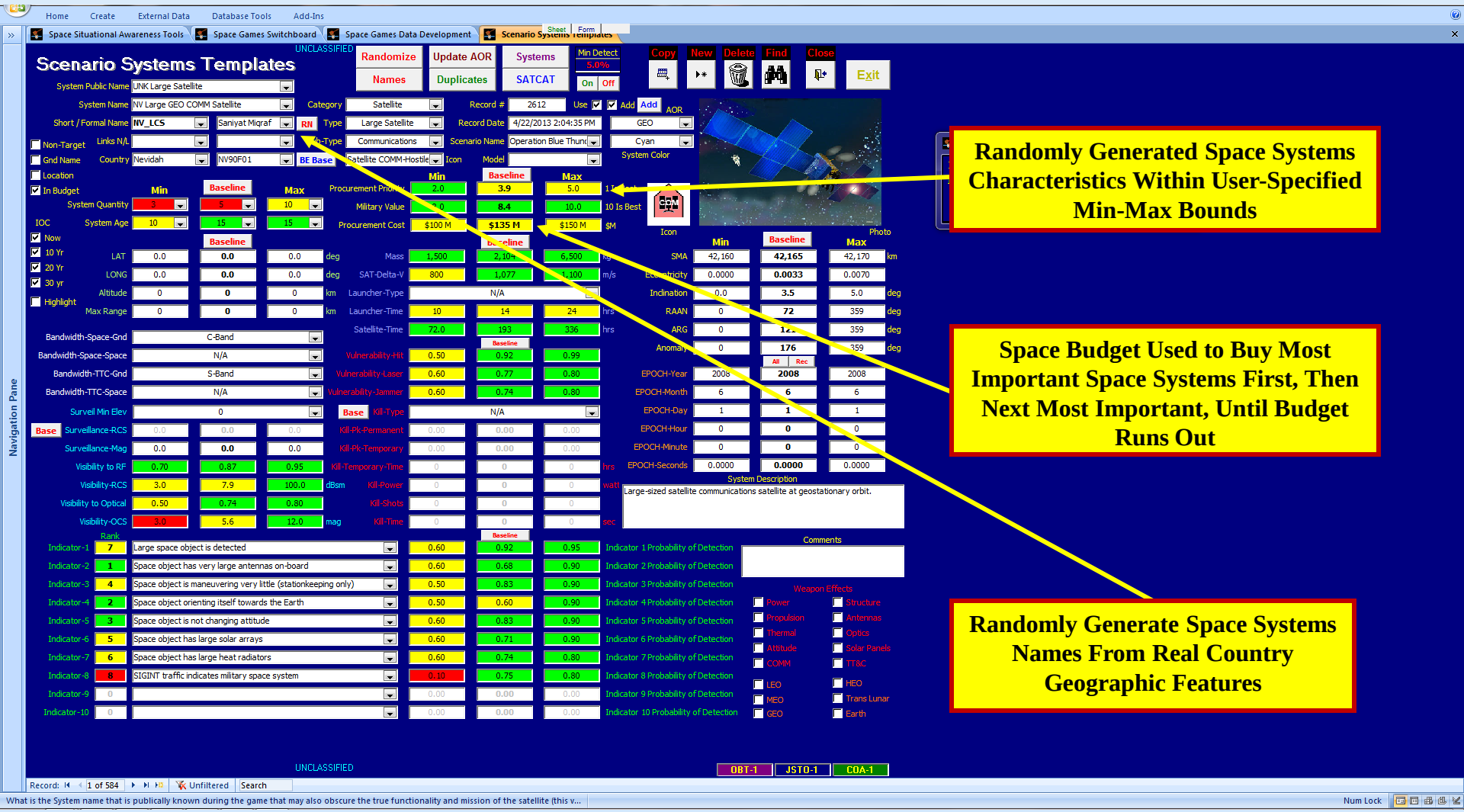


Space Orbital Regions for Geosynchronous Satellites

Wargame Notional Space Systems Development

Future Space Systems Employed in Wargame

Setup Notional Space Systems Randomized Characteristics (1)

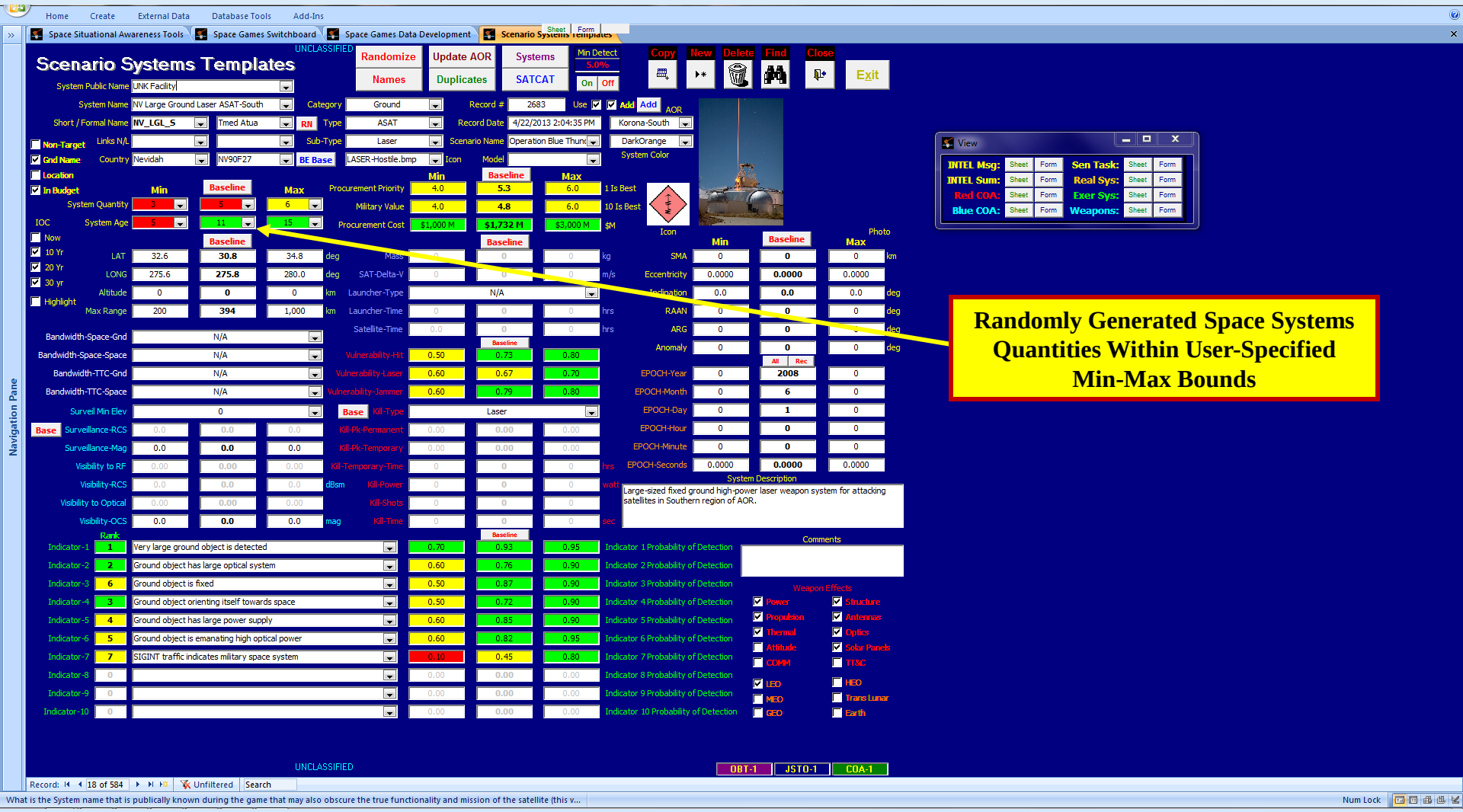


Close to 600 Different Space Systems (Current & Future) Templates

Notional Space Systems (2)

Notional Pictures for Each Space System

Notional Space Systems (3)



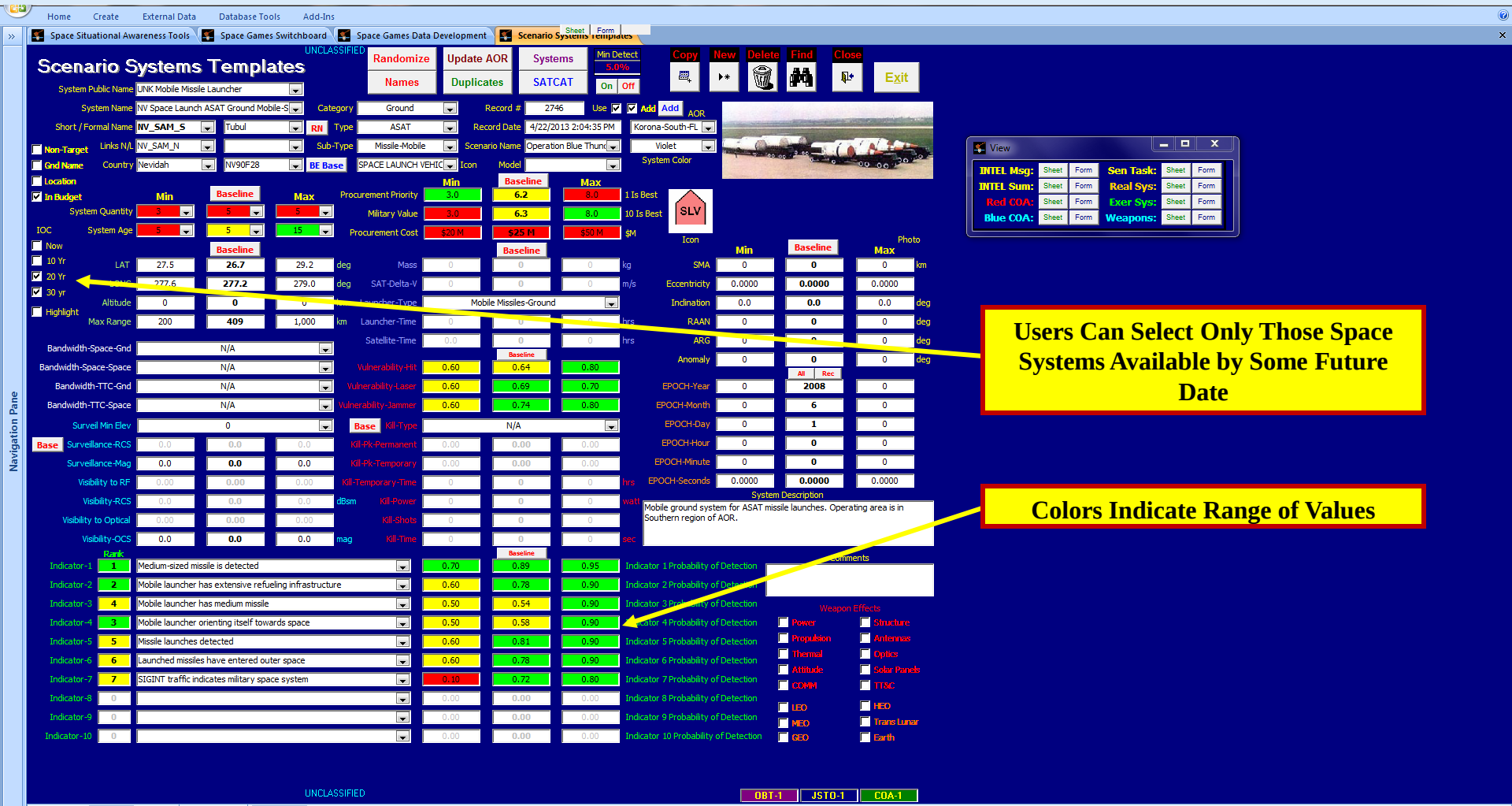
Capabilities & Locations of Space Systems (Terrestrial & Orbital) Randomized

Notional Space Systems (4)

Randomly Generated Space Systems INTEL Indicators Probability of Detection Values Within User-Specified Min-Max Bounds

Visibilities to Sensors of Space Systems (Terrestrial & Orbital) Randomized

Notional Space Systems (5)



Space Systems Capabilities Color-Coded for Instant Recognition

Notional Space Systems (6)

Some Space Systems (Terrestrial & Orbital) Randomly Obscured to Other Side

Notional Space Systems (7)

Quantities of Space Systems (Terrestrial & Orbital) Randomized

Notional Space Systems (8)

Priorities & Military Value of Space Systems (Terrestrial & Orbital) Randomized

Notional Space Systems (9)

Capabilities of Space Systems (Terrestrial & Orbital) Randomized

Notional Space Systems (10)

Probability of Kill (Pk) of Space Weapons Randomized

Notional Space Systems (11)

Intelligence Indicators Identifying Space Systems (Terrestrial & Orbital) Randomized

Notional Space Systems (12)

Intelligence Indicators Probabilities Are Randomized

Notional Space Systems (13)

Space Weapon Systems (Terrestrial & Orbital) Characteristics Randomized

Notional Space Systems (14)

Locations of Space Systems (Terrestrial & Orbital) Randomized

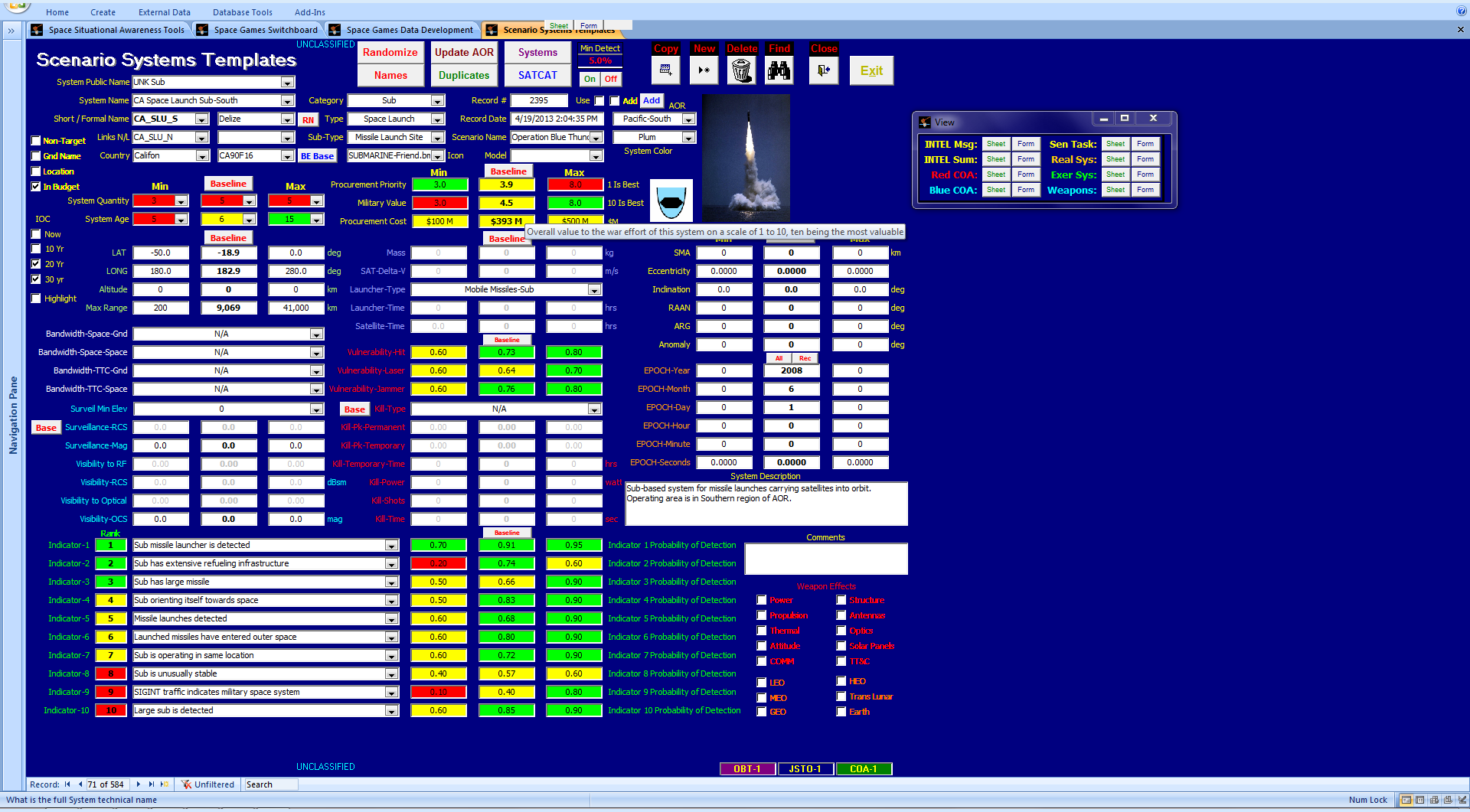
Notional Space Systems (15)

Costs of Space Systems (Terrestrial & Orbital) Randomized

Notional Space Systems (16)

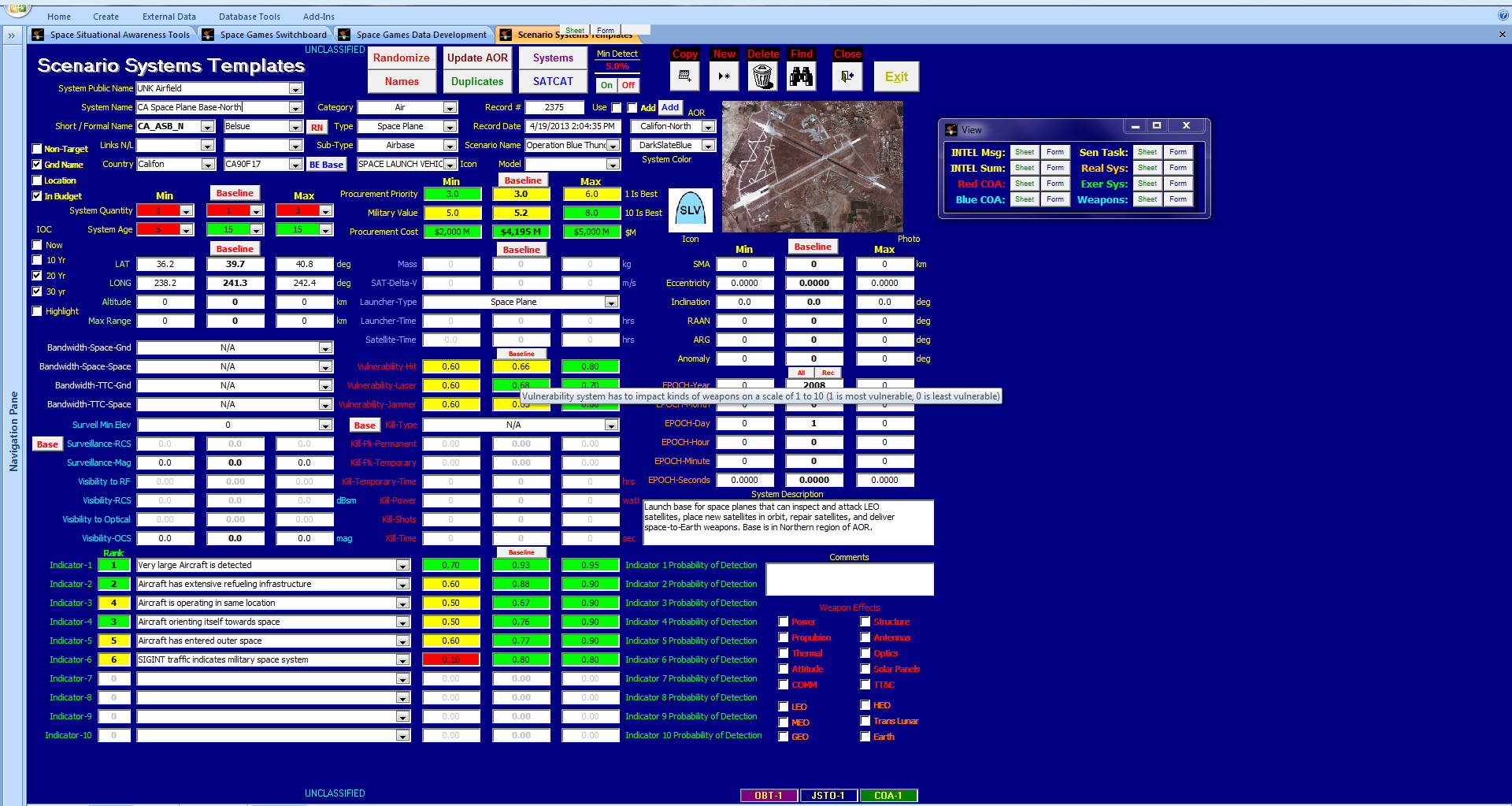
Range of Effects of Space Systems (Terrestrial & Orbital) Randomized

Notional Space Systems (17)



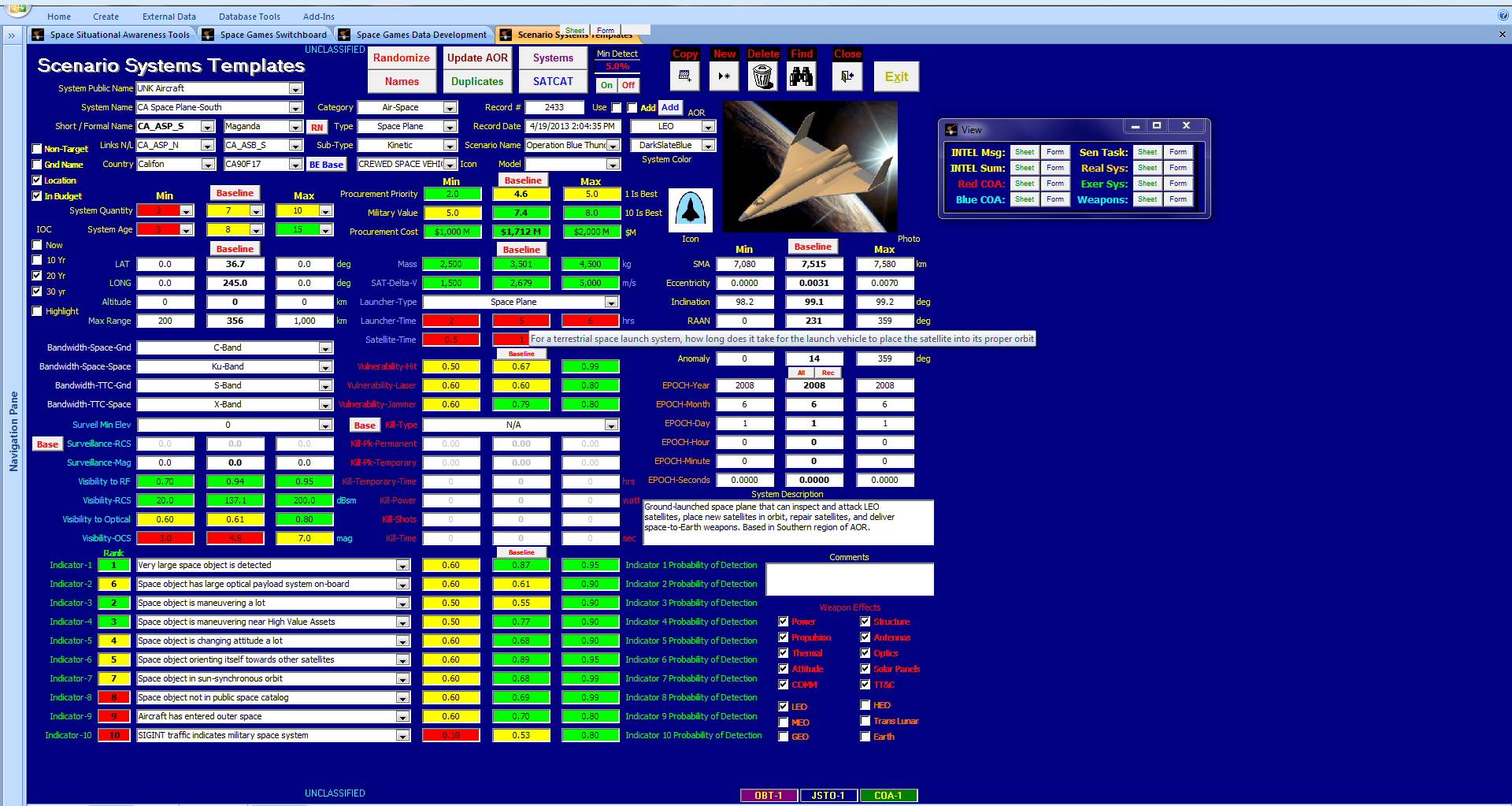
Military Value of Space Systems (Terrestrial & Orbital) Randomized

Notional Space Systems (18)



Vulnerabilities of Space Systems (Terrestrial & Orbital) Randomized

Notional Space Systems (19)



Operational Timelines of Space Systems (Terrestrial & Orbital) Randomized

Notional Space Systems (20)

Orbits of Space Objects Randomized

Notional Space Systems (21)

Space Systems Also Includes Ground Systems Related to Space

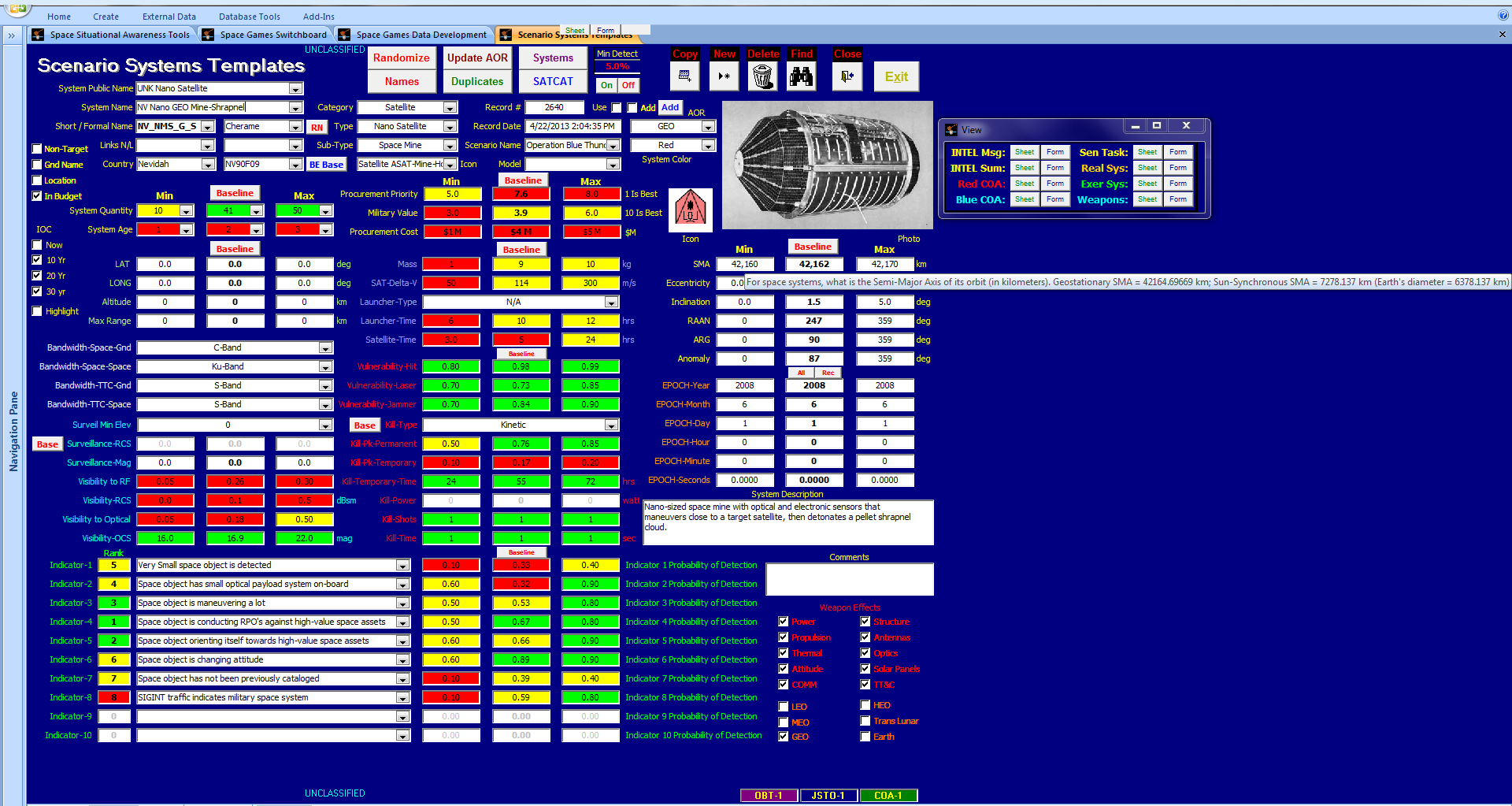
Notional Space Systems (22)

Space Systems Also Includes Naval Systems Related to Space

Notional Space Systems (23)

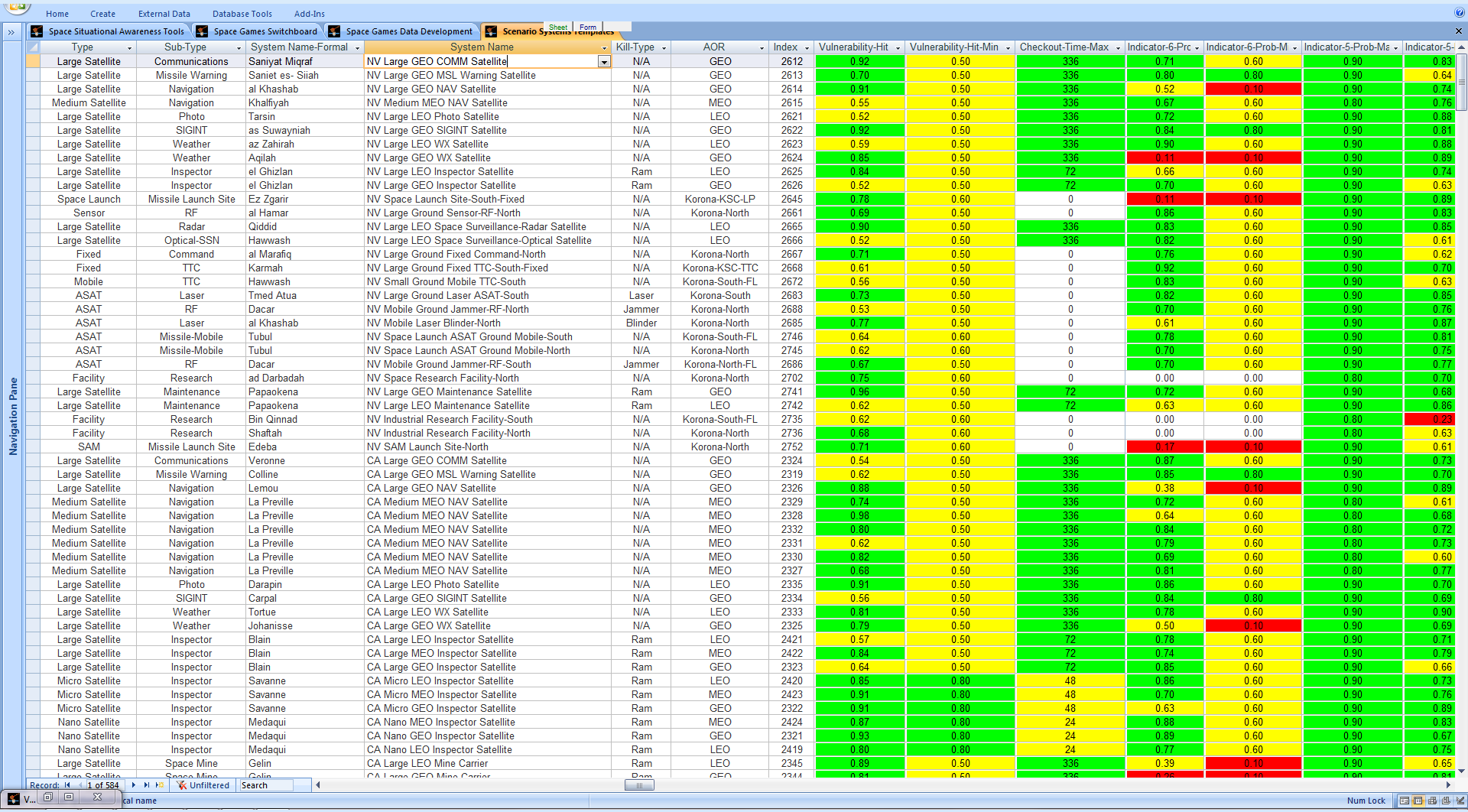
Future Notional Space Systems Can Also be Organized by Year Operational

Notional Space Systems (24)



Some Notional Future Space-Based Weapon Systems Are Included

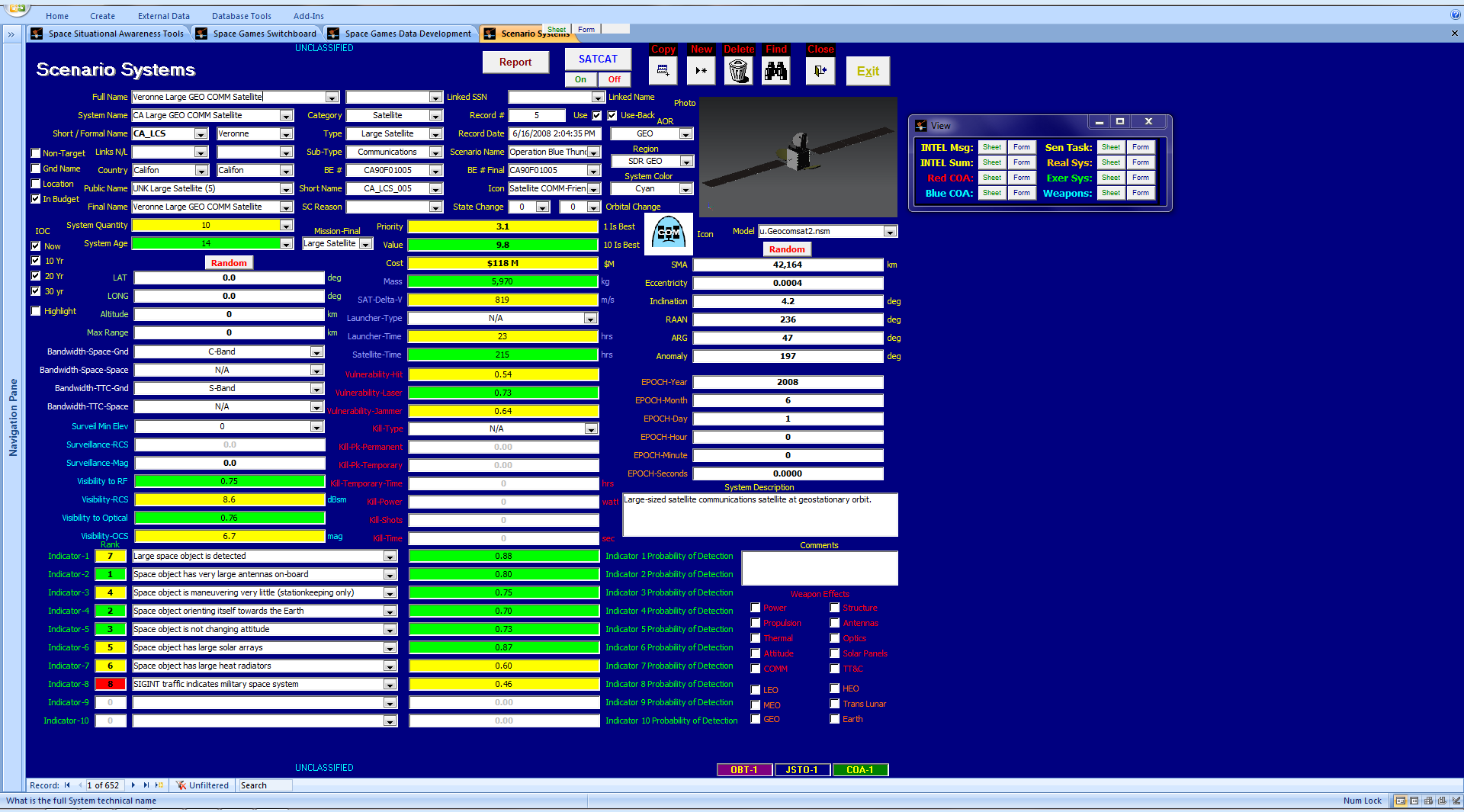
Notional Space Systems Spreadsheet



Type	Sub-Type	System Name-Formal	System Name	Kill-Type	AOR	Index	Vulnerability-Hit	Vulnerability-Hit-Min	Checkout-Time-Max	Indicator-6-Prc	Indicator-6-Prob-M	Indicator-5-Prob-Ma	Indicator-5-
Large Satellite	Communications	Saniyat Miqraf	NV Large GEO COMM Satellite	N/A	GEO	2612	0.92	0.50	336	0.71	0.60	0.90	0.83
Large Satellite	Missile Warning	Saniet es- Siiah	NV Large GEO MSL Warning Satellite	N/A	GEO	2613	0.70	0.50	336	0.80	0.80	0.90	0.64
Large Satellite	Navigation	al Khashab	NV Large GEO NAV Satellite	N/A	GEO	2614	0.91	0.50	336	0.52	0.10	0.90	0.74
Medium Satellite	Navigation	Khalfiyah	NV Medium MEO NAV Satellite	N/A	MEO	2615	0.55	0.50	336	0.67	0.60	0.80	0.76
Large Satellite	Photo	Tarsin	NV Large LEO Photo Satellite	N/A	LEO	2621	0.52	0.50	336	0.72	0.60	0.90	0.88
Large Satellite	SIGINT	as Suwayniah	NV Large GEO SIGINT Satellite	N/A	GEO	2622	0.92	0.50	336	0.84	0.80	0.90	0.81
Large Satellite	Weather	az Zahirah	NV Large LEO WX Satellite	N/A	LEO	2623	0.59	0.50	336	0.90	0.60	0.90	0.88
Large Satellite	Weather	Aqilah	NV Large GEO WX Satellite	N/A	GEO	2624	0.85	0.50	336	0.11	0.10	0.90	0.89
Large Satellite	Inspector	el Ghizlan	NV Large LEO Inspector Satellite	Ram	LEO	2625	0.84	0.50	72	0.66	0.60	0.90	0.74
Large Satellite	Inspector	el Ghizlan	NV Large GEO Inspector Satellite	Ram	GEO	2626	0.52	0.50	72	0.70	0.60	0.90	0.63
Space Launch	Missile Launch Site	Ez Zgarir	NV Space Launch Site-South-Fixed	N/A	Korona-KSC-LP	2645	0.78	0.60	0	0.11	0.10	0.90	0.89
Sensor	RF	al Hamar	NV Large Ground Sensor-RF-North	N/A	Korona-North	2661	0.69	0.50	0	0.86	0.60	0.90	0.83
Large Satellite	Radar	Qiddid	NV Large LEO Space Surveillance-Radar Satellite	N/A	LEO	2665	0.90	0.50	336	0.83	0.60	0.90	0.85
Large Satellite	Optical-SSN	Hawwash	NV Large LEO Space Surveillance-Optical Satellite	N/A	LEO	2666	0.52	0.50	336	0.82	0.60	0.90	0.61
Fixed	Command	al Marafiq	NV Large Ground Fixed Command-North	N/A	Korona-North	2667	0.71	0.50	0	0.76	0.60	0.90	0.62
Fixed	TTC	Karmah	NV Large Ground Fixed TTC-South-Fixed	N/A	Korona-KSC-TTC	2668	0.61	0.50	0	0.92	0.60	0.90	0.70
Mobile	TTC	Hawwash	NV Small Ground Mobile TTC-South	N/A	Korona-South-FL	2672	0.56	0.50	0	0.83	0.60	0.90	0.63
ASAT	Laser	Tmed Atua	NV Large Ground Laser ASAT-South	Laser	Korona-South	2683	0.73	0.50	0	0.82	0.60	0.90	0.85
ASAT	RF	Dacar	NV Mobile Ground Jammer-RF-North	Jammer	Korona-North	2688	0.53	0.50	0	0.70	0.60	0.90	0.76
ASAT	Laser	al Khashab	NV Mobile Laser Blinder-North	Blinder	Korona-North	2685	0.77	0.50	0	0.61	0.60	0.90	0.87
ASAT	Missile-Mobile	Tubul	NV Space Launch ASAT Ground Mobile-South	N/A	Korona-South-FL	2746	0.64	0.60	0	0.78	0.60	0.90	0.81
ASAT	Missile-Mobile	Tubul	NV Space Launch ASAT Ground Mobile-North	N/A	Korona-North	2745	0.62	0.60	0	0.70	0.60	0.90	0.75
ASAT	RF	Dacar	NV Mobile Ground Jammer-RF-South	Jammer	Korona-North-FL	2686	0.67	0.50	0	0.70	0.60	0.90	0.77
Facility	Research	ad Darbadah	NV Space Research Facility-North	N/A	Korona-North	2702	0.75	0.60	0	0.00	0.00	0.80	0.70
Large Satellite	Maintenance	Papaokena	NV Large GEO Maintenance Satellite	Ram	GEO	2741	0.96	0.50	72	0.72	0.60	0.90	0.68
Large Satellite	Maintenance	Papaokena	NV Large LEO Maintenance Satellite	Ram	LEO	2742	0.62	0.50	72	0.63	0.60	0.90	0.86
Facility	Research	Bin Qinnad	NV Industrial Research Facility-South	N/A	Korona-South-FL	2735	0.62	0.60	0	0.00	0.00	0.80	0.23
Facility	Research	Shaftah	NV Industrial Research Facility-North	N/A	Korona-North	2736	0.68	0.60	0	0.00	0.00	0.80	0.63
SAM	Missile Launch Site	Edeba	NV SAM Launch Site-North	N/A	Korona-North	2752	0.71	0.60	0	0.17	0.10	0.90	0.61
Large Satellite	Communications	Veronne	CA Large GEO COMM Satellite	N/A	GEO	2324	0.54	0.50	336	0.87	0.60	0.90	0.73
Large Satellite	Missile Warning	Colline	CA Large GEO MSL Warning Satellite	N/A	GEO	2319	0.62	0.50	336	0.85	0.80	0.90	0.70
Large Satellite	Navigation	Lemou	CA Large GEO NAV Satellite	N/A	GEO	2326	0.88	0.50	336	0.38	0.10	0.90	0.89
Medium Satellite	Navigation	La Preville	CA Medium MEO NAV Satellite	N/A	MEO	2329	0.74	0.50	336	0.72	0.60	0.80	0.61
Medium Satellite	Navigation	La Preville	CA Medium MEO NAV Satellite	N/A	MEO	2328	0.98	0.50	336	0.64	0.60	0.80	0.68
Medium Satellite	Navigation	La Preville	CA Medium MEO NAV Satellite	N/A	MEO	2332	0.80	0.50	336	0.84	0.60	0.80	0.72
Medium Satellite	Navigation	La Preville	CA Medium MEO NAV Satellite	N/A	MEO	2331	0.62	0.50	336	0.79	0.60	0.80	0.73
Medium Satellite	Navigation	La Preville	CA Medium MEO NAV Satellite	N/A	MEO	2330	0.82	0.50	336	0.69	0.60	0.80	0.60
Medium Satellite	Navigation	La Preville	CA Medium MEO NAV Satellite	N/A	MEO	2327	0.68	0.50	336	0.81	0.60	0.80	0.77
Large Satellite	Photo	Darapin	CA Large LEO Photo Satellite	N/A	LEO	2335	0.91	0.50	336	0.86	0.60	0.90	0.70
Large Satellite	SIGINT	Carpal	CA Large GEO SIGINT Satellite	N/A	GEO	2334	0.56	0.50	336	0.84	0.80	0.90	0.69
Large Satellite	Weather	Tortue	CA Large LEO WX Satellite	N/A	LEO	2333	0.81	0.50	336	0.78	0.60	0.90	0.90
Large Satellite	Weather	Johanisse	CA Large GEO WX Satellite	N/A	GEO	2325	0.79	0.50	336	0.50	0.10	0.90	0.69
Large Satellite	Inspector	Blain	CA Large LEO Inspector Satellite	Ram	LEO	2421	0.57	0.50	72	0.78	0.60	0.90	0.71
Large Satellite	Inspector	Blain	CA Large MEO Inspector Satellite	Ram	MEO	2422	0.84	0.50	72	0.74	0.60	0.90	0.79
Large Satellite	Inspector	Blain	CA Large GEO Inspector Satellite	Ram	GEO	2323	0.64	0.50	72	0.85	0.60	0.90	0.66
Micro Satellite	Inspector	Savanne	CA Micro LEO Inspector Satellite	Ram	LEO	2420	0.85	0.80	48	0.86	0.60	0.90	0.73
Micro Satellite	Inspector	Savanne	CA Micro MEO Inspector Satellite	Ram	MEO	2423	0.91	0.80	48	0.70	0.60	0.90	0.76
Micro Satellite	Inspector	Savanne	CA Micro GEO Inspector Satellite	Ram	GEO	2322	0.91	0.80	48	0.63	0.60	0.90	0.89
Nano Satellite	Inspector	Medaqui	CA Nano MEO Inspector Satellite	Ram	MEO	2424	0.87	0.80	24	0.88	0.60	0.90	0.83
Nano Satellite	Inspector	Medaqui	CA Nano GEO Inspector Satellite	Ram	GEO	2321	0.93	0.80	24	0.89	0.60	0.90	0.67
Nano Satellite	Inspector	Medaqui	CA Nano LEO Inspector Satellite	Ram	LEO	2419	0.80	0.80	24	0.77	0.60	0.90	0.75
Large Satellite	Space Mine	Gelin	CA Large LEO Mine Carrier	Ram	LEO	2345	0.89	0.50	336	0.39	0.10	0.90	0.65

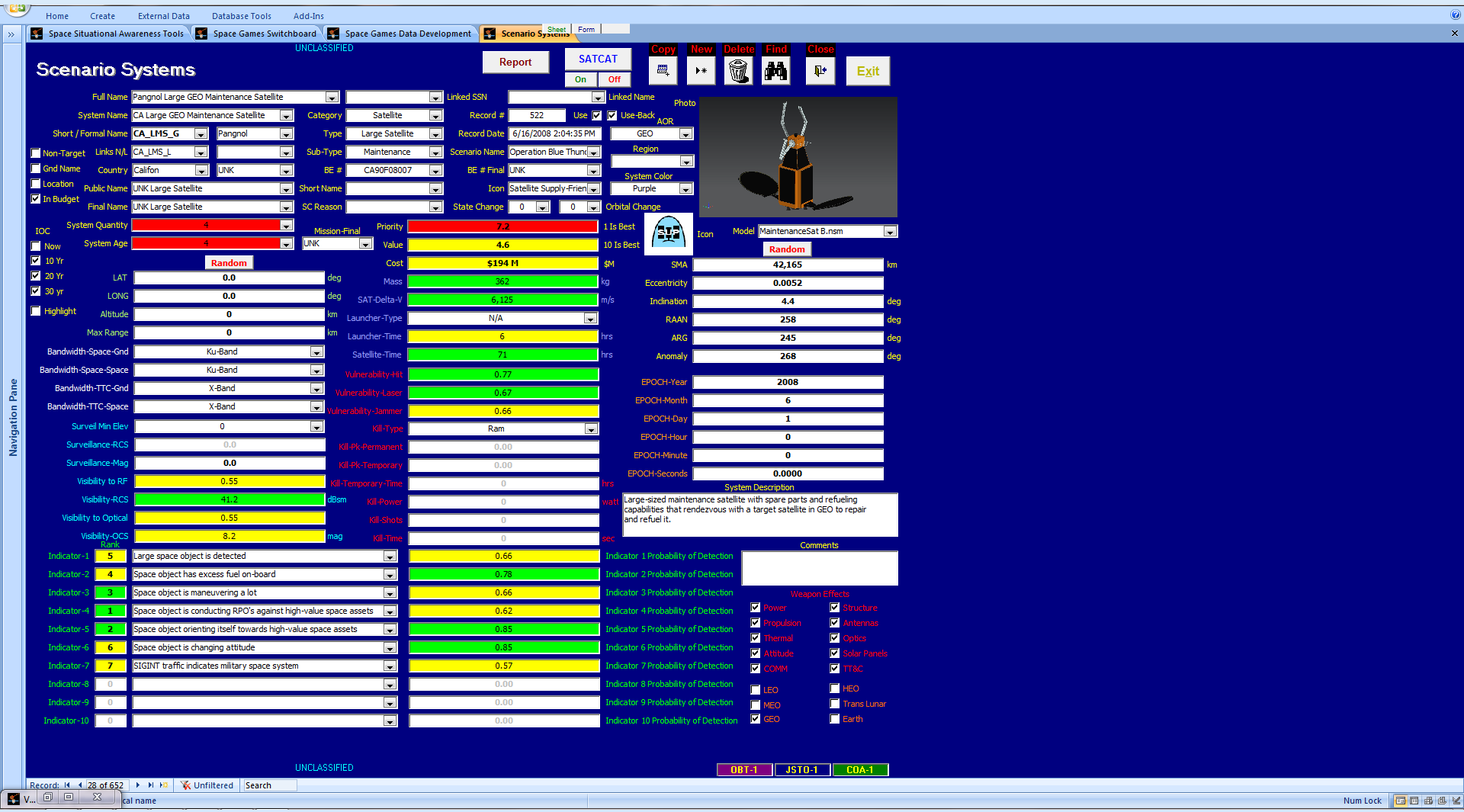
Space Systems Can be Viewed as a Spreadsheet With Characteristics Colored by Value Range

Selected Notional Space Systems (1)



These are the Actual Space Systems & Characteristics Selected After Randomization

Selected Notional Space Systems (2)

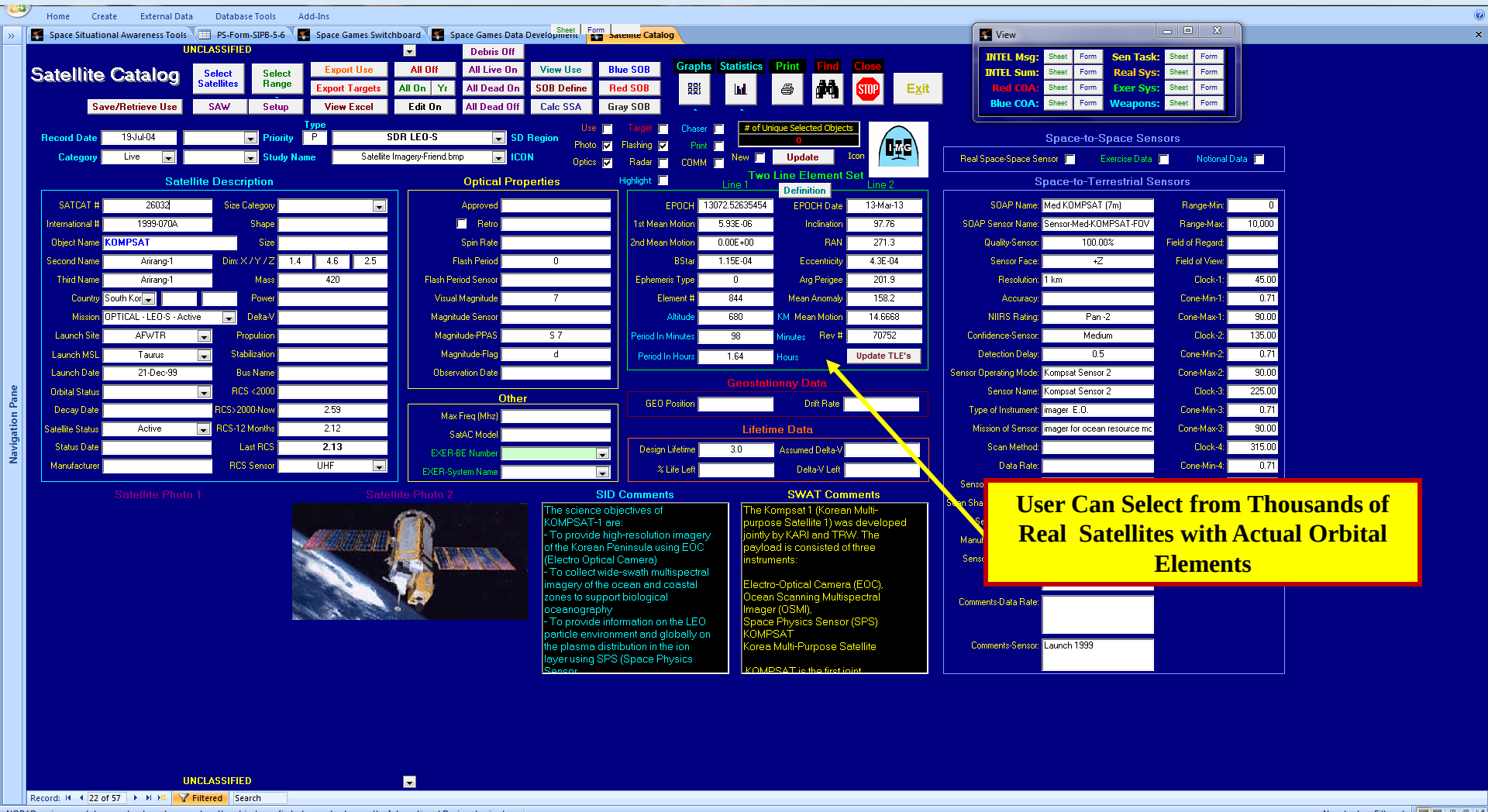


Other Space Systems Selected

Wargame Real Space Systems

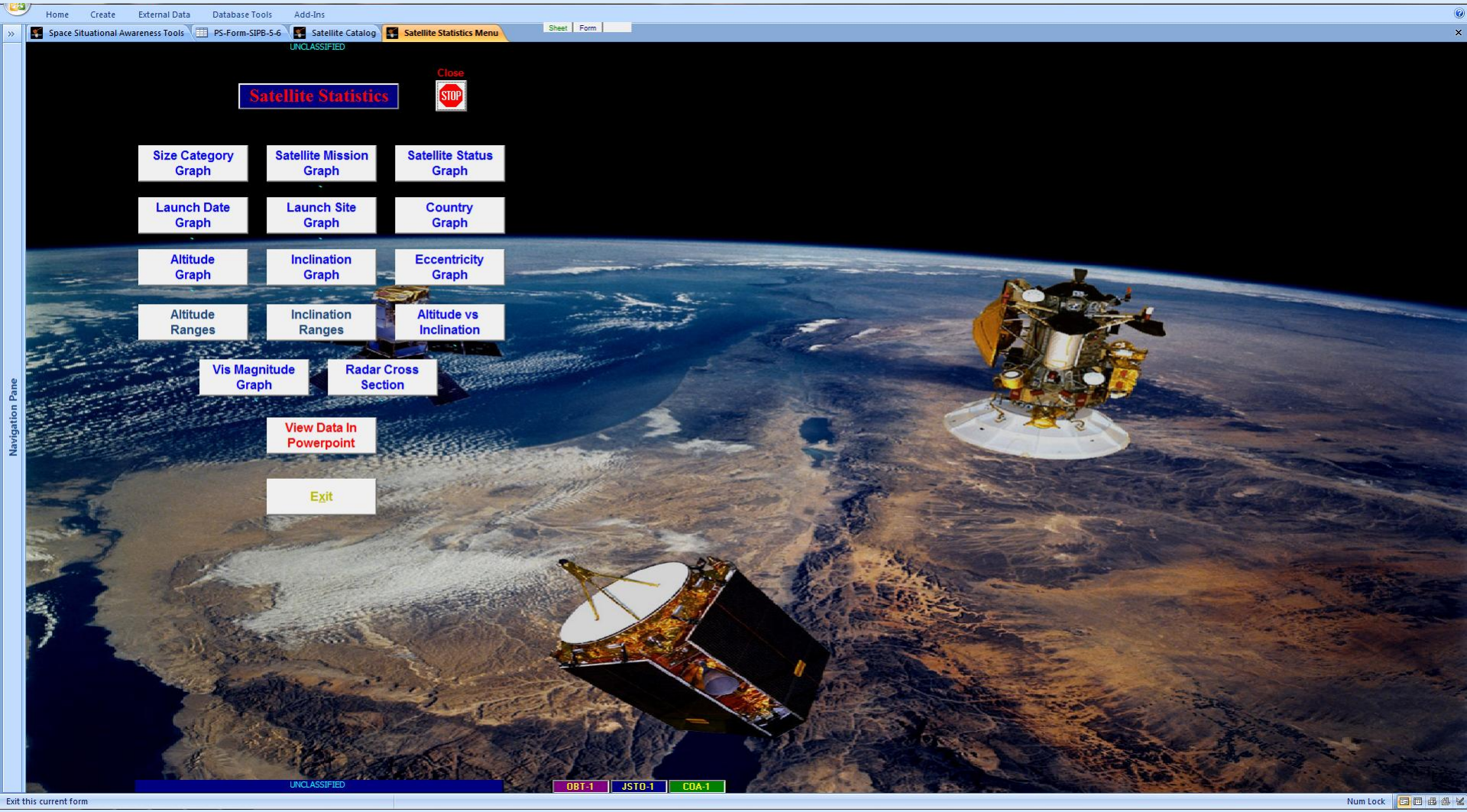
Current Space Systems Employed in Wargame

Real Space Systems



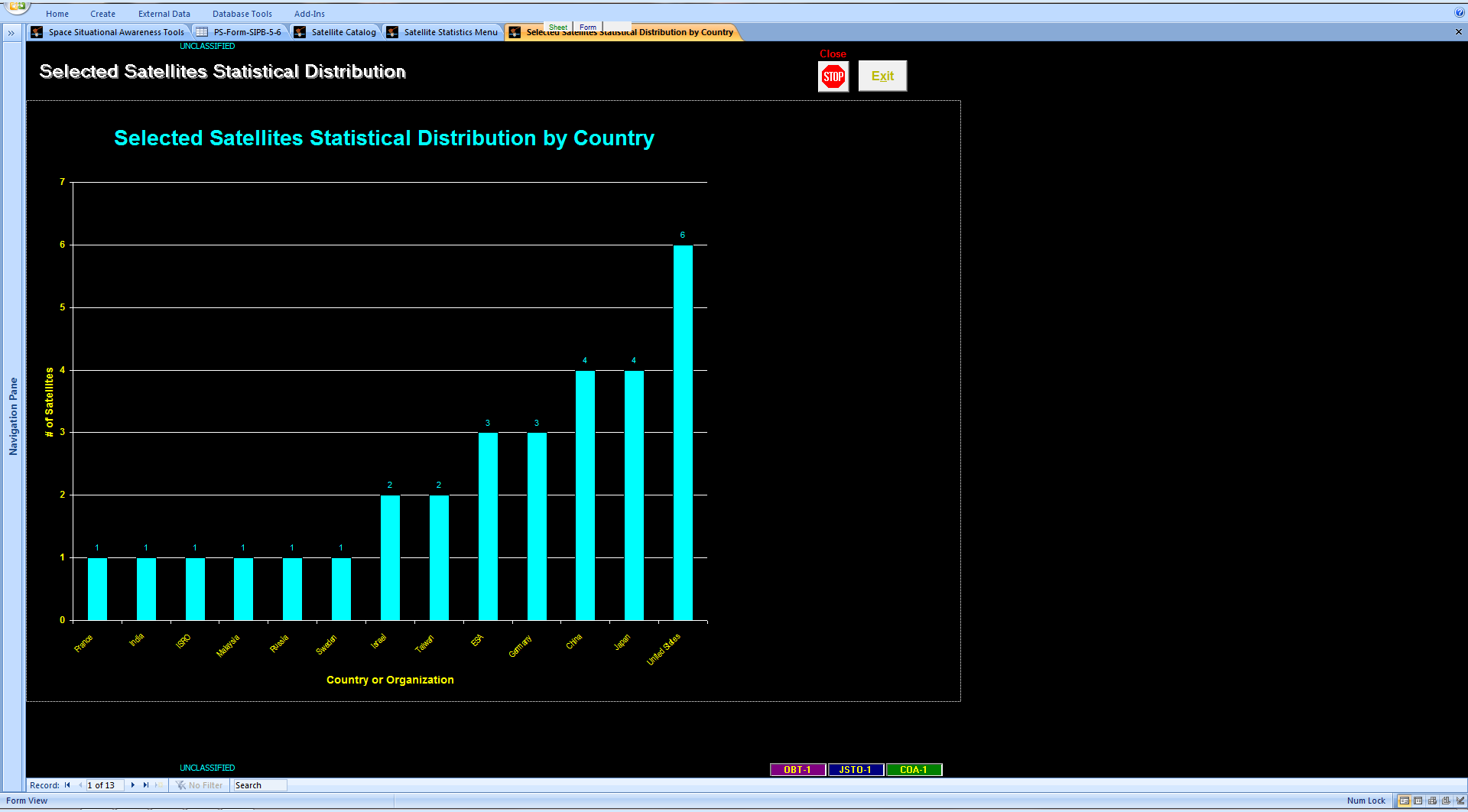
These Are Actual Space Objects in the Joint Space Operations Center (JSpOC) Databases

