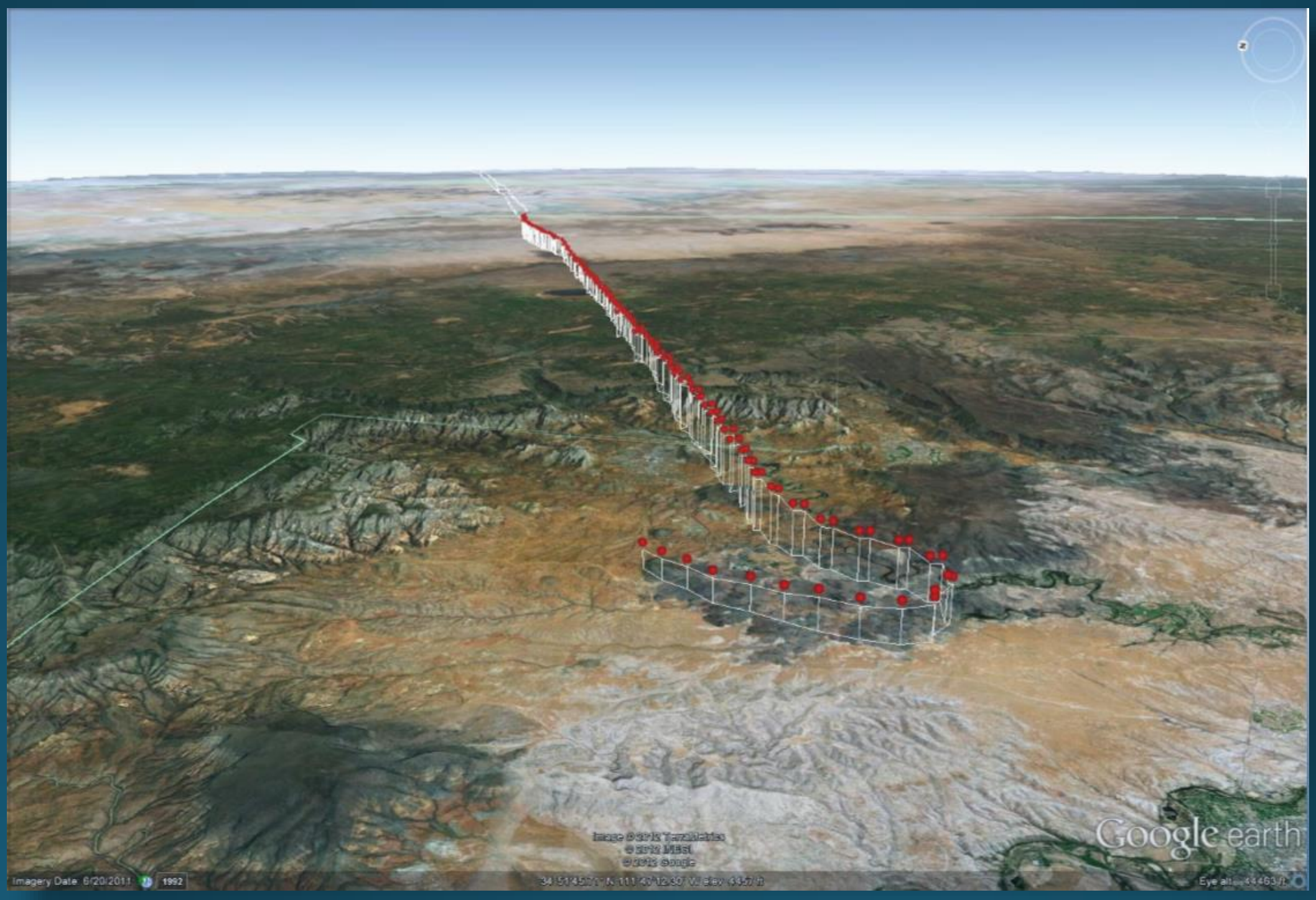
Civil Air Patrol

National Radar Analysis Team

CAP-NRAT

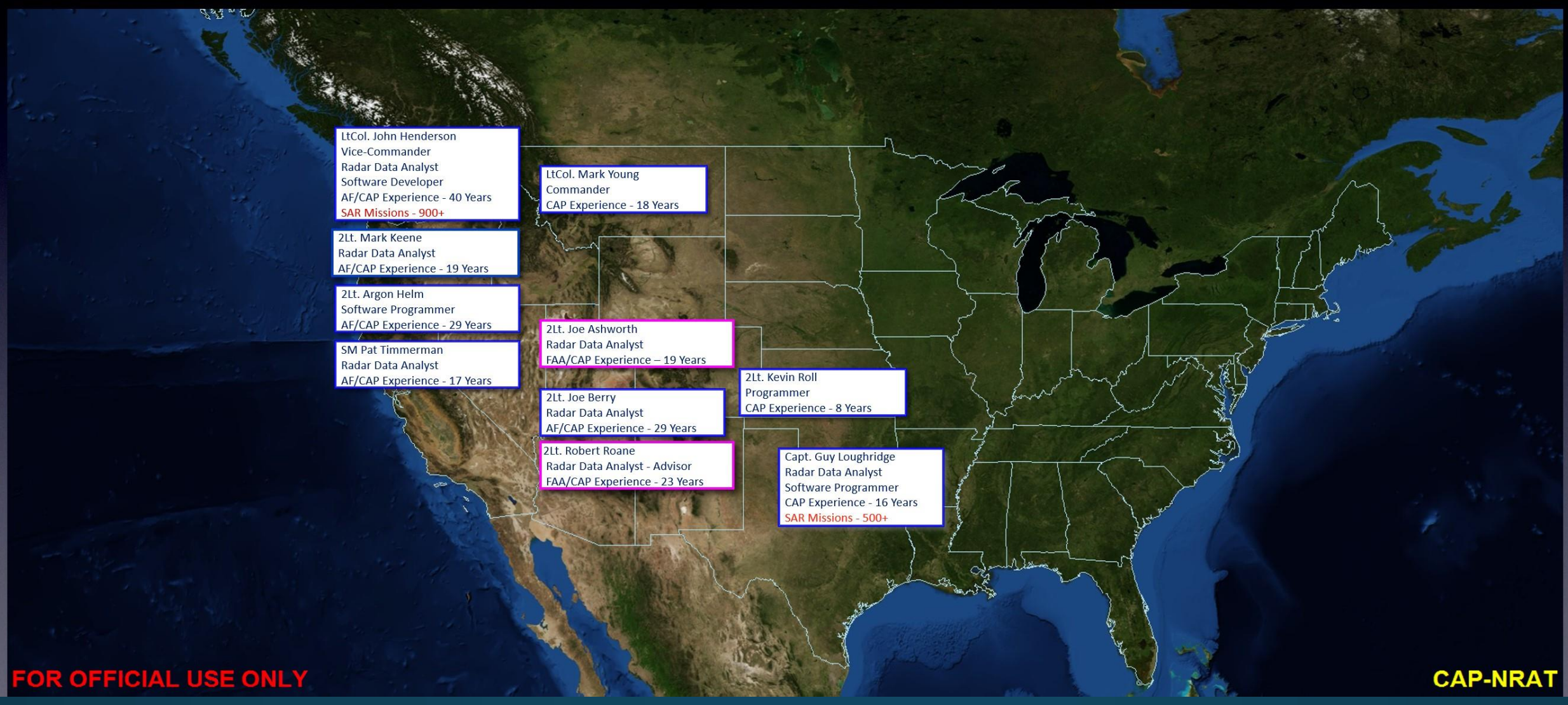
NHQ-008

History and Capabilities
2020 Update



CAP National Radar Analysis Team (NRAT)

The Team



NRAT Team History

The CAP-NRAT team was formed in 2009 by LtCol. John Henderson and Capt. Guy Loughridge. These two individuals have supported the Air Force Rescue Coordination Center (AFRCC) since 2000 with SAR radar forensics; John through a function of the Air Force's 84th RADES, and Guy as a CAP member. After working together on over 400 SAR missions, they decided that by leveraging their different areas of expertise, and gathering others from across the country, they could significantly shorten the 'crash-to-rescue' chain. This all-volunteer team was first sponsored by CAP's Rocky Mountain Region, and now the National Headquarters; providing NRAT with needed servers and analysis computers. Argon Helm, another 84th RADES member and talented radar engineer and software programmer, joined the team early; and together with Guy Loughridge, produce most of the teams unique software tools. The current team has grown to ten, hand-picked for their high level of expertise in radar, aviation, and computer science. Most have Air Force and FAA backgrounds.

