

Learning From Extreme Events

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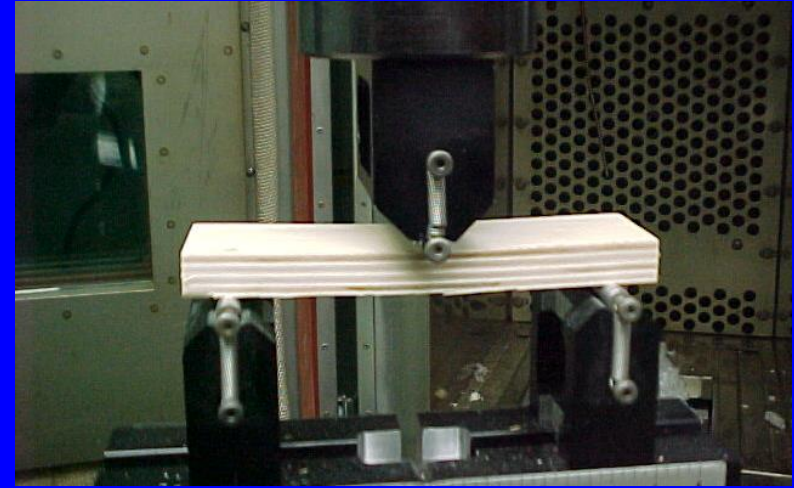
OVERVIEW

- **Disaster Reconnaissance**
 - Data Collection
 - Spatial-Temporal Approach
 - Data Management
- **Recent Events**



Engineering Reconnaissance

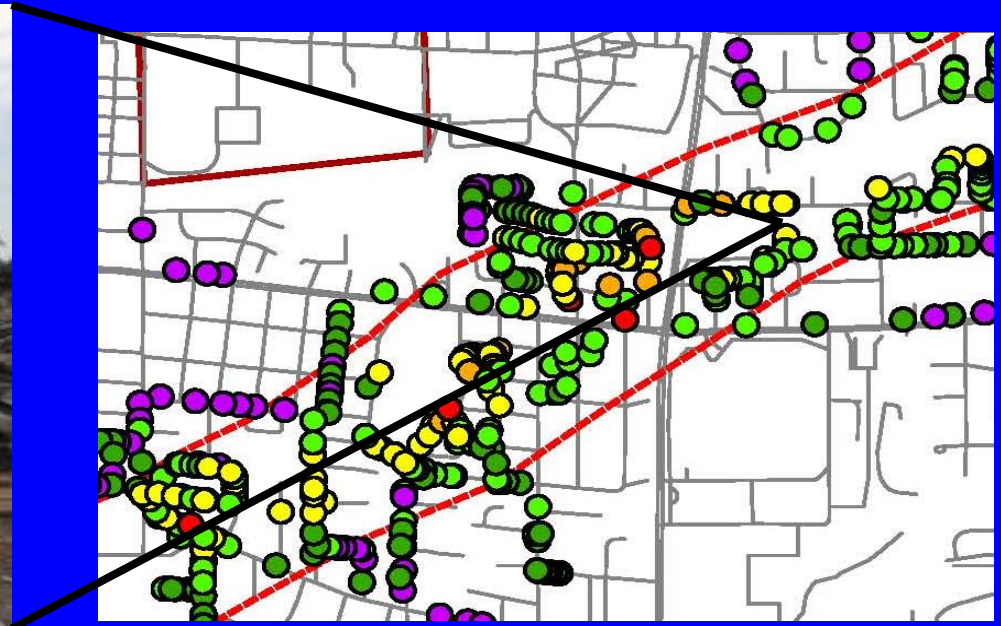
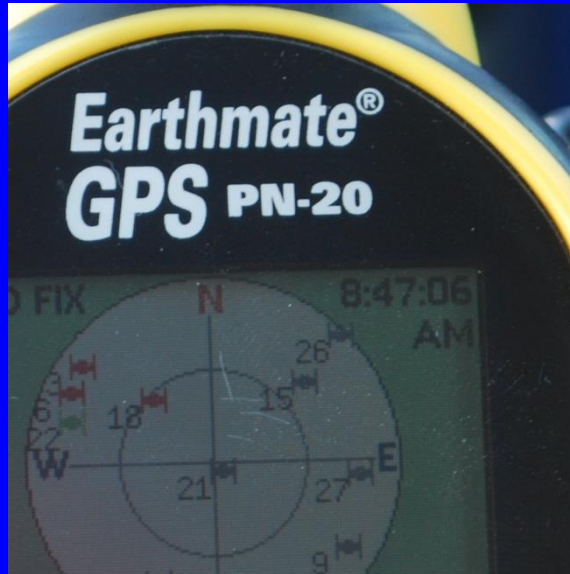
- System rather than component failures
- Track where failures occurred and time of recovery



