THE PROBLEM:

Border security in the 21st century has become increasingly more complex as more advanced technology readily available on the open market can be used by terrorists and smugglers to subvert governmental agency interdiction efforts. This is particularly true in the case of drug cartels that are now using low cost, ultralight aircraft to fly small quantities of drugs a short distance over the border to prearranged 'drop spots'. Ultralights are fairly quiet, have low radar cross sections (RCS), and can fly low and at night under traditional airspace surveillance radar. Security agencies have a requirement for an affordable, simple-to-operate system that can be used to detect and track these low RCS, low flying targets to drop zones. The system additionally needs to be a fully self-contained and portable unit to allow for the sensor to be moved as routes change as well as be networkable with other units to create wide area surveillance 'nets'.

THE SOLUTION:

DeTect's HARRIER Airspace Surveillance Radar (ASR), based on DeTect's technology for detection and tracking of very small, low RCS, low altitude and irregularly moving targets has been in use since 2005 in facility airspace surveillance and security applications and provides a powerful, flexible solution to reliable detection, tracking and alerting of small, low RCS, low flying targets.

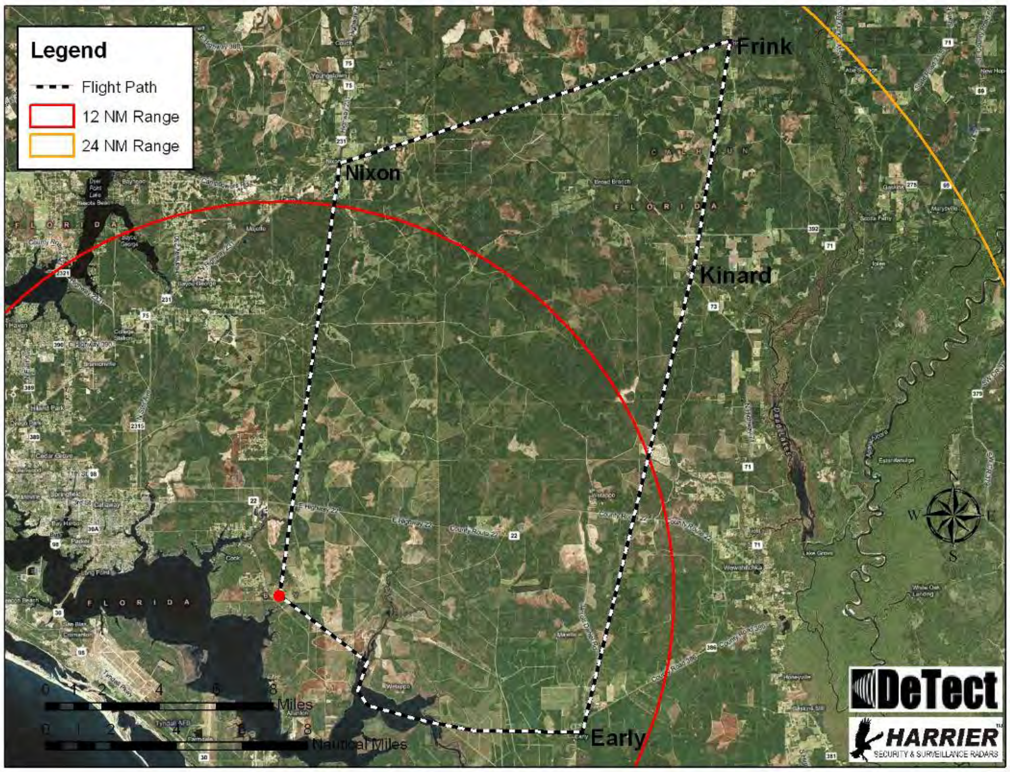
Purpose of Test

The primary purpose of the test was to determine the maximum range the radar (Kelvin Hughes S Band high pulse compression) is able to detect an ultra light aircraft. Additionally, the test also provides necessary data to optimize Harrier tracking settings for ultra light aircraft, provides quantitative information on the radar cross section of an ultra light (at various ranges and different perspectives relative to the radar), and gives insight to how the aircrafts reflectivity changes over different land use types.

