Landsat 9 calibration: New techniques for OLI-2 and TIRS-2

Joel McCorkel
NASA Goddard Space Flight Center
Instrument calibration changes

- **TIRS-2**
  - Class C to B
  - Optical design change (baffles)
  - Subsystem test for wider field characterization

- **OLI-2**
  - Spectral characterization methodology

27 July 2016
Landsat Science Team
TIRS-2 timeline

stray light highlights

• **Dec 2015** – Independent modeling effort begins
  – Reproduced features seen on-orbit with TIRS-1
  – Modeled mitigation baffle performance

• **May 2016** – Pre-PDR Engineering Peer Review for Scattered Light mitigation

• **June 2016** – PDR
  – Form review team for ambient and thermal vacuum stray light testing

• **Aug-Dec 2016** – Ambient testing w/ flight spare, flight telescope

• **June 2017** – Telescope-FPA subsystem testing for wide-field stray light characterization
  – ”TIPCE” test: TIRS Imaging Performace and Cryoshell Evaluation

• **2018** – Instrument level testing
TIRS-1 sneak paths 1of2 (13 deg)
Baffles for stray light reduction

L3 baffle
TIRS-1 sneak paths 2of2 (20 deg)
Baffles for stray light reduction

L2 baffle
Stray light modeling

GSFC & Independent (SDL) models agree

Conditions:
1) SCA-C Band 11 used in the analysis
   - 0.9 mm x 16 mm area used in the analysis
   - Results represent average detector pixel
   - $\tau_{\text{sys}} = 1$ for analysis
2) Source angle is referenced to boresight
3) Optical surface scatter models
   - Analysis wavelength 10.6 µm
   - Mirror/Lens: ~15.5Å surface roughness
   - Contamination: Level 300
4) Lens Cell: Black Anodize (sandblasted)
5) 40K, 80K, and telescope shields: Z307

Source Angles

$\varphi = -90^\circ$
$\theta = 1^\circ - 27^\circ$
TIRS-2 subsystem-level “TIPCE” testing

Instrument level

Telescope-FPA subsystem level

+26°
# TIRS-2 Schedule

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<tr>
<th>TIRS-2 Schedule Integration &amp; Test</th>
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27 July 2016  
Landsat Science Team
GLAMR for OLI-2
spectral characterization

Goddard Laser for Absolute Measurement of Radiance
Detector and laser-based calibration for next gen accuracies

• Future process and climate sensors have increasingly more stringent sensor responsivity calibration requirements
  – **PACE** has 2% laboratory calibration uncertainty requirement
  – **CLARREO** has a 0.3% requirement for reflectance

• Traditional sensor characterization methods do not meet these requirements – the solution lies in
  – More advanced instrument models
  – Appropriate parameterization of these models, i.e. use appropriate light source for instrument testing
  – Detector-based standards providing 0.09% k=2 radiometric uncertainty
Why laser-based calibration?

...because photons go everywhere

Example is the ASTER focal plane:

Example of two types of imagers:

**Multispectral pushbroom/whiskbroom**

Landsat, MODIS, VIIRS

**Imaging Spectrometer**

JPL: AVIRIS-ng, NEON, Carnegie, M3 TacSat-3 ARTEMIS CLARREO Pathfinder

White light is focused

Focused light is spectrally separated
GLAMR is required for improving instrument model parameterization

- Stray/scattered light
- Spectral/radiometric response
- Linearity
- Crosstalk
- Detector-to-detector differences
Stabilized laser source is used to transfer radiometric scale from POWR to portable transfer radiometer via another standard radiometer.
Laser system:
Goddard Laser for Absolute Measurement of Radiance

GLAMR

LBO OPOs
JPSS-2 VIIRS testing with GLAMR begins Aug 2, 2016
The GLAMR-ous Future

NIST

2000
Method and traceability development

2009

2010

2011

2012

2013

2014

2015

2016

2017

2018

2019

2020

2021

NIST-NASA partnership

NASA

G-LiHT
Goddard’s Lidar Hyperspectral & Thermal Imager

RSP
Research Scanning Polarimeter

eMAS-h
Enhanced MODIS Airborne Simulator

GLAMR will be one of tools that takes these missions to climate accuracies