Radiative forcing at local to national level associated with urbanization in China

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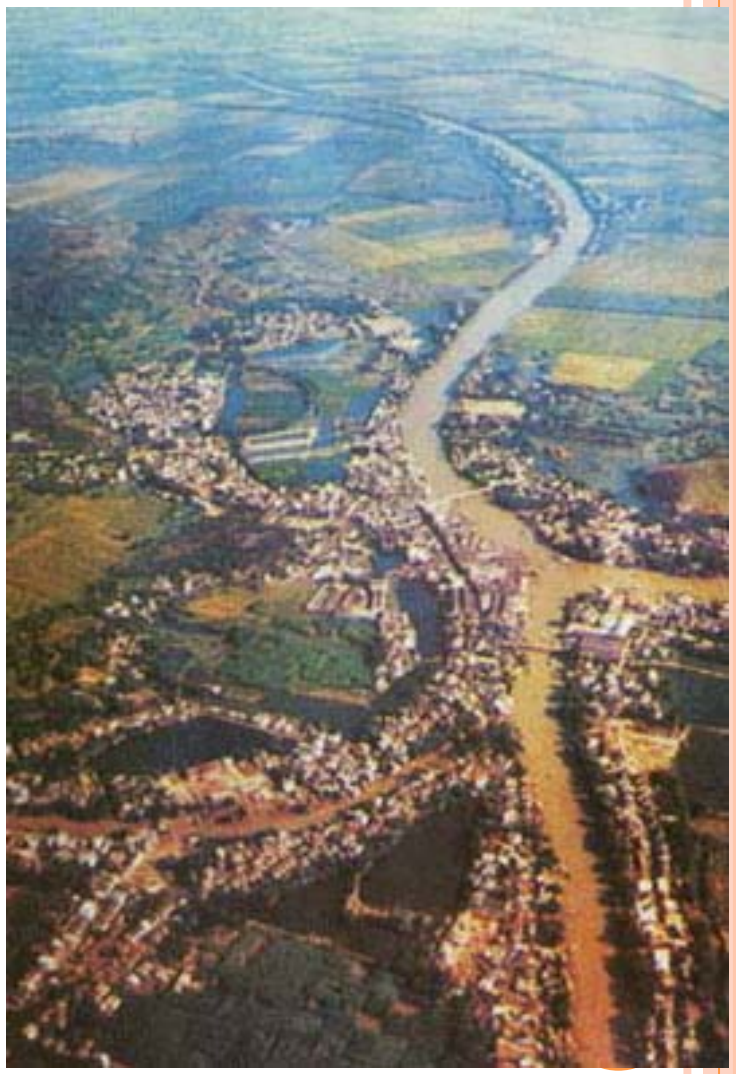
Advisor: Xuhui Lee

