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

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.

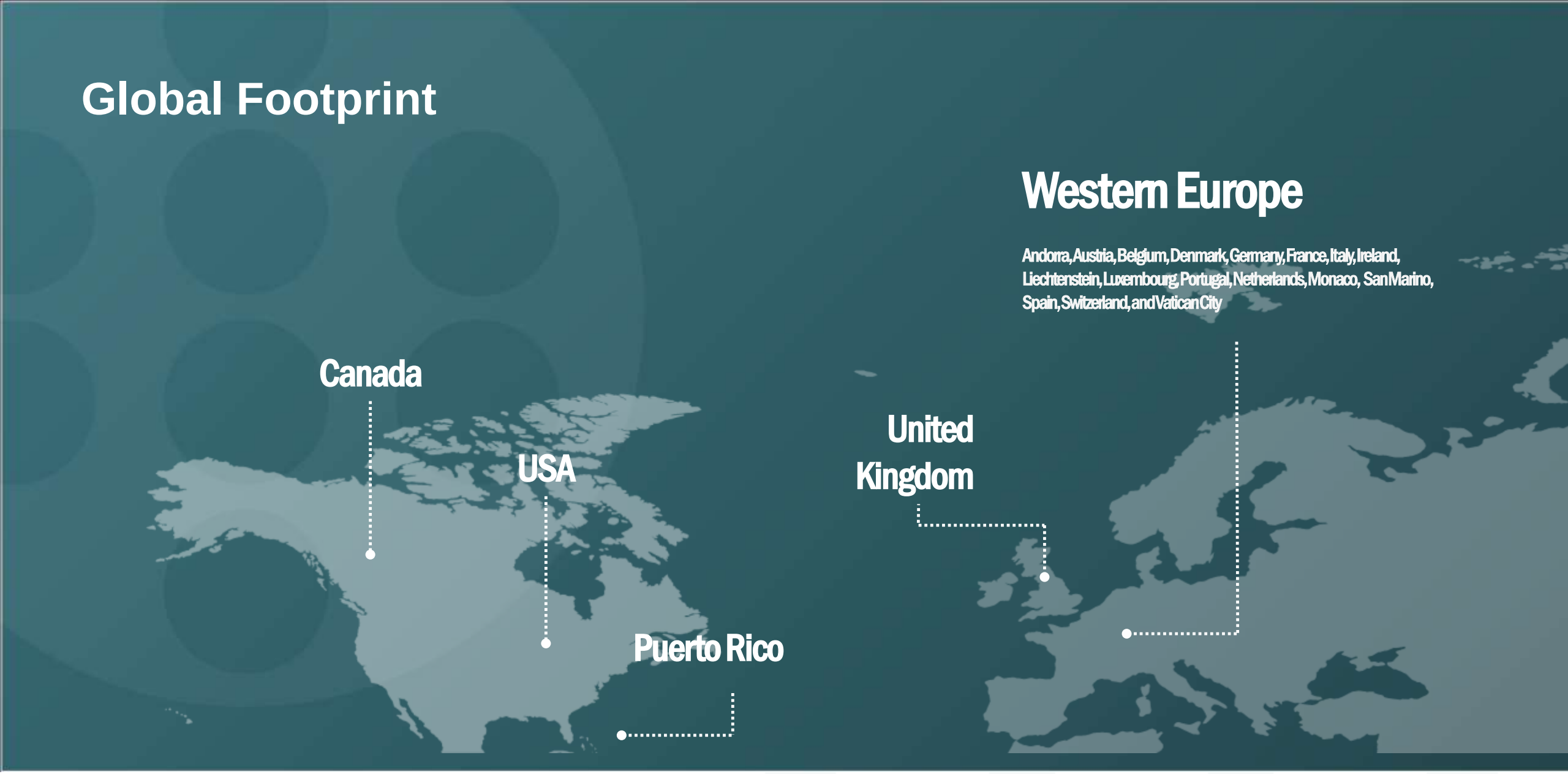
Vexcel Fleet

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



Global Footprint

WIDE AREA COLLECTION

