# Radiometric Calibration Assessment of Commercial High Spatial Resolution Multispectral Image Products

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# Background/Introduction

Describe the results from the University of Arizona group for the commercial high resolution sensors

- Follow similar outline as previous speaker
- Describe reflectance-based approach
  - Highlight differences from South Dakota State and Stennis Space Center efforts
  - Accuracy assessment
- Give results from work with the high resolution sensors
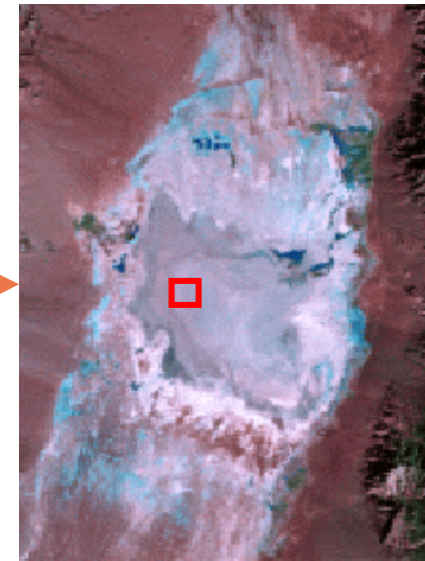- Brief comparison with work with other sensors

3/15/2006

# Reflectance-based approach

Method relies on atmospheric and surface characterization at the time of sensor overpass
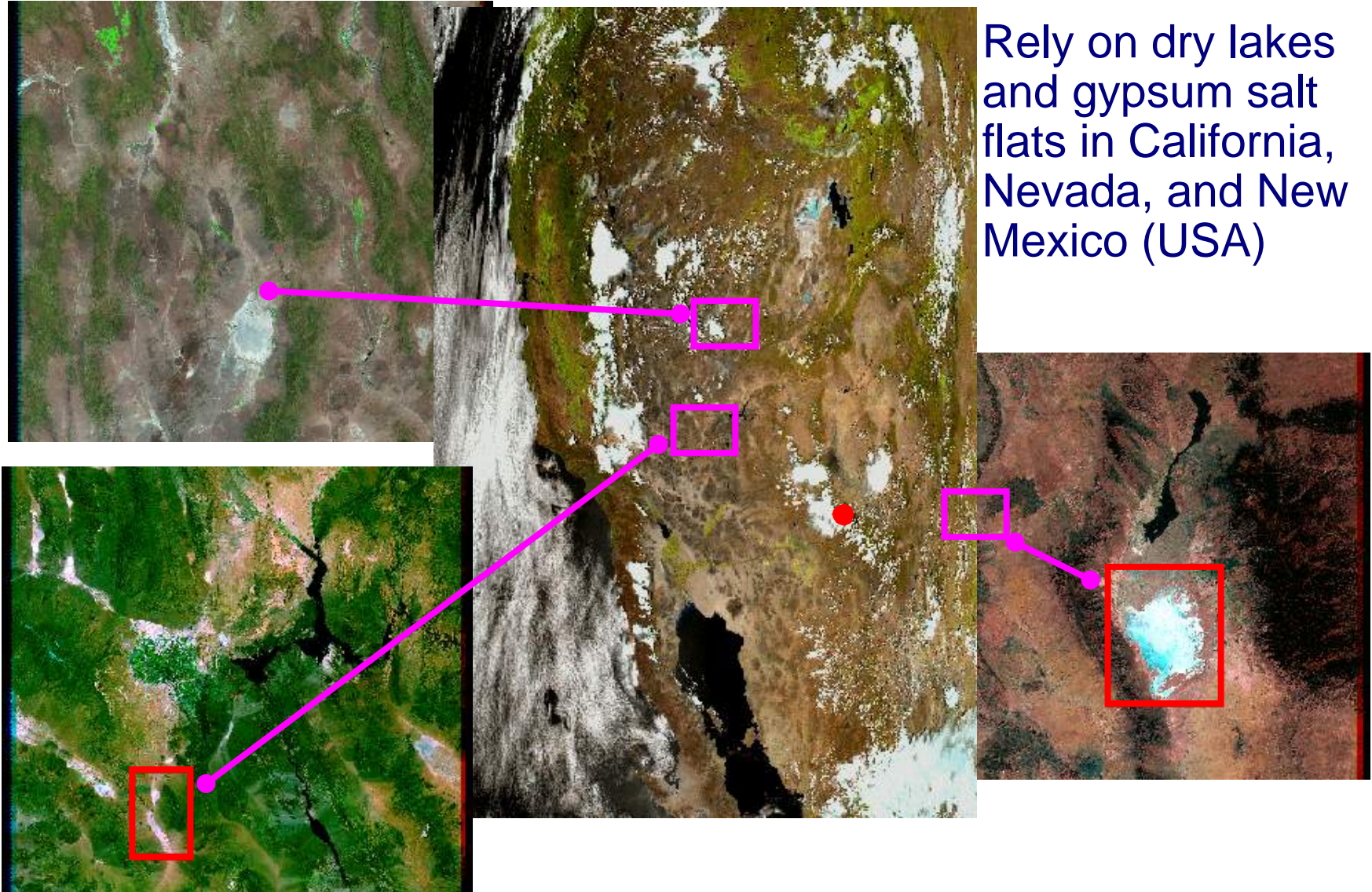


