Using Lidar to Determine Lake Erie Bluff Recession Rates

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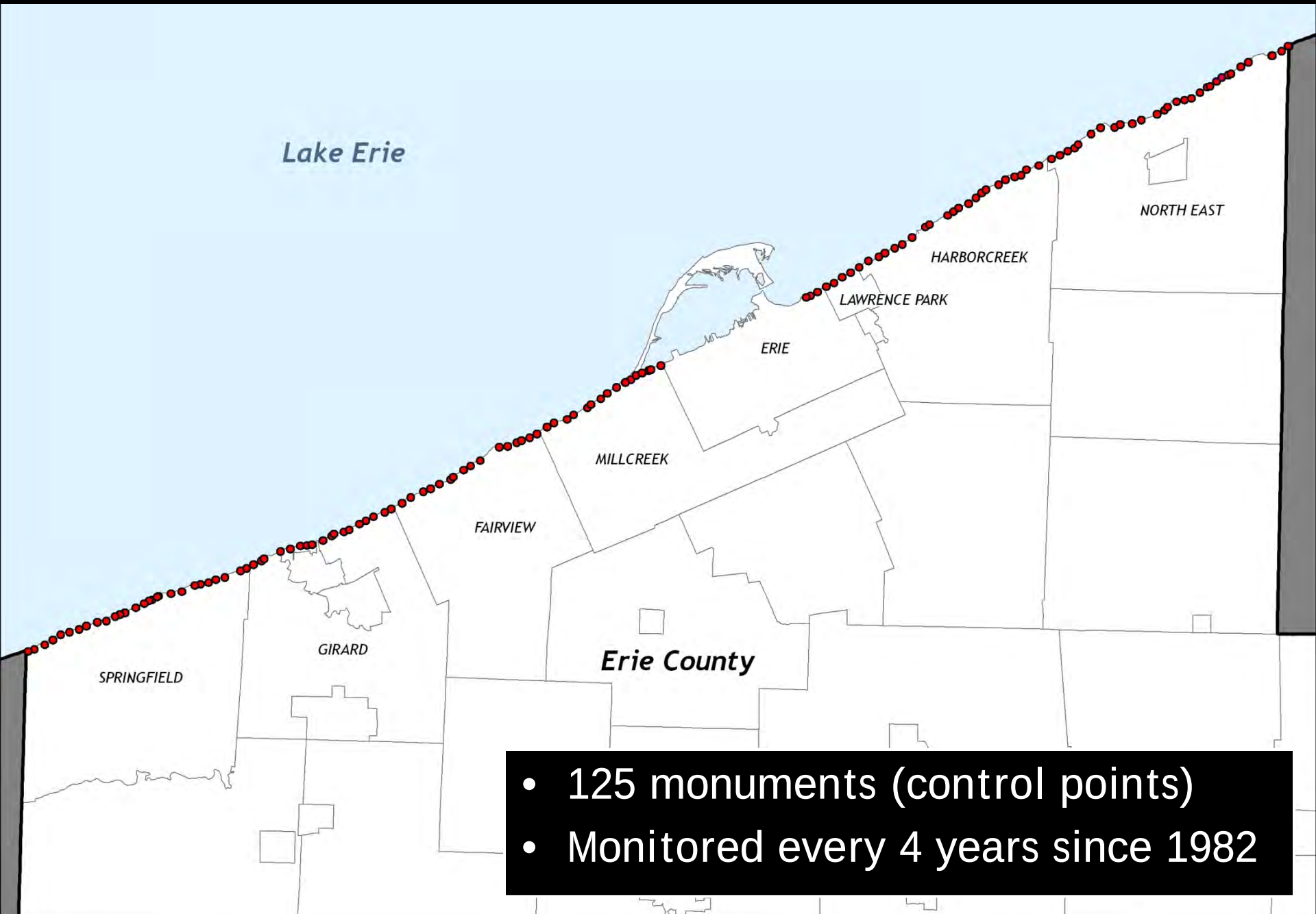
McCord Point North E

North East Twp 2007

Erie City 2008

Ohio Border Springfield Twp 2008

Existing Methods



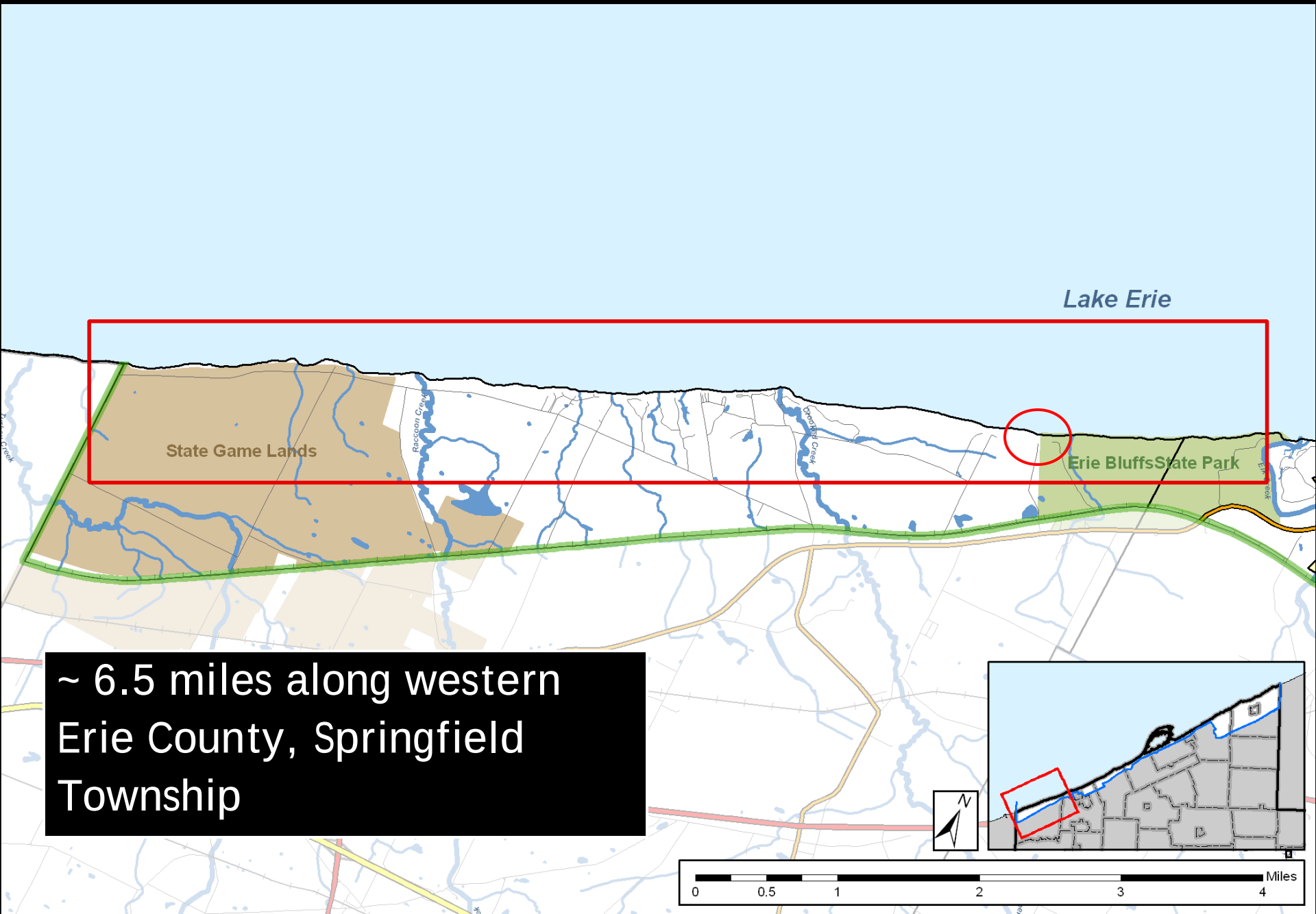
- 125 monuments (control points)
- Monitored every 4 years since 1982

