

Bluff Erosion in the LeSueur River Basin

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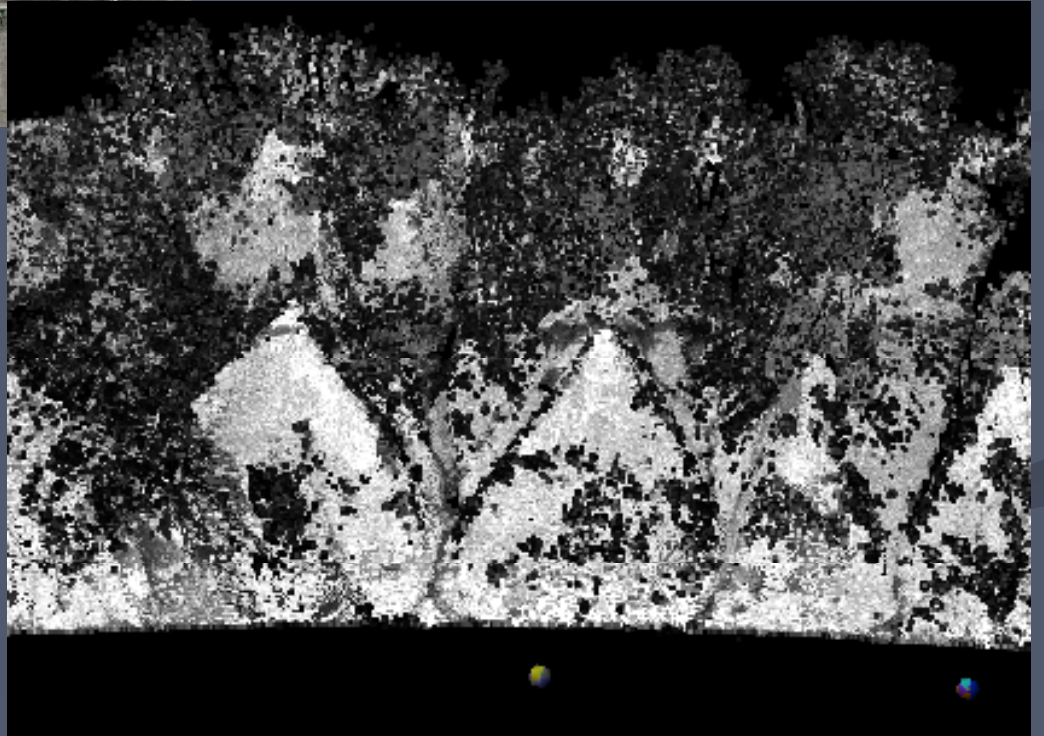
FLORIDA INTERNATIONAL UNIVERSITY

UNM
Lidar Lab



UNIVERSITY OF MINNESOTA DULUTH





Aerial Photographs



1938

1971

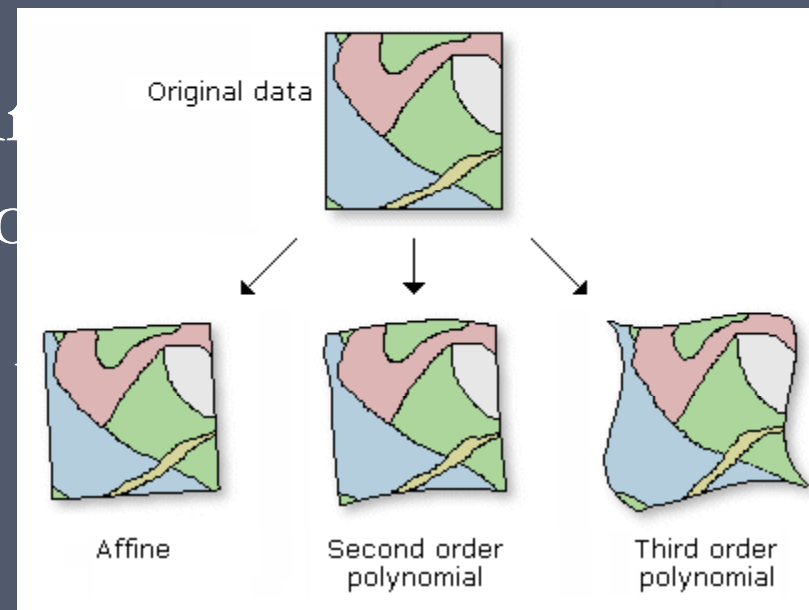
2005

Sources of Uncertainty

- Georeferencing the aerial photographs
- Selecting the bluff crest
 - Not quantified yet
- Assumptions made about how bluffs erode

Georeferencing

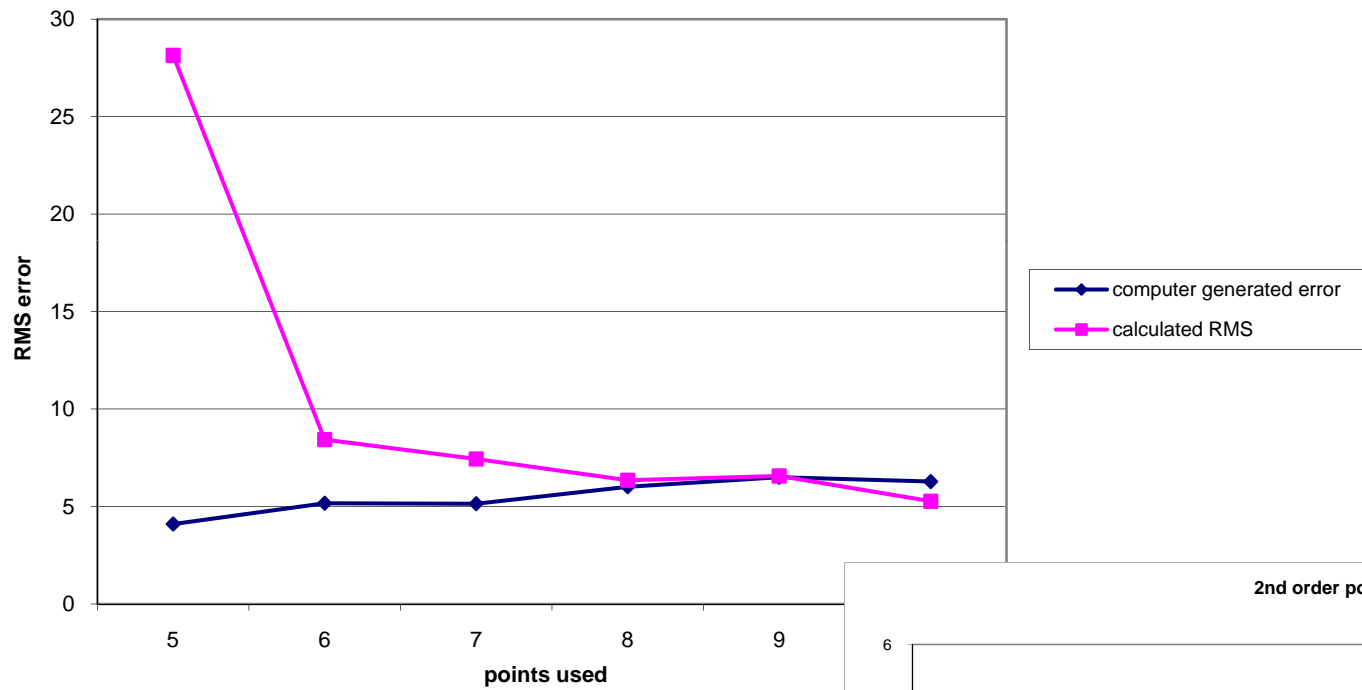
- Arc GIS was used to georeference photos
- First order polynomial (affine) transformation used to reduce warp
- Eight or more stable points used to georeference aerial photos
- RMS error calculated by georeferencing error



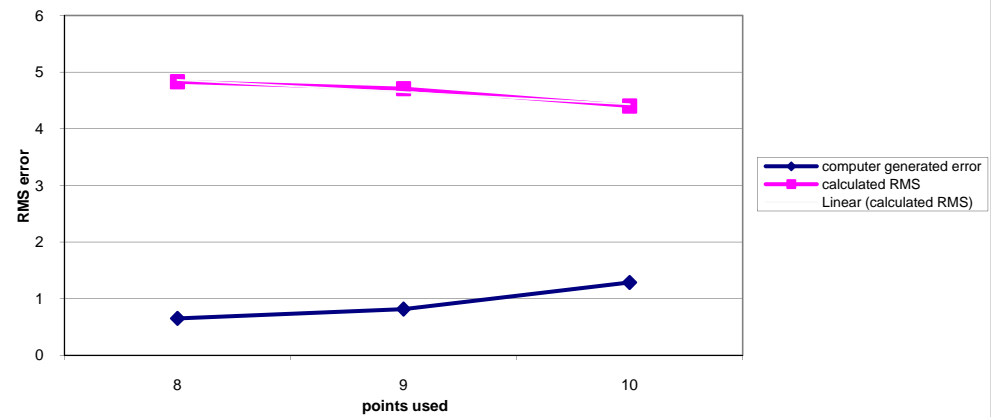
ArcGIS help (spatial analyst: warp)

