

ECOsysteM Spaceborne Thermal Radiometer Experiment on Space Station



ECOSTRESS Instrument Performance

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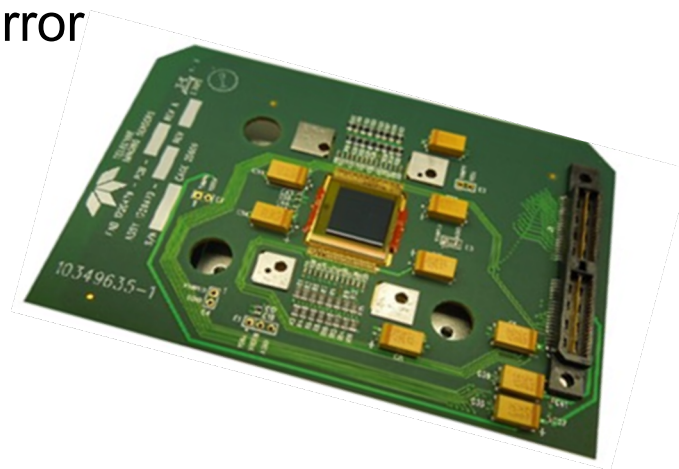
Topics:

- Overview
- Enabling Technologies
- Calibration and Validation
- Performance



Key ECOSTRESS Enabling Technologies

- Black silicon blackbody targets
- Broadband spectral filters
- High efficiency cryocoolers
- High speed focal plane and readout electronics
- Precision encoding/controlled scan mirror



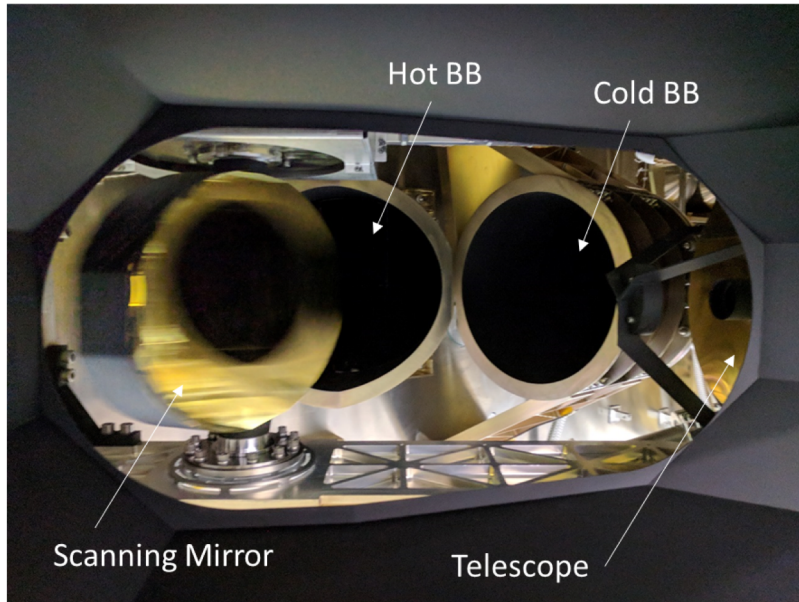


Pre-ship Radiometric Testing

ECOSTRESS Undergoing Full Functional Test

Flight-like dataset saved through DPU-IO and SDS

Baseline operation, FPA at 65K, Ambient laboratory environment (306-Hbay)