15cm GSD Orthomosaic Imagery

URBAN AREA COLLECTIONS

7.5cm GSD True Orthomosaic

Gray Sky Program

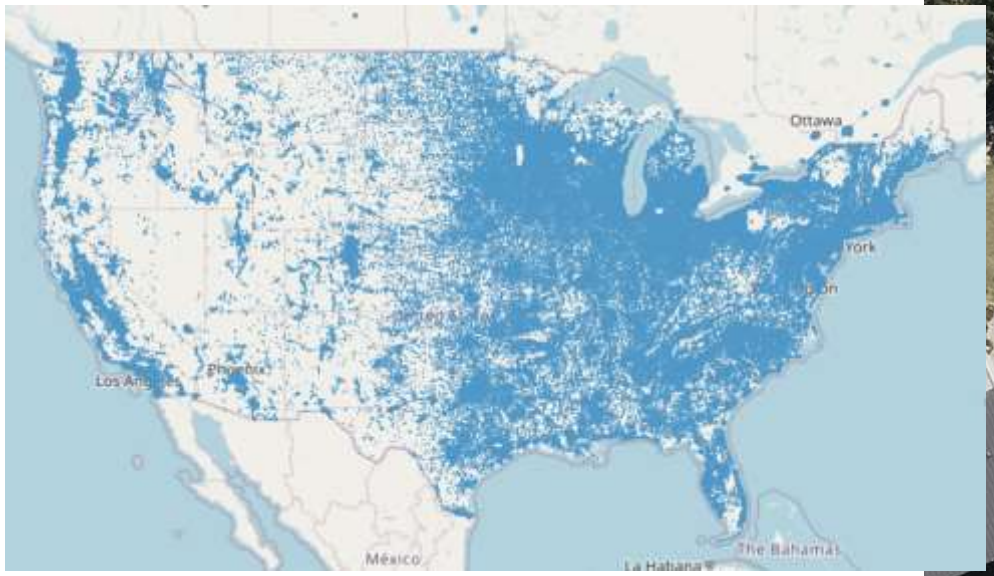
Elements

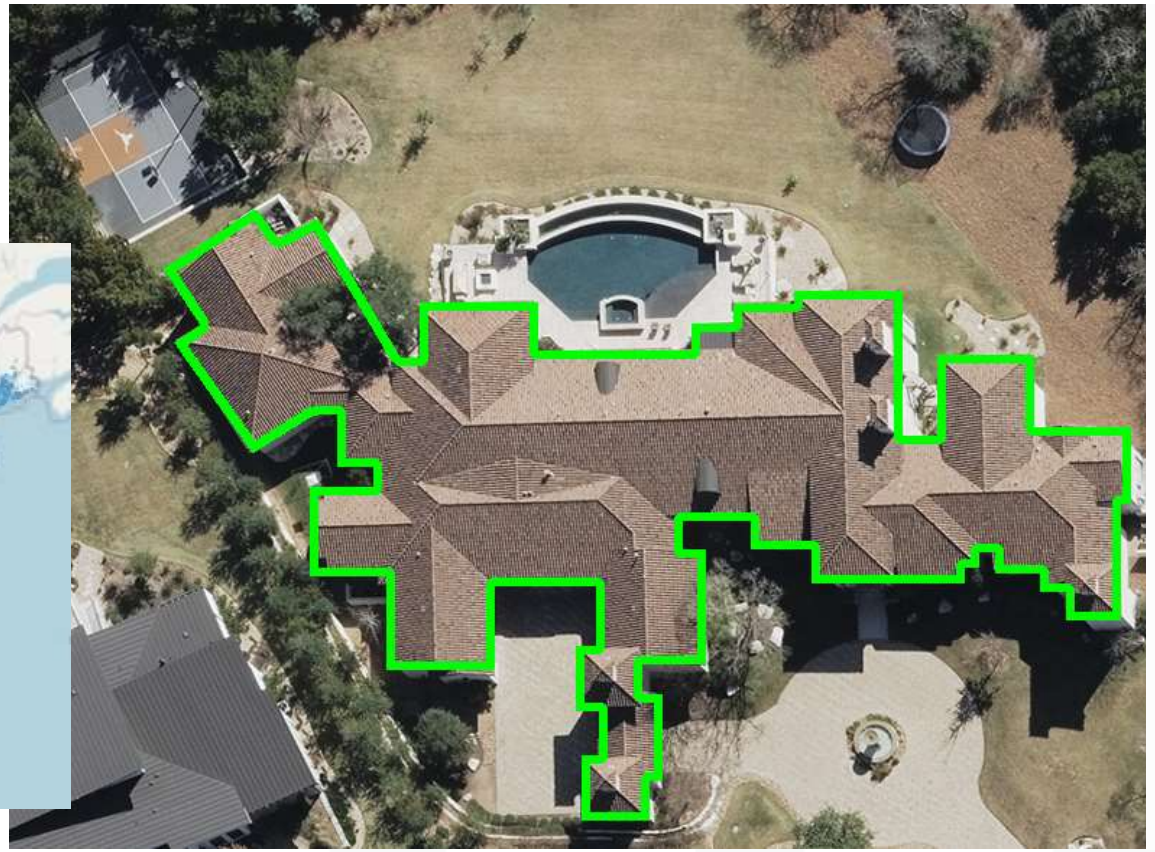
Machine Learning derived features and attributes from our imagery:

- 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

Elements

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



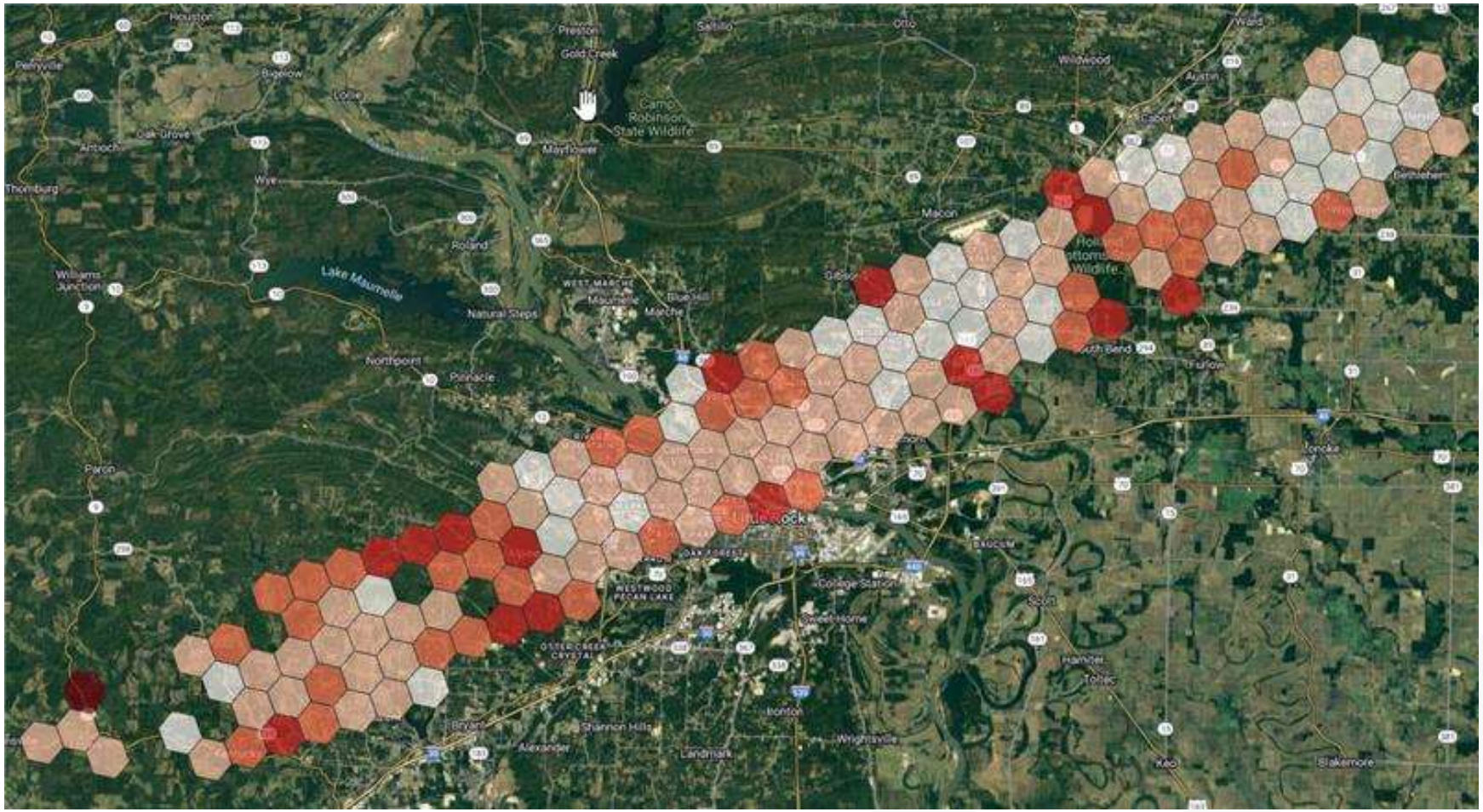


Property Attributes

- ✓ **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

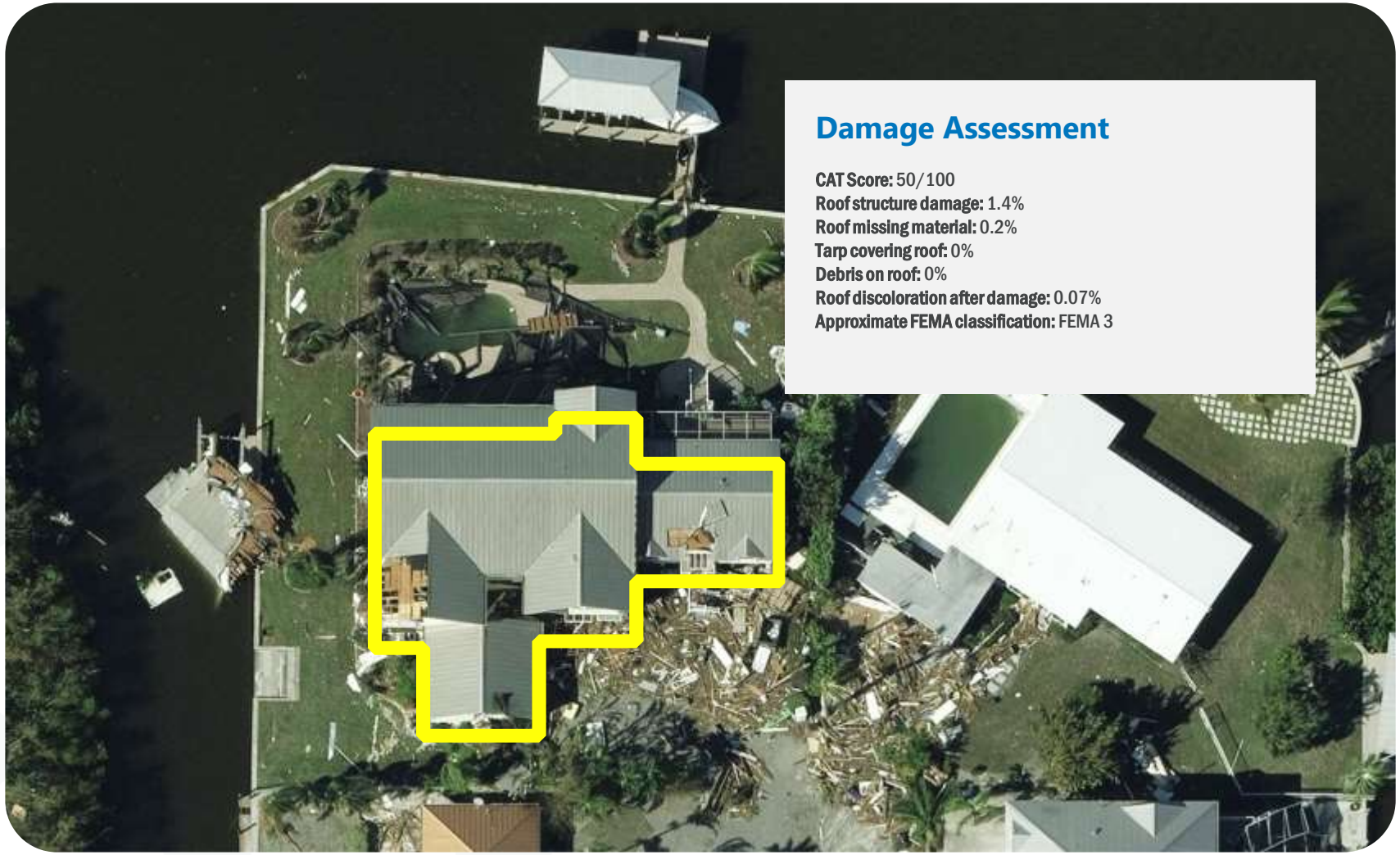


Damage Assessment

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	Buildings
0-5 ft: 0%	0-5 ft: 0%
0-30 ft: 14%	0-30 ft: 5%
0-100 ft: 14%	0-100 ft: 13%
0-200 ft: 0%	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