Methods and Observations

Detect Inc. rented a JLG lift from NES Rentals to raise the radar skid to 54 ft. AGL (likely altitude of operational tower) in an effort to raise the radar antenna up above the tree line and provide line of sight out as far as possible. This would put the radar antenna at 60 ft. AGL. Image below depicts JLG lift hoisting the skid mounted radar system up in the air.

The flight plan was designed to gather information about the ultra light's radar cross section at different perspectives relative to the radar height while the aircraft maintained specific altitudes. Flight test 1 consisted of the aircraft flying at 1000 ft AGL (Flight path depicted in image below).



Flight test 1 was a stand-alone test but was important for planning the subsequent tests. The primary objective of this test was to determine what the maximum range the radar could detect the ultra light at 1000 ft AGL. The pilot was given waypoints to navigate the specified route. He programmed the coordinates into his onboard GPS (Garmin 196). Basically, he was directed to fly to Nixon, Frink, Kinard, Early, and then back to the Sandy Creek Airfield (see Flight path map). Additionally, DeTect staff mounted 2 differential GPS data loggers to his aircraft to log his position and altitude information throughout the duration of his test flights. The aircraft and pilot are pictured below.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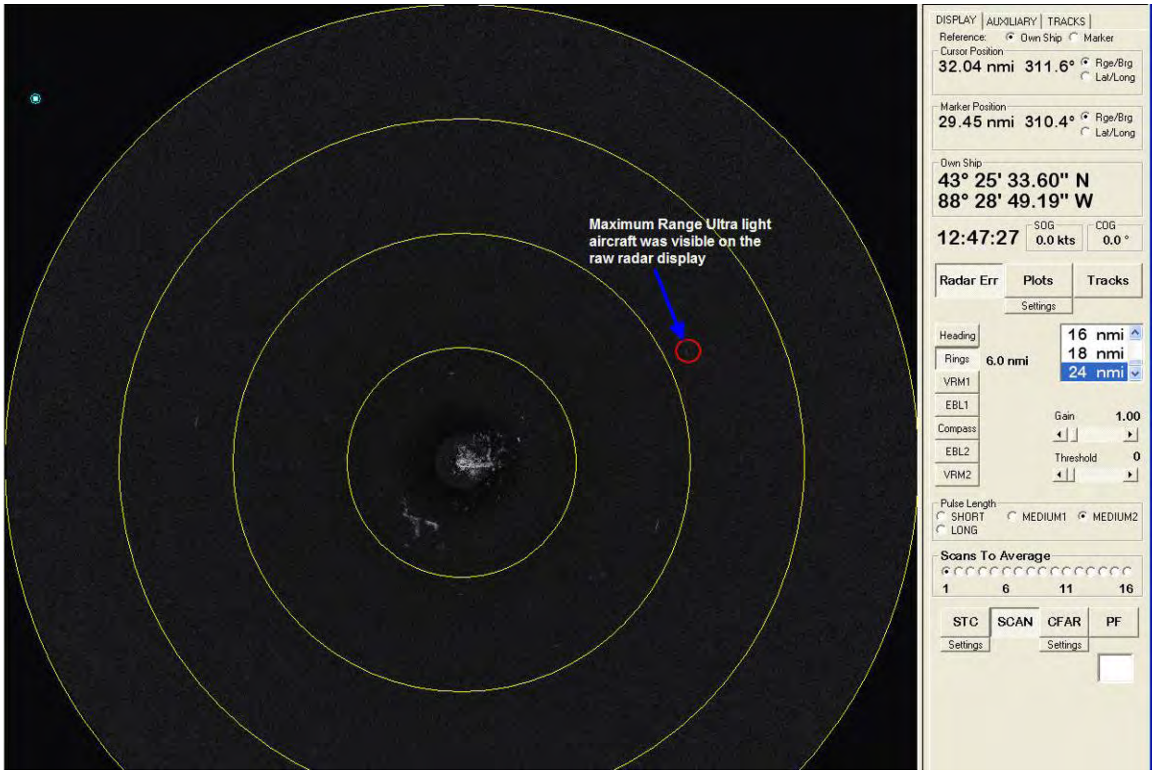
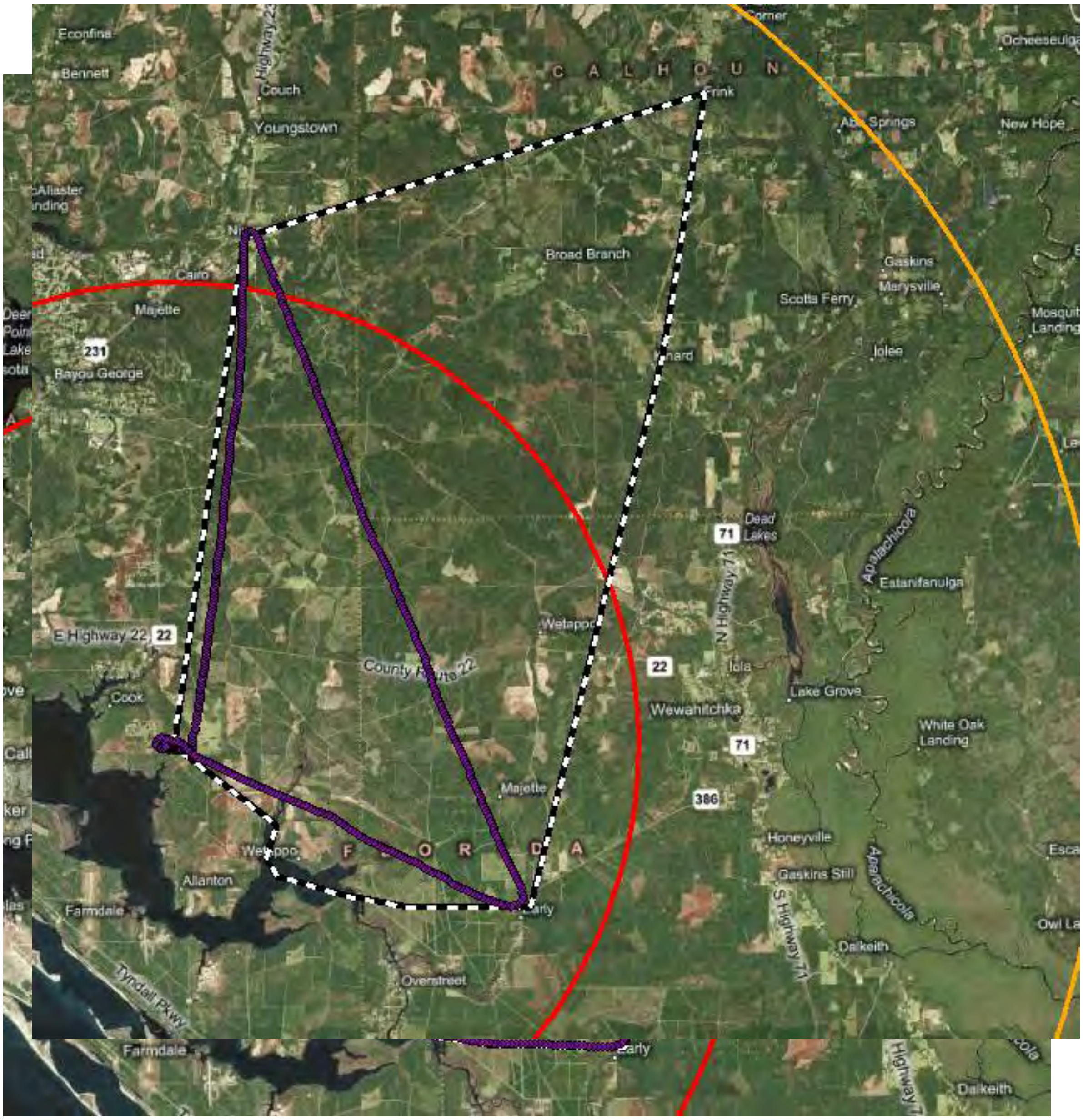
The primary reason for carrying out the 1000 ft AGL test first (24 NM) was to determine the maximum range the radar could detect the aircraft. This information was critical to determine what range and what distance we would set up subsequent radar tests. The logic here is if the radar can not detect the ultra light at 1000 ft AGL out to say 24 NM, there is no reason to do the same test at 500 ft AGL (out to 24 NM), taking into consideration 7 degree tilt.

