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Documenting Damage and Recovery across Bolivar Peninsula, Texas after Hurricane Ike using Object-Based Image Analysis (OBIA)

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Introduction

Global natural disaster costs

2011 Tohoku earthquake and tsunami, Natori City, Japan.
(Credit: AP Photo/Yasushi Kanno, The Yomiuri Shimbun)

Damage from EF5 tornado Moore, Oklahoma, May 2013.
(Credit: FEMA)

OBIA can support disaster stakeholders

Object based image analysis (OBIA)

Semi-automated - classify objects - remotely sensed data

High resolution imagery with OBIA overlay.

- Data: High resolution imagery and elevation.
- Objects: Choice highly flexible = broad applicability.
- Results: Intuitively meaningful = clear communication.

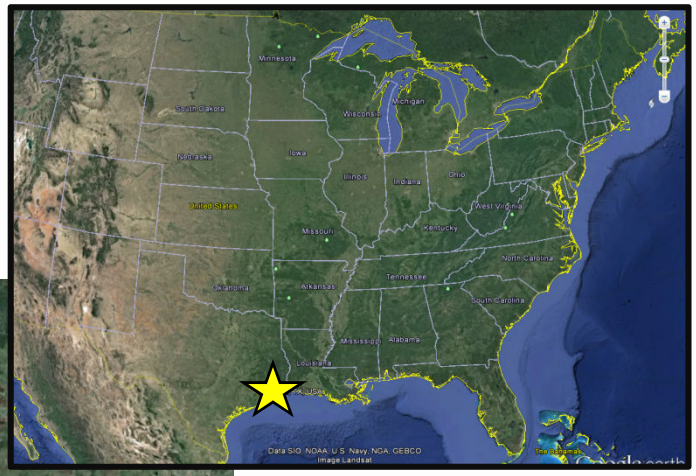
OBIA Rule Set

Sequence of algorithms

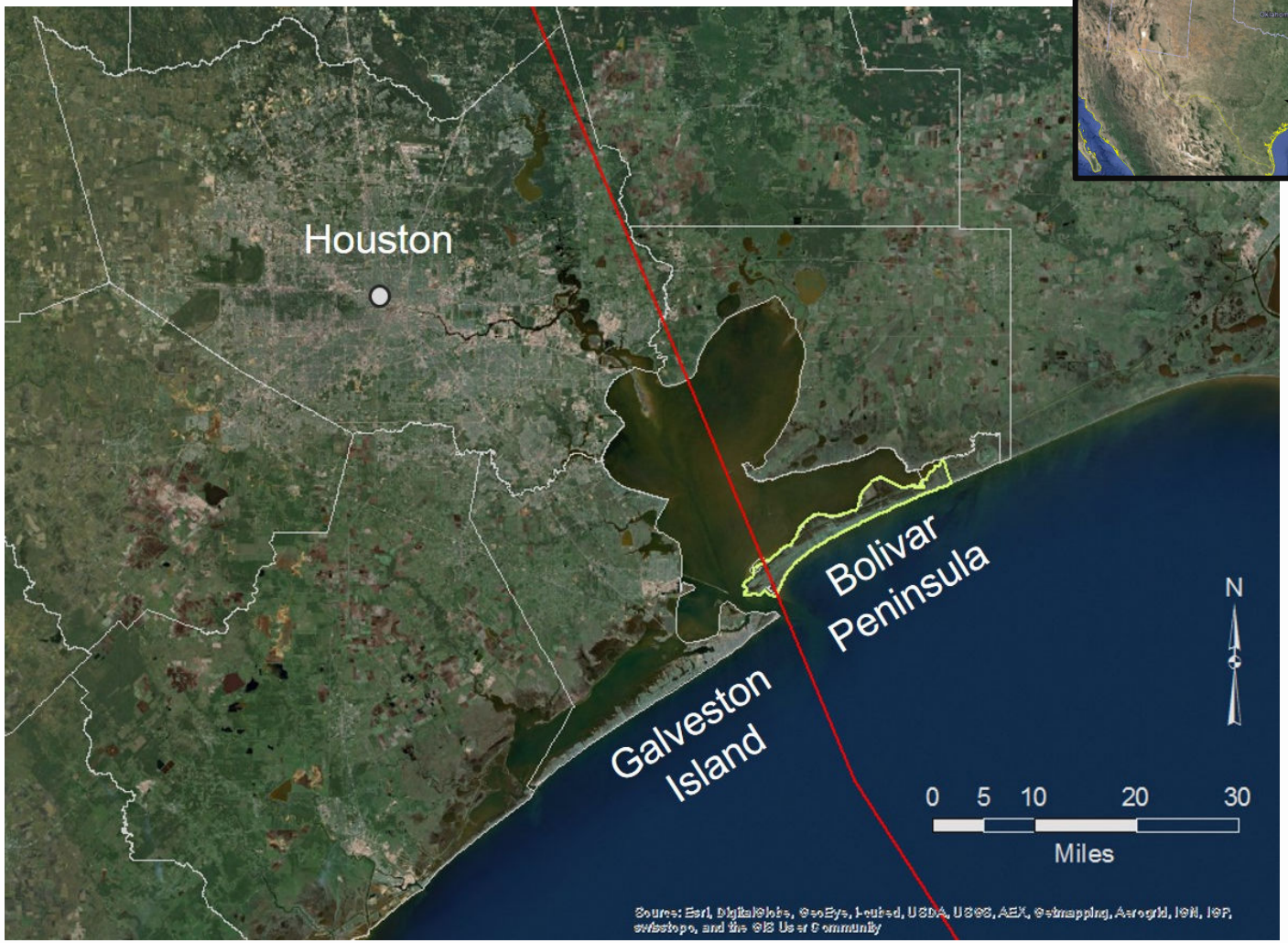
- Classes based on spectra + size, shape, texture, context (different from pixel-based approaches).
- Semi-automated once ruleset built. Faster, more consistent than manual interpretation.

