



Federal Aviation  
Administration

# Next**GEN**

## Space Vehicle Operations (SVO)

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Date: 7/12/17

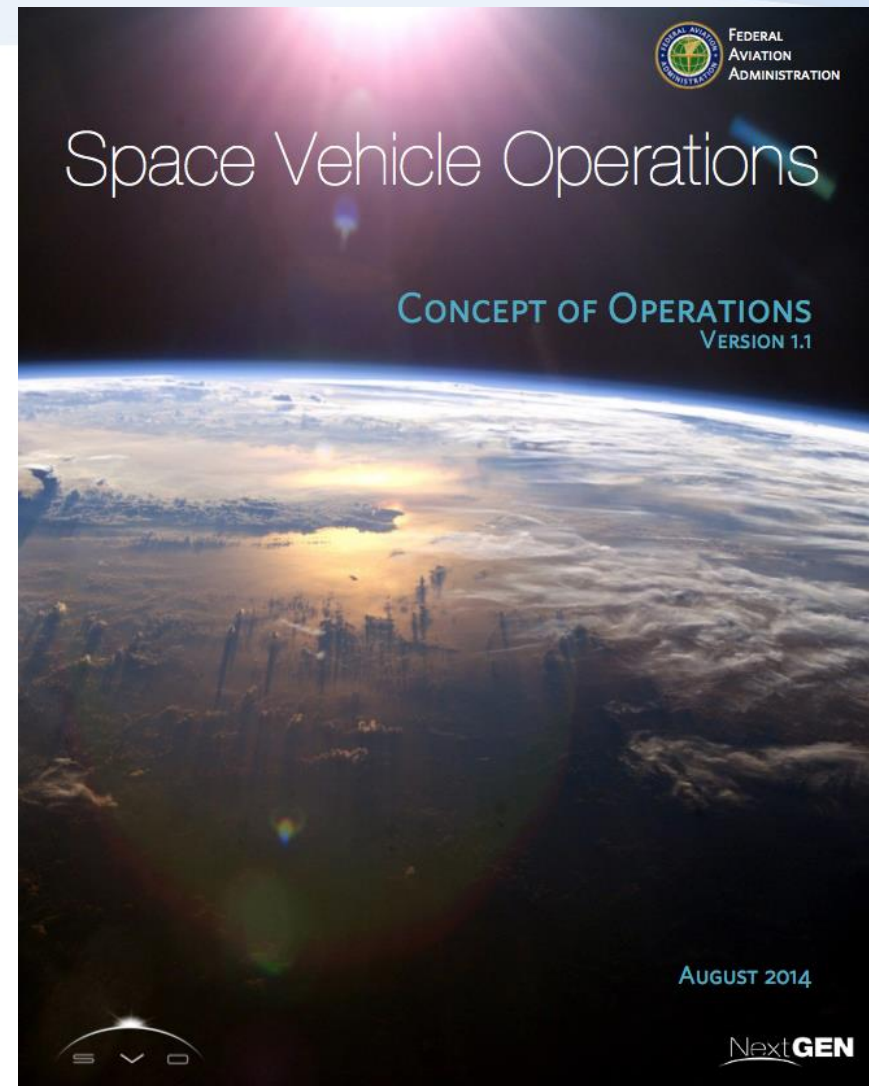


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# NextGen SVO Concept

The NextGen Space Vehicle Operations Concept of Operations identifies new procedures and capabilities that are envisioned to improve the management of space launch and recovery missions in the NAS.



# SVO Concept Outcomes

## CAPABILITIES

- Real-time vehicle tracking
- Real-time vehicle health status
- Real-time projection of debris
- Dynamic response capability for debris threats



## IMPROVEMENTS

- Smaller hazard areas
- Reduced duration of airspace closures
- Fewer aircraft need reroutes
- Less NAS impact



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# Background

## NAS Shortfalls

### PLANNING

FAA currently lacks sufficient capabilities to accurately model NAS impact of space vehicle operations during the planning phase.

### TRACKING

Lack of real-time space vehicle tracking capabilities in FAA systems results in decreased efficiency and missed opportunities for improved safety methods.

