

OrbView-3 Radiometric Calibration

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Objectives

- Review the OrbView-3 radiometric calibration approach
- Characterize relative radiometric performance
- Characterize Signal-to-Noise Ratio

OV-3 Orbit Characteristics



Launch Date	June 26, 2003
Orbit Type	Sun Synchronous
Inclination Angle	97.25°
Altitude	470 km
Descending Node	10:30 am
Revisit Period	3 Days (50° FOR)

OV-3 Sensor Characteristics

Imaging Mode	Panchromatic	Multispectral
Ground Sample Distance (Nadir)	1 m	4 m
Spectral Bandwidth	450 – 900 nm	450 – 520 nm
		520 – 600 nm
		625 – 695 nm
		760 – 900 nm
Imaging Array Width	8032 detectors	4 x 2008 detectors
Swath Width (Nadir)	8 km	
Pixel Quantization	11 bits per pixel per channel	
Compressed Bit Rate (Downlink)	2 bits per pixel per channel	

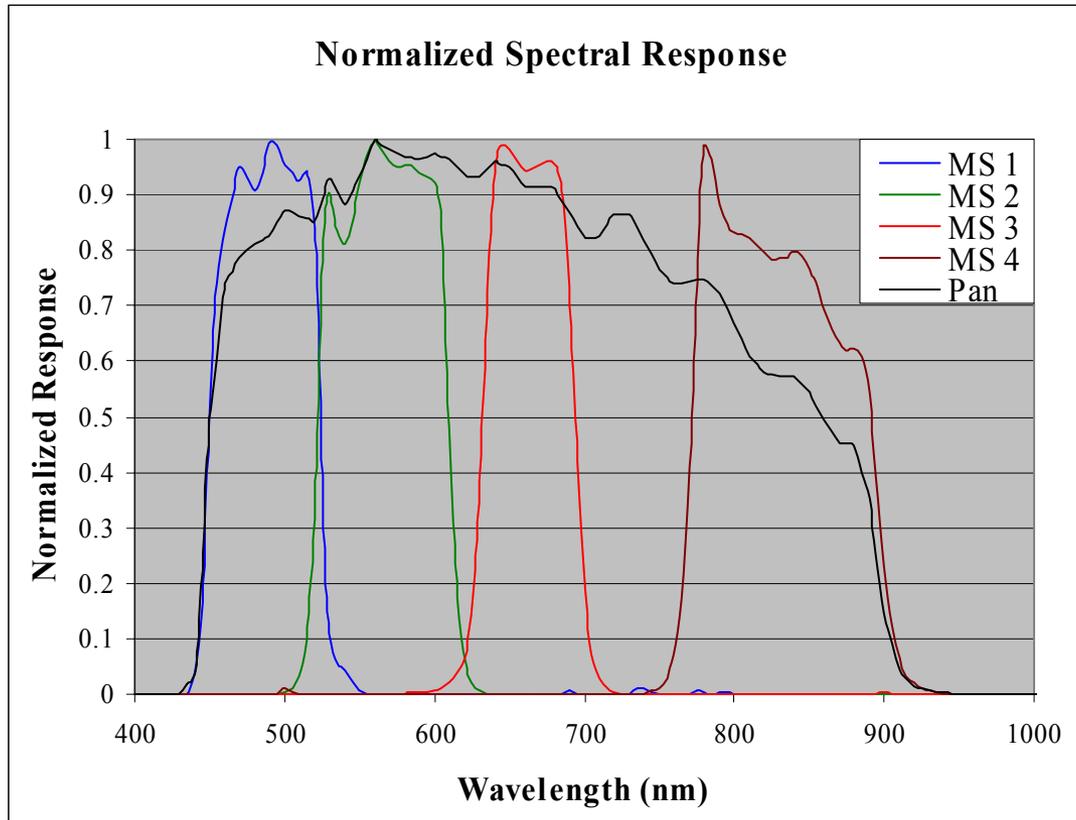
OV-3 Focal Plane

- Panchromatic detectors
 - Detector size: $6\mu\text{m}$ C/S x $5.4\mu\text{m}$ A/S
 - Co-linear array
 - Even/odd detectors offset by $24\mu\text{m}$
 - Line rates: 5000, 2500, 1000, 500 lps
 - Integration fraction: Full, 1/2, 1/4, 1/8

OV-3 Focal Plane

- Multispectral detectors
 - Detector size: $24\mu\text{m}$ C/S x $22\mu\text{m}$ A/S
 - Single linear array for each band
 - Bands offset by $560\mu\text{m}$
 - Line rate: 2500 lps
 - Integration fraction: Full

