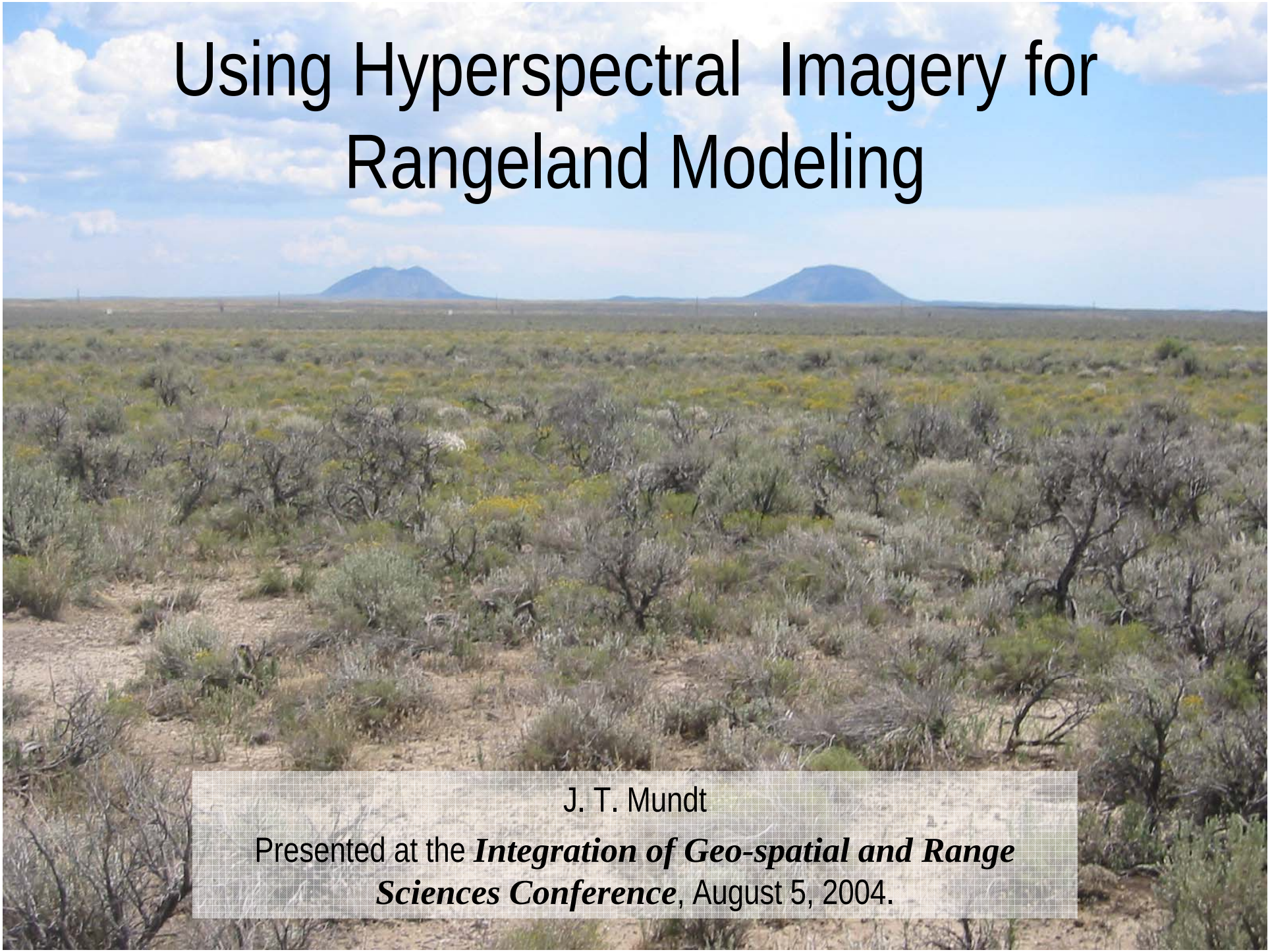
Using Hyperspectral Imagery for Rangeland Modeling



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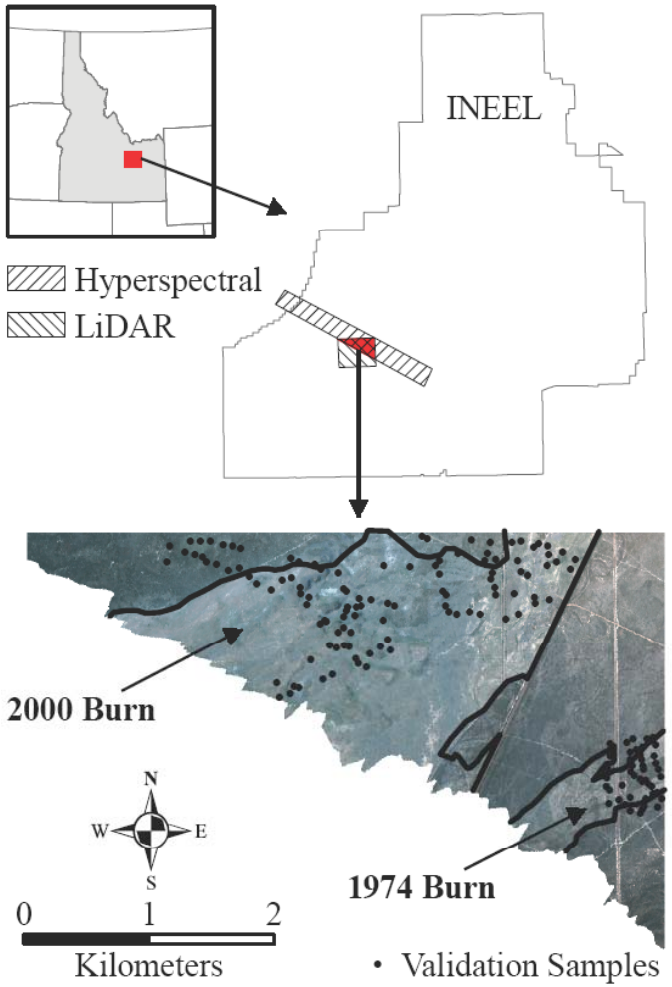
Presented at the ***Integration of Geo-spatial and Range Sciences Conference***, August 5, 2004.

