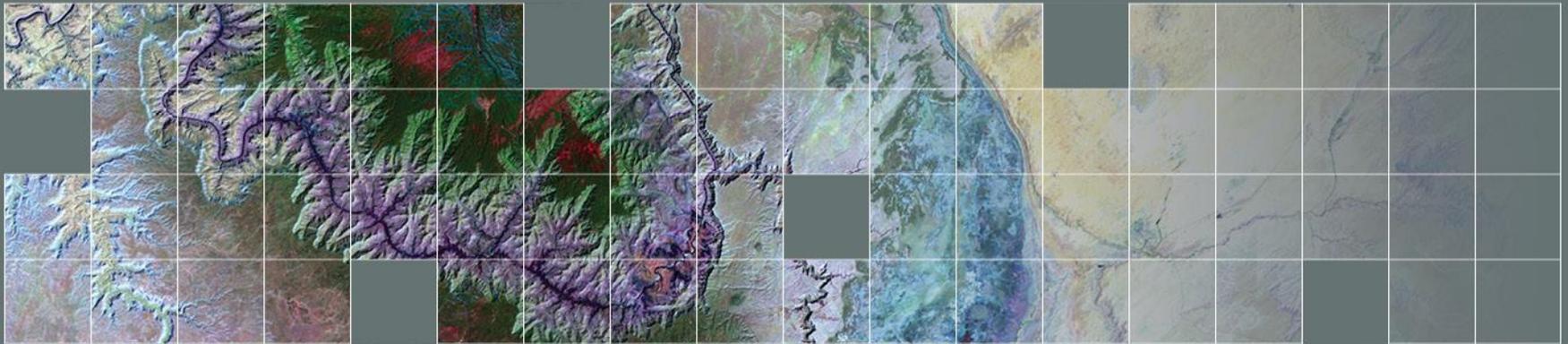


Climate and Land Use Change  
**Earth Resources Observation and Science (EROS) Center**

# A look at Pleiades 1-B and SPOT data



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# Outline

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- **Data Overview**
  - Pleiades 1-B
  - SPOT 6
- **Geometric Assessment**
  - Results
    - Pleiades 1-A
    - SPOT 6
- **Qualitative radiometric and MTF assessments**
- **Summary**

# Pleiades 1-B overview

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- **Data from Pleiades 1-B**
  - Sioux Falls – Ortho (Produced using SRTM DEM)
  - Pueblo – Ortho (Produced using 10m NED)
- **Four spectral bands**
  - Blue, Green, Red, Near Infrared
- **Ground sampling distance: 0.5 m (PAN), 2 m (MSS)**
- **Data for analysis in WGS UTM Zone 13N (Pueblo) and 14N (Sioux Falls)**
- **Reference data: Orthoimagery, Ground Control Points**

# SPOT 6 Data overview

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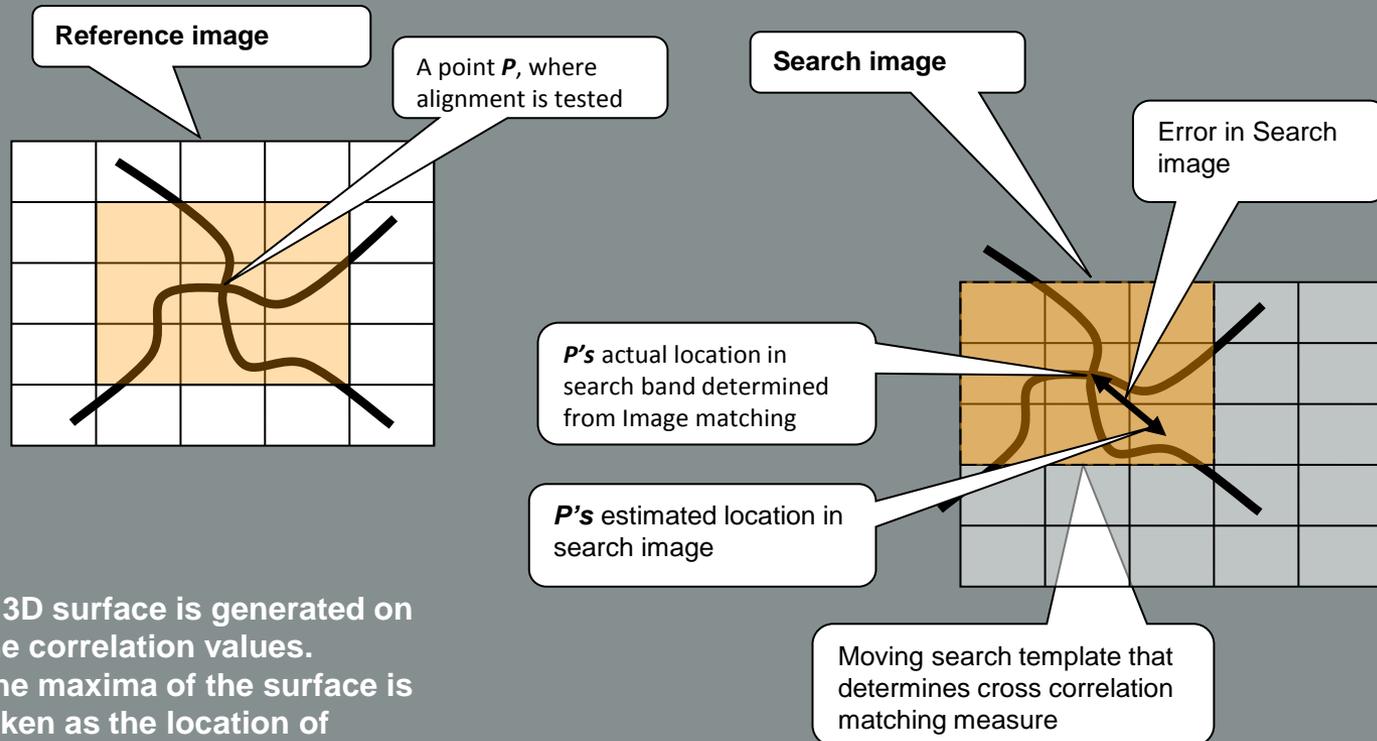
- **Data from SPOT 6**
  - Sioux Falls
  - Pueblo
- **Four spectral bands**
  - Blue, Green, Red, Near Infrared
- **Ground sampling distance: 1.5 m (PAN), 6 m (MSS)**
- **Data for analysis in WGS UTM Zone 13N (Pueblo) and 14N (Sioux Falls)**
- **Reference data: Orthoimagery**