### AIRSPACE

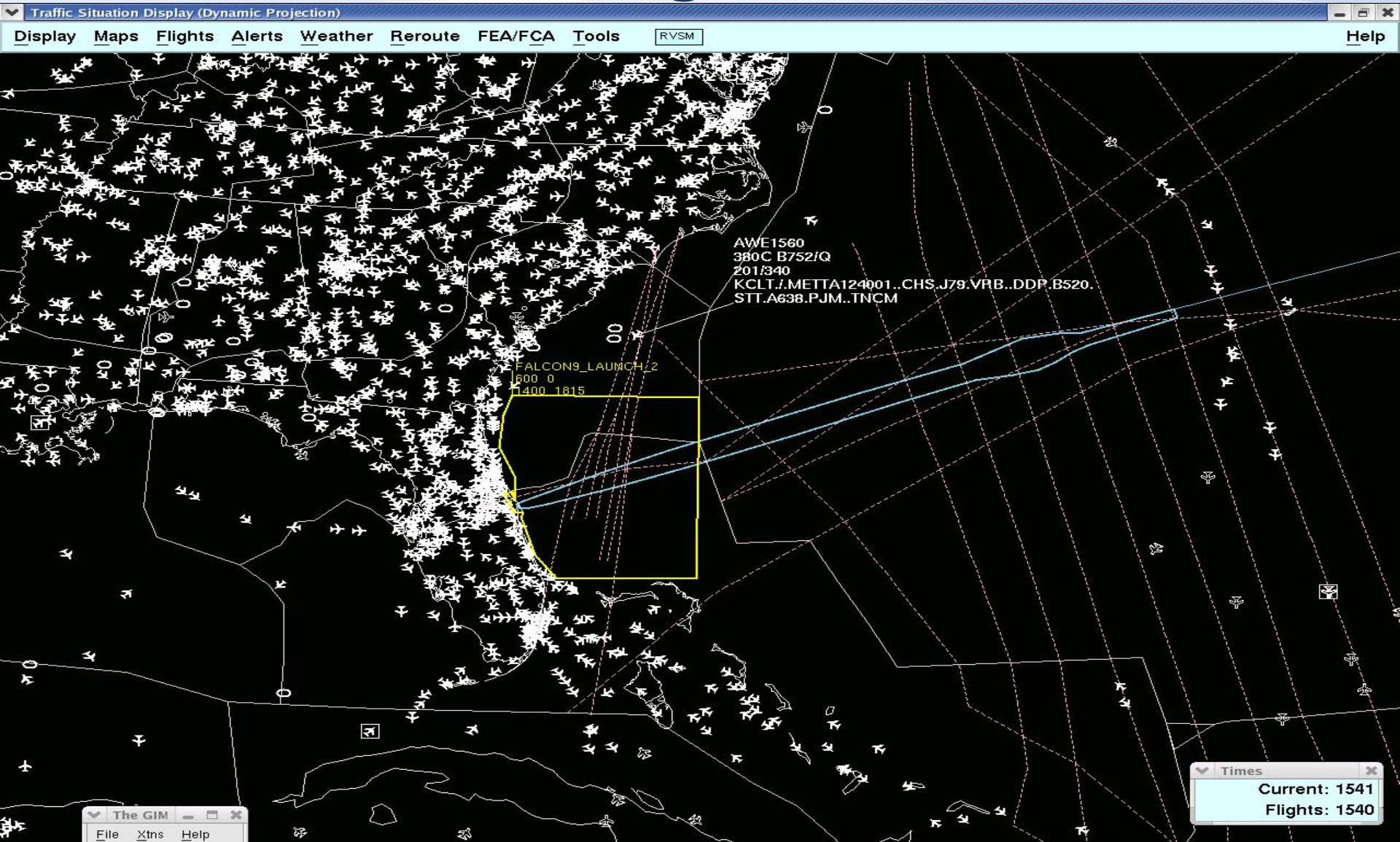
FAA currently employs airspace management approaches that include closing relatively large volumes of airspace for significant lengths of time during launch and re-entry operations.

### DEBRIS

FAA currently lacks a real-time debris threat response capability.



# Background

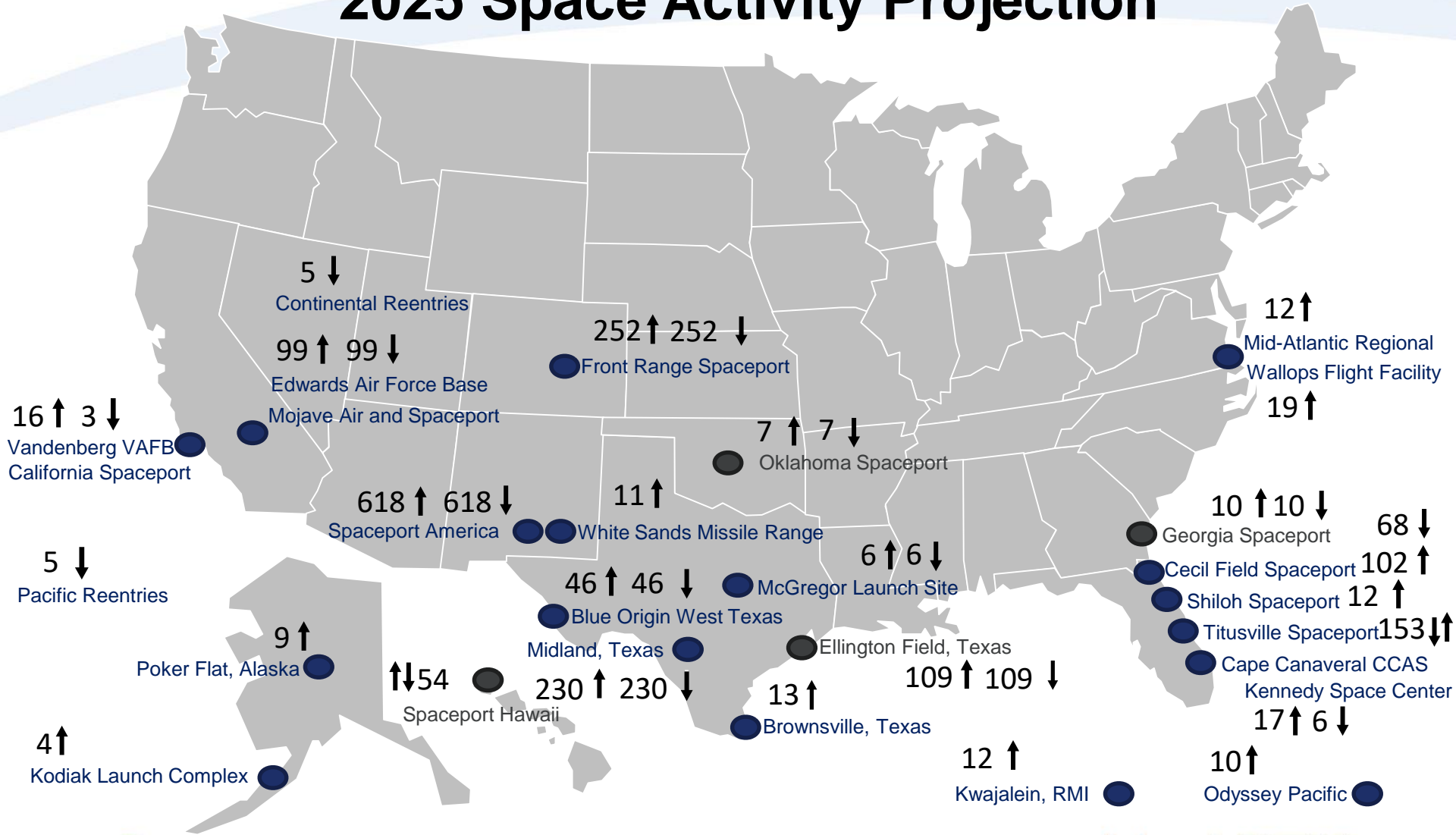


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# Background

## 2025 Space Activity Projection



↑ = Launch (over 1,800)  
↓ = Landing/Recovery (over 1,600)