Outline

- Introduction
  - Hyperspectral
  - Study area
  - Subpixel compositions
  - Semiarid environments
- Methods
  - Exploratory Data Analysis
  - Processing
  - Classification
- Results
- Case Studies

Study Area and Data



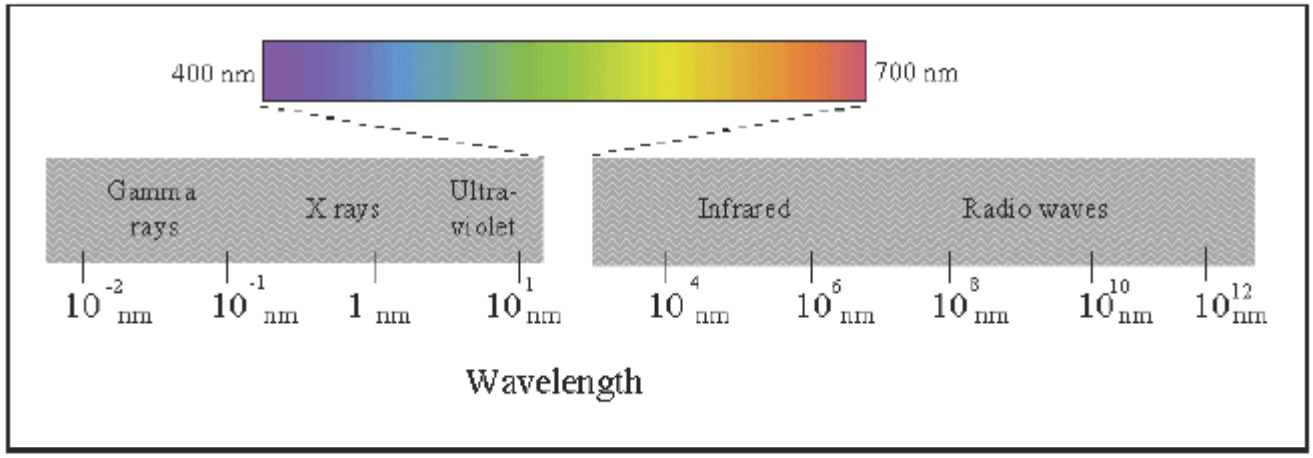
Objectives

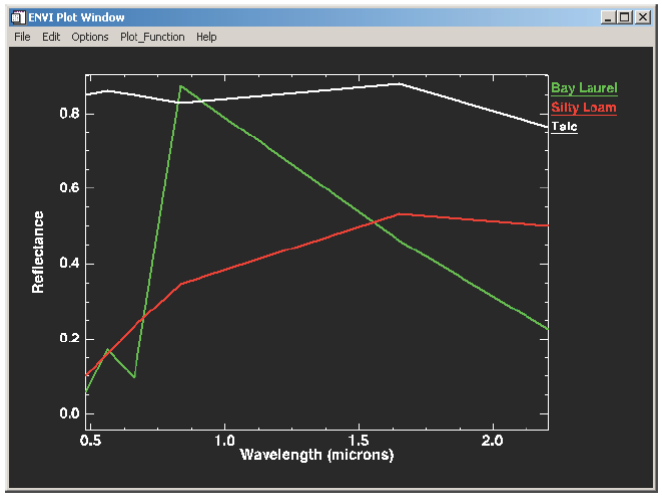
• To effectively map the distribution of sagebrush.

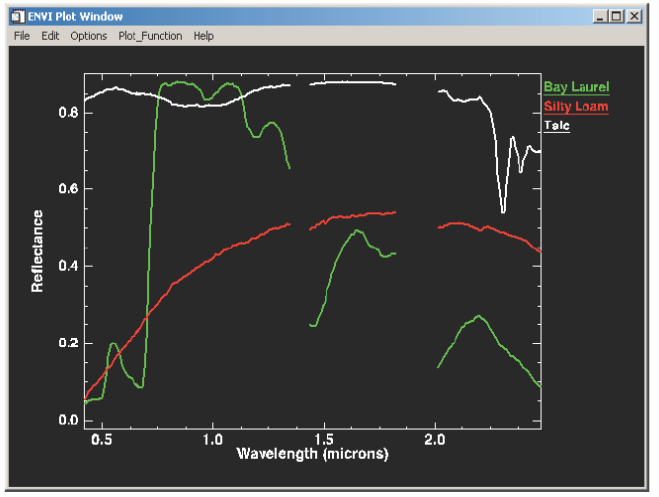
•Applications to range management and habitat inventory.

• To constrain potential difficulties and benefits of utilizing high resolution remote sensing data in a semiarid environment.