Real Space Systems Statistics Menu



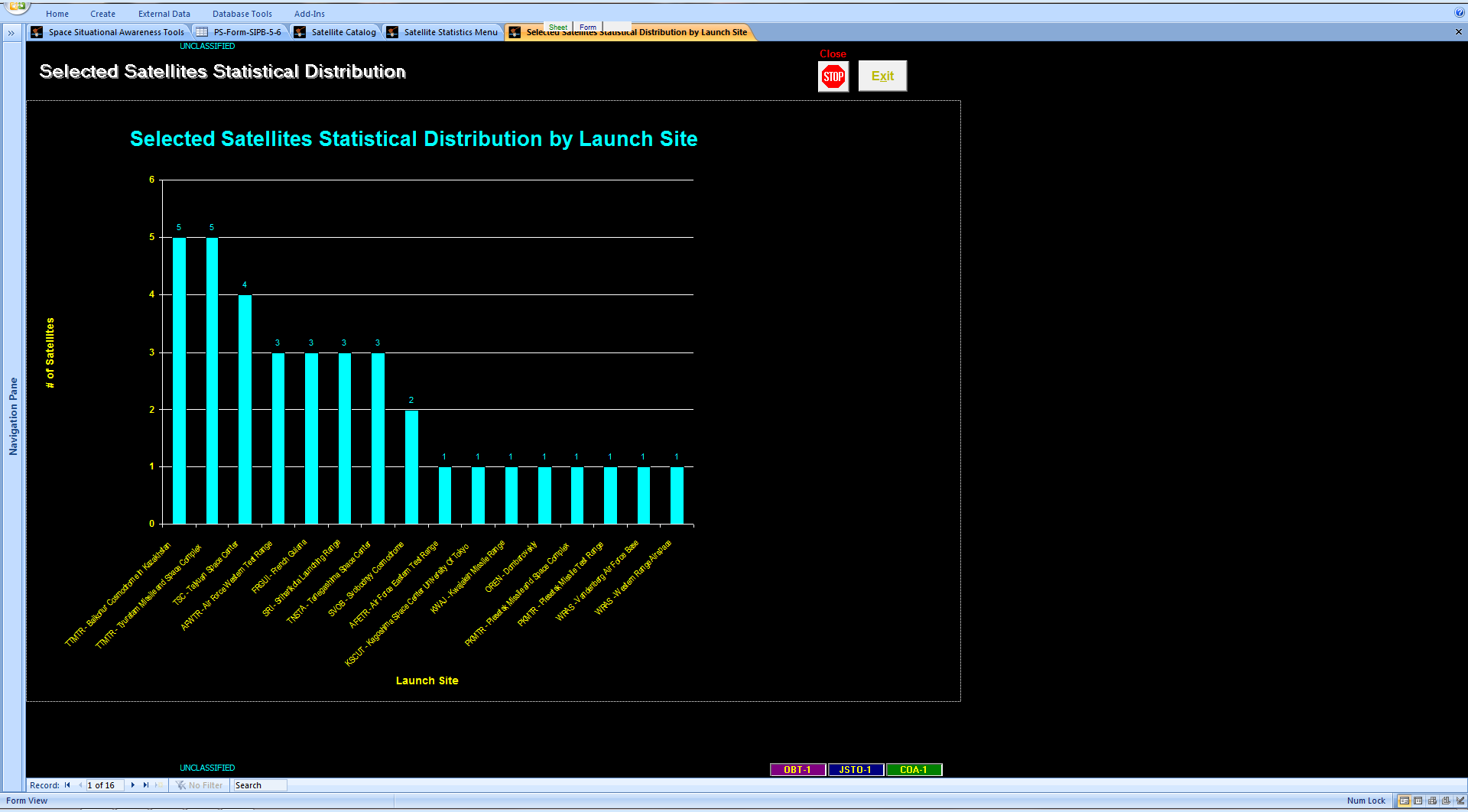
Real Space Objects can be Statistically Analyzed

Real Space Systems Statistics Graph (1)



Which Country Launched the Most Satellite of the Selected Category

Real Space Systems Statistics Graph (2)

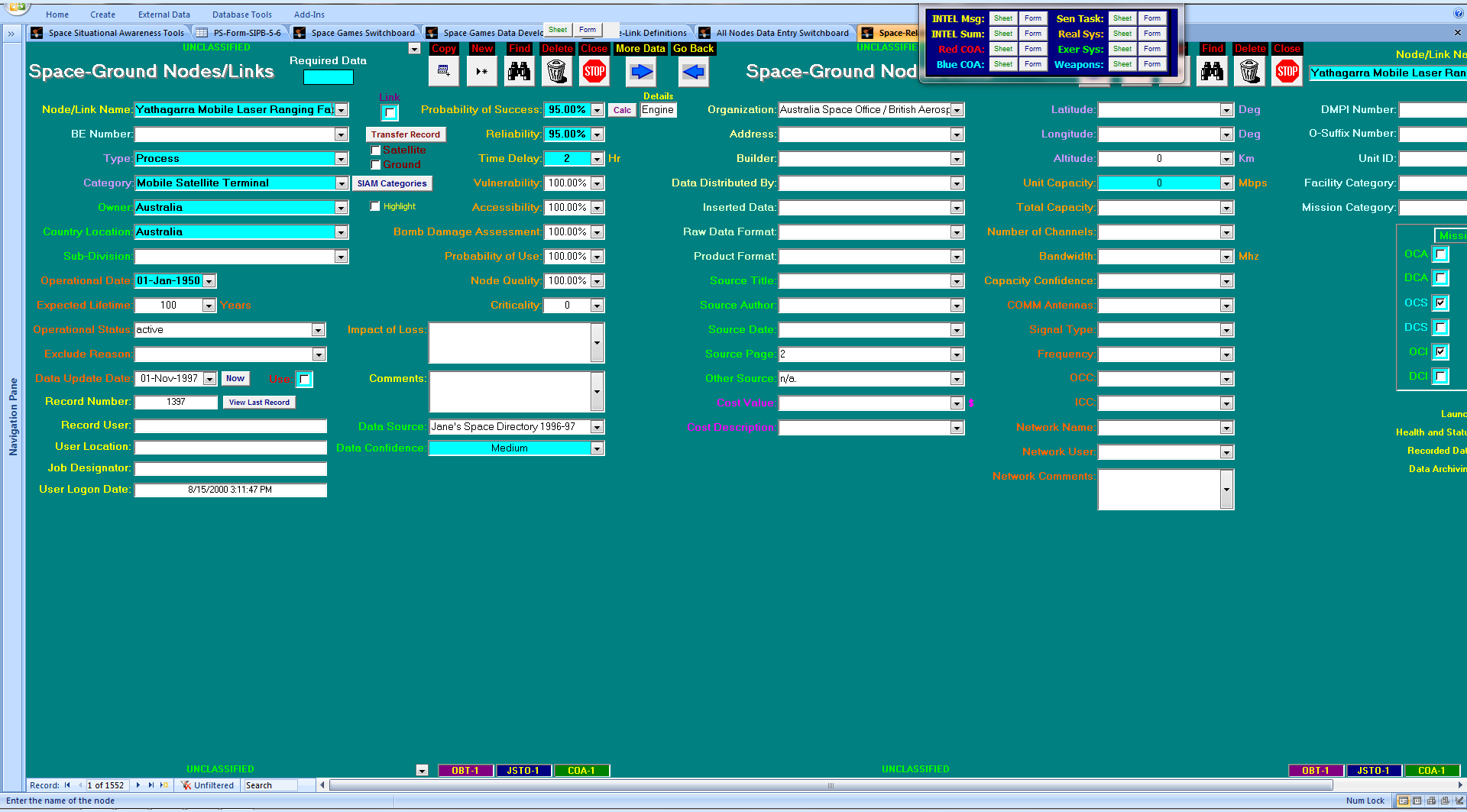


Which Site Launched the Most Satellite of the Selected Category

Real Space Systems Statistics Graph (3)

Which Satellites of the Selected Category Have the Largest RADAR Cross Section (RCS)

Real Military Terrestrial Systems

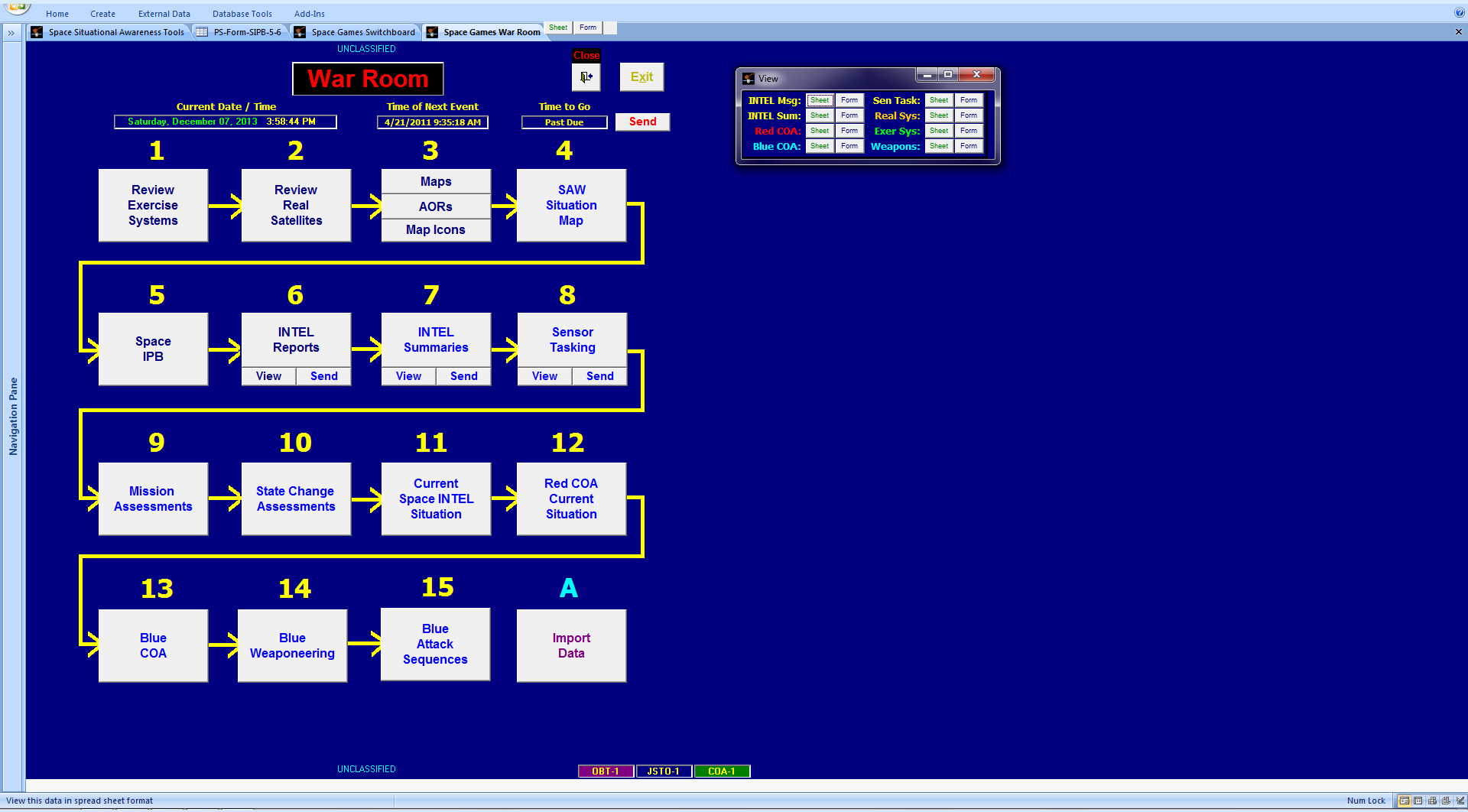


SSA-T Also includes Some Data on Non-Space Terrestrial Systems that can be Used in the Wargame

Space Wargame Execution Tools

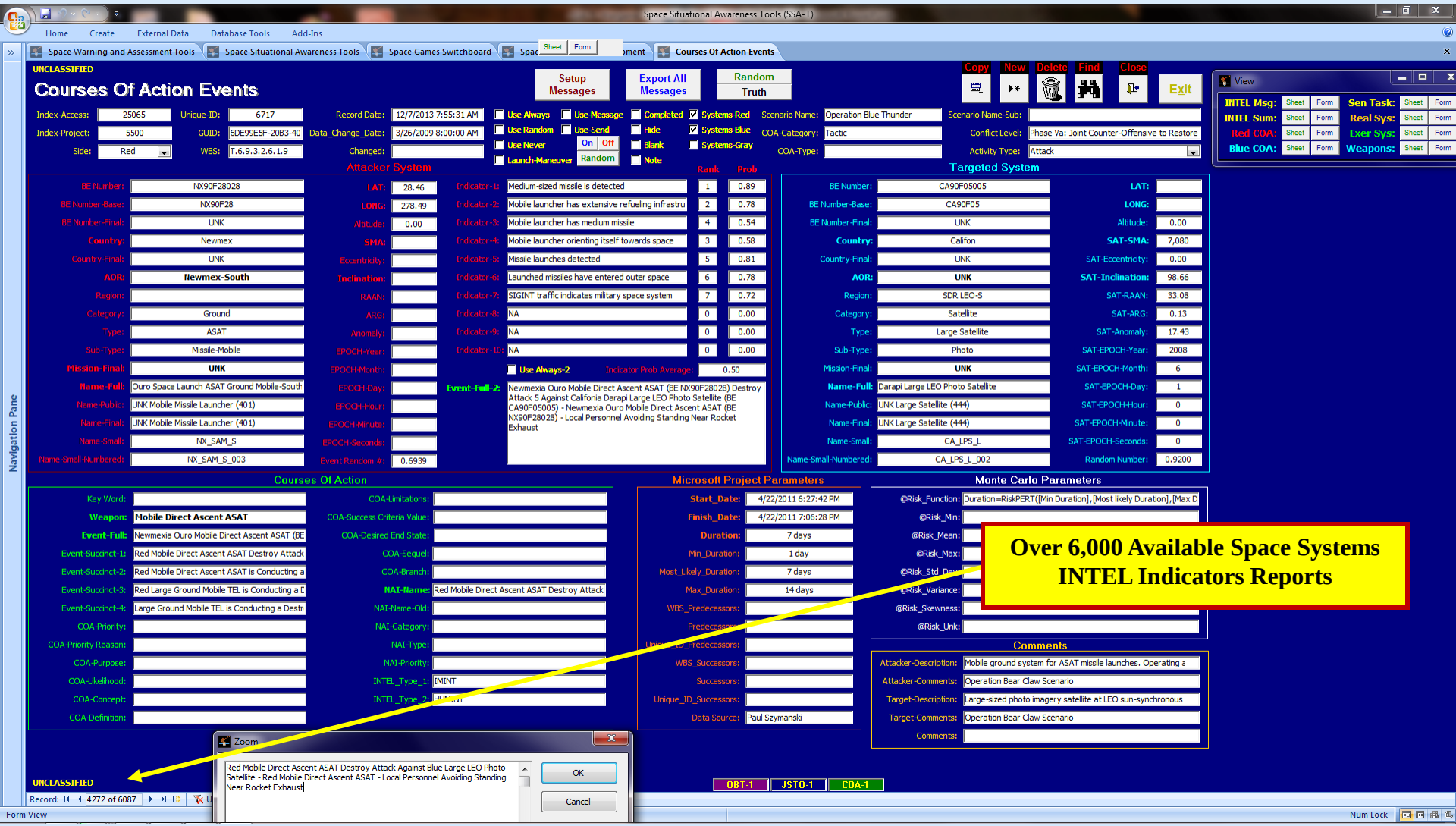
Helps Run the Space Wargame

Space Wargame Execution Main Menu



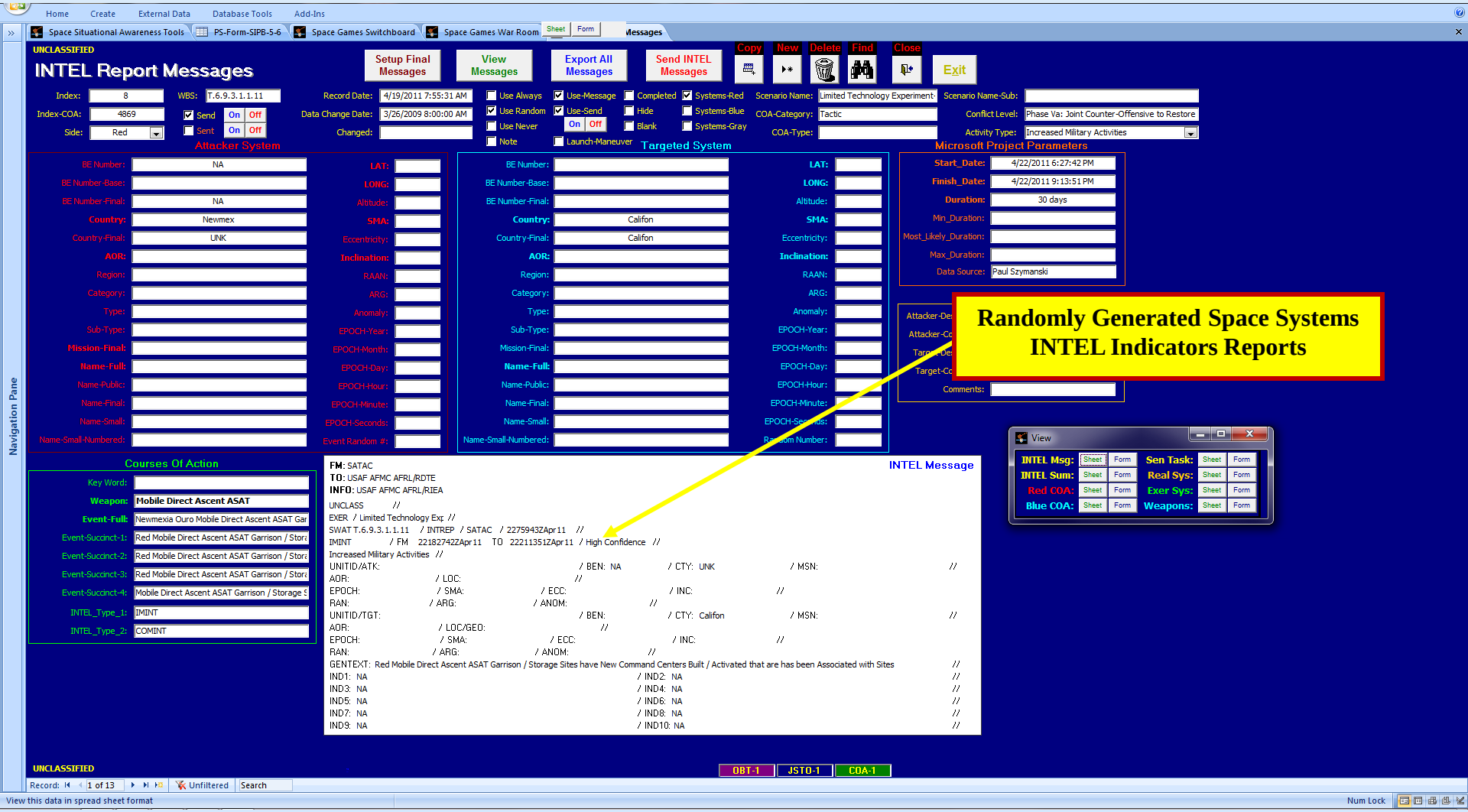
Main Wargame Execution Menu

INTEL Situation Reports

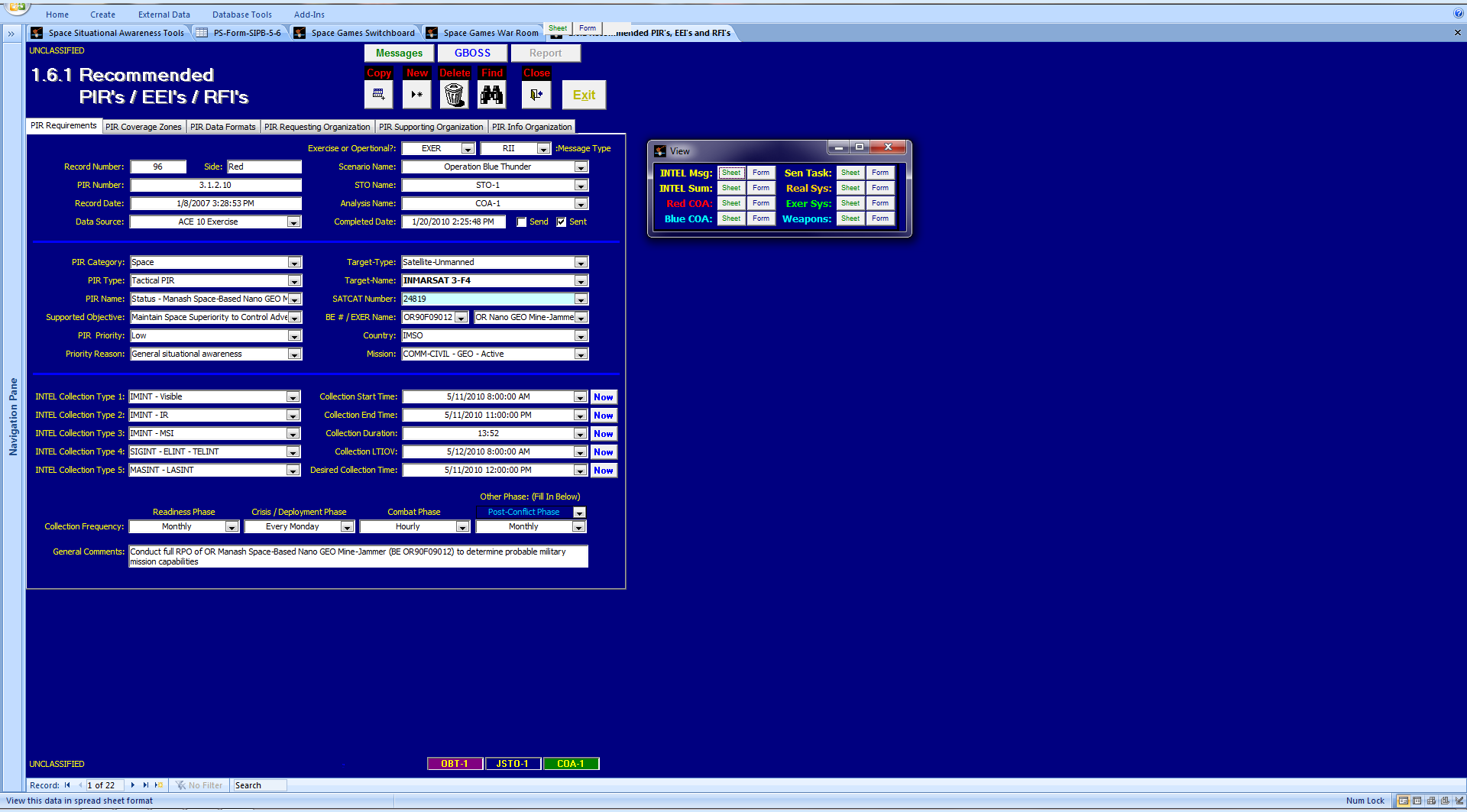


Thousands of Example INTEL Messages Can be Selected to set the Tempo of the Wargame

Random INTEL Situation Reports

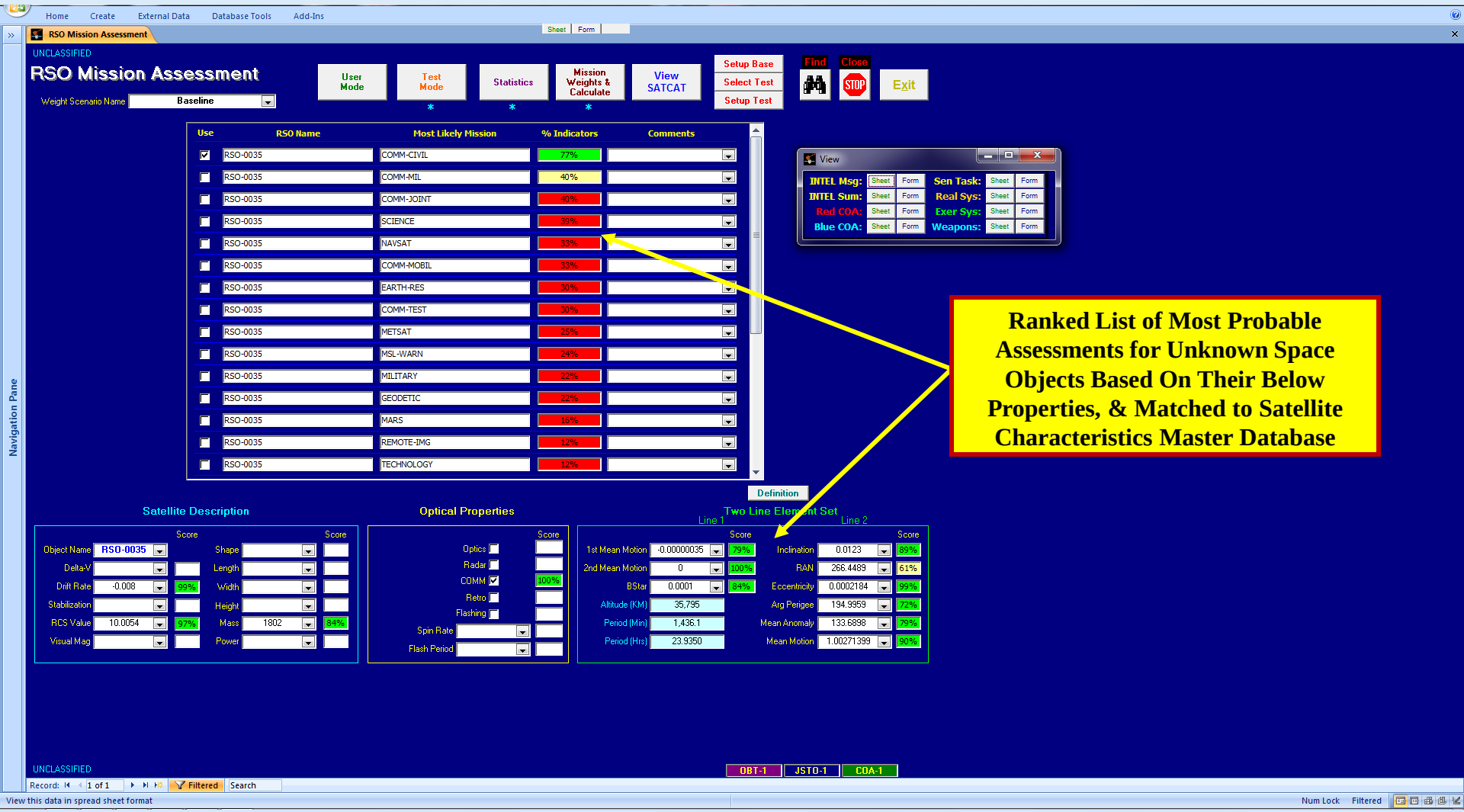


INTEL Tasking Development Tool



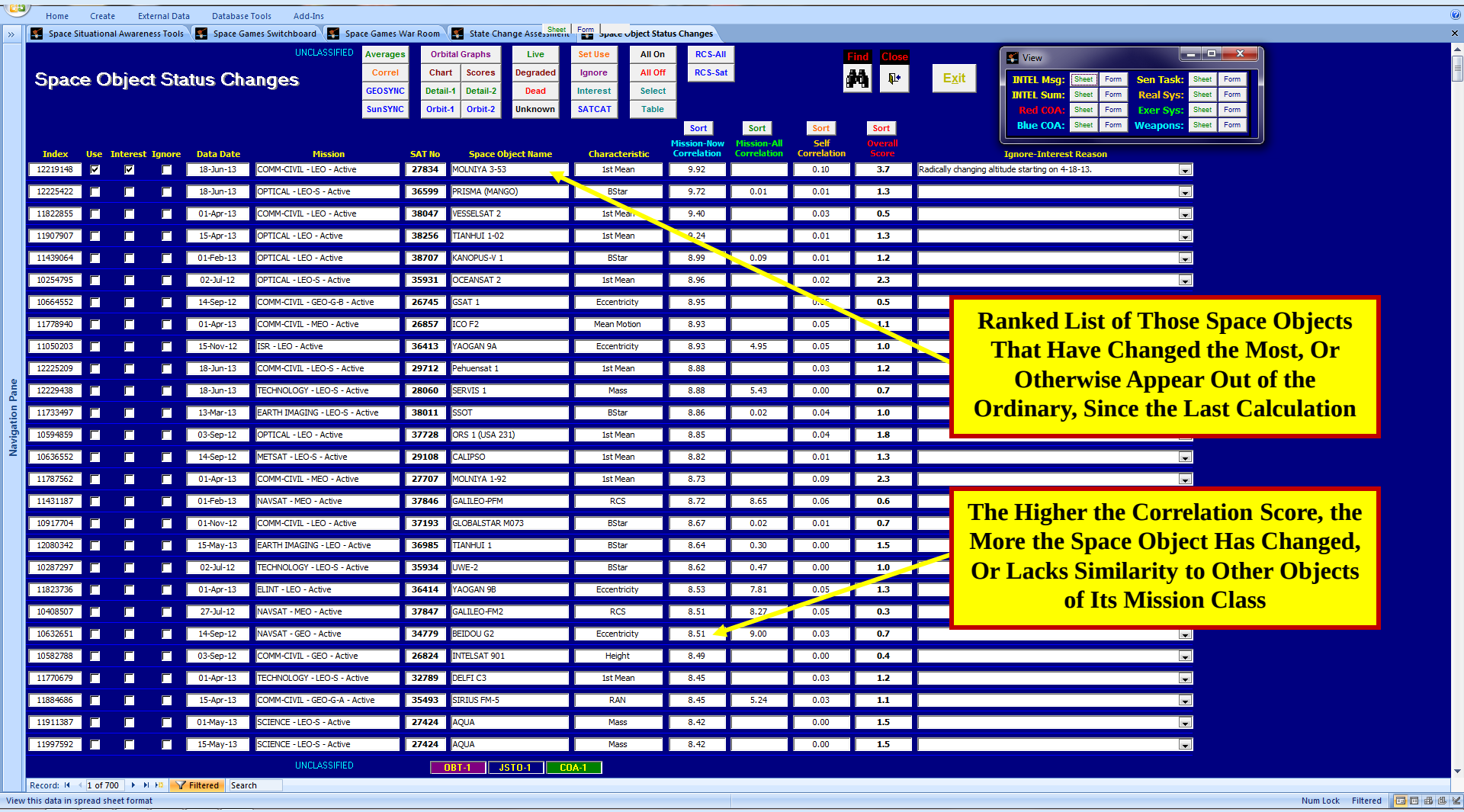
Wargame Users Can Setup INTEL Request Messages

Unknown Space Object Automatic Mission Assessment Tool



This SSA-T Tool Automatically Categorizes the Mission of Unknown Space Objects

Space Object State Change Automatic Detection Tool

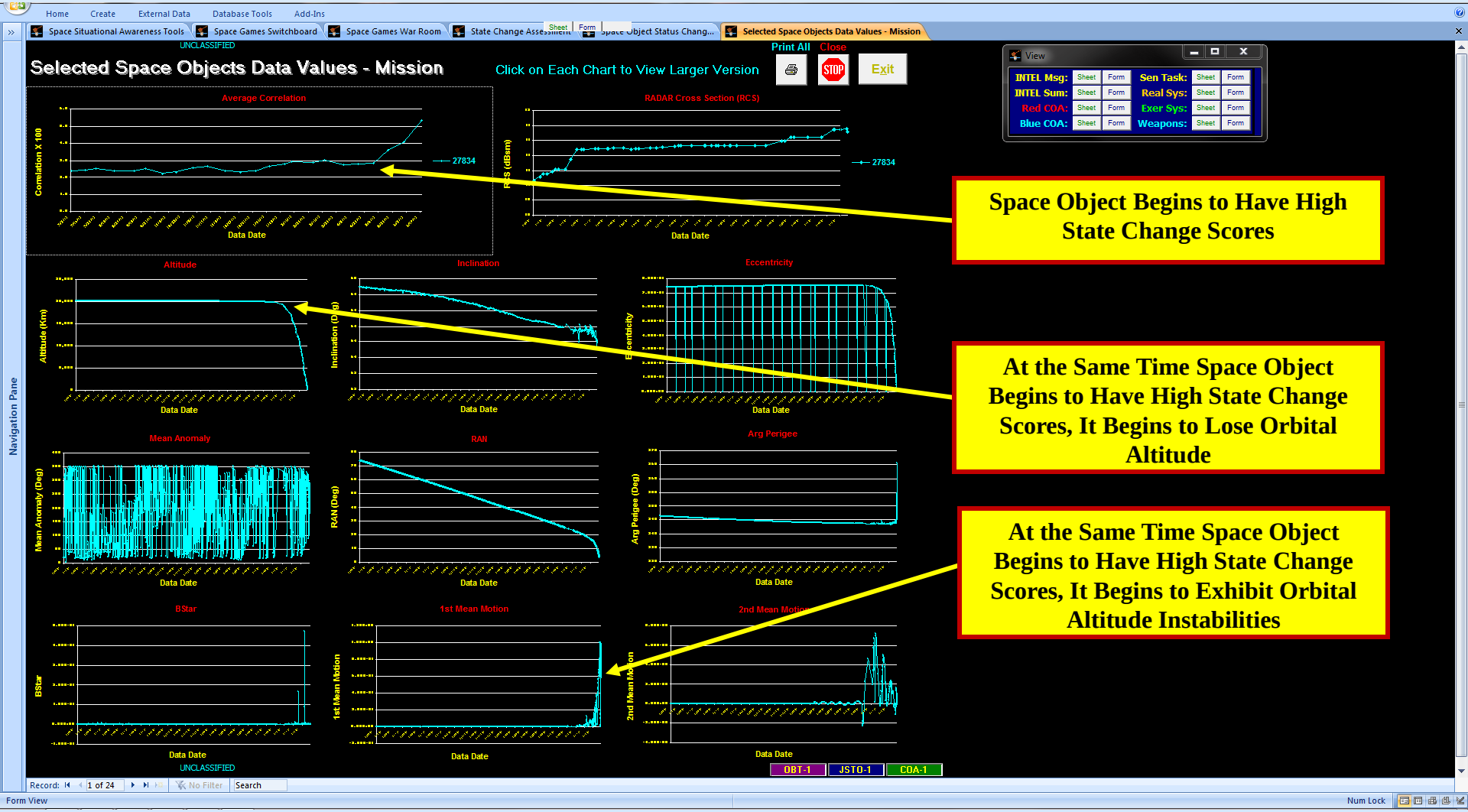


Ranked List of Those Space Objects That Have Changed the Most, Or Otherwise Appear Out of the Ordinary, Since the Last Calculation

The Higher the Correlation Score, the More the Space Object Has Changed, Or Lacks Similarity to Other Objects of Its Mission Class

This SSA-T Tool Automatically Detects Maneuvering or Changing Space Objects

Space Object State Change Automatic Detection Tool Statistics Graphs



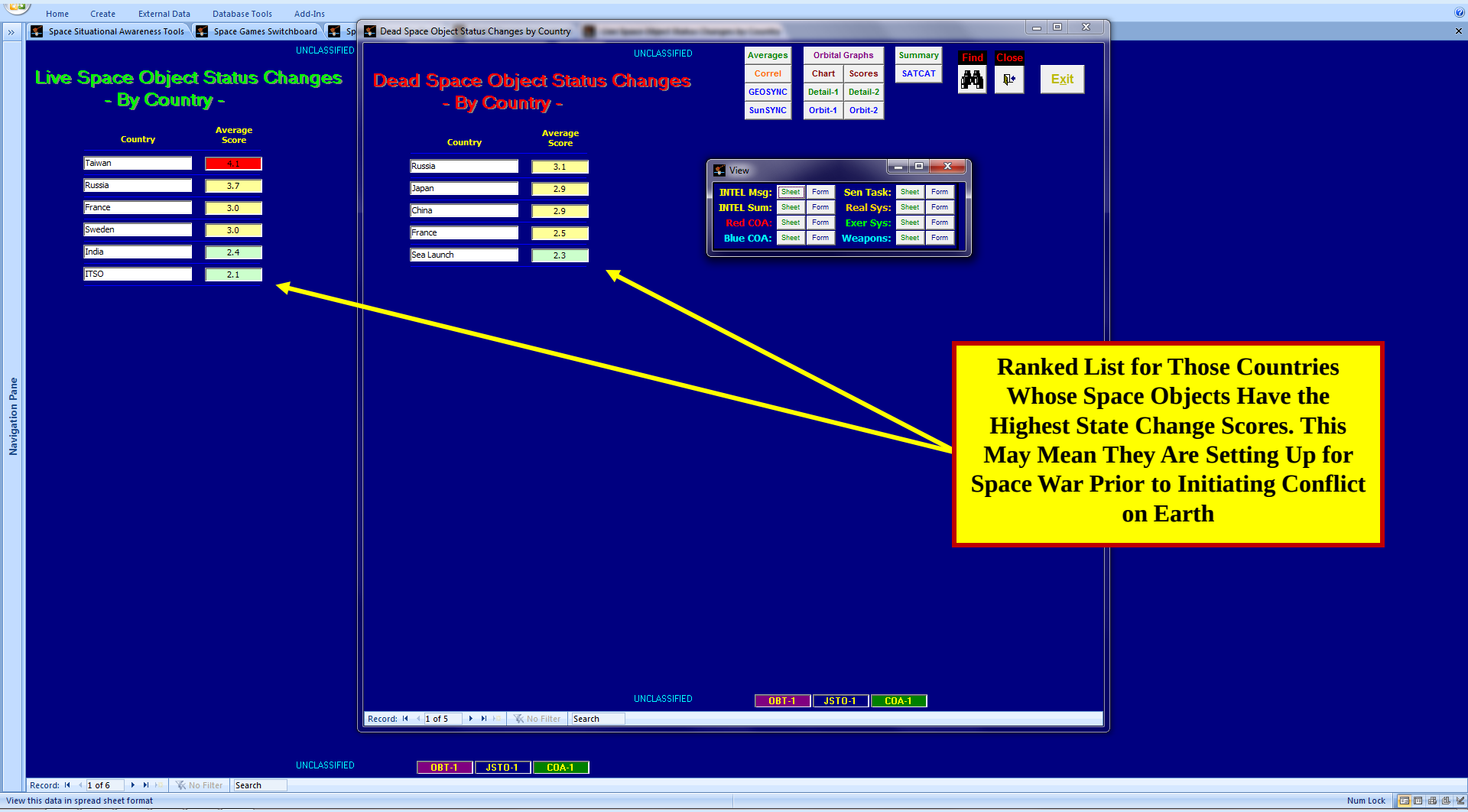
Space Object Begins to Have High State Change Scores

At the Same Time Space Object Begins to Have High State Change Scores, It Begins to Lose Orbital Altitude

At the Same Time Space Object Begins to Have High State Change Scores, It Begins to Exhibit Orbital Altitude Instabilities

Details of Maneuvering or Changing Space Objects Can be Assessed

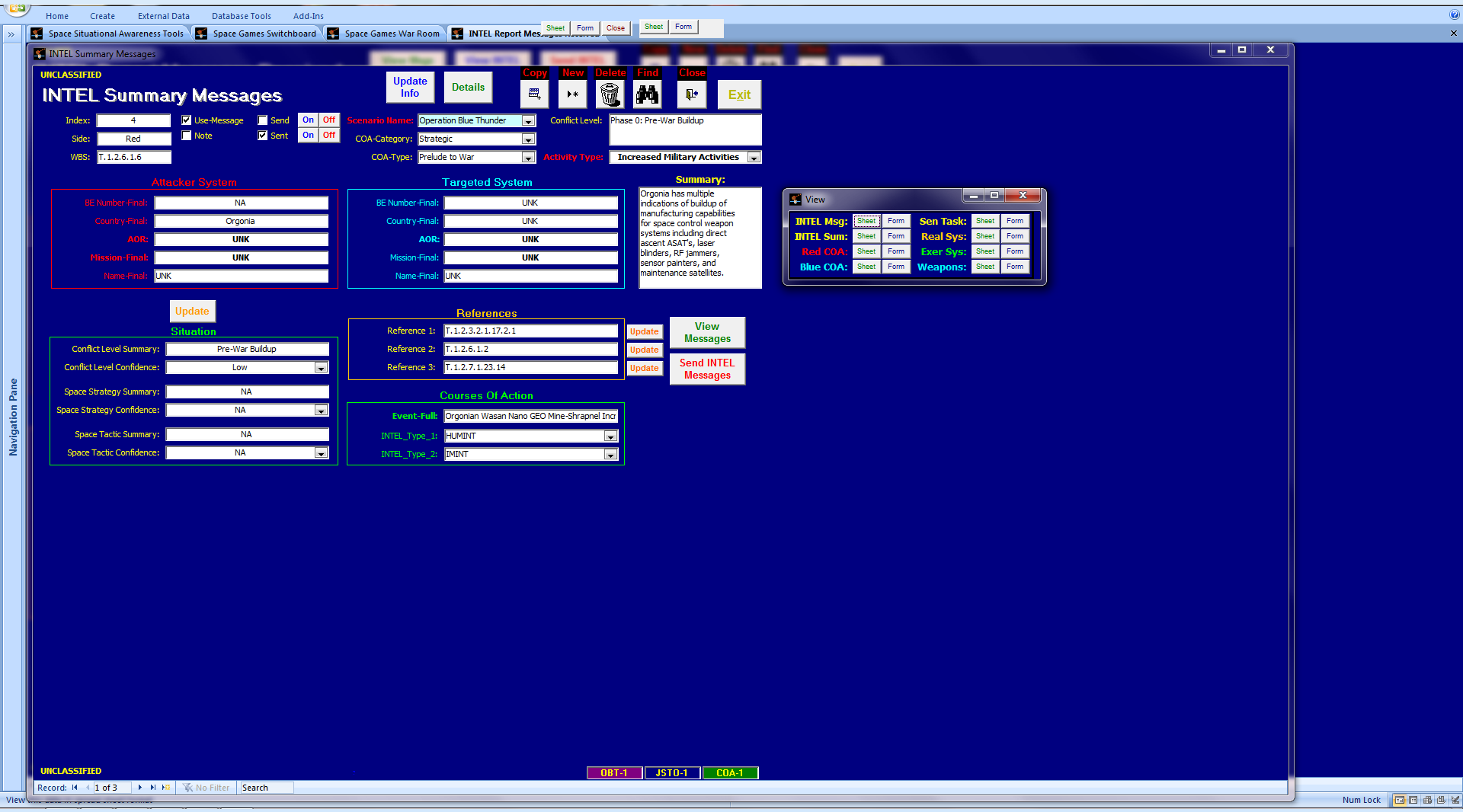
Countries With the Most Changes to Their Space Objects



Ranked List for Those Countries Whose Space Objects Have the Highest State Change Scores. This May Mean They Are Setting Up for Space War Prior to Initiating Conflict on Earth

This SSA-T Tool Automatically Shows Which Countries Have the Most Maneuvering or Changing Space Objects

Example Wargame Intelligence Warning Messages

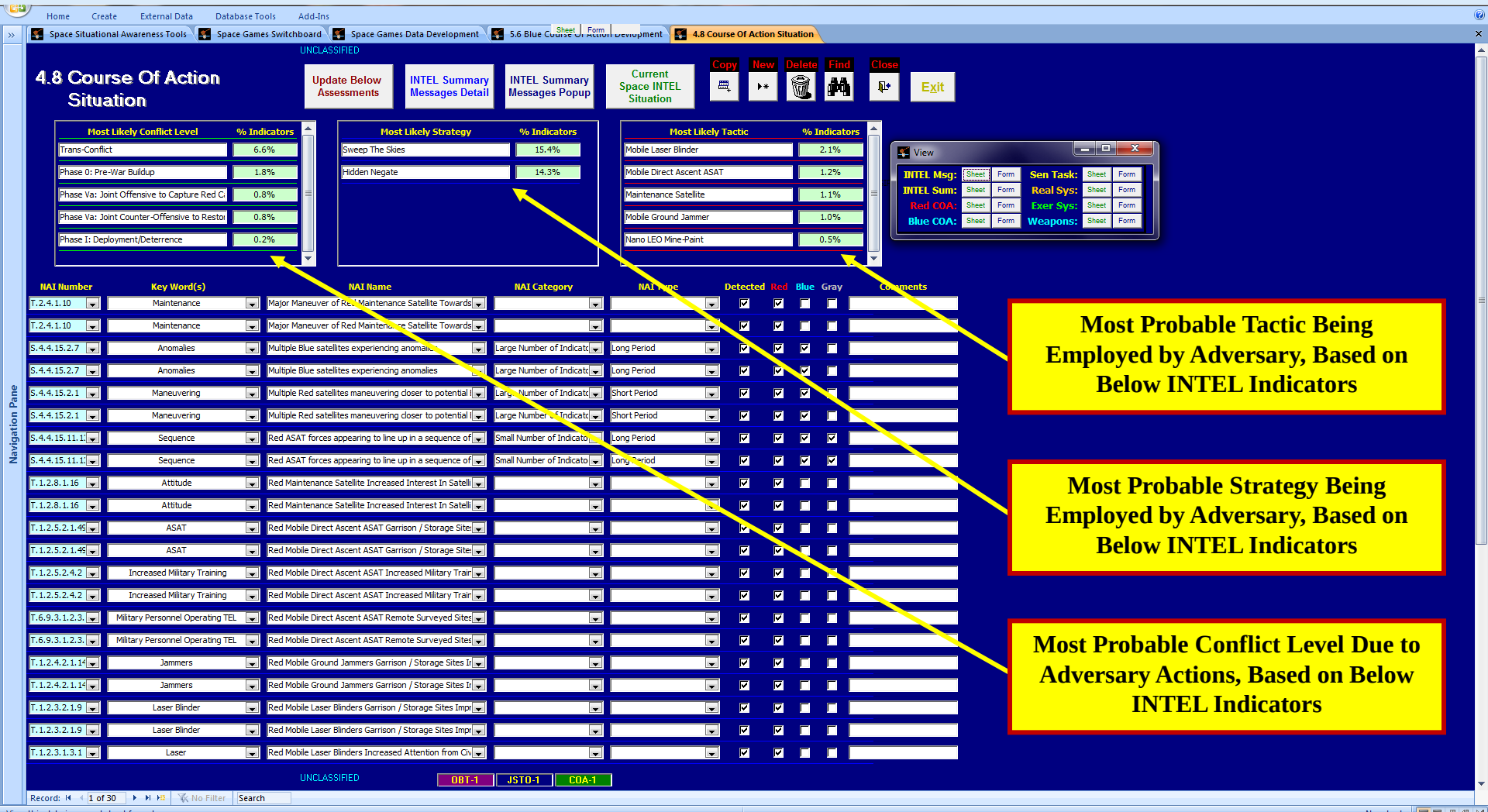


The Wargame User can Setup INTEL Adversary Attack Messages

Space Courses Of Action (COA's) Tools

Helps Develop Space War Plans

Red Space COA's Automatic Estimation



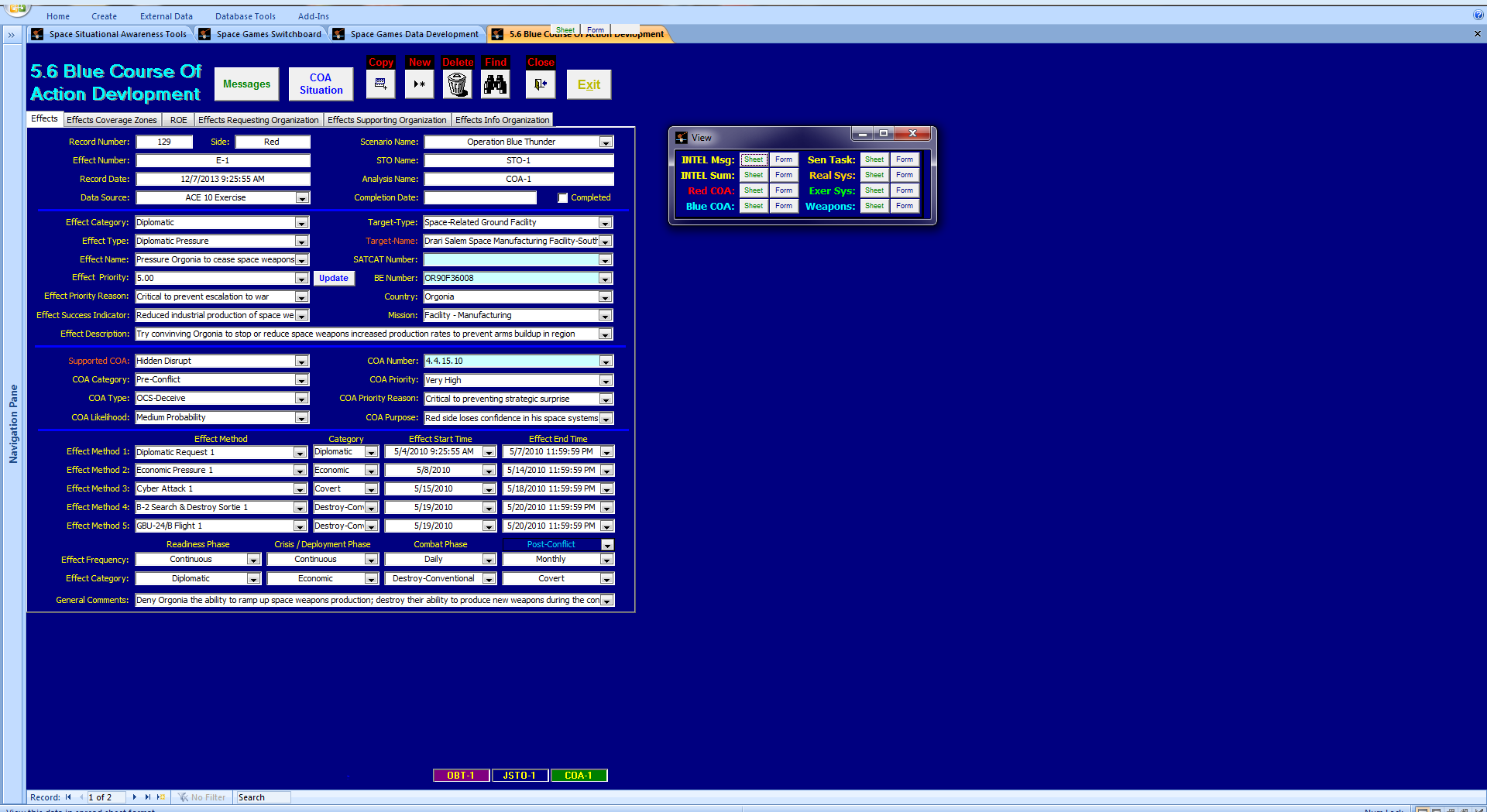
Most Probable Tactic Being Employed by Adversary, Based on Below INTEL Indicators

Most Probable Strategy Being Employed by Adversary, Based on Below INTEL Indicators

Most Probable Conflict Level Due to Adversary Actions, Based on Below INTEL Indicators

This SSA-T Tool Automatically Detects Adversary Courses Of Action (COA's) & Space Conflict Level

Blue Space Courses Of Action



SSA-T Tools can Assist the User in Developing Space Courses Of Action (COA's)

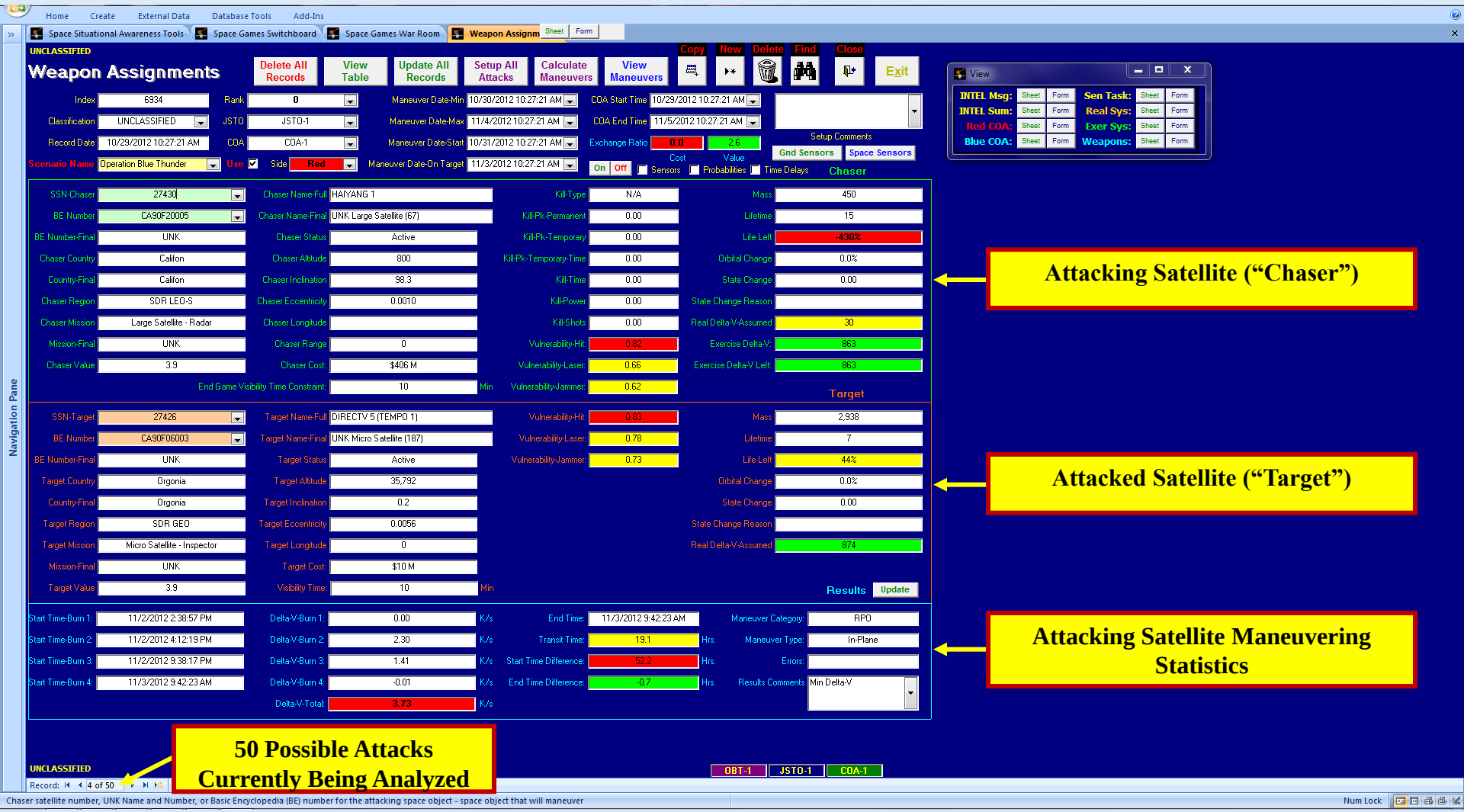
Weapon Tasking Messages

The Wargame User can Setup Blue Space Weapon Tasking Messages

Space Weaponeering

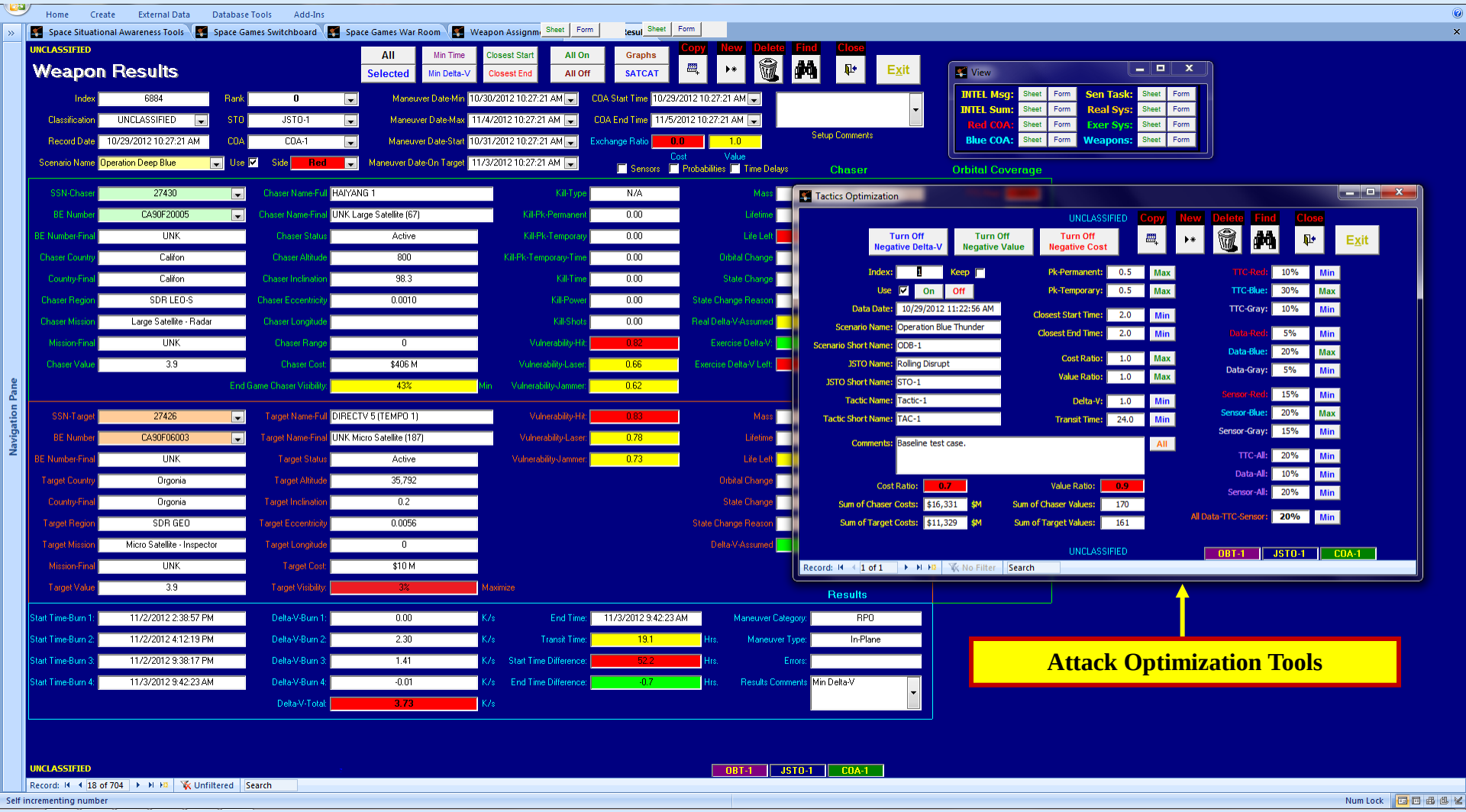
The Wargame User can Develop Detailed Optimized Space Weapons Plans

Weapon Assignments



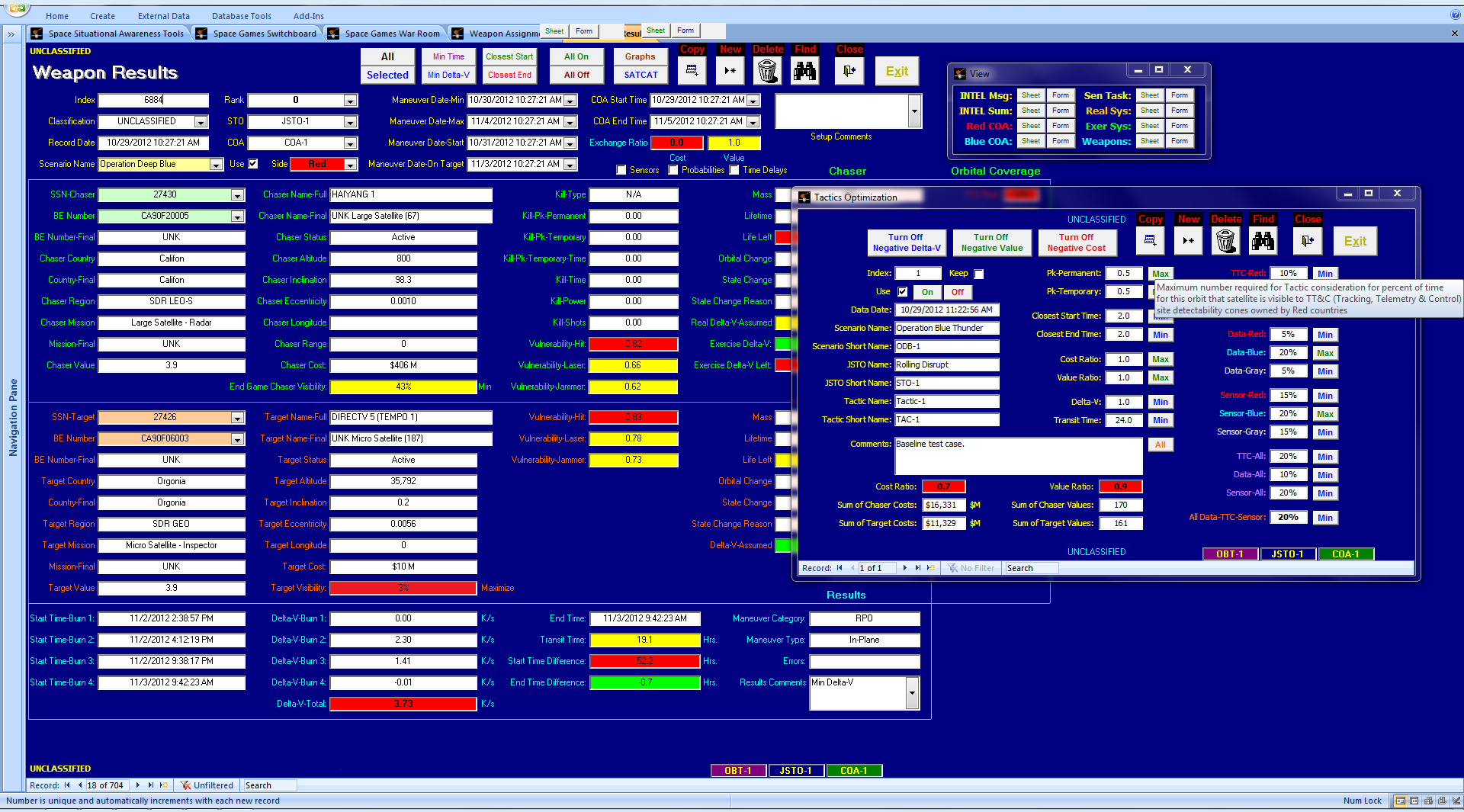
This is the Space Weapons Assignment Screen

Optimized Space Weapon Courses Of Action (1)



This is the Space Weapons Optimization Screen

Optimized Space Weapon Courses Of Action (2)