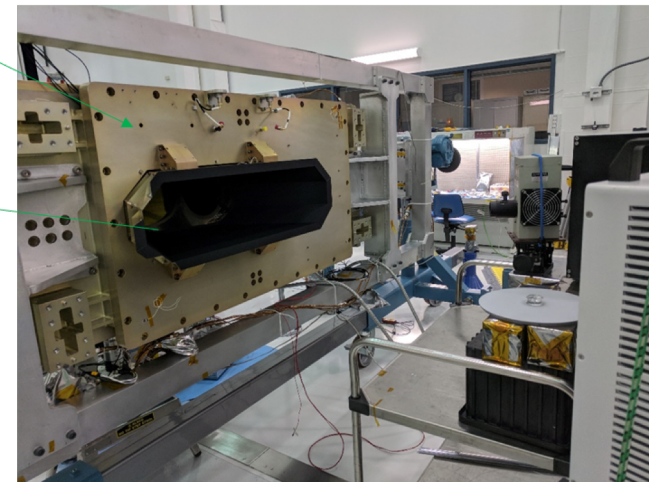
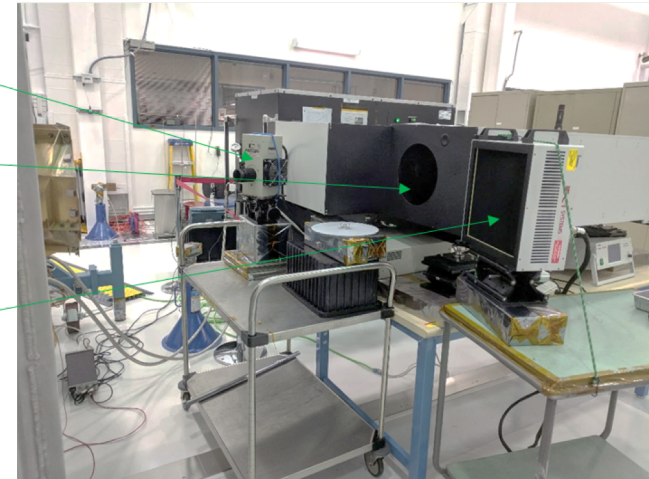