Can we use Lidar to measure recession

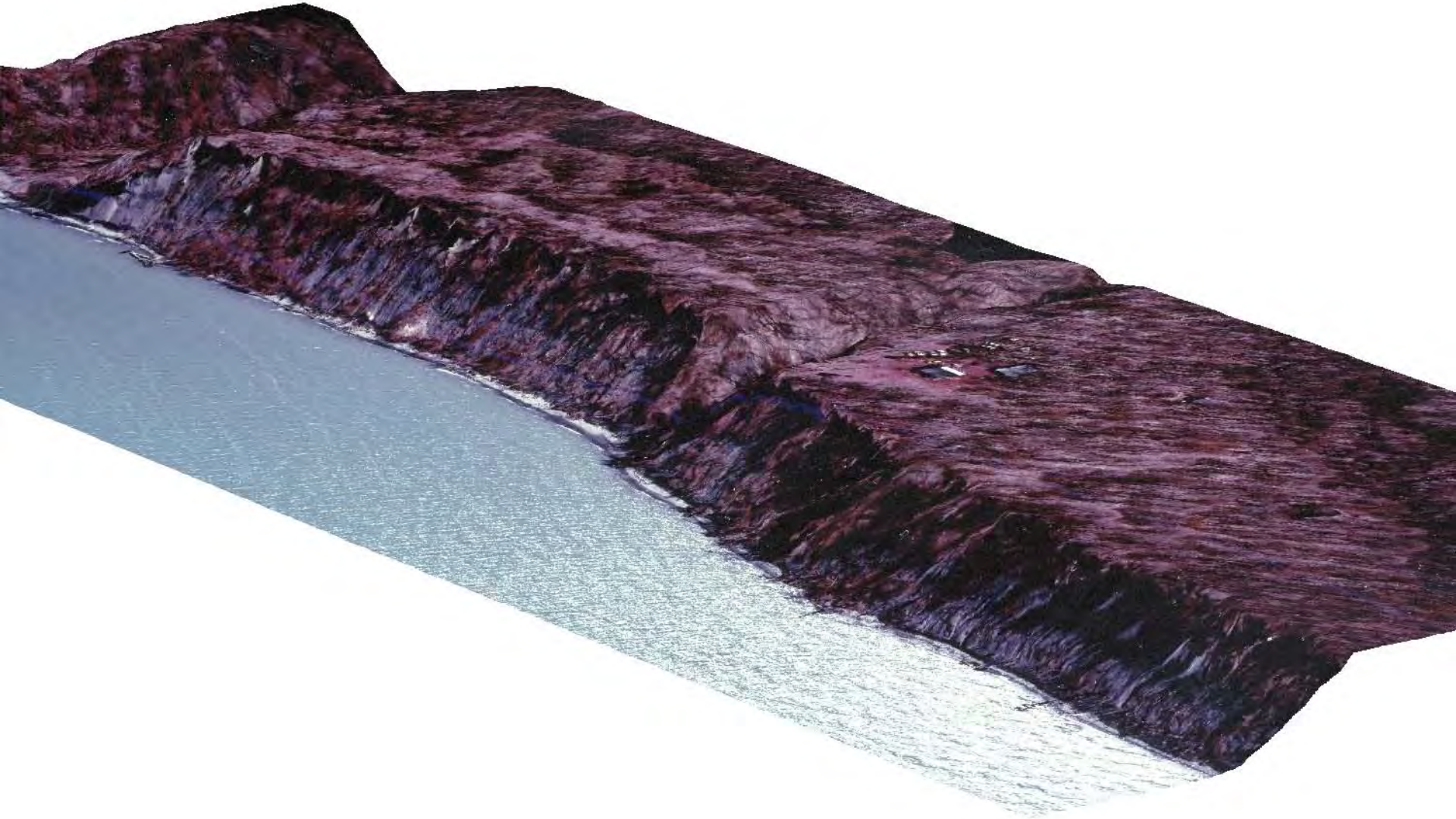
more accurately?

and cost effectively?