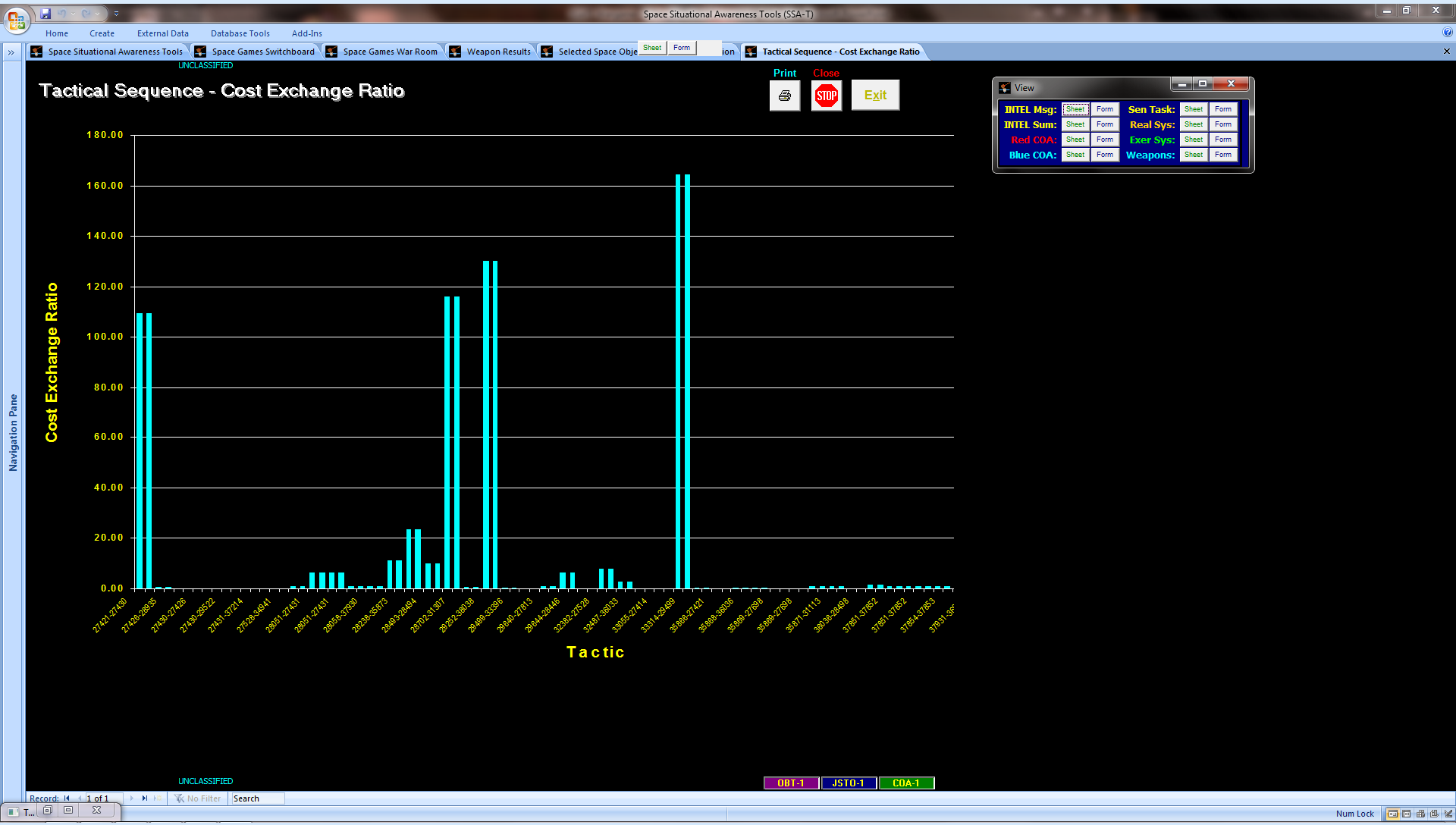


Space Weapons can be Optimized to Avoid Adversary Sensor Networks

Space Weapon Courses Of Action Optimization Statistics (1)

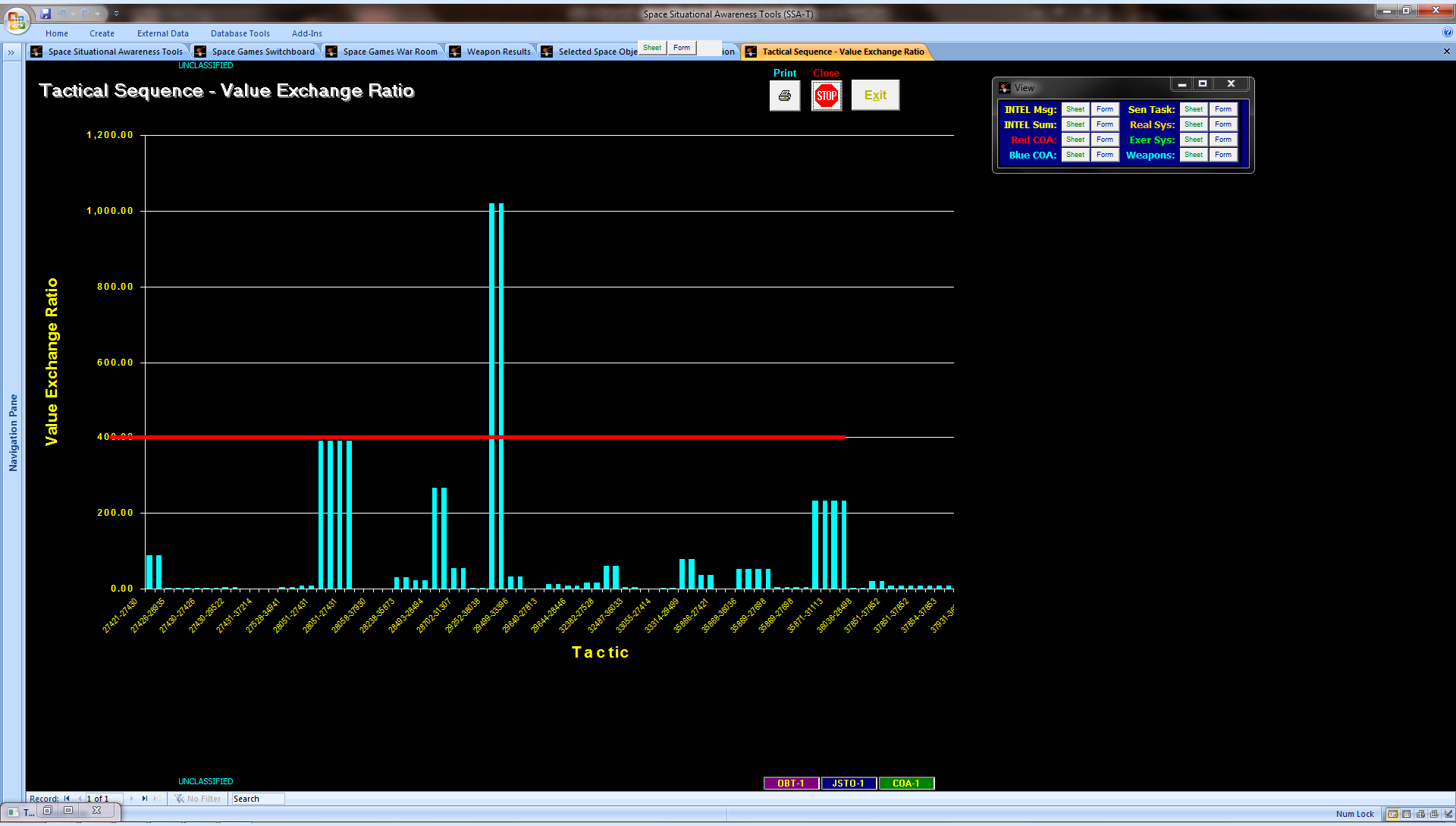
Space Weapons Attack Optimization Statistics Menu

Space Weapon Courses Of Action Optimization Statistics (2)



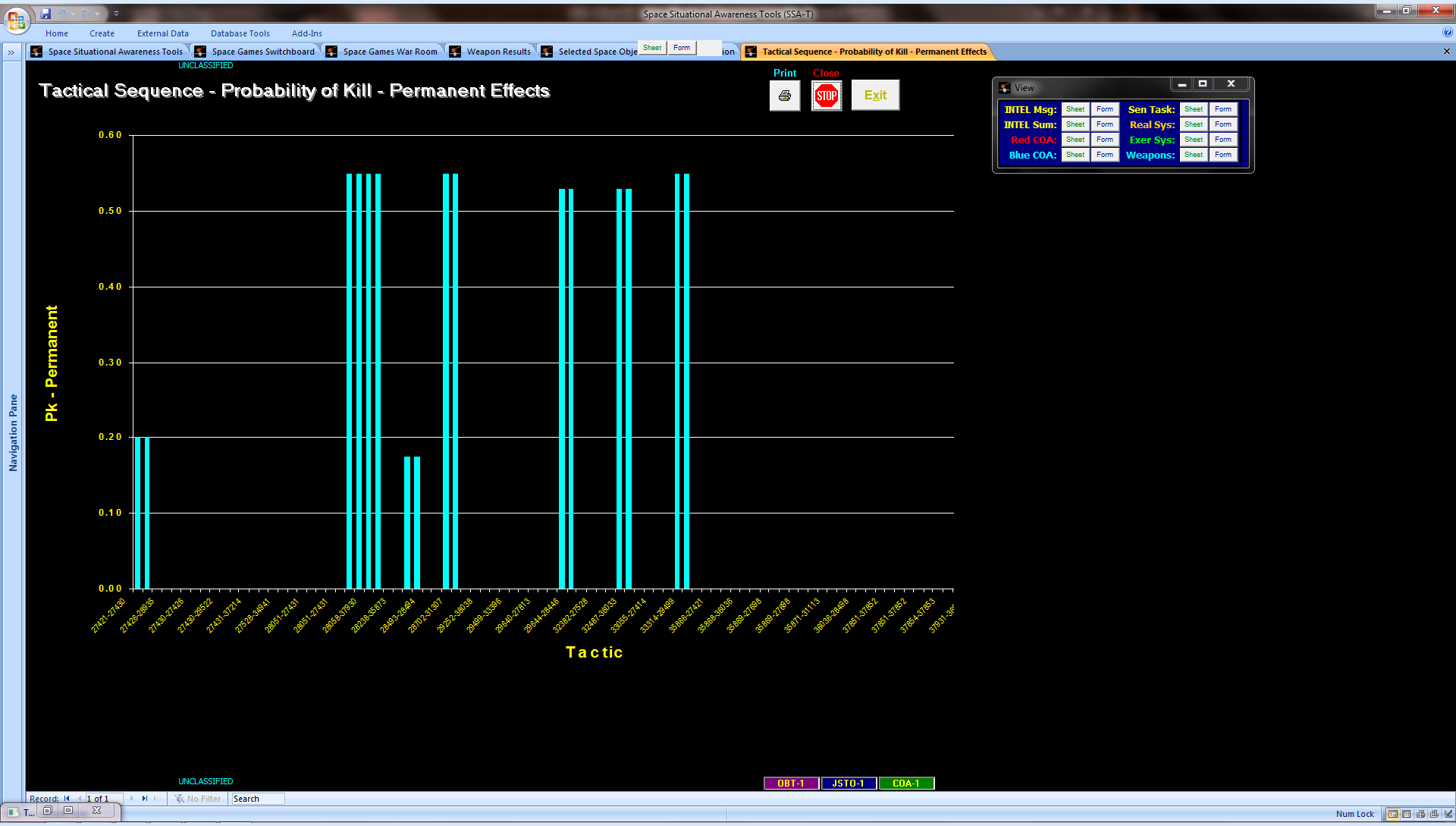
Space Weapons Attacks can be Optimized for Ratio of Target vs Expended Weapon Costs

Space Weapon Courses Of Action Optimization Statistics (3)



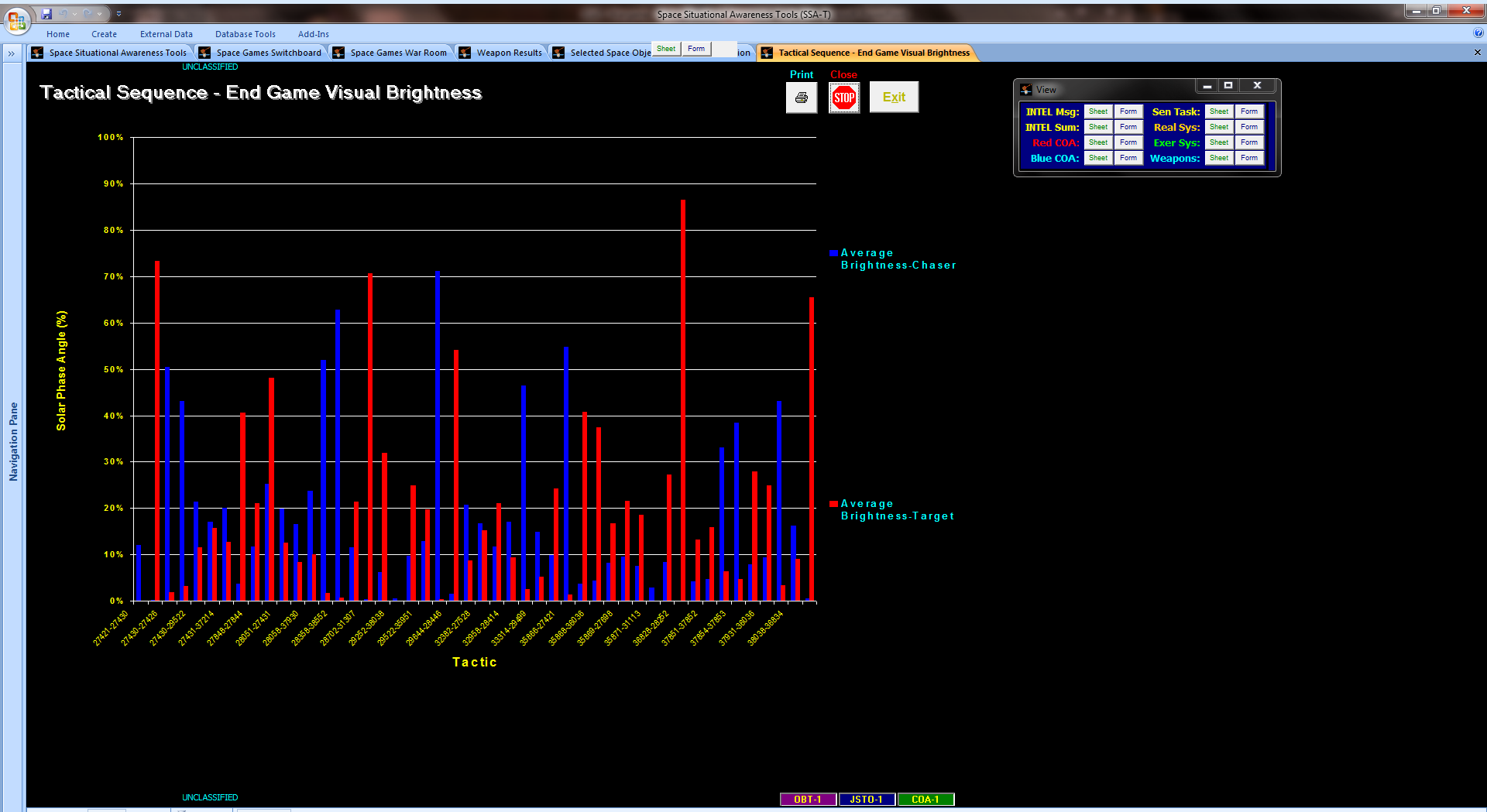
Space Weapons Attacks can be Optimized for Ratio of Target vs Expended Weapon Military Values

Space Weapon Courses Of Action Optimization Statistics (4)



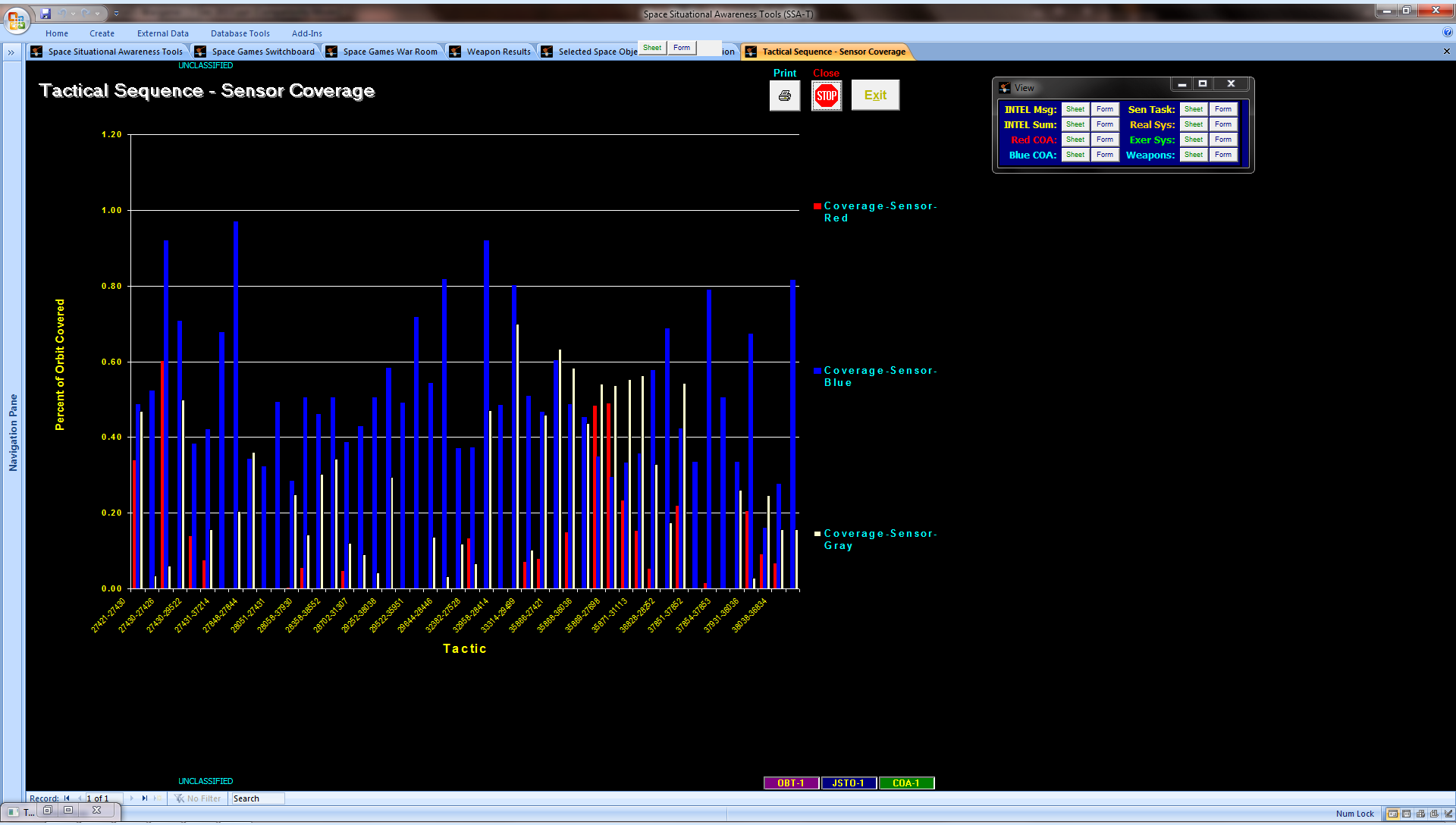
Space Weapons Attacks can be Optimized for Permanent vs Non-Permanent Kill Mechanisms

Space Weapon Courses Of Action Optimization Statistics (5)



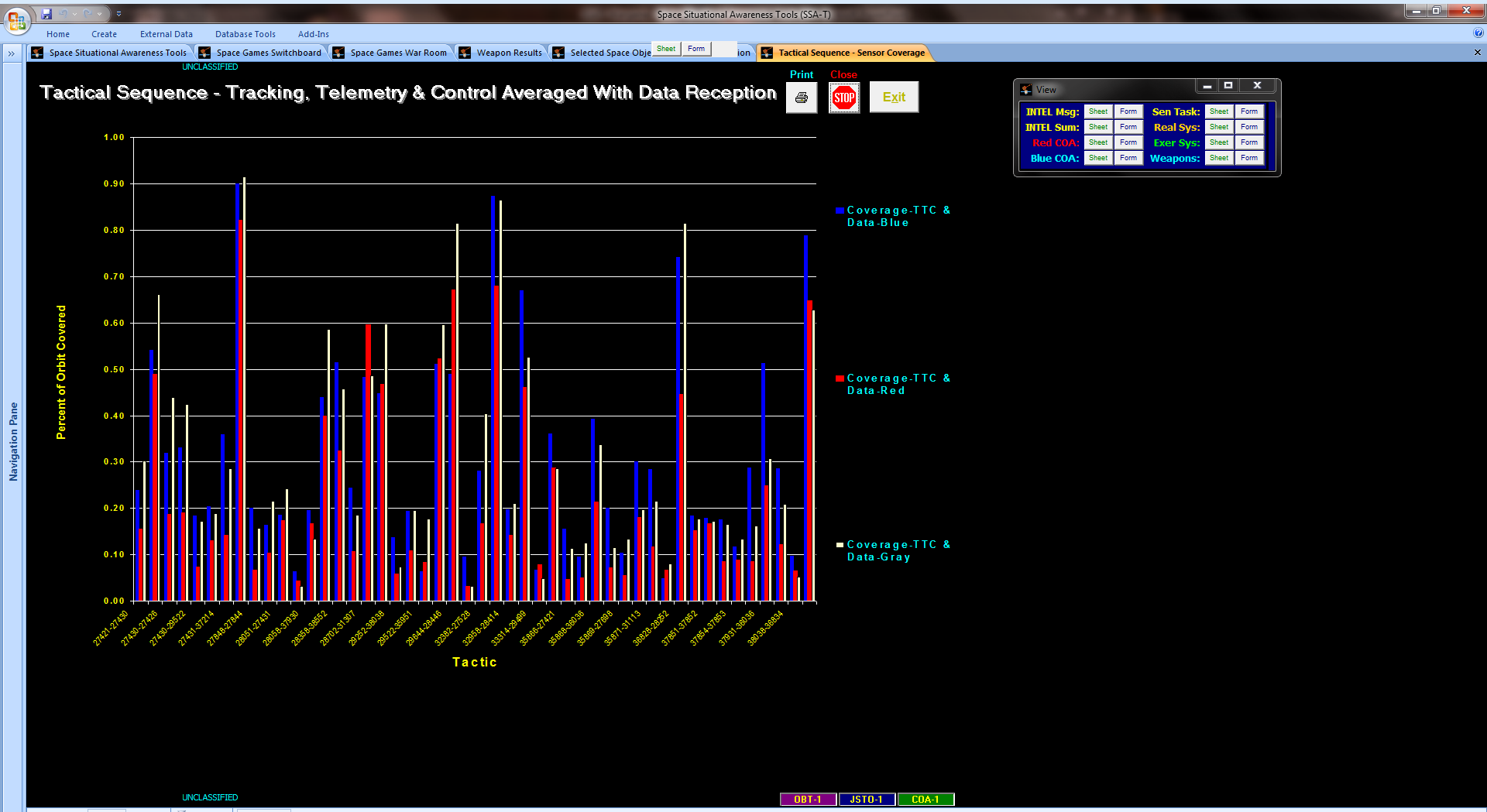
Space Weapons Attacks can be Optimized for Reduced Weapon Optical Signatures as Detected by Target

Space Weapon Courses Of Action Optimization Statistics (6)



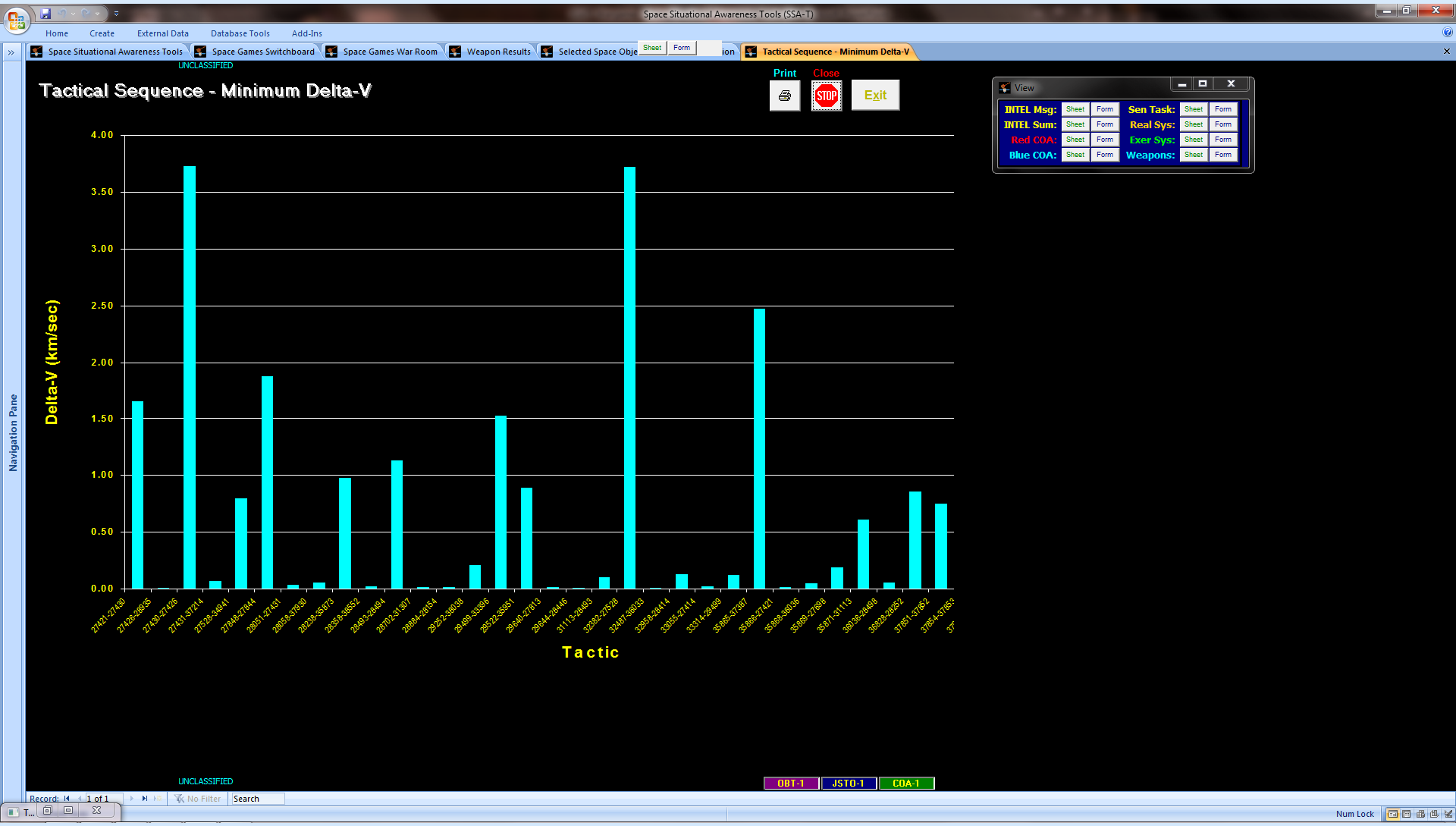
Space Weapons Attacks can be Optimized to Avoid Red Sensor Coverage

Space Weapon Courses Of Action Optimization Statistics (7)



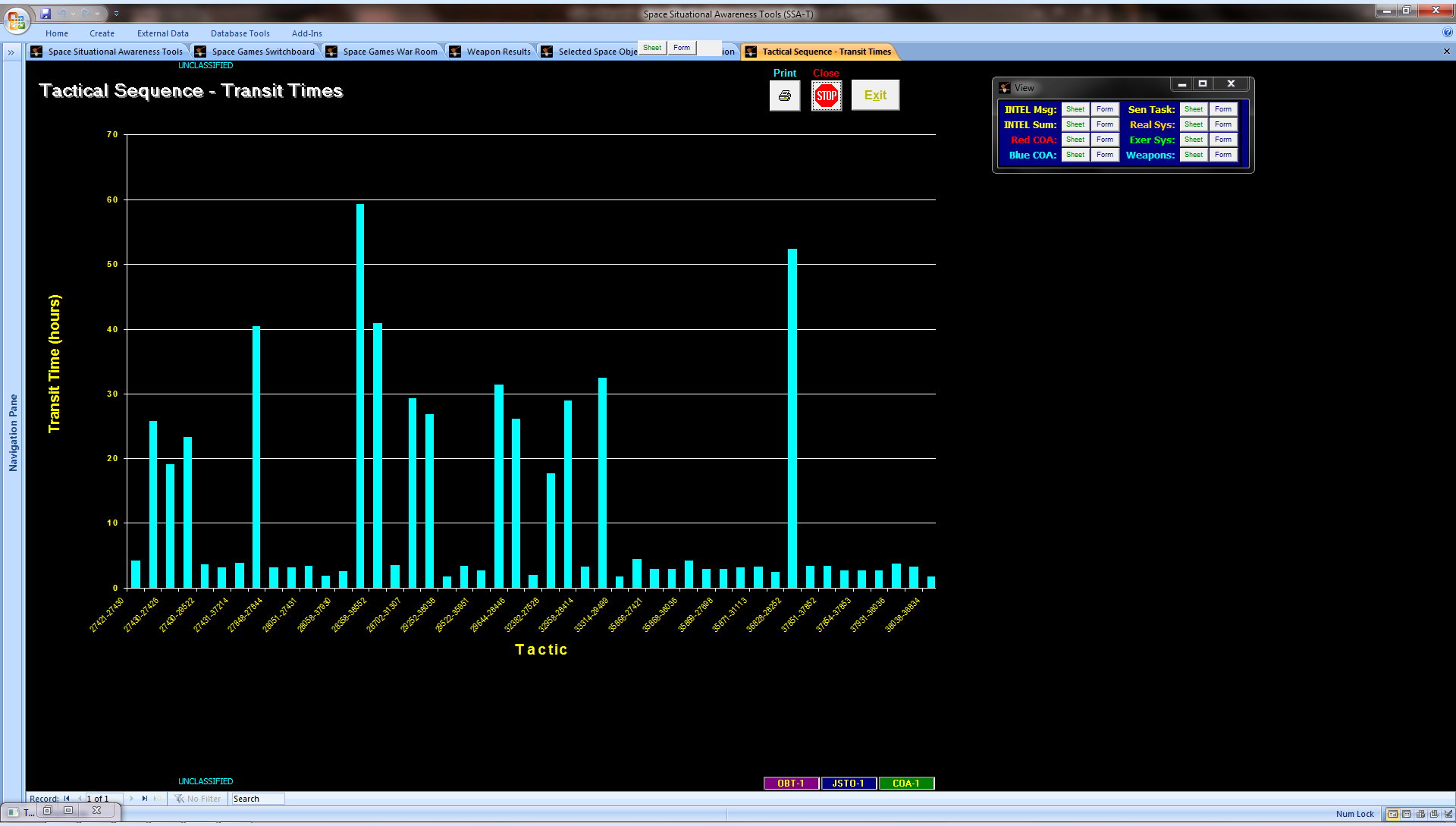
Space Weapons Attacks can be Optimized to Maximize the Time Before the Red Sides Realizes Its Been Attacked

Space Weapon Courses Of Action Optimization Statistics (8)



Space Weapons Attacks can be Optimized for Minimizing Maneuvering Fuel

Space Weapon Courses Of Action Optimization Statistics (9)



Space Weapons Attacks can be Optimized for Minimizing Transit Time

Space Weapon Courses Of Action Optimization Statistics (10)

How Close to Mission Planning Does Attacking Satellite Terminate Target (How Close Do All Attacks Reach Their Targets at the Same Time to Maximize Surprise.)

Space Weapons Attacks can be Optimized for Achieving Simultaneous Attack End Times

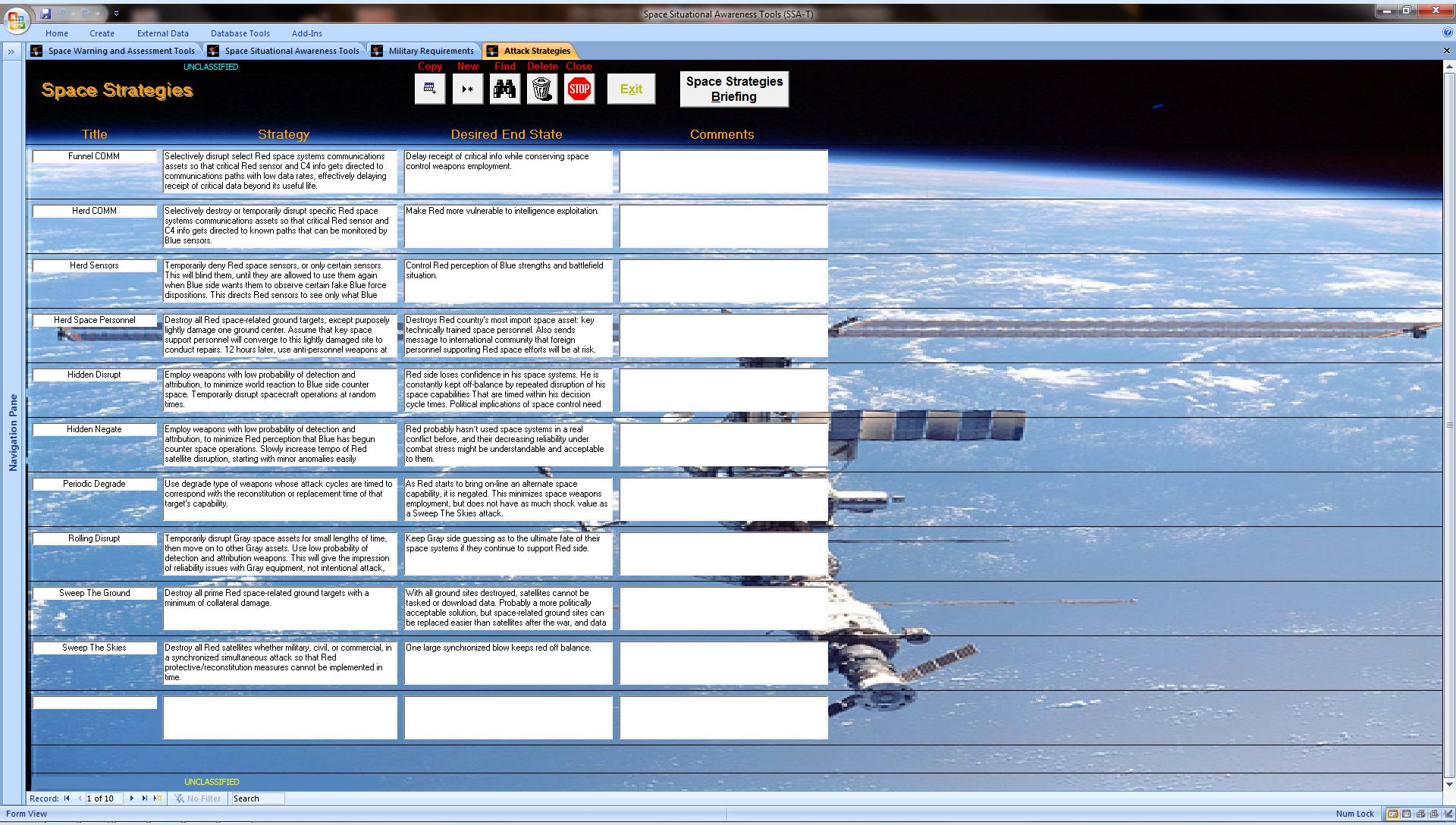
Space Weapon Courses Of Action Optimization Statistics (11)

Satellites Can Maneuver Only at Discrete Times

Space Courses Of Action Refinements

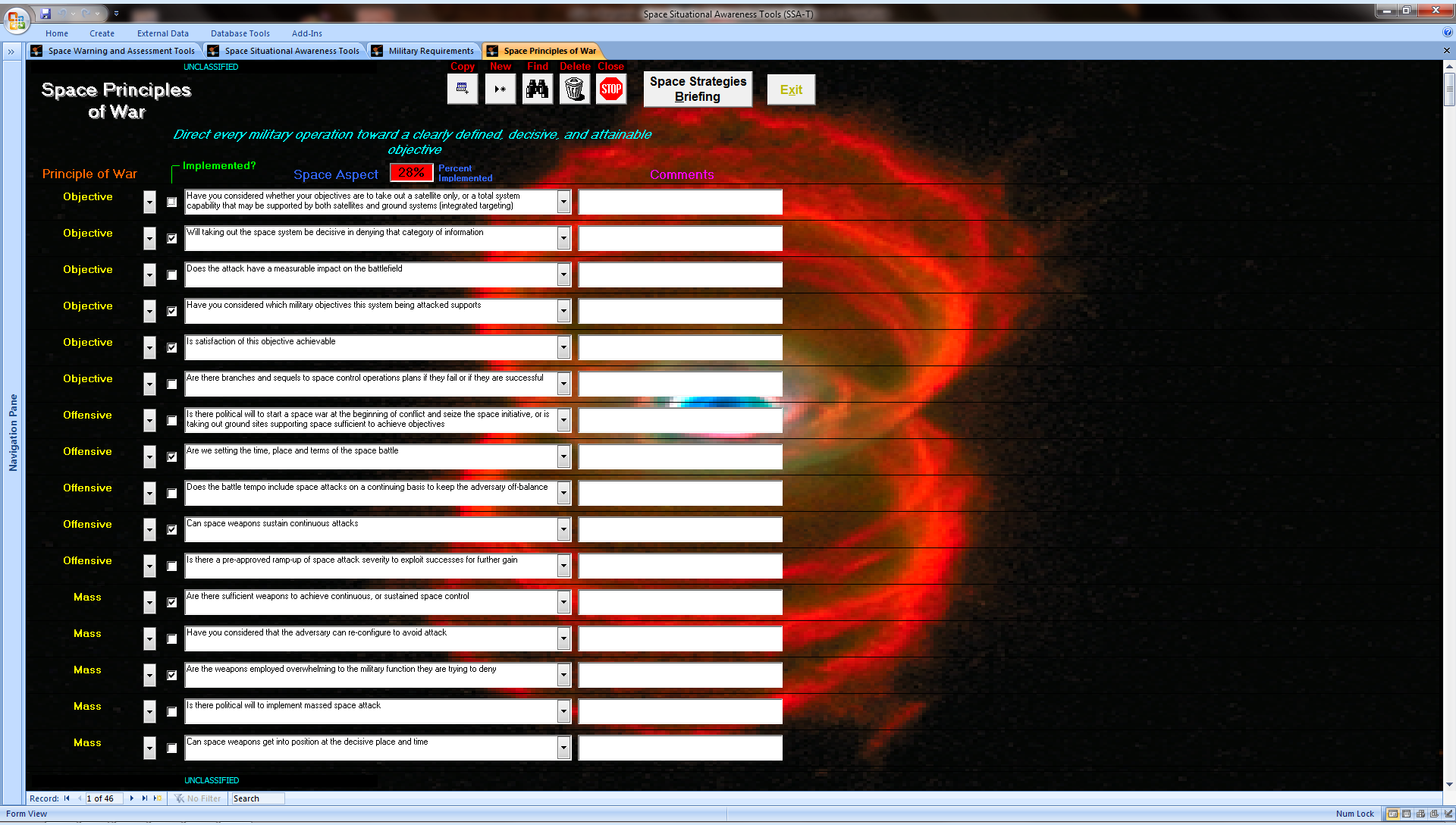
Additional Tools to Achieve Optimized Space COA's

Possible Space Strategies



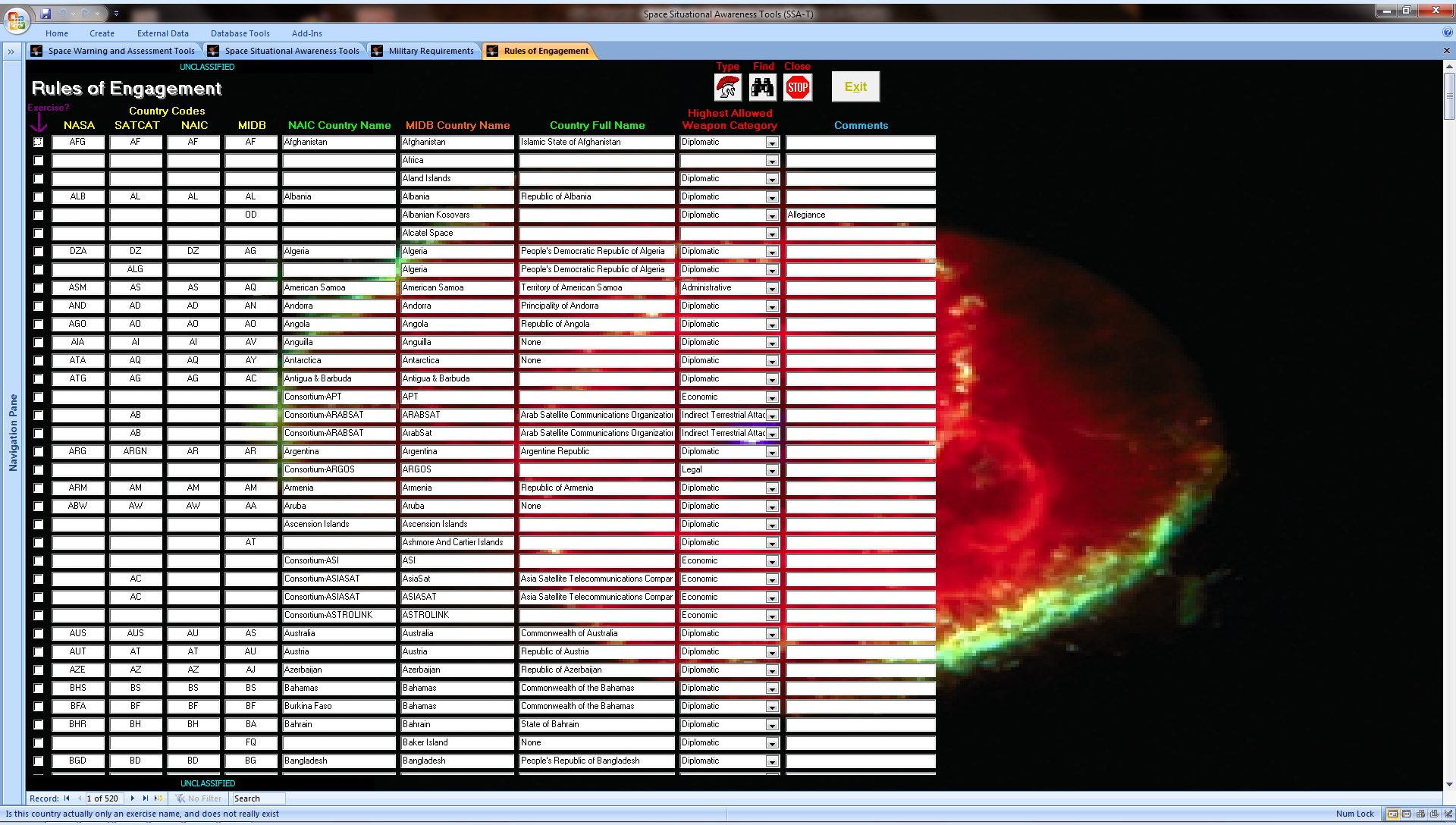
Some Unique Space Strategies

Space Principles of War Assessment



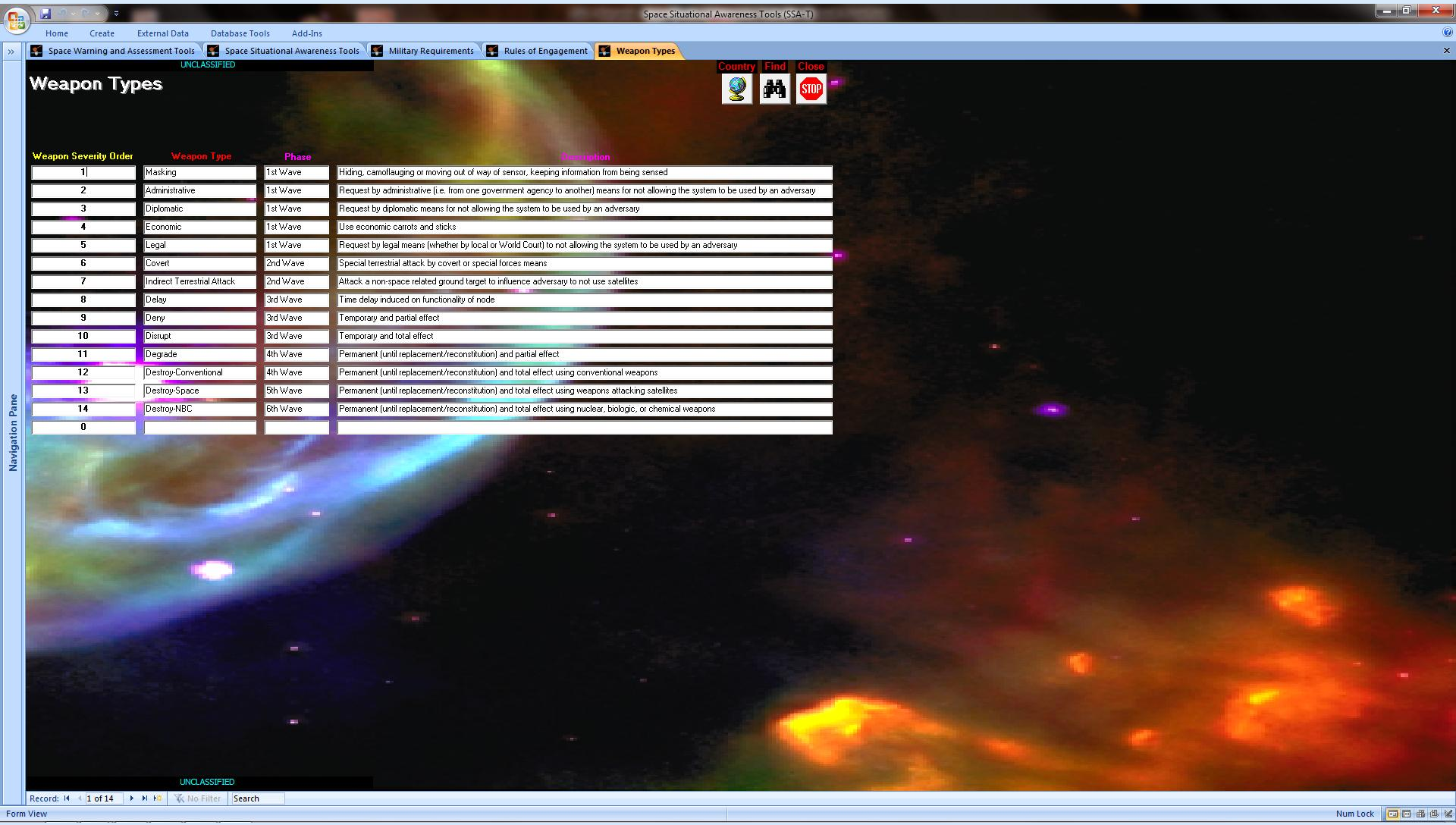
Fundamental Principles of War Applied to Space can be Assessed for Each COA

Space Courses Of Action Rules of Engagement



Each Space COA Must Follow Commander's Intent & Legal Rules of Engagement

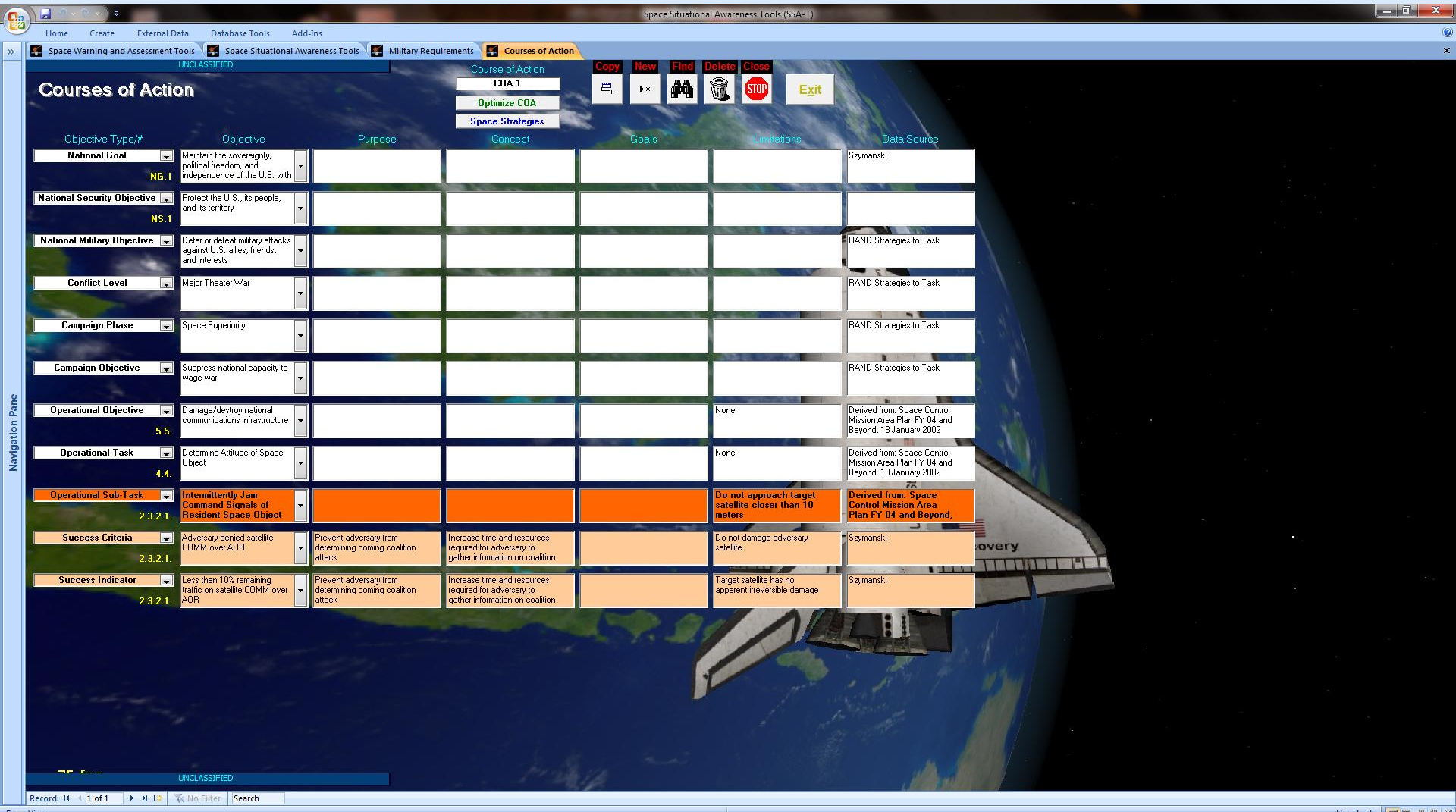
Ranked Space Weapon Types



Weapon Severity Order	Weapon Type	Phase	Description
1	Masking	1st Wave	Hiding, camoflauging or moving out of way of sensor, keeping information from being sensed
2	Administrative	1st Wave	Request by administrative (i.e. from one government agency to another) means for not allowing the system to be used by an adversary
3	Diplomatic	1st Wave	Request by diplomatic means for not allowing the system to be used by an adversary
4	Economic	1st Wave	Use economic carrots and sticks
5	Legal	1st Wave	Request by legal means (whether by local or World Court) to not allowing the system to be used by an adversary
6	Covert	2nd Wave	Special terrestrial attack by covert or special forces means
7	Indirect Terrestrial Attack	2nd Wave	Attack a non-space related ground target to influence adversary to not use satellites
8	Delay	3rd Wave	Time delay induced on functionality of node
9	Deny	3rd Wave	Temporary and partial effect
10	Disrupt	3rd Wave	Temporary and total effect
11	Degrade	4th Wave	Permanent (until replacement/reconstitution) and partial effect
12	Destroy-Conventional	4th Wave	Permanent (until replacement/reconstitution) and total effect using conventional weapons
13	Destroy-Space	5th Wave	Permanent (until replacement/reconstitution) and total effect using weapons attacking satellites
14	Destroy-NBC	6th Wave	Permanent (until replacement/reconstitution) and total effect using nuclear, biologic, or chemical weapons
0			

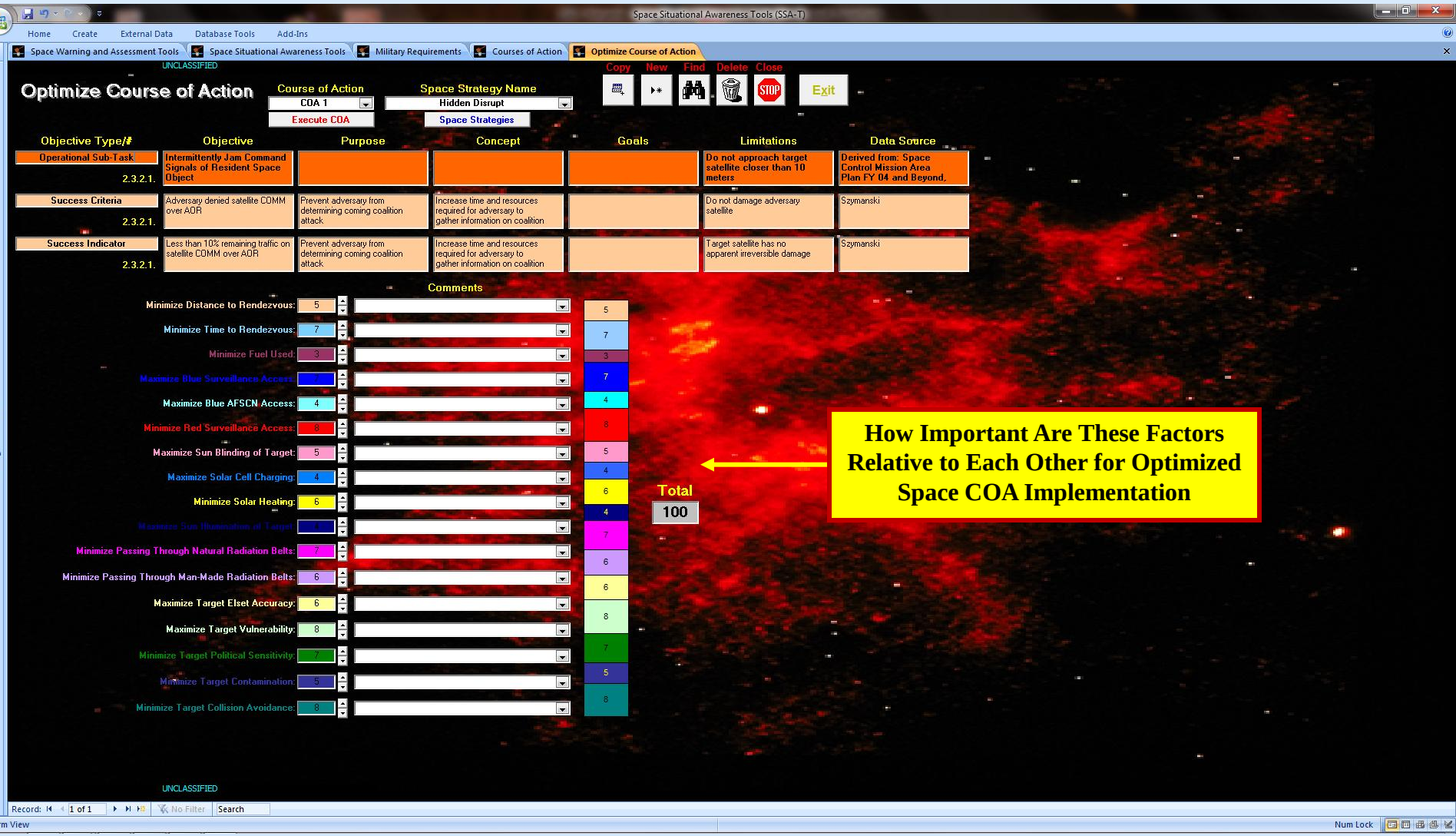
Some Weapon Types are More Escalatory to the Conflict than Others

Space Strategies-to-Task Hierarchy



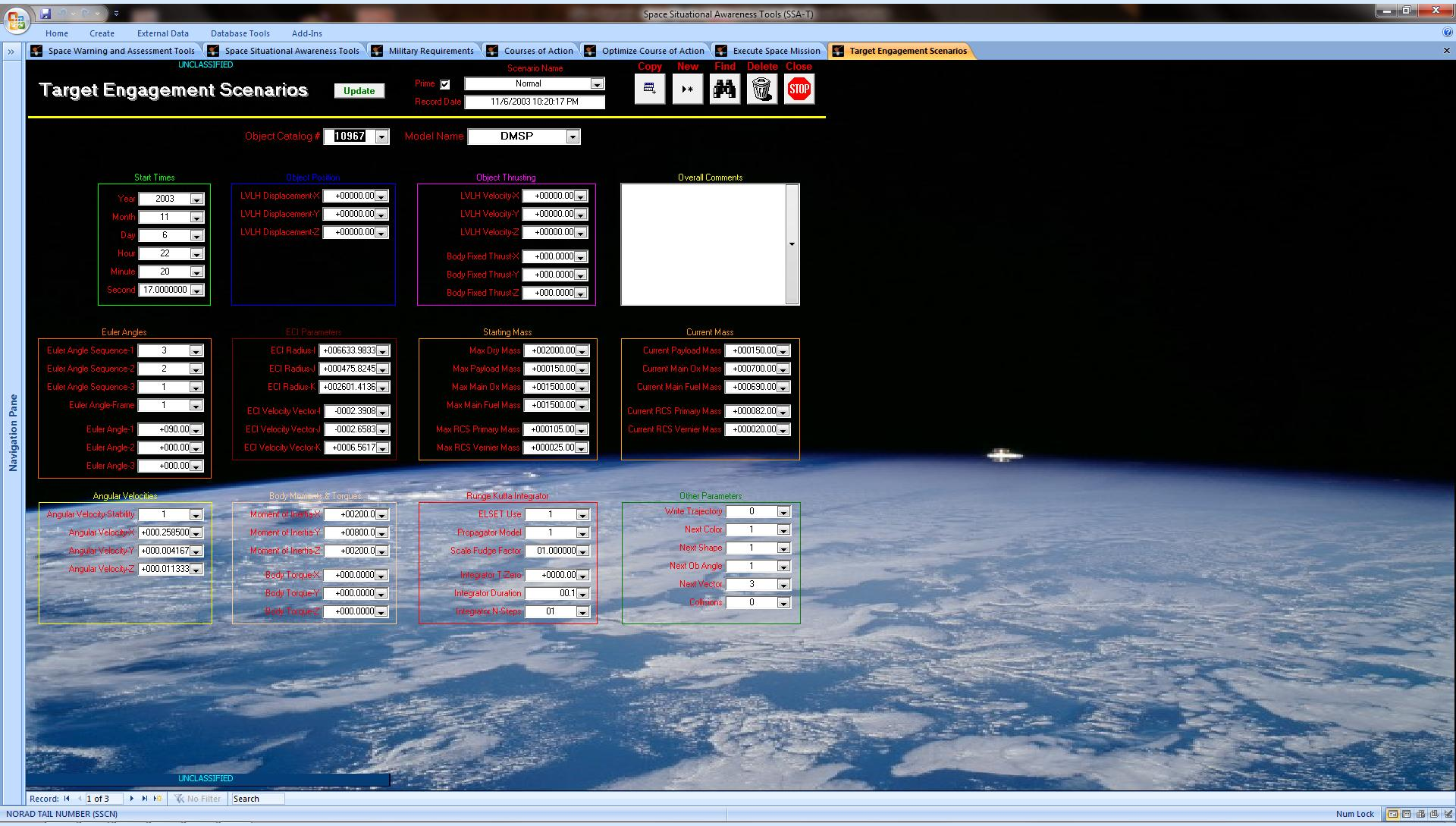
Another COA Development Methodology is to Use RAND Strategies-to-Task Hierarchies

Space Mission Objectives Optimization Rankings



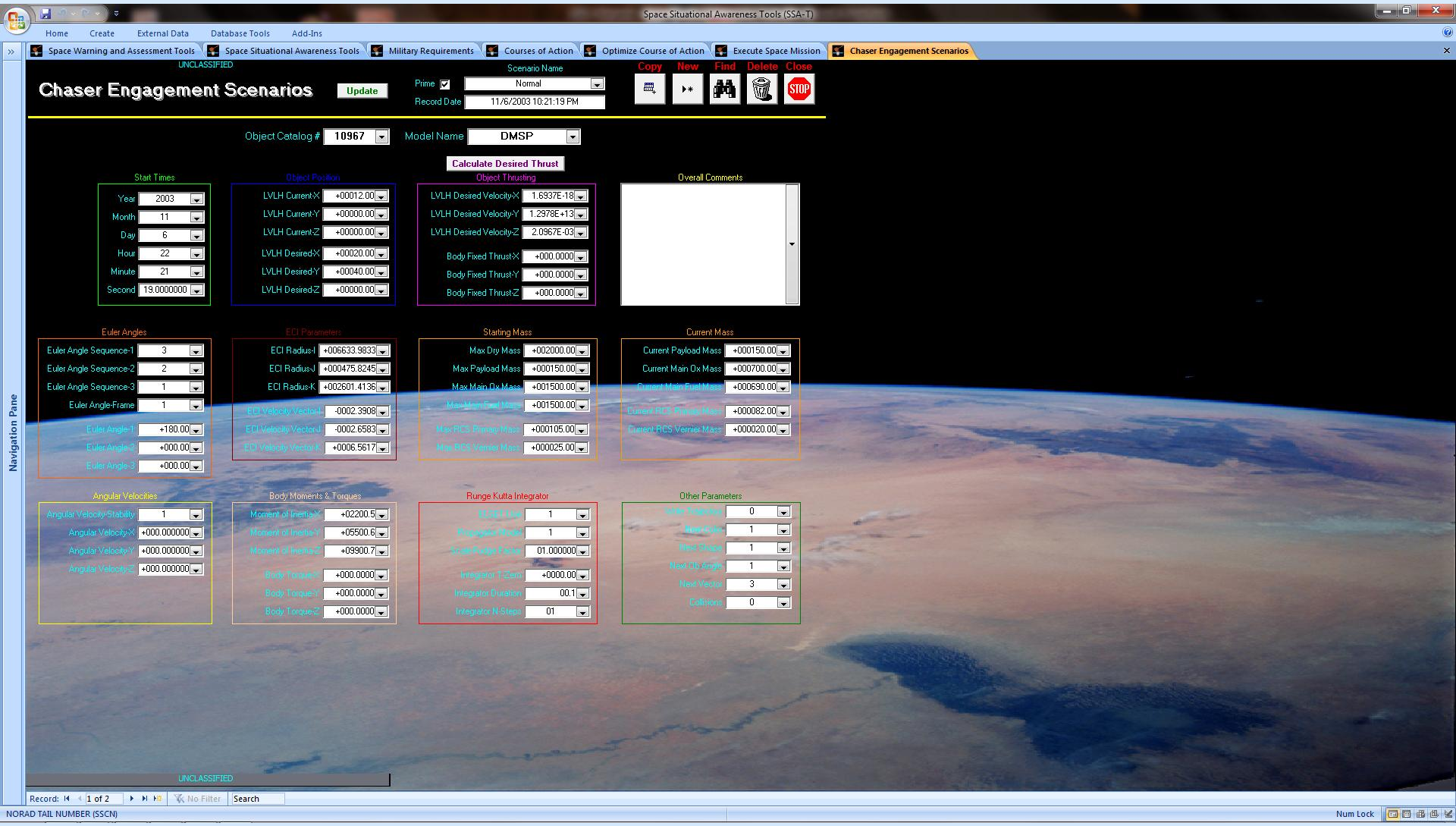
There are Many Means of Optimizing Space COA's

