

Using Hyperspectral Imagery for Rangeland Modeling



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Outline

✦ Introduction

- Hyperspectral
- Study area
- Subpixel compositions
- Semiarid environments

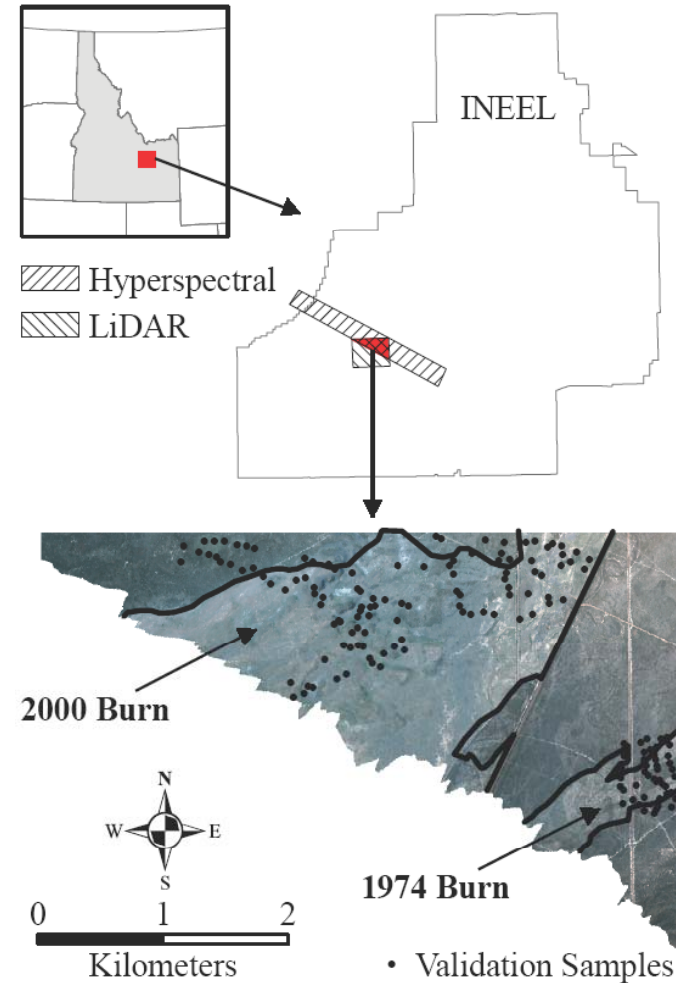
✦ Methods

- Exploratory Data Analysis
- Processing
- Classification

✦ Results

✦ Case Studies

Study Area and Data

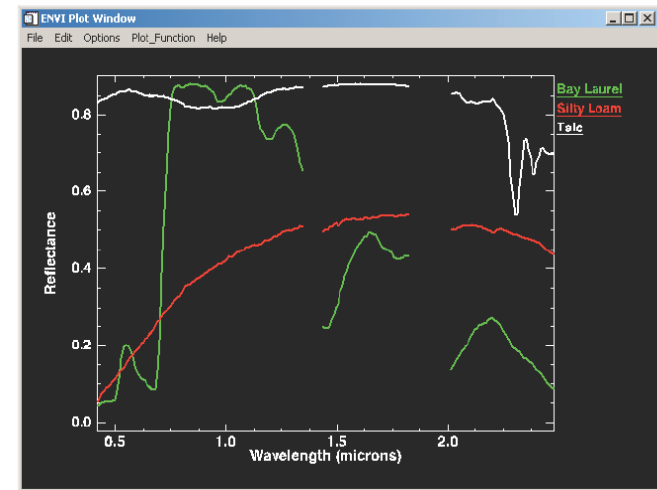
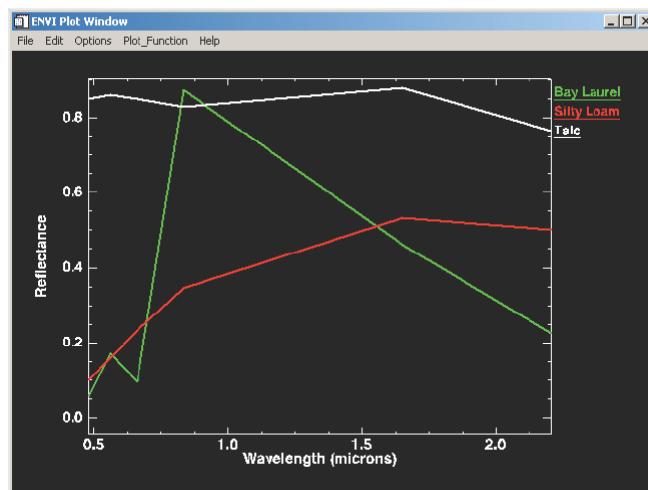
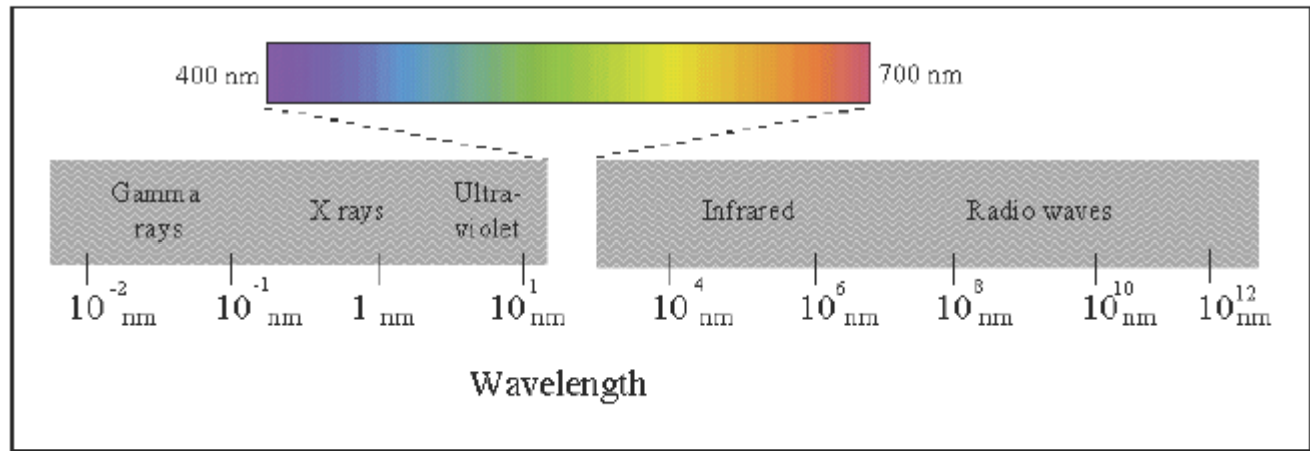


