NTSB | National Transportation Safety Board

Source: Tomas Milosch

Accident Overview

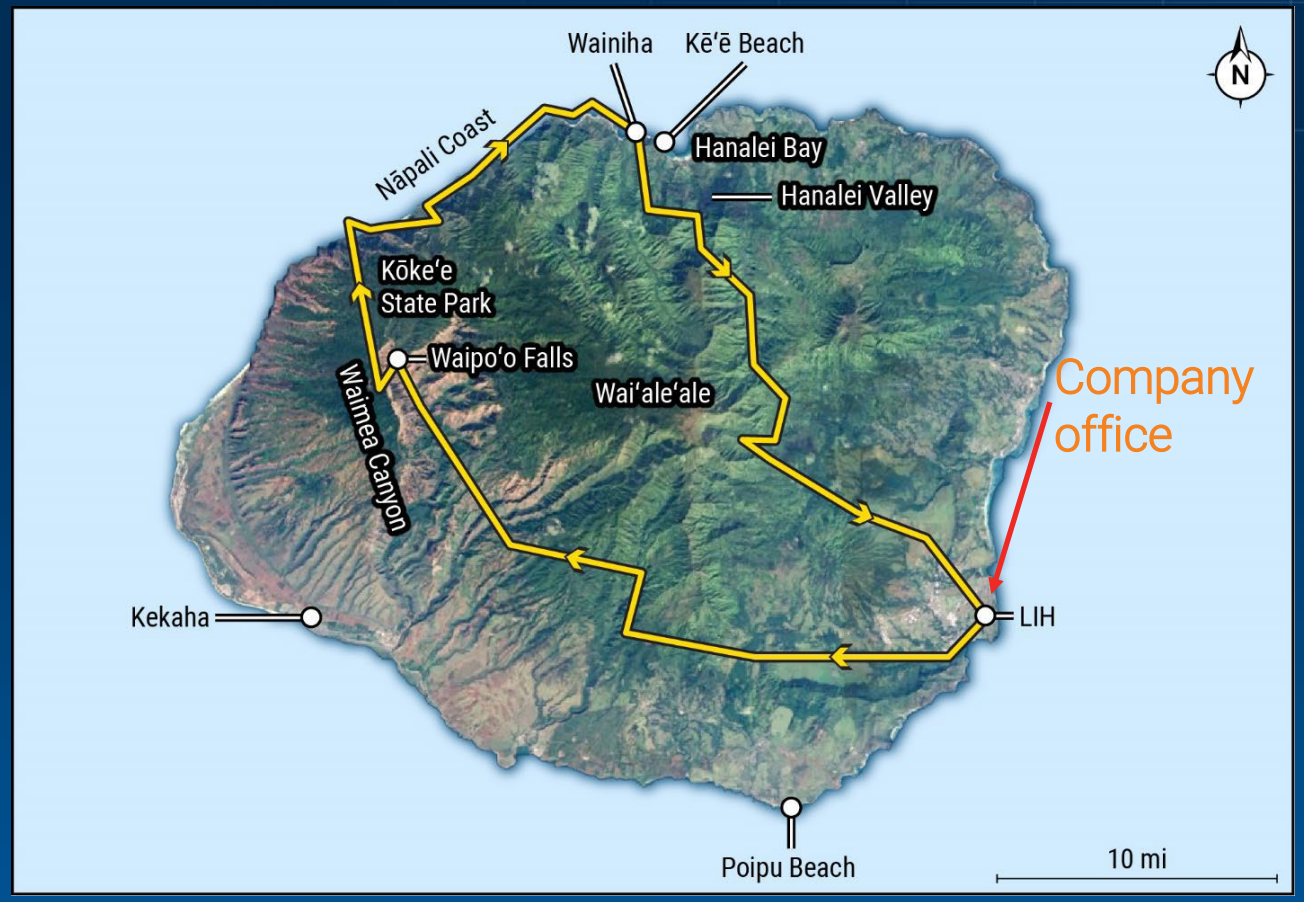
Investigator-in-Charge

General Information

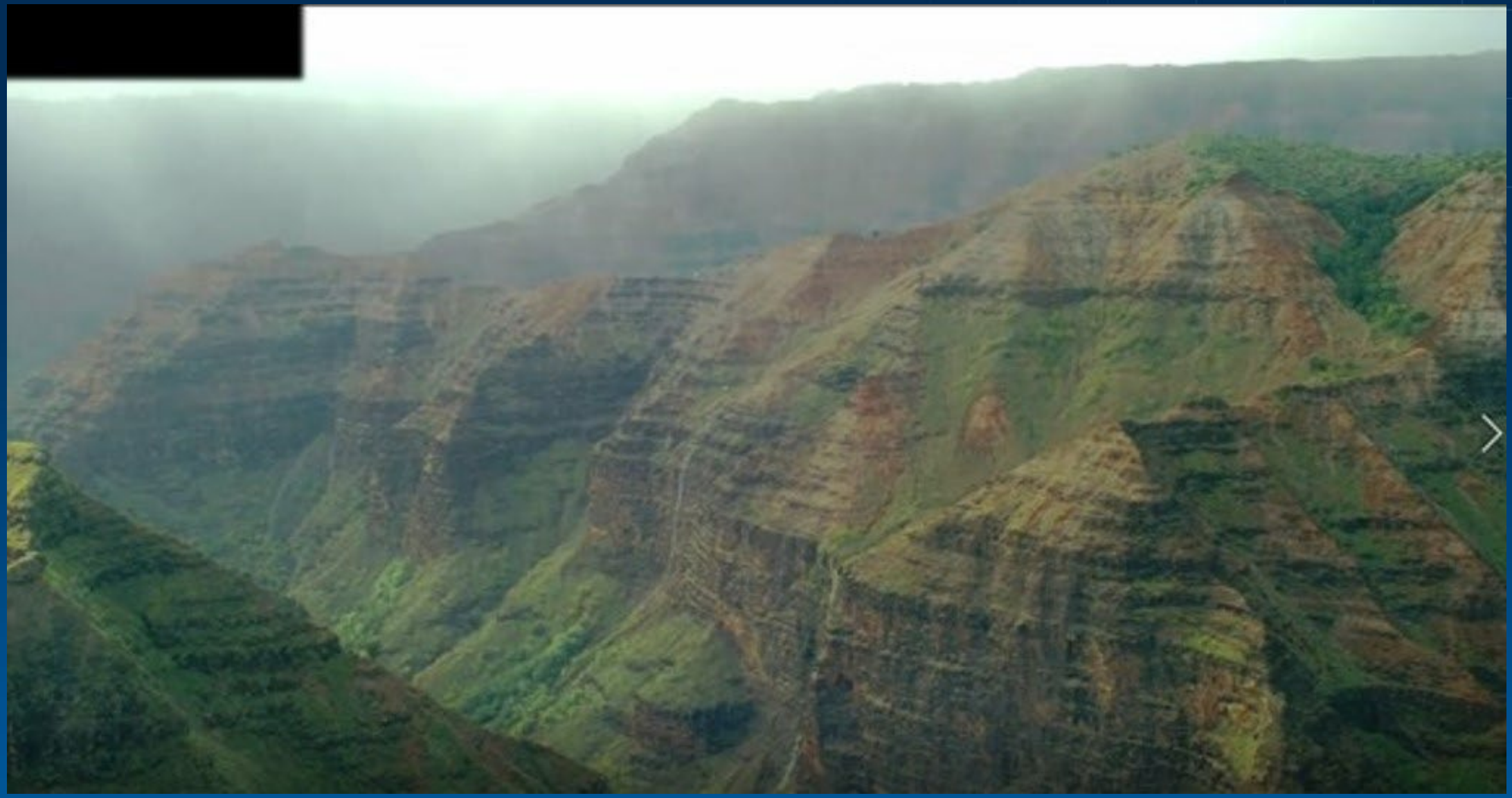
- December 26, 2019
- 4:57 p.m. Hawaii standard time
- Airbus AS350 B2 helicopter
- Safari Aviation Inc.
- Collided into terrain about 11 miles north of Kekaha, Hawaii
- Pilot and six passengers fatally injured

Accident Pilot

- Chief pilot
- Arrived at office at 6:45 a.m.
- Printed weather
- Scheduled to perform eight 50-minute tours
- 1-hour lunch break



Waimea Canyon at 4:27 p.m. (Company 1 Tour)



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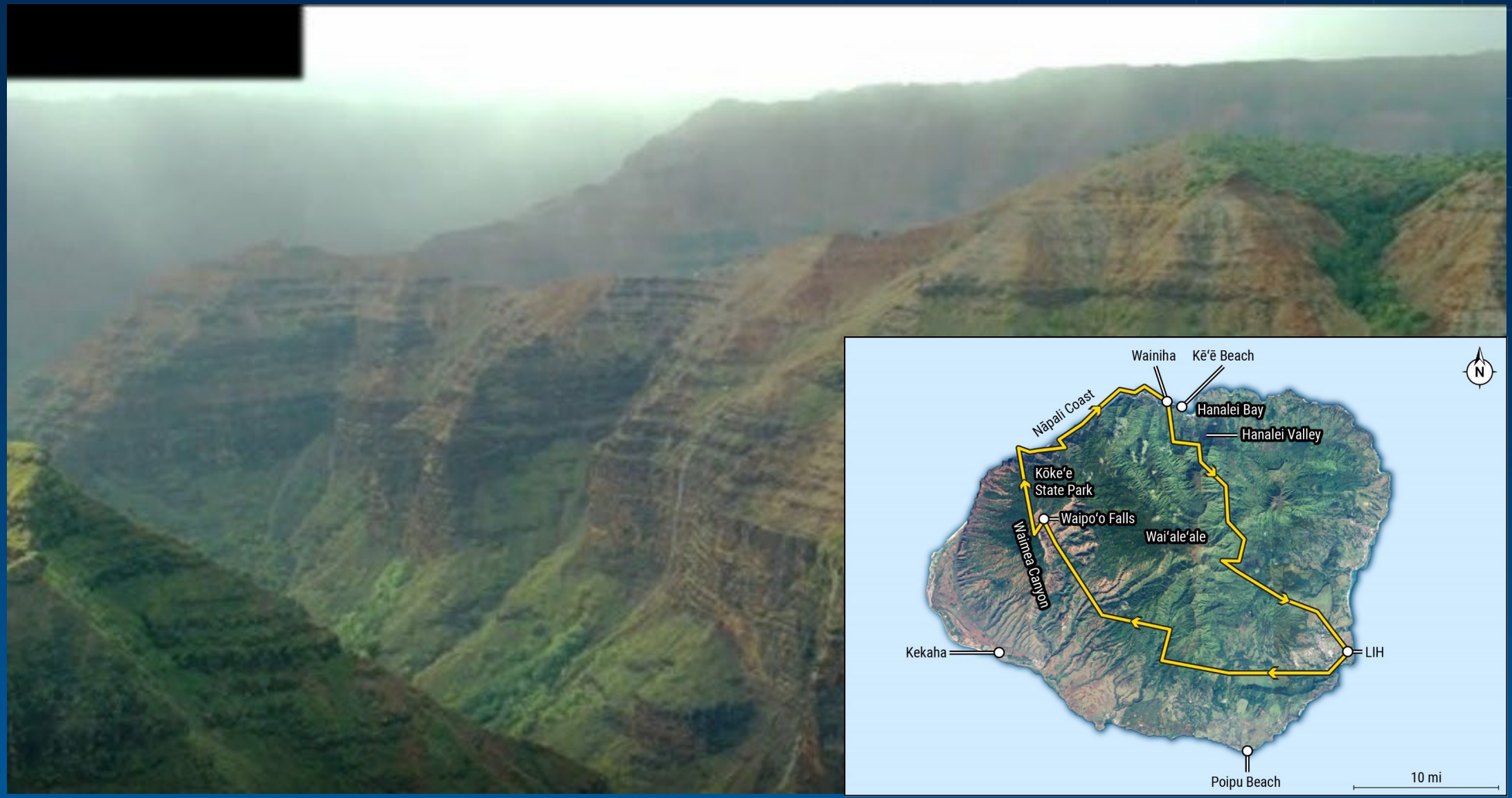