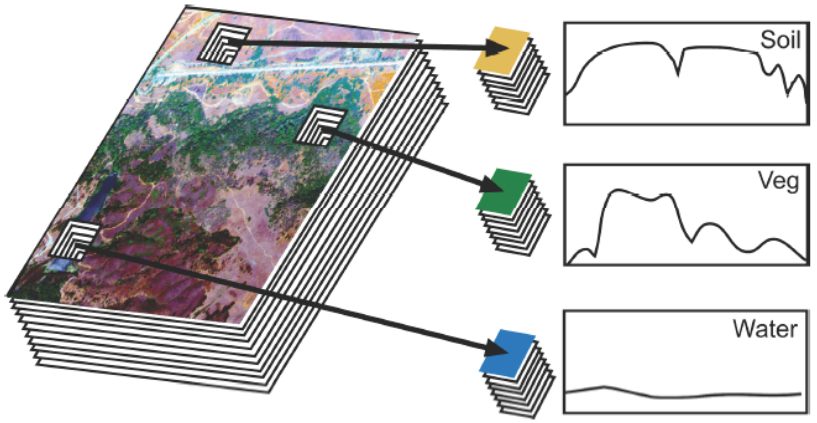
Hyperspectral vs. Multispectral

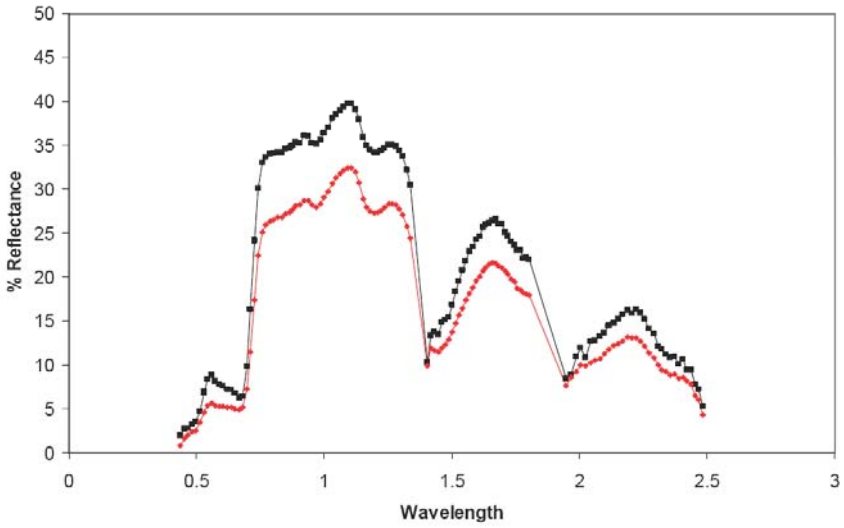






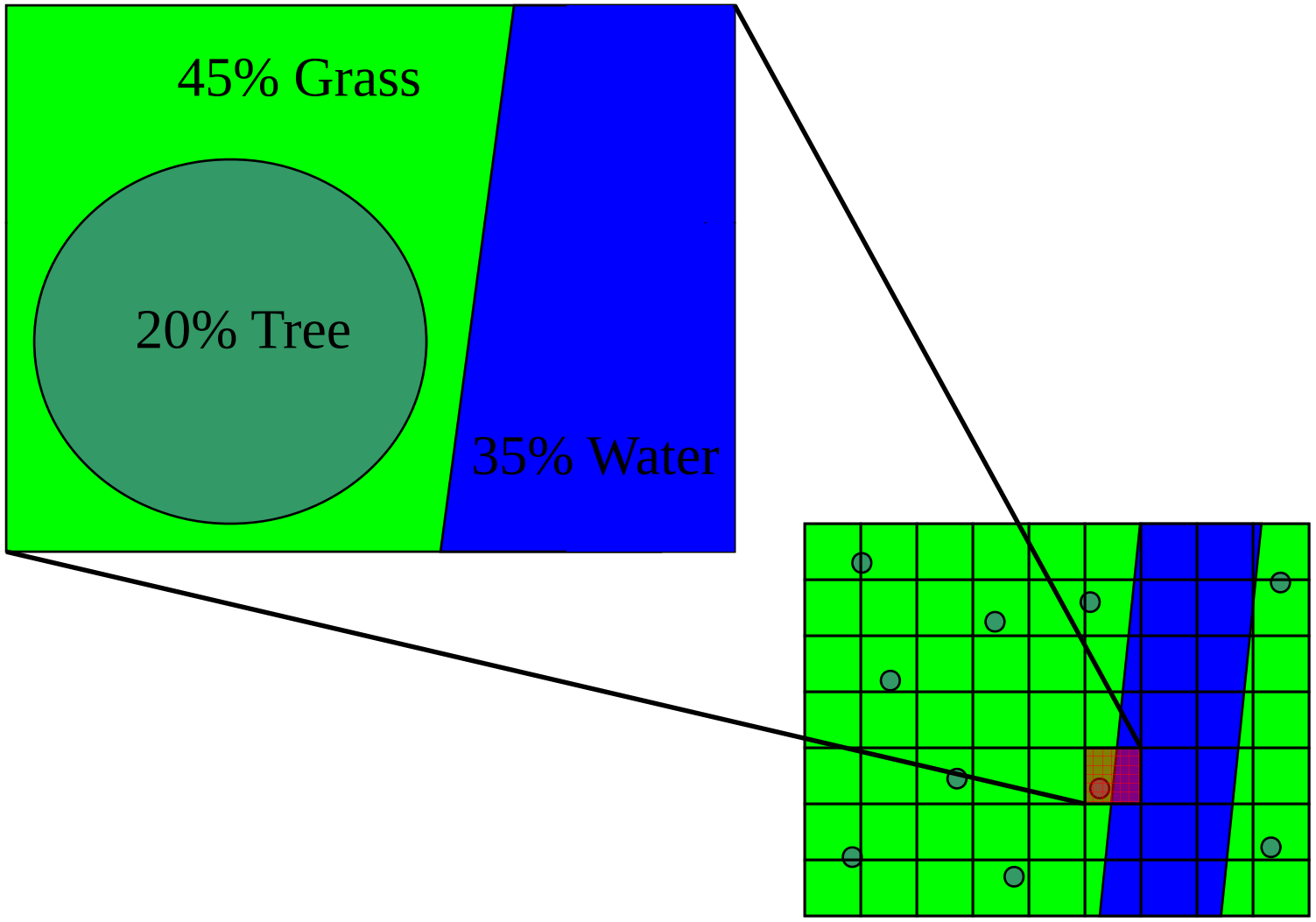
Hyperspectral Feature Extraction





- 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

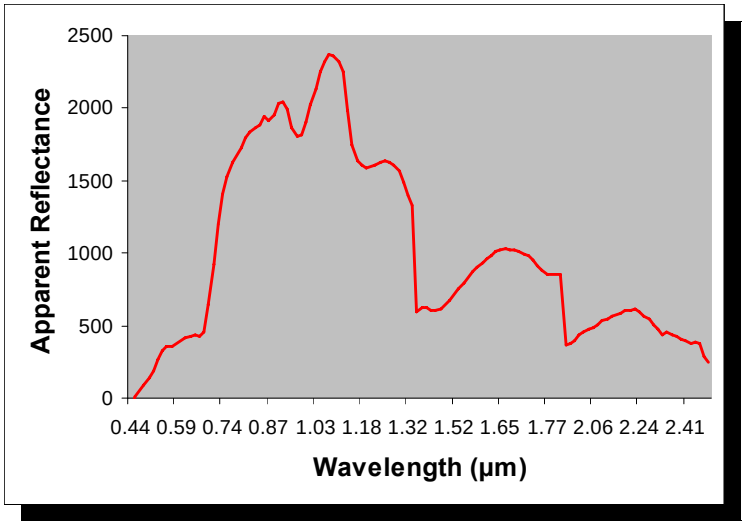
• Remote sensing images are considered constrained linear systems (100% full).

•Based on spectral properties, pixels can be ‘unmixed’ to determine the percent component of a target.

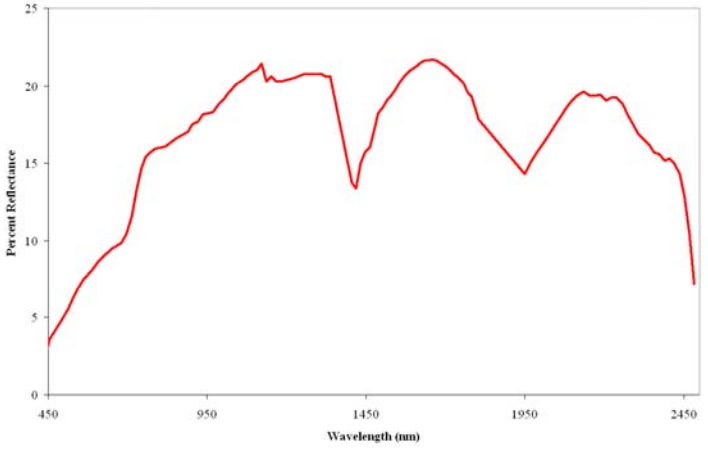
•Mixture Tuned Matched Filtering (MTMF) finds values for subpixel components (MF) and for infeasibility (MT).

• Low infeasibility values and high MF values are representative of high target abundance.