Spectral Response



Radiometric Calibration

- Absolute calibration
 - Convert DN to $\text{mW}/(\text{cm}^2\text{-str-}\mu\text{m})$
 - Based on laboratory measurements
 - 3000K integrating sphere
 - NIST-traceable
 - Conversion factor to solar radiance (5900K)
based on spectral response function of each band

Radiometric Calibration

- Relative calibration
 - Reduce pixel-to-pixel variation
 - On-orbit measurement
 - Dark current measured with camera door closed
 - Light calibration image obtained from solar diffuser

Radiometric Correction

- Second-order fit to detector response for calibration coefficients
 - Absolute component based upon laboratory measurements
 - Relative component based upon on-orbit measurements
 - Second-order fit improves relative performance
- Verification
 - Absolute: Vicarious calibration
 - NASA/Stennis independent assessment
 - Relative: Streaking / Banding metrics

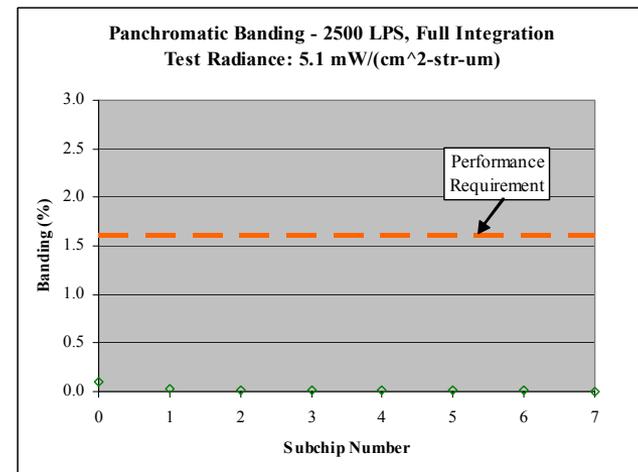
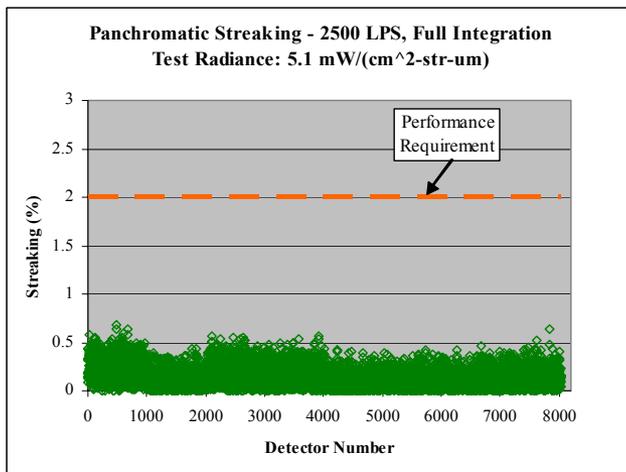
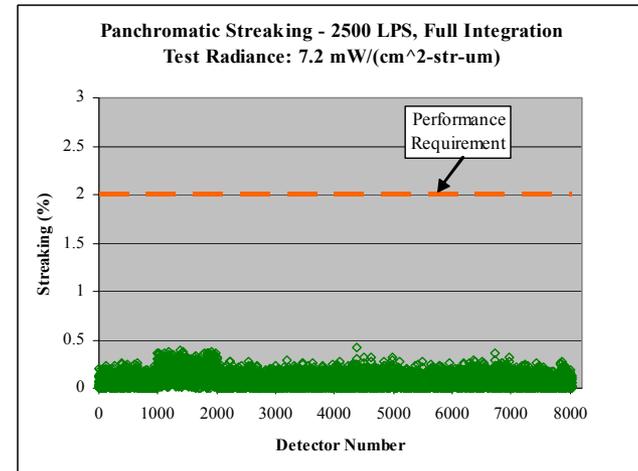
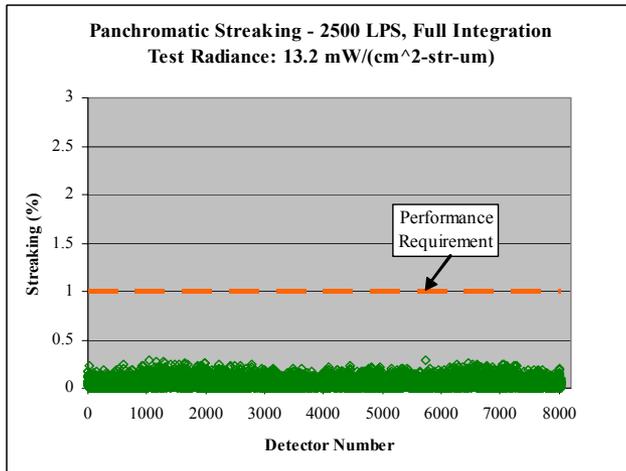
Streaking and Banding

