

# A Question of Scale: Multiple Comparisons of QuickBird, Landsat, DMC and AWiFS

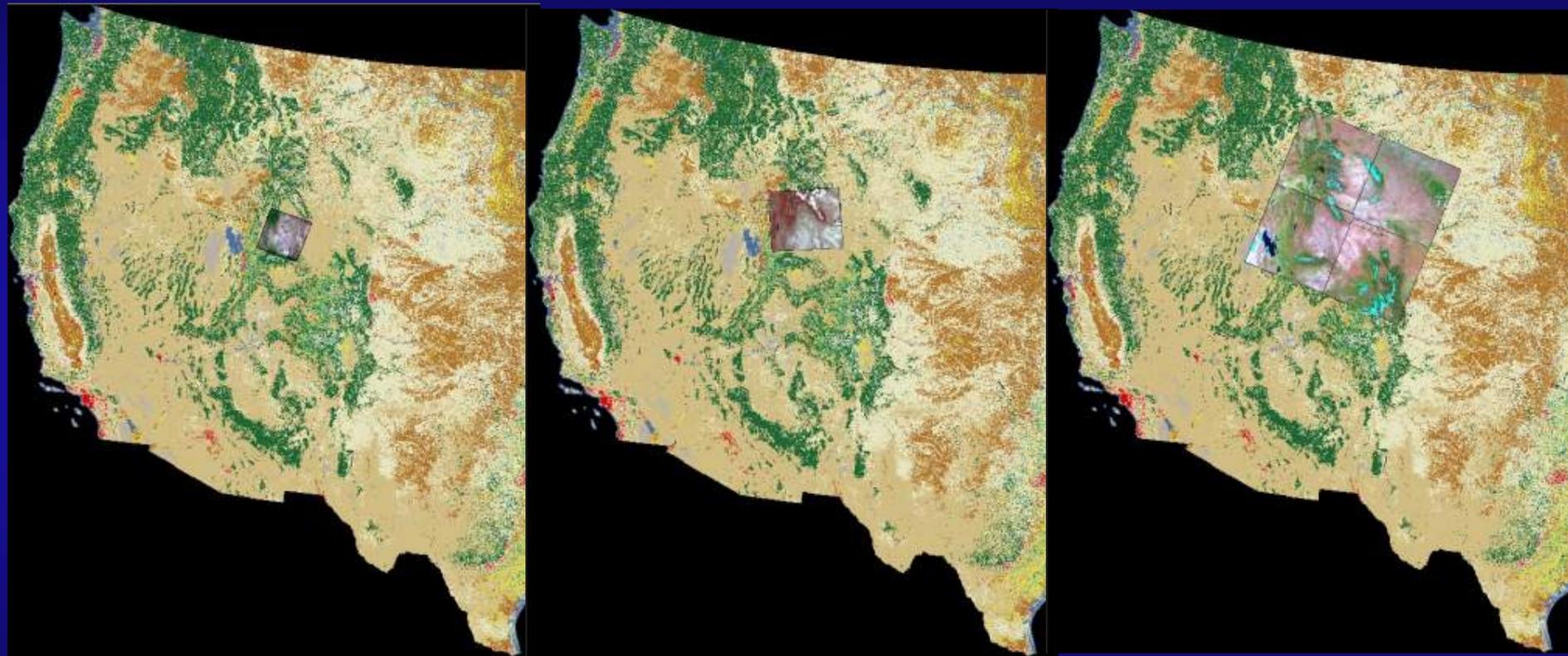
2007 Civil Commercial Image Evaluation Workshop

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Michael Coan - SAIC/USGS/EROS

Imagery: Three dates each of Landsat, DMC (NigeriaSat), AWiFS, acquired throughout 2006 growing season