Case Study

Hurricane Ike (2008) and Bolivar Peninsula, Texas



Location Map



Hurricane track (red) & study area (yellow)

Impacts on Bolivar

Buildings lost: > 65%

Transportation damaged

Eroded coastline/coastal dunes

<u>Good study area</u>

- Major impacts
- Data for 3 time periods (high res.)

Before and after photos,
Bolivar Peninsula, TX
(Credit: USGS)

Study Questions

Hurricane Ike damage, Bolivar Peninsula, TX
(Credit: Jocelyn Augustino, FEMA)

1. Can OBIA classify objects of interest to disaster stakeholders?

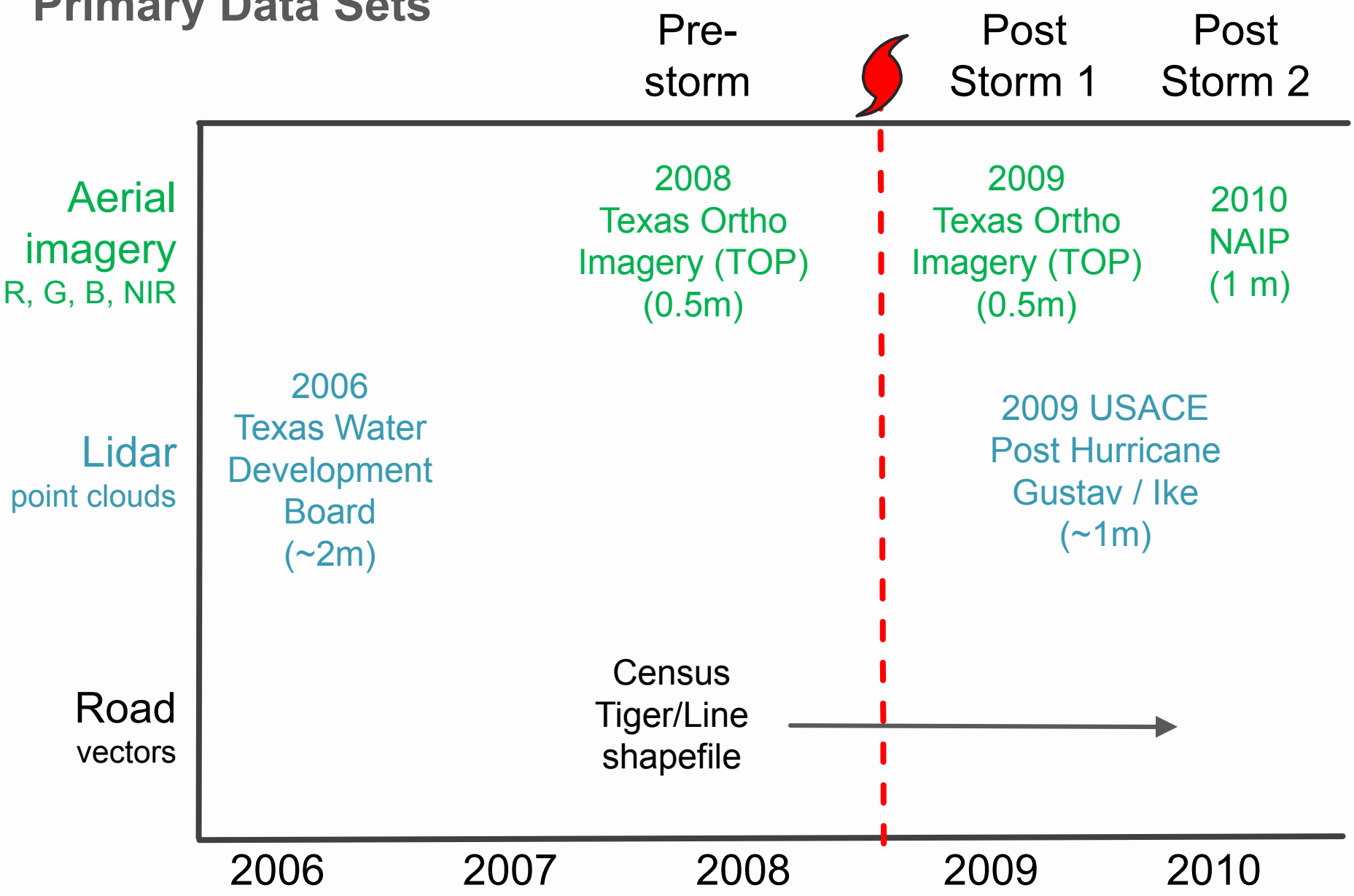
   Six test objects - Buildings, roads, water, 3 vegetation

