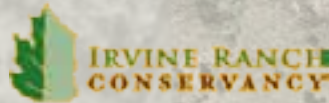


Detecting vegetation change using historical aerial photo sequences

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Jutta C. Burger, Bryan Iwamoto

Irvine Ranch Natural Landmarks

Orange County, California



- 40,000 acre National Natural Landmark
- Contains some of the most intact coastal sage scrub, chaparral, oak-sycamore woodland, and native grassland in southern California
- Experienced several disturbances

Introduction

To protect these habitats, land managers need to understand how climate change and disturbances such as fire and grazing have influenced the landscape.

Therefore, we need to find out:

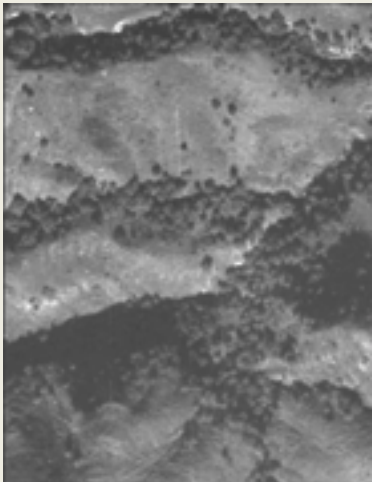
- Where vegetation cover has changed
- How (to which habitat type) it has changed
- By how much it has changed



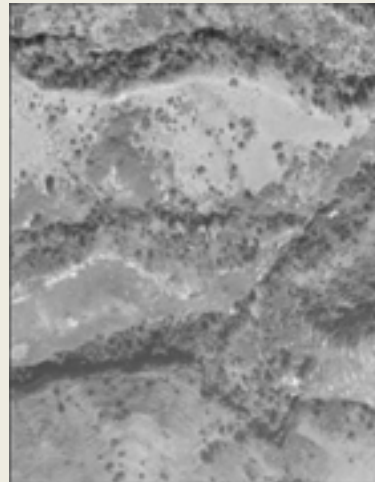
Methods

- Analyze historical aerial photos
 - Digital Black & White Film image: 1946 & 1977
Source: UC Santa Barbara Map & Imagery Laboratory (MIL)
 - Orthorectified aerial photos: 2004 & 2013
Source: Eagle Aerial Solutions
- Manual vs two Automated Image Classification Methods

1946



1977



2004

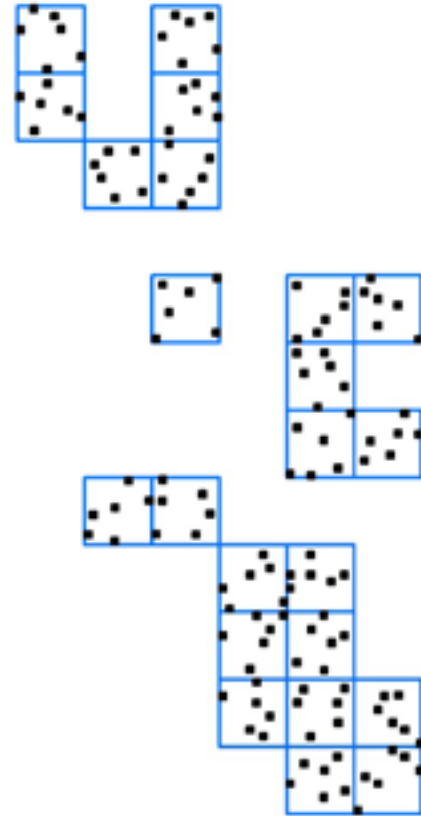


2013



Methods

- Orthorectification:
historical aerial imagery
 - Software: ENVI
 - Data required: DEM, USGS DOQQ
- Sample Areas
 - Twenty-three 1 km² blocks
 - Six randomly selected 100x100 m squares within 1 km² block



Methods

Manual Classification

- Divide each 100m x 100m square into 100 10m x 10m cell
- Assign vegetation type for each cell
 - Using 50% rule



