Fusion Of Hyperspectral And LiDAR Models Characterizing Semi-arid Vegetation (Sagebrush)

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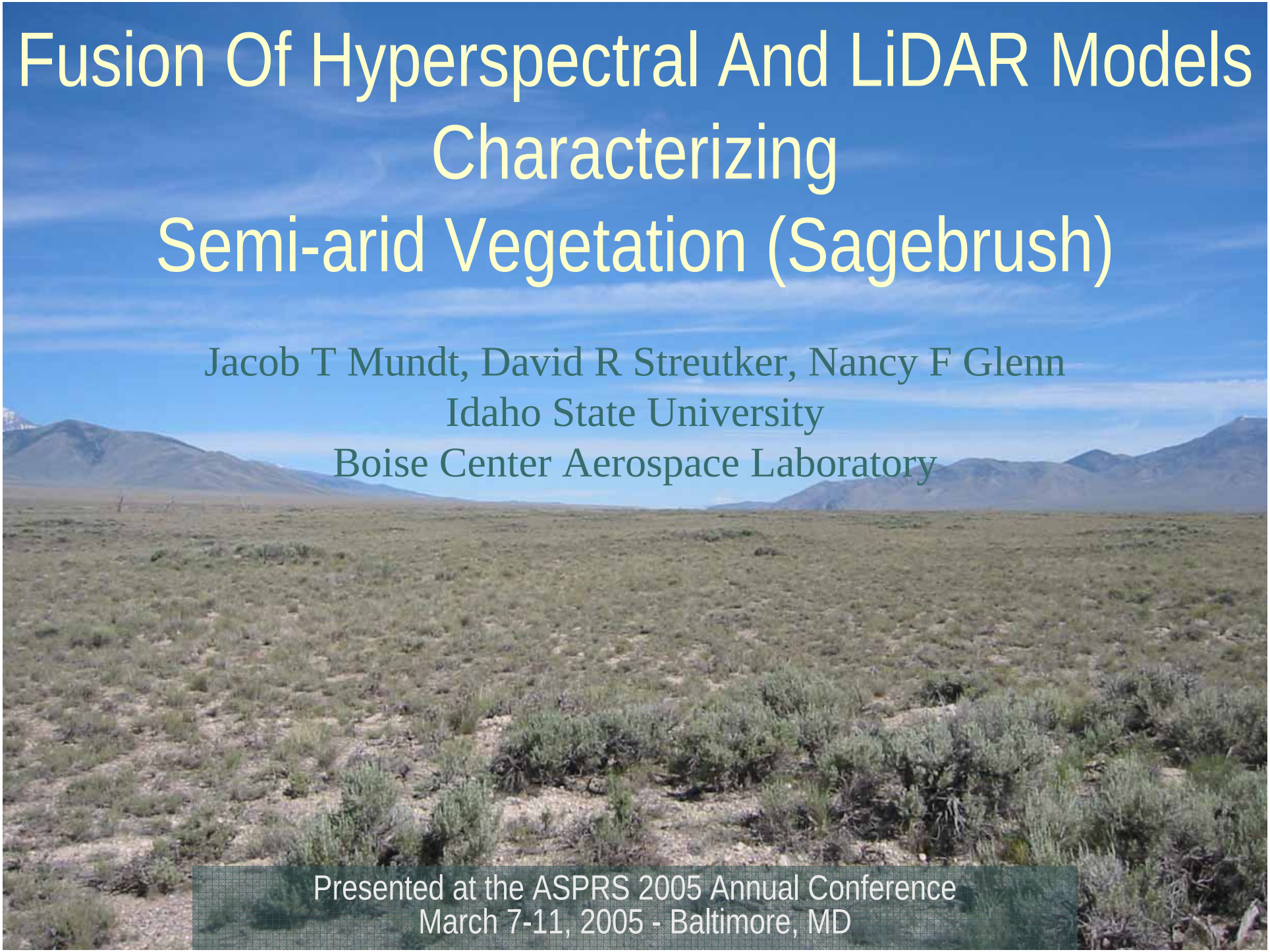