# Geometric Accuracy Assessment

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- **Performed using the Landsat Image Assessment System (IAS)**
  - Developed for Radiometric and Geometric Characterization and Calibration for Landsat data.
- **Band to Band (B2B) assessment**
  - B2B is performed to test band alignment of the image data
  - It is typically done by registering each band against every other band
- **Image to Image (I2I) registration assessment tool**
  - I2I is usually performed to compare the relative accuracy between two images
  - Performed against an image of higher accuracy (reference data)
  - The results provide an insight to the relative accuracy of the search image with respect to the reference image
  - When the correlated points are plotted in the image, it also helps to detect any systematic bias in the image

# Geometric Accuracy Assessment : Image Registration



- A 3D surface is generated on the correlation values.
- The maxima of the surface is taken as the location of offset

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# Pleiades 1-B Data Analysis

# Pleiades 1-B Data Analysis

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- **Ground Control Points based analysis for 0.5 m PAN data**
- **I2I matching using Orthoimagery as control data for MSS data**
- **Coordinate System: WGS 84 UTM Zone 13N for Pueblo and Zone 14 N for Sioux Falls data**

# Pleiades 1-B Geometric results

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## Summary statistics for Pleiades 1-B GCP analysis for imagery: Sioux Falls

Sioux Falls GCP analysis PAN Band	X	Y
	Meters	
Mean	-2.10	-2.90
StDev	0.70	0.40
RMSE	2.18	2.96
Total RMSE	3.67 m (7.3 pixels)	

## Summary statistics for Pleiades 1-B GCP analysis for imagery: Pueblo

Pueblo GCP analysis PAN Band	X	Y
	Meters	
Mean	1.96	1.10
StDev	0.60	1.30
RMSE	2.10	1.70
Total RMSE	2.7 (5.4 pixels)	

Pleiades MSS data are well registered (0.3 pixels) with PAN data

- So they have the same magnitude of errors

MSS bands are registered to within 0.2 pixels of each other

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# SPOT 6 Data Analysis

# SPOT 6 Data Analysis

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- I2I matching using Orthoimagery as control data for MSS and PAN data
- Coordinate System: WGS 84 UTM Zone 13N for Pueblo and Zone 14 N for Sioux Falls data

# SPOT 6 Geometric results

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## Summary statistics for SPOT 6 PAN band analysis: Sioux Falls

Sioux Falls I2I analysis PAN Band	X	Y
	Meters	
Mean	-11.57	-1.97
StDev	0.65	0.65
RMSE	12.85	3.28
Total RMSE	13.25 m (8.8 pixels)	

## Summary statistics for SPOT 6 PAN band analysis: Pueblo

Pueblo I2I analysis PAN Band	X	Y
	Meters	
Mean	-3.60	-0.95
StDev	0.31	0.38
RMSE	3.61	1.02
Total RMSE	3.75 (2.54 pixels)	