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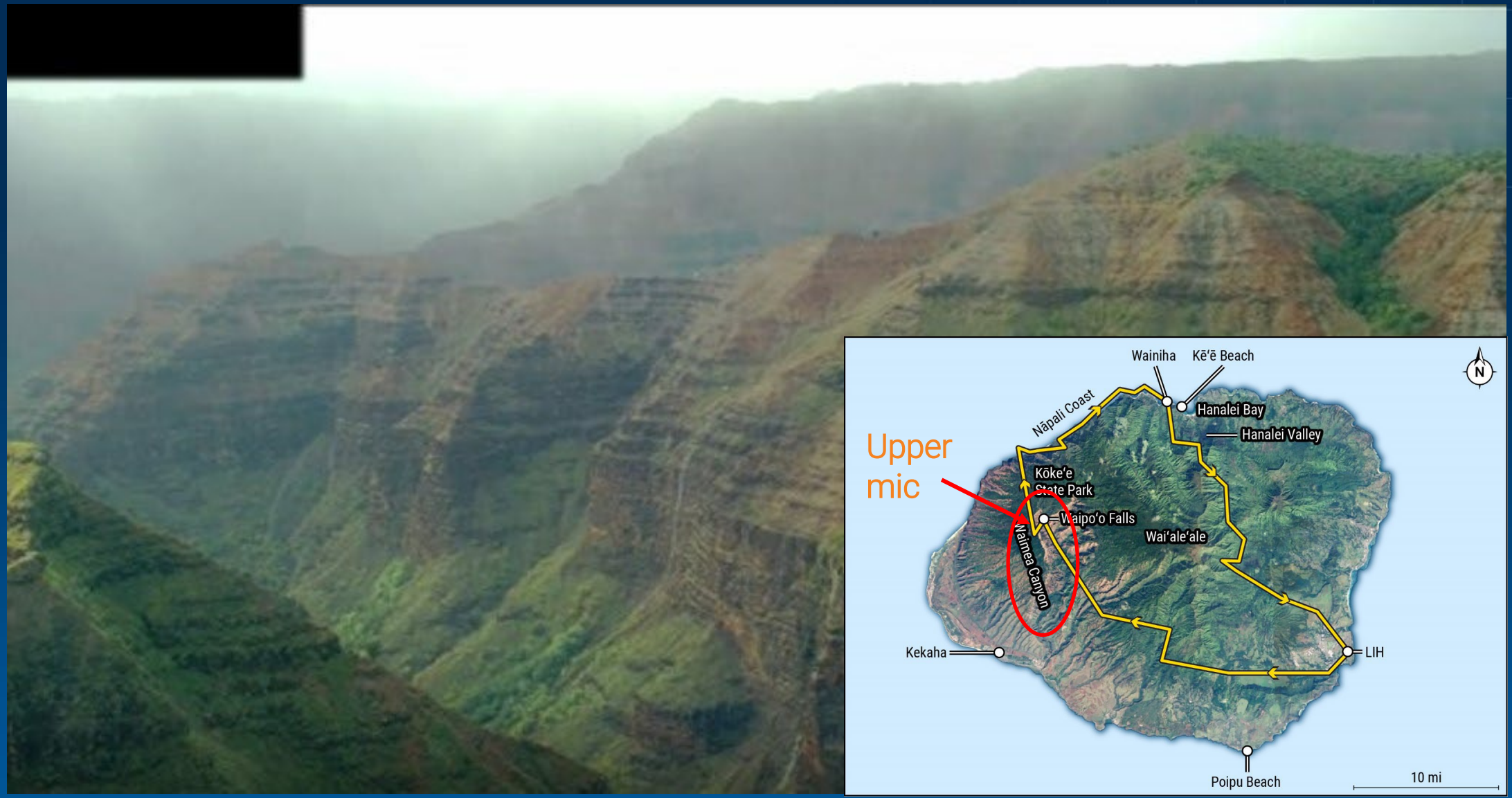

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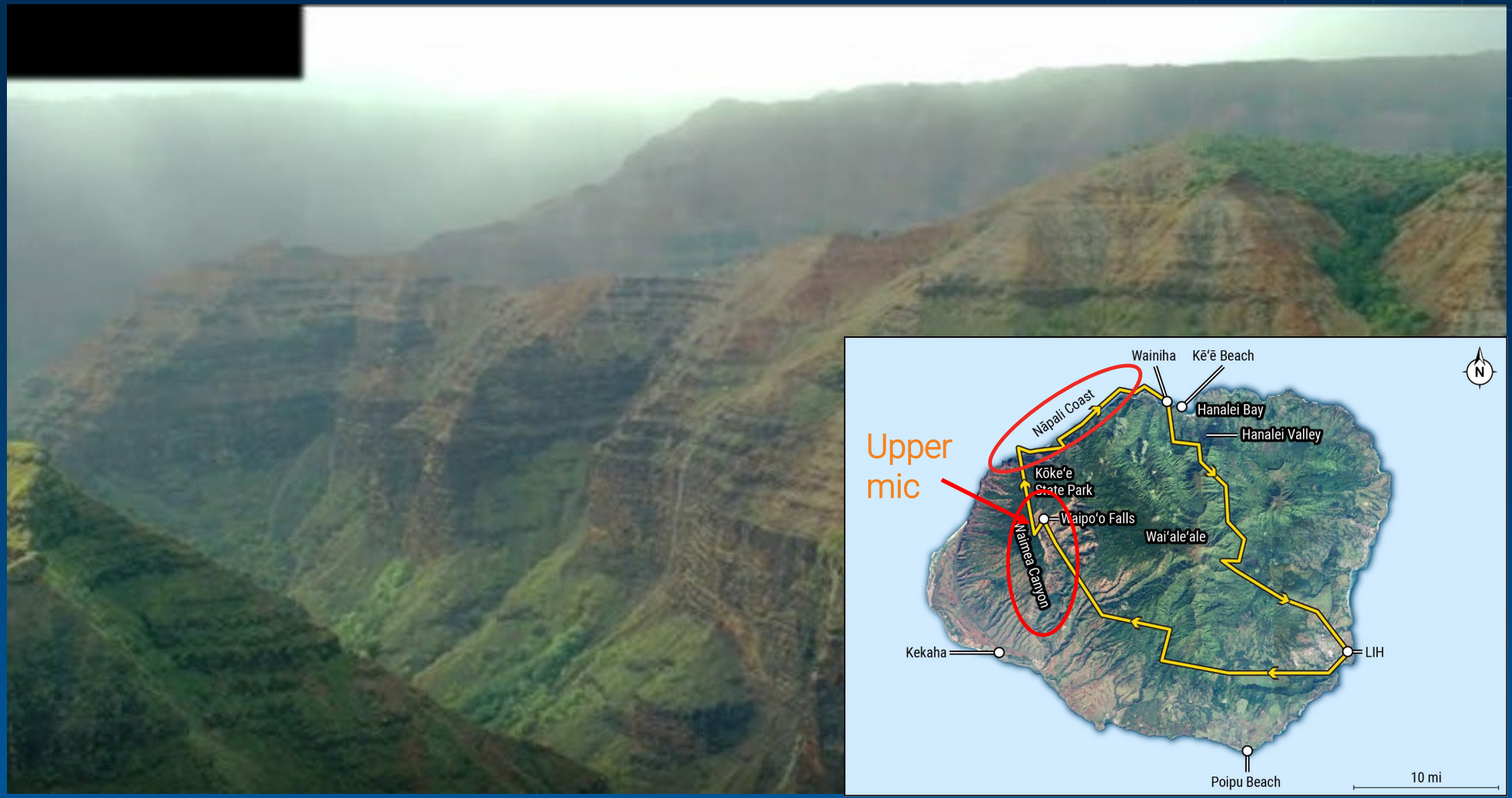
Waimea Canyon at 4:27 p.m. (Company 1 Tour)