Landsat 5 (~185 km sq)  
30m pixels, 7 bands

DMC (~280 km sq)  
32m pixels, 3 bands

AWiFS (~740 km sq)  
56m pixels, 4 bands

## Wyoming Study Site

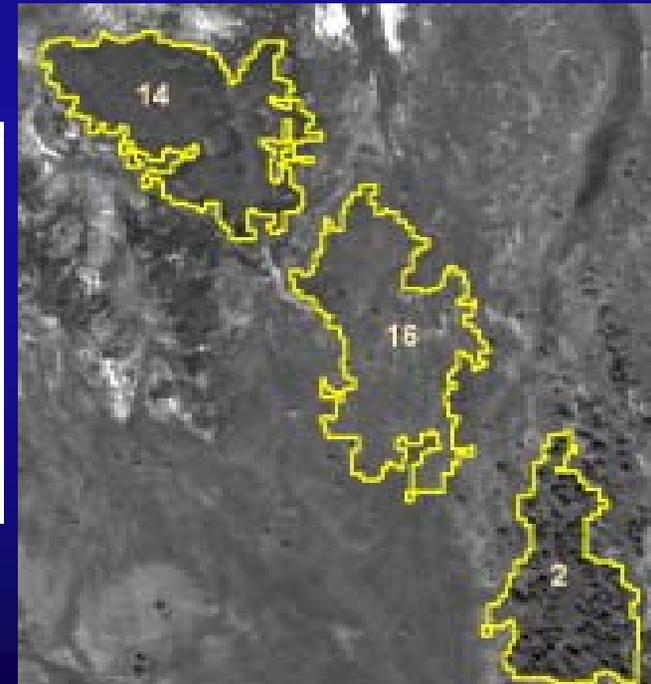
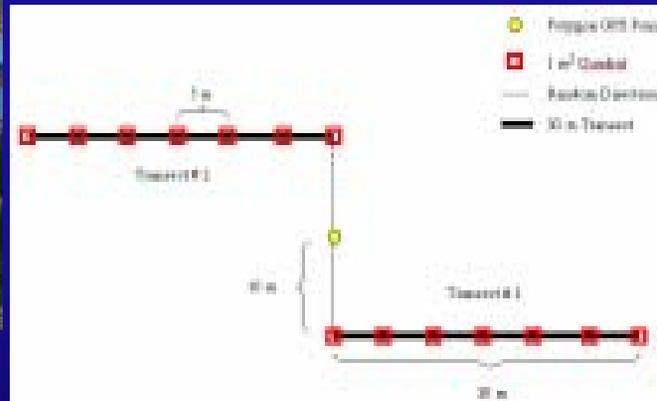
- Arid sagebrush steppe, fragile habitat for sage grouse, big game migration route, winter and birthing range
- Pinedale Anticline and Jonah Field Project Areas in the Upper Green River Basin are considered among the most significant new natural gas resources in the U.S.



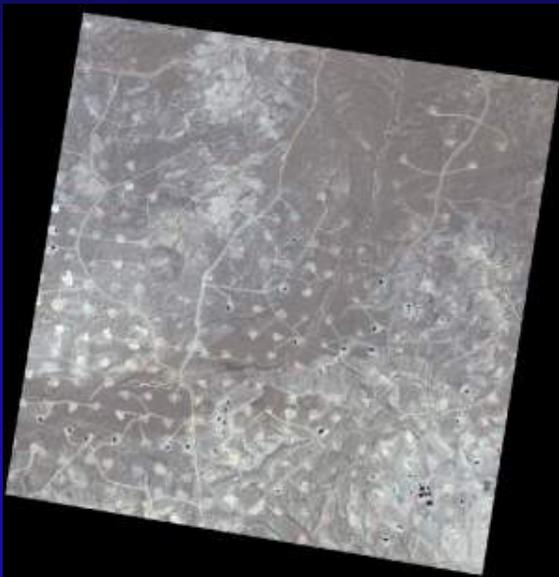
# Sagebrush Rangeland Quantification

## Rigorous Field Samples

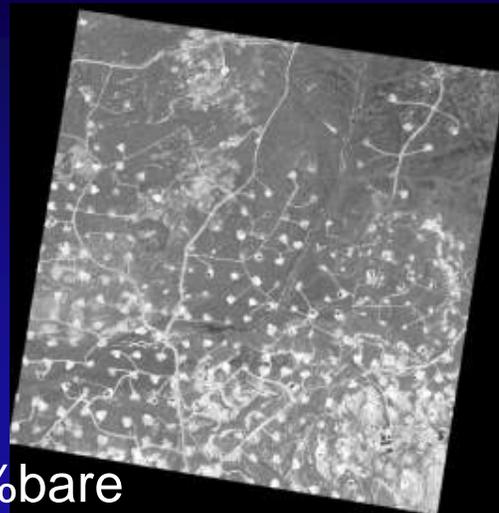
- Ground measurements of vegetation structure and composition measured with 1m Daubenmire frames
- 14 measurements per plot, estimating %bare, %shrub, %grass, %litter (+/- 5%), values assigned to segmented polygons of Quickbird imagery