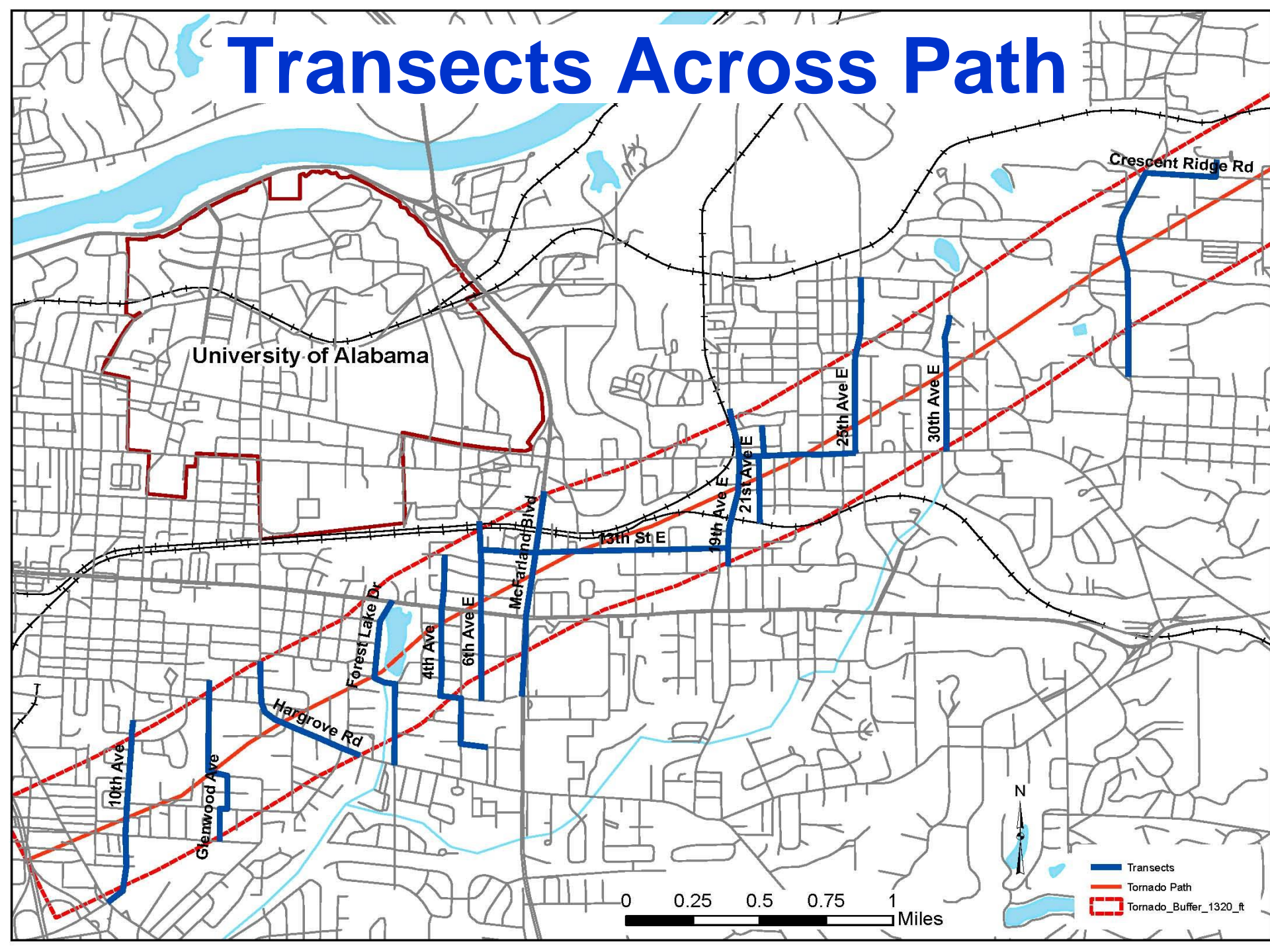
Spatial Temporal Approach

1. Synchronize sensor time to GPS
 - Take photo of GPS unit and sensor with time visible
2. Reduce in-field tasks
 - Leave GPS unit run recording points
3. Collect field data
4. Post process to create spatial data set
 - custom program
 - TIPs Time in Photos – Adds GPS Lat Long to photo
 - GPSExtractor – Extracts Lat Long from photo
5. Map data online in real time