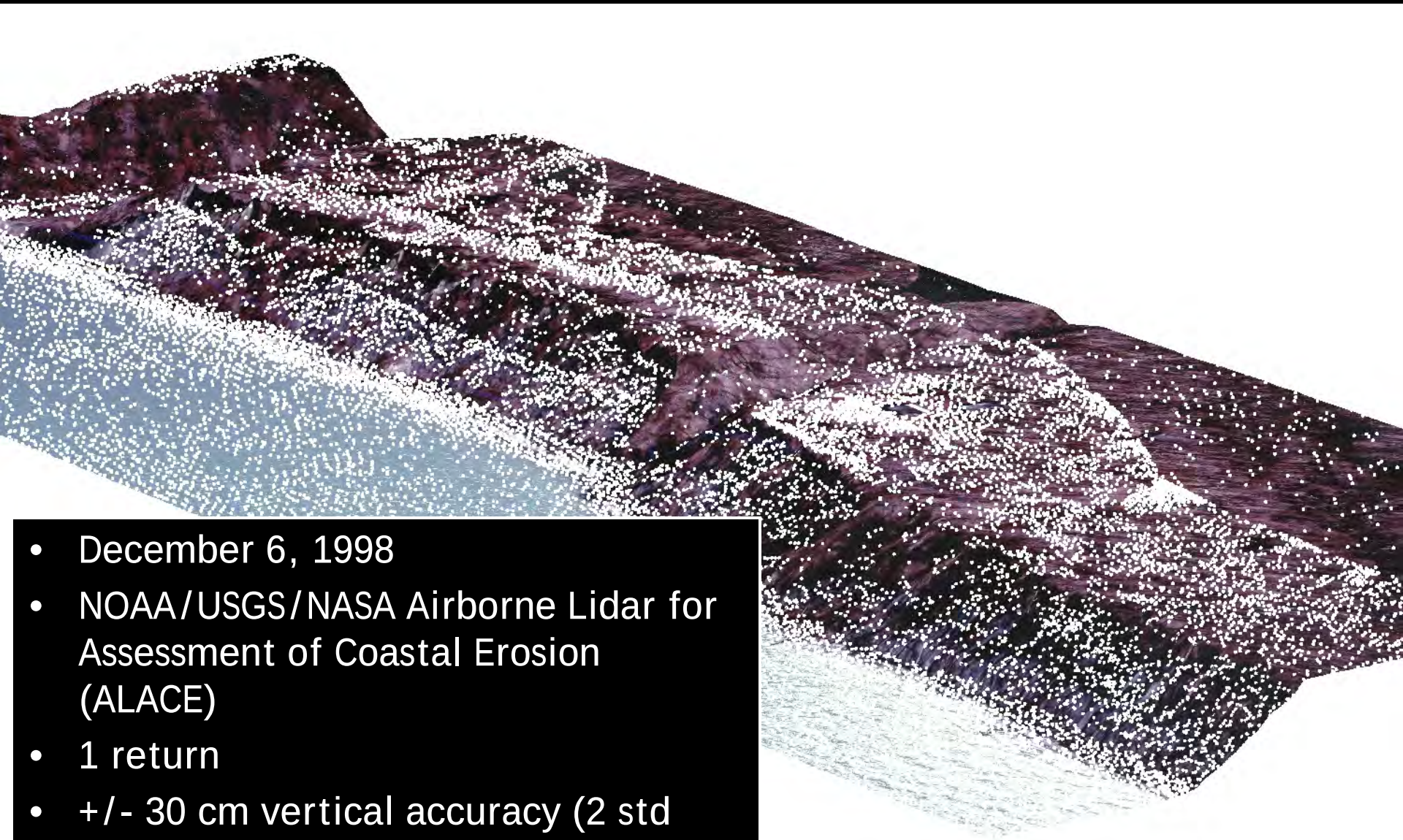
Lidar Pilot Study Area



1998 Color Infrared Image

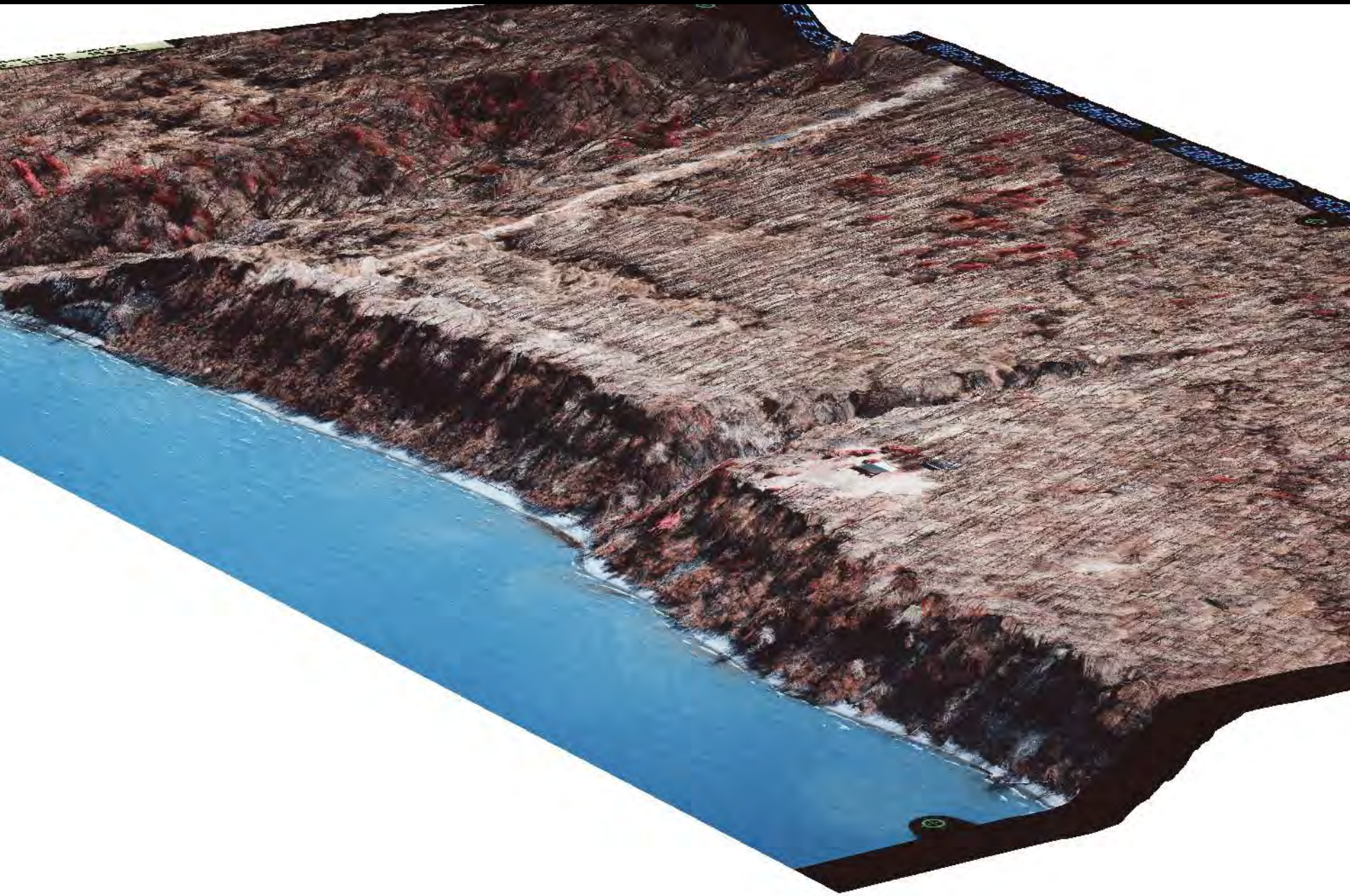


1998 Lidar

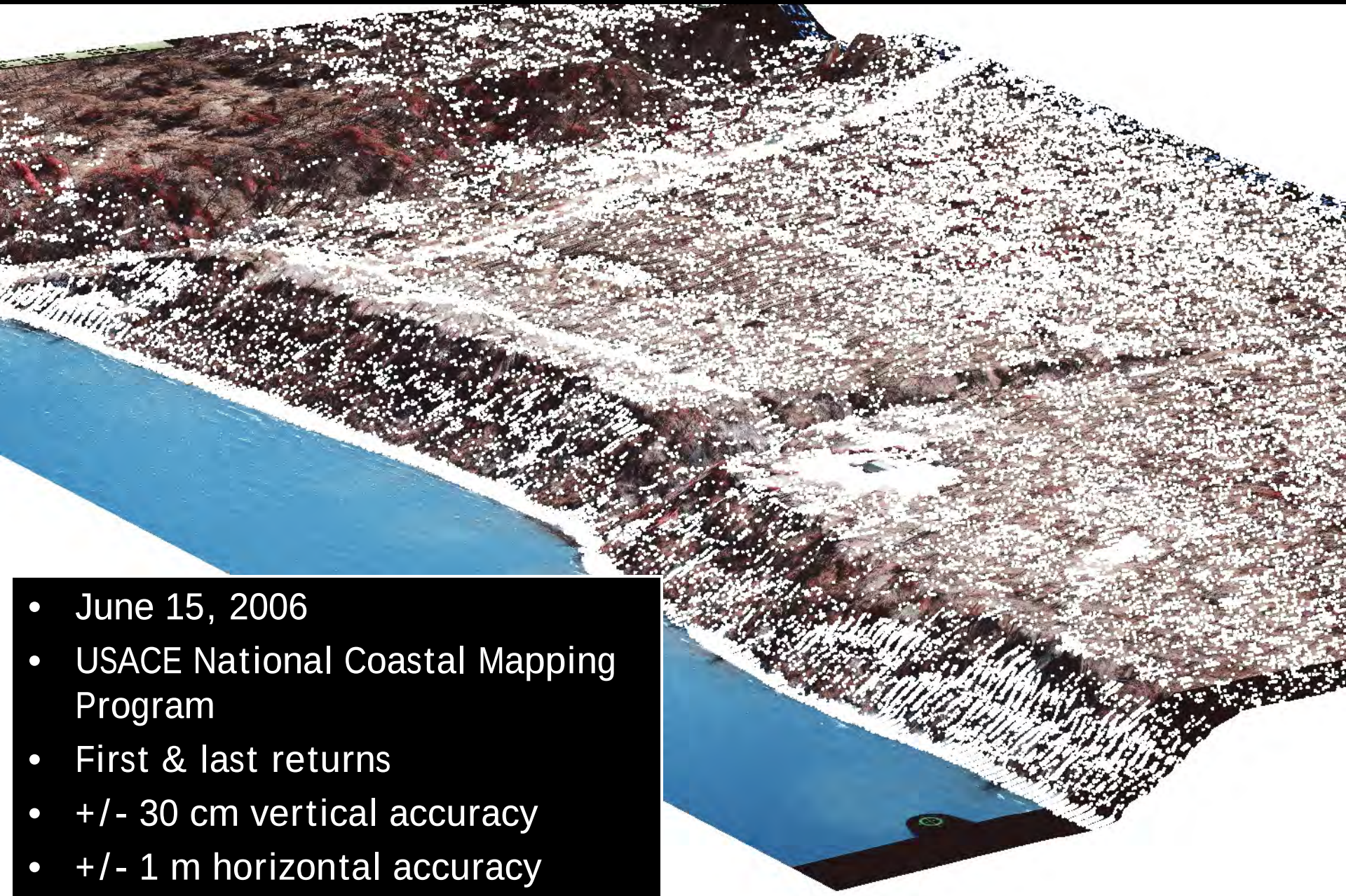


- December 6, 1998
- NOAA/USGS/NASA Airborne Lidar for Assessment of Coastal Erosion (ALACE)
- 1 return
- +/- 30 cm vertical accuracy (2 std dev)
- +/- 0.8 m horizontal accuracy

2006 CIR



2006 Lidar



- June 15, 2006
- USACE National Coastal Mapping Program
- First & last returns
- +/- 30 cm vertical accuracy
- +/- 1 m horizontal accuracy

Methods

Estimate recession between 1998 & 2006 using Lidar

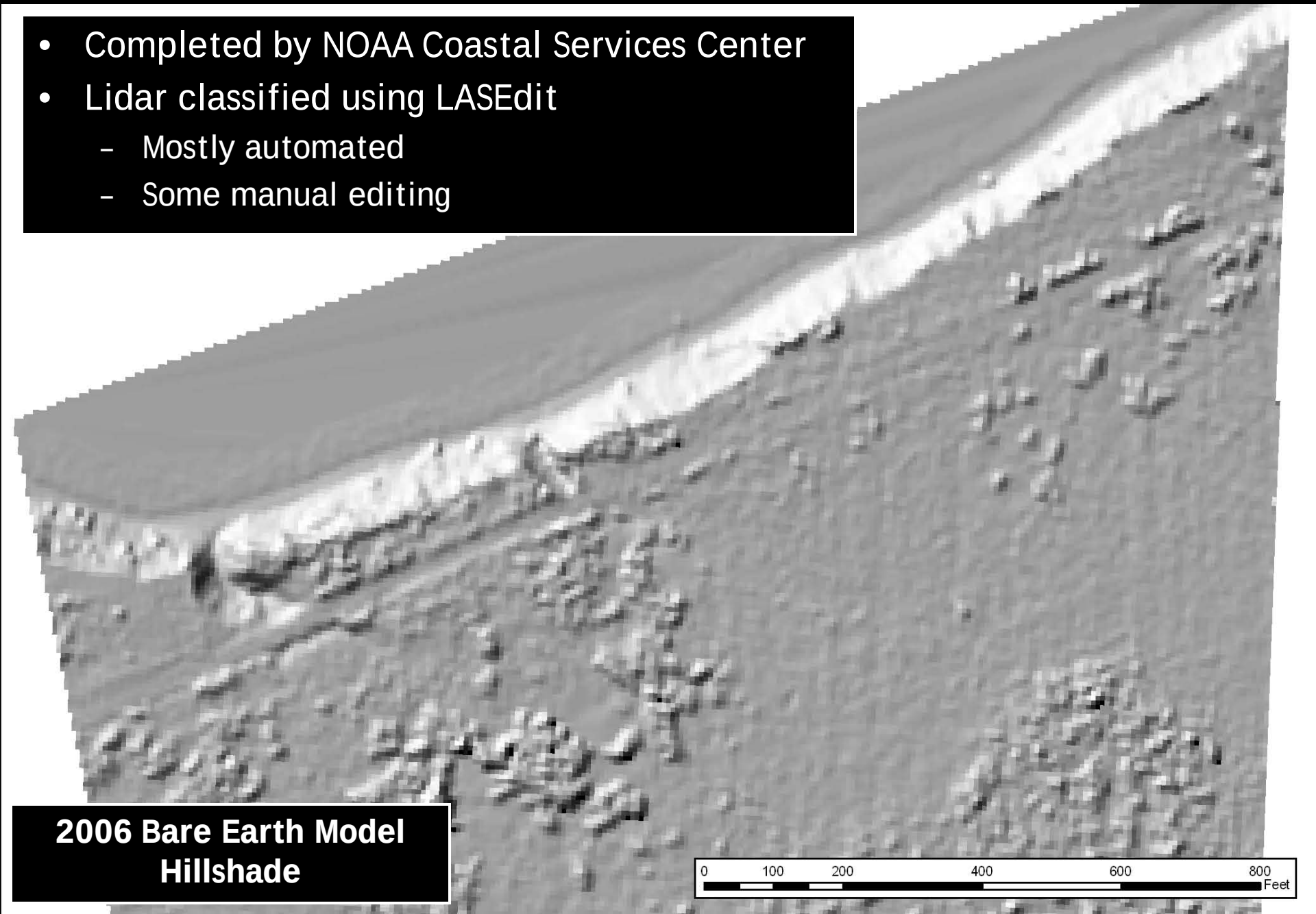
1. Classify bare earth
2. Delineate bluff edge
3. Calculate recession rates

Bare Earth Filtering

2006 Unfiltered Hillshade

Bare Earth Filtering

- Completed by NOAA Coastal Services Center
- Lidar classified using LASEdit
  - Mostly automated
  - Some manual editing

