



Space Aggressor Mission Suite Development by USSF Supra Coders

Know

Teach

Replicate



Overview



- Who are the Aggressors?
- Current Operations
- Development Effort
- Application Sustainment



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Aggressor History



Vietnam:
Dramatic drop in
air-to-air kill ratios



1975
First Red Flag
exercise – focused
on fighter pilot's first
10 missions



1975-1980
Red Flag expands to
include bombers, airlift,
rescue, coalition.

1990
Aggressor program
terminated –
end of Cold War

1970

1980

1990

1972
64th Aggressor Sq activated to
provide **dissimilar** air combat
training using Soviet tactics
and T-38s, later F-5Es



1975
Fourth Aggressor Sq
activated, 64th, 65th,
26th, 527th



1986
"Captain Midnight"
jams HBO satellite
signal



1990s
US military smaller/leaner,
more reliant on space/cyber





Aggressor History

(continued)



1991
Operation DESERT
STORM



1997
First Russian-made
GPS jammer seen at
Moscow Air Show



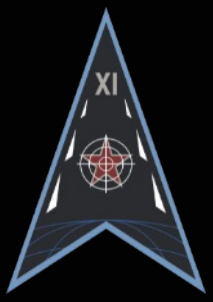
2005
57th Adversary Tactics Group activated
Full spectrum adversary tactics – air, air
defense, space, cyber



2017
First Space Flag
exercise –
ability to learn to fight
& defend systems as
an enterprise



2020
527th Space
Aggressor Sq
transition to
USSF



1990

2000

2010

2020

2000

527th Space Aggressor Sq activated to
prepare US forces for threats to space
capabilities, joined in 2003 by 26 SAS

FULL SPECTRUM OF AGGRESSORS	
AIR	  
AIR DEFENSE	
SPACE	 
INFO/CYBER	 
SUPPORT	

2007
China
conducts
successful
DA-ASAT test



2007-present
Theater exercises
increasingly focus
on space/cyber
threats

2019
USSF
established



2021
Space Delta 11
&
57th Space
Aggressor Sq
established





Mission

Prepare the U.S. Space Force to prevail in competition and conflict through innovative education, training, doctrine, and test



Vision

Prepare every Guardian, develop superior space capabilities, and deliver warfighting solutions



HQ STARCOM

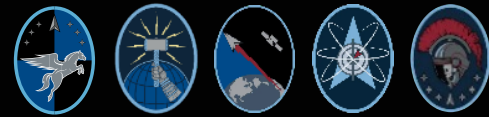
S-Staff

Special Staff

Delta 1



Training



1 DOS
392 CTS
319 CTS
328 WPS
533 TRS

Delta 10



Doctrine & Wargaming

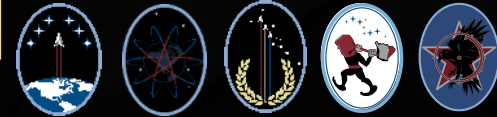


10 DOS

Delta 11



Range & Aggressors



11 DOS
57 SAS
98 SRS
25 SRS
527 SAS

Delta 12



Test & Evaluation



12 DOS
1 TES
3 TES
4 TES
17 TES

Delta 13



Education



13 DOS
NCOA
NSSI



57 SAS Mission

Know



Focus Areas

Orbital
Engagement
Systems

Anti-Satellite
Capabilities

Space Object
Surveillance &
Identification

Adversary HVAs

Adversary
BMC2

- ★ Proficiency with most up-to-date intelligence on adversary systems & tactics
 - ★ Relationships with space & counterspace offices within NSA, NASIC, NSIC, NGIC, ONI, etc.
 - ★ Kill chain analysis & construction
- ★ Analysis of, and assessments on next generation adversary capabilities & TTPs
- ★ Stay in-tune with industry advances

