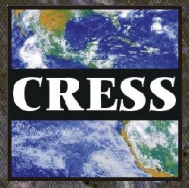
Comparing Landsat-7 and IKONOS Measurements for Selected U.S. EOS Validation Sites



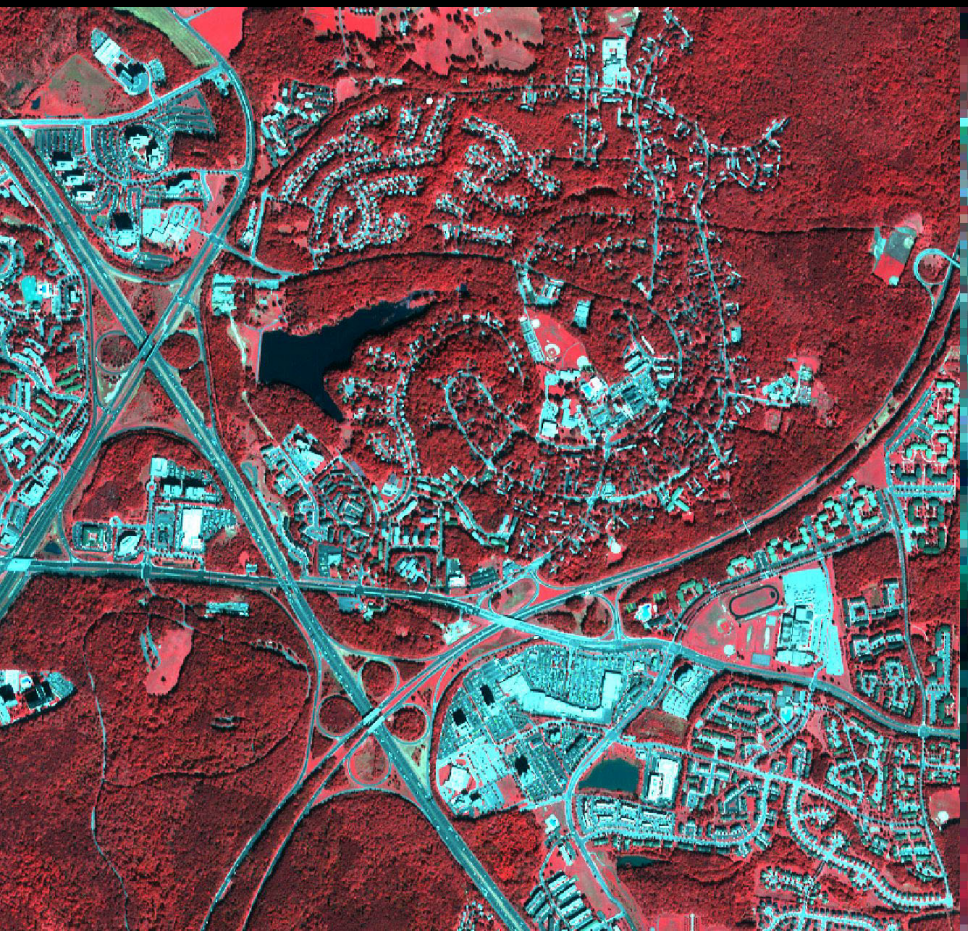
Sam Goward, John Townshend, Paul Davis, David Fleming, Lee Miller
University of Maryland

Presented at the 2002 High Spatial Resolution Commercial Imagery Workshop
Reston, Virginia, March 26, 2002

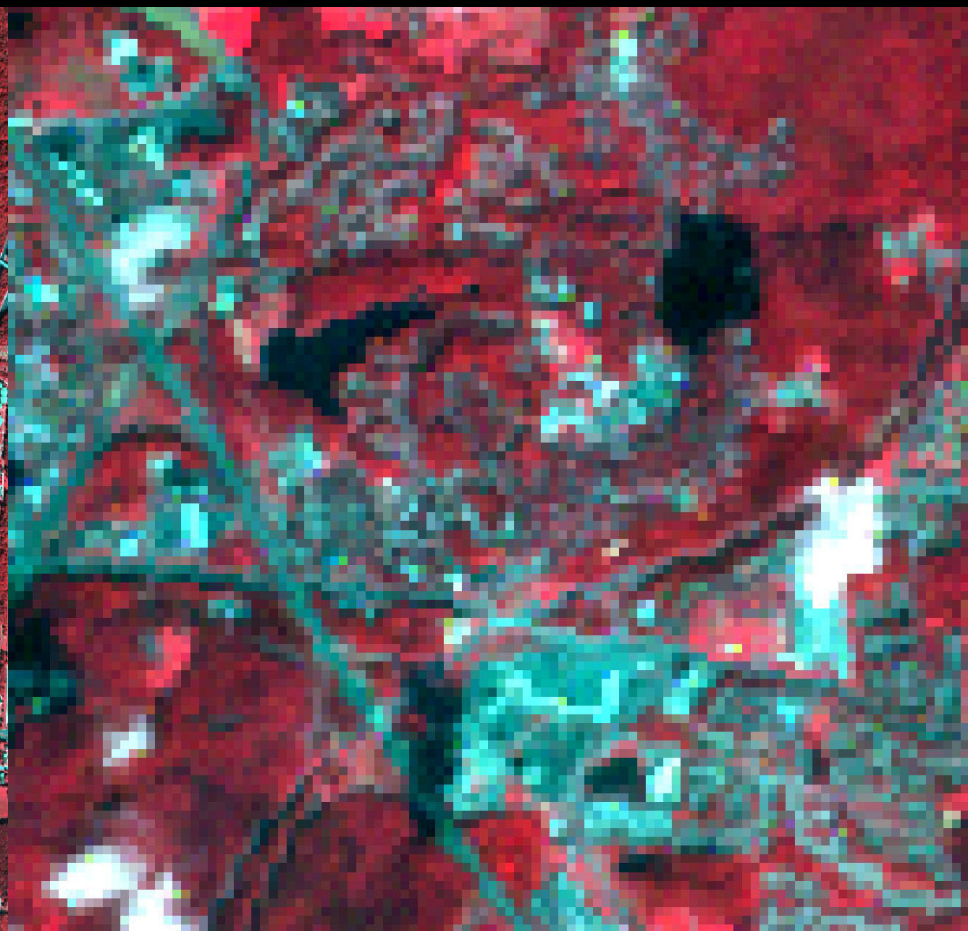
Conceptual Framework

We are evaluating how well IKONOS performs as a virtual ground truth for Earth Observing Systems such as Landsat.

IKONOS (4,3,2) 4 meter



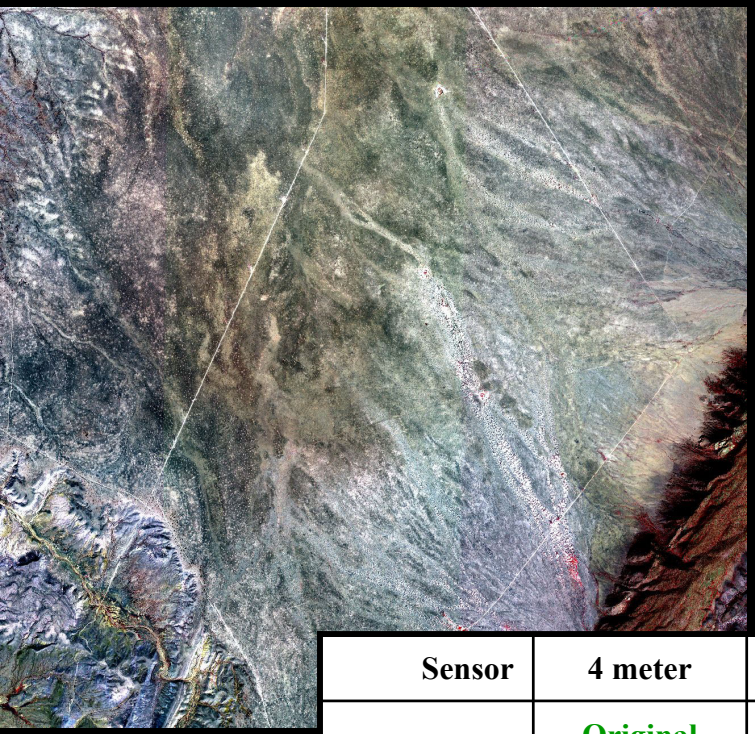
ETM+ (4,3,2) 30 meter



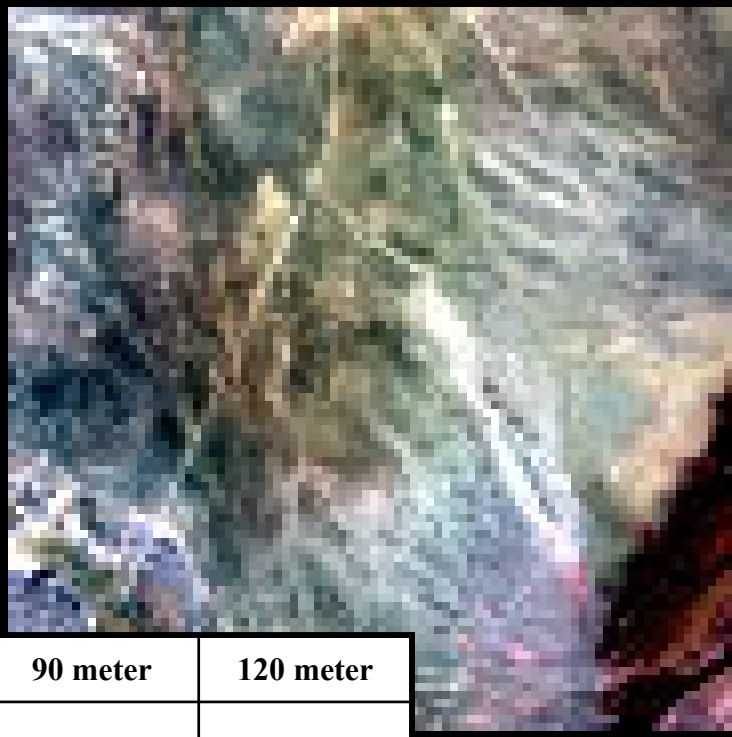
Methodology

Primary Steps:

1. Orthorectification and Pixel Alignment
2. Conversion from DN to Planetary Reflectance Values
3. Aggregation of IKONOS from 4 meter to match ETM 30 meter
4. Aggregation of IKONOS and ETM to 60, 90, 120 meter