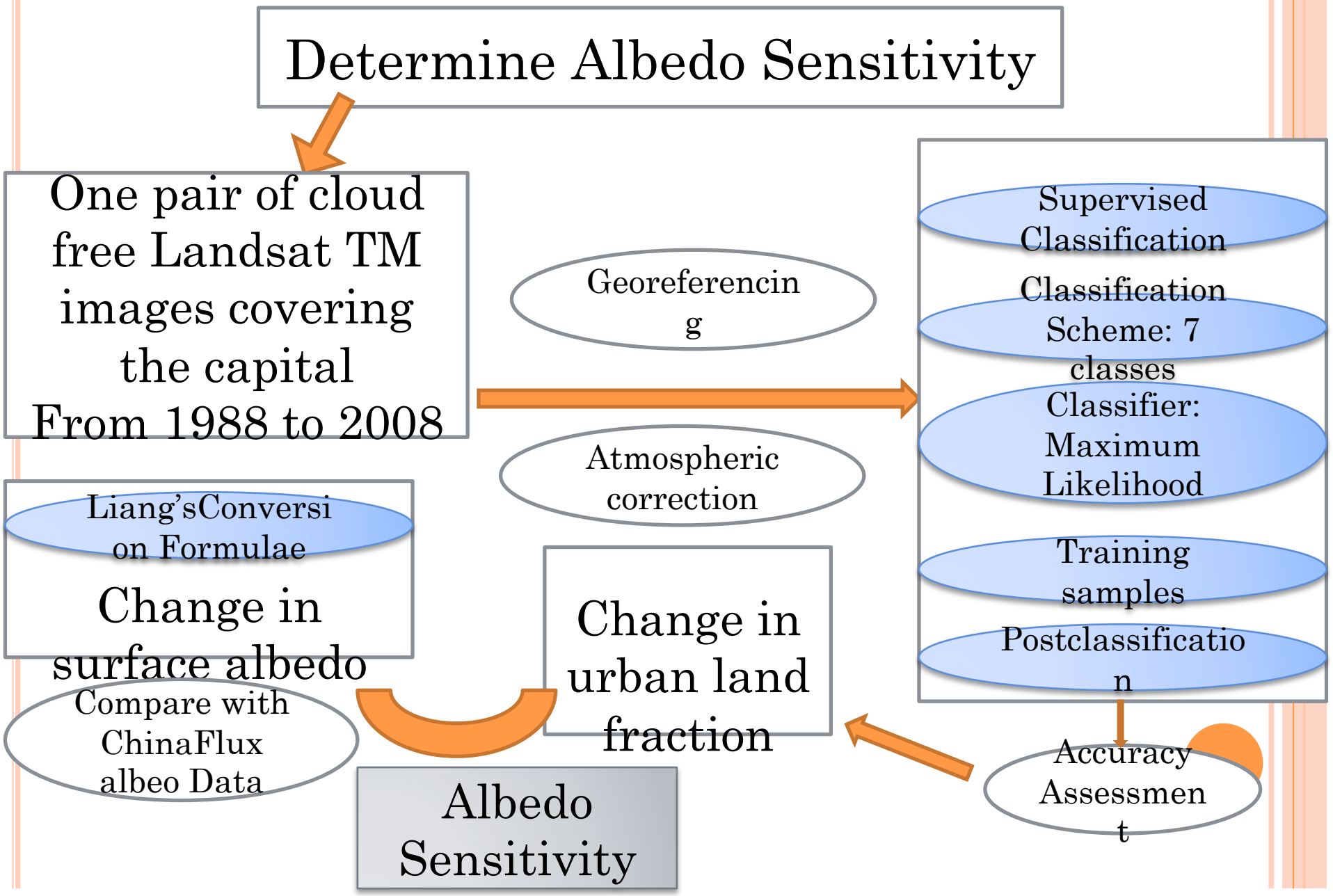
Background

- Albedo
- Radiative forcing
- Significance

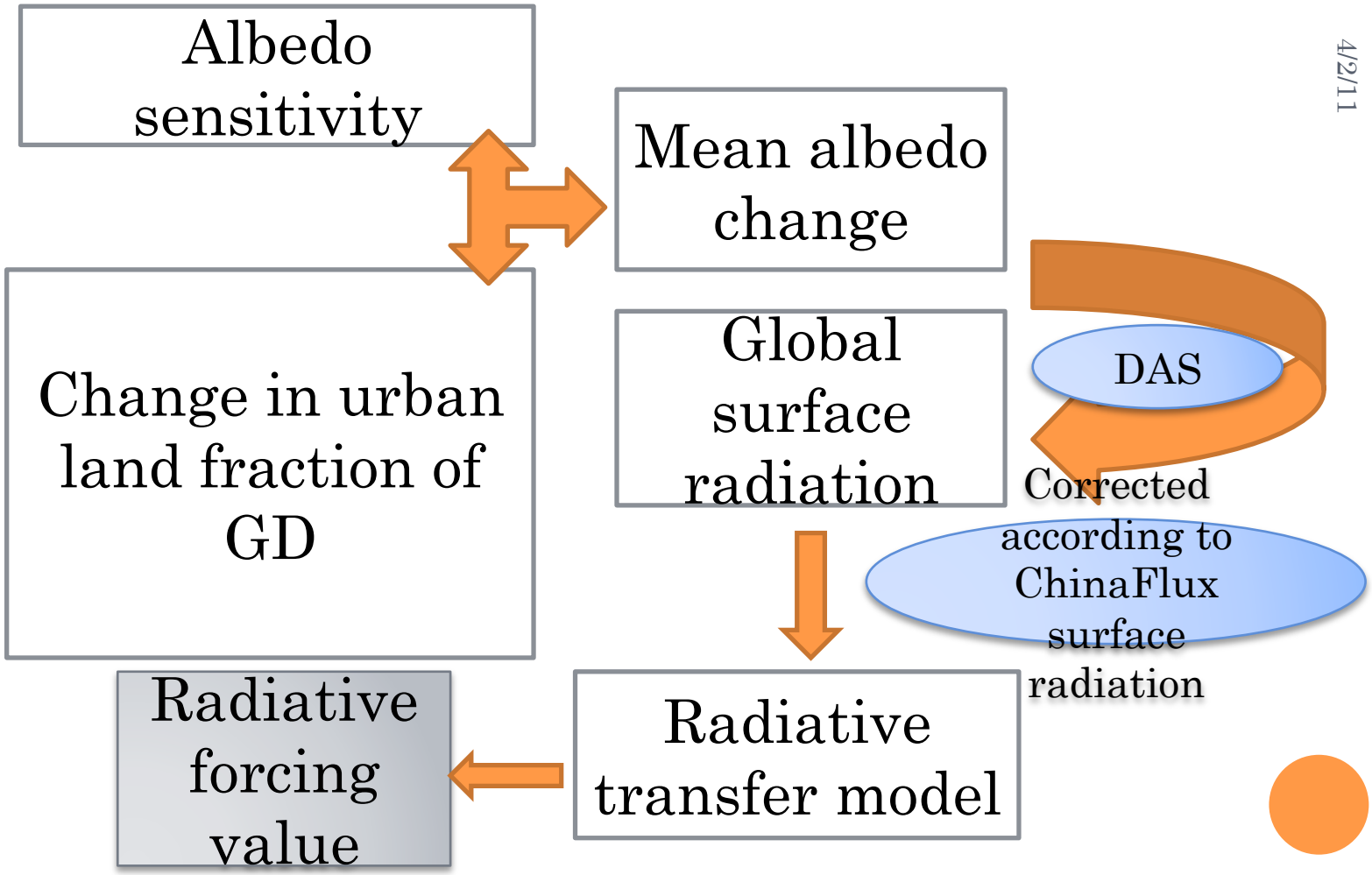
Pearl River Delta



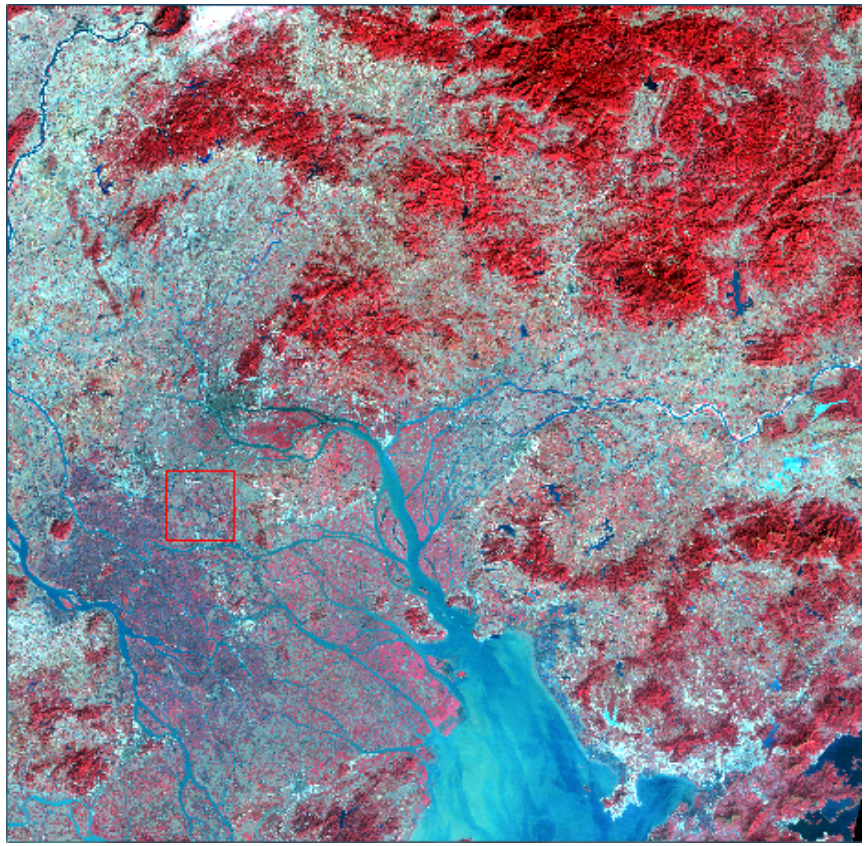
RESEARCH FRAMEWORK



Determine radiative forcing



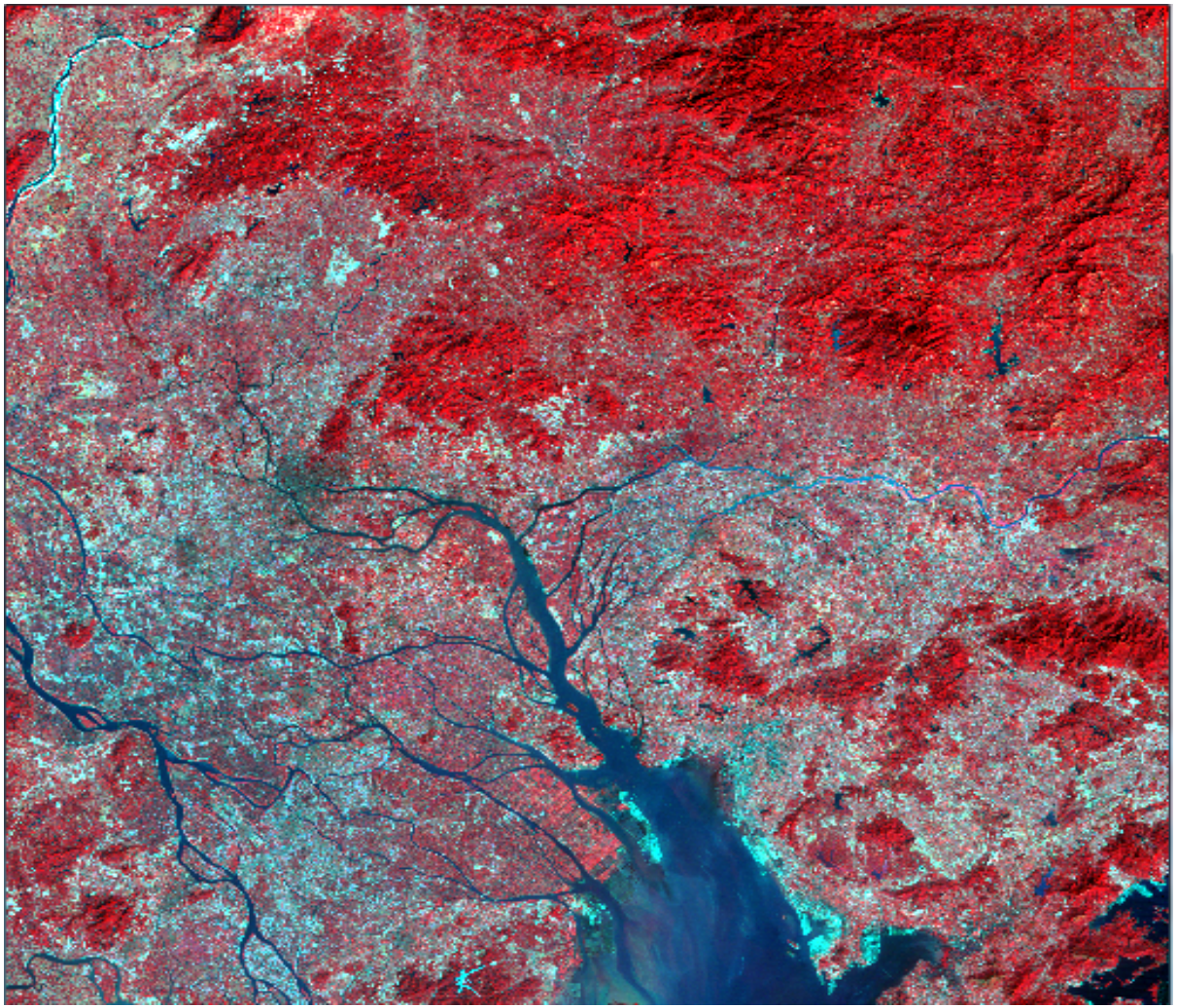
Satellite images from 1988 and 2008



1988 raw image

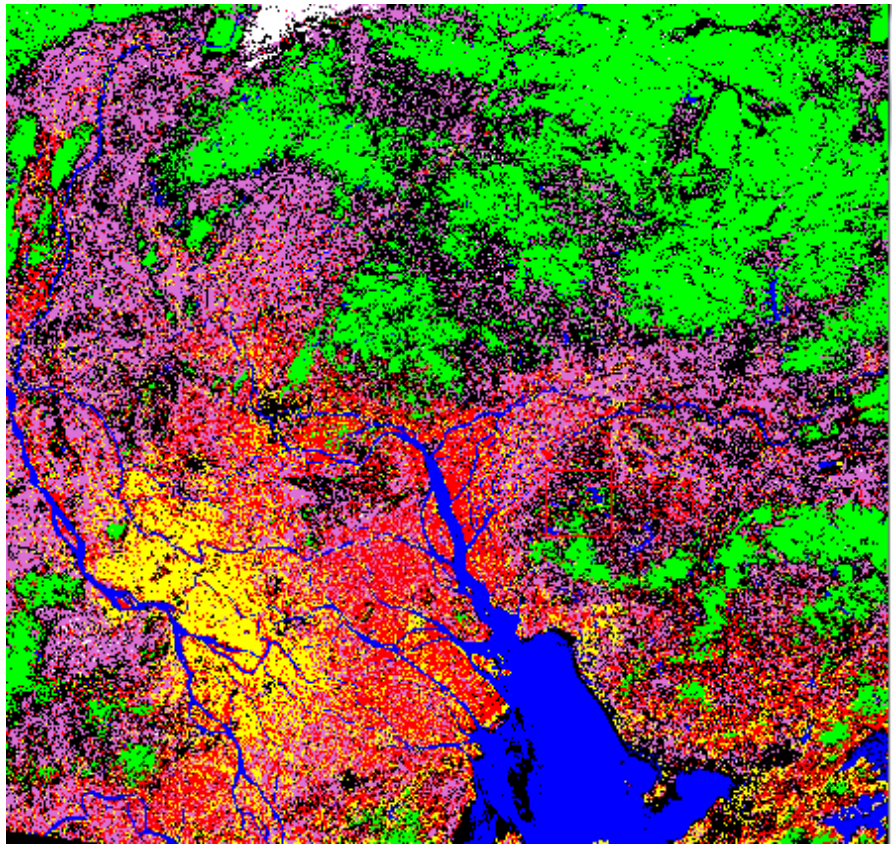
2008 raw image

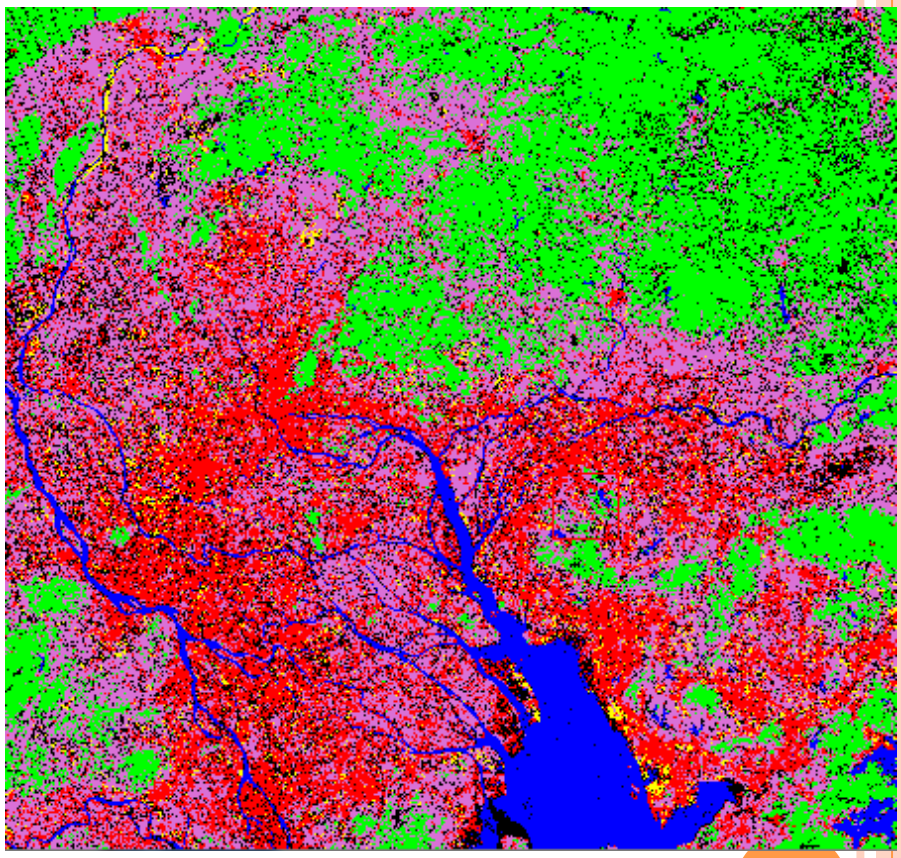
Layer stacking two images



After geo-referencing, the two images can sit on top of each other.