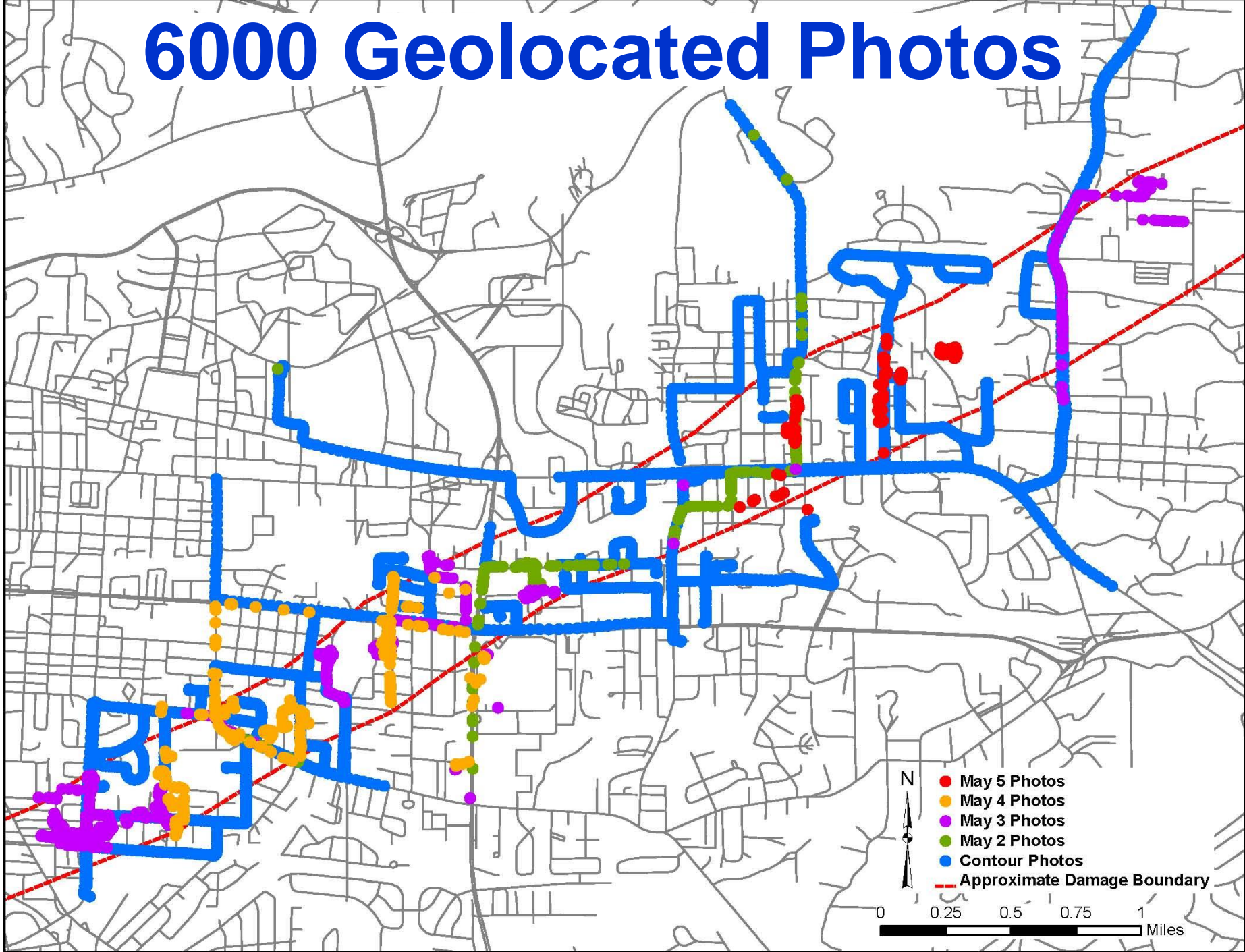
Reconnaissance Procedure



Transects Across Path



6000 Geolocated Photos



21st Street East, Alberta



EF0 (65-85 mph)



EF1 (86-110 mph)



EF2 (111-135 mph)



EF3 (136-165 mph)