Scrub/Woodland



Bare ground



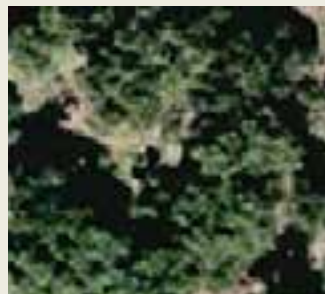
Road/Urban



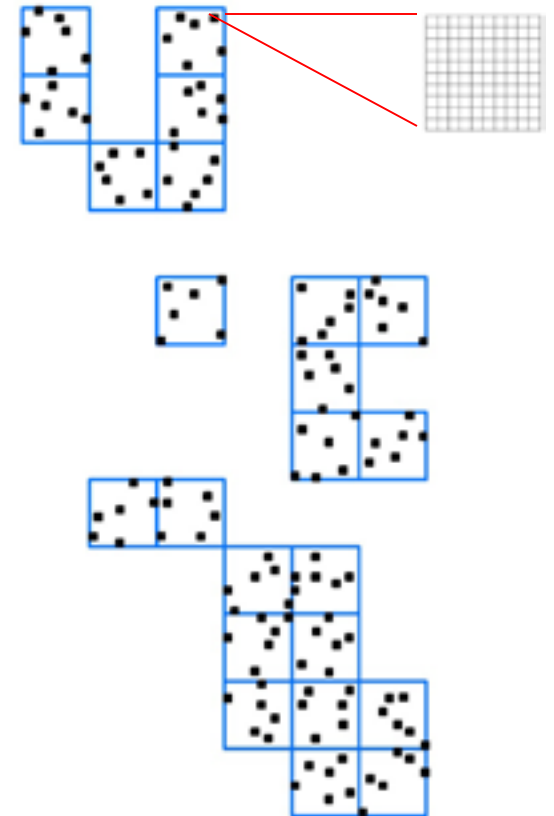
Grass



Scrub



Woodland



Manual Classification



Block_ID	Grid_ID	Grassland	Scrub	Woodland	Bareground/ Rock	Road/Urban Devlopment
18_B3	328806250	0.00	0.50	0.50	0.00	0.00
18_B3	328906250	0.00	1.00	0.00	0.00	0.00
18_B3	328006260	1.00	0.00	0.00	0.00	0.00

Automated Image Classification

