

Landscape Change Assessments in the Western US using Landsat Time Series Data and Ancillary Information

Jim Vogelmann, USGS EROS

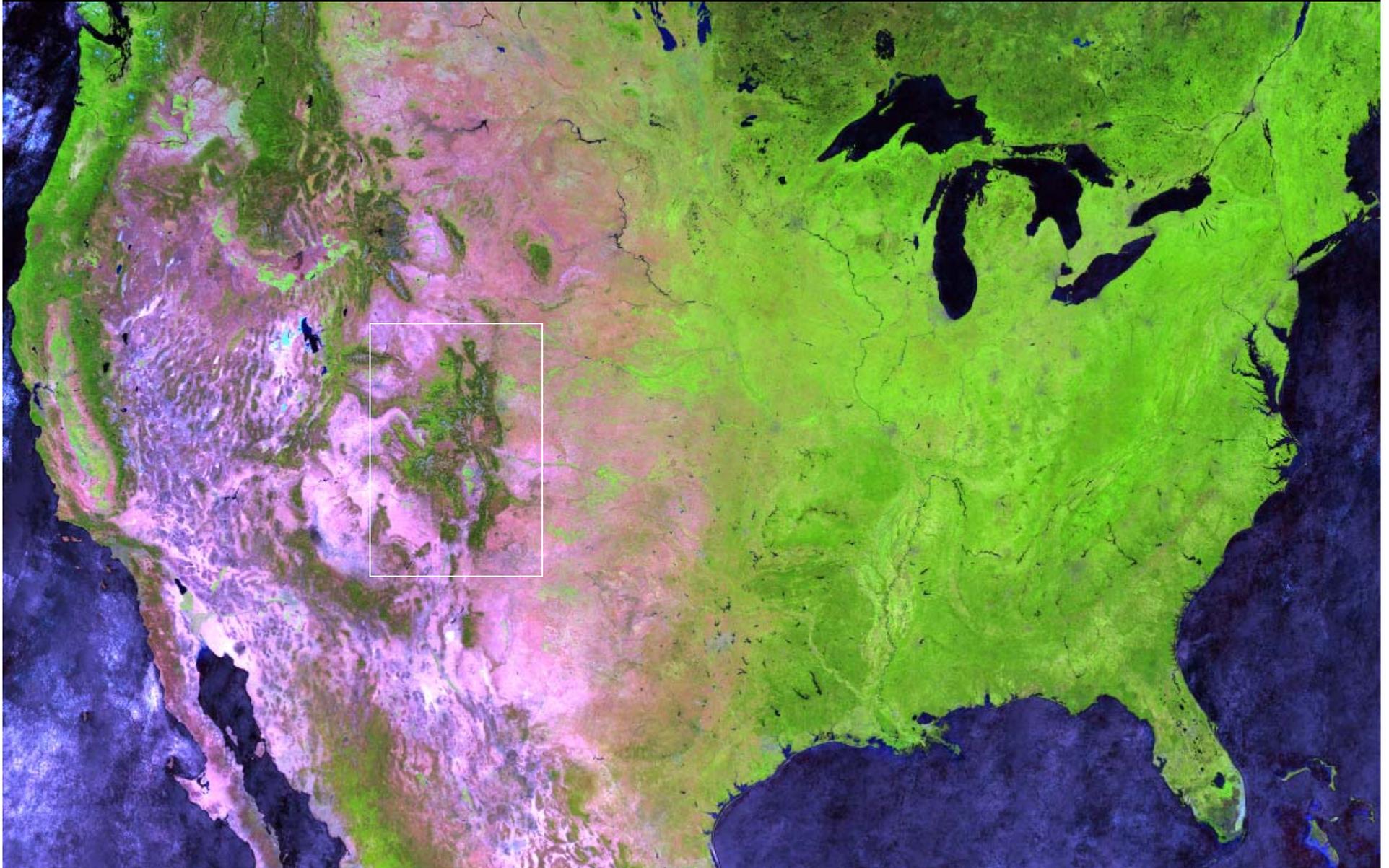
Acknowledgment of contributions from:
Brian Tolk, Gyanesh Chander and Rimy Malla
(SGT Corporation)

Some Background

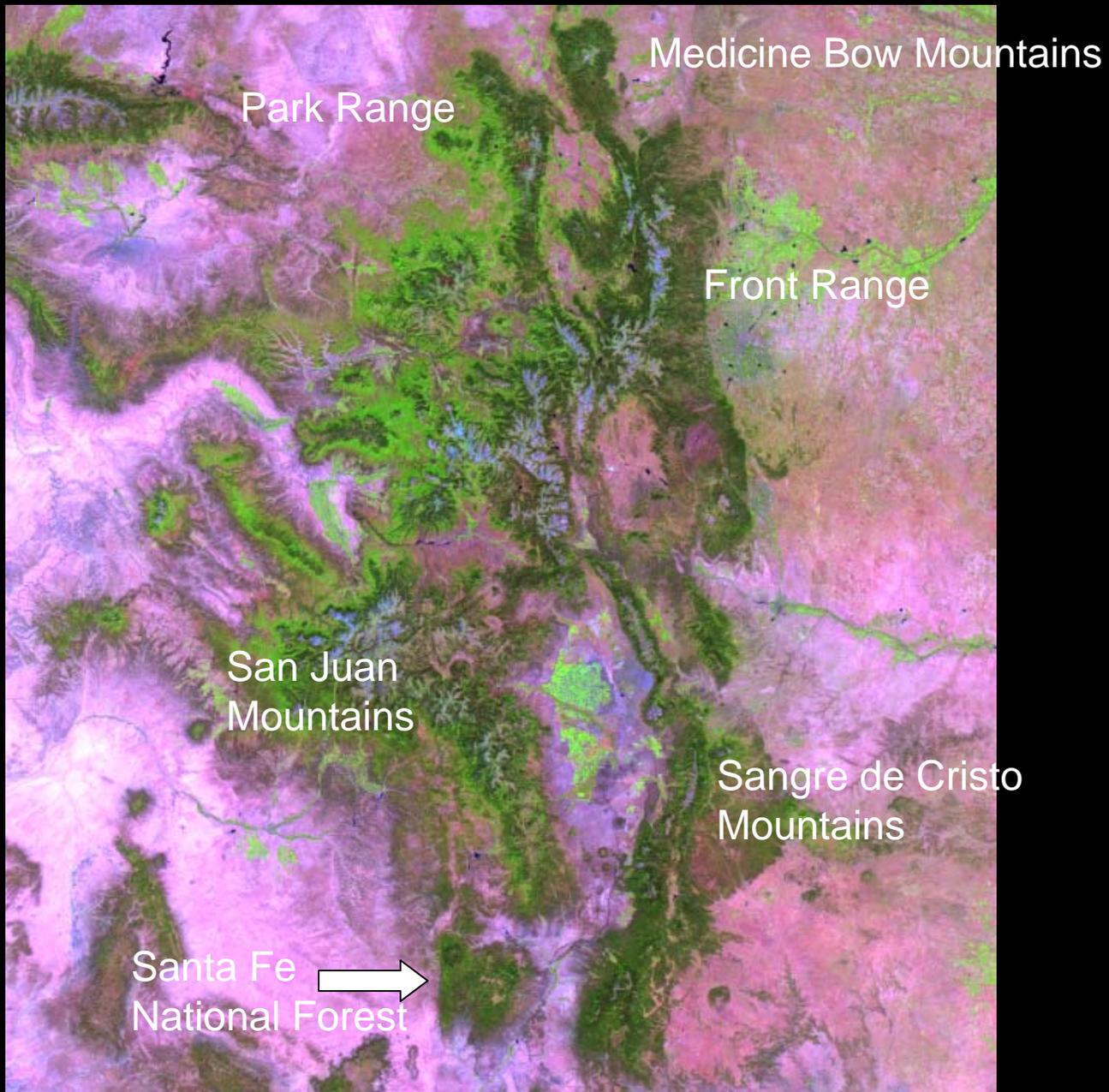
- Project started with Landsat time series investigation concentrating on San Pedro Parks Wilderness Area (n. New Mexico)
- Since have expanded to larger area
 - Southern Rocky Mountains
- Since have expanded to include AWiFS and MODIS data, and sketch map data acquired by Forest Health Monitoring program and LANDFIRE classification and field data

EMODIS Median 2003 Growing Season Data; Bands 6 2 1 (SWIR, NIR, Red)

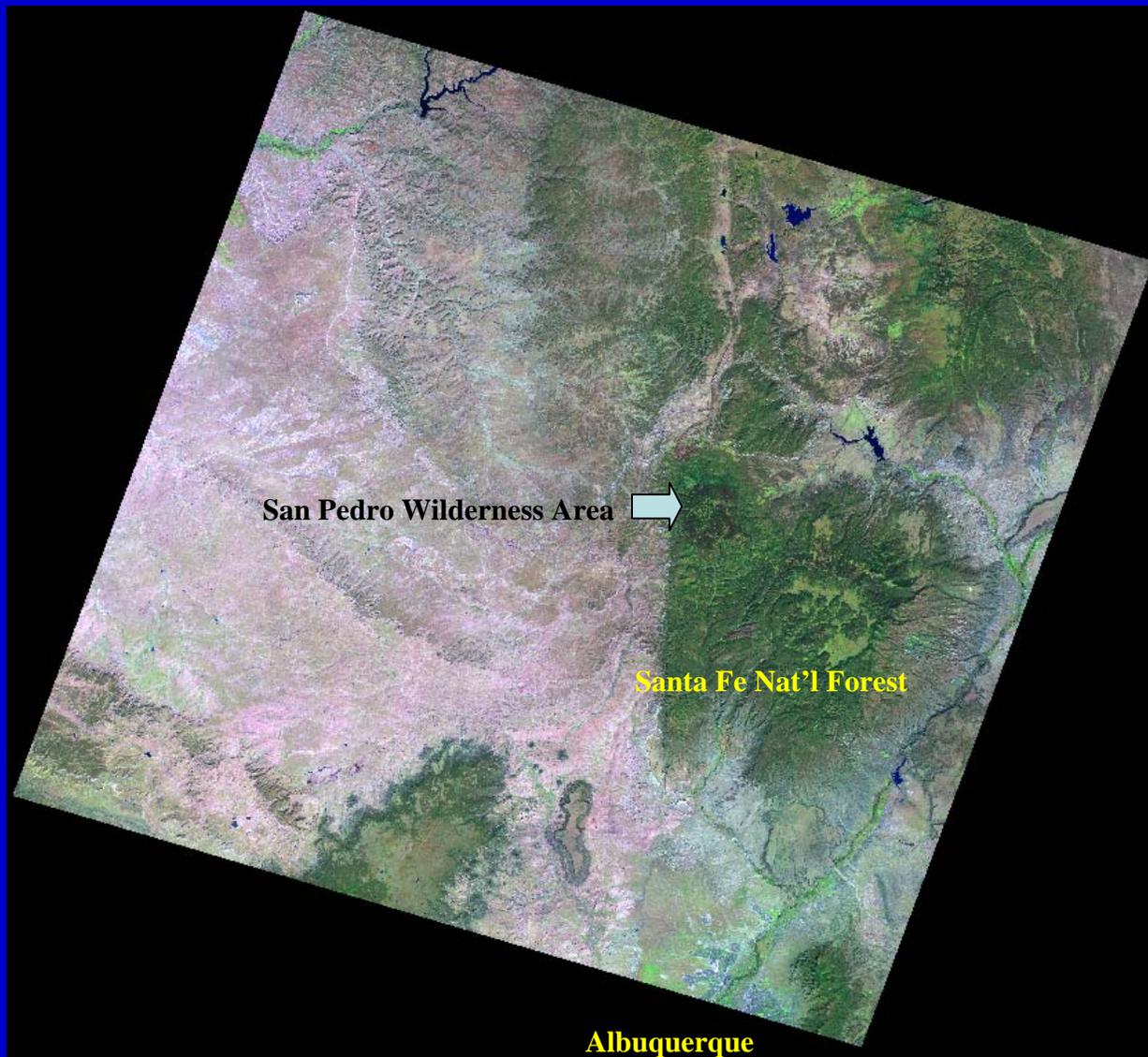
(Area in box is represents the Southern Rocky Mountains)