Classified images





CHANGE IN URBAN FRACTION

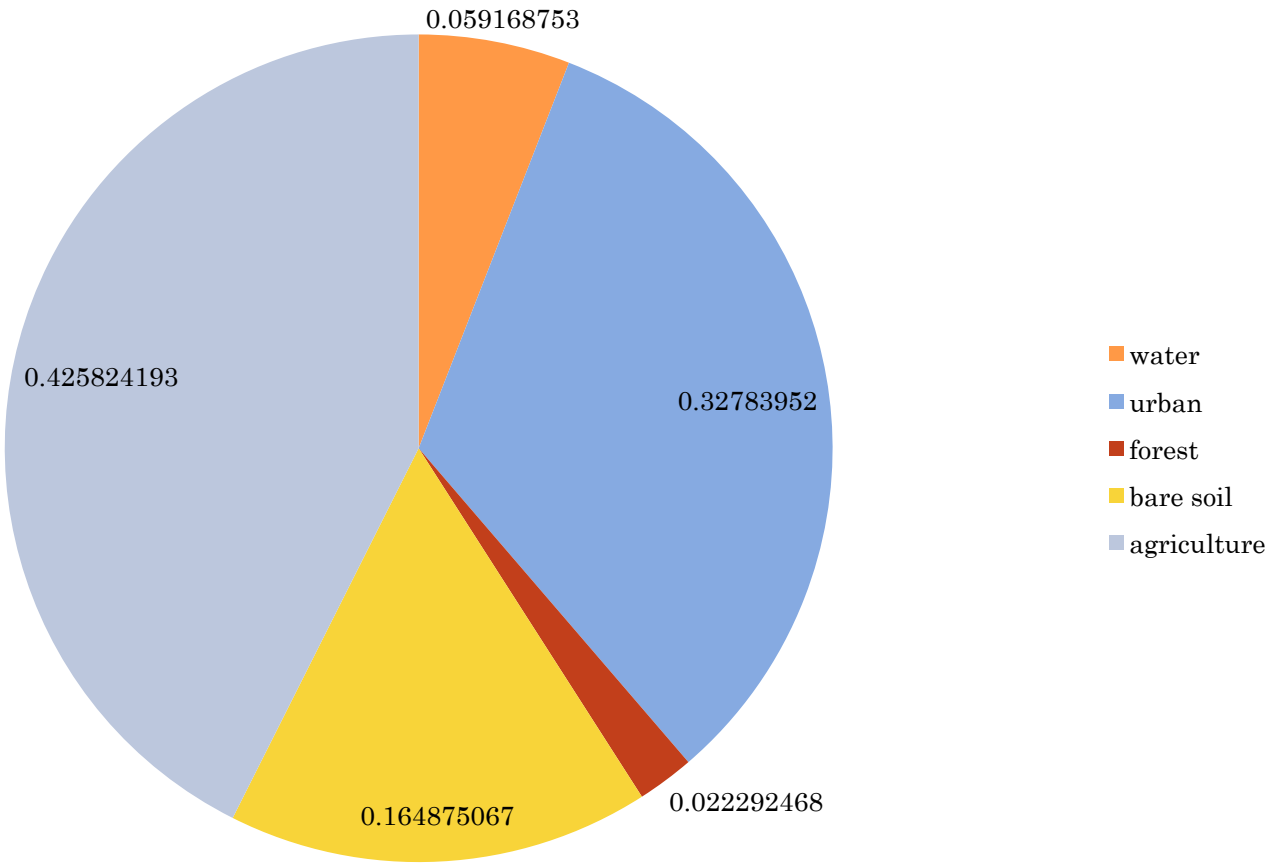
Initial State

Final State	water [Red] 6725 points	urban [Green] 11127 points	Forest [Blue] 12874 points	bare soil [Yellow] 3735 points	AG [Cyan] 5540 points	Row Total
Unclassified	122930	387915	399847	781218	1059435	2751345
water [Red] 6725 points	1243639	83830	8517	32223	25487	1393696
urban [Green] 11127 points	428139	2372213	161306	1193019	3081220	7235897
Forest [Blue] 12874 points	4575	81423	3949985	787114	205814	5028911
bare soil [Yellow] 3735 points	59939	221951	32499	259005	504095	1077489
AG [Cyan] 5540 points	75291	715035	595797	1748419	2493891	5628433
Class Total	1934513	3862367	5147951	4800998	7369942	
Class Changes	690874	1490154	1197966	4541993	4876051	
Image Difference	-510494	3505490	-88408	-3704738	-1676089	

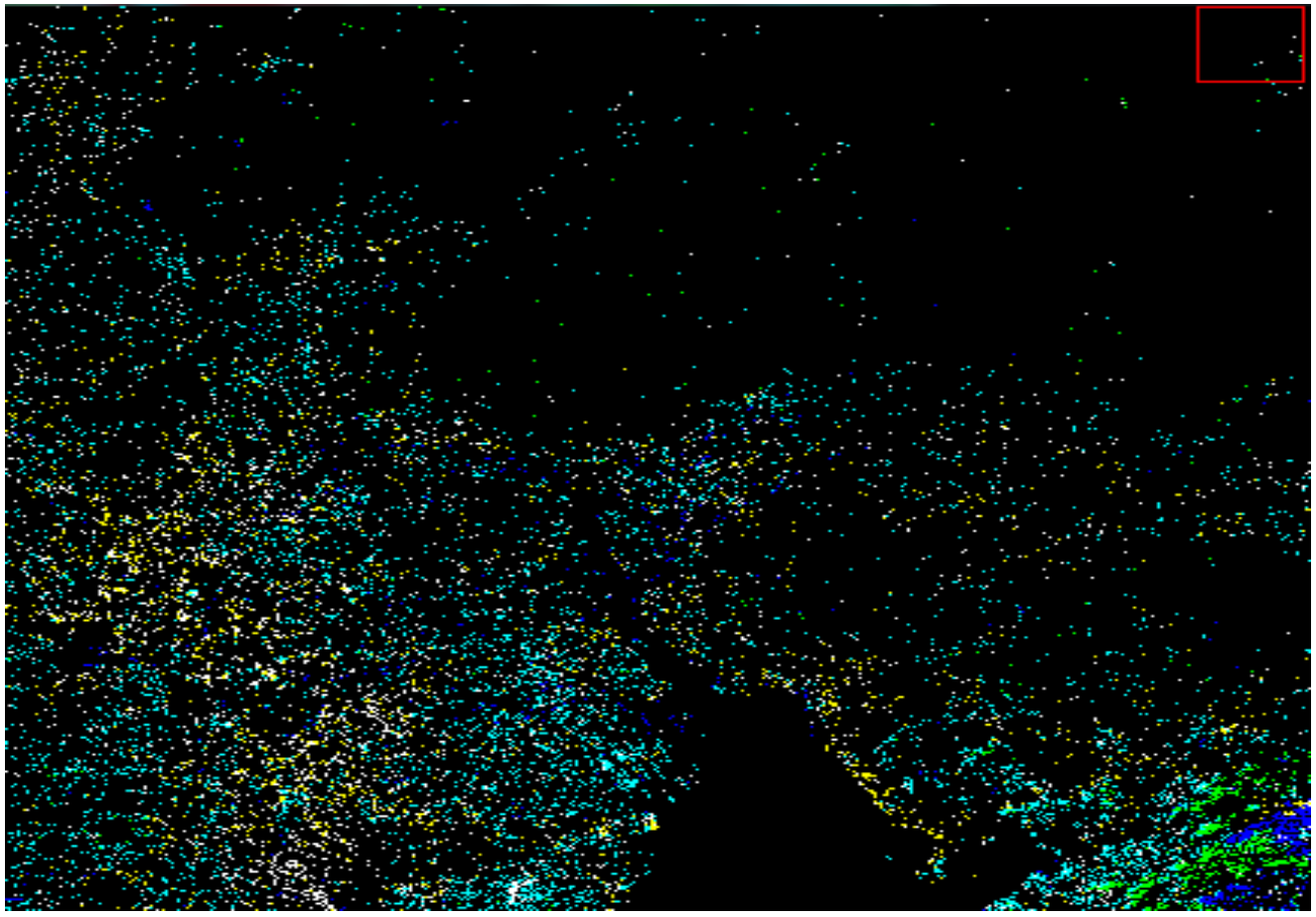
Initial State

Final State	water [Red] 6725 points	urban [Green] 11127 points	Forest [Blue] 12874 points	bare soil [Yellow] 3735 points	AG [Cyan] 5540 points	Row Total
Unclassified	6.355	10.043	7.767	16.272	14.375	98.058
water [Red] 6725 points	64.287	2.170	0.165	0.671	0.346	97.871
urban [Green] 11127 points	22.132	61.419	3.133	24.849	41.808	98.209
Forest [Blue] 12874 points	0.236	2.108	76.729	16.395	2.793	99.395
bare soil [Yellow] 3735 points	3.098	5.747	0.631	5.395	6.840	98.288
AG [Cyan] 5540 points	3.892	18.513	11.573	36.418	33.839	98.851
Class Total	100.000	100.000	100.000	100.000	100.000	
Class Changes	35.713	38.581	23.271	94.605	66.161	
Image Difference	-26.389	90.760	-1.717	-77.166	-22.742	

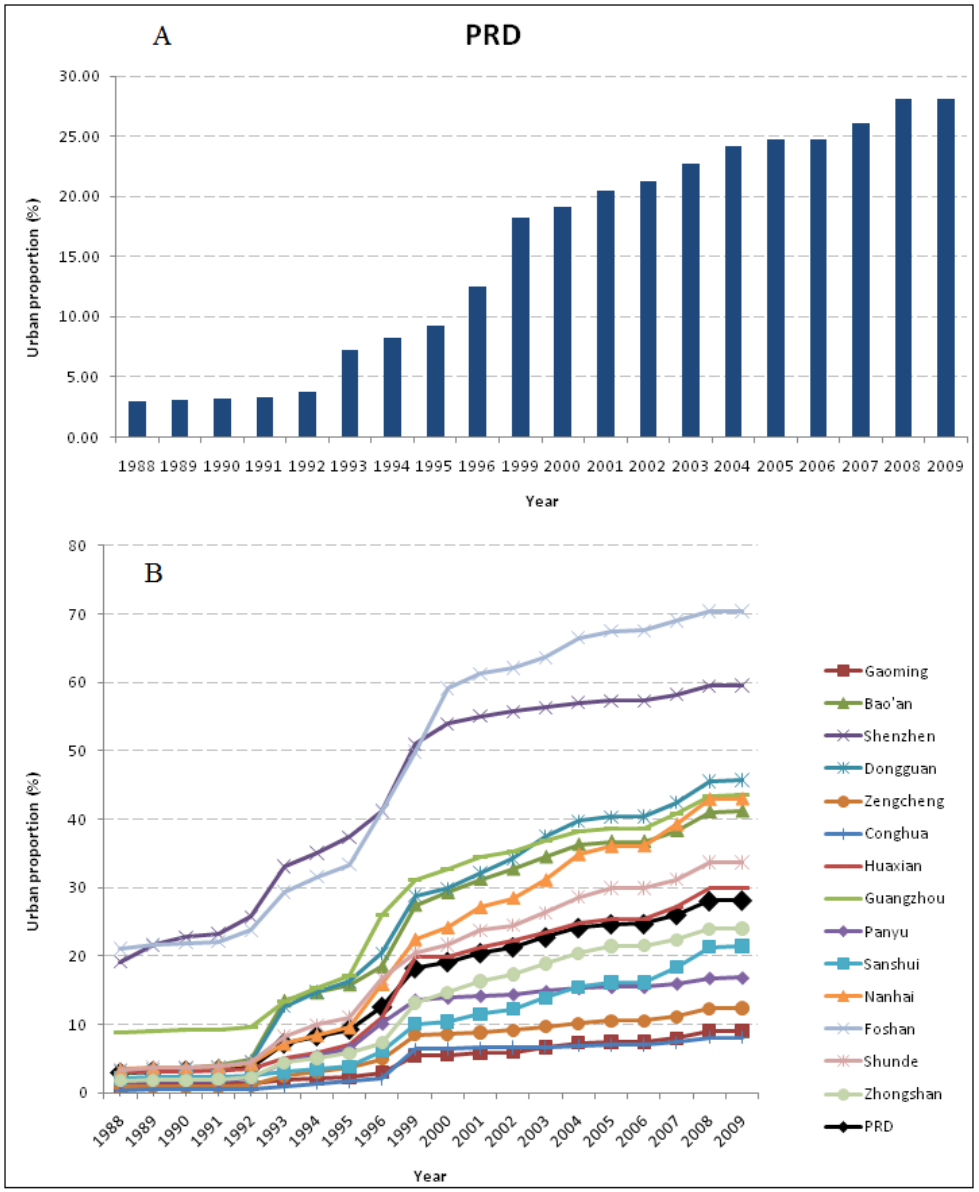
Proportions of different landcovers in urban change fraction



