



VEXCEL
DATA PROGRAM

Addressing Government and Commercial Post- Disaster Responses Using Machine Learning

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Vexcel Data

Geospatial World Forum 2023

Generating Intelligence with AI/ML

26.447390, -81.936474



Introduction

Overview Generating Intelligence from AI/ML

- **Rapid data analysis:** AI/ML algorithms process large volumes of aerial imagery quickly, providing real-time insights and reducing manual labor.
- **Enhanced pattern recognition:** AI/ML can identify patterns and trends within geospatial data that may be difficult for humans to perceive, enabling more accurate decision-making.
- **Cost-effective review:** Automating analysis of aerial imagery can significantly reduce costs associated with labor-intensive manual processes.
- **Disaster response and mitigation:** AI/ML can identify risk and assess damage after natural disasters, enabling faster and more efficient response efforts.
- **Enhanced collaboration:** AI/ML can streamline data sharing and communication between organizations, promoting more effective collaboration on geospatial projects.

About Vexcel

30 years of photogrammetric excellence

Global leaders in aerial imaging

Vexcel Imaging

Designs and manufactures the marketing-leading UltraCam sensors, and all-in-one photogrammetry software UltraMap.

Vexcel Fleet

Captures aerial data utilizing dedicated aircraft equipped with various camera sensors. In-house and third-party fliers.

Vexcel Data

The most comprehensive and accurate library of aerial content in 30+ countries.

Global Footprint

Western Europe

Andorra, Austria, Belgium, Denmark, Germany, France, Italy, Ireland, Liechtenstein, Luxembourg, Portugal, Netherlands, Monaco, San Marino, Spain, Switzerland, and Vatican City

Canada

USA

Puerto Rico

United Kingdom

Global Footprint



WIDE AREA COLLECTION

15cm GSD Orthomosaic Imagery



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Final Ortho | © OpenStreetMap contributors. © Vexcel Imaging US Inc. Image Date July 31st, 2020 51.924479, 4.469176

URBAN AREA COLLECTIONS

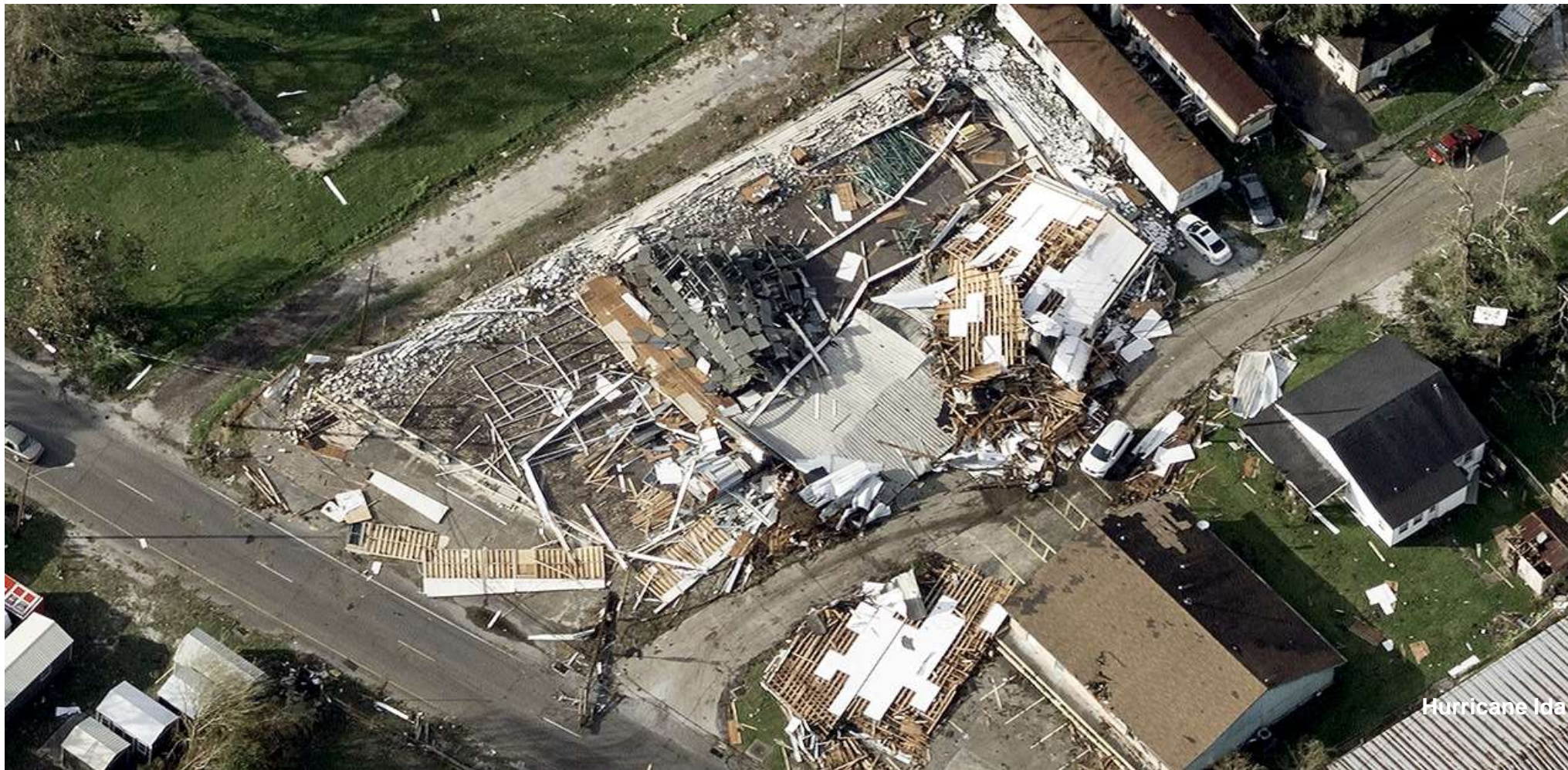
7.5cm GSD True Orthomosaic



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Final Ortho © OpenStreetMap contributors. © Vexcel Imaging US Inc. Image Date July 24th, 2022 51.949034, 4.433956

Gray Sky Program



Hurricane Ida, Houma, LA

Elements

Machine Learning derived features and attributes from our imagery:

- Property – information about property including buildings
- Building – information about buildings
- Building Footprint – geometry only of buildings
- Damage Assessment – information about post-disaster damage to buildings

Building Attributes

By analyzing our data and our proprietary machine learning AI we extract key attributes for residential buildings and structures in 15 countries. The extracted data set includes roof materials, roof material, decorative ornaments, and roof pitch.