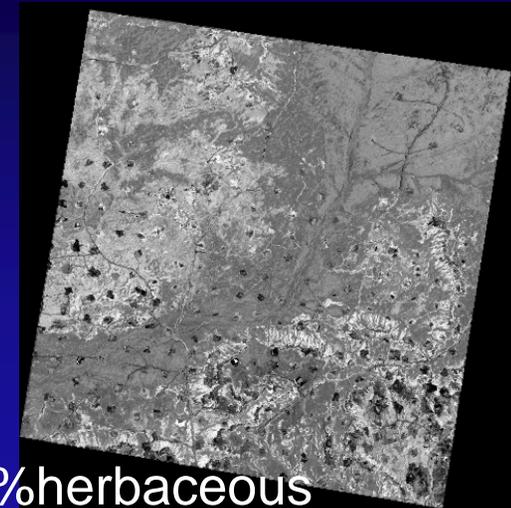
# Polygon data used to generate QB estimates...



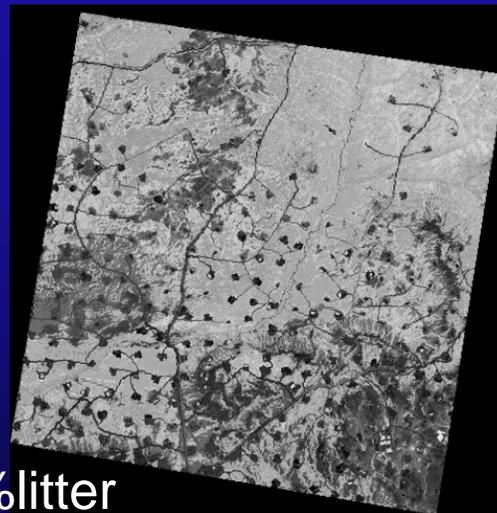
2.4m R-G-B-Nir  
Quickbird Scene, classified  
by continuous estimate for  
each variable



