Exploring Remote Sensing Applications for Electric Utilities

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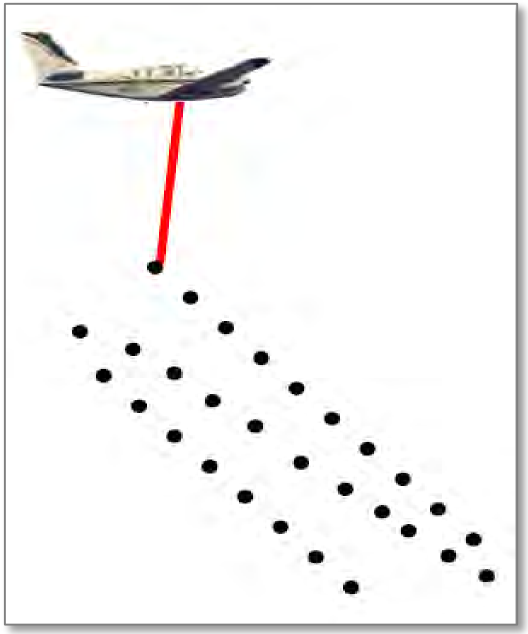
Remote sensing platforms

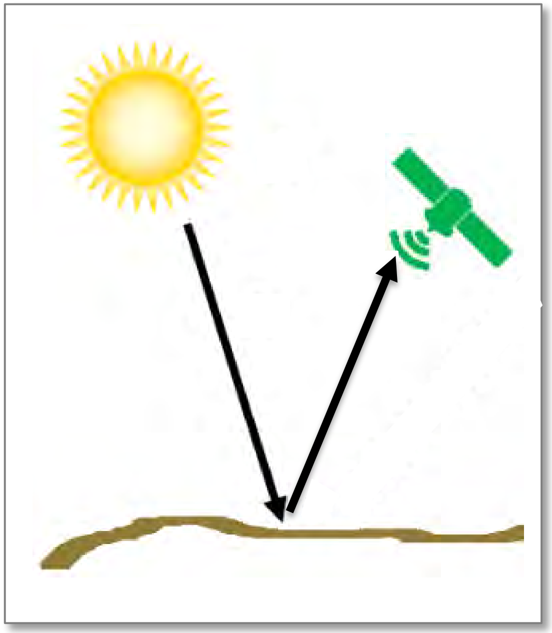
- Can be mounted on satellite, aircraft, motor vehicles, or tripods.

Sensors

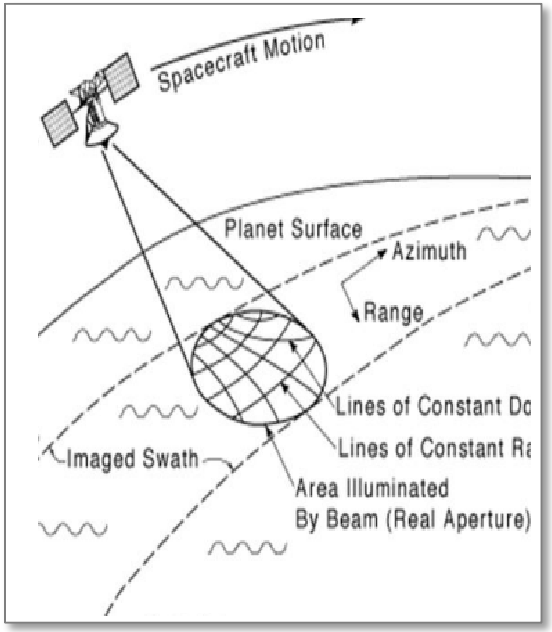
Light Detection and Ranging (LiDAR)



Spectral Imagery



Synthetic Aperture Radar



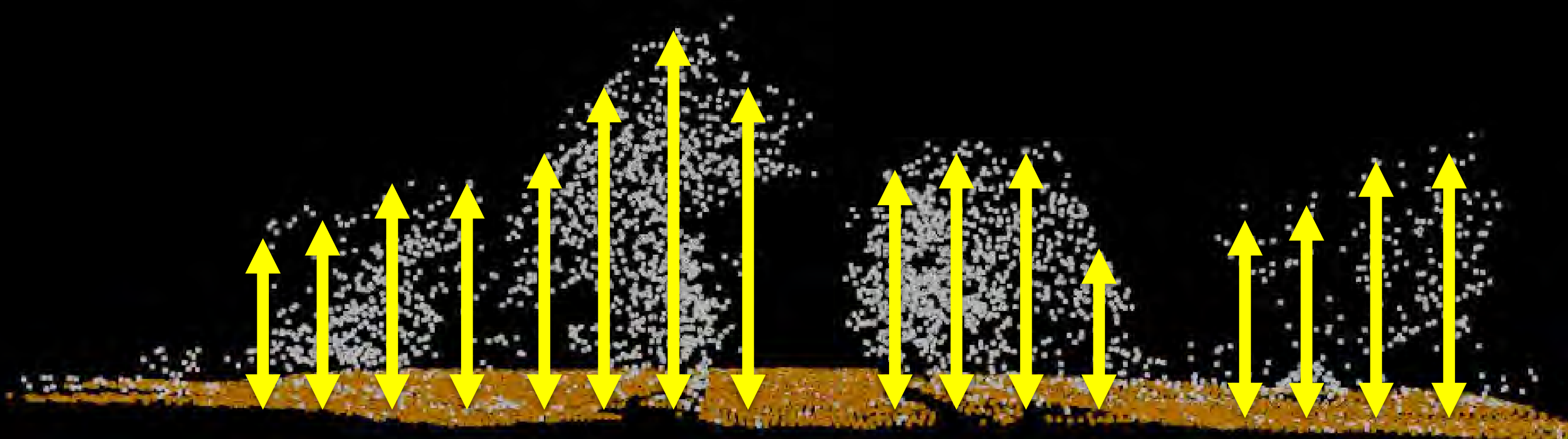
LiDAR (aerial, low-resolution)