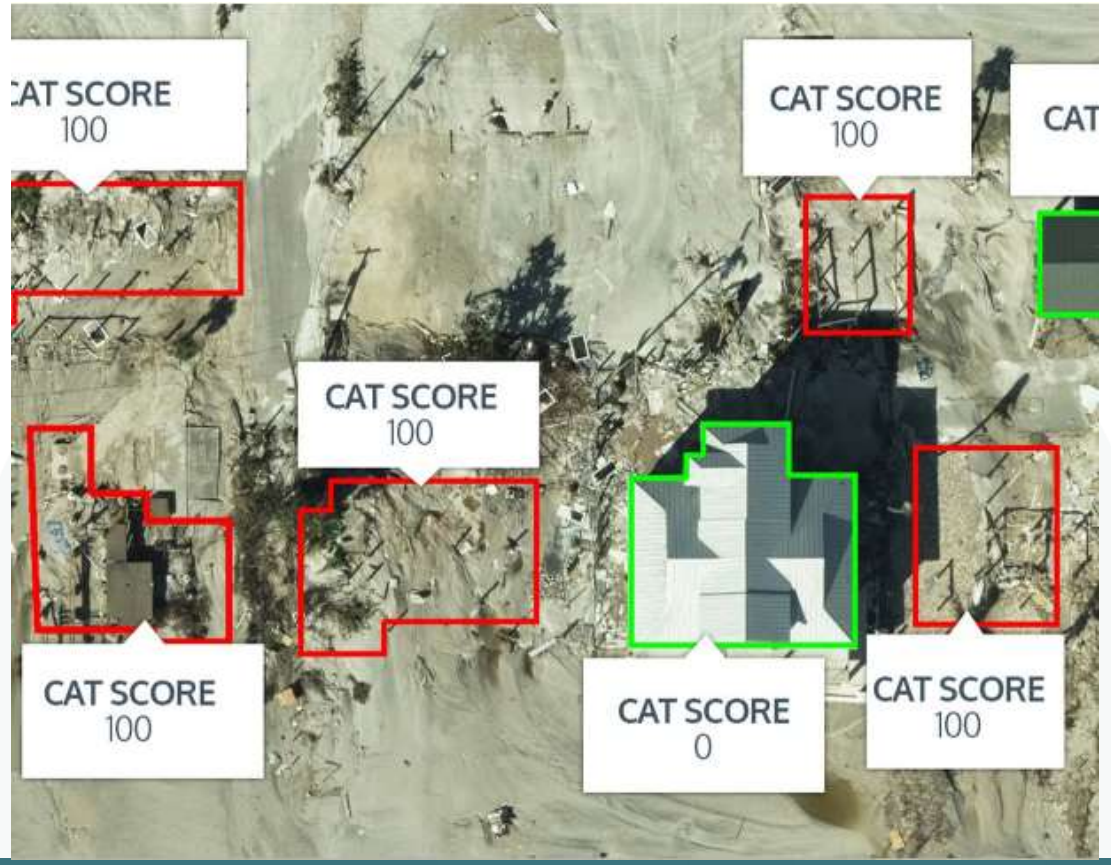
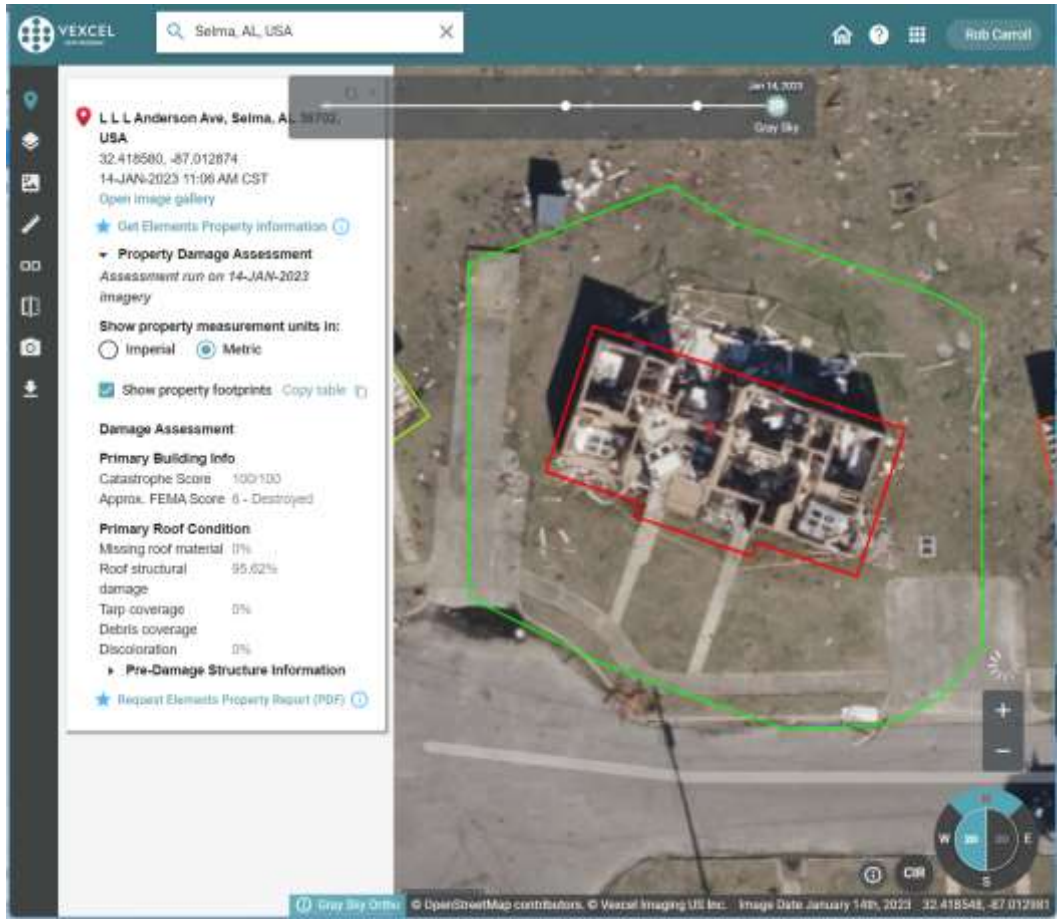