Pixel-based Classification

- Unsupervised Classification
 - IsoCluster Unsupervised Classification ArcTool
- Supervised Classification
 - Interactive Supervised Classification Tool

Object-based Classification

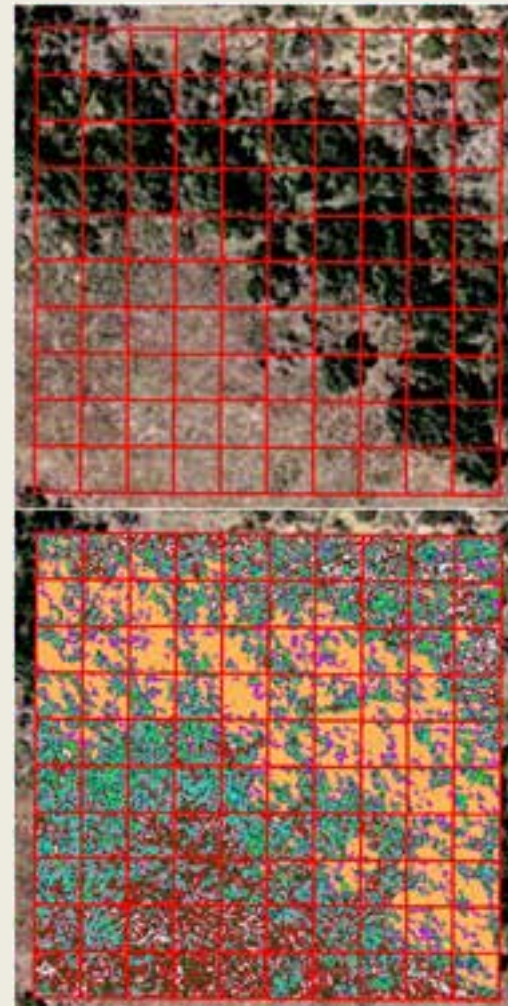
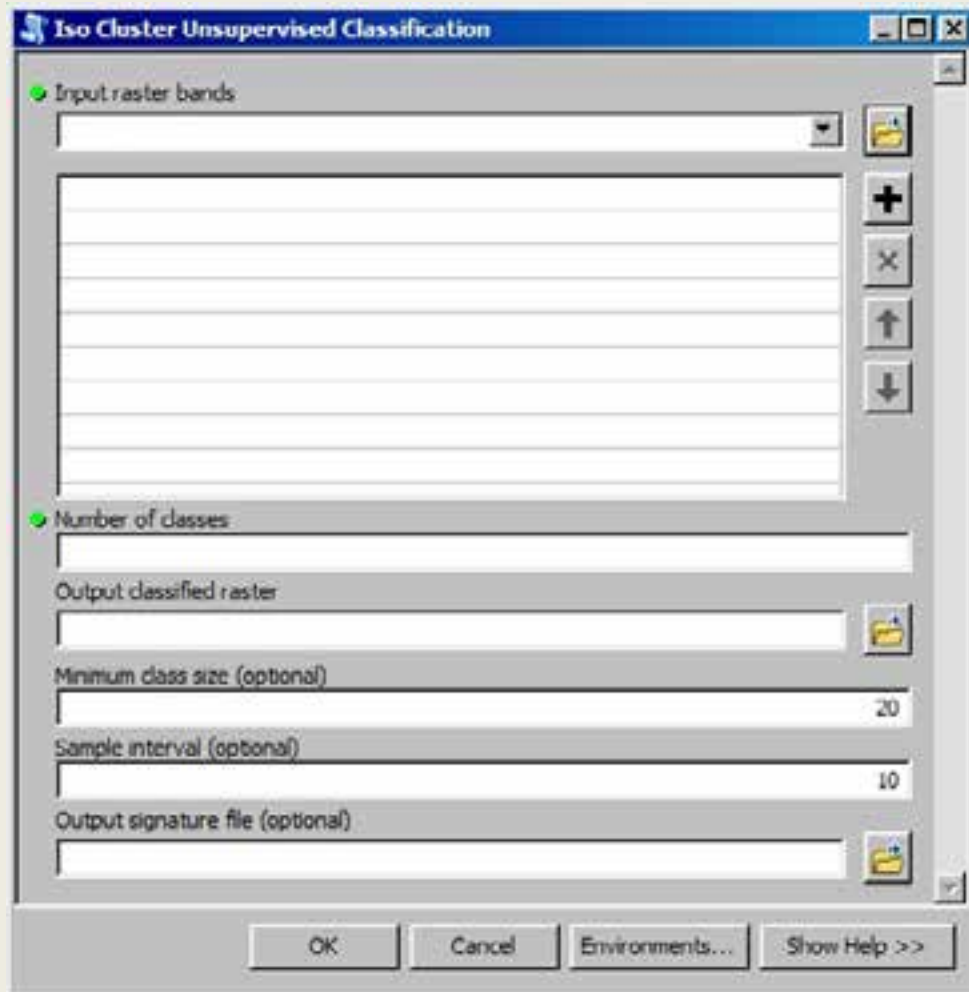
- Feature Extraction
 - Example-Based Classification ENVI Tool
 - Rule-Based Classification ENVI Tool