IKONOS 4m



IKONOS 120m

Sensor	4 meter	30 meter	60 meter	90 meter	120 meter
IKONOS	Original Resolution	Aggregated	Aggregated	Aggregated	Aggregated
ETM+		Original Resolution	Aggregated	Aggregated	Aggregated

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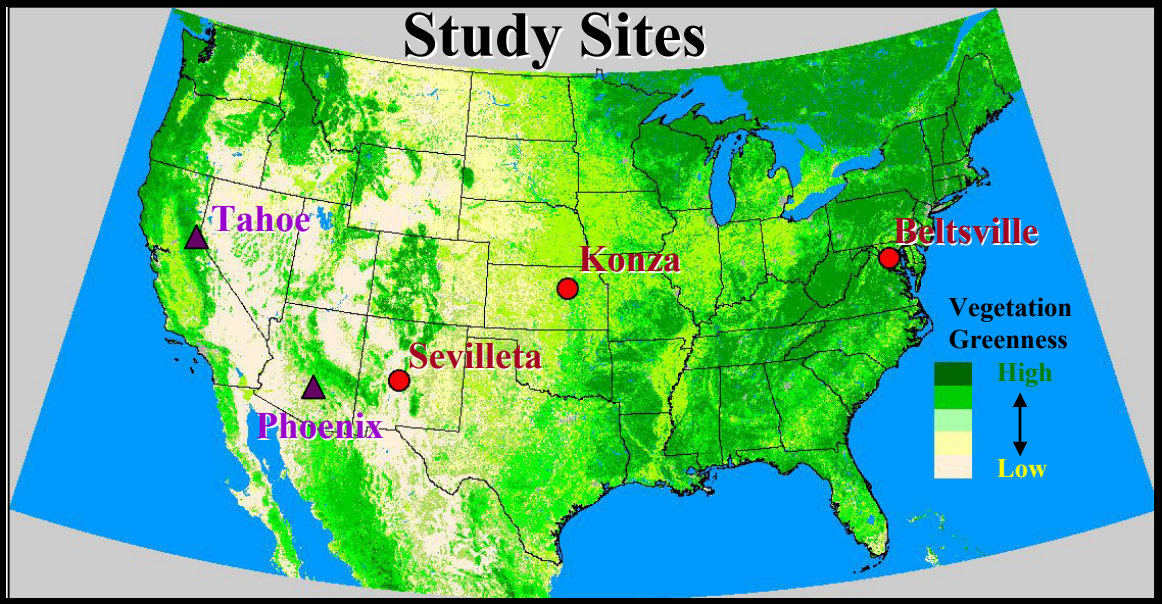
Site Selection

Comparison of IKONOS and ETM+ radiometry based upon:

1. Vegetation Zones
2. Seasonal Change

Study Site Characteristics

	Beltsville Maryland	**Konza** Kansas	**Sevilleta** New Mexico	**Tahoe** California	**Phoenix** Arizona
Land Cover	Forest	Grassland	Desert	Water, Snow	Urban
Greening	May	May	June	-	-
Full Leaf	July	July	August	-	-
Senescence	September	September	October	-	-
Snow	-	-	-	February	-



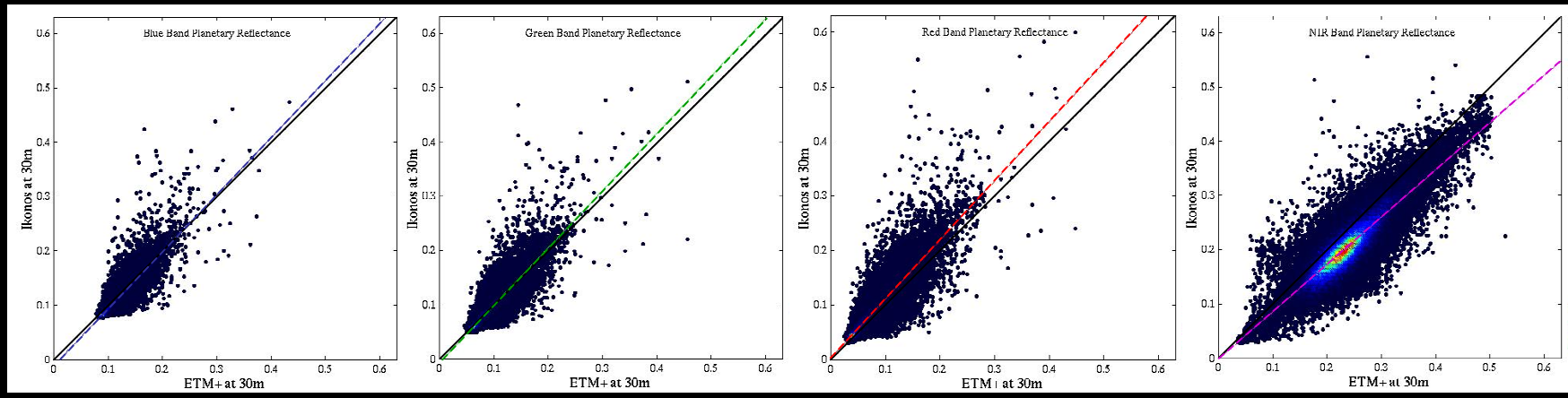
Fifteen scene pairs were acquired, but only Five were used. The reasons why are to follow:

Relative Vegetation

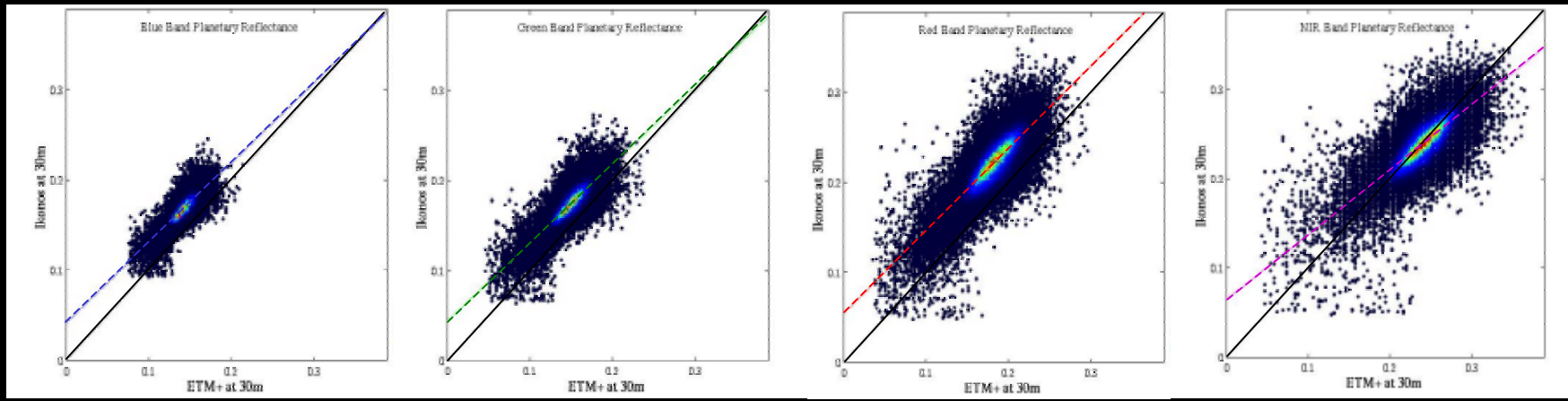
Beltsville 2

Blue Green Red NIR

Vegetated Site



Non-Vegetated Site



30 meter resolution

Sevilleta 3

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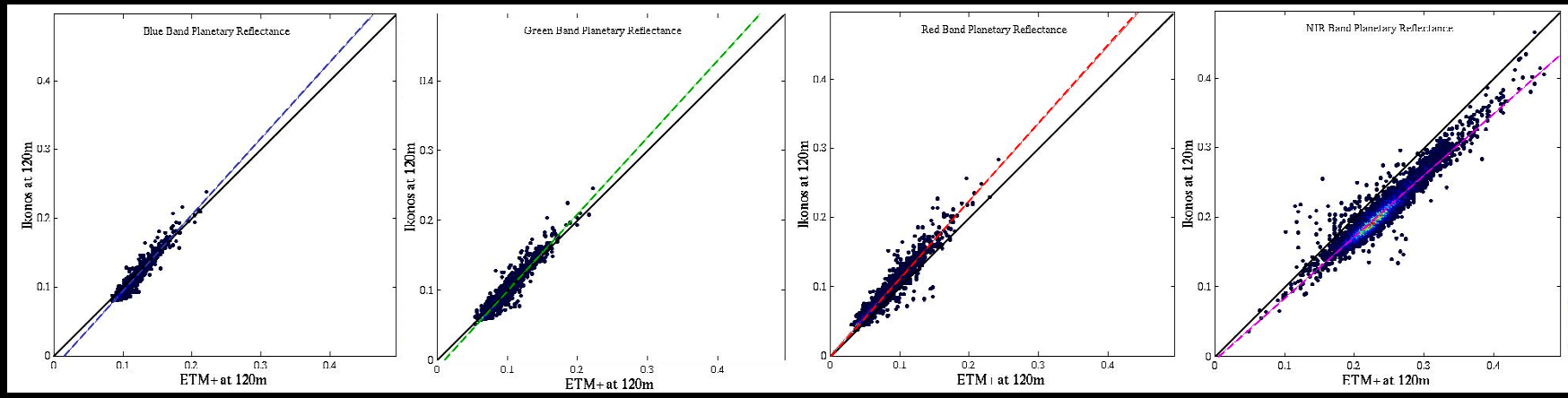
Relative Vegetation