Space Weapon Orbital Engagement (Target Parameters)



Specific Physics Parameters of Space Attacks for the Targeted Space Object

Space Weapon Orbital Engagement (Weapon Parameters)

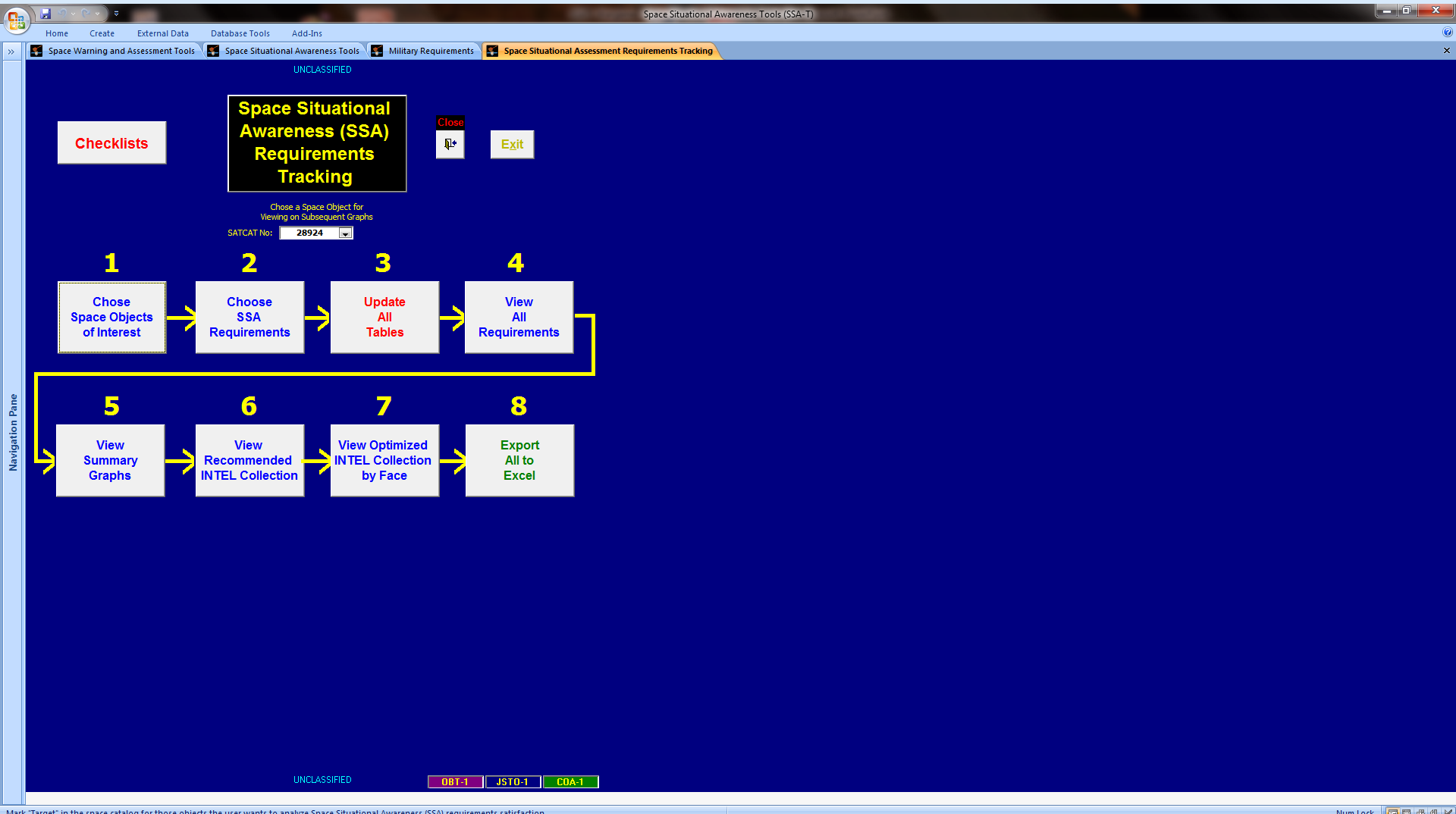


Specific Physics Parameters of Space Attacks for the Attacking Satellite (Rendezvous)

Space Situational Awareness (SSA) Optimization Tools

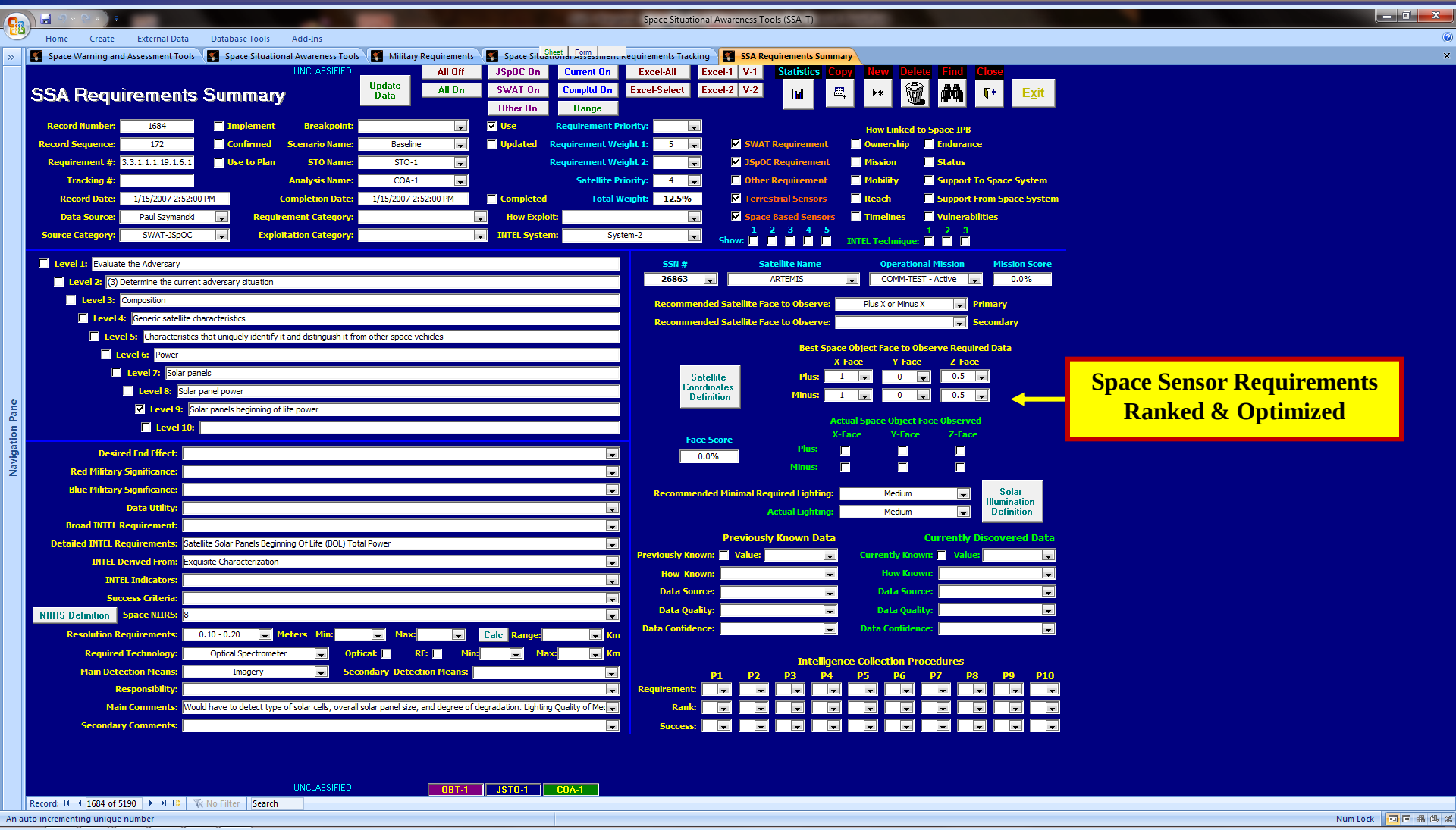
SSA-T Tools to Help Optimize & Manage Space Sensor Tasking

SSA Optimization Main Menu Screen



Manage Space Sensor Tasking

SSA Requirements Matrix



Space Sensor Requirements Ranked & Optimized

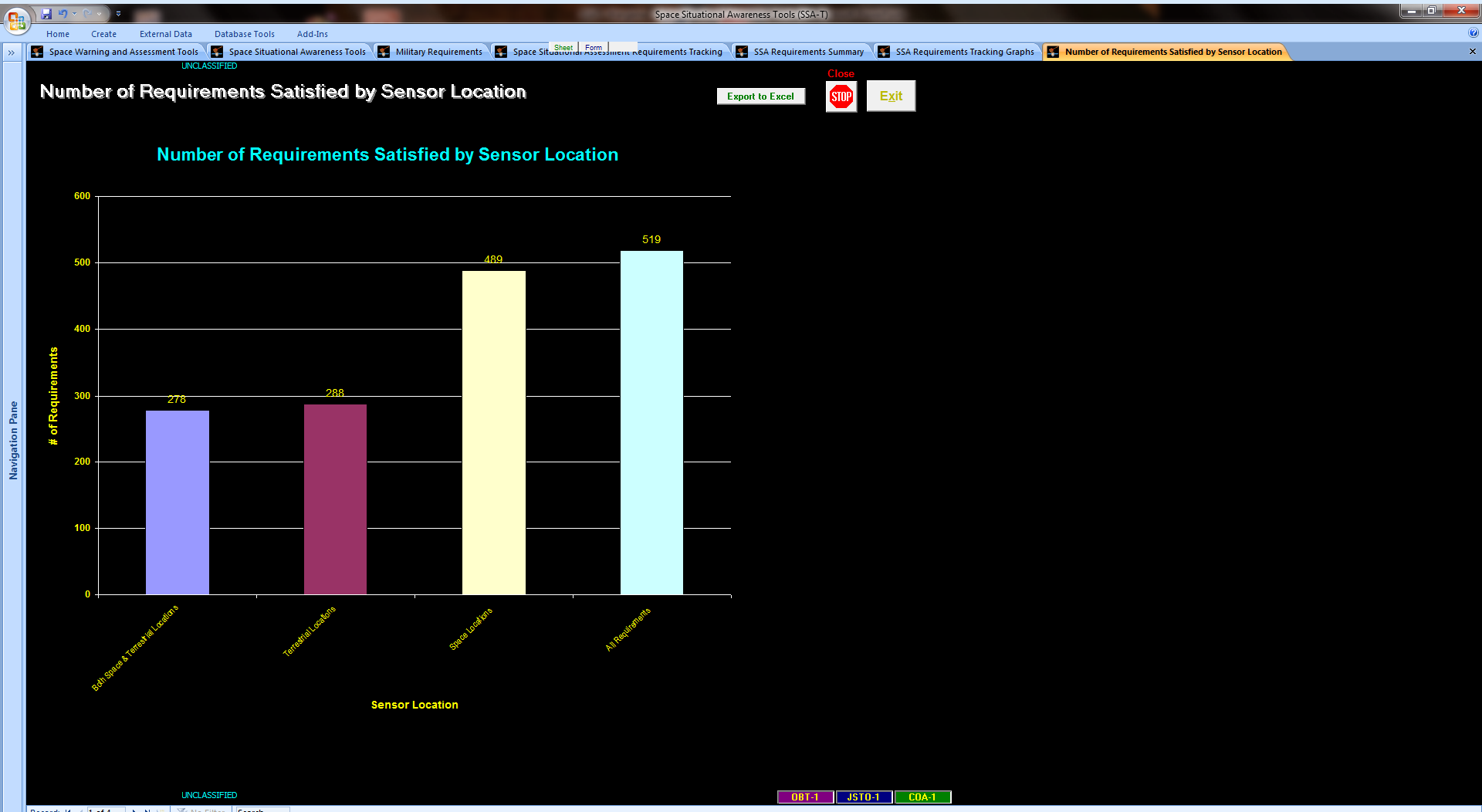
Delineates Space Situational Awareness (SSA) Requirements Details

SSA Sensor Optimization Graphs (1)

Click On Each Graph to View Details

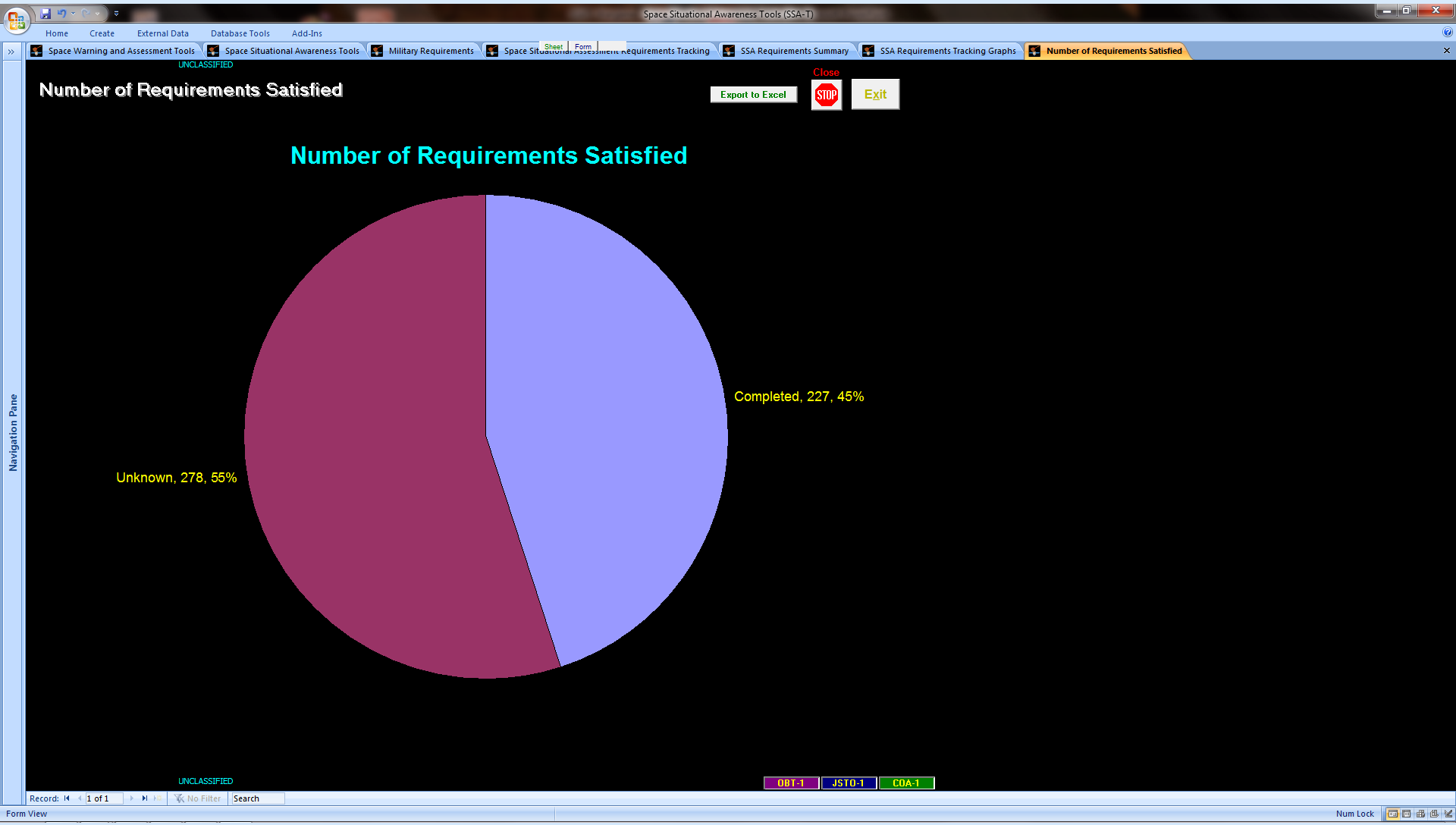
SSA Requirements Statistics Main Menu

SSA Sensor Optimization Graphs (2)



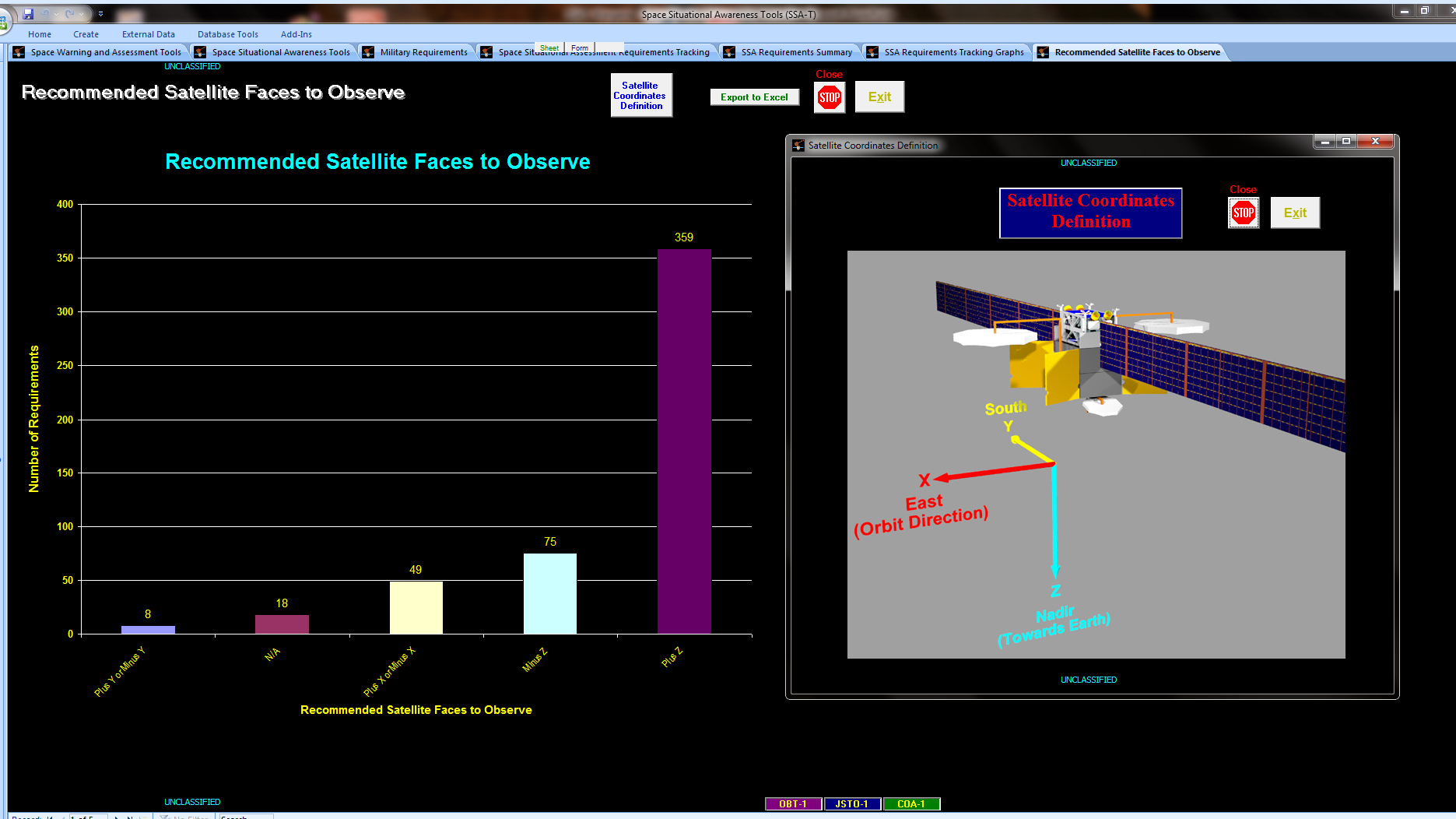
All SSA Requirements Statistics

SSA Sensor Optimization Graphs (3)



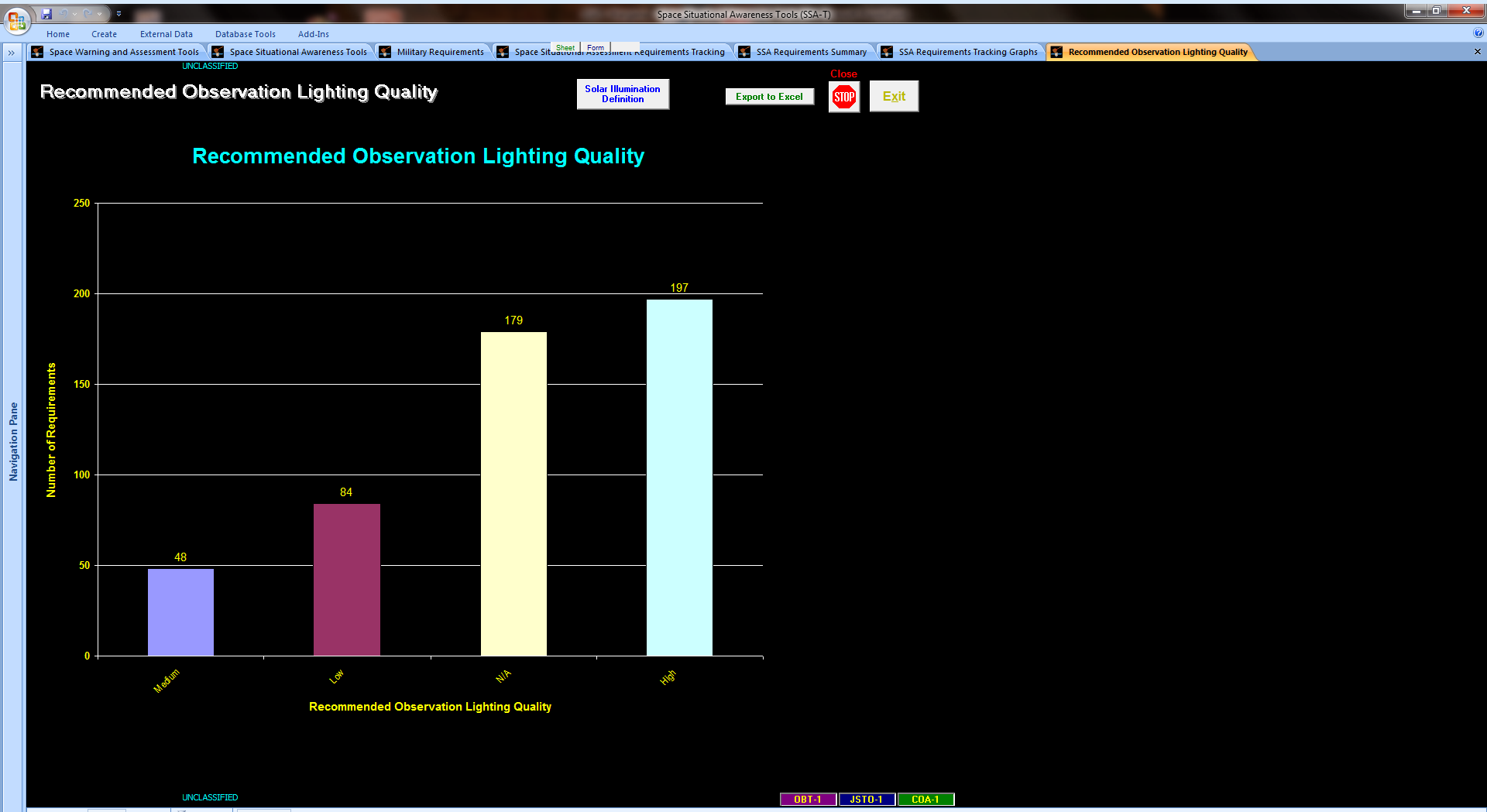
Fulfilled SSA Requirements Statistics

SSA Sensor Optimization Graphs (4)



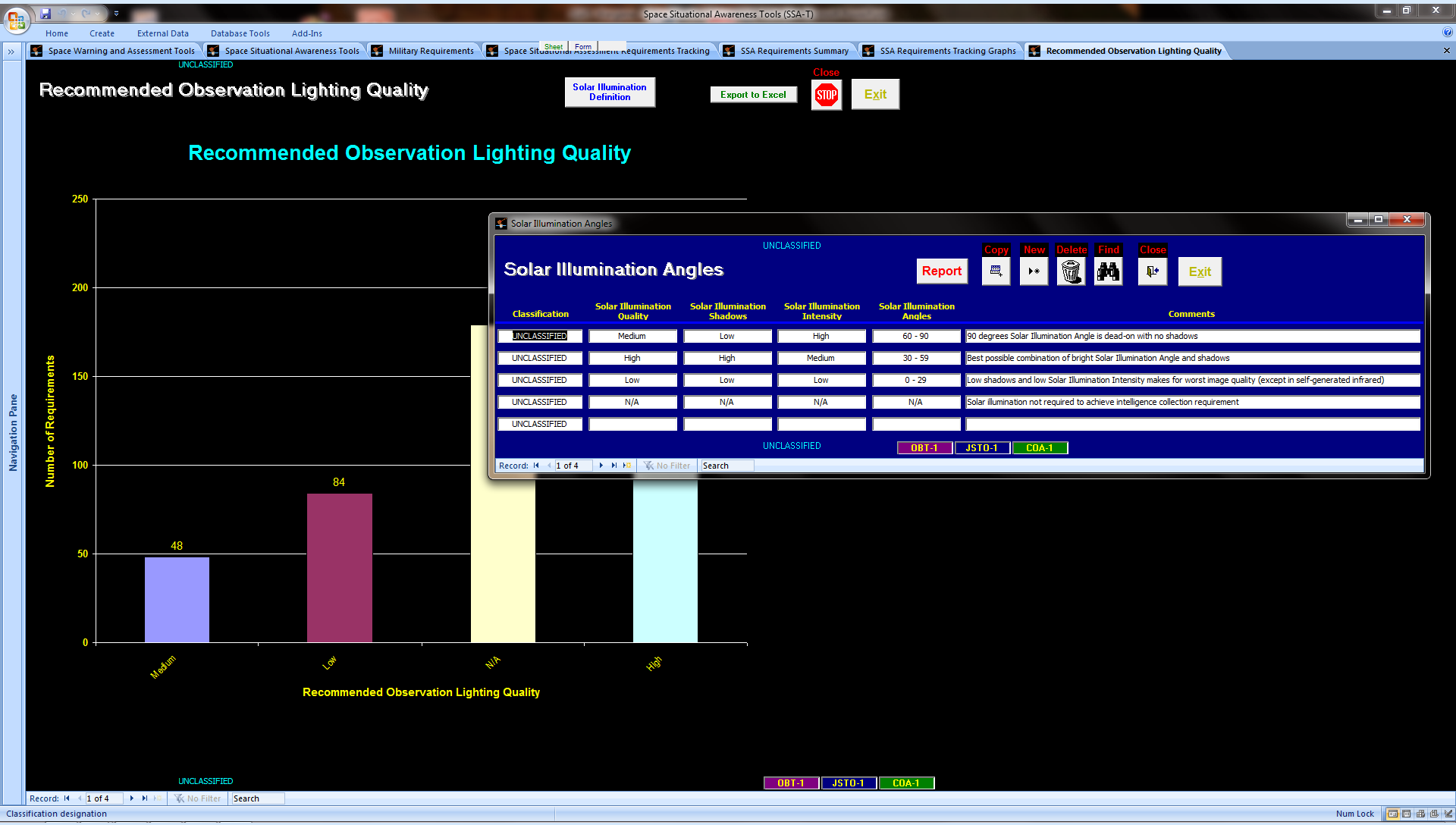
Best Side of Satellite to Observe Statistics – Suggests Best Sensor System to Employ

SSA Sensor Optimization Graphs (5a)



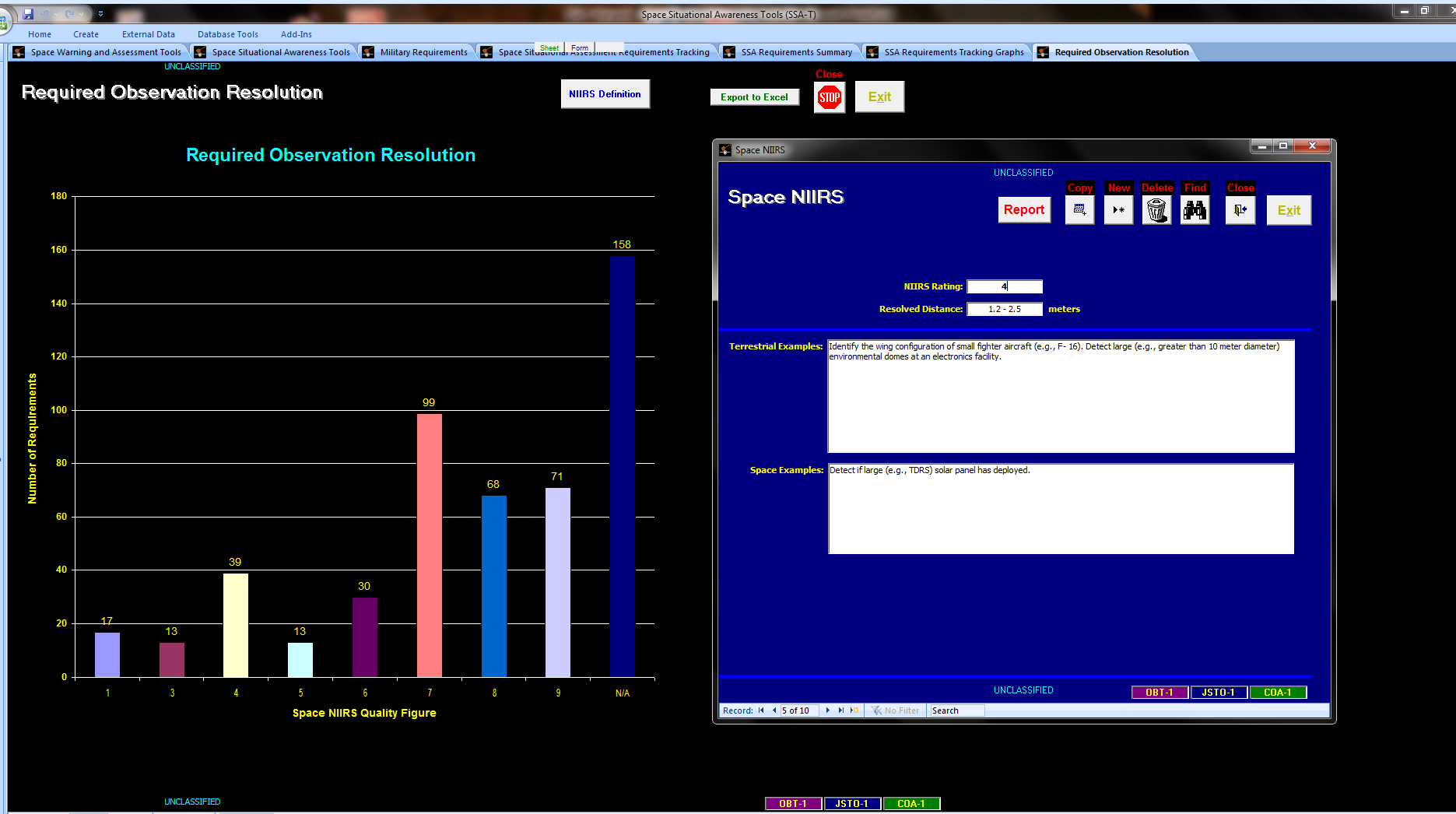
How Well Target Satellites Must be Sun Illuminated to Satisfy SSA Requirement

SSA Sensor Optimization Graphs (5b)



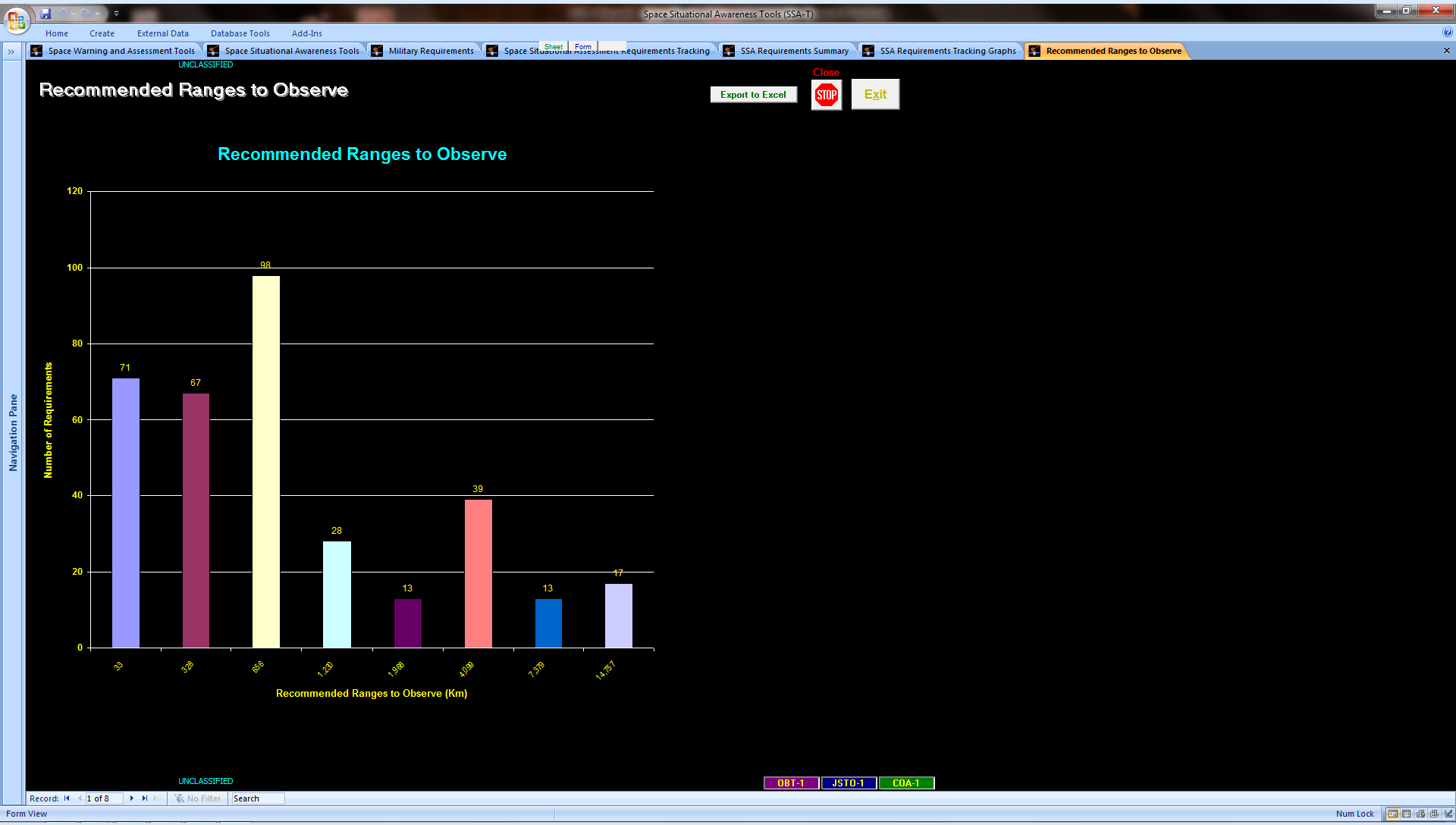
Definition of Solar Illumination Quality

SSA Sensor Optimization Graphs (6)



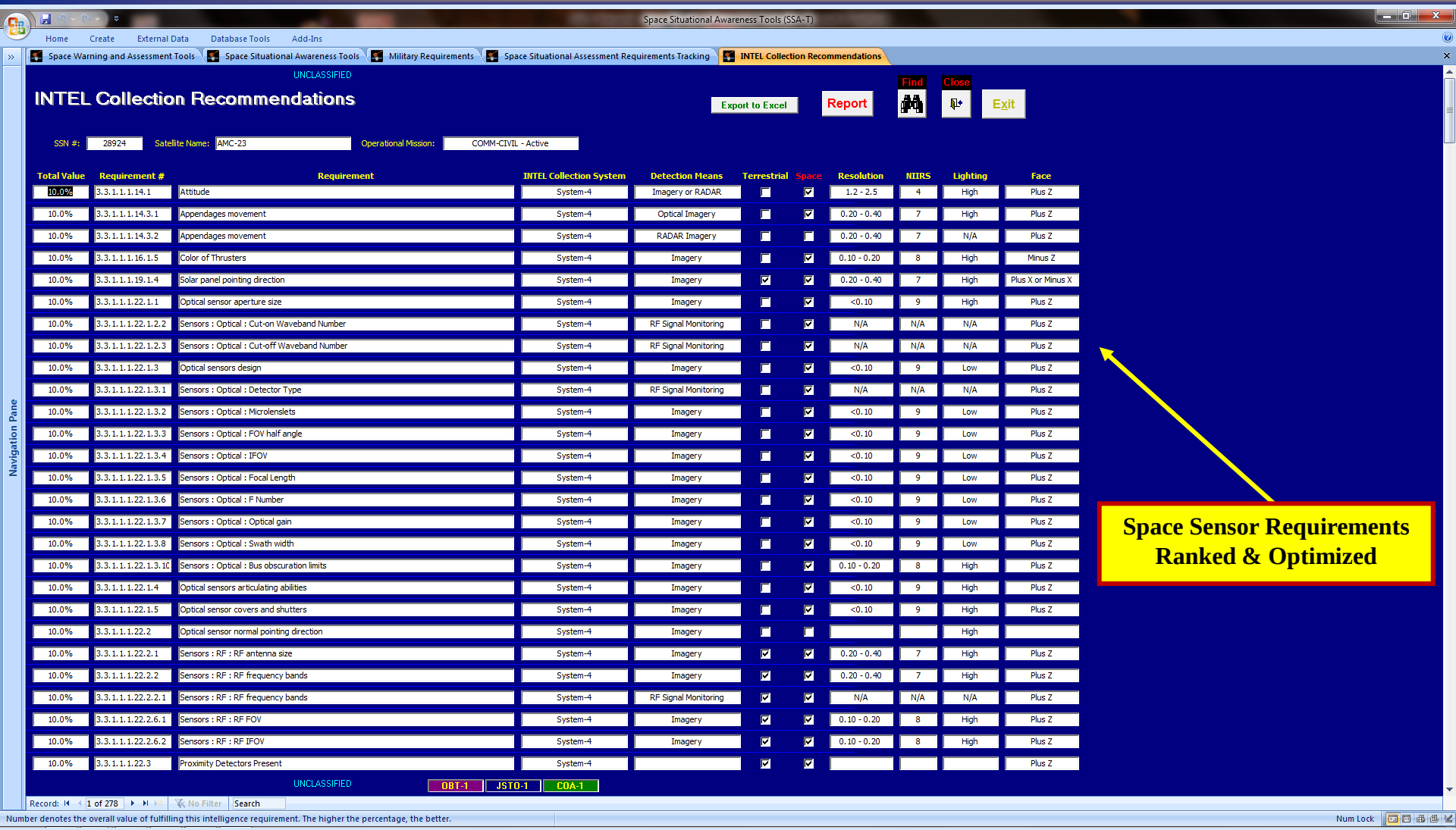
What are Required Sensor / Target Image Resolutions

SSA Sensor Optimization Graphs (7)



At What Ranges Must Observations be Accomplished

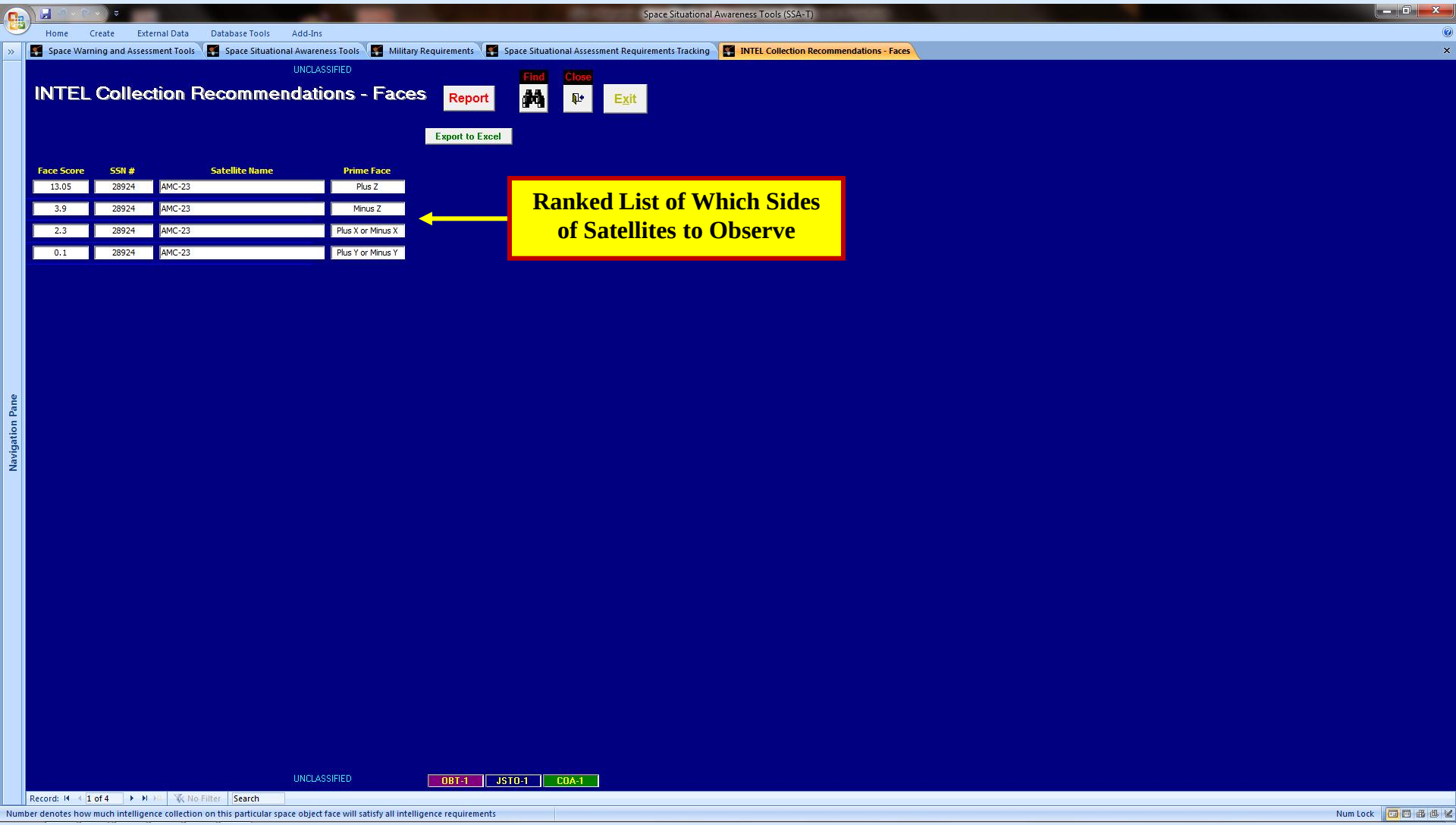
SSA Sensor Collection Strategy



Total Value	Requirement #	Requirement	INTEL Collection System	Detection Means	Terrestrial	Space	Resolution	NIIRS	Lighting	Face
10.0%	3.3.1.1.1.14.1	Attitude	System-4	Imagery or RADAR	☐	☑	1.2 - 2.5	4	High	Plus Z
10.0%	3.3.1.1.1.14.3.1	Appendages movement	System-4	Optical Imagery	☐	☑	0.20 - 0.40	7	High	Plus Z
10.0%	3.3.1.1.1.14.3.2	Appendages movement	System-4	RADAR Imagery	☐	☐	0.20 - 0.40	7	N/A	Plus Z
10.0%	3.3.1.1.1.16.1.5	Color of Thrusters	System-4	Imagery	☐	☑	0.10 - 0.20	8	High	Minus Z
10.0%	3.3.1.1.1.19.1.4	Solar panel pointing direction	System-4	Imagery	☑	☑	0.20 - 0.40	7	High	Plus X or Minus X
10.0%	3.3.1.1.1.22.1.1	Optical sensor aperture size	System-4	Imagery	☐	☑	<0.10	9	High	Plus Z
10.0%	3.3.1.1.1.22.1.2.2	Sensors : Optical : Cut-on Waveband Number	System-4	RF Signal Monitoring	☐	☑	N/A	N/A	N/A	Plus Z
10.0%	3.3.1.1.1.22.1.2.3	Sensors : Optical : Cut-off Waveband Number	System-4	RF Signal Monitoring	☐	☑	N/A	N/A	N/A	Plus Z
10.0%	3.3.1.1.1.22.1.3	Optical sensors design	System-4	Imagery	☐	☑	<0.10	9	Low	Plus Z
10.0%	3.3.1.1.1.22.1.3.1	Sensors : Optical : Detector Type	System-4	RF Signal Monitoring	☐	☑	N/A	N/A	N/A	Plus Z
10.0%	3.3.1.1.1.22.1.3.2	Sensors : Optical : Microlenslets	System-4	Imagery	☐	☑	<0.10	9	Low	Plus Z
10.0%	3.3.1.1.1.22.1.3.3	Sensors : Optical : FOV half angle	System-4	Imagery	☐	☑	<0.10	9	Low	Plus Z
10.0%	3.3.1.1.1.22.1.3.4	Sensors : Optical : IFOV	System-4	Imagery	☐	☑	<0.10	9	Low	Plus Z
10.0%	3.3.1.1.1.22.1.3.5	Sensors : Optical : Focal Length	System-4	Imagery	☐	☑	<0.10	9	Low	Plus Z
10.0%	3.3.1.1.1.22.1.3.6	Sensors : Optical : F Number	System-4	Imagery	☐	☑	<0.10	9	Low	Plus Z
10.0%	3.3.1.1.1.22.1.3.7	Sensors : Optical : Optical gain	System-4	Imagery	☐	☑	<0.10	9	Low	Plus Z
10.0%	3.3.1.1.1.22.1.3.8	Sensors : Optical : Swath width	System-4	Imagery	☐	☑	<0.10	9	Low	Plus Z
10.0%	3.3.1.1.1.22.1.3.10	Sensors : Optical : Bus obscuration limits	System-4	Imagery	☐	☑	0.10 - 0.20	8	High	Plus Z
10.0%	3.3.1.1.1.22.1.4	Optical sensors articulating abilities	System-4	Imagery	☐	☑	<0.10	9	High	Plus Z
10.0%	3.3.1.1.1.22.1.5	Optical sensor covers and shutters	System-4	Imagery	☐	☑	<0.10	9	High	Plus Z
10.0%	3.3.1.1.1.22.2	Optical sensor normal pointing direction	System-4	Imagery	☐	☐			High	
10.0%	3.3.1.1.1.22.2.1	Sensors : RF : RF antenna size	System-4	Imagery	☑	☑	0.20 - 0.40	7	High	Plus Z
10.0%	3.3.1.1.1.22.2.2	Sensors : RF : RF frequency bands	System-4	Imagery	☑	☑	0.20 - 0.40	7	High	Plus Z
10.0%	3.3.1.1.1.22.2.2.1	Sensors : RF : RF frequency bands	System-4	RF Signal Monitoring	☑	☑	N/A	N/A	N/A	Plus Z
10.0%	3.3.1.1.1.22.2.6.1	Sensors : RF : RF FOV	System-4	Imagery	☑	☑	0.10 - 0.20	8	High	Plus Z
10.0%	3.3.1.1.1.22.2.6.2	Sensors : RF : RF IFOV	System-4	Imagery	☑	☑	0.10 - 0.20	8	High	Plus Z
10.0%	3.3.1.1.1.22.3	Proximity Detectors Present	System-4		☑	☑				Plus Z

Top SSA Requirements for This Conflict Phase

SSA Sensor Collection Strategy
- Recommended Satellite Faces to Observe -

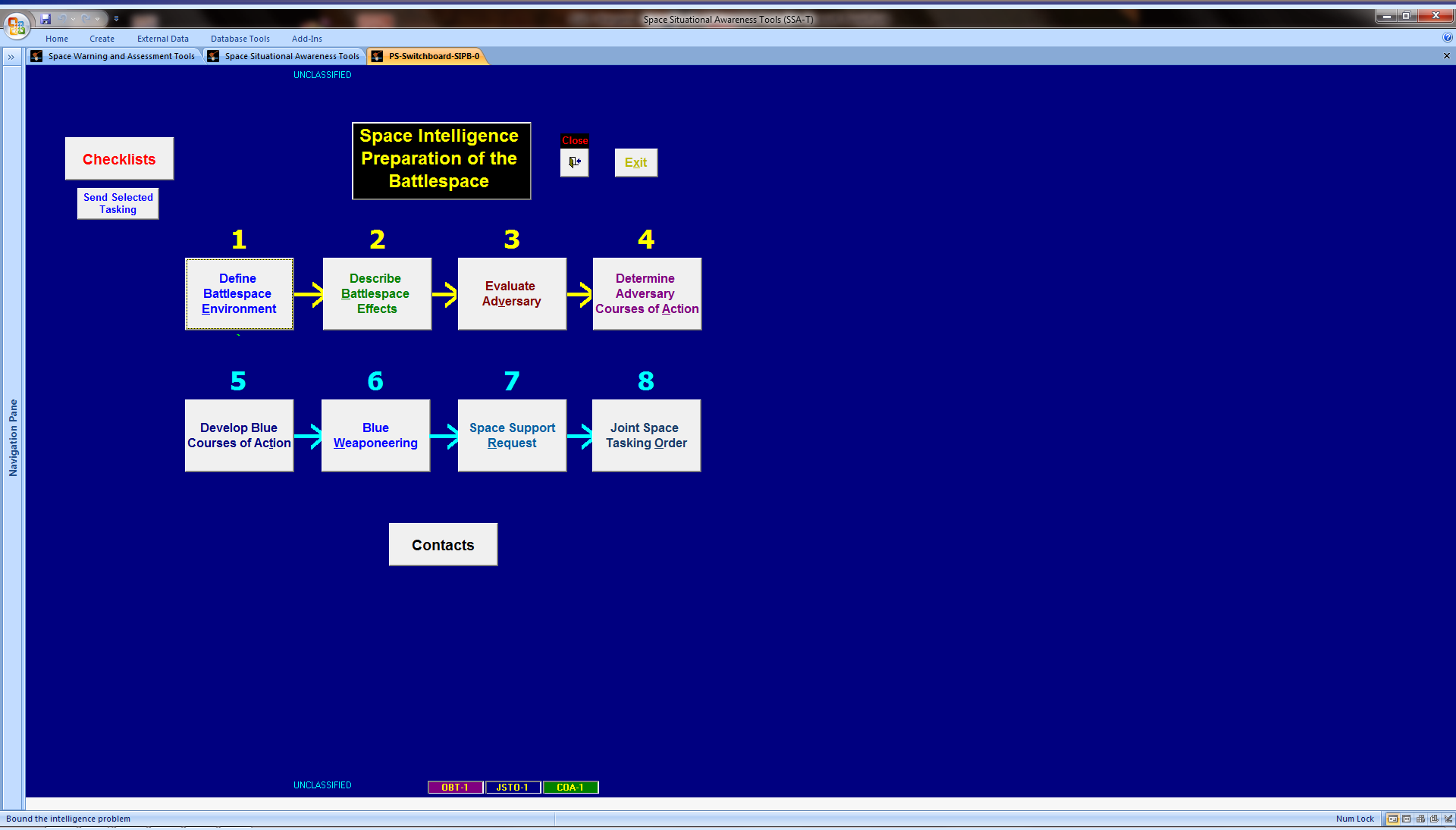


Prime Satellite Faces to Observe for a Particular Resident Space Object (RSO)

Space Intelligence Preparation of the Battlespace (SIPB) Tools

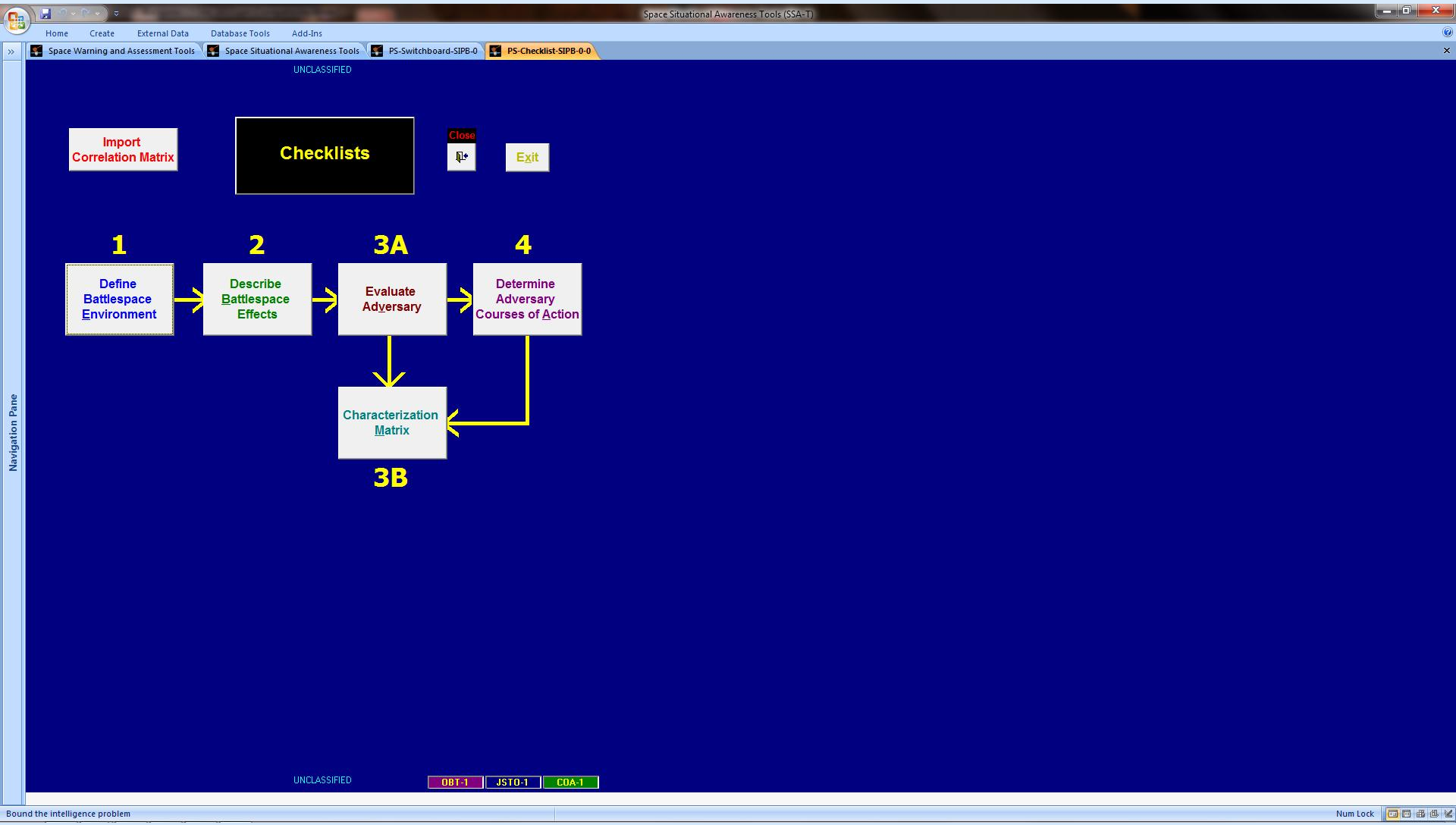
How to Organize Intelligence Collection Against Adversary Systems

SIPB Main Menu Screen



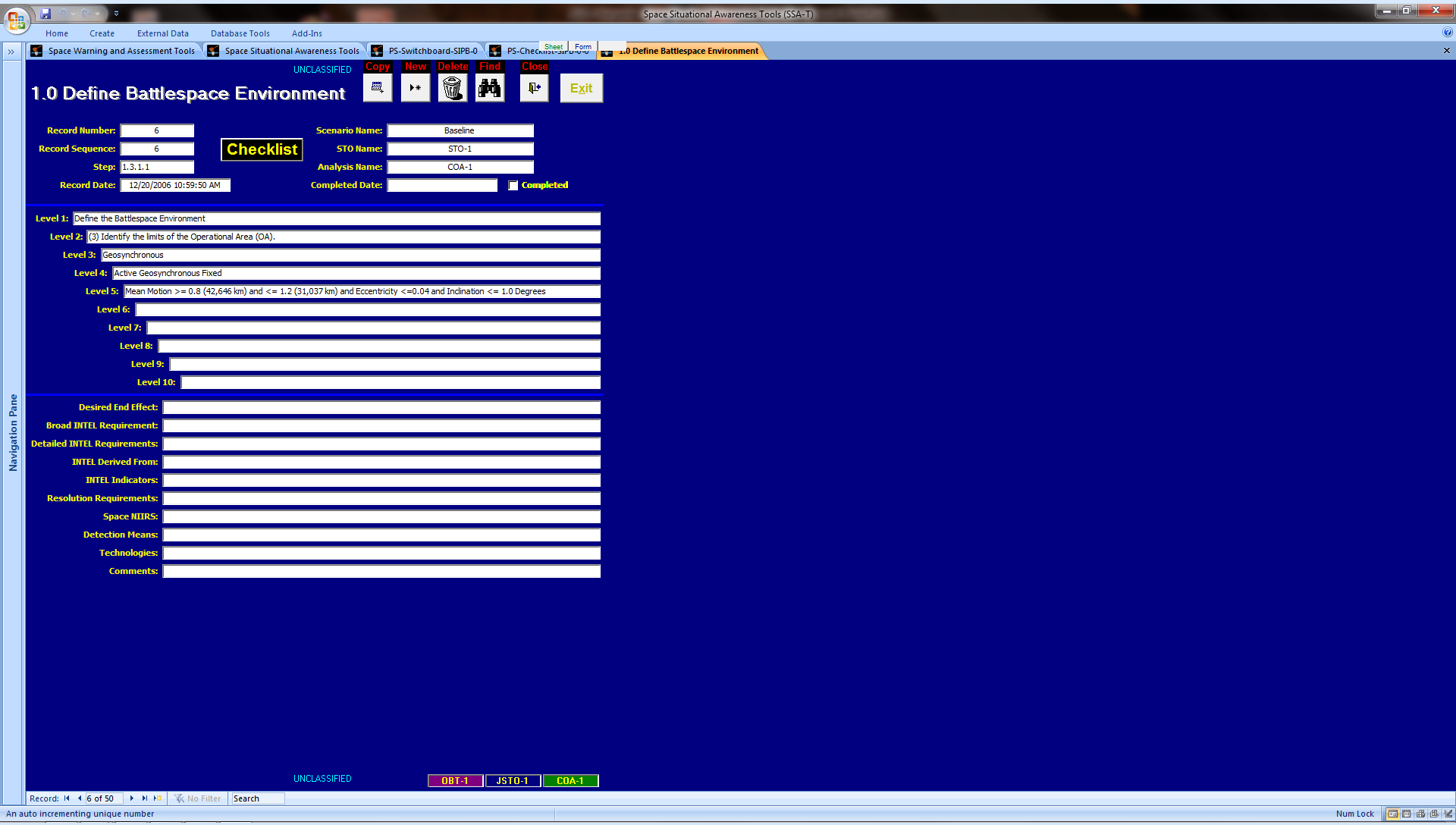
SIPB Top Level Organization

SIPB Options Screen (1)



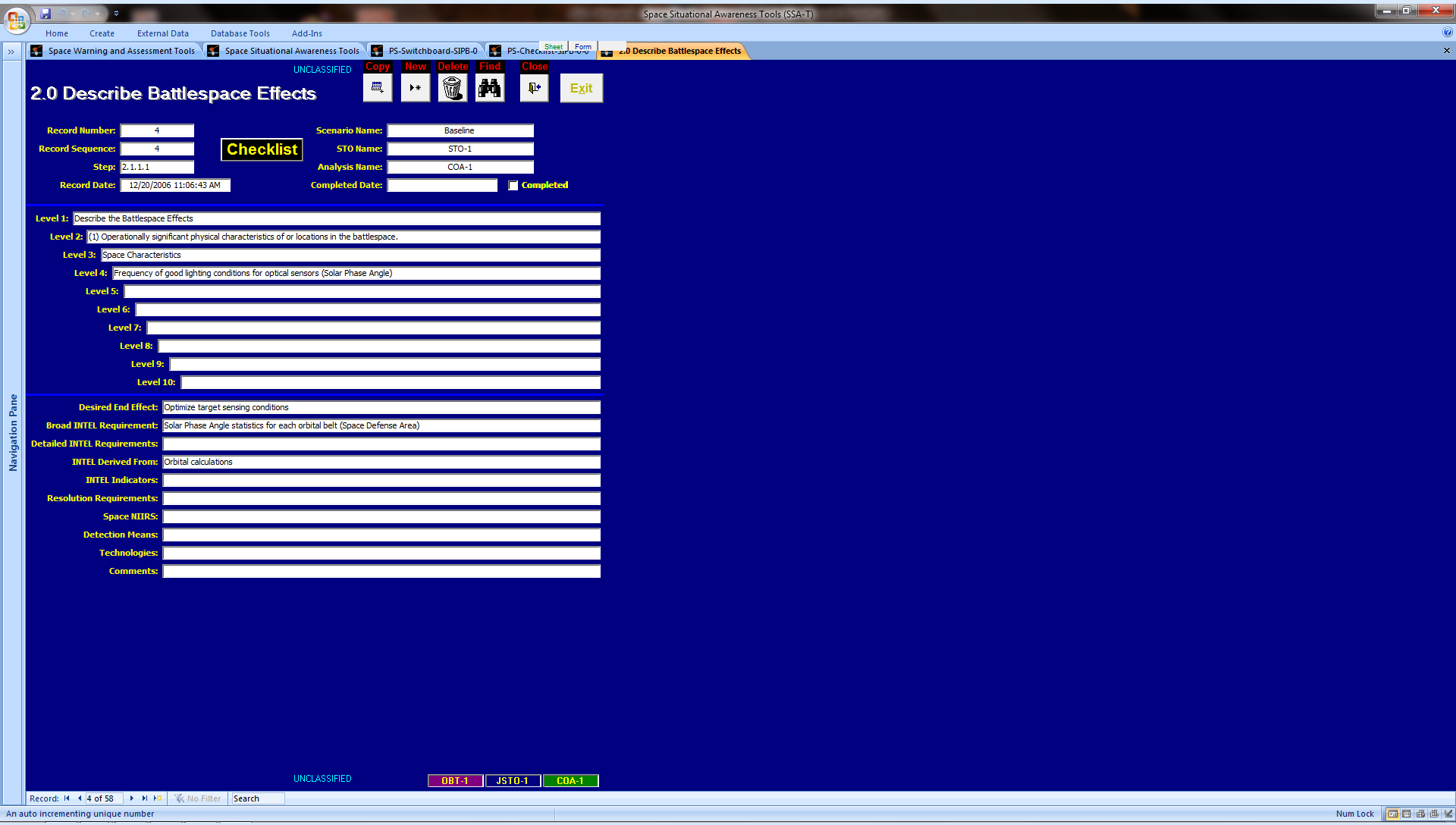
SIPB Relation to SSA Collection Requirements