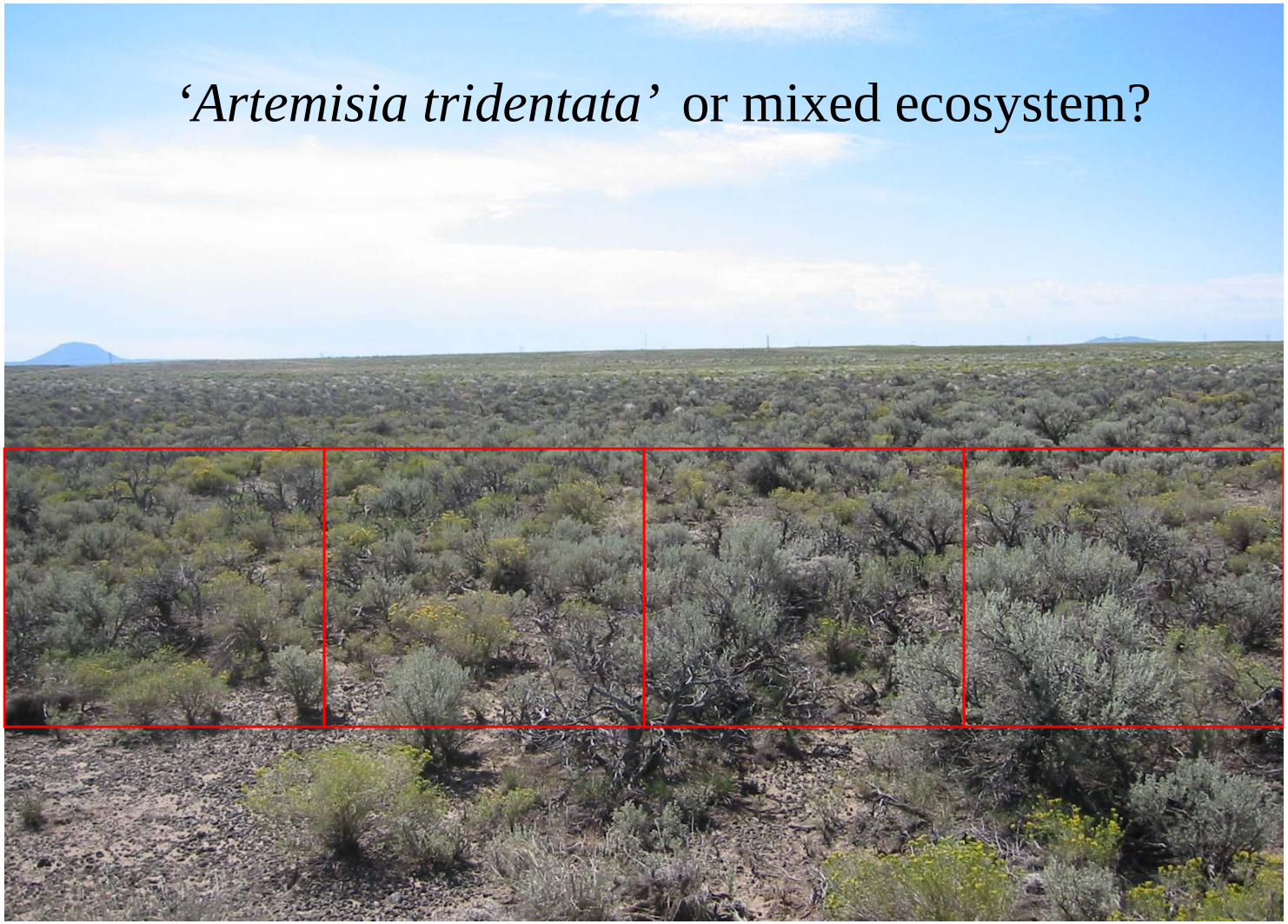
Semiarid Remote Sensing - Challenges



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



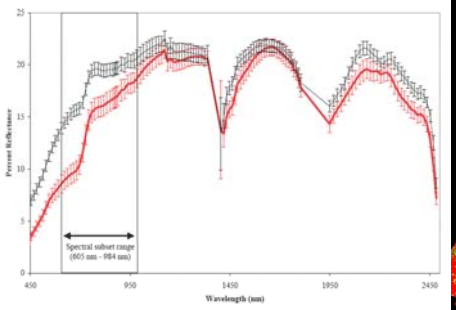
“Sagebrush”

