Spectral Calibration of the EO-1 Advanced Land Imager*

Jeffrey A. Mendenhall

Advanced Space Systems and Concepts Group

MIT/Lincoln Laboratory

*This work was sponsored by NASA/Goddard Space Flight Center under U.S. Air Force Contract number F19628-00-C-0002. Opinions, interpretations, conclusions, and recommendations are those of the authors and are not necessarily endorsed by the United States Government.

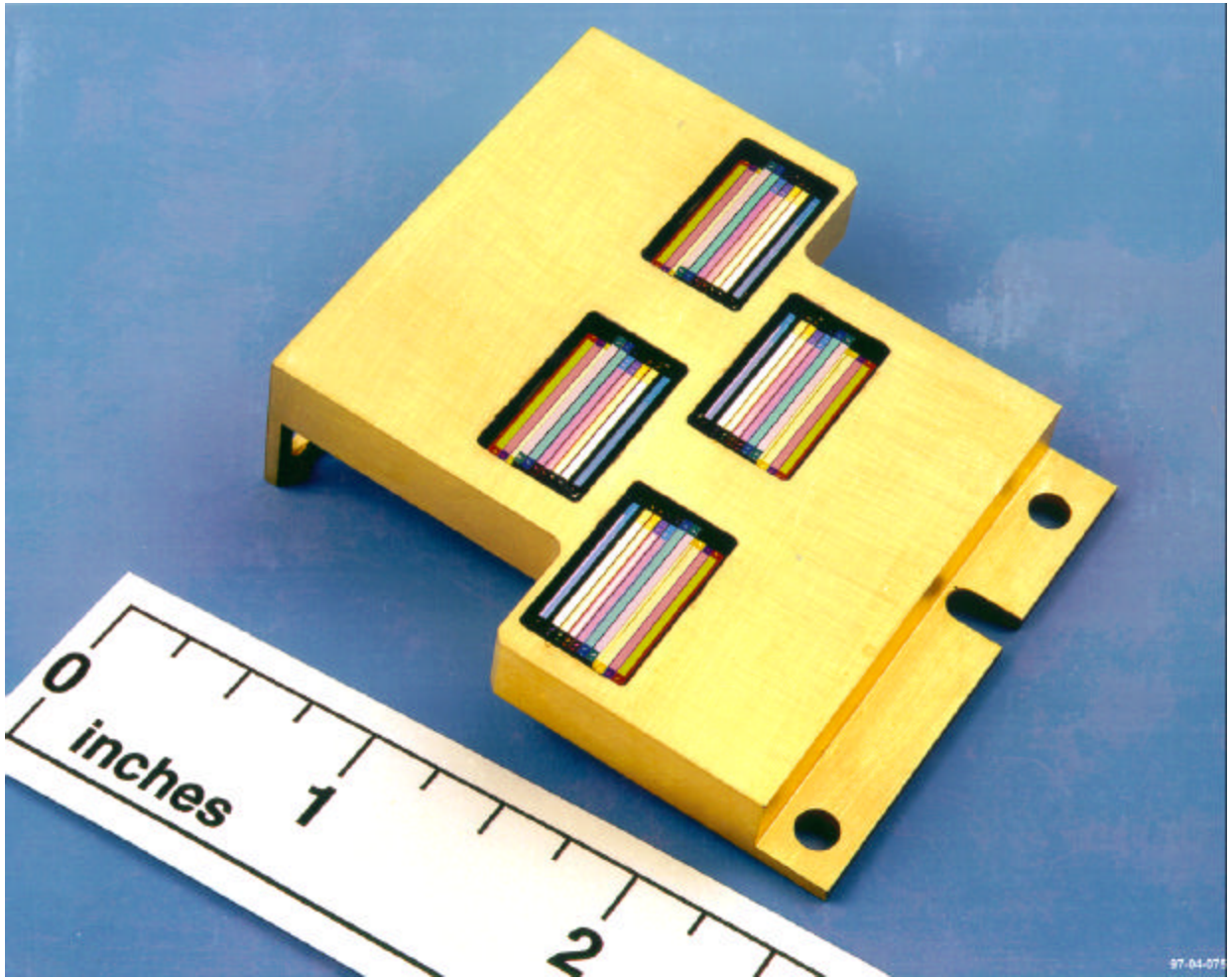
Outline