2. Can rule sets be re-used (same data; different data)?

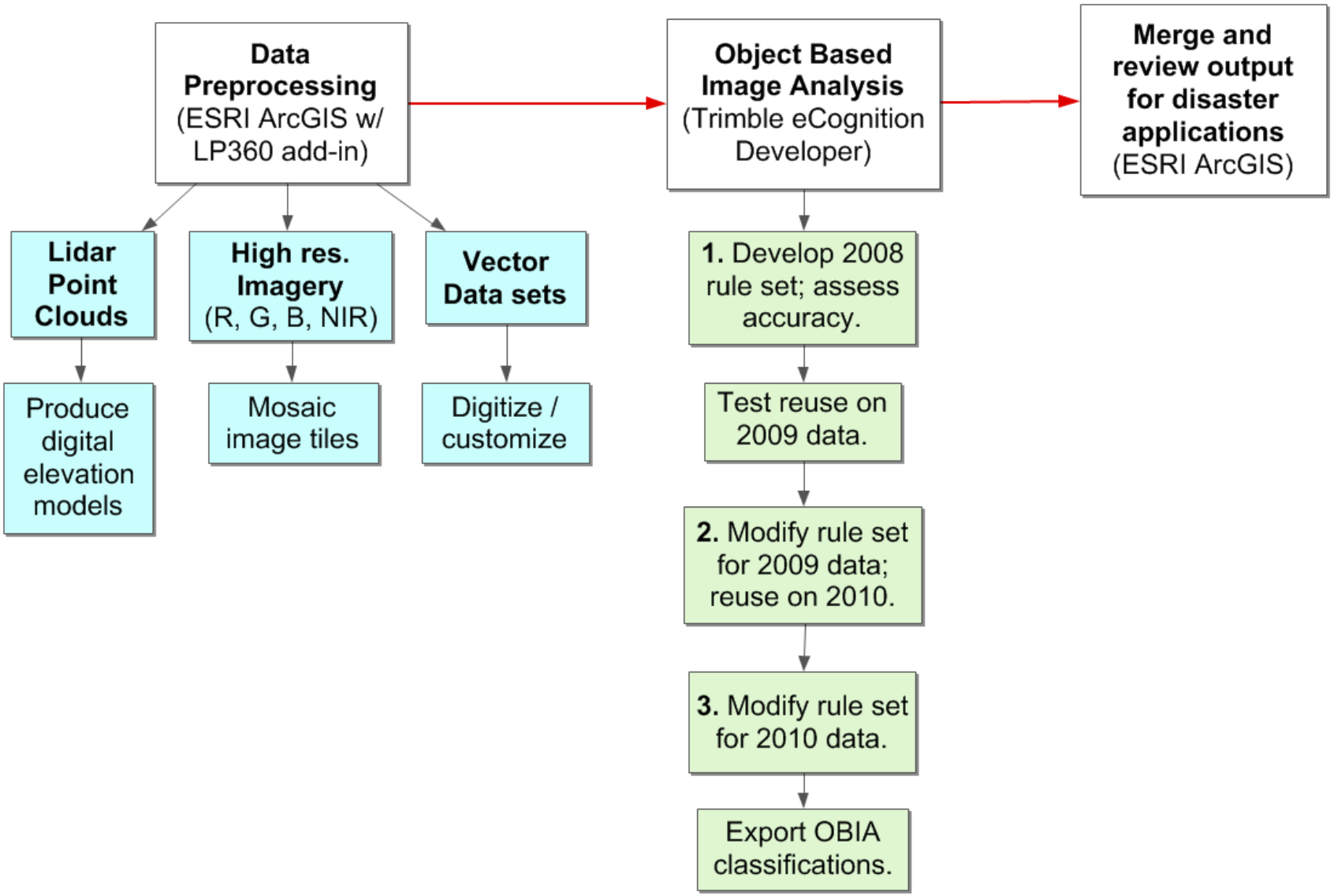
   Three data sets – Pre-storm, Post storm1, Post storm2