Success Story - 1



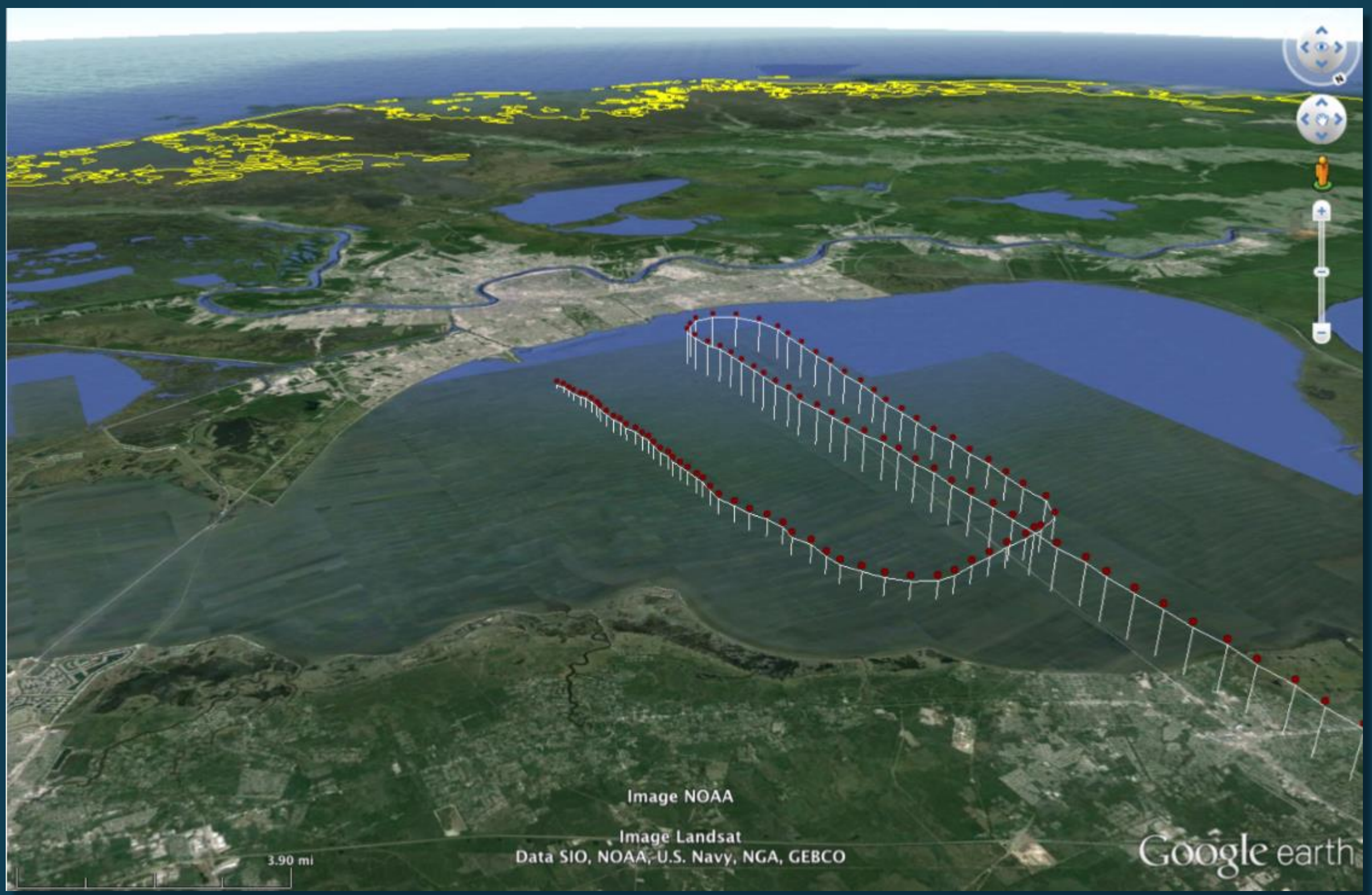
Mission 12-M-0582A
20 September 2012

While vacationing in Hawaii, Guy Loughridge received an alert on a missing aircraft flying from Baytown, TX to Sarasota, FL. Guy was able to use the team's rapid data request process to quickly receive the needed radar data, and quickly located the missing aircraft. Using the team-developed software's 'terrain probe' function, Guy was able to pinpoint a probable crash area, and assist the Coast Guard in locating the two survivors, in the water, just before sunset.

Without this quick access to NRAT radar data, actionable analysis results would have been several hours later.