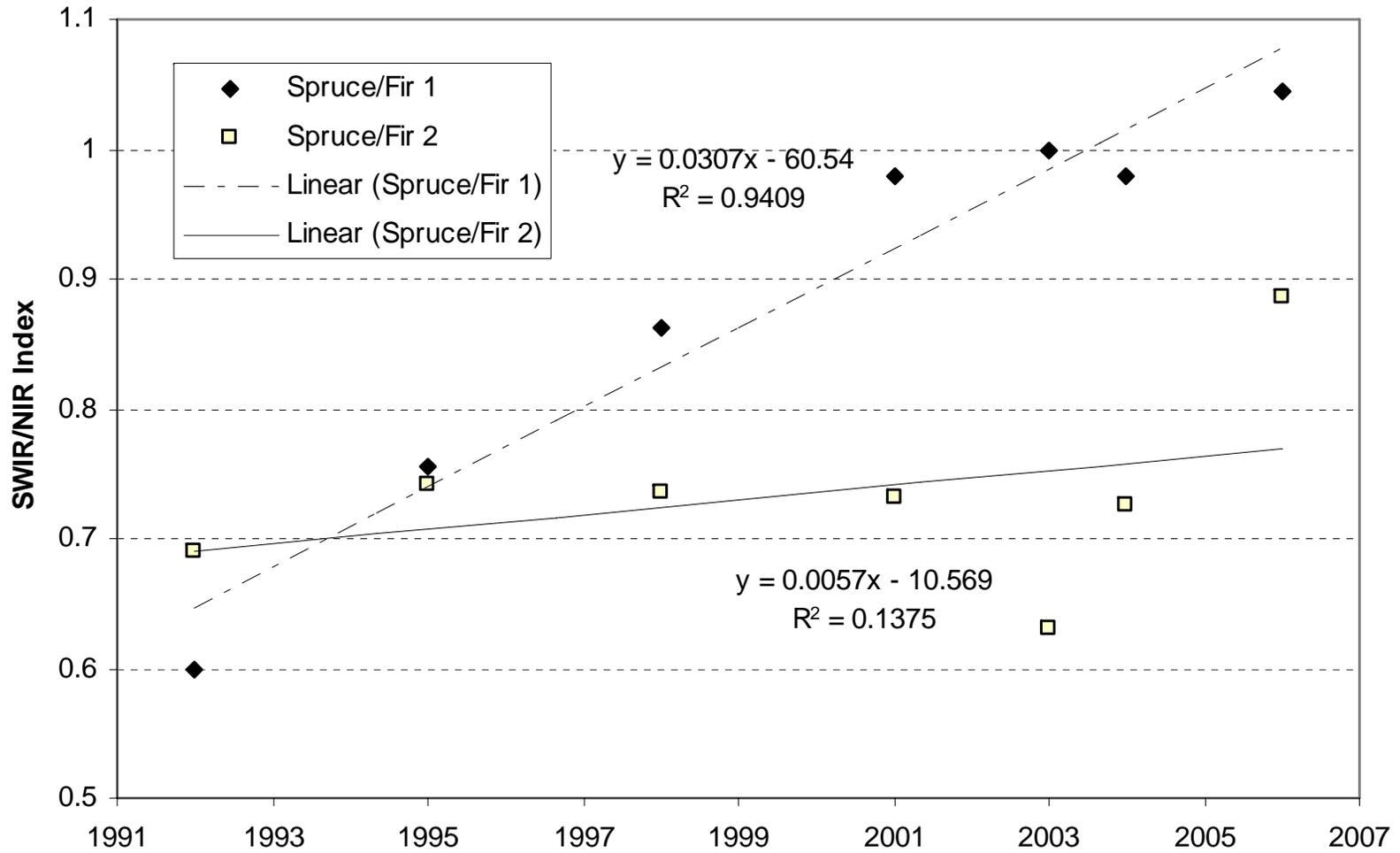
Southern Rocky Mountains (MODIS Data)



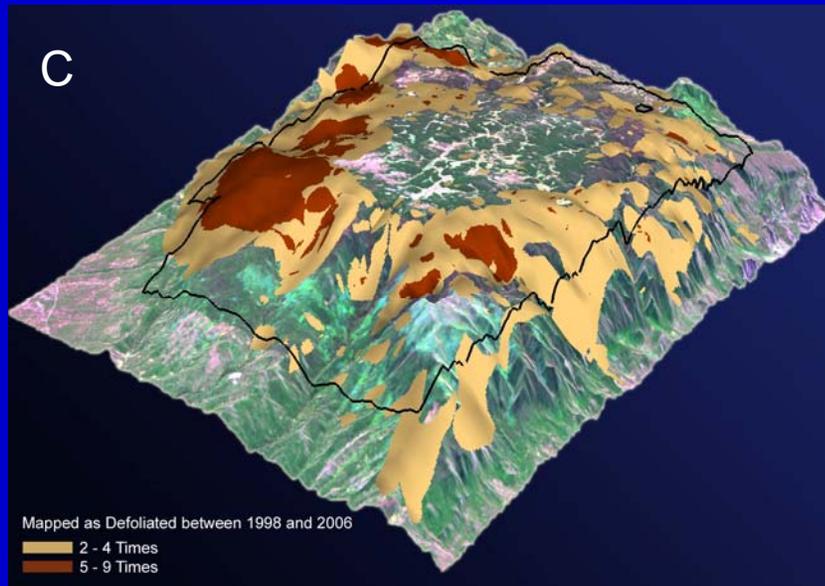
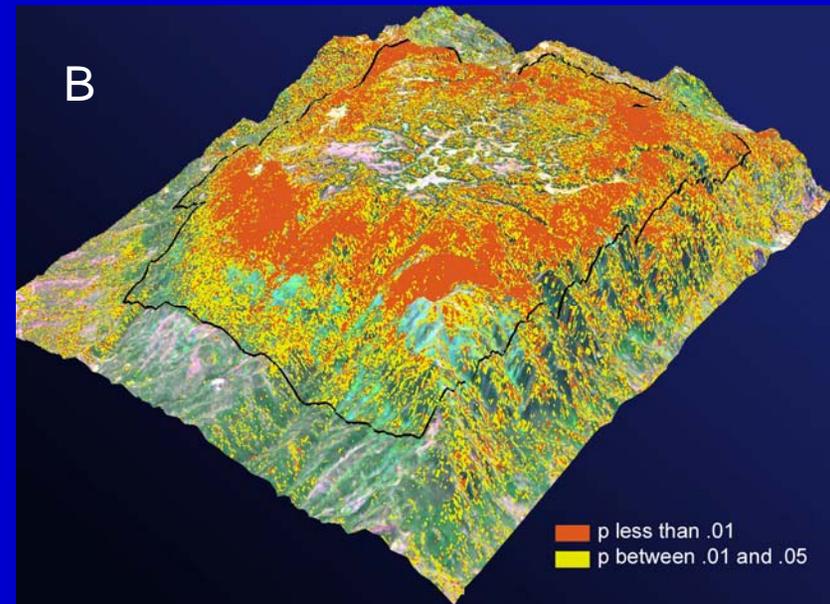
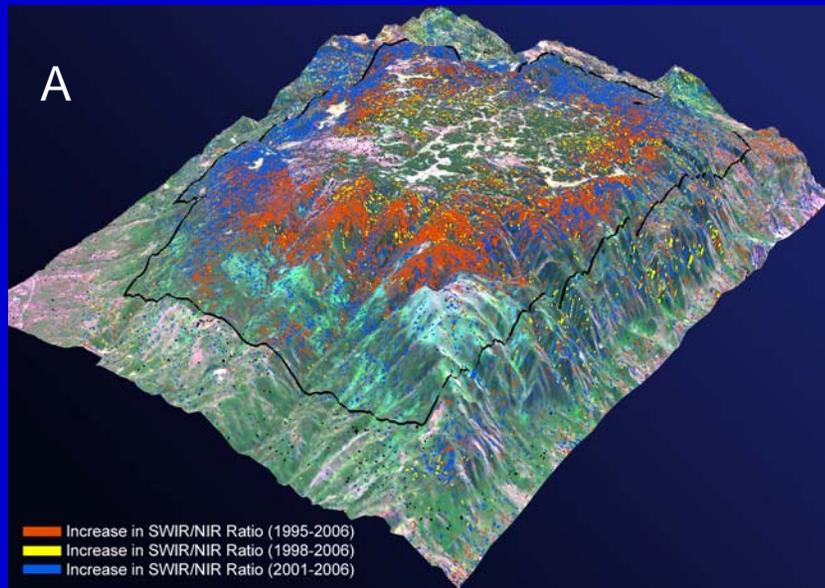
WRS Path 34 Row 35
Landsat TM; September
30, 2006



Spectral Trends from Two Spruce/Fir FIA Plots



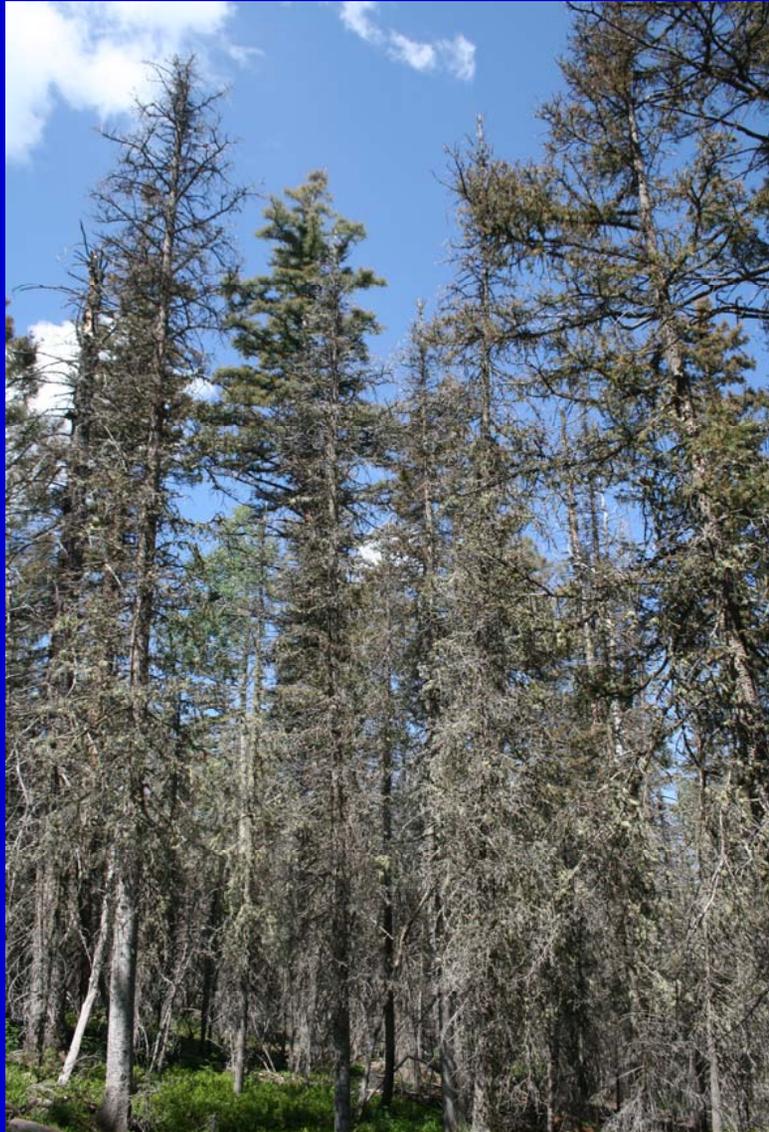
What we can do by analyzing Landsat spectral trends; Insect defoliation damage



A. Trends of declining forest as measured by Landsat TM trend analysis (1995-2006). Red, blue and yellow indicate different rates of decline.