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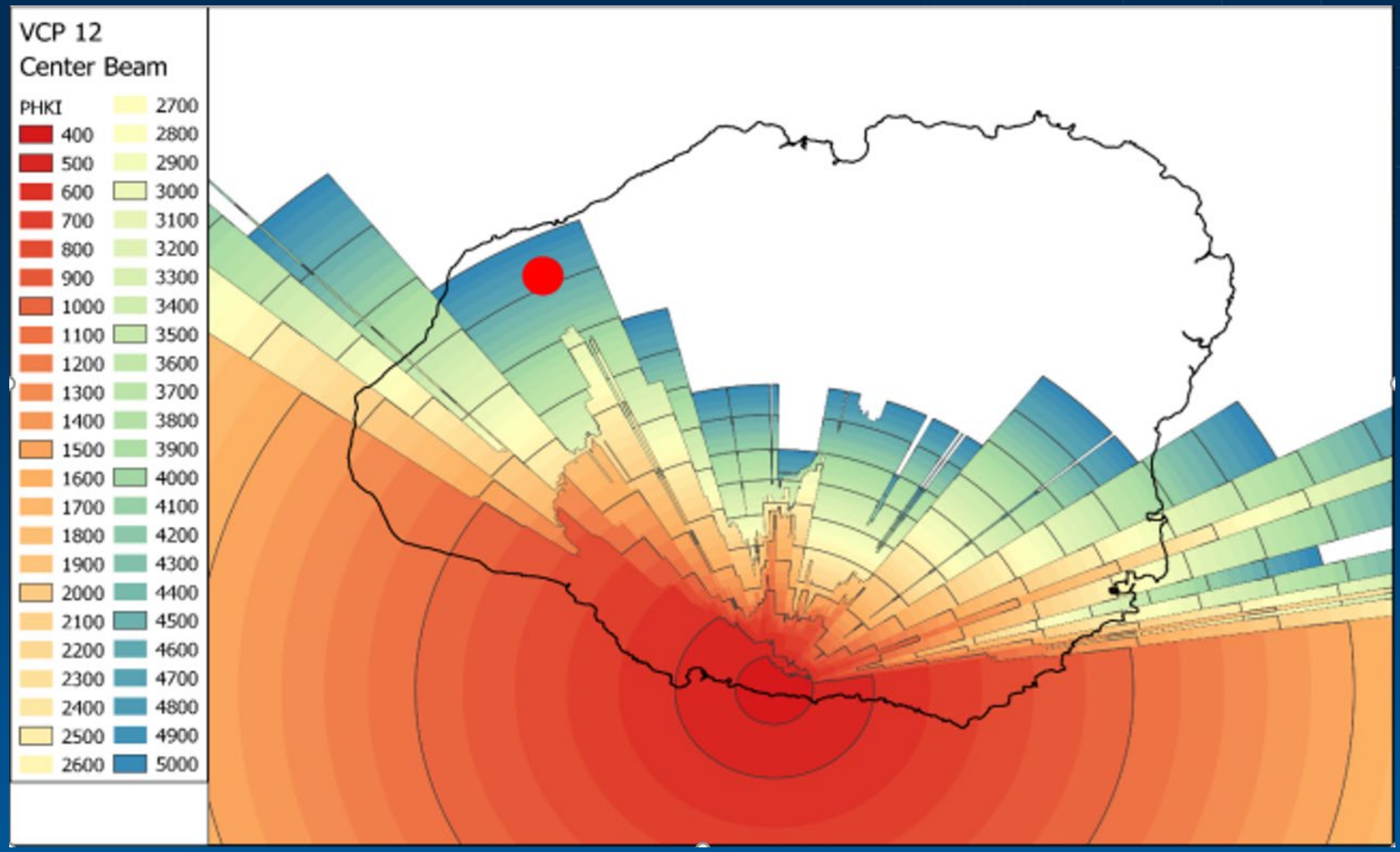
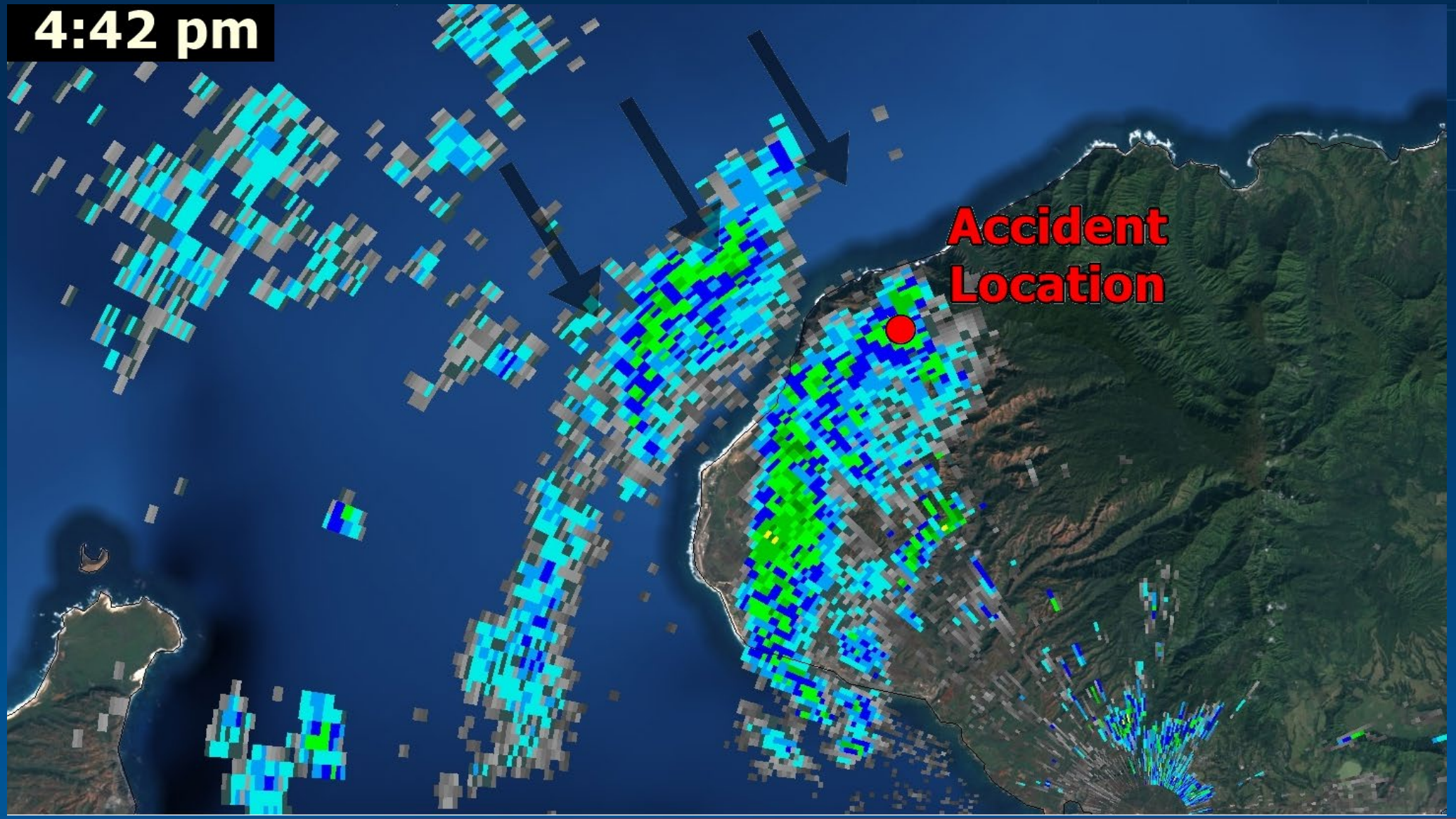
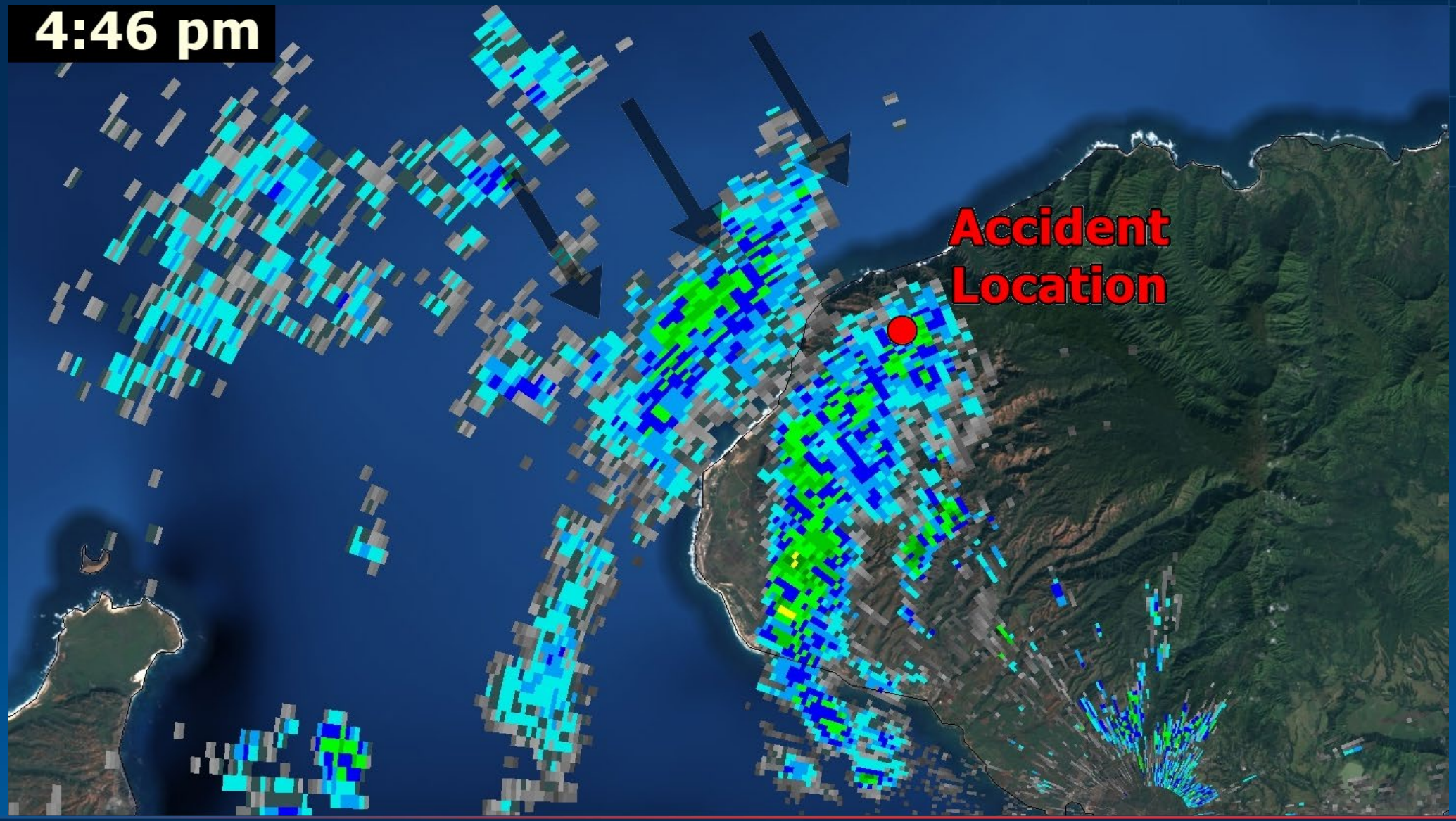
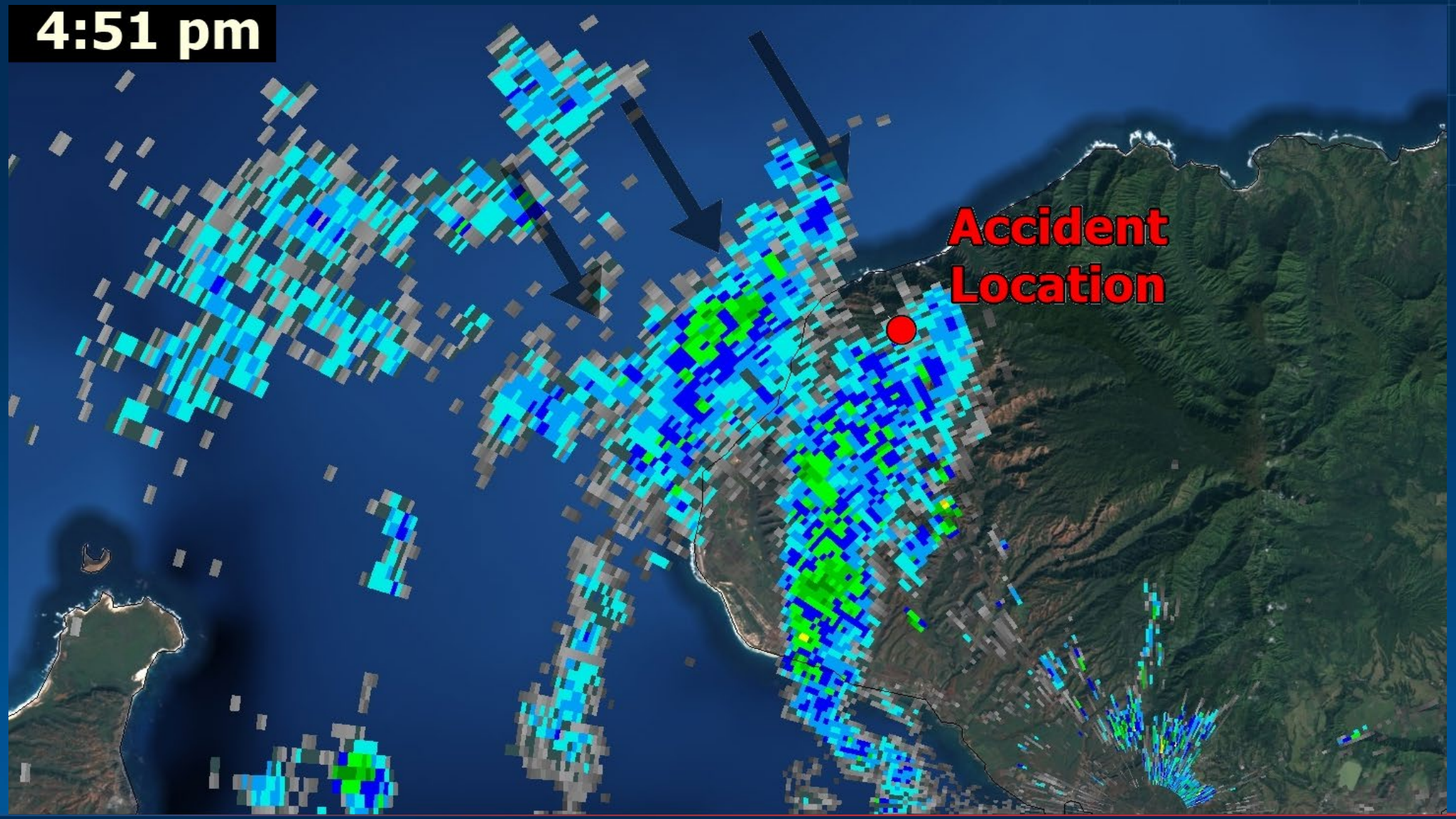
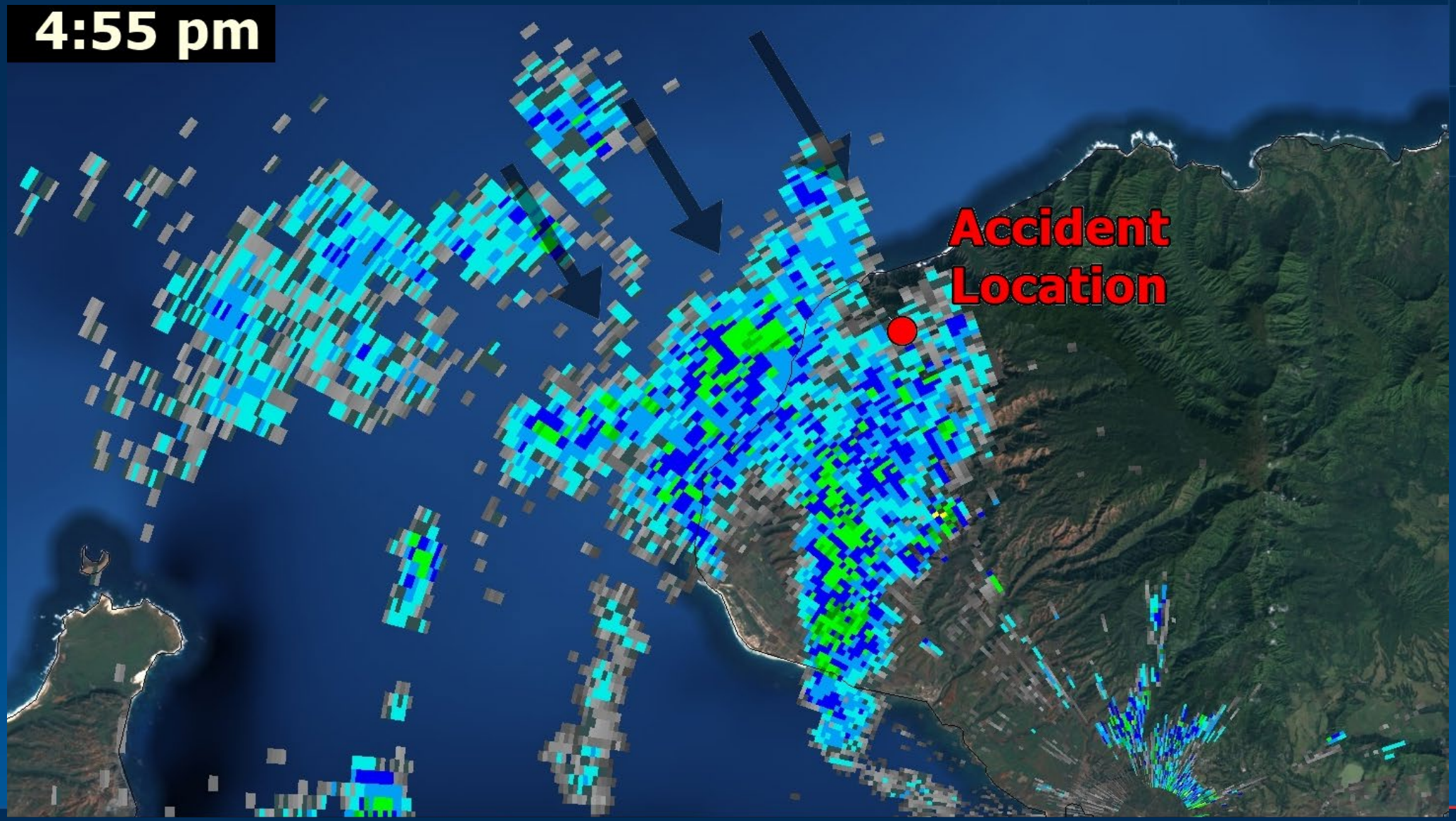
Lihue Weather Radar Coverage below 5,000 ft msl