SWIR
Lamp

Target
Projector

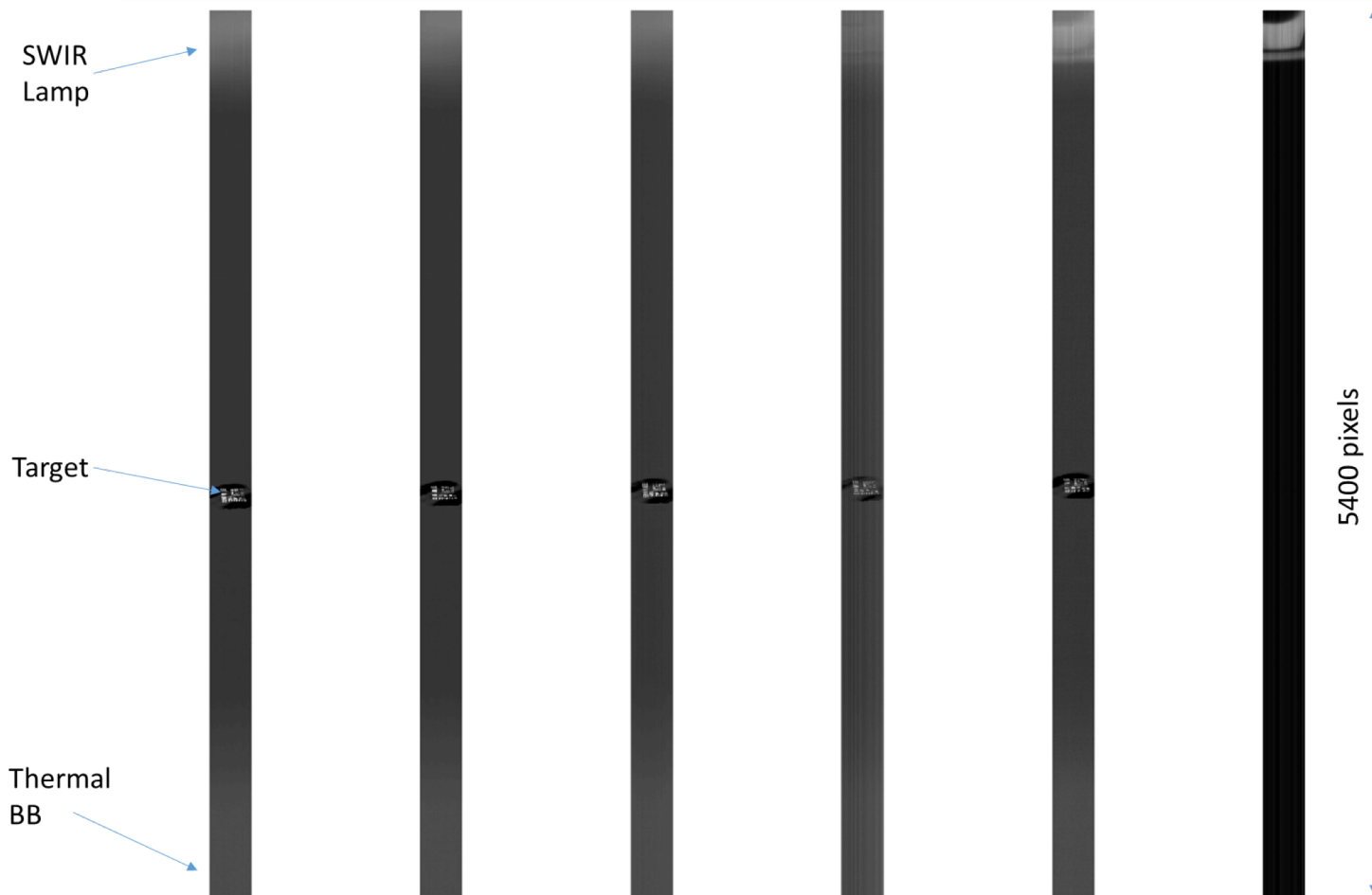
Variable
Temp
Blackbody

ECOSTRESS
Payload



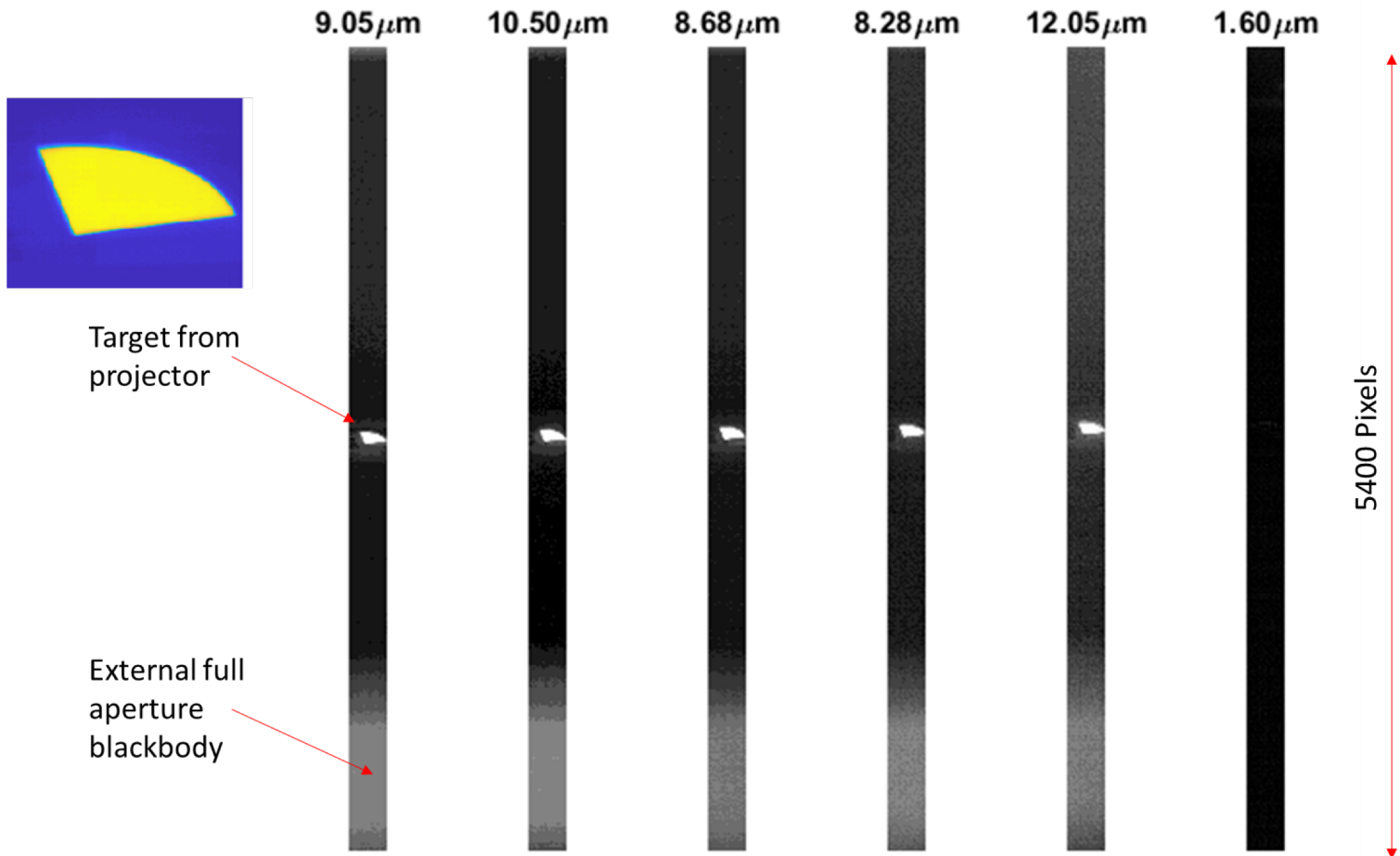


Pre-ship Radiometric Testing: Field of Regard



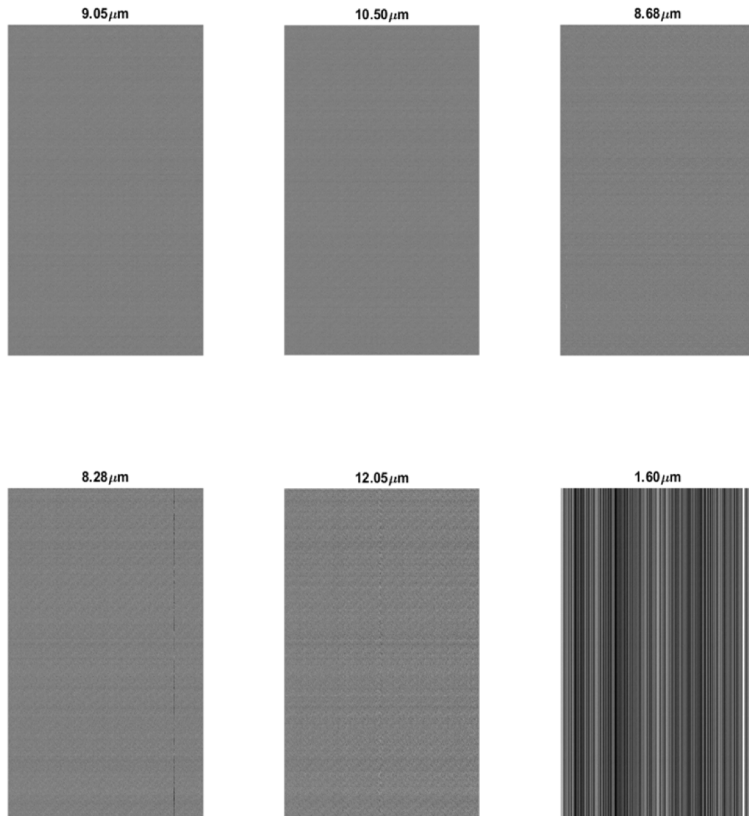


Pre-ship Radiometric Testing: Field of Regard

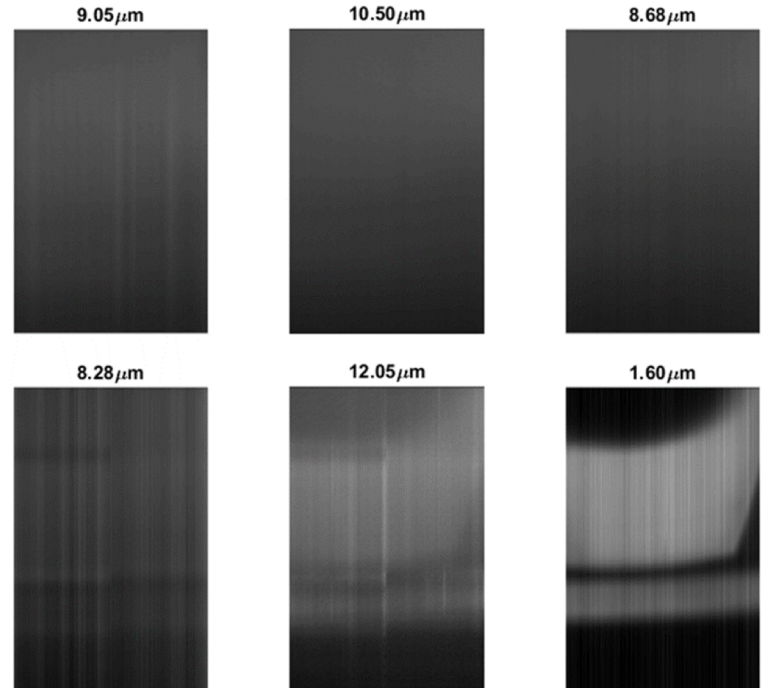