B. Trends of declining forest as measured by Landsat TM trend analysis (1995-2006). Red, blue and yellow indicate different rates of decline.

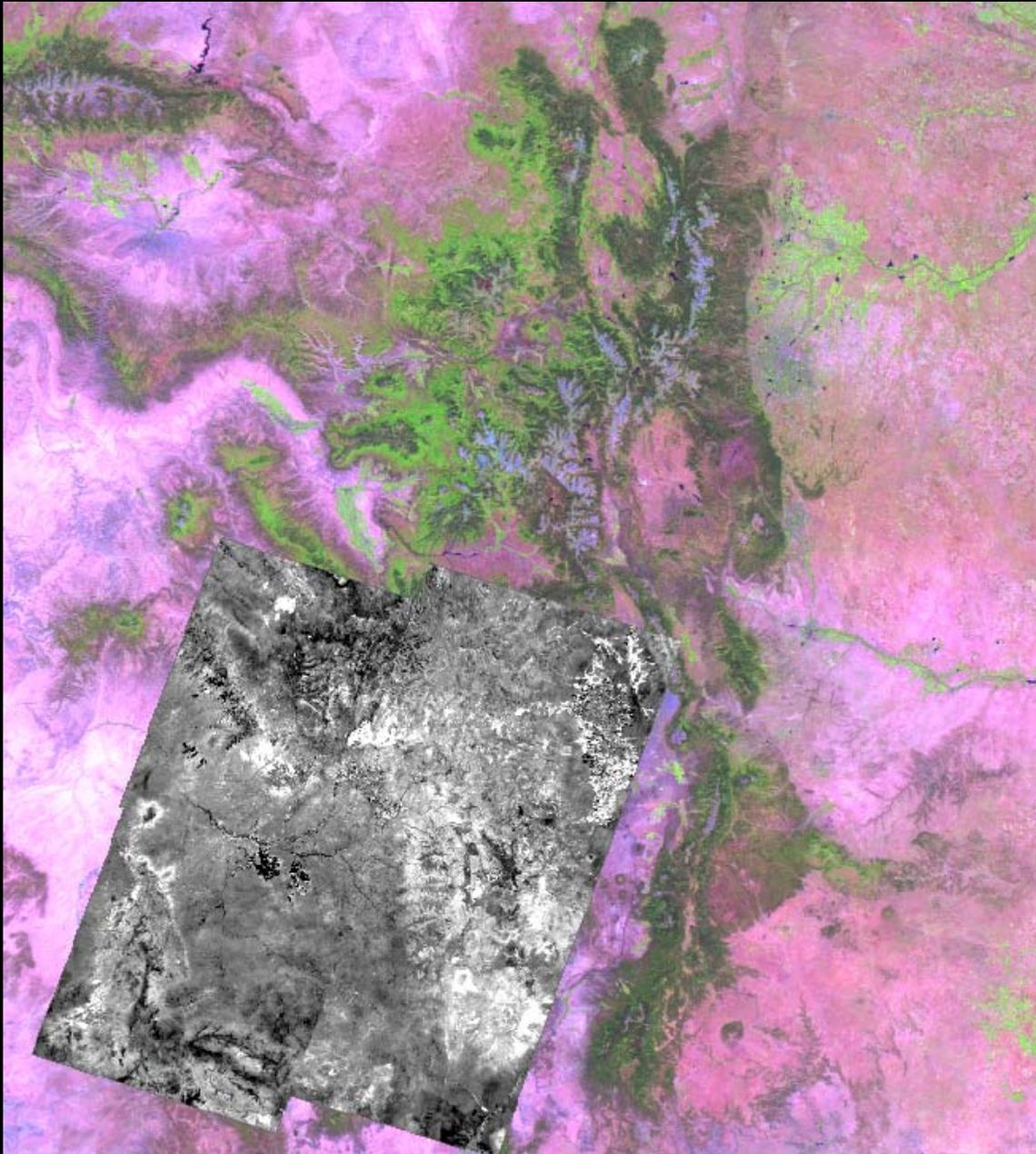
C. Forest Health Monitoring Program data (multiple defoliations caused by western spruce budworm) as detected by aerial sketch mapping (1998-2006)



Zone of spectral trend (SWIR/NIR) increase



Zone of spectral trend (SWIR/NIR) "stasis"



Expansion of
Spectral Trends
Analysis to four-
scene area

Slope of SWIR/NIR vs Time derived from Landsat (1992 – 2006)

Bright areas represent high slope of SWIR/NIR vs time. This generally implies an increase in vegetation stress.

Area shown represents portions of four Landsat scenes. Some minor seam-lines can be seen (arrows)

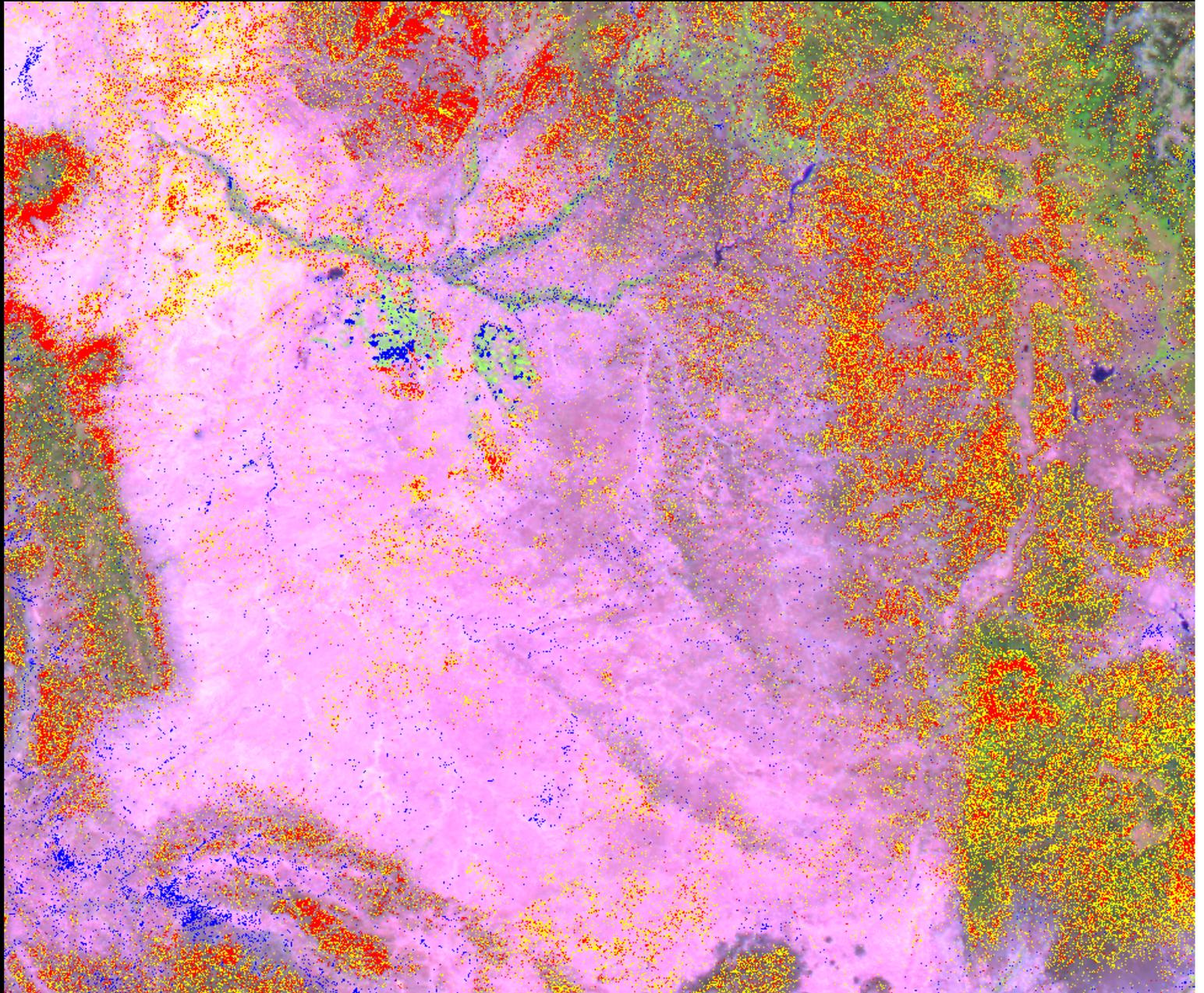


Where Significant 1992-2006 SWIR/NIR trends exist (on MODIS Image backdrop)