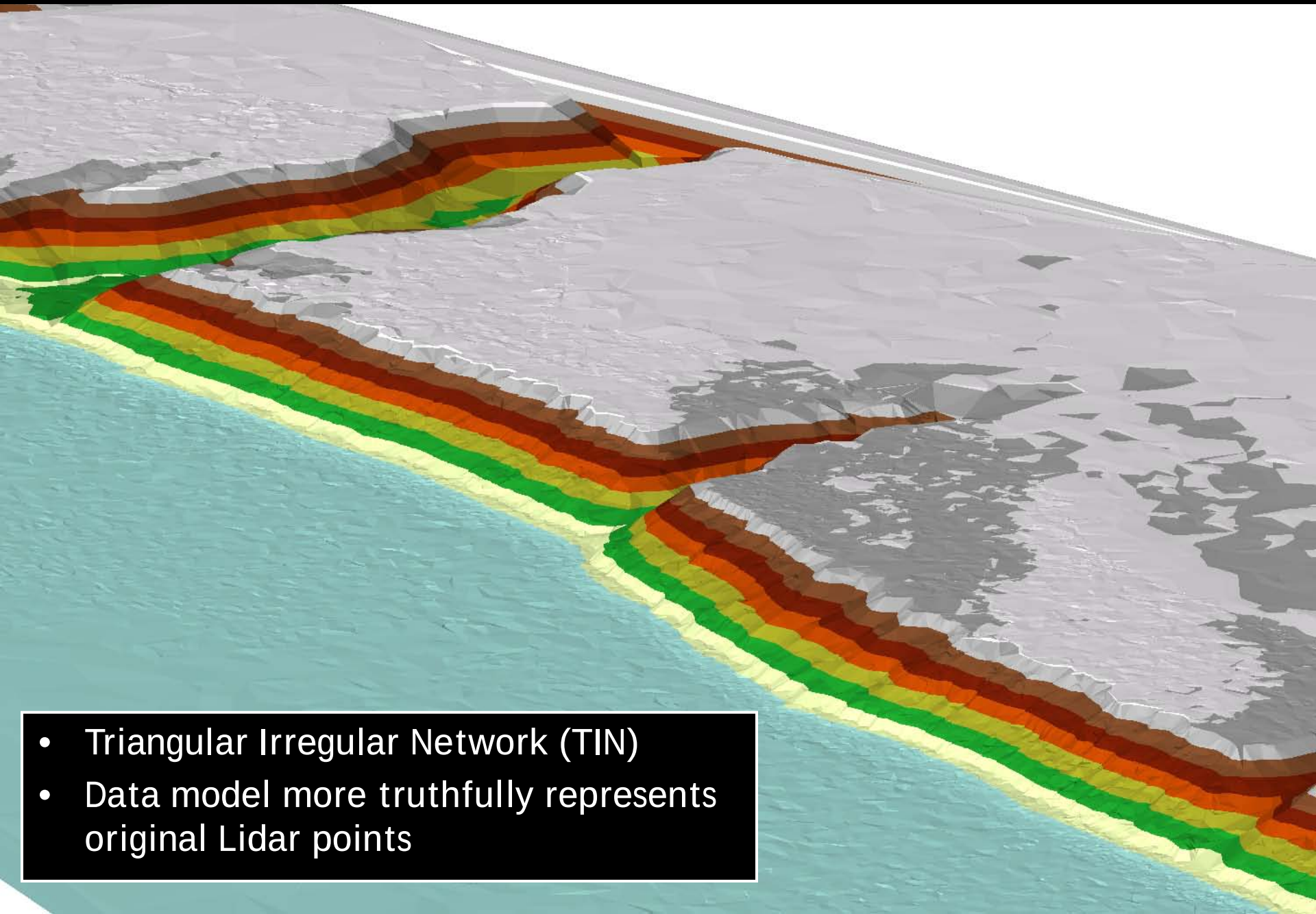


2006 Bare Earth Model Hillshade

Methods

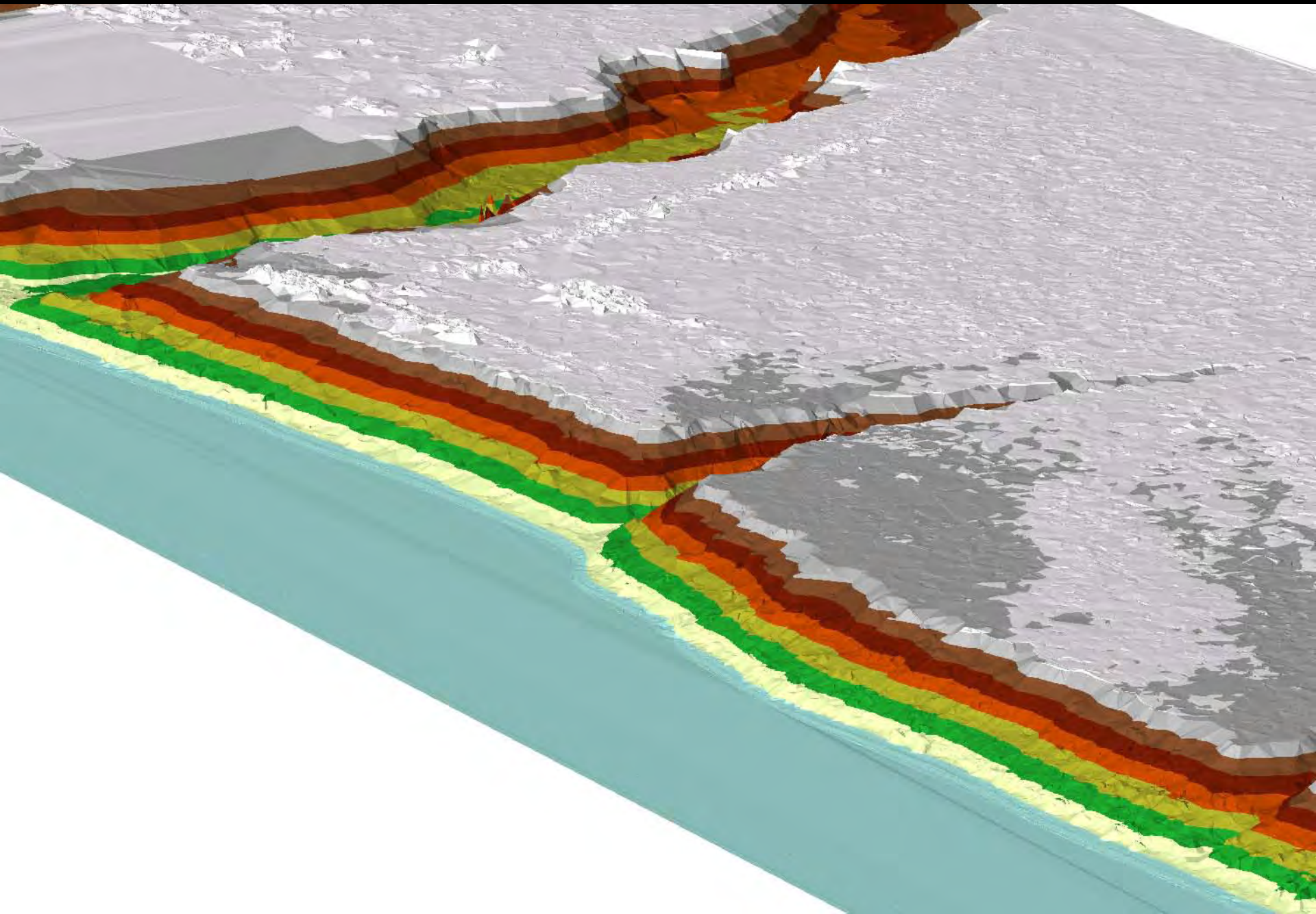
1. Classify bare earth
2. Delineate bluff edge
3. Calculate recession rates