Radiative Transfer Code

# UofA test sites

Rely on dry lakes and gypsum salt flats in California, Nevada, and New Mexico (USA)

# Test site selection

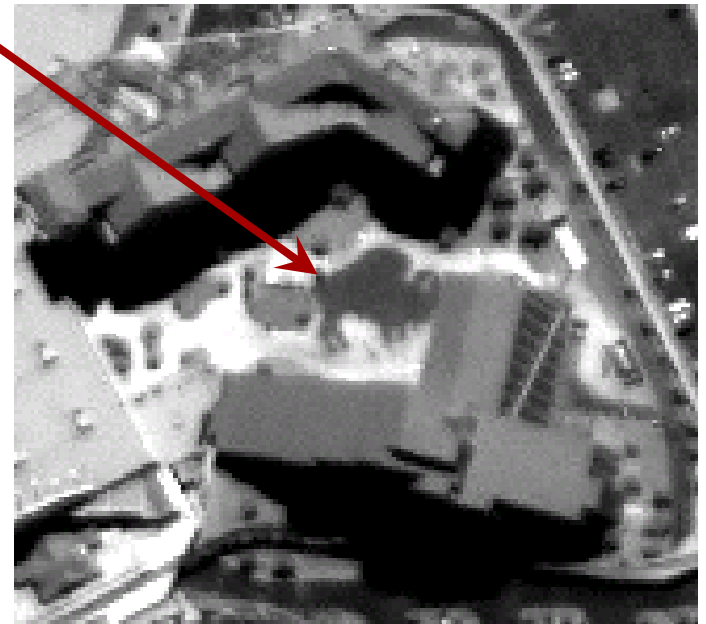Site selection plays a role in the level of accuracy of the results

# Resort Living

Of course, there are the advantages of such places as Primm Valley Resort and a buffalo-shaped pool