Results

The maximum range the radar was able to detect the ultra light aircraft was 12.27 NM (14.12 miles) as the aircraft went away from the radar. The maximum range the aircraft was able to detect the ultra light aircraft was 13.2 NM (15.19 miles) as the aircraft approached the radar. The image below depicts the ultra light aircraft on the raw radar display at the maximum range the target was visible to the radar. The yellow rings represent 6 NM buffers. The entire raw radar display is 24 NM. It should be noted that the ability to detect the aircraft was spotty at these maximum ranges. Consistent scan to scan detection was prevalent at ~ 0-10 NM (0-11.5 miles).



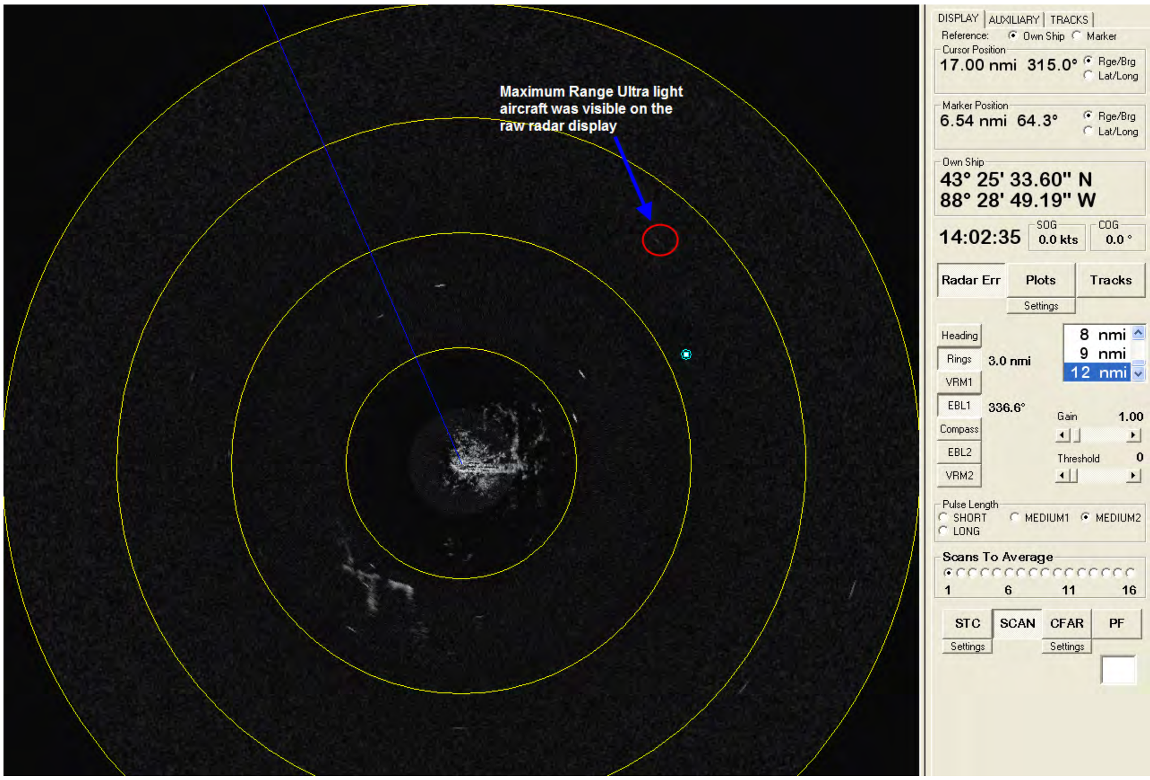
The image below shows the planned flight route and the observed flight route (GPS points from onboard data loggers).



After the 1st flight (24 NM at 1000 ft) DeTect staff reviewed raw radar data to determine the maximum range the ultra light was detected.