Red =
significant
increase
at .01 level

Yellow =
significant
increase at
.05 level
confidence

Blue =
significant
decrease at
.05 level
confidence

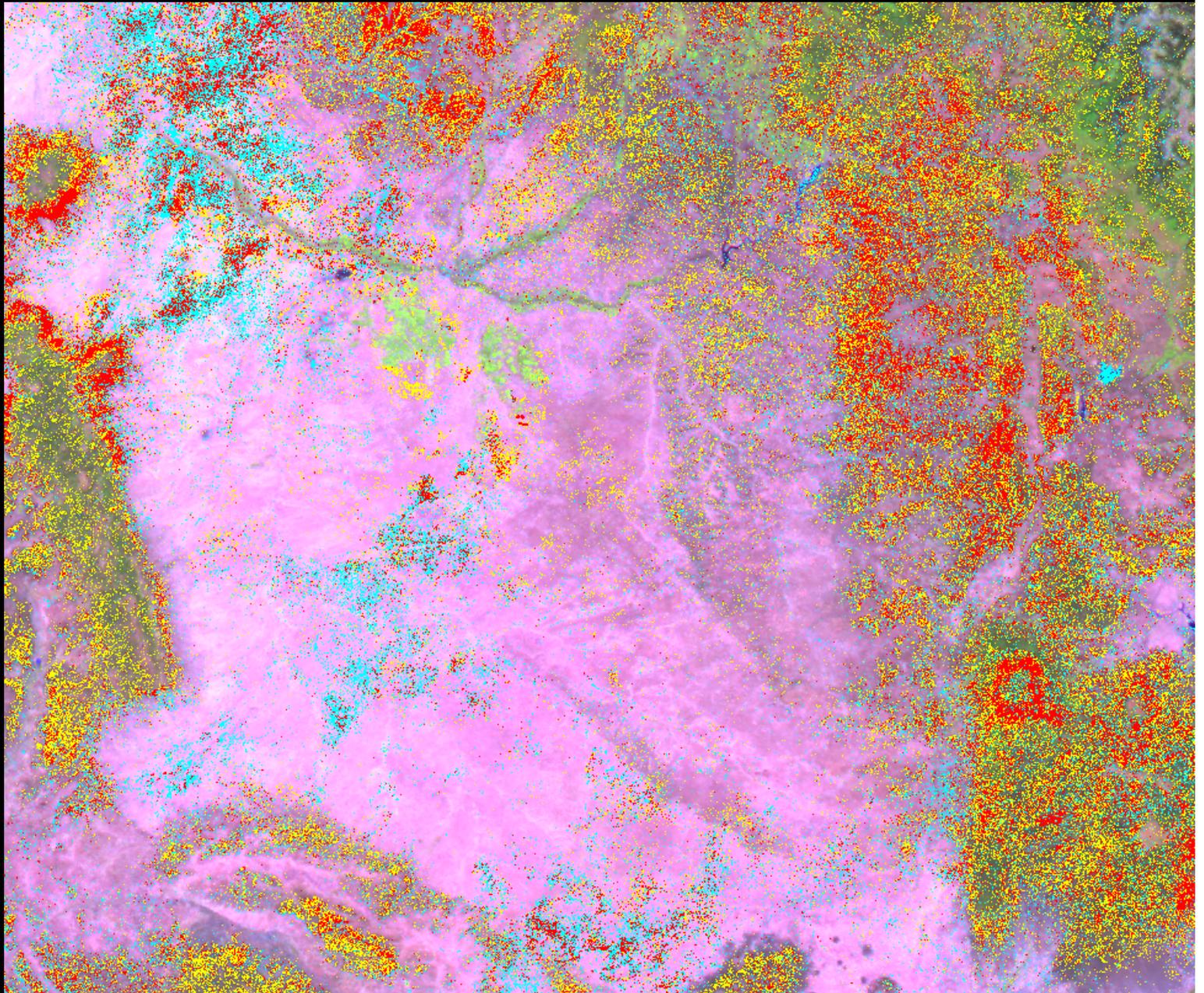


SWIR/NIR and NDVI Trends Data Overlain onto MODIS Imagery

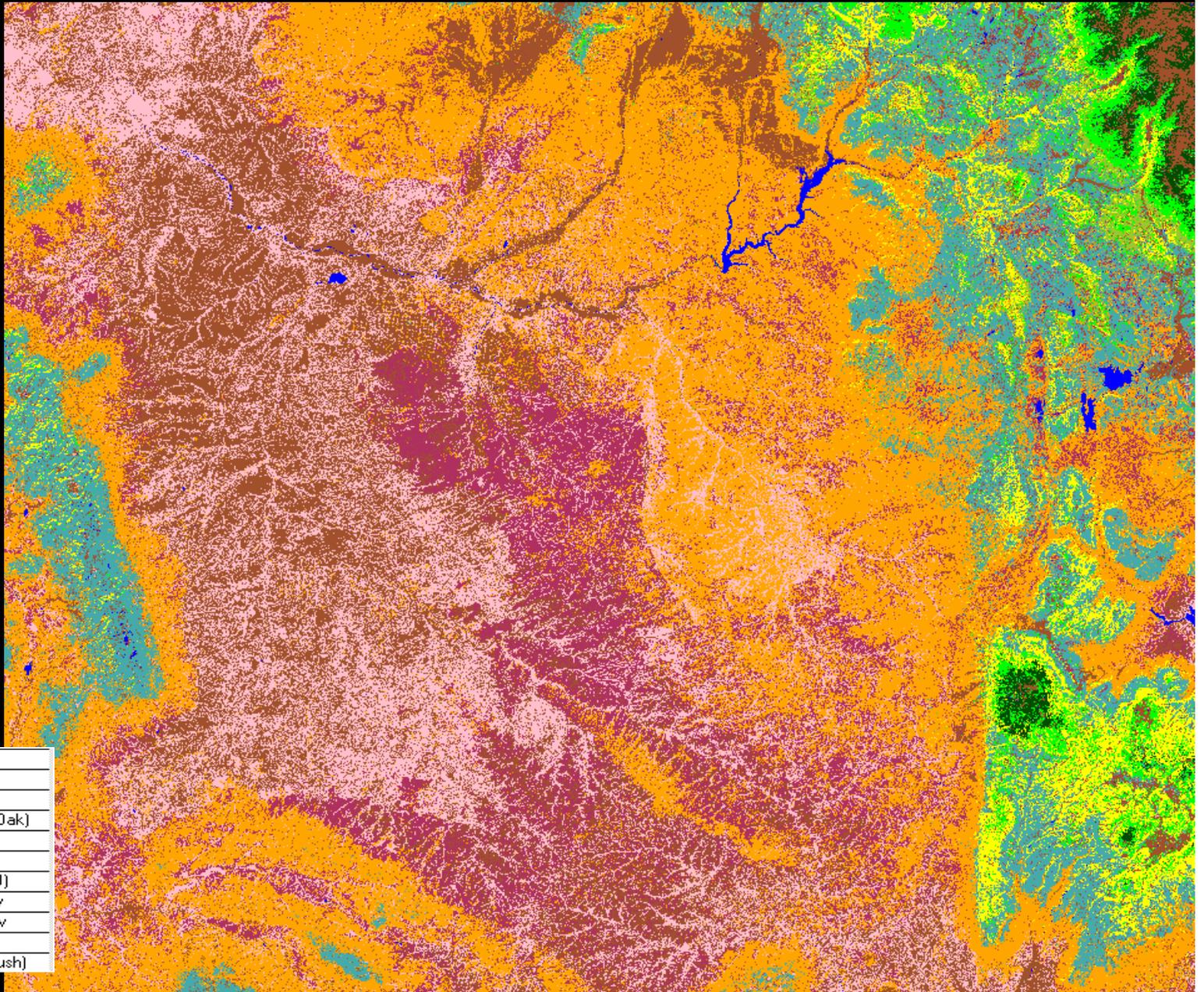
Red =
increase in
SWIR/NIR and
decrease in
NDVI

Yellow =
increase in
SWIR/NIR but
no significant
change in NDVI

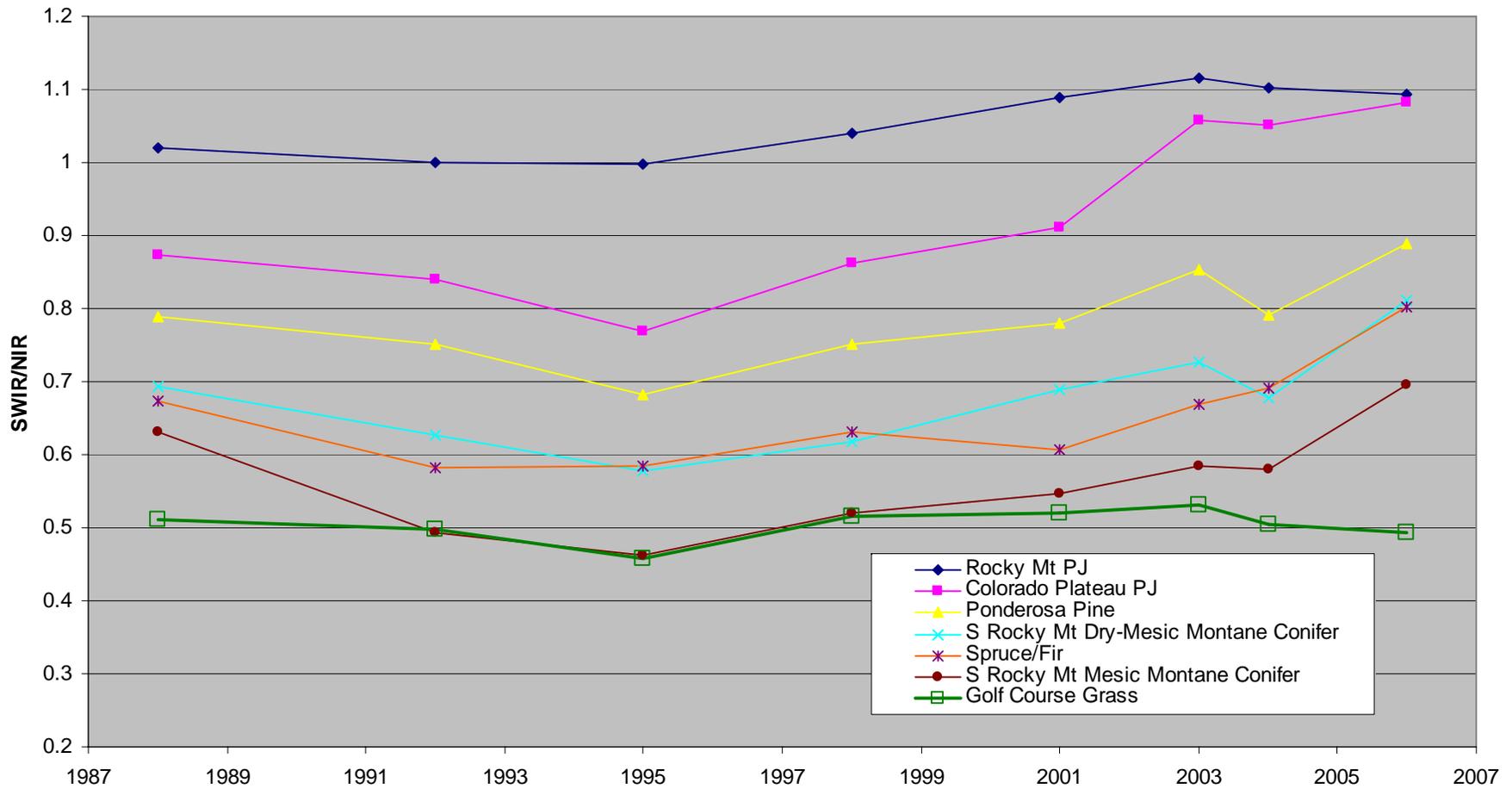
Turquoise =
decrease in
NDVI, but no
significant
change in
SWIR/NIR