Image Classification Structural Damage Assessment

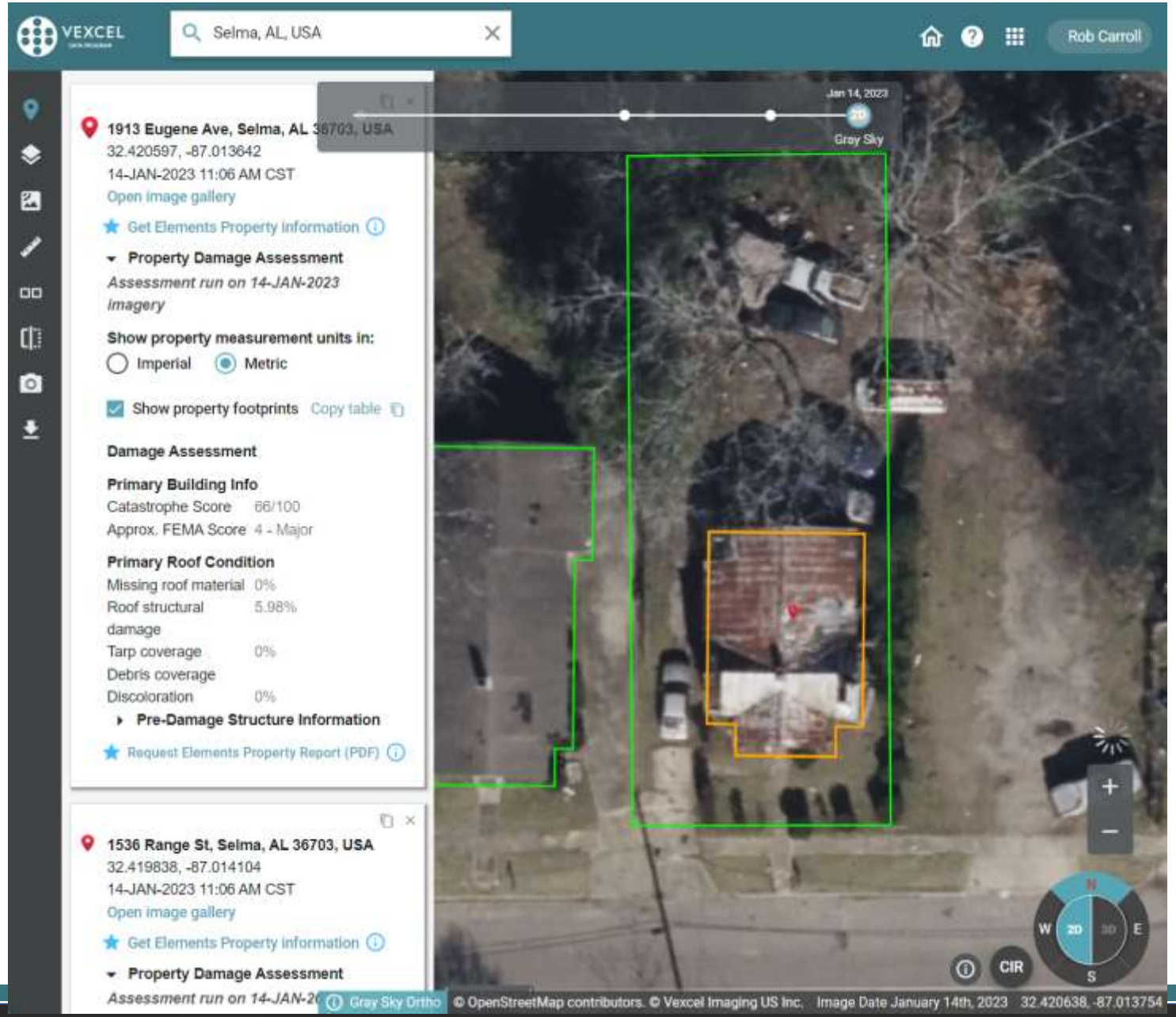
- Advantages:
- Rapid, comprehensive
- Higher accuracy than manual
- Ability to analyze large amounts of data
- Training Data:
- High-quality aerial imagery before and after disaster
- Labeled data to train ML algorithms
- Workflow:
- Collection of imagery post disaster
- Preprocess before imagery
-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

Performance Evaluation ML Models

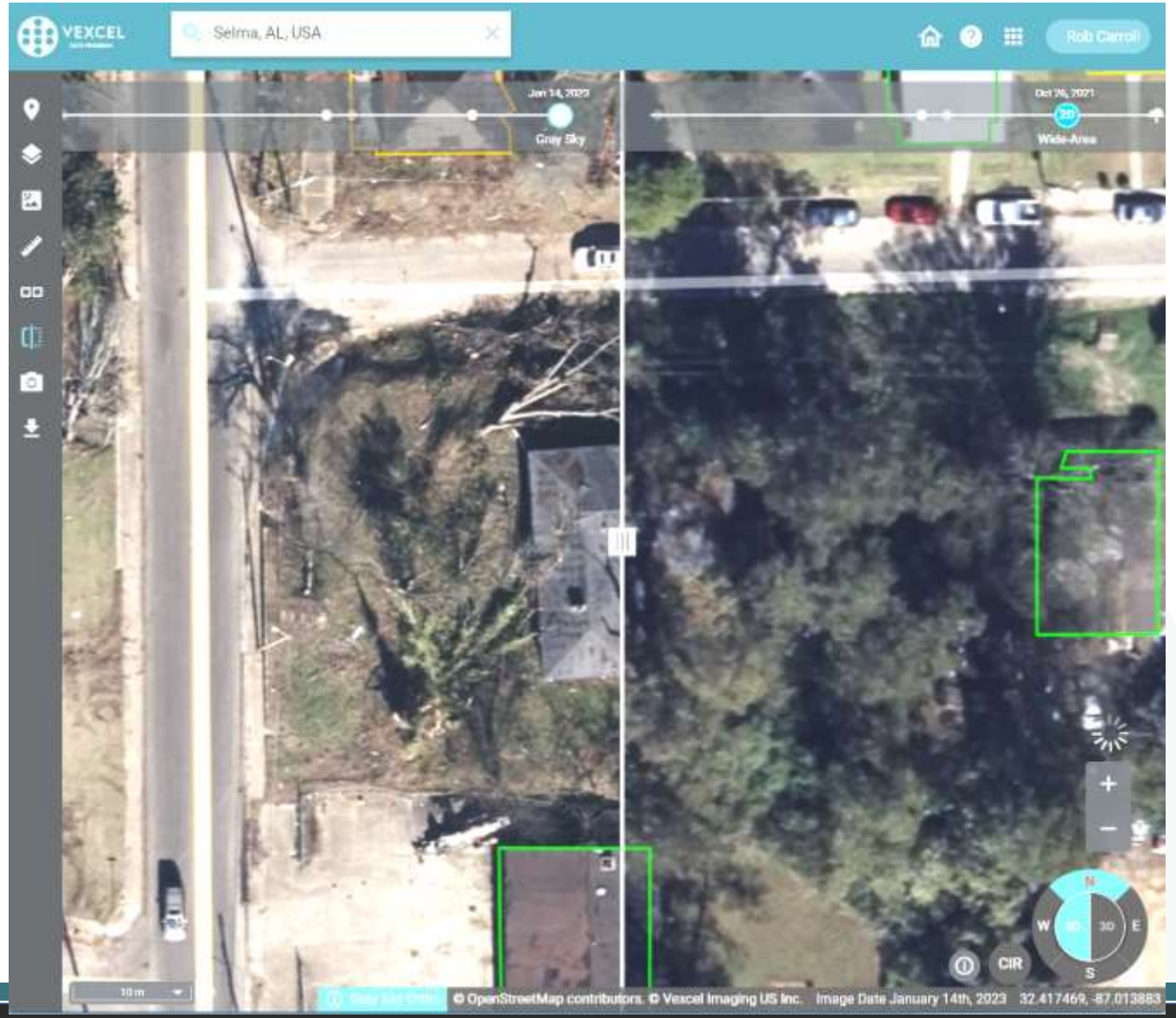


- Key factors affecting performance false positives and negatives.
- False Positives:
  - Occurs when undamaged structures are classified as damaged
  - Leads to unnecessary and potentially costly activities
- False Negatives:
  - Occurs when damaged structures are classified as undamaged
  - Results 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