Flat Field and Shortwave Bulb



BB thermal source flat fields



SWIR source lamp on other edge of FOR



Spatial Performance

Spatial Performance

9.05 μ m

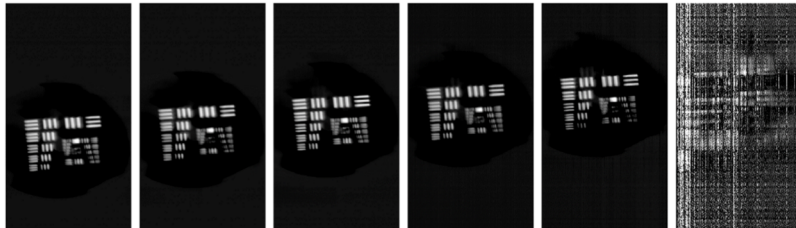
10.5 μ m

8.68 μ m

8.28 μ m

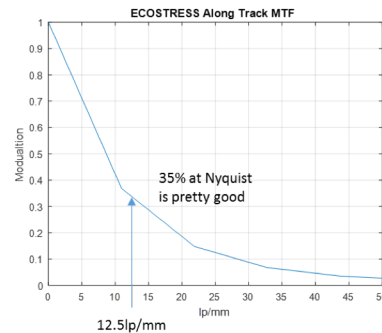
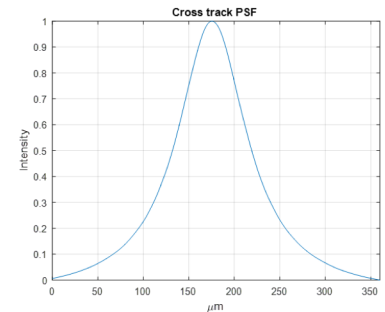
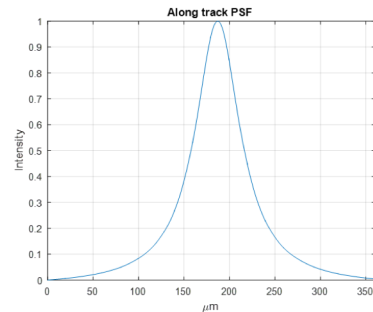
12 μ m

SWIR

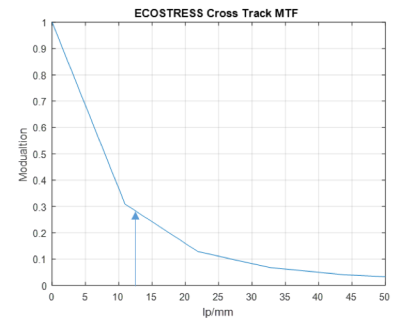


The Air Force bar chart has a range of spatial frequencies beyond the resolution of the ECOSTRESS Radiometer. Half of the target will have good focus while half (smaller features) will not.

No SWIR light used in this test (will start tracking it going forward)