If our new (currently in development) system called ICARUS had been in place, rescuers would have known within 20 minutes of hitting the water, that there was the probable of a crash.

Success Story - 2

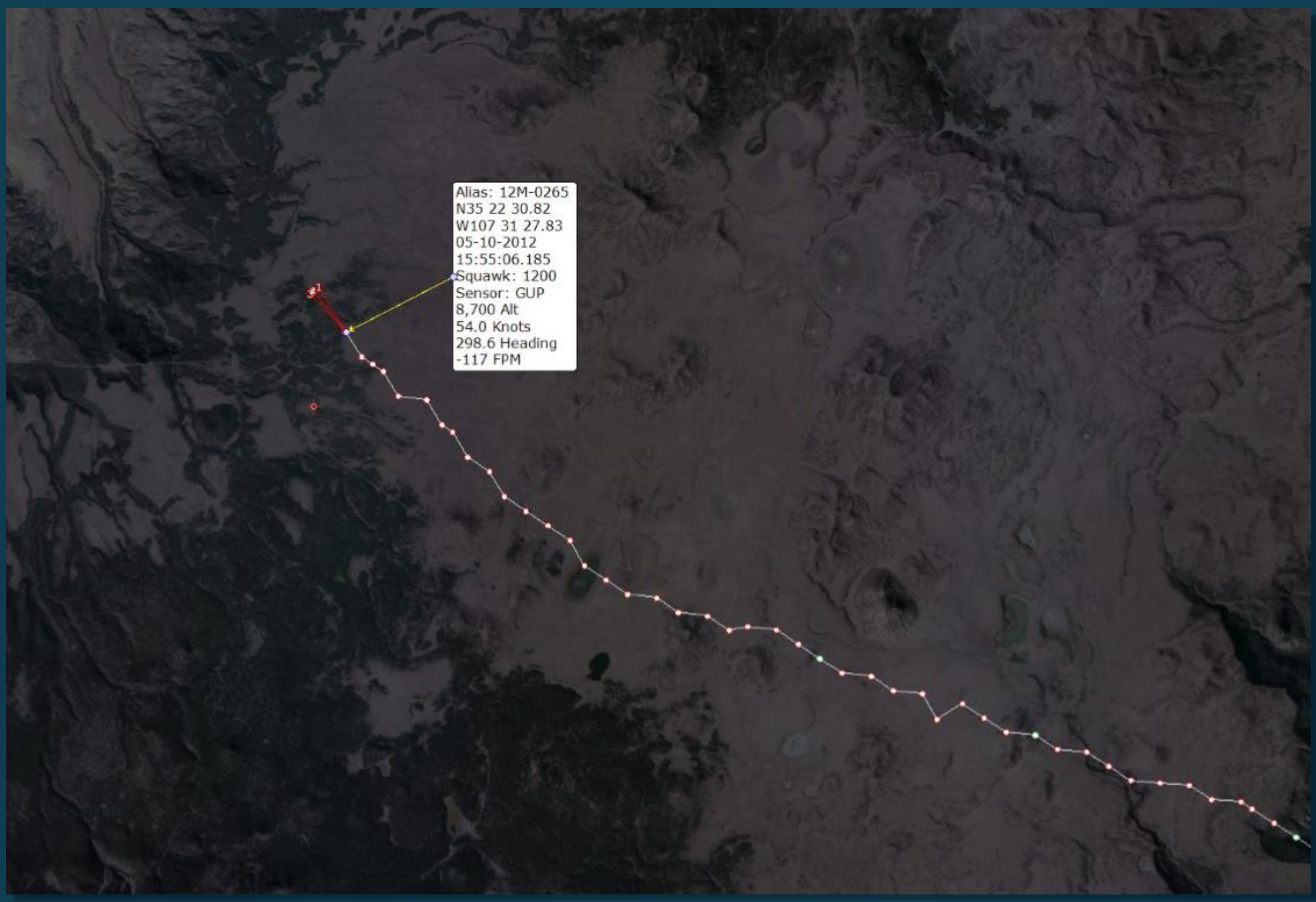


Coast Guard Request
24 January 2010

John Henderson received a request for radar analysis to assist the Coast Guard in locating a missing Navy T-34 single engine trainer, that had disappeared over Lake Pontchartrain while making a night-time instrument approach into Lakefront airport near New Orleans. Quick analysis pinpointed a probable crash location which assisted the Coast Guard in locating the surviving student pilot; unfortunately, the instructor pilot did not survive.

ICARUS could have alerted very quickly, shortening the ‘crash-to-rescue’ time and possibly saved the instructor.