Change detection



COMPARISON OF URBAN FRACTION



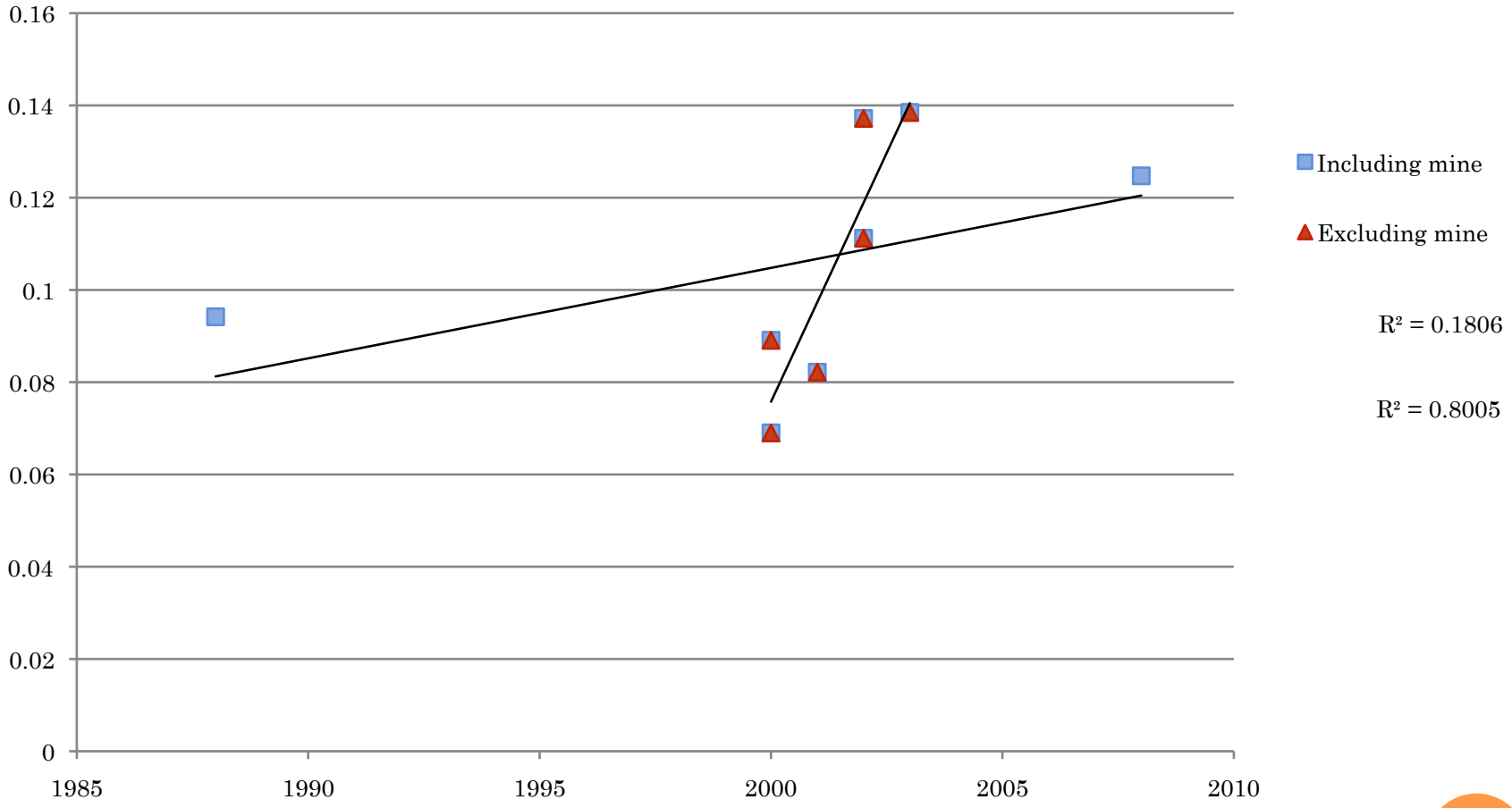
My urban fraction in 1988 is 8%,

In 2008 is 24%, increase is a

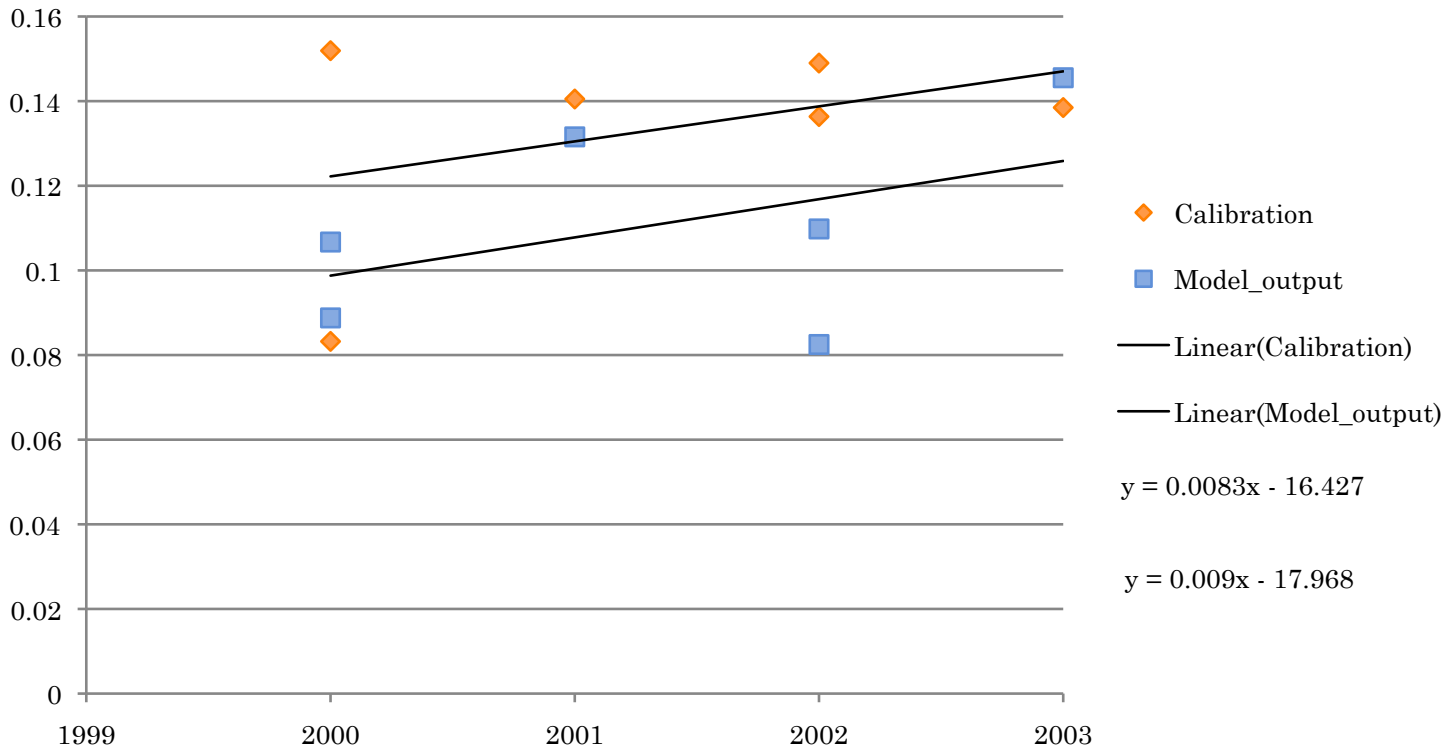
little bit lower than that in

Qingling's result.

Rough estimation of albedo(dark subtraction)



Model verification



ATMOSPHERIC CORRECTION

- ATREM

- FLAASH (http://www.creaso.com)

Fast Line-of-sight Atmospheric Analysis of Spectral Hypercube -corrects for

water vapors, oxygen, carbon dioxide, methane, and ozone in the atmosphere, as well as molecular and aerosol scattering.

- ACORN (http://www.imspec.com)

Atmospheric CORrection Now - atmospheric gas absorption as well as molecular and aerosol scattering effects

- ATCOR (http://www.rese.ch)

aerosol type, the visibility or optical thickness, and the water vapor. Some models

Relative atmospheric correction

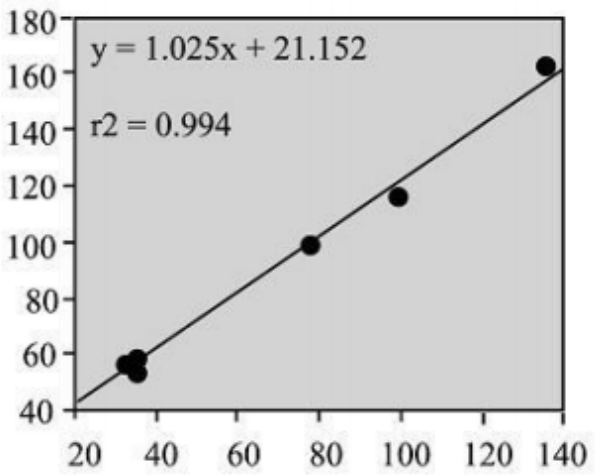
- Histogram adjustment (single image normalization)

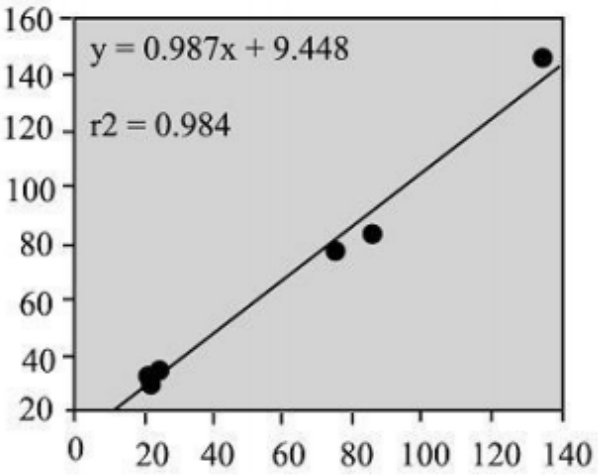
Dark Object Subtraction

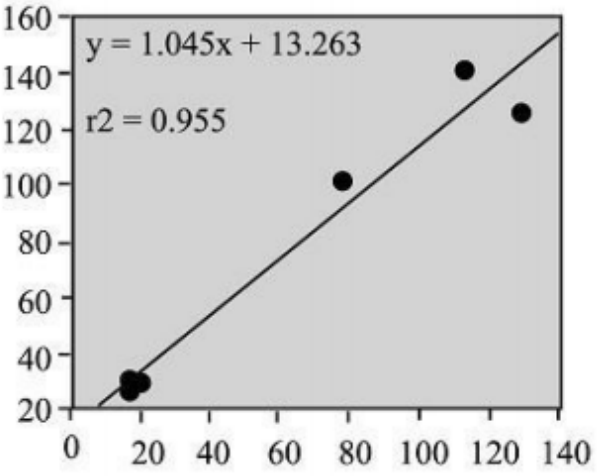
Minimum Value

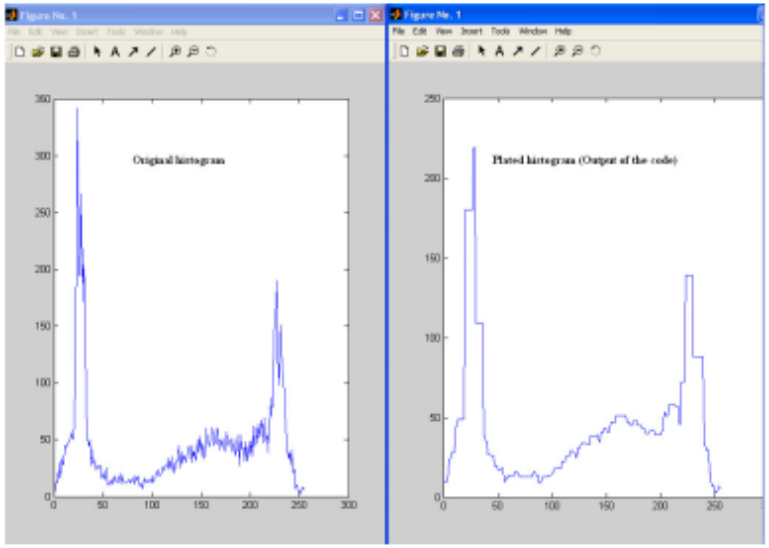
Histogram matching/ Regression(multiple dates)