64% at 6.25lp/mm
52% at 8.33lp/mm



60% at 6.25lp/mm
47.5% at 8.33lp/mm

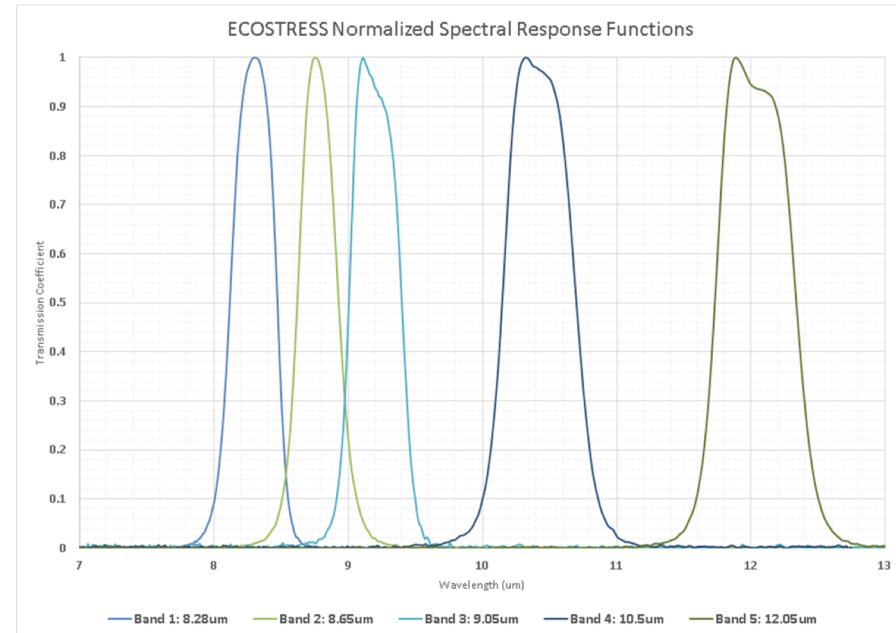


Spectral Performance

Dark current noise is approximately 200e-

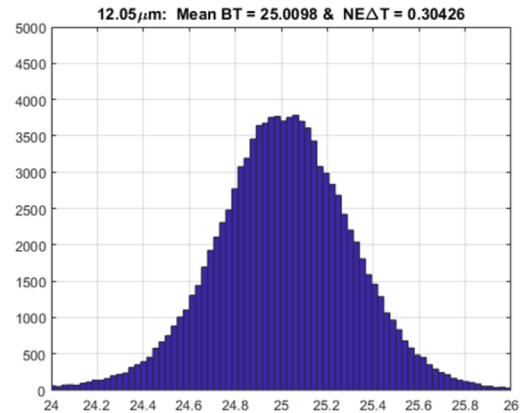
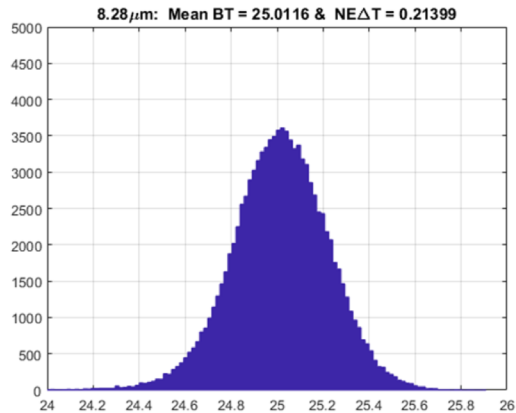
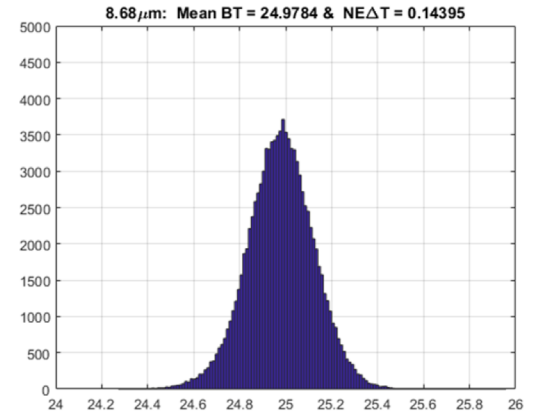
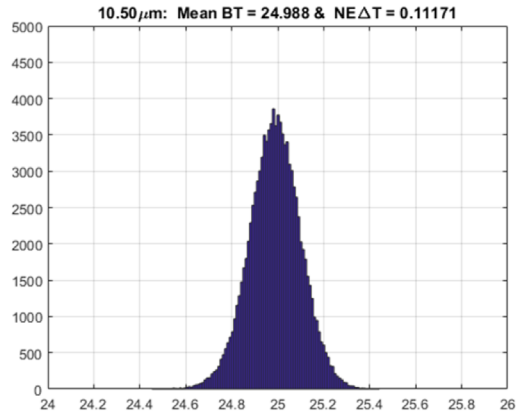
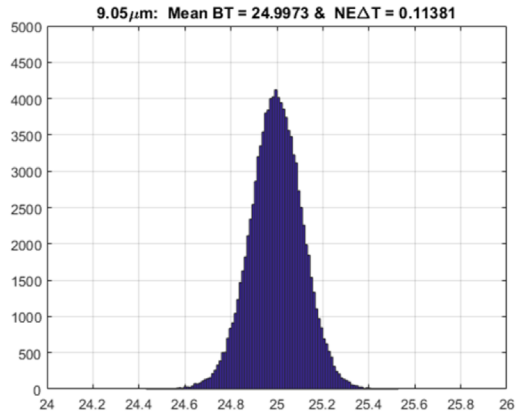
Read noise is approximately ~1000e-