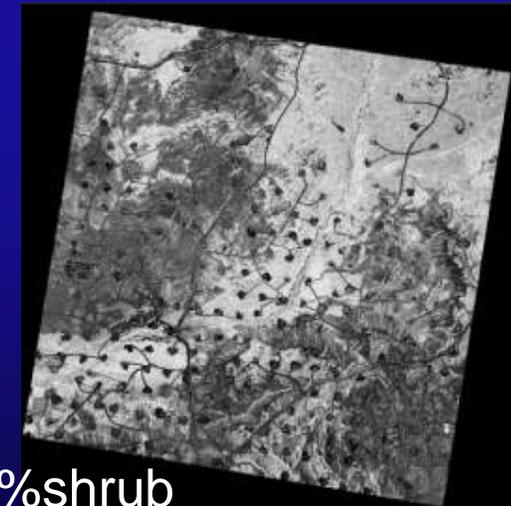
%bare



%herbaceous



%litter

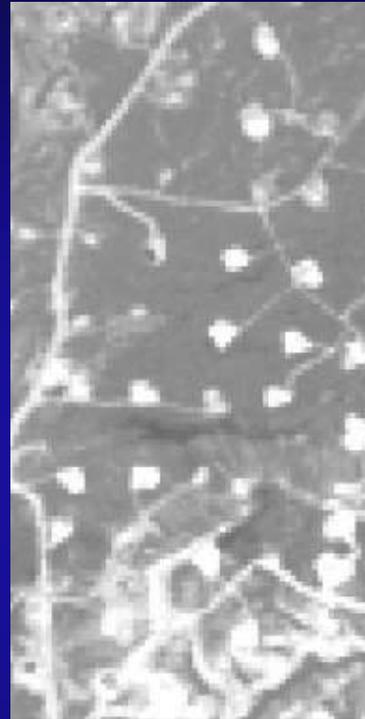
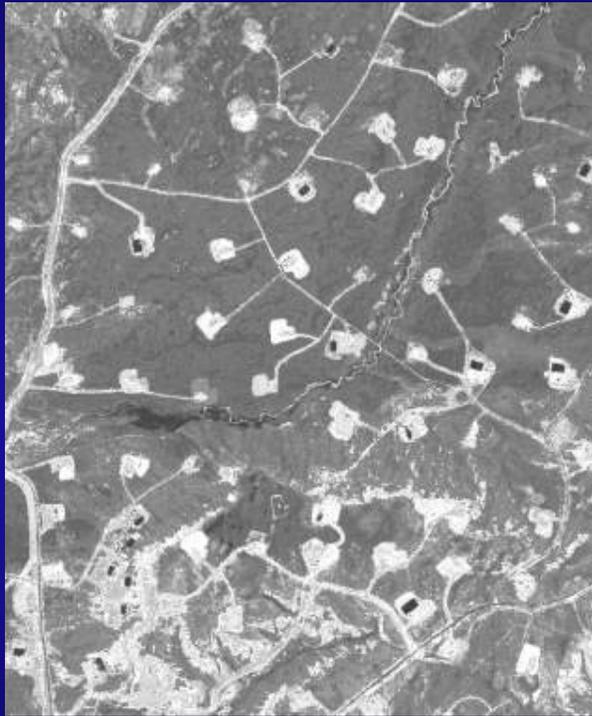