- Introduction
- Collimator
- Technique
- Results
- Summary

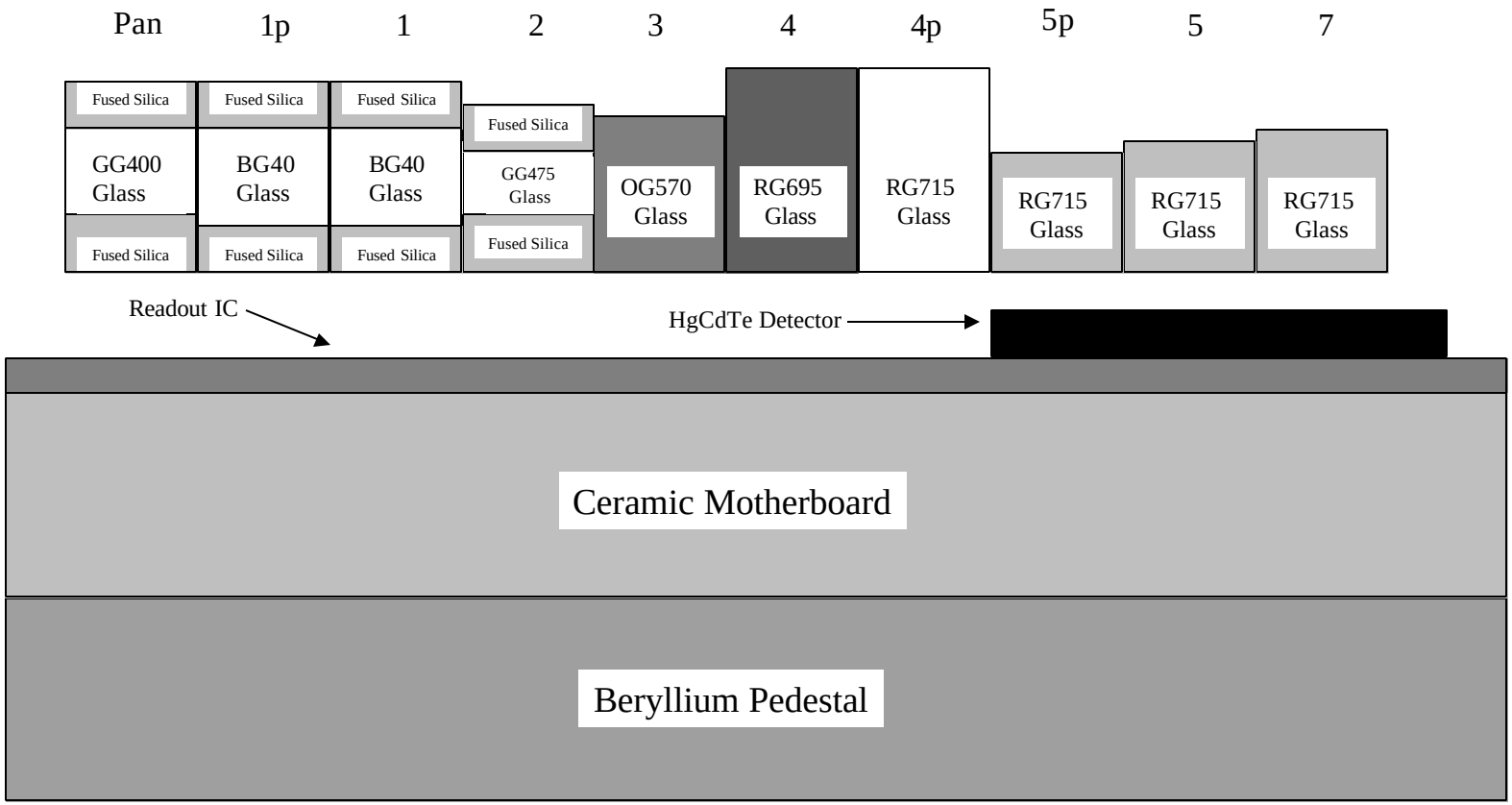
EO-1 ALI MS/PAN
Spectral and Spatial Coverage

Band	Wavelength(mm)	Detector Type	GSD (m)	# of Detectors
Pan	0.480-0.690	Si Photodiode	10	3840
MS-1’	0.433-0.453	Si Photodiode	30	1280
MS-1	0.450-0.515			
MS-2	0.525-0.605			
MS-3	0.630-0.690			
MS-4	0.775-0.805			
MS-4’	0.845-0.890			
MS-5’	1.200-1.300	PV HgCdTe	30	1280
MS-5	1.550-1.750			
MS-7	2.080-2.350			