- Relative radiometric assessment
- Flat field from solar diffuser
- Streaking
 - % diff. between a pixel response and the average response of adjacent pixels
- Banding
 - % diff. between a group of pixels (serviced by same amplifier) and the average response of adjacent groups

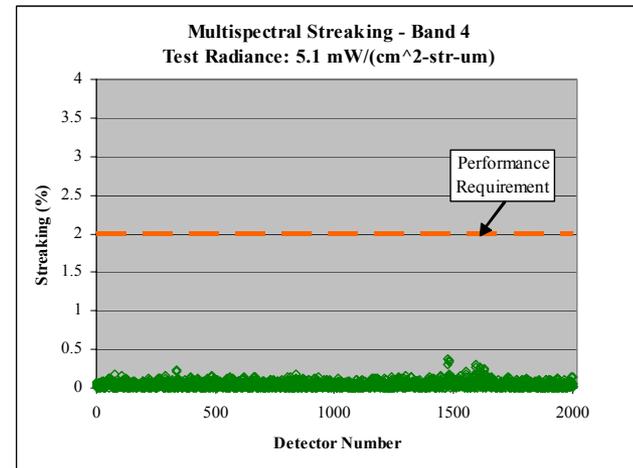
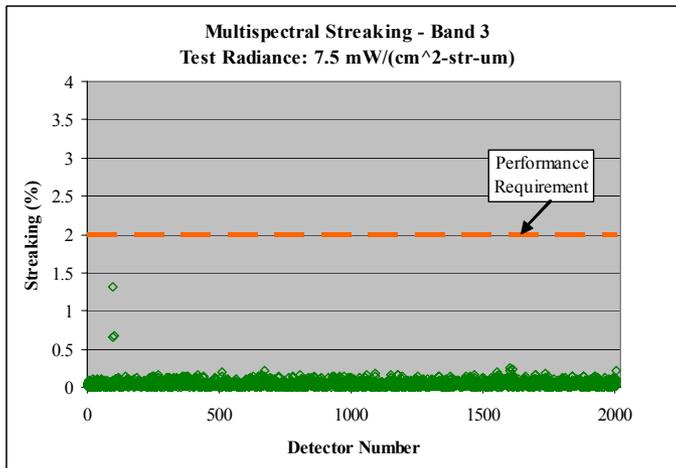
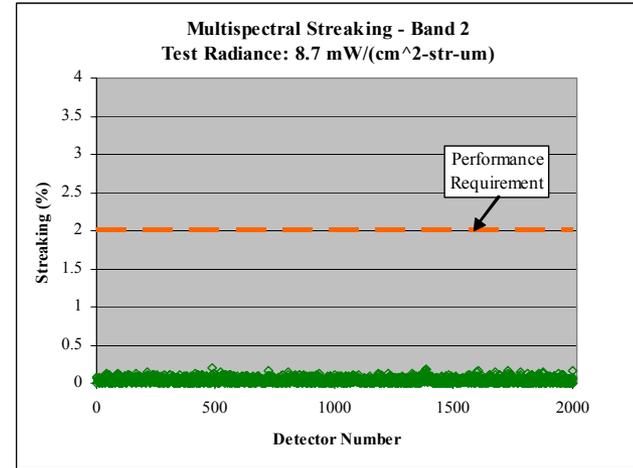
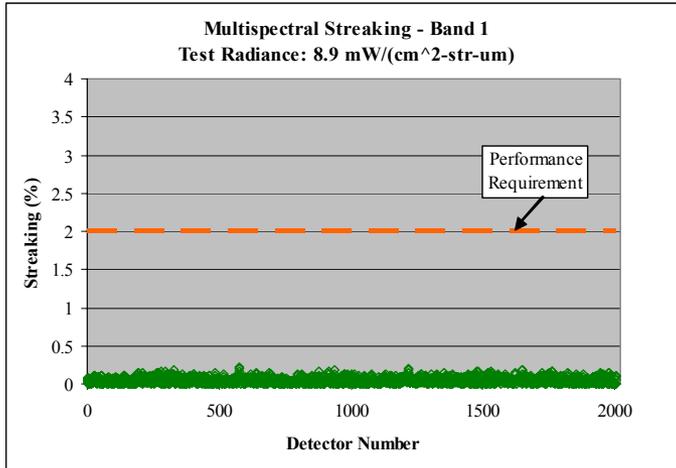
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Panchromatic Streaking and Banding (2500 lps / full int.)



