All-domain Anomaly Resolution Office (AARO)

U.S. Department of Defense

Case: "The Puerto Rico Object"

Case Resolution | 20 March 2025

AARO Assessment and Case Status:

AARO assesses with high confidence[1] that the objects did not exhibit anomalous behavior or transmedium capabilities. AARO assesses with moderate confidence that the objects were a pair of sky lanterns.

Case Overview

On April 26, 2013, an infrared (IR) sensor onboard a U.S. Customs and Border Protection (CBP) De Havilland Canada 8 aircraft flying above Rafael Hernandez Airport near Aguadilla, Puerto Rico captured thermal video footage of two objects drifting at wind speed and direction. The objects appeared to move at a high rate of speed over the airport and surrounding area before separating from one another. The objects seemed to enter, exit, and disappear into the Atlantic Ocean off Puerto Rico's northwestern coast.

During the encounter, the CBP aircraft flew in an arc around the Rafael Hernandez Airport, gaining approximately 1,725 feet in altitude before losing sensor contact with the objects at 3,600 feet. The aircraft entered a layer of scattered clouds as it passed 3,000 feet in altitude. These clouds partially obscured the sensor's view, potentially affecting the objects' sensor return. The range between the aircraft and the objects nearly tripled during the encounter. These factors contribute to the

Case Synopsis

Location: Puerto Rico

Date: April 26, 2013

Object Altitude (Reported): N/A

Object Altitude (Assessed): 656 ft

Object Speed (Reported): N/A

Object Speed (Assessed): 8 mph

Object Shape (Reported): N/A

Object Shape (Assessed): Indistinct

Reporter: Publicly available media, originally recorded by U.S. Customs and Border Protection.

Data Type: Infrared

Reported Behavior: Split or replicated; transmedium behavior.

Assessed Behavior: The objects did not demonstrate anomalous performance characteristics.

Confidence: High confidence that the objects did not demonstrate anomalous performance characteristics. Moderate confidence that the objects were a pair of sky lanterns.

video's diminishing quality over time. Figure 1 reconstructs the aircraft's flight path, sensor line-of-sight to the ground, and position relative to the objects.