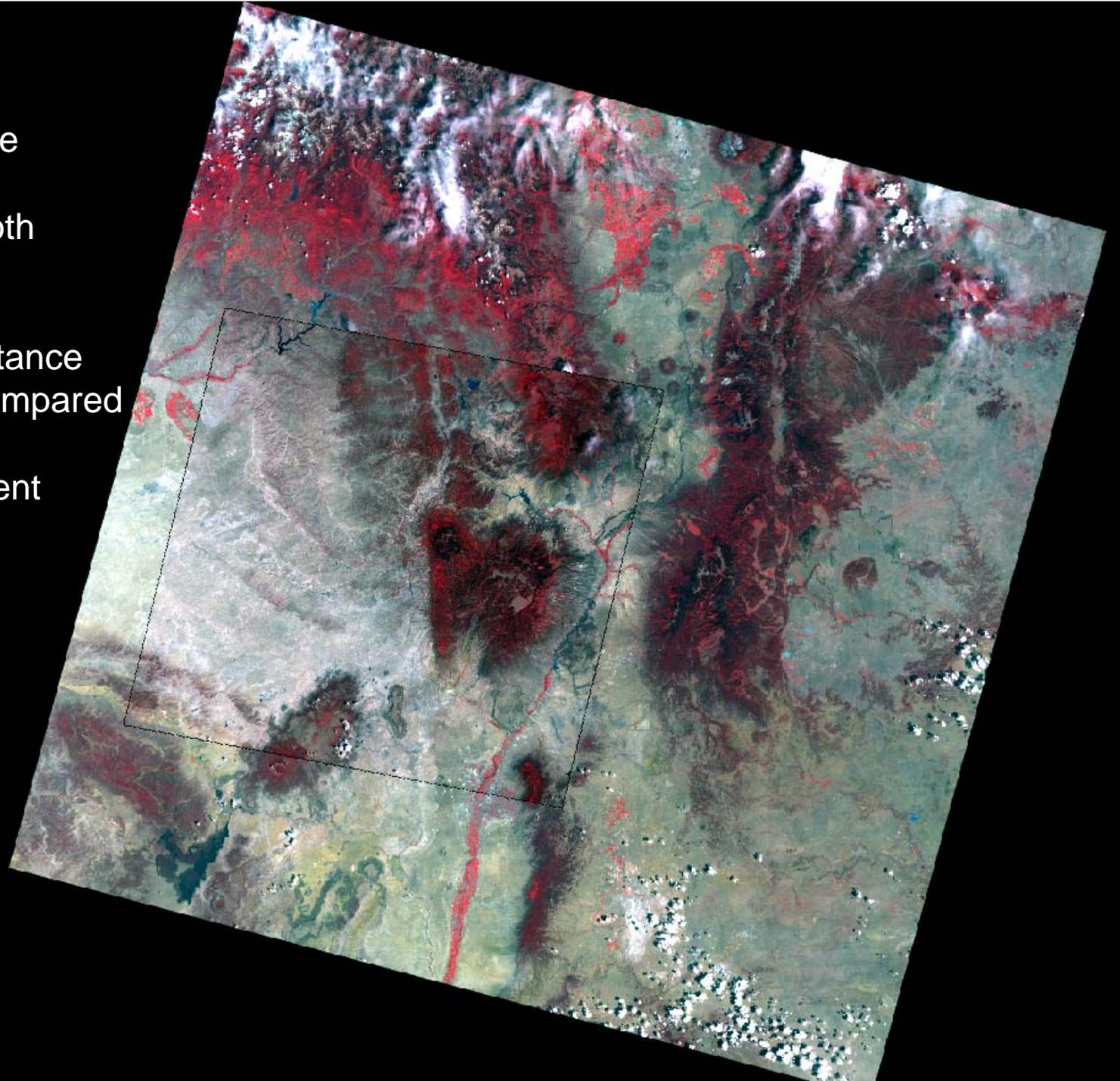
Portion of MODIS Scene (Bands 6 2 1) in SW US (Four Corners Area)

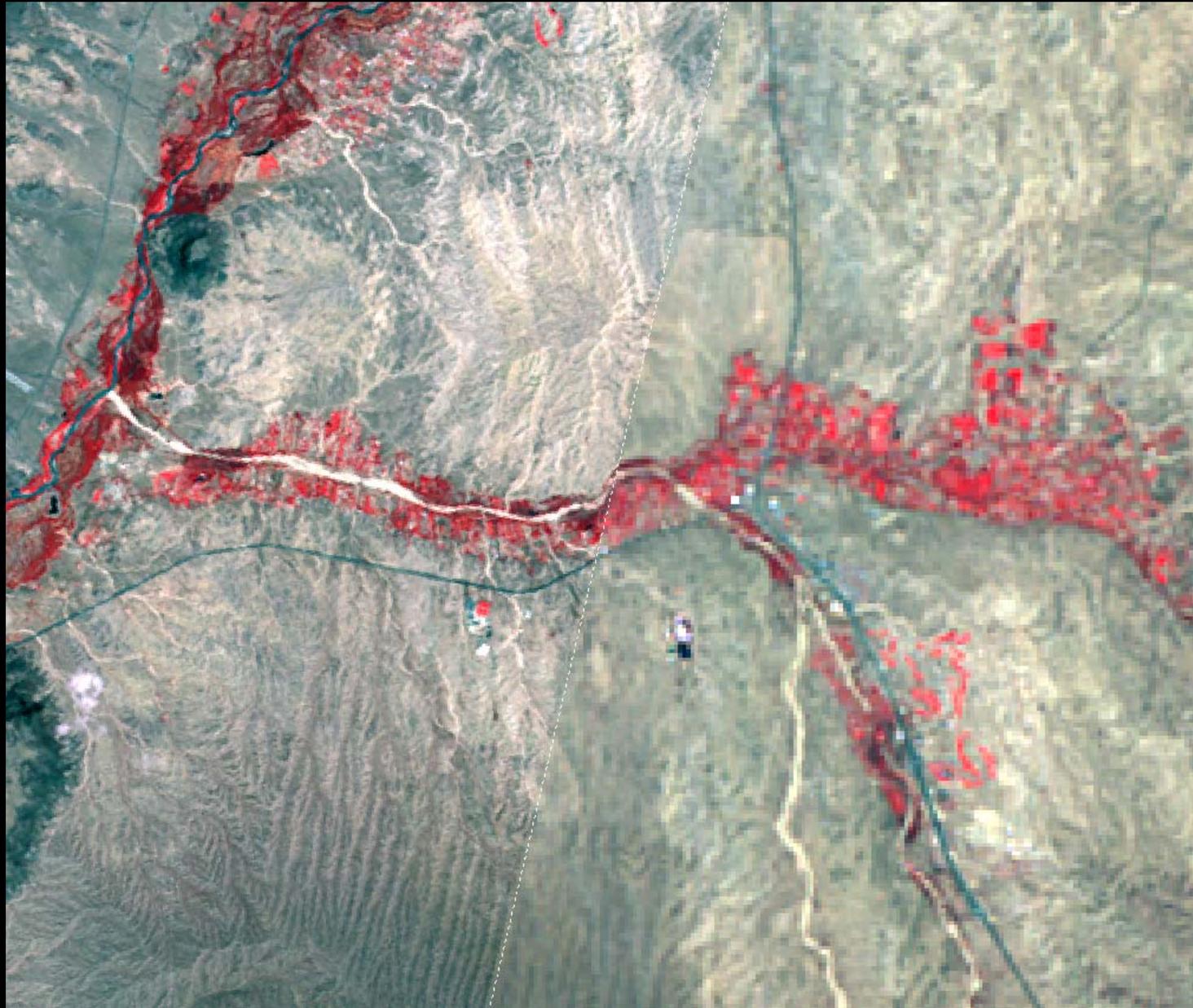


Mean SWIR/NIR Trends; Six Conifer Types and Golf Course Grass



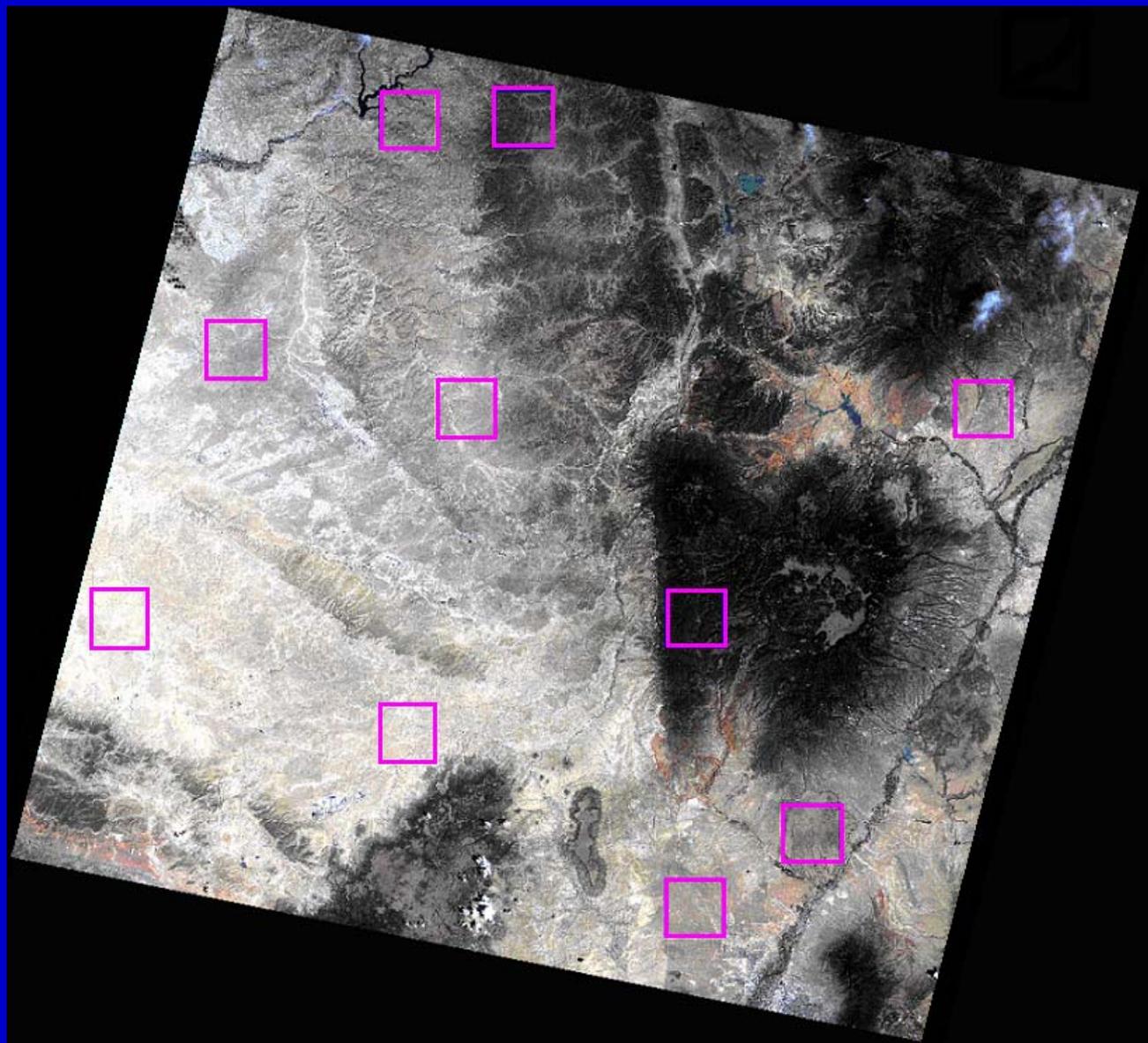
Landsat TM scene
overlay onto an
AWiFS scene. Both
data sets were
acquired on June
10, 2006. Reflectance
data are being compared
between the two
sensors for different
vegetation types