SPOT MSS data are well registered with PAN data

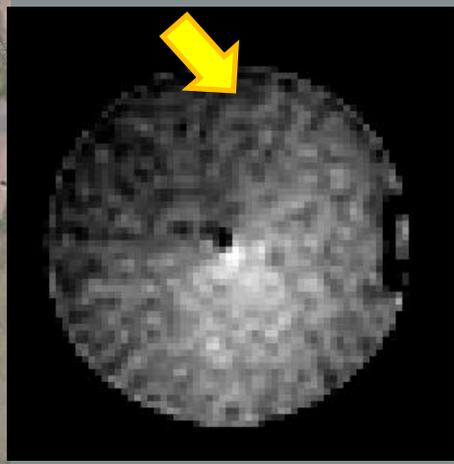
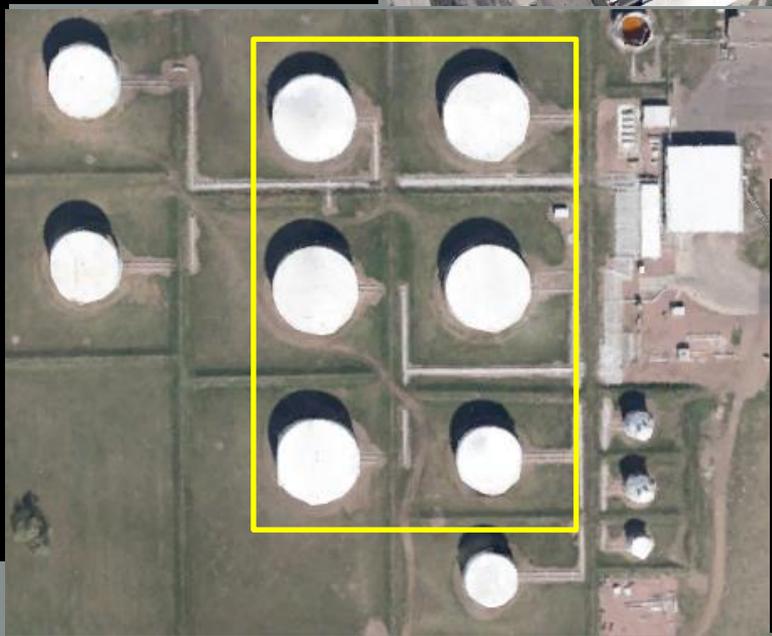
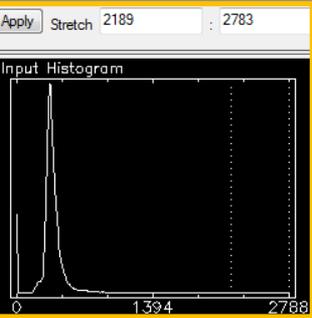
- So they have the same magnitude of errors

MSS bands are registered to within 0.39 pixels of each other

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- Image data for Quality Checking
  - Quality
    - ✓ #17, Ringing
    - ✓ #12/#13, Compression noise (artifacts)

# Ringing



Ringing may be after MTFK in PAN.