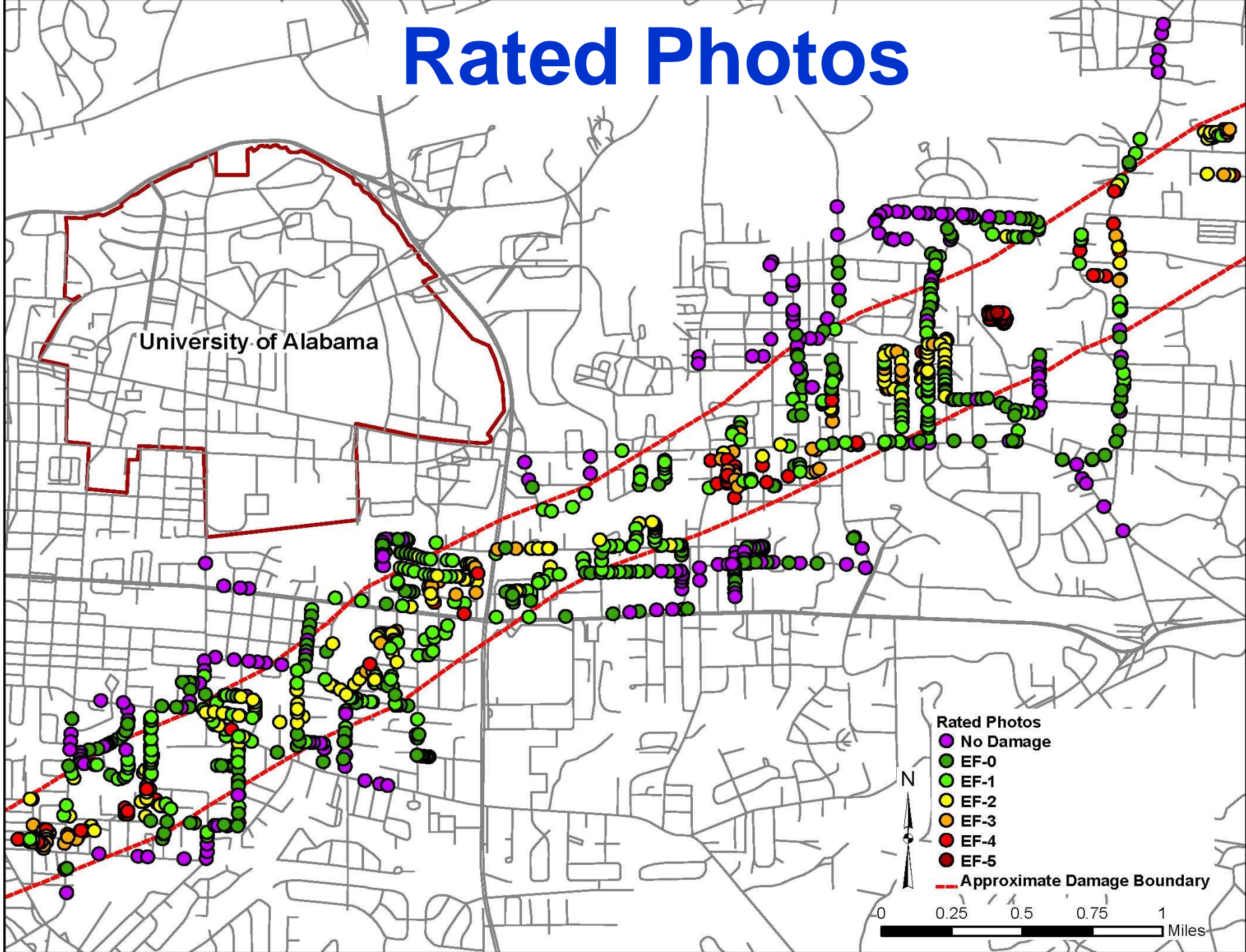
EF4 (166-200 mph)



EF5 (> 200 mph)

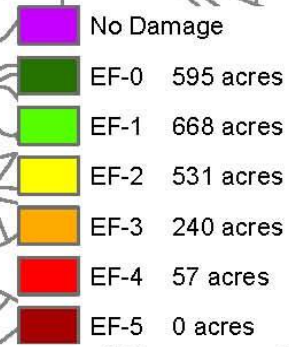


Rated Photos



Contour map of EF ratings

University of Alabama



Tuscaloosa EF Ratings Areas and Percentages

	Wind Speed	Area (acres)	Percentage
EF-0	65-85	595	28.5%
EF-1	86-110	668	32.0%
EF-2	111-135	531	25.4%
EF-3	136-165	240	11.5%
EF-4	165-200	57	2.7%
EF-5	>200	0	0%

360 camera - Passive data collection



<https://www.youtube.com/watch?v=7RcEIEyOs2M>

Deep Learning – Machine Learning

- Automated image capture



Deep Learning – Machine Learning

- TensorFlow



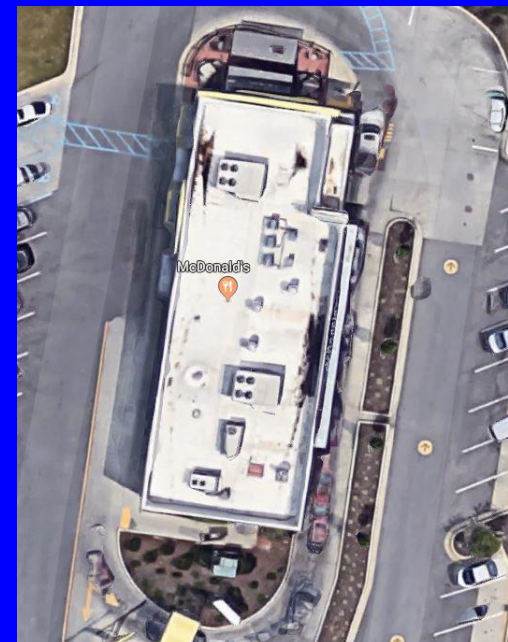
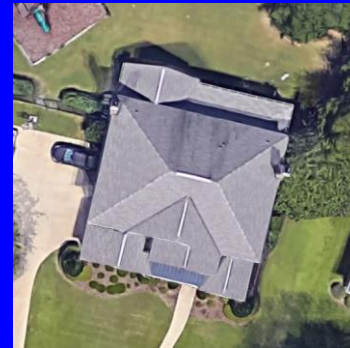
- Information – automated attribution