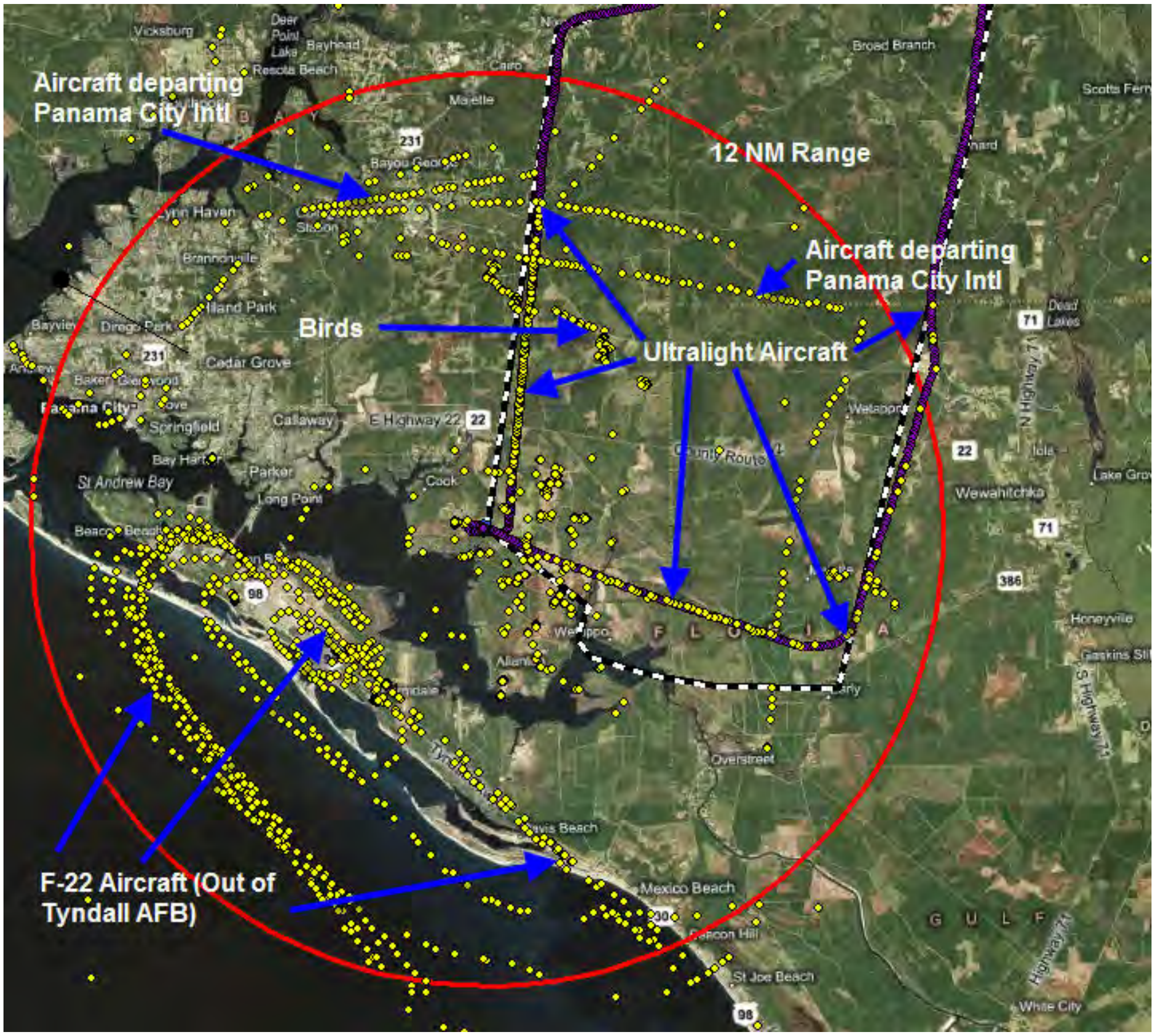
This information assisted in planning whether or not we would run the 500 ft flight test out to 24 NM. Given that we only faintly detected the aircraft out past 12 NM, we determined that the 500 ft flight test should be conducted at a 12 NM range setting with a revised flight path. Flight path detected in image below with purple data points.

The maximum range of radar detection was 8.36 nm (9.6 miles). A 300 ft. flight was planned and later cancelled due to significant turbulence at low altitudes. The image below depicts the maximum extent the aircraft was detected.