1998 Elevation TIN

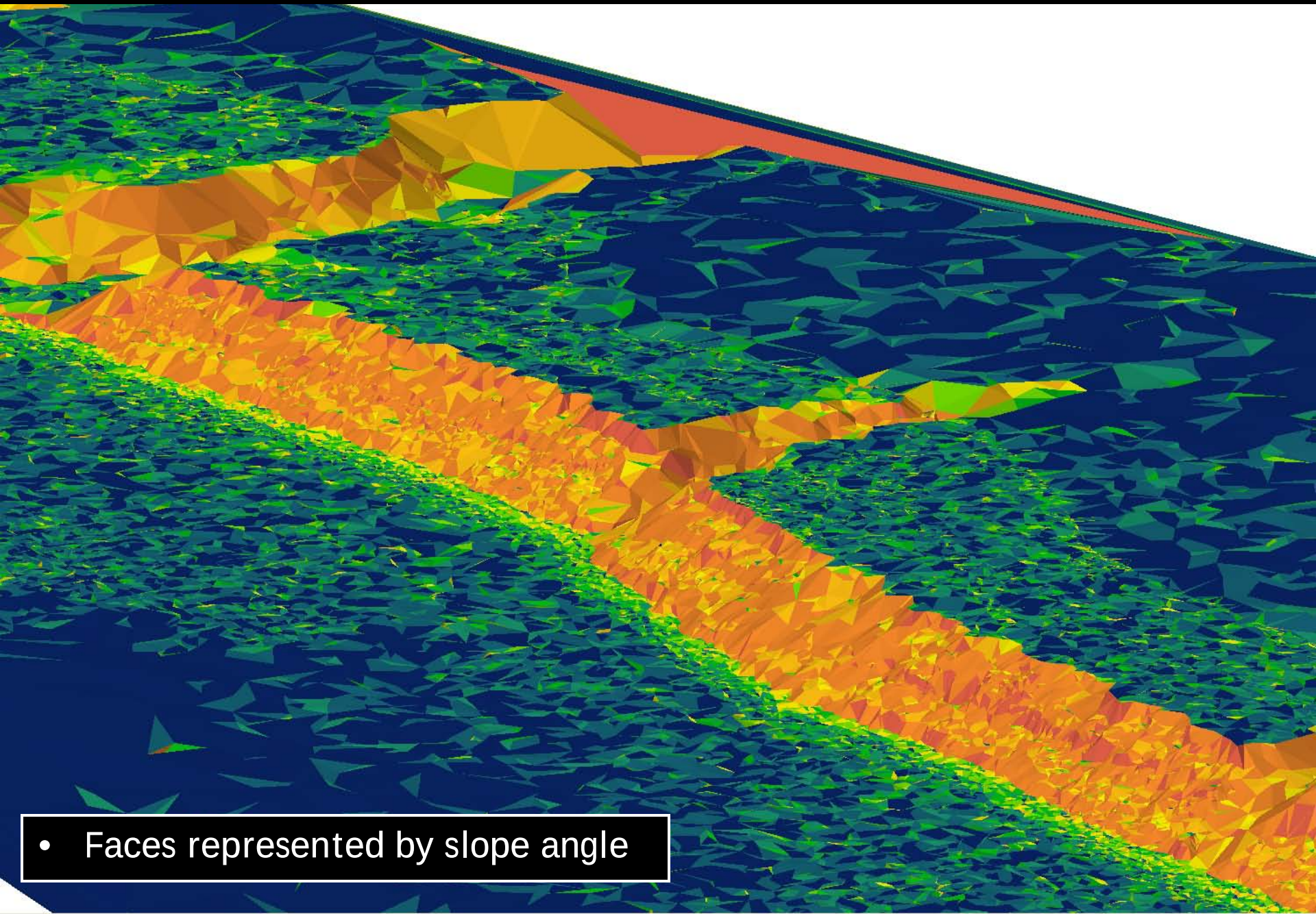


- Triangular Irregular Network (TIN)
- Data model more truthfully represents original Lidar points