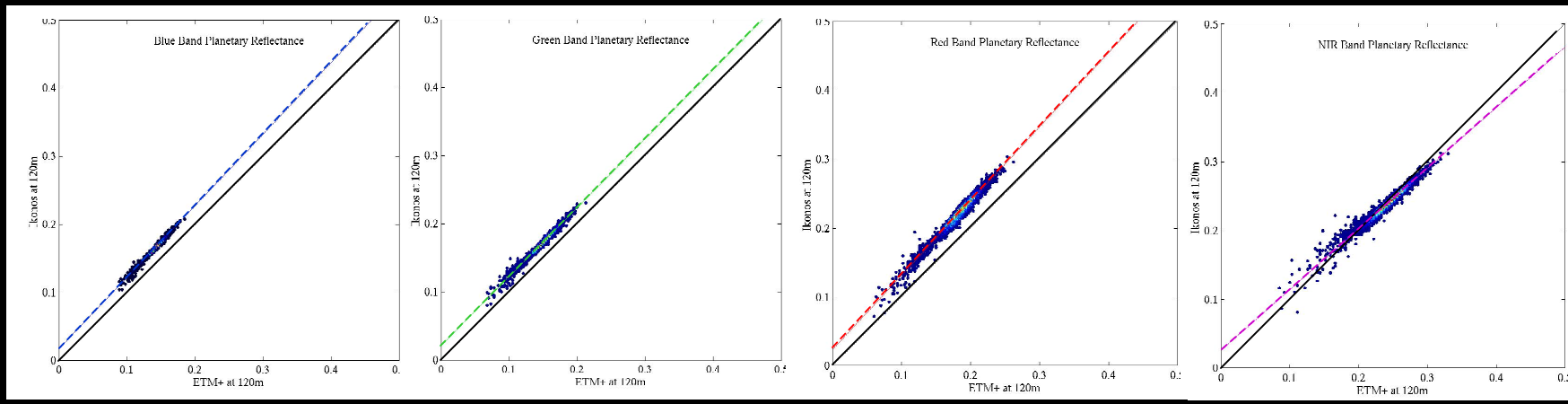
Beltsville 2

Blue Green Red NIR

Vegetated Site



Non-Vegetated Site



120 meter Resolution

Sevilleta 3

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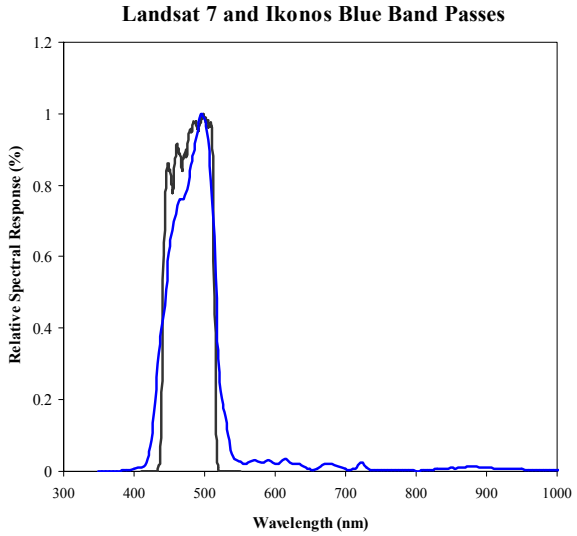
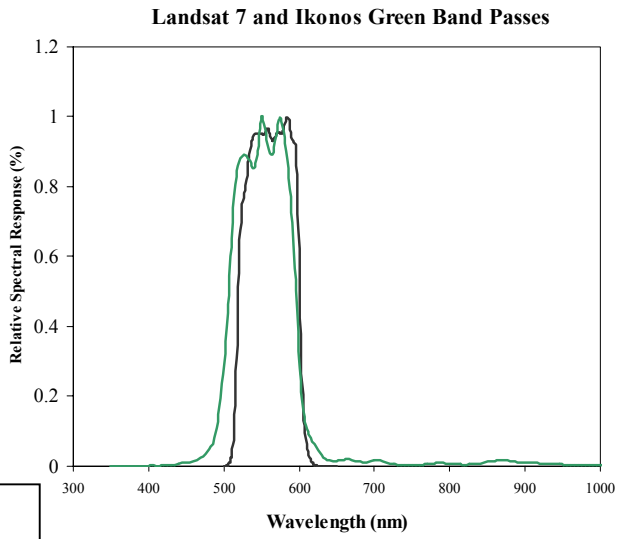
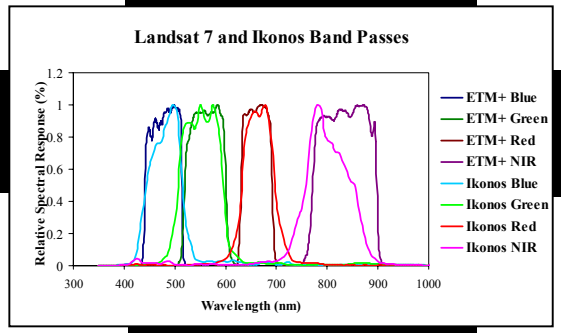
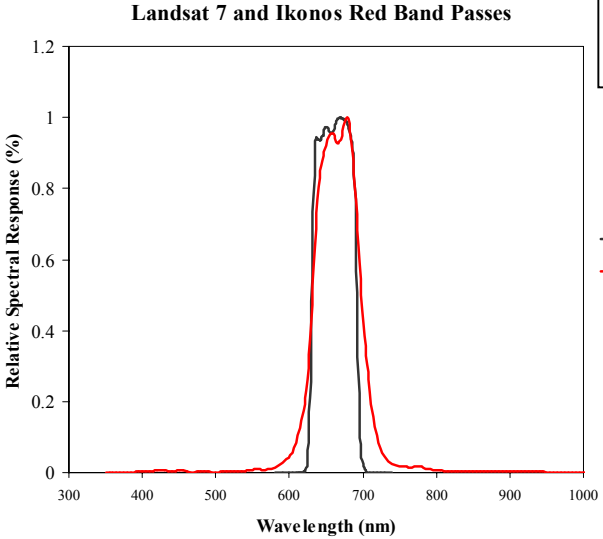
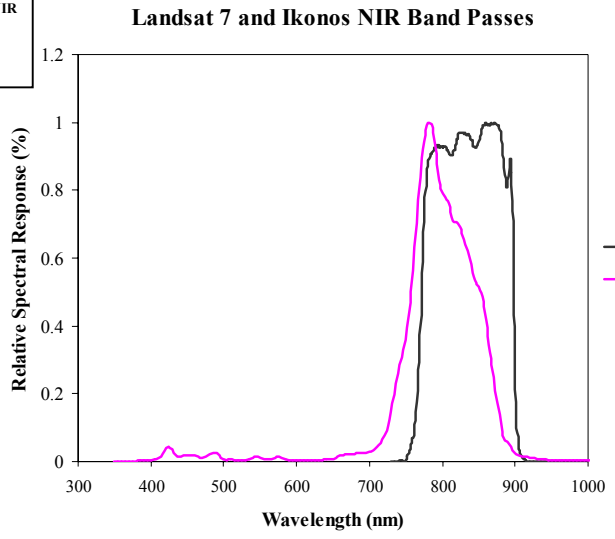
Band Pass Analysis