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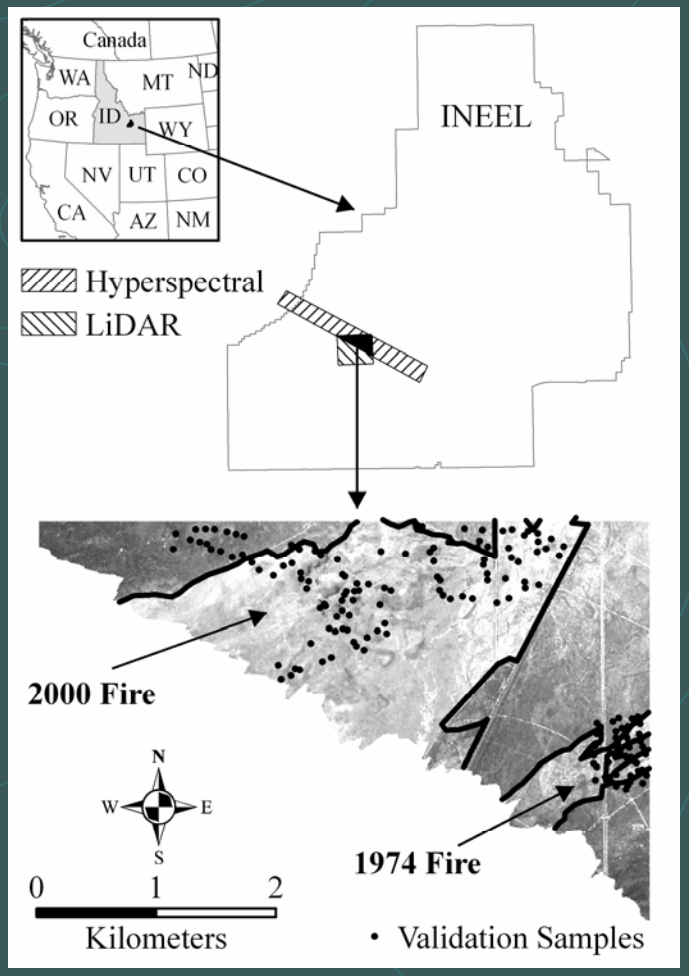
Outline of Presentation

- Study Area and Data
- Hyperspectral Data and Analysis
- LiDAR Data and Analysis
- Product Fusion
- Conclusions
- Questions

Study Area

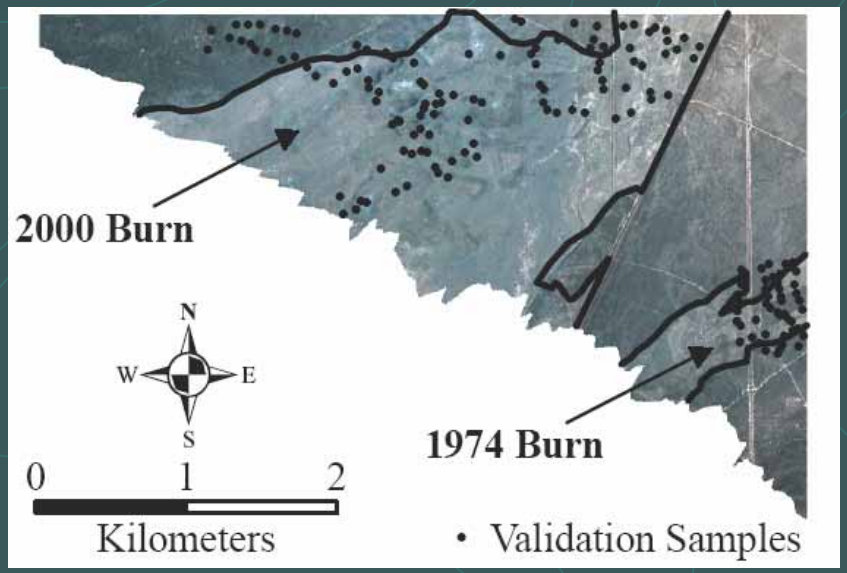
- Reduced vegetation cover
- Spectrally ‘intermediate’
- Dry
- Abundant litter and dry grass
- Increased soil exposure
- Soil variability
- Non-linear mixing