Pixel-based Classification

Unsupervised Classification

- Iso Cluster unsupervised Classification ArcTool




Pixel-based Classification






Supervised Classification

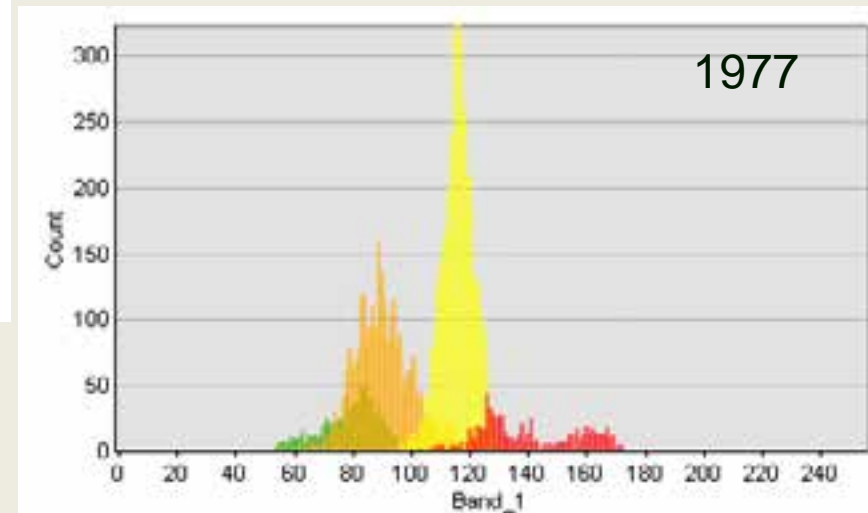
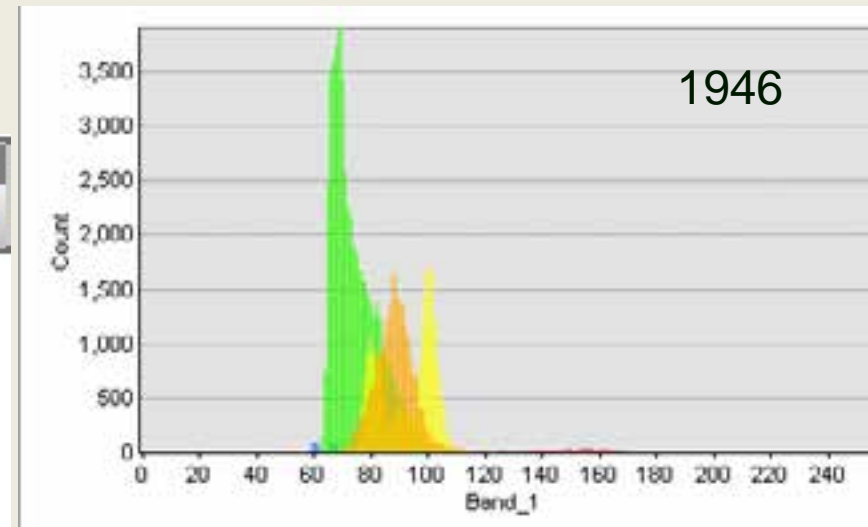
- Interactive Supervised Classification Tool