3. Can OBIA clearly document change through time?

Primary Data Sets

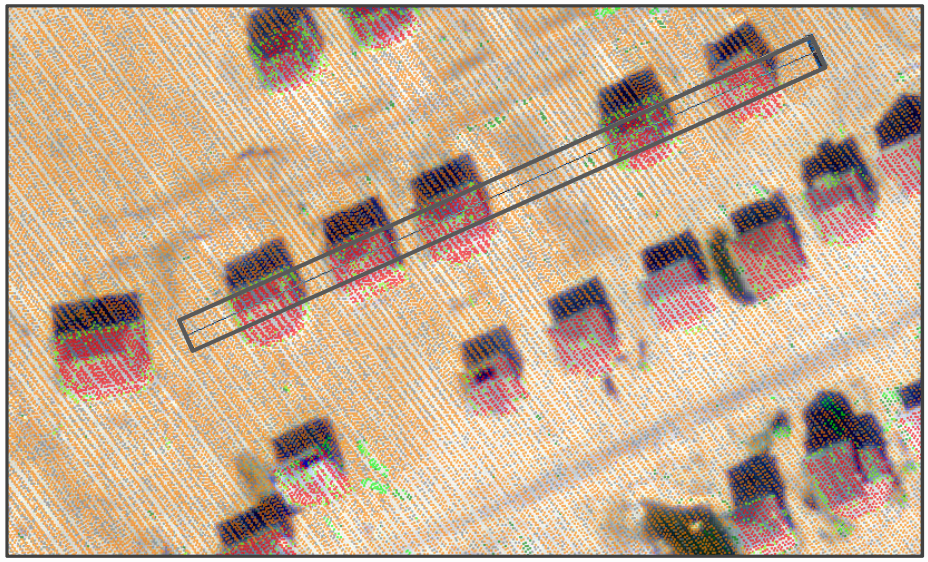


Methodology



Digital Elevation Models

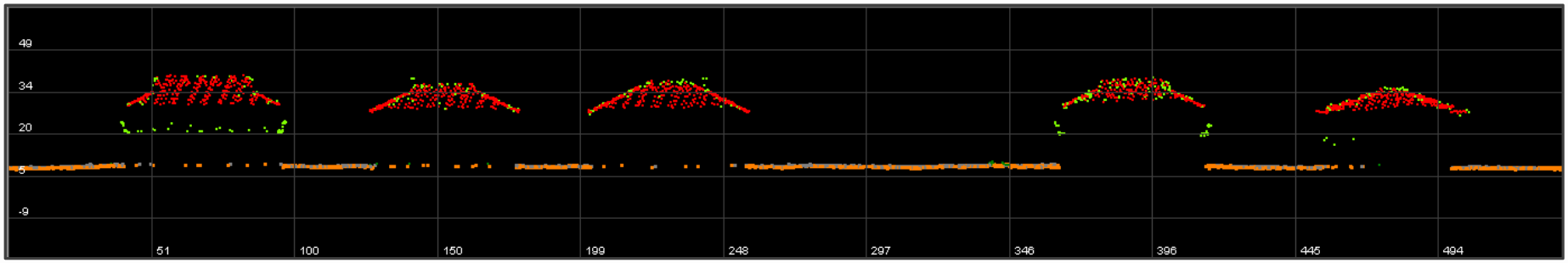
Map view – 2009 lidar point cloud



1. Bare earth DEM (ground)

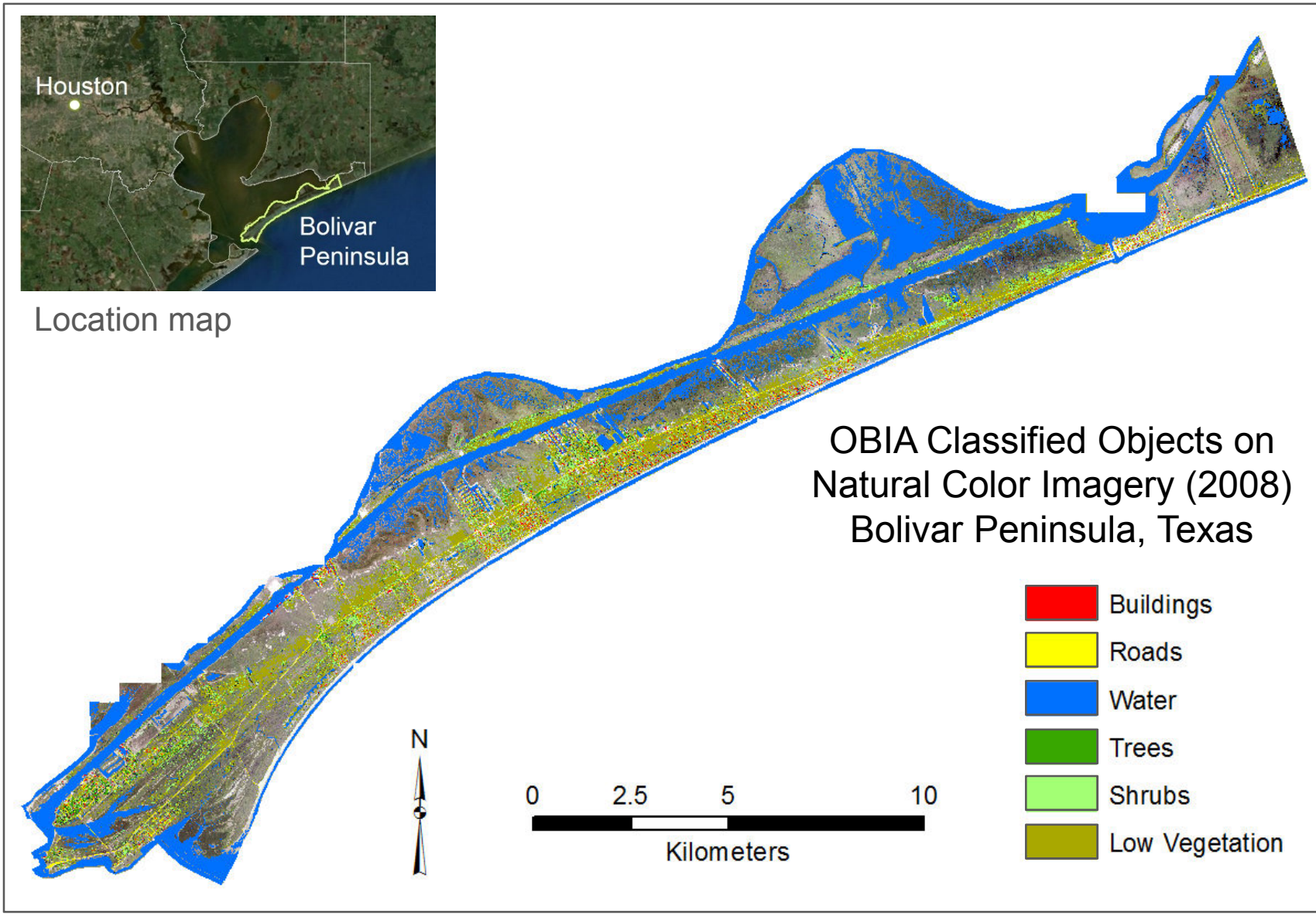
2. First return DSM
   "digital surface model"