ly available in CT
ul for modeling:
errain
orest canopy
nd cover

Measuring forest canopy height

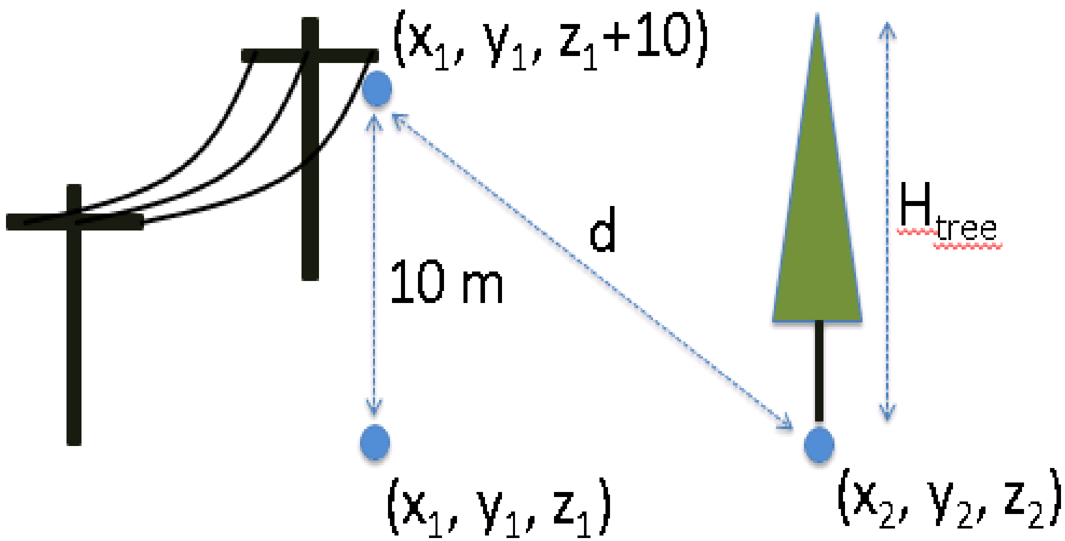
Forest Canopy Height Model

- Estimate of height at any given location



Identifying tree risk to infrastructure

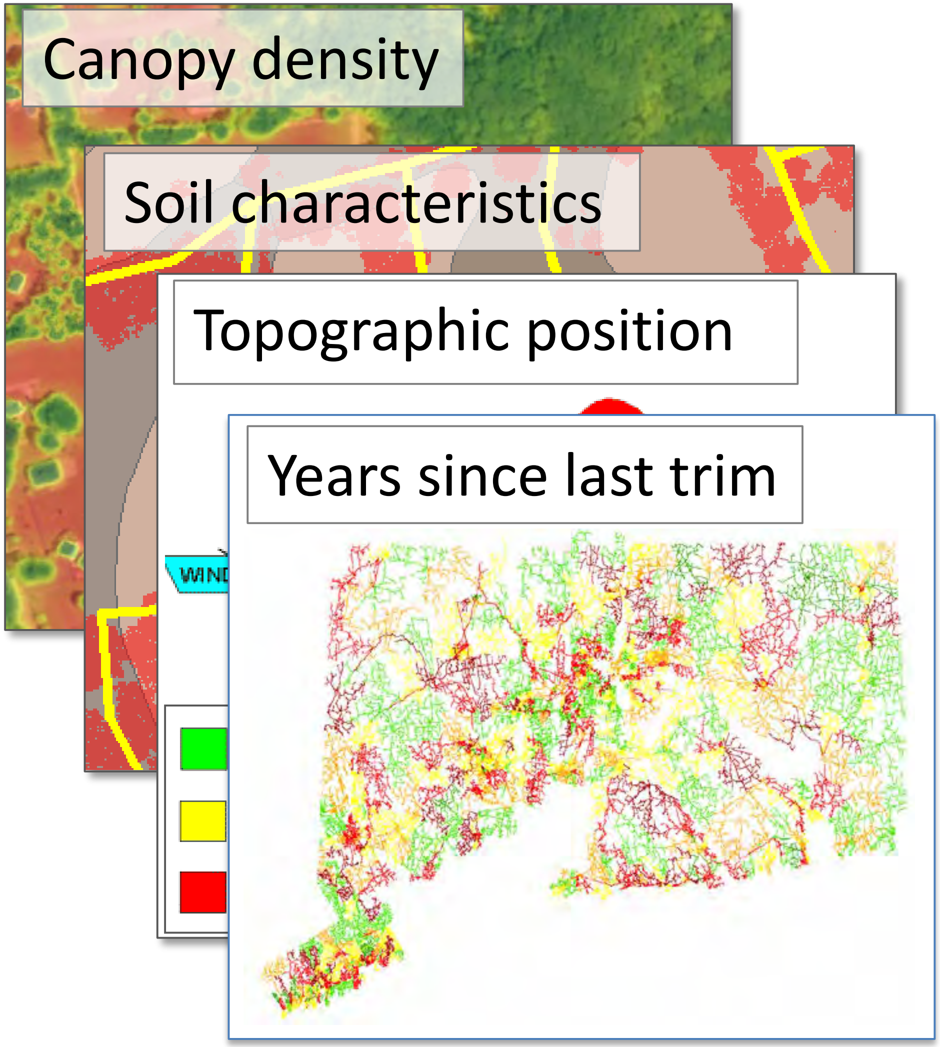
- Use canopy height model to identify locations where trees are capable of striking power lines.