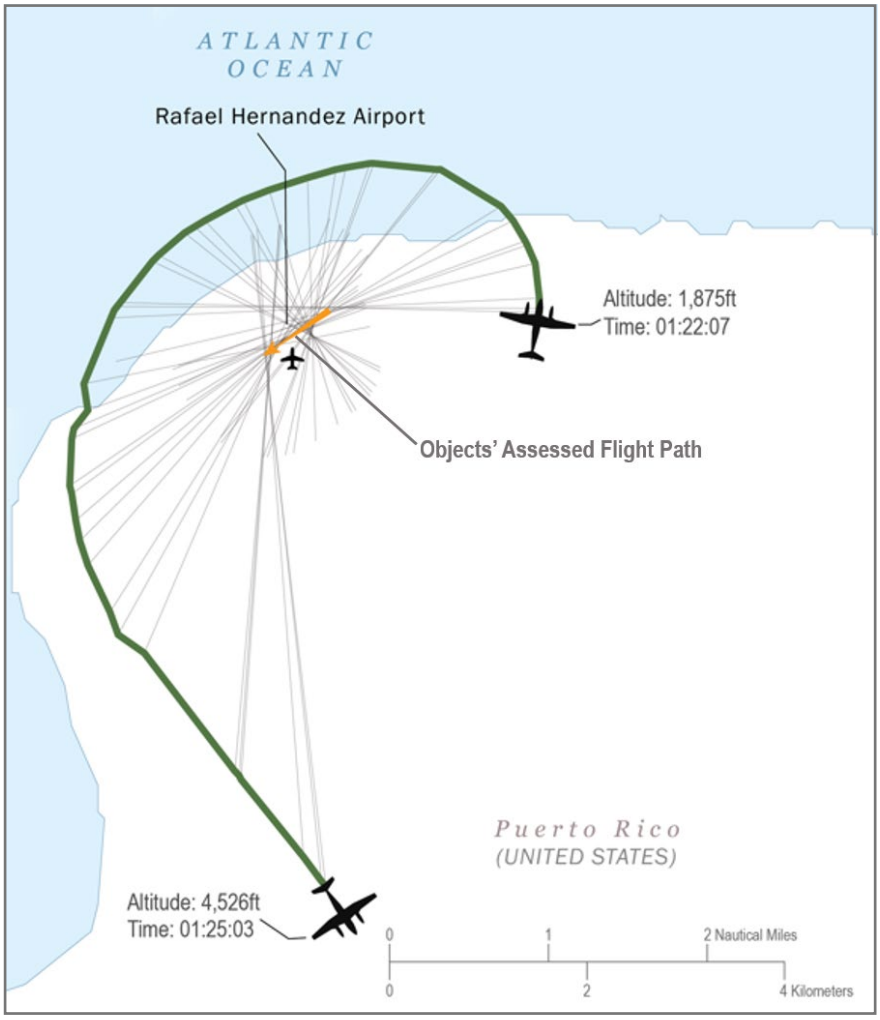

Figure 1: A reconstruction of the CBP aircraft's flight path is shown in green. Grey lines indicate the sensor's line-of-sight to the ground from the aircraft. The yellow arrow shows the objects' assessed flight path.

Key Findings

AARO assesses with high confidence that:

- The objects did not exhibit anomalous speeds or other behavior exceeding known state-of-the-art performance characteristics.
- The video depicts two objects traveling near each other rather than a single object splitting into two.

Performance Characteristics

Object Speed: Systems Toolkit (STK) reconstruction determined the objects drifted at approximately 3.6 meters per second (8 mph) in a straight line over land, consistent with the recorded wind speed of 4.4 meters per second (9.8 mph) from the east/northeast.[2]

The objects' apparent high speed is attributable to motion parallax. Motion parallax is an optical effect that induces an observer to perceive that a stationary or slow-moving object is moving much faster than its actual speed when viewed from a moving frame of reference. The more quickly an observer moves relative to an observed object, the more pronounced this effect is. In this case, the aircraft's flight speed, the sensor's zoom, and the change in relative positions of the aircraft and the objects influenced their perceived behavior and performance characteristics.

Object Flight Path: STK reconstruction integrated the aircraft's position with key sensor parameters (e.g., elevation, azimuth, and slant angle) to model the objects' flight path. The IR sensor first detected the objects near the northeastern side of the airport at an altitude of approximately 200 meters (656 feet). The objects drifted southwest at wind speed before the IR sensor lost contact with them over the airport's central parking apron.

AARO reconstructed the sensor's look angle by plotting the aircraft's position and the sensor's view-to-ground projection onto a map (Figure 1). The reconstruction demonstrates that the objects remained over land during the encounter.

Apparent Separation: AARO assesses with high confidence that the recording captures two objects traveling near each other rather than a single object splitting or replicating. The objects visibly separate multiple times within the first minute, suggesting that the video depicts two objects the entire time. Separation occurs at approximately 00:29.56, 00:40.76, and 00:47.00 seconds (Figure 2). The IR sensor's view of the objects changed from side-on to top-down as the aircraft gained altitude. The sensor's steeper viewing angle from a higher altitude likely made the objects' separation more visually dramatic near the end of the video (Figure 3, Image C).

Apparent Transmedium Behavior: The STK reconstruction demonstrates that the objects did not exhibit transmedium performance characteristics. "Transmedium" refers to objects that transition between two or more domains, e.g., space, the atmosphere, or water, in ways not attributable to known technologies. The objects remained over land throughout the video.

Figure 2: Stills images of object separation from within the first minute of the video.

Figure 3: These stills demonstrate how the changing view angle from the sensor to the objects influenced their perceived behavior as the aircraft gained altitude. They appear to be one object from a low angle and a low magnification, as shown in Image A at 00:05.14. The objects appear distinct from one another from a steeper viewing angle and moderate magnification, as shown in Image B at 00:33.41. Image C, at 02:37.44, shows the objects from a high angle and increased magnification, clearly showing object separation from a more top-down perspective.

Observable Characteristics and Attribution

Size and Shape: AARO employed pixel analysis to estimate the objects' sizes to be smaller than one meter (three feet). Pixel analysis is a method of measuring an object's size by comparing it to an object of known dimensions. The objects' shapes are indistinct.