Learn More



Property Attributes

We have more than 20 features within a property or parcel boundary. Property attributes include both building and property details.

From identifying pools to determining utility to various roof features, gain a better understanding of property features with our proprietary AI and geospatial data for high resolution imagery. Available for residential properties in U.S. and Australia.

Learn More



Damage Assessment

Recent satellite high-resolution aerial imagery of properties required by major insurers. This disaster imagery is quickly analyzed and a damage assessment is created for its delivery within the imagery solution which has FEMA classification and the percentage of roof and structure damage to each building.

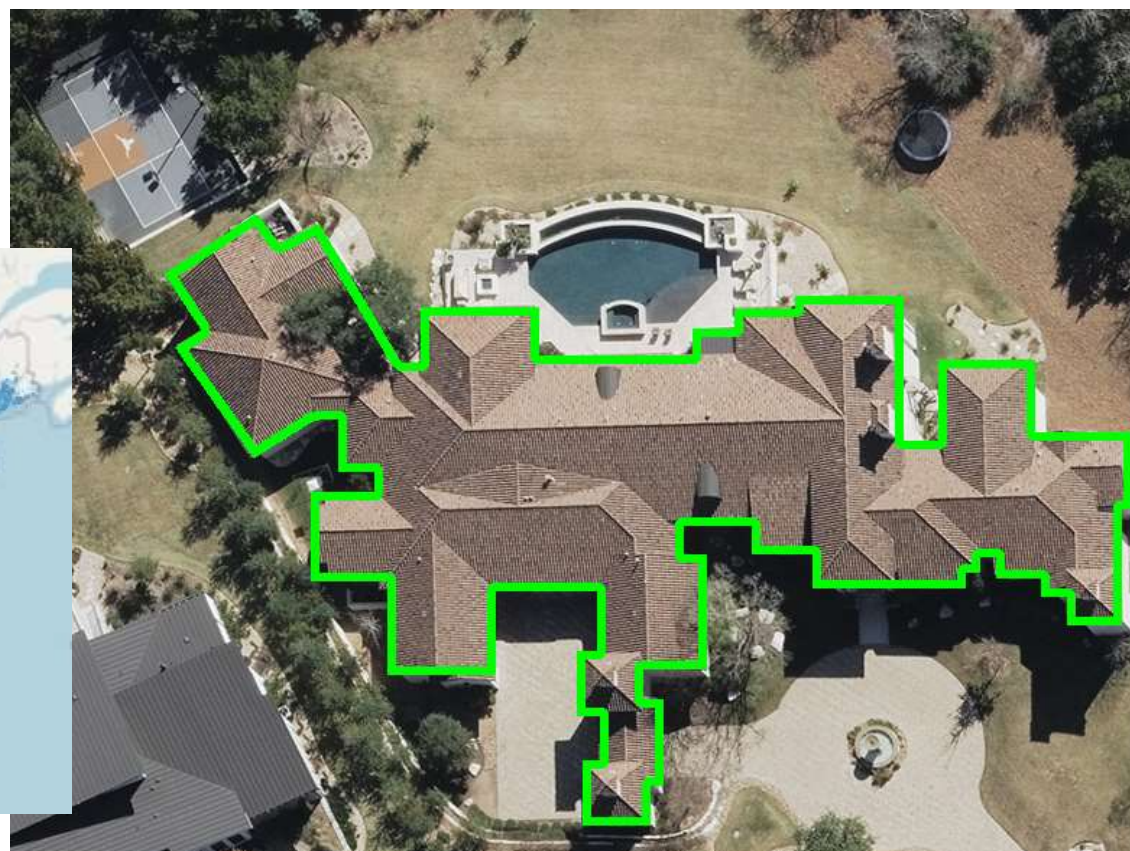
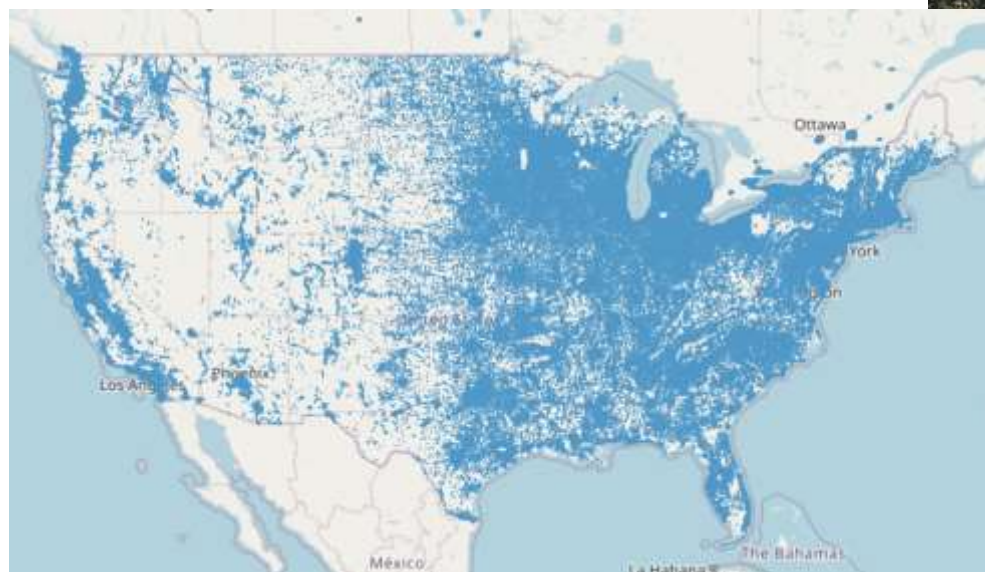
This post-DFP analysis is available for all hurricanes, hurricanes, and fire events covered by the service from 2013 and going forward.