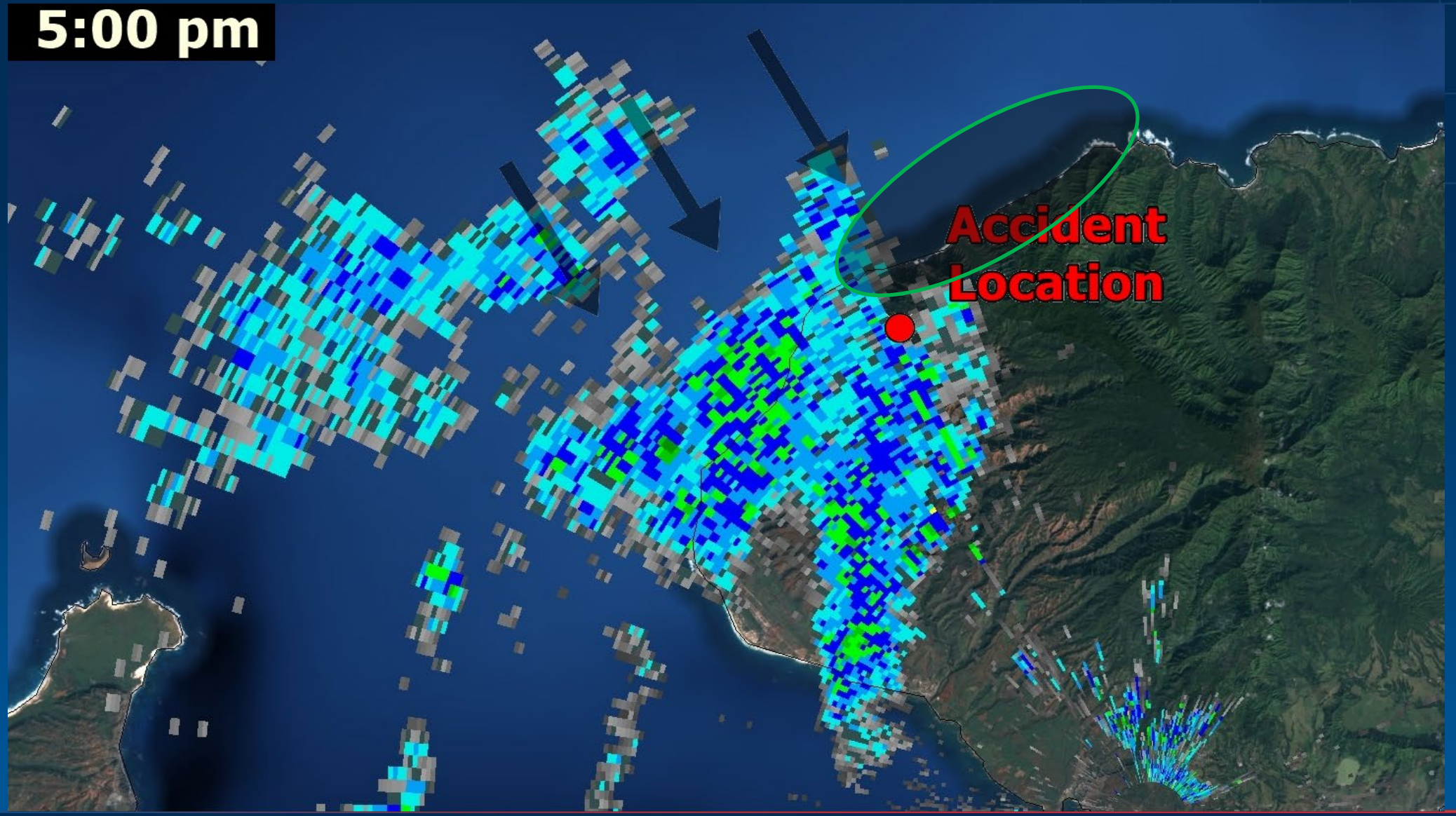



4:42 pm
Accident
Location

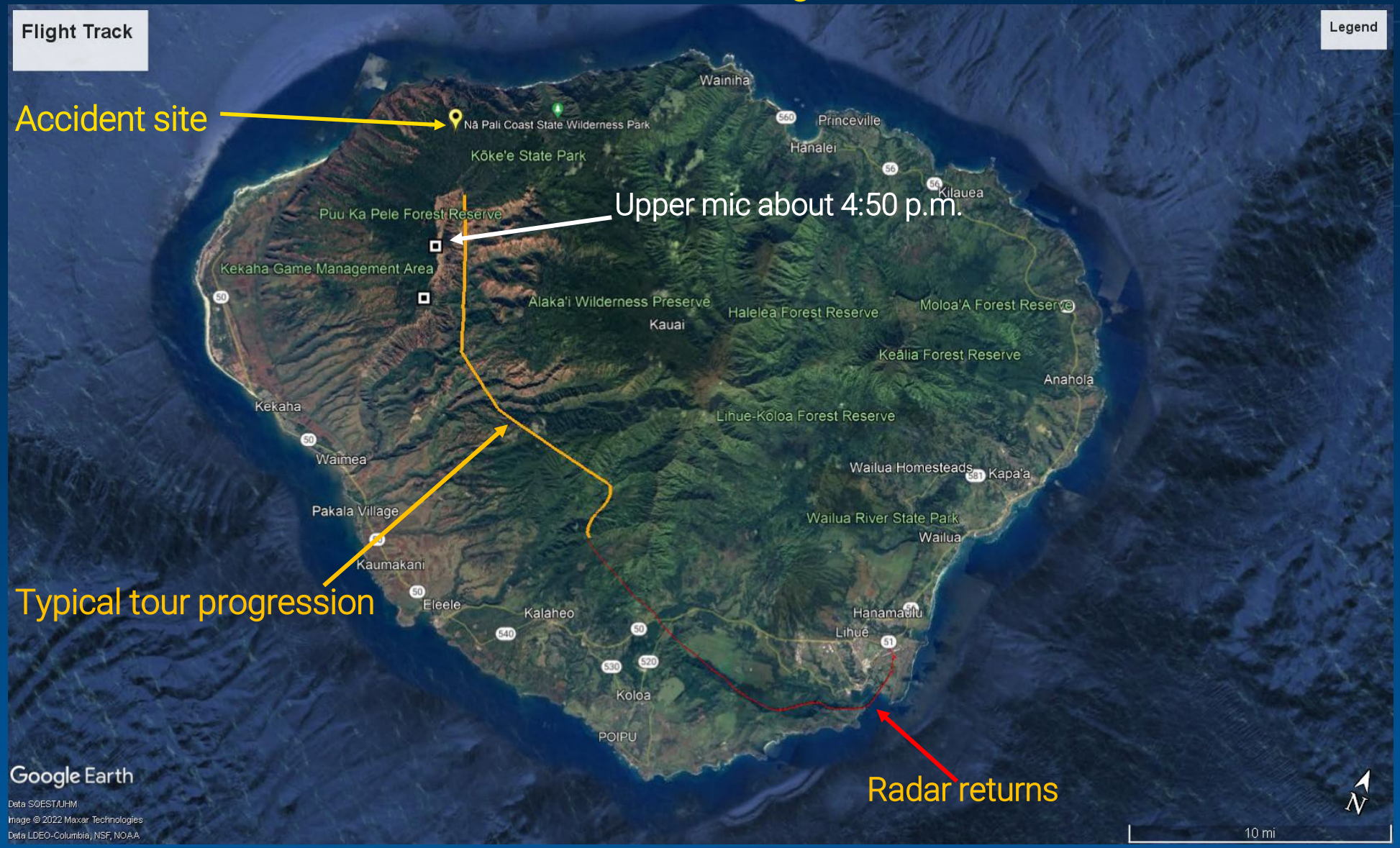

4:46 pm
Accident Location


4:51 pm
Accident
Location


4:55 pm
Accident Location


5:00 pm
Accident Location

Accident Flight



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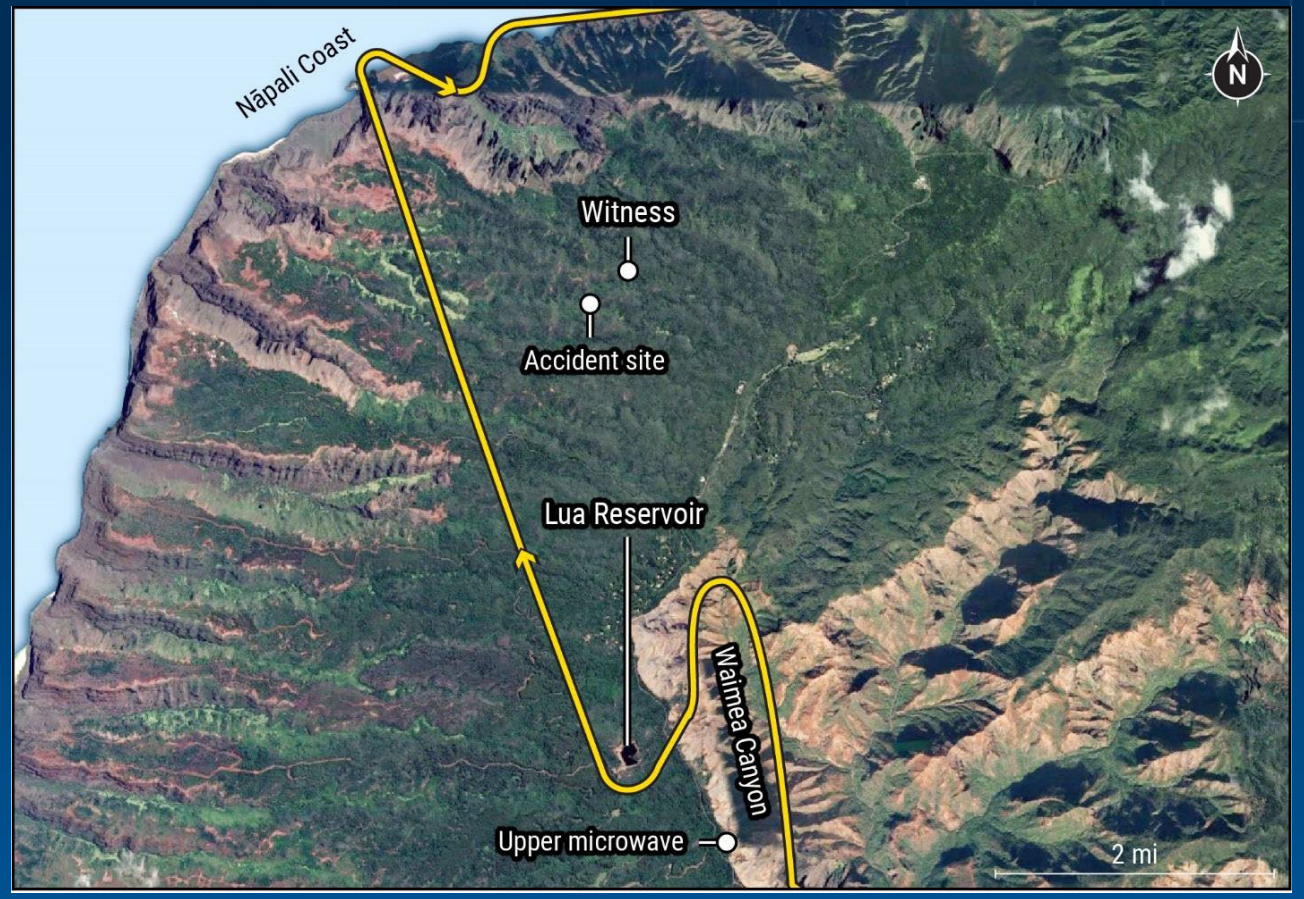
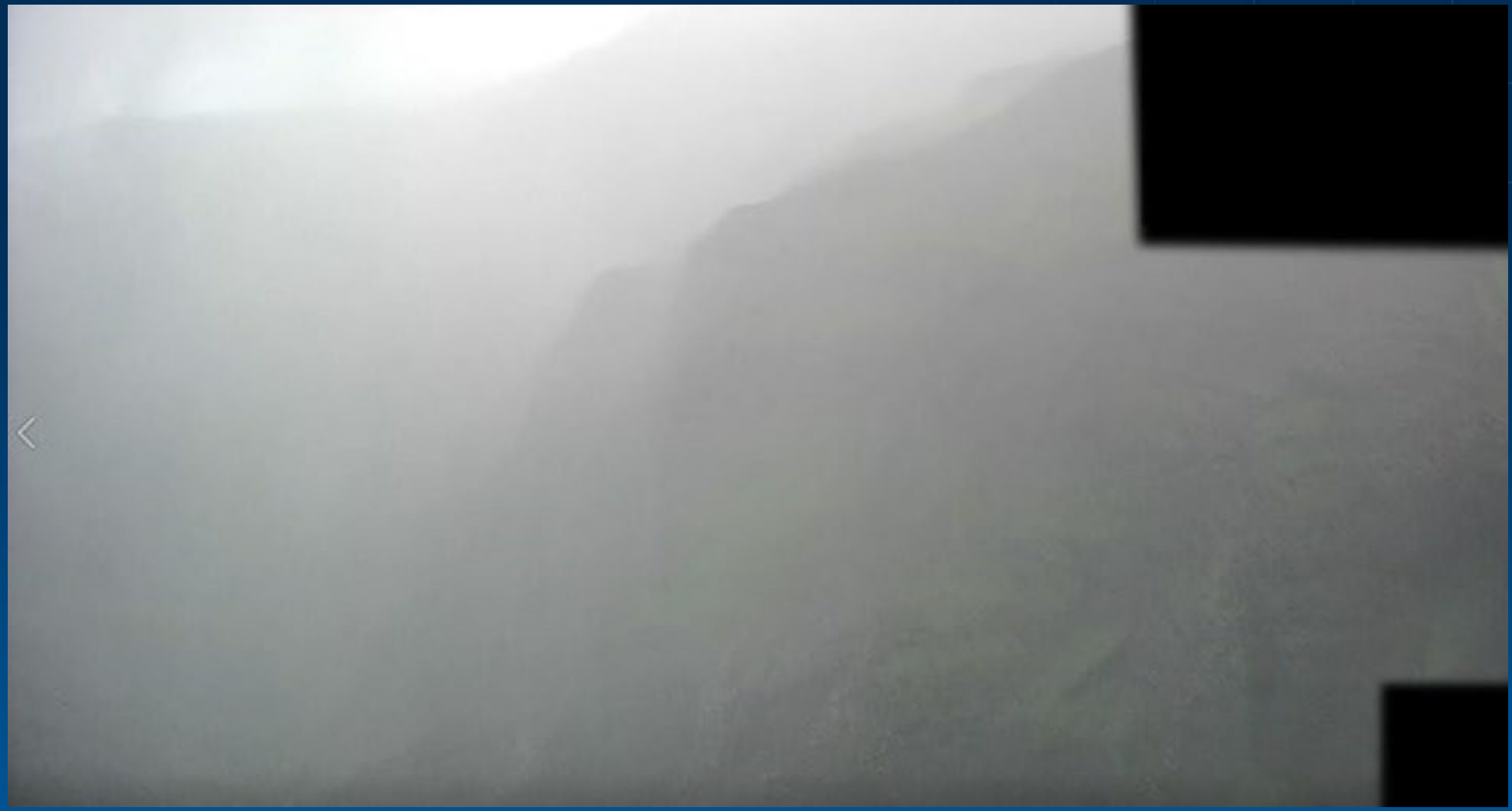
Accident Site

- Witness on hiking trail
- Heavy rain between 4:00 and 4:45 p.m.
- Dense fog with about 20 ft visibility
- Heard helicopter for about 30 to 50 seconds

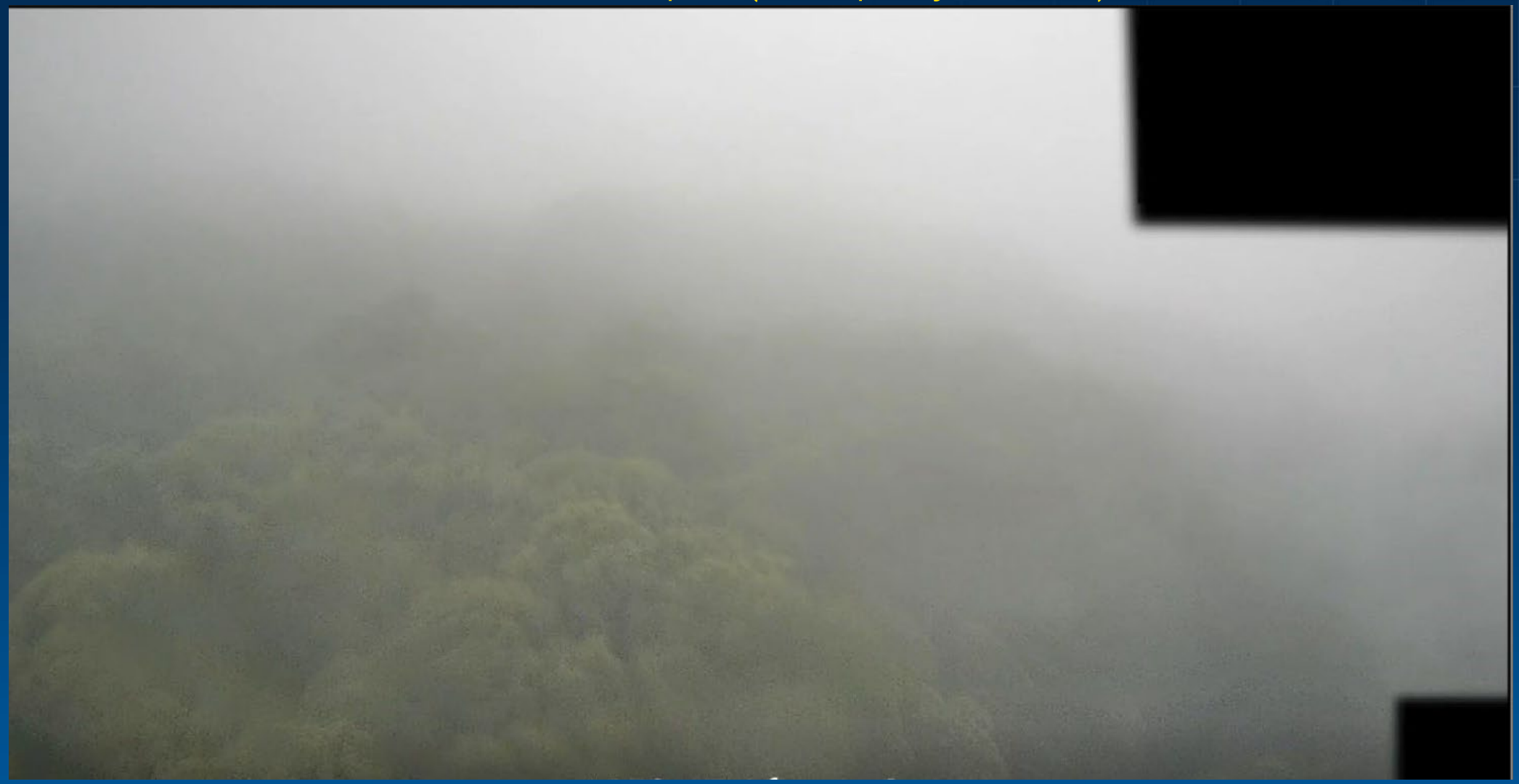


Accident Site

Conditions in North End of Waimea Canyon about 4:57 p.m. (Company 2 Tour)



Conditions North of Waimea Canyon about 4:59 pm (Company 2 Tour)



Accident Circumstances

- Accident pilot continued flight into an area of deteriorating weather
- Limited information about accident helicopter's flight track
- Lack of onboard recorders
- Controlled flight into terrain or loss of control