Success Story - 3

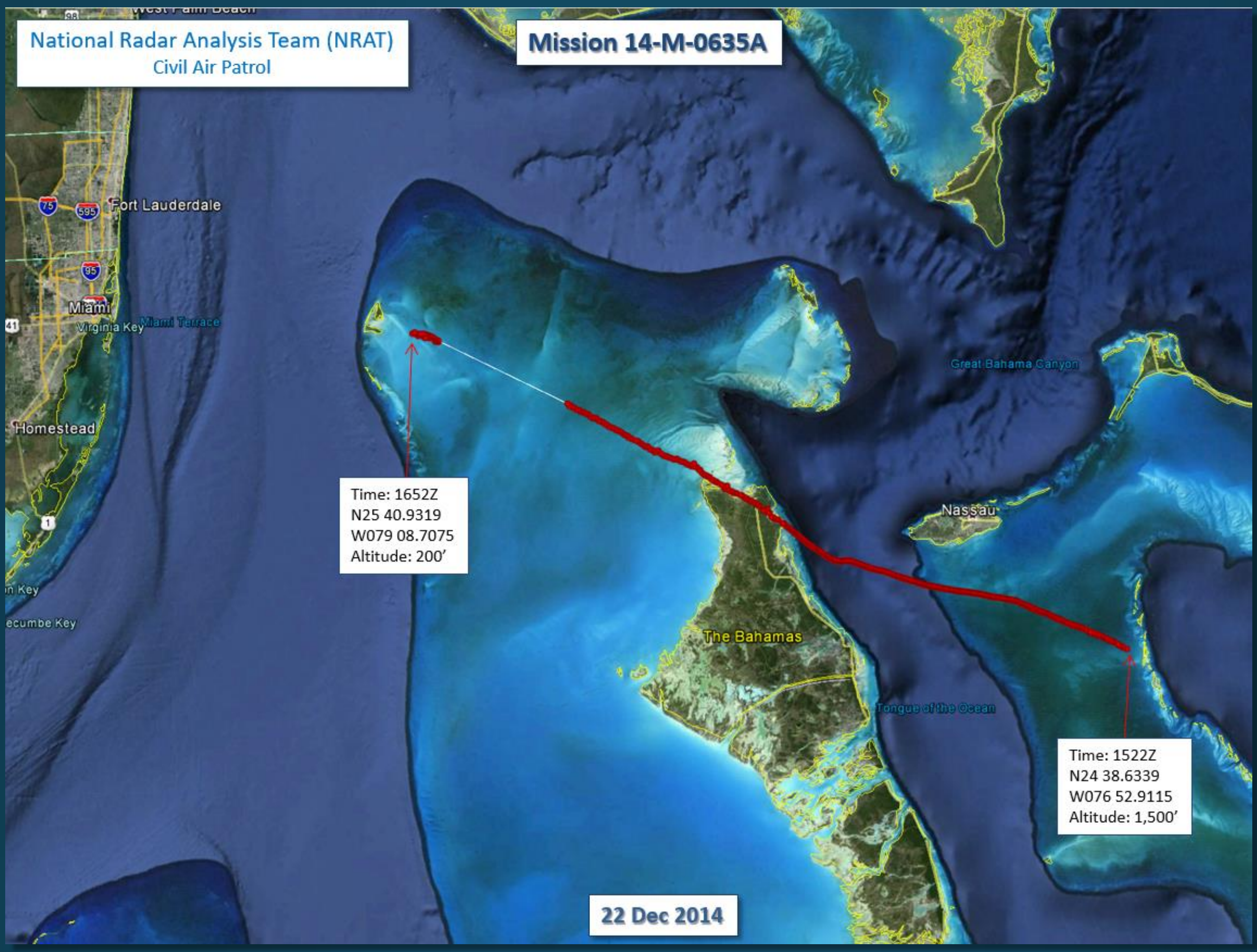


Mission 12-M-0265
10 May 2012

John Henderson received an alert from AFRCC for a missing Robinson R44 helicopter flying from Albuquerque, NM to Page, AZ. Quick reaction, using ARGUS, the team-developed analysis tool's terrain probe function, pin-pointed a probable crash location and both pilots were rescued. The aircraft had developed engine problems and made a hard emergency landing severely damaging the helicopter. The crash occurred in a remote, high desert location.