Learn More



Elements

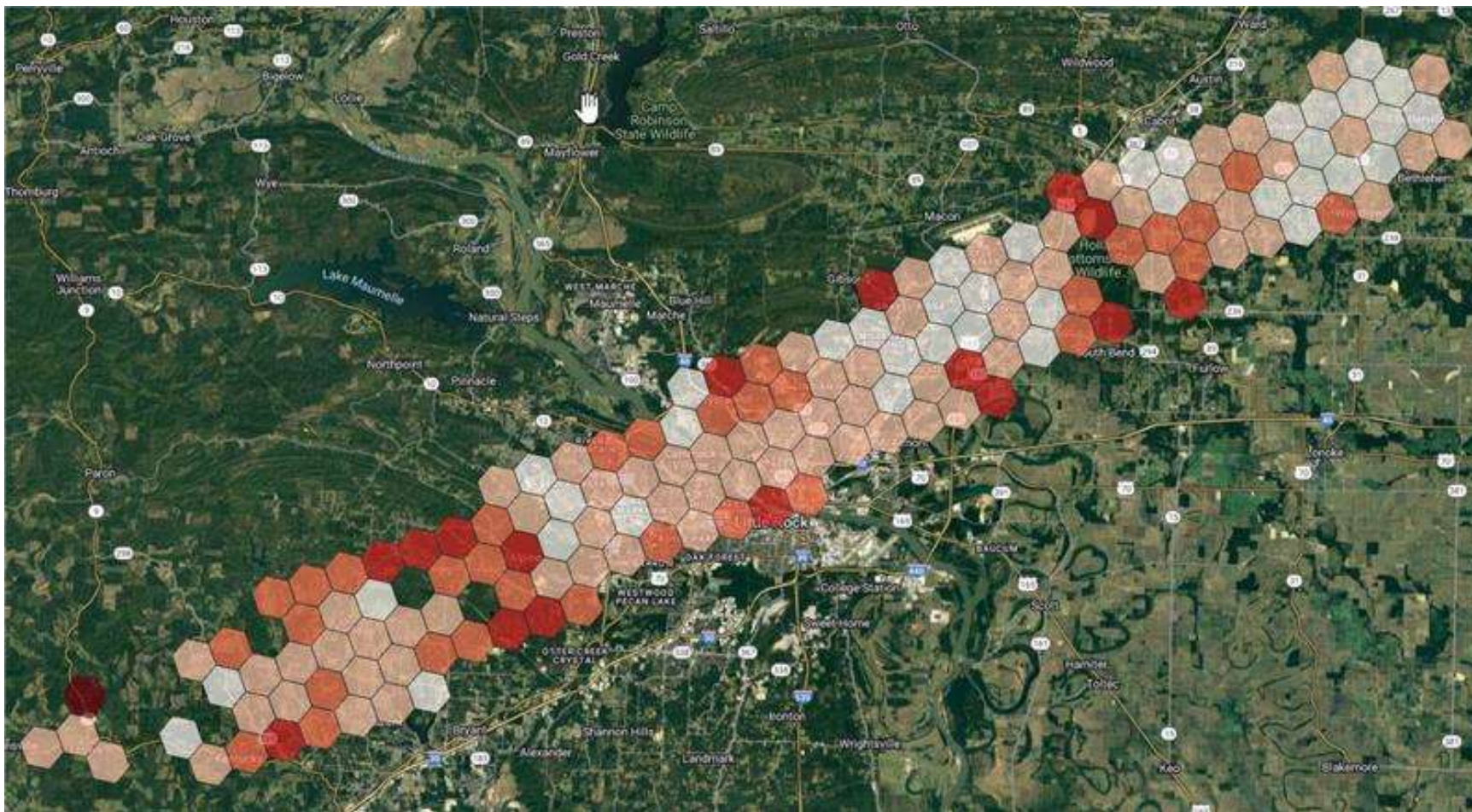
- 30+ property & building attributes
- Available in 30 countries
 - Precomputed for North America
 - On-the-fly compute for ROW



Property Attributes

- Footprint Area: 1605.06 m²
 - Roof Height: 5.73 m
 - Roof Solar: No
 - Roof Condition: 4/5
 - Roof Shape: Hip
 - Roof Material: Tile
 - Defensible Space Report:
30 ft: 19%, 100 ft: 36%
 - Pool: Yes
 - Enclosure: No
 - Diving Board: No
 - Water Slide: No
 - Trampoline: Yes
 - Sport Court: Yes
- Location: TX, USA