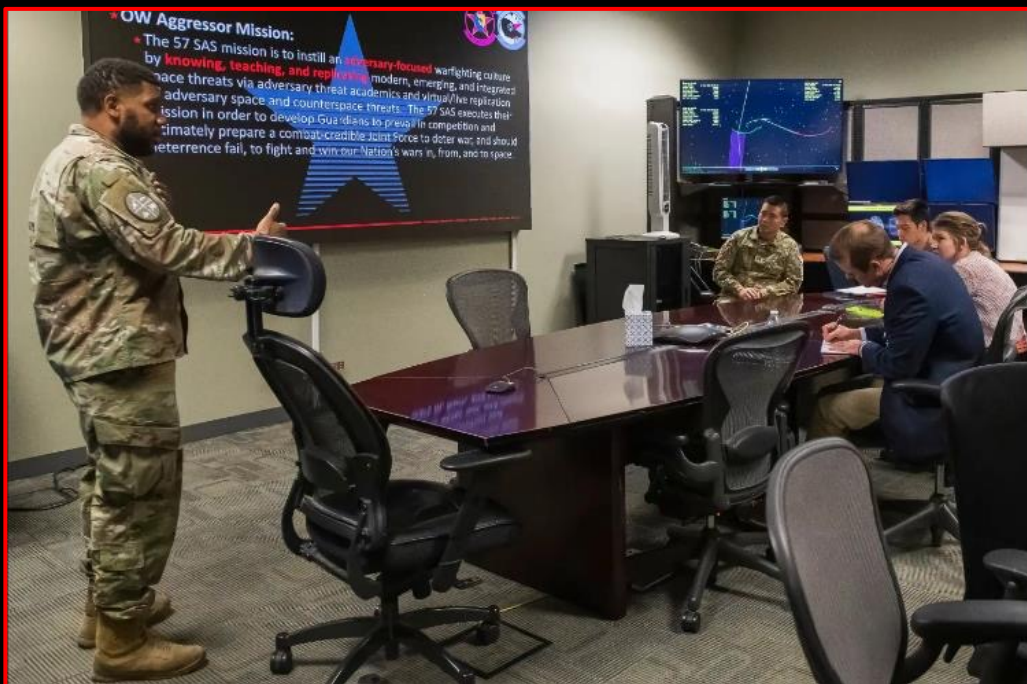


Develop Combat-Credible Guardians



57 SAS Mission

Teach



- ★ Develop and publish research requirements
- ★ Aid in exercise and test development
- ★ Active part of debriefing process during events/exercises
- ★ Advanced threat training
 - ★ Bridge space operators' knowledge gap on adversary capabilities