# Aerosol parameters

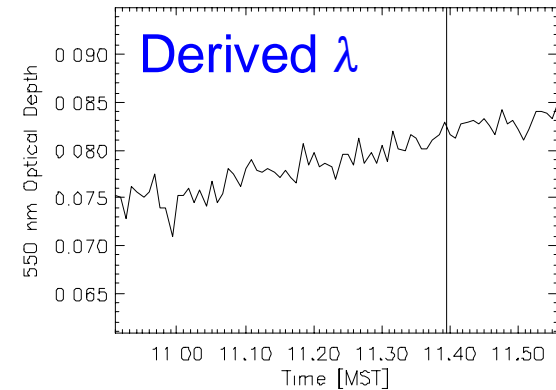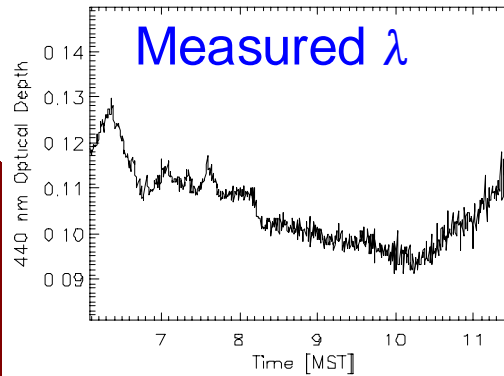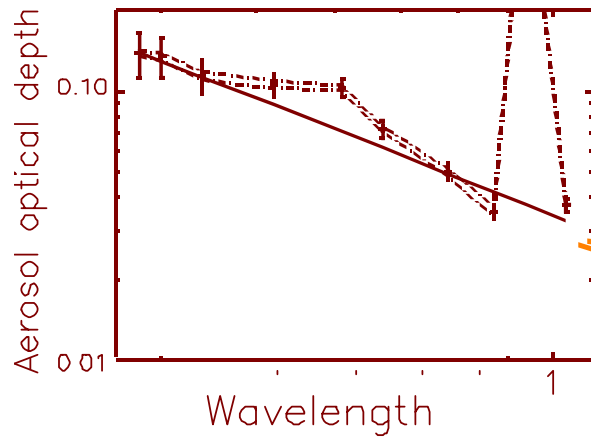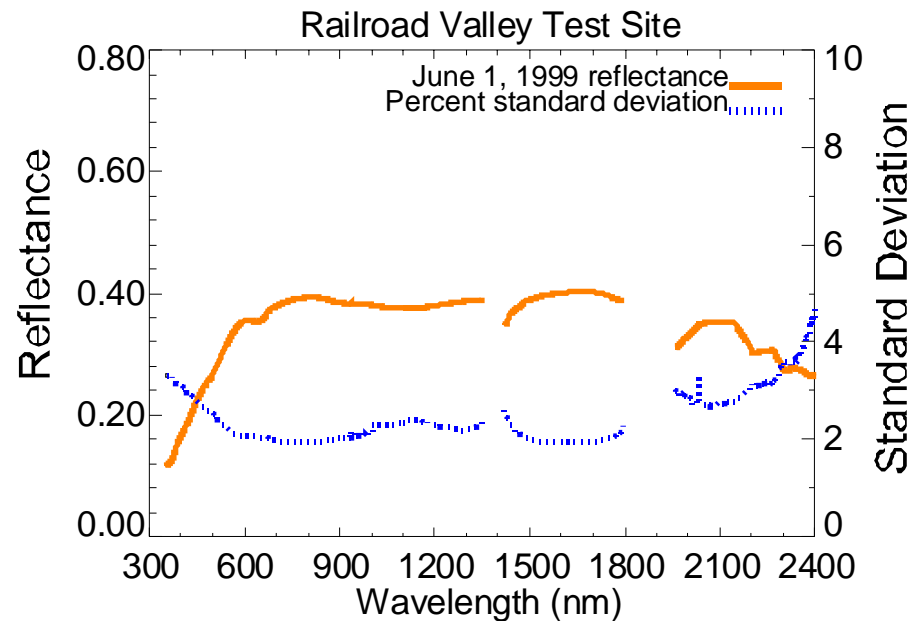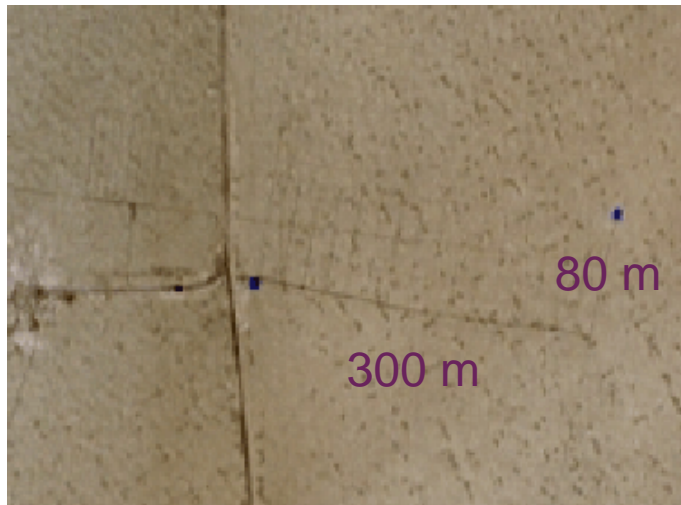Primary parameter is spectral transmittance which is used to derive spectral and temporal results