Damage Impact along Tornado Path



Damage Assessment



Blue Sky

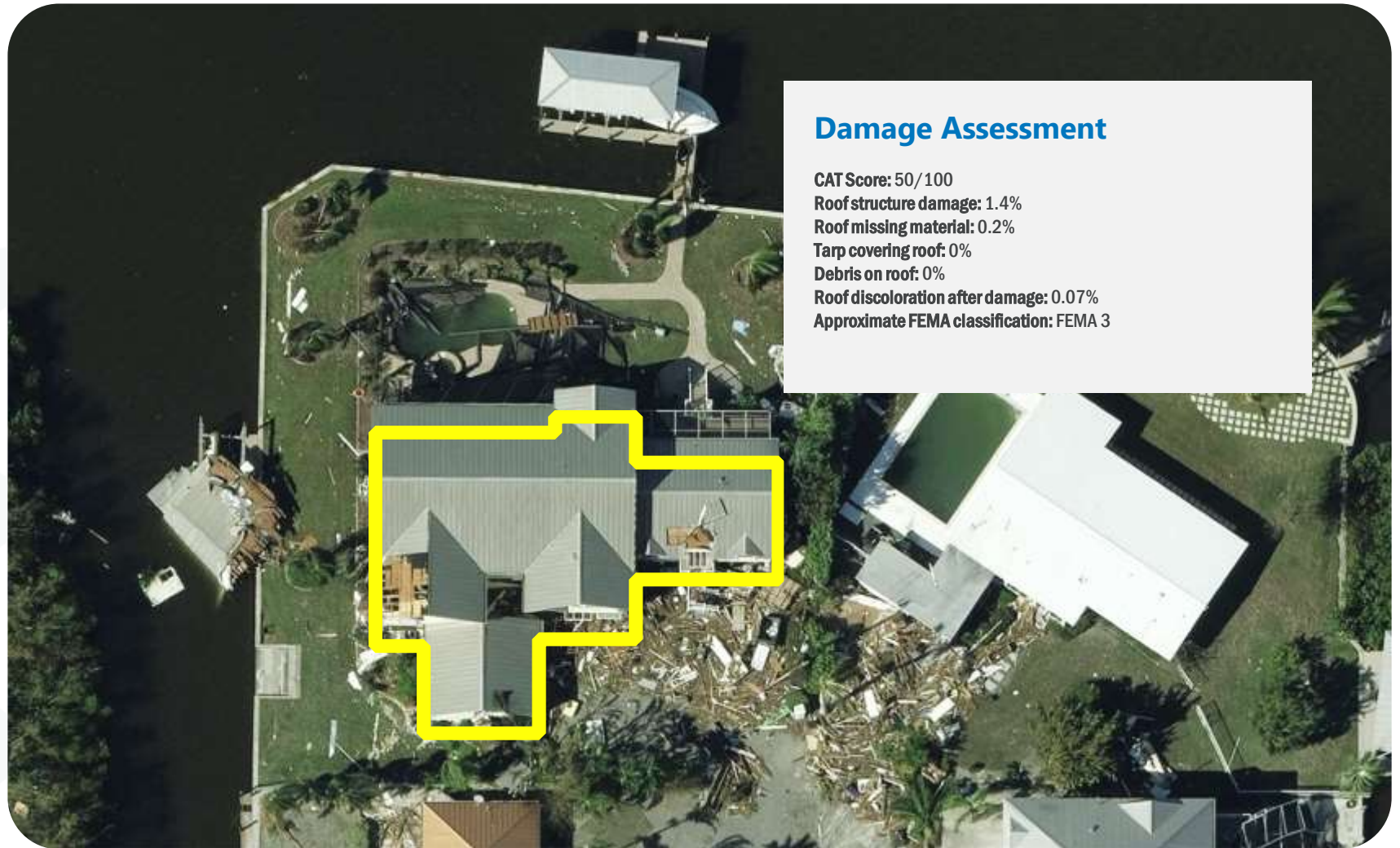
Footprint area: 526.7m²
Roof condition: 5/5
Roof material: metal
Roof discoloration: 0%
Roof shape: gable
Roof solar: no
Tree cover over roof: 0%
Defensible space report:

Trees

0-5 ft: 0%
0-30 ft: 14%
0-100 ft: 14%
0-200 ft: 0%

Buildings

0-5 ft: 0%
0-30 ft: 5%
0-100 ft: 13%
0-200 ft: 0%



Damage Assessment

CAT Score: 50/100
Roof structure damage: 1.4%
Roof missing material: 0.2%
Tarp covering roof: 0%
Debris on roof: 0%
Roof discoloration after damage: 0.07%
Approximate FEMA classification: FEMA 3



Aerial Imagery in Disaster Recovery

ML Algorithms Used for Post Disaster Analysis

- Image Classification
 - Uses training data to identify/categorize specific features
 - Used to classify damage levels of structures
- Object Detection
 - Identifies and locates specific objects (e.g. buildings)
 - Used to identify damaged structures and estimate extent of damage
- Image Segmentation
 - Used to identify and analyze specific areas of damage or distinguish between different types of structures