3. nDSM (height above ground) ← Used in OBIA
   "normalized digital surface model"

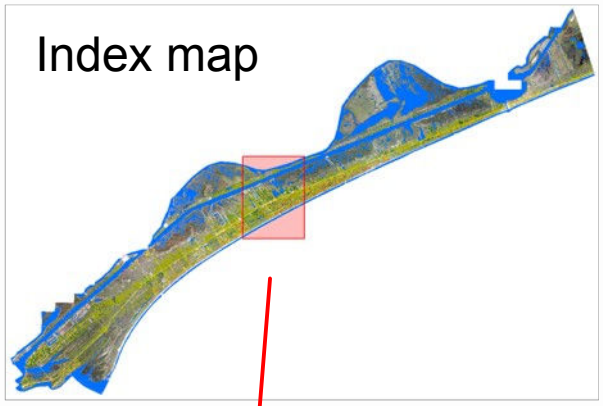


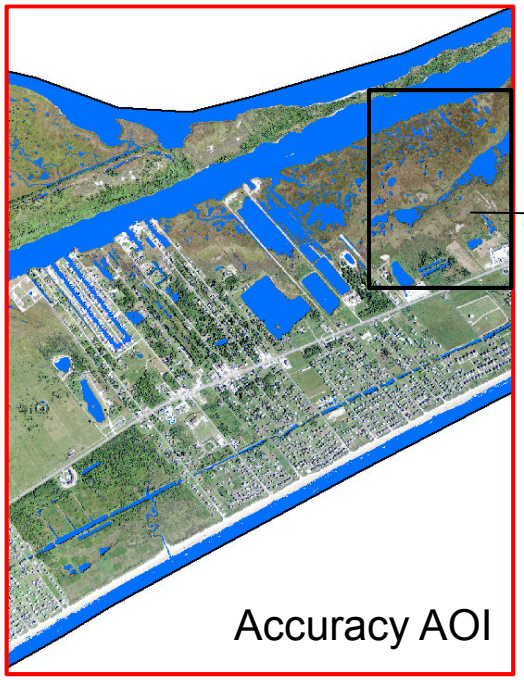
Profile view – 2009 lidar point cloud

Q1: Can OBIA classify objects of interest? Yes.



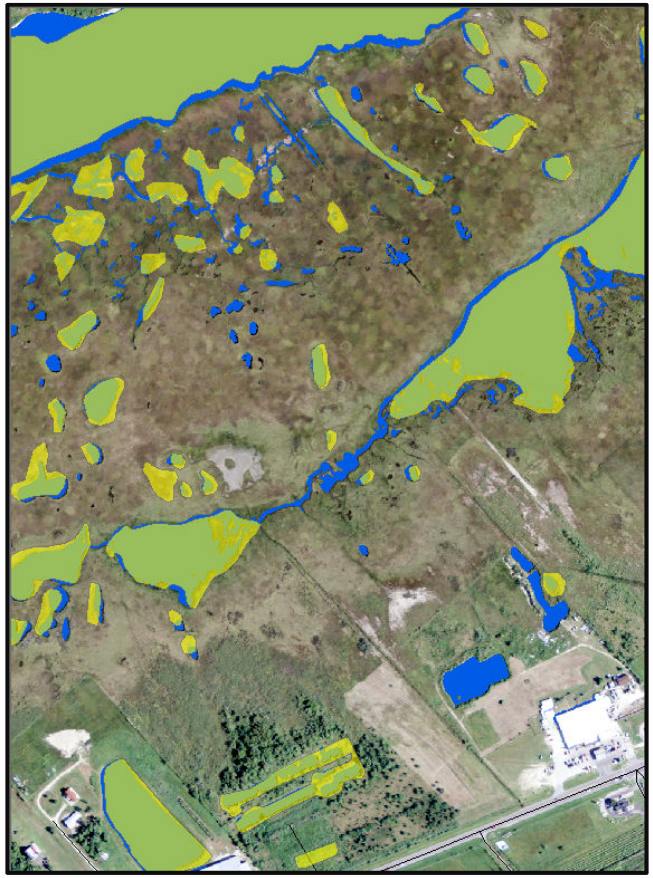
Thematic Accuracy (2008)
Water





OBIA Water over imagery
(Closer view)