Field(spectra) =radiance*gain(image)+offset

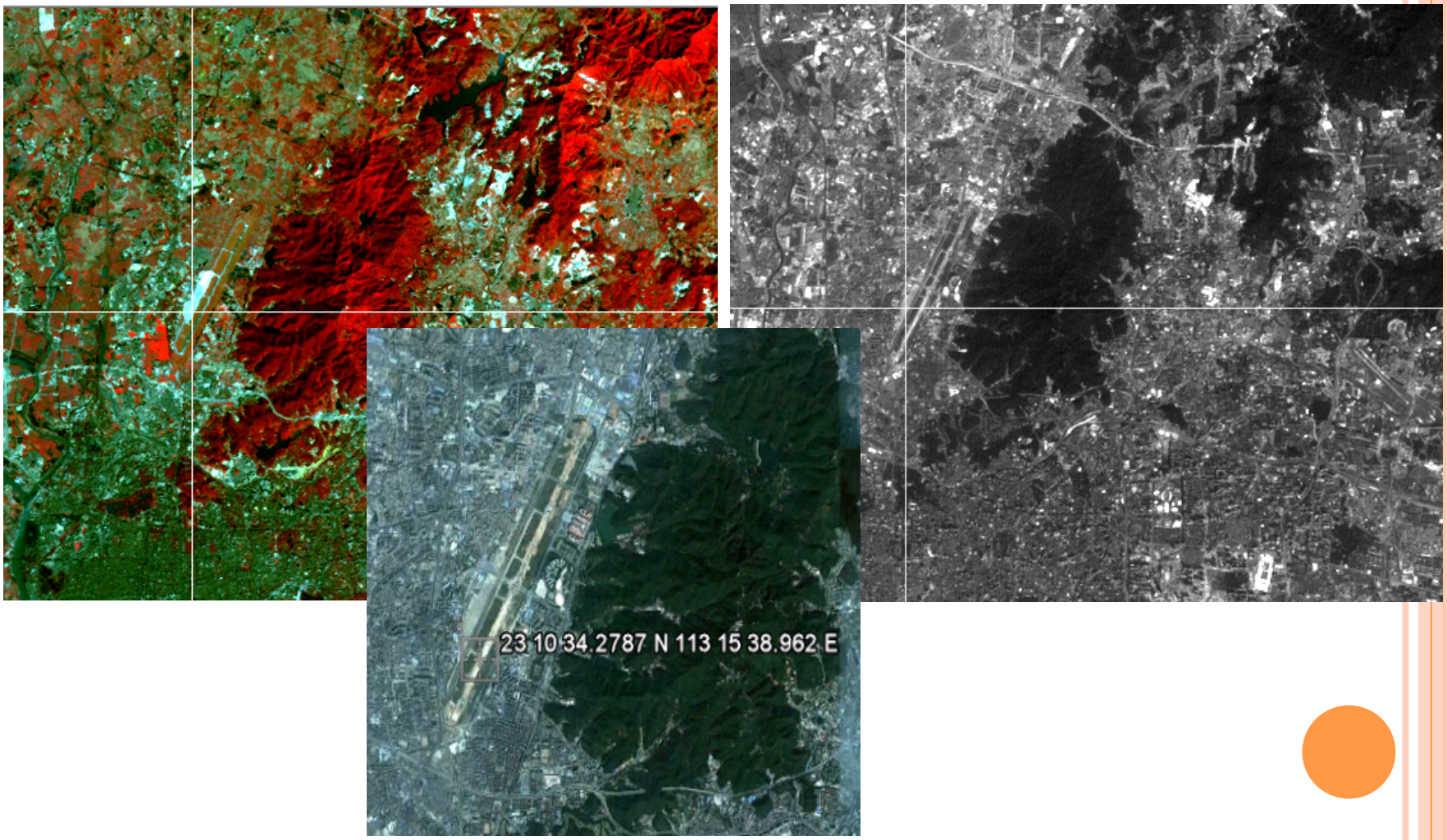

y = 1.025x + 21.152
r2 = 0.994
180
160
140
120
100
80
60
40
20
40
60
80
100
120
140


y = 0.987x + 9.448
r2 = 0.984
160
140
120
100
80
60
40
20
0
20
40
60
80
100
120
140

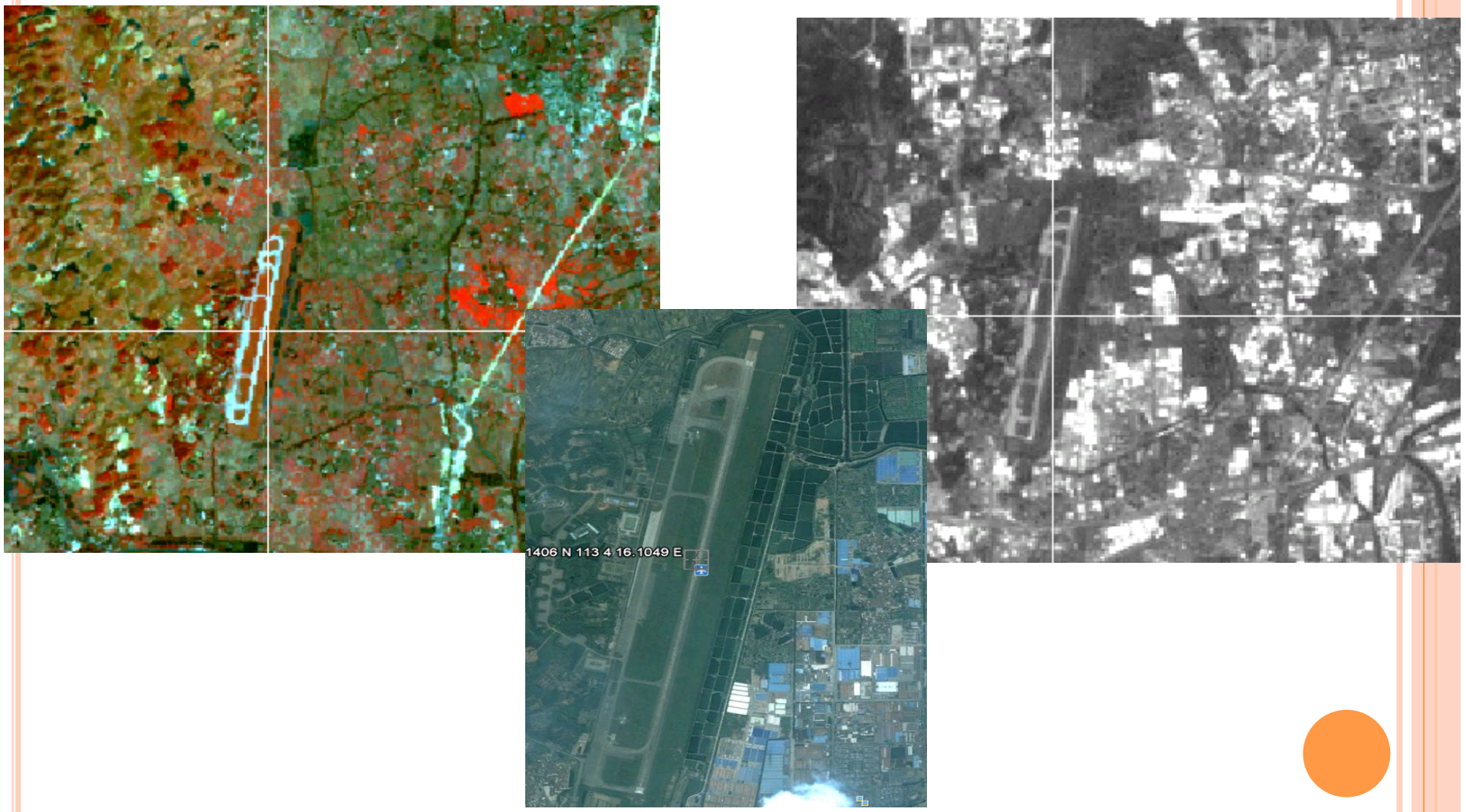

y = 1.045x + 13.263
r2 = 0.955
160
140
120
100
80
60
40
20
0
20
40
60
80
100
120
140


Original histogram
Plotted histogram (Output of the code)

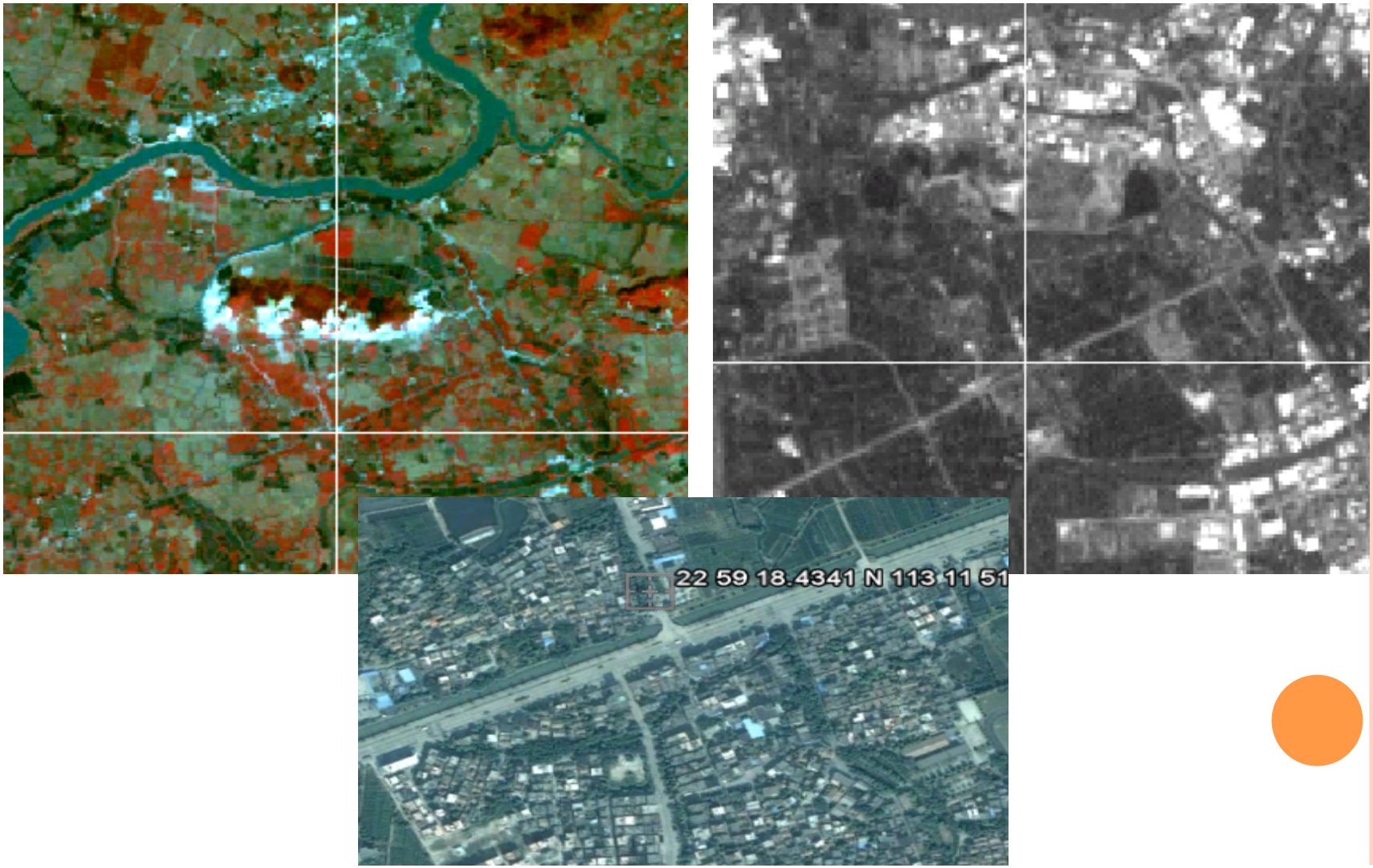
STABLE BRIGHT PIXELS(AIRPORT)