Number of Objects: AARO assesses with high confidence that the video footage depicts two objects traveling near each other rather than a single object splitting into two.

Attribution: AARO assesses with moderate confidence that the objects depicted in the video are sky lanterns. AARO confirmed with local hospitality industry vendors that it is common practice for hotels and resorts in the area to release sky lanterns during celebrations. The objects' size and thermal signature variability support this conclusion. Sky lanterns are typically smaller than one meter in diameter and emit a flickering, weakening thermal signature as they expend fuel, gradually losing distinctiveness against the background environment when viewed through an IR sensor. However, the video's poor quality reduces AARO's confidence in categorically identifying the objects.

IR signatures can appear to "vanish" when the thermal contrast between the object and background becomes indistinguishable (Figure 4). The objects seem to disappear shortly after the ocean appears in the background. The objects did not enter the water. Rather, the sensor could not distinguish the objects from their environment due to a lack of thermal contrast between them and the ocean.

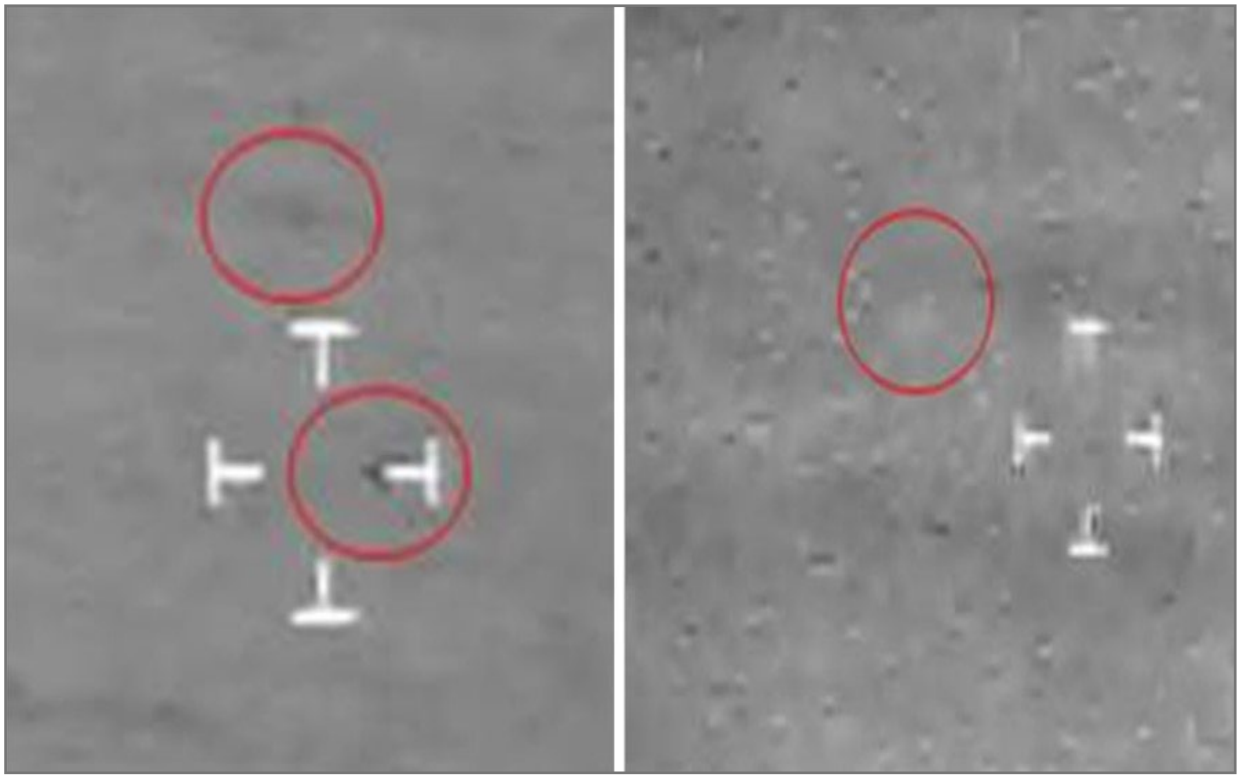

Figure 4: IR signatures can lose distinctiveness when thermal contrast is low.