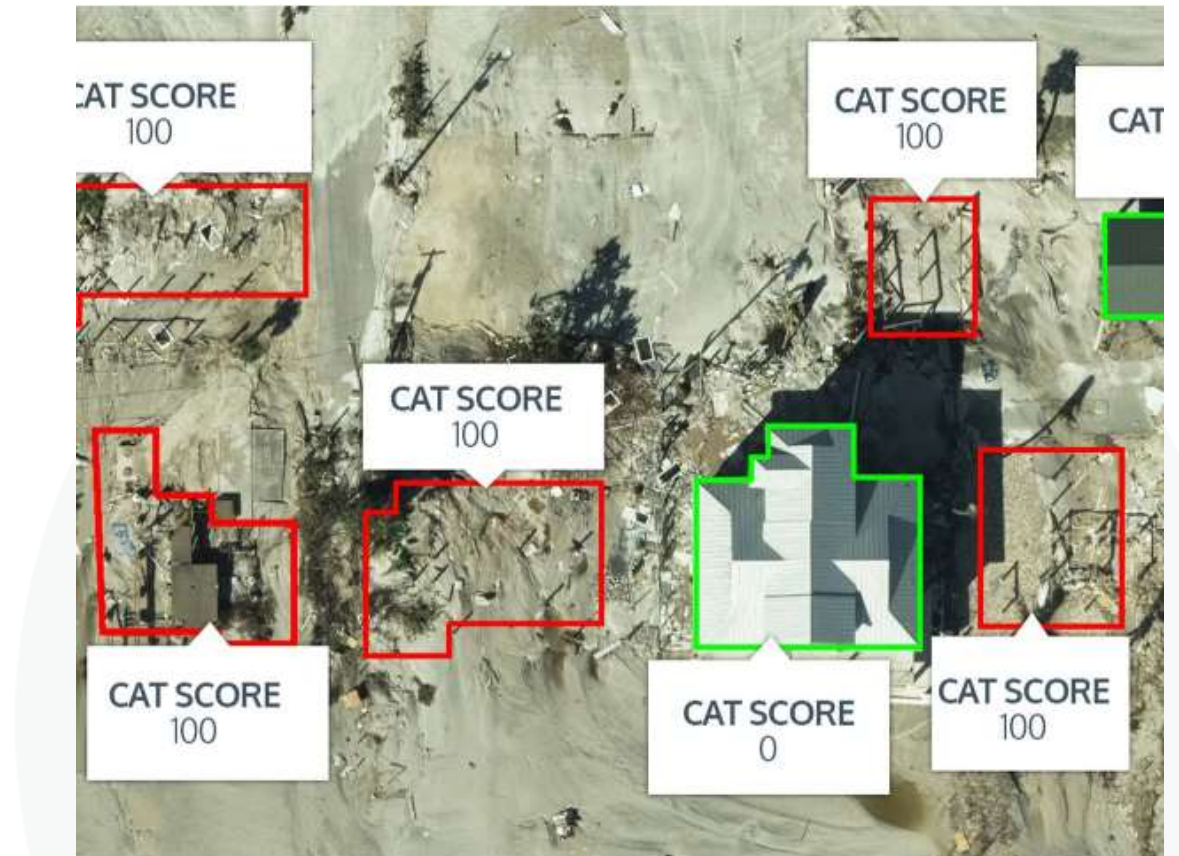
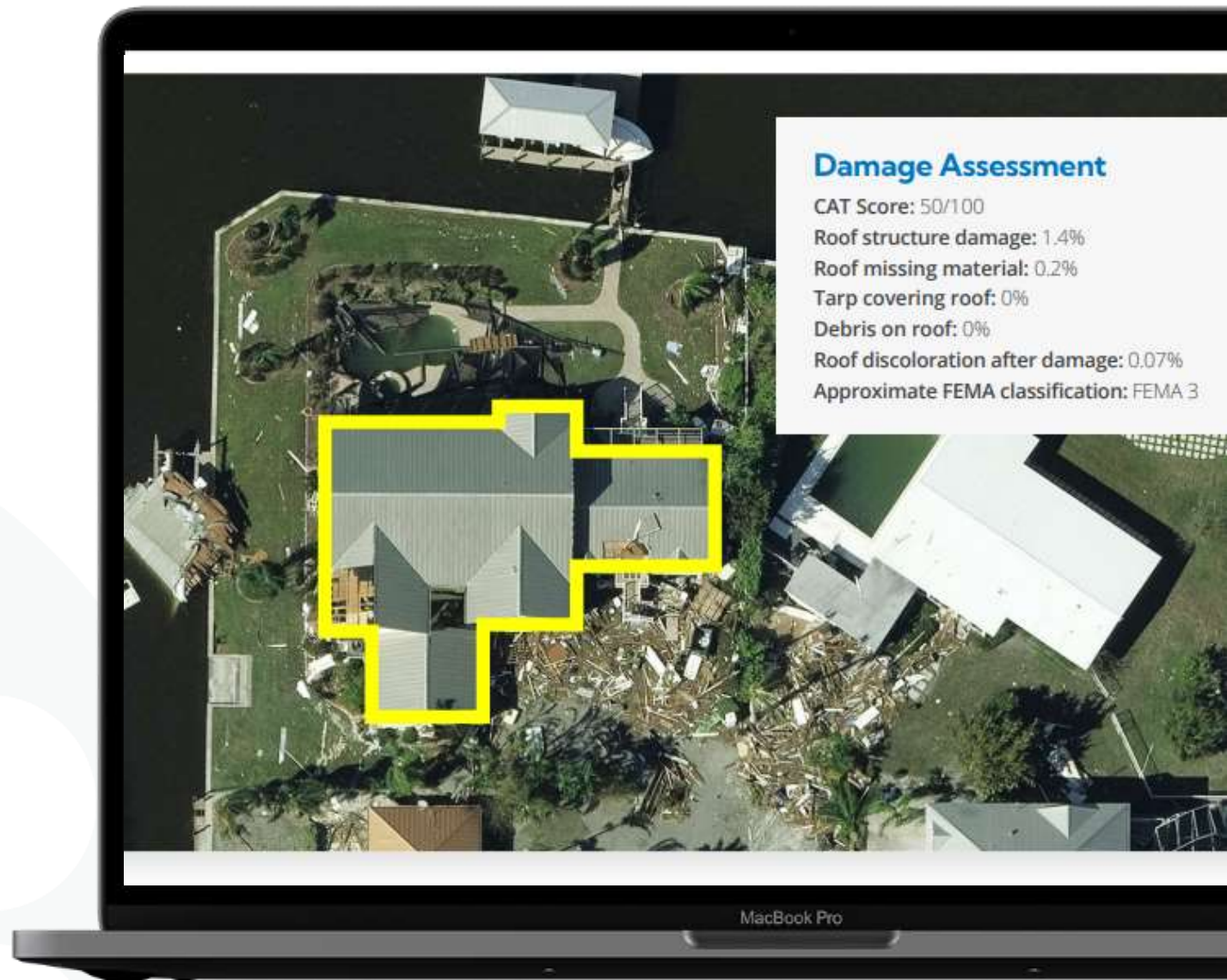
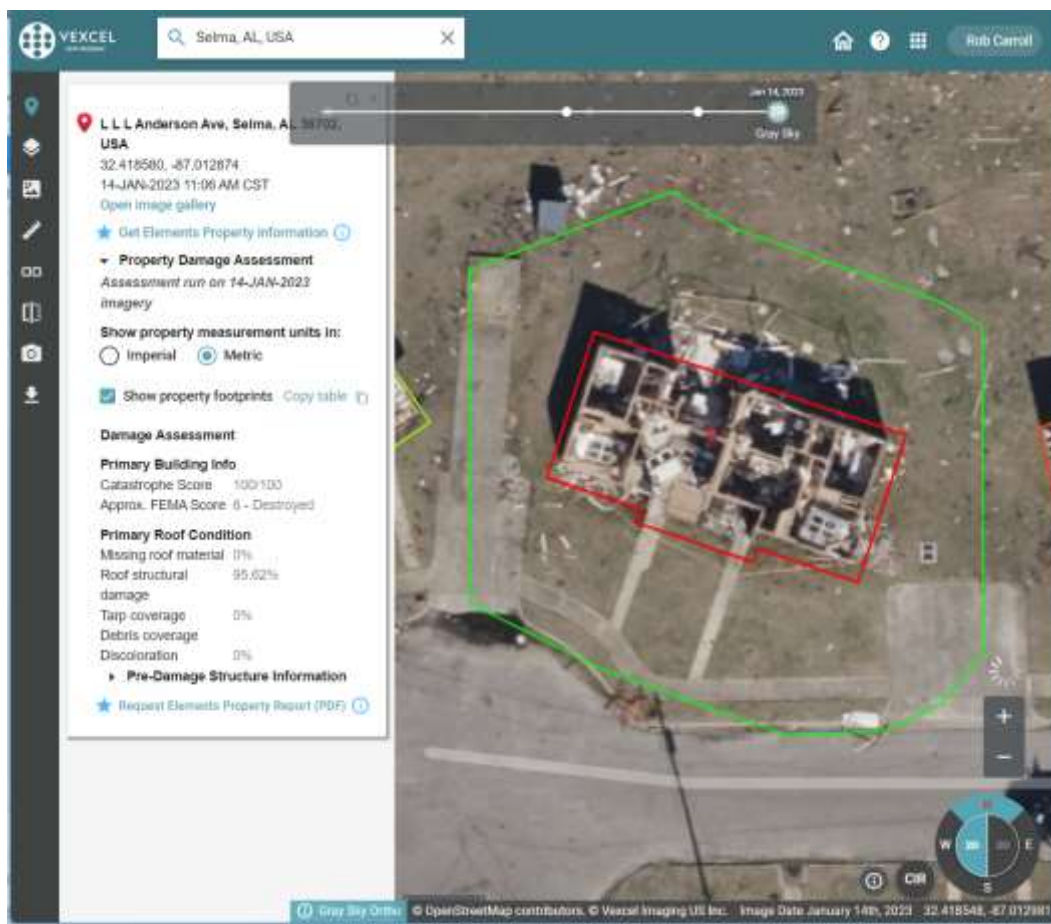