Trees within striking distance of lines

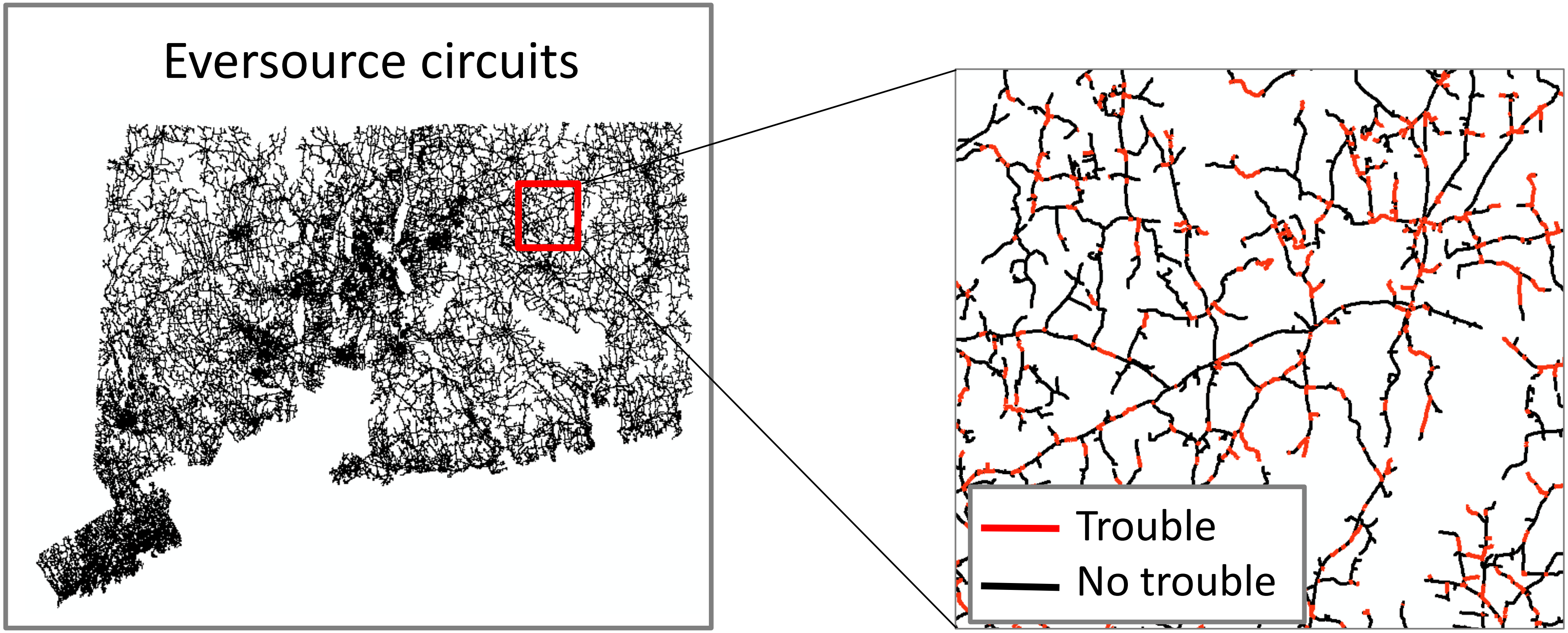
Evaluating tree risk due to environmental conditions

- Can environmental conditions help predict tree susceptibility?
- What conditions make trees susceptible to breakage or windthrow?
  - Poor wind adaptation
  - Shallow roots
  - Wind exposure
  - Trimming history



Validating a vegetation risk model

- Do trouble spot locations differ from locations with no trouble spots?
  - Compare statewide using airborne LiDAR and GIS data



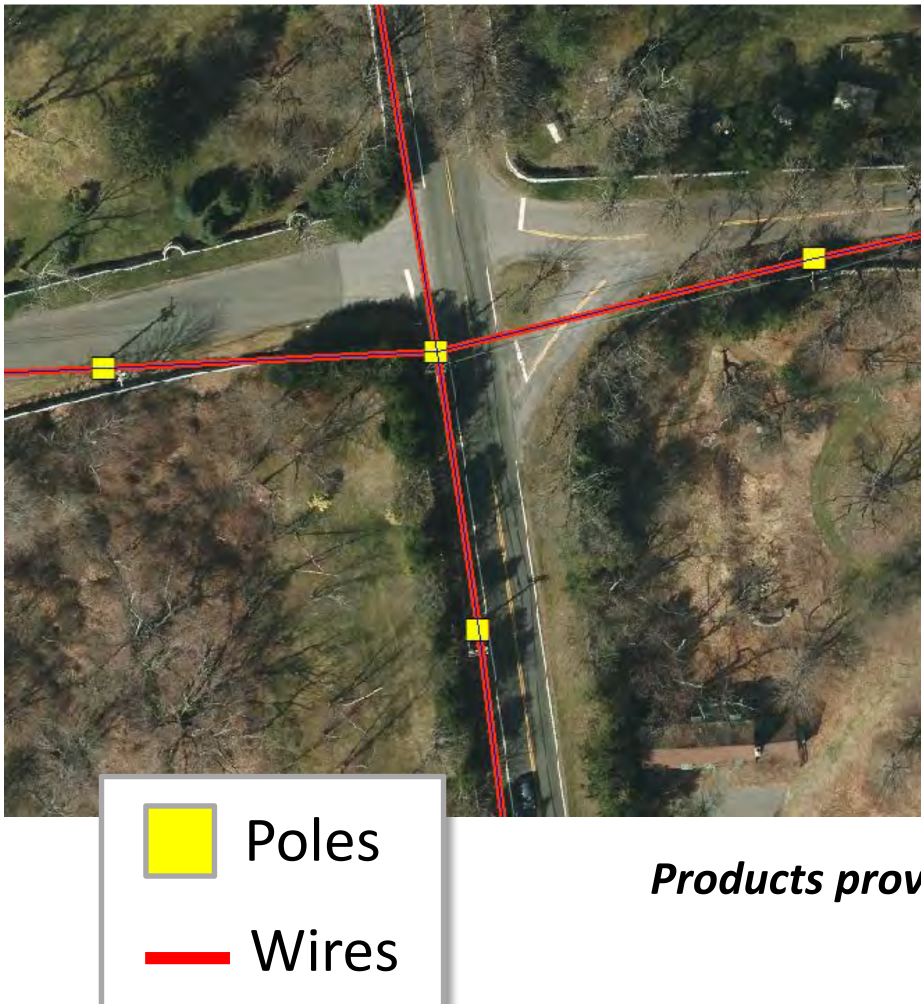
LiDAR (aerial, moderate-resolution)