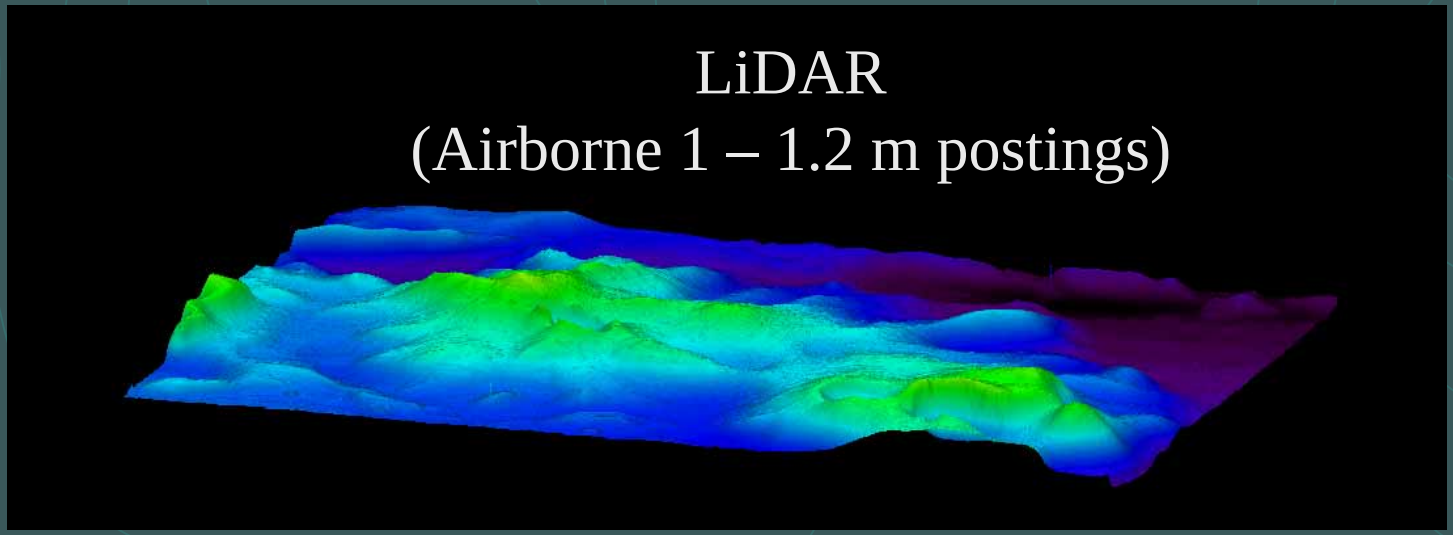
Data

Hyperspectral
(HyMap 3.5m pixels)