2006 Elevation TIN

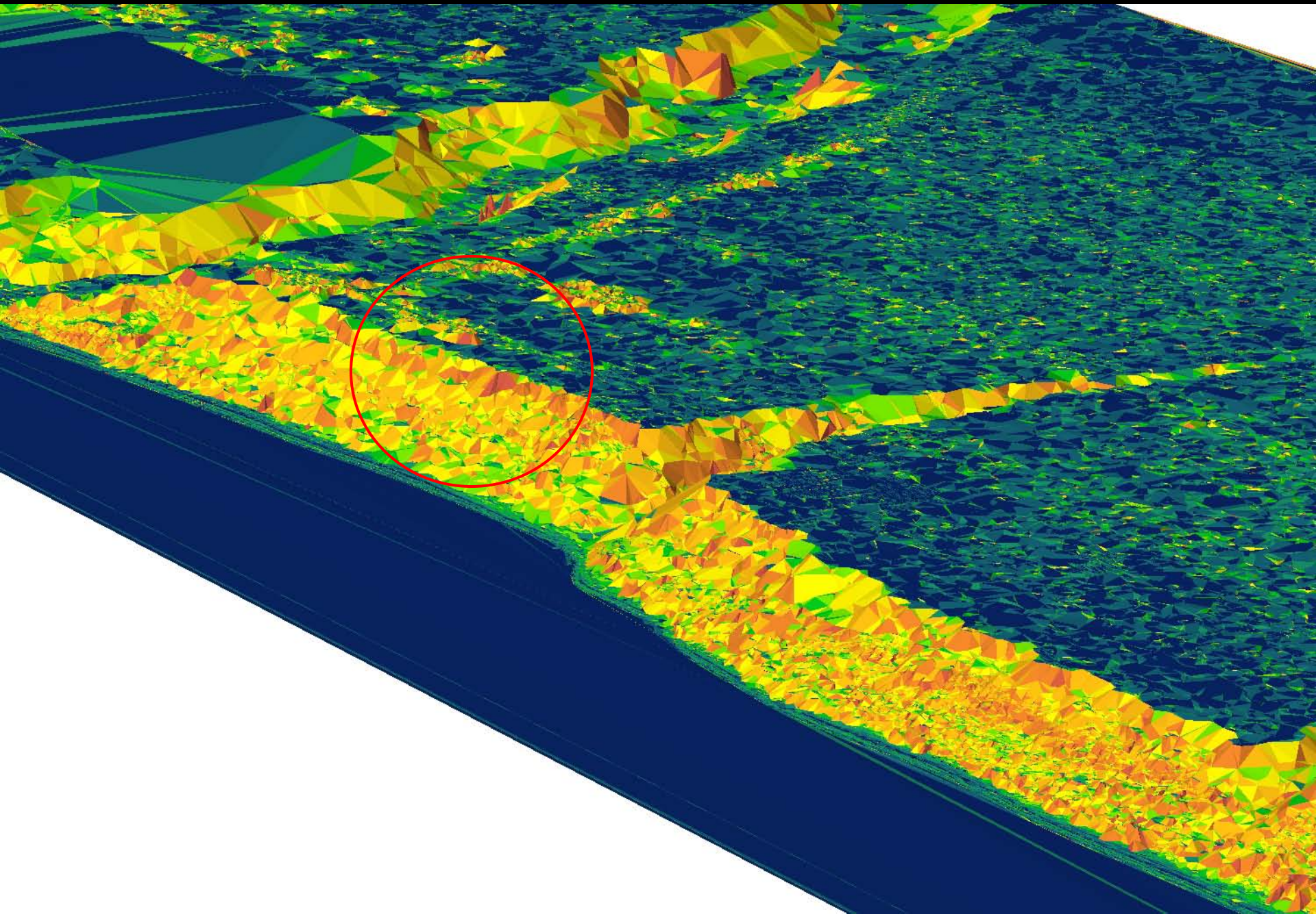


1998 Slope TIN

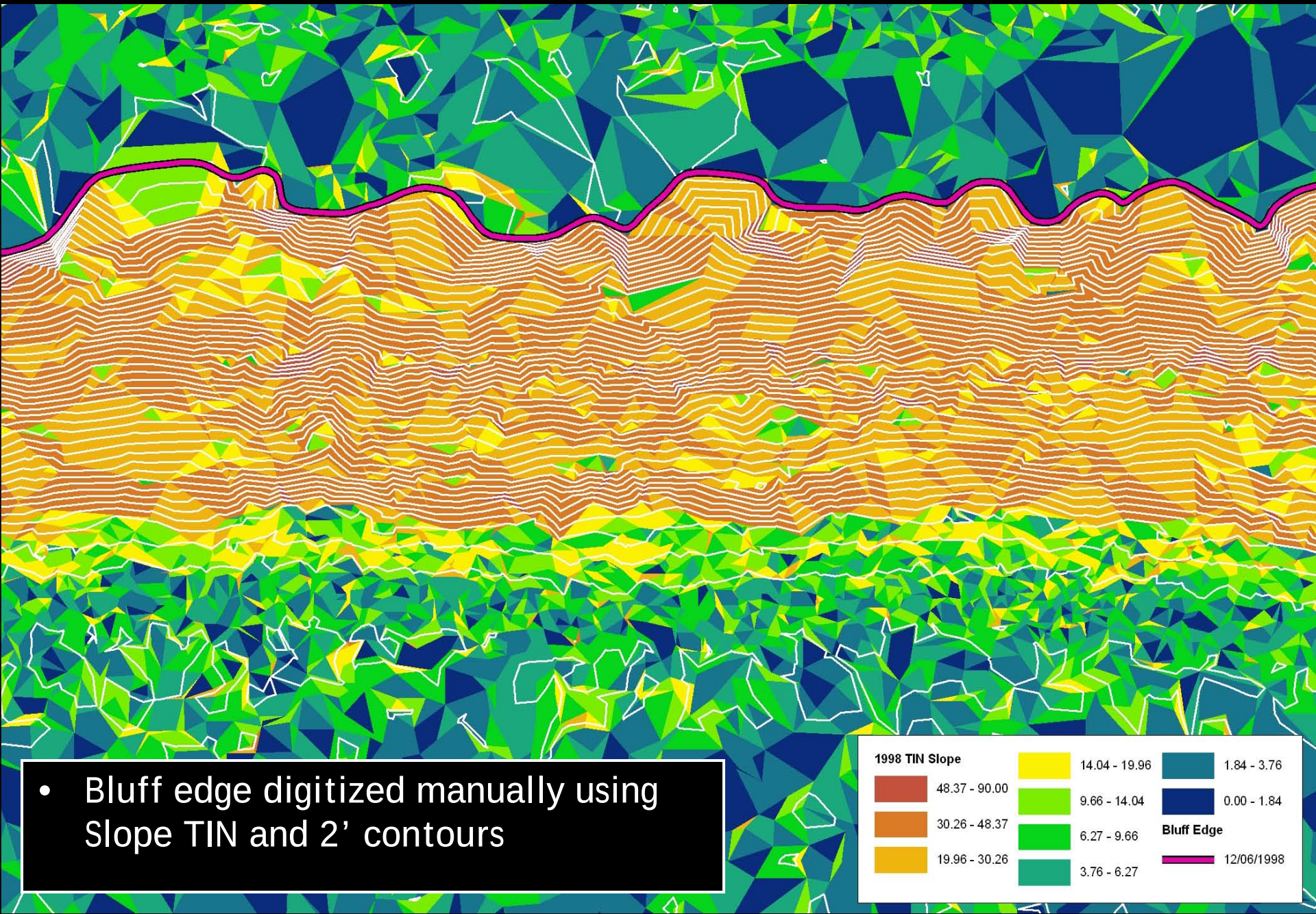


- Faces represented by slope angle

2006 Slope TIN

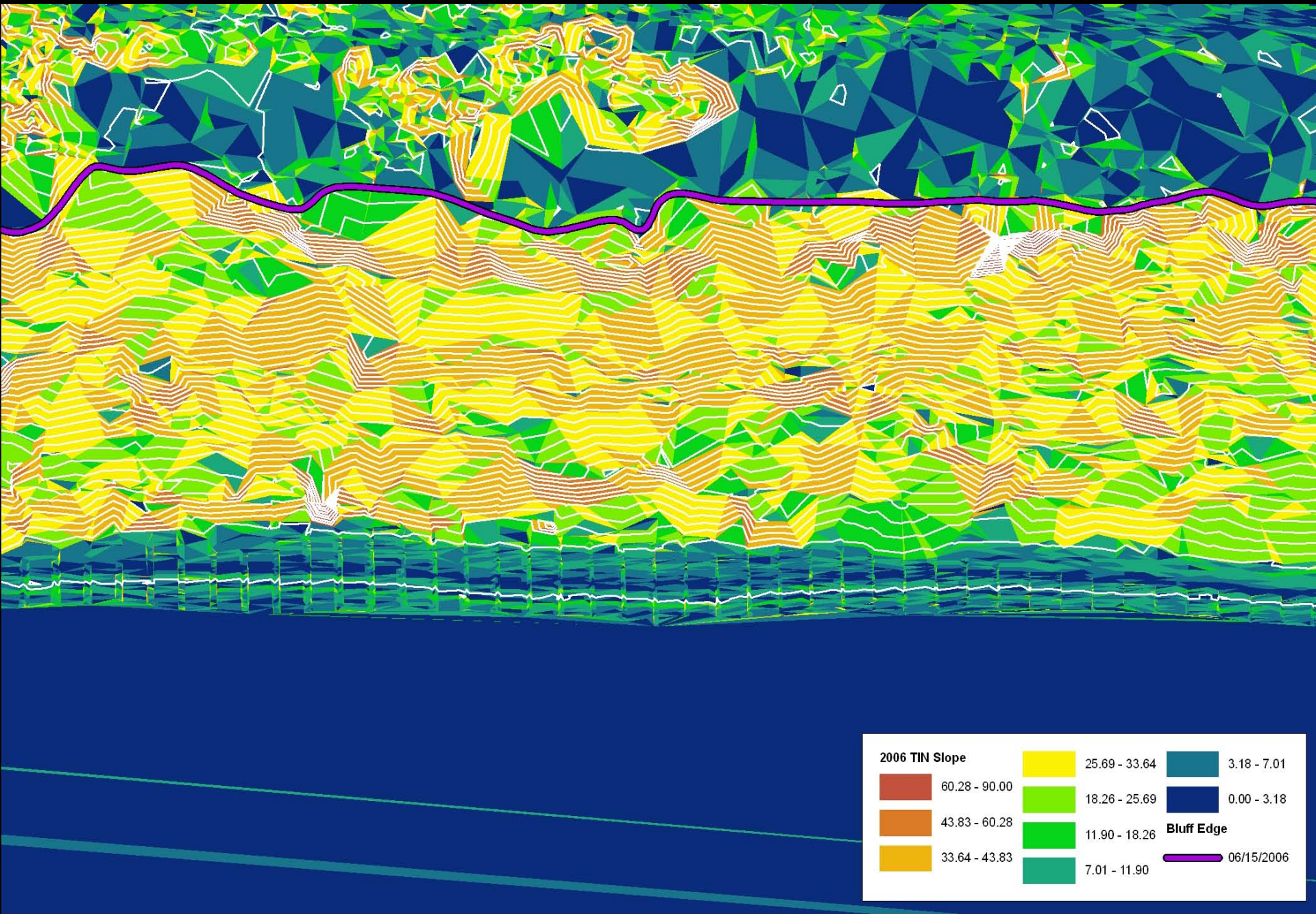


1998 Bluff Line



- Bluff edge digitized manually using Slope TIN and 2’ contours

2006 Bluff Line



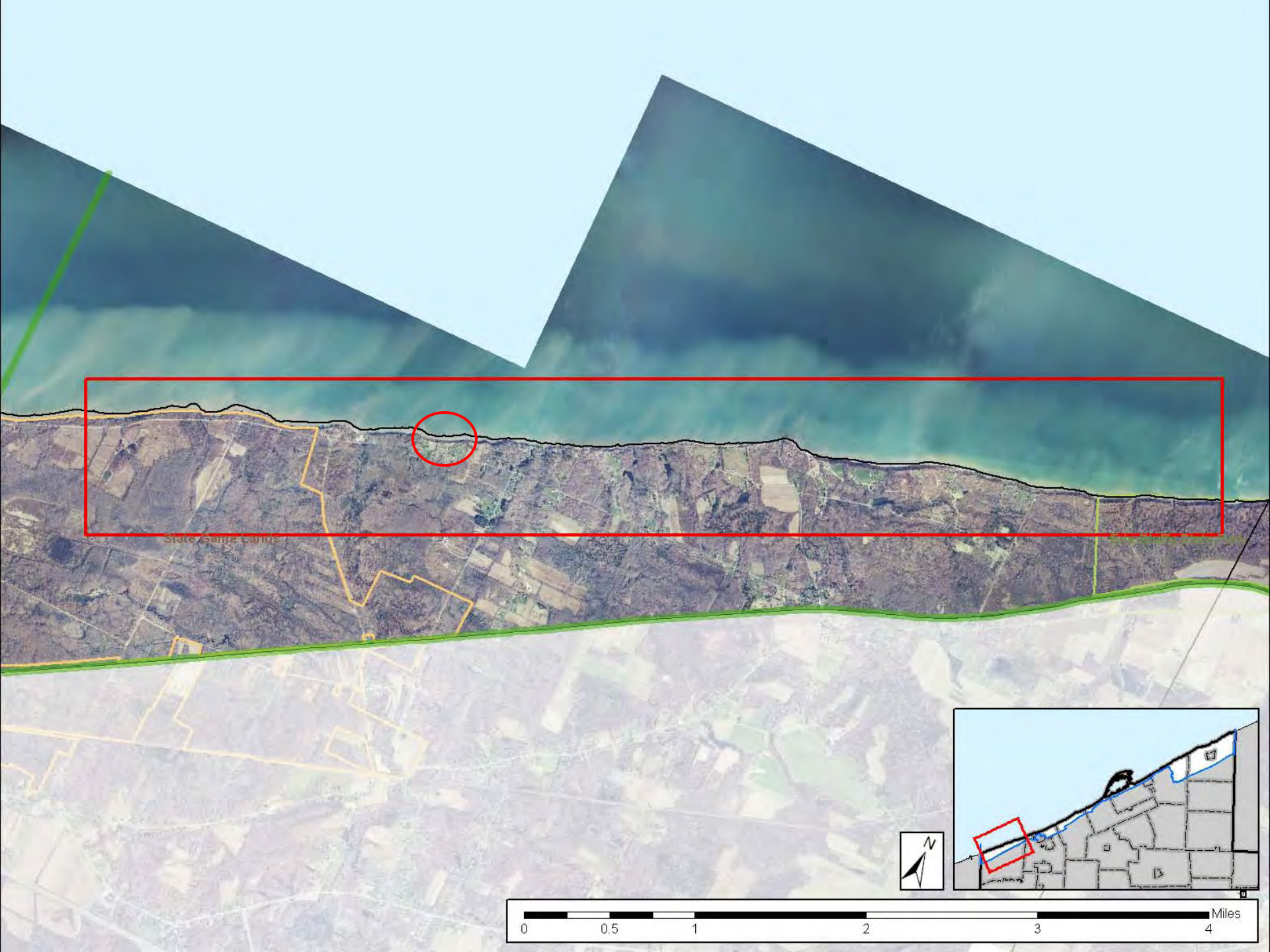
Methods

1. Classify bare earth
2. Delineate bluff edge
3. Calculate recession rates

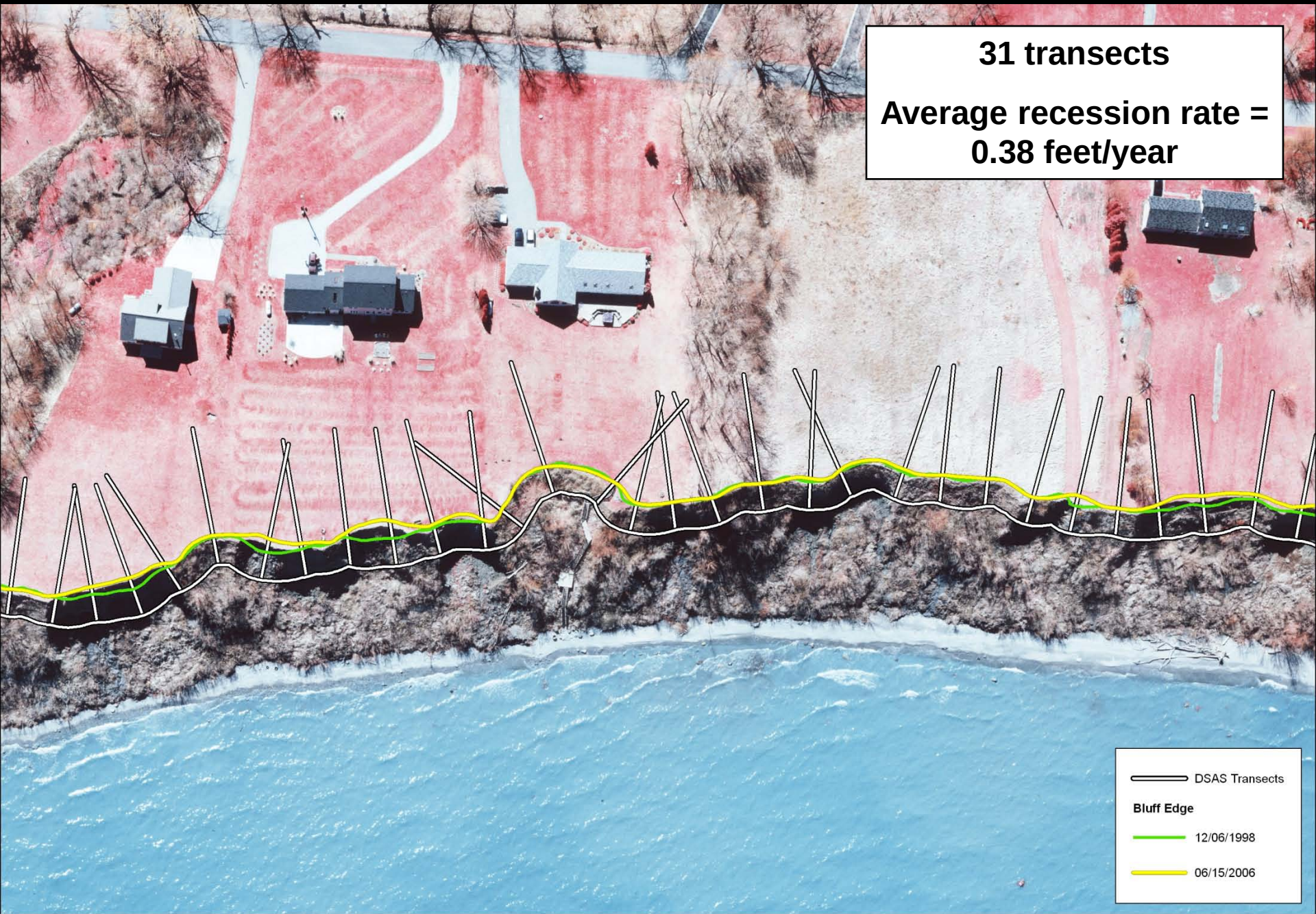
- Digital Shoreline Analysis System extension for ArcGIS
  - Calculates rate of change statistics from a time series

Thieler, E.R., Himmelstoss, E.A., Zichichi, J.L., and Miller, T.L., 2005, Digital Shoreline Analysis System (DSAS) version 3.0: An ArcGIS extension for calculating shoreline change: U.S. Geological Survey Open-File Report 2005-1304.

http://woodshole.er.usgs.gov/project-pages/dsas/


N
Miles
0
0.5
1
2
3
4

10 Meter Transects