- Ground
- Low veg.
- Med. veg.
- High veg.
- Pole
- Wires

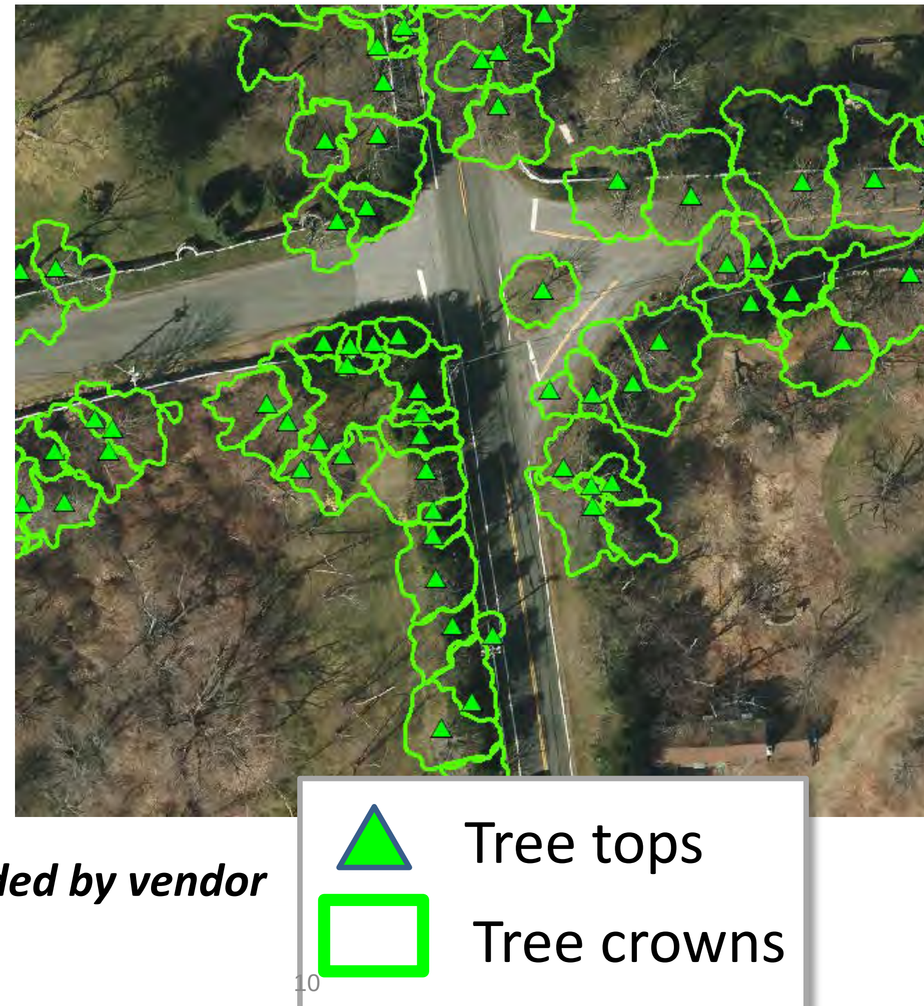
eful for modeling:
Tree crowns
Small features
(e.g. utility poles)

LiDAR (aerial, moderate-resolution)

Utility poles and wires



Tree tops and crowns



Products provided by vendor

LiDAR (aerial, moderate-resolution)

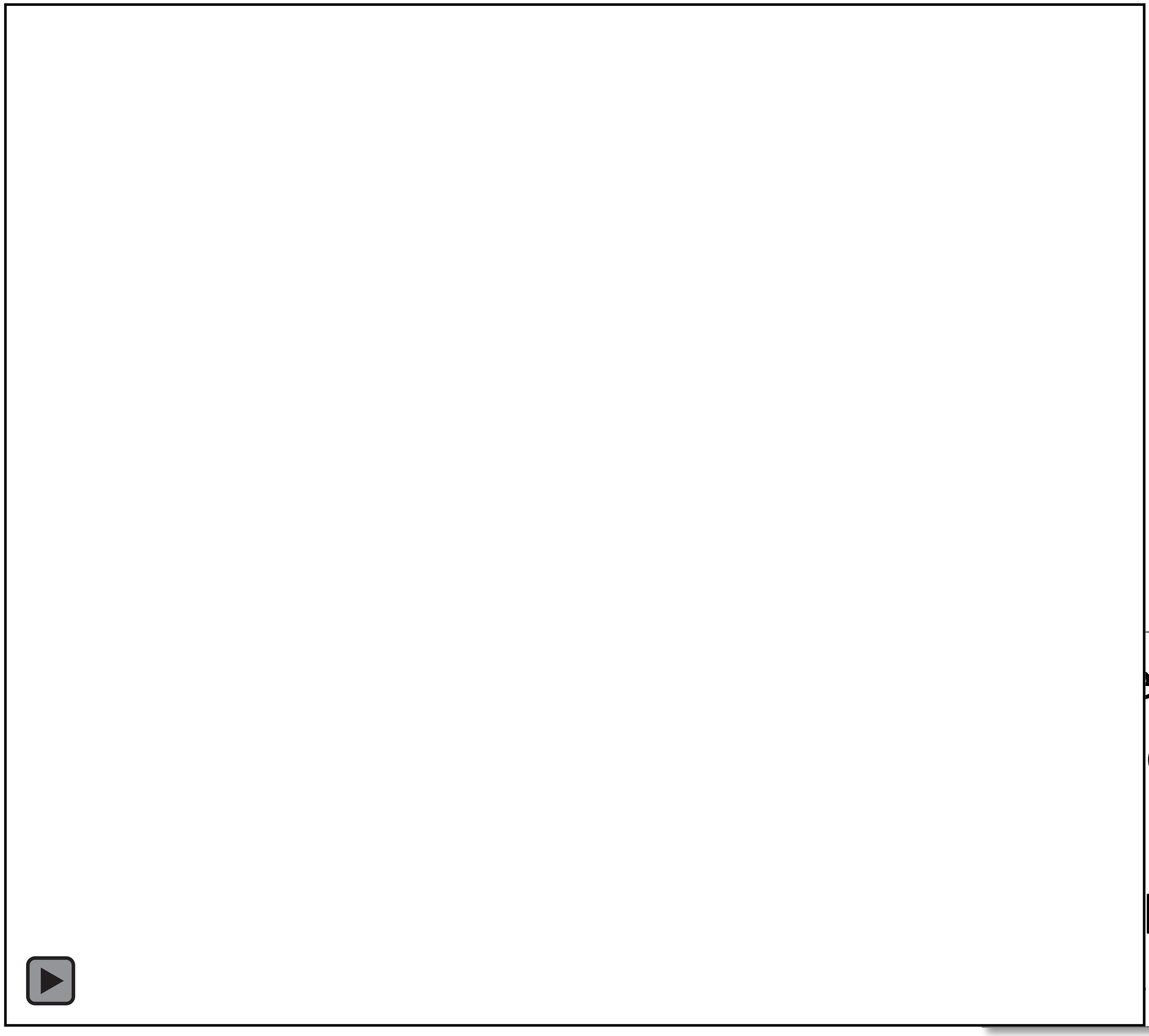
Proximity of vegetation to wires

Distance from wires

- Veg. > 12’
- Veg. 8-12’
- Overhanging veg.
- Veg. 2-8’
- Veg. < 2’