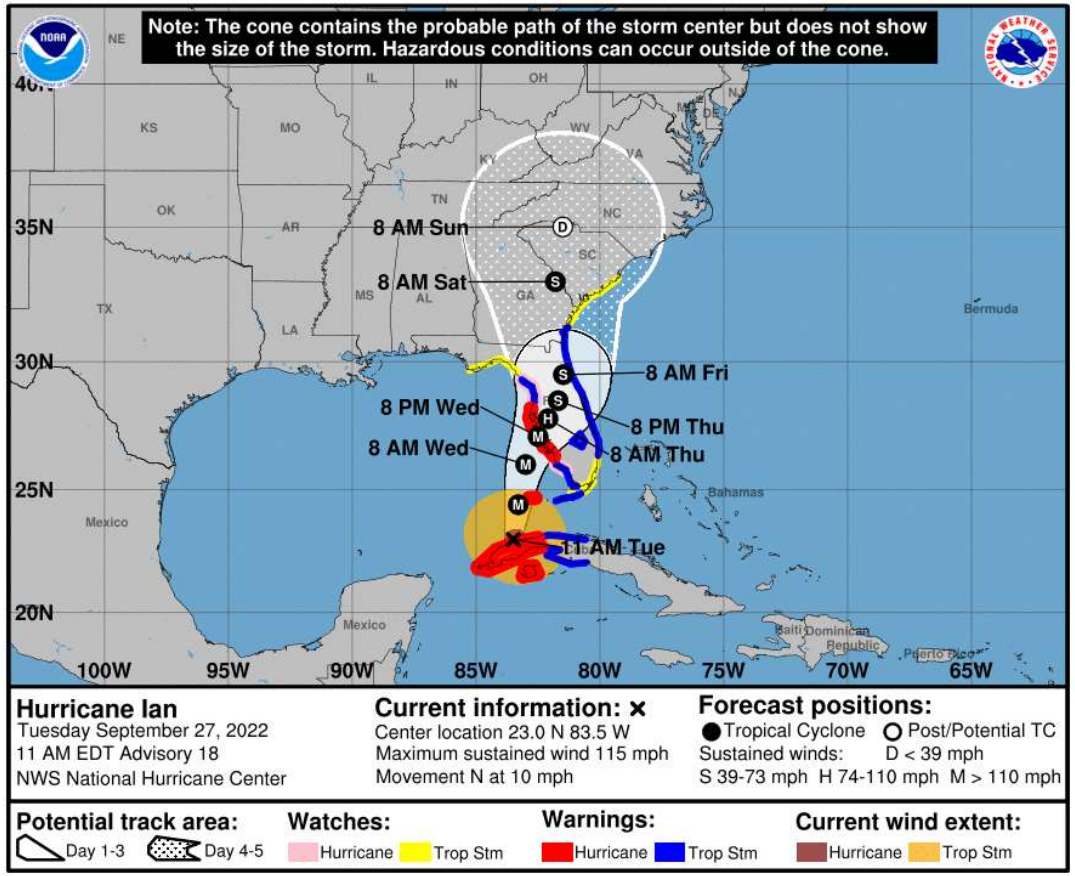
Performance Evaluation – False Negative



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

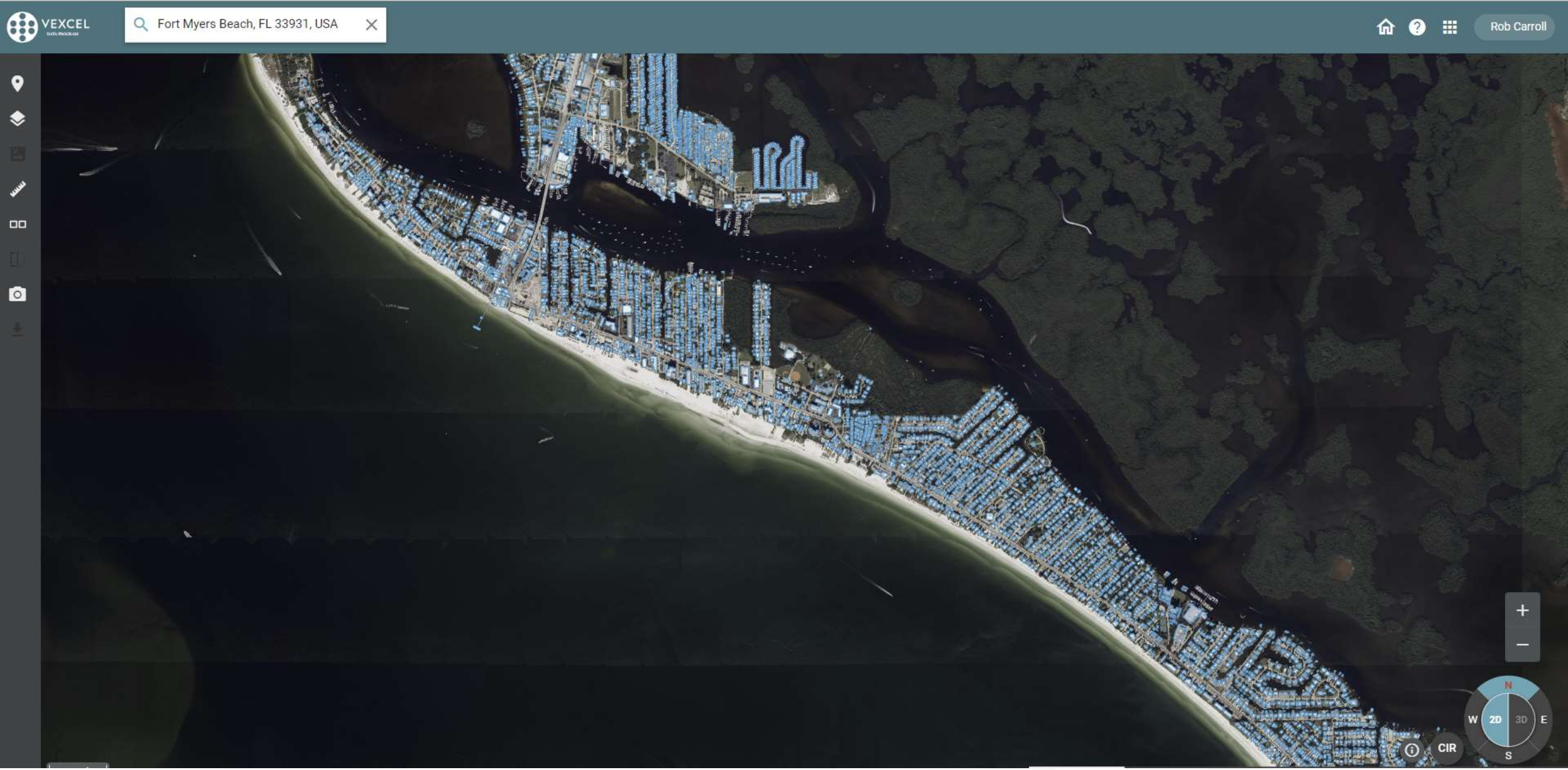
10 planes engaged

Multi-day collection

Over 44,000 km^2 collected

Damage Assessment for millions of buildings

High-res Oblique & Ortho imagery available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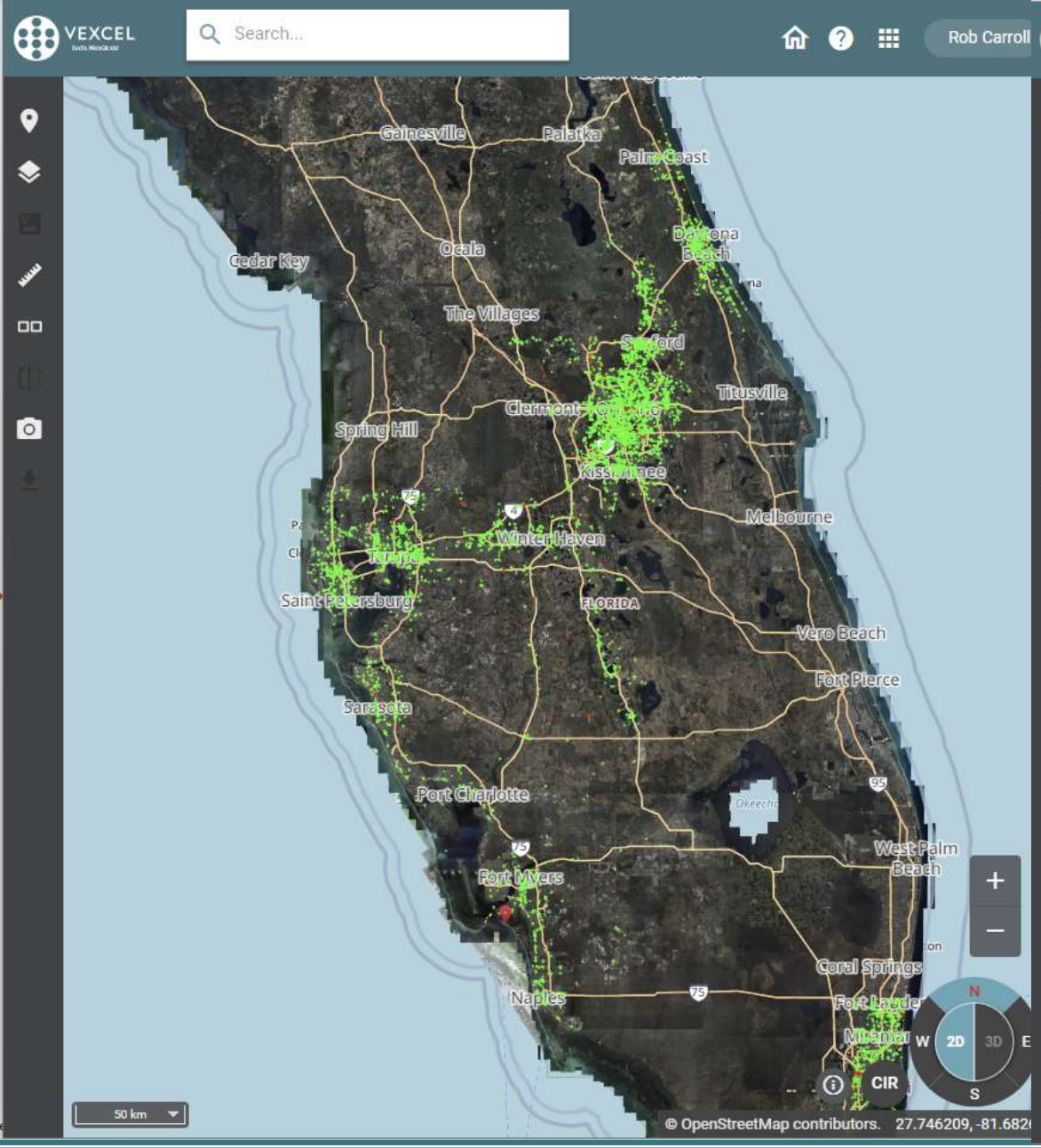