RMS error

1st order polynomial



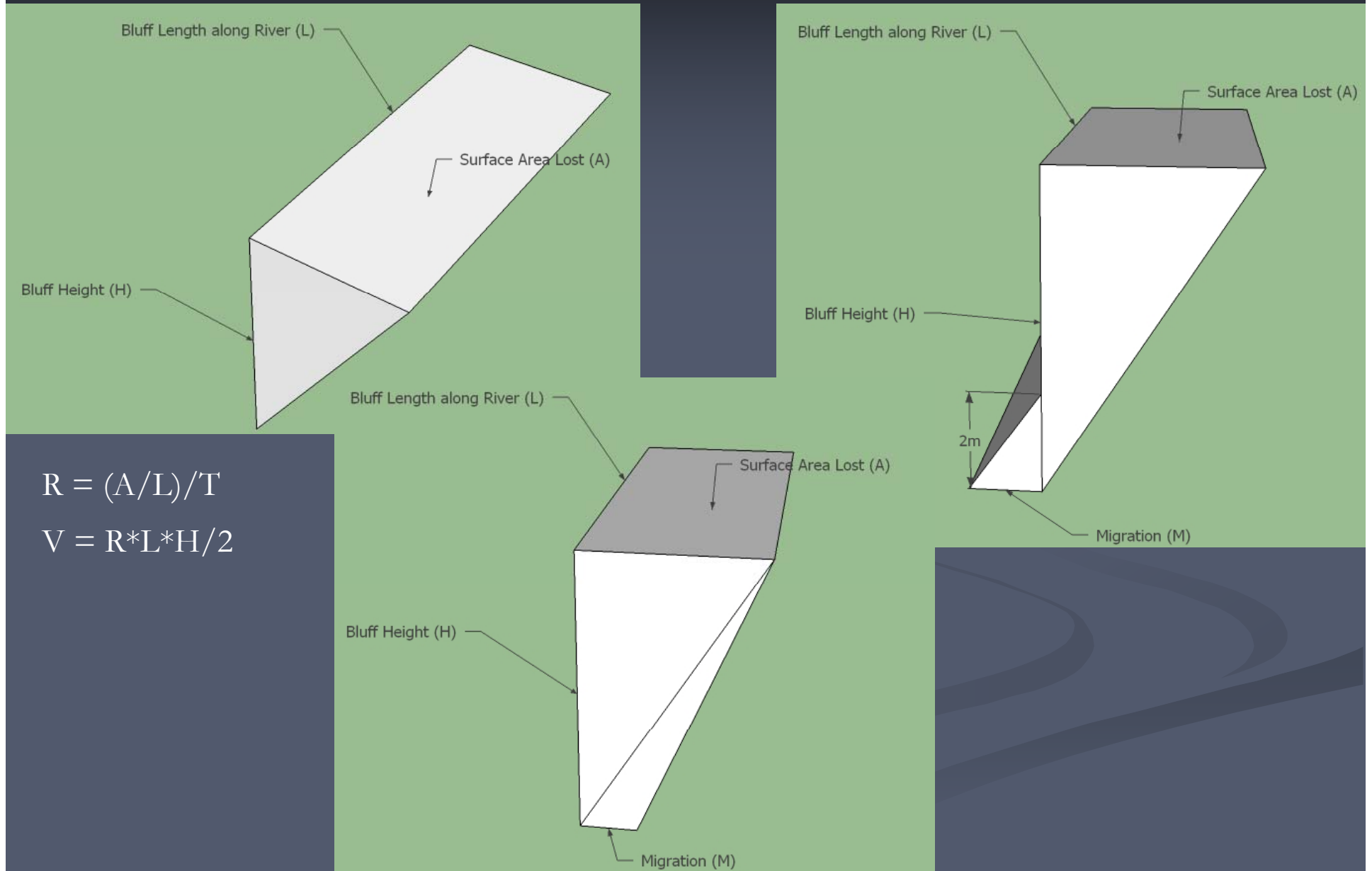
2nd order polynomial

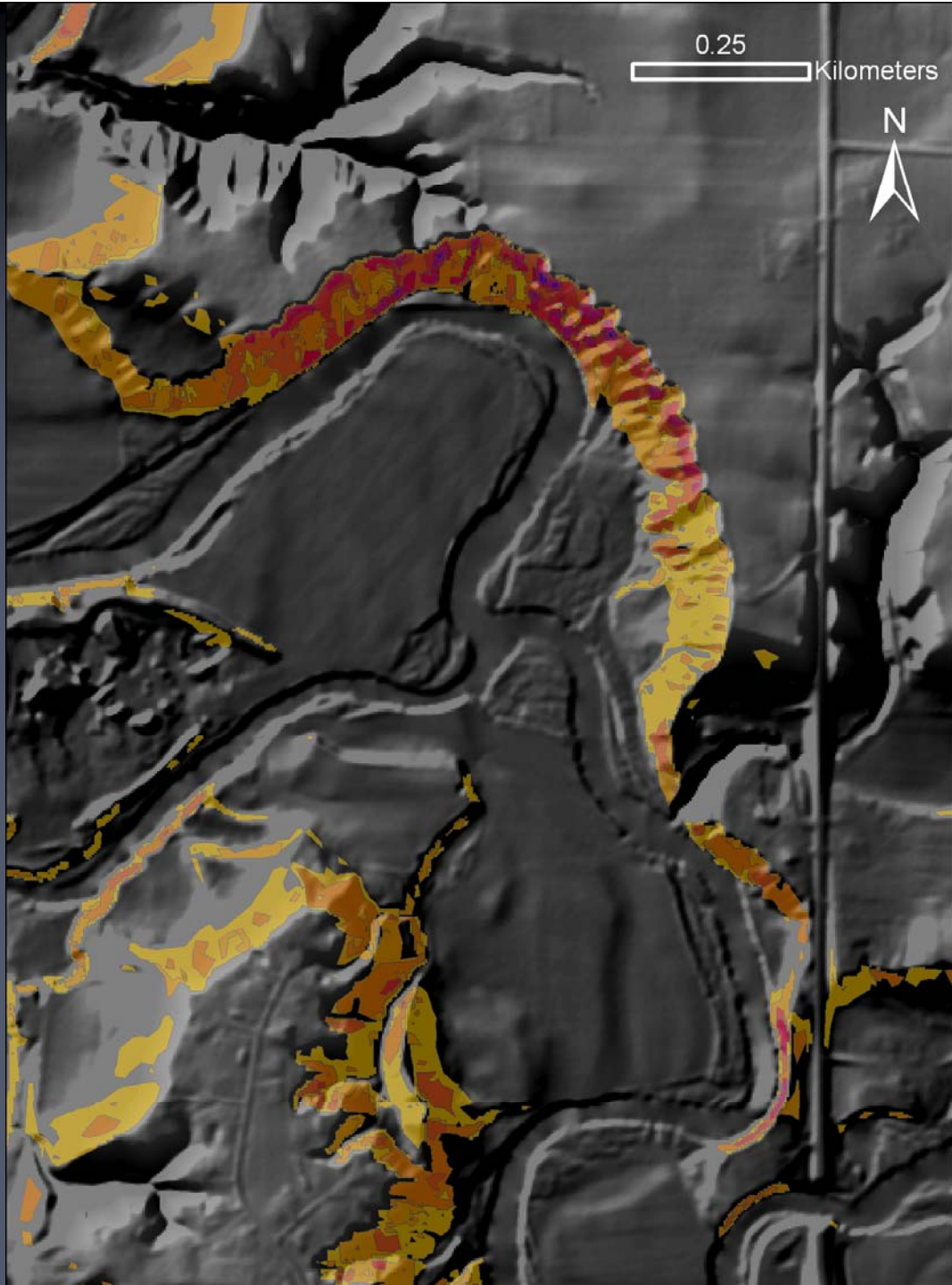


Assumptions on bluff erosion

- Erosion at the base of the bluff causes failures near the crest of the bluff
- Material that slumps down and forms a toe is removed quickly by the river
- Minimum estimate of bluff erosion assumes a wedge of material being removed where greatest amount of sediment is removed near the crest of the bluff