Image Classification

Classification ▾ |  Classification_1977_11-1.tif

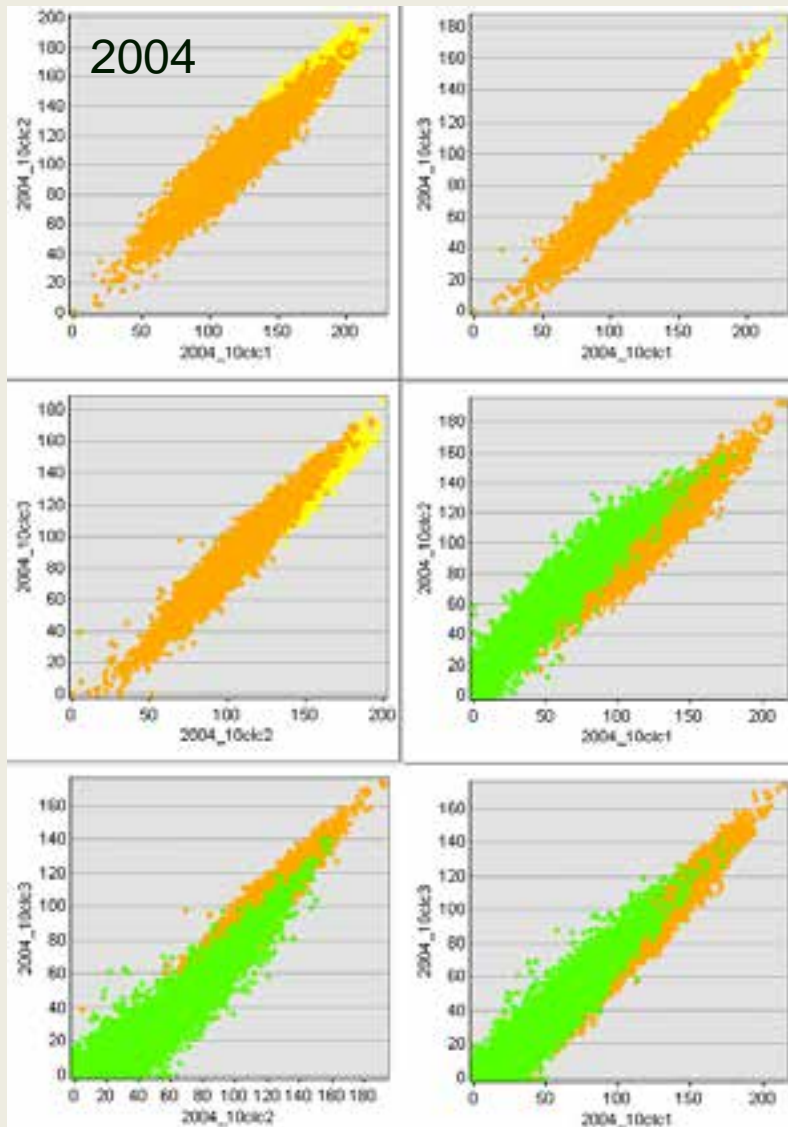
Training Sample Manager

ID	Class Name	Value	Color	Count
1	Woodland	1		1438
2	Scrub	2		3293
3	Grass	3		1409
4	Bare Ground	4		25
5	Shadow	5		21