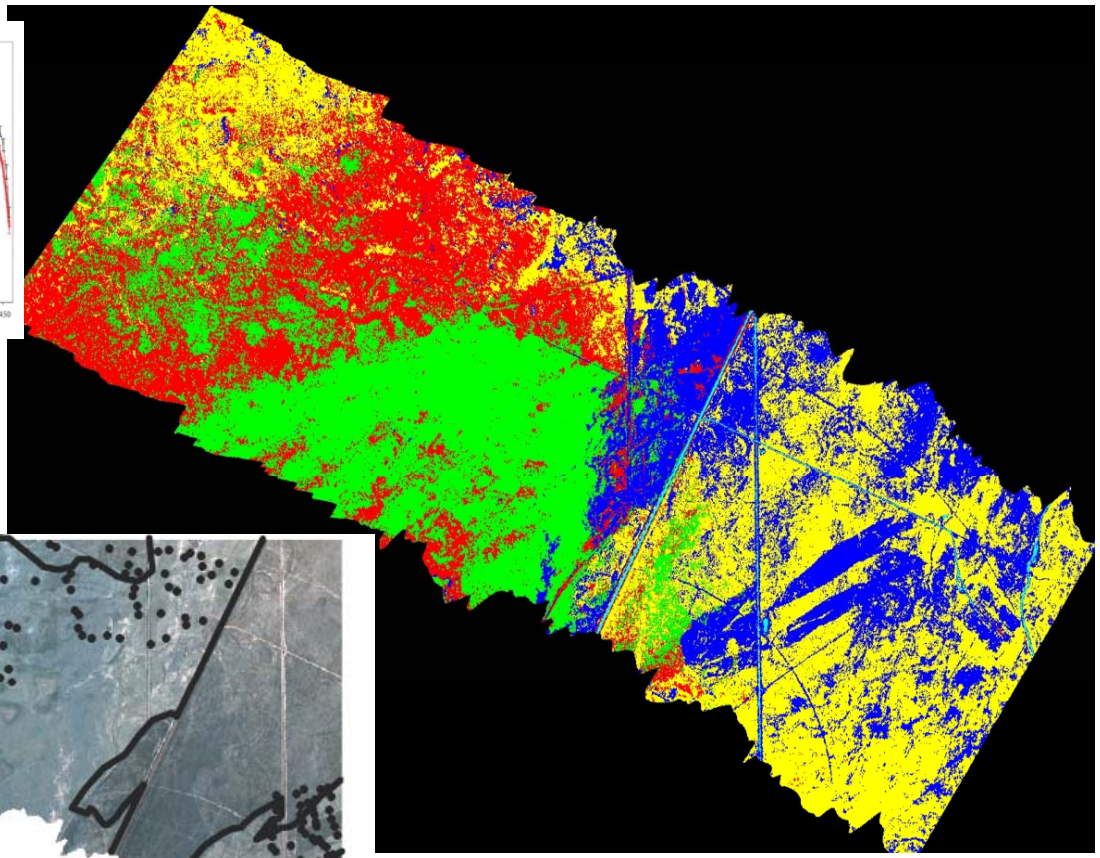


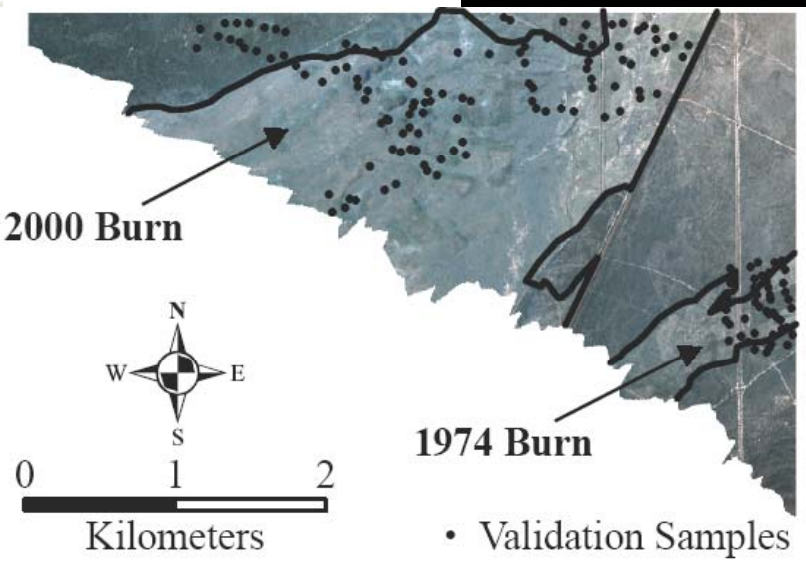
Field Validation

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

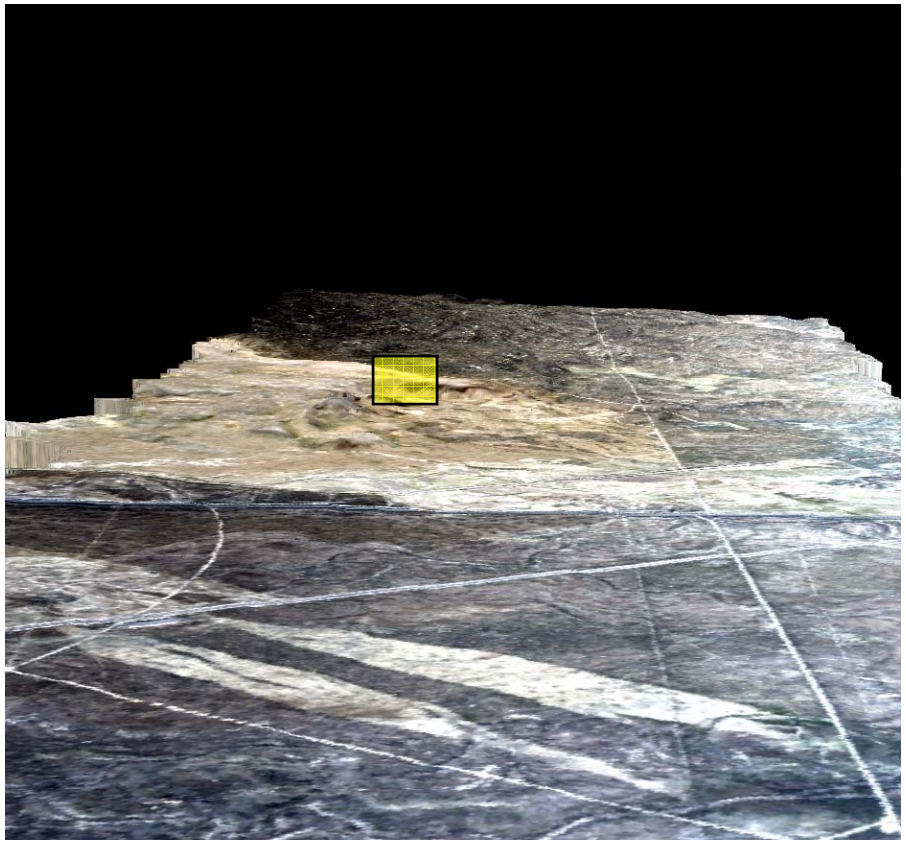
Data Exploration

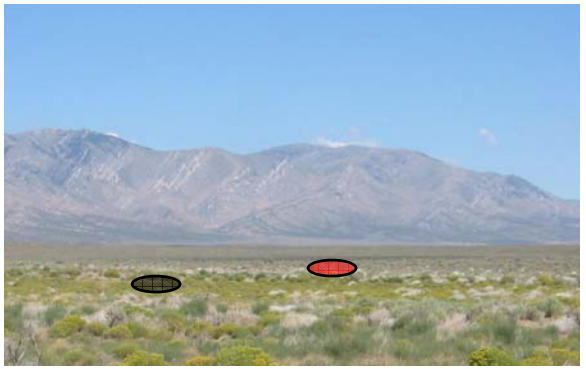