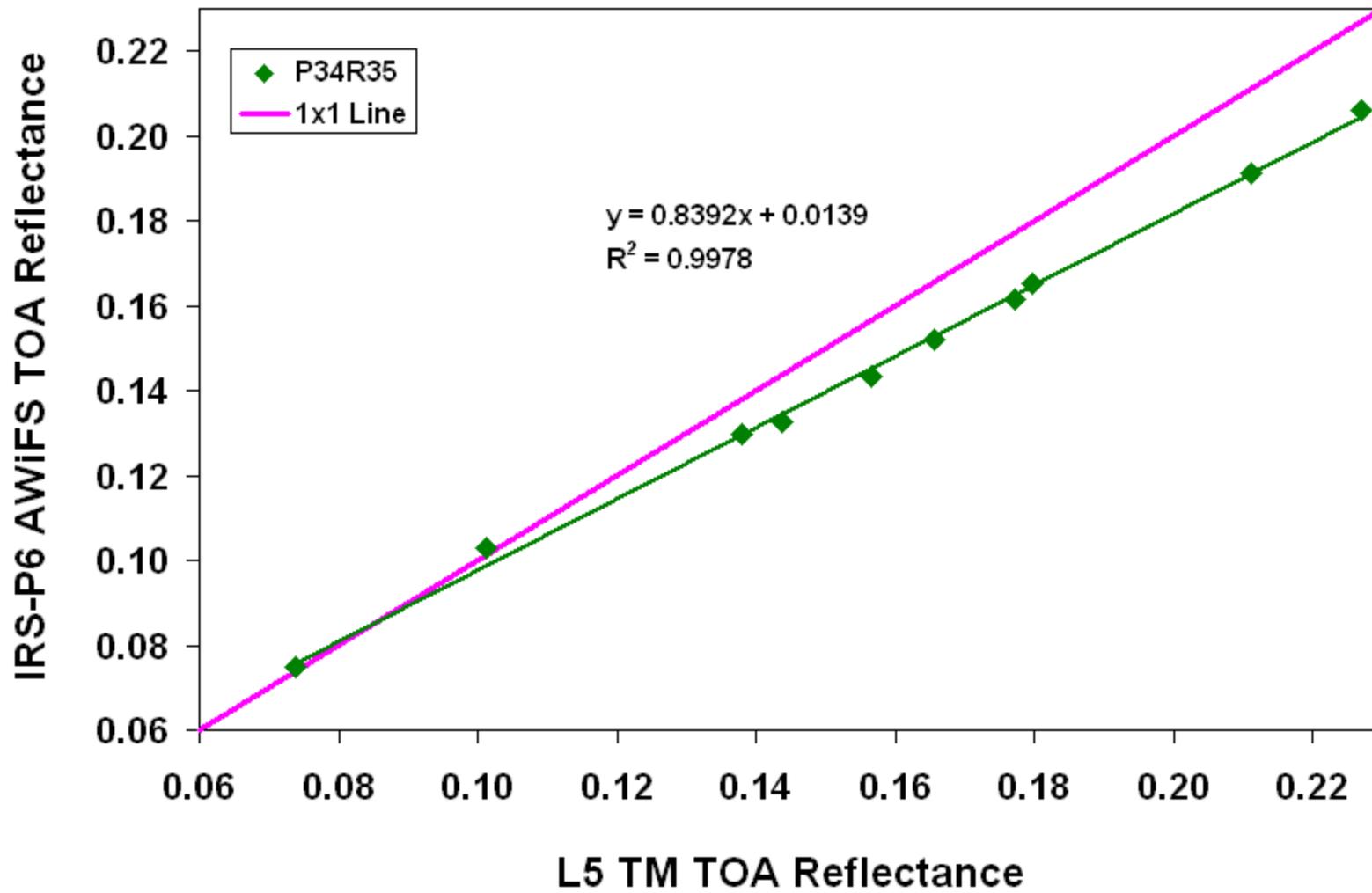


Comparison between Landsat TM (left) and AWiFS (right) showing differences in spatial resolution (30 m vs 56 m pixels)

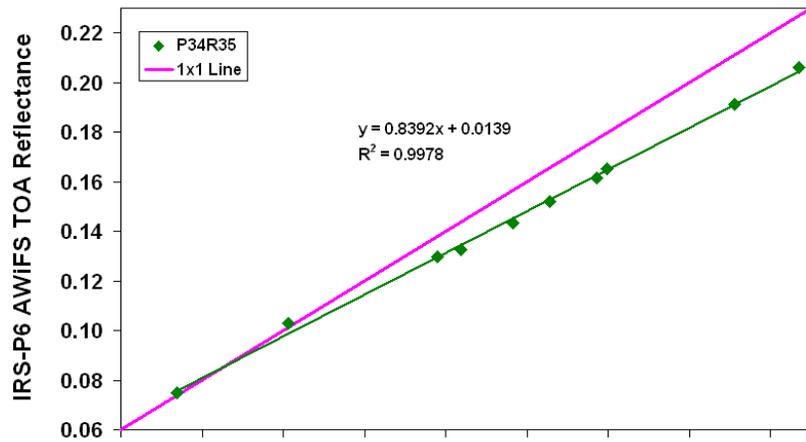
Sample blocks used for comparing TOA reflectance between AWiFS and TM
(Preliminary analysis)



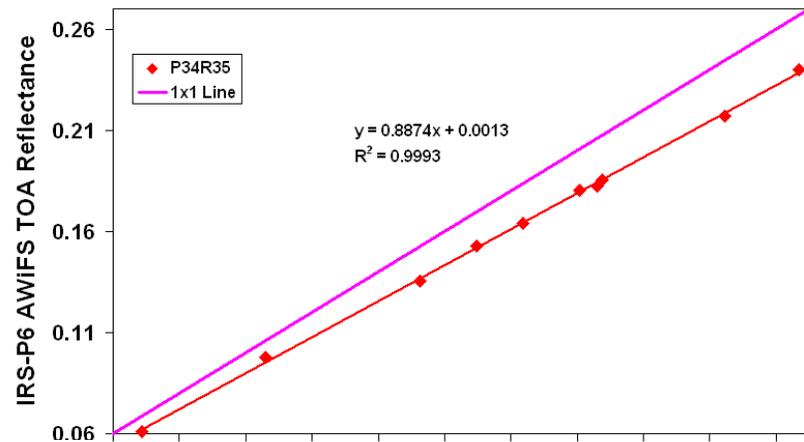
L5 TM & IRS-P6 AWiFS TOA Reflectance, Band 2



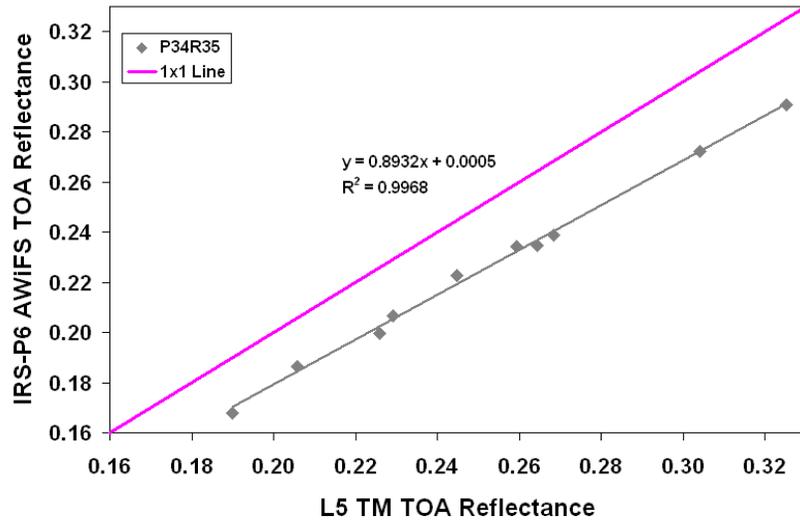
L5 TM & IRS-P6 AWiFS TOA Reflectance, Band 2



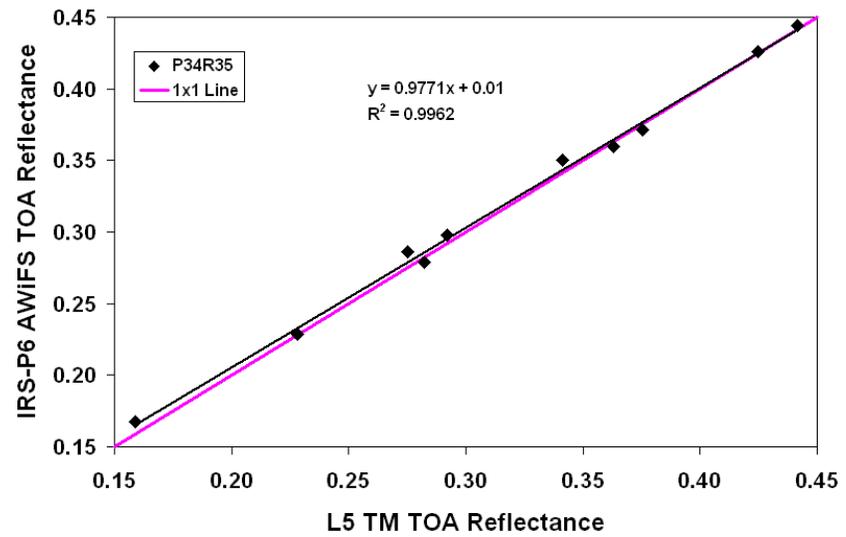
L5 TM & IRS-P6 AWiFS TOA Reflectance, Band 3