# Ringings

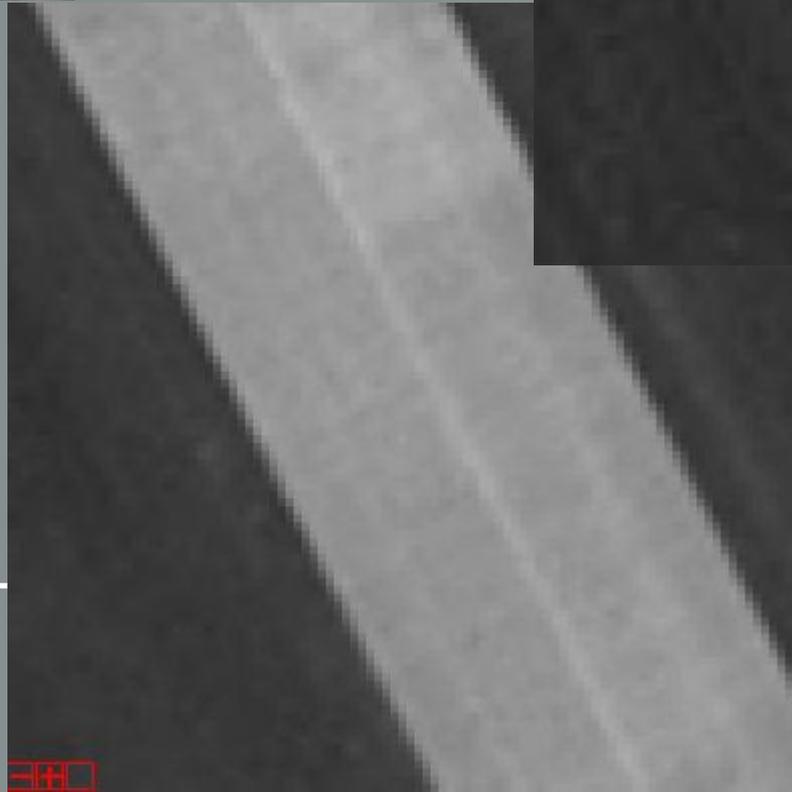


Google  
map

SPOT6



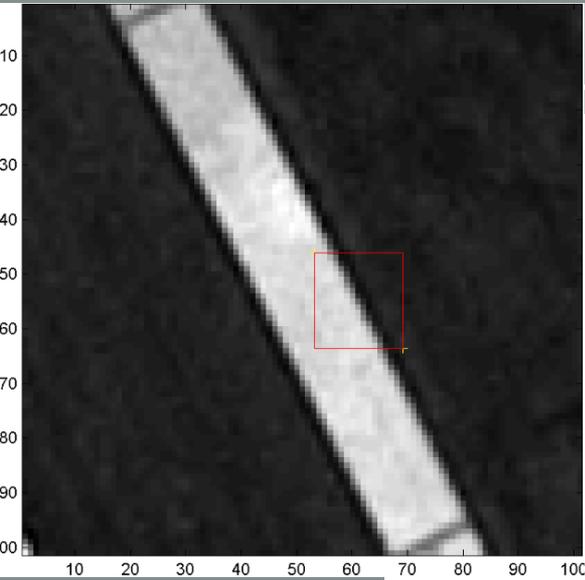
PHR-1B



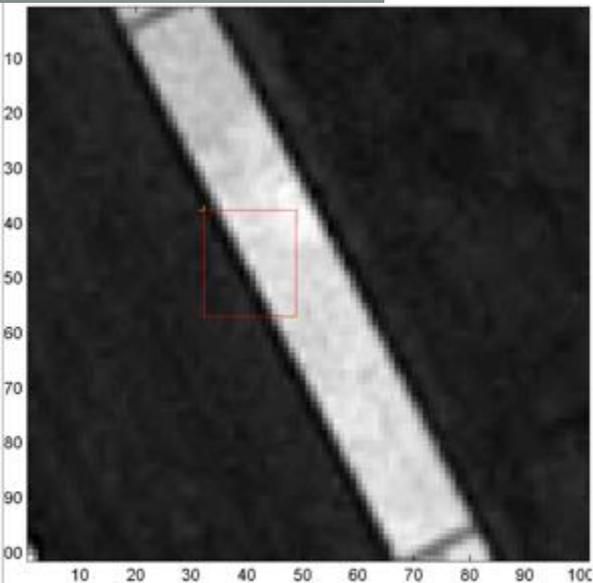
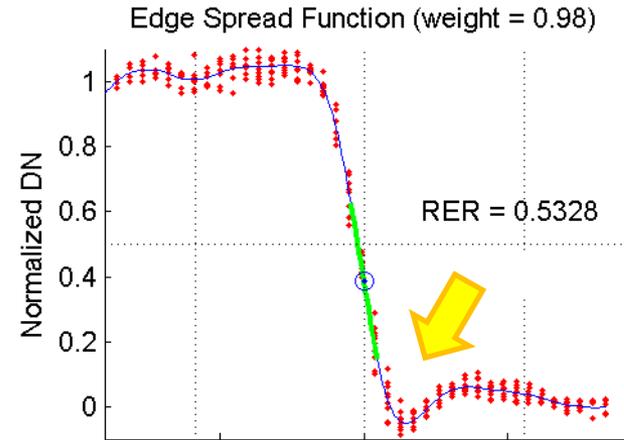
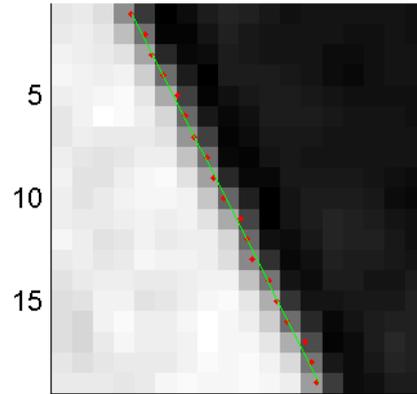
Ringings may be  
after MTFC in PAN  
SPOT6 has it.  
PHR-1B has a little.