Objectives

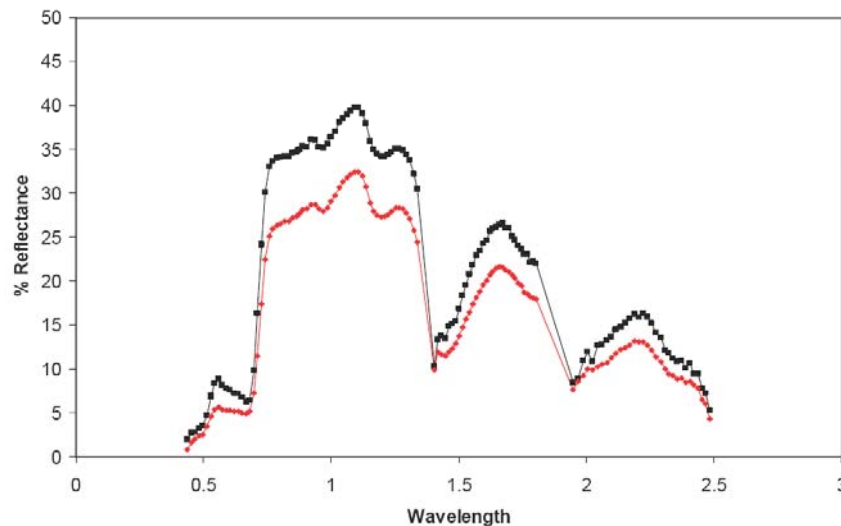
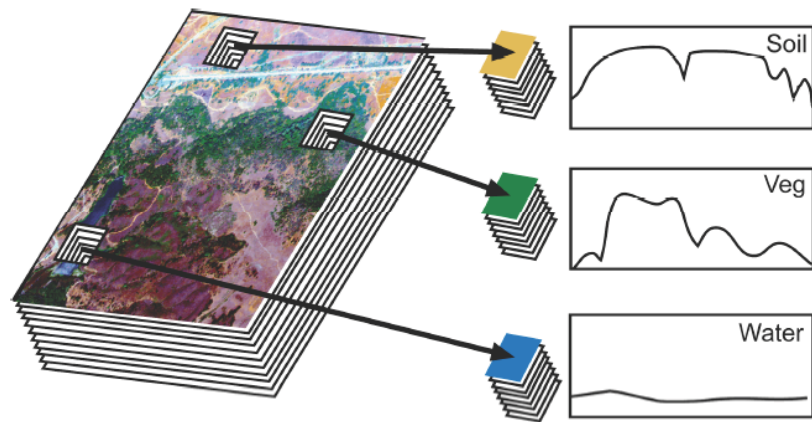
- To effectively map the distribution of sagebrush.
- Applications to range management and habitat inventory.
- To constrain potential difficulties and benefits of utilizing high resolution remote sensing data in a semiarid environment.



Hyperspectral vs. Multispectral

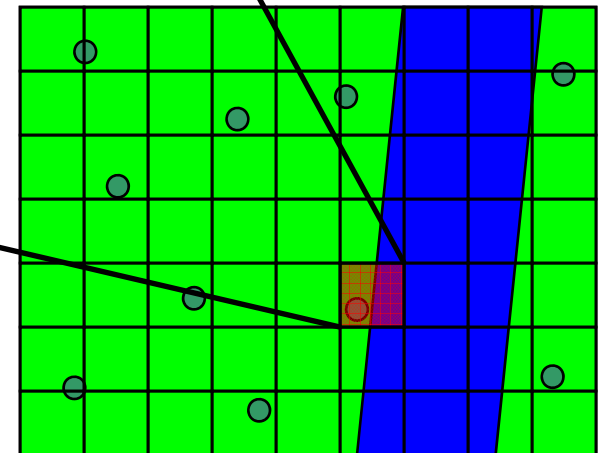
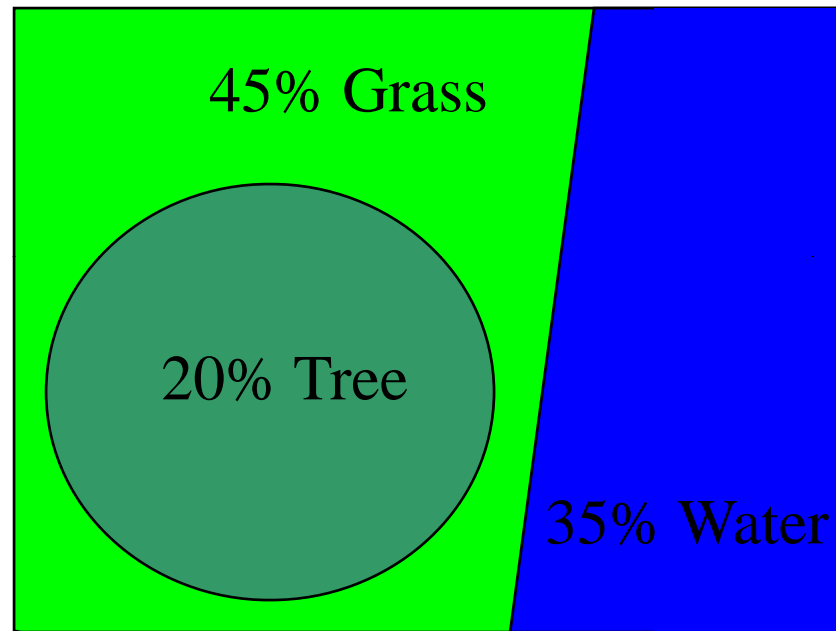


Hyperspectral Feature Extraction



- Discriminate between soil, veg, and water.
- Discriminate between similar targets (grass and leafy spurge).
- Discriminate what percentage of a target lies within a pixel (abundance).