Assumptions on bluff erosion





Results

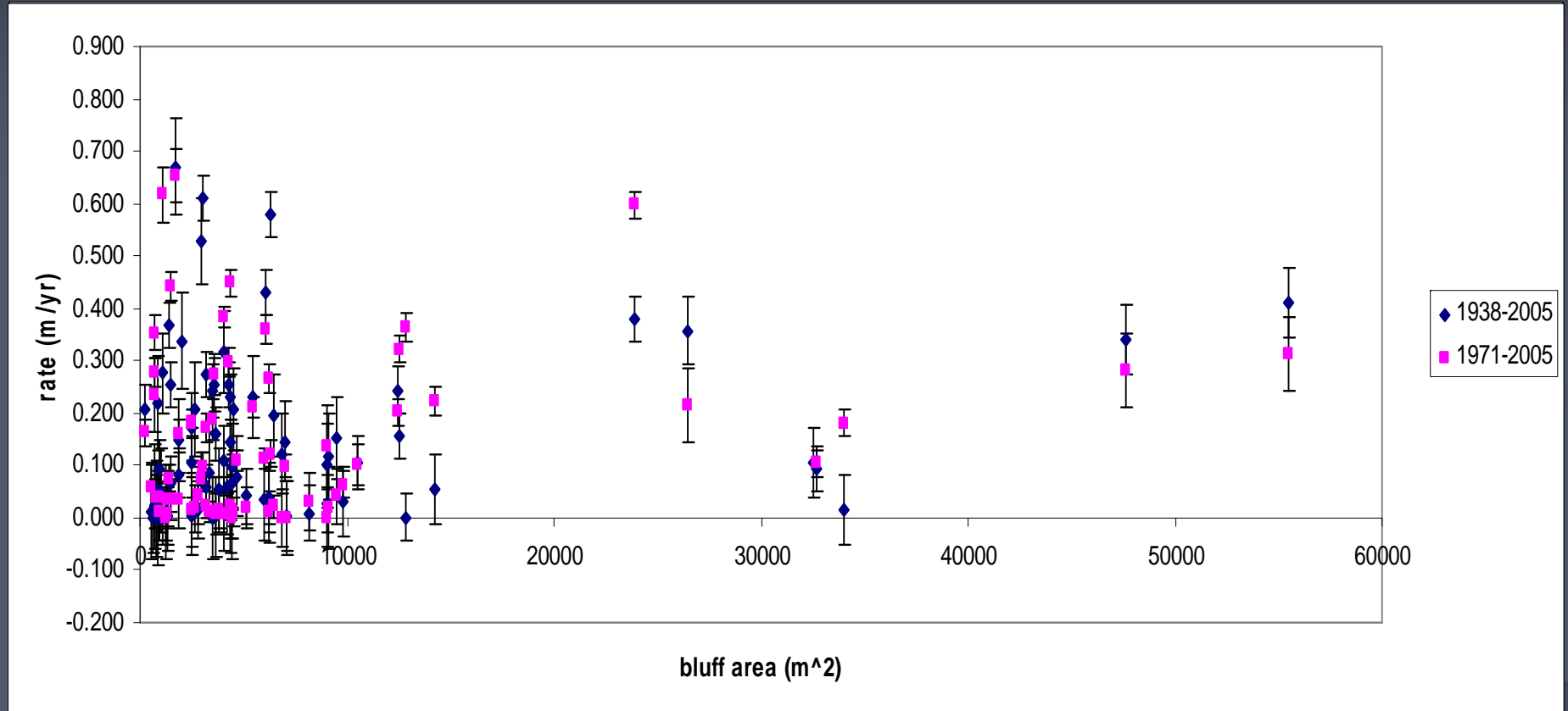


1938

1971

2005

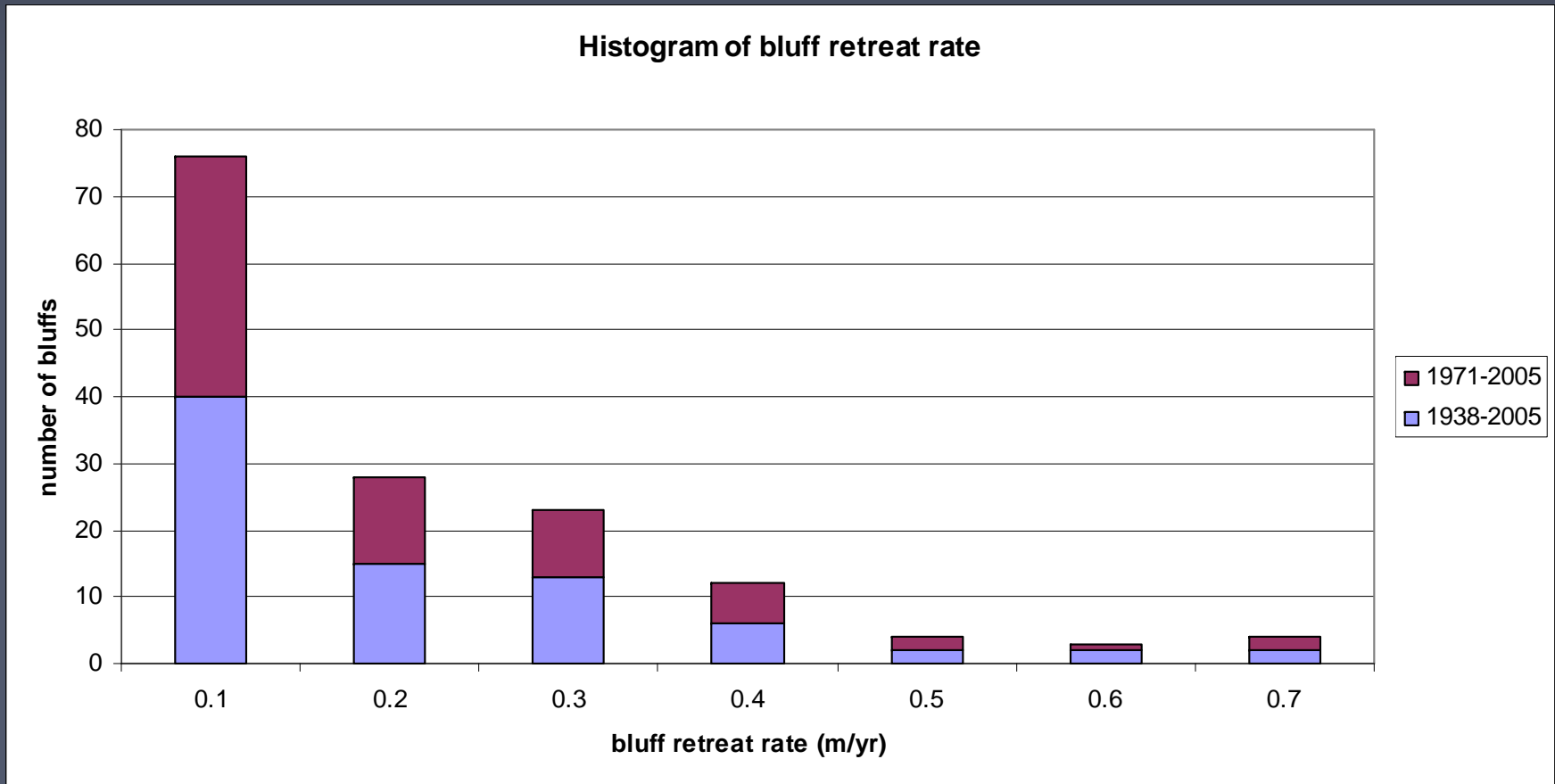
Results



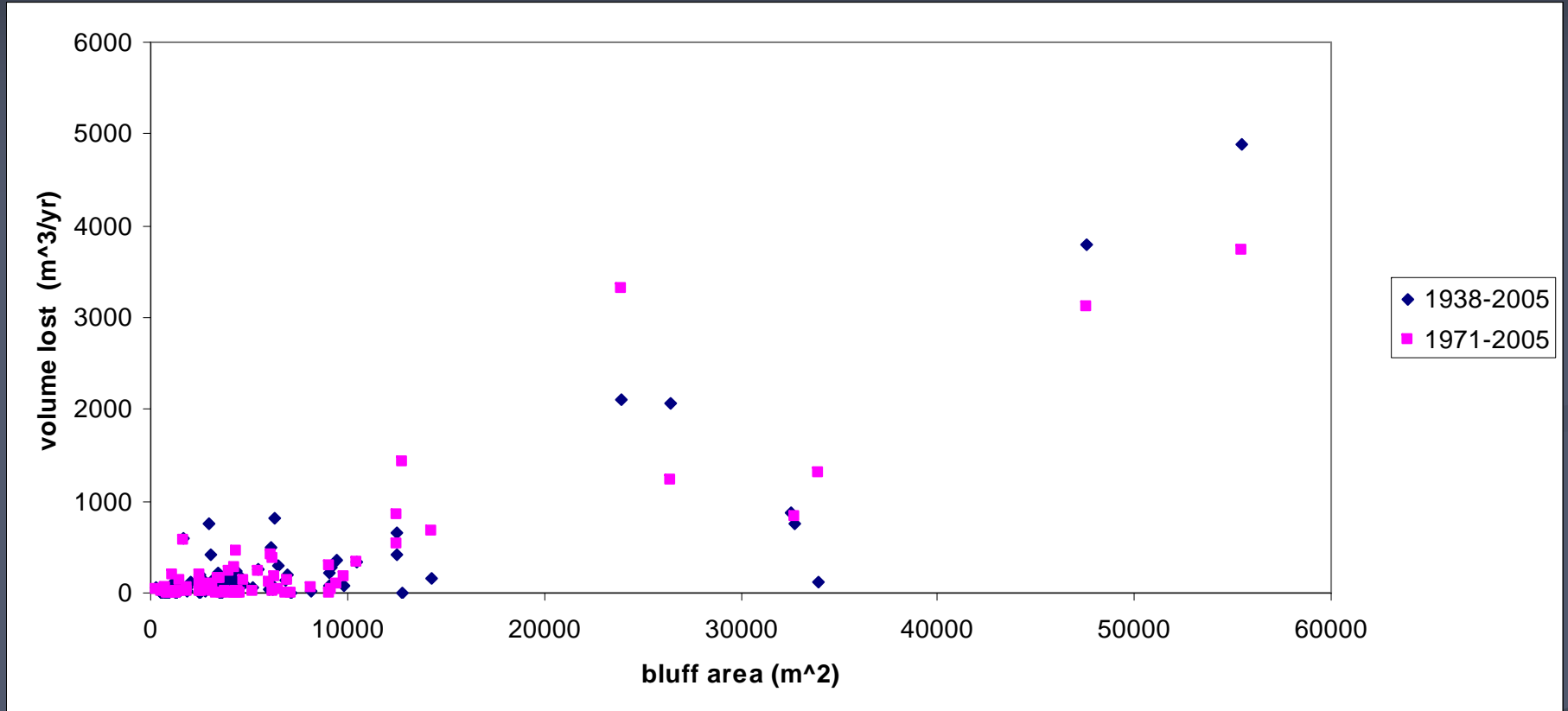
Average erosion 1938-2005: 0.15 m/yr \pm 0.06