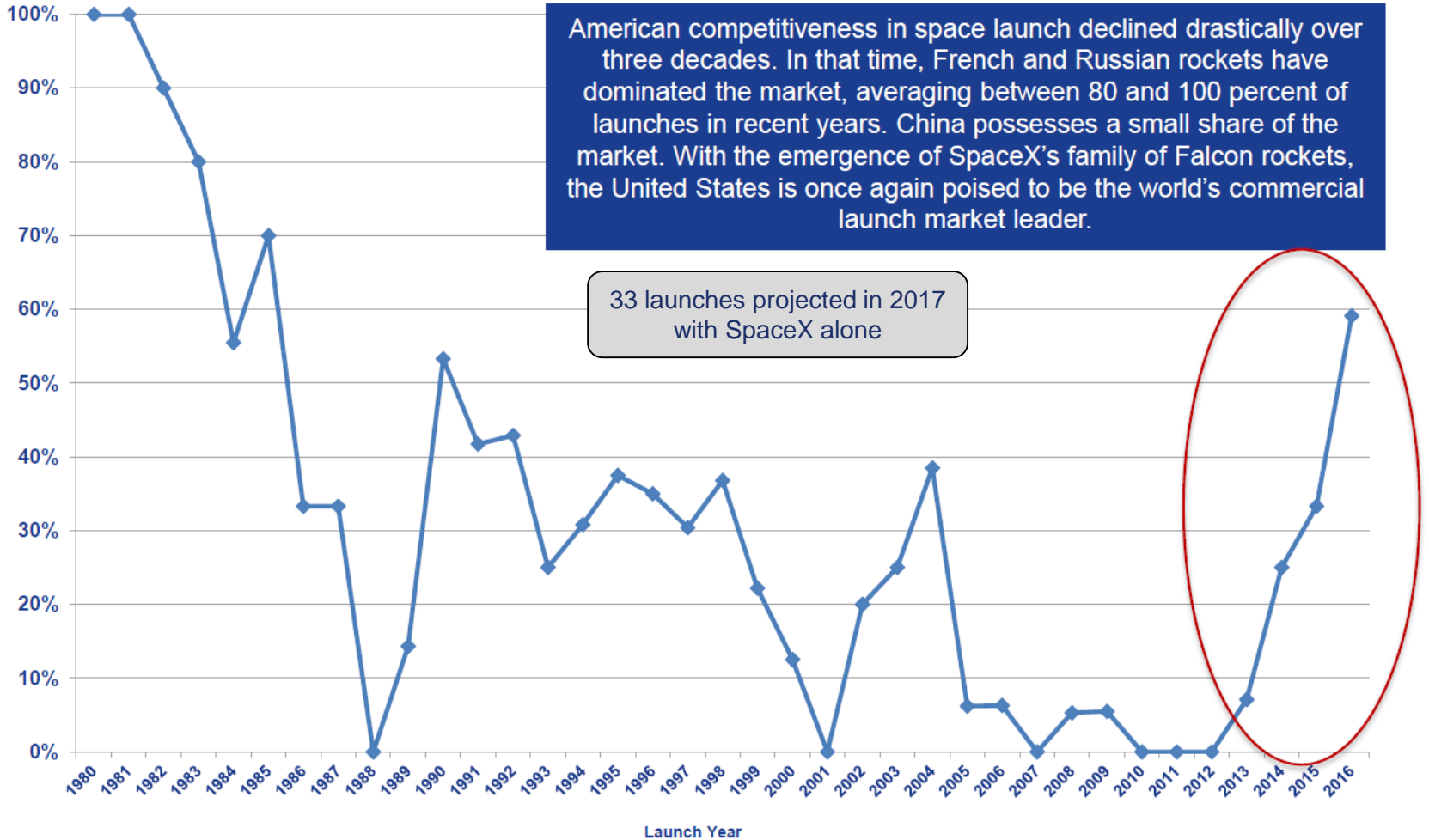


# Background

## Bringing Commercial Launch Back to the U.S.

American competitiveness in space launch declined drastically over three decades. In that time, French and Russian rockets have dominated the market, averaging between 80 and 100 percent of launches in recent years. China possesses a small share of the market. With the emergence of SpaceX's family of Falcon rockets, the United States is once again poised to be the world's commercial launch market leader.

33 launches projected in 2017 with SpaceX alone



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# Concept Solution

## Hazard Risk Assessment and Management (HRAM)

- Improved automation and data exchange
- Real-time space vehicle data to ATC
  - Operator telemetry (e.g. Space Data Integrator)
  - ADS-B
- Accident response
  - Debris Hazard Volumes (DHV) - AHA
- Aircraft-space vehicle separation
  - Space transition corridors (STC) - AHA
  - Planning volume
    - For traffic managers, not controllers
    - Gives situational awareness