'Subpixel' Composition

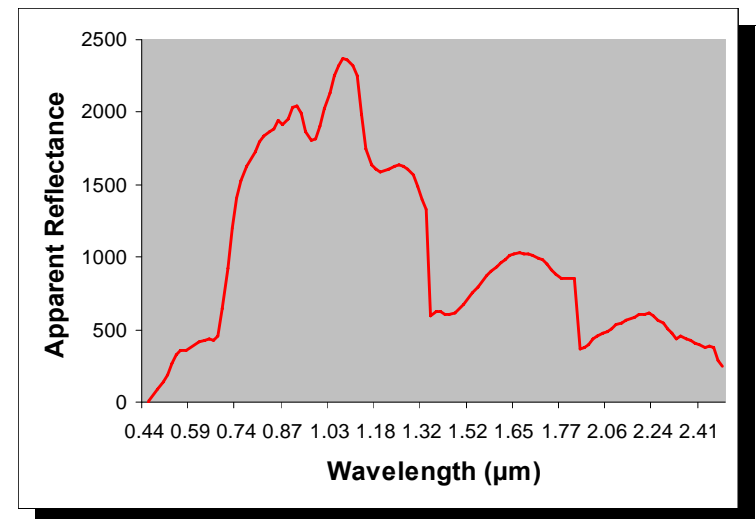




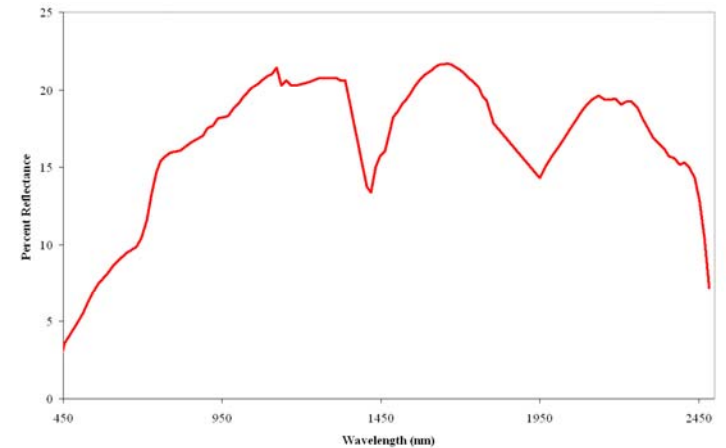
Pixel Unmixing

- Remote sensing images are considered constrained linear systems (100% full).
- Based on spectral properties, pixels can be ‘unmixed’ to determine the percent component of a target.
- Mixture Tuned Matched Filtering (MTMF) finds values for subpixel components (MF) and for infeasibility (MT).
- Low infeasibility values and high MF values are representative of high target abundance.