MS/PAN Flight Module



Spectral Filters



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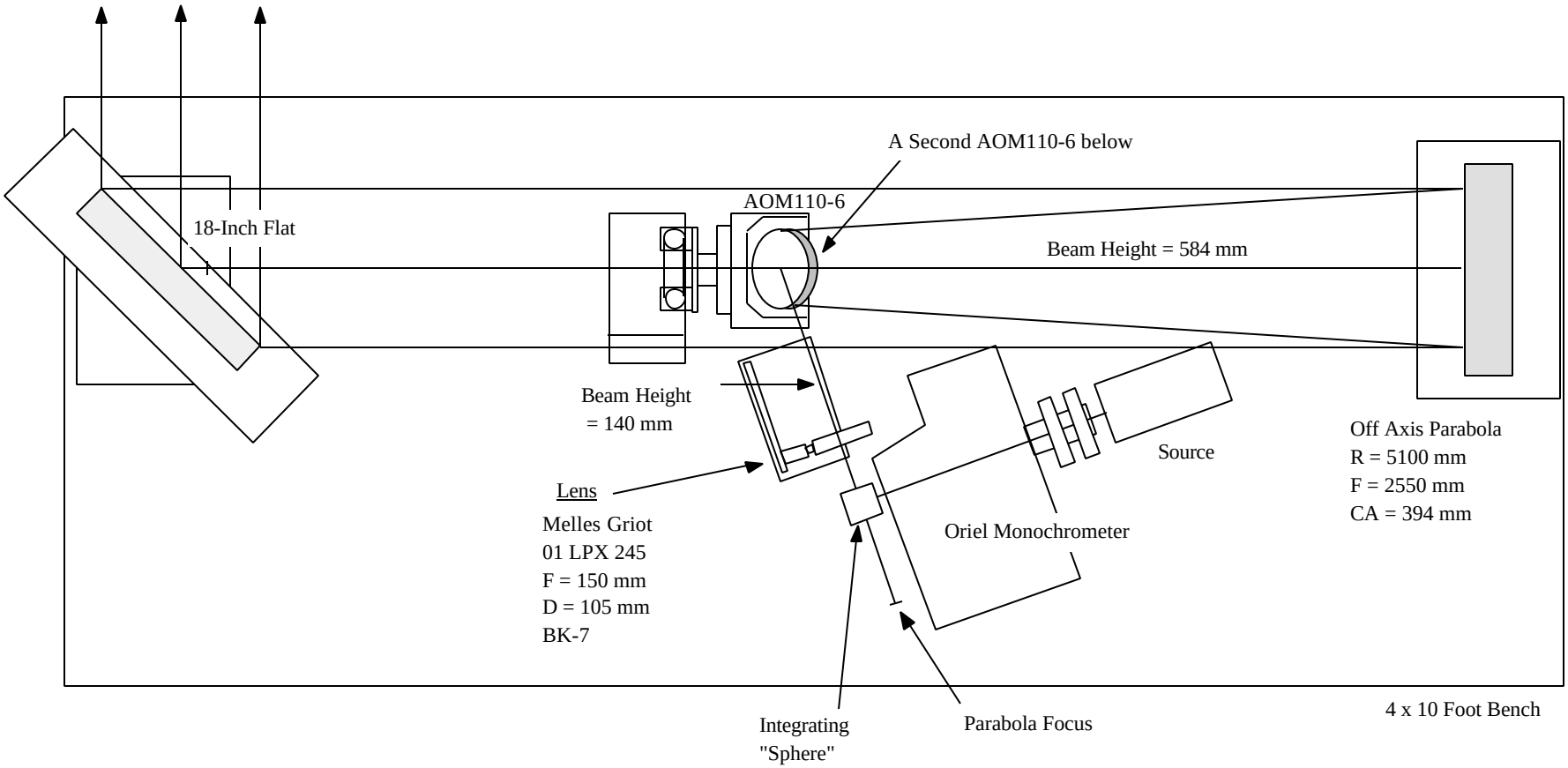
Spectral Collimator

- **Source**
  - Quartz tungsten halogen lamp
  - Oriel MS257 monochromator
  - 2” diameter (id) integrating sphere
    - 0.5” diameter exit port
- **Collimating Optics(0.5^{o} field)**
  - 6” diameter Condensing lens
  - 17” diameter, 100” focal length off-axis parabola
  - 20” diameter turning flat
- **Careful baffling to ensure proper stray light rejection**

Spectral Collimator



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Spectral Calibration Technique

- **Measure spectral response of multispectral and panchromatic detectors from 0.4-2.5 mm**

- **Technique**
  - **Flood focal plane with 2 nm FWHM beam sequentially from 350 to 1000 nm in 2 nm intervals for VNIR**
  - **Flood focal plane with 4 nm FWHM beam sequentially from 1000 to 2500 nm in 4 nm intervals for SWIR**
  - **Record response of focal plane at each interval**
  - **Record response of spectrally calibrated silicon and lead sulfide detectors to monitor flux and stability of beam**