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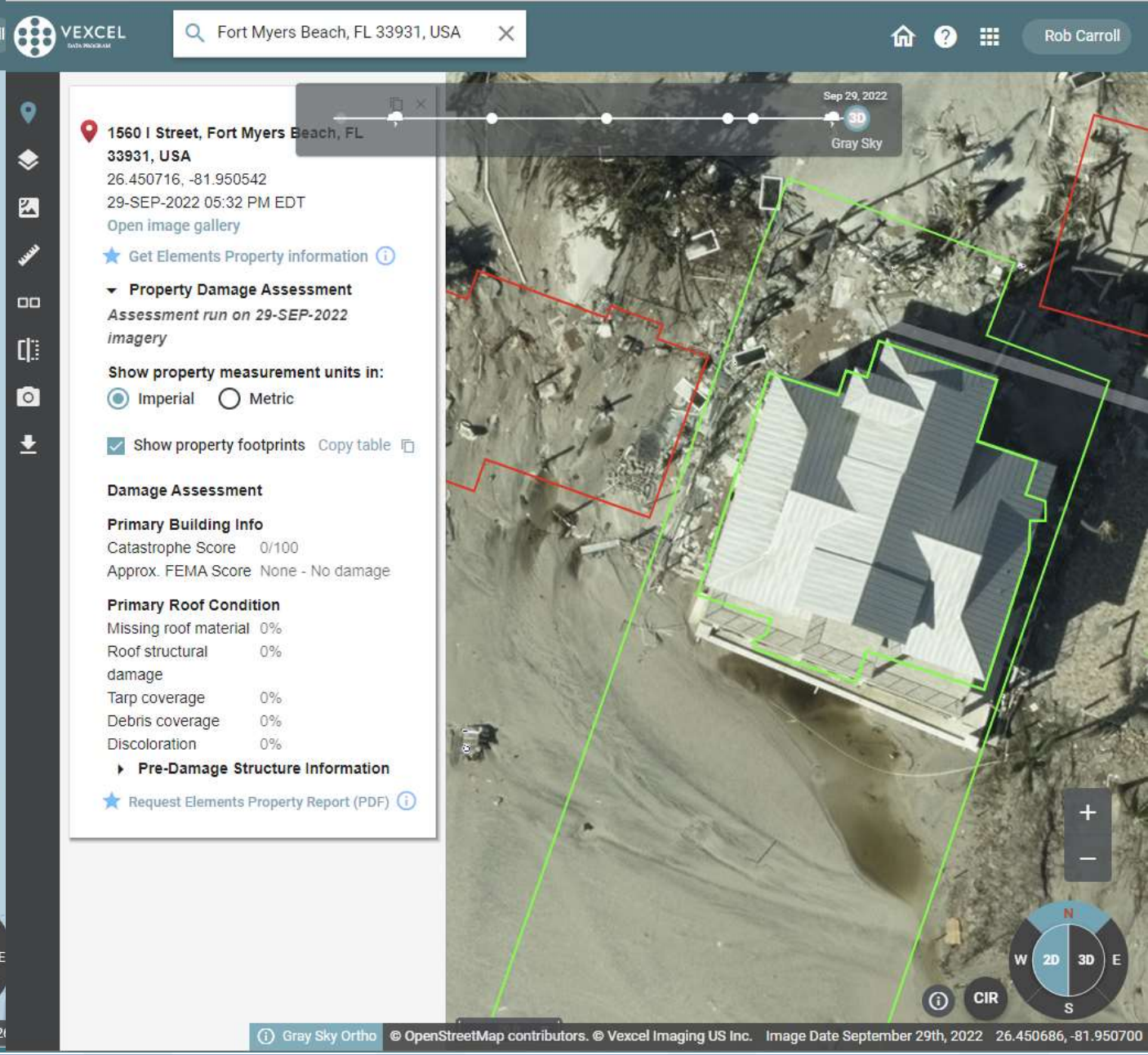
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26.450716, -81.950542
29-SEP-2022 05:32 PM EDT
Open image gallery
Get Elements Property information
Property Damage Assessment
Assessment run on 29-SEP-2022 imagery