Semiarid Remote Sensing - Challenges

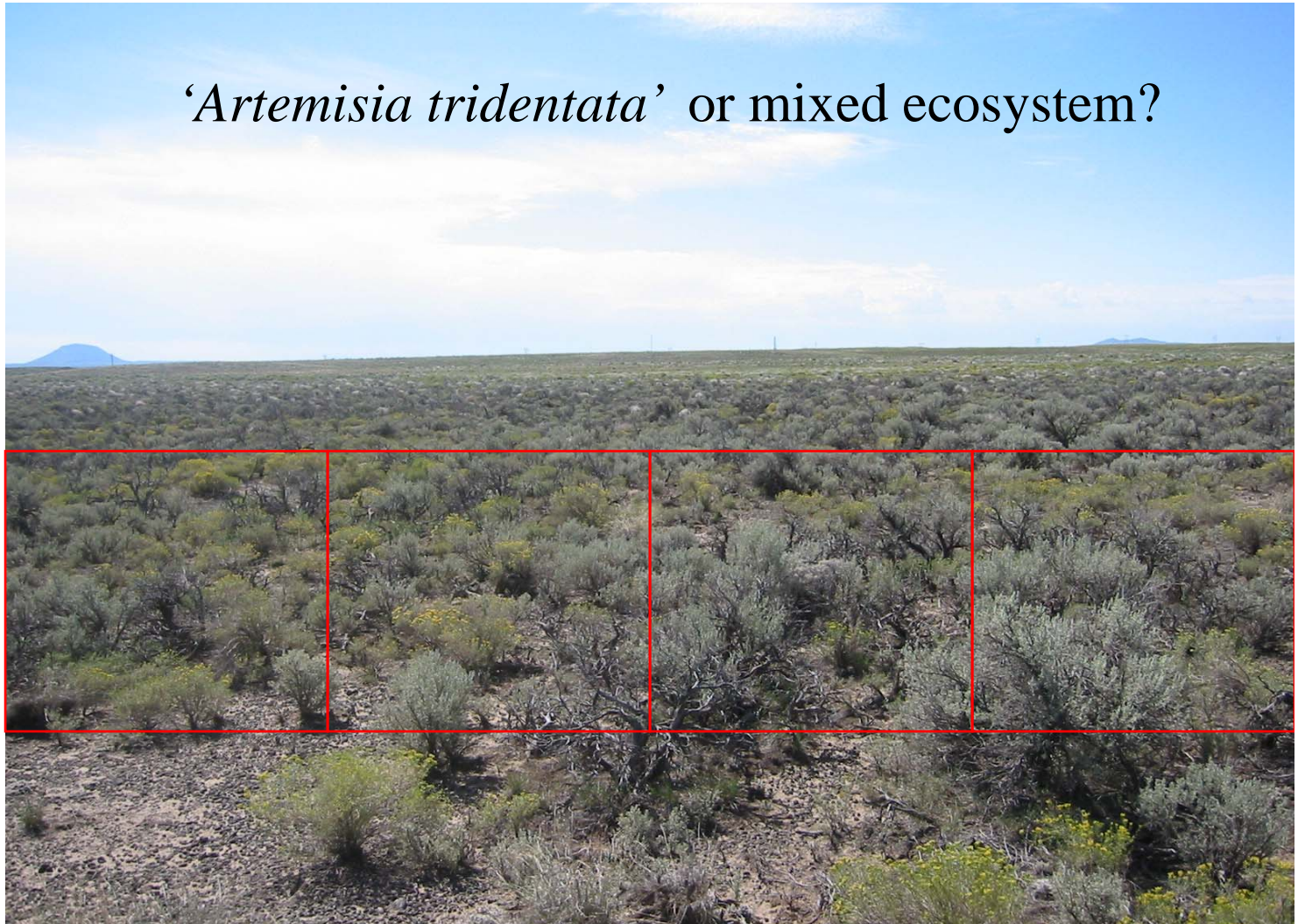


- Reduced vegetation cover
- Spectrally 'intermediate'
- Dry
- Abundant litter and dry grass
- Increased soil exposure
- Soil variability
- Non-linear mixing



"Sagebrush"

Artemisia tridentata or mixed ecosystem?

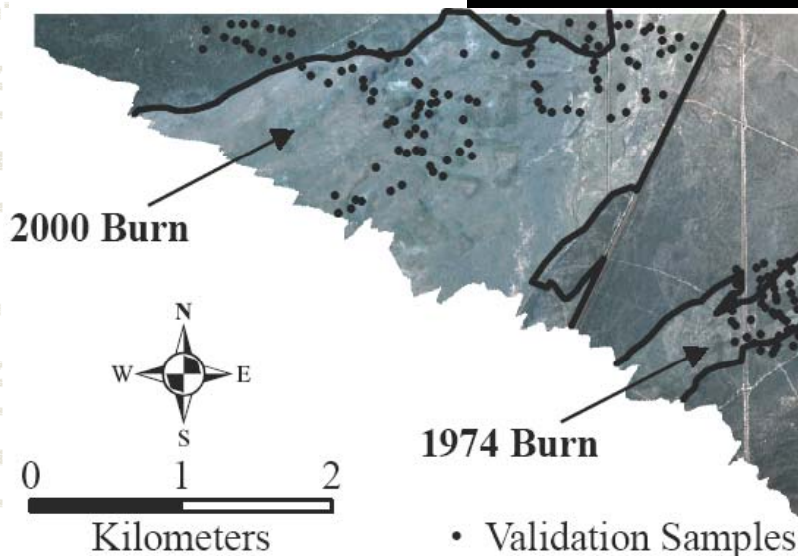
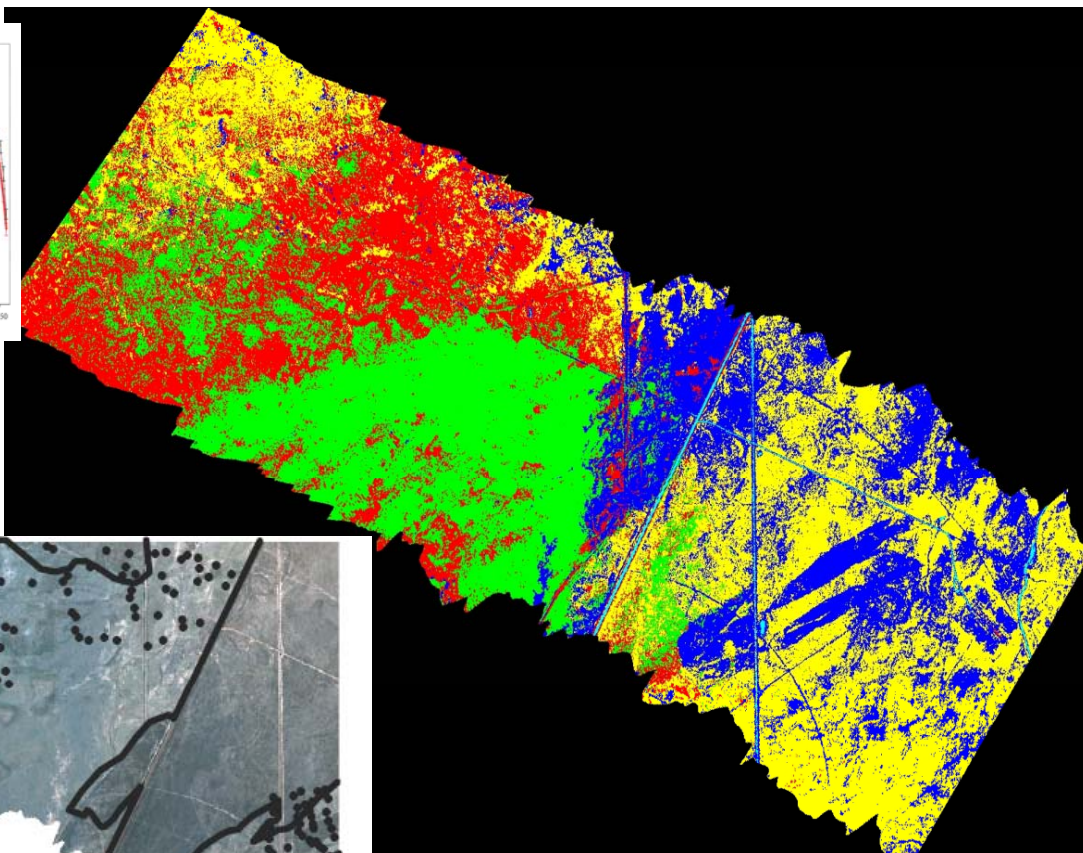
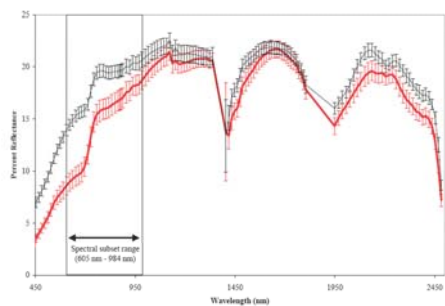