■ Convert transmittance to optical depth

■ Spectral optical depth used to retrieve

● Column absorbers

● Concentration

● Aerosol size



Measured λ

Derived λ

Derived results

Derived results
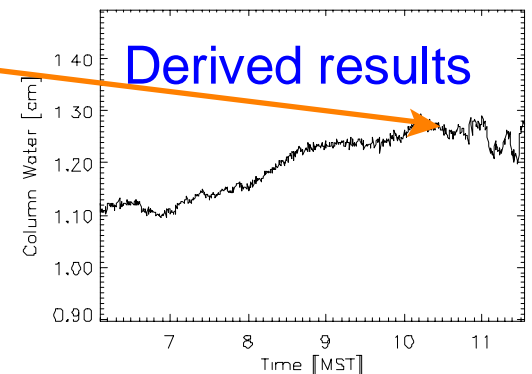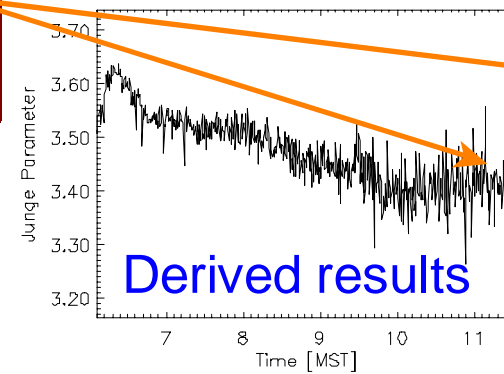
# Surface reflectance retrieval



Railroad Valley Test Site



June 1, 1999 reflectance
Percent standard deviation

# Accuracy/precision

Studies using ETM+, MODIS, and traceability to NIST standards show several key results

- There are no significant site-dependent effects in the data sets collected to date

- Precision (repeatability) of approach is at the 2.5% level (1-$\sigma$) in the mid-visible

  - Based on knowledge of measurement repeatability
  - Verified through theoretical modeling of uncertainties

- Accuracy is more difficult to prove but uncertainty estimates indicate a similar 2.5% value in mid-visible

- Improvements in the accuracy and precision will require improvements in characterization of surface reflectance

# Data Sets

Two Ikonos images, three QuickBird and four Orbview data sets acquired for RSG since July '04

- Ikonos scenes were June 23, 2005 (Ivanpah) and August 28, 2005 (RRV)
  - Data collected at Ivanpah on June 18 for ETM+/Terra and August 28 was a Terra/ETM+ overpass day
- QuickBird scenes were Dec. 14, 2005 (RRV); July 8, 2005 (Ivanpah); and July 13, 2005 (RRV)
  - Data collected at Ivanpah on Dec. 15 for ETM+/Terra and on July 11 at RRV for Terra/ETM+
- Orbview scenes were July 11, 2004 (RRV), Aug. 28, 2004 (Ivanpah), Dec. 15, 2004 (RRV), and July 13, 2005
  - Data co-collected at  with other sensors except for Aug. 28 data set