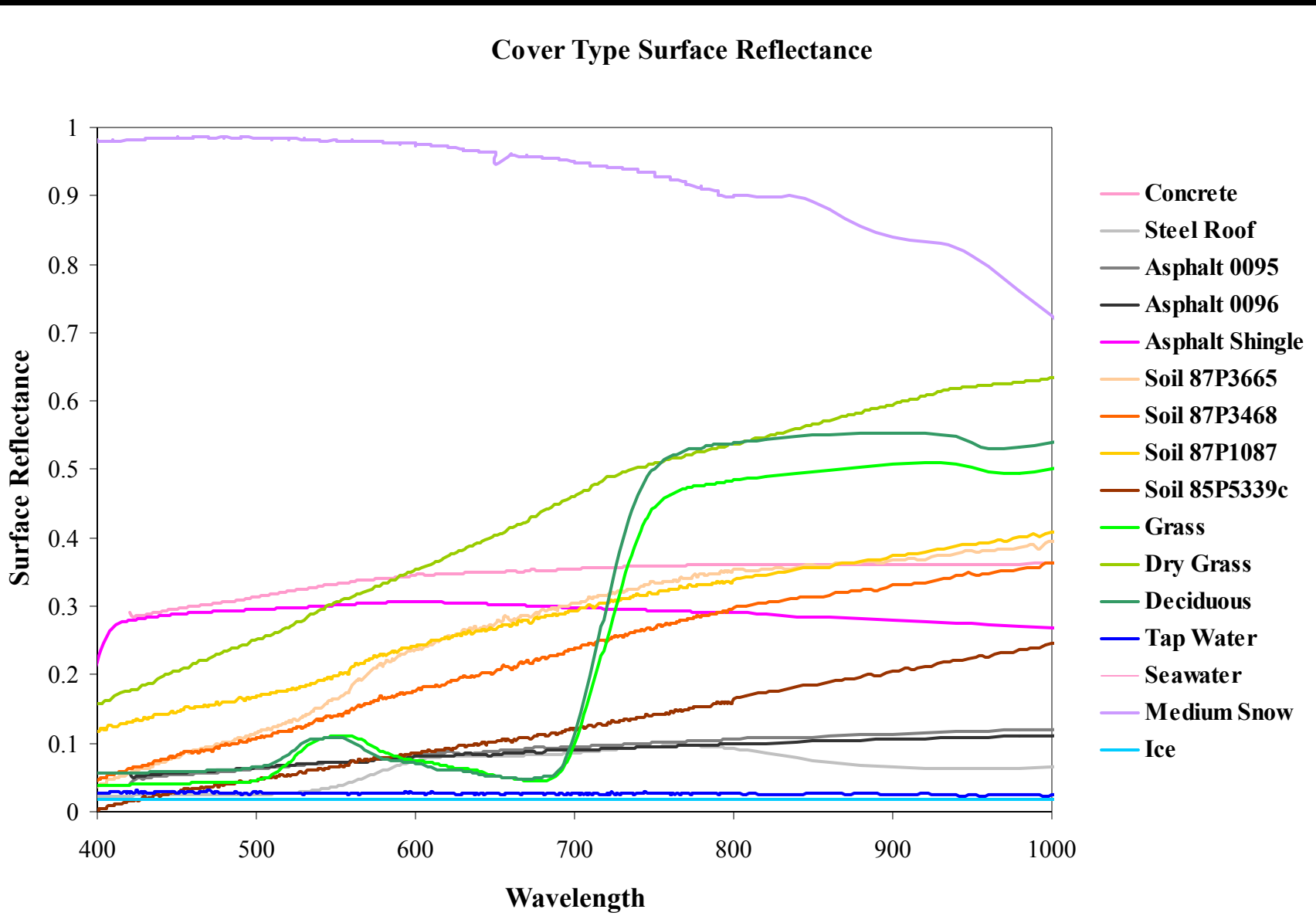








Spectral Curves



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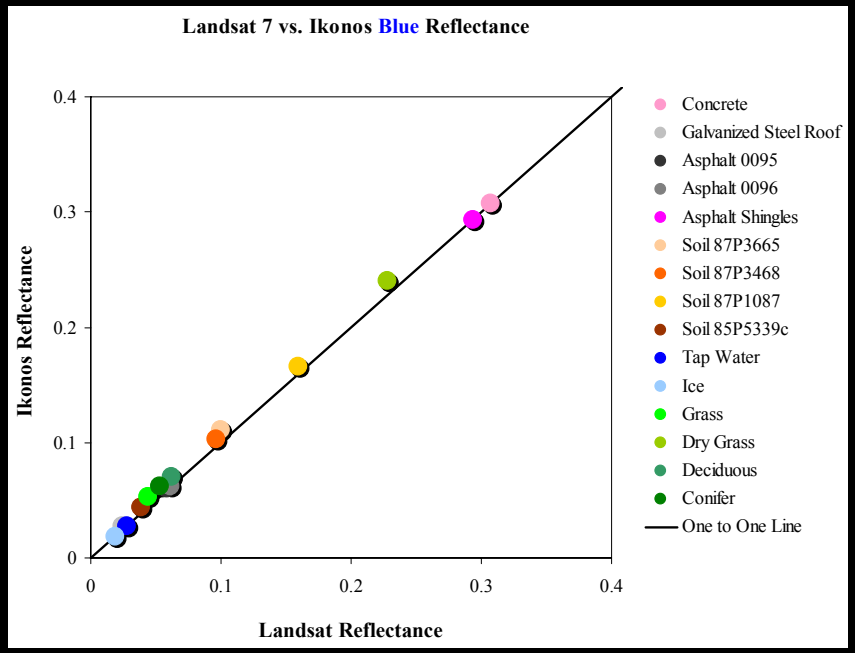
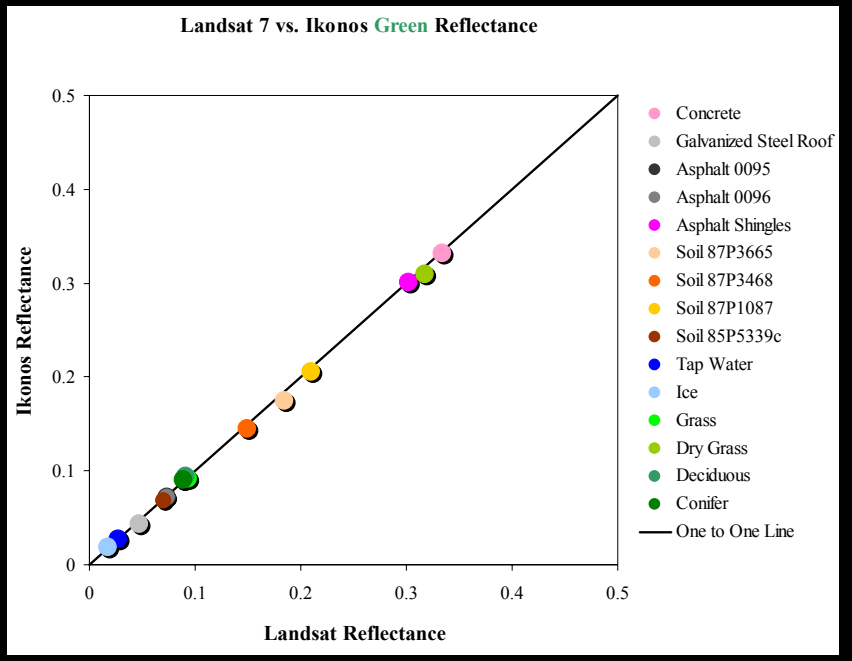
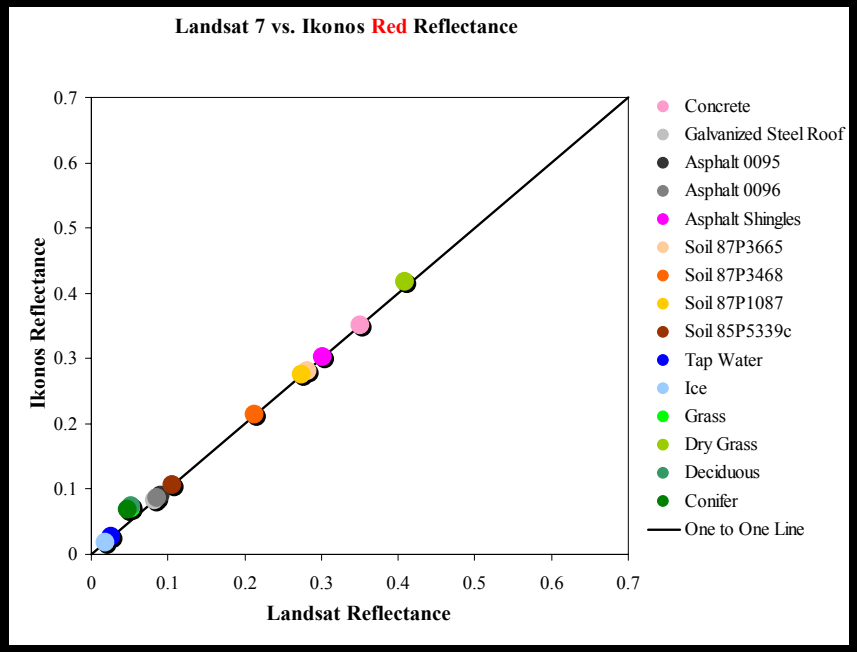
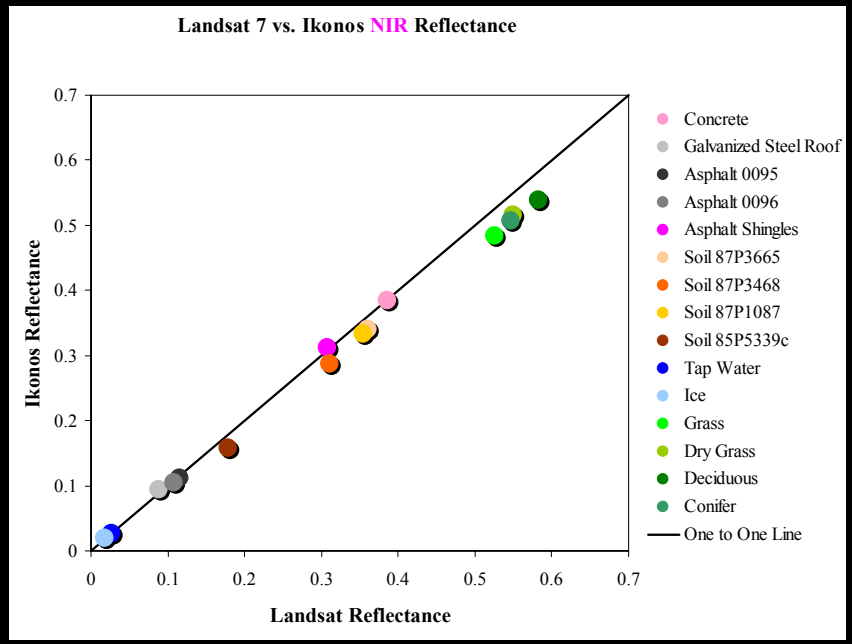
Integrated Reflectance









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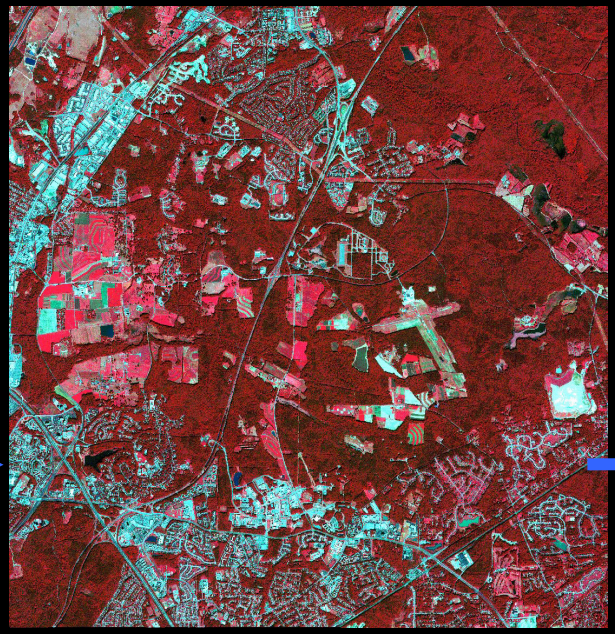
Color Range