57 SAS Mission Replicate



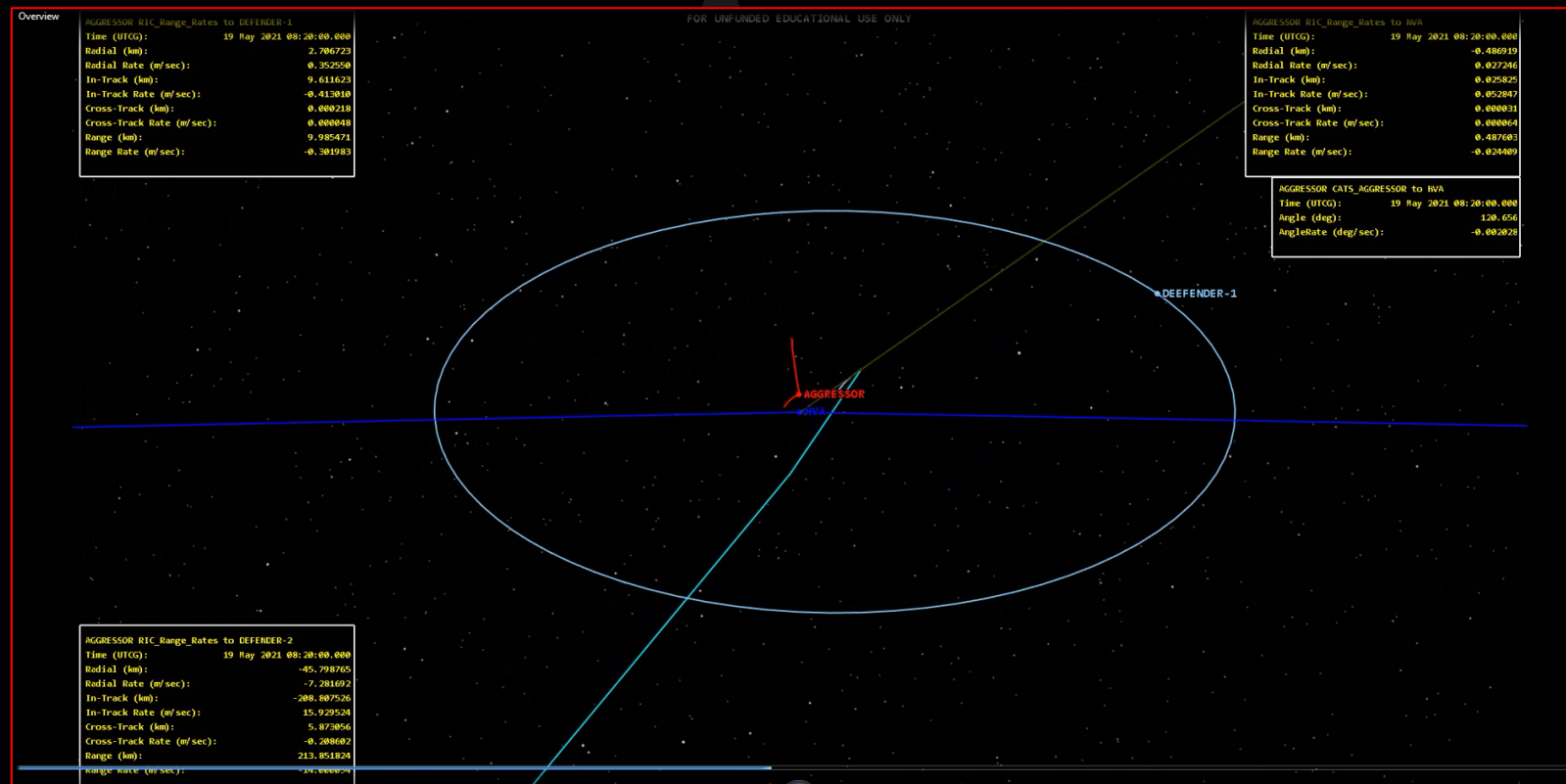
Orbital
Engagement
Systems

Anti-Satellite
Capabilities

Space Object
Surveillance &
Identification

Adversary HVAs

Adversary
BMC2



CSO LOE#1

- We must have range capacity and representative training devices capable of preparing Guardians to **engage a thinking adversary** in a realistic threat environment.
- A combat-credible force has demonstrated the ability to conduct offensive and defensive operations against an adversary

Develop Combat-Credible Guardians



CUI

Mission Execution



Core Exercises

- SPACE FLAG
 - 3 per Fiscal Year
 - 14-day execution, 8-member team
- OW CAPSTONE
 - 2 per Fiscal Year
 - 5-day execution, 5-member team
- WSDOM
 - 2 per Fiscal Year
 - 5-day execution, 4-member team
- WSINT
 - 2 per Fiscal Year
 - 21-day execution, 8-member team

**104 total days of mission
execution per year**

Advanced Training

- Squadron/Delta-level trng events
 - 3-4 day execution
 - 3-6 member team
- Current:
 - 328 WPS: 2 events/year
 - Delta 4: 2 events/year
 - Delta 9: 3 events/year
- Requested:
 - 9 CTS
 - 319 CTS
 - 392 CTS

Test Support

- Focused on threat replicative scenario development and OT&E exercises
- Threat Table Top Working Gp
 - SSC-led initiative
 - Next-Gen OPIR
- 3 TES Integrated Test Force
- Mission set expected to grow; must understand potential impact to 57 SAS baseline for support and replication rqmts

CUI



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Exercise Operations

- Combination of Mod/Sim & threat surrogate expertise
- Operations worldwide
 - INDOPACOM
 - EUCOM
 - Space Flag
 - AFWPS
 - Tactical Units





Replication LOE's



- On-Orbit Activities
 - Analysis of kinematic capabilities
 - Sub-system threat modeling
 - Trajectory optimization
 - Threat-based testing
- DA ASAT Replication
 - All domain threat simulations
 - Variety of means
 - Replication of left-of-launch actions
- Replication of adversarial Space Domain Awareness (SDA)
 - Optical
 - Radar
 - Space-based
 - Exquisite
 - Estimation of the uncertainty inherent with both blue and red systems
 - Sensor kill-chain analysis



Capability Gaps



- Software Solution Limitations
 - Locked behind standalone systems, paywalls, licensing structures
 - NOT Gov owned
 - Limited customizability to aggressor (and USSF) needs
- Mission Planning
 - Limited ability to iterate over large amounts of planning options
 - No inherent ability to quickly model complete SDA networks
 - Limited launch modeling capability
 - No Cislunar solution