Example Data

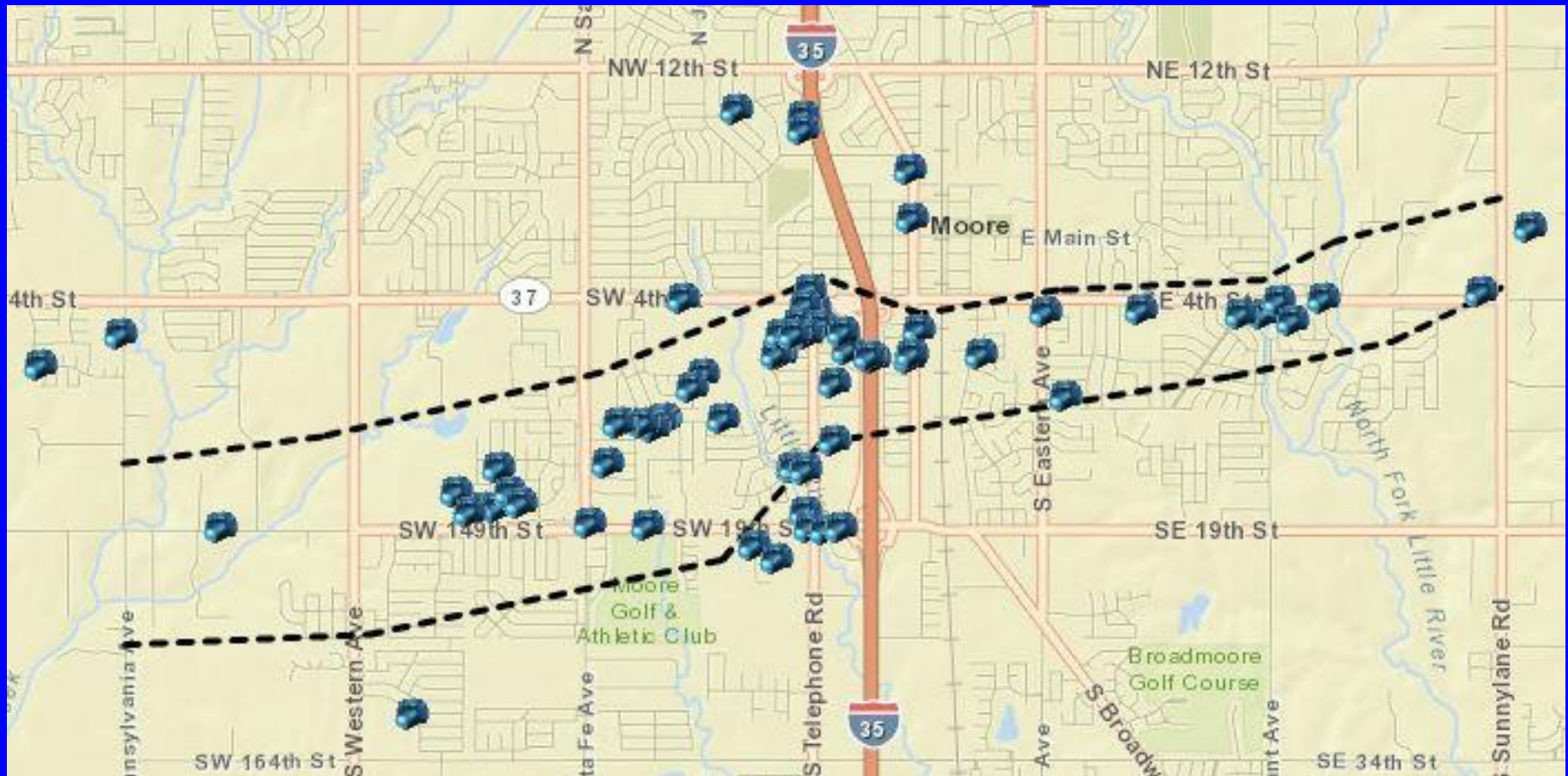
Google Streetview



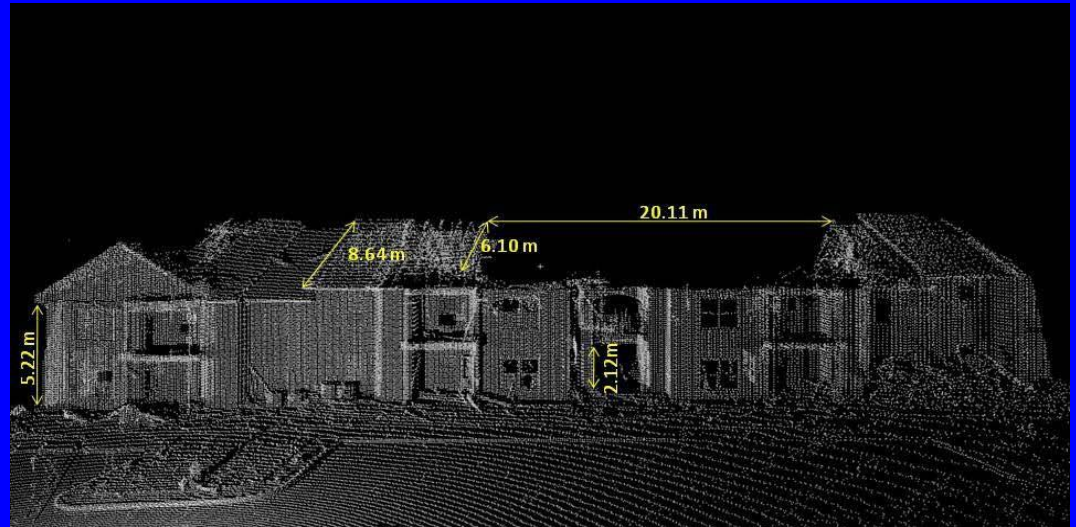
Google Earth aerial

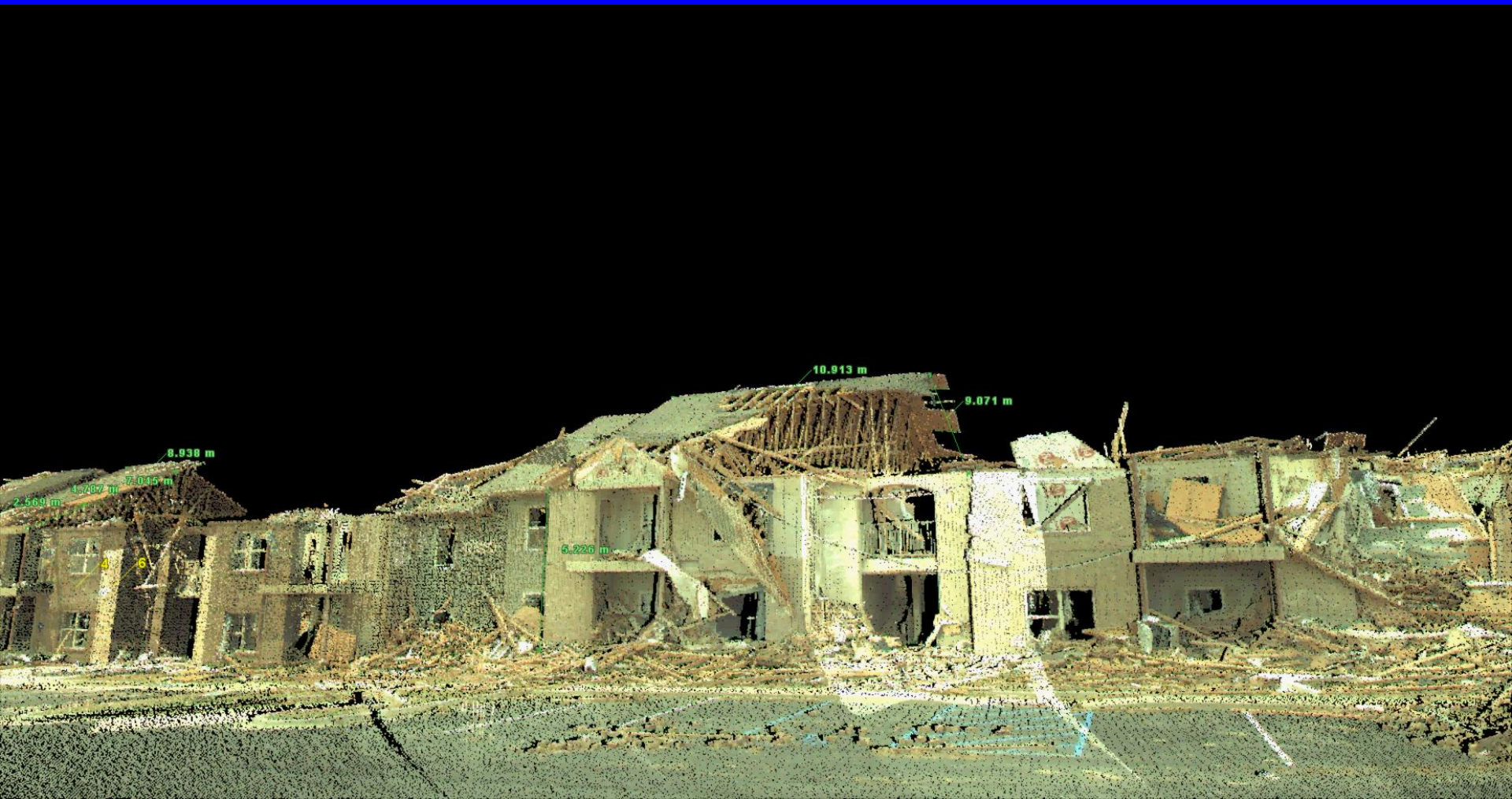


Crowdsourced: Social Media



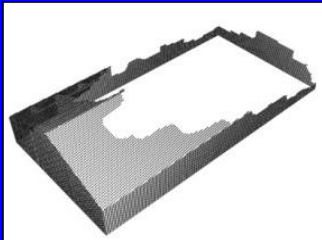
3D Laser Scanner



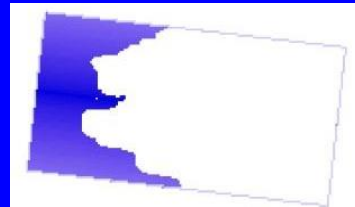


Automated LiDAR Analysis

Post-event Roof Detection Model



Post-event point cloud data



Slope-based filtering within a local neighborhood



Binary raster representing roof and non-roof cells



Post-event roof polygon

Pre-event Roof Detection Model



Pre-event Aerial image



Buffering post-event roof polygon

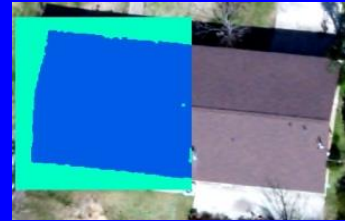
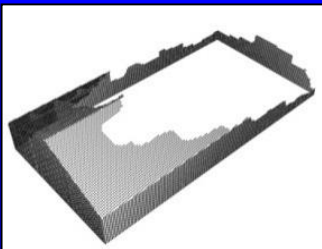