# Ringings (SPOT6, PAN)

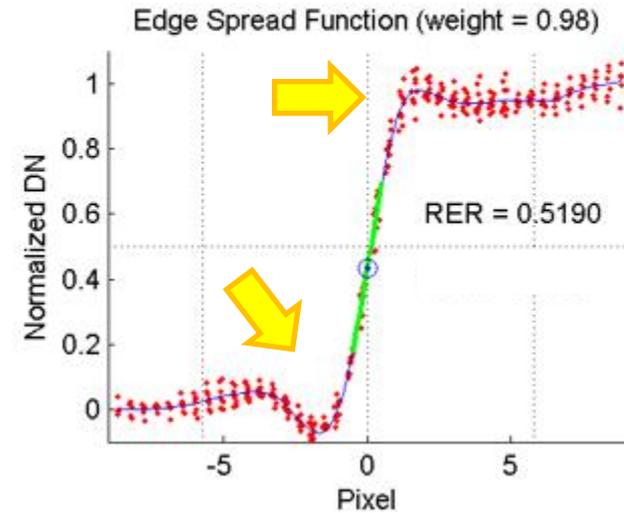
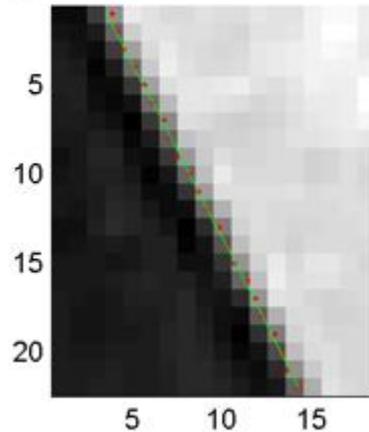
- There is Ringing after MTFC



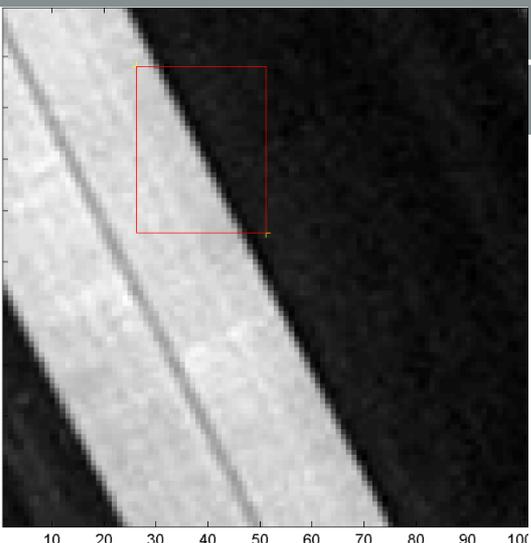
Edge Detection in Each Line - Across



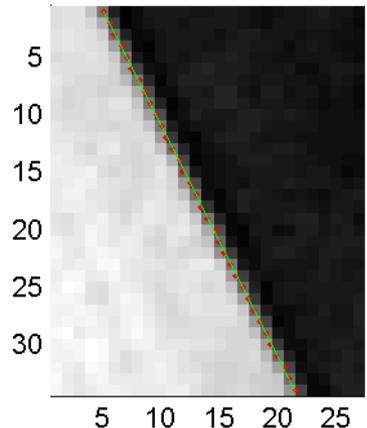
Edge Detection in Each Line - Across



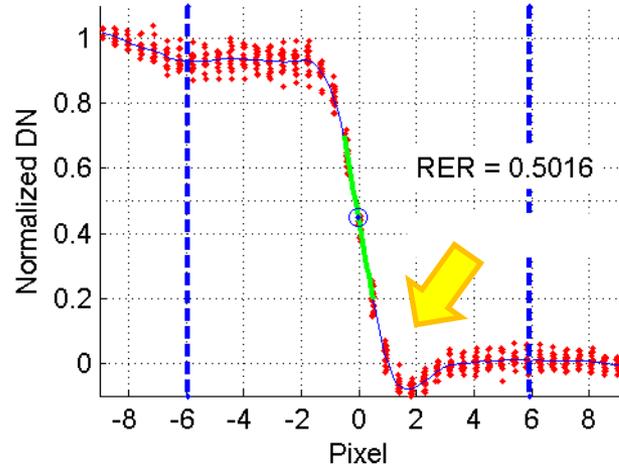
# Ringling (PHR1B, PAN)



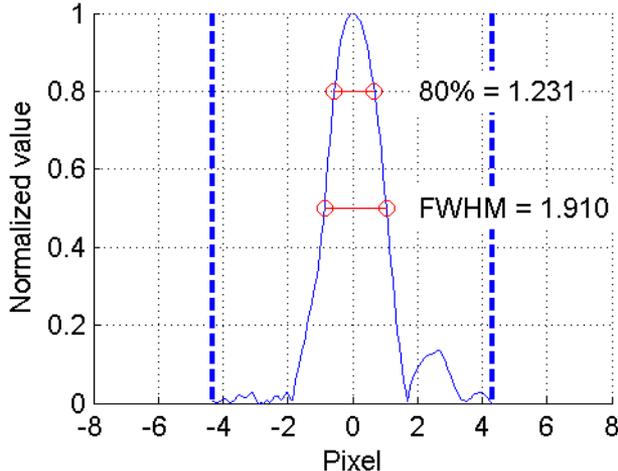
Edge Detection in Each Line (Across)