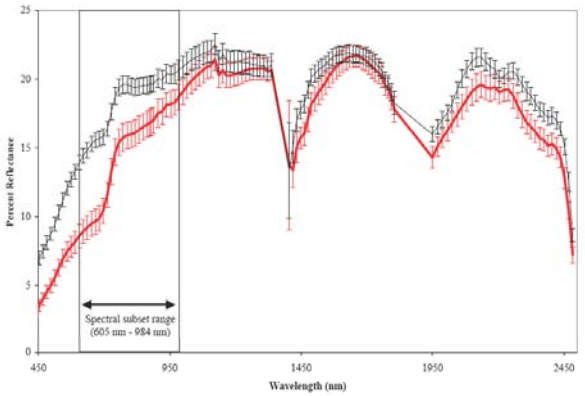




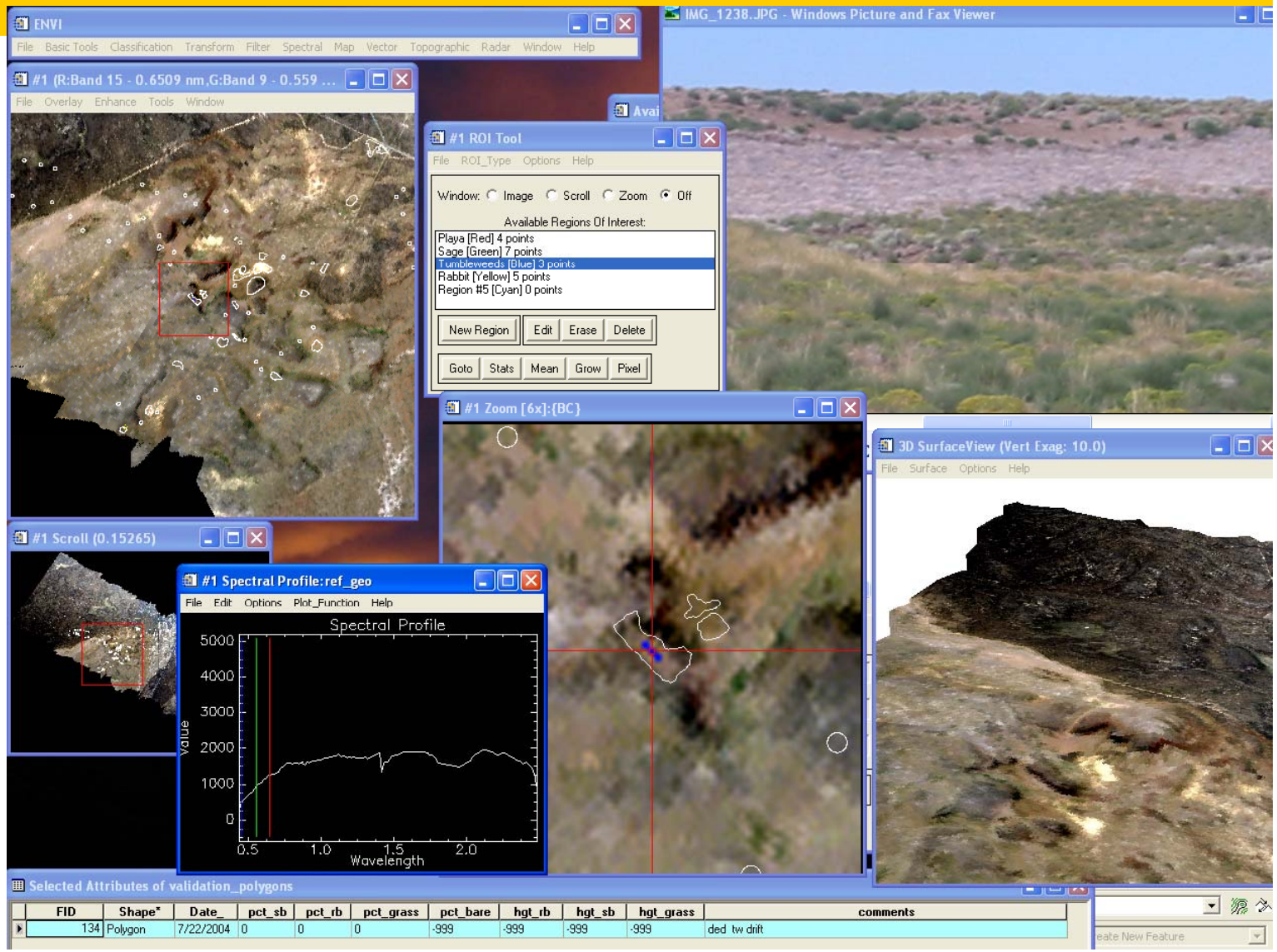
Hyperspectral Processing



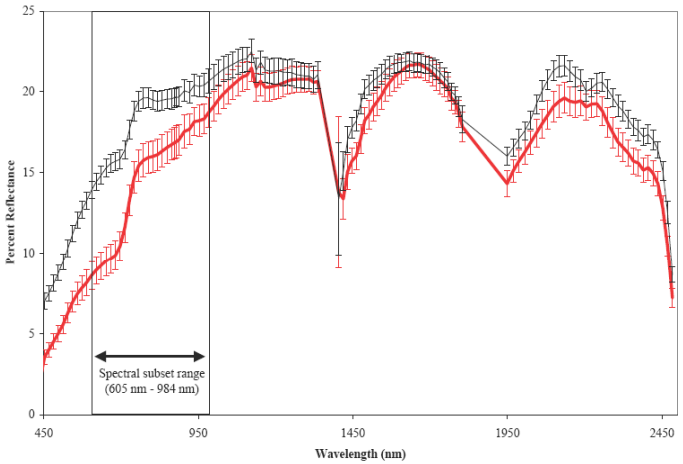




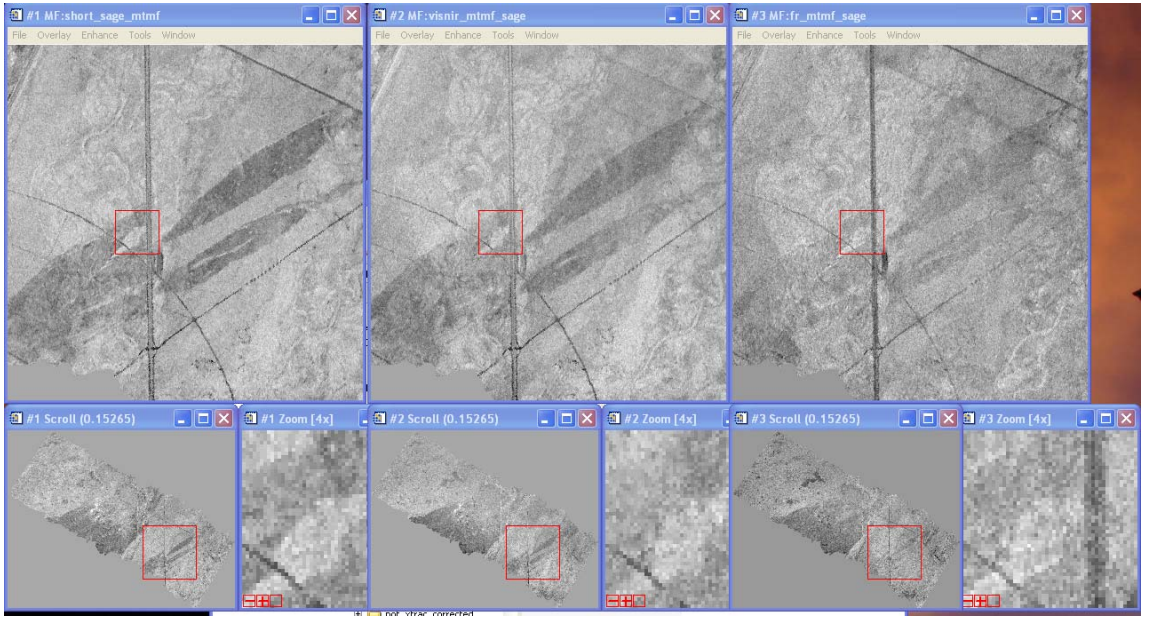
Endmember Selection