Field GPS



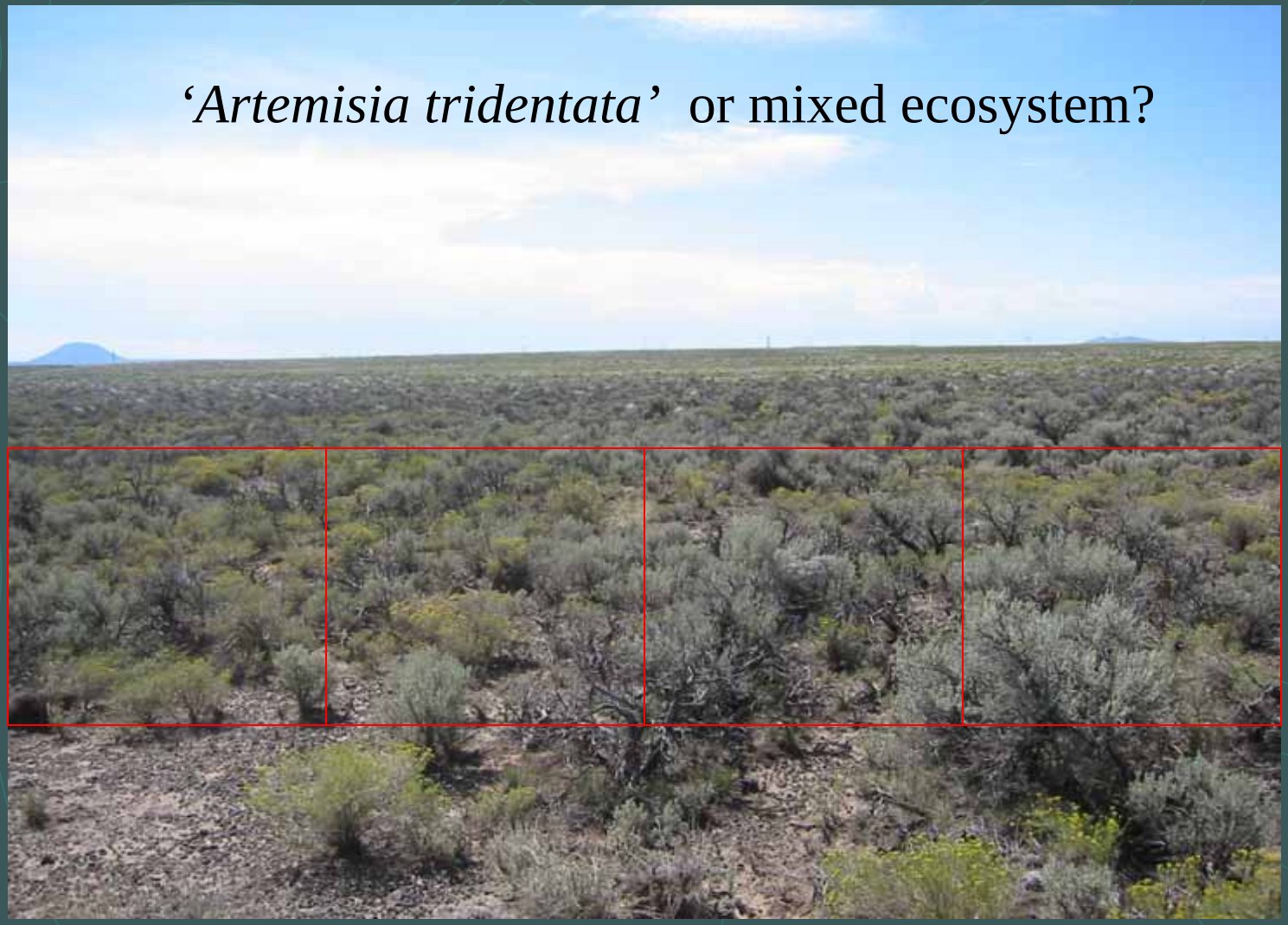
LiDAR
(Airborne 1 – 1.2 m postings)