# June 23, 2005 for Ikonos

## Test sites used by UofA typically have clear skies with low aerosol loading

- June 23 date marked by smoke from forest fires
- Clearly visible from the ground and in some satellite data
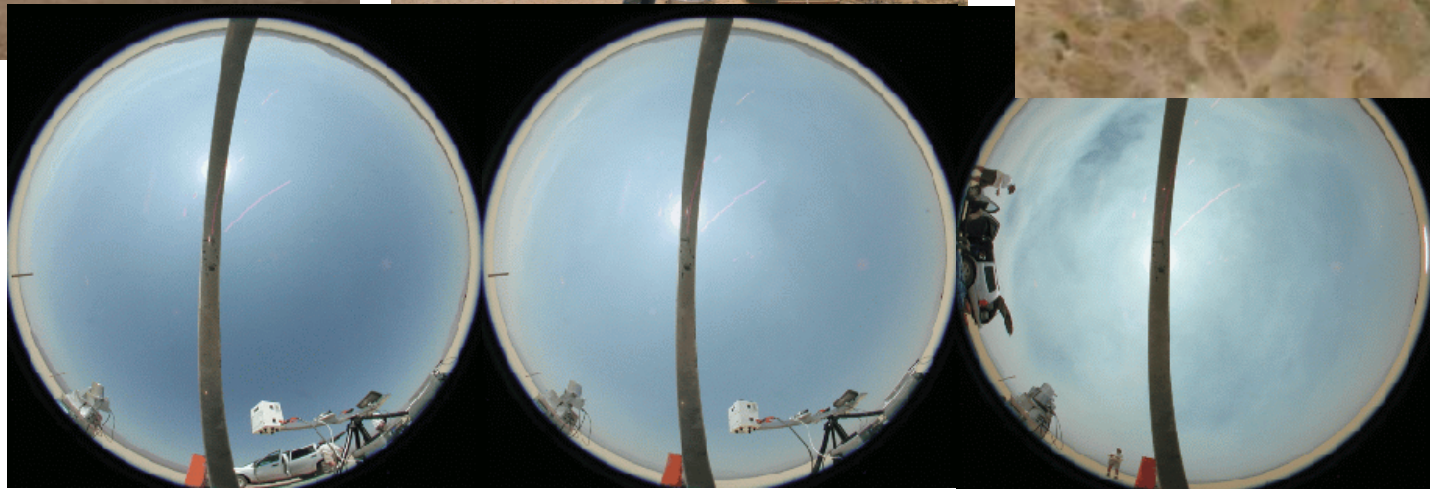
# June 23, 2005 Ikonos

No noticeable effect in the Ikonos imagery from the date (below left) especially compared to QuickBird from July 8
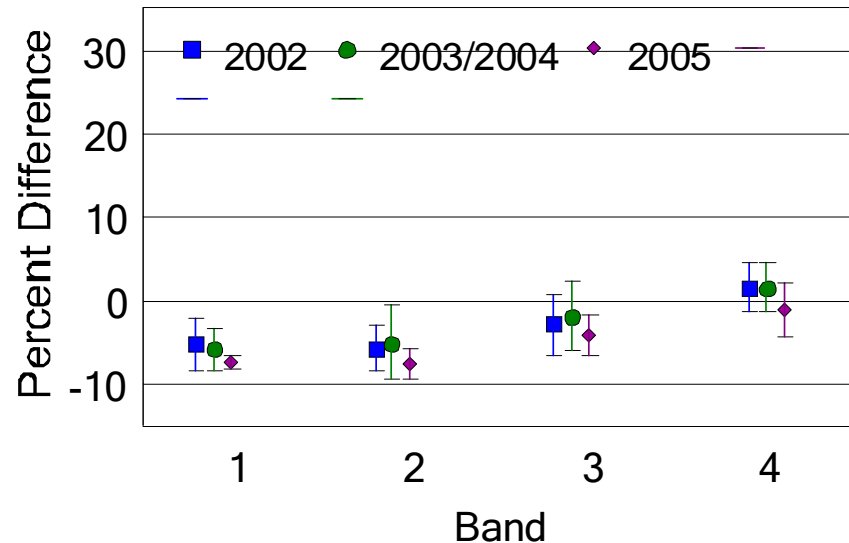
# QuickBird Results

Have computed calibration results relative to the reported values for QuickBird

- Compute a percent difference between the ground-based values and the imagery
  - Determine average for the dates
  - Compute the standard deviation of that average
- Results for QuickBird show consistency with past years