Spectral Calibration Analysis

- **A pixel's spectral response is derived by normalizing its response as a function of wavelength to account for various artifacts**
  - **Dark current**
  - **Vacuum tank window transmission**
  - **Beam flux**

$$S_P(b, l) = \frac{R_P(dn, l)\, R_d(l)}{T_W(l) F(l)}.$$

- **$S_P(b, l)$ is the derived spectral response for pixel P as a function of band b and wavelength l**
- **$R_P(dn, l)$ is the ALI dark subtracted focal plane response for pixel P as a function of wavelength**
- **$R_d(l)$ is the spectral responsivity of the reference detector used to monitor the beam**
- **$T_W(l)$ is the spectral transmission of the vacuum tank window**
- **$F(l)$ is the measured flux of the beam as a function of wavelength**

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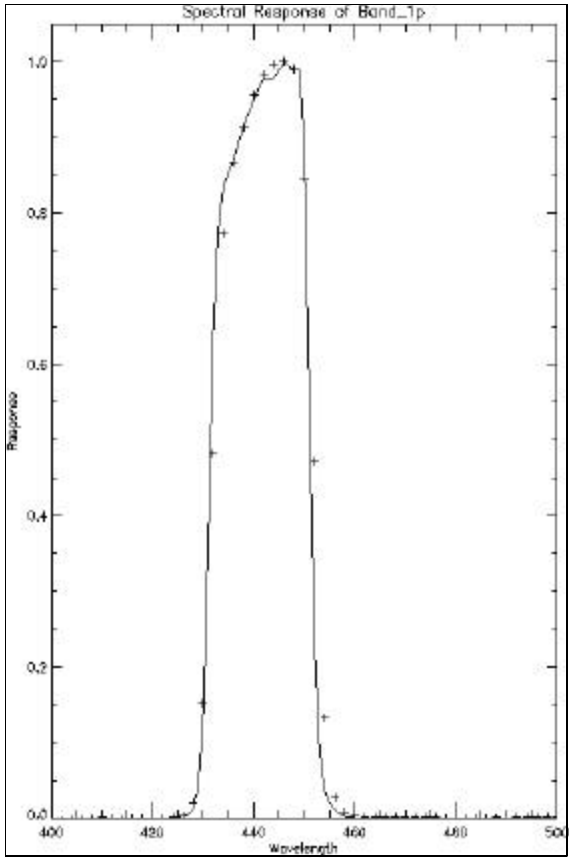
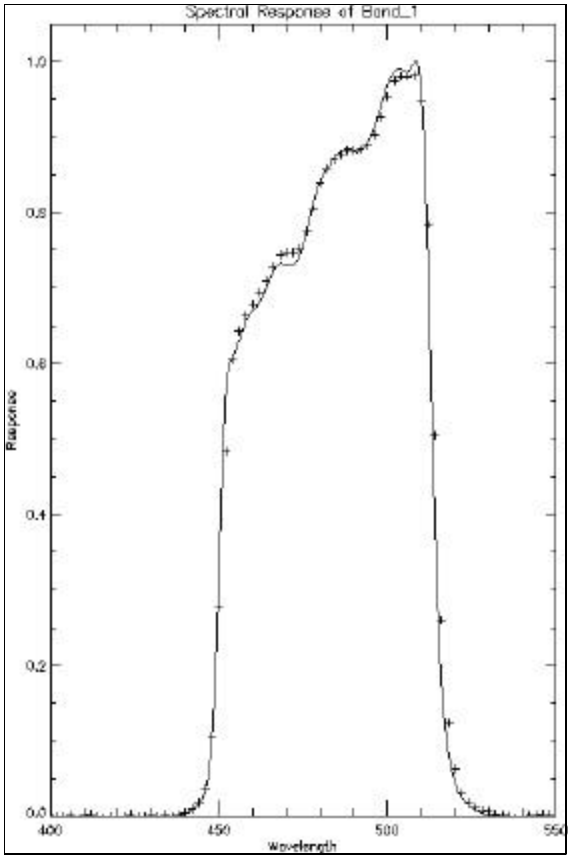
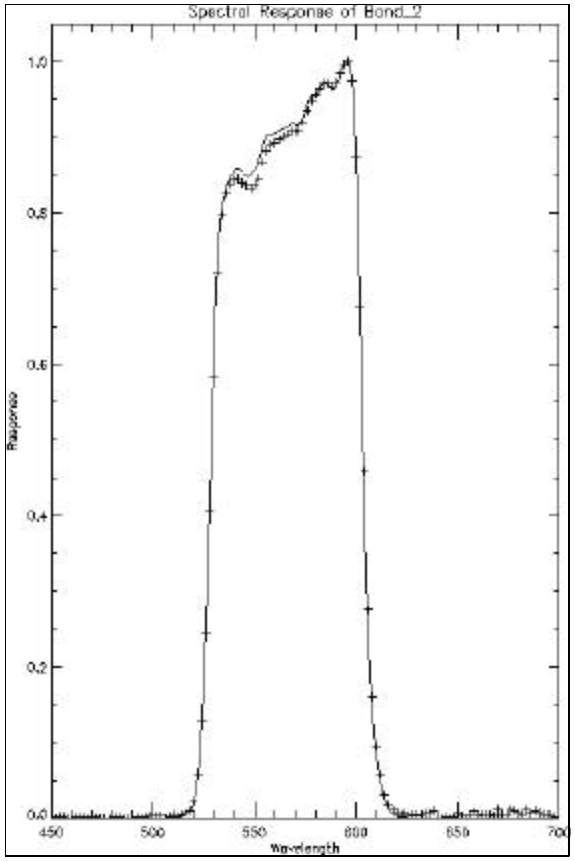
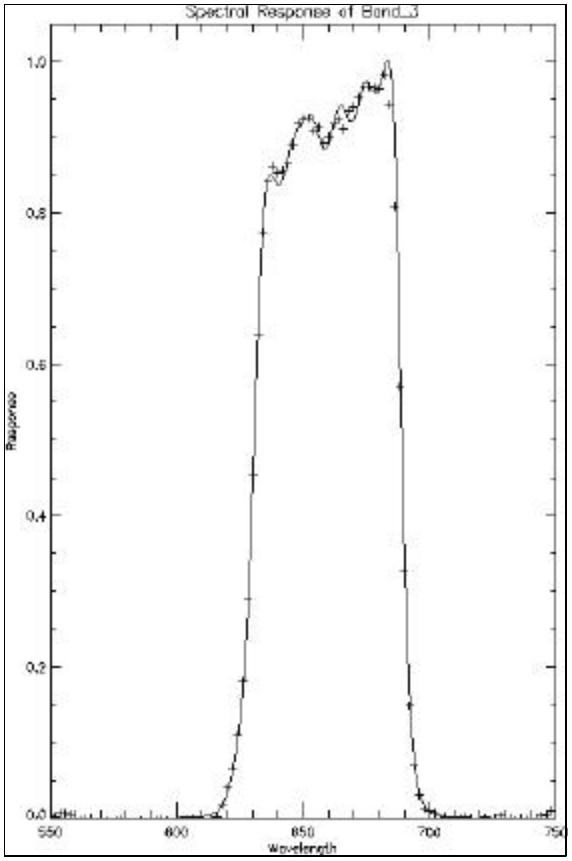
Spectral Calibration Results: Band 1p and 1