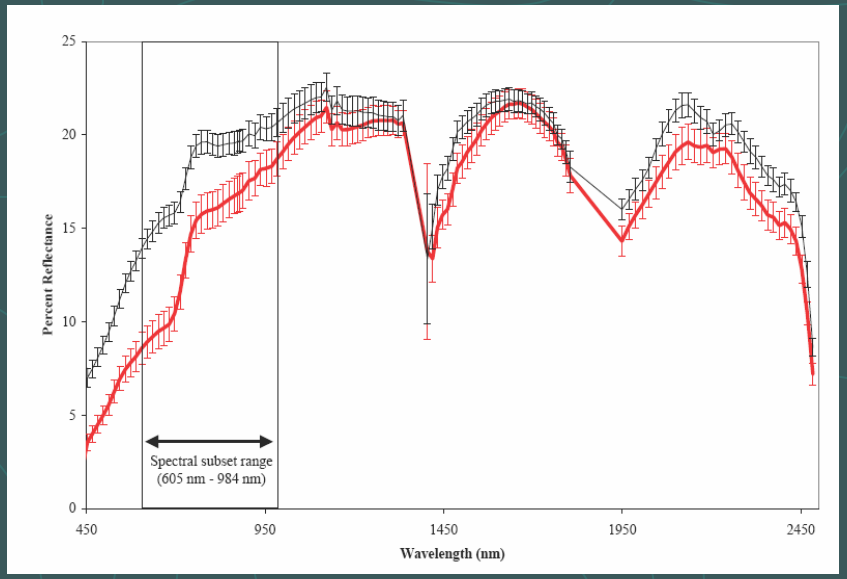
Objectives

- 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.

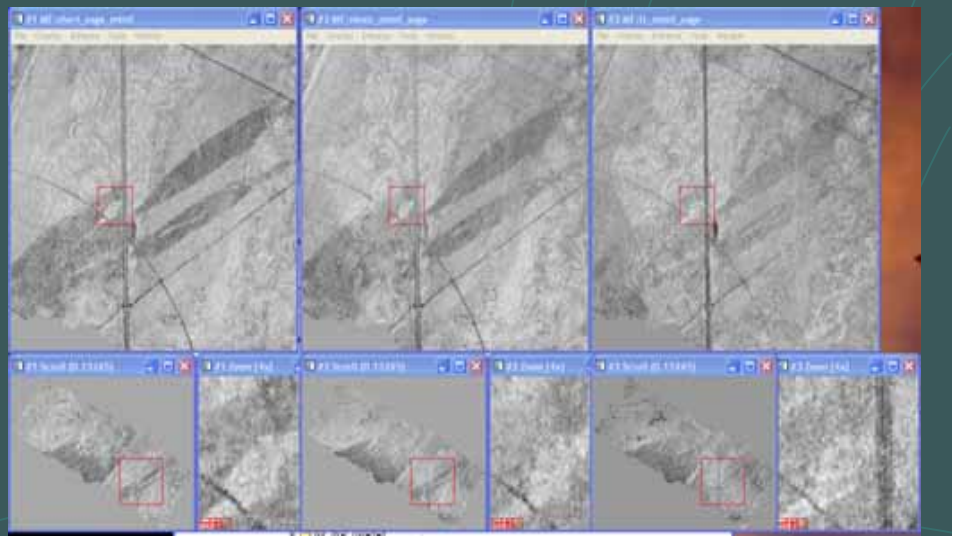
“Sagebrush”