Band	QE	Sat temp (C)
8.28	0.665	113.85
8.63	0.665	85.85
9.05	0.748	90.85
10.5	0.629	94.85
12	0.334	161.85



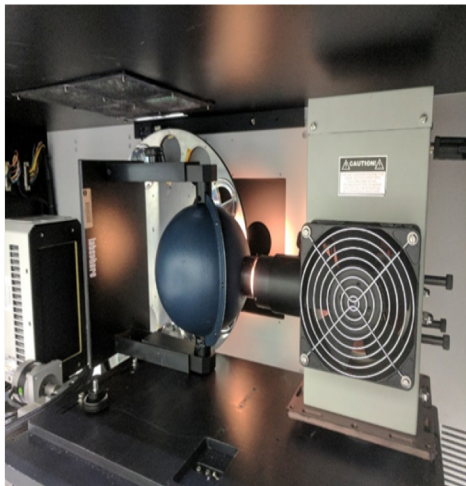


Radiometric Performance ($NE\Delta T$)





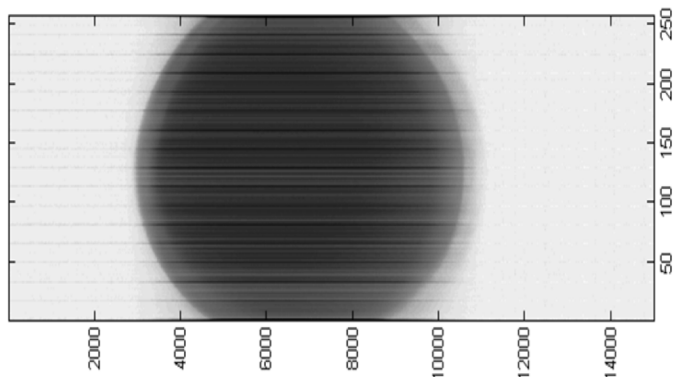
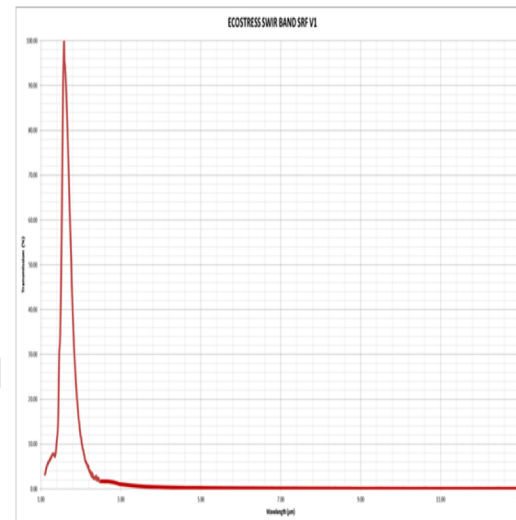
SWIR Channel for Geolocation



Integrating sphere at collimator input

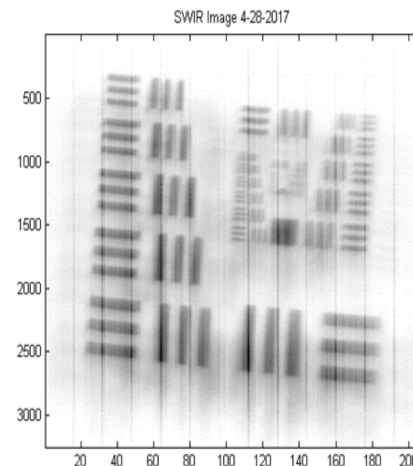
- 200W QTH source
- Target projector
- Inverted contrast

Filter totally blocks thermal signal while allowing SWIR to pass.



Unprocessed SWIR Band Flat field Scanning

Unprocessed SWIR Band
Illuminated Bar Chart

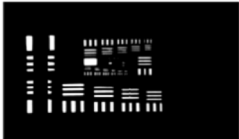




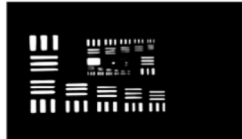
Stability

Collimator image of Air Force bar chart before and after RV/TVAC. No significant change detected.