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Lines of Effort



1. Co-Orbital Engagement Planner

- All regime
- Iteration-focused
- Data-rich

2. SDA Simulator

- Estimate Covariance Ellipsoid

3. Direct Ascent Protection Planner

4. Cislunar Trajectory Developer



Design Philosophy

1. Front-end Web-based

- All calculations in browser, max exportability

2. Three-click rule

3. SPEED

- 90% solution in 30 seconds can be more useful than 99% in 30 minutes

4. Iteration friendly

- Constant code-rewrites as aggregator needs become apparent and morph with changing customer demand



Coding Infrastructure



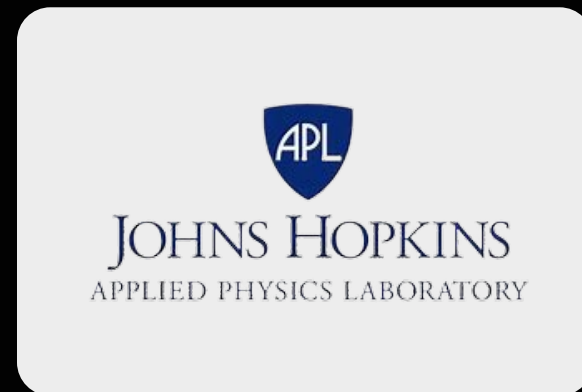
- JavaScript
- HTML
- CSS
- Only utilized library is MathJS specifically for higher-level algorithms