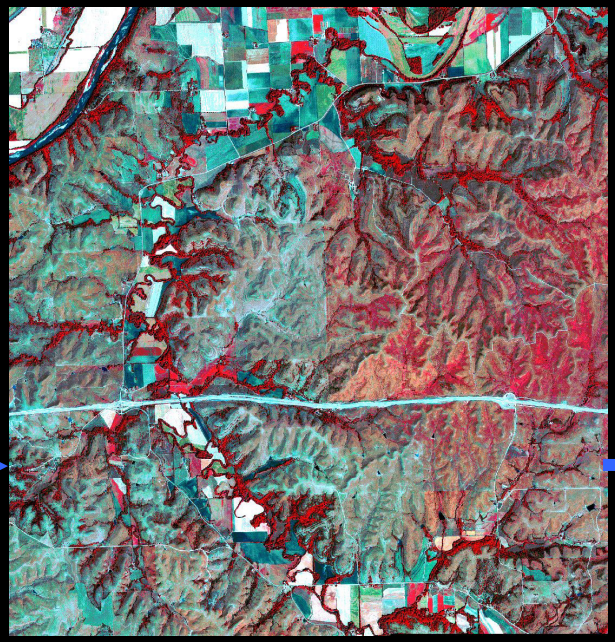
Beltsville 2, Maryland, Sept 2000

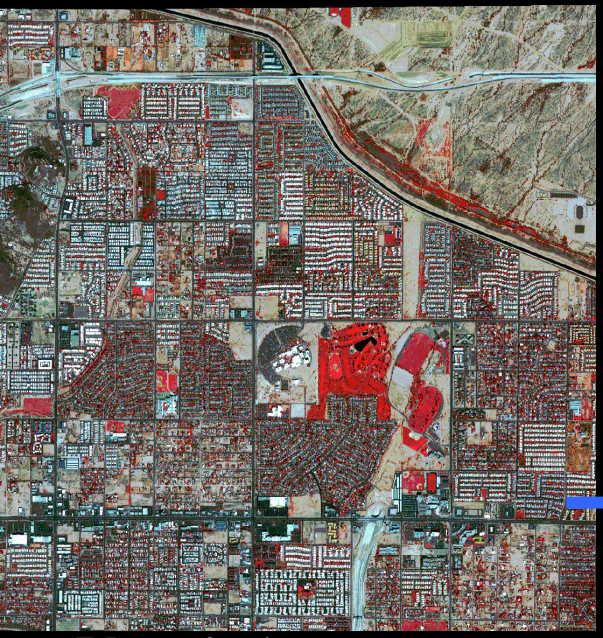
Konza 3, Kansas, Sept 2000

Most Color

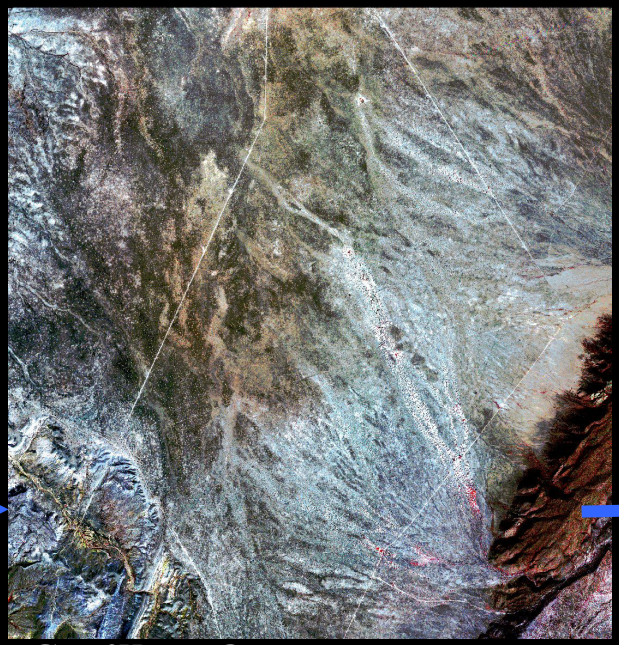
4,3,2 Band Combinations







Phoenix 1, Arizona, Oct 1999



Sevilleta 3, New Mexico, Sept 2000

Sevilleta 5, New Mexico, Dec 2000

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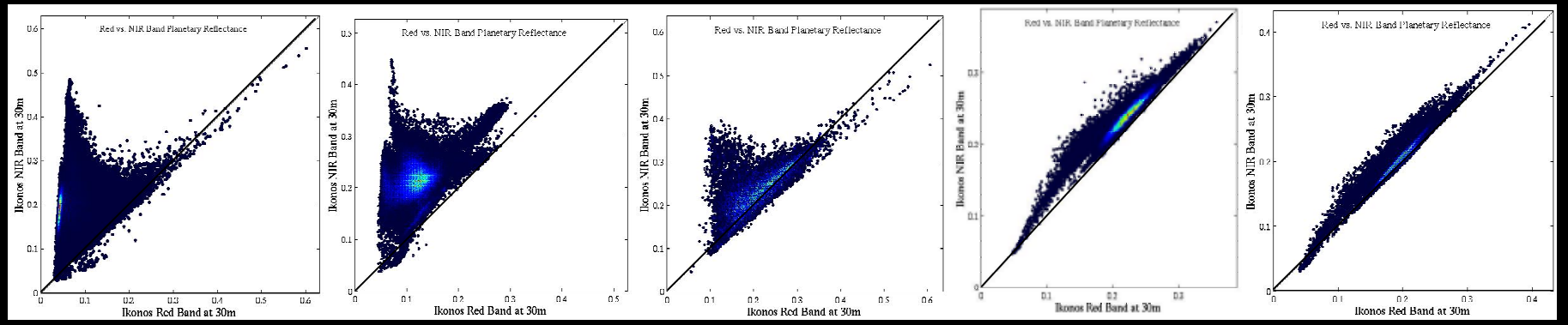
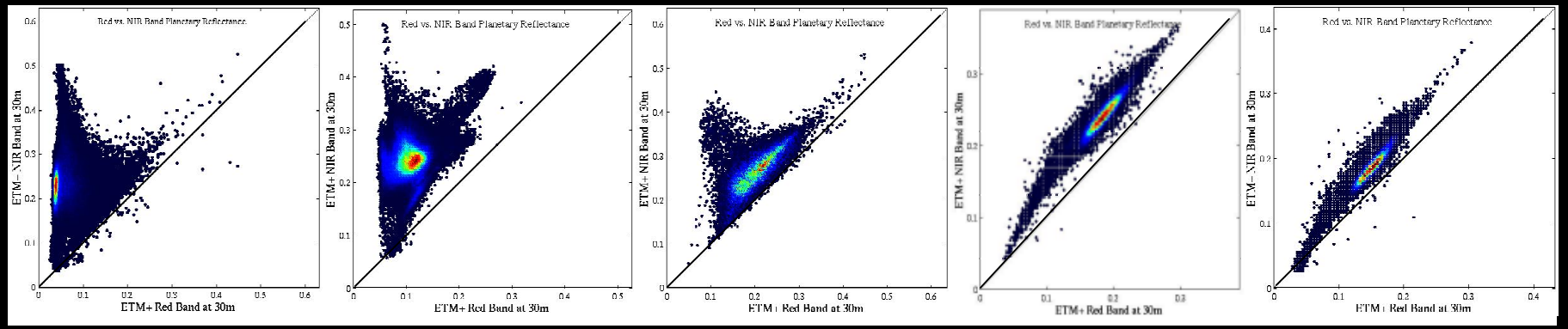
Red vs NIR

IKONOS



ETM+



Beltsville 2	Konza 3	Phoenix 1	Sevilleta 3	Sevilleta 5
(Beltsville, Maryland)	(Konza Prairie, Kansas)	(Phoenix, Arizona)	(Sevilleta, New Mexico)	(Sevilleta, New Mexico)
July 2000	September 2000	October 1999	September 2000	December 2000

30 meter resolution

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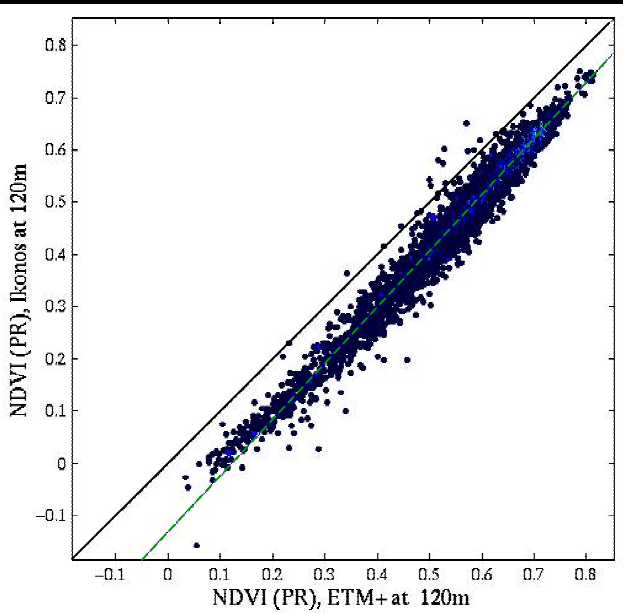
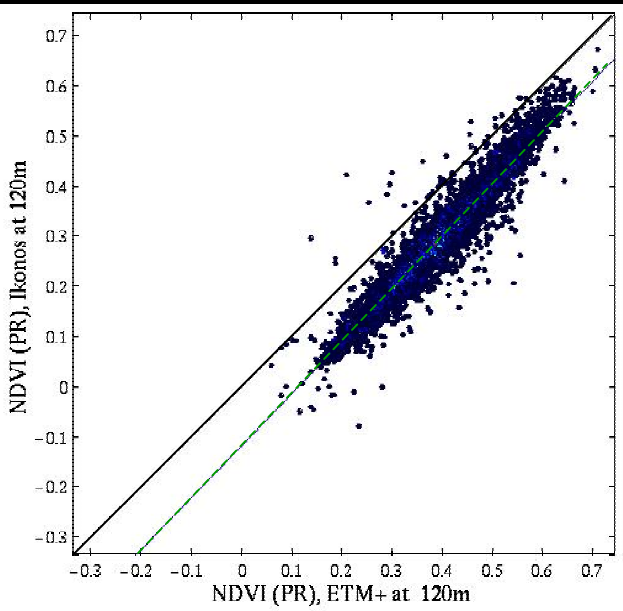
NDVI Analysis

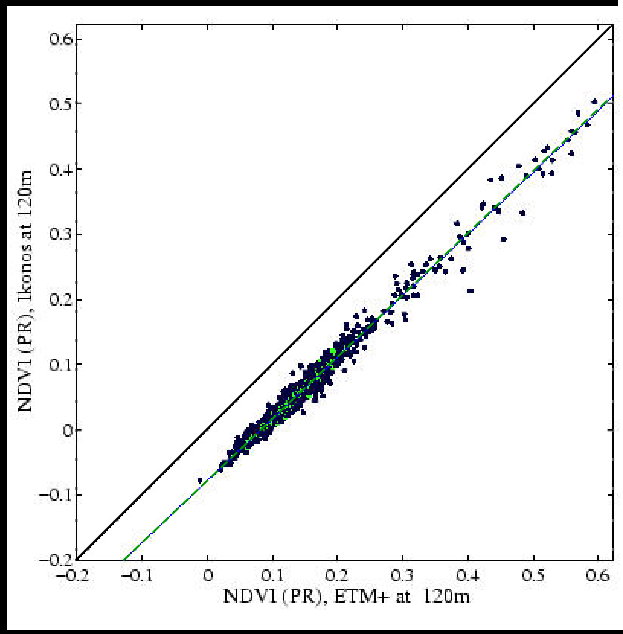
NDVI=(NIR-Red/NIR+Red)