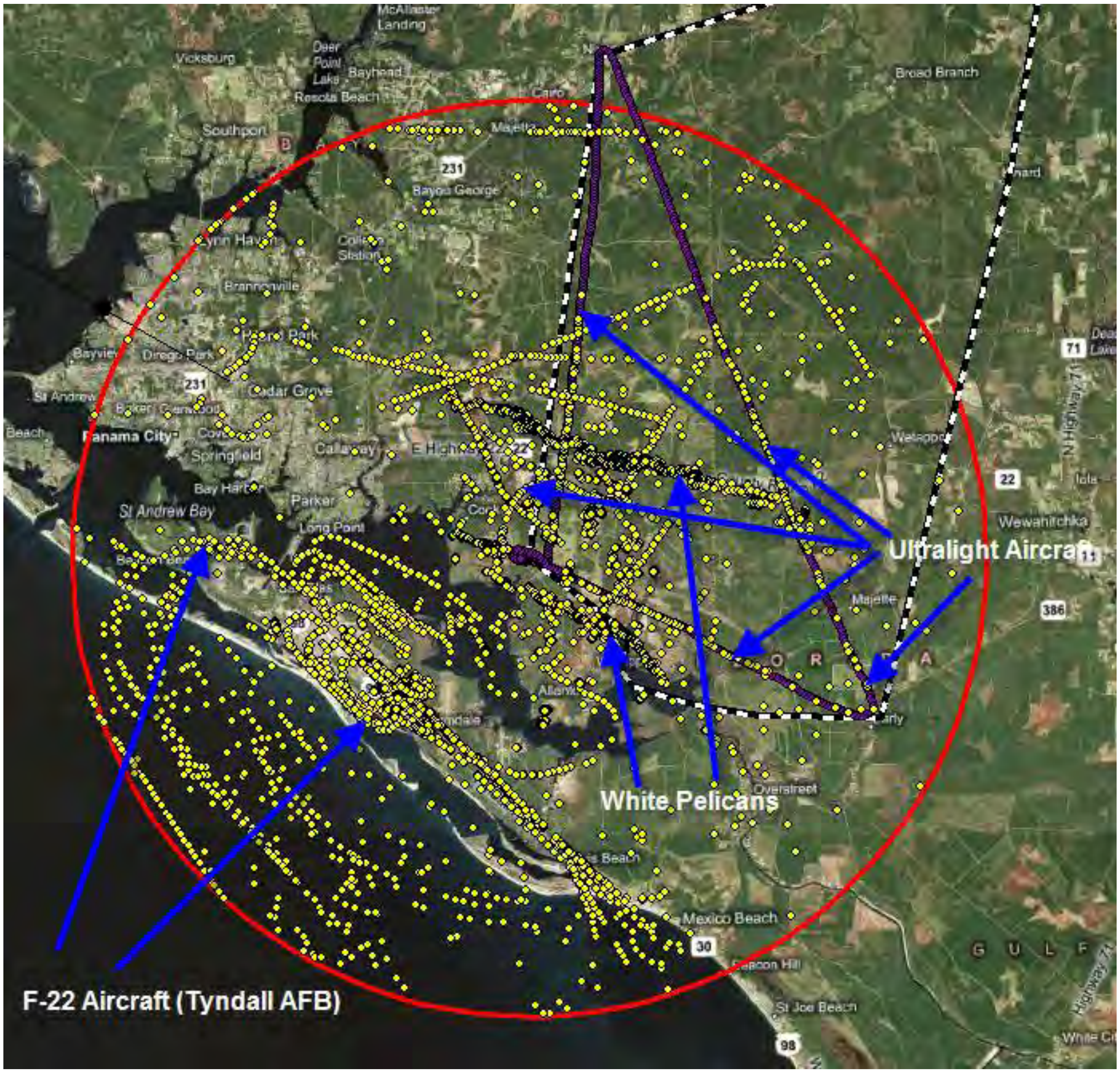


Preliminary Tracking

DeTect Inc. used existing Harrier Tracking settings to determine how well current the settings would perform tracking ultra light aircraft at both the 24 NM range setting and the 12 NM range setting (current settings are optimized for larger aircraft). This test proved useful in determining where and how DeTect can improve tracking settings that are specific to ultra light aircraft. Specifically, we now have the data to optimize Harrier tracking software to maintain consistent tracks. Additionally we now have the background data to determine the differences between larger aircraft and ultra aircraft. This is particularly useful information in an operational sense to eliminate false positives for ultra light aircraft. Below is an image of the 1000 ft 24 NM flight pattern (black and white line), onboard GPS coordinates (purple points), and the associated Harrier points (yellow).



Below is an image of the 500 ft 24 NM flight pattern (black and white line), onboard GPS coordinates (purple points), and the associated Harrier points (yellow). It should be noted that these tracking results were a first cut using existing settings designed for larger aircraft. There are further improvements to be made with tracking/software development.


Ultralight Aircraft
White Pelicans
F-22 Aircraft (Tyndall AFB)