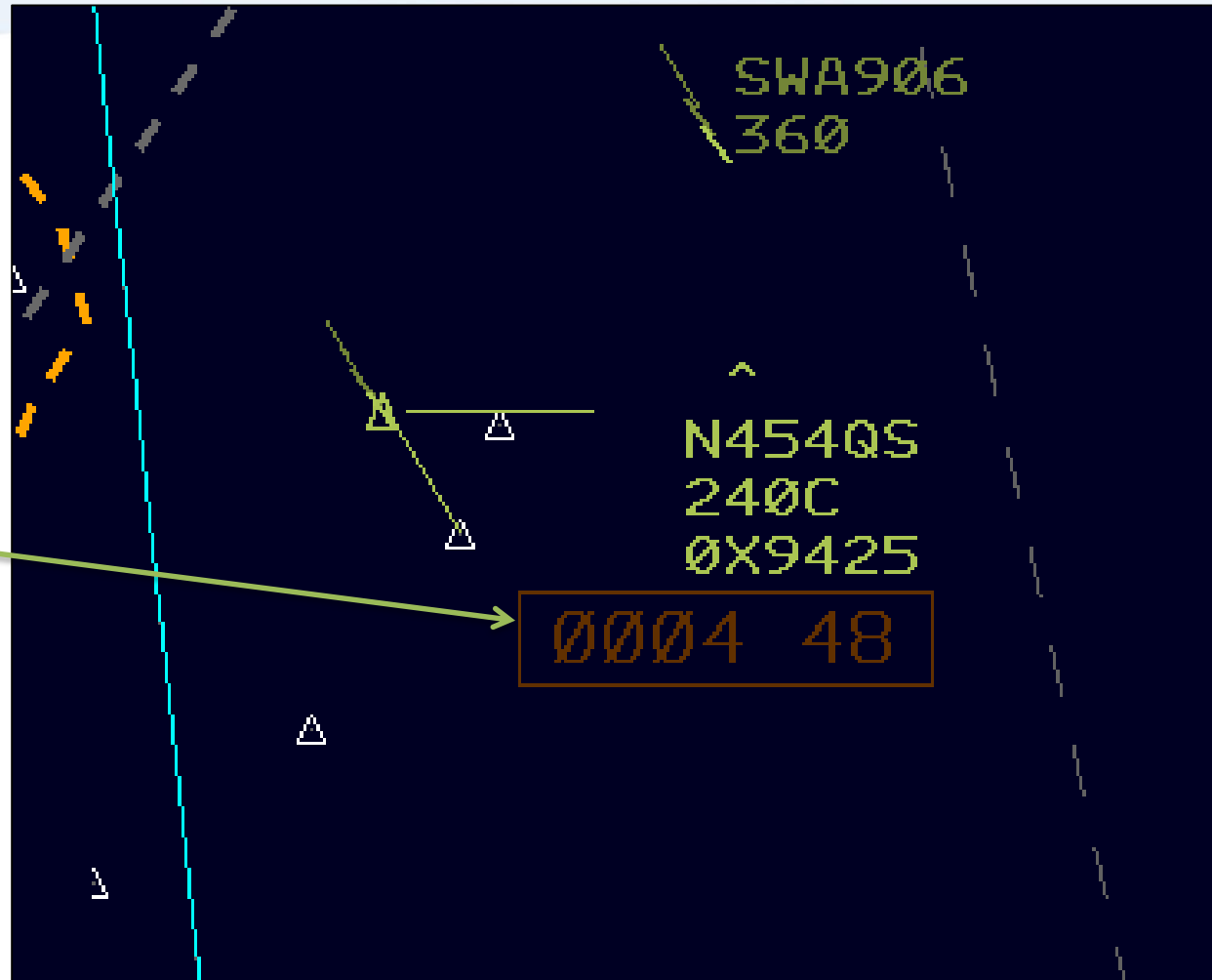




# STC – Pre-Activation

## COUNTDOWN TIMER

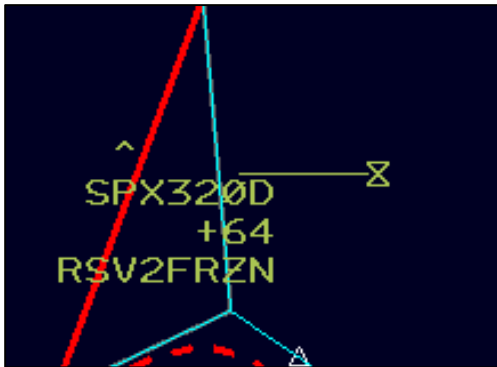
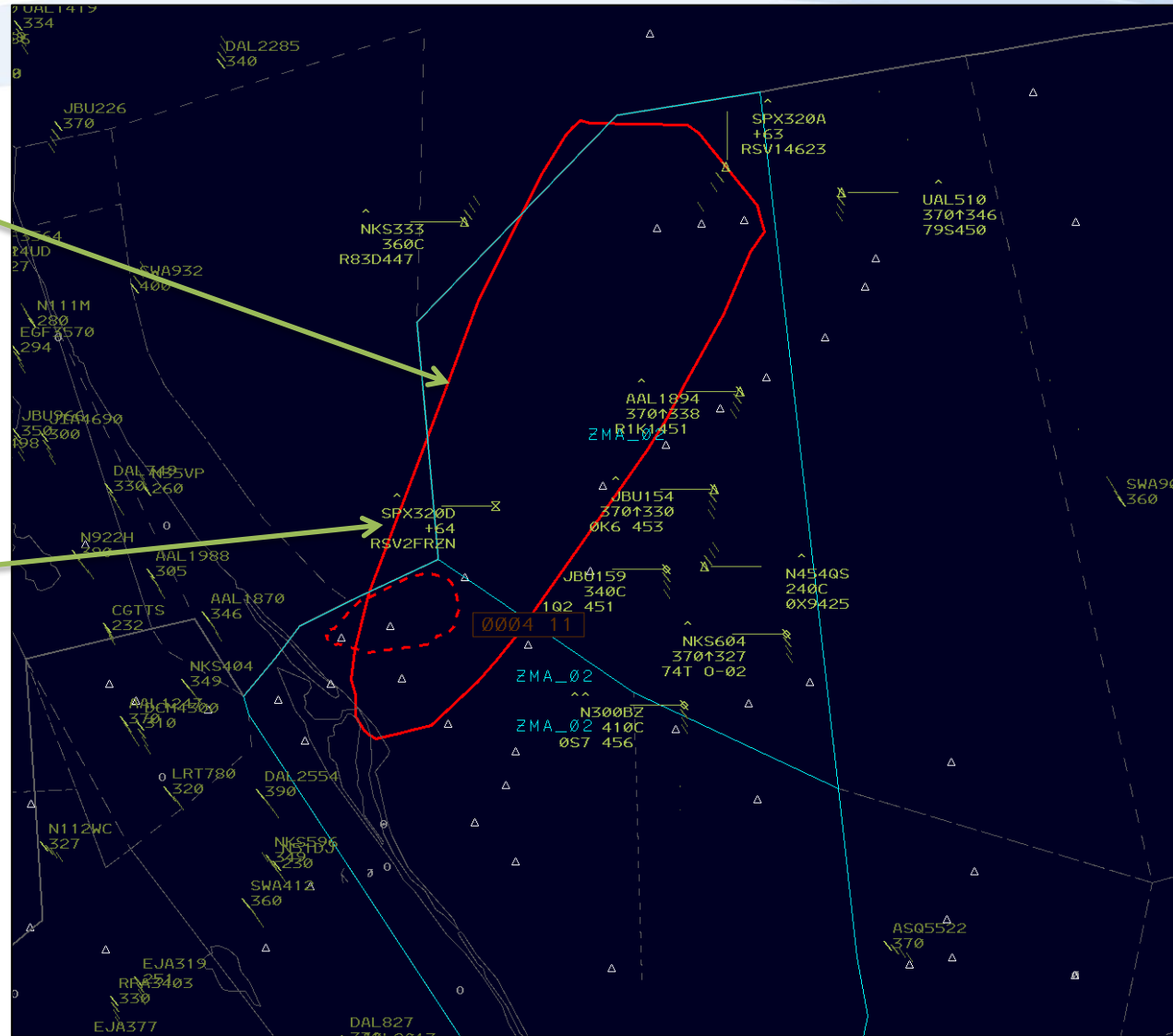
- Time remaining until launch/recovery in red
- Starts at T minus 10:00 minutes
- STC is “HOT” when countdown reaches 00:00