Data Quality and Methodology

AARO assesses that the sensor data associated with the encounter provides sufficiently detailed information to resolve this case with high confidence. AARO's assessment is informed by reconstruction of the event using STK and Minimum Separation Vectors analysis.

Sensor Effects and Limitations

Thermal imaging can fail to differentiate a target object from the background when its thermal signature is virtually identical to the surrounding environment to be distinct, known as thermal crossover. When a sensor fails to discriminate a target from its environment, the object can seem to vanish or intermittently disappear and reappear.[3] Several factors affected the objects' IR signature, contributing to the perception that they entered the water or disappeared.

- **Thermal Crossover:**
  - This natural phenomenon reduces the effectiveness of thermal imaging systems in detecting the contrast between an object and its environment during and after a rapid temperature change, such as during sunrise and sunset. It can persist for up to two hours.[4]
  - On April 26, 2013, sunset occurred at 7:48 p.m. local time. The IR sensor recorded the event at 9:22 p.m. local time, within the two-hour window when thermal crossover can influence IR sensor return.[5]
- **Sensor Distance:**
  - The aircraft's distance from the objects nearly tripled during the observation period. Sensor fidelity degrades with increasing distance to a target, especially for objects of such small size.
- **Cloud Cover:**
  - Scattered clouds at 3,000 feet partially obscured the sensor's view. Cloud cover can intermittently reduce an object's thermal contrast, similar to the loss of detection that can occur during thermal crossover.[6] Intermittent sensor contact can make an object appear to flicker or disappear and reappear on thermal imaging systems.

Alternative Hypotheses

Anomalous Phenomena: During specific frames, the objects seem to pass behind a utility pole, indicating that they were at a much lower altitude and traveling much faster than would be typical for objects of this size. AARO employed pixel analysis to investigate this alternative and found that the objects did not pass behind the pole, ruling out anomalous performance characteristics. Pixel analysis alone cannot determine the objects' altitude or trajectory, though it can set parameters for further analysis. Therefore, AARO used STK reconstruction to assess the objects' flight behavior and performance characteristics. The STK reconstruction demonstrates that the objects moved in a straight line at wind speed over land.

Marine Birds: An AARO partner assessed that the objects traveled between 35 and 130 mph at an altitude between 300 and 900 feet. The partner suggested that the objects were a pair of marine birds that descended to the surface of the Atlantic Ocean but noted that poor data quality

makes identification difficult. AARO considered this interpretation unlikely, as the STK reconstruction demonstrates that the objects moved in a straight line at wind speed over land. Further, birds viewed through an IR sensor at the distances involved in this encounter would retain identifiable features, such as wings, or pulsate at the frequency of wing beats.

Mylar Balloons: An AARO partner assessed that the objects were a pair of mylar or "party" balloons. The objects' behavior is consistent with a pair of balloons drifting together and apart while tied together. The partner also suggested that the objects' fluctuating IR sensor return may be attributable to the balloons' surface reflecting light from the full moon through intermittent cloud cover. AARO does not concur with this assessment, because it is unlikely that an IR sensor could detect reflected moonlight.

(U) AARO is not a member of the intelligence community. This AARO information report should not be considered finished intelligence. It may contain references to finished intelligence reports and/or information provided by AARO's coordinating interagency partners to provide context, show relevance, or substantiate AARO analytic perspectives.

[1] Office of the Director of National Intelligence – Intelligence Community Directive 203: Analytic Standards
[2] www.timeanddate.com
[3] Journal article, Optics Express; Felton, M. et al.; 22 APR 2010; Measured comparison of the crossover period for mid- and long-wave IR (MWIR and LWIR) polarimetric and conventional thermal imagery; Vol. 18, No.15.
[4] Ibid.
[5] www.sunrisesunset.com
[6] Journal article, Optics Express; Felton, M. et al.; 22 APR 2010; Measured comparison of the crossover period for mid- and long-wave IR (MWIR and LWIR) polarimetric and conventional thermal imagery; Vol. 18, No.15.