Image Classification Structural Damage Assessment

- Advantages:
 - Rapid, comprehensive
 - Higher accuracy than manual
 - Ability to analyze large amounts of data
- Training Data:
 - High-quality aerial imagery before and after disaster
 - Labeled data to train ML algorithms
- Workflow:
 - Collection of imagery post disaster
 - Preprocess before imagery
 - Image classification using damage ML
 - Output damage scores for each structure



Performance Evaluation ML Models



- Key factors affecting performance false positives and negatives.
- False Positives:
 - Occurs when undamaged structures are classified as damaged
 - Leads to unnecessary and potentially costly activities
- False Negatives:
 - Occurs when damaged structures are classified as undamaged
 - Results in failure to address critical damage
- Strategies to minimize false positives and negatives:
 - Incorporating human SME knowledge into analysis process
 - Regular performance evaluation and fine-tuning of models
 - Incorporating diverse and representative training data

Performance Evaluation— False Positive

VEXCEL Selma, AL, USA Rob Carroll

Jan 14, 2023
Gray Sky

1913 Eugene Ave, Selma, AL 36703, USA
32.420597, -87.013642
14-JAN-2023 11:06 AM CST
[Open image gallery](#)

★ [Get Elements Property information](#)

▼ **Property Damage Assessment**
Assessment run on 14-JAN-2023 imagery

Show property measurement units in:
 Imperial Metric

Show property footprints [Copy table](#)

Damage Assessment

Primary Building Info
Catastrophe Score 66/100
Approx. FEMA Score 4 - Major

Primary Roof Condition

Missing roof material	0%
Roof structural damage	5.98%
Tarp coverage	0%
Debris coverage	0%
Discoloration	0%

► **Pre-Damage Structure Information**

★ [Request Elements Property Report \(PDF\)](#)