"Precision" is similar to that for other sensors with more data points

# Ikonos results

Have computed calibration results relative to the reported values for Ikonos

■ Compute a percent difference between the ground-based values and the imagery

- Determine average for the dates

- Compute the standard deviation of that average

■ Results for Ikonos show little variability with year

"Precision" is larger than that for other sensors with more data points but note 2005 data set
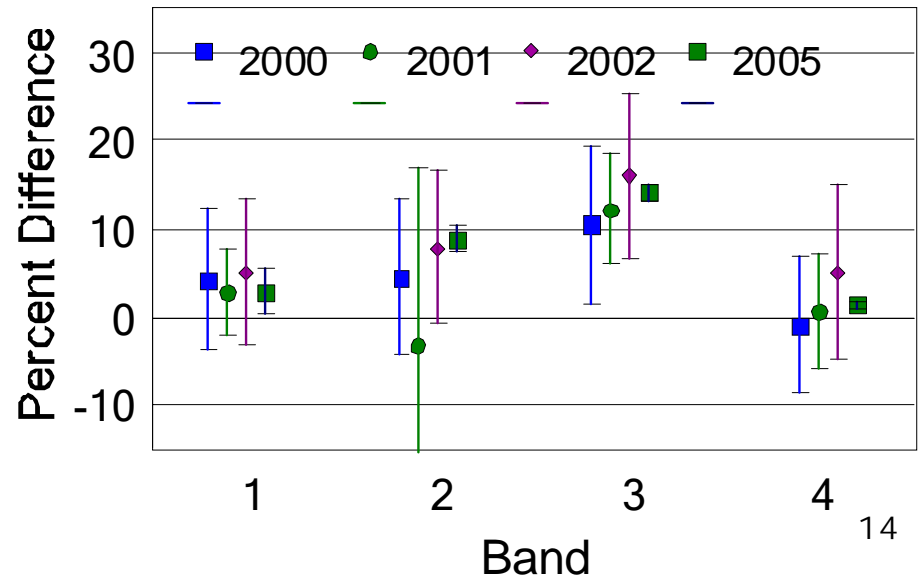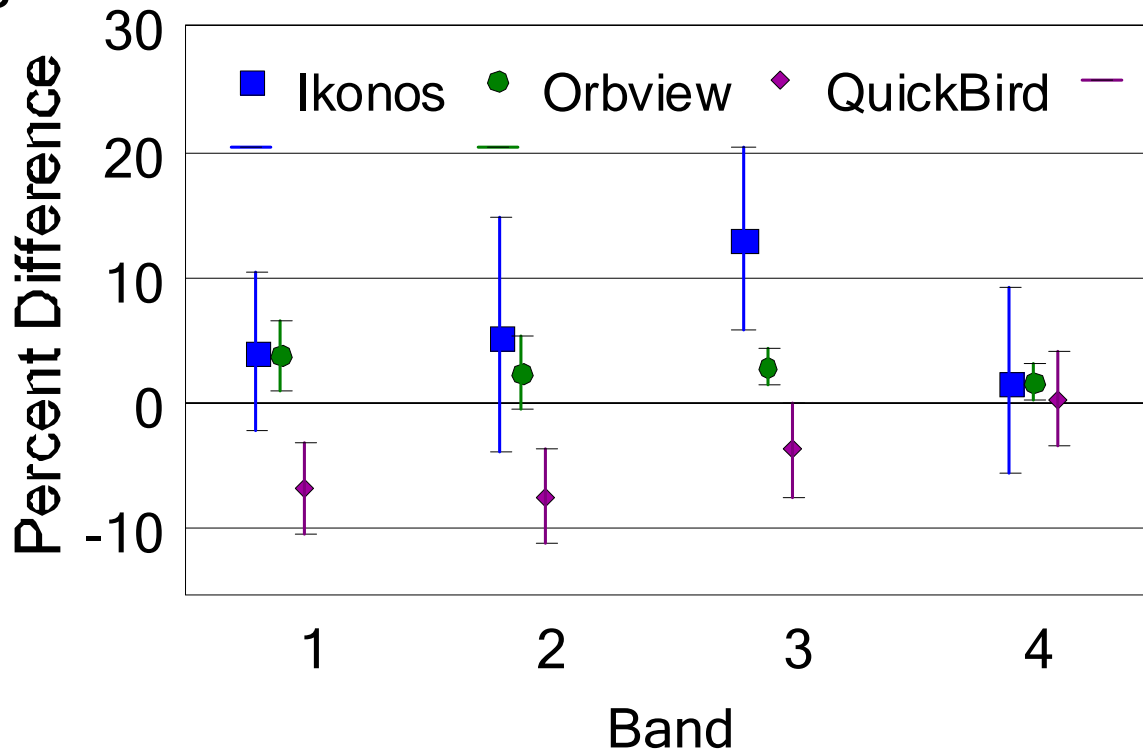
# Orbview results