%shrub

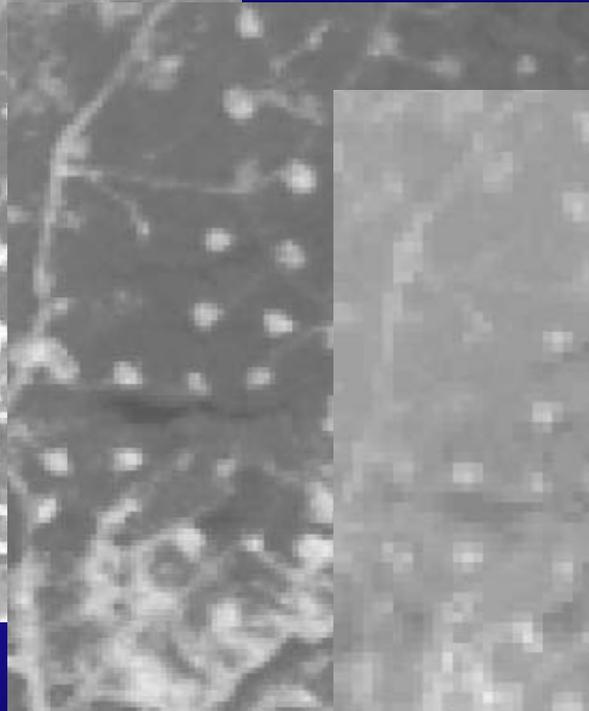


# ...QB estimates used for Landsat, DMC, AWiFS estimates

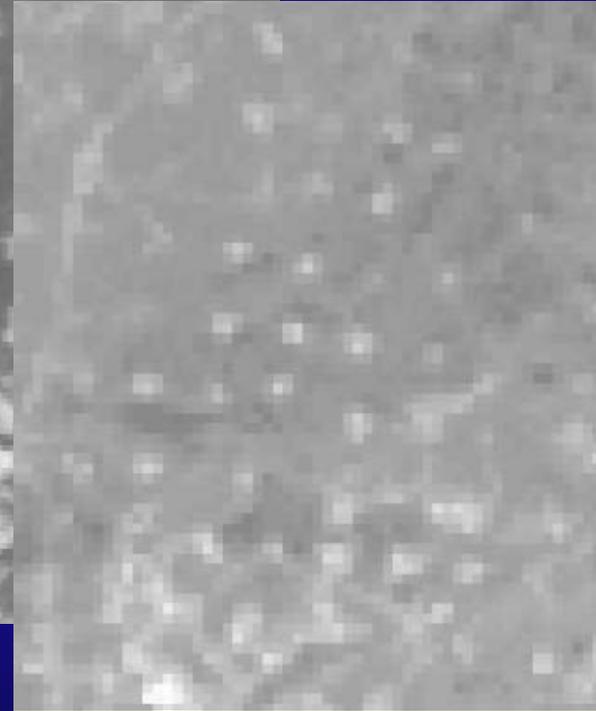
QB %bare



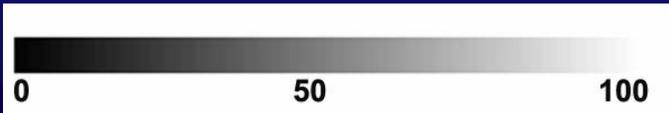
Landsat %bare  
(156 QB)



DMC %bare  
(178 QB)



AWiFS %bare (545 QB)



## Preliminary Percent Estimation Results –

% Estimate	Training Plots				Quickbird			
	Min	Max	Mean	StDev	Min	Max	Mean	StDev
Bare	21	98	52.34	18.62	23	93	51.41	15.96
Shrub	1	24	10.95	6.87	0	21	10.82	5.55
Herbaceous	0	40	16.67	9.34	1	31	17.07	5.87
Litter	1	39	18.41	10.00	2	30	19.00	8.14
Sage	0	24	10.39	7.32	0	22	10.62	5.78

Training Plot Values used to assess QB estimations (n=61)

% Estimate	Validation Plots				Landsat				DMC				AWiFS			