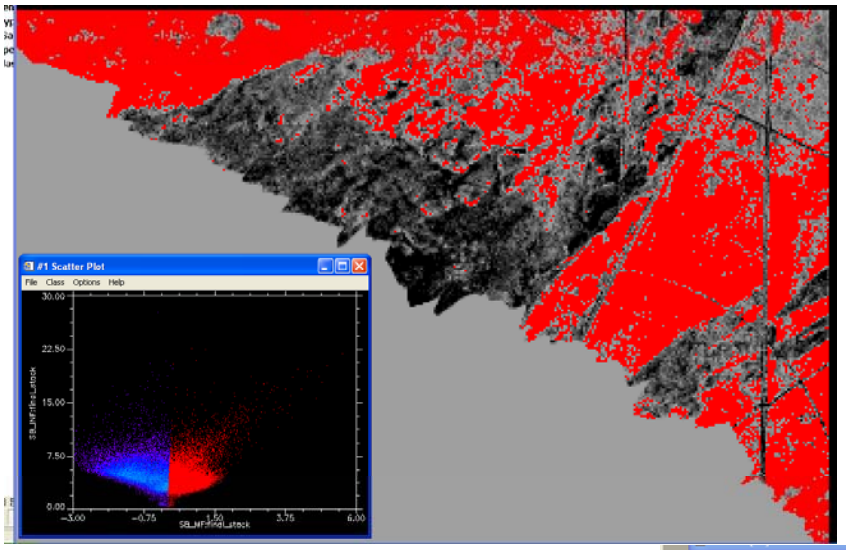
Iterative Processing

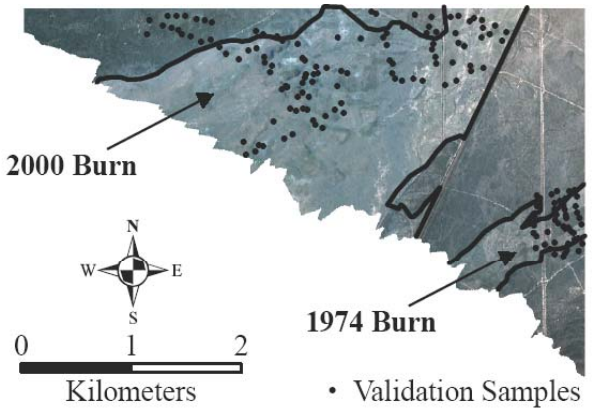


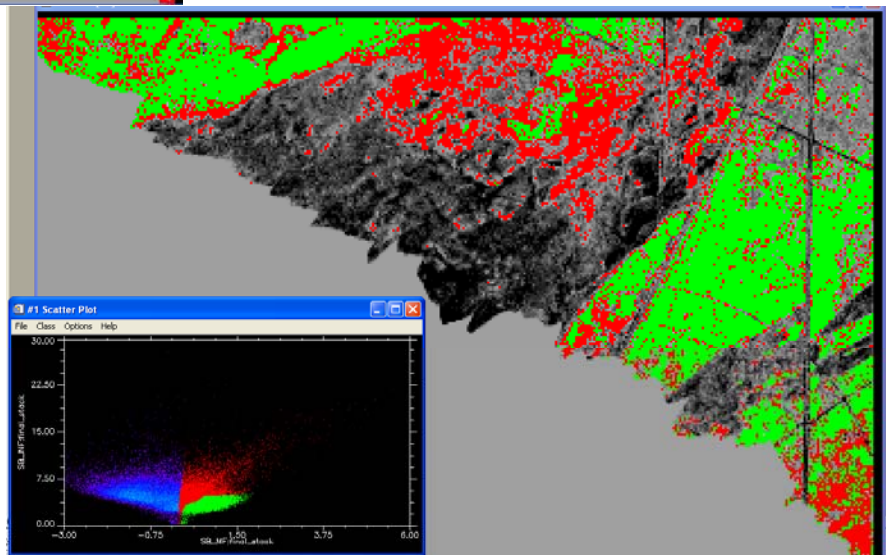
- Spectral subsets
- Different endmembers
- Classification strategy
- Interpretative assessment