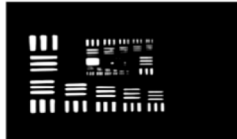
Before



8.28 μm



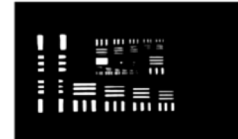
8.68 μm



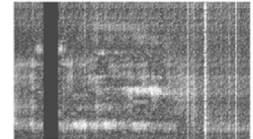
9.05 μm



10.50 μm

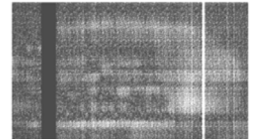
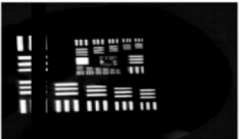


12.05 μm



1.60 μm

After





Forward: IOC

Radiometric Calibration

Radiometric Accuracy: Acquire one cloud-free, calibrated scene, preferably at nighttime, from either Lake Tahoe CA/NV or Salton Sea CA. Calculate at sensor brightness temperature using in-situ field measurements from validation points and compare with measured scene brightness temperature for same points.

Tahoe (~9 measurements in two weeks, over a ~10 hour local time spread)

Salton Sea (~7 measurements in two weeks, over a ~12 hour local time spread)

Radiometric Precision: Acquire one cloud-free, calibrated nighttime scene from any high altitude lake. Calculate the standard deviation of a block of pixels to determine an NE Δ T.

Geometric Calibration

Update the ECOSTRESS instrument camera model, using data from Global Landsat 7 dataset and ASTER California mosaic (~15 measurements in two weeks over California).

Compare retrieved pixel latitude/longitude (geolocation error < 50m) to Global Landsat 7 dataset and ASTER California mosaic. Mean and standard deviation represent geometric accuracy and precision.



Forward: IOC

Simulations using HyTES for NE Δ T

HyTES on the ER-2

Approximately 35m pixels (cross track)

Averaged bands to mimic ECOSTRESS bandwidth

Brightness NE Δ T measured

Sim Band 2: 0.1226C (8.28 μ m eq HyTES)

Sim Band 3: 0.1412C (8.79 μ m eq HyTES)

Sim Band 4: 0.1450C (9.05 μ m eq HyTES)

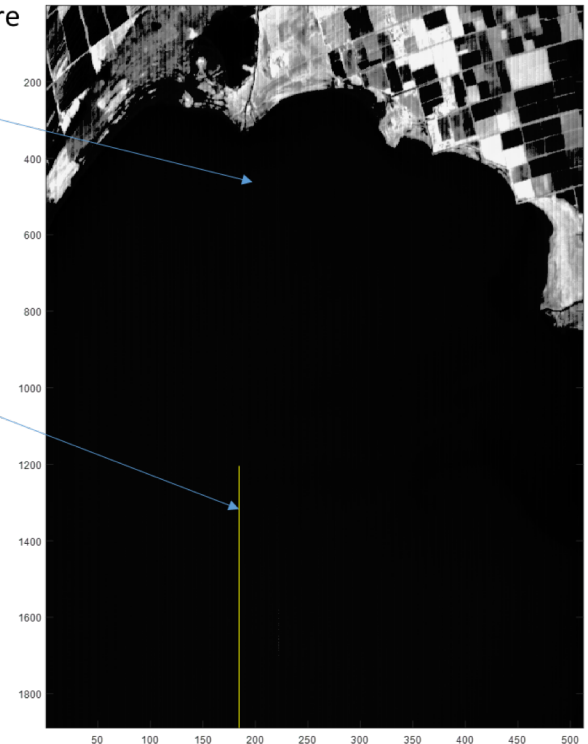
Sim Band 5: 0.1527C (10.5 μ m eq HyTES)

Sim Band 6: 0.3044C (12.05 μ m eq HyTES)

Measured NEDT measurements mimic very closely to the expected ECOSTRESS measurements after adjusting narrow HyTES bands to ECOSTRESS equivalent

Stay away from temperature variations on the coast

Standard deviation of 600 pixel length along track



Averaged BT HyTES Bands 62 to 83
8.79 μ m band