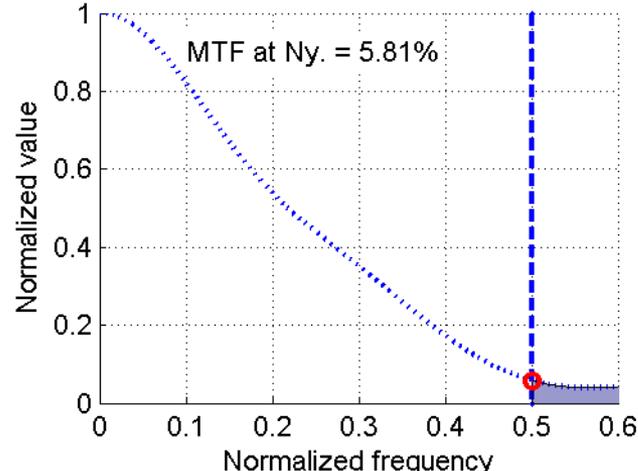
Edge Spread Function (weight = 0.98)



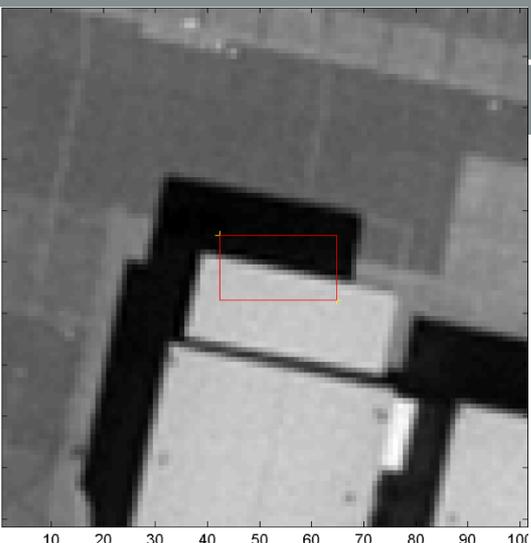
Line Spread Function (Resolution x 0.05)



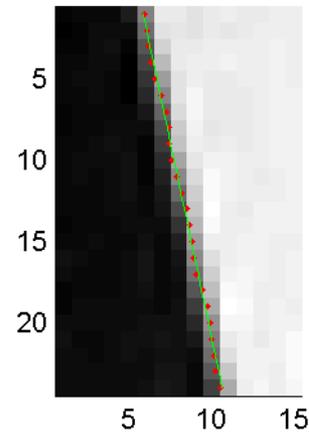
MTF



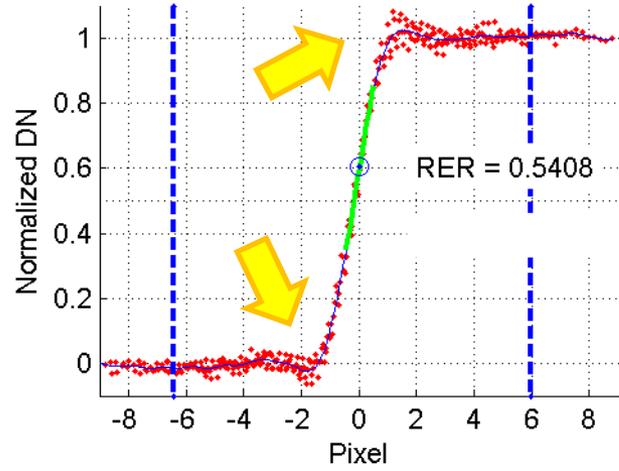
# Ringing (PHR1B, PAN)



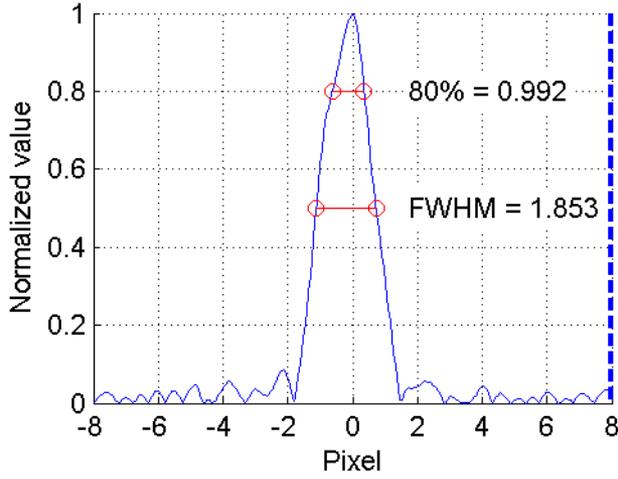
Edge Detection in Each Line (Along)