1971-2005: 0.14 m/yr \pm 0.04

Results

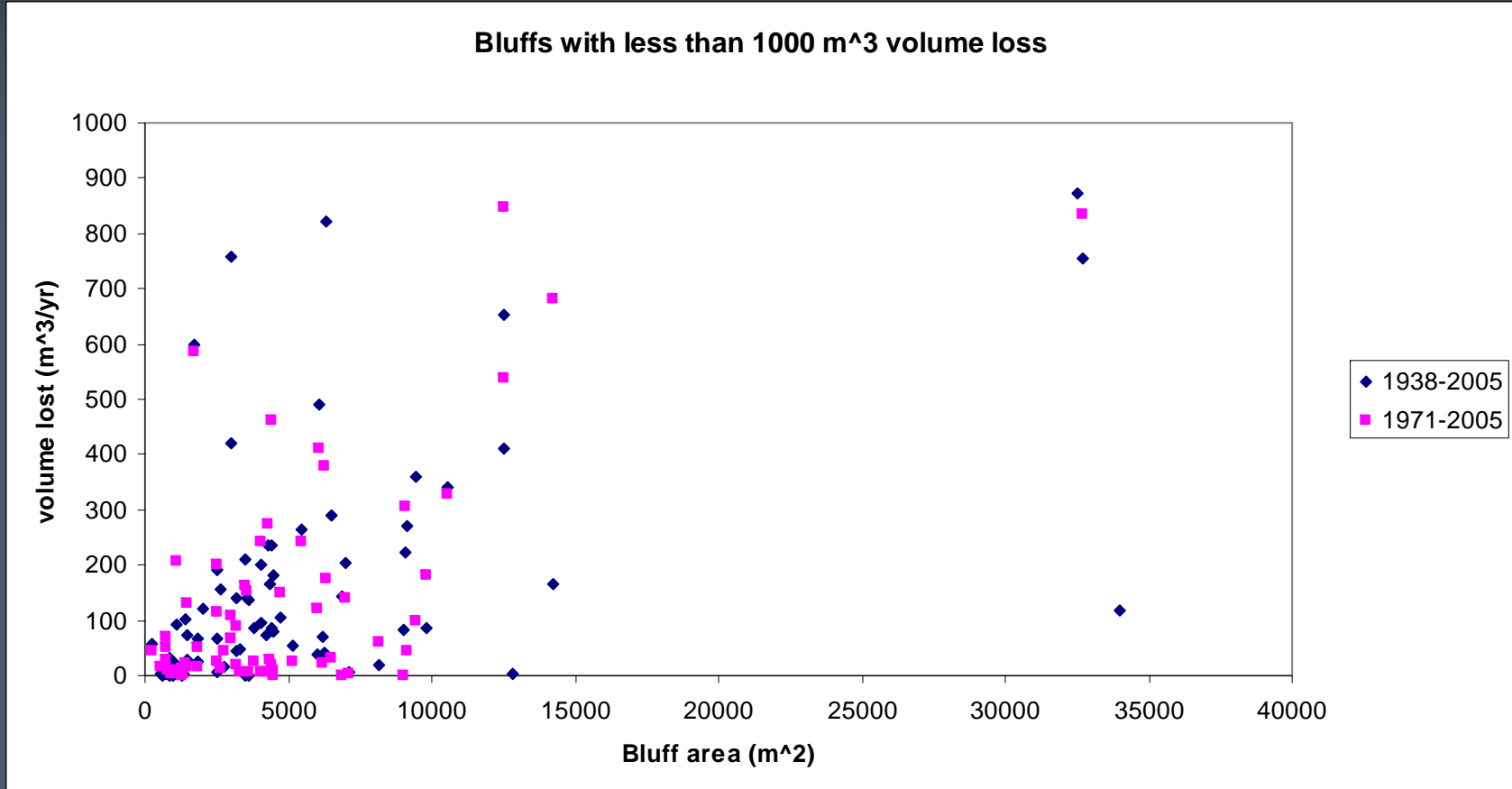


Results

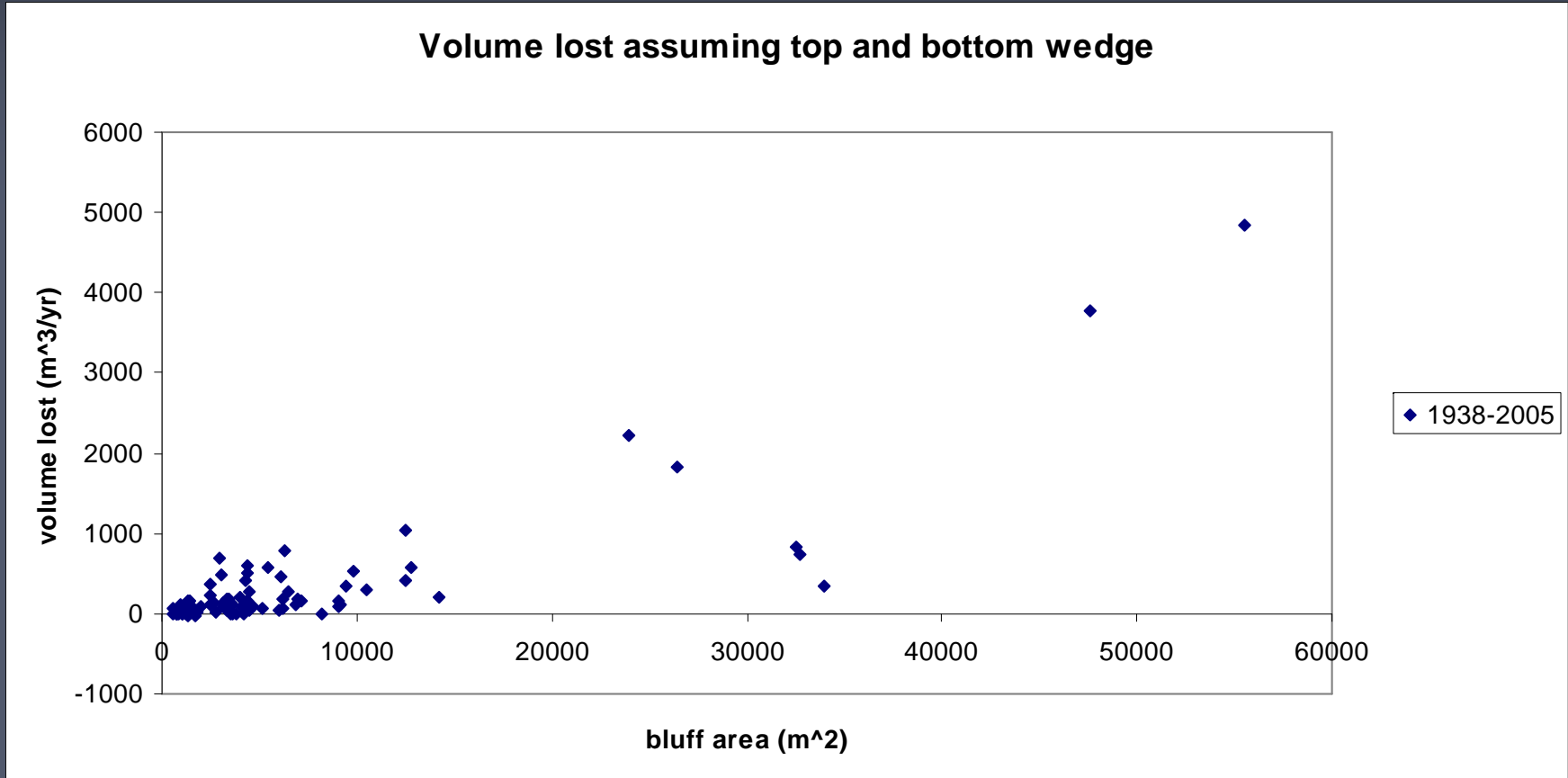


Total Volume lost assuming top wedge only 1938-2005: 25000 m³/yr
1971-2005: 23000 m³/yr