SIPB Requirements Screen (1)



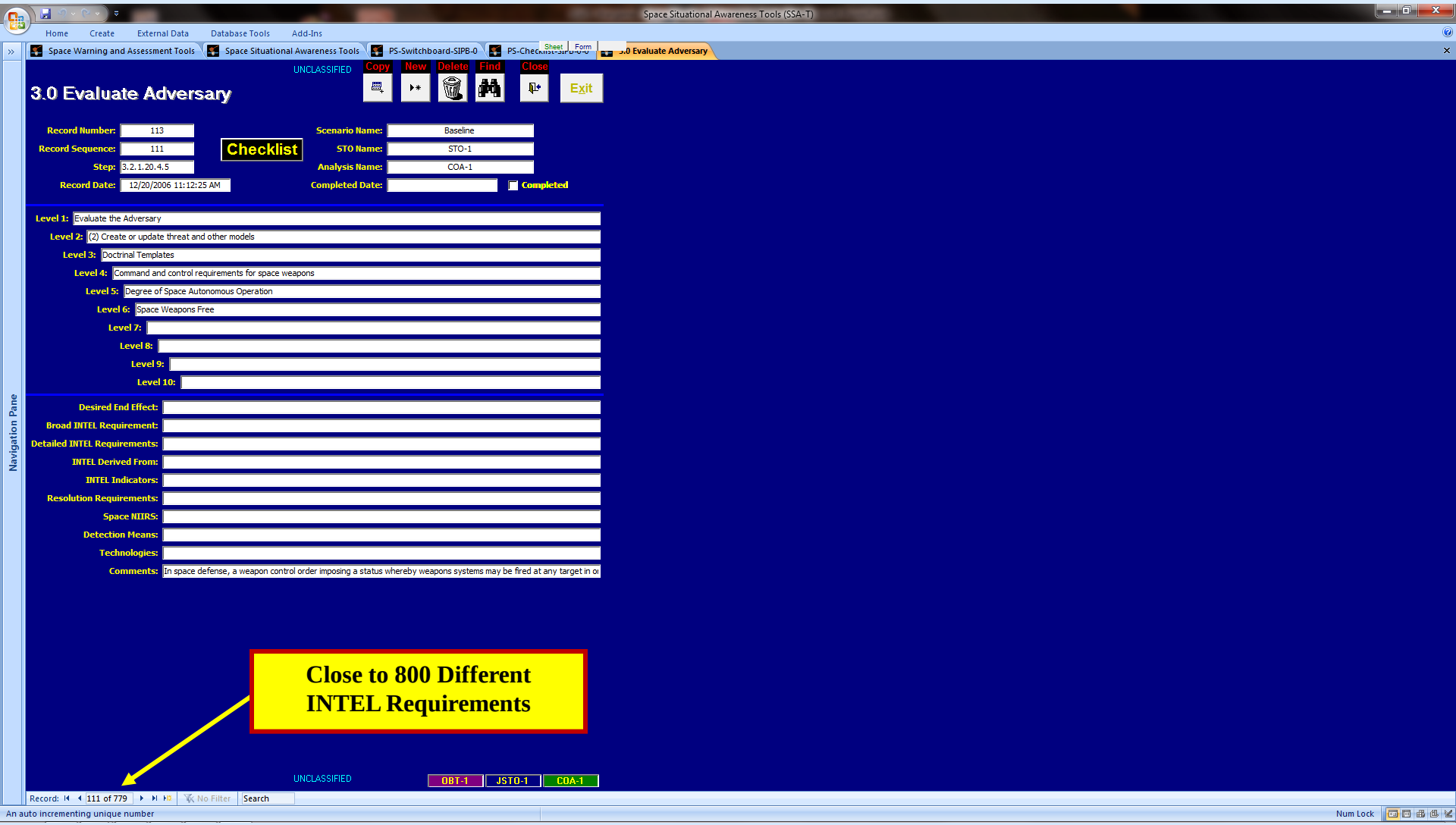
SIPB Step 1

SIPB Requirements Screen (2)



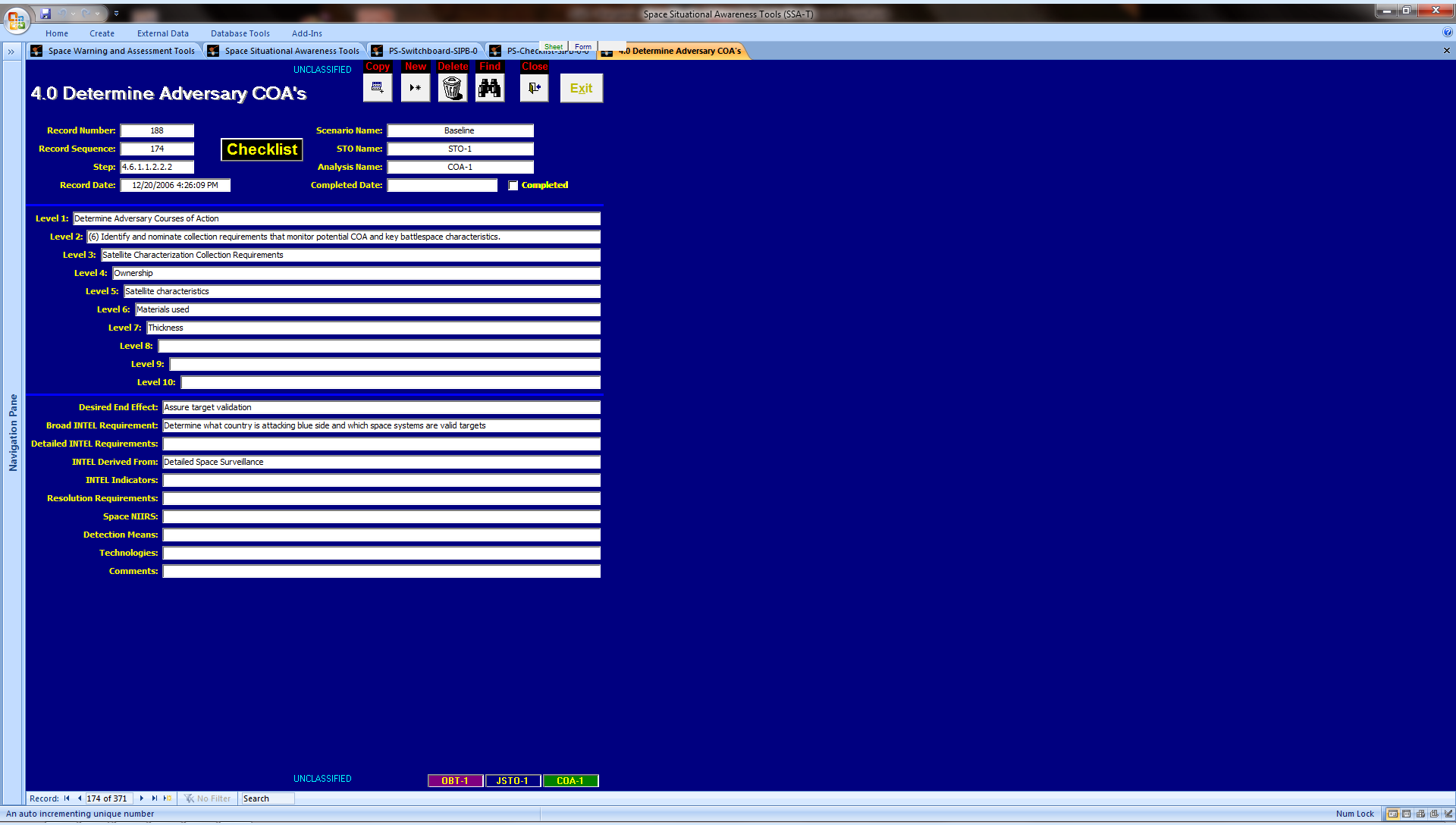
SIPB Step 2

SIPB Requirements Screen (3)



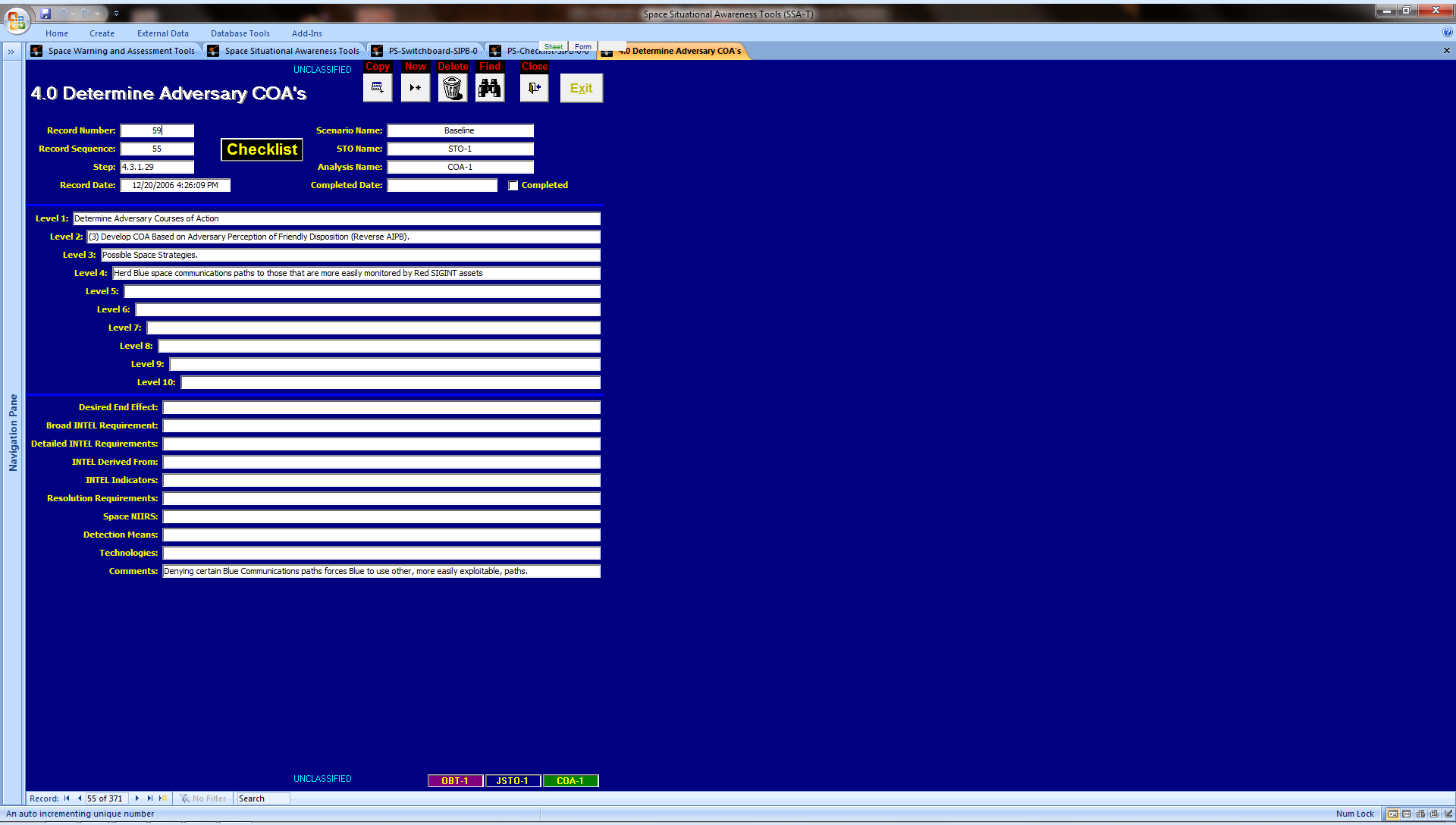
SIPB Step 3

SIPB Requirements Screen (4)



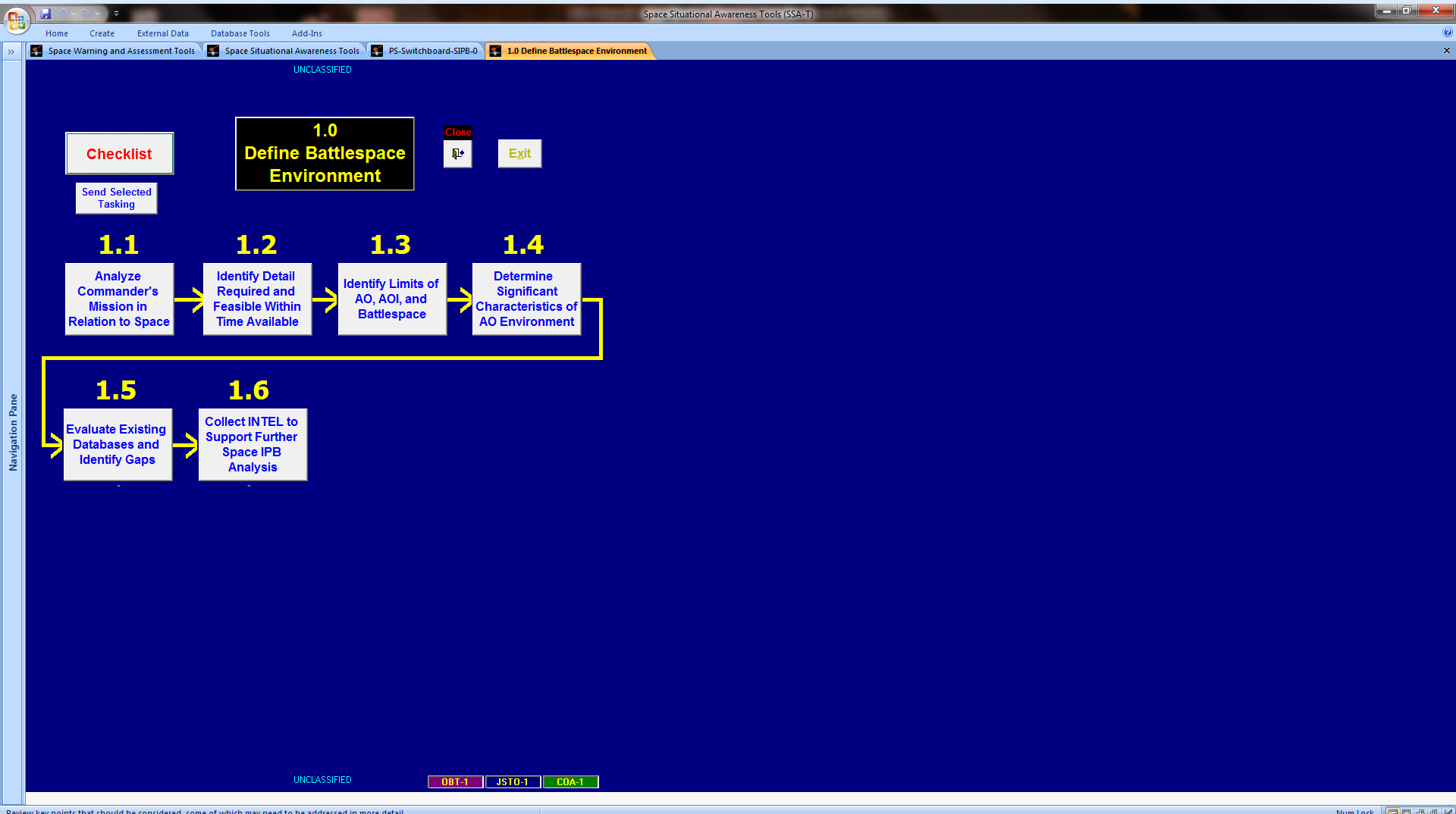
SIPB Step 4

SIPB Requirements Screen (5)



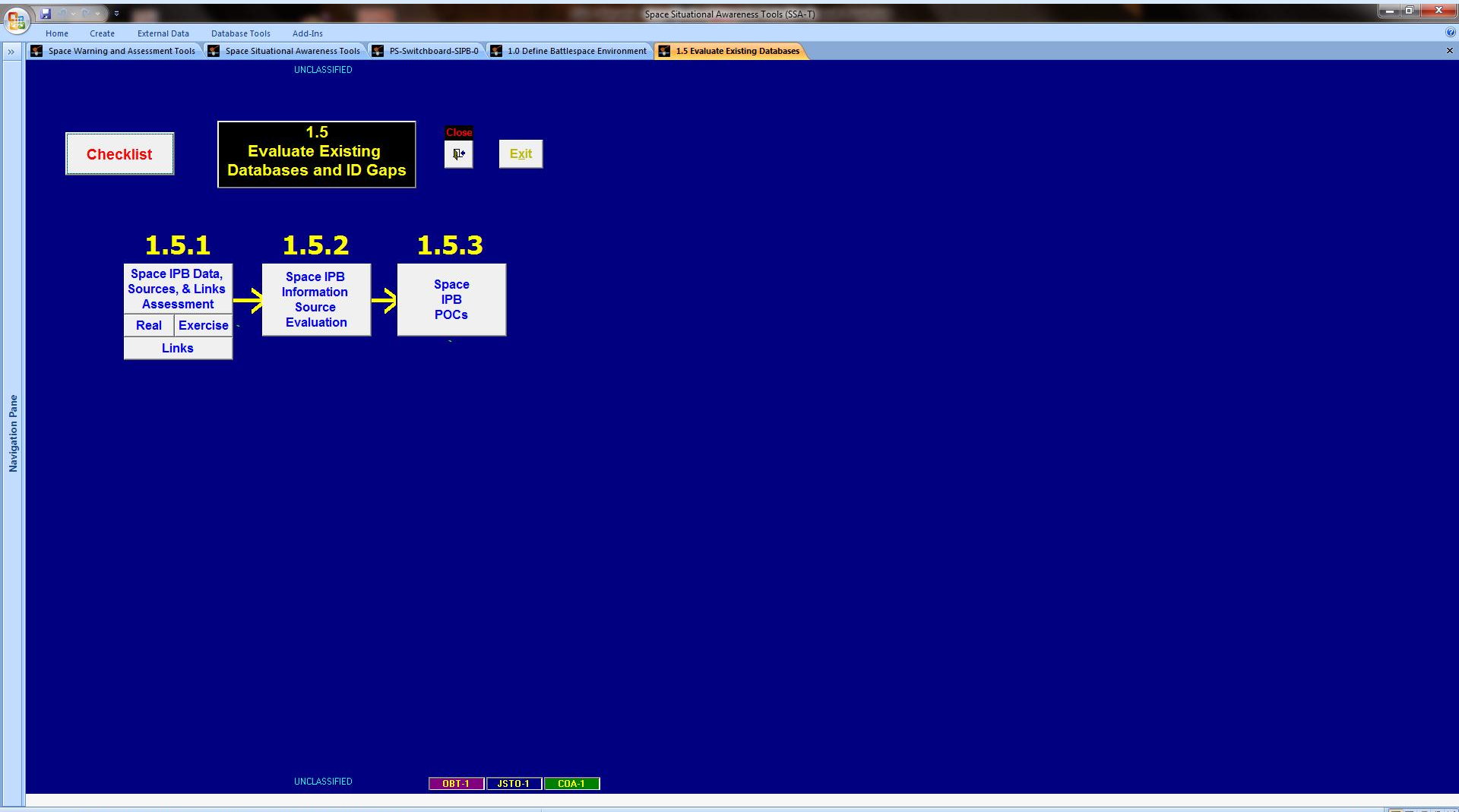
SIPB Step 4 Additional Example

SIPB Options Screen (2)



SIPB Step 1 Sub-Categories (1)

SIPB Options Screen (3)

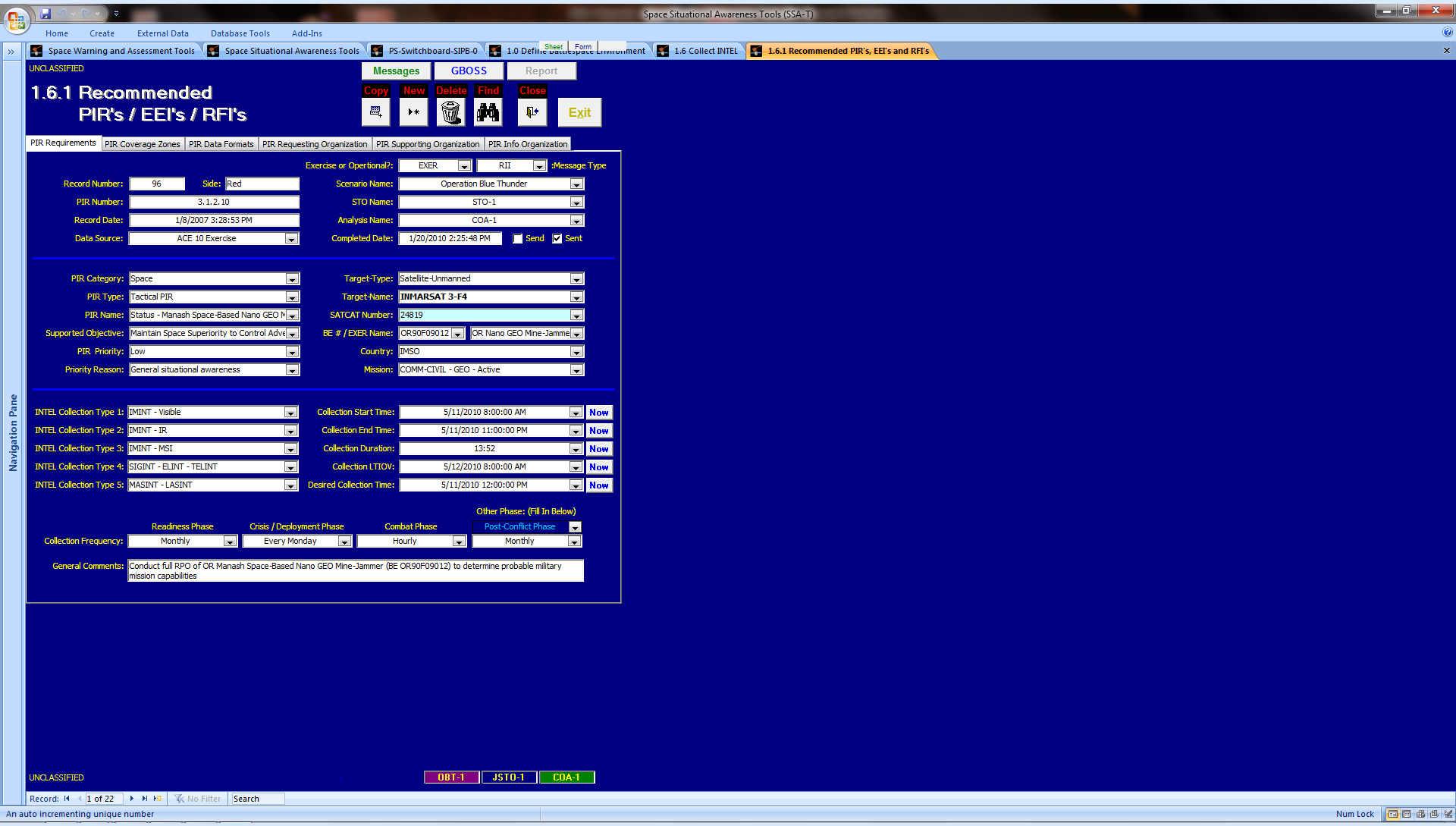


SIPB Step 1 Sub-Categories (2)

SIPB Options Screen (4)

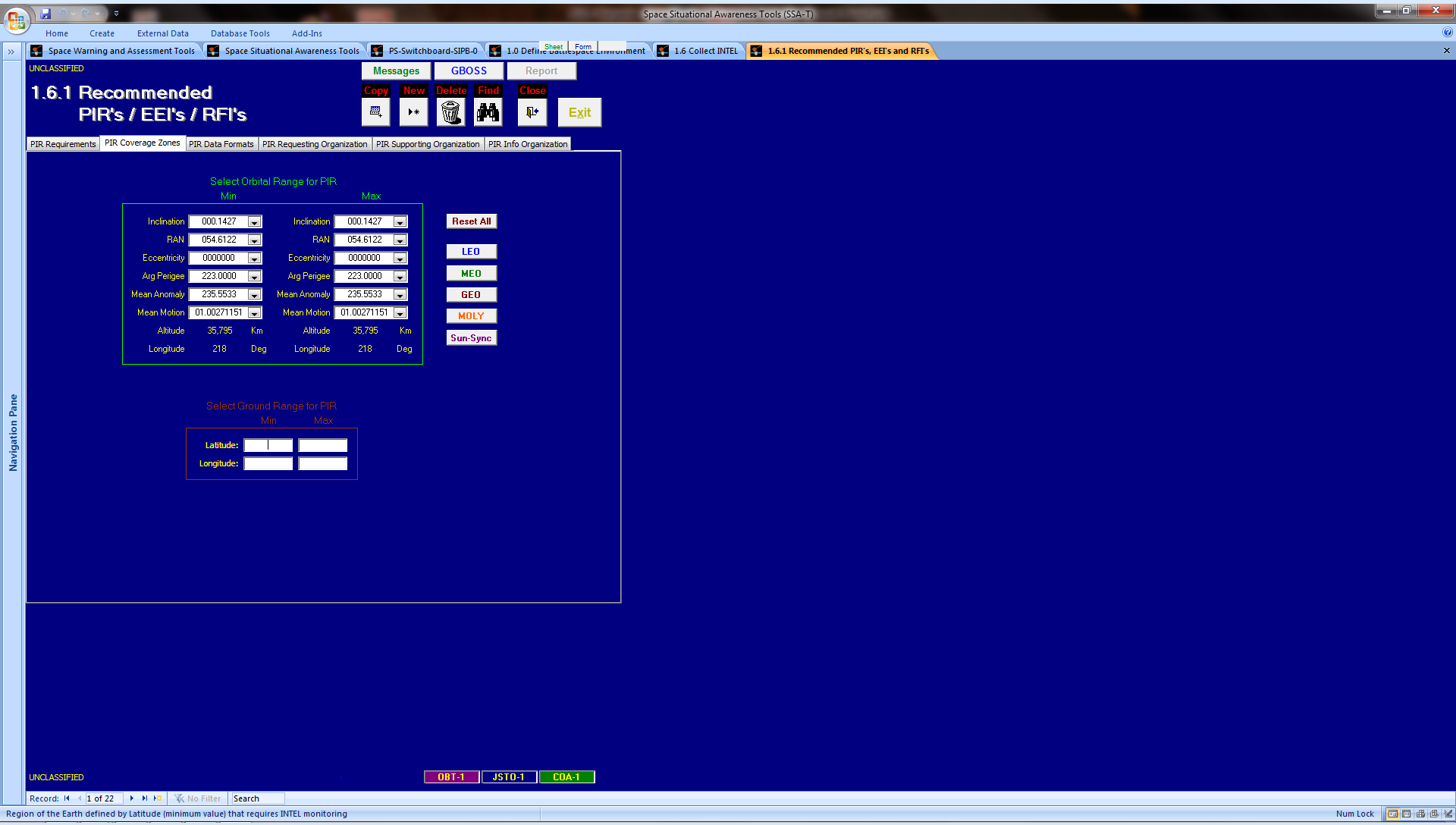
SIPB Step 1 Sub-Categories (3)

SIPB Intelligence Collection Requirements (1)



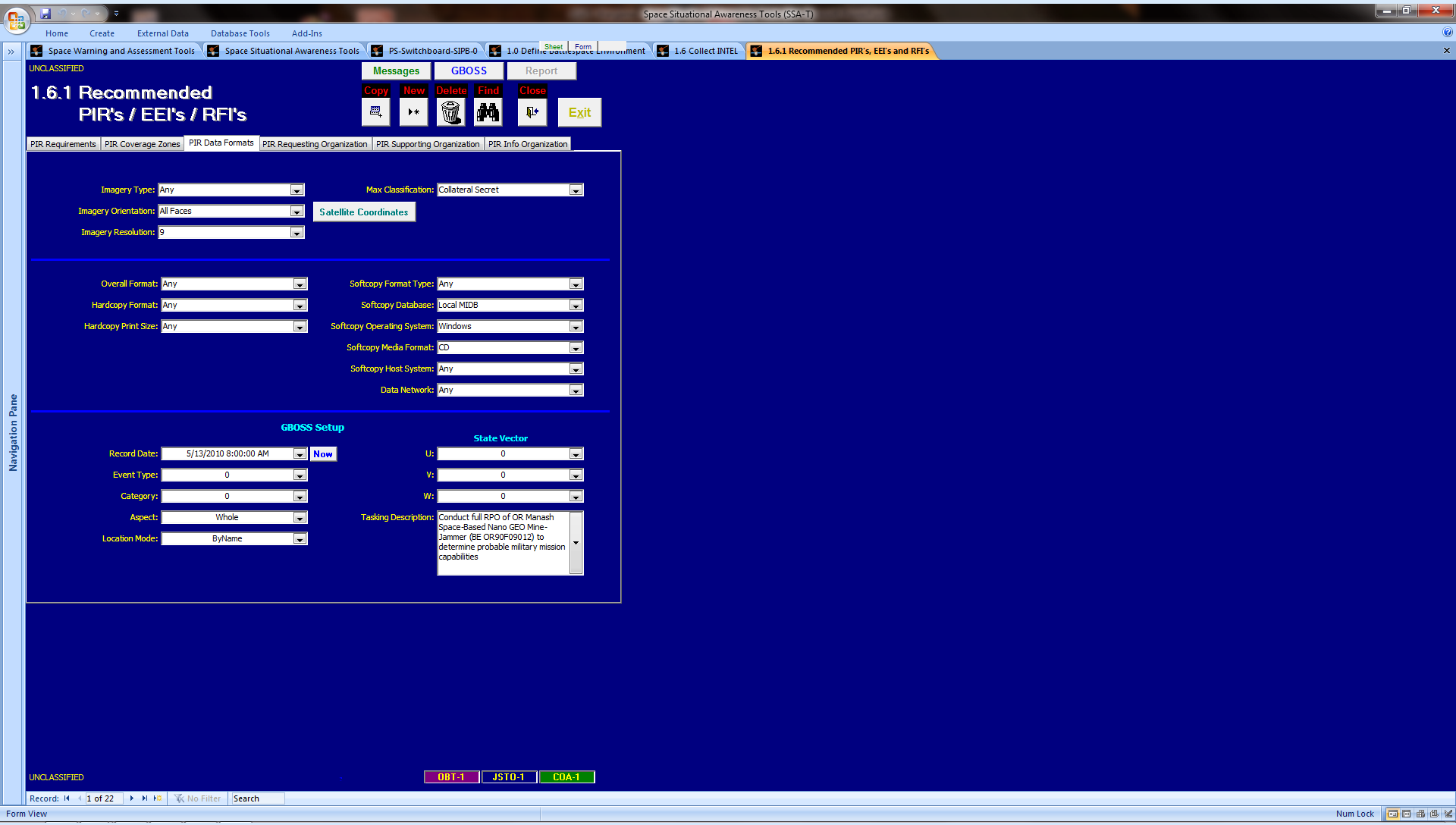
Priority Intelligence Requirements (PIR) Tasking Form

SIPB Intelligence Collection Requirements (2)



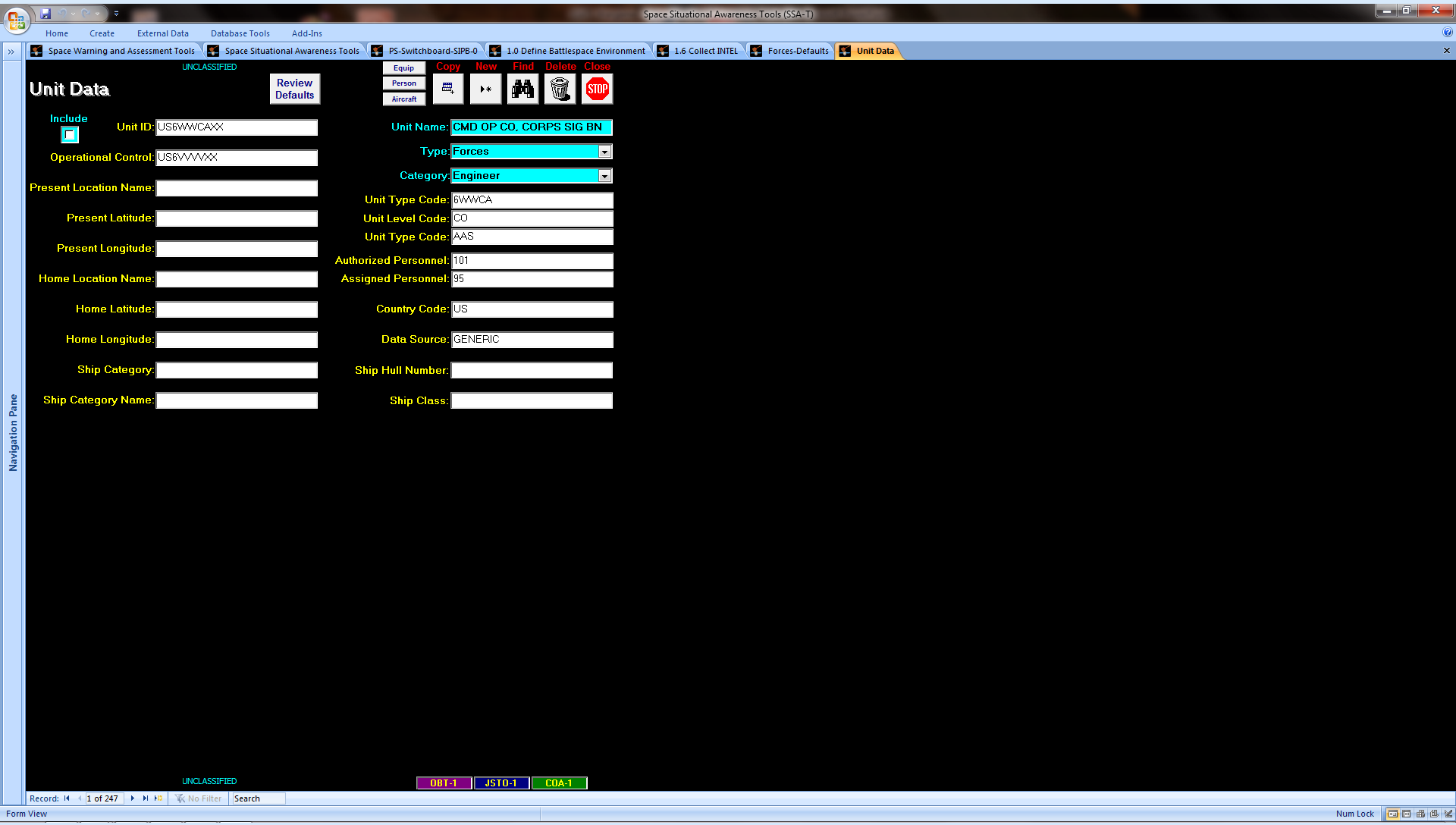
Required PIR Orbital (or Geographic) Coverage Zones

SIPB Intelligence Collection Requirements (3)



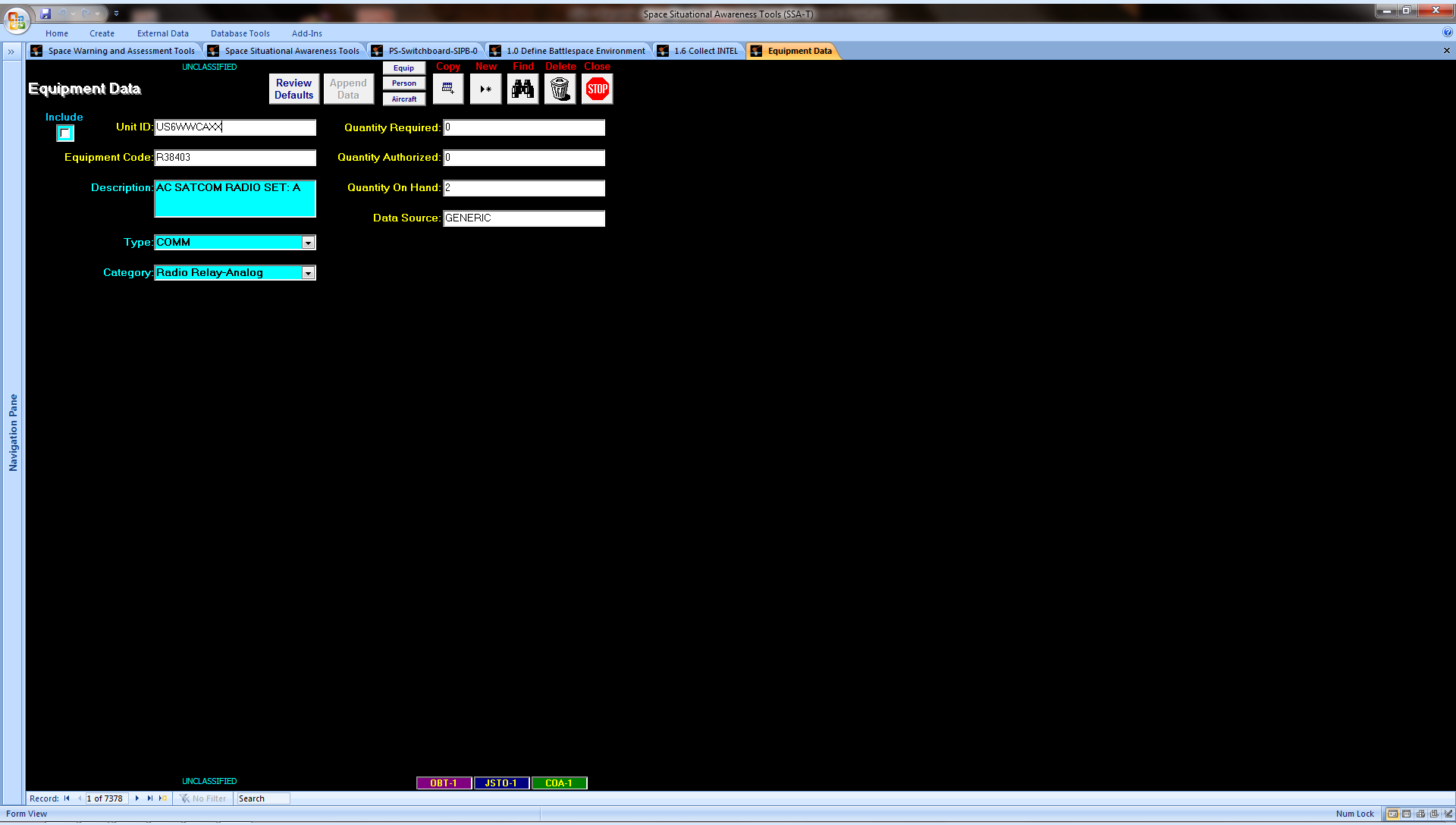
Required PIR Data Formats

Terrestrial Forces Categories



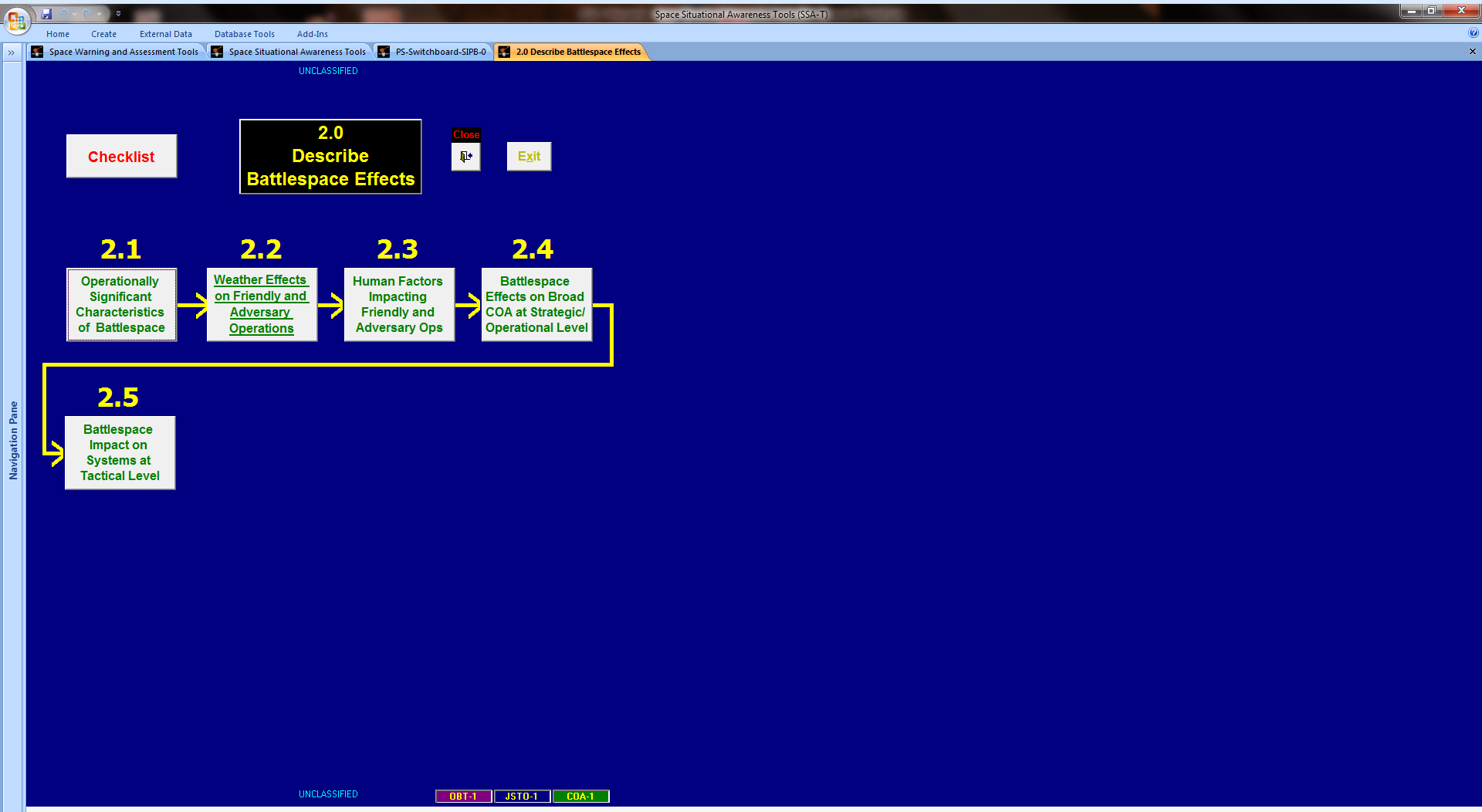
Terrestrial Forces Unit Data Definitions

Terrestrial Forces Equipment Categories



Terrestrial Forces Equipment Data Definitions

SIPB Options Screen (5)

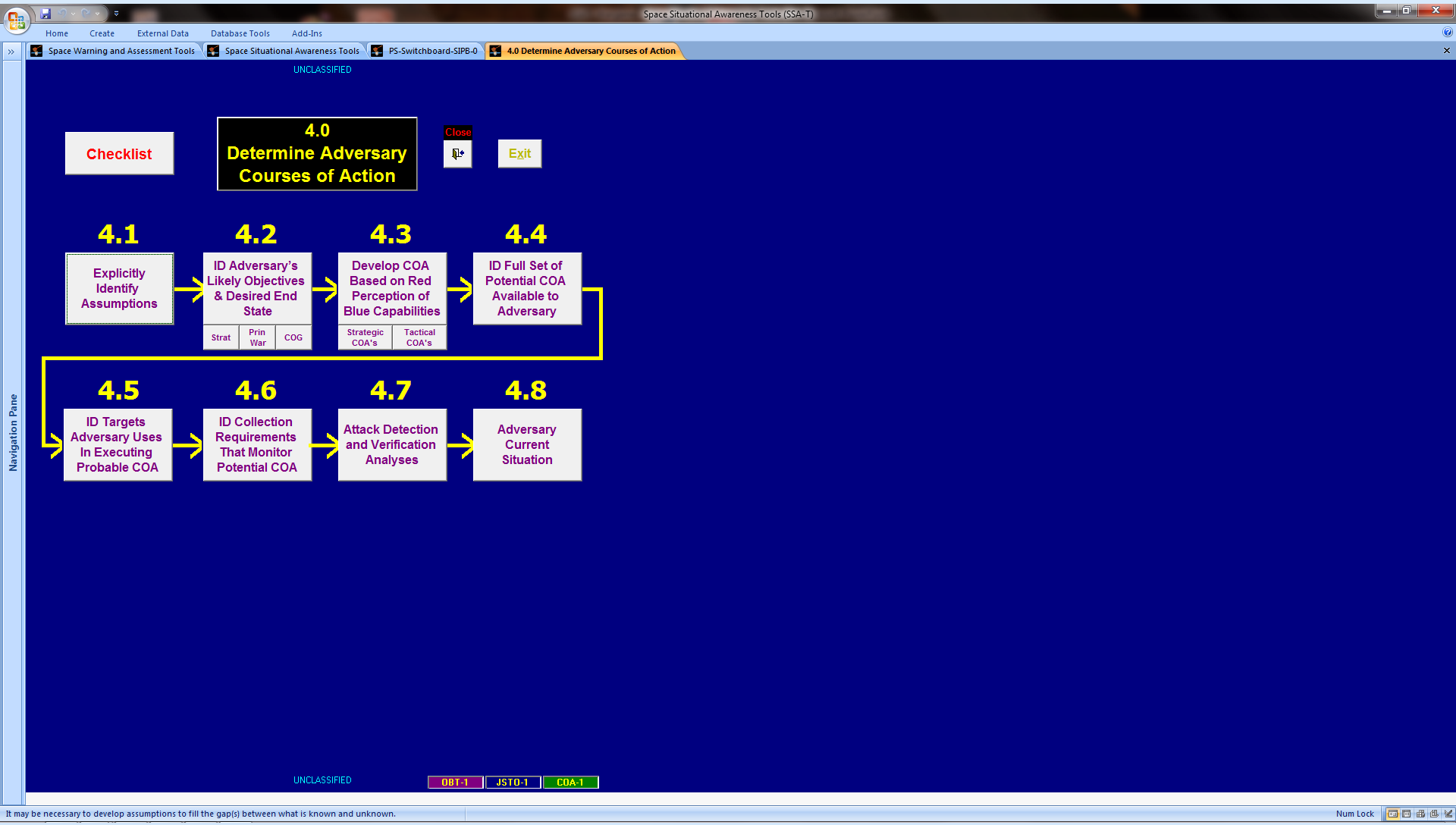


SIPB Step 2 Sub-Categories

SIPB Options Screen (6)

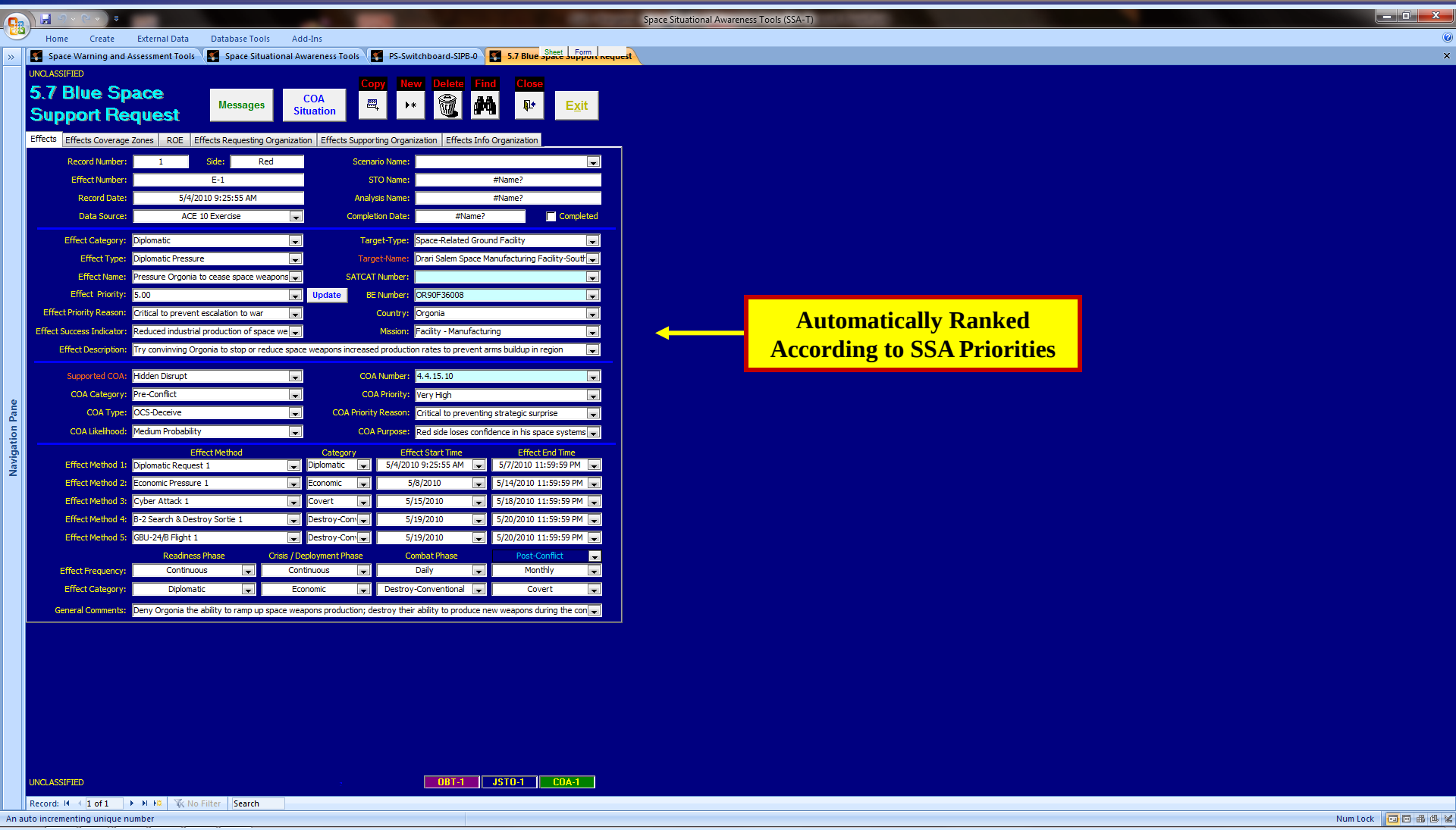
SIPB Step 3 Sub-Categories

SIPB Options Screen (7)



SIPB Step 4 Sub-Categories (1)

Space Support Request Worksheet

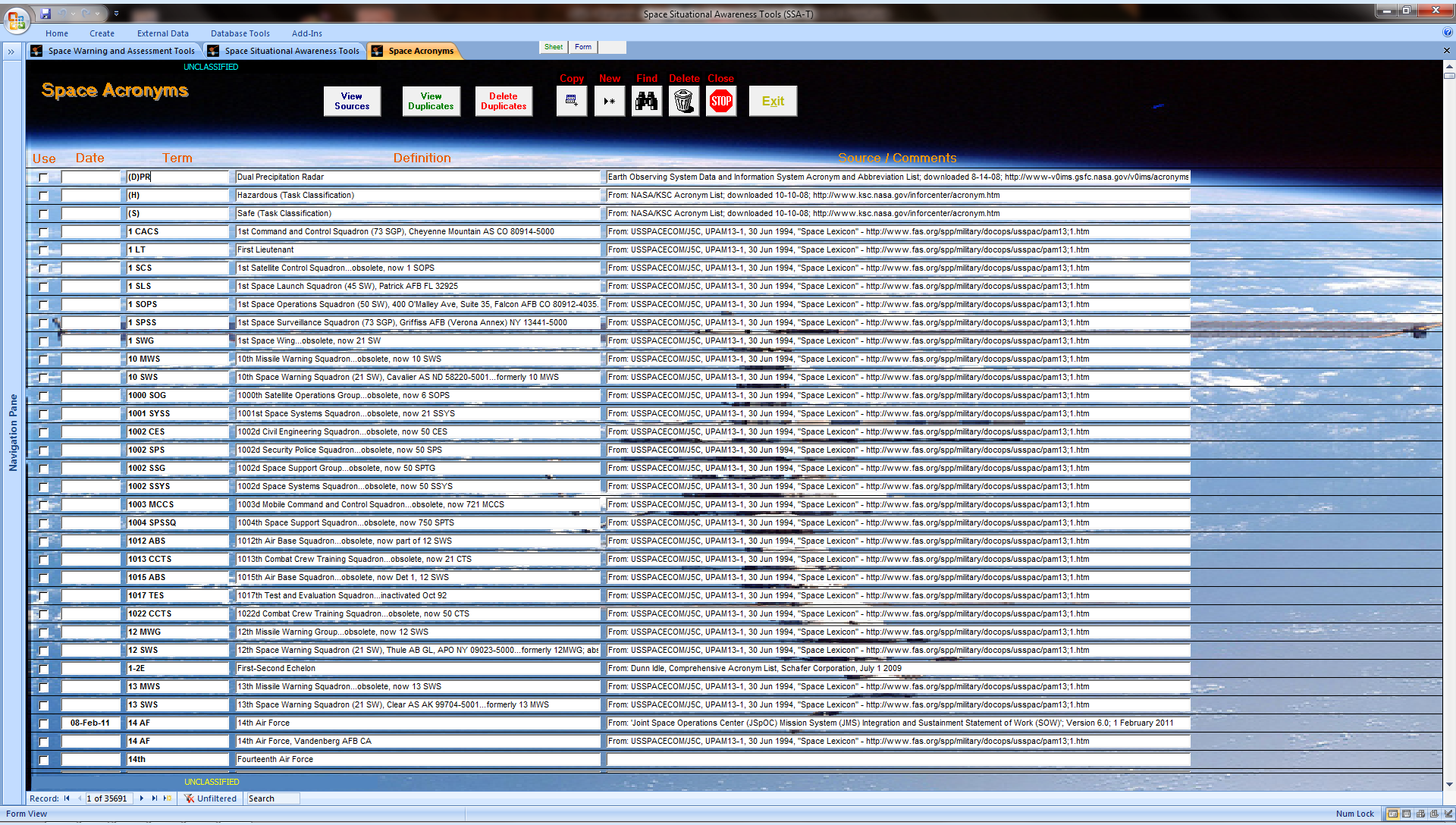


Automatically Ranked According to SSA Priorities

Blue-Side External Information or Support Request Form

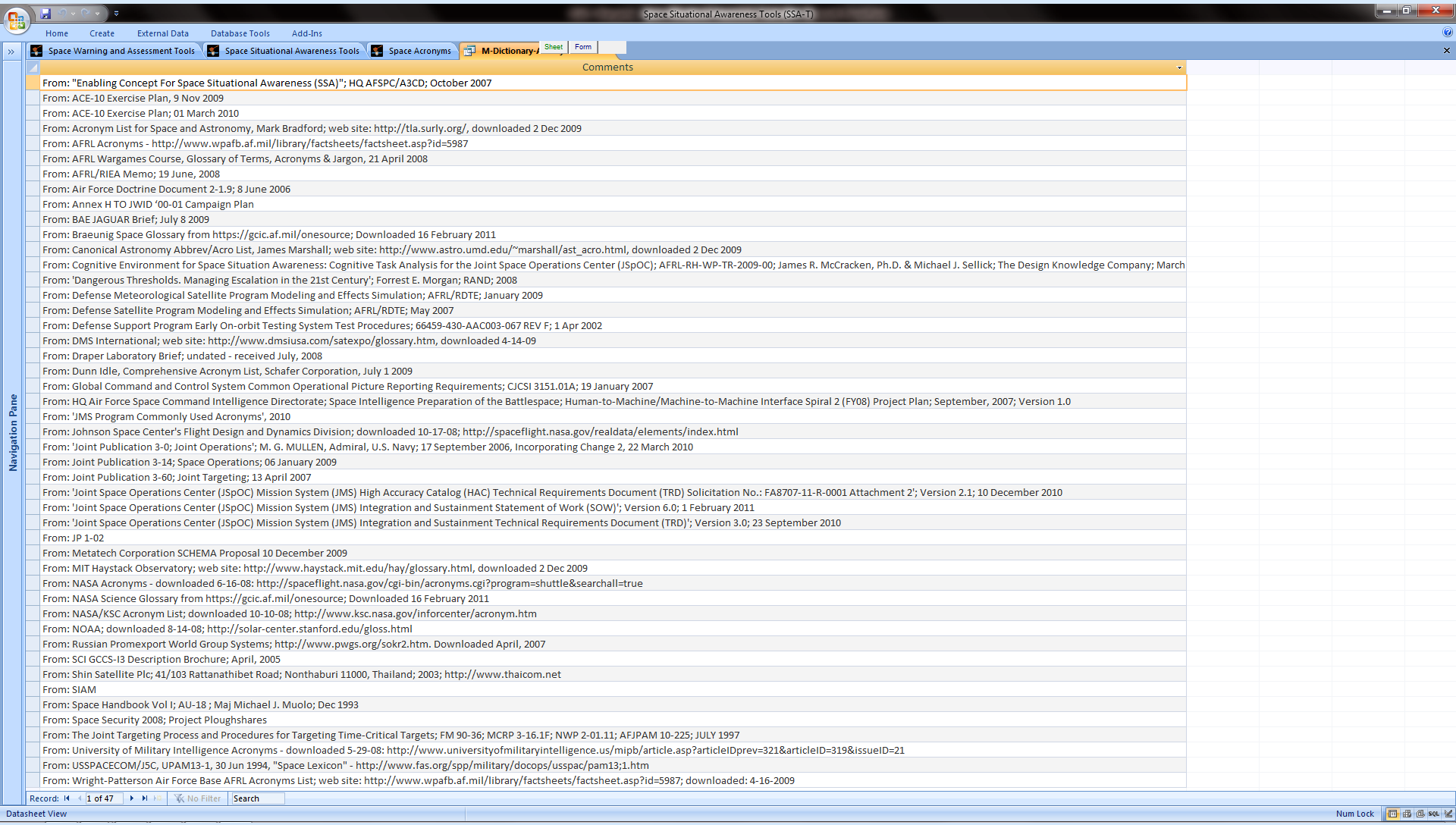
Additional Space Warfare Support Tools

Space Acronym Definitions



Important to Get Future Space Warfare Definitions Correct

Space Acronym Data Sources



Comments
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Future Space Warfare Data Sources

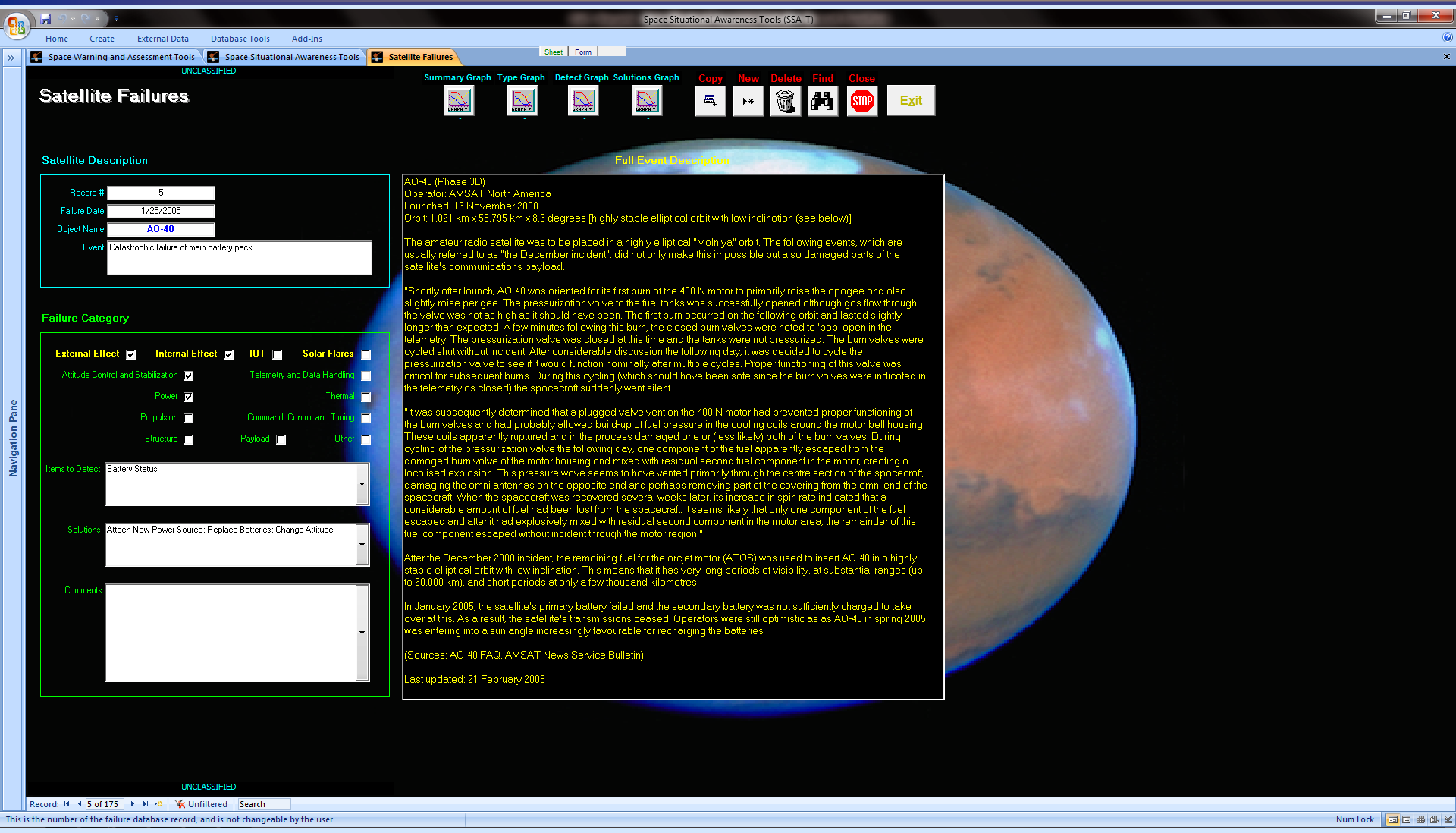
Future Space Warfare Doctrine Definitions