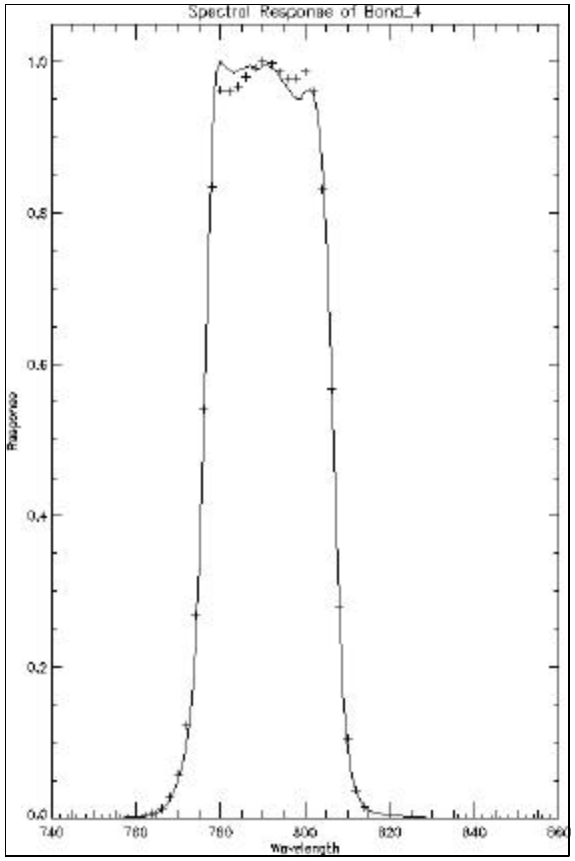


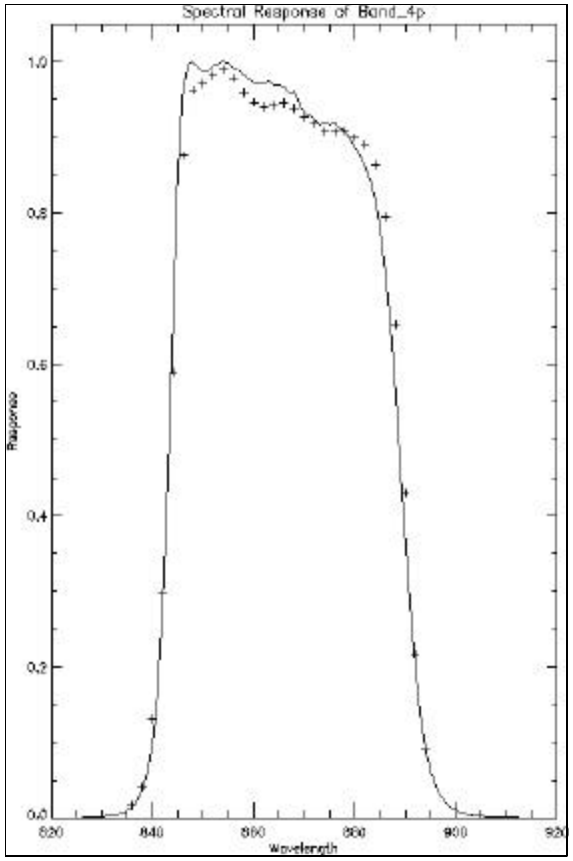
Spectral Calibration Results: Bands 2 and 3



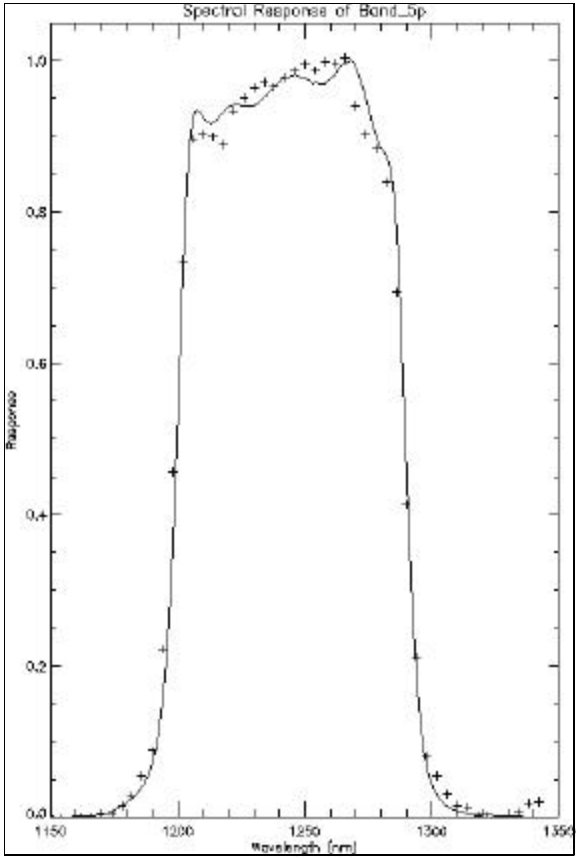


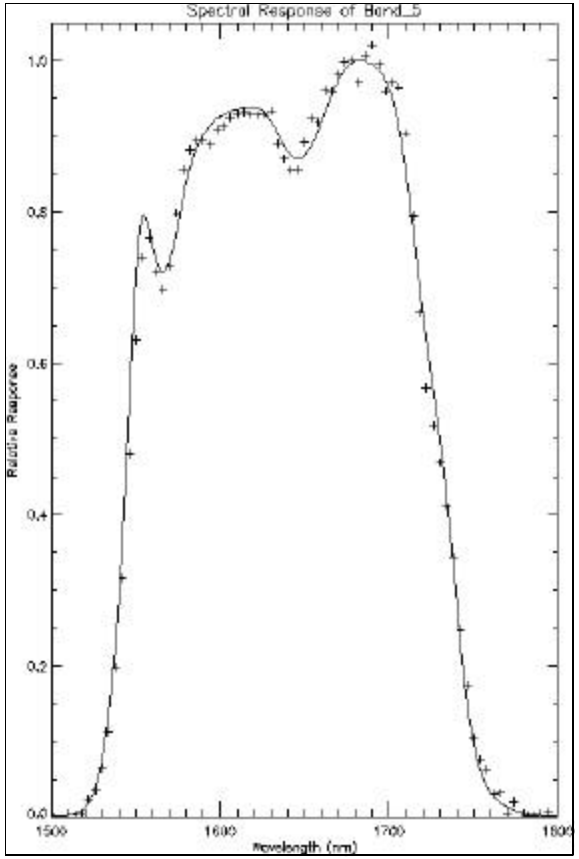
Spectral Calibration Results: Bands 4 and 4p