Results

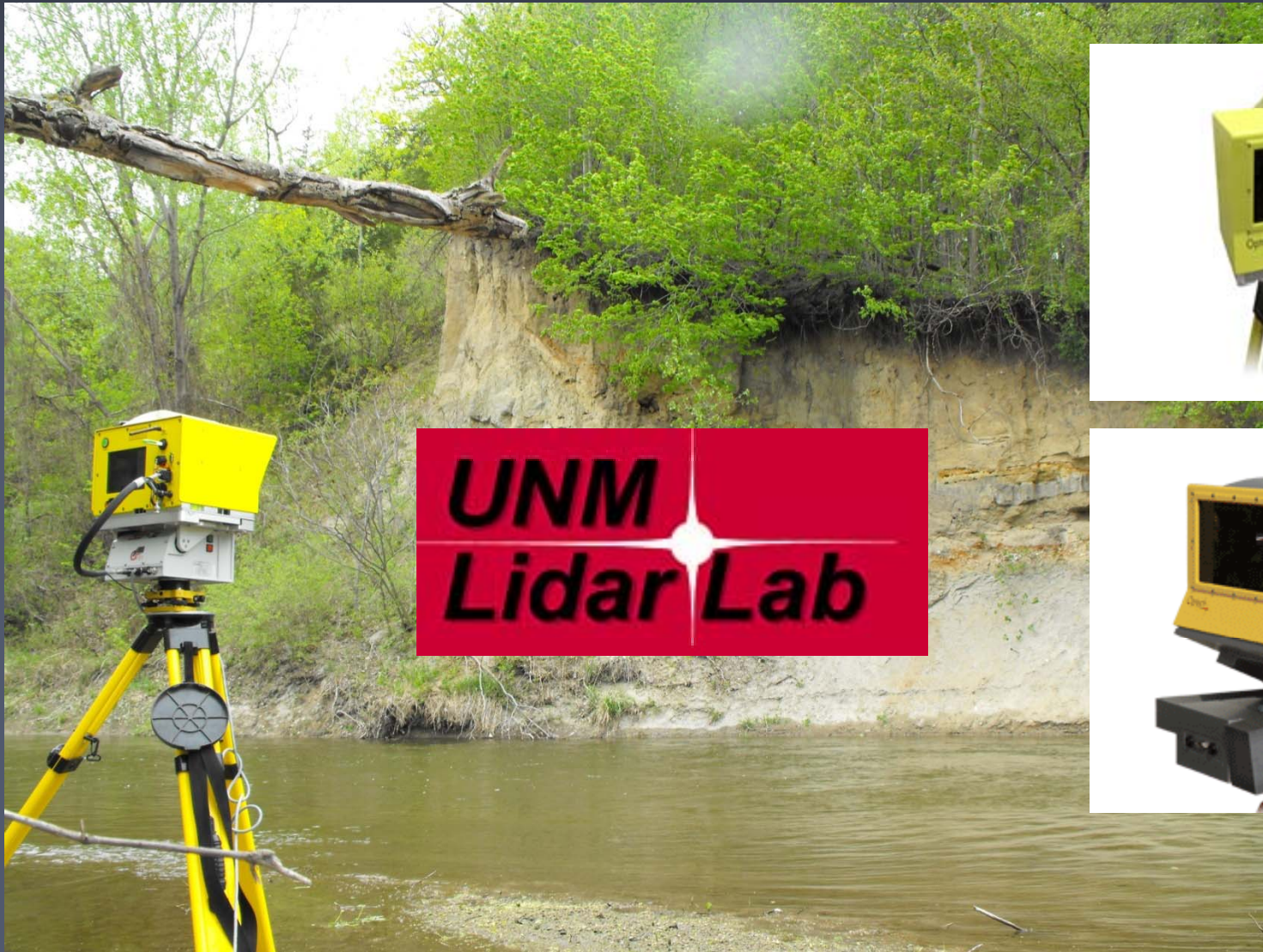


Results



Volume lost for top and bottom wedge 1938-2005: 28000 m³/yr

Ground Based LiDAR



Software – PolyWorks Suite



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Solutions
How to buy
Partners
Technical support
Media center
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Upcoming events

03-11-2010 **Journée de la métro...**
03-18-2010 **German PolyWorks Us...**
03-22-2010 **INDUSTRIE Paris 201...**



Breaking news

11-19-2009 **PolyWorks® V11.0.11**
Sets New Standard in Hybrid
Metrology Capabilities



Free download

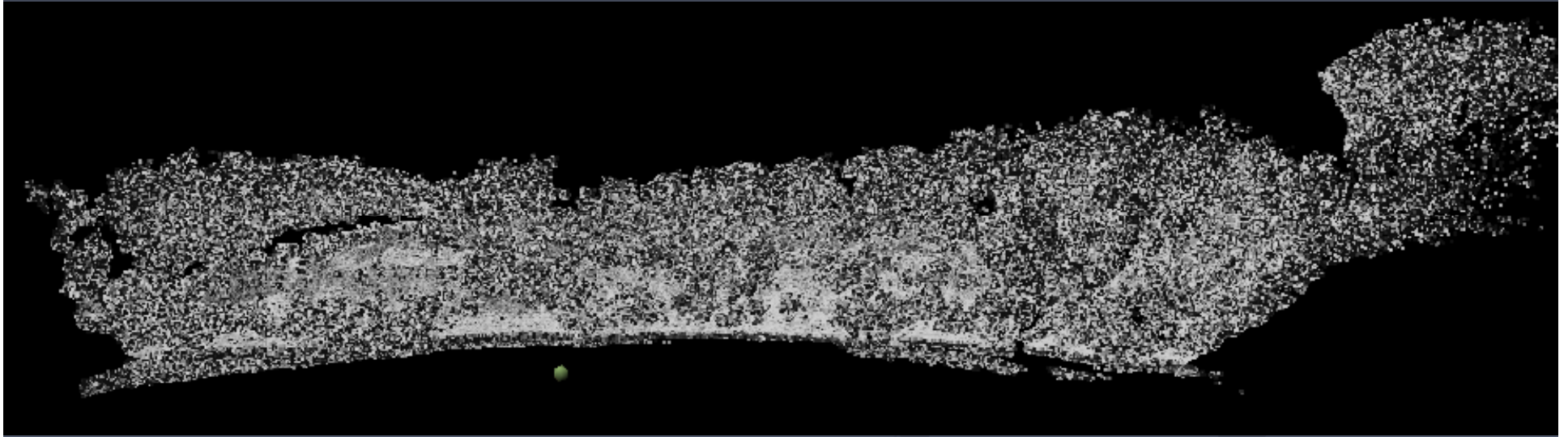
PolyWorks/IMView™ viewer for
PolyWorks inspection projects
and polygonal models



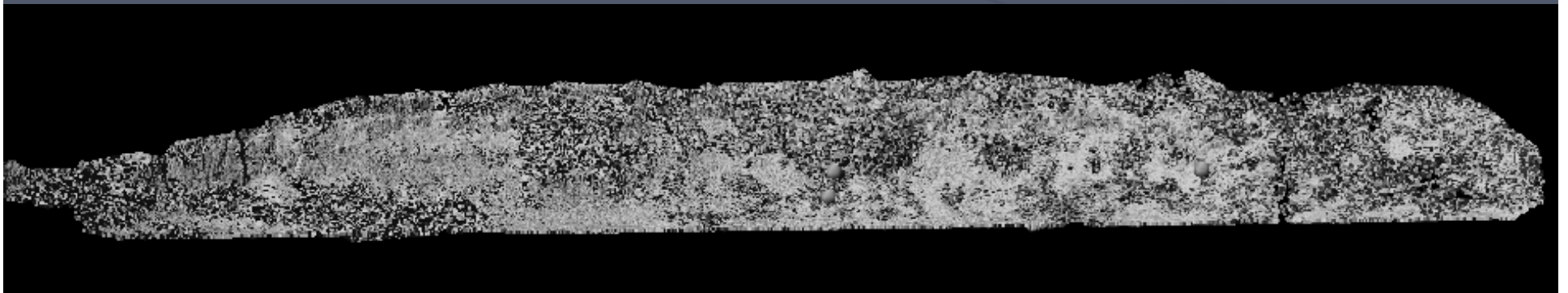
Sources of Uncertainty

- Error associated with scanner
- Bluff alignment – done using PolyWorks
- Vegetation and other erroneous points
- Direction of change

LiDAR and Vegetation

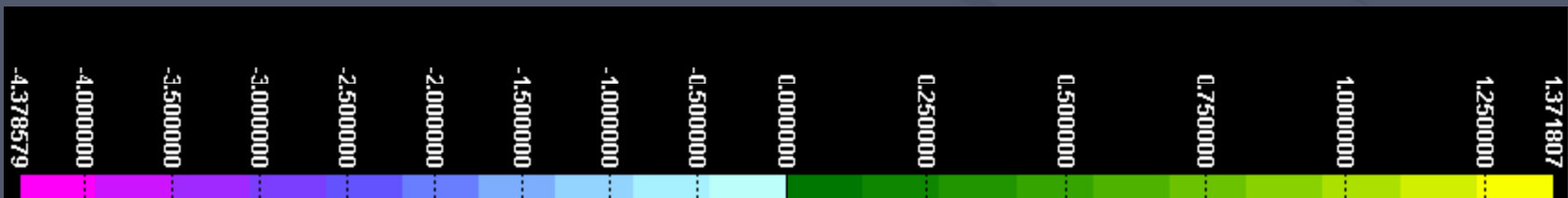
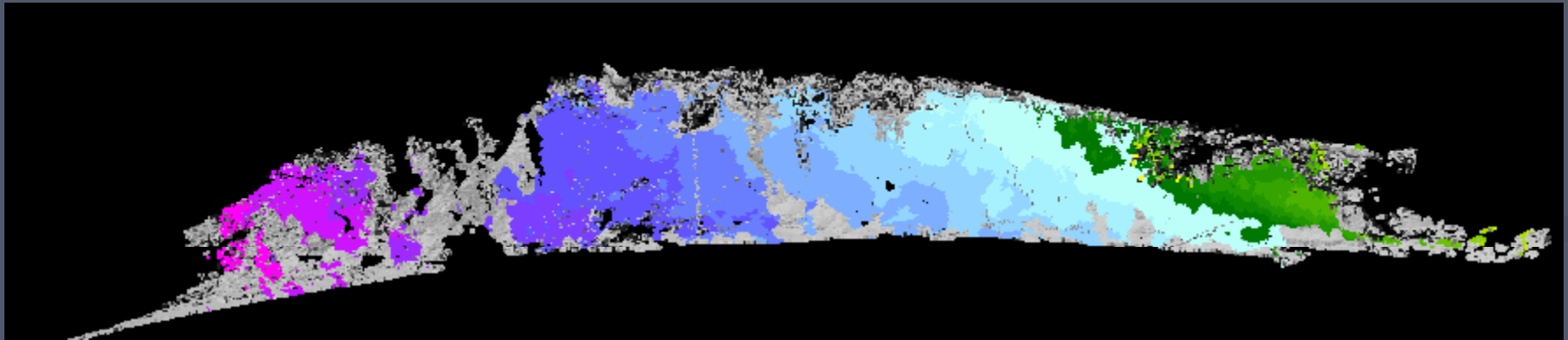


Before Vegetation is removed



After Vegetation is removed

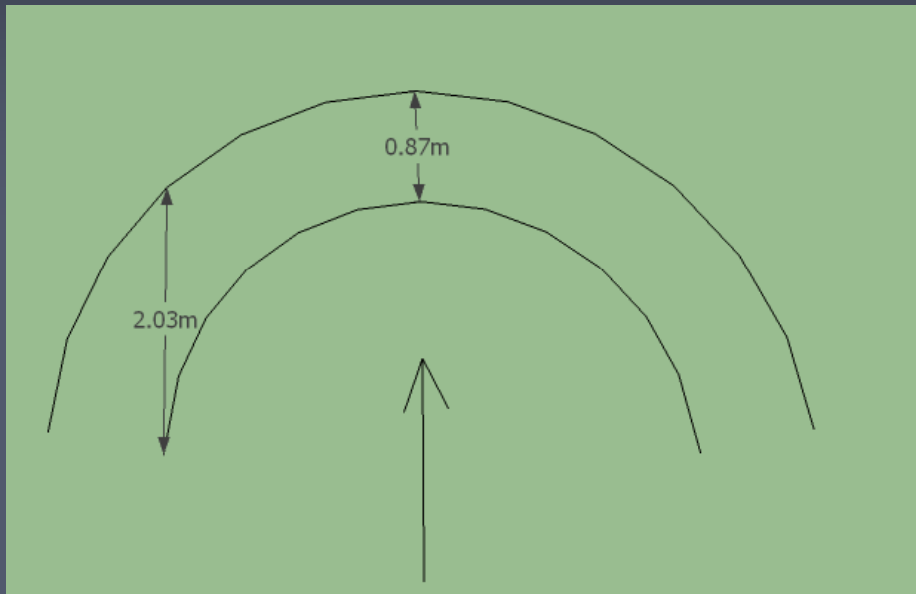
Bluff Alignment



This is an example of bad alignment.