Important to Get Future Space Warfare Concepts Defined

Satellite Failures and Potential Fixes Database

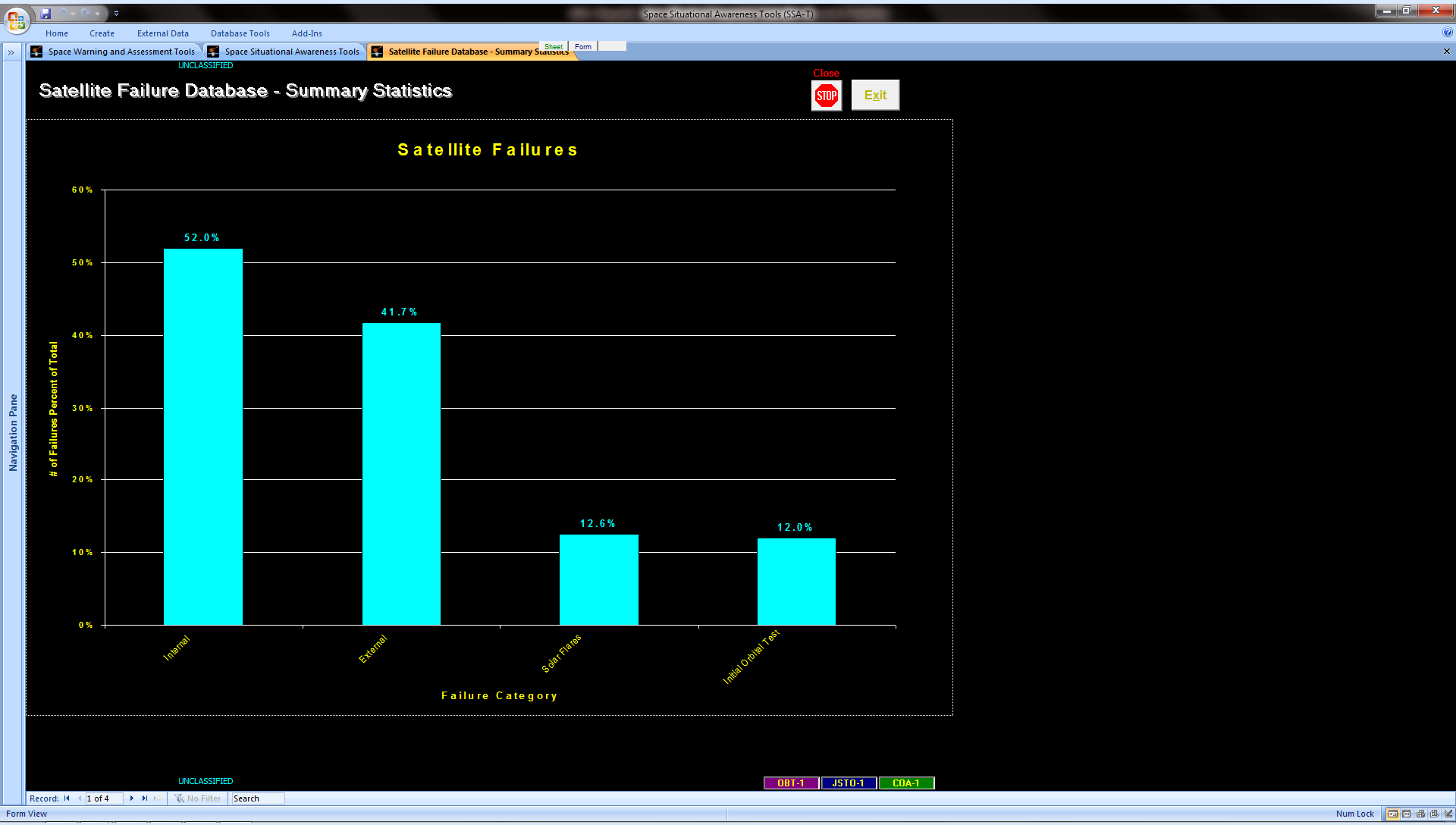
Enables Warfighters to Better Understand Whether Satellite Failures are Natural, Intentional or Accidental

Satellite Failures Database



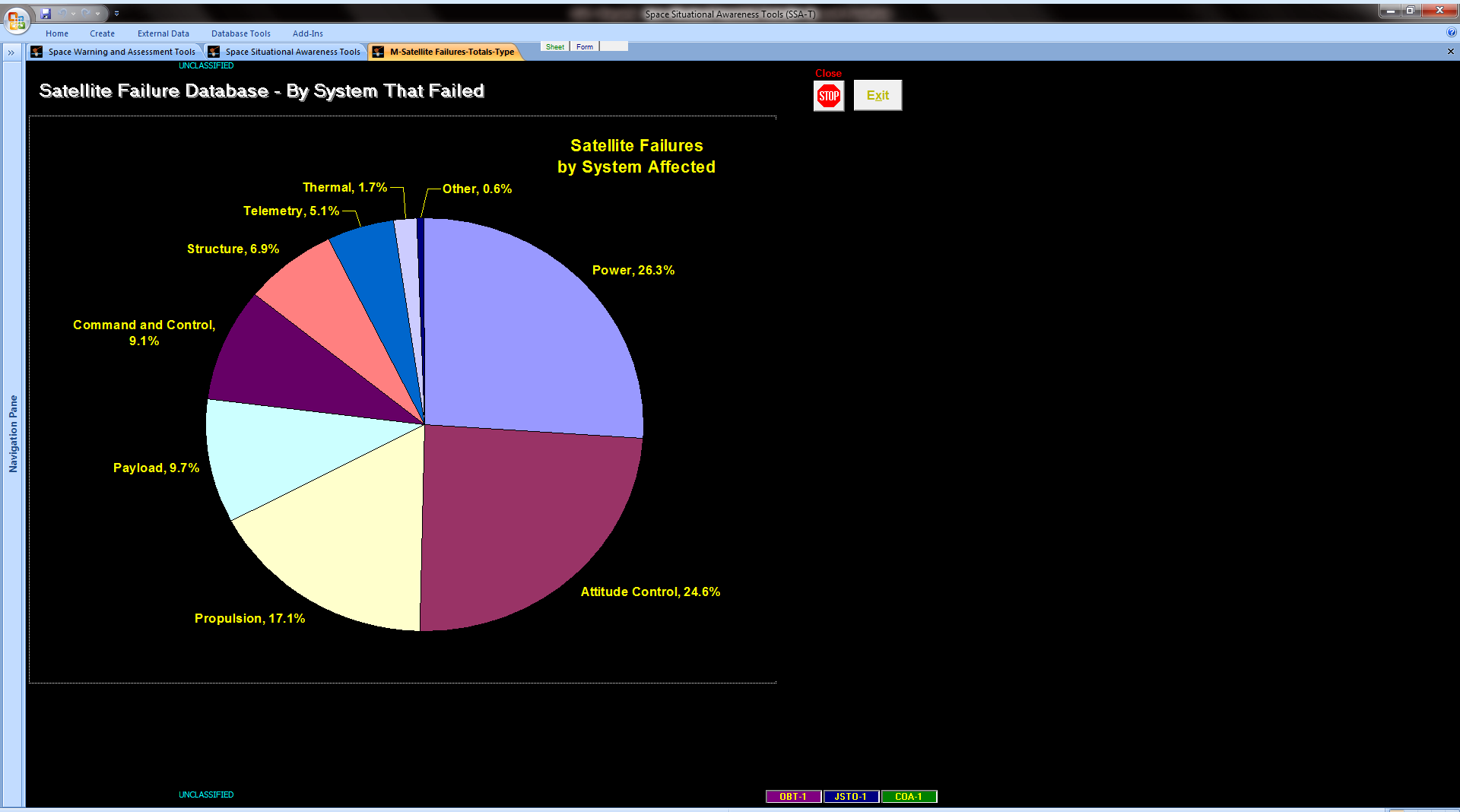
Detailed List of Commercial Satellite Failures

Satellite Failures Database Statistics (1)



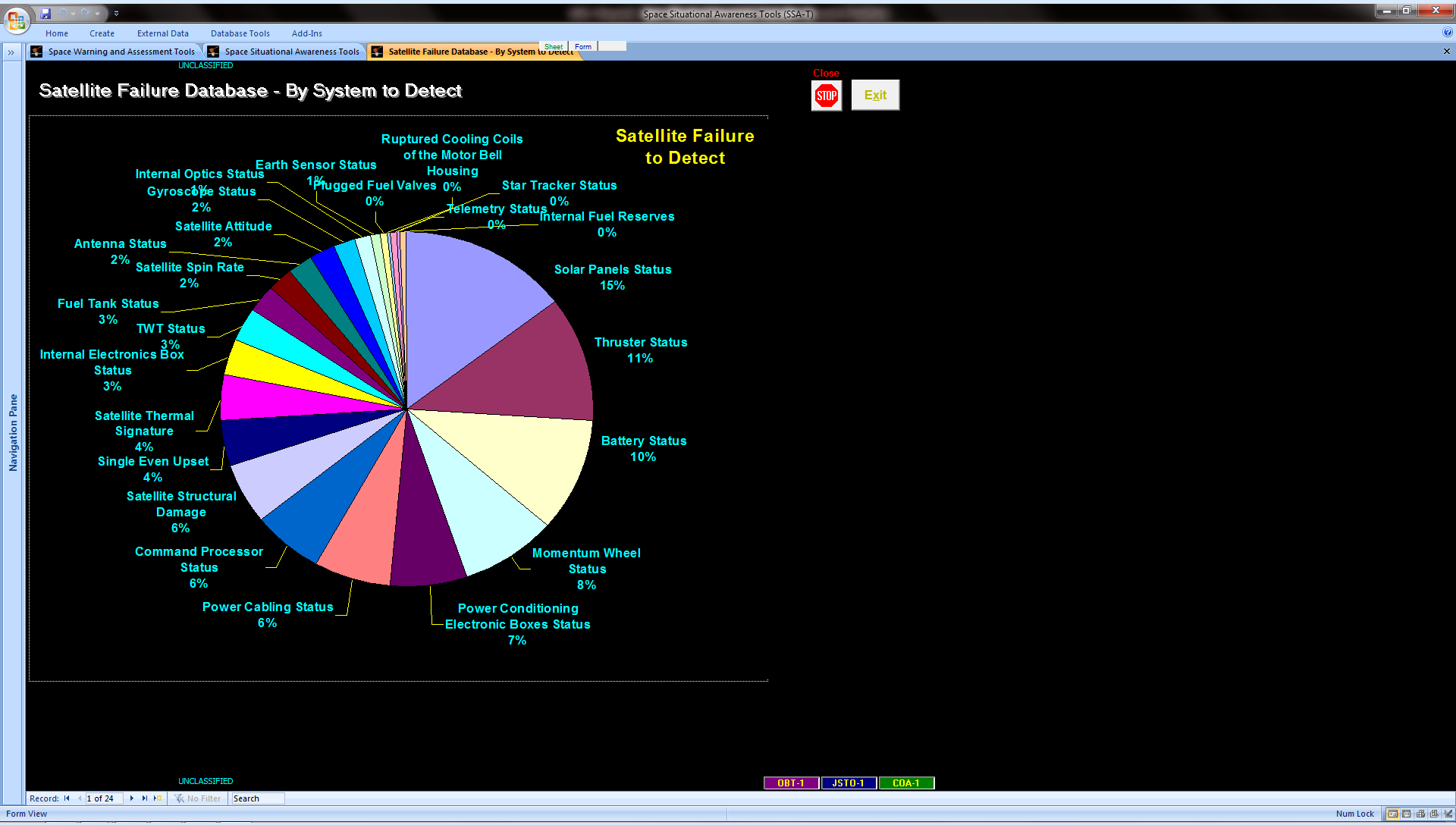
Commercial Satellite Failure Statistics by Category

Satellite Failures Database Statistics (2)



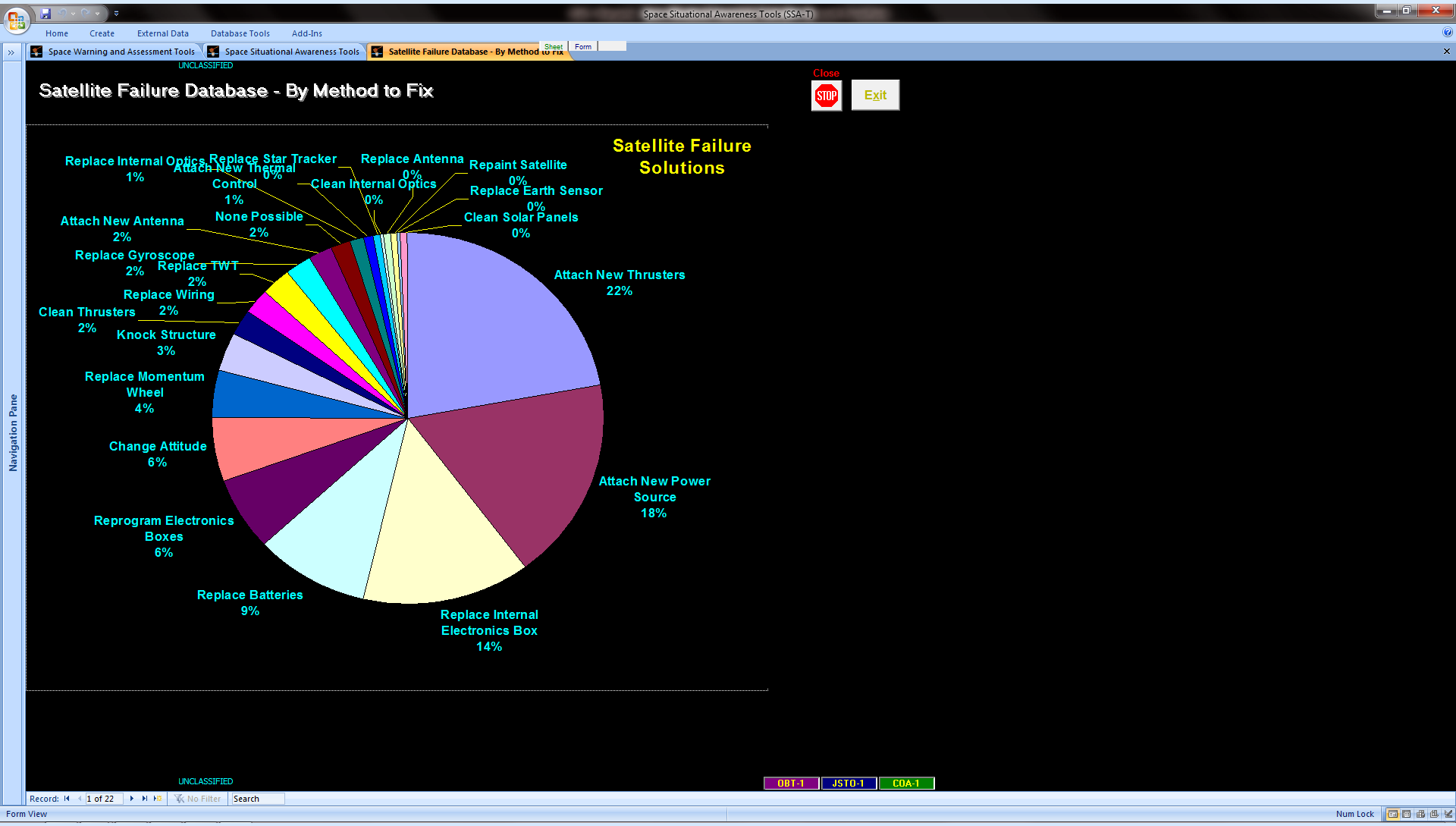
Commercial Satellite Failure Statistics by System

Satellite Failures Database Statistics (3)



Commercial Satellite Failure Statistics by System – How to Detect

Satellite Failures Database Statistics (4)

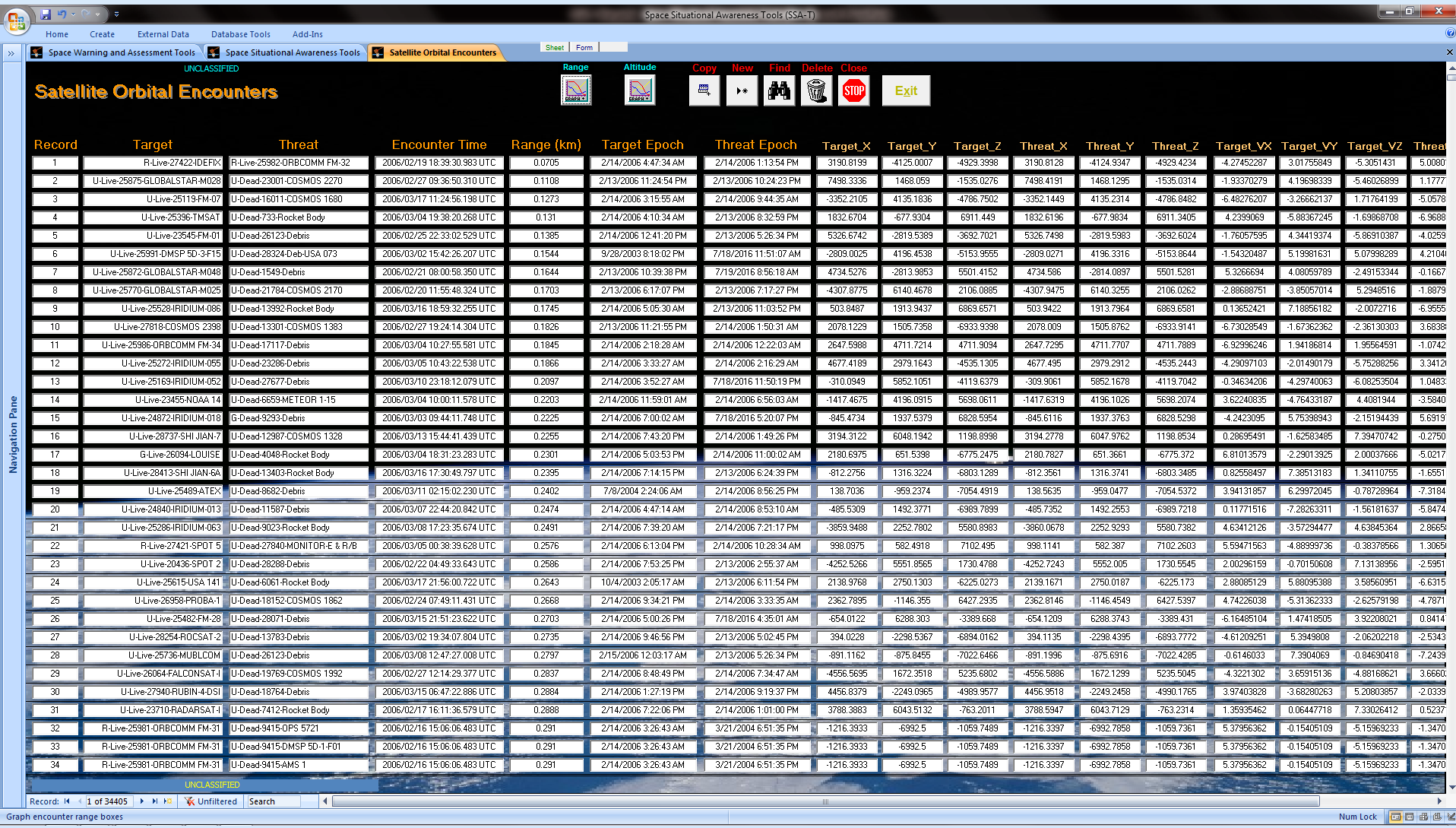


Commercial Satellite Failure Statistics by System – How to Fix

Statistics of Natural Close Approaches Between Space Objects

Statistics on How Often do Space Objects Naturally Approach Each Other Without Willful Intent

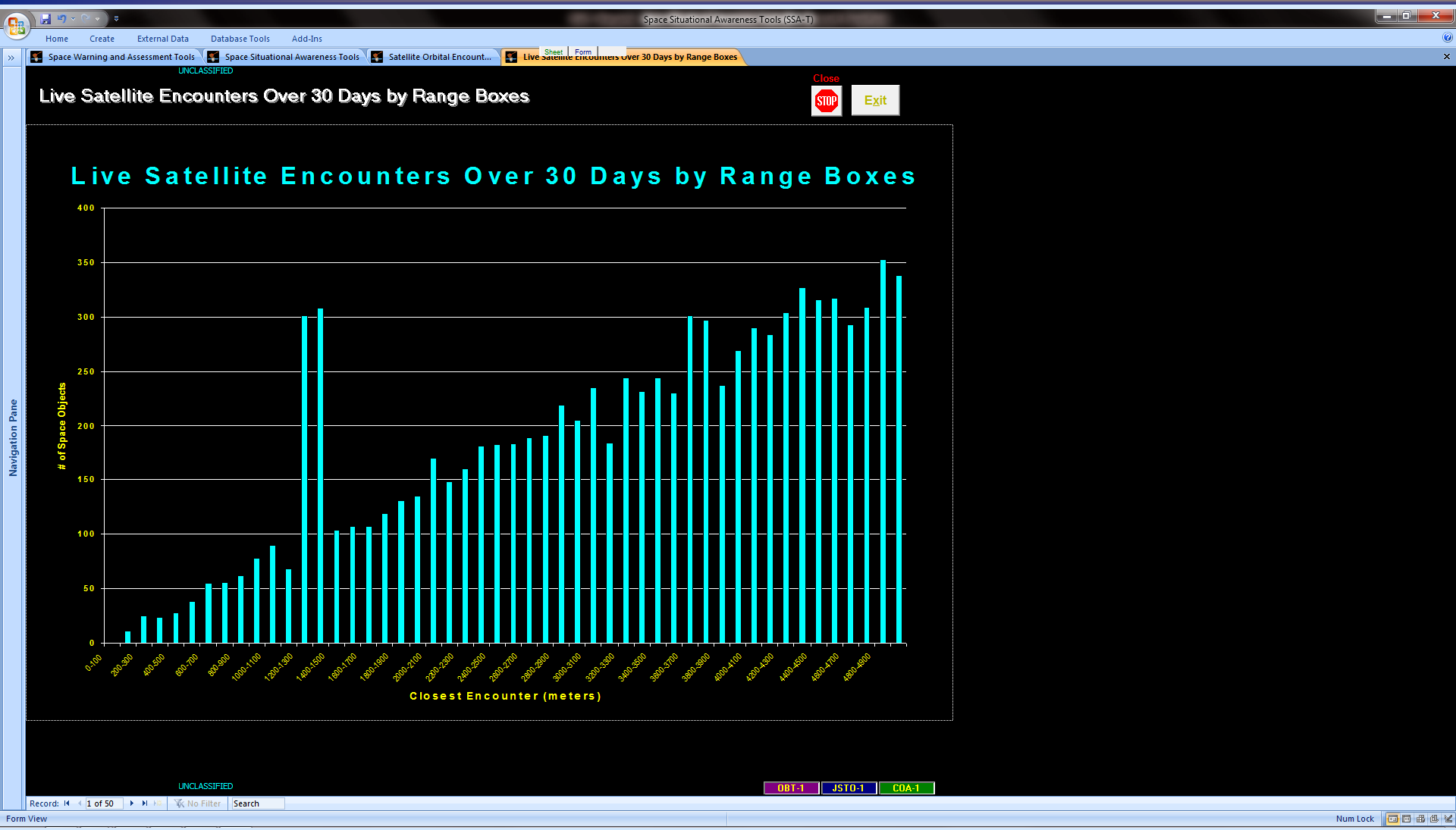
Typical Satellite Encounters



Record	Target	Threat	Encounter Time	Range (km)	Target Epoch	Threat Epoch	Target_X	Target_Y	Target_Z	Threat_X	Threat_Y	Threat_Z	Target_VX	Target_VY	Target_VZ	Threat
1	R-Live-27422-IDEFIX	R-Live-25982-ORBCOMM FM-32	2006/02/19 18:39:30.983 UTC	0.0705	2/14/2006 4:47:34 AM	2/14/2006 1:13:54 PM	3190.8199	-4125.0007	-4929.3998	3190.8128	-4124.9347	-4929.4234	-4.27452287	3.01755849	-5.3051431	5.0080
2	U-Live-25875-GLOBALSTAR-M028	U-Dead-23001-COSMOS 2270	2006/02/27 09:36:50.310 UTC	0.1108	2/13/2006 11:24:54 PM	2/13/2006 10:24:23 PM	7498.3336	1468.059	-1535.0276	7498.4191	1468.1295	-1535.0314	-1.93370279	4.19698339	-5.46026899	1.1777
3	U-Live-25119-FM-07	U-Dead-16011-COSMOS 1680	2006/03/17 11:24:56.198 UTC	0.1273	2/14/2006 3:15:55 AM	2/14/2006 9:44:35 AM	-3352.2105	4135.1836	-4786.7502	-3352.1449	4135.2314	-4786.8482	-6.48276207	-3.26662137	1.71764199	-5.0578
4	U-Live-25396-TMSAT	U-Dead-733-Rocket Body	2006/03/04 19:38:20.268 UTC	0.131	2/14/2006 4:10:34 AM	2/13/2006 8:32:59 PM	1832.6704	-677.9304	6911.449	1832.6196	-677.9834	6911.3405	4.2399069	-5.88367245	-1.69868708	-6.9688
5	U-Live-23545-FM-01	U-Dead-26123-Debris	2006/02/25 22:33:02.529 UTC	0.1385	2/14/2006 12:41:20 PM	2/13/2006 5:26:34 PM	5326.6742	-2819.5389	-3692.7021	5326.7498	-2819.5983	-3692.6024	-1.76057595	4.34419374	-5.86910387	-4.0259
6	U-Live-25991-DMSP 5D-3-F15	U-Dead-28324-Deb-USA 073	2006/03/02 15:42:26.207 UTC	0.1544	9/28/2003 8:18:02 PM	7/18/2016 11:51:07 AM	-2809.0025	4196.4538	-5153.9555	-2809.0271	4196.3316	-5153.8644	-1.54320487	5.19981631	5.07998289	4.2104
7	U-Live-25872-GLOBALSTAR-M049	U-Dead-1549-Debris	2006/02/21 08:00:58.350 UTC	0.1644	2/13/2006 10:39:38 PM	7/19/2016 8:56:18 AM	4734.5276	-2813.9853	5501.4152	4734.586	-2814.0897	5501.5281	5.3266694	4.08059789	-2.49153344	-0.1667
8	U-Live-25770-GLOBALSTAR-M025	U-Dead-21784-COSMOS 2170	2006/02/20 11:55:48.324 UTC	0.1703	2/13/2006 6:17:07 PM	2/13/2006 7:17:27 PM	-4307.8775	6140.4678	2106.0885	-4307.9475	6140.3255	2106.0262	-2.88688751	-3.85057014	5.2948516	-1.8879
9	U-Live-25528-IRIDIUM-086	U-Dead-13992-Rocket Body	2006/03/16 18:59:32.255 UTC	0.1745	2/14/2006 5:05:30 AM	2/13/2006 11:03:52 PM	503.8487	1913.9437	6869.6571	503.9422	1913.7964	6869.6581	0.13652421	7.18856182	-2.0072716	-6.9555
10	U-Live-27818-COSMOS 2398	U-Dead-13301-COSMOS 1383	2006/02/27 19:24:14.304 UTC	0.1826	2/13/2006 11:21:55 PM	2/14/2006 1:50:31 AM	2078.1229	1505.7358	-6933.9398	2078.009	1505.8762	-6933.9141	-6.73028549	-1.67362362	-2.36130303	3.6838
11	U-Live-25986-ORBCOMM FM-34	U-Dead-17117-Debris	2006/03/04 10:27:55.581 UTC	0.1845	2/14/2006 2:18:28 AM	2/14/2006 12:22:03 AM	2647.5988	4711.7214	4711.9094	2647.7295	4711.7707	4711.7889	-6.92996246	1.94186814	1.95564591	-1.0742
12	U-Live-25272-IRIDIUM-055	U-Dead-23286-Debris	2006/03/05 10:43:22.538 UTC	0.1866	2/14/2006 3:33:27 AM	2/14/2006 2:16:29 AM	4677.4189	2979.1643	-4535.1305	4677.495	2979.2912	-4535.2443	-4.29097103	-2.01490179	-5.75288256	3.3412
13	U-Live-25169-IRIDIUM-052	U-Dead-27677-Debris	2006/03/10 23:18:12.079 UTC	0.2097	2/14/2006 3:52:27 AM	7/18/2016 11:50:19 PM	-310.0949	5852.1051	-4119.6379	-309.9061	5852.1678	-4119.7042	-0.34634206	-4.29740063	-6.08253504	1.0483
14	U-Live-23455-NOAA 14	U-Dead-6659-METEOR 1-15	2006/03/04 10:00:11.578 UTC	0.2203	2/14/2006 11:59:01 AM	2/14/2006 6:56:03 AM	-1417.4675	4196.0915	5698.0611	-1417.6319	4196.1026	5698.2074	3.62240835	-4.76433187	4.4081944	-3.5840
15	U-Live-24872-IRIDIUM-018	G-Dead-9293-Debris	2006/03/03 09:44:11.748 UTC	0.2225	2/14/2006 7:00:02 AM	7/18/2016 5:20:07 PM	-845.4734	1937.5379	6828.5954	-845.6116	1937.3763	6828.5298	-4.2423095	5.75398943	-2.15194439	5.6919
16	U-Live-28737-SHI JIAN-7	U-Dead-12987-COSMOS 1328	2006/03/13 15:44:41.439 UTC	0.2255	2/14/2006 7:43:20 PM	2/14/2006 1:49:26 PM	3194.3122	6048.1942	1198.8998	3194.2778	6047.9762	1198.8534	0.28695491	-1.62583485	7.39470742	-0.2750
17	G-Live-26094-LOUISE	U-Dead-4048-Rocket Body	2006/03/04 18:31:23.283 UTC	0.2301	2/14/2006 5:03:53 PM	2/14/2006 11:00:02 AM	2180.6975	651.5398	-6775.2475	2180.7827	651.3661	-6775.372	6.81013579	-2.29013925	2.00037666	-5.0217
18	U-Live-28413-SHI JIAN-6A	U-Dead-13403-Rocket Body	2006/03/16 17:30:49.797 UTC	0.2395	2/14/2006 7:14:15 PM	2/13/2006 6:24:39 PM	-812.2756	1316.3224	-6803.1289	-812.3561	1316.3741	-6803.3485	0.82558497	7.38513183	1.34110755	-1.6551
19	U-Live-25489-ATEX	U-Dead-8682-Debris	2006/03/11 02:15:02.230 UTC	0.2402	7/8/2004 2:24:06 AM	2/14/2006 8:56:25 PM	138.7036	-959.2374	-7054.4919	138.5635	-959.0477	-7054.5372	3.94131857	6.29972045	-0.78728964	-7.3184
20	U-Live-24840-IRIDIUM-013	U-Dead-11587-Debris	2006/03/07 22:44:20.842 UTC	0.2474	2/14/2006 4:47:14 AM	2/14/2006 8:53:10 AM	-485.5309	1492.3771	-6989.7899	-485.7352	1492.2553	-6989.7218	0.11771516	-7.28263311	-1.56181637	-5.8474
21	U-Live-25286-IRIDIUM-063	U-Dead-9023-Rocket Body	2006/03/08 17:23:35.674 UTC	0.2491	2/14/2006 7:39:20 AM	2/14/2006 7:21:17 PM	-3859.9488	2252.7802	5580.8983	-3860.0678	2252.9293	5580.7382	4.63412126	-3.57294477	4.63845364	2.8665
22	R-Live-27421-SPOT 5	U-Dead-27840-MONITOR-E & R/B	2006/03/05 00:38:39.628 UTC	0.2576	2/14/2006 6:13:04 PM	2/14/2006 10:28:34 AM	998.0975	582.4918	7102.495	998.1141	582.387	7102.2603	5.59471563	-4.88999736	-0.38378566	1.3065
23	U-Live-20436-SPOT 2	U-Dead-28288-Debris	2006/02/22 04:49:33.643 UTC	0.2586	2/14/2006 7:53:25 PM	2/13/2006 2:55:37 AM	-4252.5266	5551.8565	1730.4788	-4252.7243	5552.005	1730.5545	2.00296159	-0.70150608	7.13138956	-2.5951
24	U-Live-25615-USA 141	U-Dead-6061-Rocket Body	2006/03/17 21:56:00.722 UTC	0.2643	10/4/2003 2:05:17 AM	2/13/2006 6:11:54 PM	2138.9768	2750.1303	-6225.0273	2139.1671	2750.0187	-6225.173	2.88085129	5.88095388	3.58560951	-6.6315
25	U-Live-26958-PROBA-1	U-Dead-18152-COSMOS 1862	2006/02/24 07:49:11.431 UTC	0.2668	2/14/2006 9:34:21 PM	2/14/2006 3:33:35 AM	2362.7895	-1146.355	6427.2935	2362.8146	-1146.4549	6427.5397	4.74226038	-5.31362333	-2.62579198	-4.7871
26	U-Live-25482-FM-28	U-Dead-28071-Debris	2006/03/15 21:51:23.622 UTC	0.2703	2/14/2006 5:00:26 PM	7/18/2016 4:35:01 AM	-654.0122	6288.303	-3389.668	-654.1209	6288.3743	-3389.431	-6.16485104	1.47418505	3.92208021	0.8414
27	U-Live-28254-ROCSAT-2	U-Dead-13783-Debris	2006/03/02 19:34:07.804 UTC	0.2735	2/14/2006 9:46:56 PM	2/13/2006 5:02:45 PM	394.0228	-2298.5367	-6894.0162	394.1135	-2298.4395	-6893.7772	-4.61209251	5.3949808	-2.06202218	-2.5343
28	U-Live-25736-MUBLCOM	U-Dead-26123-Debris	2006/03/08 12:47:27.008 UTC	0.2797	2/15/2006 12:03:17 AM	2/13/2006 5:26:34 PM	-891.1162	-875.8455	-7022.6466	-891.1996	-875.6916	-7022.4285	-0.6146033	7.3904069	-0.84690418	-7.2439
29	U-Live-26064-FALCONSAT-I	U-Dead-19769-COSMOS 1992	2006/02/27 12:14:29.377 UTC	0.2837	2/14/2006 8:48:49 PM	2/14/2006 7:34:47 AM	-4556.5695	1672.3518	5235.6802	-4556.5886	1672.1299	5235.5045	-4.3221302	3.65915136	-4.88168621	3.6660
30	U-Live-27940-RUBIN-4-DSI	U-Dead-18764-Debris	2006/03/15 06:47:22.886 UTC	0.2884	2/14/2006 1:27:19 PM	2/14/2006 9:19:37 PM	4456.8379	-2249.0965	-4989.9577	4456.9518	-2249.2458	-4990.1765	3.97403828	-3.68280263	5.20803857	-2.0339
31	U-Live-23710-RADARSAT-I	U-Dead-7412-Rocket Body	2006/02/17 16:11:36.579 UTC	0.2888	2/14/2006 7:22:06 PM	2/14/2006 1:01:00 PM	3788.3883	6043.5132	-763.2011	3788.5947	6043.7129	-763.2314	1.35935462	0.06447718	7.33026412	0.5237
32	R-Live-25981-ORBCOMM FM-31	U-Dead-9415-OPS 5721	2006/02/16 15:06:06.483 UTC	0.291	2/14/2006 3:26:43 AM	3/21/2004 6:51:35 PM	-1216.3933	-6992.5	-1059.7489	-1216.3397	-6992.7858	-1059.7361	5.37956362	-0.15405109	-5.15969233	-1.3470
33	R-Live-25981-ORBCOMM FM-31	U-Dead-9415-DMSP 5D-1-F01	2006/02/16 15:06:06.483 UTC	0.291	2/14/2006 3:26:43 AM	3/21/2004 6:51:35 PM	-1216.3933	-6992.5	-1059.7489	-1216.3397	-6992.7858	-1059.7361	5.37956362	-0.15405109	-5.15969233	-1.3470
34	R-Live-25981-ORBCOMM FM-31	U-Dead-9415-AMS 1	2006/02/16 15:06:06.483 UTC	0.291	2/14/2006 3:26:43 AM	3/21/2004 6:51:35 PM	-1216.3933	-6992.5	-1059.7489	-1216.3397	-6992.7858	-1059.7361	5.37956362	-0.15405109	-5.15969233	-1.3470

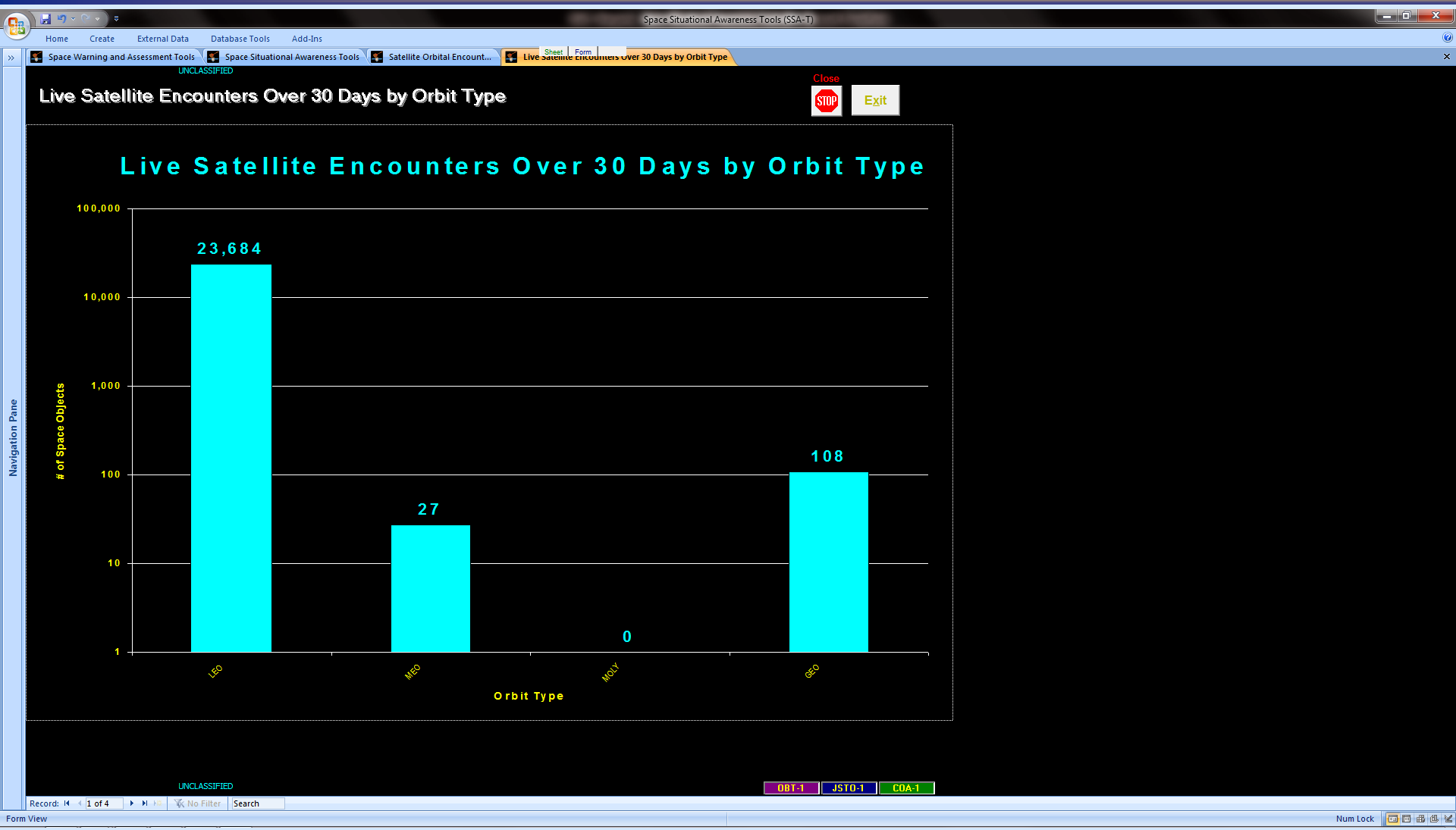
Historical Space Object Close Approach Examples

Typical Satellite Encounters Statistics (1)



Historical Space Object Close Approach Statistics by Closest Range

Typical Satellite Encounters Statistics (2)

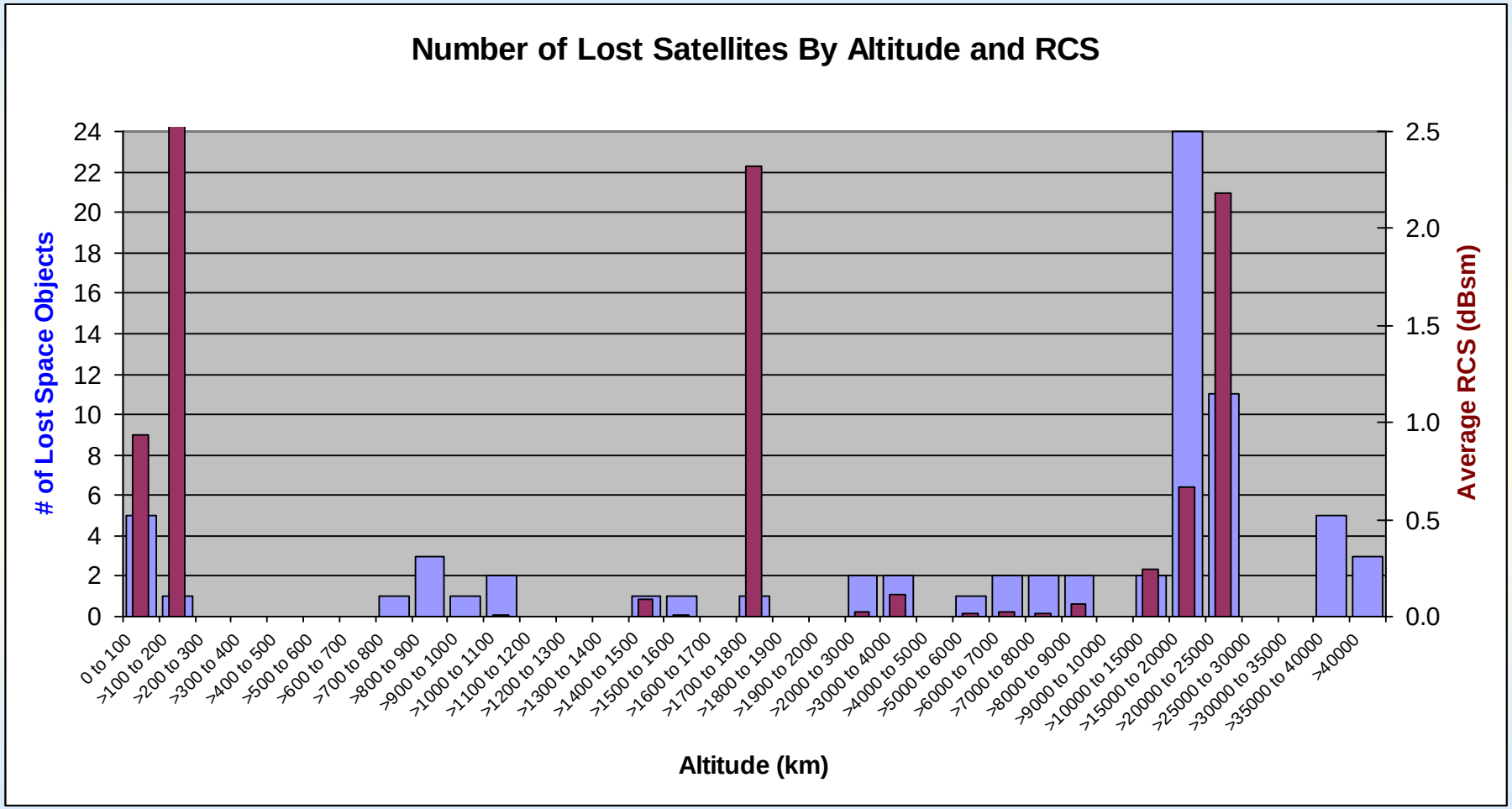


Historical Space Object Close Approach Statistics by Orbital Region

Statistics of Lost Space Objects

How Often does the JSpOC Lose Track of Space Objects

JSpOC Catalog Missing Space Objects

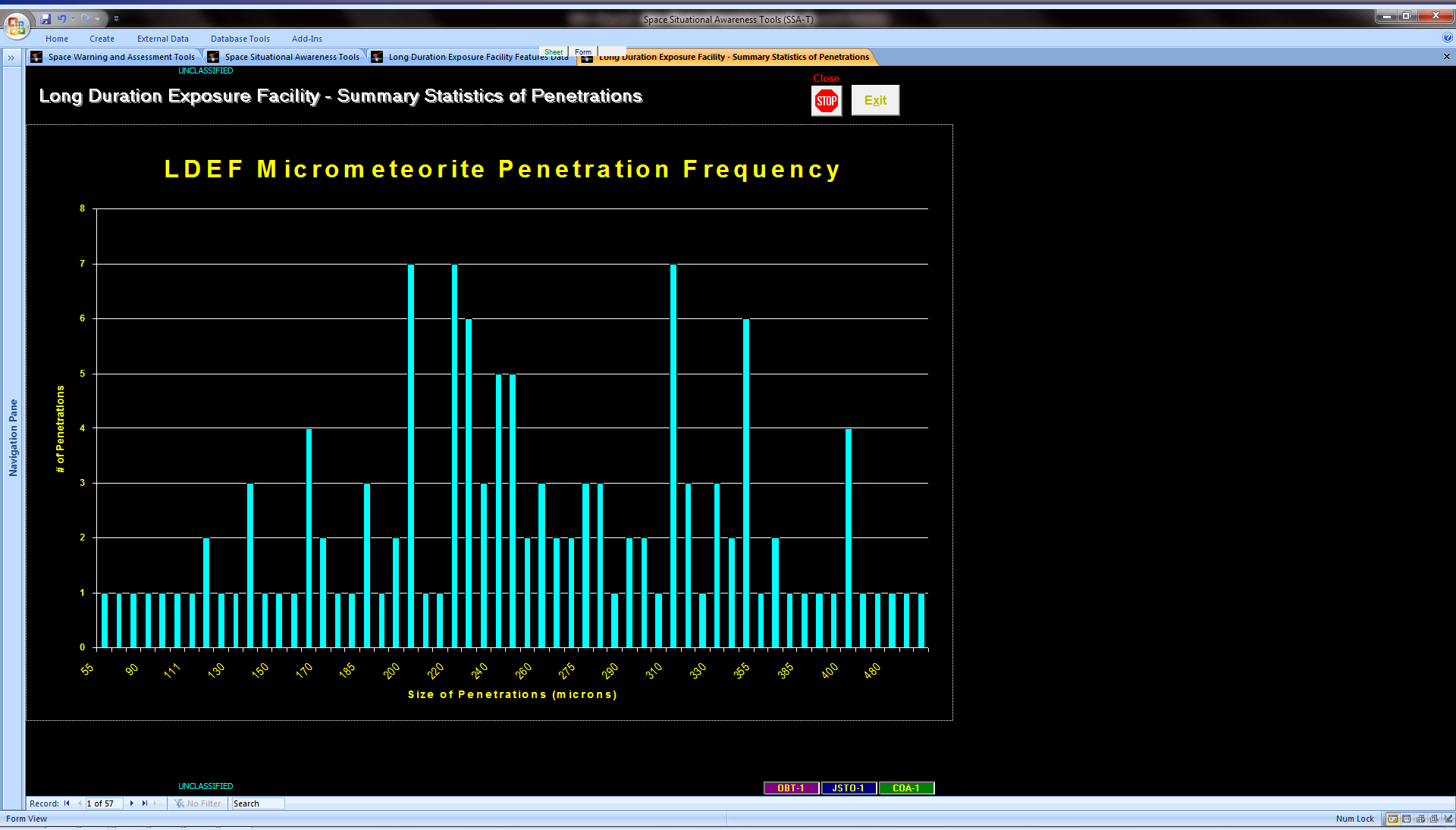


Space Object Tracks are Frequently & Easily Lost

Statistics of Natural Kinetic Penetrations on Typical Satellite Materials

Statistics on How Often Space Objects are Naturally Penetrated by Micrometeorites

LDEF Penetration Size & Frequency



Compares to Kinetic Kill Weapon Attacks

Space Object State Change Algorithms

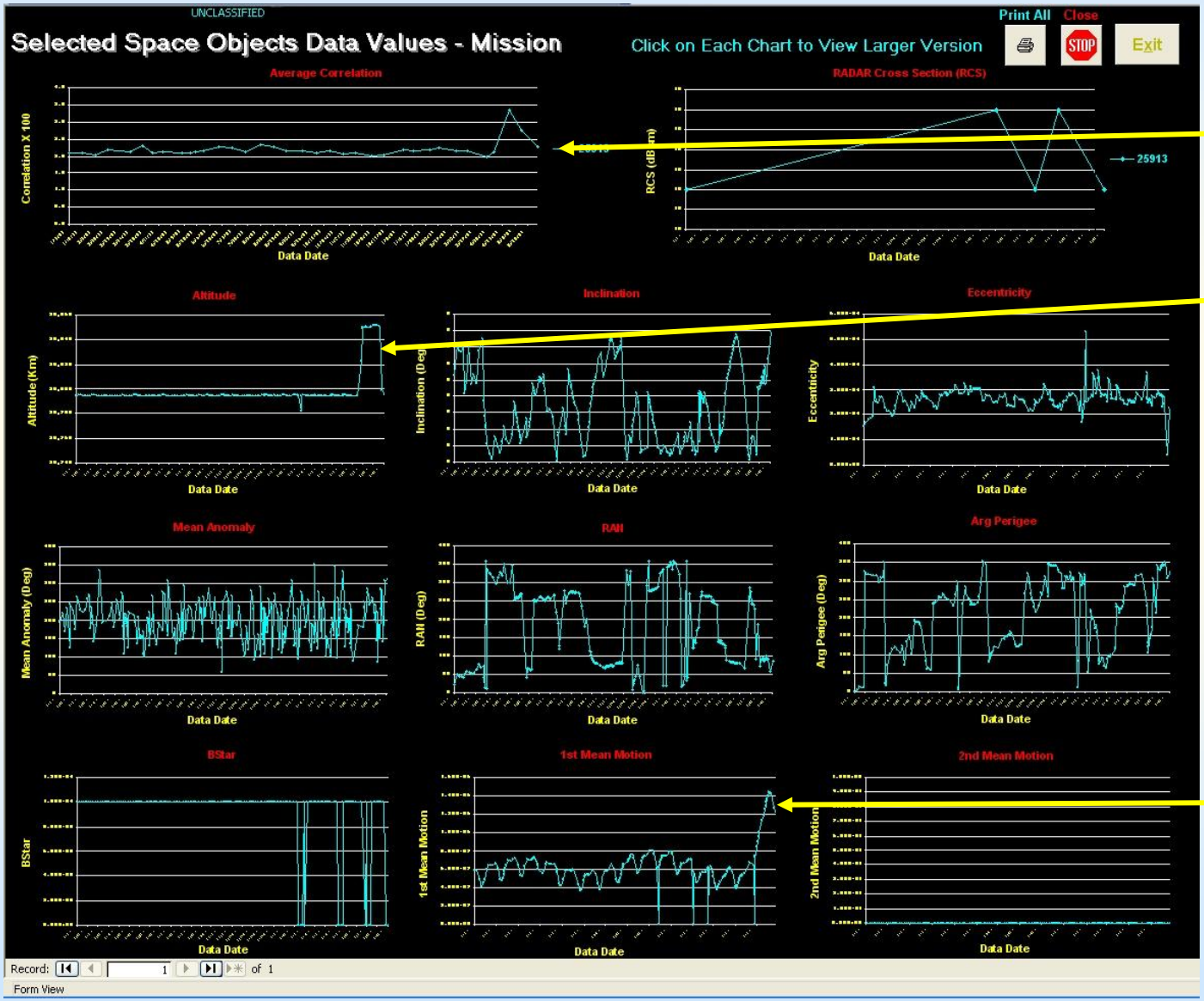
SSA-T Databases

- Space Objects: 37,932 Records
  - Also Includes Decayed Objects
- Orbital Elements: 5.3 Million Records
  - 15 Months of Data Internal to SSA-T
  - All Orbital Data Since 1957 In External Archives
- RADAR Cross Sections: 1.5 Million Records
  - All RCS's for All Space Objects Since 1957
- Satellite Characteristics History: 7.5 Million Records
  - Almost 3 Years History for All Space Objects (Live & Dead)
- Optical Visual Magnitude & Flash Rate: 73 Thousand
- Space Acronyms: 35,542 Records

Example State Changes

- GPS (Verbal Discussion)
- ECHOSTAR 5
- MOLNIYA
- Beidou GEO

ECHOSTAR 5 Maneuver

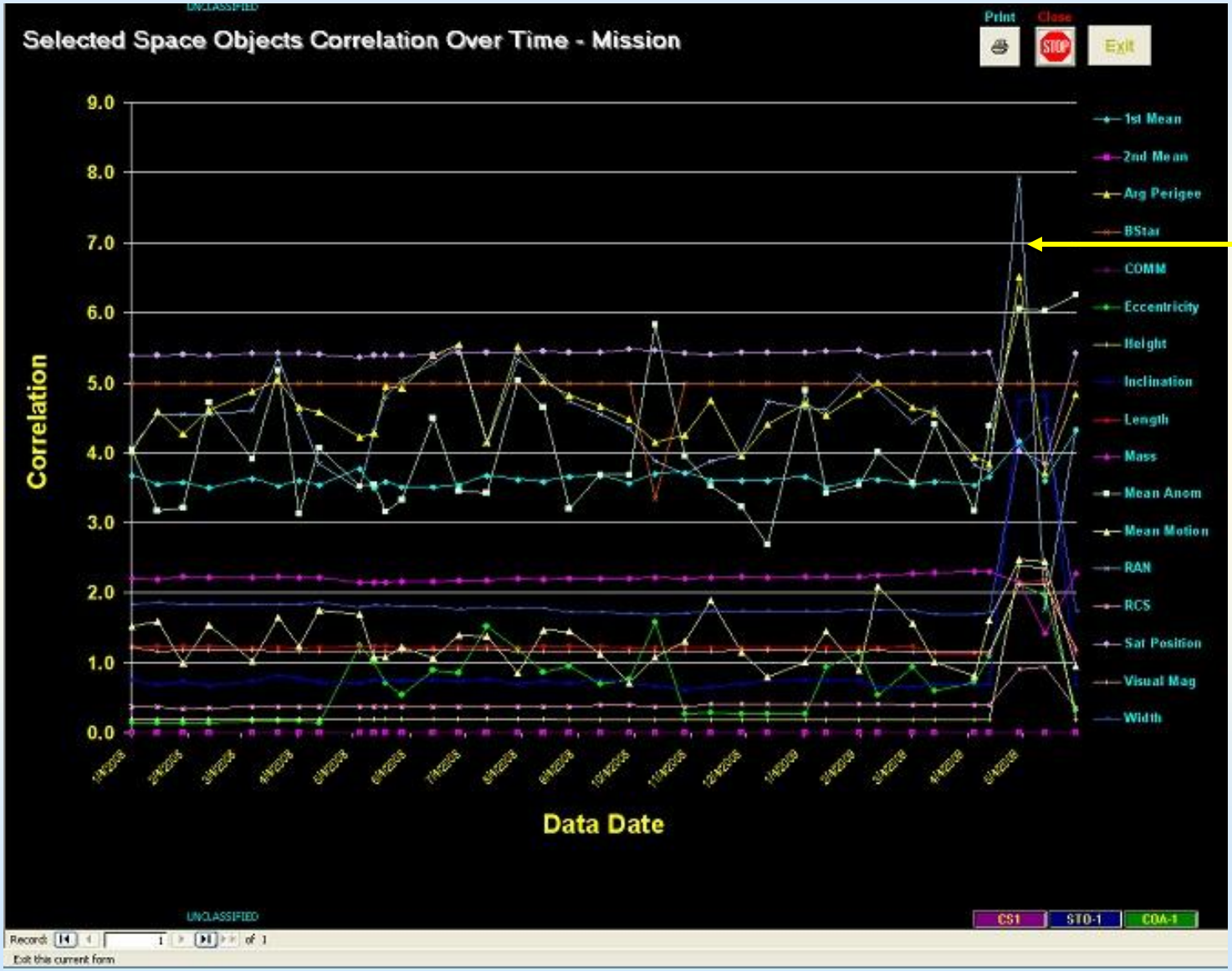


Orbital Maneuver Detected In State Change Algorithms

Orbital Maneuver (57 km)

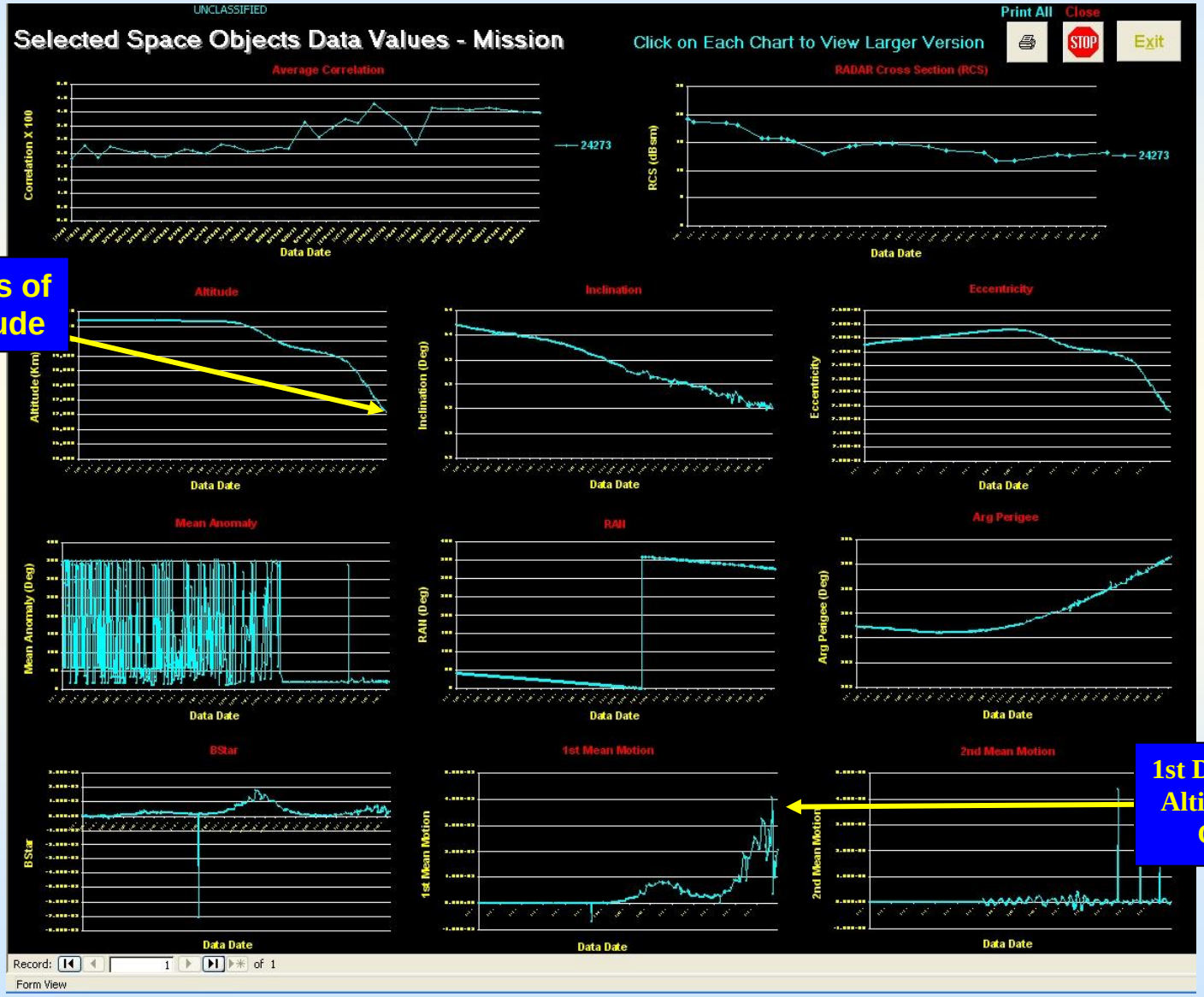
1st Derivative of Altitude Rapid Change

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.