Exclusions

- Pilot qualifications
- Pilot medical conditions/impairment
- Helicopter mechanical malfunction or failure

Safety Issues

- Communications and ADS-B infrastructure along tour routes in Hawaii
- Real-time decision-making support for air tour pilots
- Federal Aviation Administration (FAA) guidance for Hawaii air tour operators to implement cue-based training
- ADS-B equipment requirements for air tour operators
- FAA surveillance of Hawaii air tour operations
- Safety technologies for helping helicopter pilots escape from inadvertent encounters with IMC

Safety Issues

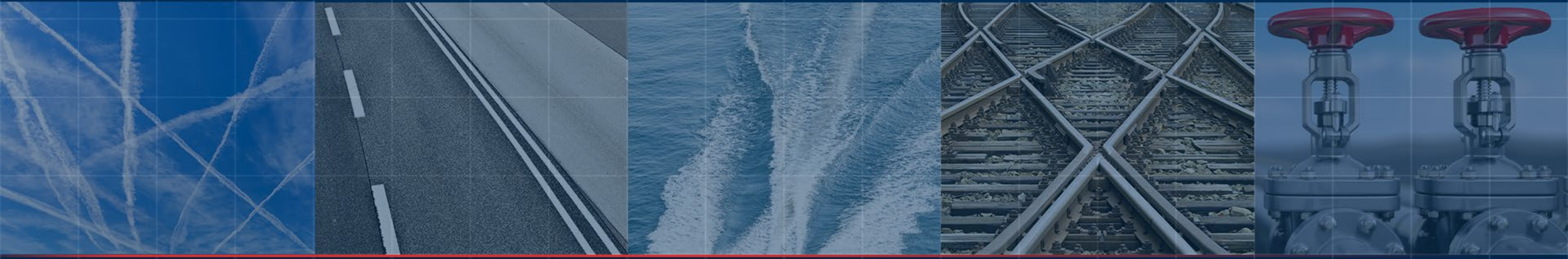
- Safety management systems (SMS) requirements and guidance on scalability
- Onboard video review and ADS-B flight data by operators
- Crash-resistant flight recorder systems
- Hawaii weather camera program
- Flight data monitoring (FDM) programs for Part 135 operators

Parties to Investigation

- FAA
- Safari Aviation Inc.