Hyperspectral Processing



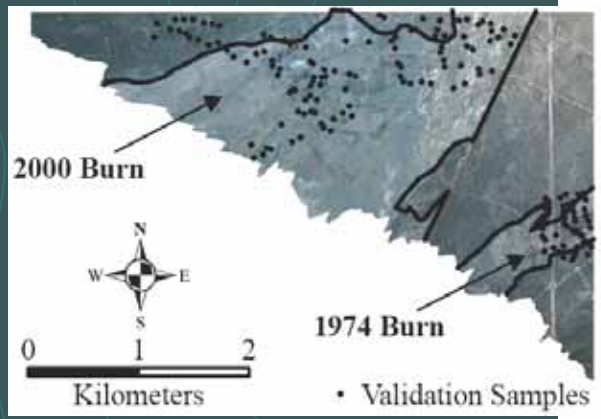
- Spectral subsets
- Different endmembers
- Classification strategy
- Interpretative assessment

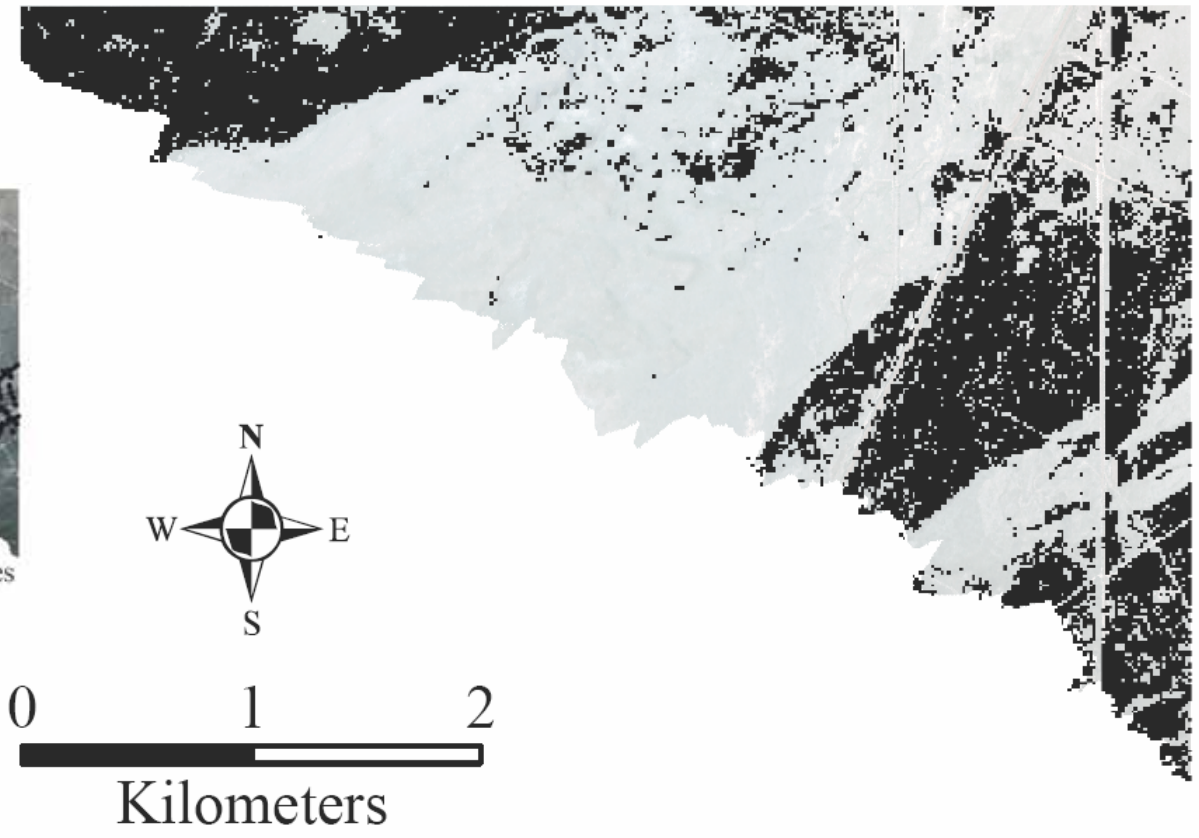


Hyperspectral Results

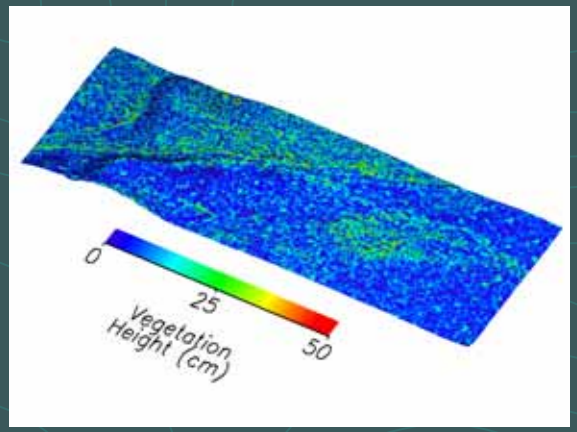
Producer's Accuracy = 91%
User's Accuracy = 64%
Total Accuracy = 75%

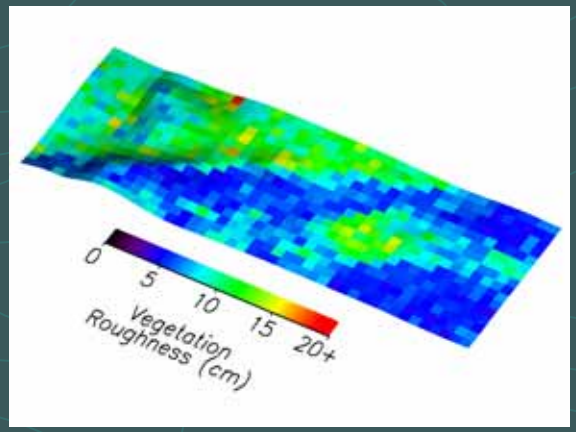
Sagebrush Classification Error Matrix		Reference	
		Present	Absent
Classified	Present	58	32
	Absent	6	56