# STC – Active

## ACTIVE STC

- Solid red boundary
  - NO Aircraft in STC
- 
- Full data block
  - 1-second update



# Space Vehicle Data Block on ERAM

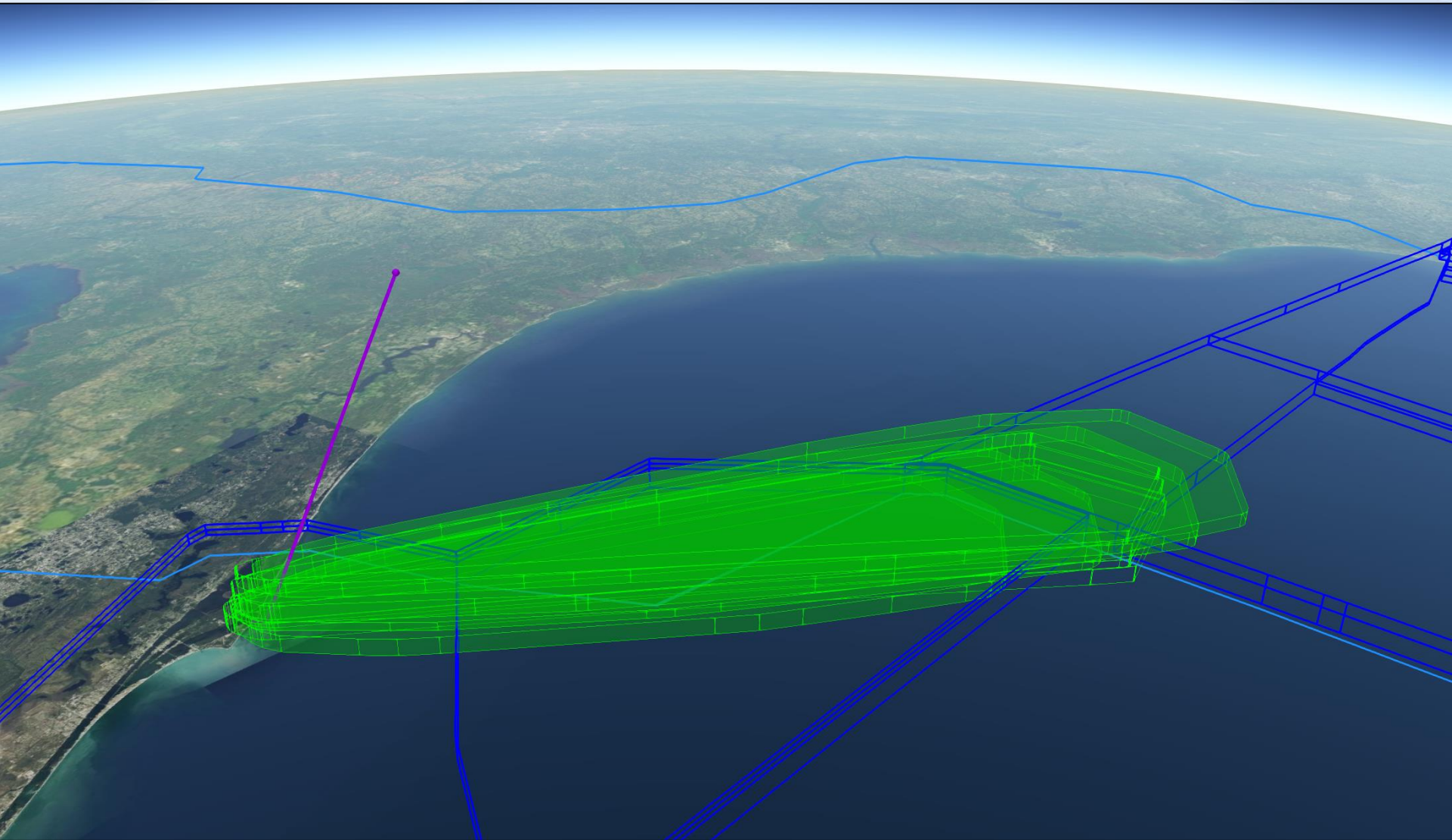


Above 100,000 feet:  
“+” followed by  
altitude in

**Tens of Thousands**

+16 = 160,000 feet

# STC 3D Model – NIEC Web Platform

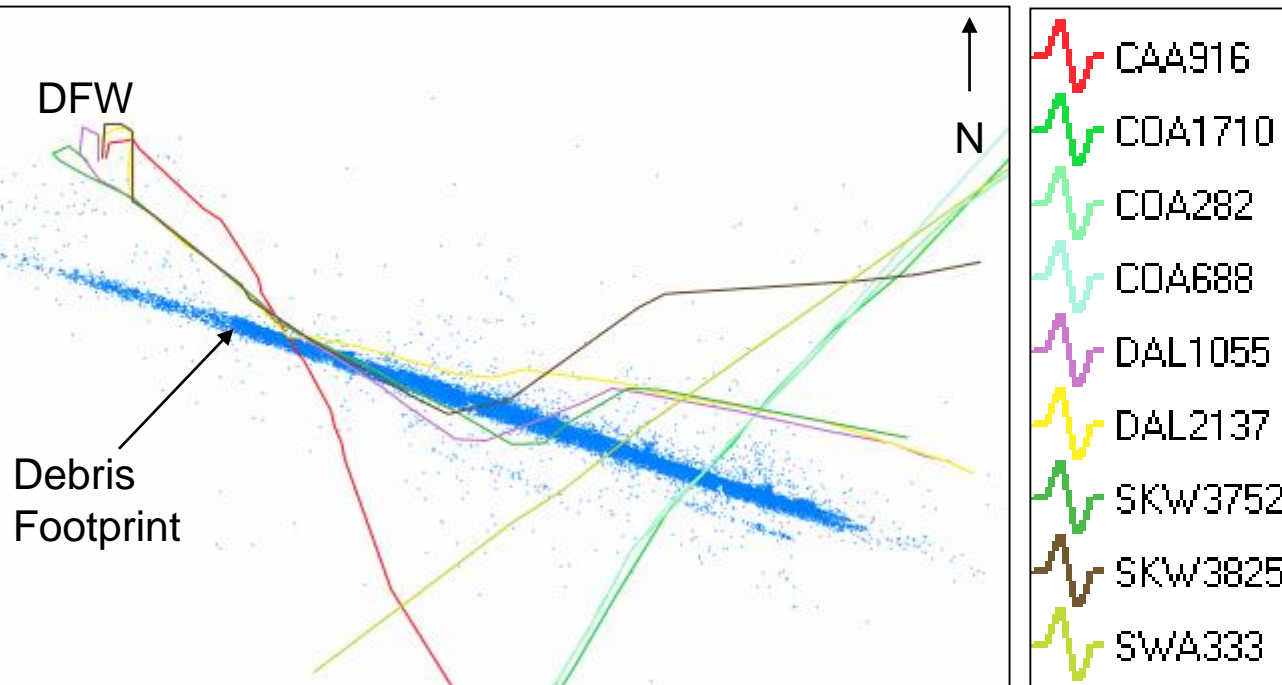