Accredited Representative

- Bureau d'Enquêtes et d'Analyses pour la Sécurité de l'Aviation Civile (BEA) of France
  - Airbus Helicopters
  - Safran Engines



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Human Performance

Presentation Overview

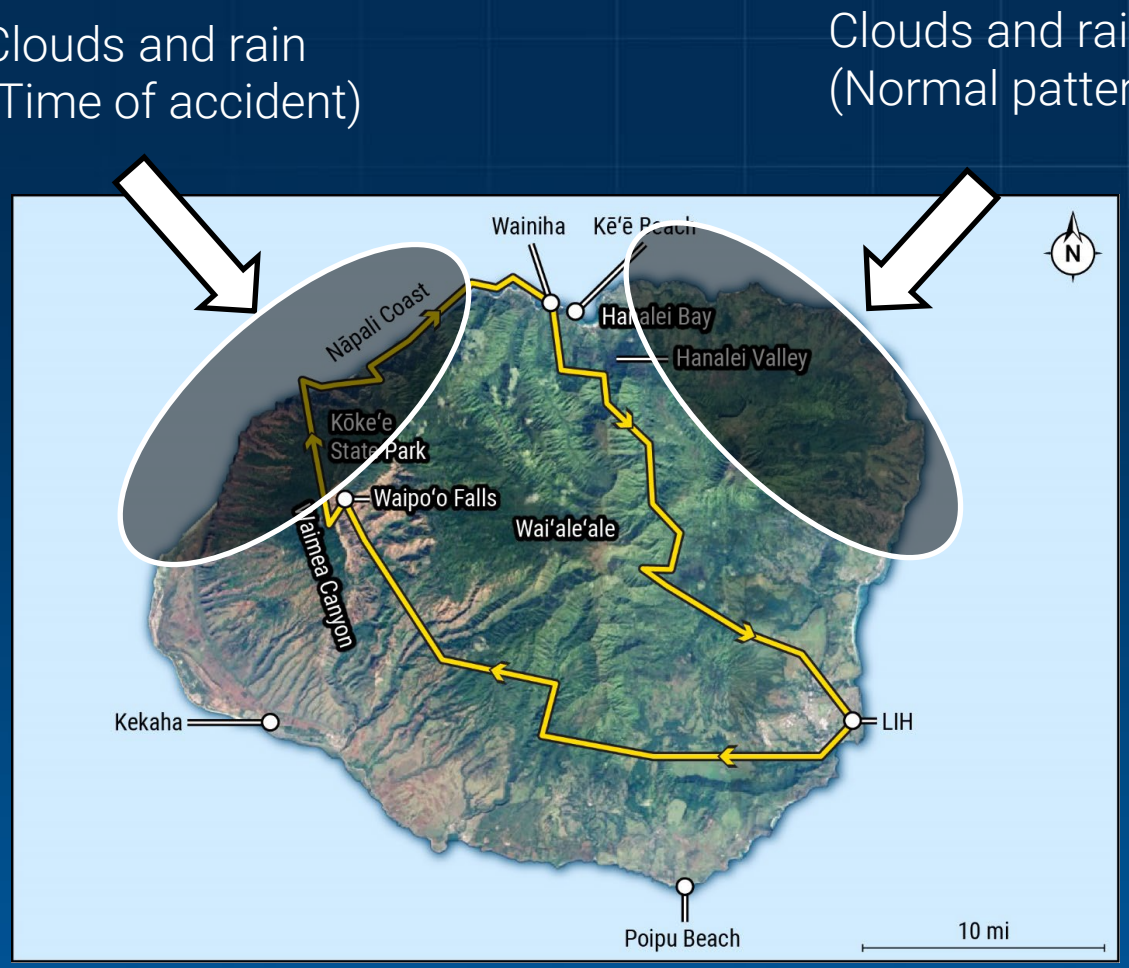
- Pilot decision-making
- Safety assurance
- Safety management systems
- Emerging technologies

Factors that Likely Influenced Pilot's Decision to Continue Flight into Deteriorating Conditions

- Atypical weather pattern
- Lack of relevant weather information

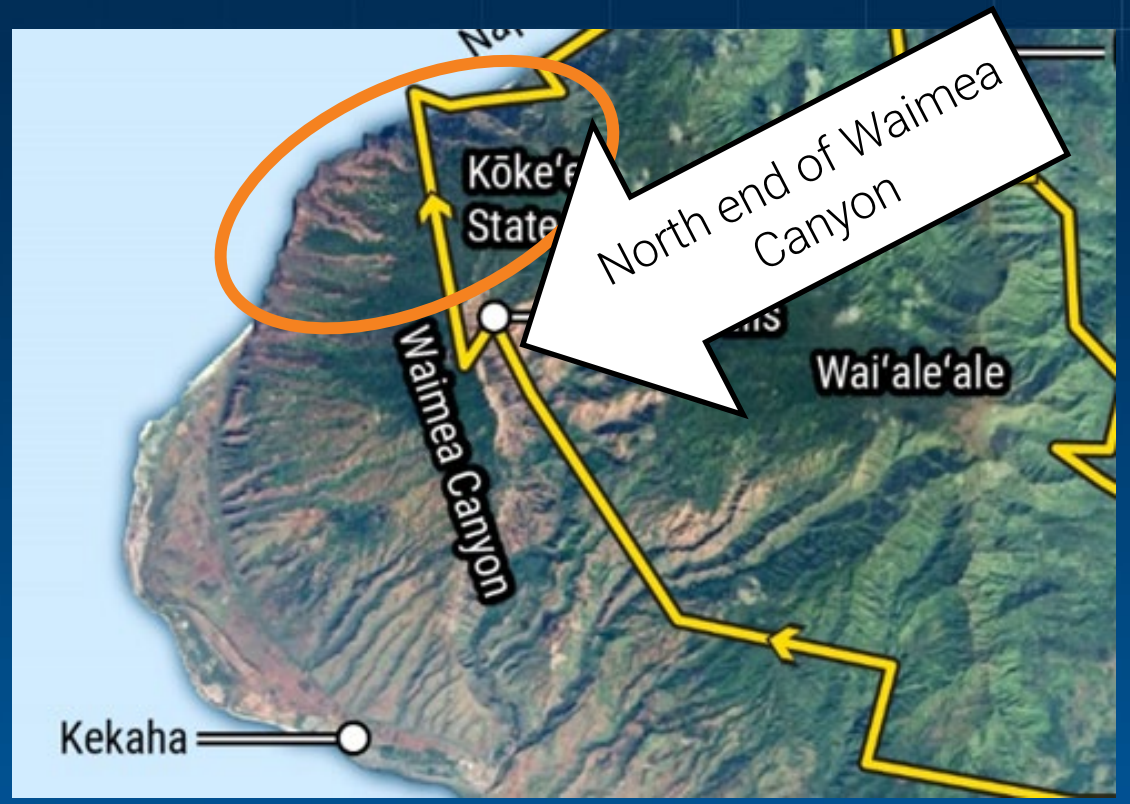
Atypical Weather Pattern

- Northeast trade winds normally bring clouds and rain to northeast Kauai
- On afternoon of accident, northwest winds brought clouds and rain to northwest side
- Atypical weather pattern



Atypical Weather Pattern

- Accident occurred in high terrain north of Waimea Canyon (orange circle)
- Pilots cannot see that area when flying inside canyon
- Good weather present during pilot's previous flight but conditions deteriorated
- When pilot reached north Waimea Canyon, low clouds, rain, and reduced visibility present

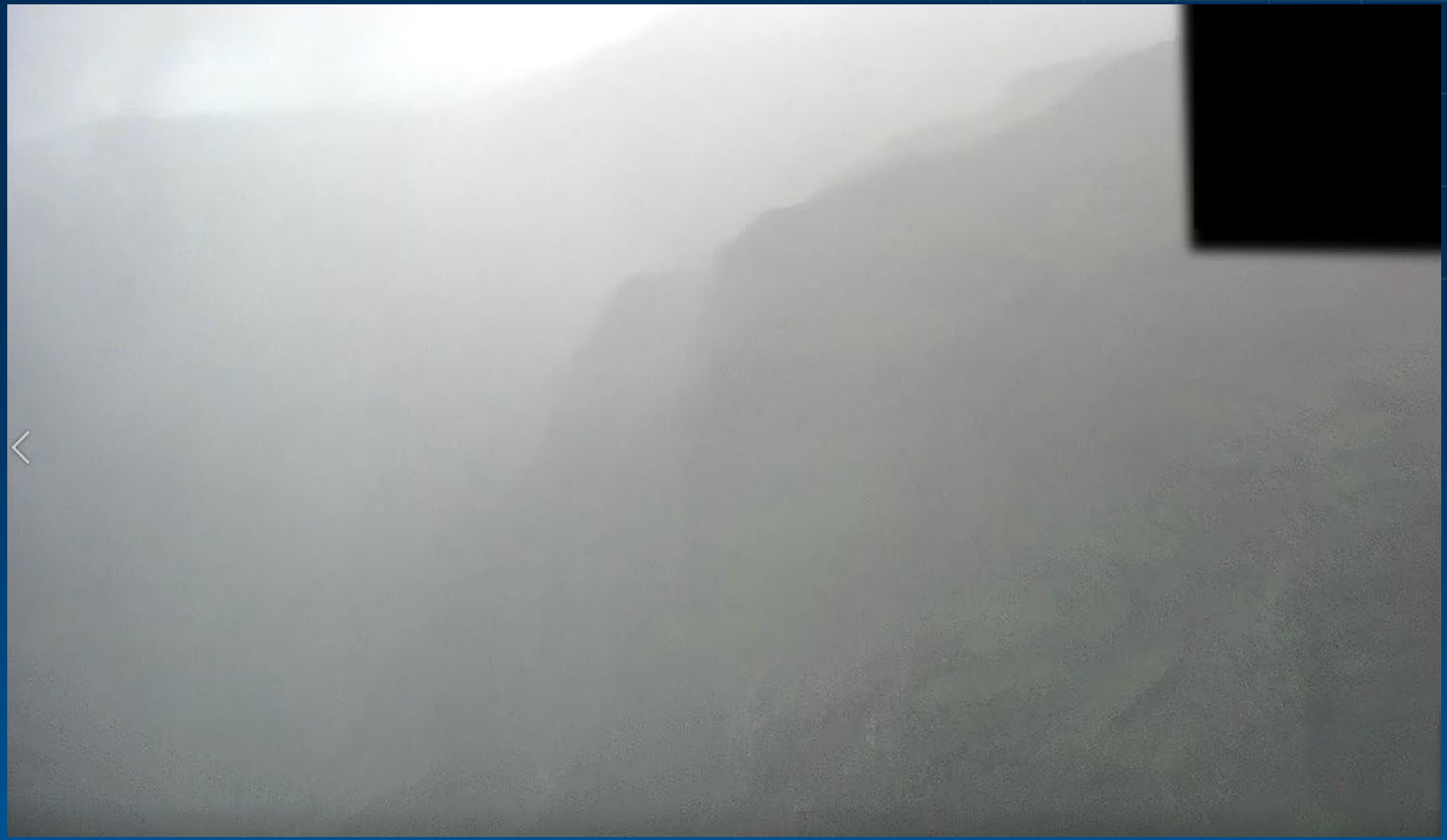


Company 1 Helicopters in North Waimea Canyon about 23 Minutes before Accident Flight Arrived

Time: 4:27 p.m.

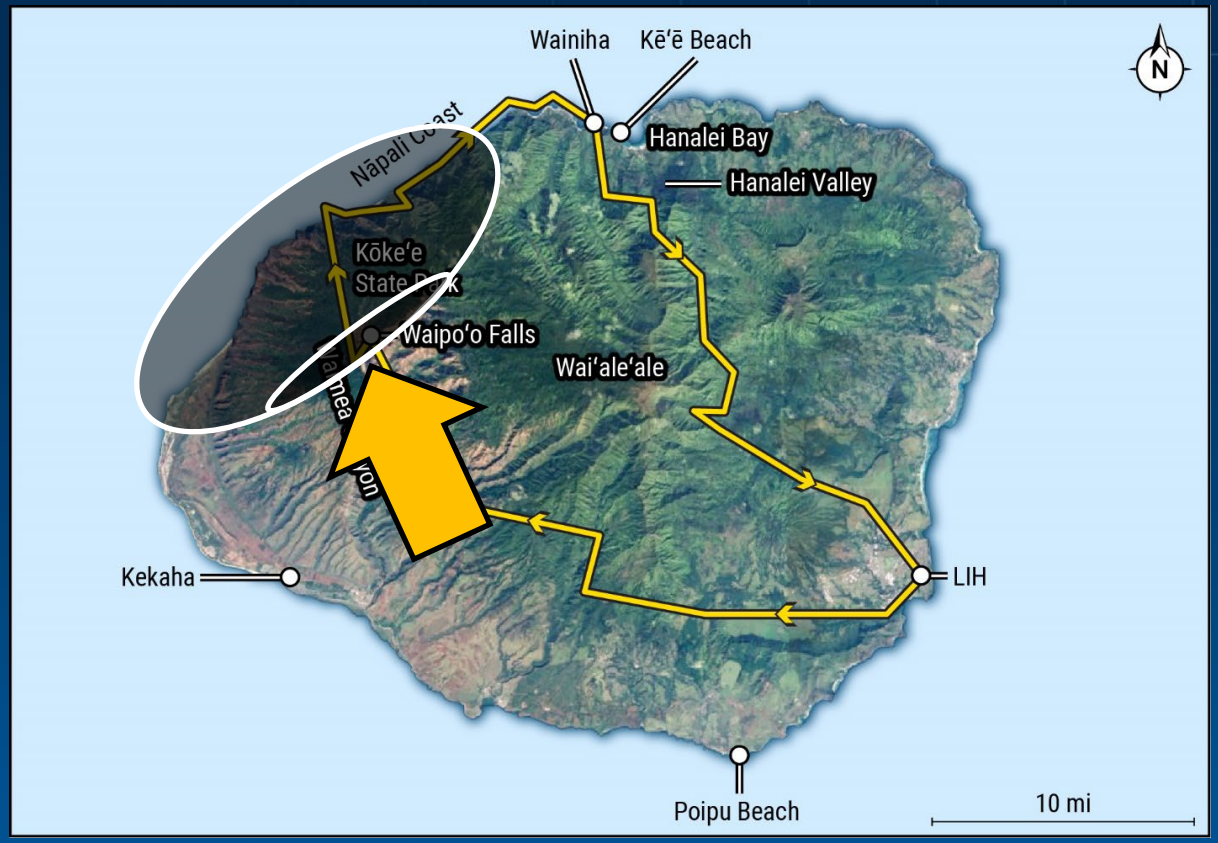
Company 2 Helicopter in North Waimea Canyon about 7 minutes after Accident Flight Arrived

Time: 4:57 p.m.