Field Validation

- ✦ 157 GPS polygons collected in 2004
- ✦ Each polygon collected 15m diameter holistic measurements
- ✦ Sagebrush presence or absence, and estimated cover

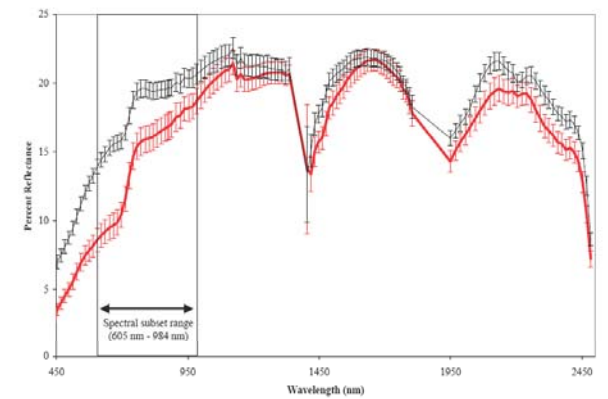
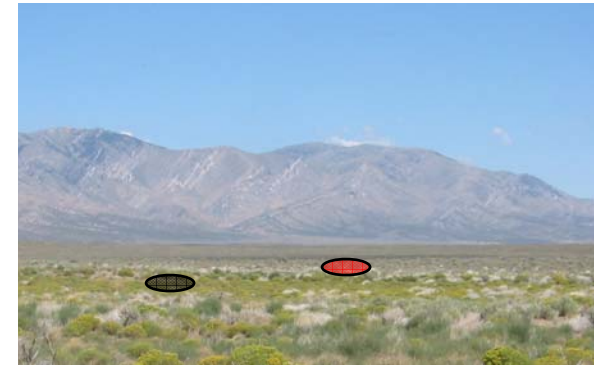
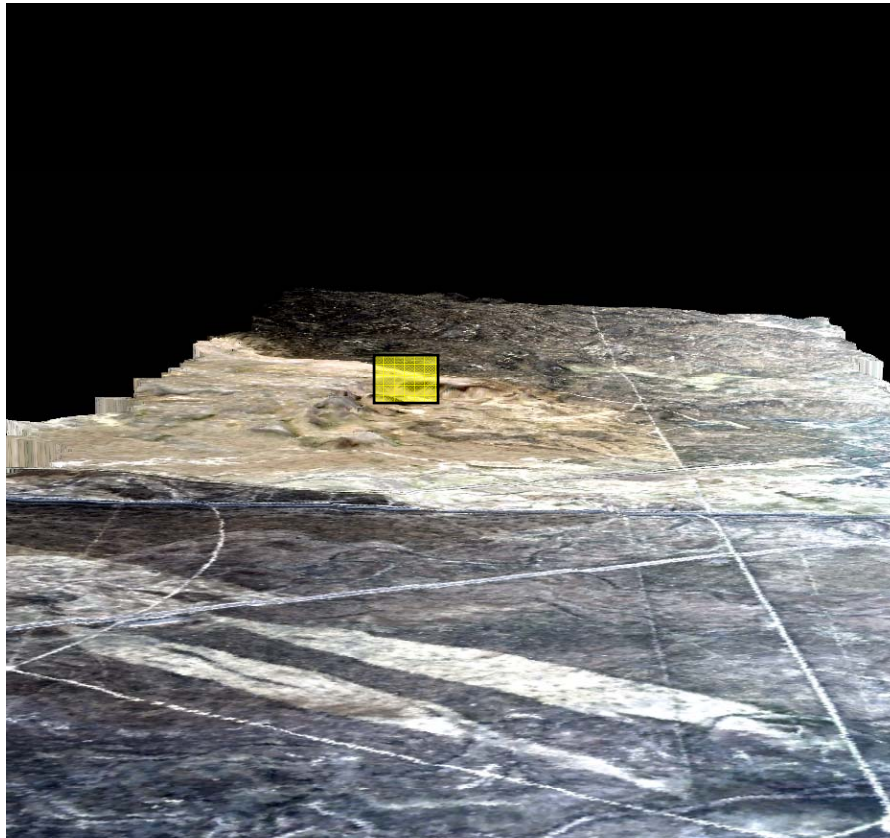


Data Exploration



• Validation Samples

Hyperspectral Processing



Endmember Selection

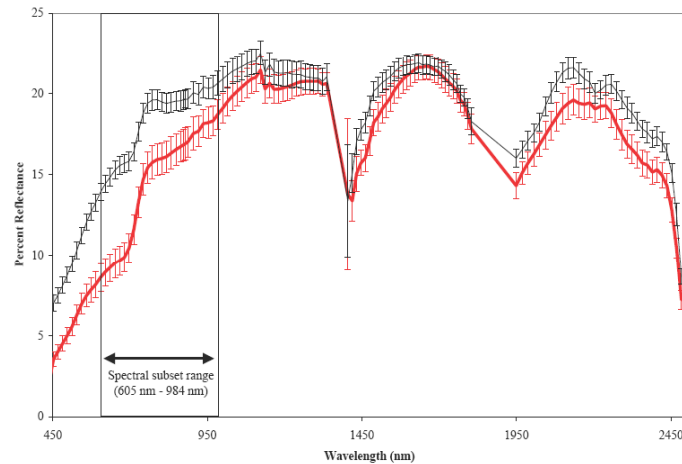
The screenshot displays the ENVI software interface with several windows open for endmember selection:

- #1 ROI Tool**: A dialog box listing available regions of interest:
 - Playa [Red] 4 points
 - Sage [Green] 7 points
 - Tumbleweeds [Blue] 3 points
 - Rabbit [Yellow] 5 points
 - Region #5 [Cyan] 0 points
- #1 Spectral Profile:ref_geo**: A graph showing the spectral profile of a selected region. The y-axis is labeled 'value' (0 to 5000) and the x-axis is 'Wavelength' (0.5 to 2.0). A red vertical line is positioned at approximately 0.65 micrometers.
- #1 Zoom [6x]:(BC)**: A zoomed-in view of the selected region.
- 3D SurfaceView (Vert Exag: 10.0)**: A 3D perspective view of the terrain.
- #1 Scroll (0.15265)**: A scroll view of the selected region.

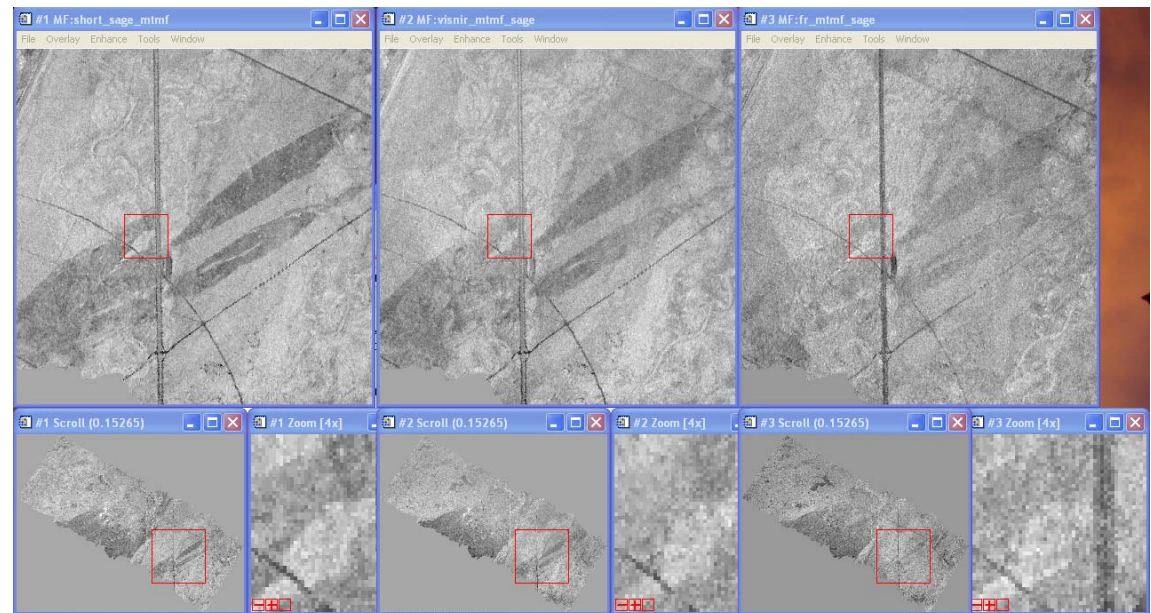
At the bottom, a table titled "Selected Attributes of validation_polygons" is visible:

FID	Shape*	Date_	pct_sb	pct_rb	pct_grass	pct_bare	hgt_rb	hgt_sb	hgt_grass	comments
134	Polygon	7/22/2004	0	0	0	-999	-999	-999	-999	ded tw drift

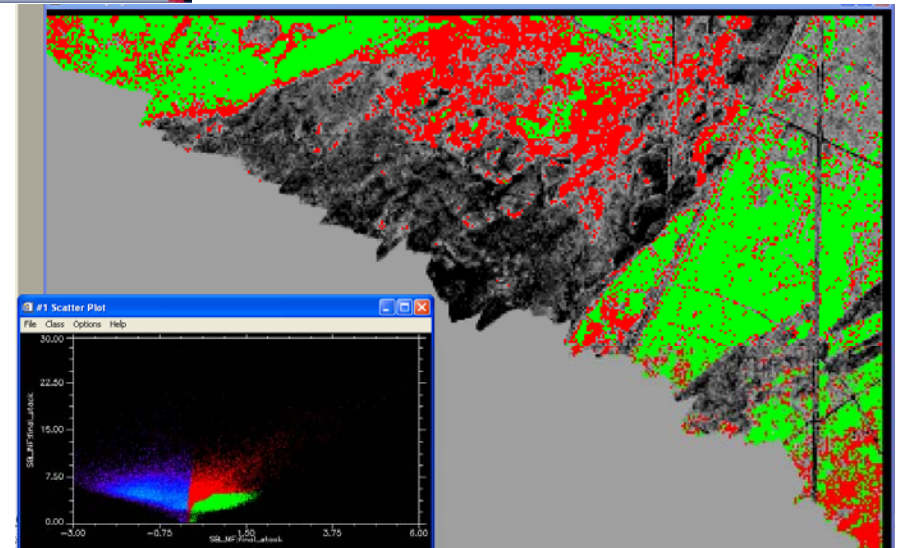
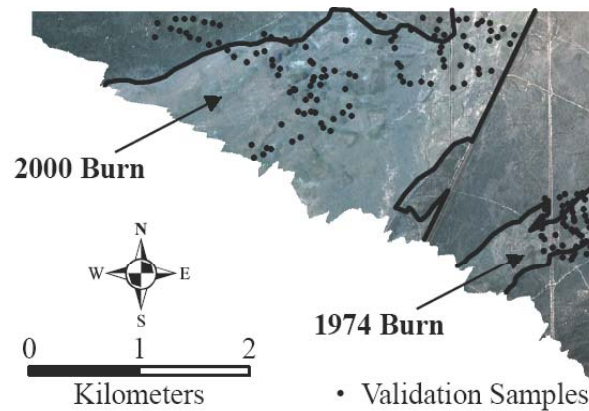
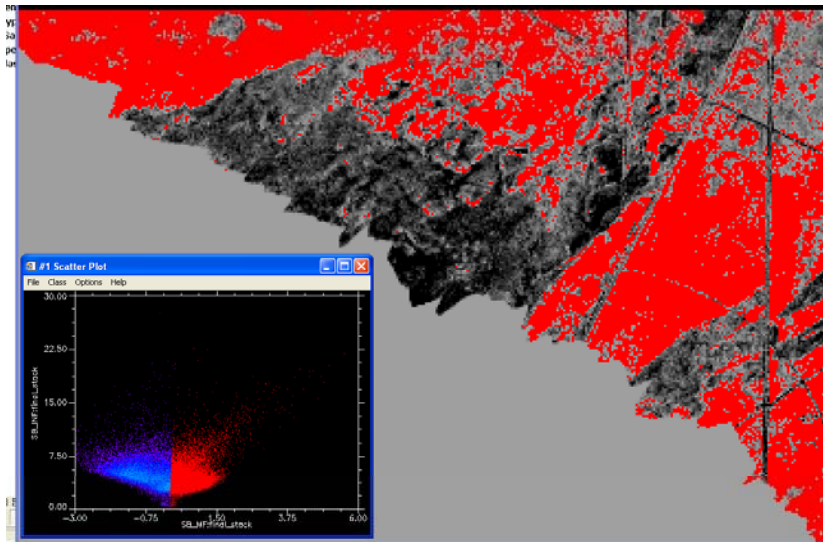
Iterative Processing