Image classification within a local neighborhood

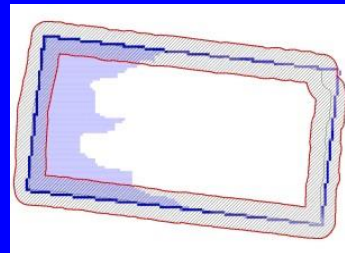


Pre-event roof polygon

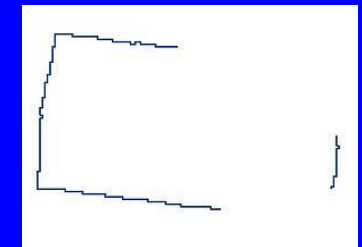
Post-event Wall Detection Model



Post-event point cloud data

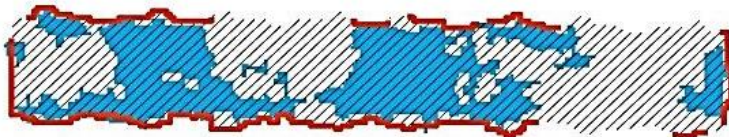


Identifying walls with pre-event outline of building



Post-event wall polyline

Results of Case Study



- Post-event Wall Polylines
- Pre-event Roof Polygons
- Post-event Roof Polygons

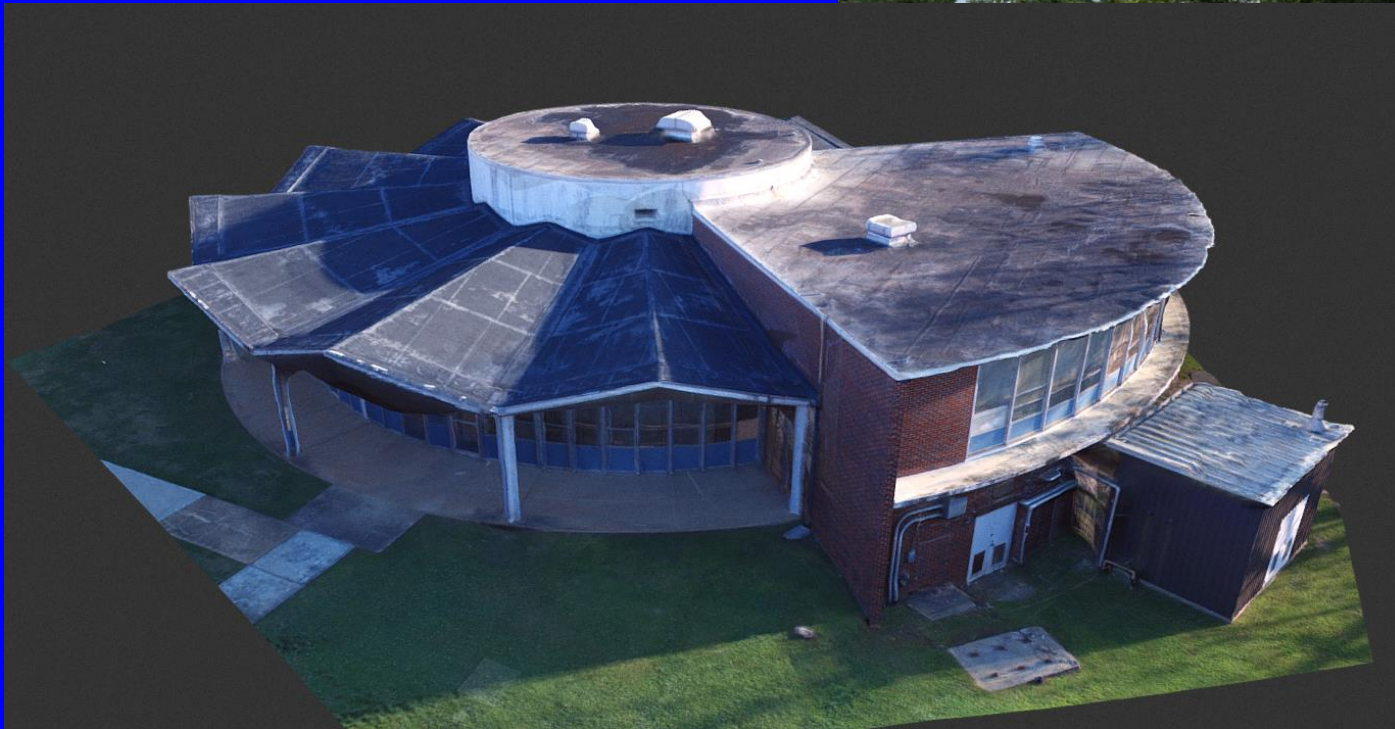
0 5 10 20 30 40 Meters