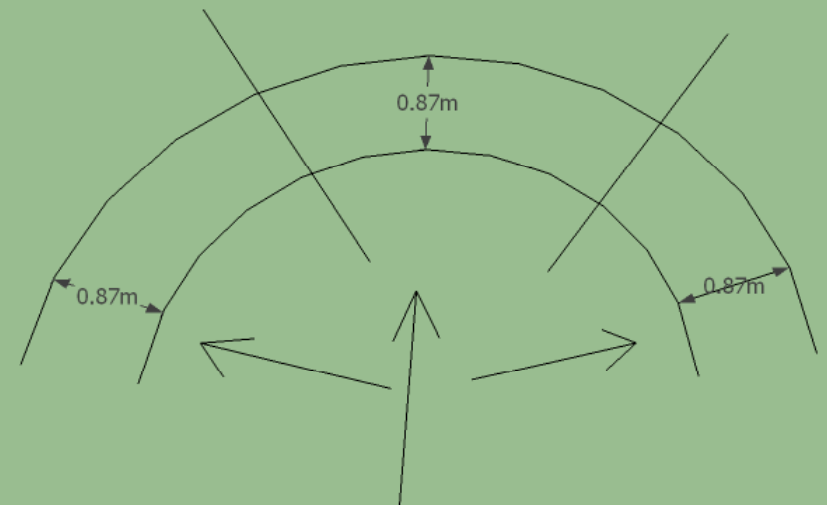
- The colors indicate the magnitude of change between two scans

Direction of Change



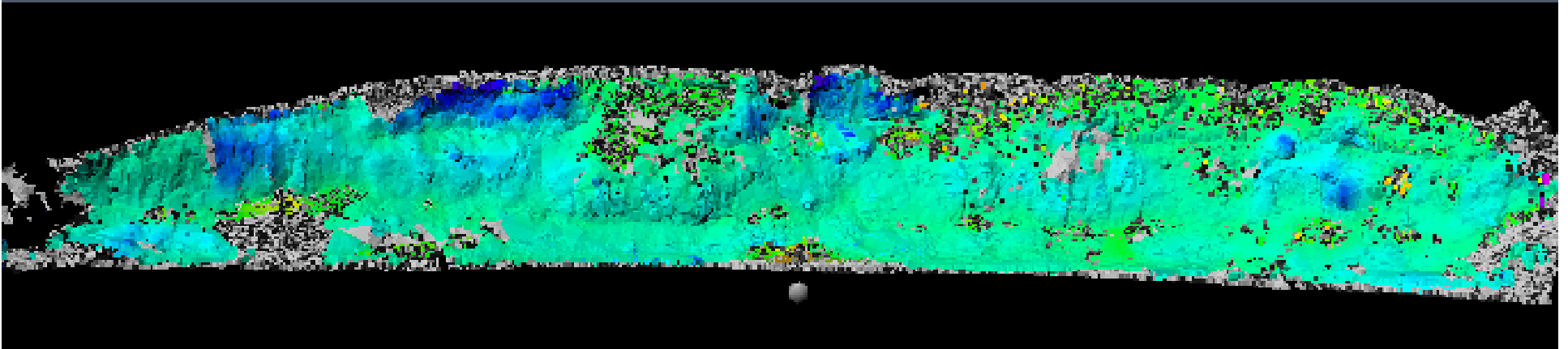
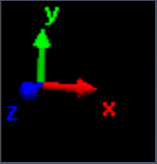
Result of looking at change in only one direction where bluff is curved

When using multiple vectors normal to the average surface, a more accurate estimation of the retreat is found