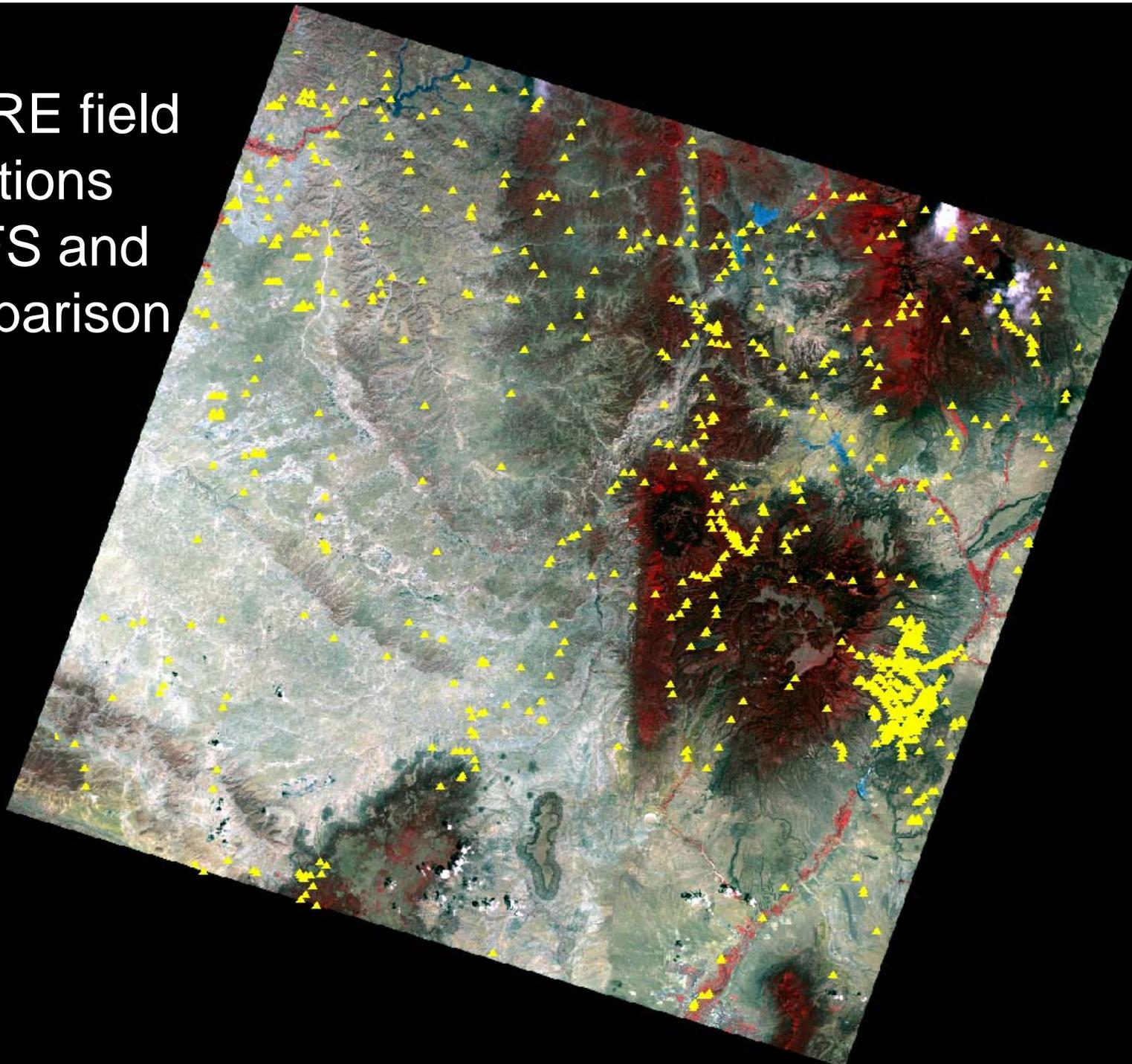
L5 TM & IRS-P6 AWiFS TOA Reflectance, Band 4



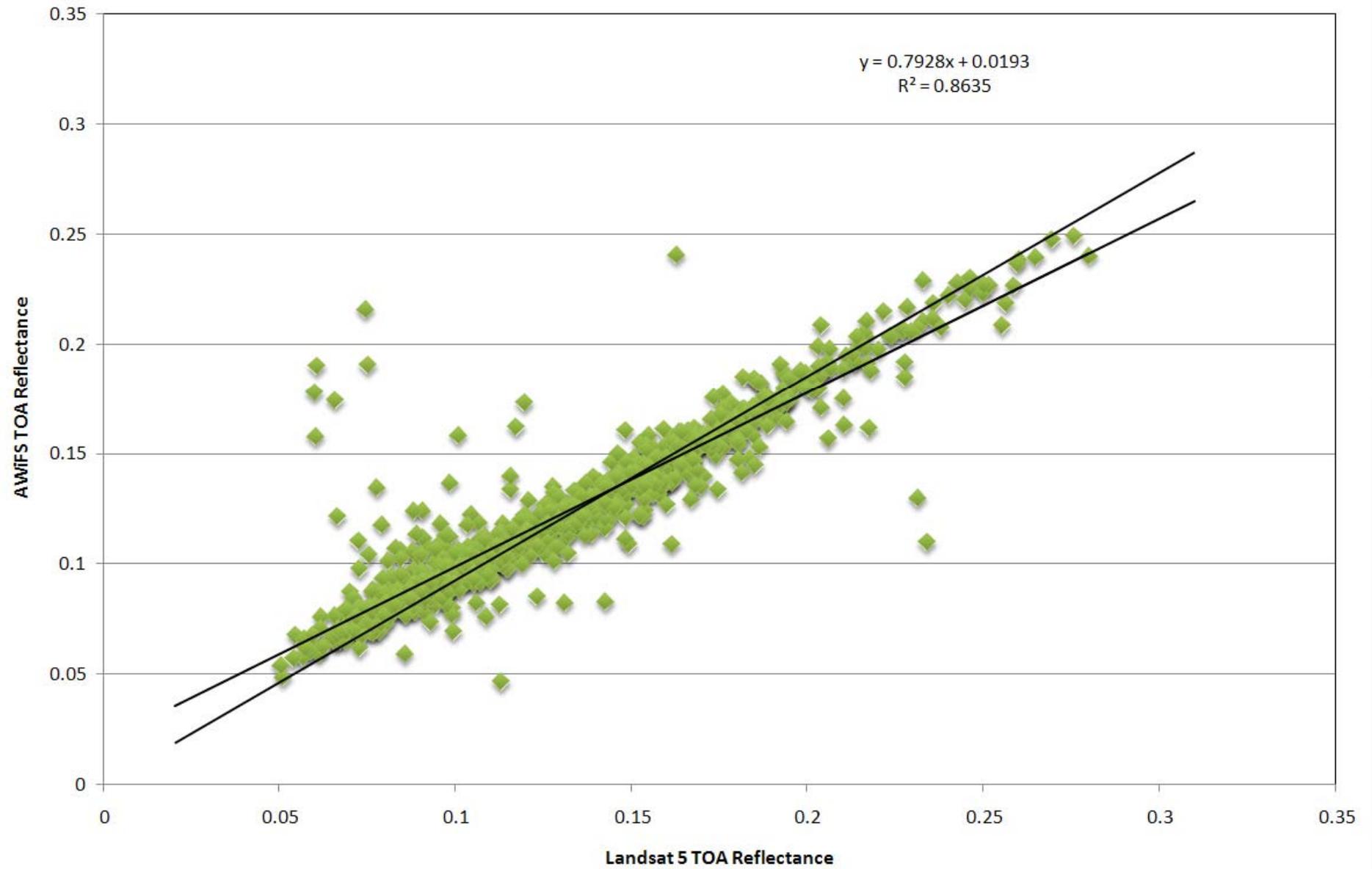
L5 TM & IRS-P6 AWiFS TOA Reflectance, Band 5



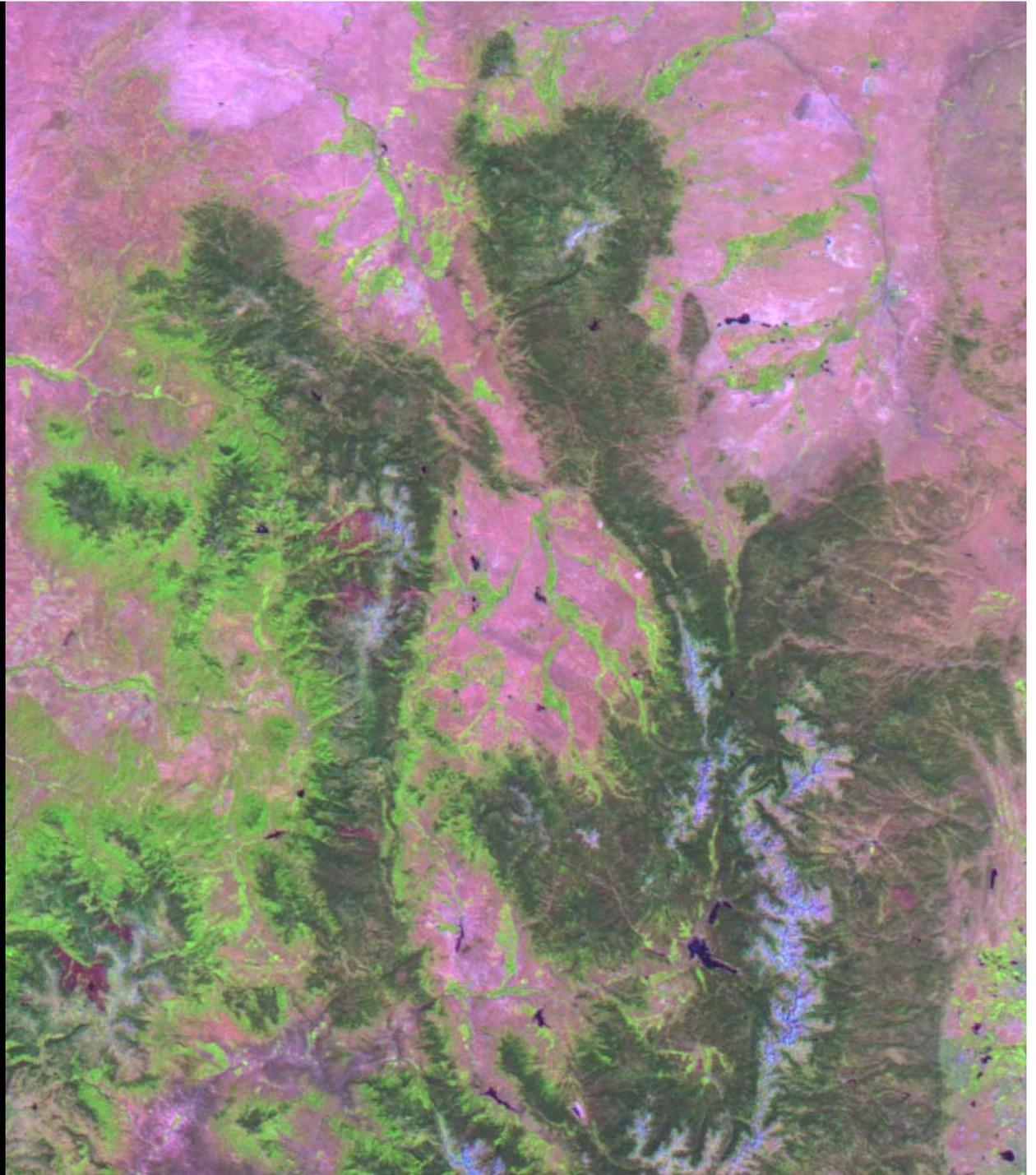
LANDFIRE field
plot locations
for AWiFS and
TM comparison



IRS-P6 AWiFS / Landsat 5 TM TOA Reflectance (Green Band) for 1036 Sample Locations