Products provided by vendor

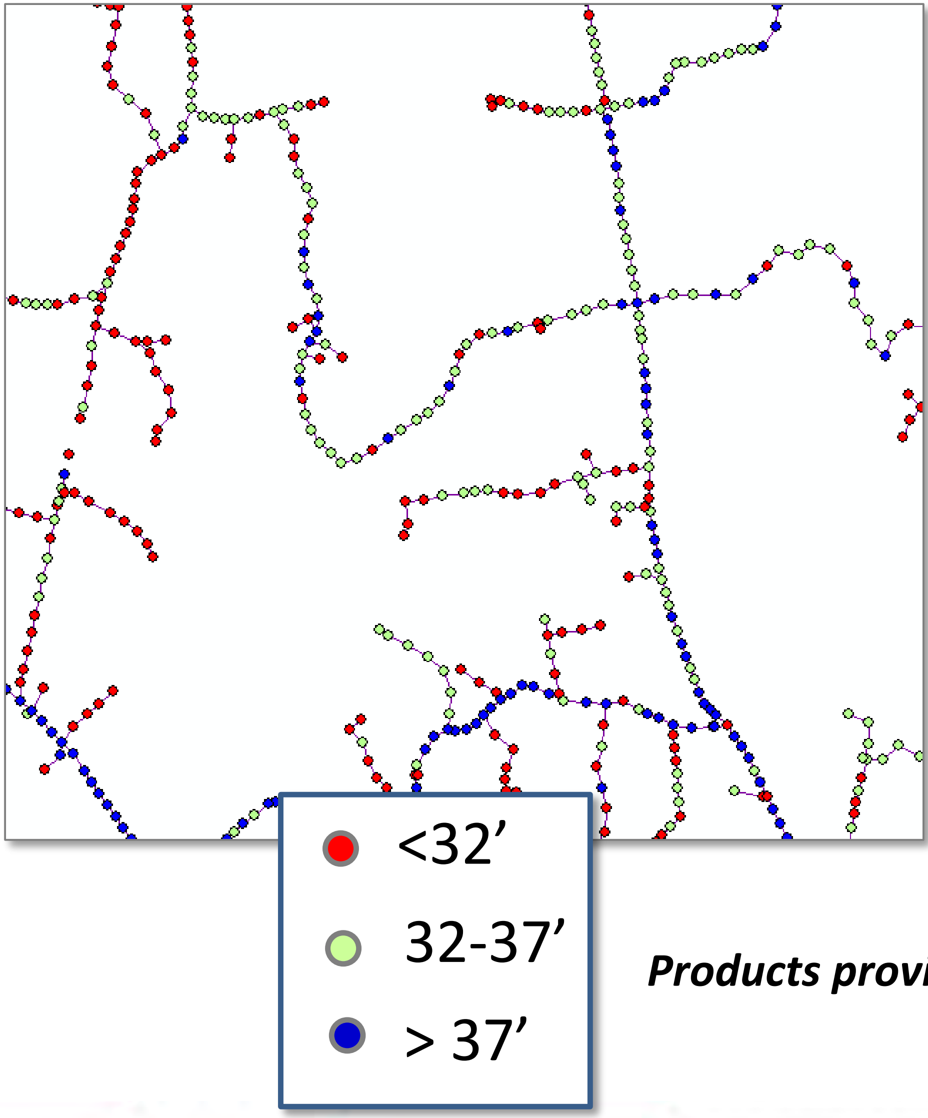
LiDAR (mobile, high resolution)



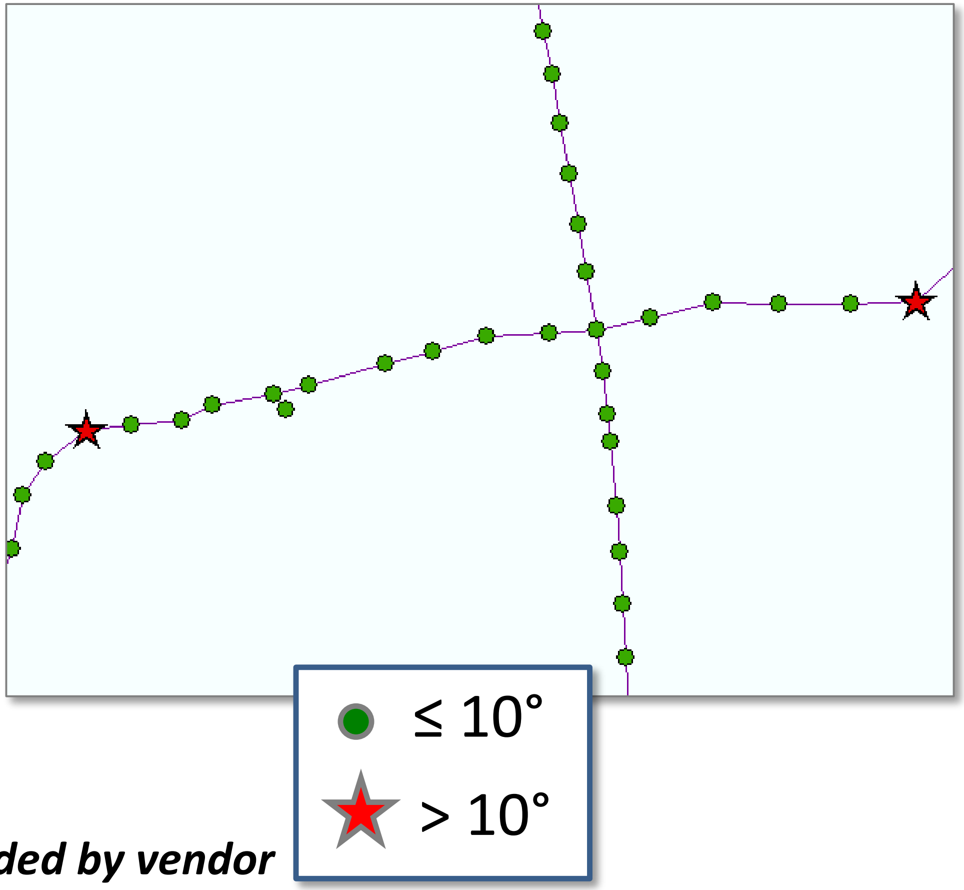
eful for providing data
engineering analyses.
e.g. utility pole integrity
pping infrastructure
cured by tree cover.

LiDAR (mobile, high resolution)

Pole height



Pole lean > 10°



Products provided by vendor

Extracting information from LiDAR

- Large share of project costs, if done by vendor
- EEC goals include development of algorithms to automate in-house feature extraction.