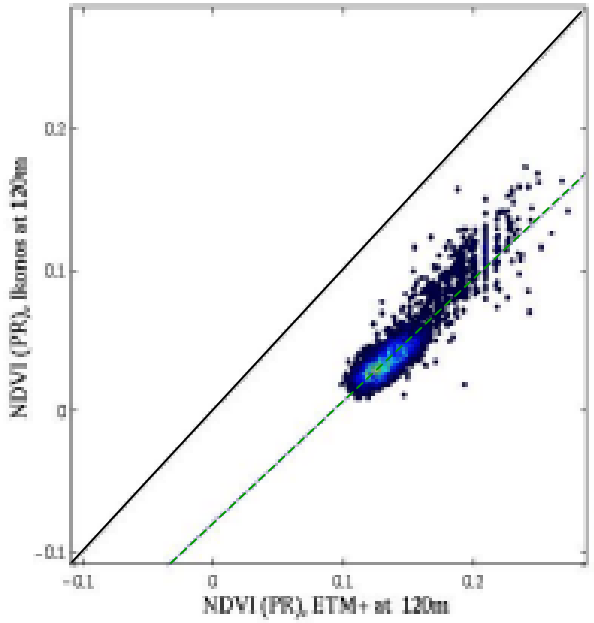
Beltsville 2, Maryland, Sept 2000

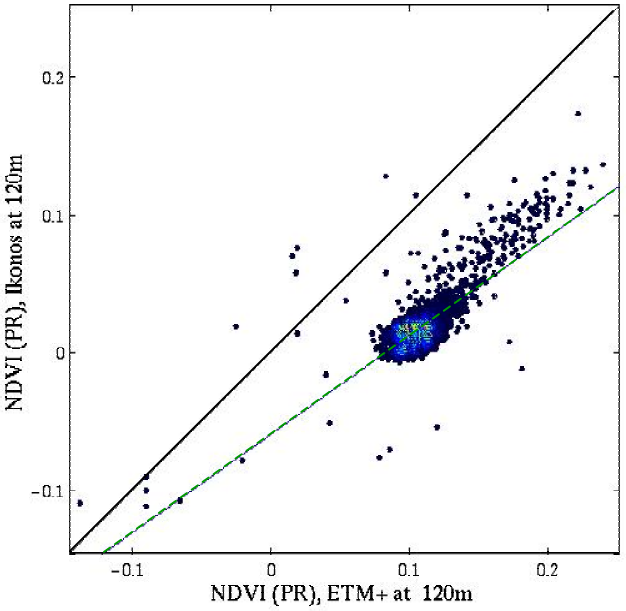


Konza 3, Kansas, Sept 2000









Phoenix 1, Arizona, Oct 1999

Sevilleta 3, New Mexico, Sept 2000

Sevilleta 5, New Mexico, Dec 2000

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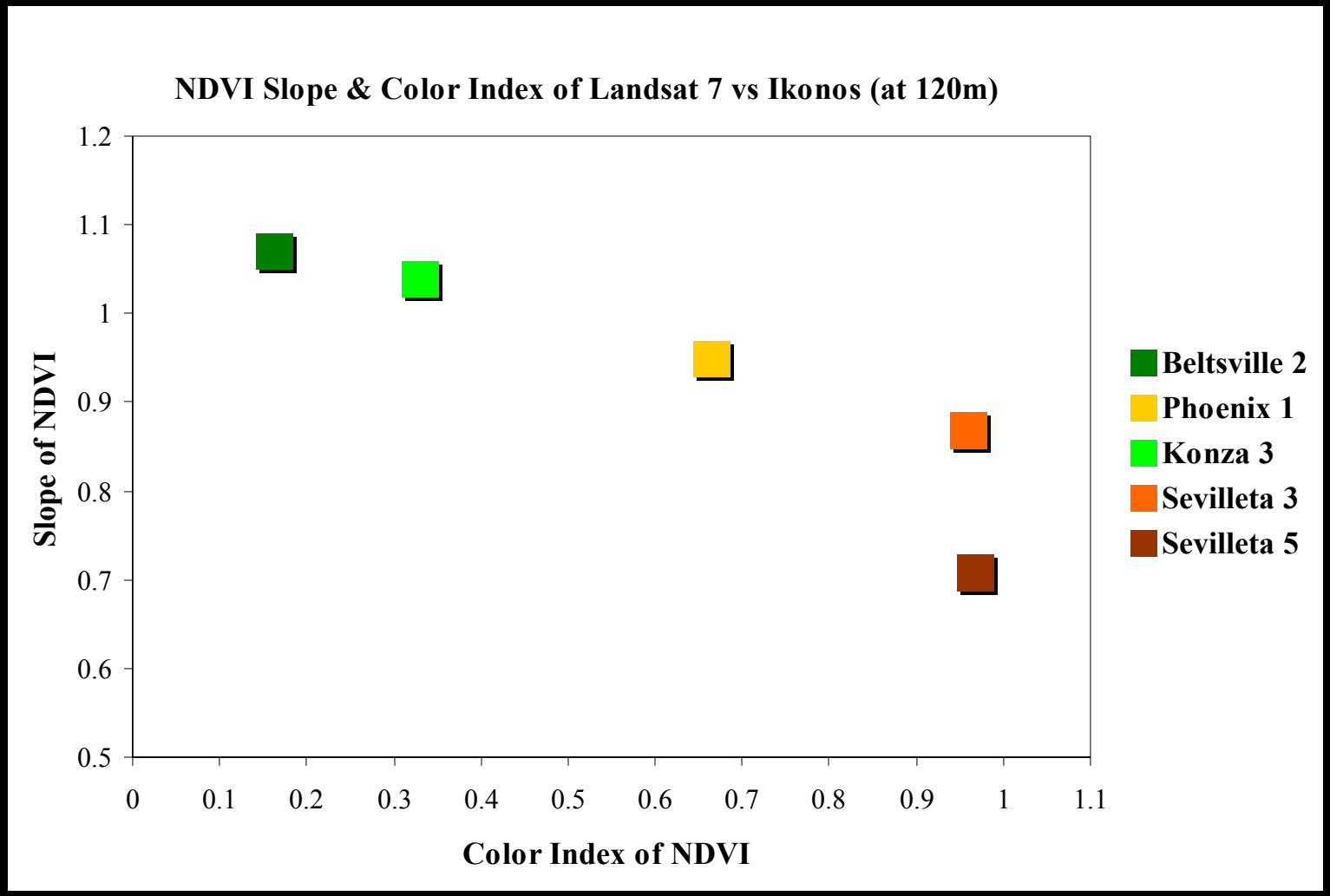
Color Index Analysis



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Current Conclusion:

The relationship between the IKONOS and ETM+ sensors varies as a function of the green vegetation present

*** Remember Landsat MSS**

Beltsville, Maryland

Sevilleta, New Mexico

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What happened to the other scenes?

Fifteen scene pairs were acquired, but only **Five** were used. The reasons why:

Scene Pair Sites	Vegetation	Excluded - Phenology	Excluded - BRDF	Excluded - Clouds	Included
Beltsville 1	Ag, Deciduous			X	
Beltsville 2	Ag, Deciduous				Y
Beltsville 3	Ag, Deciduous			X	
Konza 1	Grassland	X			
Konza 2	Grassland			X	
Konza 3	Grassland				Y
Phoenix 1	Urban				Y
Sevilleta 1	Desert			X	
Sevilleta 2	Desert			X	
Sevilleta 3	Desert				Y
Sevilleta 4	Desert			X	
Sevilleta 5	Desert				Y
Tahoe 1	Water, Snow	X			
Tahoe 2	Water, Snow	X			

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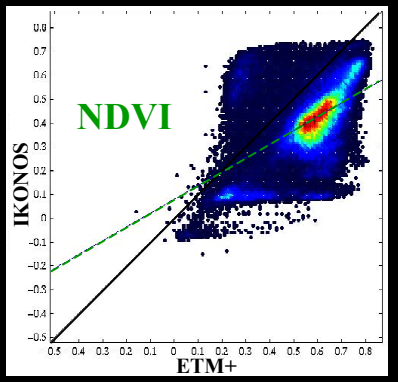
Phenology