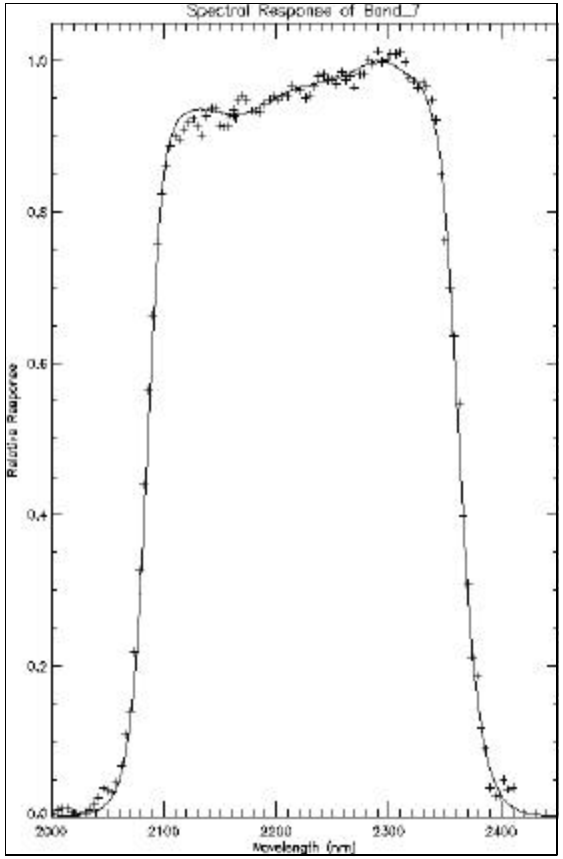




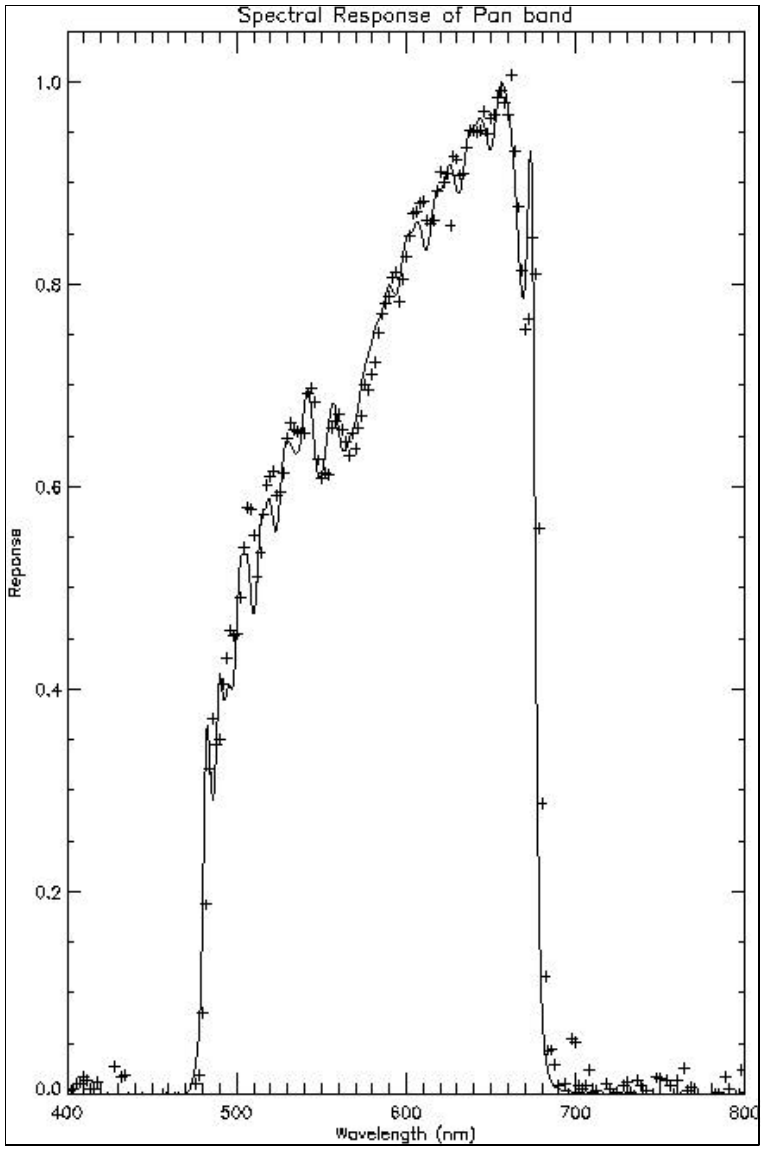
Spectral Calibration Results: Bands 5p, 5 , and 7