With 2016 NHD “best resolution” overlay (yellow)

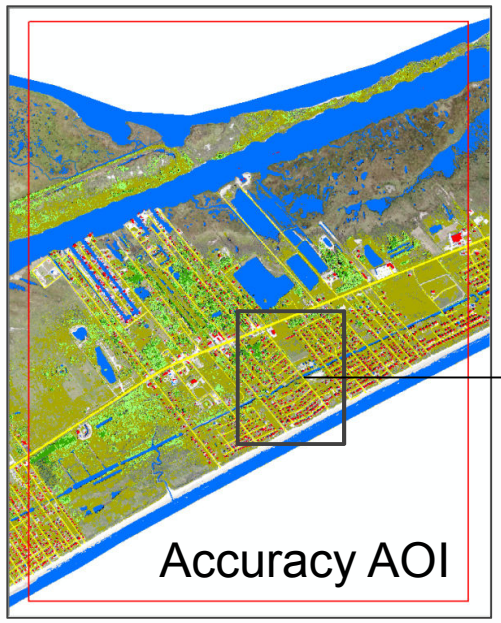


Buildings and Roads

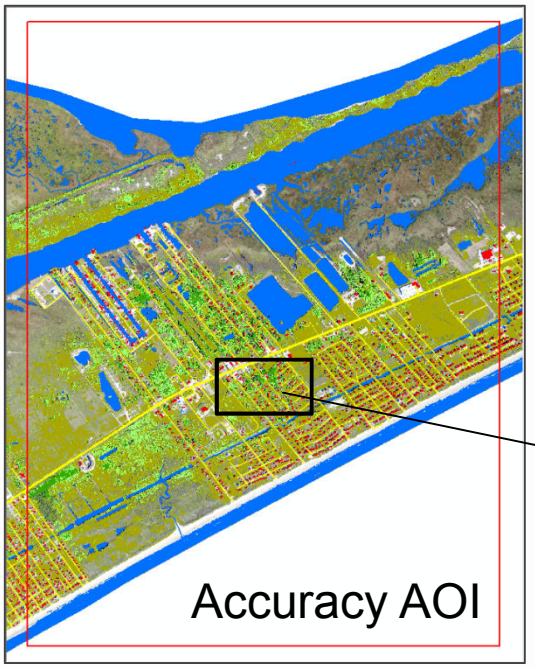
Provisional accuracies

Buildings: 96% correctly classified
5% commission errors

Roads: 96% correctly classified