Results

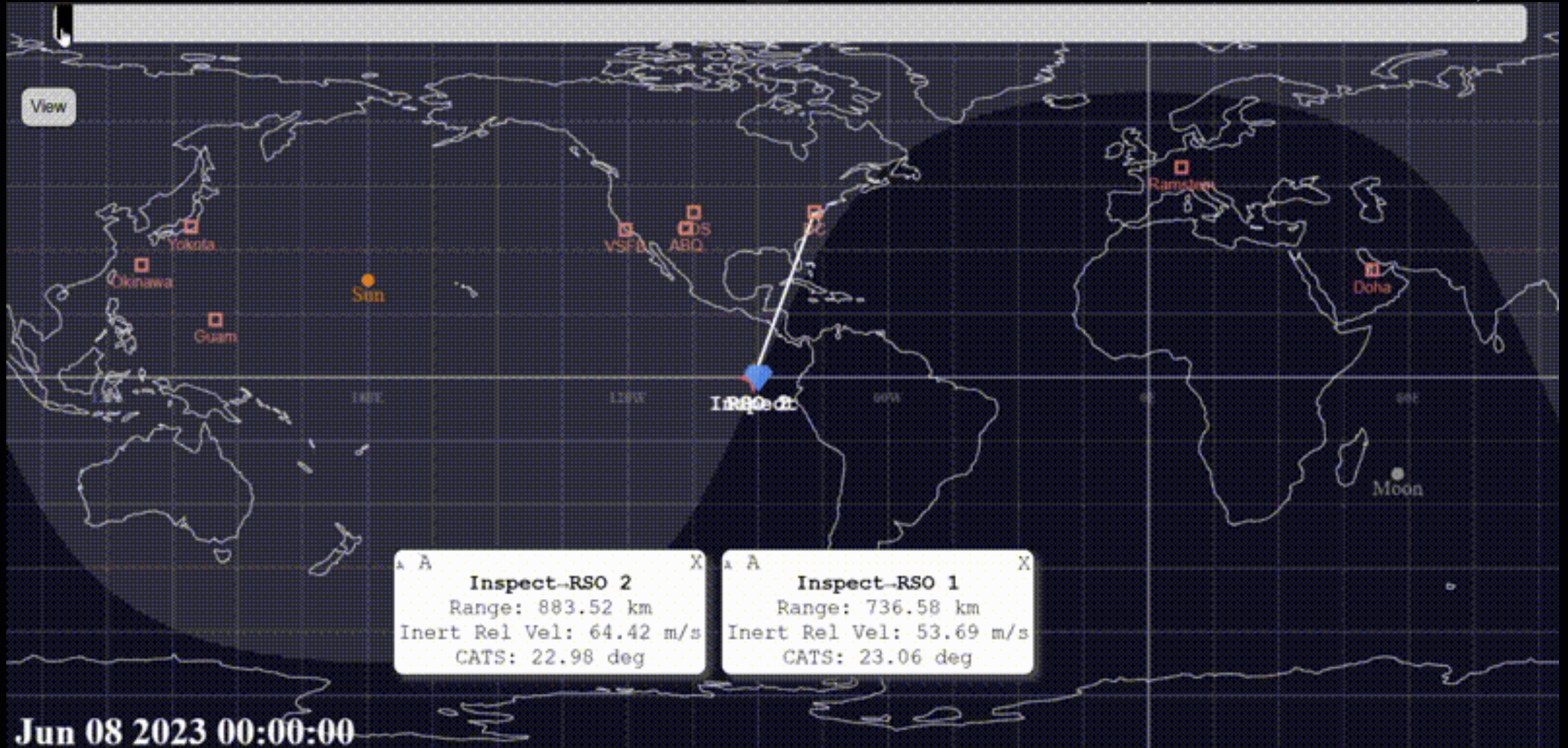


- ARTS as morphed into the 57 SAS' primary mission planning system for both mod/sim & live-fly operations
- Mission system has become ingrained in large force exercises within Delta 1, including the driving force behind implementation of SDA and uncertainty modeling
- Implementation for concept and test development within multiple orgs