Pixel-based Classification

Interactive Supervised Classification Tool



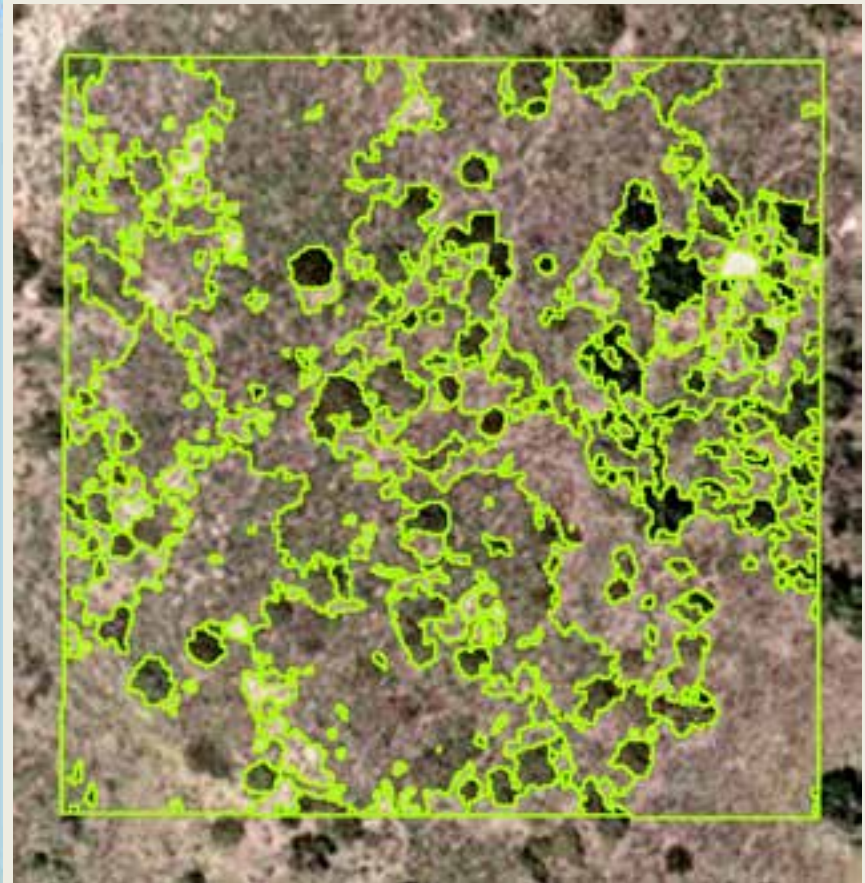
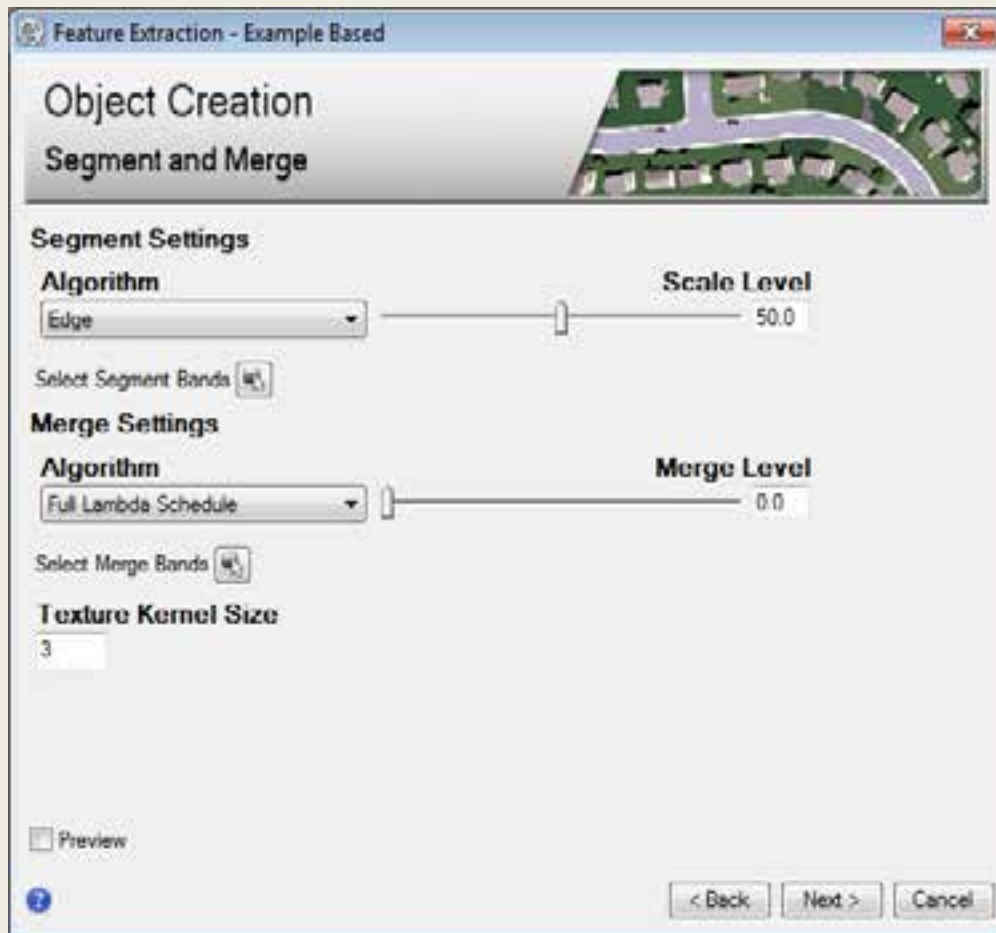
Woodland	2004_10dc1	2004_10dc2	2004_10dc3
Statistics			
Minimum	0.00	1.00	0.00
Maximum	186.00	173.00	150.00
Mean	67.92	72.92	45.26
Std.dev	26.19	24.51	23.27
Covariance			
2004_10dc1	685.78	623.31	592.84
2004_10dc2	623.31	600.87	554.96
2004_10dc3	592.84	554.96	541.32