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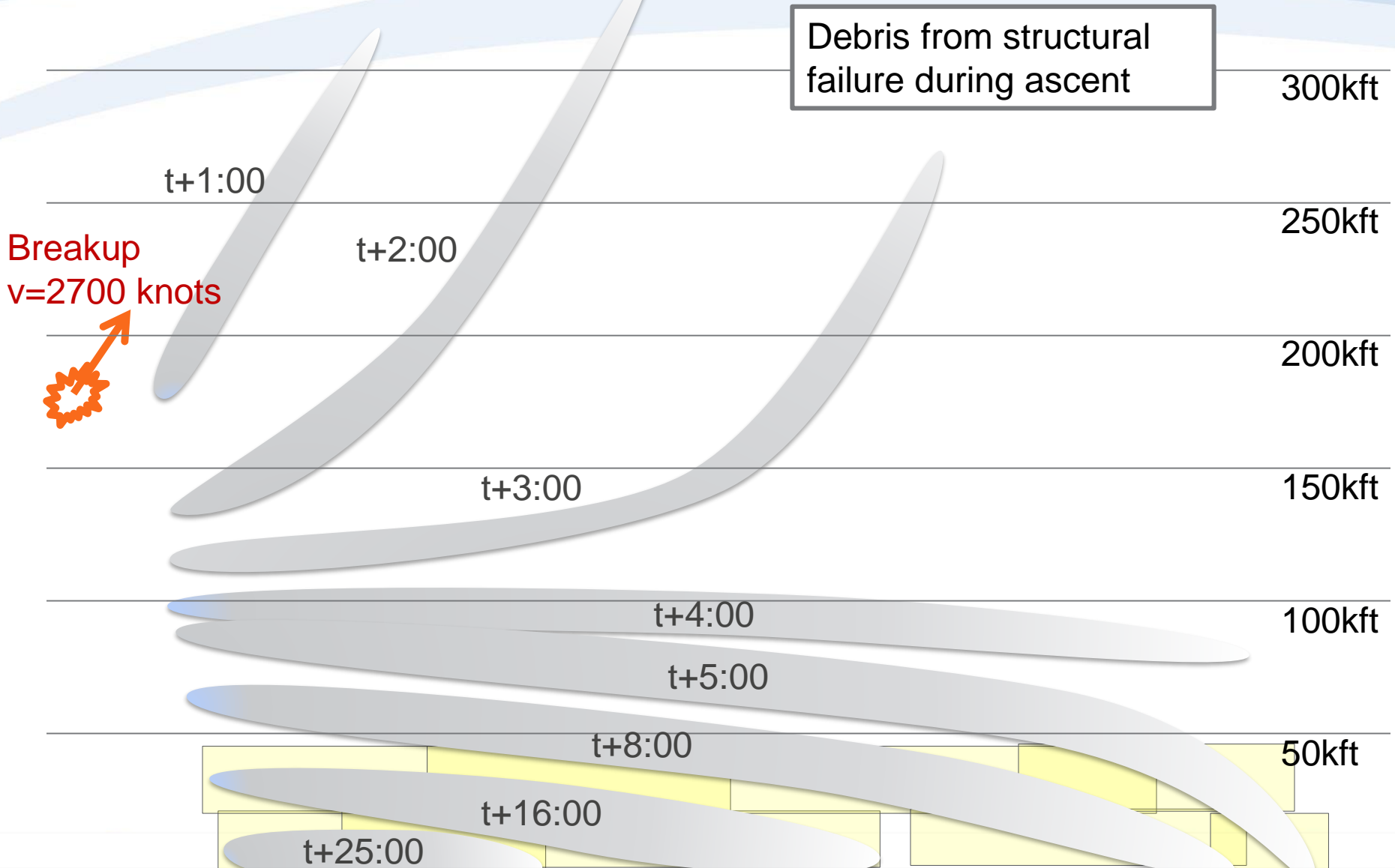
- The 2003 Columbia accident illustrated a need to better manage the risk to aircraft flying near the potential debris hazard associated with space vehicle operations
- FAA ATO procedures existed for Shuttle landings prior to Columbia, but they did not address the hazards to aircraft of falling debris