	Min	Max	Mean	StDev	Min	Max	Mean	StDev	Min	Max	Mean	StDev	Min	Max	Mean	StDev
Bare	16	90	55.88	20.67	35	77	47.38	13.10	35	71	45.44	10.71	35	57	41.22	5.58
Shrub	0	33	15.00	9.69	3	20	13.56	5.30	4	20	14.31	5.11	2	20	13.38	4.92
Herbaceous	3	38	18.88	8.74	9	23	16.34	3.15	11	21	16.53	2.44	10	19	14.81	2.38
Litter	0	25	9.97	6.88	7	27	20.34	6.20	7	26	20.78	5.90	6	25	20.13	6.05
Sage	0	33	14.41	9.91	7	27	20.34	6.20	4	21	14.03	5.76	3	21	13.31	5.52

QB estimations scaled to 30m, 32m, 56m to train Landsat, DMC, AWiFS estimations. Validation plots outside QB footprint are used to assess each sensor's results (n=32).



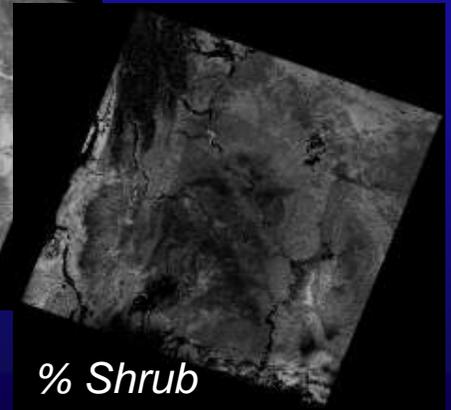
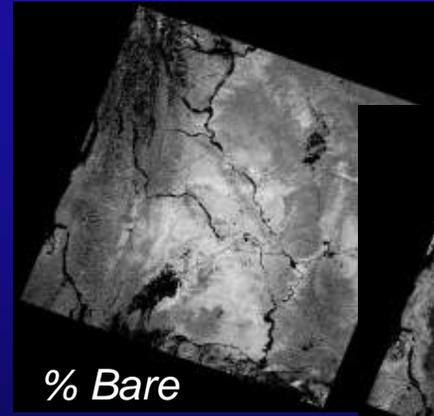
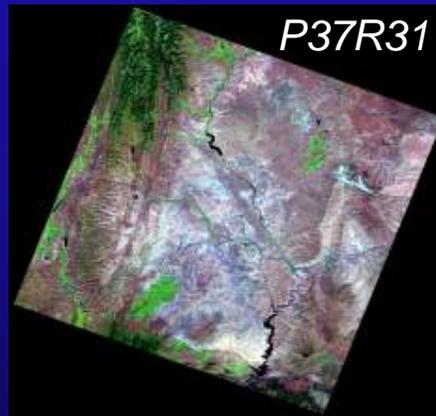
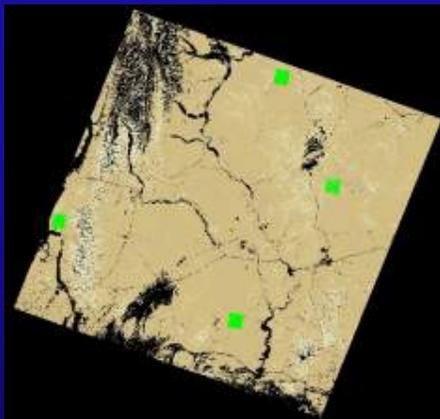
## Discussion-