Multispectral Streaking



Multispectral Banding

MS Band	Test Radiance mW/(cm ² -str-μm)	Performance Requirement (%)	Banding (%)
1	8.9	0.80	0.05
2	8.7	0.80	0.08
3	7.5	0.80	0.07
4	5.1	0.80	0.08

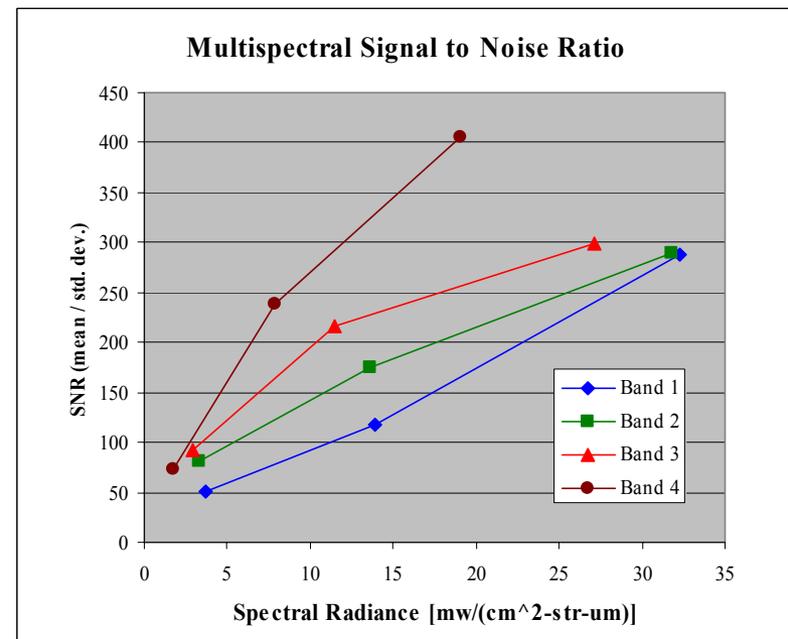
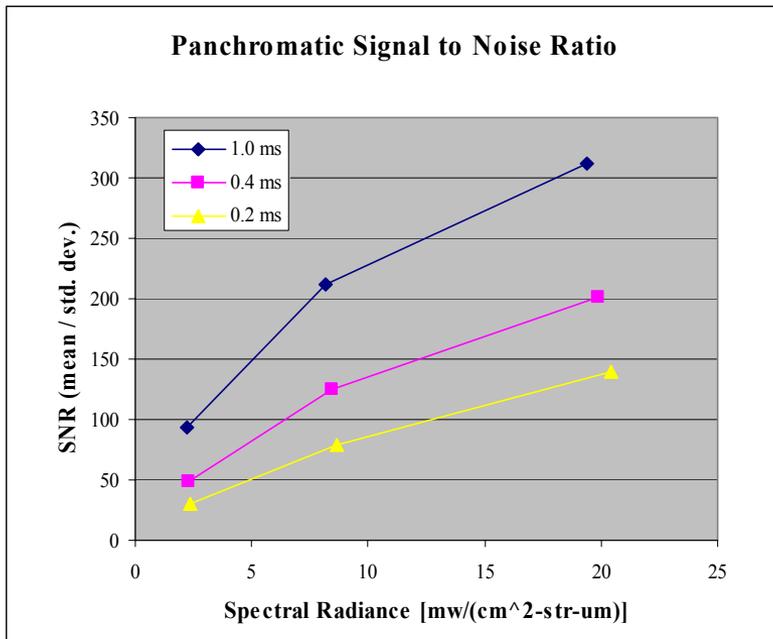
- Streaking and banding pass Pan and MS performance requirements

Signal-to-Noise Ratio (SNR)

- 200 x 200 pixel sections of flat field images from solar diffuser
- 3 input radiance levels
- 3 panchromatic modes, 1 MS mode
- For this analysis

$$\text{SNR} = \text{mean}[\text{pixels}] / \text{std. dev.}[\text{pixels}]$$

Signal-to-Noise Ratio



Conclusions

- OrbView-3 is characterized for relative radiometric quality and signal to noise
- Periodic monitoring and reporting of results will continue throughout the program