2% commission errors



Vegetation



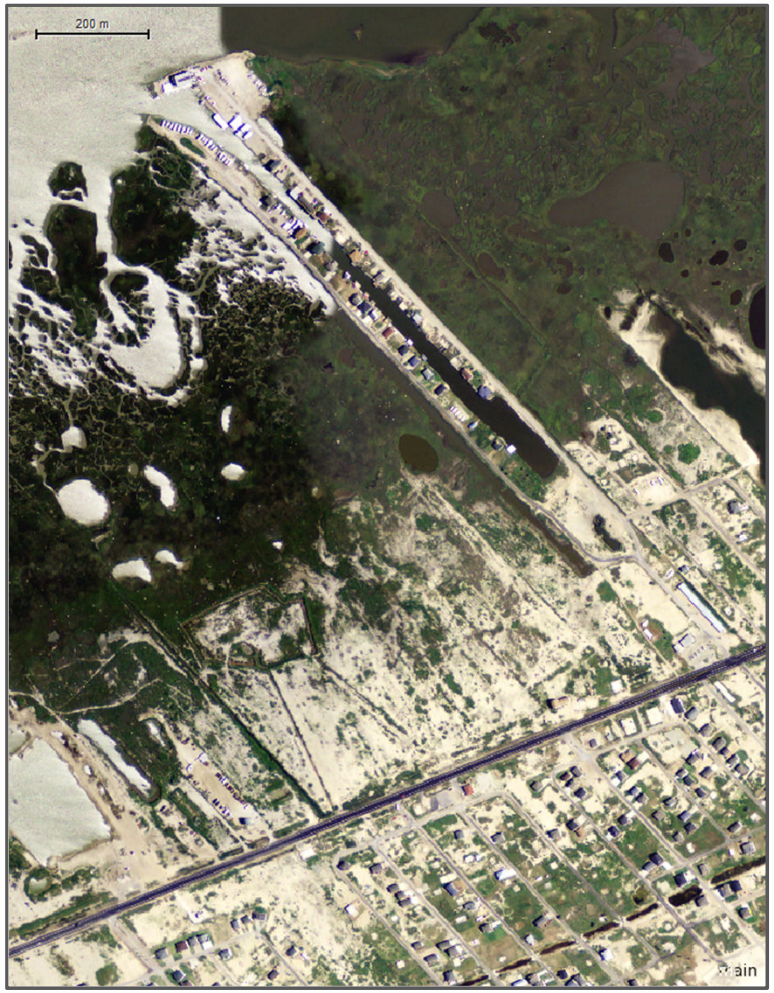
Imagery only

Imagery with OBIA vegetation class overlay

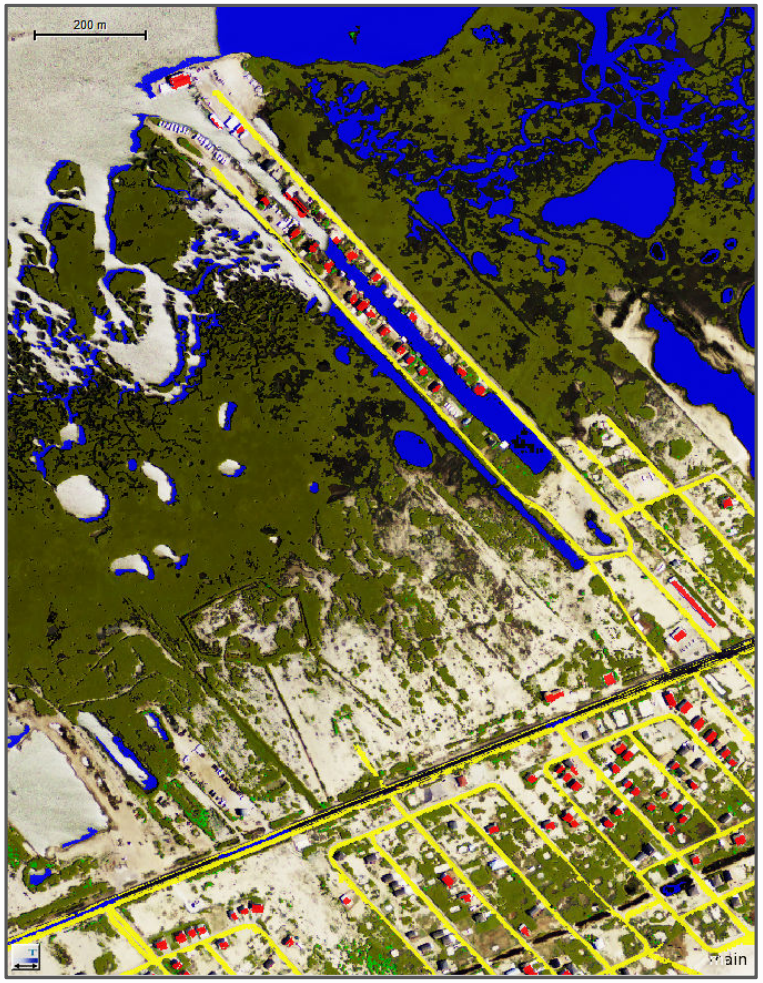
- Trees ≥ 16 ft.
- Shrubs
- Low veg. < 2 ft.

Q2: Could rule sets be reused in this study?