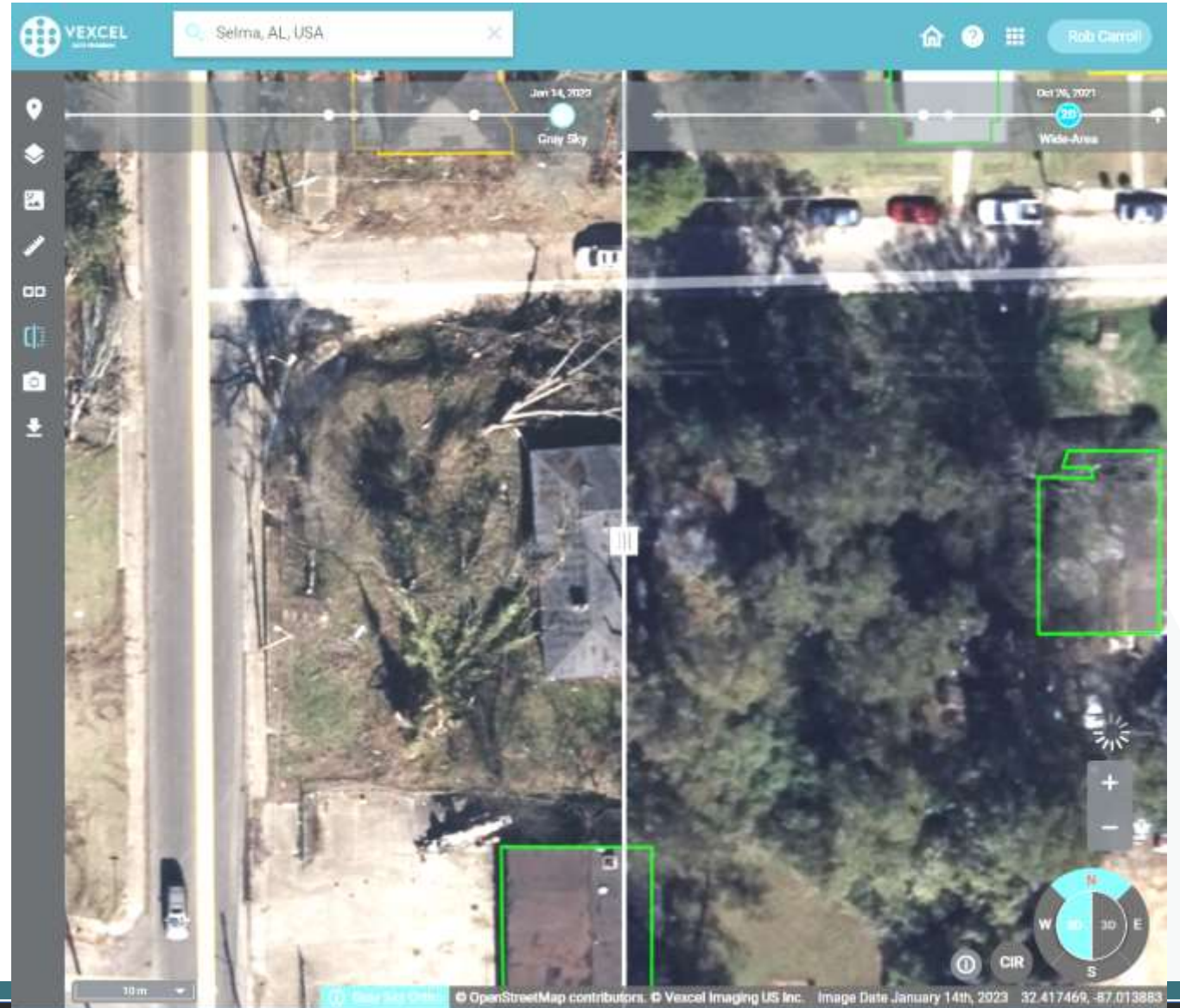
1536 Range St, Selma, AL 36703, USA
32.419838, -87.014104
14-JAN-2023 11:06 AM CST
[Open image gallery](#)

★ [Get Elements Property information](#)

▼ **Property Damage Assessment**
Assessment run on 14-JAN-2023 [Gray Sky Ortho](#)

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Performance Evaluation – False Negative