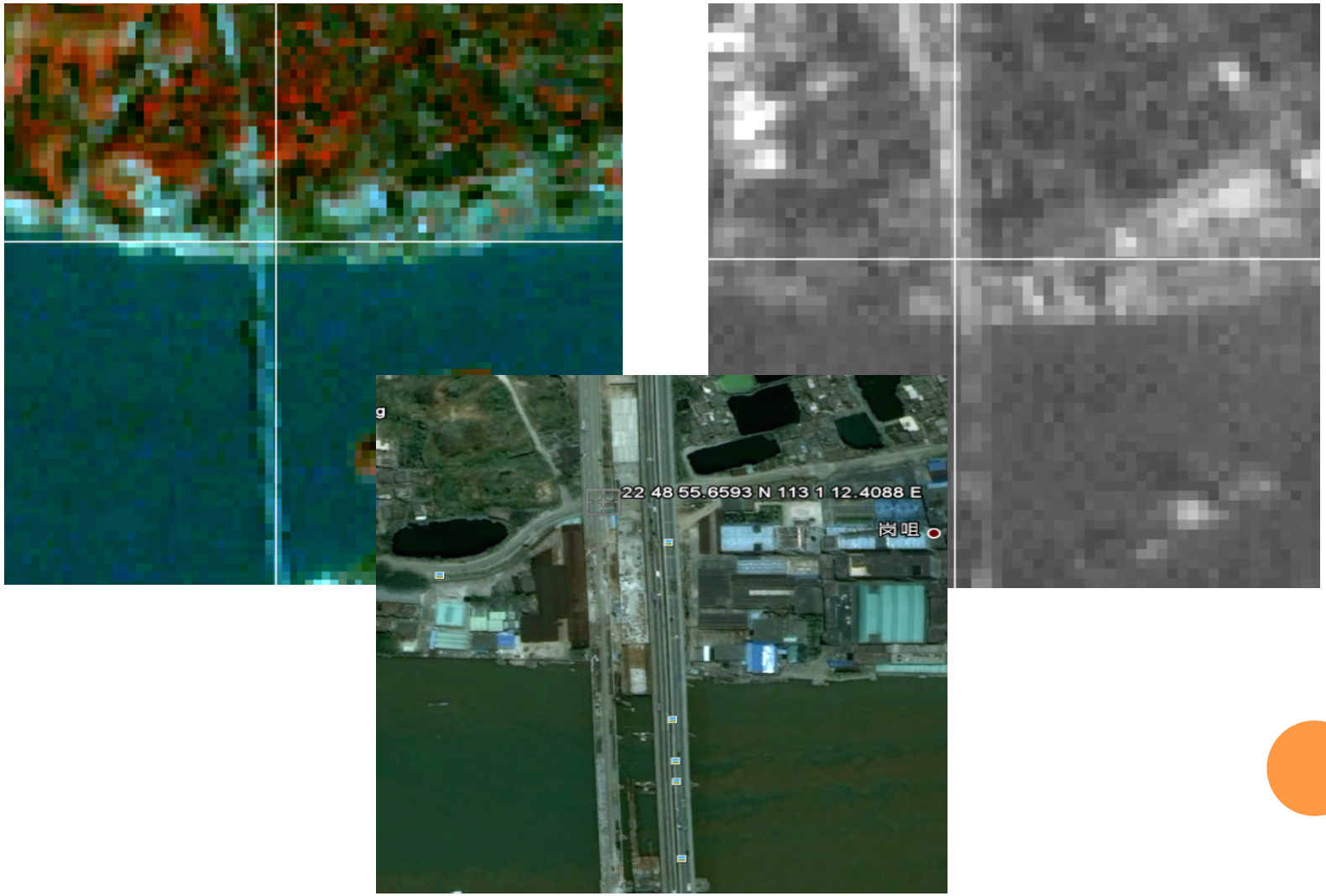
AIRPORT TAKE-OFF LANES

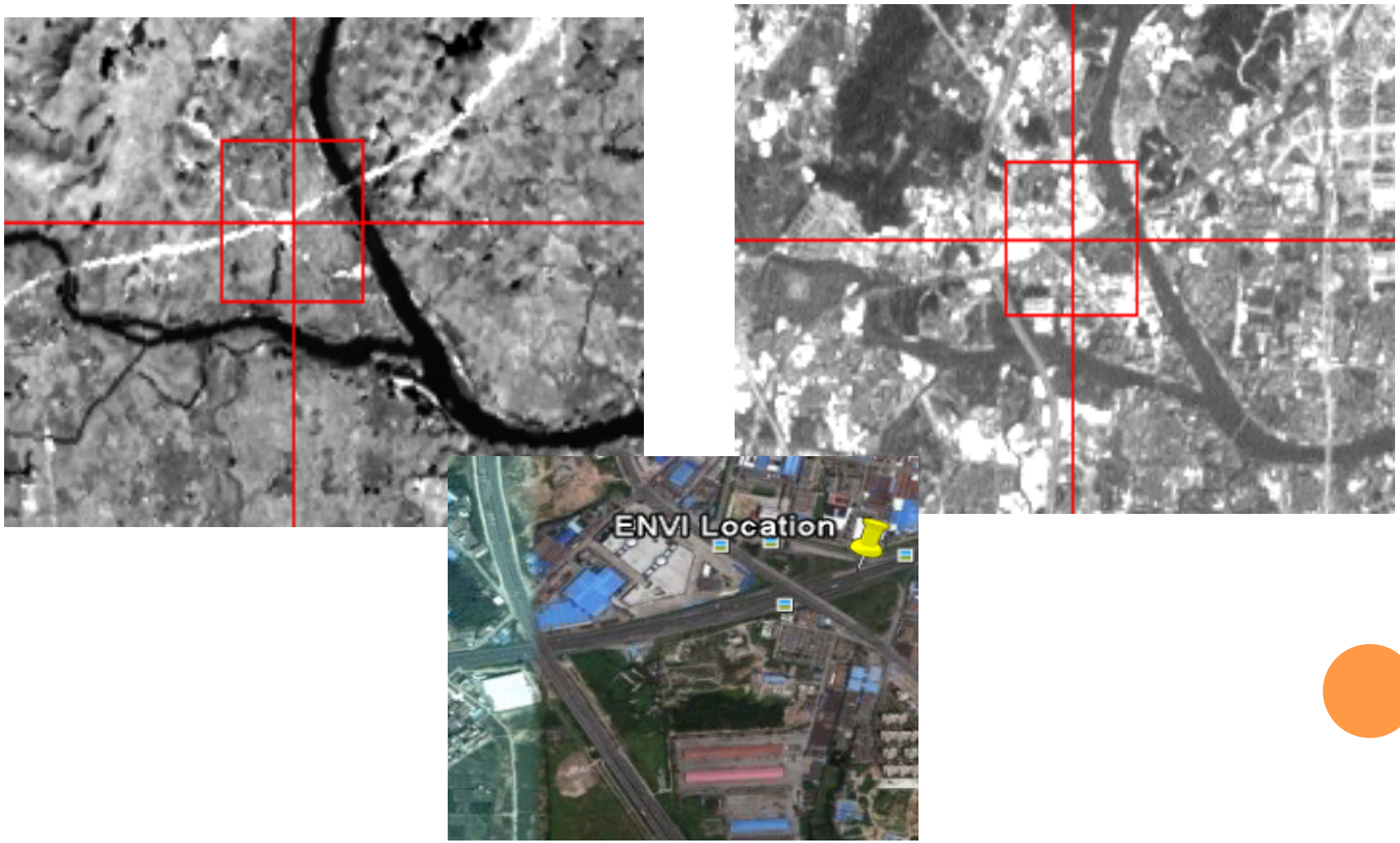


Road segment



BRIDGE

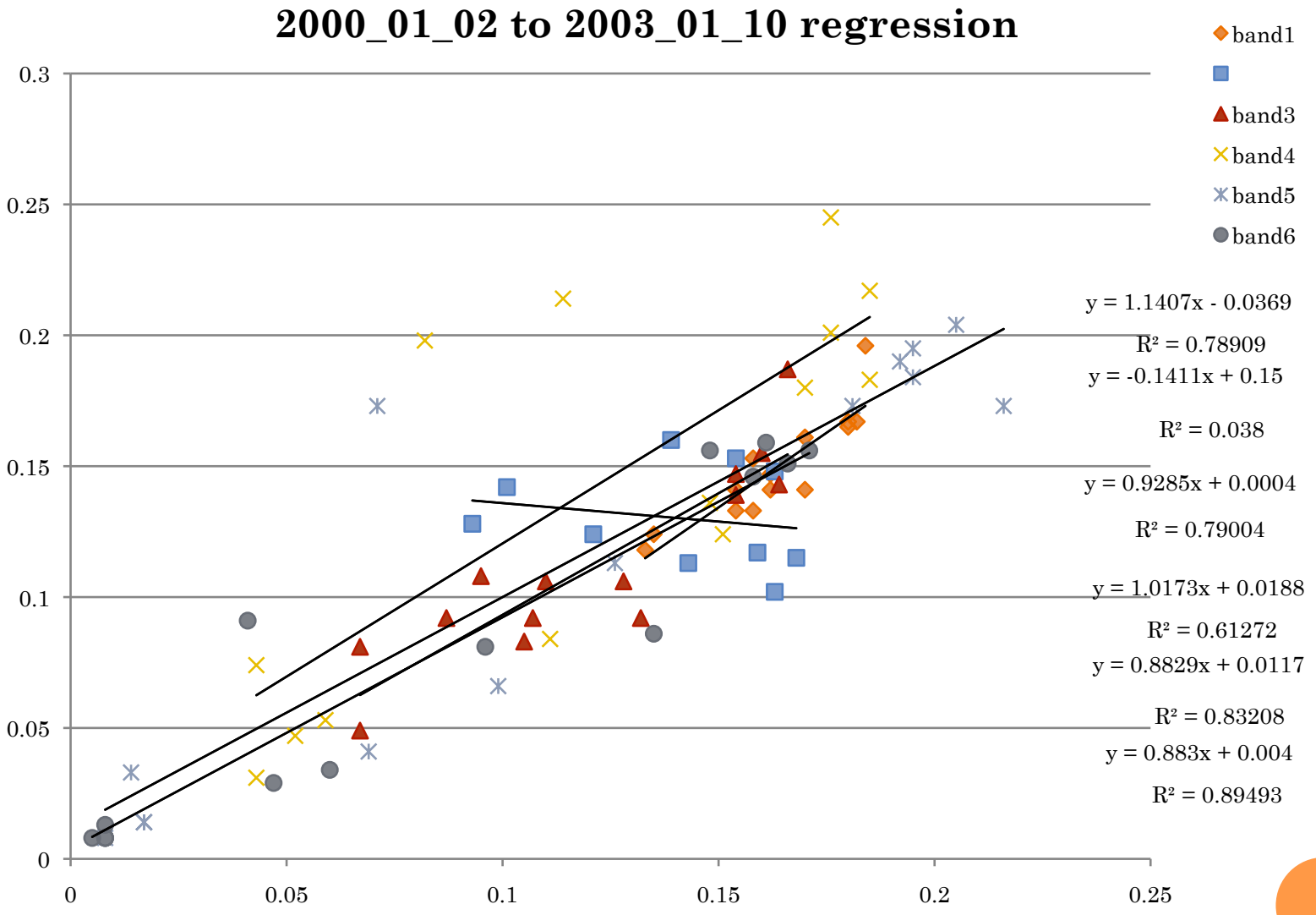


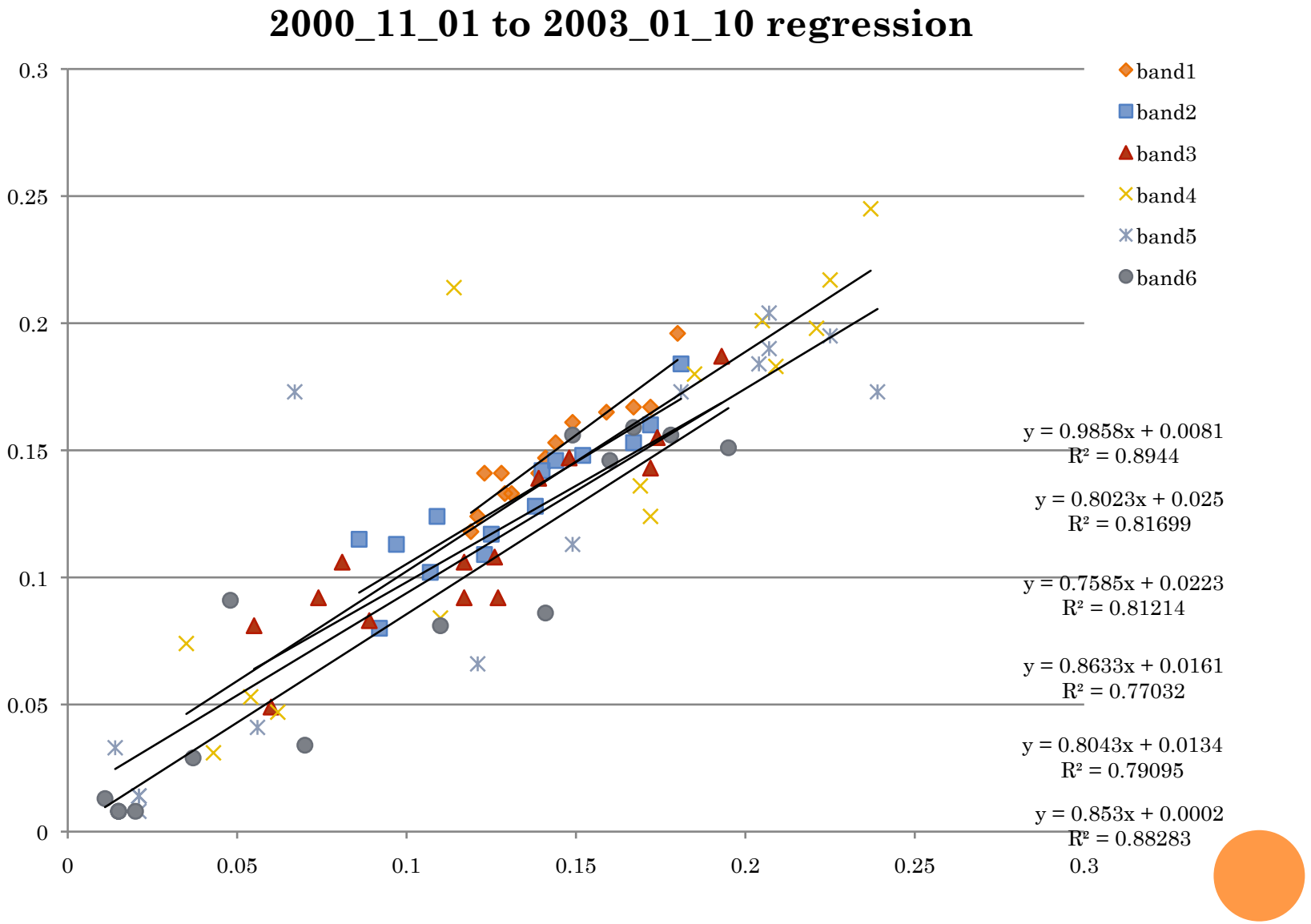

ENVI Location

STABLE DARK PIXELS

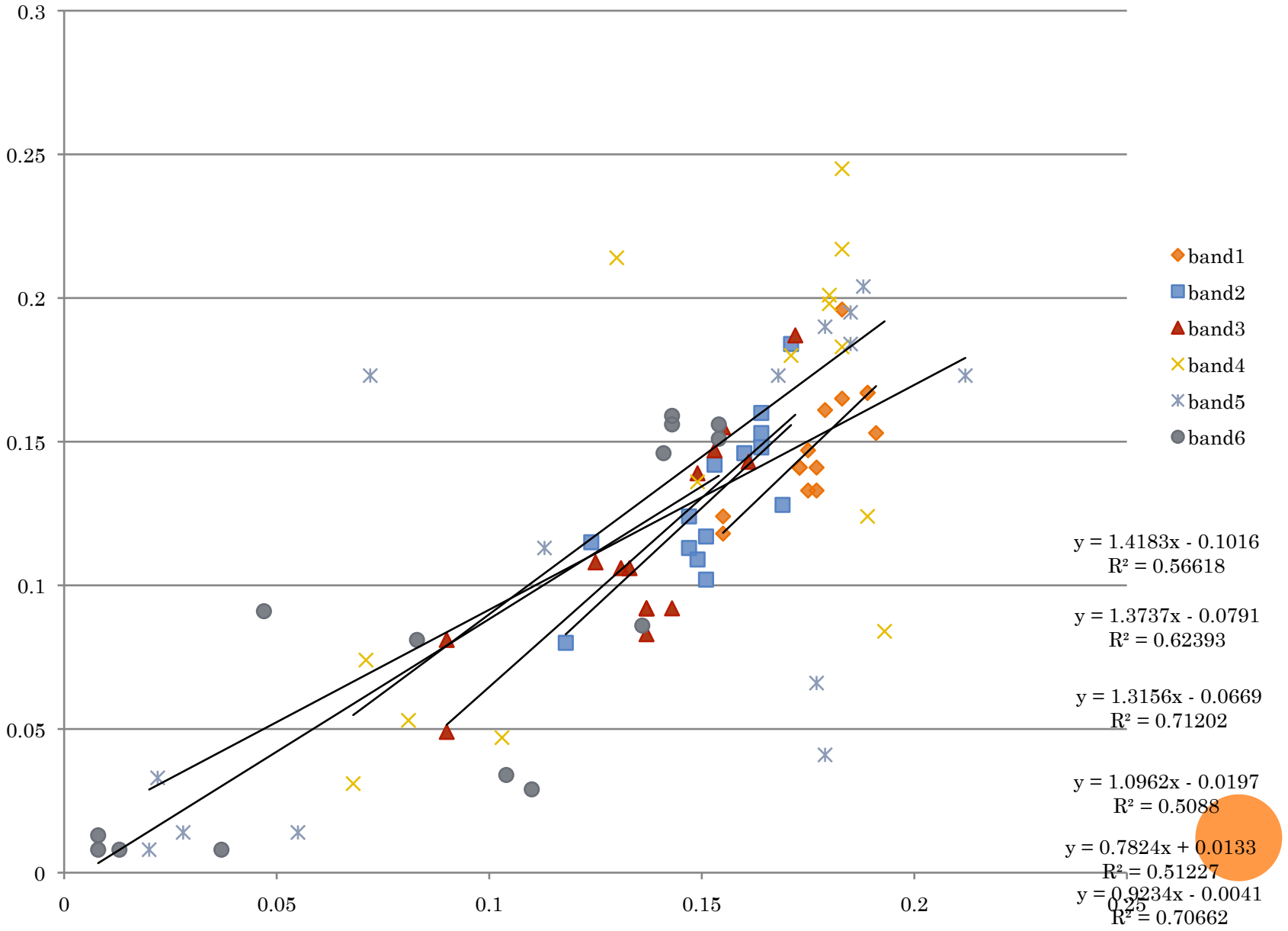
- Although water may not necessarily be the darkest pixels of each scene, it's a very stable dark pixel.

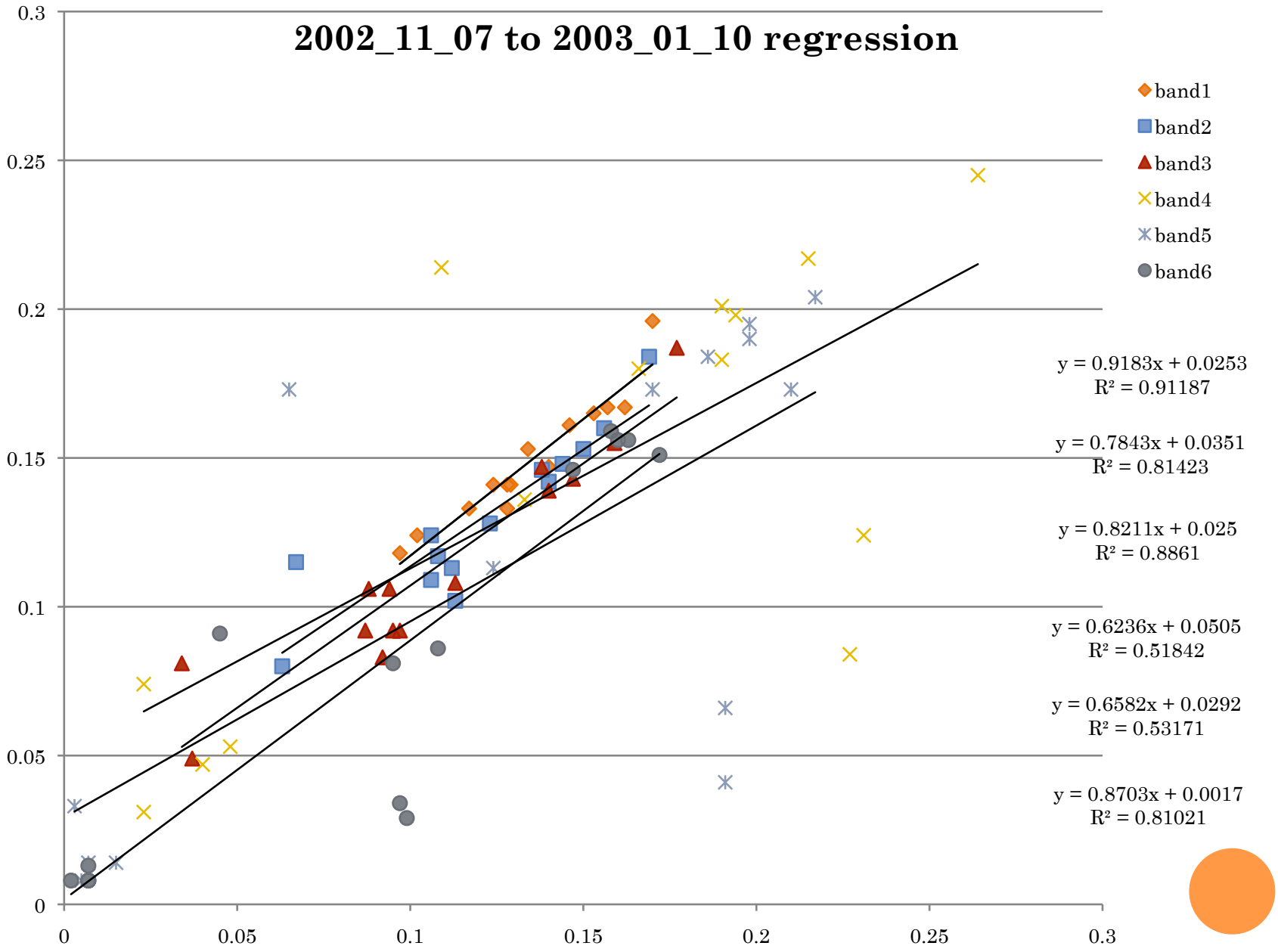
	band1	band2	band3	band4	band5	band6
GCP1	0.064	0.164	0.225	0.276	0.394	0.425
	0.139	0.3	0.234	0.362	0.233	0.354
GCP2	0.058	0.17	0.225	0.276	0.394	0.418
	0.117	0.254	0.197	0.306	0.198	0.3
GCP3	0	0.04	0.086	0.261	0.362	0.227
	0.095	0.209	0.16	0.251	0.162	0.245
GCP4	0	0.057	0.101	0.132	0.207	0.178
	0.115	0.249	0.193	0.3	0.194	0.294
GCP5	0.007	0.087	0.125	0.089	0.153	0.128
	0.09	0.198	0.152	0.238	0.155	0.233
Dark pixels						
GCP1	0.044	0.102	0.074	0.121	0.08	0.118
	0.044	0.102	0.074	0.121	0.08	0.118
GCP2	0.093	0.204	0.156	0.244	0.158	0.239
	0.093	0.204	0.156	0.244	0.158	0.239