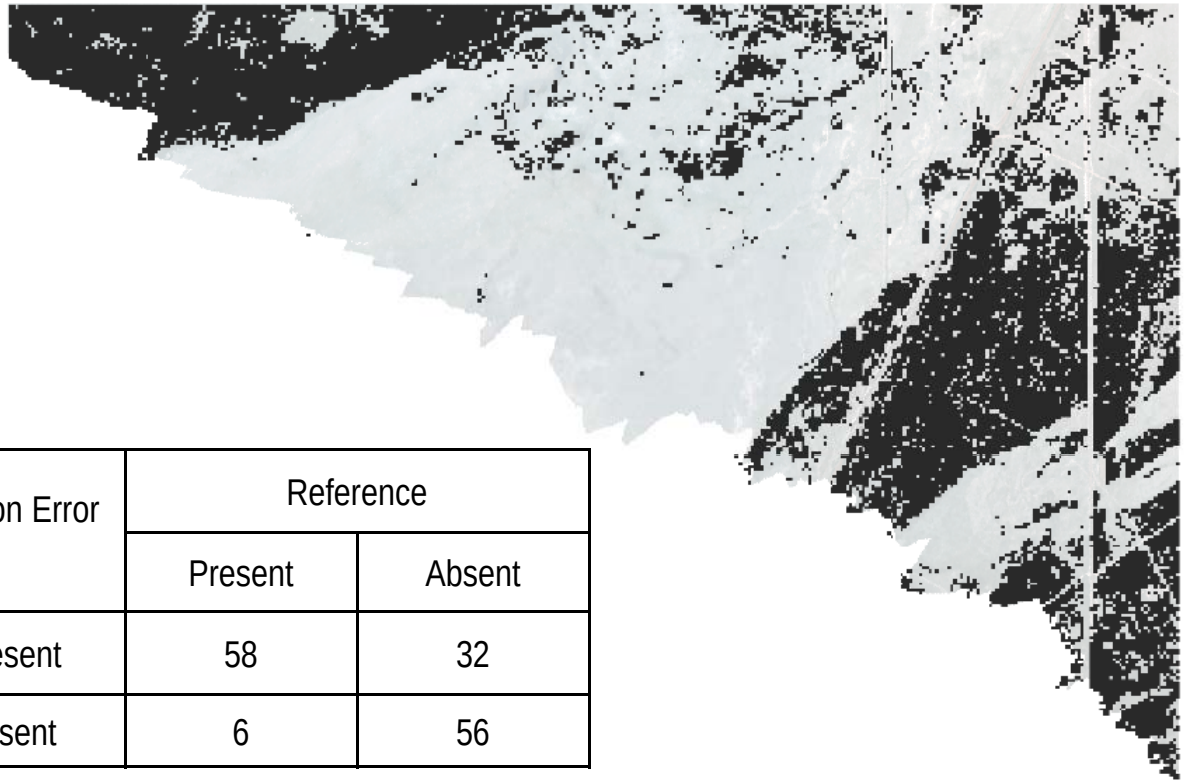
Classification







Accuracy



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

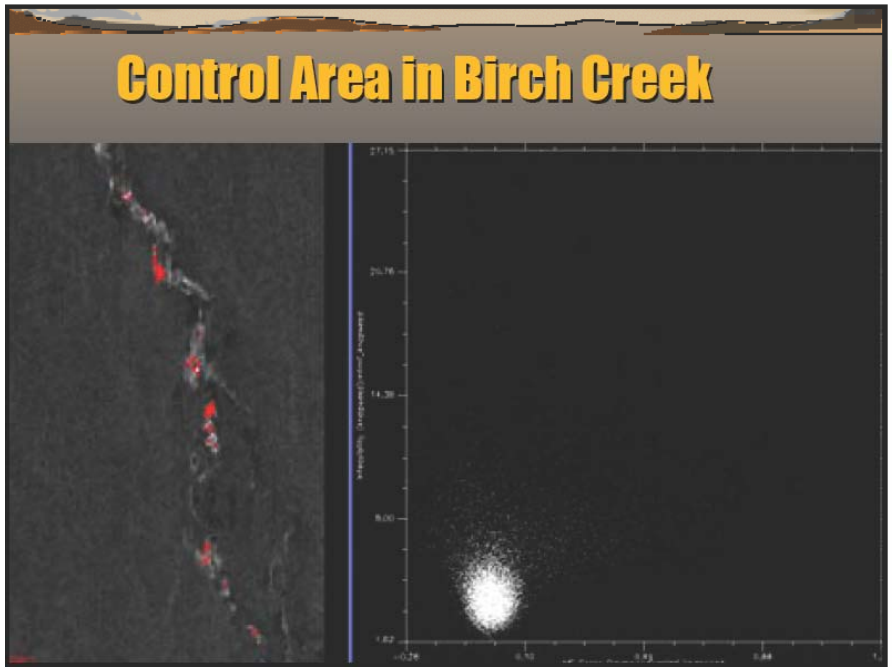
Producer's Accuracy = 91%

User's Accuracy = 64%

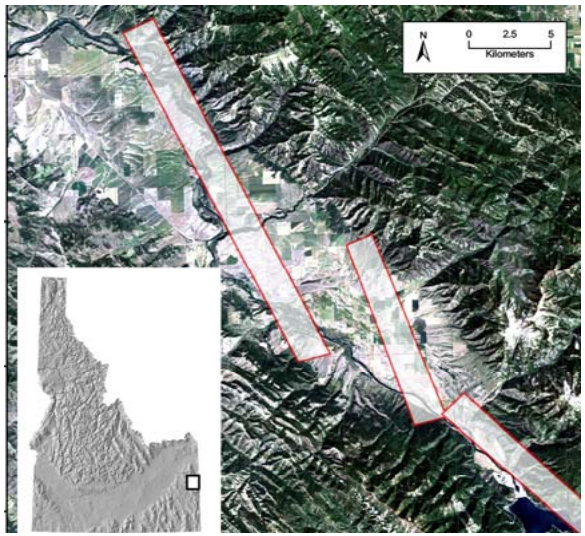
Total Accuracy = 75%

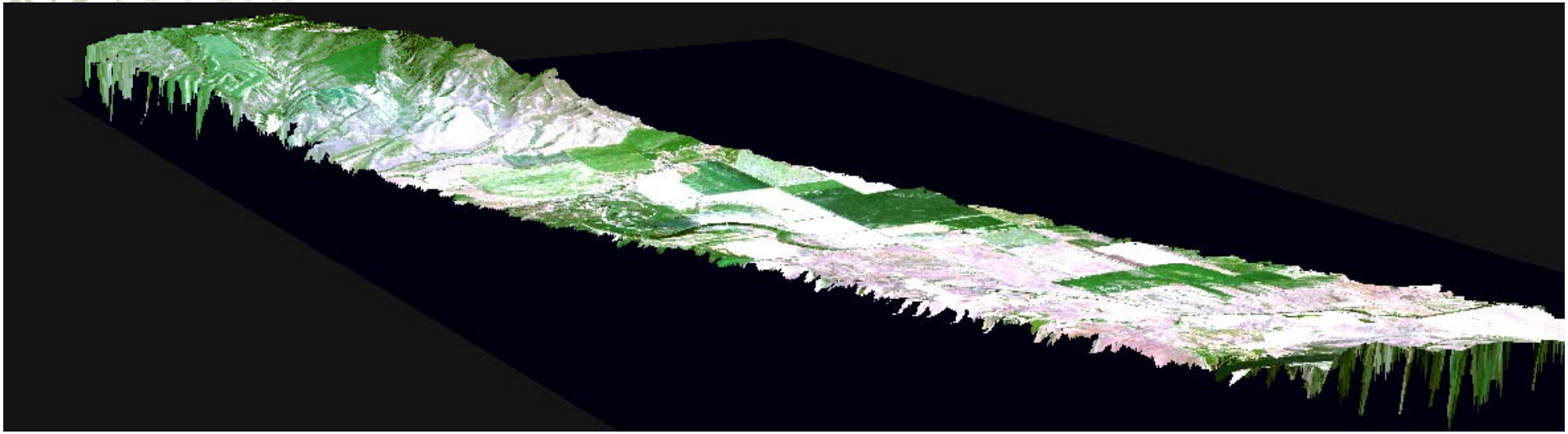
Spotted Knapweed - INEEL

- Accuracies approximately 80%
- Lack of Data



Leafy Spurge – Swan Valley

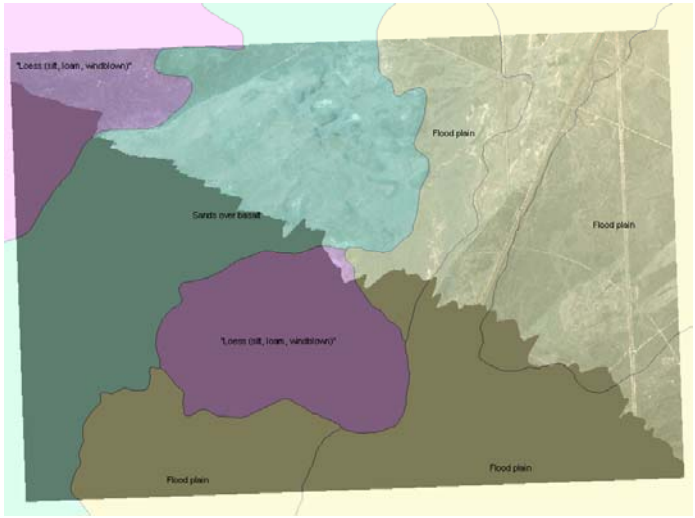


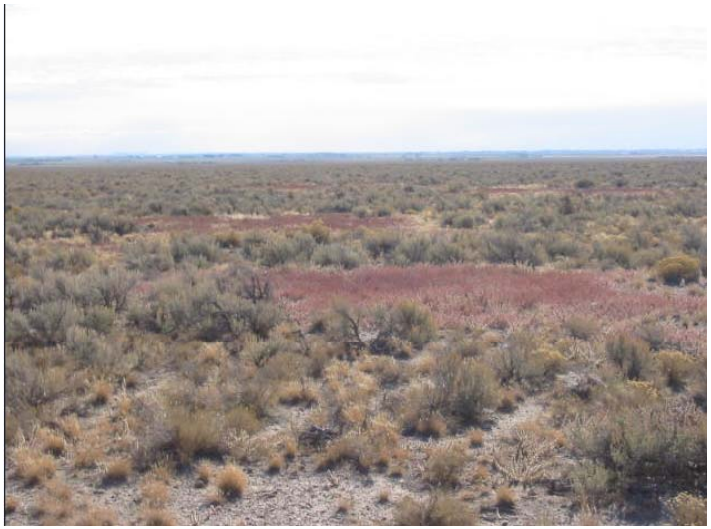


Leafy Spurge (cont.)

- 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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