Scrub	2004_10dc1	2004_10dc2	2004_10dc3
Statistics			
Minimum	30.00	17.00	1.00
Maximum	217.00	190.00	174.00
Mean	131.34	104.78	92.27
Std.dev	27.01	25.03	25.59
Covariance			
2004_10dc1	729.48	658.68	681.01
2004_10dc2	658.68	626.29	627.57
2004_10dc3	681.01	627.57	654.75

Grass	2004_10dc1	2004_10dc2	2004_10dc3
Statistics			
Minimum	109.00	93.00	74.00
Maximum	227.00	200.00	186.00
Mean	163.50	148.06	124.87
Std.dev	13.98	13.88	13.16
Covariance			
2004_10dc1	195.38	177.29	172.16
2004_10dc2	177.29	192.69	173.36
2004_10dc3	172.16	173.36	173.14

Object-based Classification

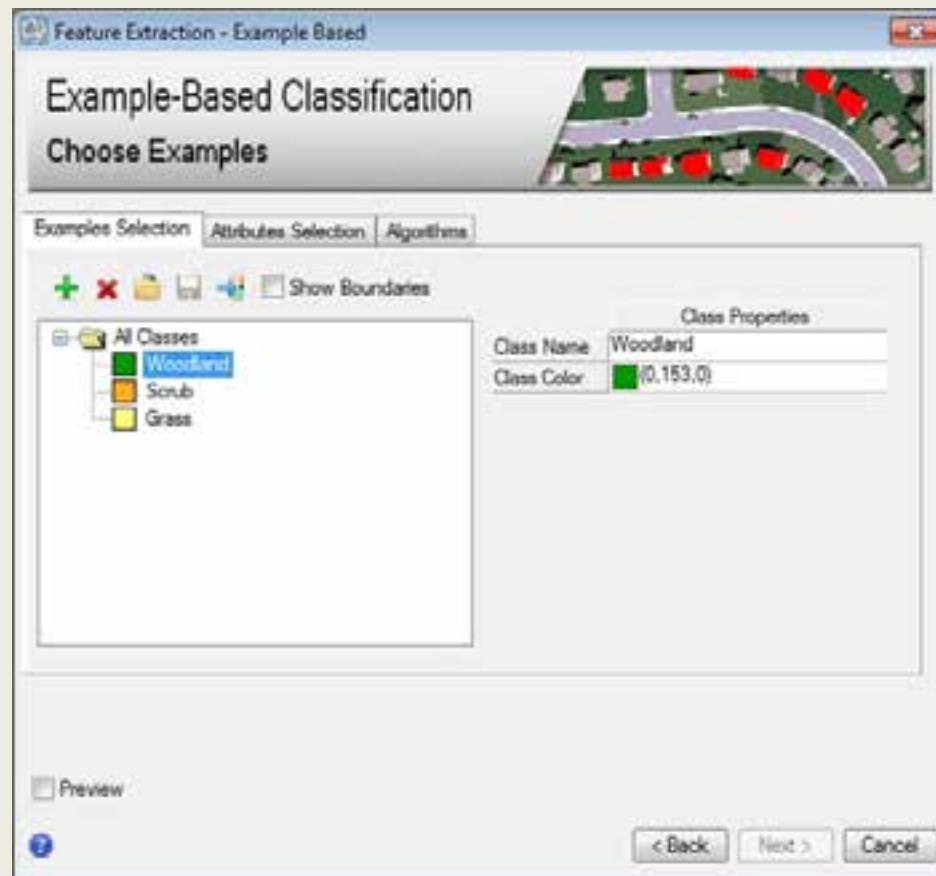
Feature Extraction



Object-based Classification

Feature Extraction

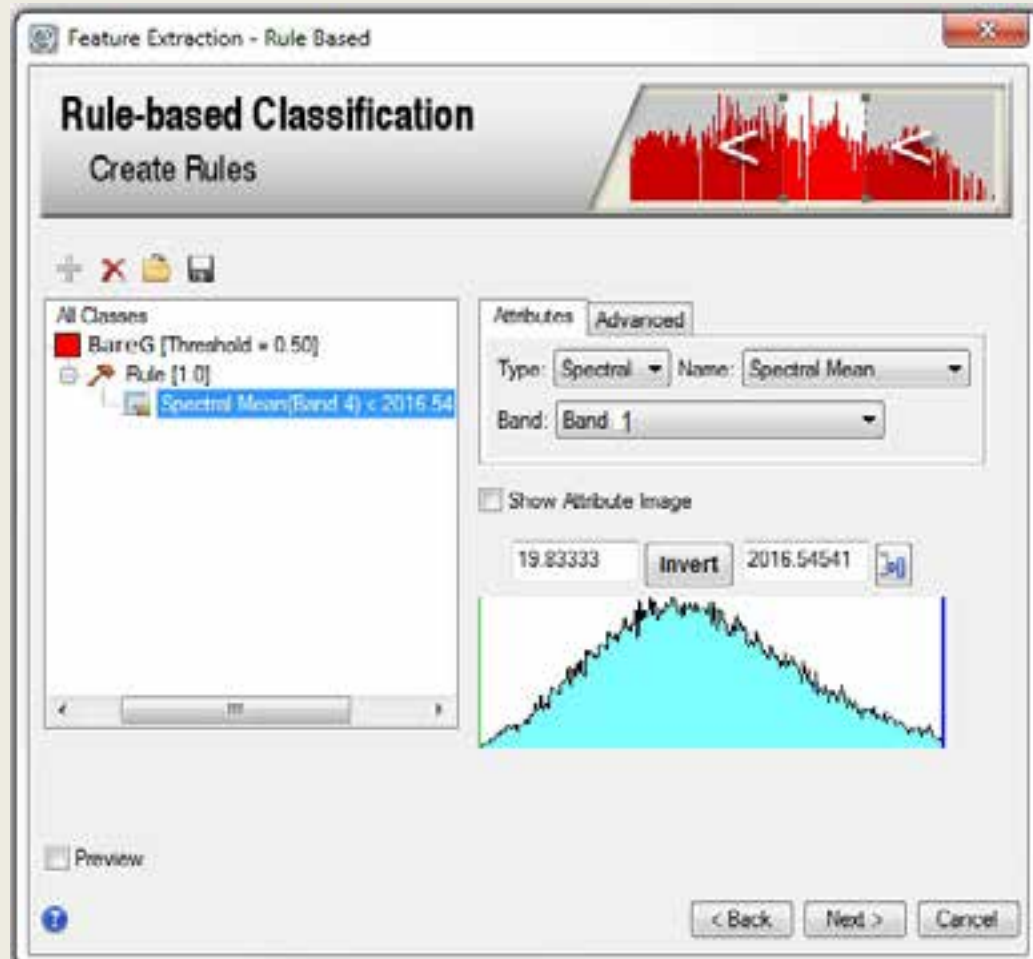
- Example-Based Classification ENVI tool