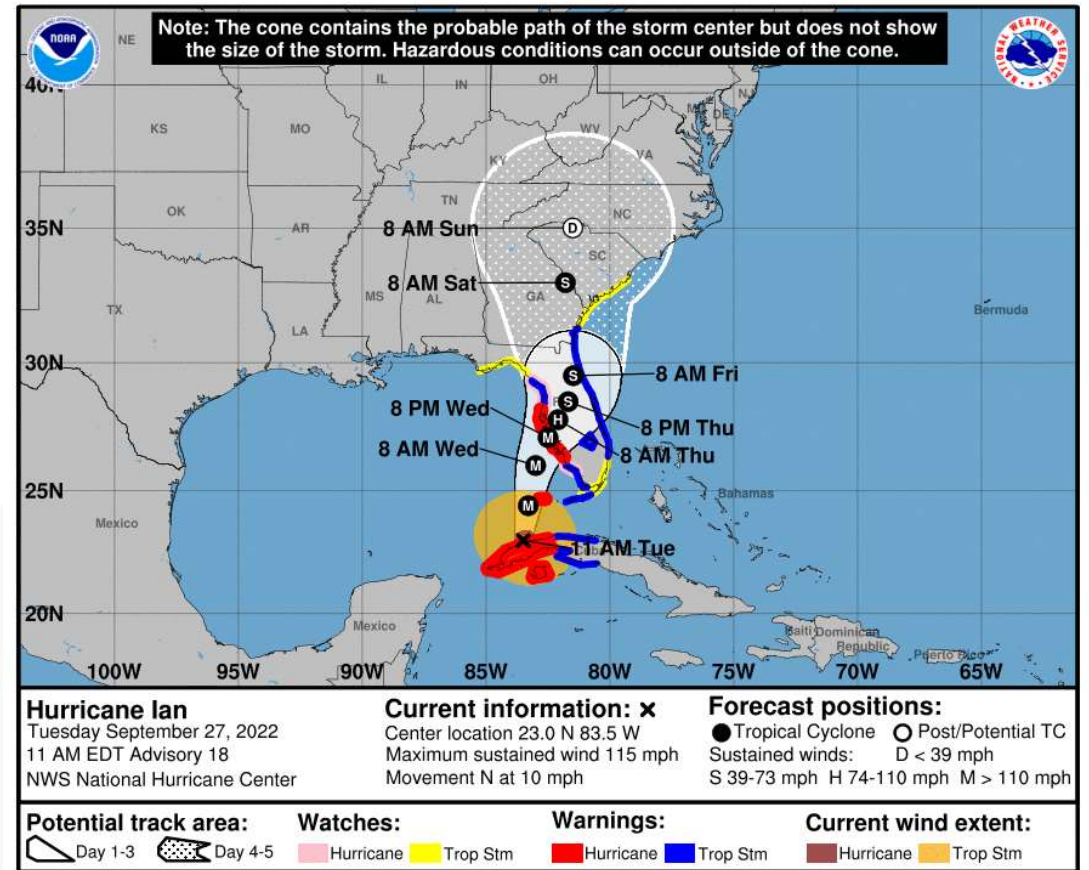




Case Study: Using ML for Damage Assessment Hurricane Ian

Hurricane Ian 2022

- Cat 4 hurricane formed September 2022.
- September 12 made landfall in Caribbean
- Tracked northward making landfall in Florida
- Response and recovery efforts began immediately
 - Aerial imagery and machine learning being deployed



Data Collection and Preparation



10 planes engaged



Multi-day collection



Over 44,000 km² collected

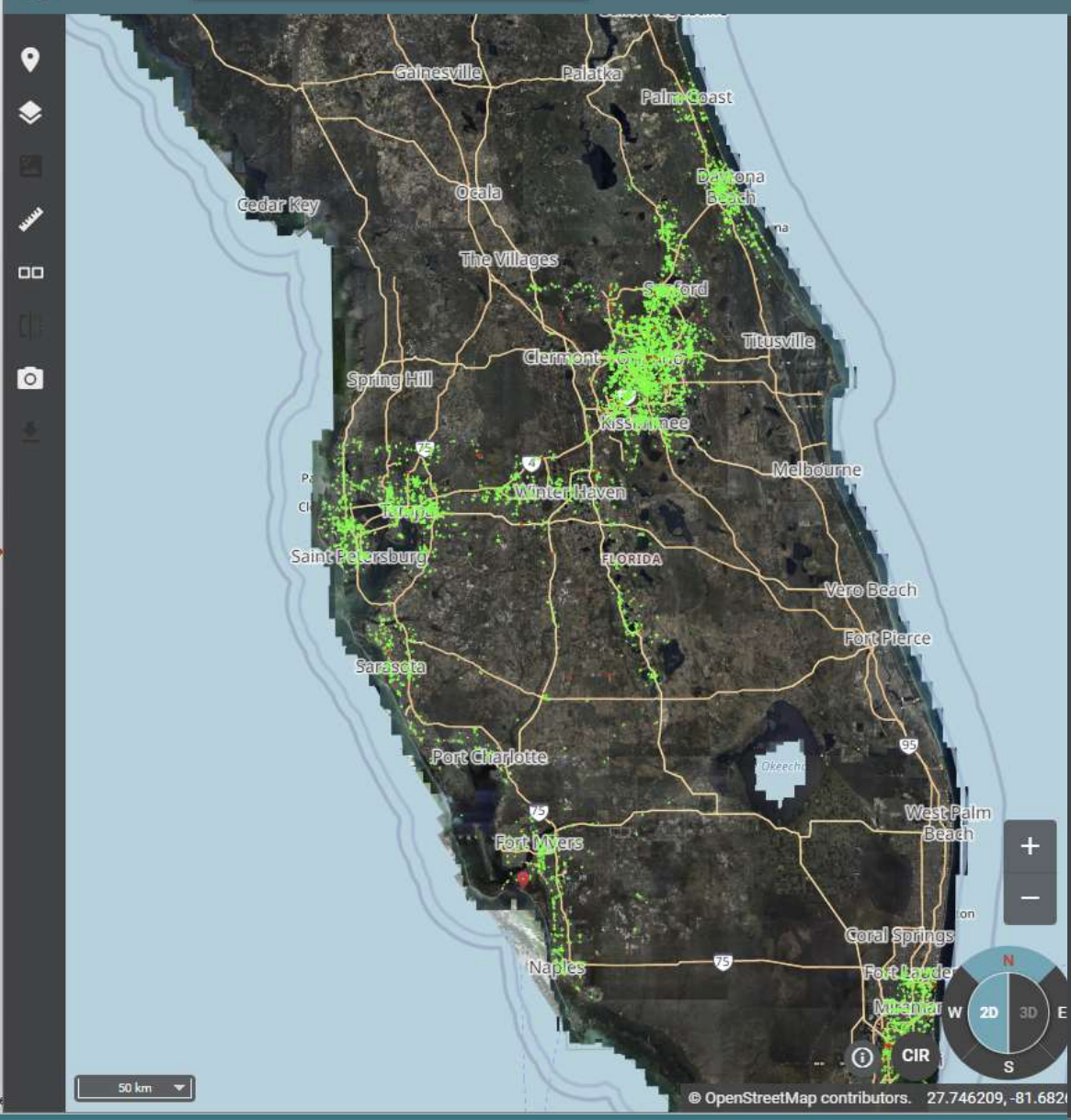


Damage Assessment for millions of buildings



High-res Oblique & Ortho imagery available





1560 I Street, Fort Myers Beach, FL 33931, USA
 26.450716, -81.950542
 29-SEP-2022 05:32 PM EDT
[Open image gallery](#)
[★ Get Elements Property information](#)

Property Damage Assessment
 Assessment run on 29-SEP-2022 imagery

Show property measurement units in:
 Imperial Metric

Show property footprints [Copy table](#)

Damage Assessment

Primary Building Info
 Catastrophe Score 0/100
 Approx. FEMA Score None - No damage

Primary Roof Condition
 Missing roof material 0%
 Roof structural damage 0%
 Tarp coverage 0%
 Debris coverage 0%
 Discoloration 0%

Pre-Damage Structure Information
[★ Request Elements Property Report \(PDF\)](#)



BEFORE



AFTER



Thank you for your interest

www.vexceldata.com