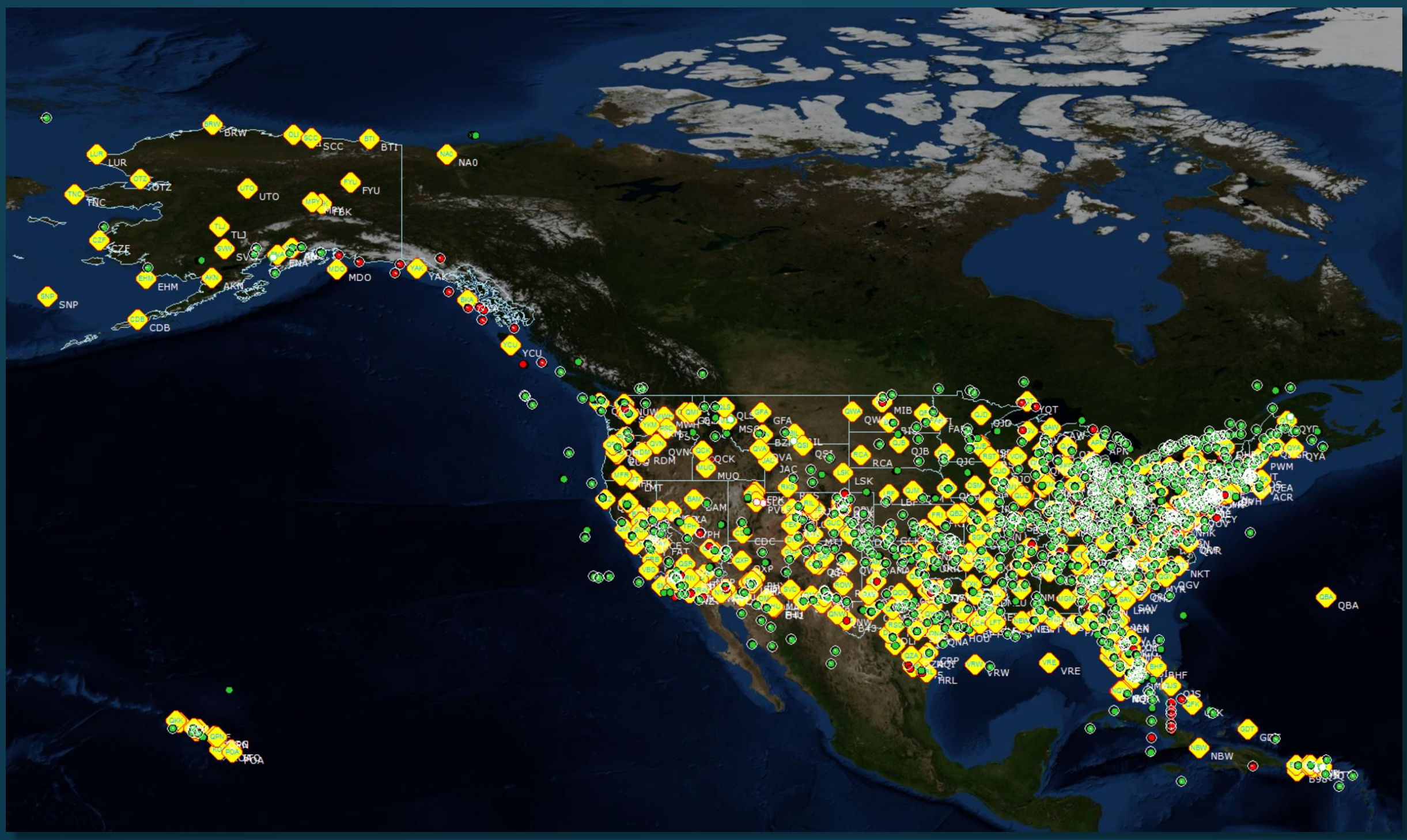
ICARUS would have alerted on this crash as well, and cut hours off the 'crash-to-rescue' time.

Success Story - 4



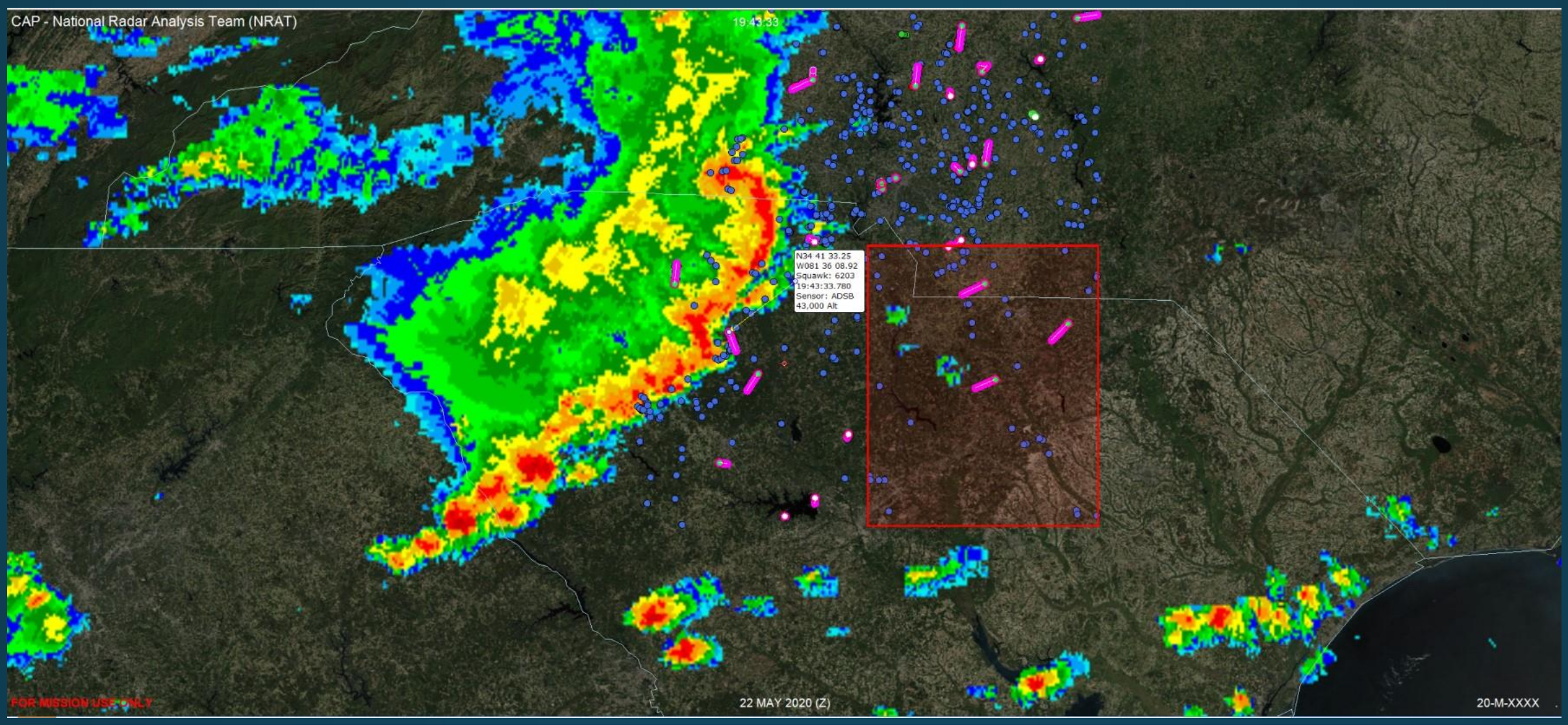
Mission 14-M-0635A
22 December 2014

The NRAT team was alerted to a missing Cessna 172 that had departed Norman Cay in the Bahamas, flying to Fort Lauderdale, FL. The NRAT analyst located the track down to 200’ above open ocean, thanks to data from a tethered aerostat radar, located in the Florida Keys and just added to the NRAT radar cloud a few days before. Products were quickly developed and sent to the Coast Guard, who had just started their search. The surviving pilot, floating in the water said “the helicopter came straight to me”. That’s the results we always want.