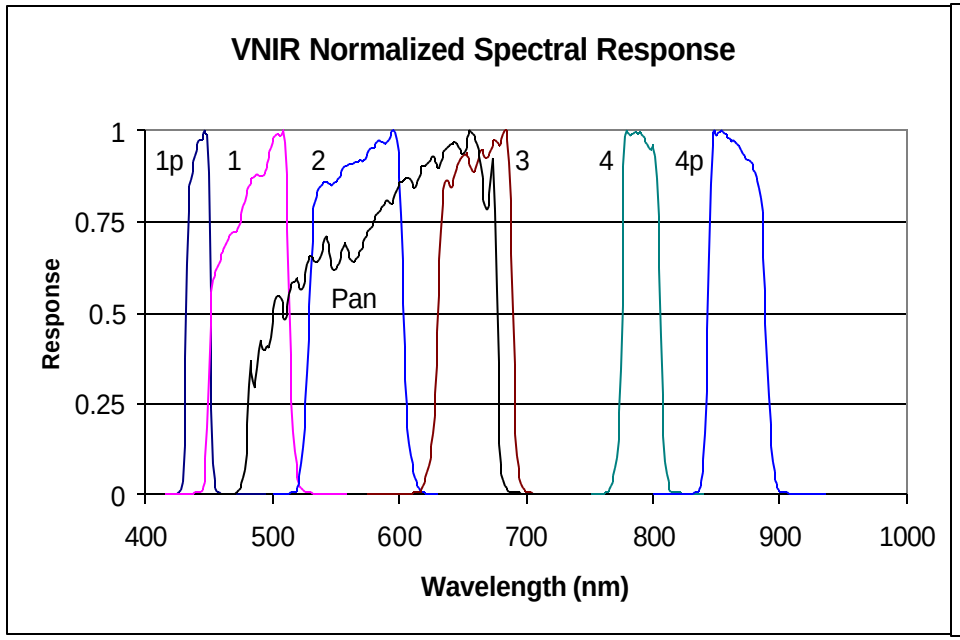


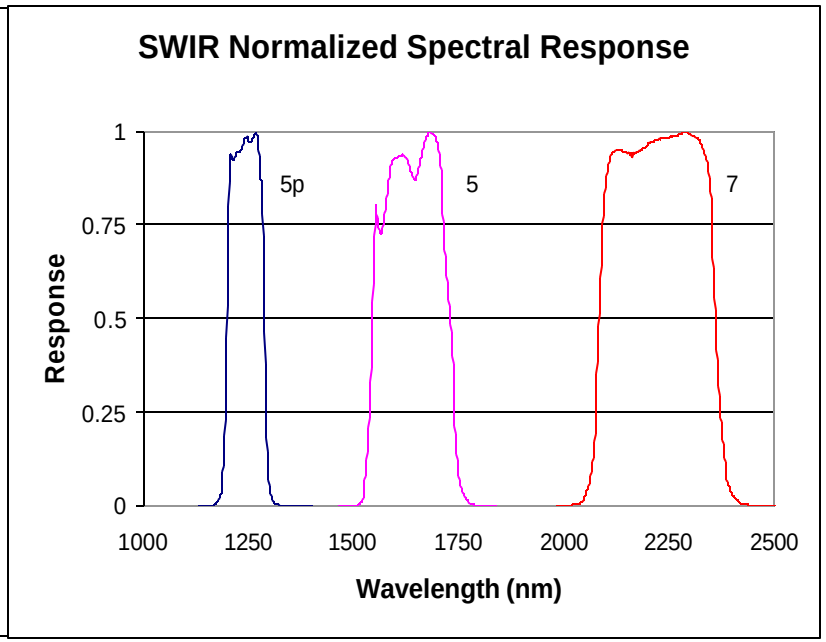


Spectral Calibration Results: Panchromatic Band



ALI Spectral Response Functions





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Summary

- We find excellent morphological agreement between system and subsystem level spectral calibration measurements.
- Based on system level measurements, the finer subsystem level calculations were adopted for the flight spectral response functions of the ALI.
- Characterization of a fully populated array would require substantial commitment at the system level and may be more appropriate at the subsystem level.