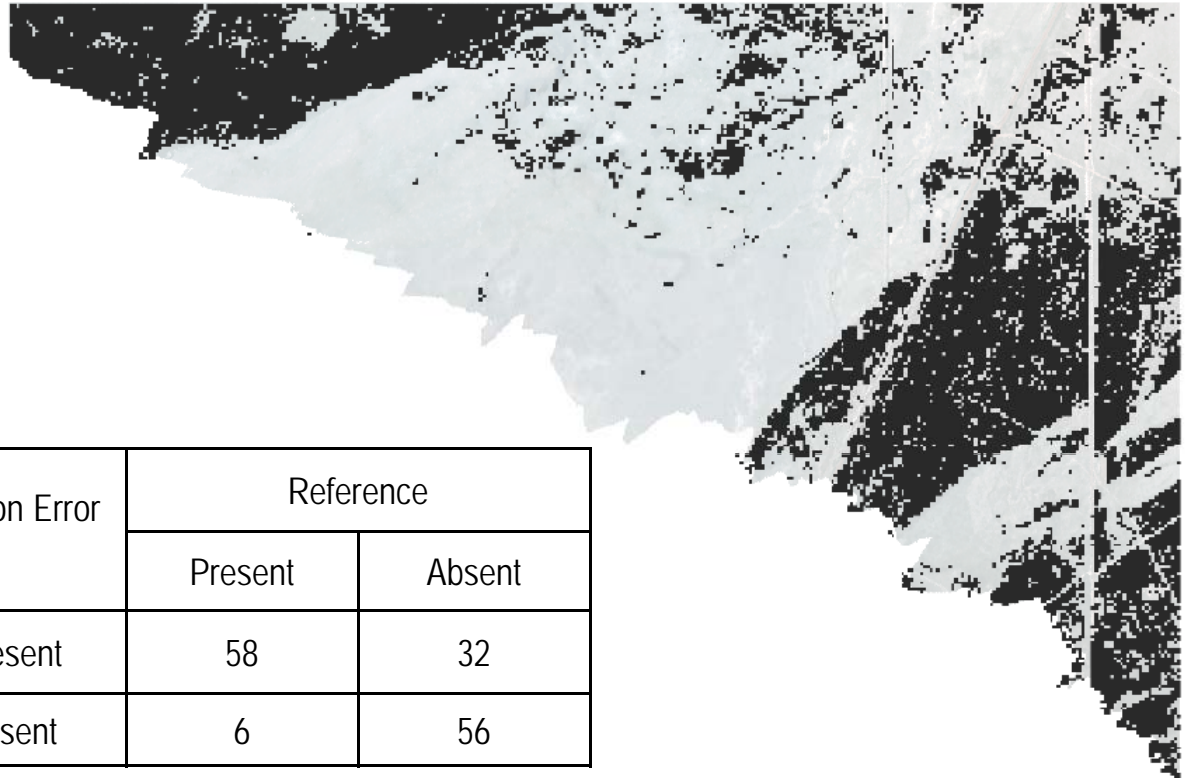
- Spectral subsets
- Different endmembers
- Classification strategy
- Interpretative assessment



Classification



Accuracy



Sagebrush Classification Error Matrix		Reference	
		Present	Absent
Classified	Present	58	32
	Absent	6	56