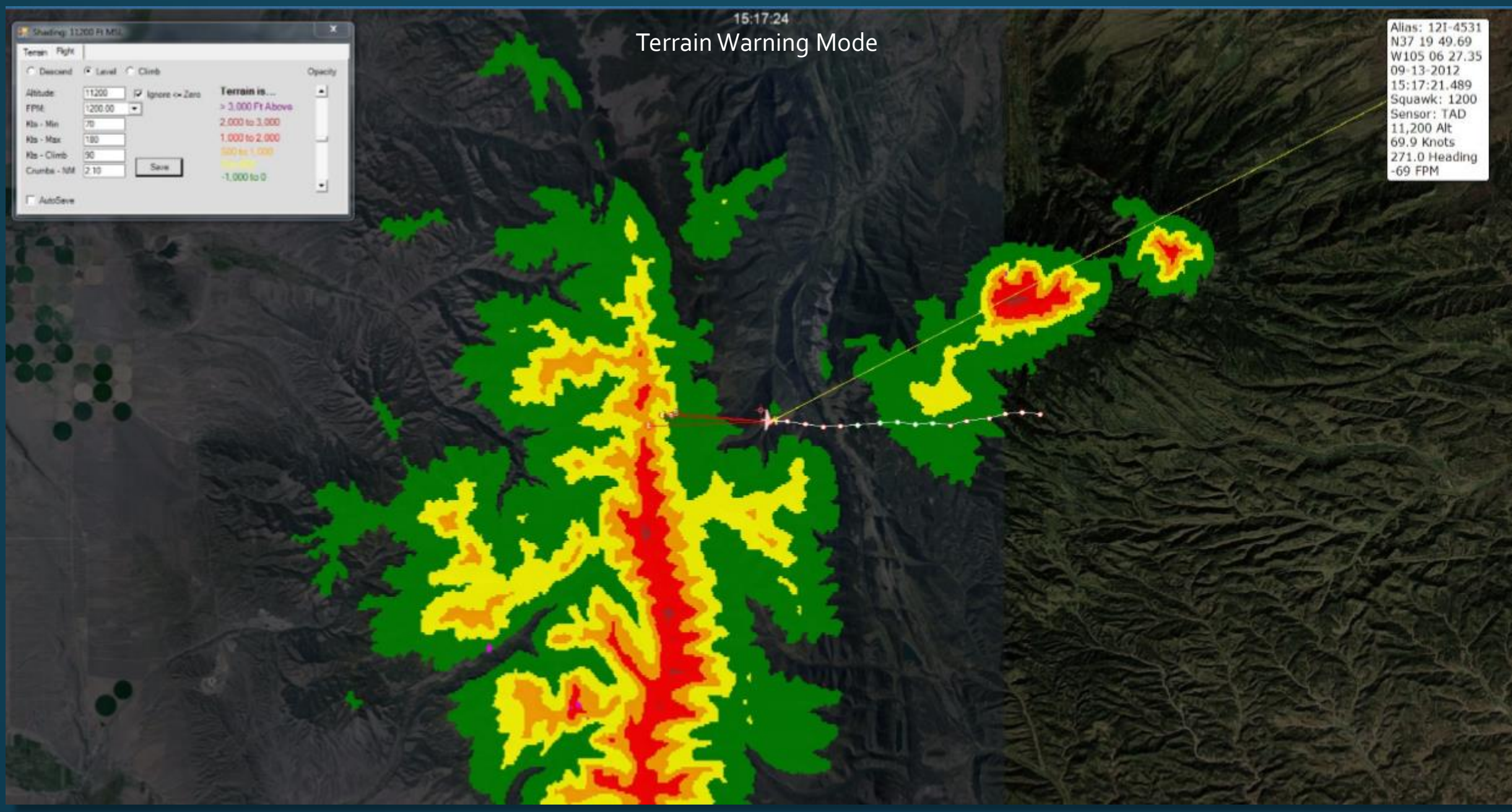
Capabilities

- The NRAT team provides the ‘only source’ for enhanced, aircraft SAR specific, data, tools and expertise
- Recorded SAR Radar Data:
  - 380 Radars and ADS-B data stretching from Hawaii, to Alaska, to Bermuda
  - Data archived for up to 30 days
  - Recorded in NRAT developed radar format - with added enhancements for SAR
- Data Request Engine – Able to retrieve a 1-hour / 1-degree block of data in 10 seconds
  - Adds weather data, such as NEXRAD, METAR, to SAR data request package
  - Request-to-actionable-data time reduced from 4+ hours to 5-10 minutes
- ARGUS – Team developed track analysis program, designed for SAR radar analysis
  - Fuses data from radar, weather, terrain warning, radar coverage prediction, and multiple map imagery sets, into one integrated display
- Depth of Team – 10 individually recruited professionals – each with unique talents
  - Six on-call radar analysts allow for a flexible schedule
- ICARUS – Near-Real-Time track analysis system designed to provide crash alerts
  - First-of-its-kind system – provides alerts to team within 15 minutes of crash
  - Scoring system will determine likelihood of crash (currently being Beta tested)