Results



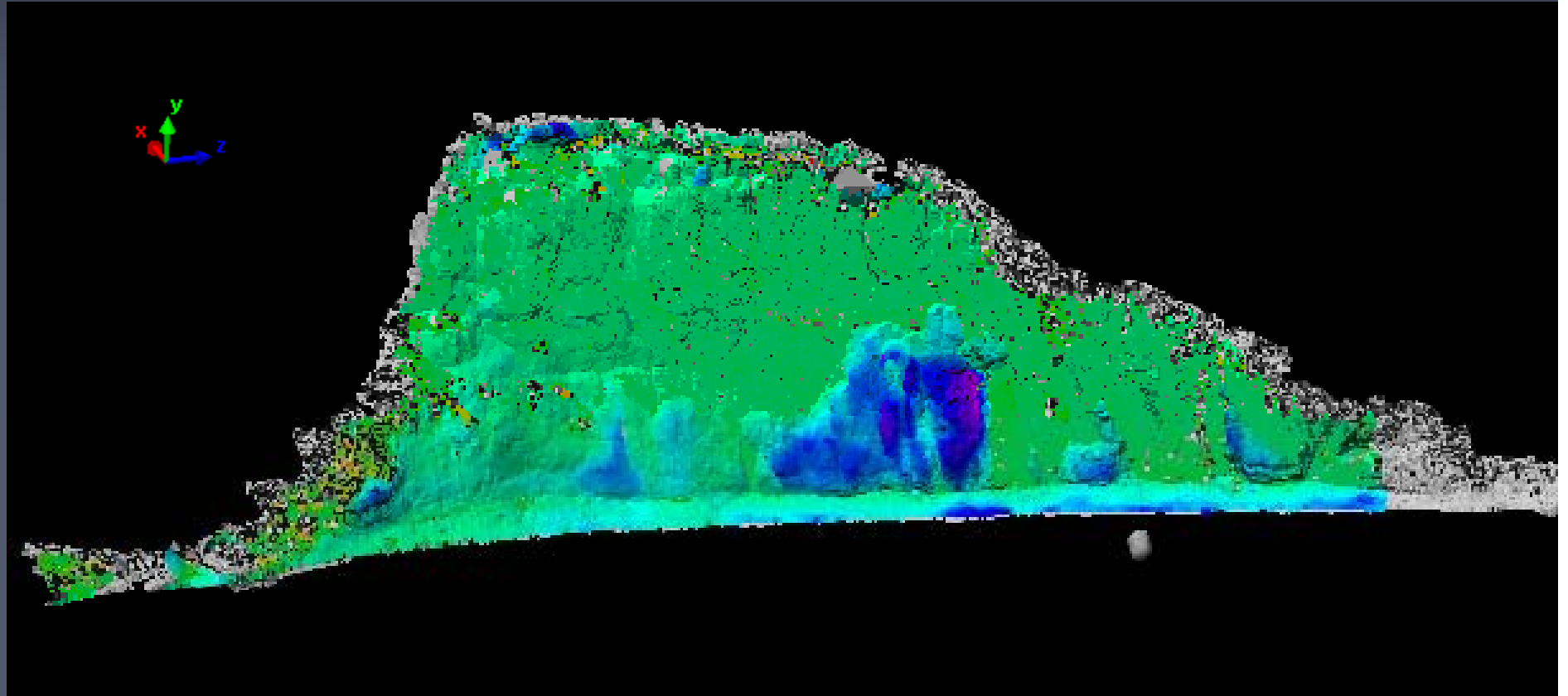
erosion

2007-2008

deposition



Results

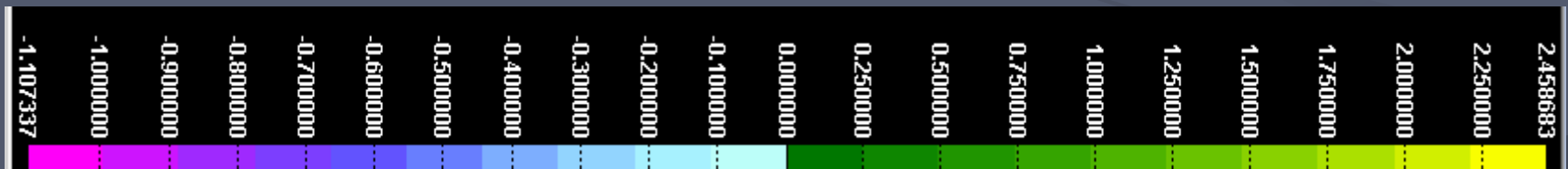
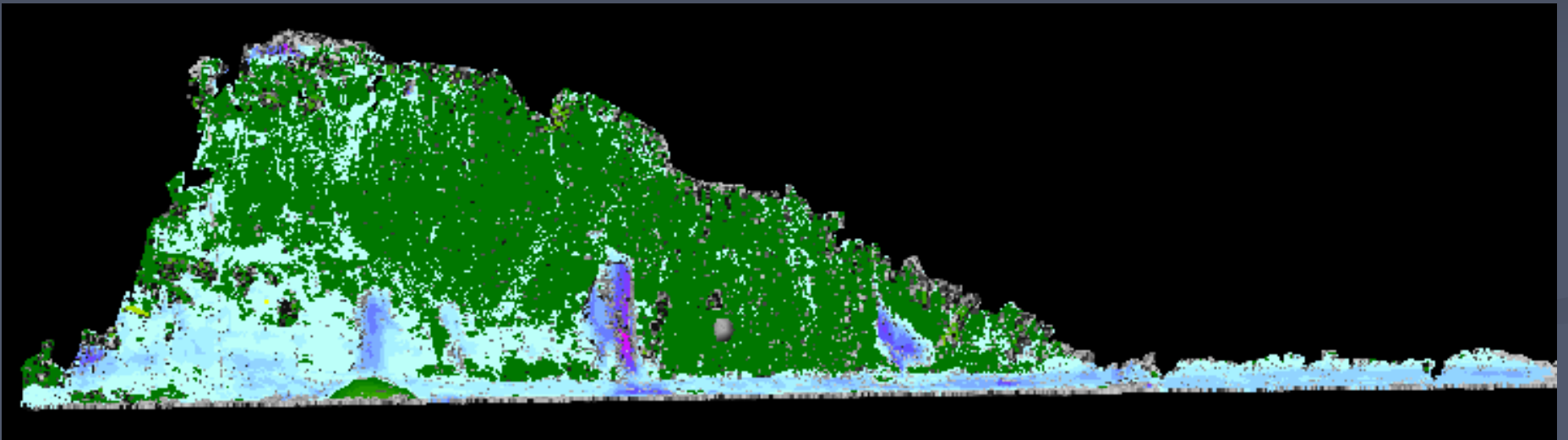


erosion

2007-2008

deposition

Results



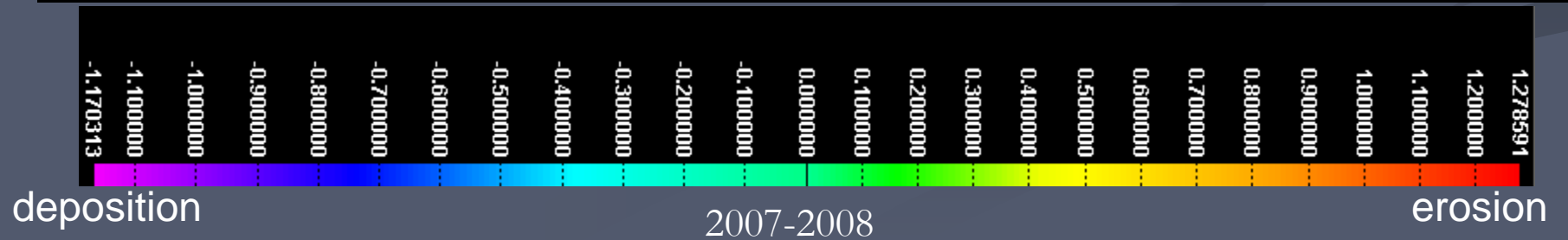
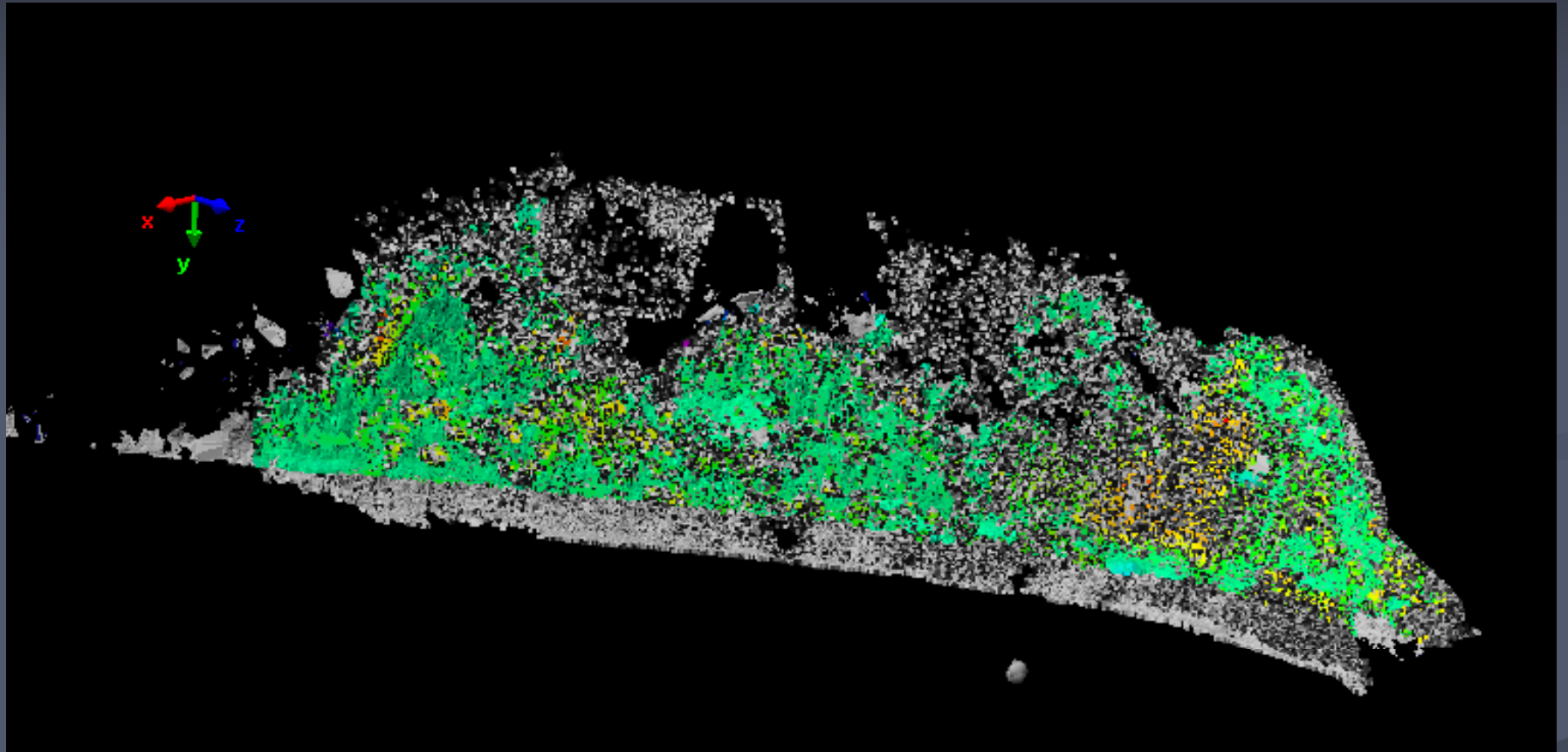
erosion