Same data/different areas: Yes Between time periods: No



2010 natural color imagery

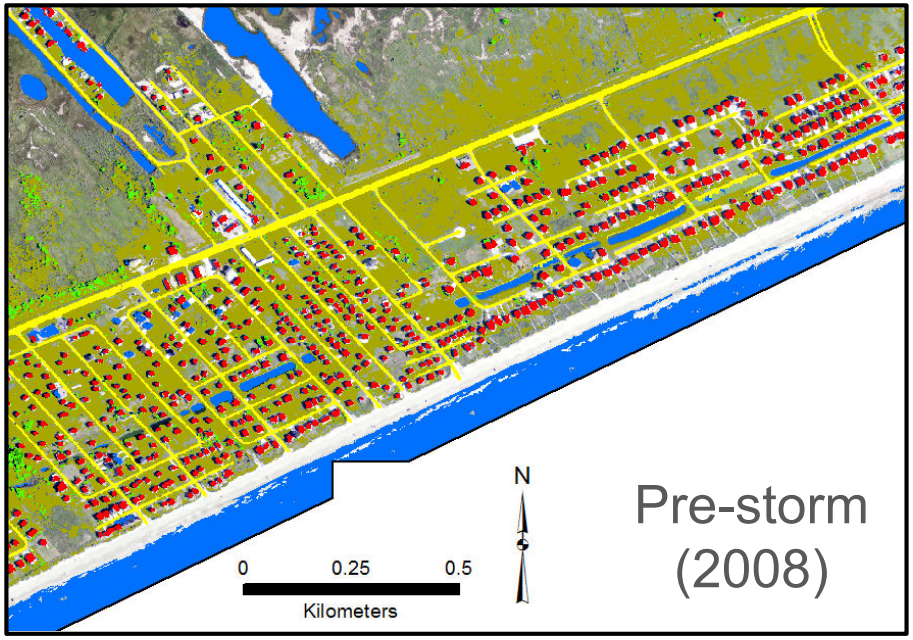


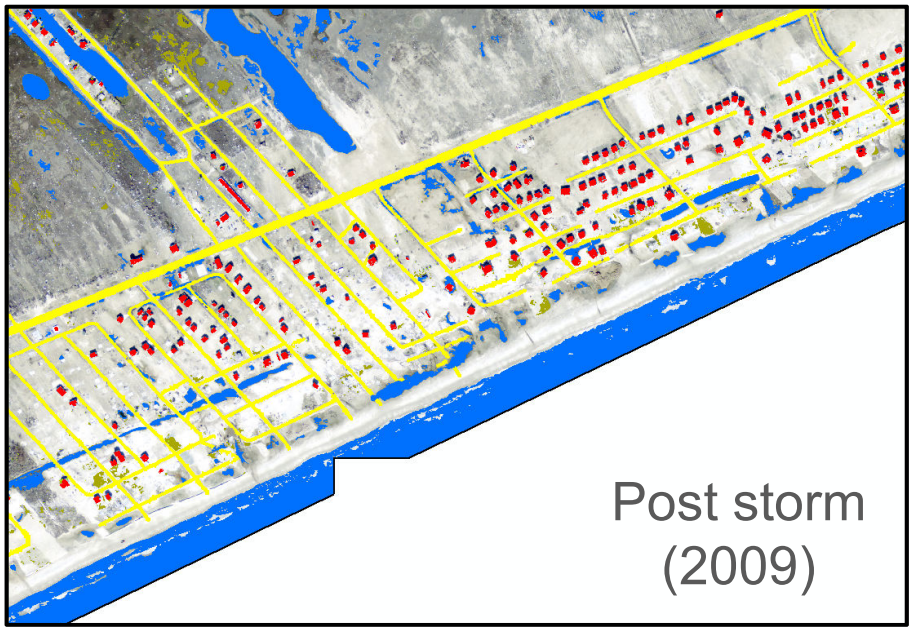
Classified using **2009** rule set

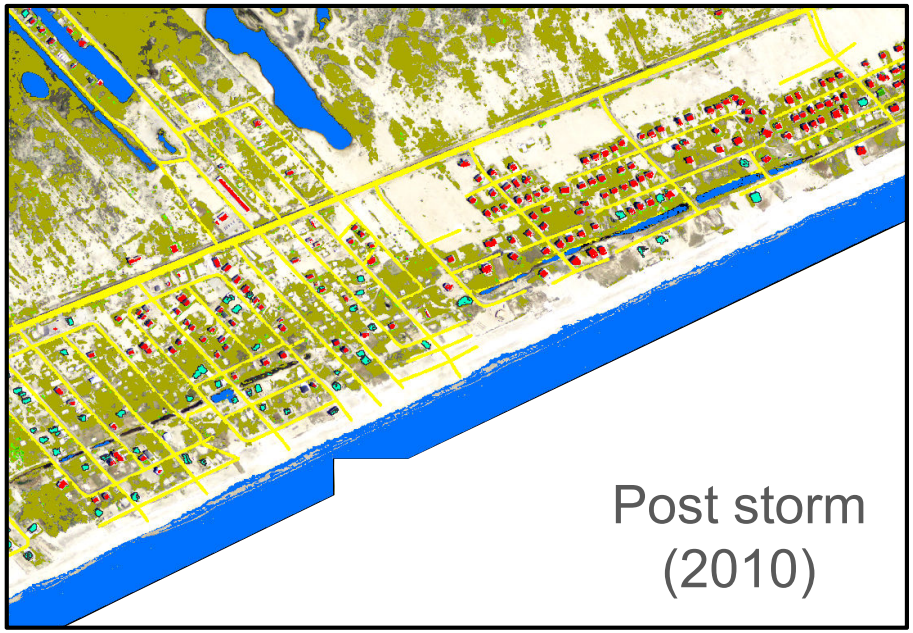
2010 data / 2009RS: Poor water, buildings. Roads fair. Vegetation good.

Q3: Can OBIA document change through time? Yes.

Vegetation change
Building change
Water change
Roads least affected

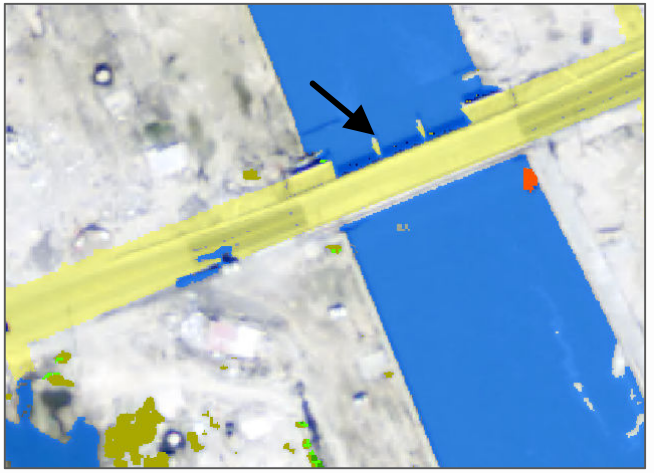






Conclusions

Partly collapsed bridge,
2009 post storm classification,
Bolivar Peninsula.



1. OBIA can accurately classify objects of interest

- Concurrent data sets are best; NIR & elevation important.
- Have specific goals in mind.
- Subdivide large AOIs for efficient processing.
- Distinct objects easiest to verify and communicate.

2. Rule set reuse? Yes (same time period/adjacent areas)
No (between time periods)

3. OBIA can document change through time.

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Thank you