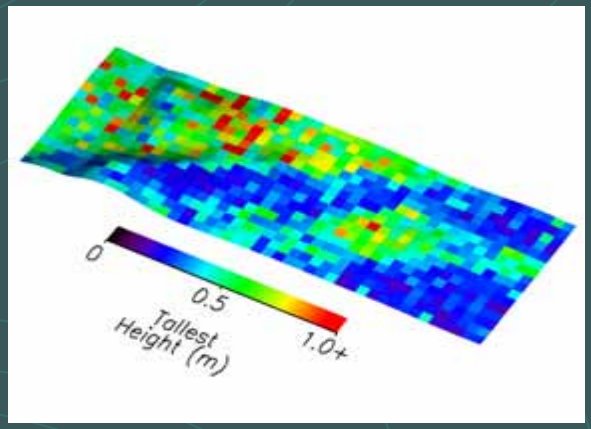


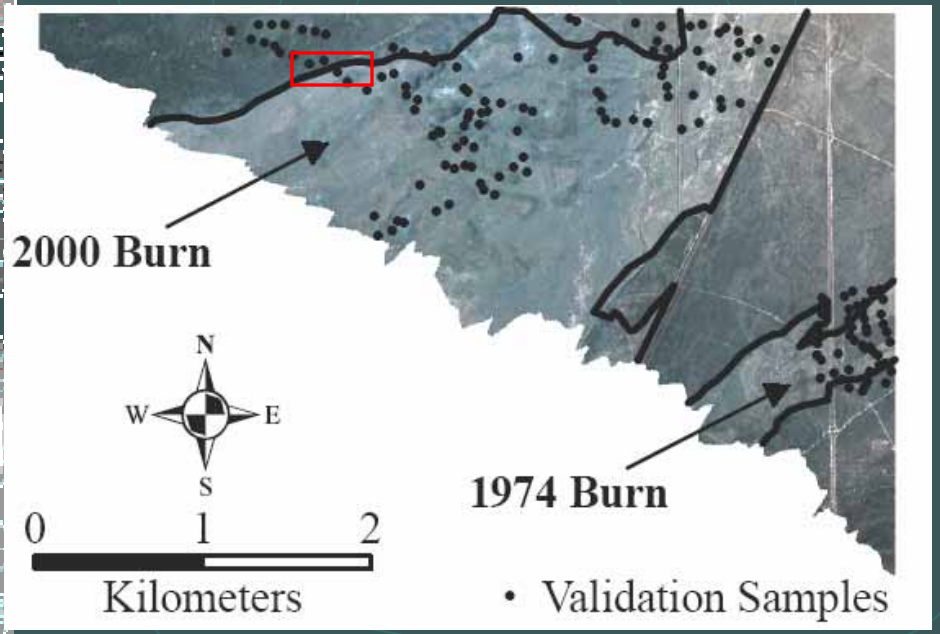


LiDAR Processing









LiDAR Results

- Statistically separable populations
- Greater understanding of vegetative structure
- Quantifiable results at very high resolution
- Higher quality obtainable than just using field measurements

	Mean	Median	Standard Deviation	F-Statistic (F_{crit}= 1.02)
Mean Pixel Height (cm)	7.8 / 9.6	7.1 / 9.2	3.5 / 2.8	1.52
Mean Vegetation Height (cm)	10.0 / 11.9	9.0 / 11.3	4.2 / 3.2	1.72
Percent Bare Soil	7.0 / 19.4	6.0 / 18.2	4.5 / 4.3	2.50
Roughness (cm)	6.8 / 9.2	5.9 / 8.5	3.8 / 3.5	1.17
Tallest Vegetation (cm)	34.1 / 53.2	30.0 / 51.0	15.2 / 16.4	1.17

Coregistration

Polynomial Resampling to 16 GCPs

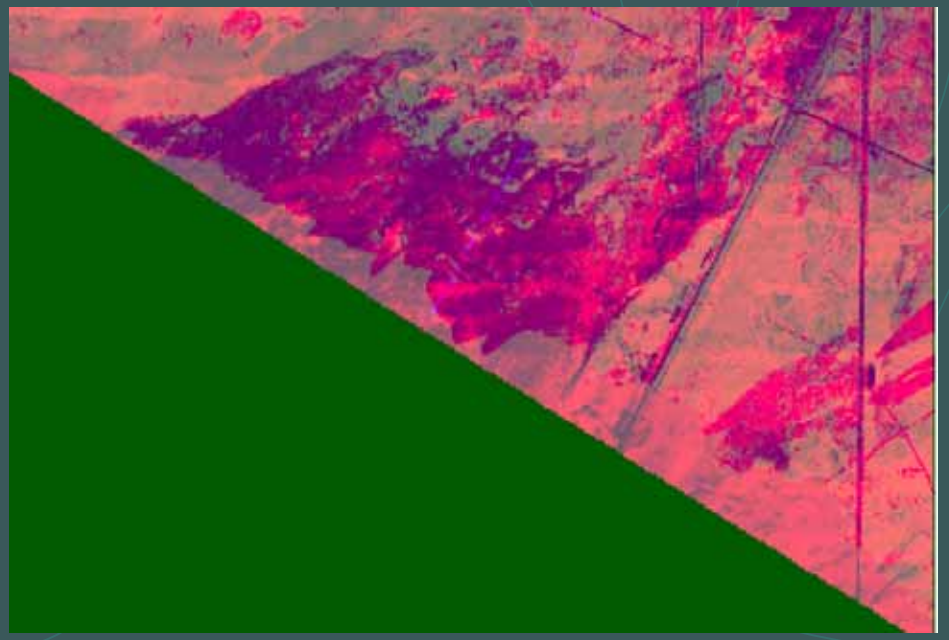
Residual Error of 11.5 m (9 ICPs) – Local Variance

Resampled to 13.8 m (3 hyperspectral pixels)