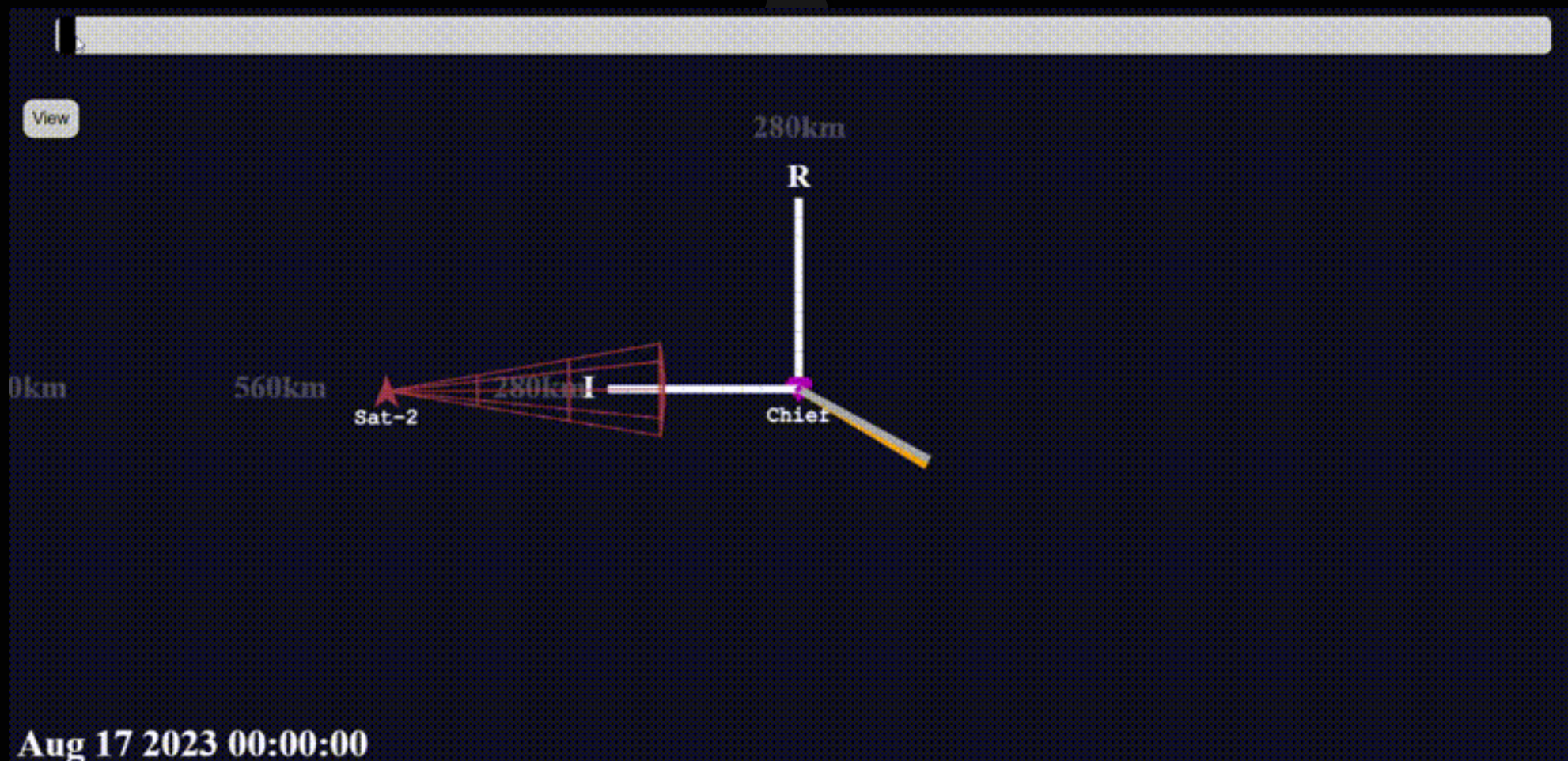


Results





Results





Results

OD Epoch 08/18/2023 05:27 AM

J2000 State

-or-

GEO Long

Create GEO Sat

Import .e

Display Map

Save Tasking

Task Name

Scaling Factor

100

%

ISSP

a: 42164.1 e: 0.0000 i: 0.0 Ω : 0.0 ω : 0.0 v: 48.2

6

hrs

Generate Obs

Estimate Covariance

Add Sensor

Cholesky Decomposition of Covariance

25.583388	X	X	X	X	X	0 hr 25.70 km
0.211518	1.059642	X	X	X	X	2 hr 49.82 km
-1.896243	-0.173299	1.031951	X	X	X	4 hr 98.27 km
0.002027	-0.000150	-0.000042	0.000192	X	X	6 hr 175.92 km
0.001120	0.000247	0.000039	-0.000163	0.000085	X	8 hr 279.71 km
0.000069	0.000007	0.000111	-0.000034	-0.000017	0.000080	10 hr 399.23 km
						12 hr 519.64 km

Socorro^{optical} Availability

Maui^{optical} Availability

Diego Garcia^{optical} Availability

Eglin^{radar} Availability

Clear^{radar} Availability

Cape Cod^{radar} Availability

Thule^{radar} Availability

Cavalier^{radar} Availability

Beale^{radar} Availability

Fylindales^{radar} Availability

Maui Radar^{radar} Availability

Kwajalein^{radar} Availability

Millstone^{radar} Availability

Leo-1^{radar} Availability Update State



Results





Results

Search Information

Start Time 06/24/2022 02:00 PM  z

Duration 12 hrs

Time Step 5 min

Sun Angle Limit ☐ 90 deg

Range Limit ☐ 100000 km

Target in Sunlight ☐

Apogee Adjustment ☐ 100% ☐

Calculate

Results

Site	Launch Time	Range	TOF	CATS	Azimuth	DOT	Display	
Middle Atlantic	2022-06-24 14:00:00z	38443 km	255.54 mins	148.2°	73.4°	0.905	Ground Track	STK
Middle Atlantic	2022-06-24 14:05:00z	38487 km	257.61 mins	149.2°	73.7°	0.907	Ground Track	STK
Middle Atlantic	2022-06-24 14:10:00z	38487 km	257.61 mins	150.2°	73.7°	0.907	Ground Track	STK
Middle Atlantic	2022-06-24 14:15:00z	38487 km	257.61 mins	151.2°	73.7°	0.907	Ground Track	STK
Middle Atlantic	2022-06-24 14:20:00z	38487 km	257.61 mins	152.2°	73.7°	0.907	Ground Track	STK
Middle Atlantic	2022-06-24 14:25:00z	38487 km	257.61 mins	153.2°	73.7°	0.907	Ground Track	STK
Middle Atlantic	2022-06-24 14:30:00z	38487 km	257.61 mins	154.2°	73.7°	0.907	Ground Track	STK
Middle Atlantic	2022-06-24 14:35:00z	38486 km	257.61 mins	155.1°	73.7°	0.907	Ground Track	STK



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Development Lessons Learned



- Colors of money
 - Operational units do not always have established pipeline for RTD&E funds which run many existing contracts
- Single-developer projects
 - Code review can be extended if development not done as a team
 - Code less organized
- Military assignment system
 - Contract timelines do not always line up well with military move timeline





Sustainment Timeline



- Summer 2023 – Partnership initiated
- 21 Aug-8 Sept – Code review with ICR engineers
- 11-15 Sept – ICR meetings with 57 SAS operators for user story generation
- Oct – ICR reps attend aggressor missions
- Oct-Feb 2024 – Active dev with current funding





Sustainment Goals



1. Functionality unchanged
2. Host application at all relevant security levels
3. Build data pipelines (UDL, owner/operator feeds)
4. Perfect Application UI
5. Additional 57 SAS requirements
6. Additional USSF requirements





Questions?