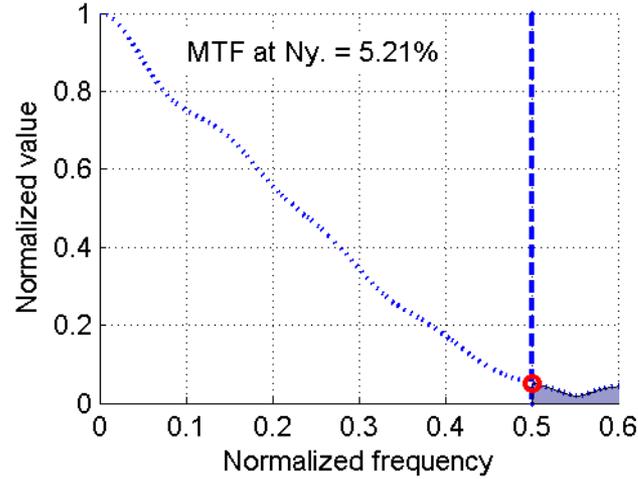
Edge Spread Function (weight = 0.98)



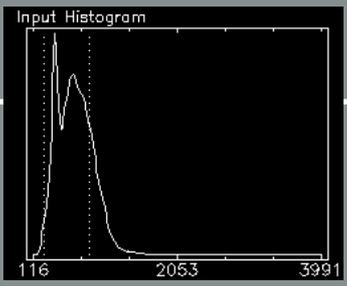
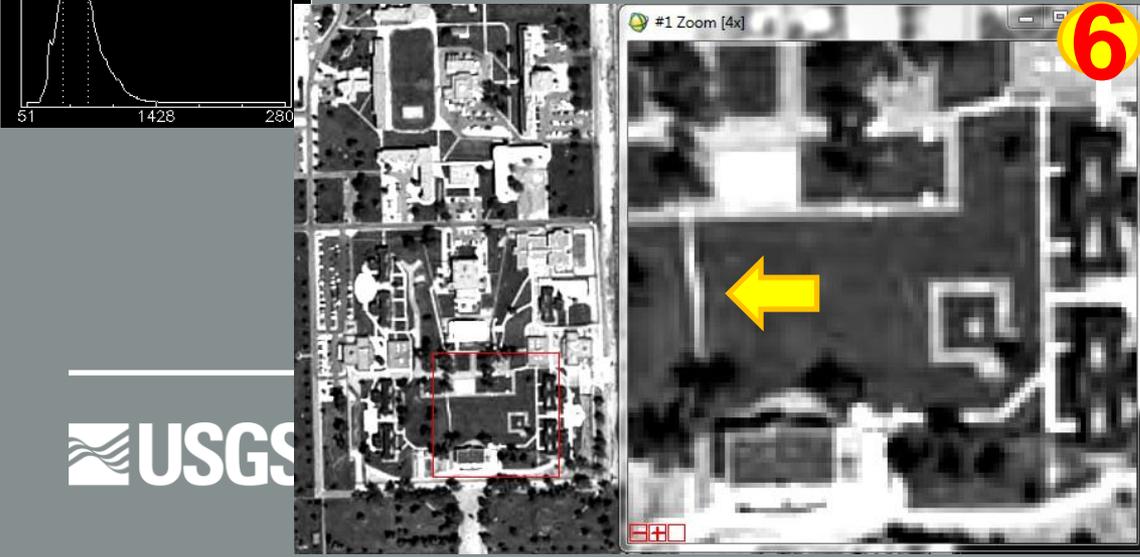
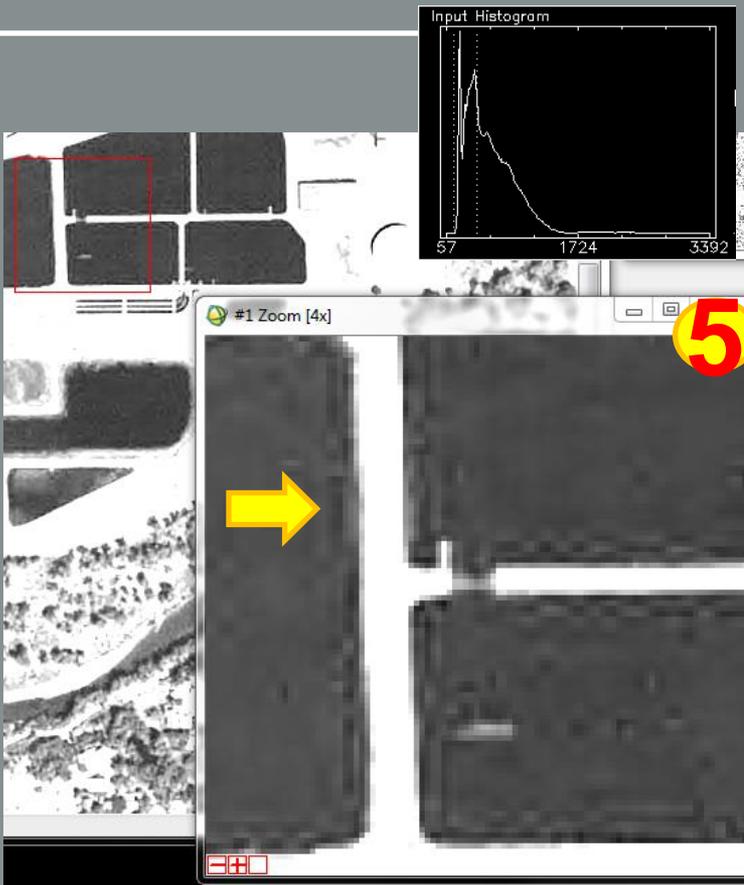
Line Spread Function (Resolution x 0.05)