4.5
Control Points (Field Data)
1998-99
Control Points
Intersections
Bluff Edge
12/06/1998
06/15/2006

Methods

1. Classify bare earth
2. Delineate bluff edge
3. Calculate recession rates
4. Compare Lidar results with field data

Resulting Values

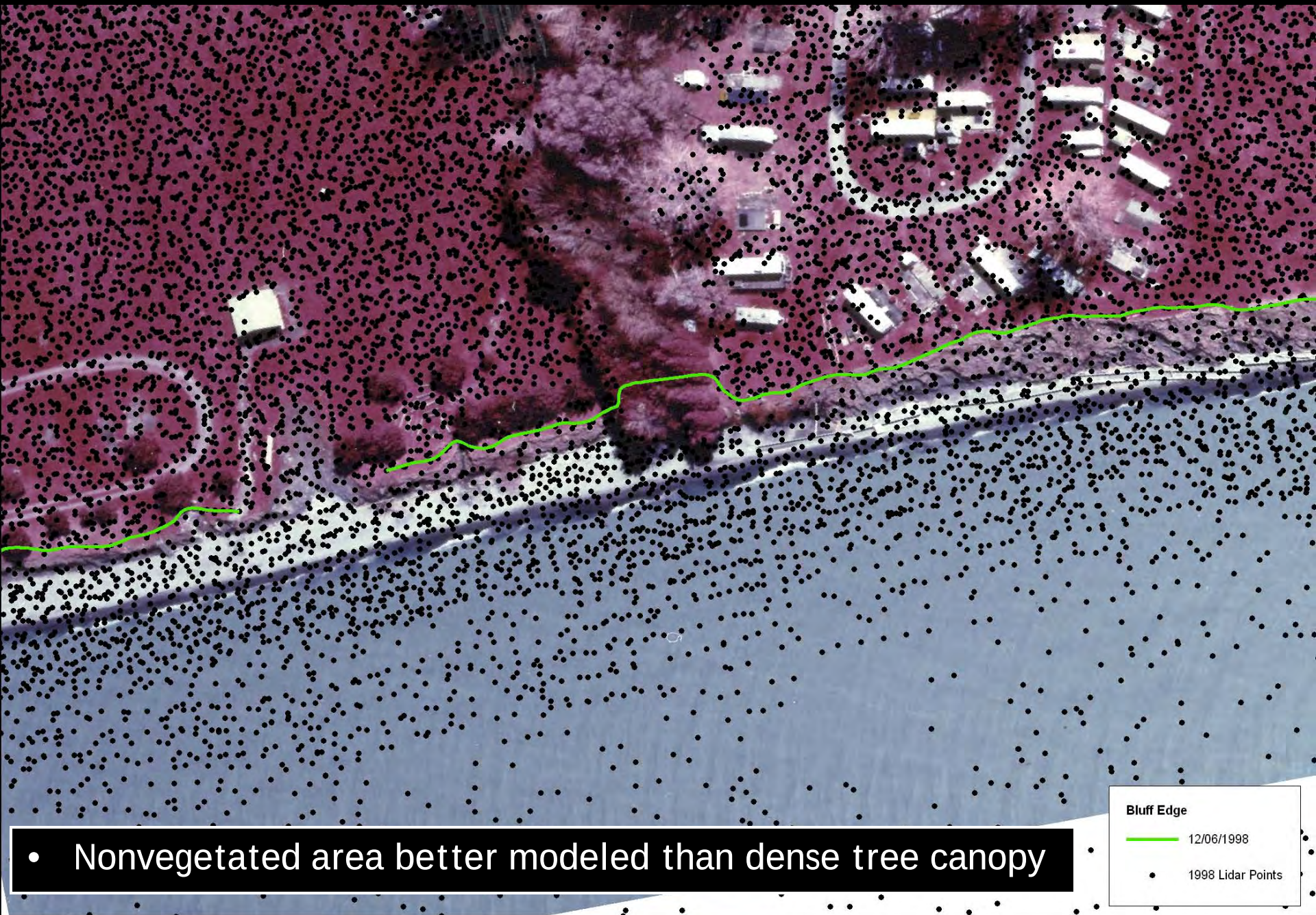
		Control Points	Lidar (all)	Lidar (gains excluded)*	Lidar (gains set to 0)**
# Measurements		22	930	518	930
Distance (ft)	**Min**	0	43.44 (gain)	0	0
	Max	18.30	45.54	45.54	45.54
	Average	**4.46**	**1.40**	**7.10**	**3.95**
Rate (ft/year)	**Min**	0	5.77 (gain)	0	0
	Max	2.29	6.04	6.04	6.04
	Average	**0.64**	**0.19**	**0.94**	**0.53**

"Gains" are assumed to be errors (2006 bluff line lakeward of 1998 bluff line)
* Gains are removed from analysis
** Gains are assumed to mean no change in bluff crest and are set to zero

Problems

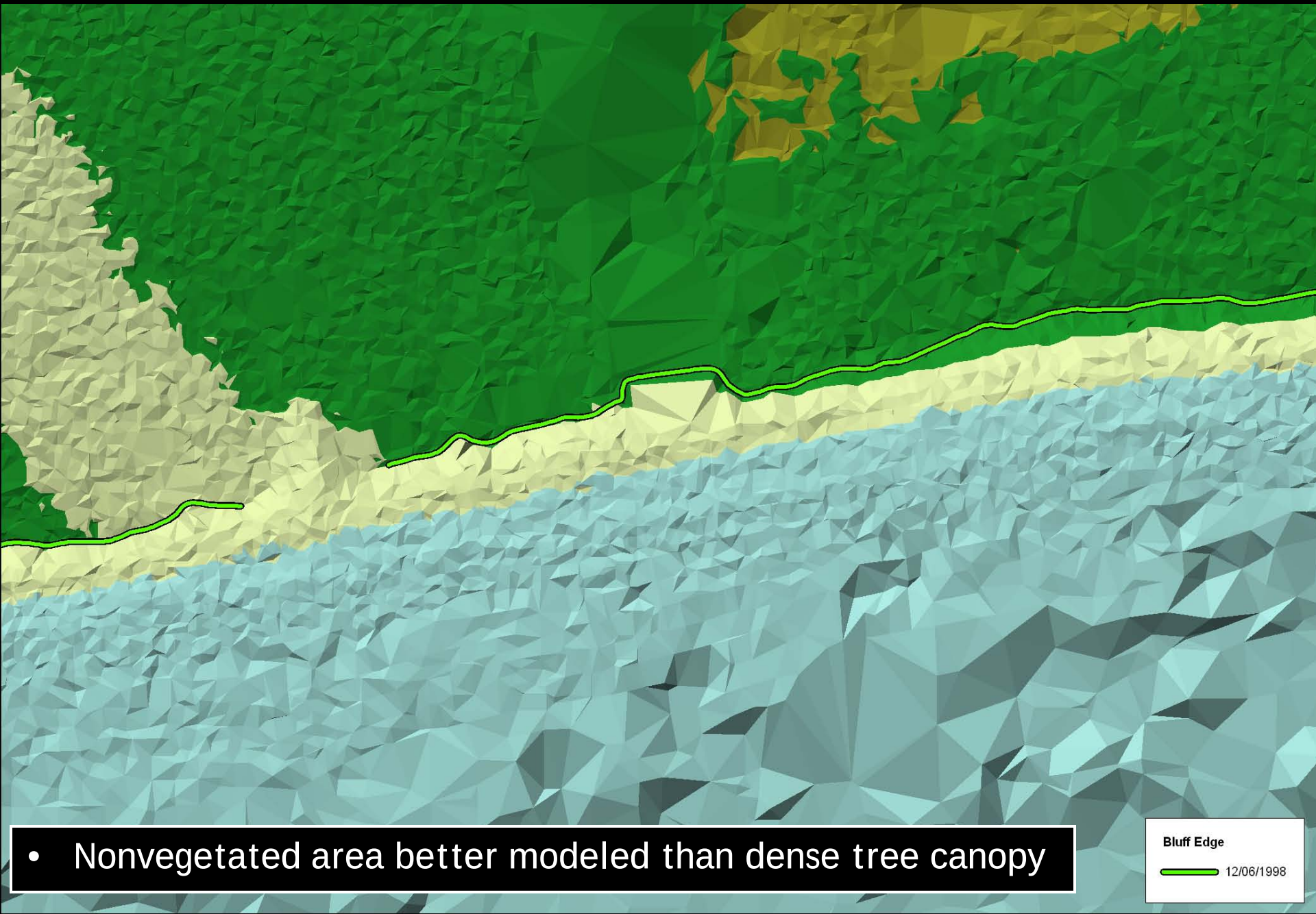
- Bluff line accuracy dependent on density of Lidar points