2007-2008

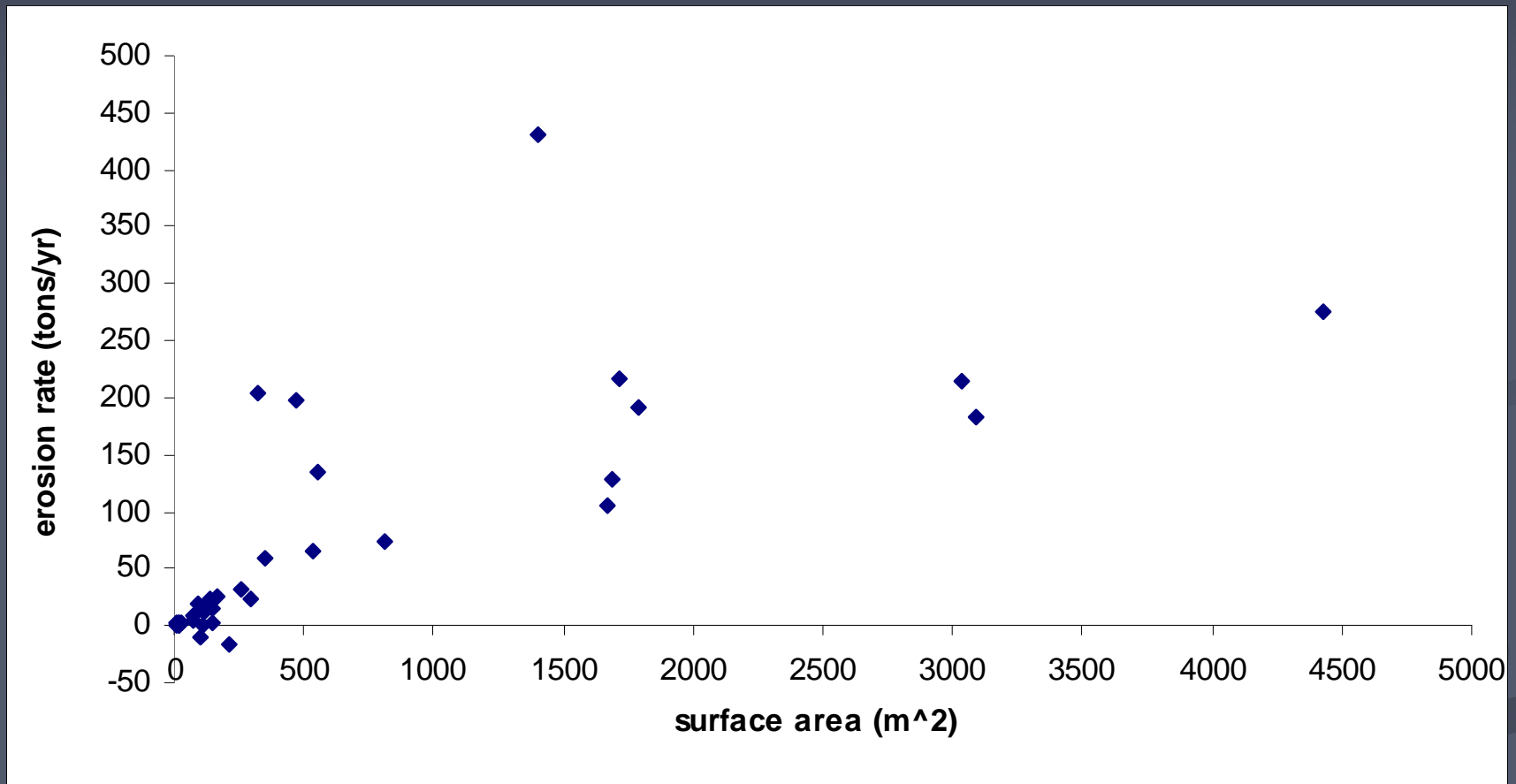
deposition



Results

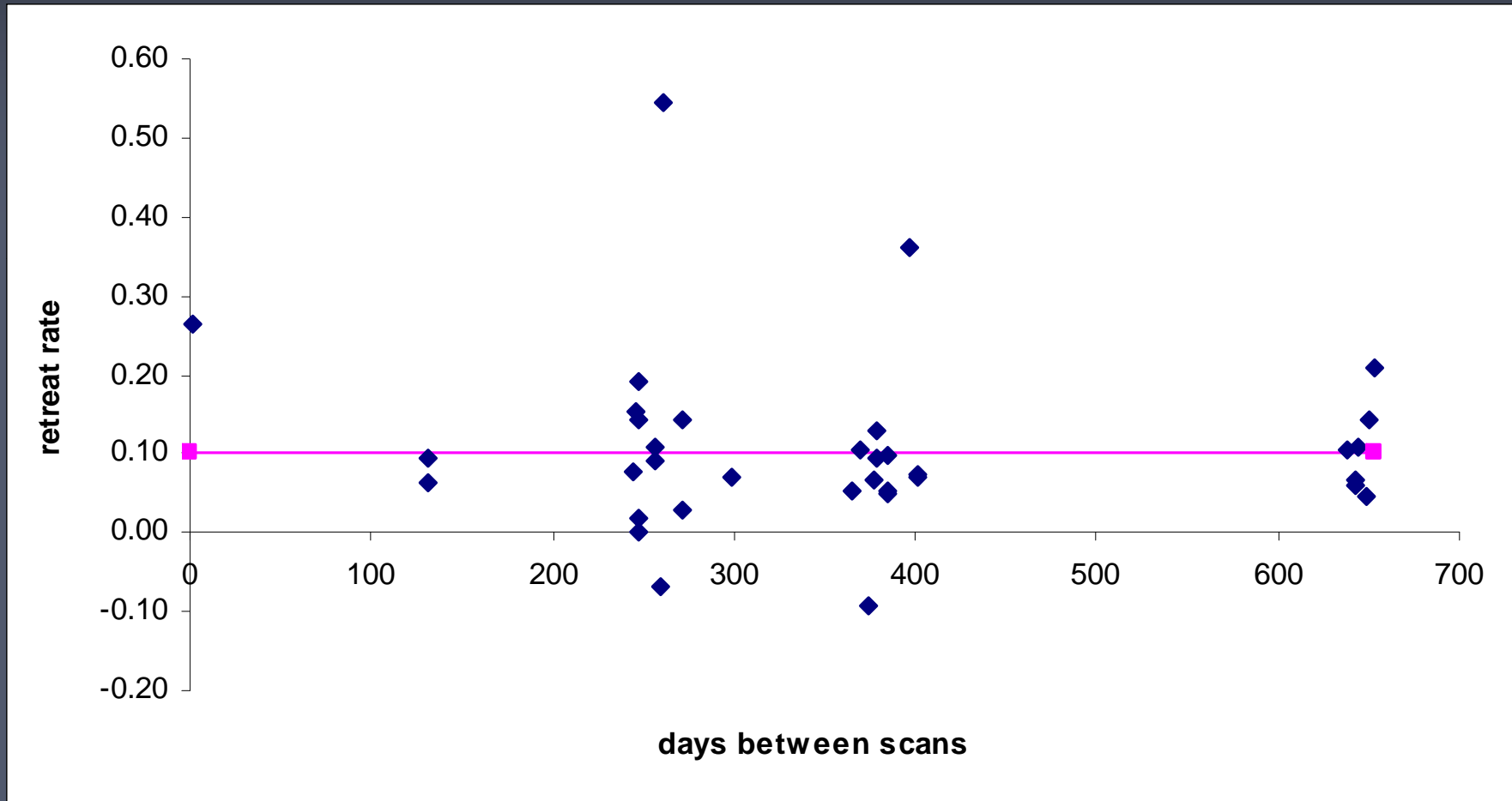


Results

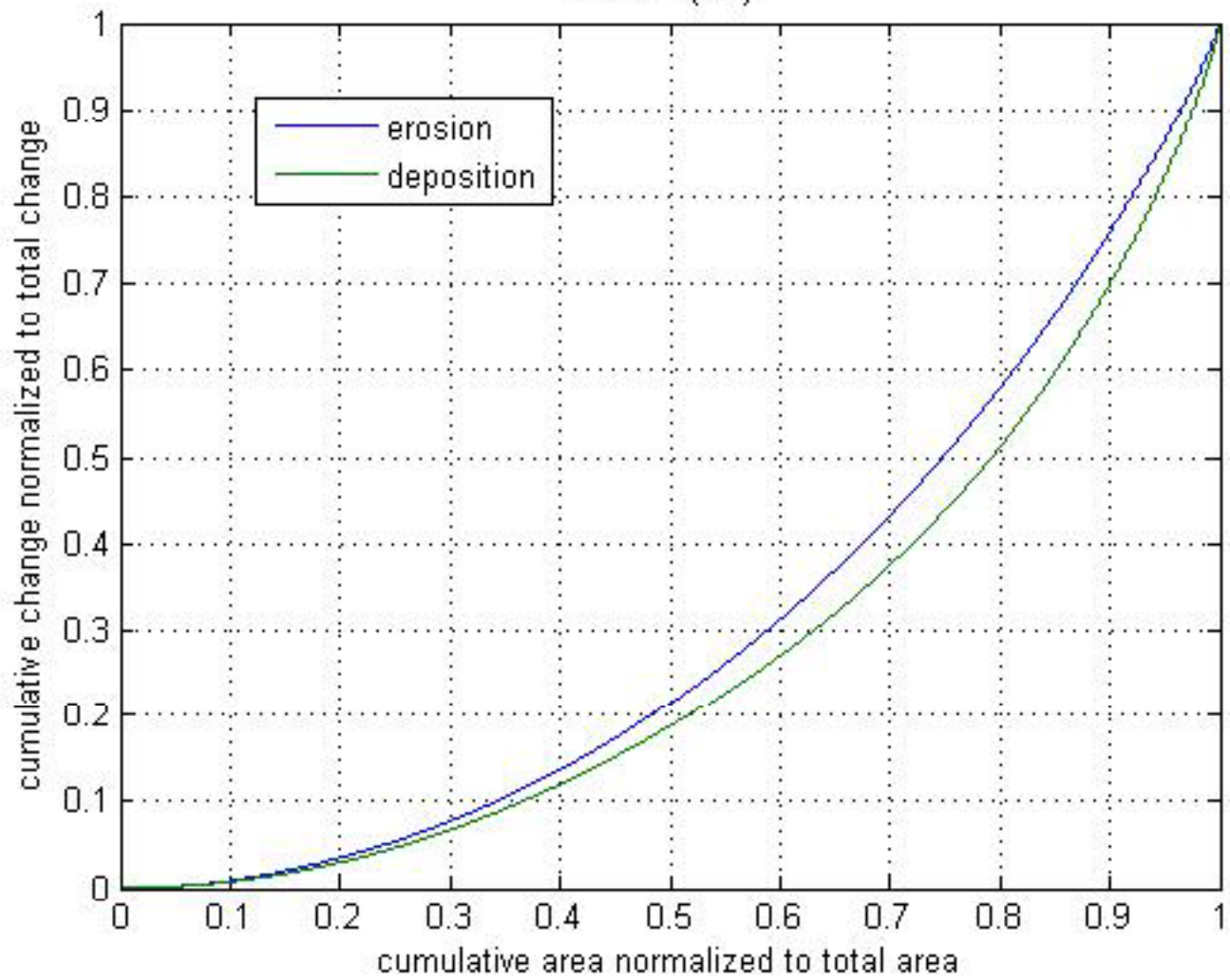


Average erosion rate 0.10 m/yr
Average volume lost 50 m³/yr

Results



H16LS (1-4)



Review

- Aerial Photographs:
 - 80 bluffs measured
 - Bluff change from 1938-2005 (67 years)
 - Retreat Rate: 0.15 ± 0.06 m/yr
- LiDAR:
 - 40 comparisons made on 13 bluffs
 - Amount of bluff change in 100 to 650 days
 - Retreat Rate $0.10 \pm \dots$ m/yr

Aerial Photographs

- Inexpensive – many aerial photos are available online
- Only shows changes of bluff crest and river migration
- Low resolution (m)
- Covers longer time period

Ground Based LiDAR

- Equipment costs >\$100,000 to own; to rent is about \$8000
- Shows changes on the bluff face and may give details about erosion processes
- High resolution (mm-cm)
- Can be used to track annual changes

Thank you