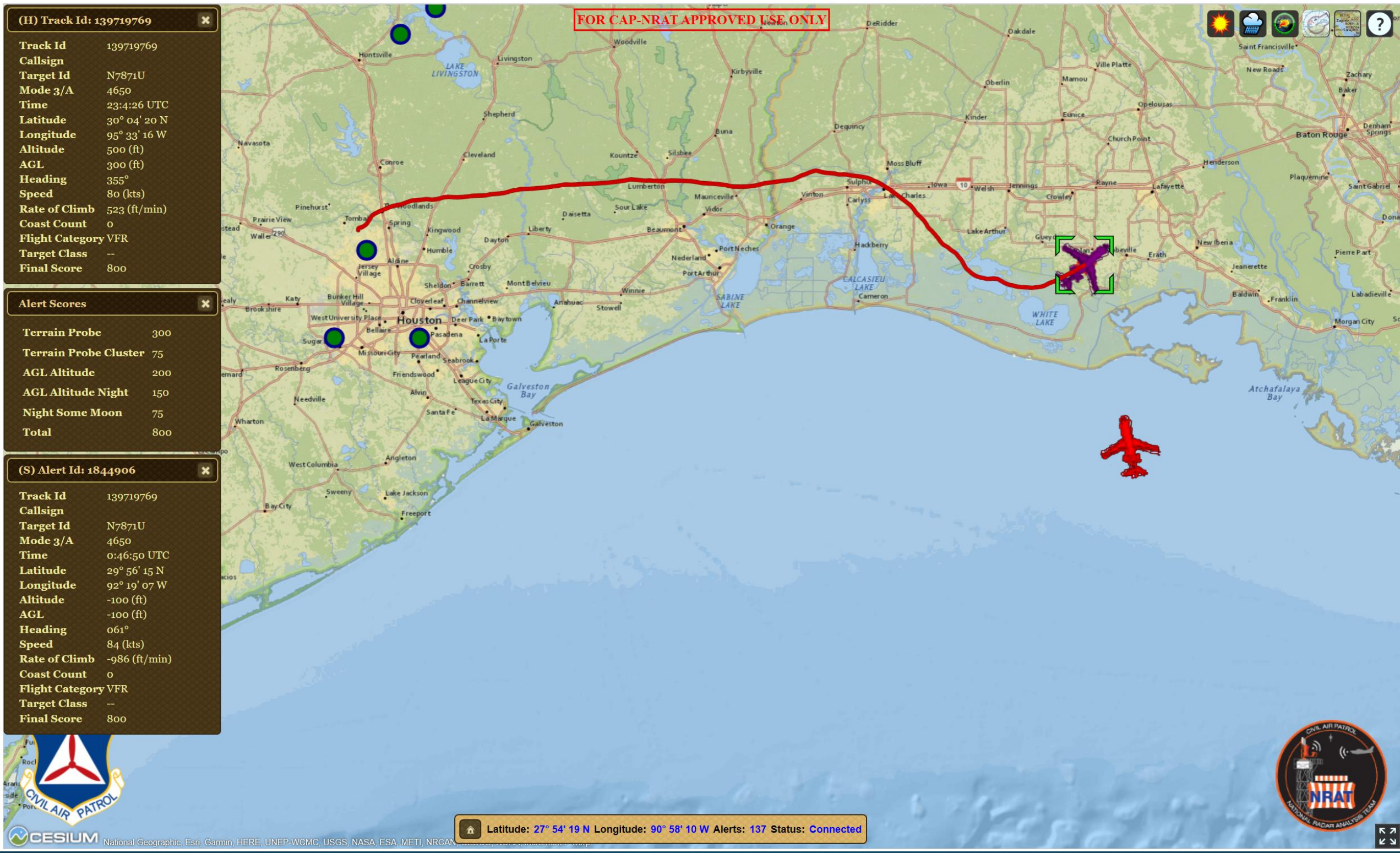
Data Request – Analysis Process

- AFRCC alerts all team members of mission via CAP Mission Alerting System
- On-Call NRAT analyst confirms ALNOT data with AFRCC and gets amplifying data
- Analysts collaborate on NRAT web site
  - Use chat system to communicate between AFRCC, Cell Phone Team and CAP IC's
- Using ARGUS, analyst creates 1-Degree structured data requests, based on projected route of flight, take-off time, and speed of aircraft
- Using skills honed after hundreds of missions, several team analysts work to find the right set of radar targets that belong to the missing aircraft
- Analyst studies the end of track to determine where the aircraft ended up after last hit
  - Weather – LIFR?, IFR?, SVFR?, or VFR; Mountain Obscuration? Thunderstorms?
  - Radar Coverage Prediction – Why did aircraft fade? Where's the next coverage
  - Terrain Warning – Heading into higher terrain? Blind canyons ahead?
  - Time of Day – Day?, Night?, Evening Civil Twilight?, Full Moon?
- Analyst sends track to Briefing Production Folder – Auto produces briefings in less than two minutes
  - Enhanced Google Earth product – can be animated with enhanced overlays
    - Time-synced NEXRAD overlays and METAR data
    - Aircraft Altitude-synced Terrain Warning and Radar Coverage Prediction overlays
  - Interactive briefing tool located on web site – Even more info then the Google tool
  - Time from notification to actionable intel – 10 minutes to several hours, depending on mission complexity