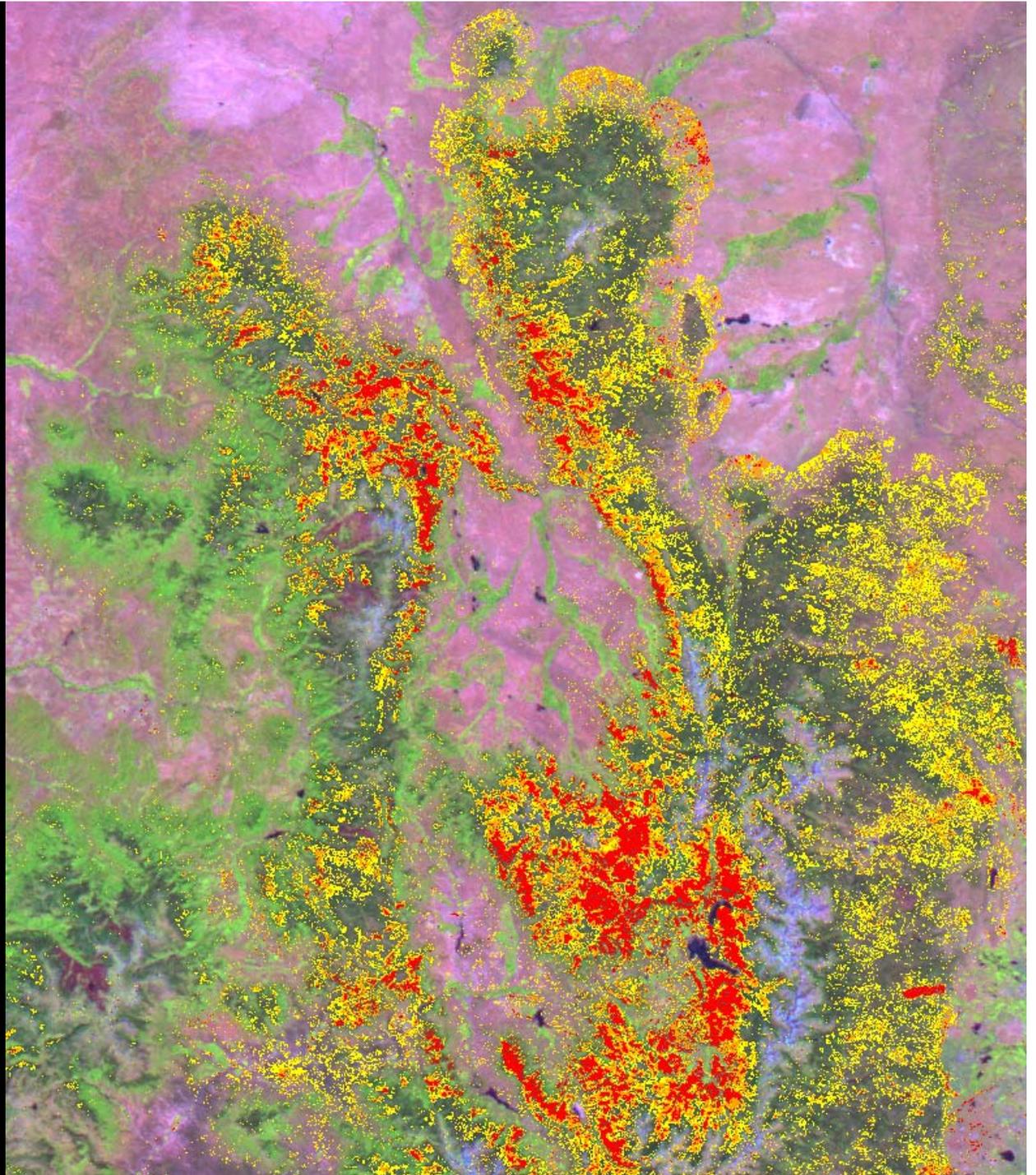
MODIS image of
northern portion
Of Southern
Rocky Mountains



Decrease in
seasonal
median NDVI
between 2003
and 2008

Red = Largest
decrease,
followed by
orange, then
yellow

Areas of decrease
in NDVI correspond
with areas of
pine beetle damage

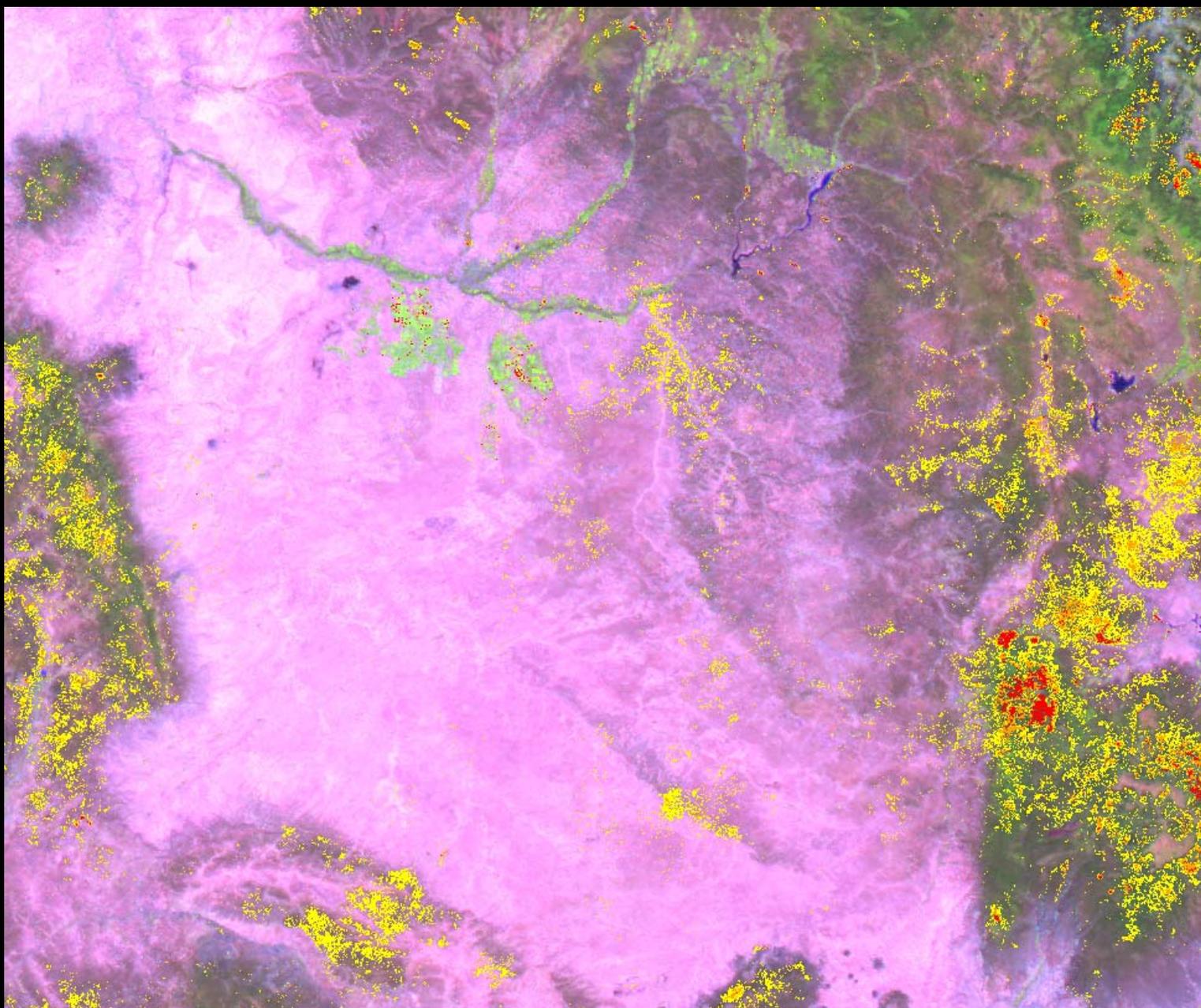


Where MODIS NDVI decreased between 2003-2008

Red = Large decrease in NDVI

Orange = Medium-high decrease in NDVI

Yellow = Medium-low decrease in NDVI

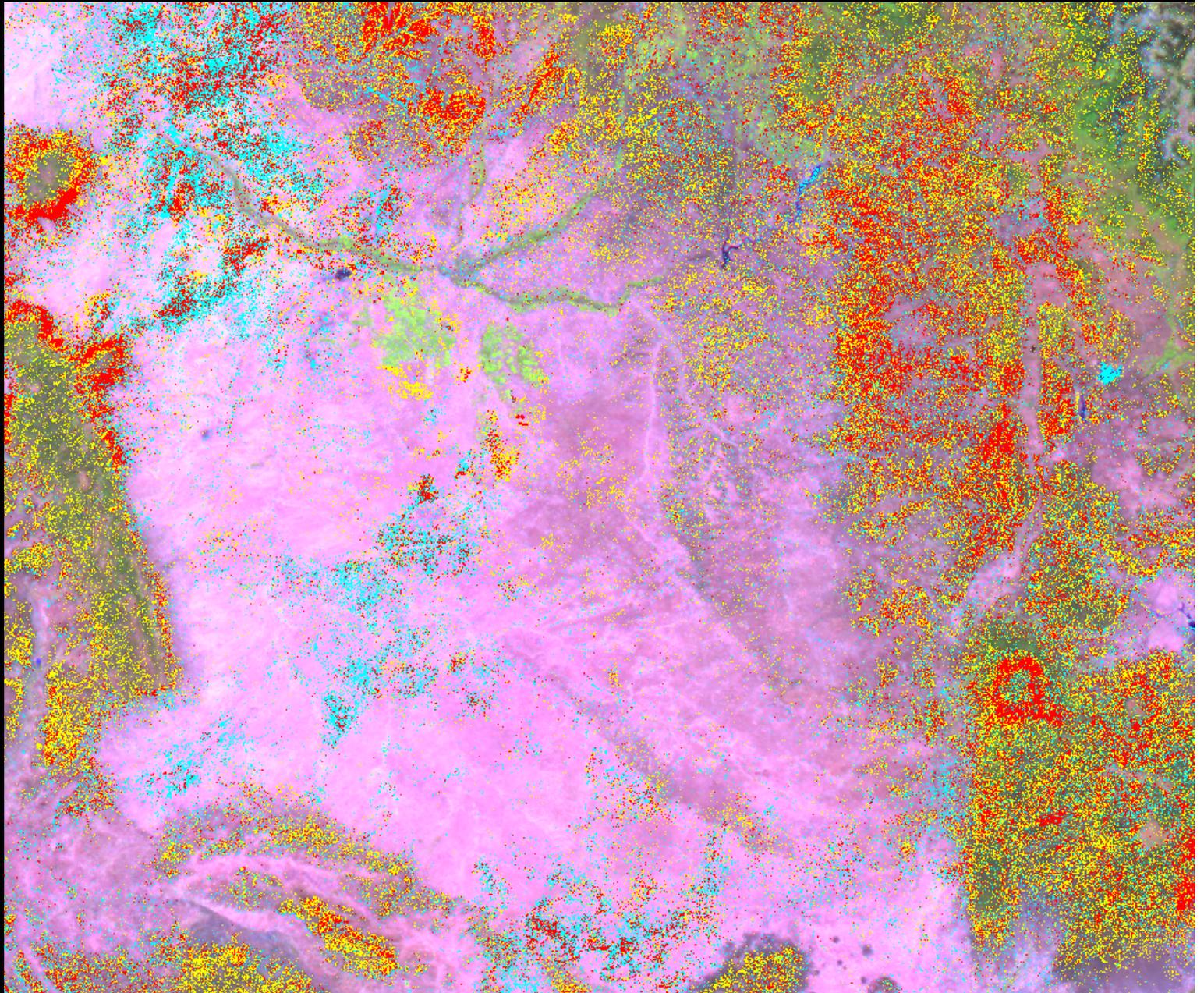


SWIR/NIR and NDVI Trends Data Overlain onto MODIS Imagery

Red =
increase in
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Yellow =
increase in
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change in NDVI

Turquoise =
decrease in
NDVI, but no
significant
change in
SWIR/NIR



A few conclusions

- Landsat time series data powerful for assessing patterns of non-conversion type changes
 - Need to do more to assess patterns and trends of change for different types of vegetation
- AWiFS data looks like it has a lot of potential for “filling in the gaps”
 - Need to do more to assess vegetation AWiFS-Landsat reflectance differences
- MODIS provides good overview of many changes, but clearly Landsat provides more precision and detail