- Sagebrush characteristics occur on a certain range of spatial scales, captured well at 2.4m QB resolution.
- Percent estimates generated at coarser scales typically lose the high and low ends of the characteristic – the modeled range is compressed as the resolution decreases.
- “Modifiable Areal Unit Problem” (MAUP), where the mean value does not change, but variance declines with increasing aggregation.
- Issues are a function not of spectral content, but spatial resolution. Little practical difference seen between modeling capabilities of estimated % bare, shrub, herbaceous, litter, for 30m Landsat, 32m DMC, and 56m AWiFS.

## Future work-

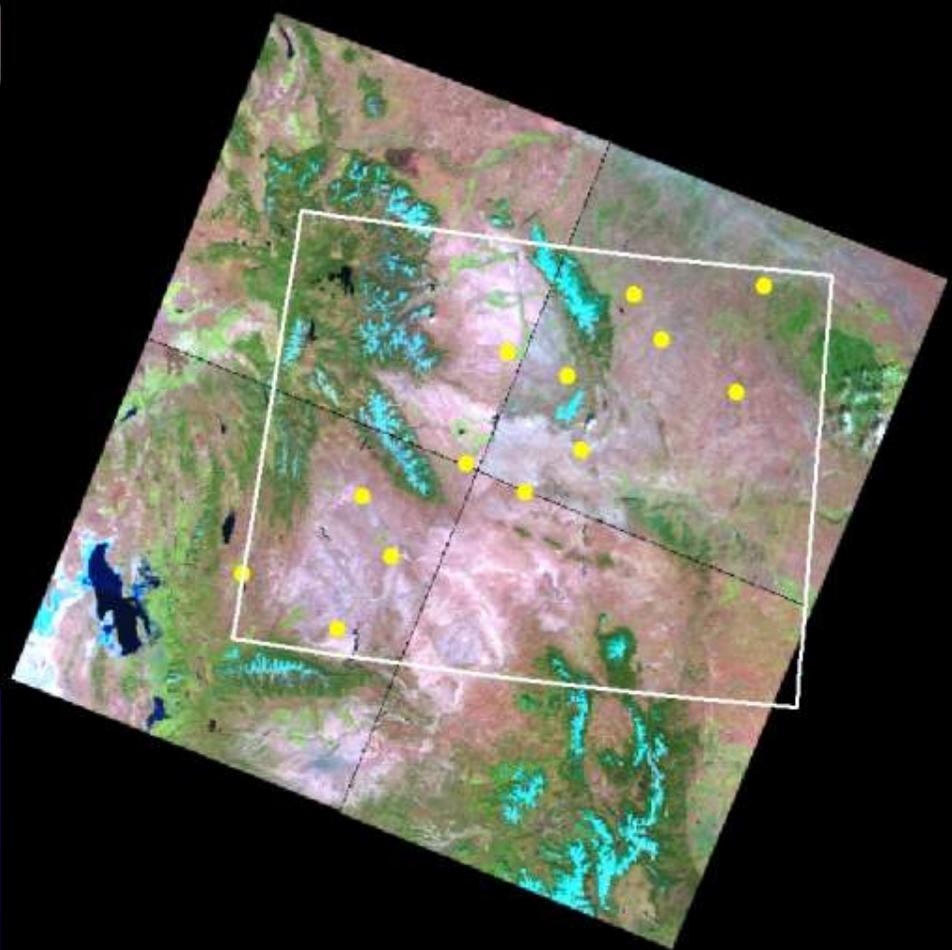
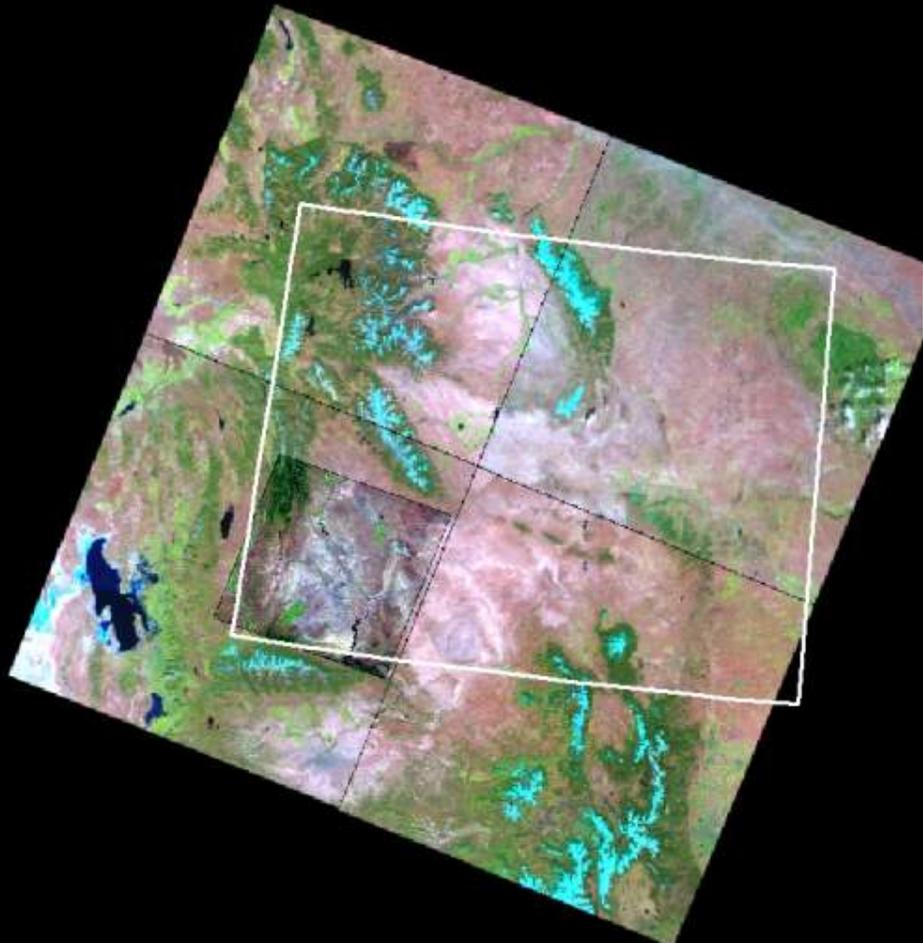
- Generate 4 QB training images for each of 3 Landsat path/rows, apply to 3 entire landsat footprints.
- Use those 3 landsat footprints as training for 4 quadrants of AWiFS footprint (entire State of Wyoming).
- Estimate historical conditions (1988 Landsat)
- Monitor future construction and reclamation efforts



*4 QB Training sites within one Landsat scene*



Wyoming Outlined Over AWIFS & 13  
QB footprints, training data for  
Landsat P37R31, P36R30, P35R29



Wyoming Outlined Over AWIFS  
& Landsat Path 37, Row 31

## Acknowledgements:

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Quickbird Acquisitions, Fieldwork – Collin Homer, USGS/EROS  
DMC Acquisitions – Mike Benson, USGS/CRSSP  
AWiFS Acquisitions – Robert Tetrault, USDA/FAS

## References:

Jelinski, D. E., Wu, J., “The modifiable areal unit problem and implications for landscape ecology”, Landscape Ecology vol. 11 no. 3 pp 129-140 (1996)

<http://www.jonahfield.com>    <http://skytruth.org>    <http://www.mrlc.gov>