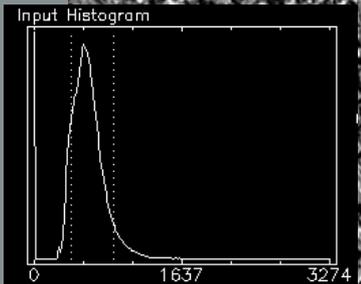
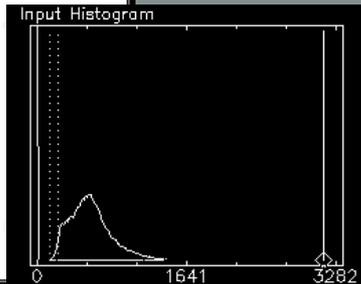
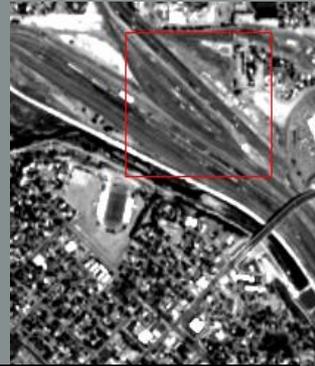
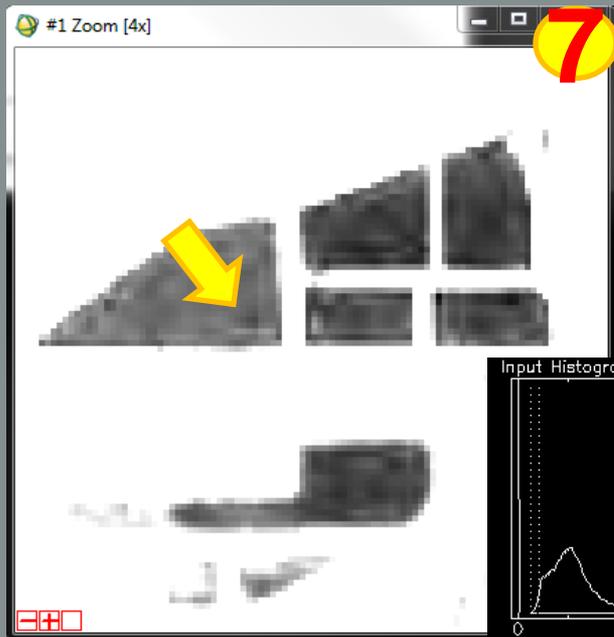
MTF



# Compression noise (artifacts)- PAN



# Compression noise (artifacts)- MS



# Compression noise (artifacts)

- The compression noise may have a side effect on the image data;
  - ✓ (Smoothing) a shape of water seething
  - ✓ (Changing) A small object (1~3 pixels) with low DN value on the image data may be determined to a noise,
    - and then smoothed
  - ✓ (Changing) There is possibility that the edge (boundary) may be changed(smoothed); shape & location.
- More Research required



# Summary

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- **Pleiades 1-B and SPOT 6 Characterizations performed**
  - Following on from Pleiades 1-A in 2013
- **Future Analysis:**
  - Continued data assessments for Medium resolution datasets ..
  - Elevation data characterizations
    - Working on Pleiades Stereo pair data
    - Working on World DEM- More about that later in JACIE 2014
  - More data are welcome
  - More collaborations welcome