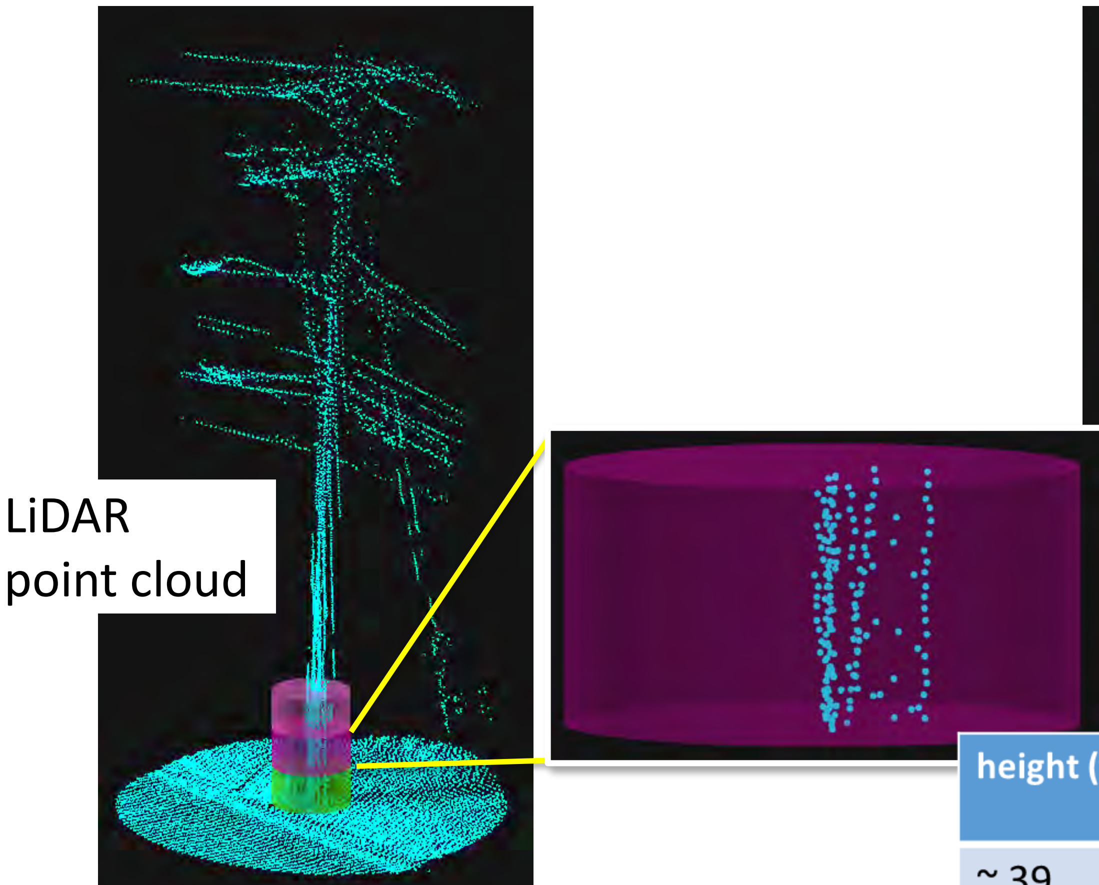
LiDAR points

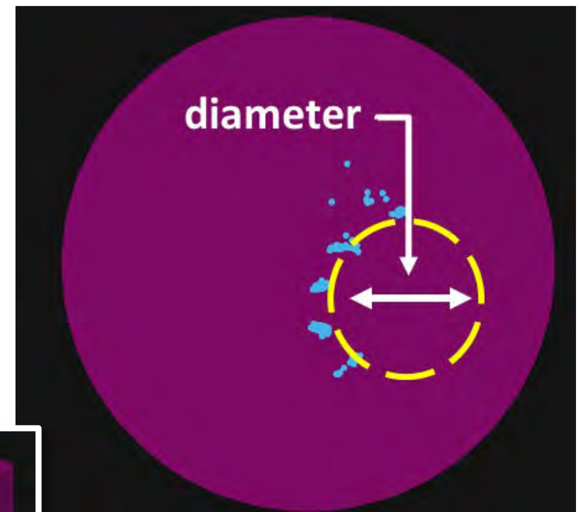
Reported lines

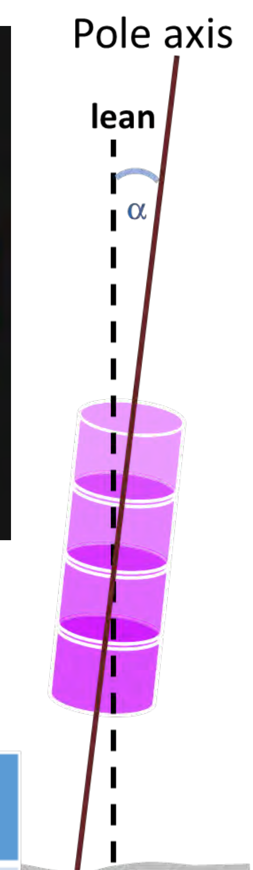
Mapped lines

Extracting information from LiDAR

- Point cloud analytics for automated extraction of pole attributes (height, lean, diameter)