Konza Prairie, Kansas

Ikonos (4,3,2)
May 11, 2000



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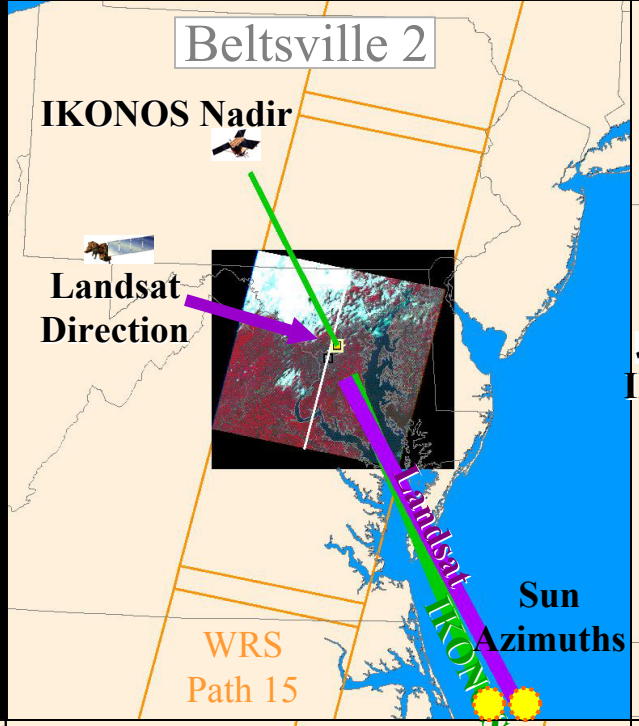
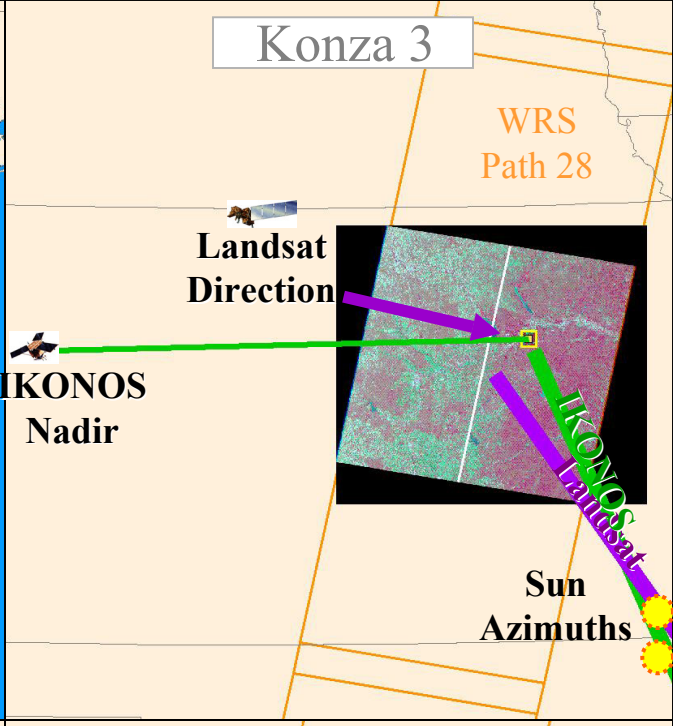
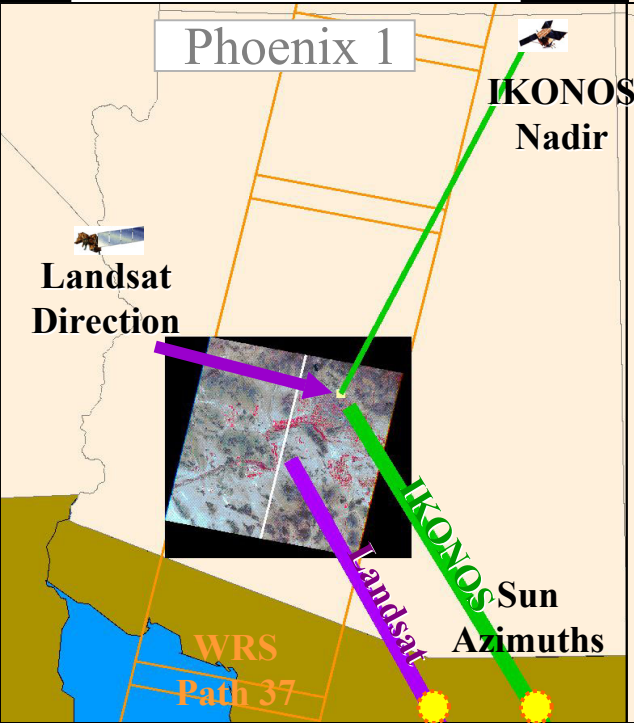
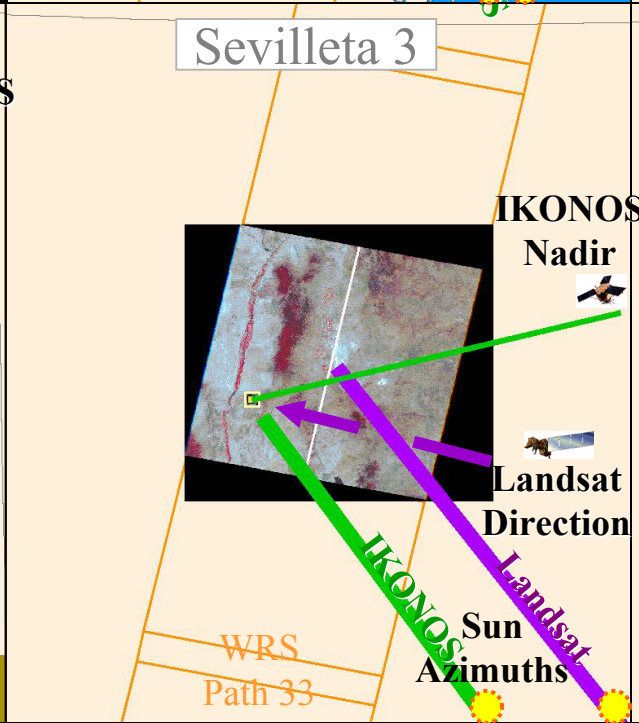
BRDF

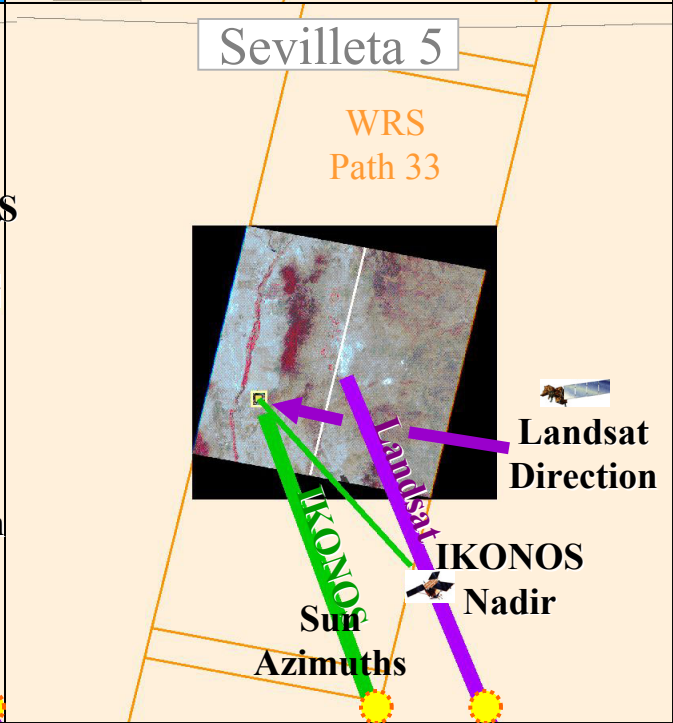
Beltsville 2	Landsat	Ikonos
Sun Azimuth:	152.00°	157.18°
Satellite Azimuth:	278.20°	333.39°
Satellite Elevation:	0.23°	74.04°
Date:	10/02/2000	09/29/2000
Konza 3	**Landsat**	**Ikonos**
Sun Azimuth:	144.87°	156.24°
Satellite Azimuth:	278.20°	268.65°
Satellite Elevation:	1.23°	61.82°
Date:	09/11/2000	09/15/2000
Phoenix 1	**Landsat**	**Ikonos**
Sun Azimuth:	150.73°	148.51°
Satellite Azimuth:	278.20°	27.82°
Satellite Elevation:	1.80°	60.72°
Date:	10/10/1999	10/12/1999
Sevilleta 3	**Landsat**	**Ikonos**
Sun Azimuth:	141.56°	143.41°
Satellite Azimuth:	98.20°	76.70°
Satellite Elevation:	2.27°	66.54°
Date:	9/14/2000	9/18/2000
Sevilleta 5	**Landsat**	**Ikonos**
Sun Azimuth:	157.40°	159.84°
Satellite Azimuth:	98.20°	137.72°
Satellite Elevation:	2.27°	75.33°
Date:	12/3/2000	12/4/2000