- EF2
- EF3
- EF4

Drone



Inspire 1



<https://sketchfab.com/models/06bfe5ffe1b842e6afdd5b9eba3419dd>

Extreme Event Web Site

<http://extremeevents.caps.ua.edu/>

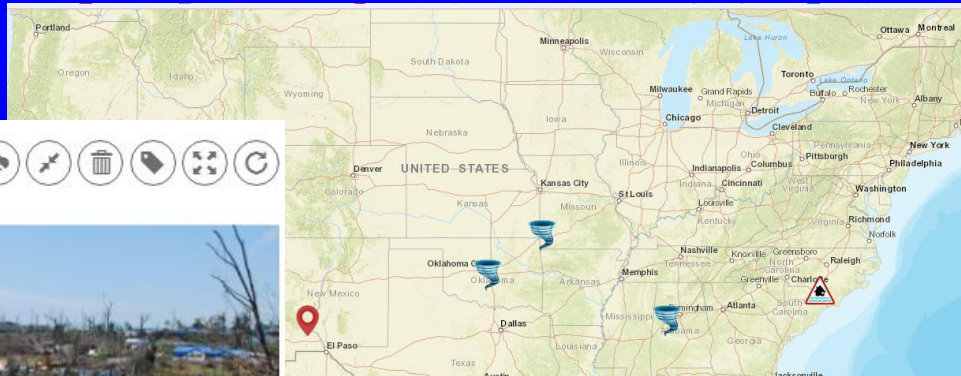
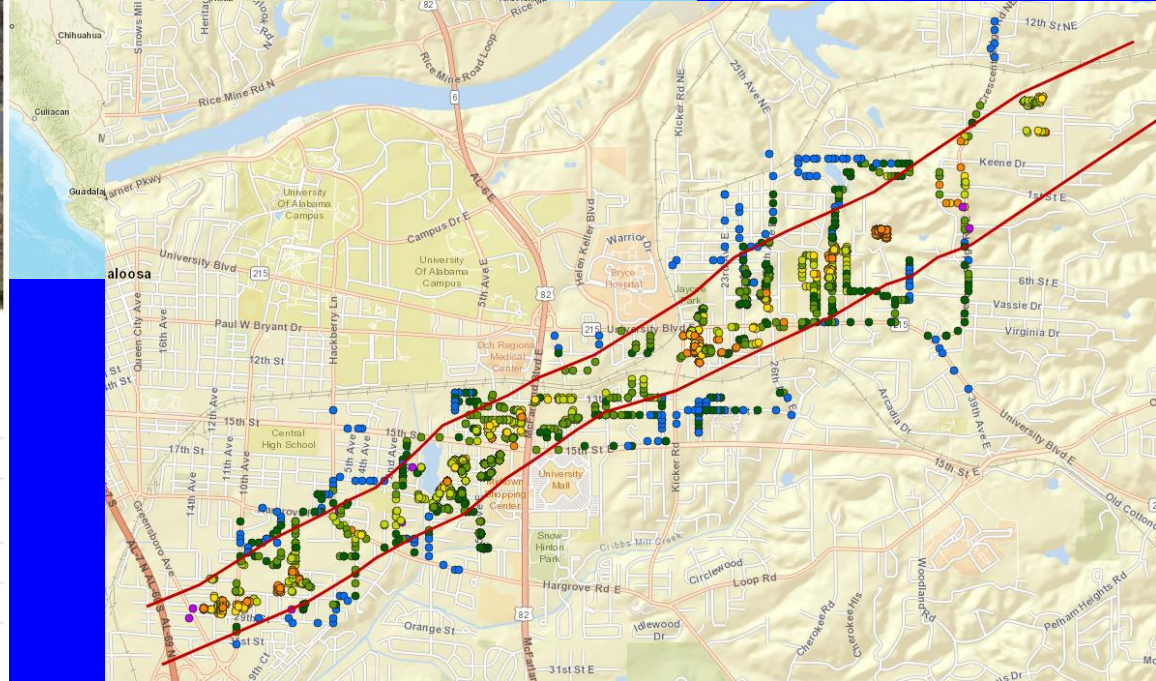



Photo Id	28995
Date Taken	Thu May 05 2011 12:12:55 GMT-0500 (Central Daylight Time)
Photographer	Dr. John van de Lindt
Source	Camera

EF Rating 4





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Sunset over the ruins of Joplin. Credit: AP