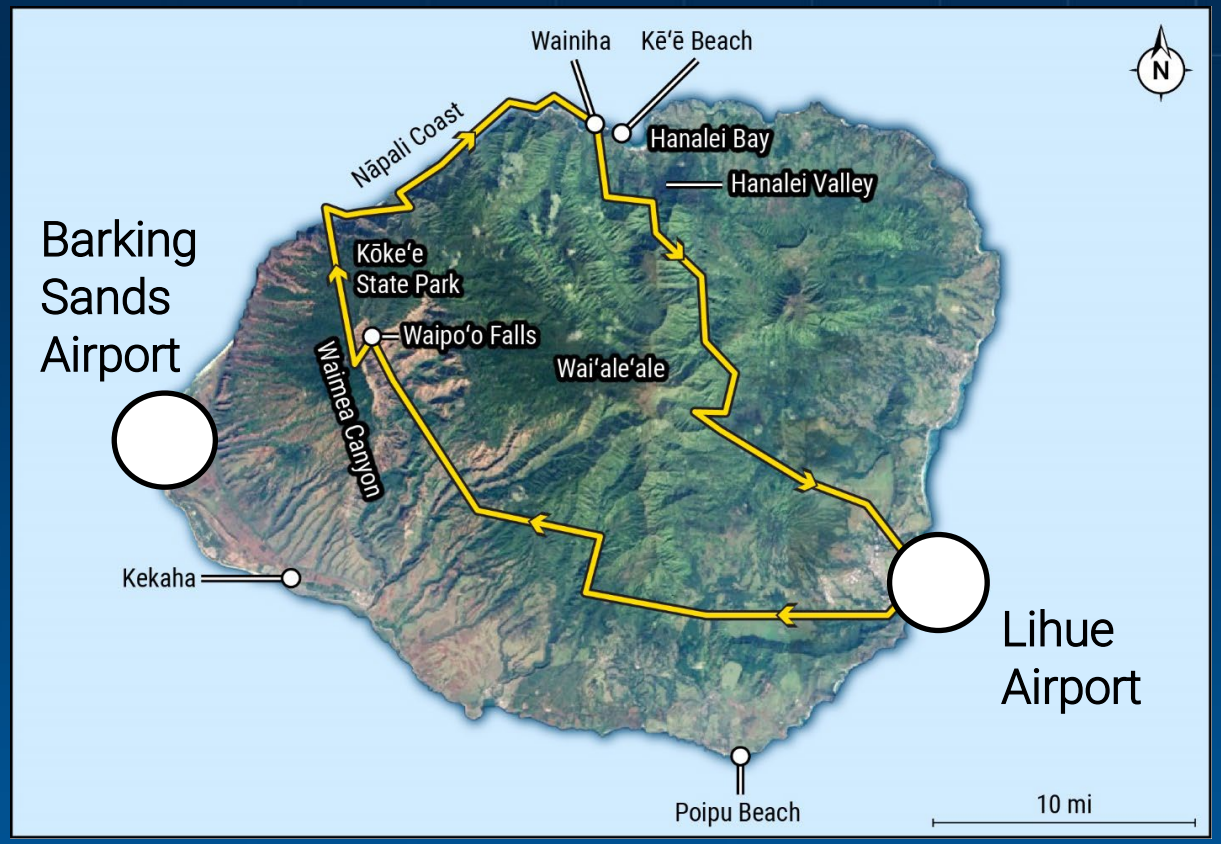
Atypical Weather Pattern

- When pilot decided to continue north, he likely expected brief weather encounter
- Instead entered widespread area of poor weather that extended to coast



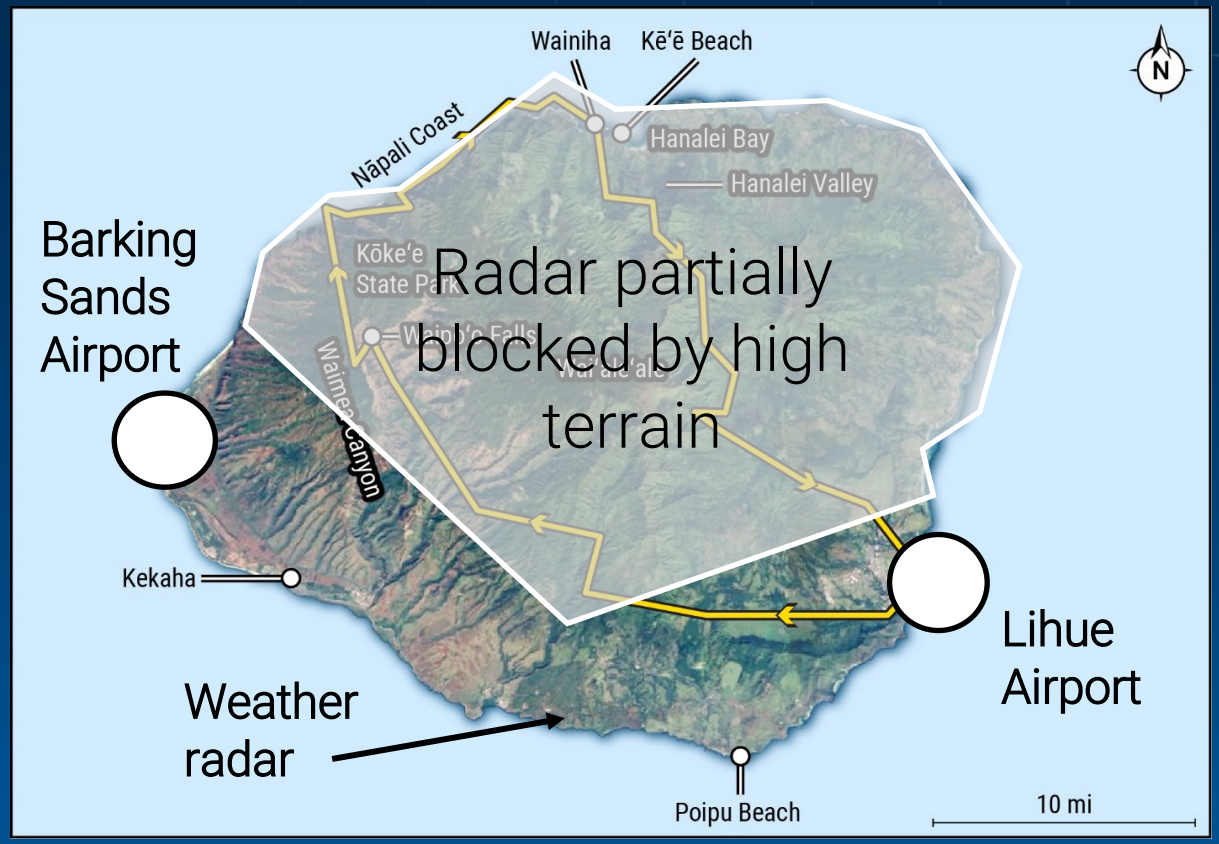
Lack of Relevant Weather Information

- Pilots need relevant information to form accurate expectations
- Weather reporting sites existed at Lihue and Barking Sands
- No sites located on north side of island



Lack of Relevant Weather Information

- Weather radar from facility on south side partially blocked by high terrain
- Pilots in Lihue had limited information about changing conditions on north side
- Lack of relevant information increases difficulty of making appropriate decisions before each flight

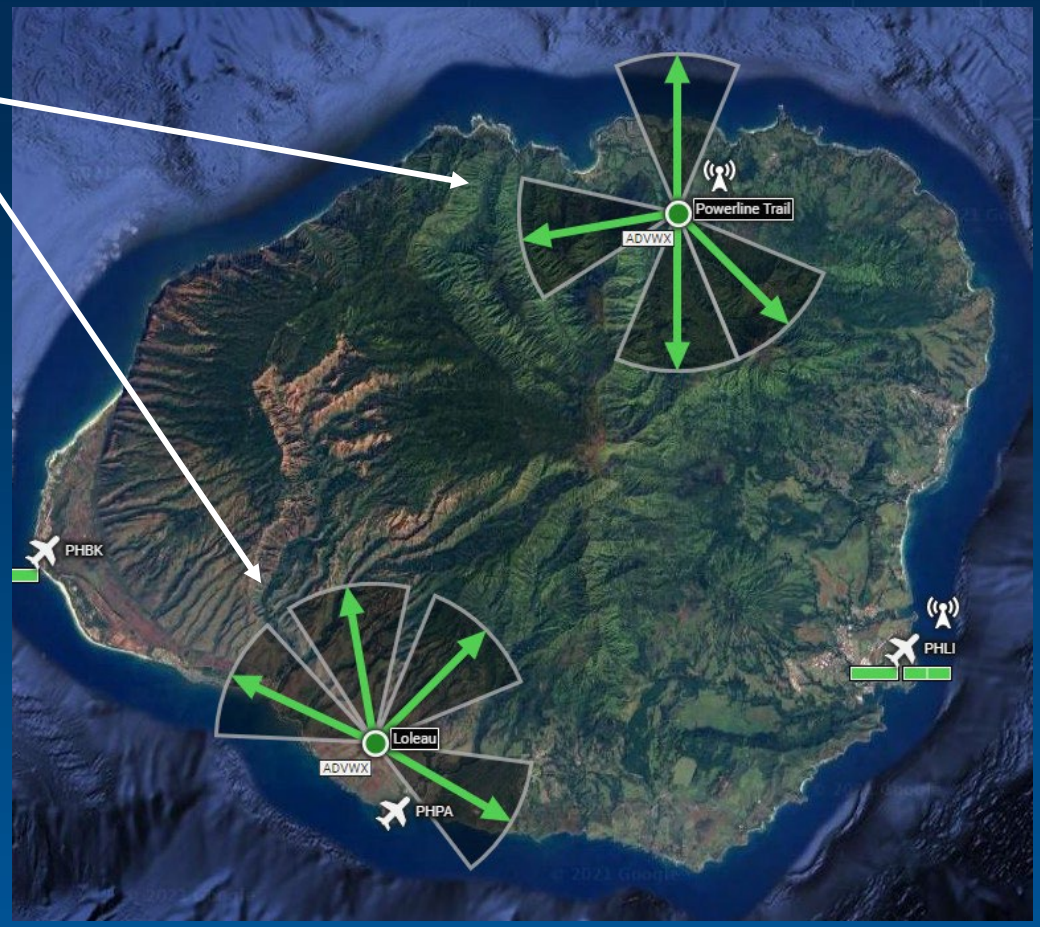


Lack of Relevant Weather Information

- NTSB previously recommended aviation weather camera program for Hawaii (A-13-25)
- By 2019, FAA planned to install 23 weather camera facilities in Hawaii, including 5 on Kauai, but none installed before accident
- Camera on northwest side of island could have allowed pilot to see deteriorating weather there before departing