Object-based Classification

Feature Extraction

- Rule-Based Classification ENVI tool



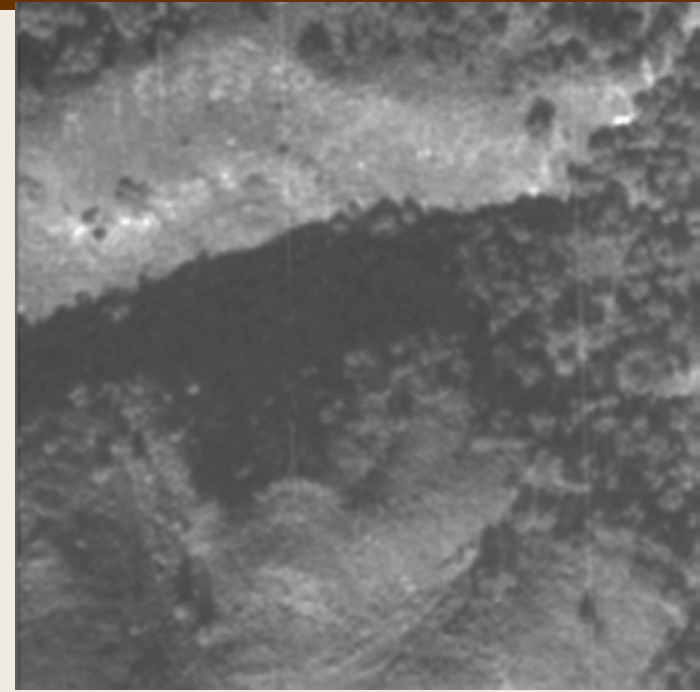
Challenges

Image Quality

- Shadow

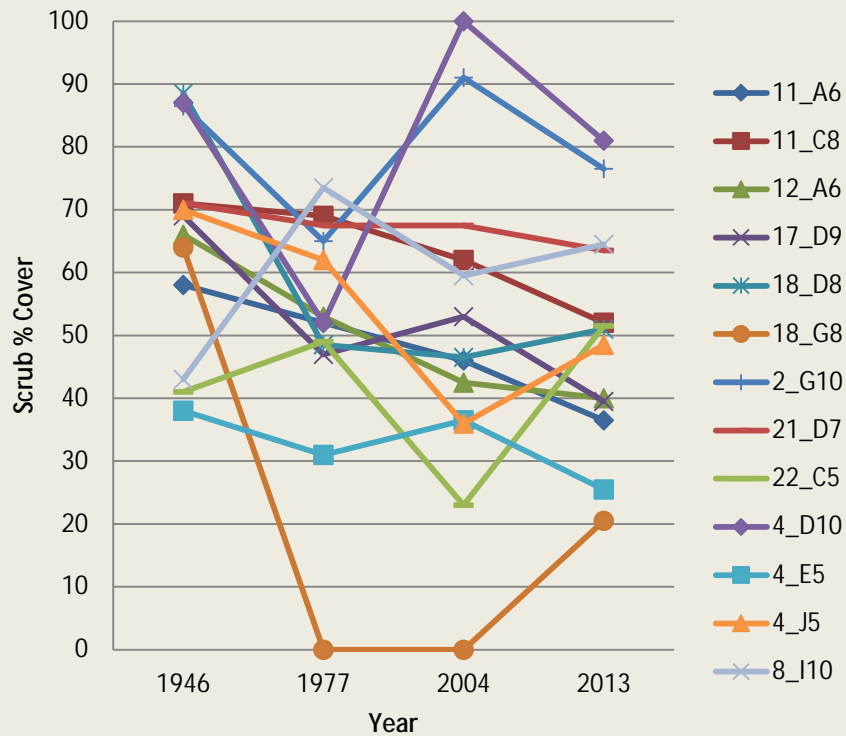
Classification

- Woodland VS Scrub(chaparral)
- Scrub VS Grassland (mustard)

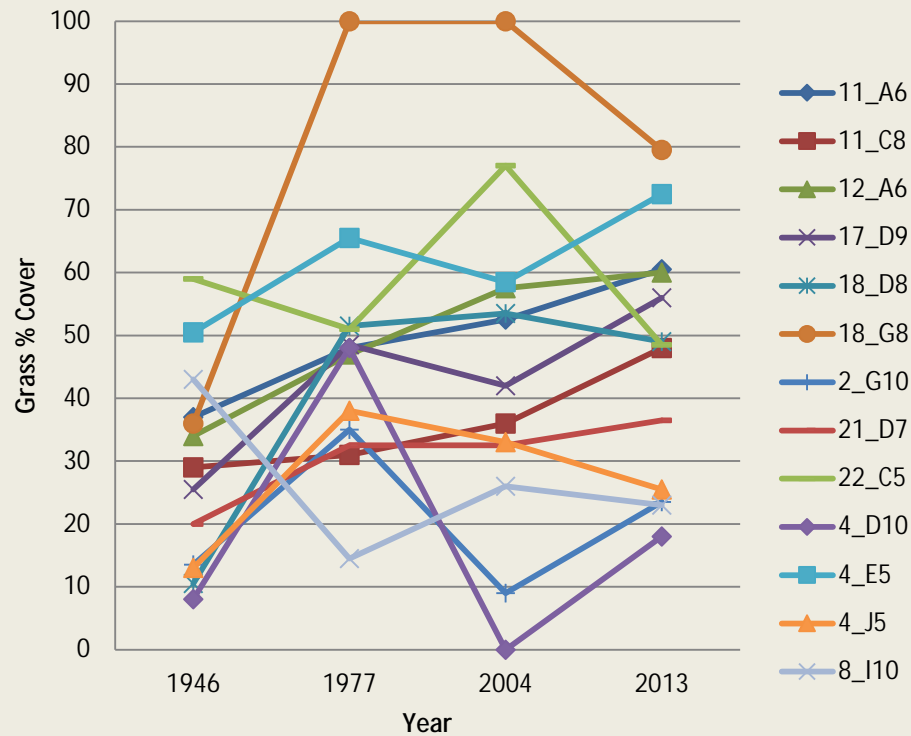


Results

Grass-Scrub Ecotone



Grass-Scrub Ecotone



Summary

Manual Classification

- Overall scrub cover decreased in scrub-grass ecotone
- Significant error based on Human interpretation

Automated Classification

- Some classes represent two vegetation types



Next Step

- Use combined method to improve classification and ground truth to performing accuracy Assessment
- Apply the classification method to the entire landscape for vegetation changing detection. Use results to describe past and predict future landscape-level changes in vegetation structure.



Question?

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Acknowledgments

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