Have computed calibration results relative to the values for Orbview

- Include the Ikonos and QuickBird results for reference
- The advantage of reflectance-based method is that it can be used to determine a "cross-calibration" between sensors
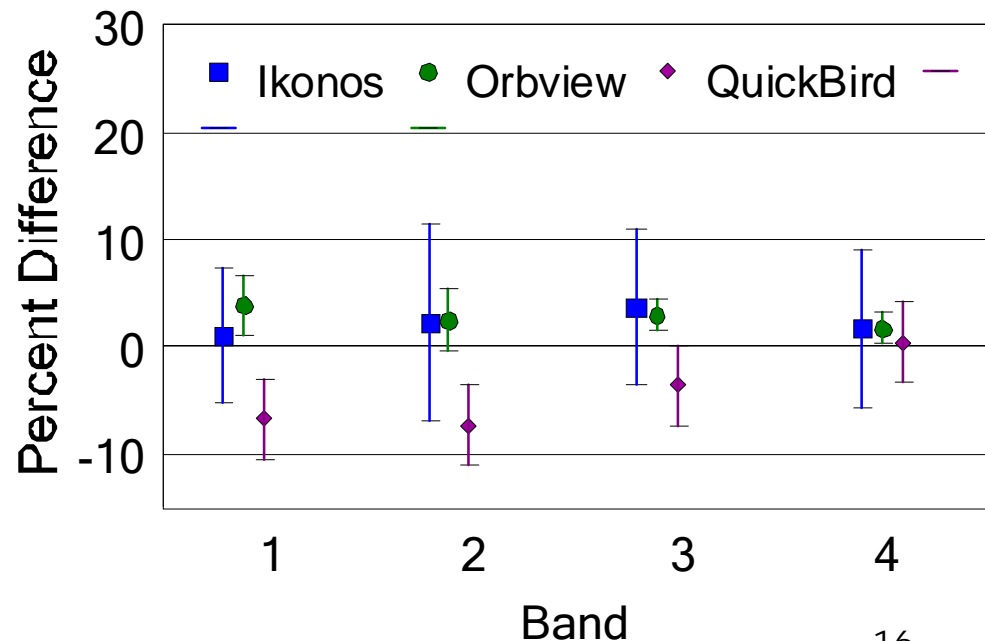
# Ikonos redux

## Behavior of band 3 prompted an additional look at the Ikonos data

- Did not see such an effect in the Stennis-based results (as will be seen)