What We Found: *Need for Aviation Weather Cameras*

- In 2021, FAA installed two camera facilities on Kauai
- Neither shows northwest side of island
- What we propose:
  - One reiteration to FAA (A-13-25)



Possible Additional Factors Affecting Pilot's Weather-Related Decision-Making

- Inadequate in-flight weather assessment
- Inaccurate risk perception

In-Flight Weather Assessment

- Pilots may not recognize when conditions have deteriorated to the point of becoming unsafe
- Pilots can be trained to make better in-flight weather assessments through cue-based training

What We Found: *Need for Cue-Based Weather Training*

- In 2007, NTSB recommended FAA develop and require cue-based training for Hawaii air tour pilots (A-07-18 and -19)
- In 2008, FAA responded that it was requiring Hawaii tour operators to provide cue-base training
- In 2011, FAA assembled team to develop related guidance, but none was issued
- As a result, Safari did not provide type of training FAA research has found effective for improving pilots' in-flight weather assessments

What We Found: *Need for Cue-Based Weather Training*

- FAA's efforts to aid development, production, and maintenance of cue-based weather training programs for air tour pilots have been inconsistent
- What we propose:
  - Two reiterations to FAA (A-07-18 and -19)

Risk Perception

- Risk perception can play role in errors at action selection stage of decision-making
- Pilots may have higher-than-average self-appraisals of skill and judgment in flying
- Implications for risk perception and willingness to engage in high-risk behaviors

Risk Perception

- Pilot was described as safety conscious, but colleague said that, due to his expertise, he sometimes flew closer to adverse weather than more novice or conservative pilots
- Maintaining required minimum 3-mile visibility would have provided opportunity to avoid hazardous conditions
- Pilot's decision to continue when others diverted suggests possibility that he was overconfident in his ability to fly safely through an area of poor visibility

Drift Toward Risky Operating Practices

- Safety theorists assert that work performed by system “operators” often differs from work as described in policies and procedures, and that work practices can sometimes deviate beyond safe boundaries
- Three other pilots diverted before reaching the accident area, but all flew in reduced visibility conditions that may have been below required minimums
- Possibility of a drift toward risky operating practices among local air tour pilot community

Operational Monitoring and Safety Assurance

- Monitoring is needed to detect and correct possible drift toward risky operating practices, could be accomplished as part of a safety management system (SMS)
- SMS is formal, top-down, organization-wide approach to managing safety-related risks
- SMS components:
  - Safety policy
  - Safety risk assessment
  - Safety assurance
  - Safety promotion

What We Found: *Need for Operational Monitoring and Safety Assurance in Air Tour Operations*

- Safari had policy that defined company expectations for pilot adherence to minimum weather requirements
- Did not have adequate safety assurance processes to determine whether policies were effective
- What we propose:
  - One reiteration to FAA (A-16-35)
  - One recommendation to FAA

What We Found: *Need for SMS among Part 135 Operators*

- NTSB has long encouraged the FAA to require SMS, but it is not required for Part 135 operators like Safari
- Safety assurance is most likely to be effective when performed in context of integrated SMS
- What we propose:
  - One reiteration to FAA (A-16-36)

What We Found: *Need for FAA Guidance on Scalability of SMS*

- Safari's president believed operator was too small for SMS, and Safari did not implement SMS
- SMS is scalable to any size operator
- Safety of air tour operators would be enhanced by SMS
- Guidance on scalability for small operators is lacking
- What we propose:
  - One recommendation to FAA

Helicopter Safety Technologies

- Inadvertent flight into IMC is leading category of fatal helicopter accidents
- Efforts to reduce such accidents have historically relied on pilot avoidance of low-visibility conditions, but such accidents continue
- US Helicopter Safety Team (USHST): If all rotorcraft met some IFR stability requirements (e.g., force gradient trim, stability augmentation), pilots could better maintain control and maneuver to avoid terrain during temporary loss of outside visual cueing

What We Found: *Need for Increased Adoption of Helicopter Safety Technologies*

- Historically, complexity, weight and cost have made automatic flight control technologies impractical for normal category helicopters
- Existing technologies have matured, and new solutions are being introduced
- What we propose:
  - One recommendation to FAA

What We Found: *Need for Increased Adoption of Helicopter Safety Technologies*

- Tour Operators Program of Safety (TOPS): An independent nonprofit organization dedicated to enhancing safety of helicopter air tours with members in seven states, including Hawaii
- TOPS could help promote voluntary adoption of safety technologies among air tour operators
- What we propose:
  - One recommendation to TOPS

What We Found: *Need for Increased Adoption of Helicopter Safety Technologies*

- Vertical Aviation Safety Team (VAST) plans to introduce a “Safety Rating for Helicopters” to promote safety-related design enhancements
- VAST working group is developing criteria for rating system
- Not been determined whether rating system will consider technologies for reducing weather-related accidents
- What we propose:
  - One recommendation to VAST

Simulation Technologies for Helicopter Pilot Training

- Training aimed at reducing VFR into IMC accidents could be enhanced by use of simulation technologies
- In 2020, USHST encouraged greater use of simulation in helicopter pilot training
- Emerging technologies, such as head-mounted augmented reality displays, could allow practice of simulated IMC avoidance and escape maneuvers while experiencing actual flight forces

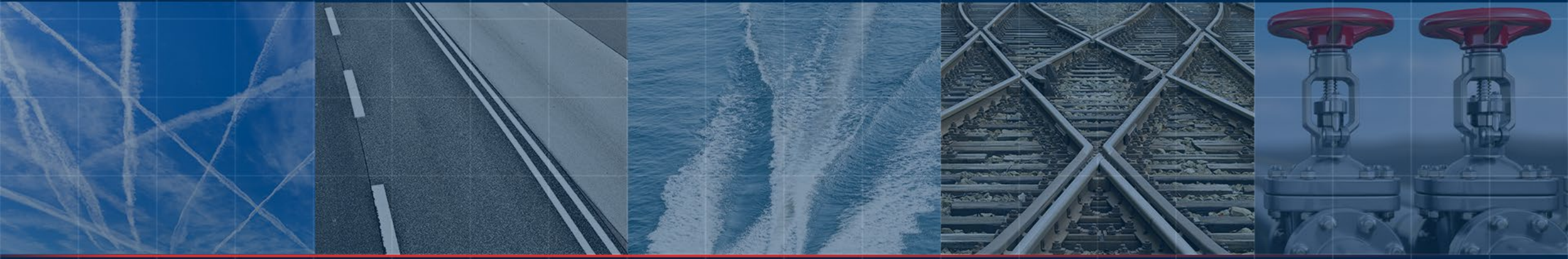
Simulation Technologies for Helicopter Pilot Training

NTSB previously recommended that FAA

- Require simulation for training Part 135 helicopter pilots on hazardous weather avoidance and escape (A-21-5)
- Evaluate spatial disorientation simulation technologies to determine which are most beneficial to pilot training (A-21-6)

What We Found: *Need for Greater Use of Simulation Technologies in Helicopter Pilot Training*

- Simulation technologies could enhance training of
  - Hazardous weather avoidance and escape
  - Spatial disorientation recognition and mitigation
- What we propose:
  - Two reiterations to FAA (A-21-5 and -6)



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Source: Tomas Milosch

Operational Factors

Overview

Needs identified

- Real-time decision support for air tour pilots
- Aviation infrastructure improvements in Hawaii
- Improved FAA surveillance
- Crash-resistant flight recorders

Need for Real-Time Decision Support

- Kauai has dynamic weather conditions
- Pilots rely on in-flight visual weather assessments and pilot reports
- Weather cameras will provide timely weather information
- Pilots would benefit from ground-based decision support
- Existing aviation infrastructure is not adequate to support this

What We Found: *Need for Improved Air-to-Ground Communications*

- Terrain precludes radio communications between Lihue and north side of Kauai
- Ground personnel cannot provide updated weather information or offer guidance to pilots
- Technology is available to extend radio coverage to low-flying aircraft
- What we propose:
  - One recommendation to Federal Aviation Administration (FAA)

Improved ADS-B Capabilities

- Some Hawaii air tour aircraft are equipped with automatic dependent surveillance broadcast (ADS-B) technology
- Safari did not have ADS-B equipment but has since installed it
- Terrain blocks transmission of ADS-B information
- Precludes continuous tracking of aircraft on north side of Kauai

Improved ADS-B Capabilities

- In 2007, NTSB recommended FAA accelerate ADS-B implementation in Hawaii, design it to support low-flying aircraft, and require tour operators to equip aircraft with ADS-B (A-07-25 and -26)
- In 2014, FAA responded that tour operators were not voluntarily equipping with ADS-B and that expanding ground infrastructure would not improve safety unless tour operators had appropriate avionics
- In 2015, FAA completed its installation of ADS-B ground infrastructure, which did not provide service to low-flying aircraft

What We Found: *Insufficient ADS-B Infrastructure in Hawaii*

- ADS-B infrastructure in Hawaii is insufficient to enable real-time flight position tracking along air tour routes of ADS-B equipped aircraft and to support safety assurance
- What we propose:
  - Two recommendations to FAA

Benefits of Operational Control Support for Pilot Tactical Decision-Making

- Decision-making was performed exclusively by tour pilots
- Pilot vulnerabilities to limitations of in-flight visual assessments and possible influences of cognitive biases (like overconfidence)
- Safari was not required to have operational control support personnel
- Evidence indicates support personnel can help reduce accidents

What We Found: *Benefits of Operational Control Support for Pilots' En Route Weather-Related Decision-Making*

- Real-time decision-making support and monitoring from trained company personnel would support operational safety assurance
- What we propose:
  - One recommendation to FAA

FAA Surveillance

- Honolulu Flight Standards District Office (FSDO) had large territory
- From 2013 to 2016, air tour surveillance involved outreach meetings and in-person surveillance
- By April 2017, FSDO was experiencing a staffing shortage, struggling with surveillance
- FSDO manager's focus for air tour was on updating the Hawaii Air Tour Common Procedures Manual (HATCPM), which imposes safety requirements on air tour operators
- No revision has been issued

FAA Surveillance

- Honolulu FSDO uses risk-based surveillance to prioritize inspector resources
- Safari was not identified as a high-risk operator
- Effective, routine operational surveillance could help stop a drift toward risky operating practices
- Technology could permit innovative and efficient strategies for operational surveillance
  - Trend analysis of ADS-B data and weather camera images
  - Reviews of on-board video from tour aircraft

What We Found: *Increased Surveillance to Reduce Risk-Related Drift*

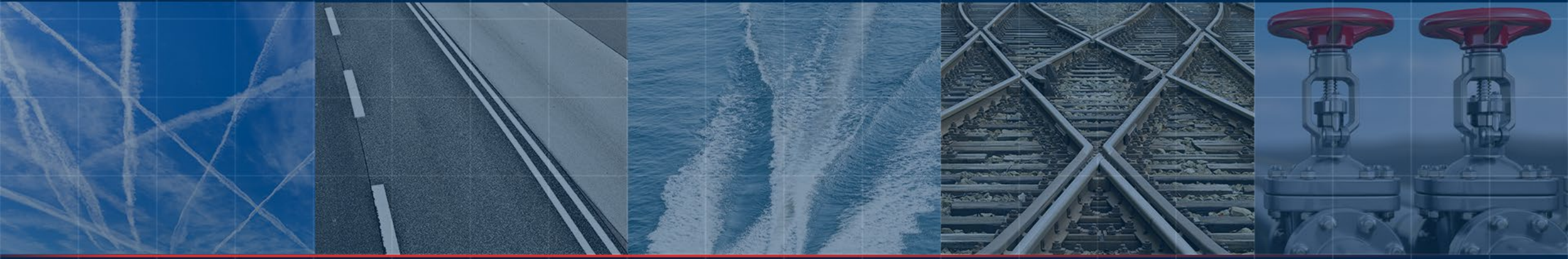
- Increased surveillance could decrease the likelihood of a drift toward risky operating practices by tour operators and their pilots
- What we propose:
  - One recommendation to FAA

Crash-Resistant Flight Recorder Systems

- Certain circumstances of this accident could not be determined
- Crash-resistant recorder could have provided information and identification of additional safety issues
- Staff was unable to distinguish if this accident was due to controlled flight into terrain or inflight-loss-of-control

What We Found: *Need for Onboard Recorders*

- Crash-resistant flight recorder system could have provided valuable information to prevent similar accidents
- What we propose
  - Reiterate one recommendation to FAA (A-13-13)



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