Fused (Coregistered) Product

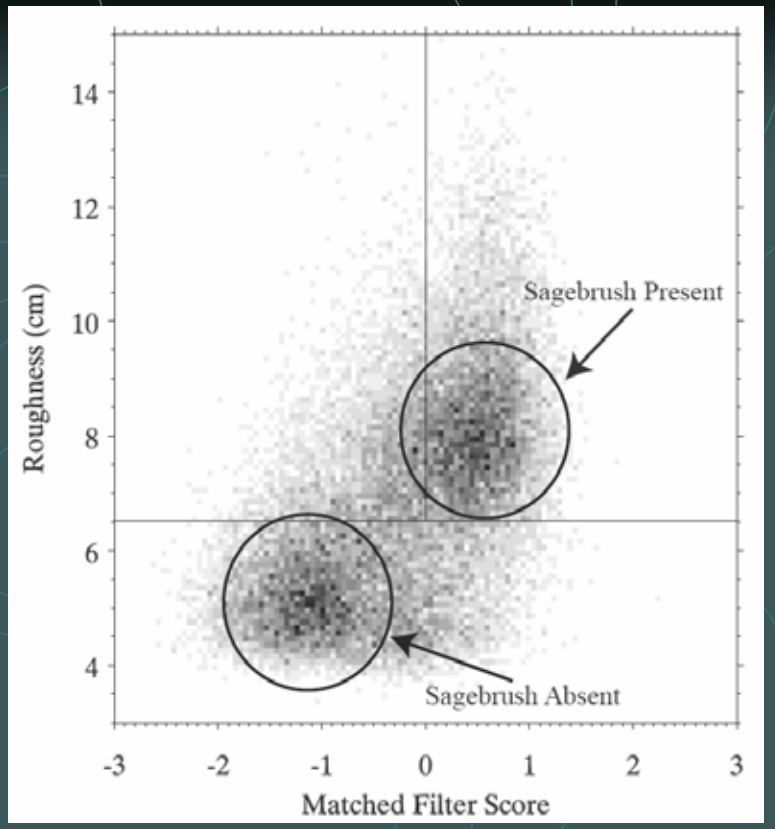
12 Band Product

- MTMF classification (2)
- Hyperspectral Reflectance (4)
- LiDAR Intensity
- LiDAR Roughness
- LiDAR Mean Heights (2)
- LiDAR Tallest Vegetation
- LiDAR Percent Bare Soil



Fusion Hypothesis

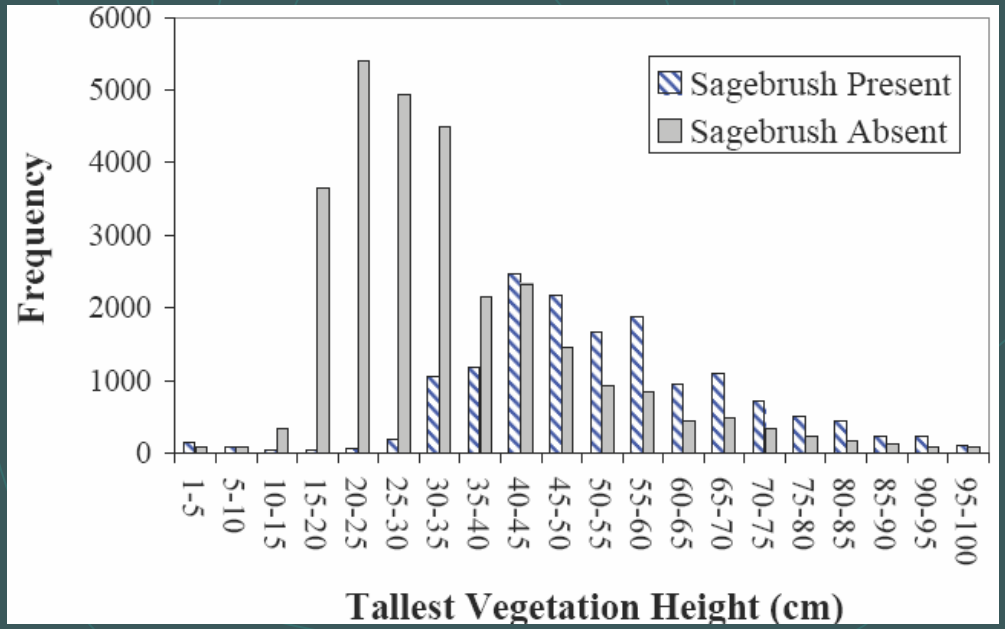
LiDAR variables can enhance classification accuracy and stand structure descriptions.



	Sagebrush Absent	*Sagebrush Present*
Mean (cm)	7.0	9.1
Median (cm)	5.8	8.1
Integer Mode (cm)	5	8
Standard Deviation (cm)	4.5	3.6
Number of Samples	88	64
F - Statistic	1.57	
F - Critical	1.48	
P	0.03	

Fusion Results

Classification Strategy	Producer's Accuracy	User's Accuracy	Overall Accuracy
MF greater than 0	91%	64%	75%
MF greater than 0 AND Infeasibility less than 7	72%	75%	74%
MF greater than 0 AND Roughness between 6.5 and 75	88%	86%	87%
MF greater than 0 AND Infeasibility less than 7 AND Roughness between 6.5 and 75	84%	92%	89%



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 via focus areas and indicator plots.

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Questions?

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