Producer's Accuracy = 91%

User's Accuracy = 64%

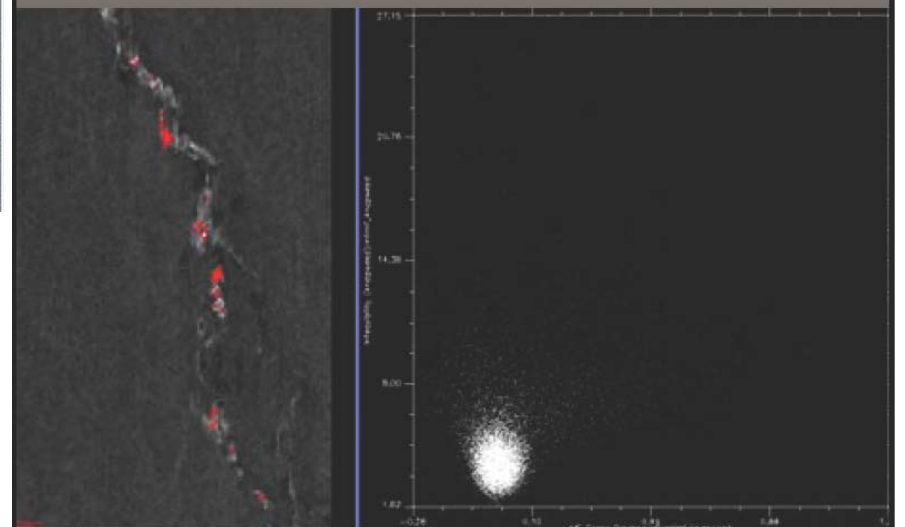
Total Accuracy = 75%

Spotted Knapweed - INEEL

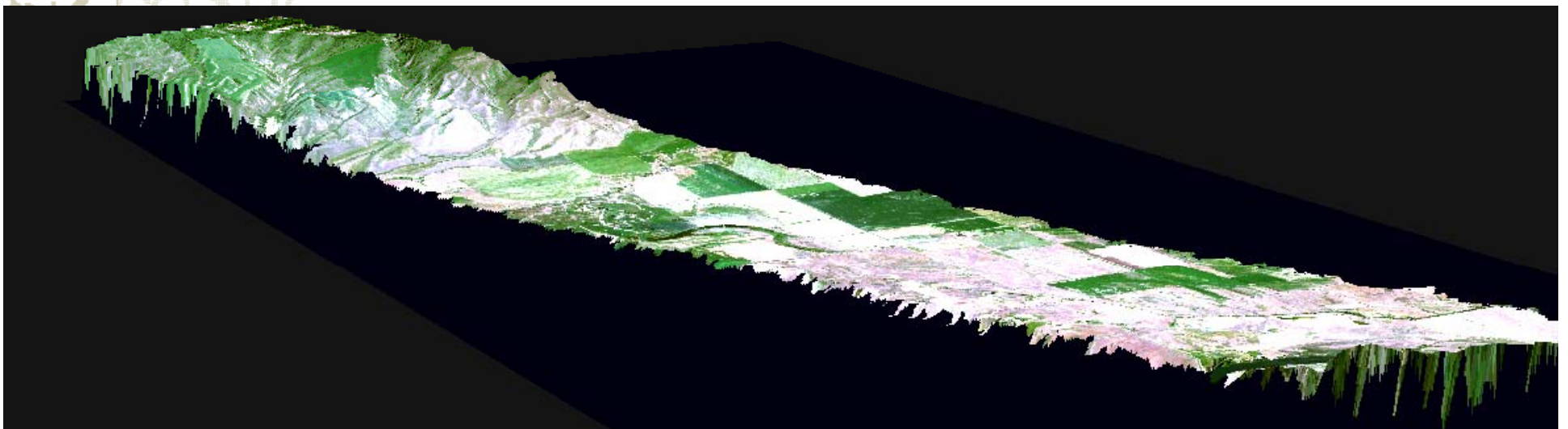
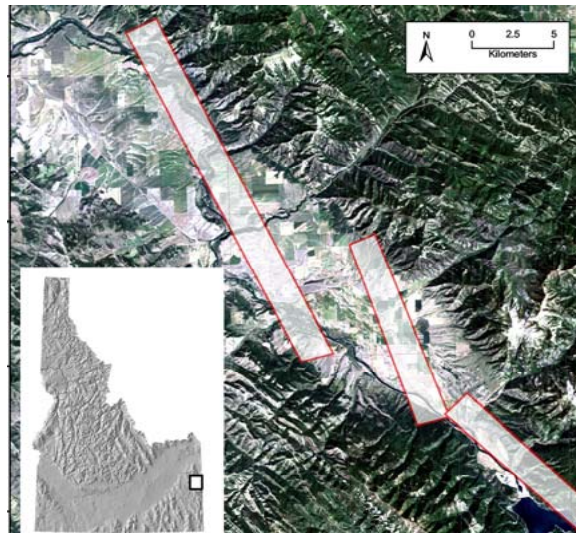


- Accuracies approximately 80%
- Lack of Data

Control Area in Birch Creek



Leafy Spurge – Swan Valley

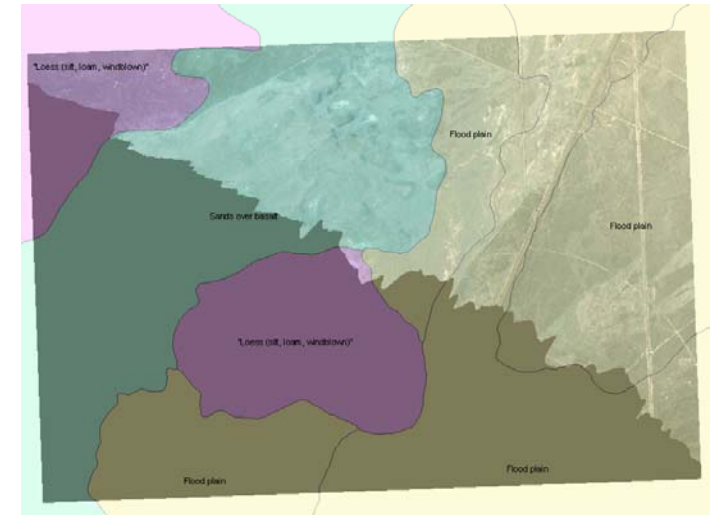


Leafy Spurge (cont.)

- 65% Producer's accuracy
- 88% User's accuracy
- Dominantly small and low cover infestations



Semiarid Complications





Conclusions and Future Work

- Hyperspectral data has a demonstrated ability to discriminate rangeland vegetation and weeds.
- High spatial resolution data provides high spatial resolution maps for inventory and management decision support.
- Semiarid environments are difficult in the context of remote sensing, however intensive processing can result in a worthwhile product.
- The next generation: operational level implementation! Researching what works and what does not in an applied context.

Questions?

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