Show property measurement units in:
Imperial
Metric
Show property footprints
Copy table
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)
Sep 29, 2022
3D
Gray Sky
CIR
Gray Sky Ortho
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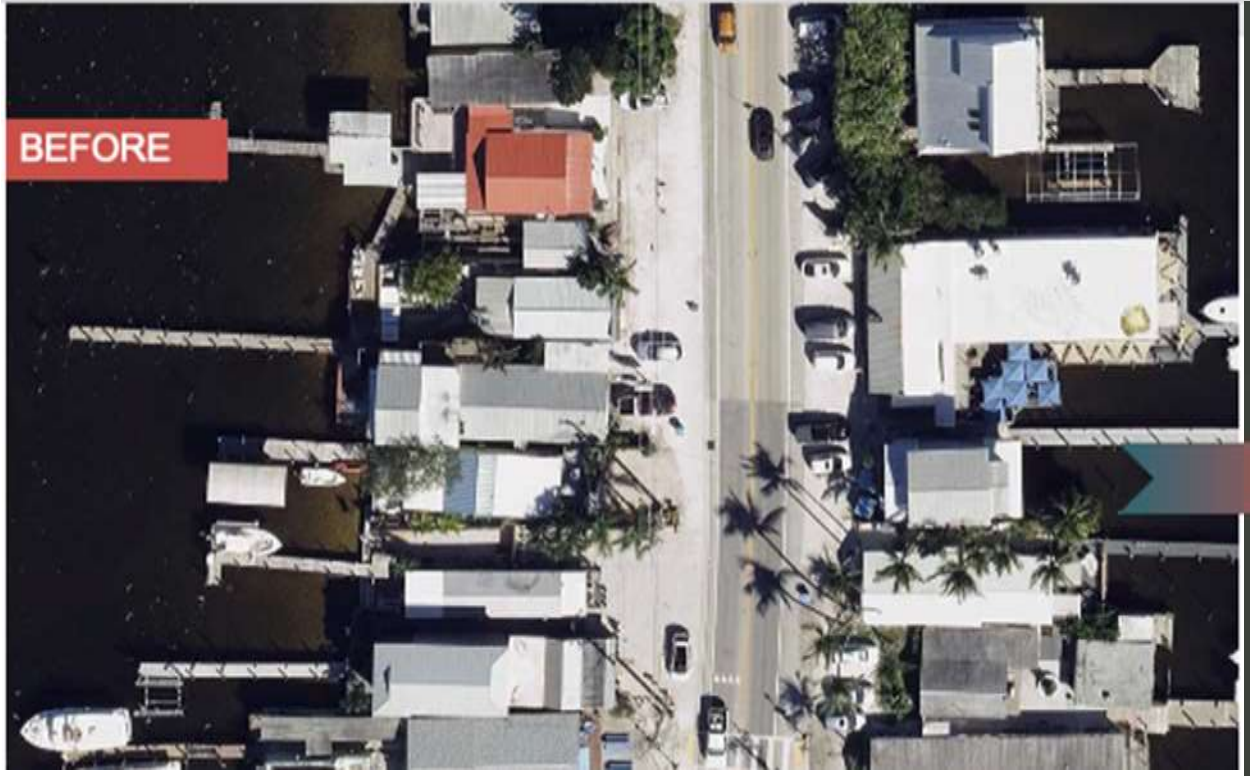
Image Date September 29th, 2022
26.450686, -81.950700



Thank you for your interest

www.vexceldata.com