These are some of the aircraft that flew through the falling debris during the approximately 90 minutes that it was falling

# Animation of Debris Fall

Debris from structural failure during ascent

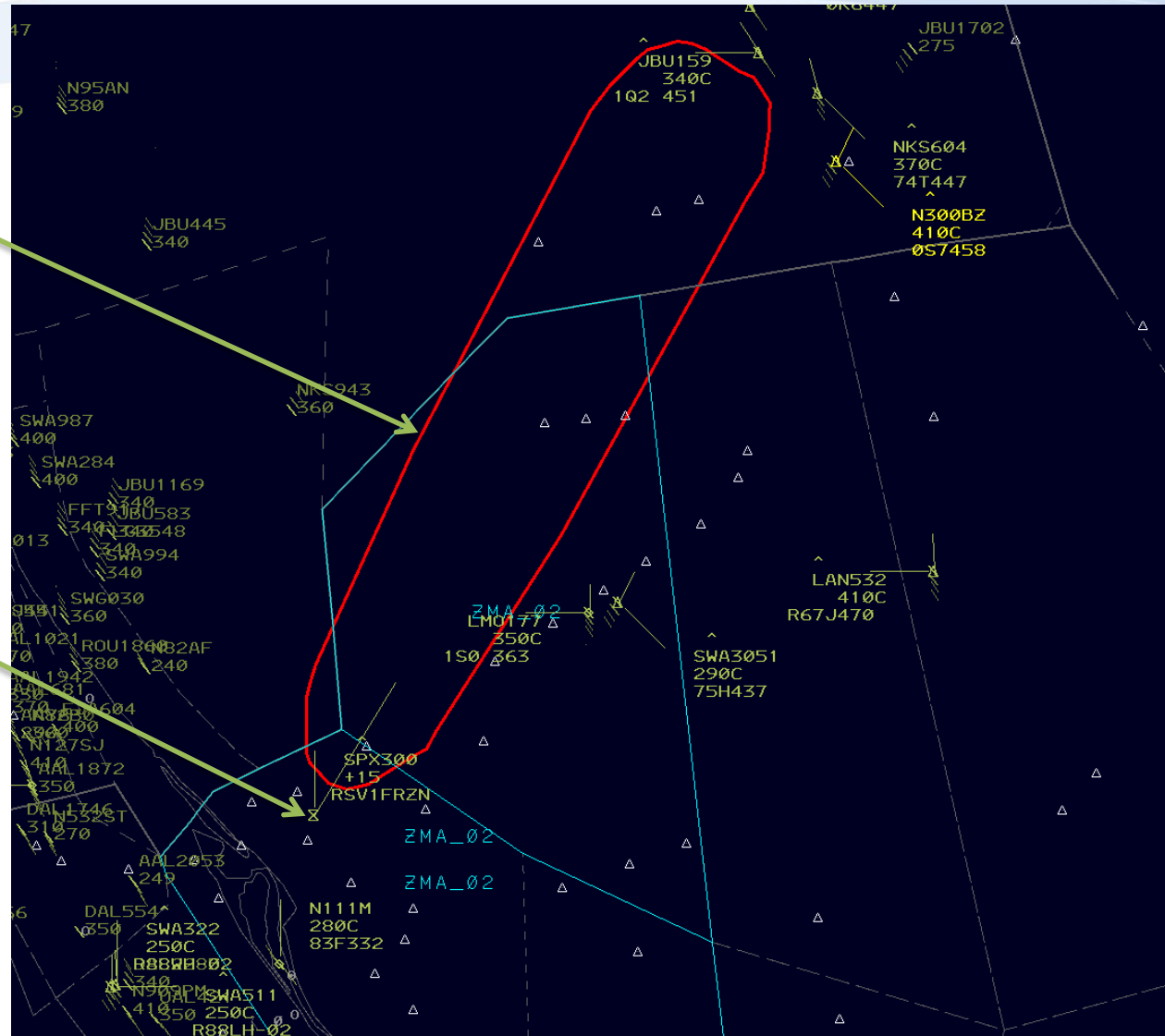


# Debris Hazard Volume - AHA

## ACTIVE DHV

- Solid red boundary
- NO Aircraft in DHV

Space Vehicle data block shows last known altitude and speed before breakup



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# Placeholder for CRS7 Angled Animation