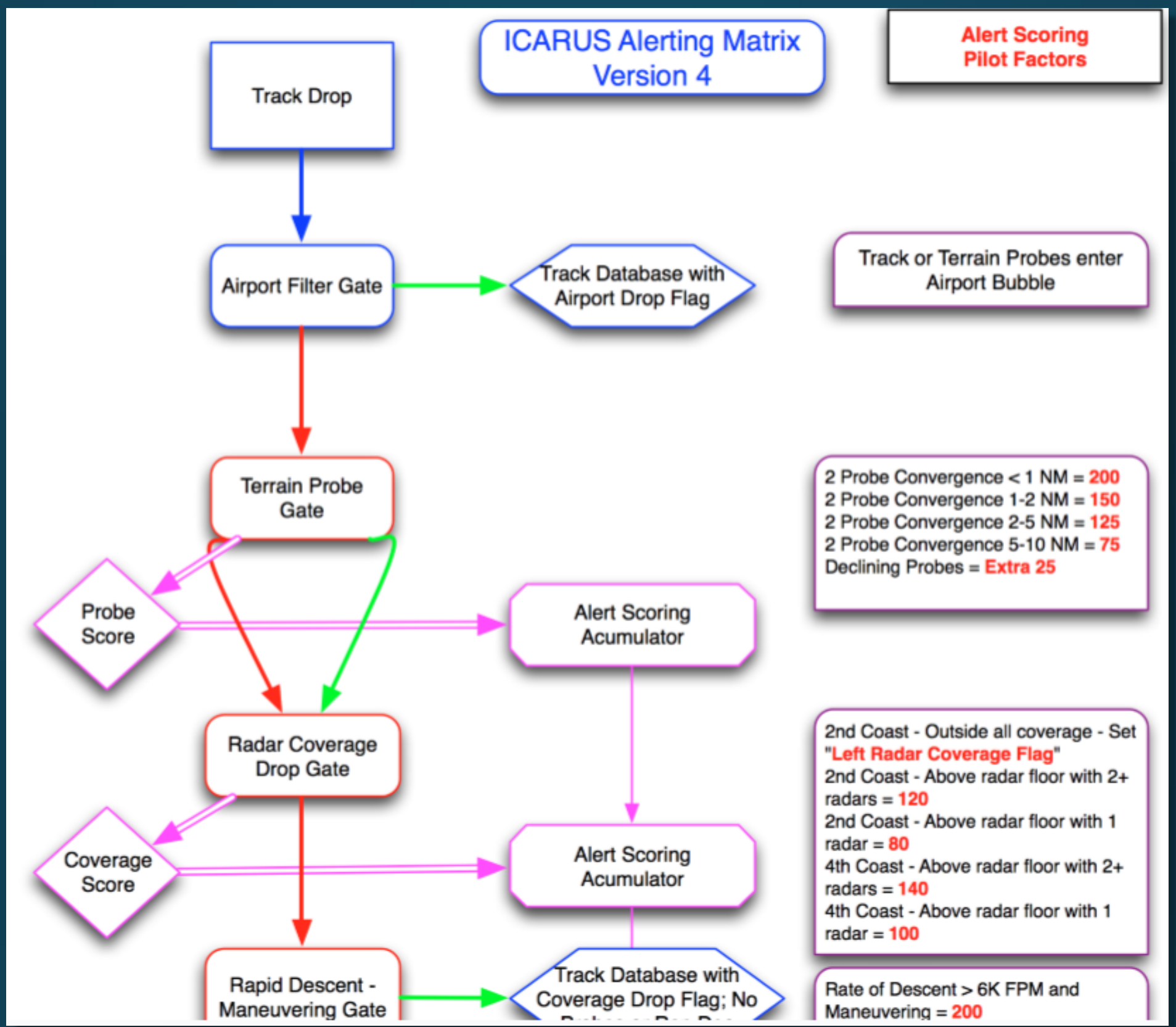
ARGUS

- Team developed specifically for SAR data analysis
- Capable of analyzing most radar data types, including FAA, Air Force, Navy and team developed Icarus Radar Archive (.ira) formats
- Uses multiple map imagery sets including NASA, and FAA Aviation Sectional Charts
- Fuses multiple weather data-overlays including time-synced NEXRAD and METAR automated surface reports
- Advanced filtering capabilities allow the analyst to search through millions of radar targets and narrow down to the missing aircraft.
- A ‘Speed Ring” allows the track to be re-acquired through extensive radar coverage gaps
- Has the ability to display radar coverage, allows the analyst to greatly reduce the search area by eliminating areas with good radar coverage
- Terrain Warning Mode allows the analyst to predict areas where the aircraft is likely to encounter terrain



The ICARUS Process

- The ICARUS tracker will process over 20 million radar targets per hour
- It waits for track to fade, archives track in the SAR Track Database, then starts the track crash evaluation process
- Determines if track entered “Airport Bubble” so it can be eliminated from further evaluation
- Determines if track departed available radar coverage, without being in distress
- Sends remaining tracks through “Alert Scoring Matrix” – eleven scoring gates to determine the likelihood of a crash
- If track achieves a high enough score, system produces an alert evaluation package, alerts NRAT team, who evaluate data validity
- Team sends alert information off to AFRCC for their decision on starting mission
- Being the analysis has already been accomplished, and the probable crash site has been determined; a single CAP aircraft, or State/Local SAR assets could quickly validate crash
- **ICARUS can change the “Crash-to-Notification’ time span from hours, and sometimes days . . . . . to minutes**



The Alerting/Scoring Process

- The heart of ICARUS is its ability to use artificial intelligence to think and react, emulating what a trained, experienced NRAT analyst would do
- ICARUS looks at “factors” that contribute to a crash or poor pilot decisions
- Here are some of the “measurable factors” the system will work with:
  - Terrain Probes – Is the aircraft on a path for terrain collision?
  - Radar Coverage – Should the aircraft have “disappeared” from radar?
  - Rapid Descent Rate – Did the aircraft have a high rate at the end?
  - Maneuvering – Did the aircraft make a lot of unexpected heading changes?
  - Emergency Mode 3 Codes – Was the aircraft squawking 7700 or 7600?
  - NEXRAD Scoring – Was the aircraft flying near, around, or through significant weather?
  - METAR Scoring – Was the aircraft flying near LIFR, IFR, or MVFR conditions?
  - SIGMET/AIRMET Scoring – MTN OBSCN, ICE, TURB in track fade area?
  - Terrain Lighting Scoring – Was it day, night; was the moon up?