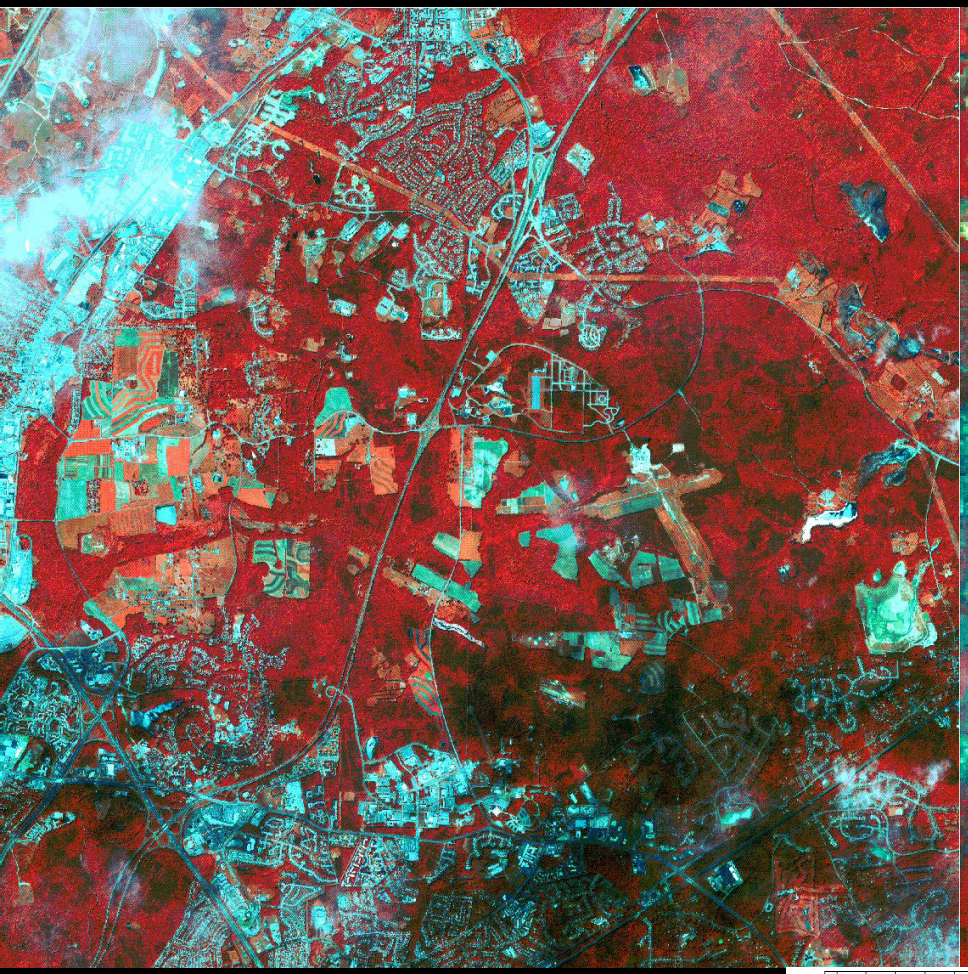


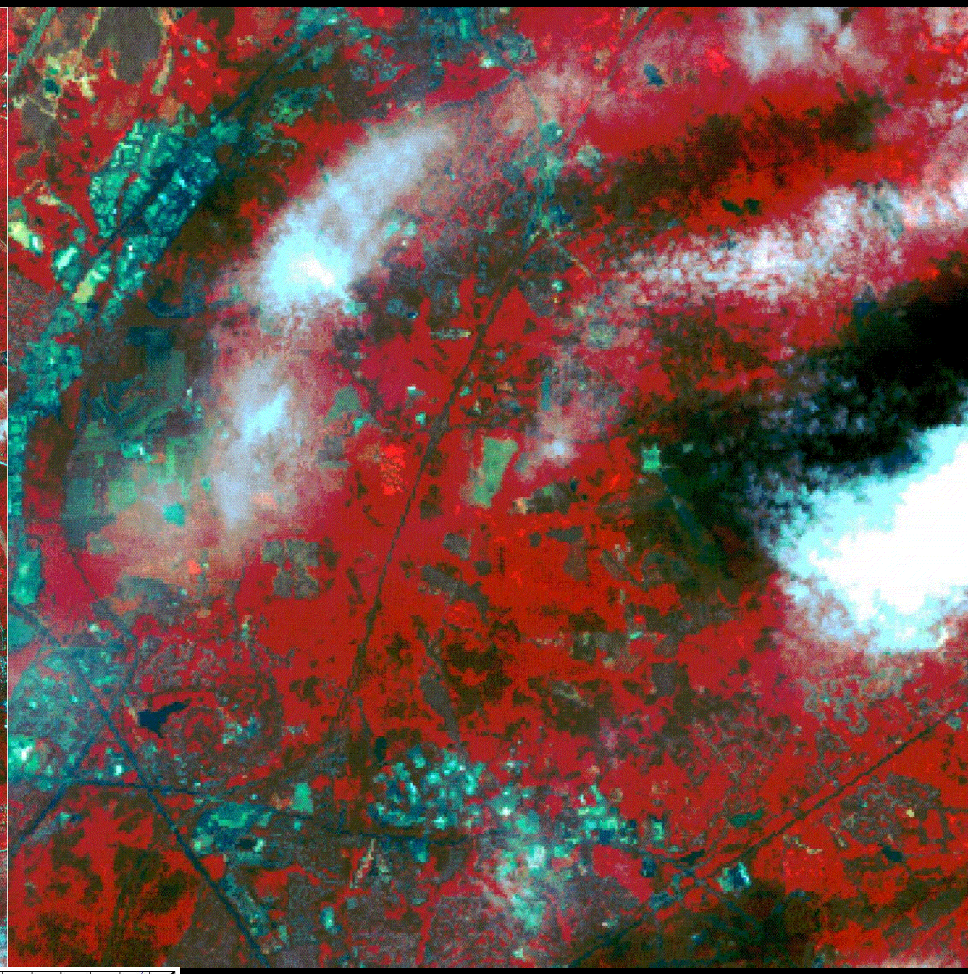




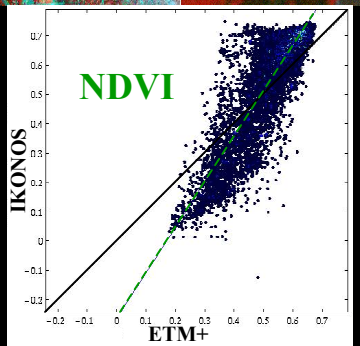
Obvious Clouds

Beltsville, Maryland





IKONOS (4,2,1)
June 3, 2000



ETM+ (4,2,1)
June 12, 2000

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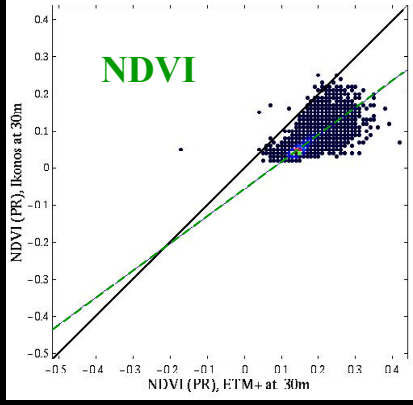
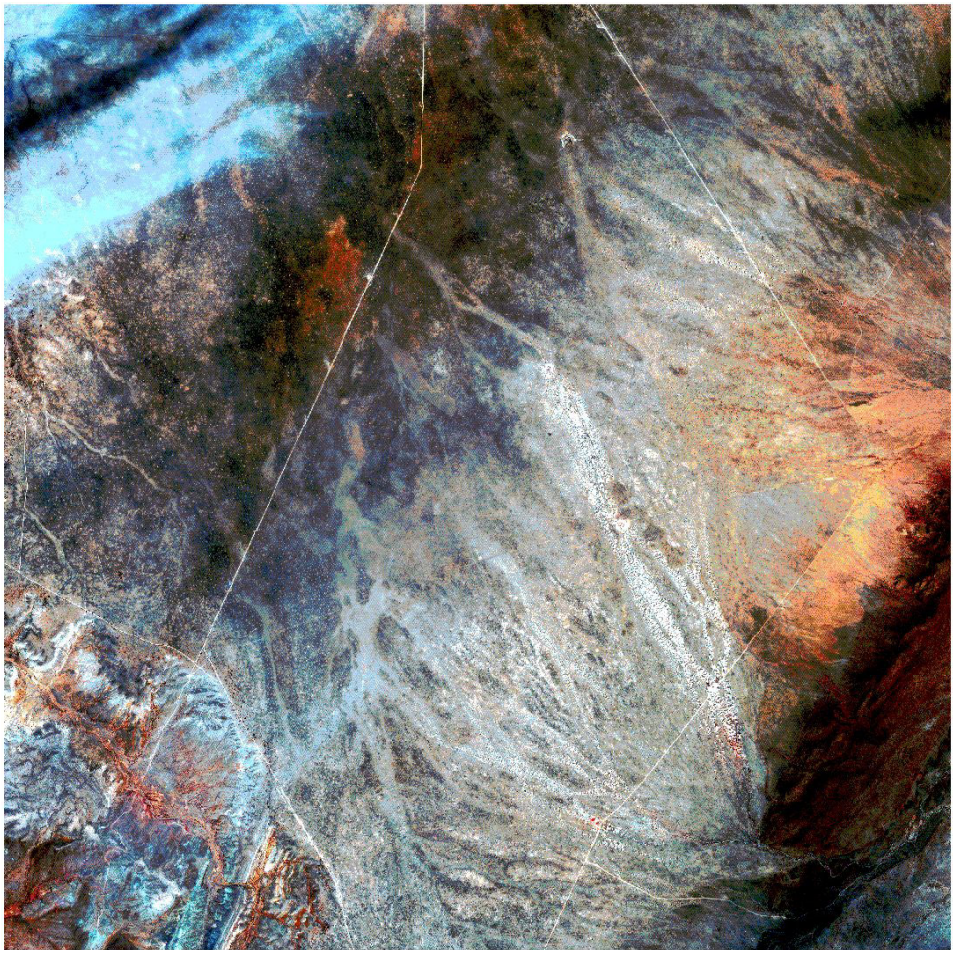
Cirrus Clouds

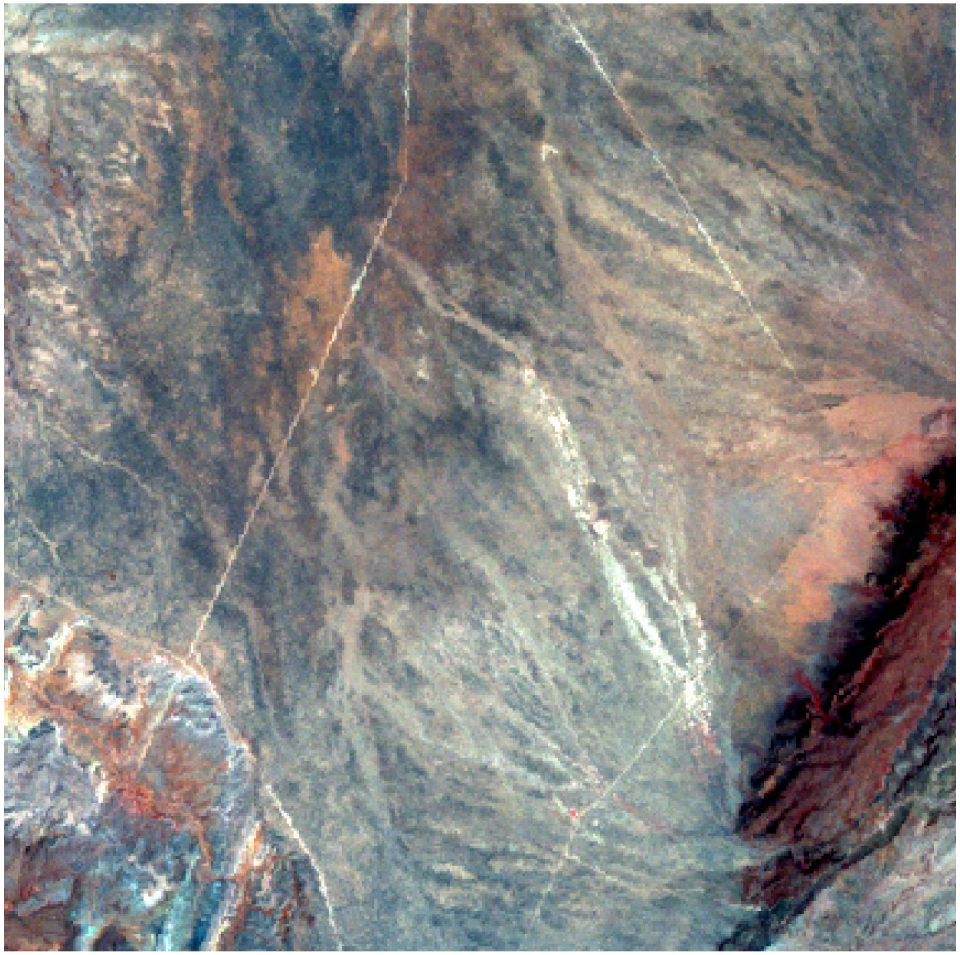
Sevilleta, New Mexico



IKONOS (4,2,1) May 12, 2000



ETM+ (4,2,1) May 9, 2000

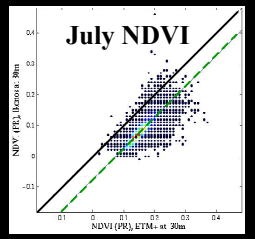


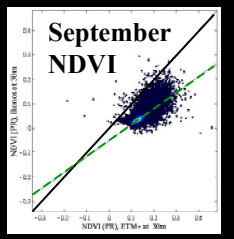
Hidden Clouds

Sevilleta, NM

ETM+ Blue Band

July 2000





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Conclusions

- Lost 2/3 of scenes to clouds (phenology)
- Differing spectra band passes matter
- Vegetation Index relation varies with vegetation conditions
- IKONOS is a suitable, if complicated, source of virtual ground truth

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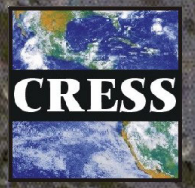
For Further Information, please contact:

The CRESS Project

University of Maryland



www.geog.umd.edu/cress

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