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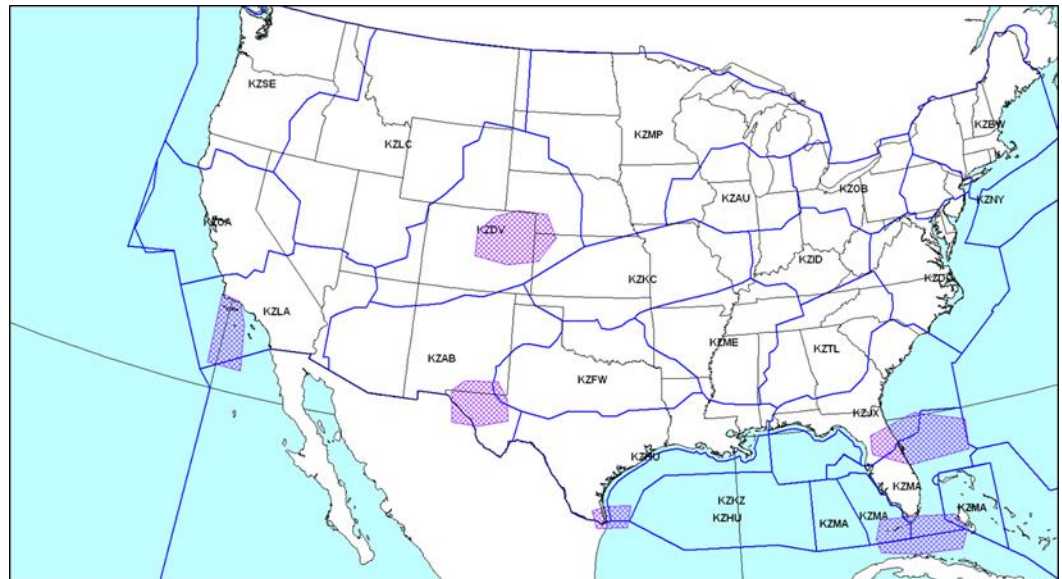
# Current Research

## Failure Mode Analysis

- Locations selected to represent different airspace regions
- Fifteen preliminary scenarios identified
- Preliminary facility briefs to ATC SMEs at ZMA and ZLA

## ConOps Update

- Identifying updated procedures and capabilities that are envisioned to improve the management of space launch and recovery missions



# Future Research

## Space Vehicle Data Exchange and Architecture

Data exchange processing needs and format from operator

## Multiple Phase of Flight NAS Impact Analysis

- Launch
- EnRoute – Transition Flight Trajectory
- Re-Entry/Recovery

## Multiple Vehicle Type Data Modeling and Analysis

Expansion of vehicle type data for HRAM modeling

## SVO ConUse Document

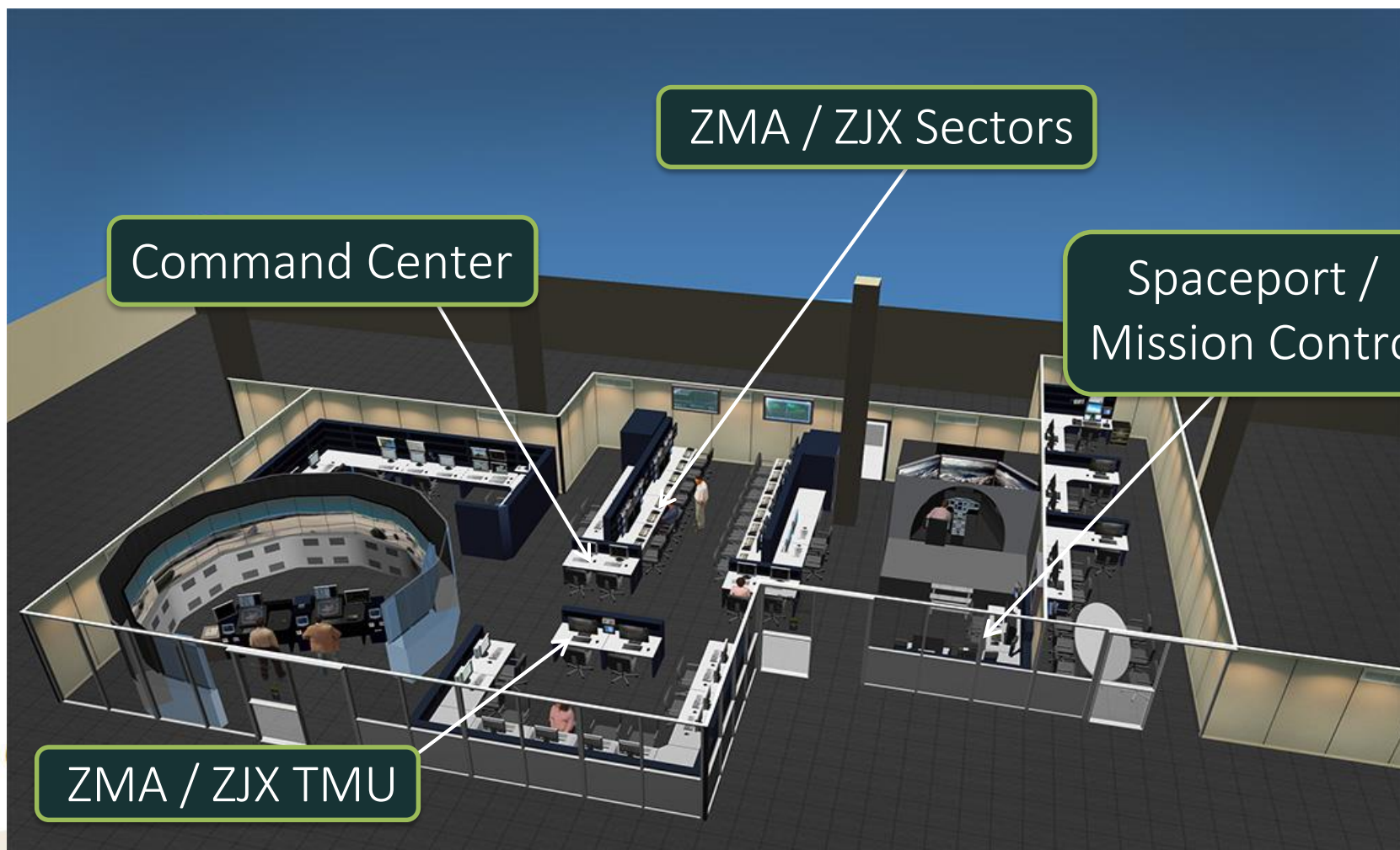
- Field requirements
- Procedures
- Initial display
- ARTCC, TRACON, Oceanic debris threat response capability



# Upcoming Research

East Coast Scenario Human-in-the-Loop with HRAM and SDI Prototype

Integration of the HRAM and SDI integration systems through a demonstration conducted at the NIEC Lab



# Thank You!



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