More Problems



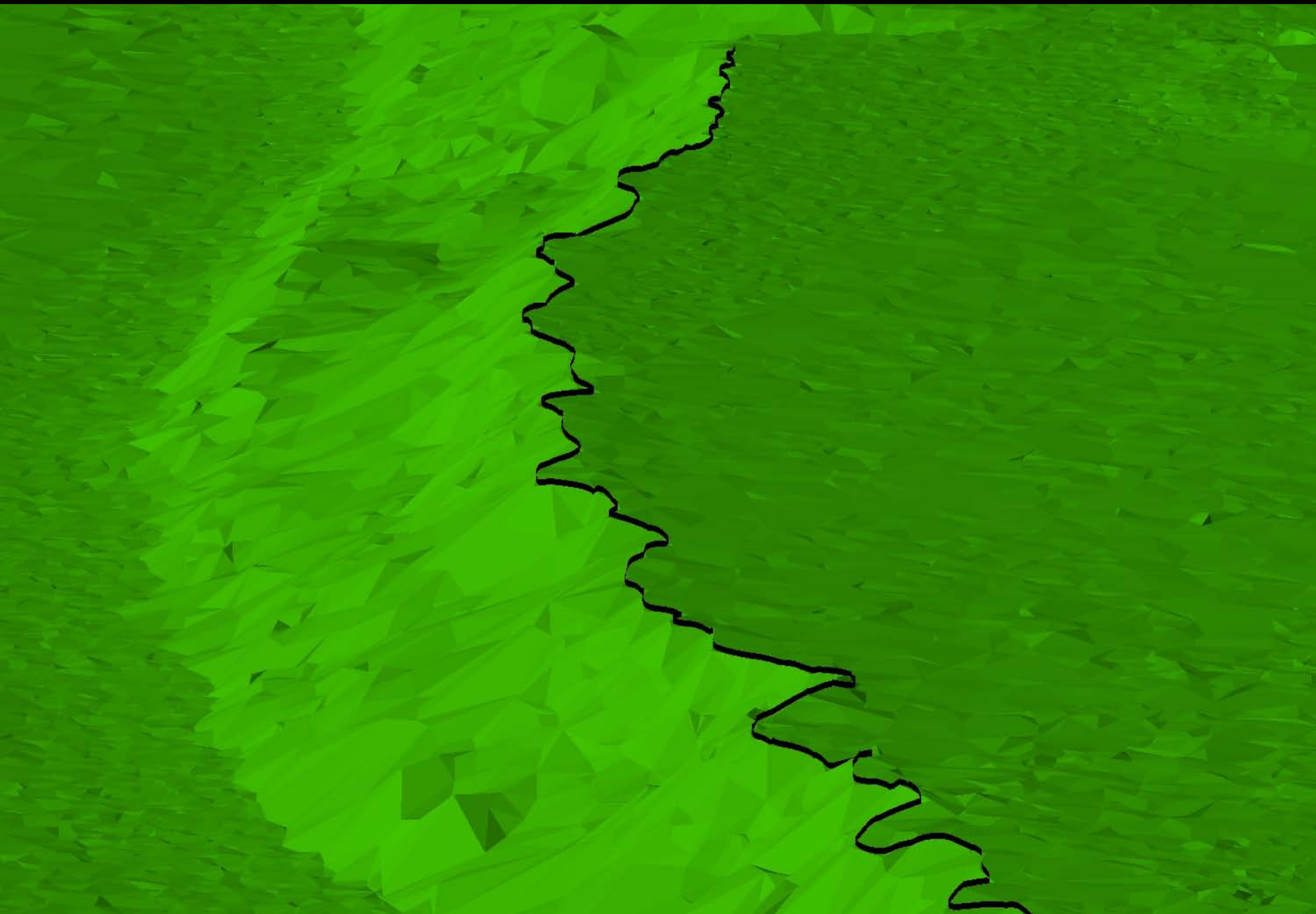
- Nonvegetated area better modeled than dense tree canopy

More Problems

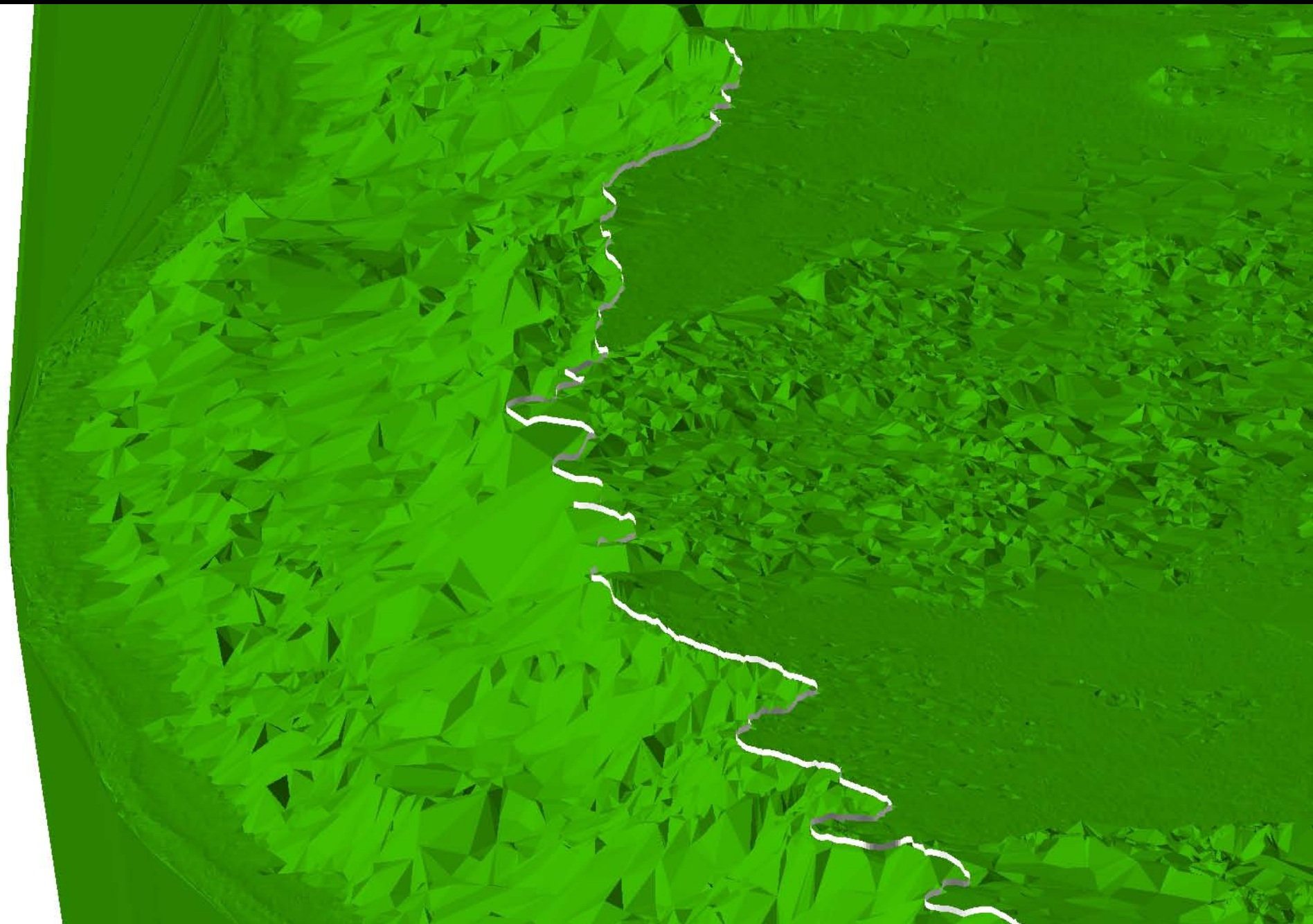


- Nonvegetated area better modeled than dense tree canopy

Some areas very successful



Step Recession



Bluff Edge

12/06/1998

06/15/2006

Next Steps

- Examine remaining 50+ miles of coastline using re-classified data
- New PAMAP Lidar from 2007
- Inclusion of Aerial imagery

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