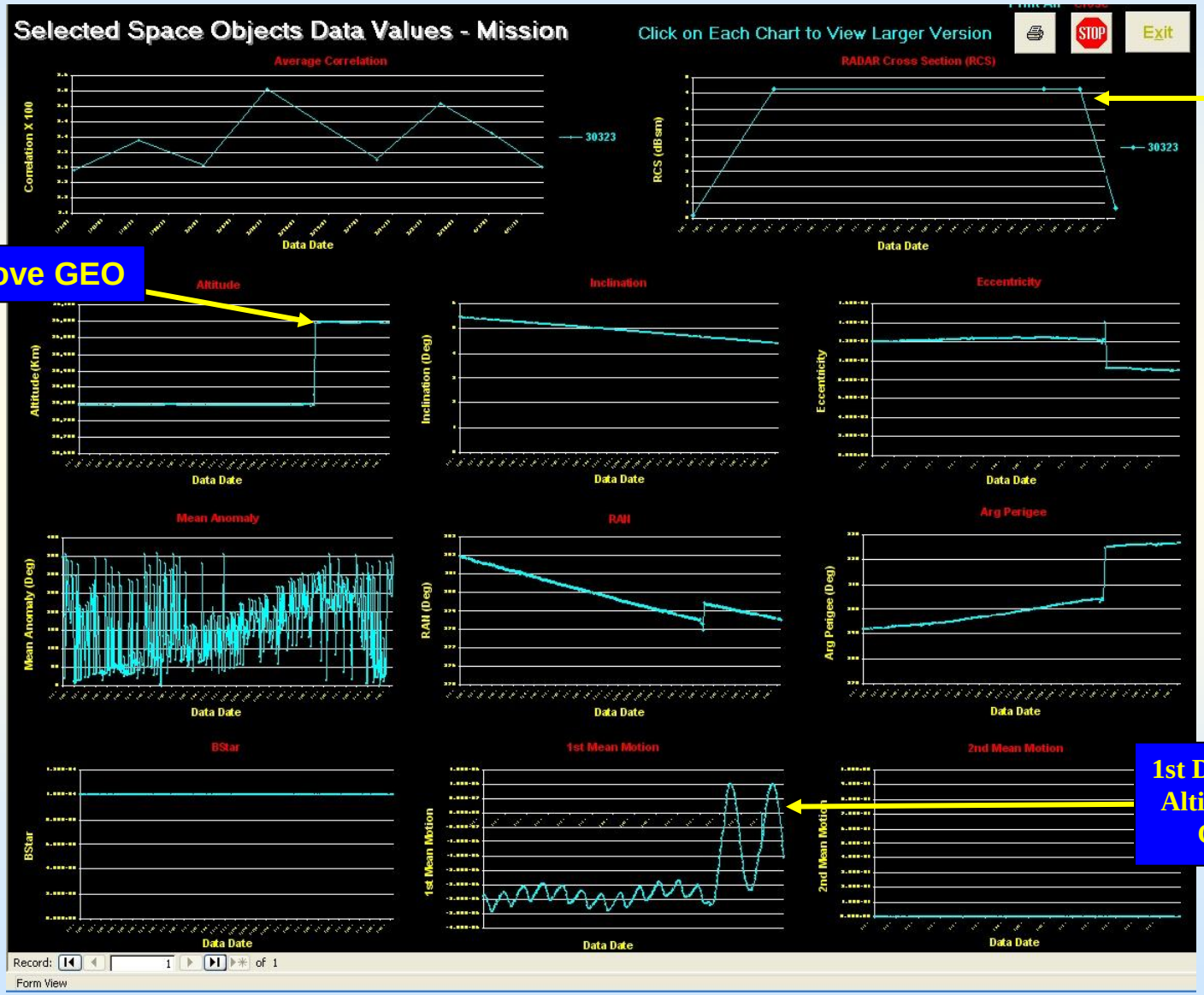
MOLNIYA Decay



3,097 Km Loss of Average Altitude

1st Derivative of Altitude Rapid Changes

Beidou - GEO Maneuver



RCS Changes

251 Km Above GEO

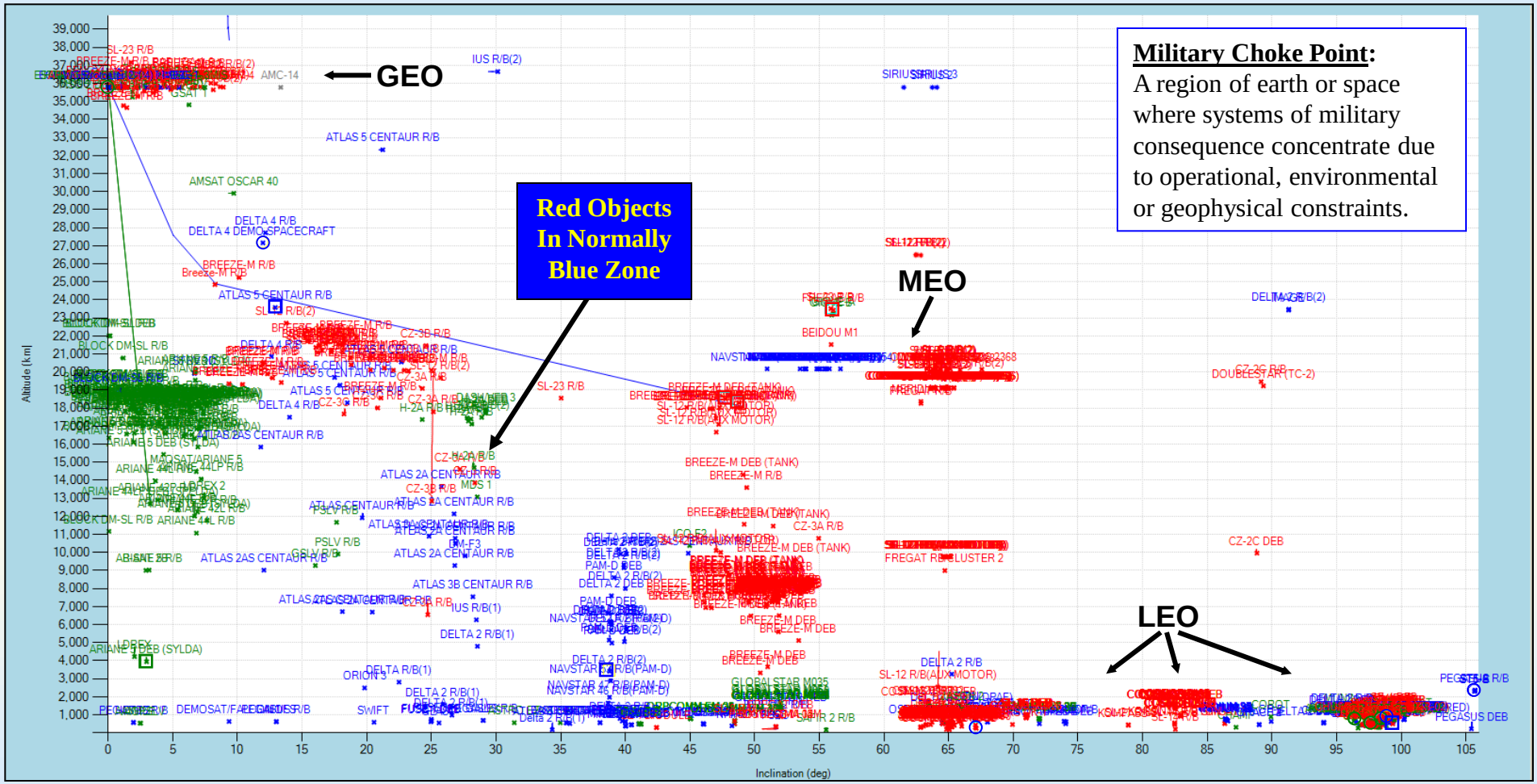
1st Derivative of Altitude Rapid Changes

SSA-T 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
- Success – Working Now & Ready for Operational Evaluation

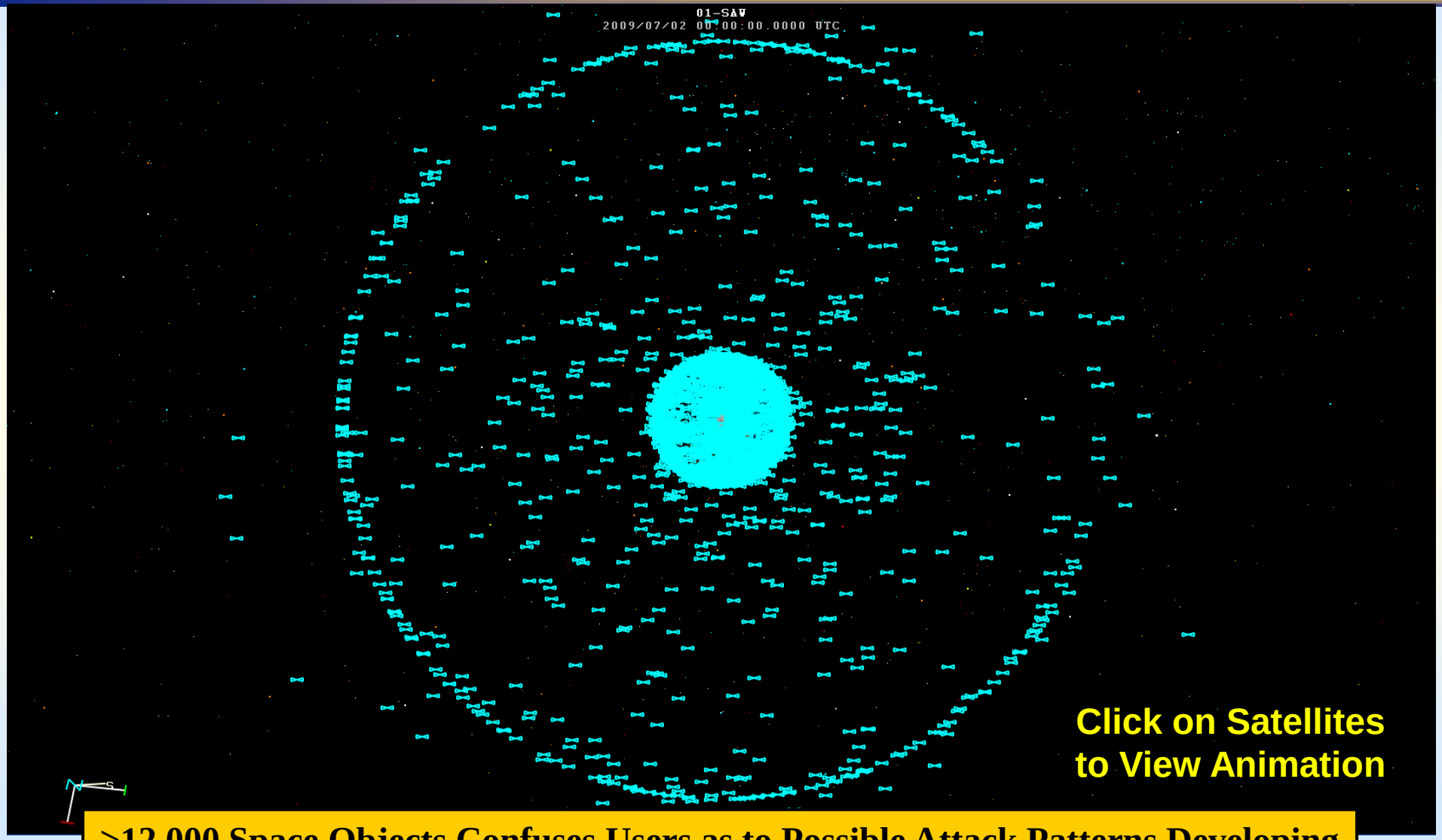
SSA-T Determines If Space Systems Have Changed State – Could Signal an ASAT Attack

Satellite Attack Warning (SAW) – All Altitudes



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

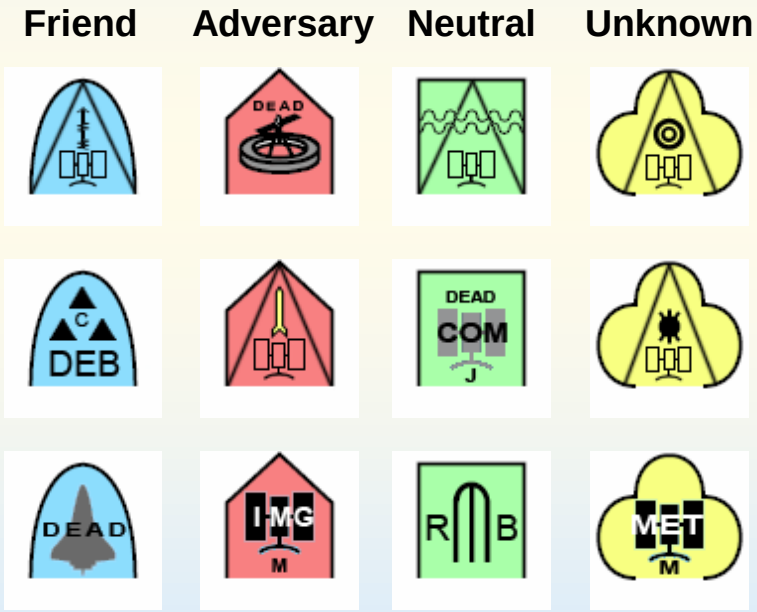
Traditional Orbital View



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

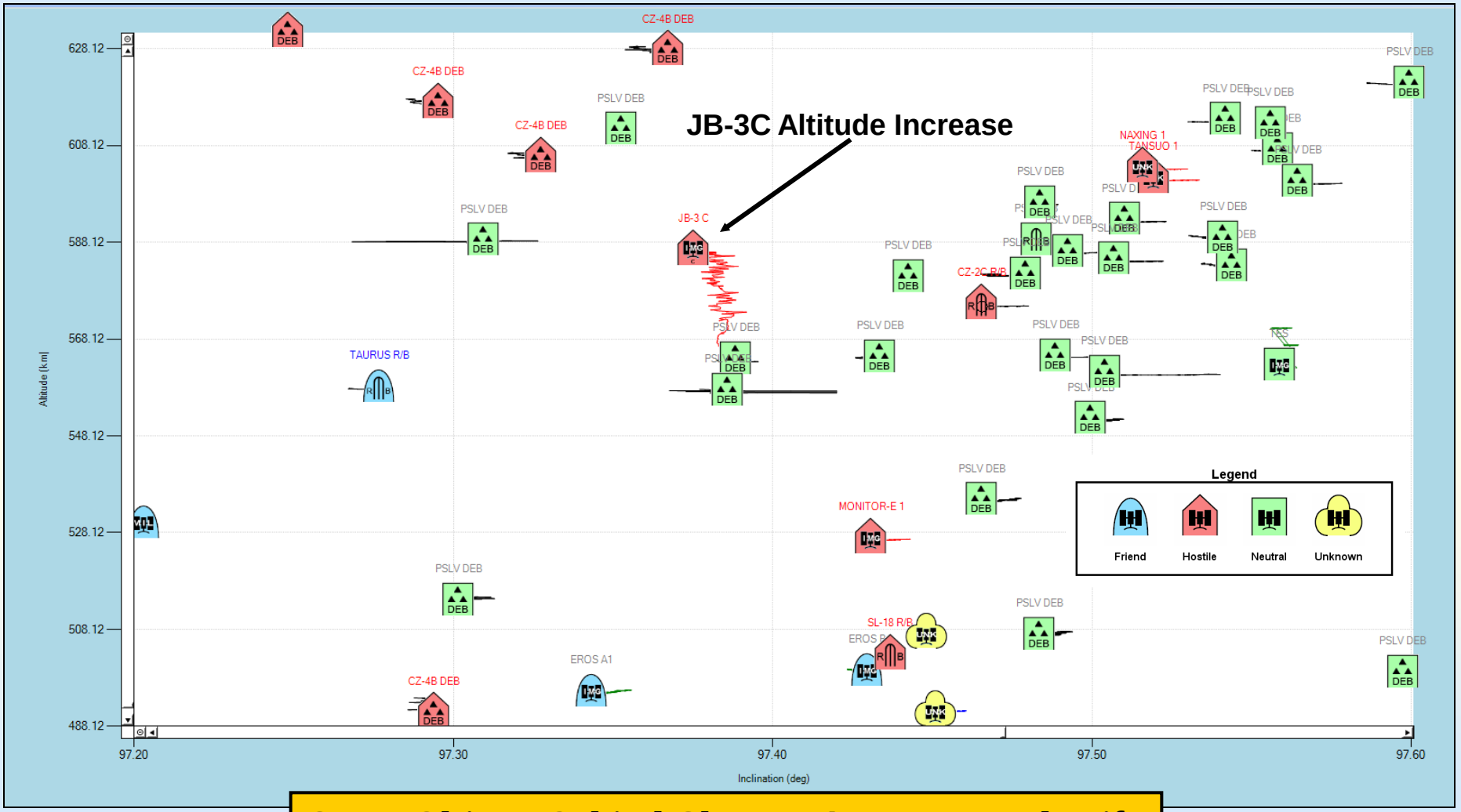
SAW – Icons

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



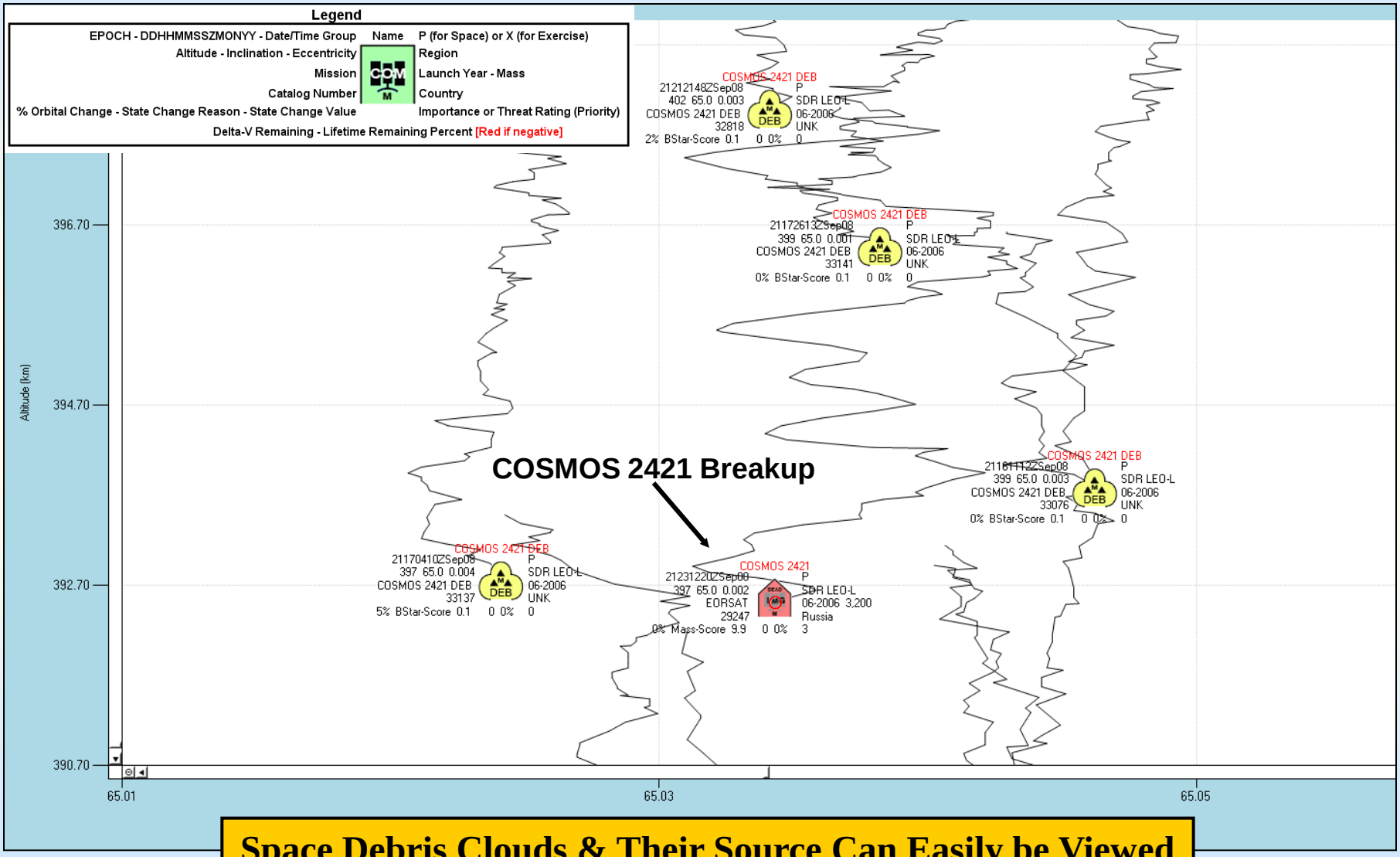
Make SAW Maps Similar to Terrestrial Situation Maps

SAW – View 1



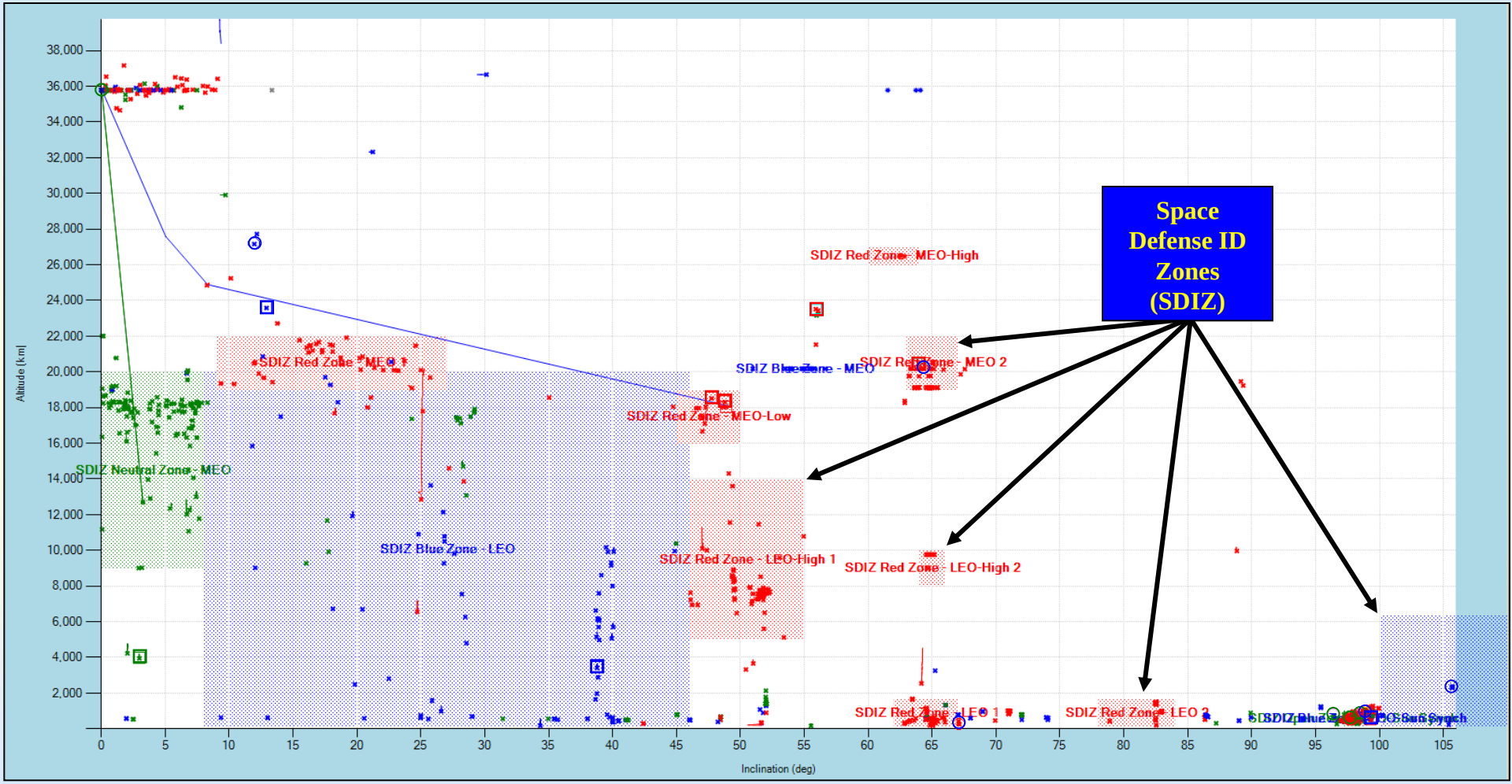
Space Objects Orbital Changes Are Easy to Identify

SAW – View 2



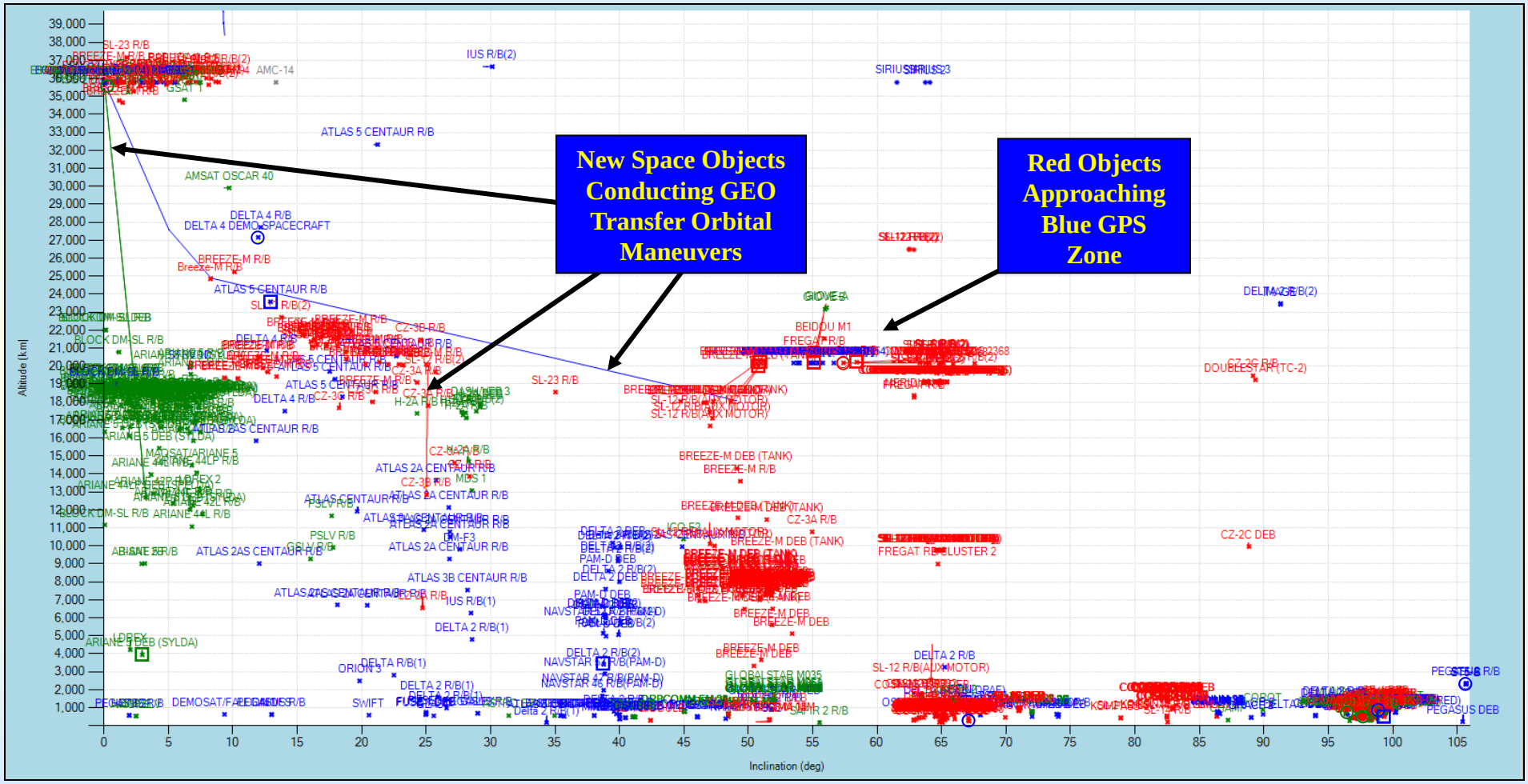
Space Debris Clouds & Their Source Can Easily be Viewed

SAW – SDIZ



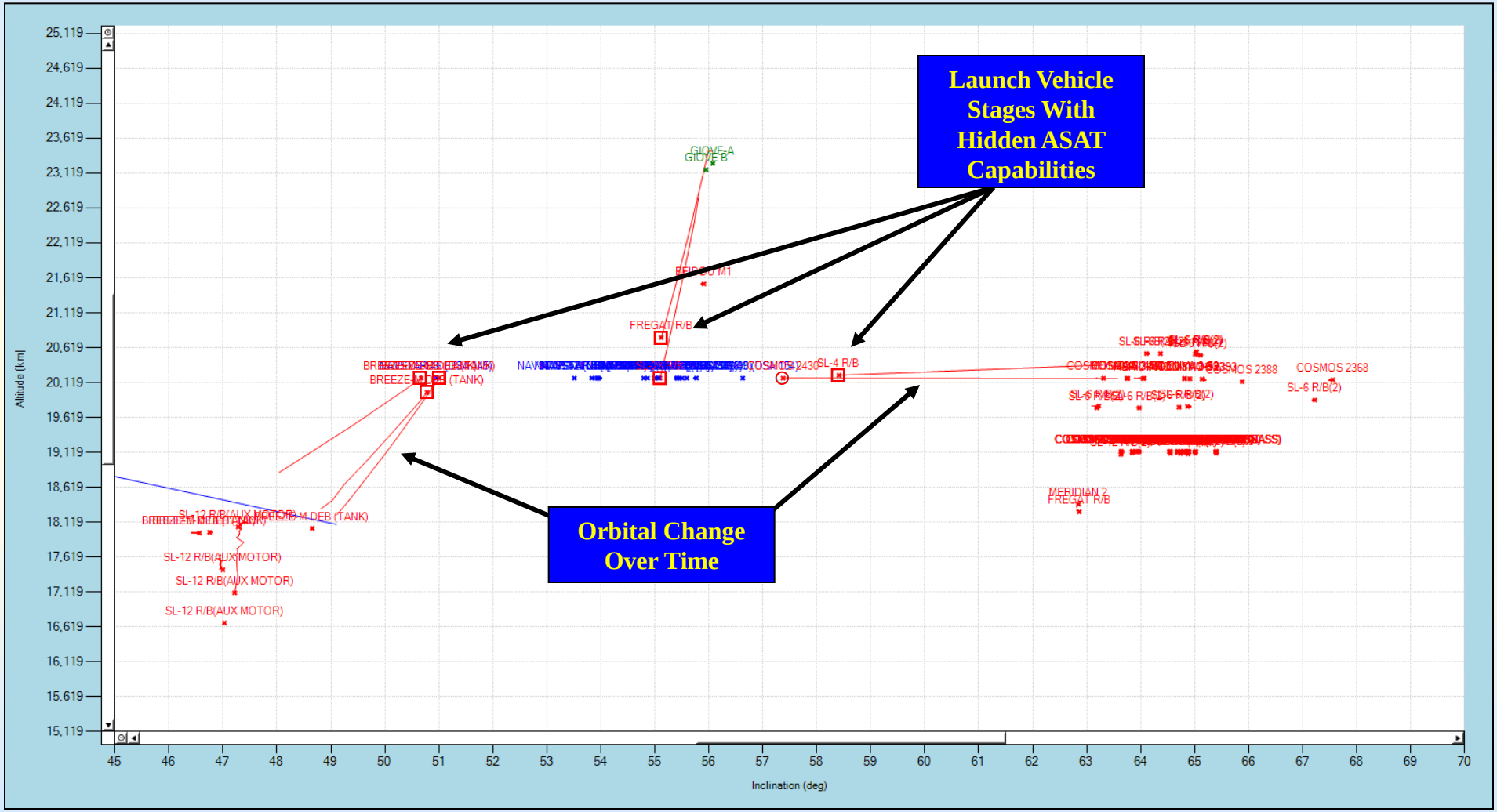
SSA Detection Zones Help Partial Out Operational Responsibility

SAW – Simulated Attack Against GPS



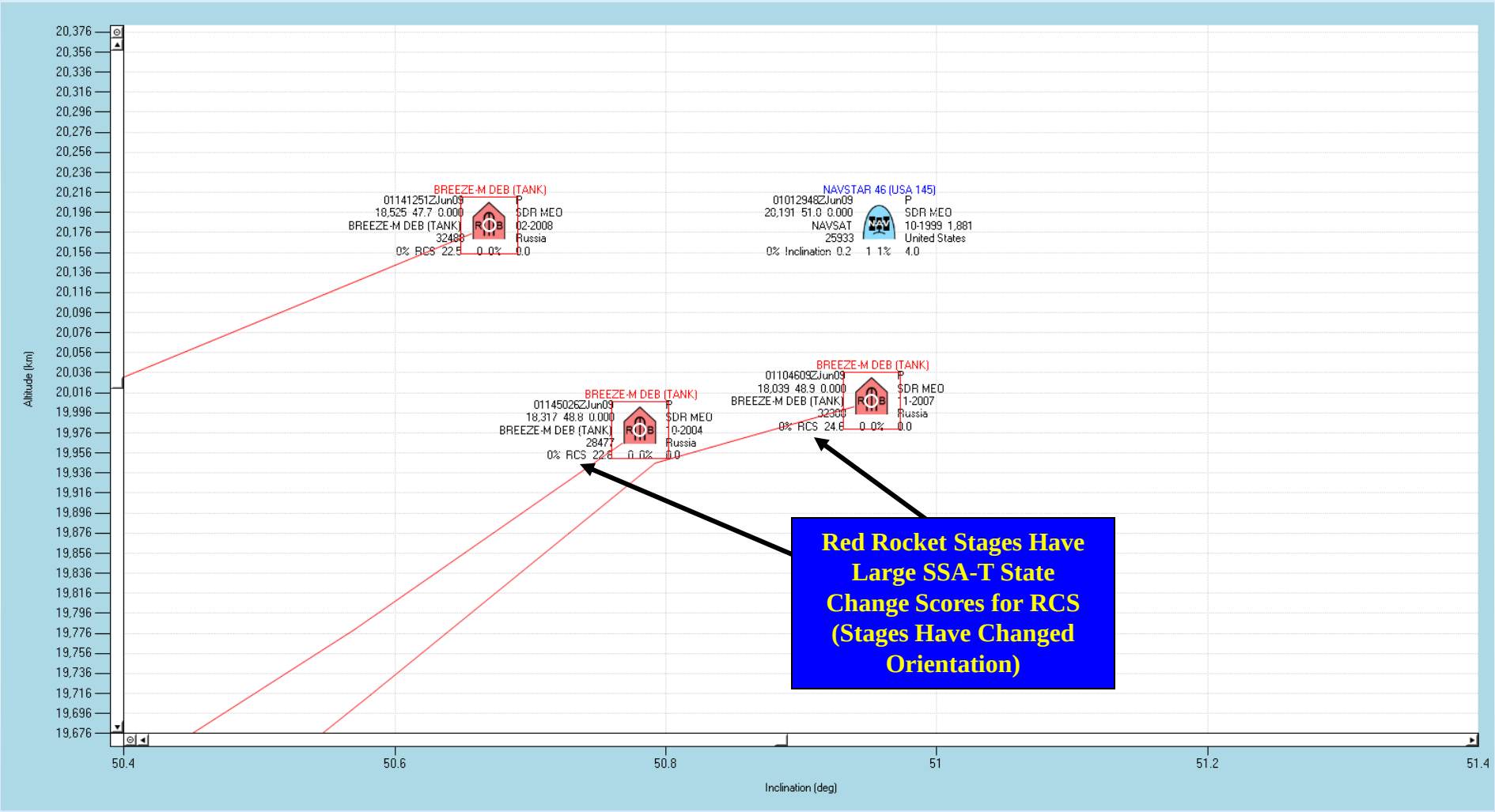
Major Maneuvers of Space Objects are Easily Visualized

SAW – "Dead" Stages as ASATS



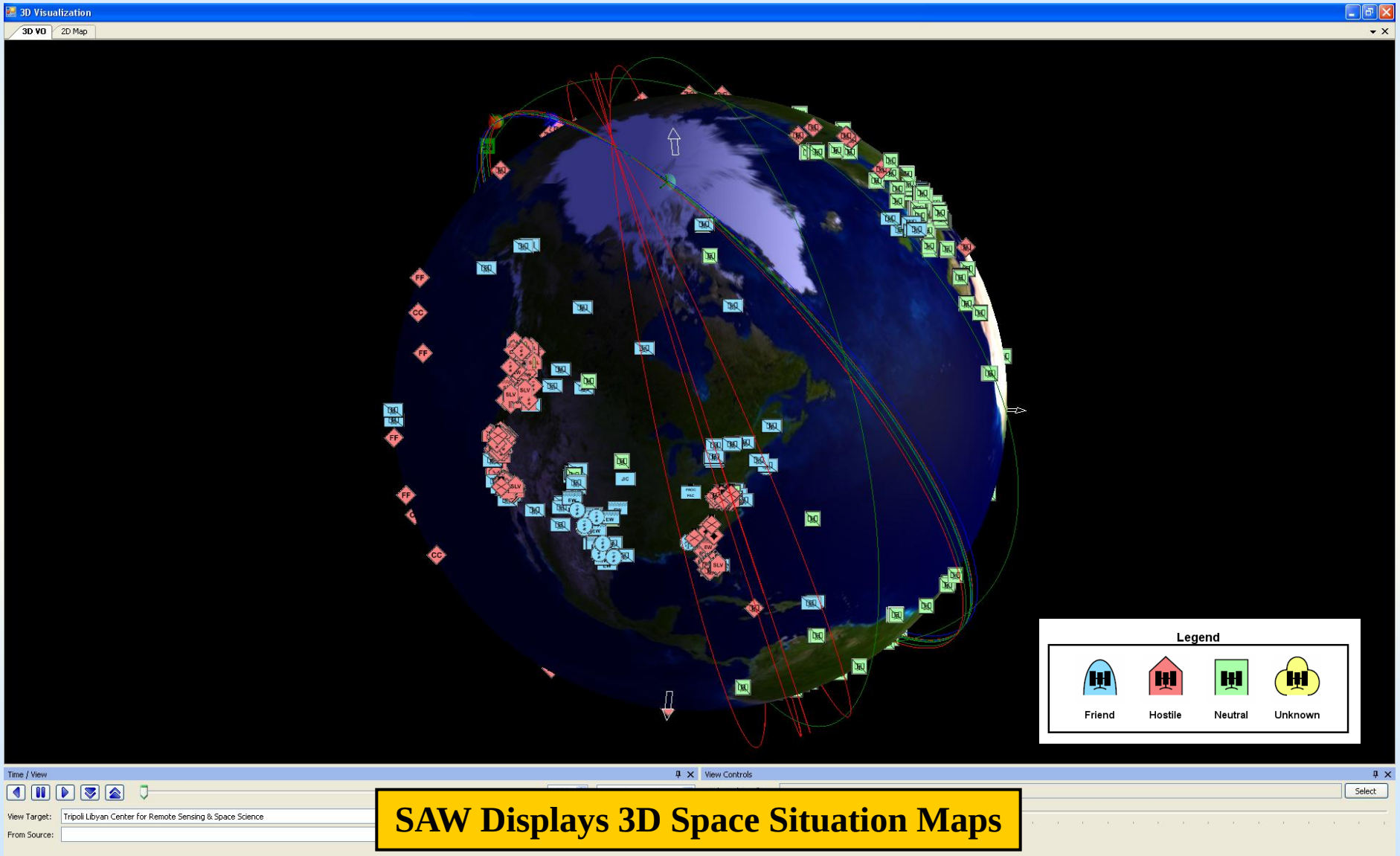
Simultaneous Attack Maneuvers Can Easily be Detected

SAW – Multiple Attacks Against One GPS



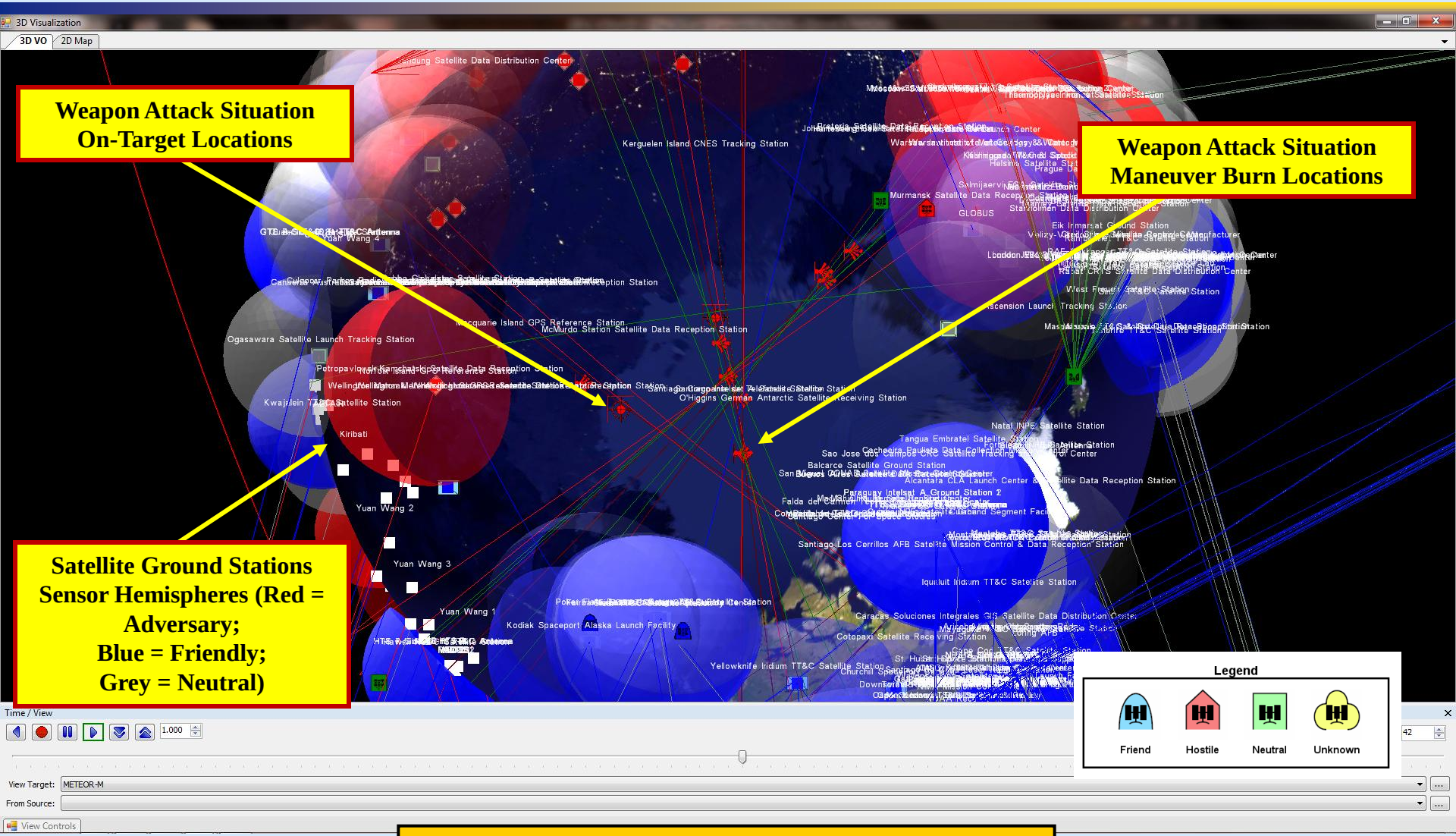
Space Objects Playing Dead Can be Detected With Unusual Movements

SAW – 3D View (1)



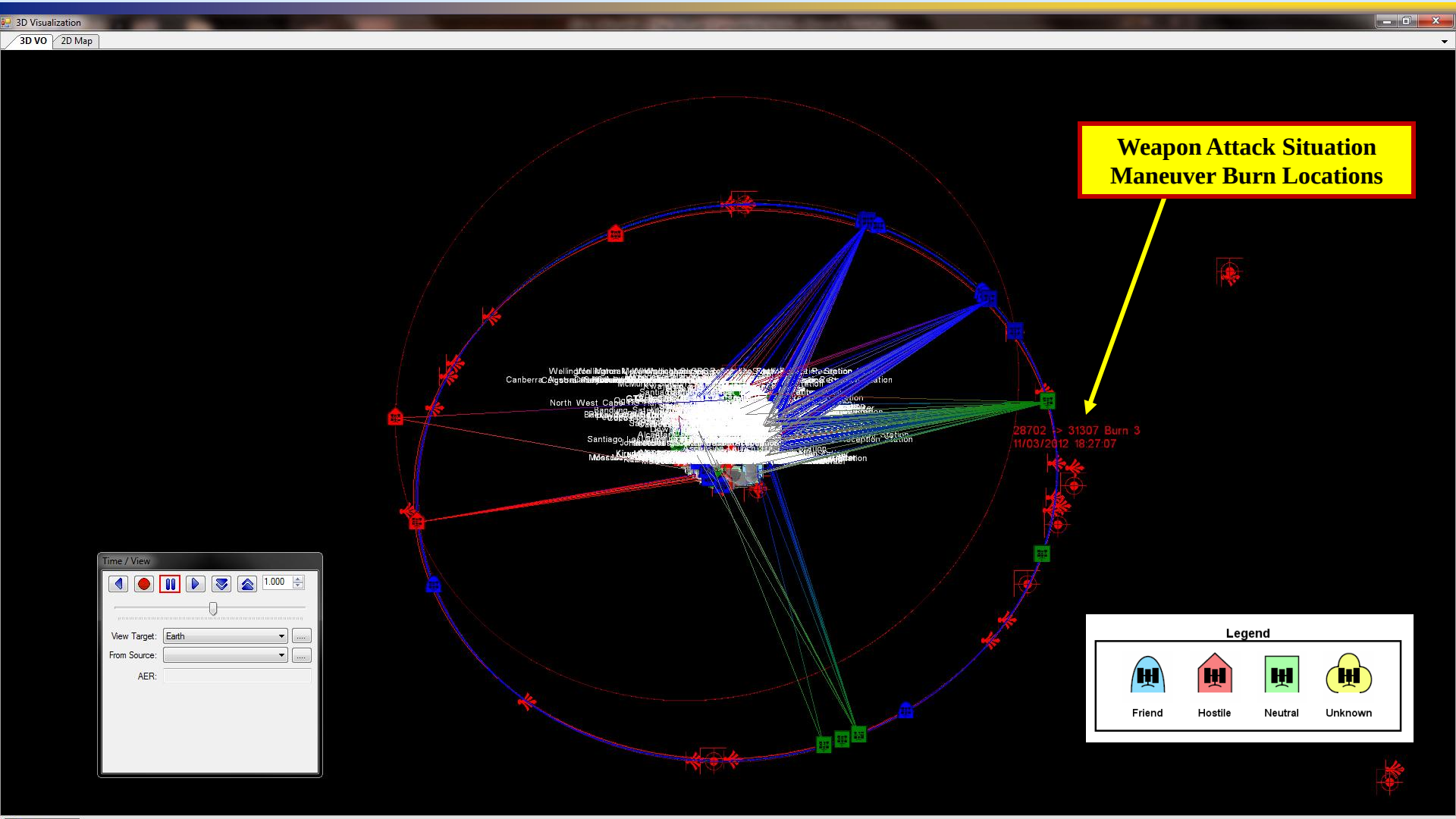
SAW Displays 3D Space Situation Maps

SAW – 3D View (2)



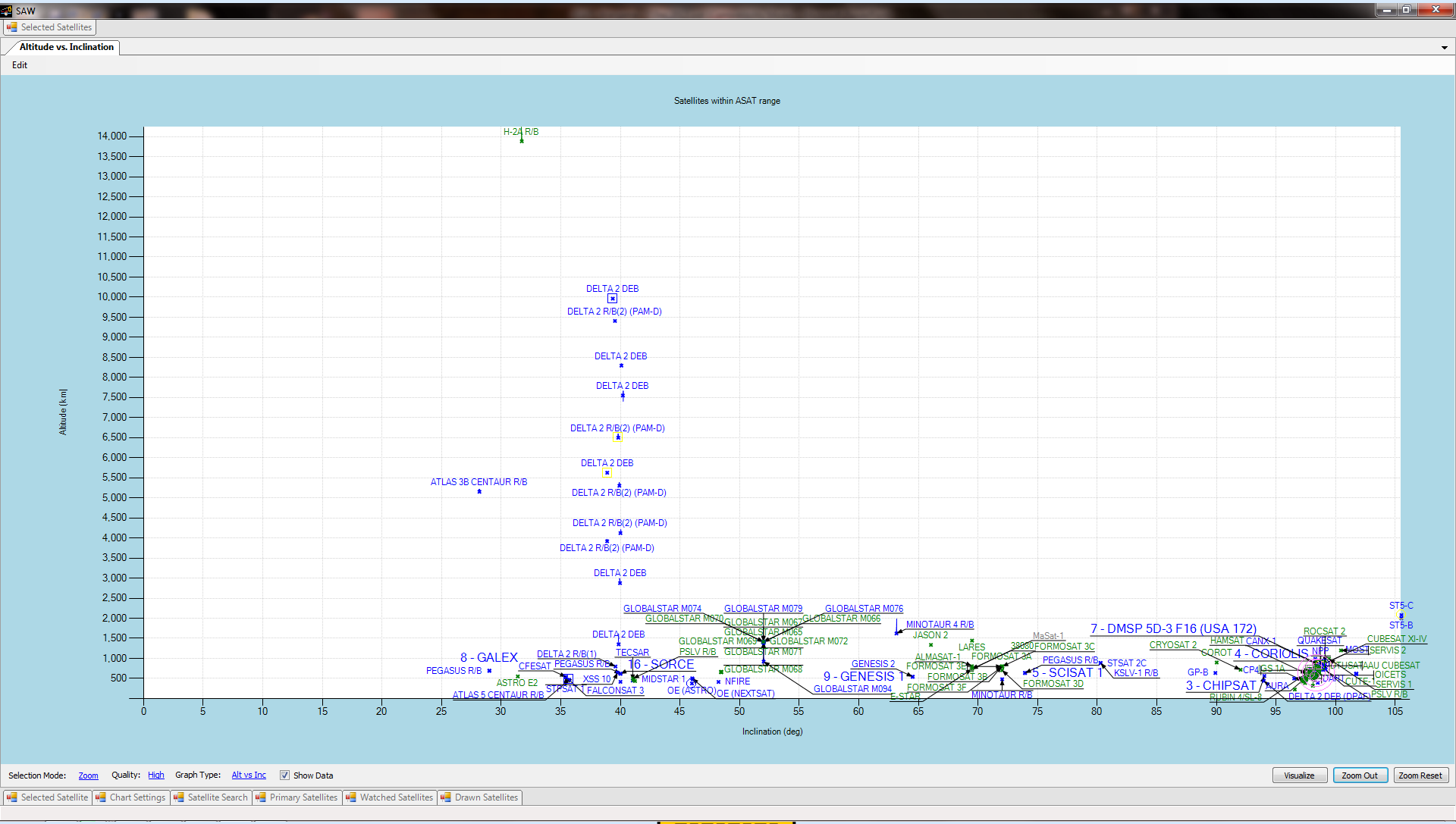
SAW Displays 3D Space Situation Maps

SAW – 3D View (3)



SAW Displays 3D Space Situation Maps

SAW – Space Objects Within Weapons Range



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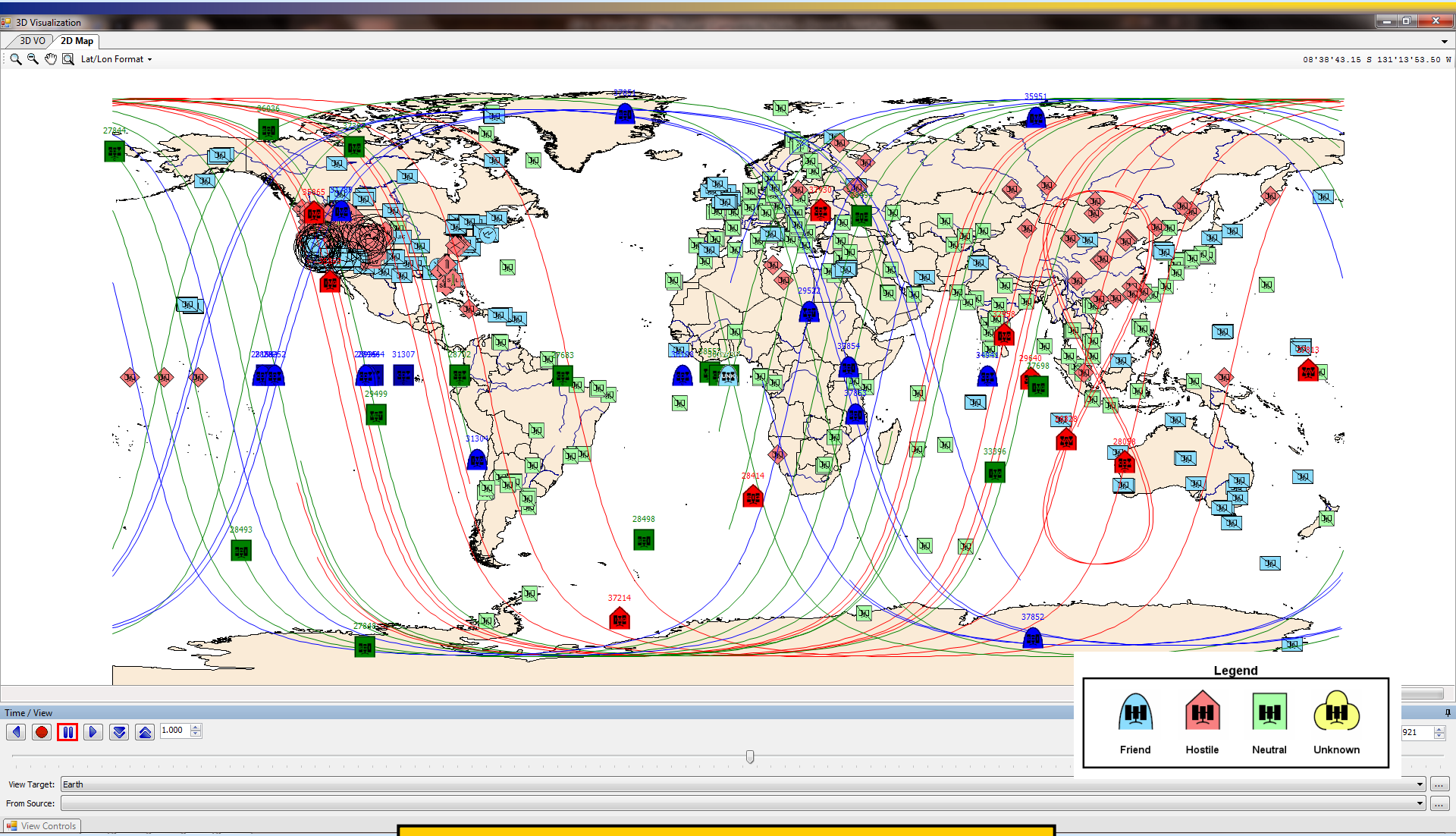
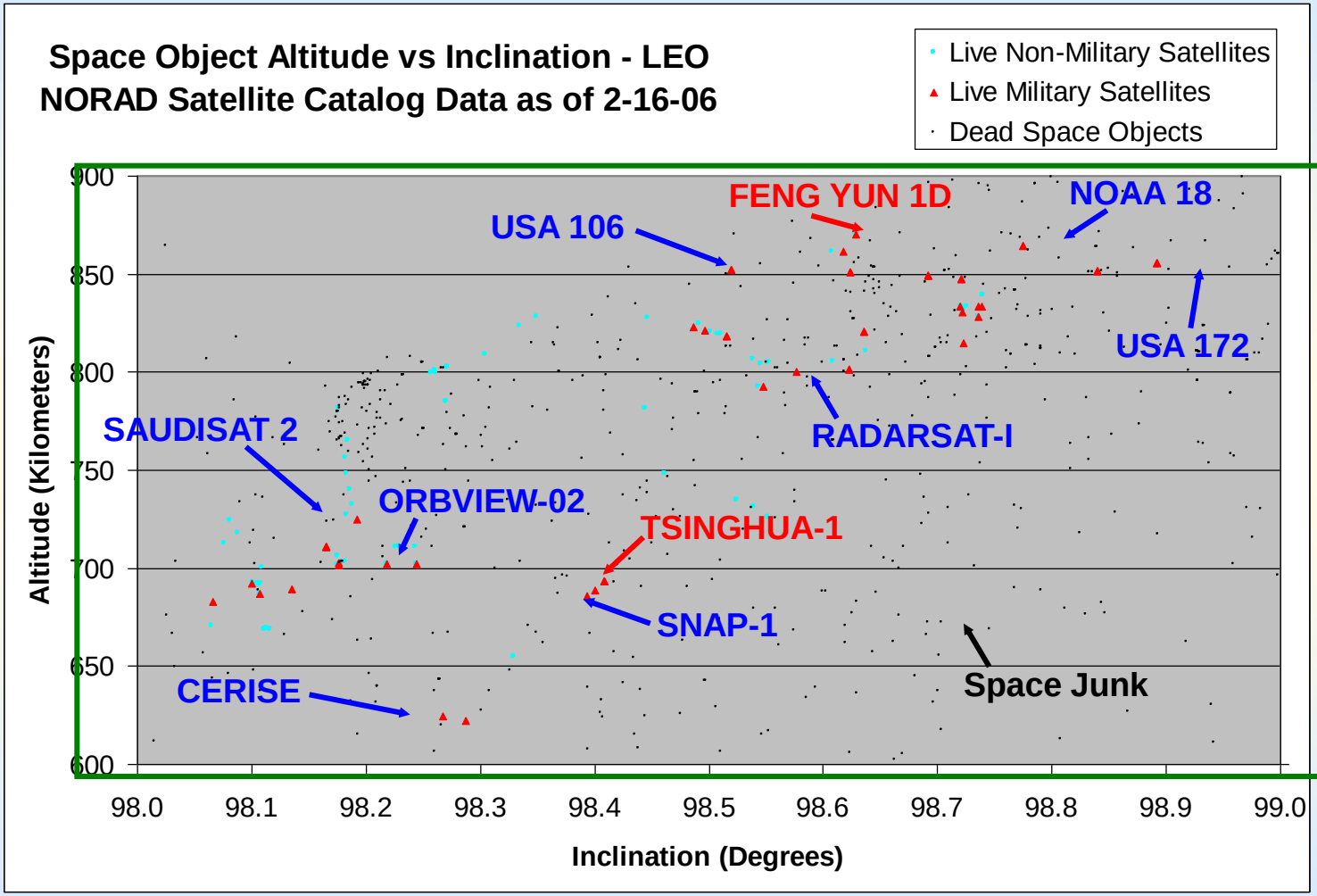
SAW – Flat Map View



SAW Displays 3D Space Situation Maps

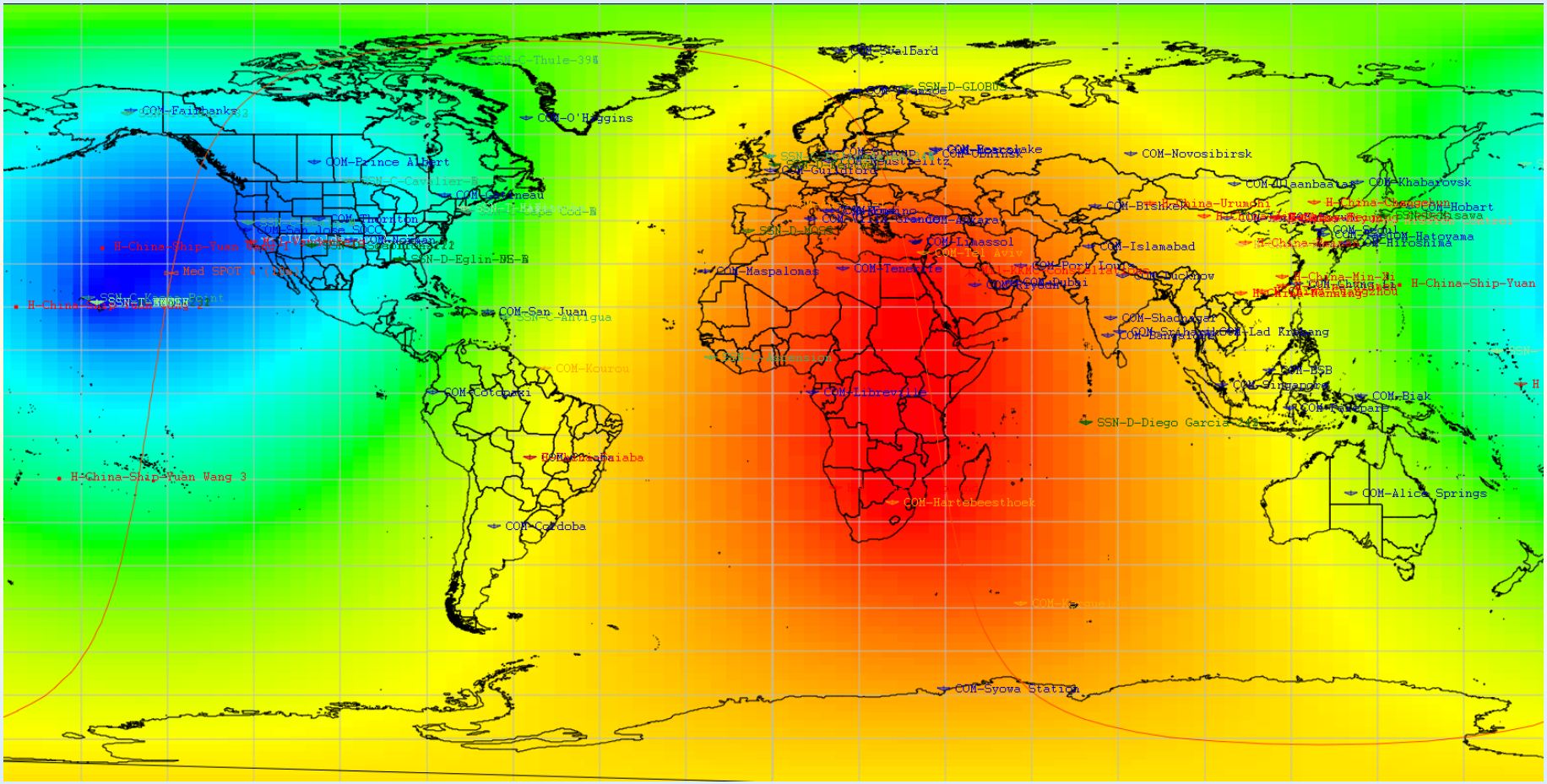
Space Choke Points



Hohmann Maneuver Envelope at 100 M/Sec Delta-V

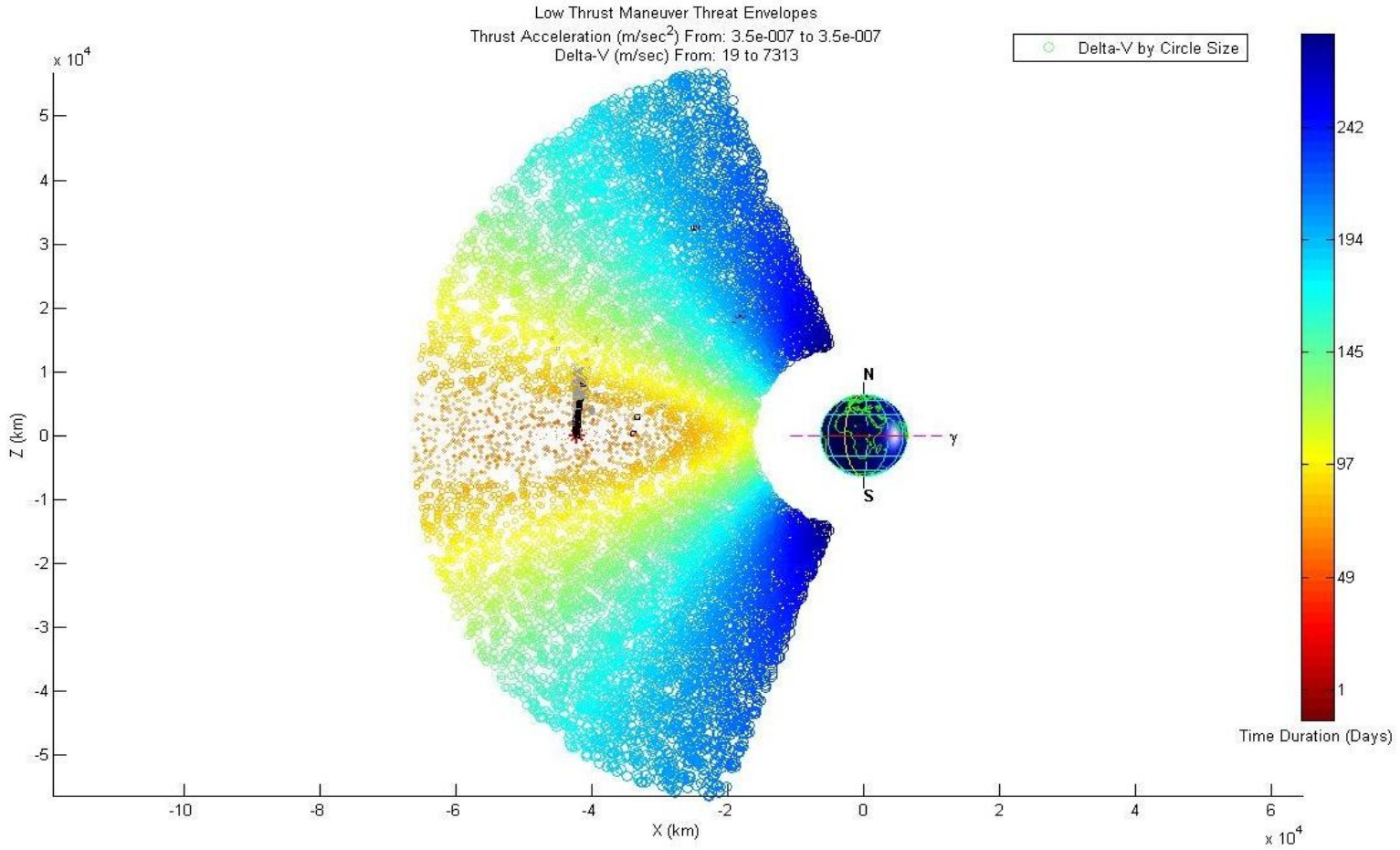
There are Many Potential Sources of Attack