height (ft)	lean	Mean diameter (in)
~ 39	<10º	~ 12

Mapping with aerial imagery

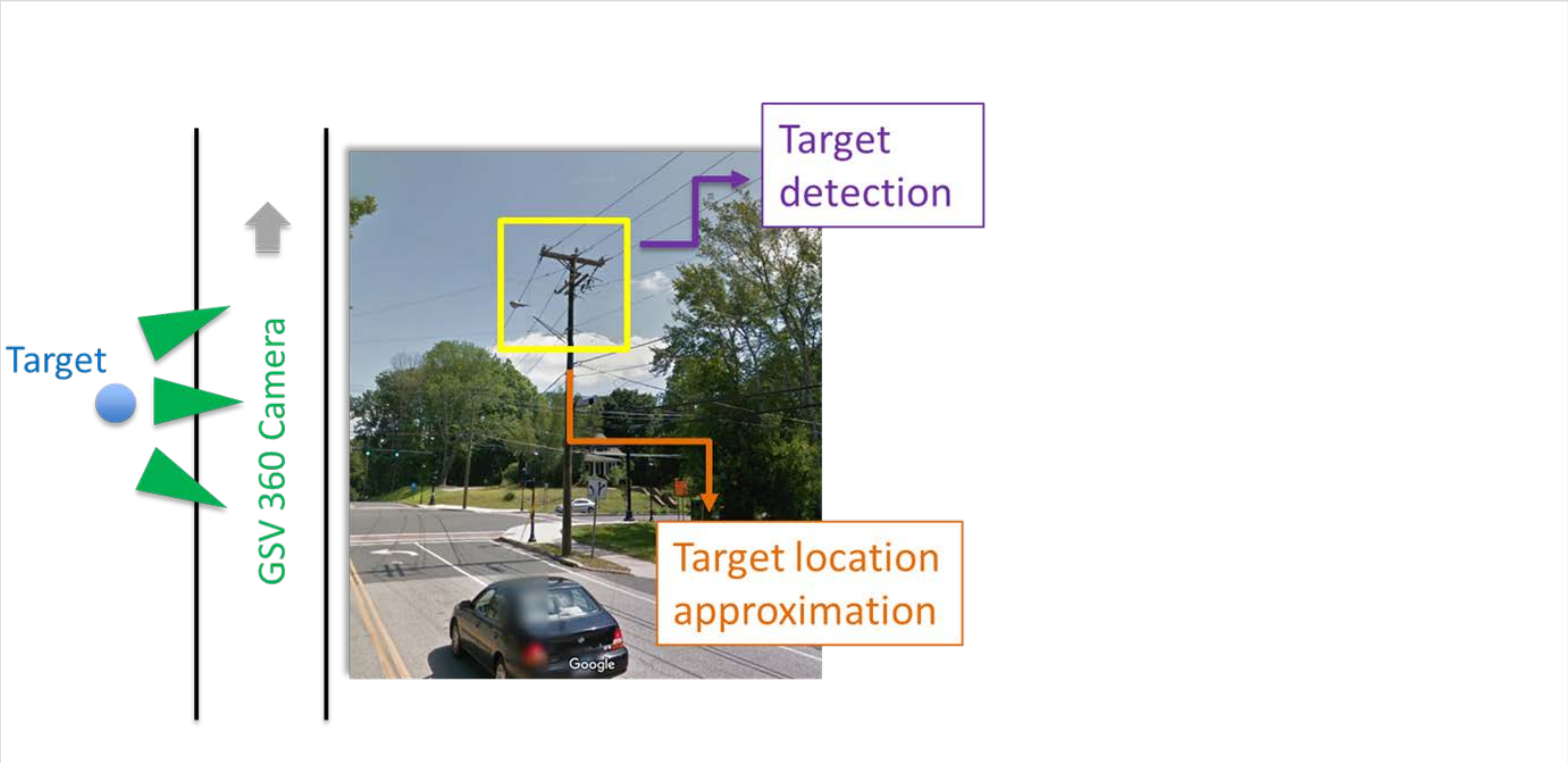
- Aerial imagery is freely available for all of Connecticut.
- Explored feasibility of mapping utility poles and wires from aerial imagery.
  - 1400 student-hours invested
  - 100,000+ poles mapped
  - 42 towns completed
- Estimated time and cost for completing all towns:
  - 3500 student-hours
  - < $50K (at $12 / hour)

Google street-view (GSV) imagery

- GSV is freely available for the majority of roads in Connecticut.
- Outstanding dataset for classification of utility equipment that are difficult to identify in LiDAR point clouds (e.g. transformers, etc.)
- EEC is working on developing machine learning techniques to help automate identification of features seen in GSV.

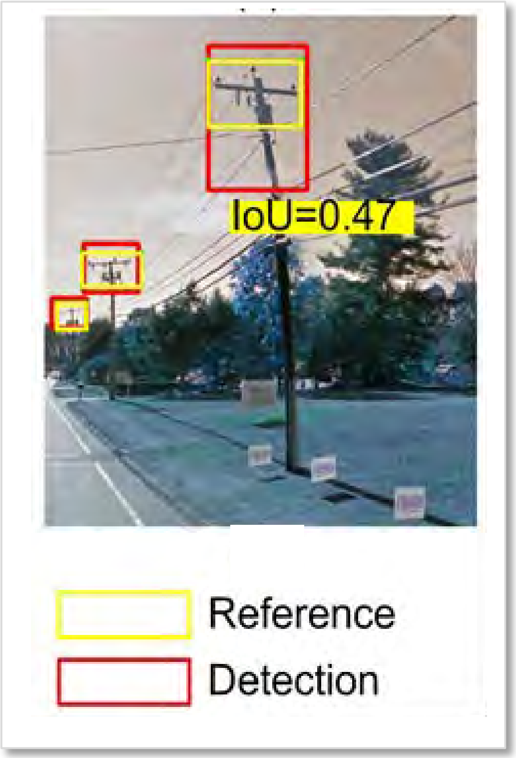
Feature identification from GSV

- Complementary to accurate feature positioning provided by LiDAR point clouds.



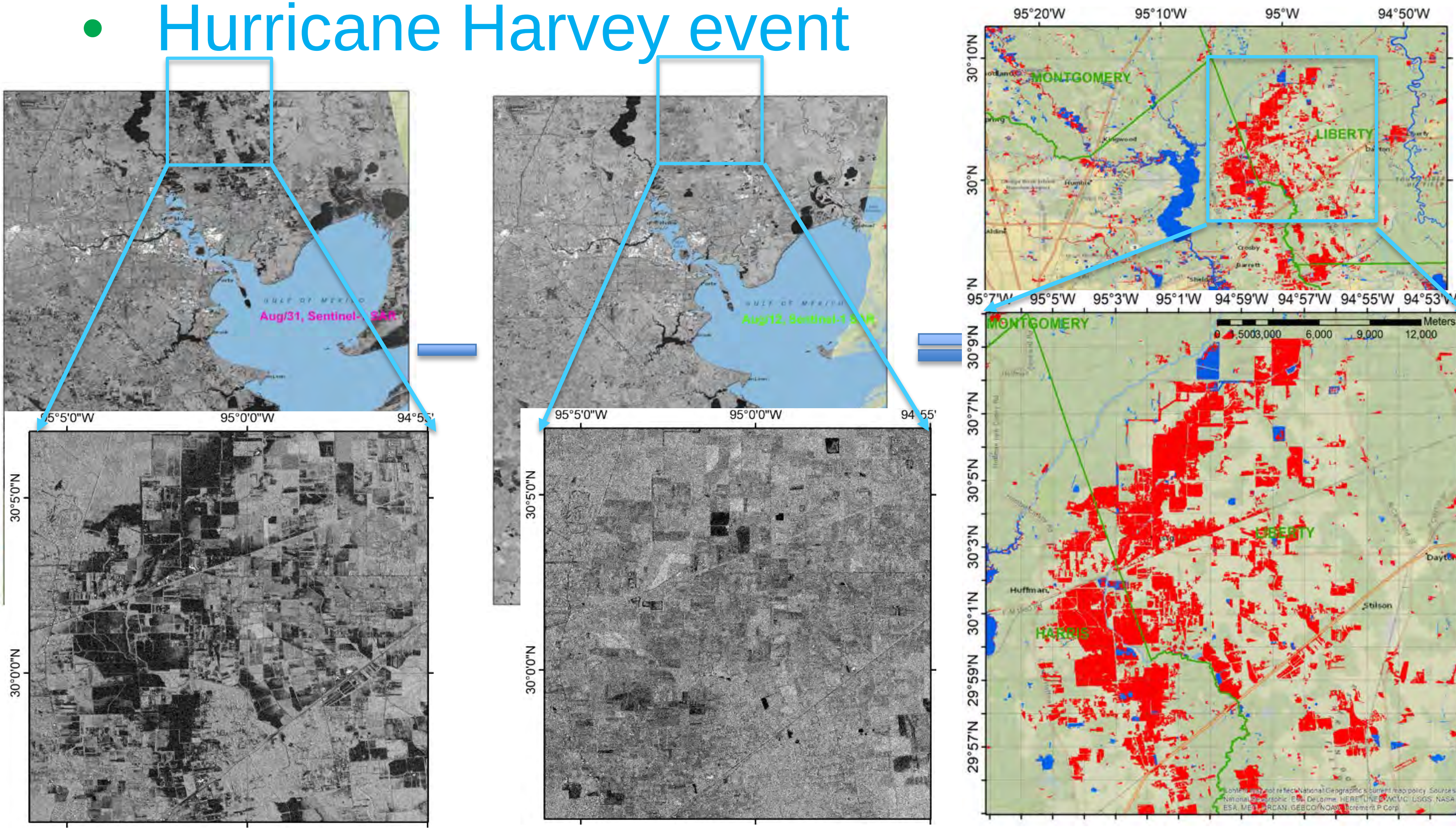
Evaluation of GSV classification algorithm