- Opted to recompute the results with a change in the approach to band averaging

Ikonos-supplied calibration is band integrated

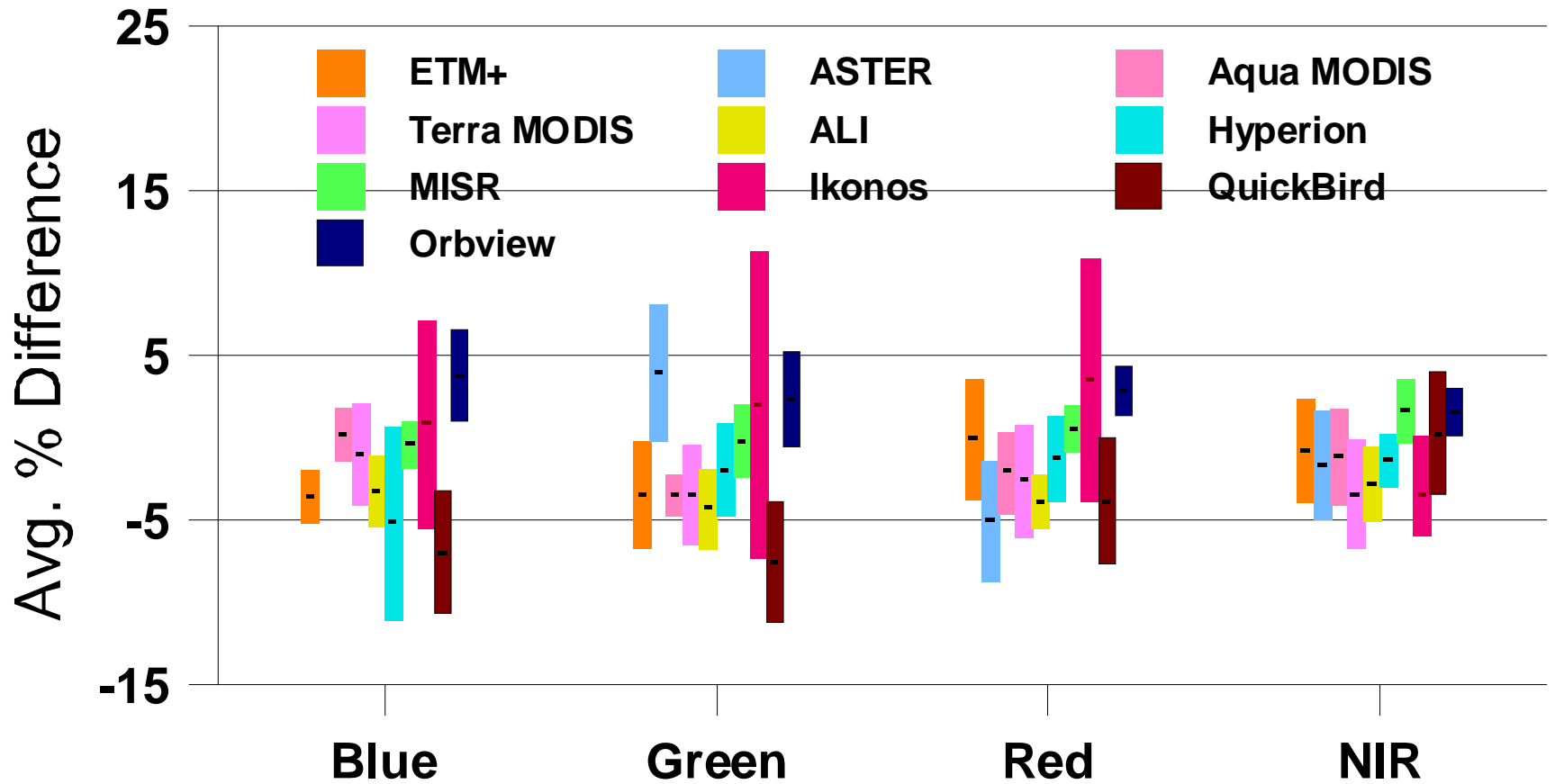Conversion can use either FWHM or integral approach

New results are integral based

# Overall results

Comparisons can then be made amongst other sensors of varying spectral and spatial resolution

# Summary/conclusions

The use of three independent groups continues to prove valuable in understanding these sensors

- Subtle band-averaging effect would not have been found otherwise (along with collaboration with the companies)

- UofA results for the high resolution commercial sensors are of similar quality as those of other sensors

  - High-resolution results rely on fewer data points

  - Still obtain similar levels of precision

  - Confidence in results is strengthened through coincident or near-coincident collects with other systems

- Look forward to further work to see if the quality of the 2005 data sets can be repeated