2000_01_02 to 2003_01_10 regression
band1
band3
band4
band5
band6
y = 1.1407x - 0.0369
R² = 0.78909
y = -0.1411x + 0.15
R² = 0.038
y = 0.9285x + 0.0004
R² = 0.79004
y = 1.0173x + 0.0188
R² = 0.61272
y = 0.8829x + 0.0117
R² = 0.83208
y = 0.883x + 0.004
R² = 0.89493
0.3
0.25
0.2
0.15
0.1
0.05
0
0
0.05
0.1
0.15
0.2
0.25


2000_11_01 to 2003_01_10 regression
0.3
0.25
0.2
0.15
0.1
0.05
0
0
0.05
0.1
0.15
0.2
0.25
0.3
band1
band2
band3
band4
band5
band6
y = 0.9858x + 0.0081
R² = 0.8944
y = 0.8023x + 0.025
R² = 0.81699
y = 0.7585x + 0.0223
R² = 0.81214
y = 0.8633x + 0.0161
R² = 0.77032
y = 0.8043x + 0.0134
R² = 0.79095
y = 0.853x + 0.0002
R² = 0.88283


2001_11_20 to 2003_01_10 regression
band1
band2
band3
band4
band5
band6
y = 1.026x + 0.0054
R² = 0.88632
y = 0.8336x + 0.0233
R² = 0.78563
y = 0.7801x + 0.0206
R² = 0.77353
y = 0.5547x + 0.059
R² = 0.39637
y = 0.5794x + 0.0353
R² = 0.47702
y = 0.7466x + 0.007
R² = 0.7313
0.3
0.25
0.2
0.15
0.1
0.05
0
0
0.05
0.1
0.15
0.2
0.25
0.3


2002_01_07 to 2003_01_10 regression
0.3
0.25
0.2
0.15
0.1
0.05
0
0
0.05
0.1
0.15
0.2
0.25
band1
band2
band3
band4
band5
band6
y = 1.4183x - 0.1016
R² = 0.56618
y = 1.3737x - 0.0791
R² = 0.62393
y = 1.3156x - 0.0669
R² = 0.71202
y = 1.0962x - 0.0197
R² = 0.5088
y = 0.7824x + 0.0133
R² = 0.51227
y = 0.9234x - 0.0041
R² = 0.70662


2002_11_07 to 2003_01_10 regression
band1
band2
band3
band4
band5
band6
y = 0.9183x + 0.0253
R² = 0.91187
y = 0.7843x + 0.0351
R² = 0.81423
y = 0.8211x + 0.025
R² = 0.8861
y = 0.6236x + 0.0505
R² = 0.51842
y = 0.6582x + 0.0292
R² = 0.53171
y = 0.8703x + 0.0017
R² = 0.81021
0
0.05
0.1
0.15
0.2
0.25
0.3

ALBEDO AFTER TWO WAYS OF CORRECTION

- Dark Sub Min Max Mean Stdev

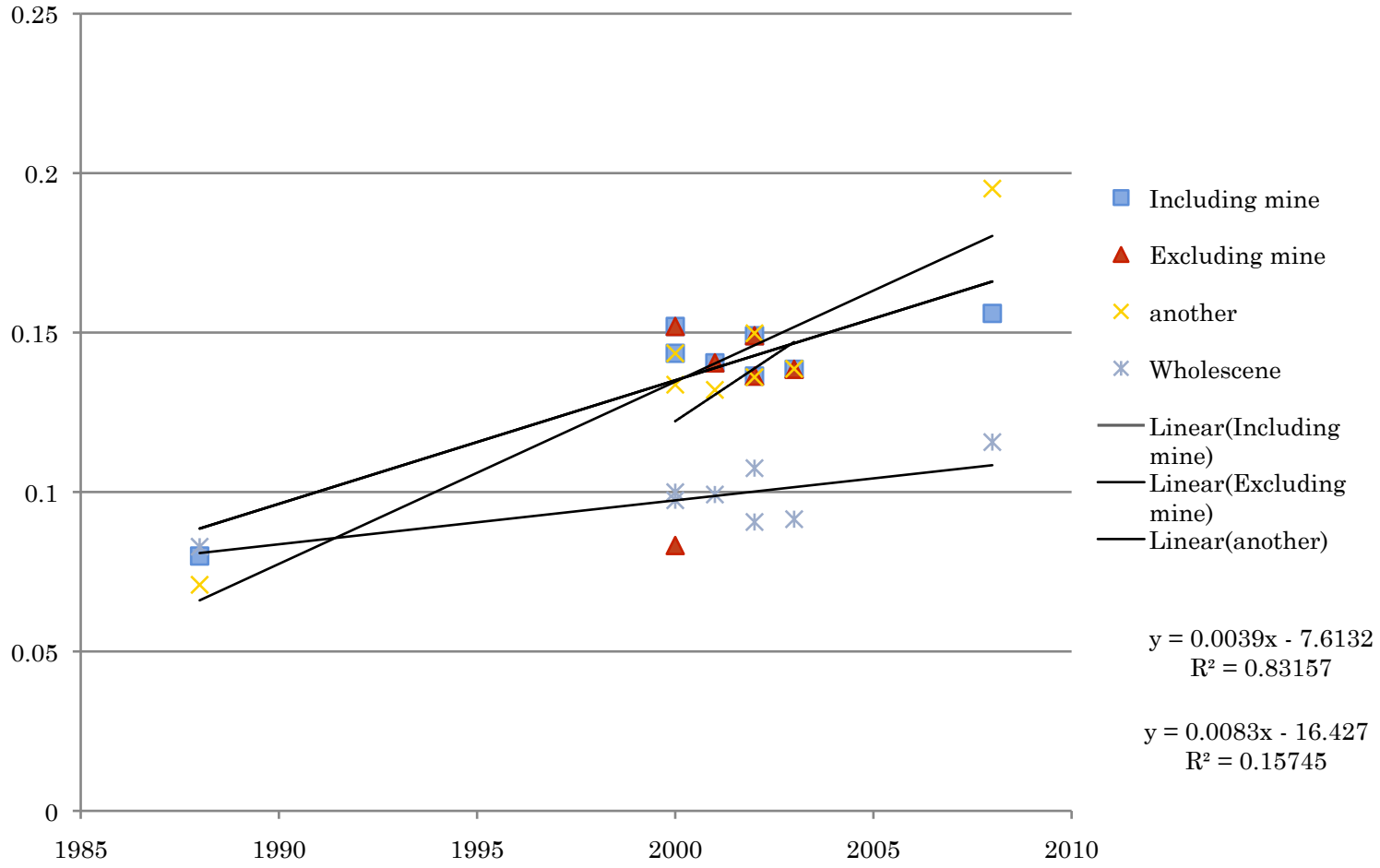
-0.001841 1.300867 0.114957 0.055091

- Regression

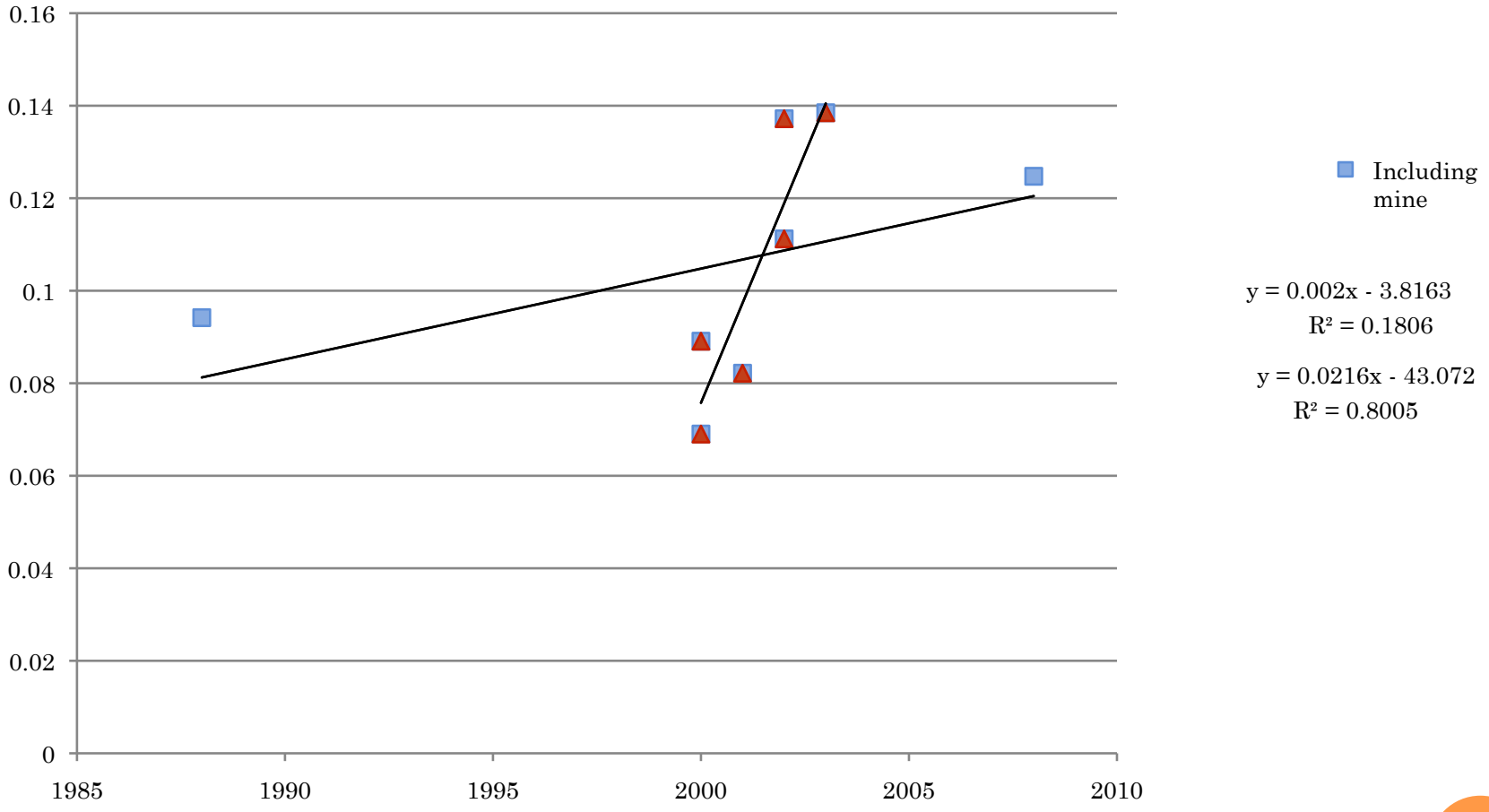
0.118435 0.595496 0.166025 0.022164

	dark subtract	regression
20000102	0.032656	0.133541
20001101	0.060122	0.130609
20011120	0.059897	0.123803
20020107	0.02777	0.122736
20021107	0.059007	0.124885

AFTER HISTOGRAM MATCHING



Rough estimation of albedo(dark subtraction)



ALBEDO SENSITIVITY

- Albedo sensitivity is defined by the ratio of change in surface albedo to the change in urban fraction
- Mean albedo in 1988 is 0.082837

  Mean albedo in 2008 is 0.115648

Urban fraction increase is estimated to be 0.016.

A rough estimation of albedo sensitivity is 0.002 per percentage change of urban fraction.

Comparison between MODIS and Landsat