- Cross-arm identification algorithm tested on > 900 poles.
- Detection accuracy ≈ 80%
- Locations triangulated from overlapping images; positional accuracy generally < 10 meters
  - Close enough to match to locations provided by LiDAR.

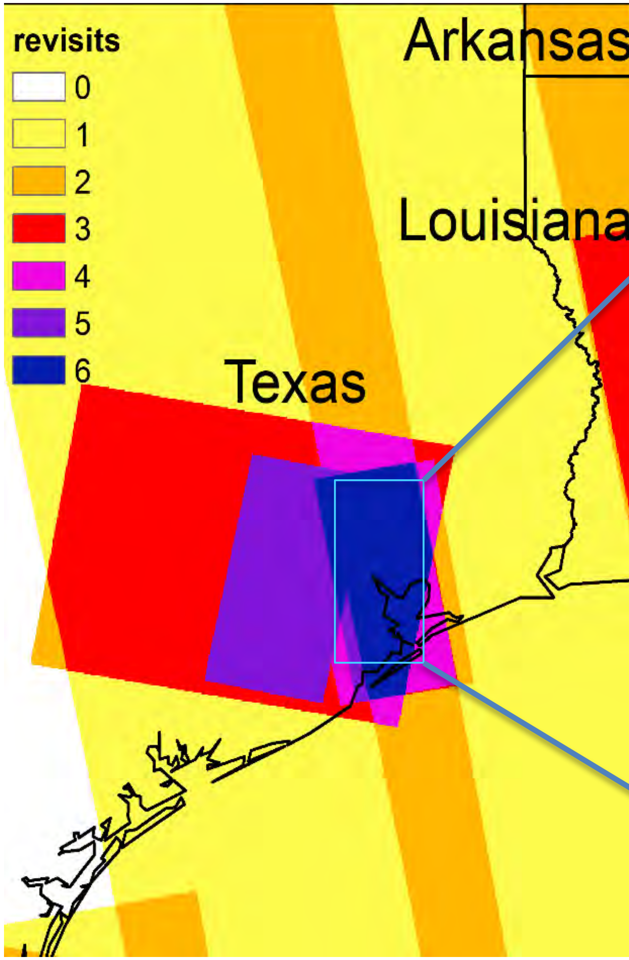


Flood Delineation by SAR data

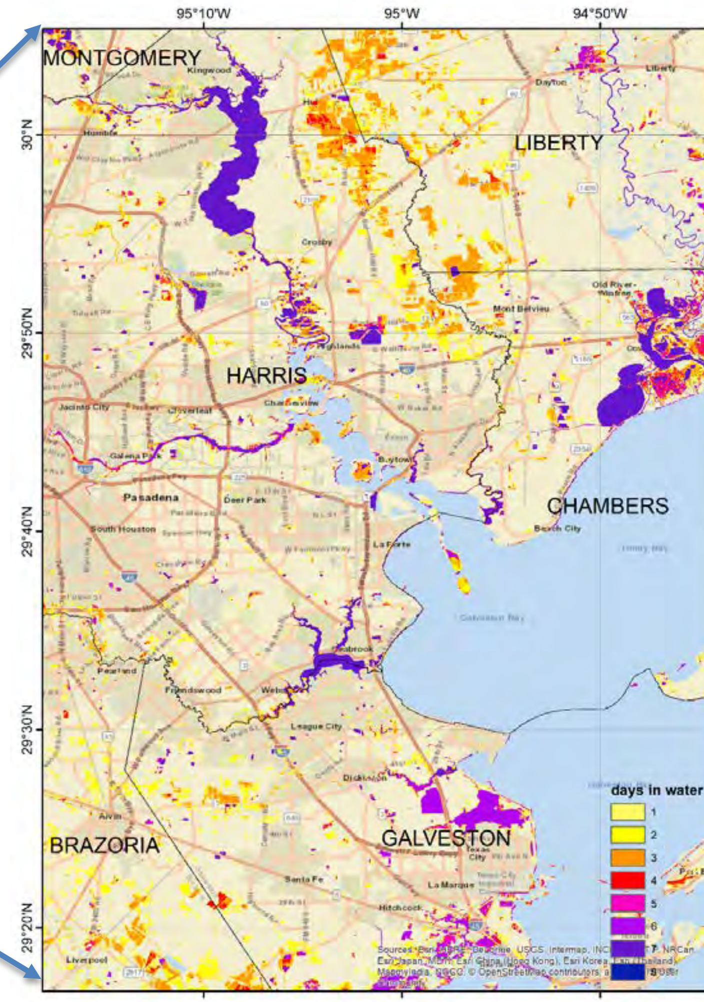
- Hurricane Harvey event



Sentinel-1 Capability



Revisit frequency and coverage during Harvey (Aug. 27-Sept. 12)



Inundated “times”