Example Attack Locations Optimized for Space Surveillance



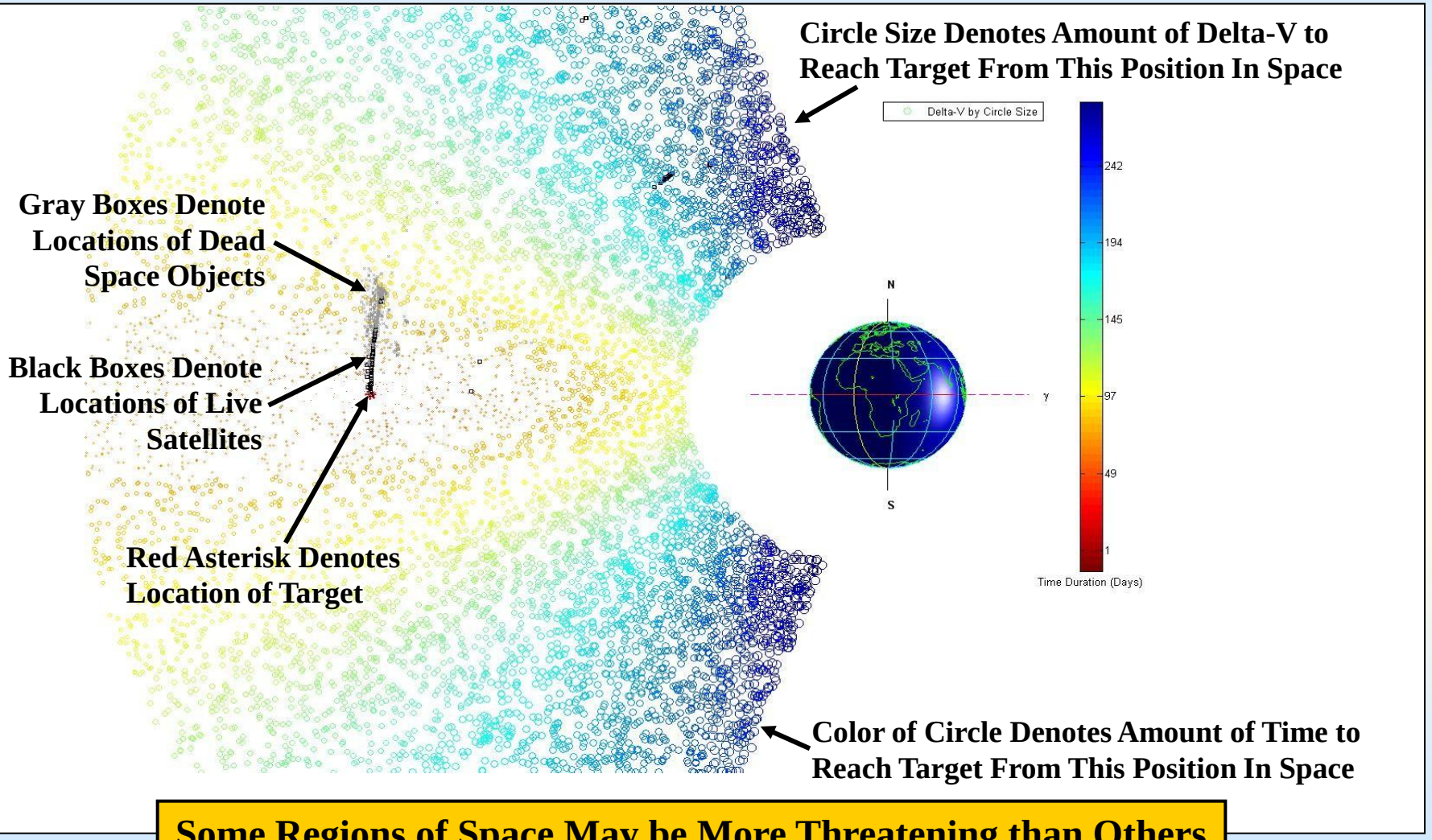
Some Parts of a Satellite's Orbit May Be More Vulnerable than Others

Example Threat Envelope View 1



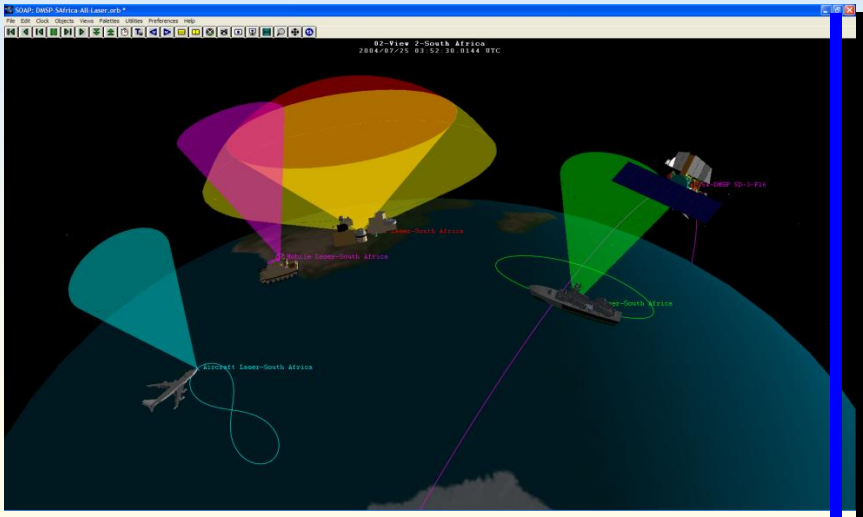
Some Orbits are Easier to Maneuver to Than Others

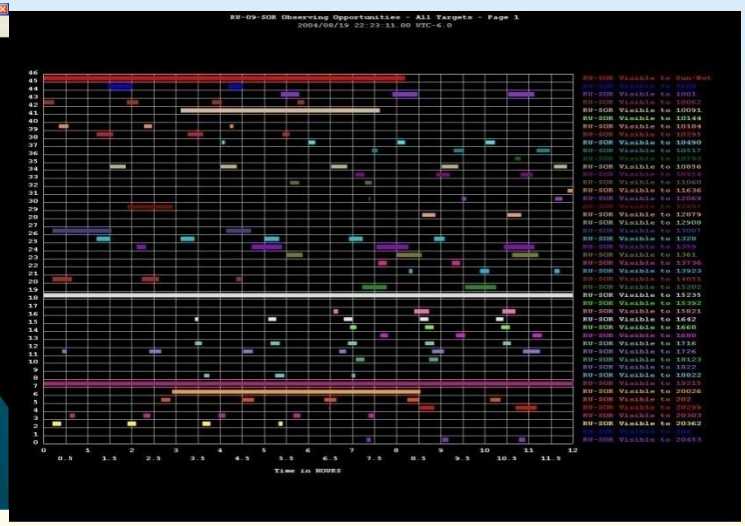
Example Threat Envelope View 2

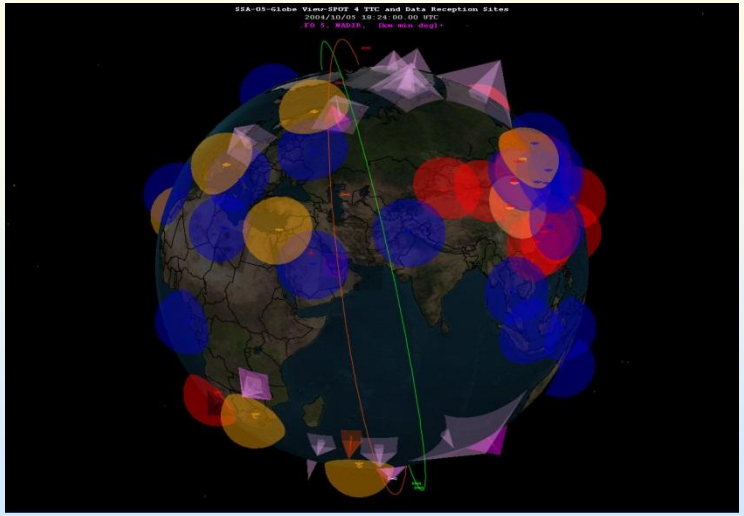


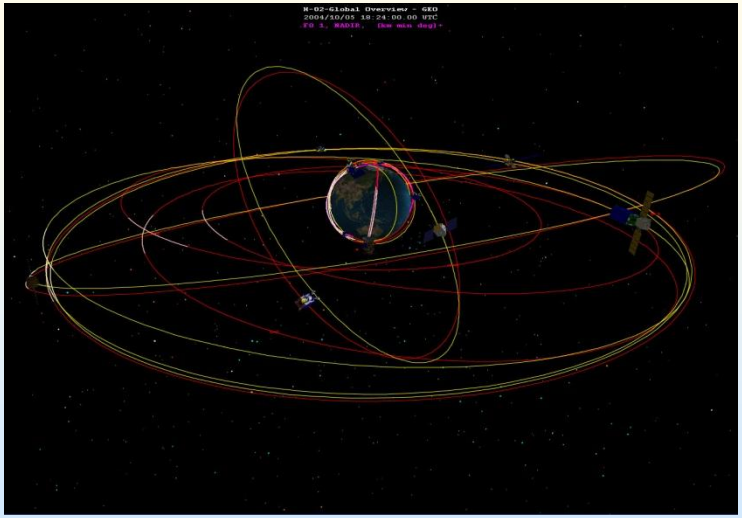
Some Regions of Space May be More Threatening than Others

ASAT Range / Access Assessments

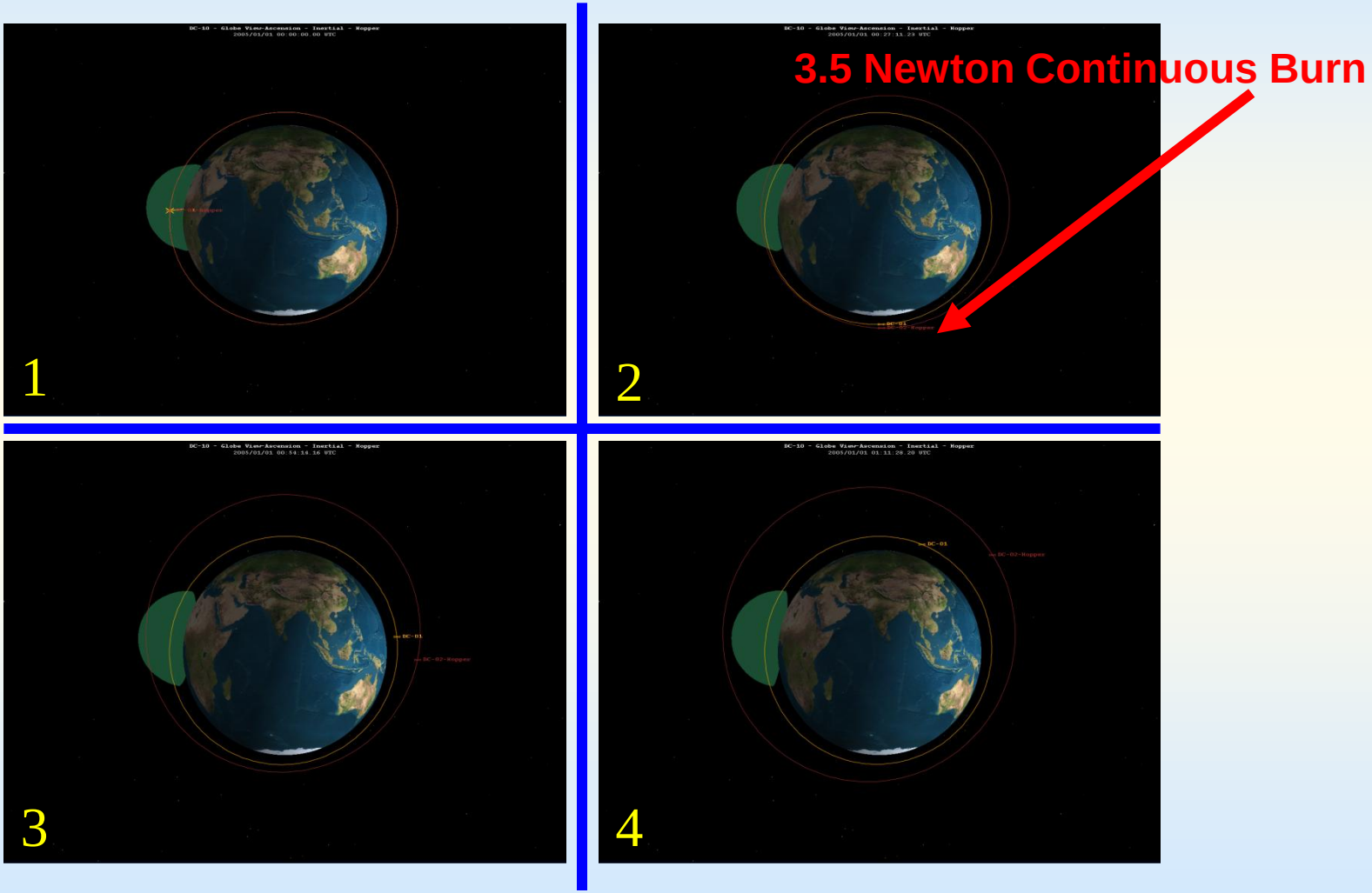




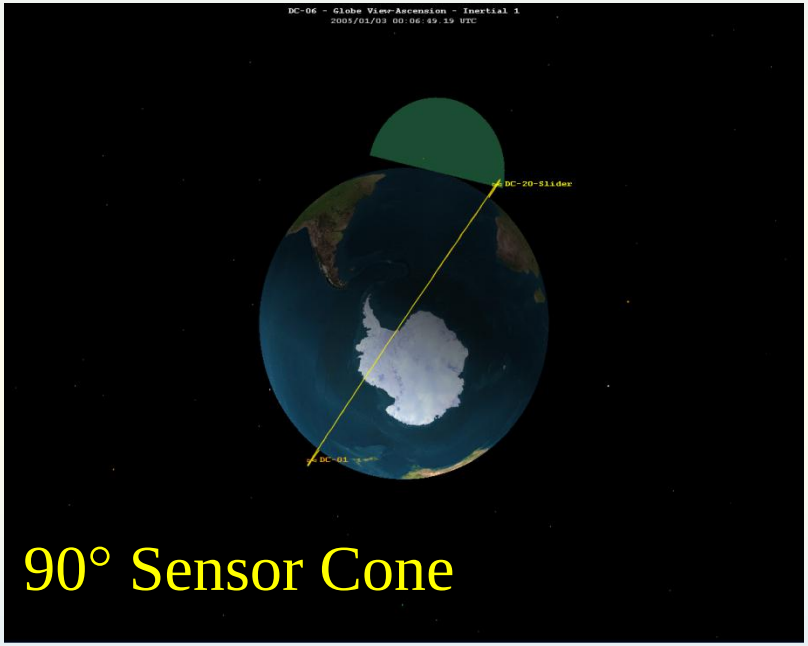




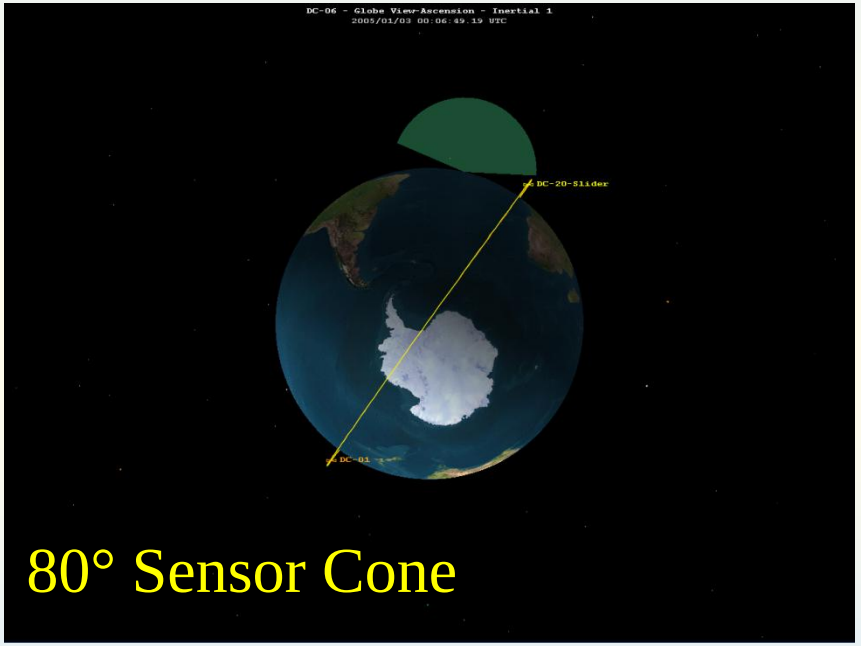
Avoid Space Radar - Hopper



Avoid Space Radar - Slider

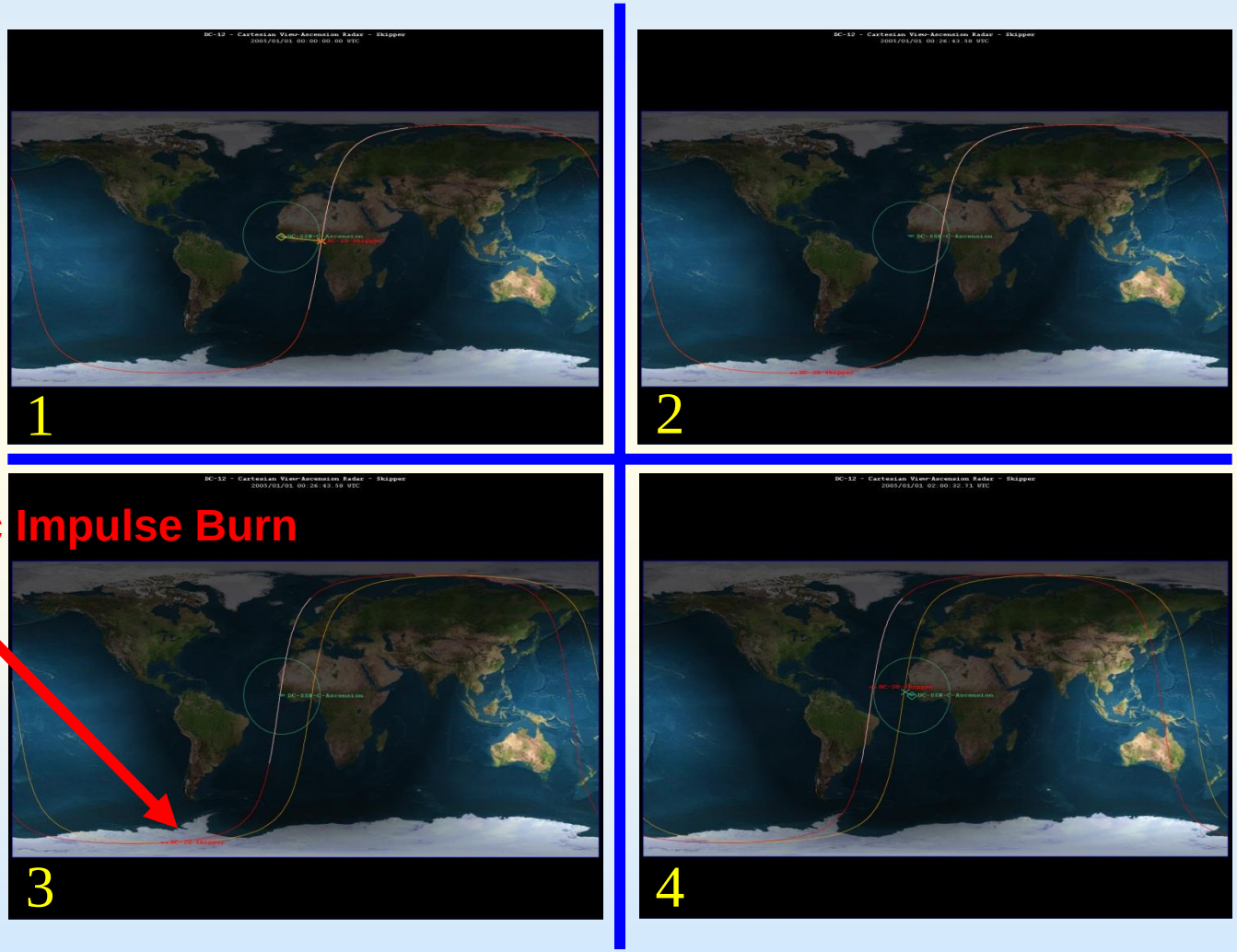


90° Sensor Cone

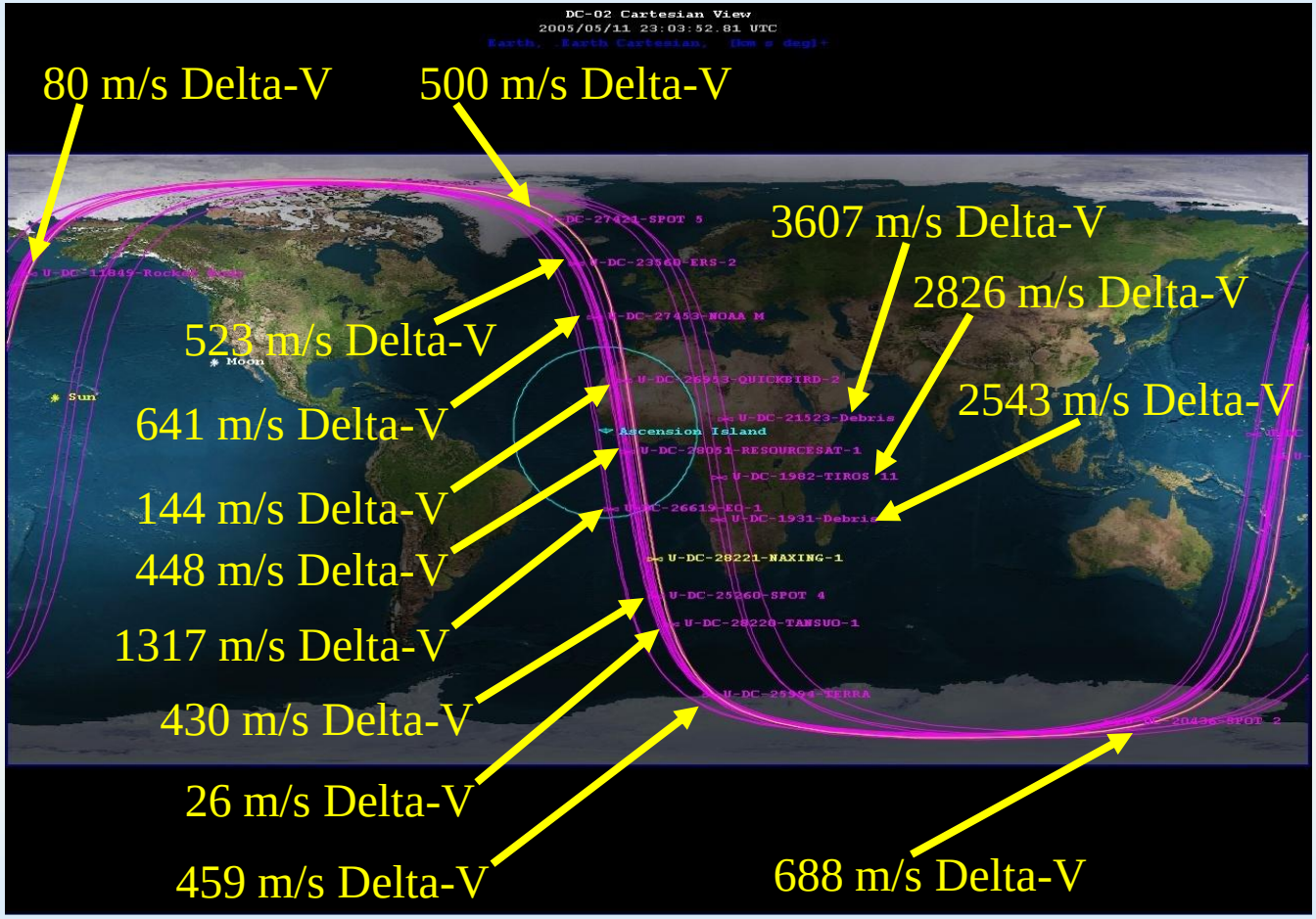


80° Sensor Cone

Avoid Space Radar - Skipper



Hide Satellite Among Others

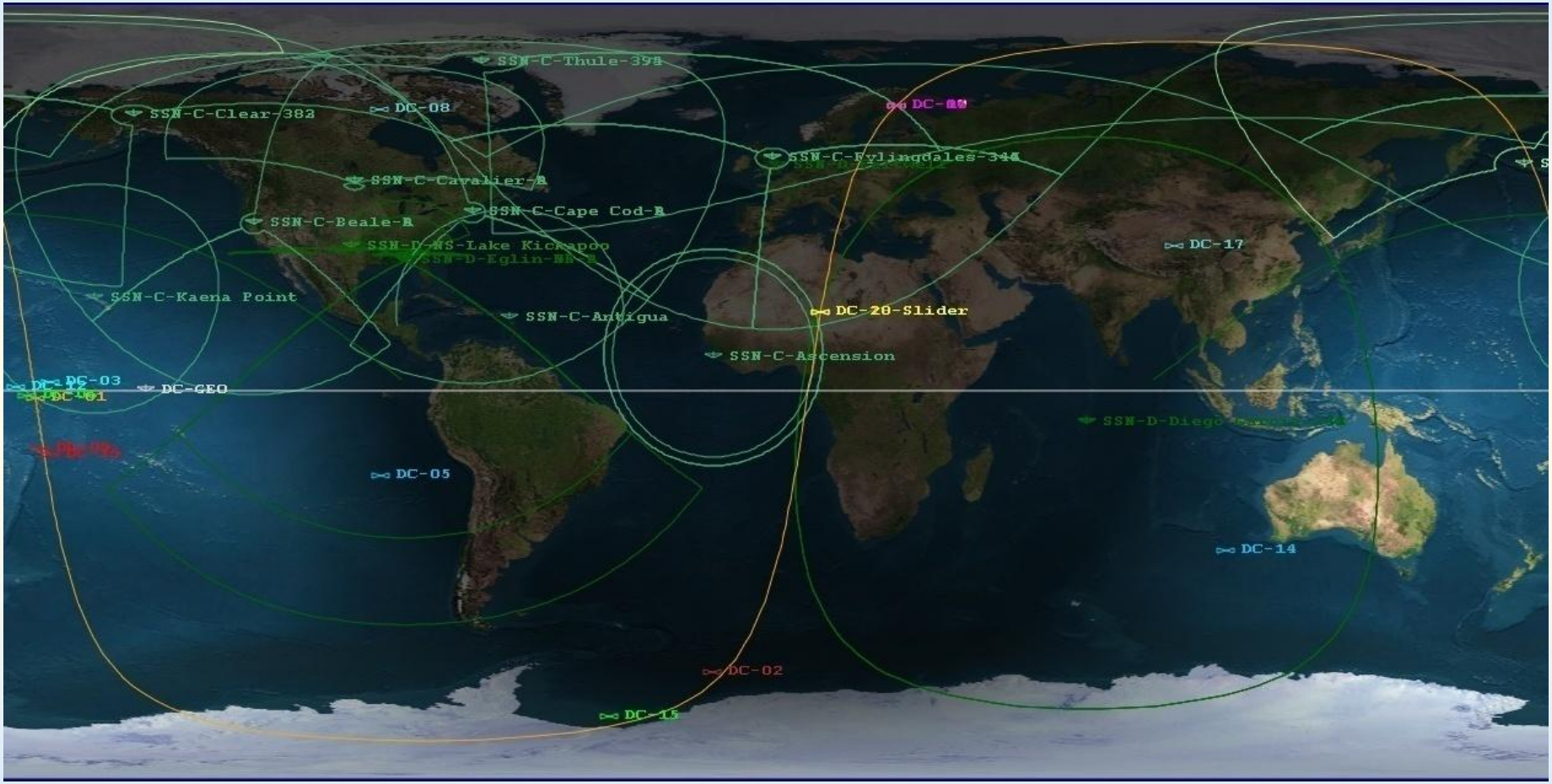


Goal: Appear Like Nearby Satellite

Delta-V Required for 2-Burn Hohmann Transfer Rendezvous

Satellites Can Maneuver to Confuse Targeting Assets

Space Surveillance Network



SSA-T Contacts

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

BACKUP

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

Principles of War

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

Principles of War Equally Applicable to Space & Terrestrial Warfare

Space Principles of War Example

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

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

Space Strategies Example

Title:
Herd Space Personnel

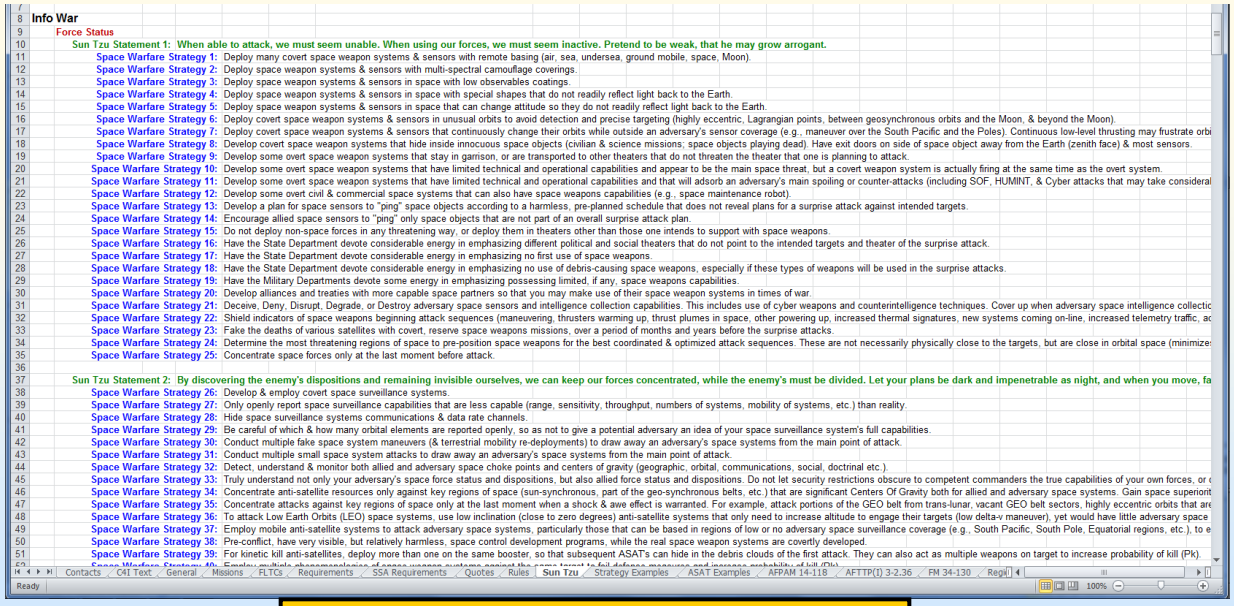
Action:
Destroy all Red space-related ground targets, except purposely lightly damage one ground center. Assume that key space support personnel will converge to this lightly damaged site to conduct repairs. 12 hours later, use anti-personnel weapons at this site, with destroy weapons 2 hours later.

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

War Is Hell

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**
  - **546 Space Warfare Strategies Already Derived**
  - **Only 1/3 the Way Through Sun Tzu's Teachings**

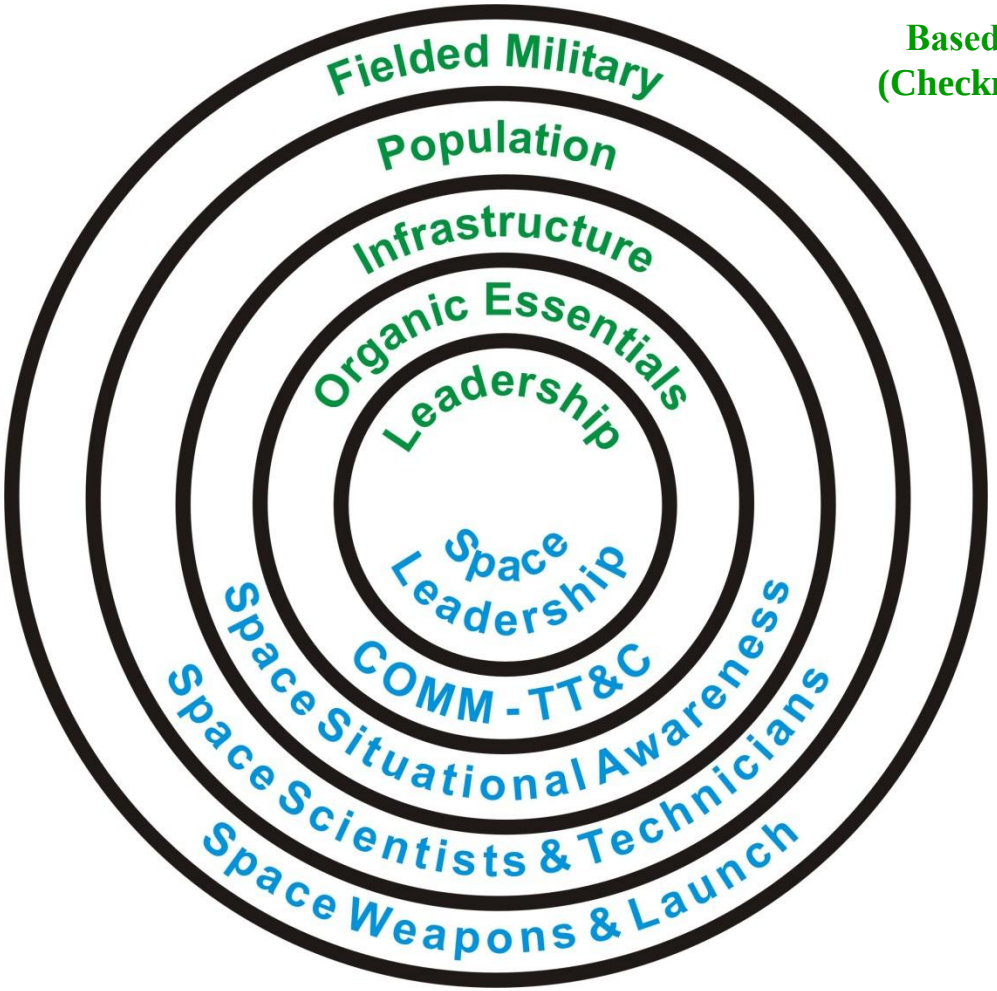


Info War
Force Status
Sun Tzu Statement 1: When able to attack, we must seem unable. When using our forces, we must seem inactive. Pretend to be weak, that he may grow arrogant.
Space Warfare Strategy 1: Deploy many covert space weapon systems & sensors with remote basing (air, sea, undersea, ground 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 Regi
Ready
100%

Methods of War Are Eternal

Space Centers of Gravity Model

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



Space Equivalent 5-Ring COG Model

Space Systems Strategic Targeting Is Similar to Terrestrial Targeting Strategies

Example Space Centers of Gravity

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

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SSA-T Has Extensive Space Centers of Gravity Checklists

SSA-T 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
- SSA-T Automatically Increases Space INTEL Collection Priorities In IPB Tasking Forms Based On Probable Red Actions

SSA-T Helps the Satellite Analyst Determine If Space Systems Are Under Attack

INTEL Indicators Example

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

Example Space Objectives

⋮ ⟵ 5,000 Other Space Objectives

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

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SSA-T Has Space Objectives for Both Red & Blue Sides

Example Space COA Indicators

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

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

COA Reactions Example

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

COA Reactions Example (Cont.)

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

Space Escalation Ladder

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

Space Actions May Be Conducted Pre-Conflict

Space Escalation Ladder (Cont.)

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

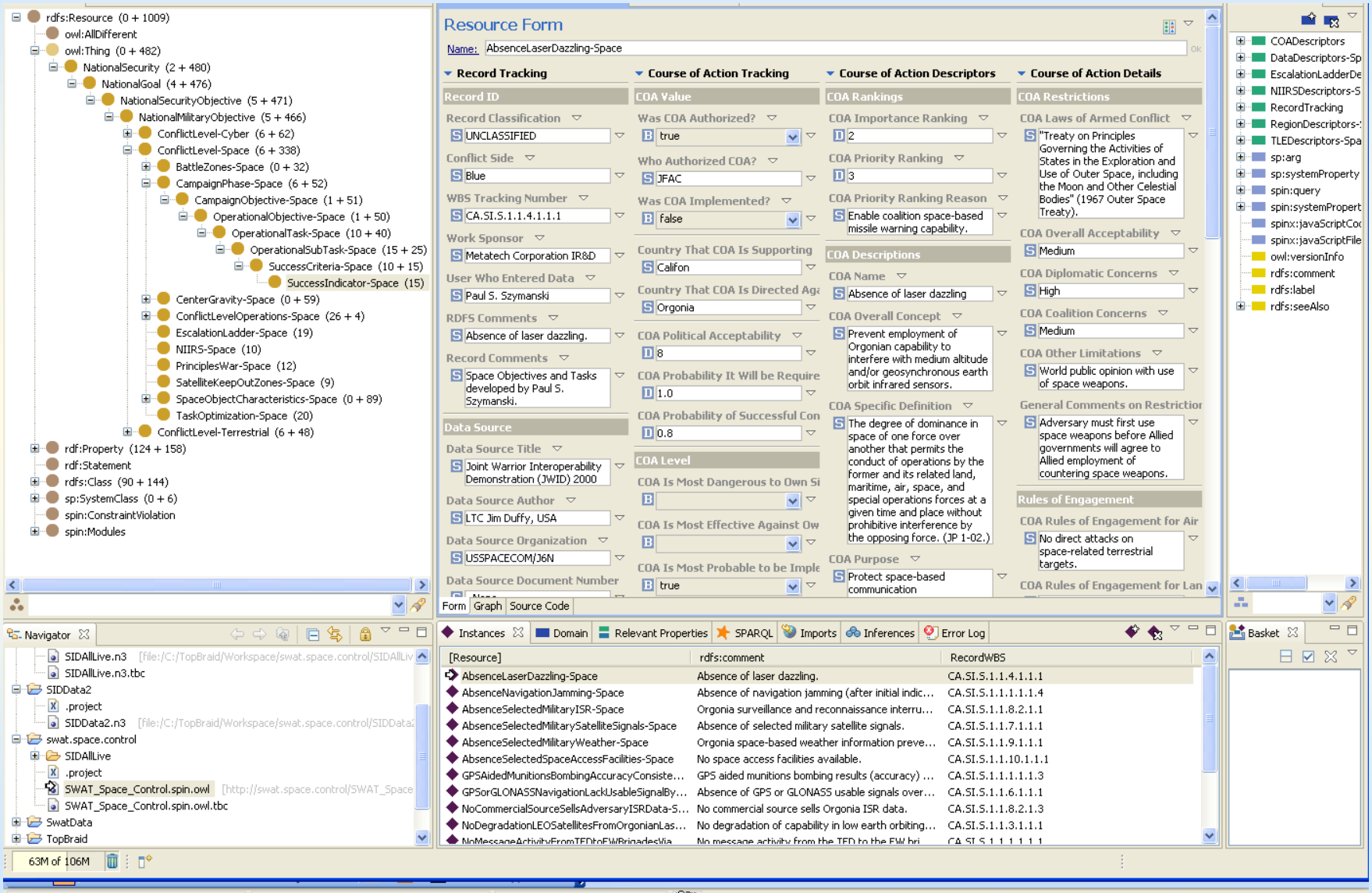
Space Provides Finer Gradations & Thus Better Control During Conflict Escalation

Space Web Ontology

Space Ontology

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

Space Ontology Example



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**

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

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

Space NIIRS Based on Equivalent Terrestrial NIIRS Definitions

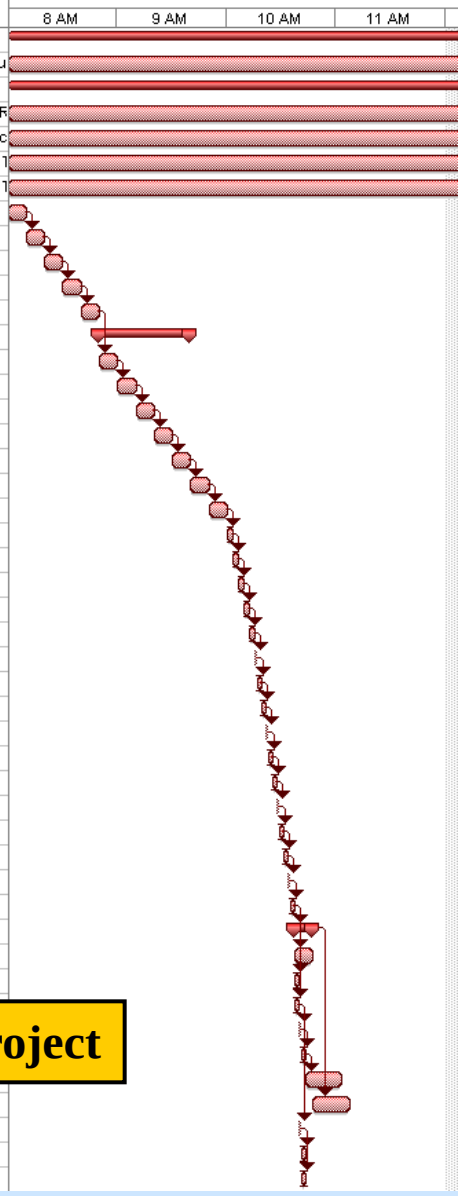
SSA-T Automatic Space Object Classification

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

SSA-T Helps the Satellite Analyst In Determining Surveillance Tasking Priorities

Scenario Partial Example 1

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



Battle in the Blue Scenario Time Lines in Microsoft Project

Scenario Partial Example 2

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

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

Success Criterion:

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

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

Tactical Tasks:

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

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

Success Indicator:

IND: North Korea surveillance and reconnaissance interrupted

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

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

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

Deny third party capability to image selected protected areas

Success Indicator:

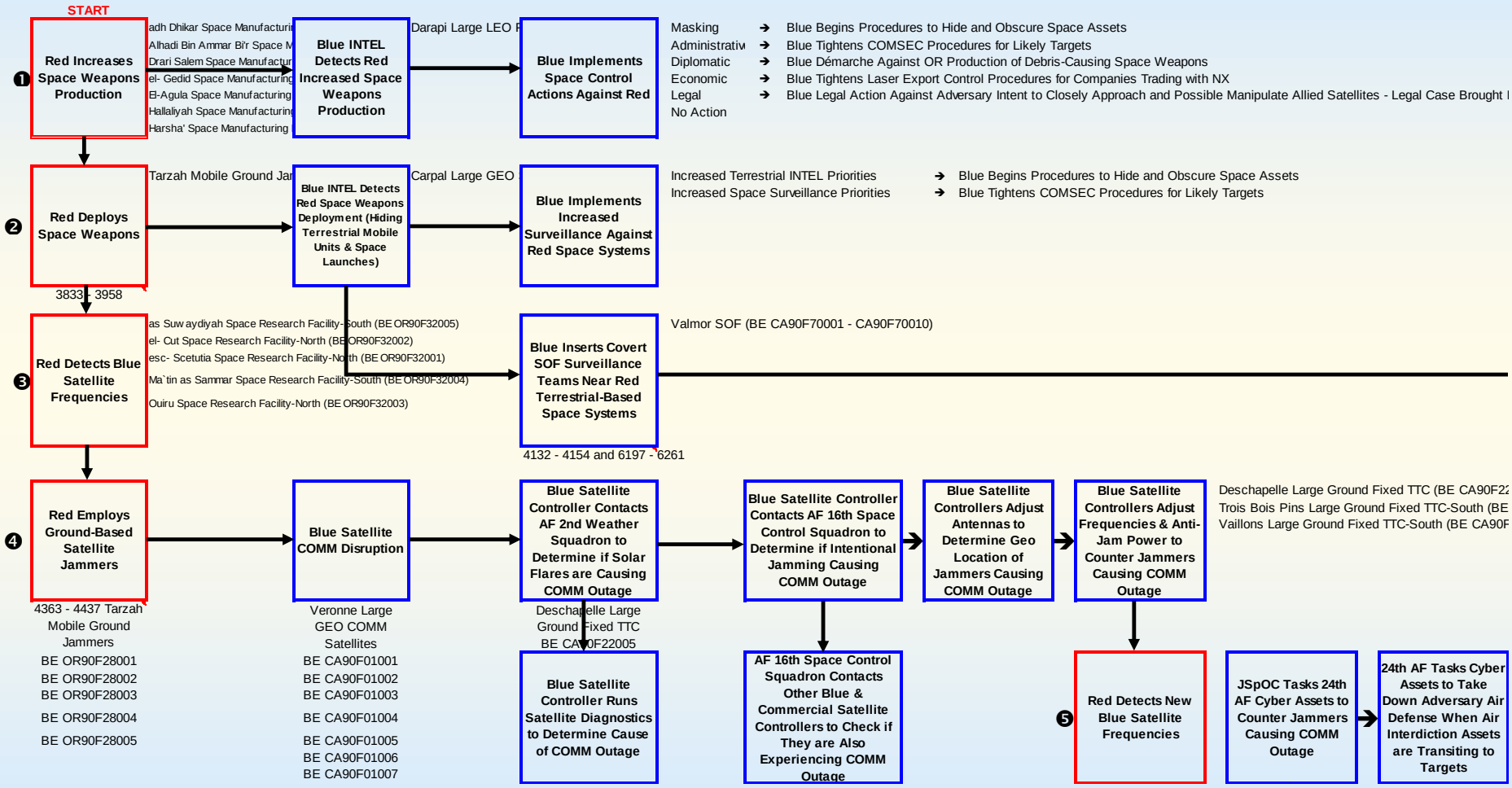
IND: No commercial source sells North Korea ISR data

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

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

Space Objectives Available Also

Scenario Partial Example 3



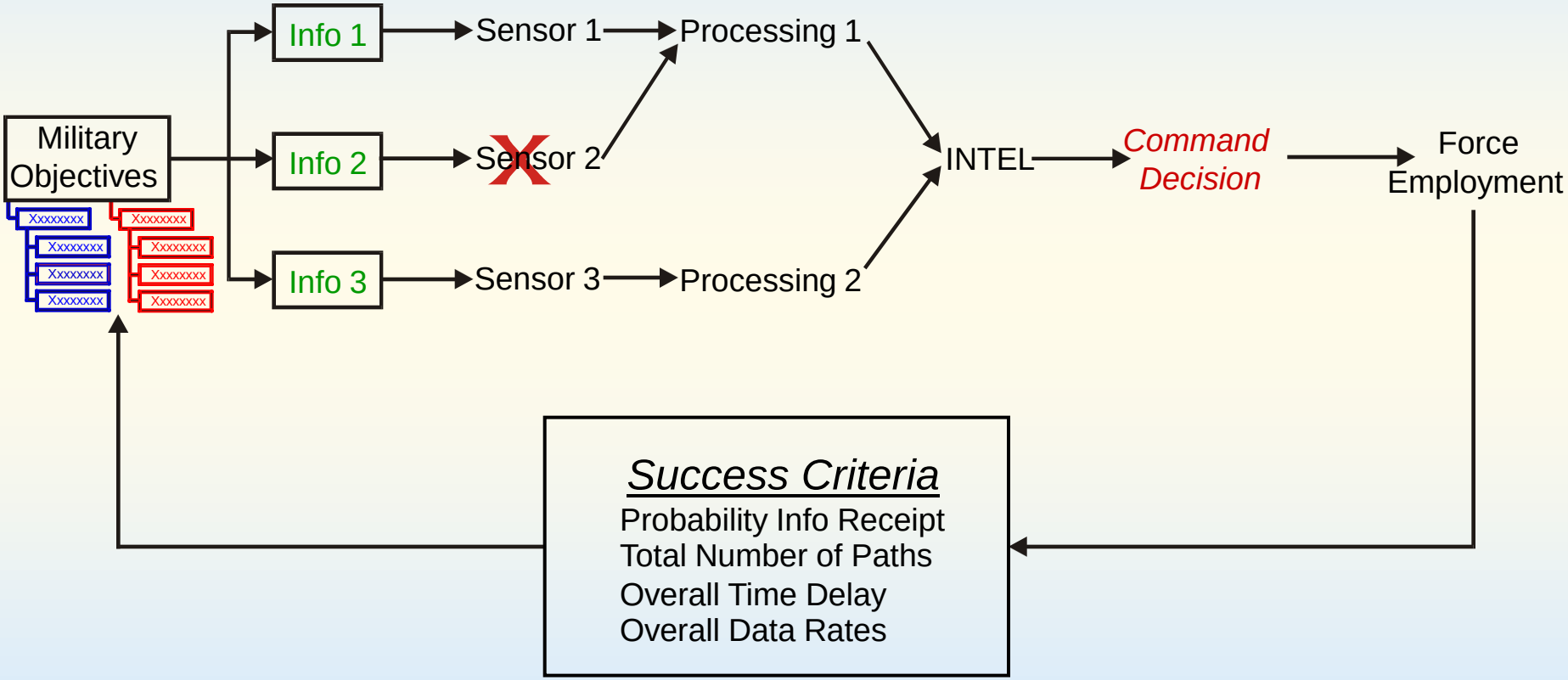
Detailed Space Control Scenarios Available for Analyses

Space Info Choke Points Network Analyses

- **SHIVA (Space Highest Information Value Assessment)**
  - **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**

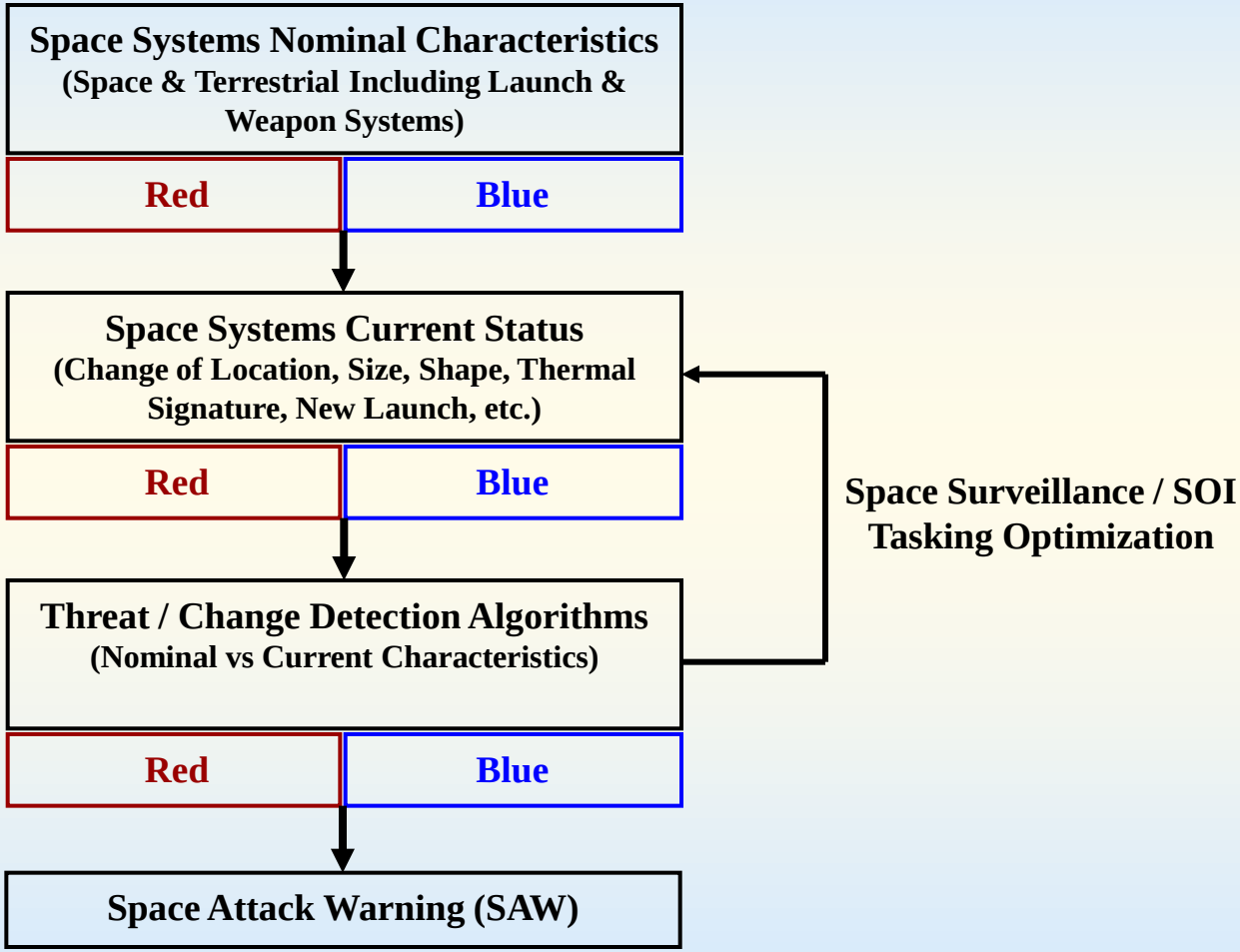
SHIVA Can Show the Value of Space Systems

SHIVA Methodology



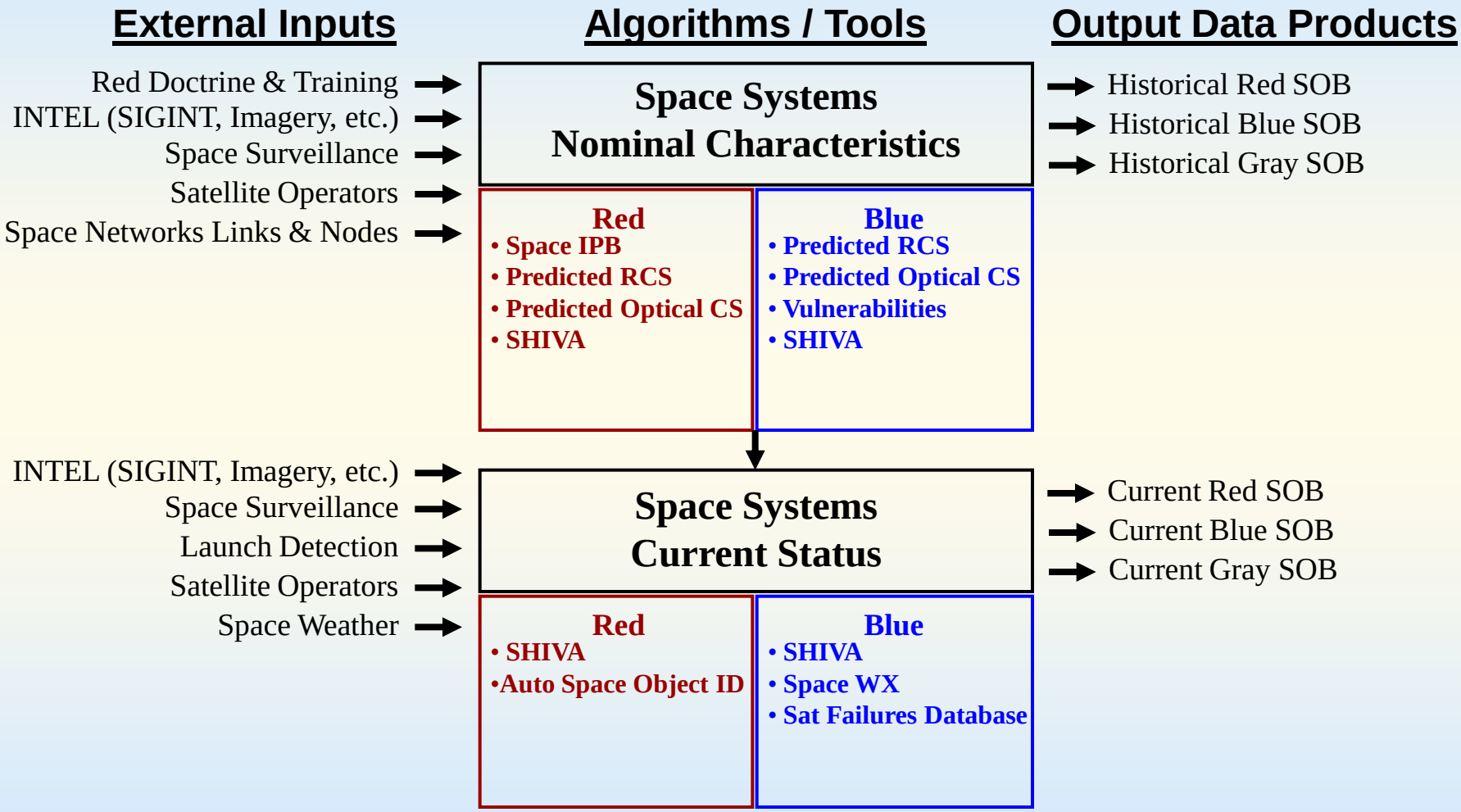
SHIVA Calculates All Possible Paths Between Sensors and Shooters

SSA & SAW Integrated Concept



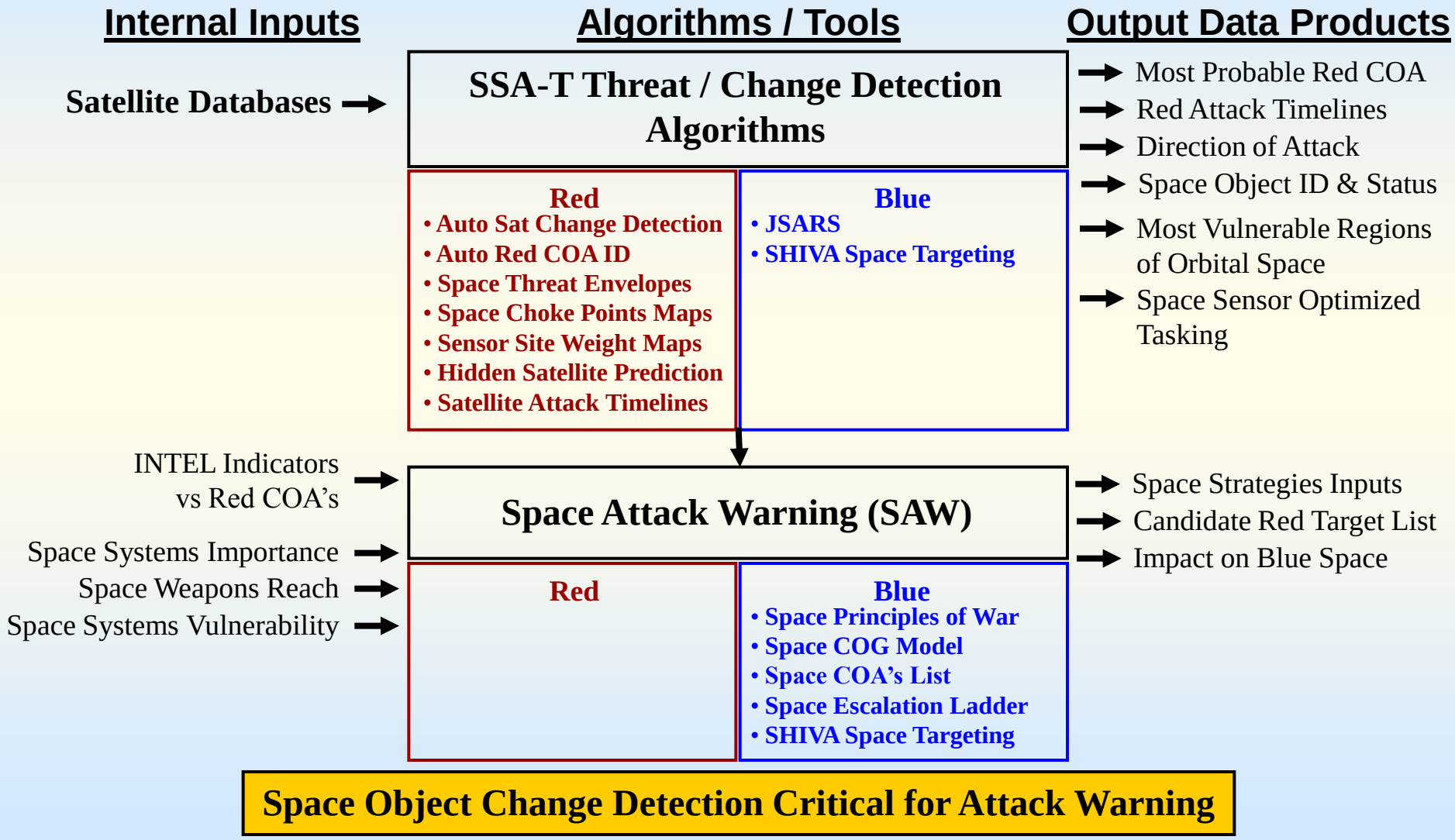
Predict an Adversary's Intentions & Next Moves Against Space Systems

SSA & SAW Detail 1



Space Characteristics Databases Critical for Attack Detection

SSA & SAW Detail 2



Proposed SSA-T Future Developments

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

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