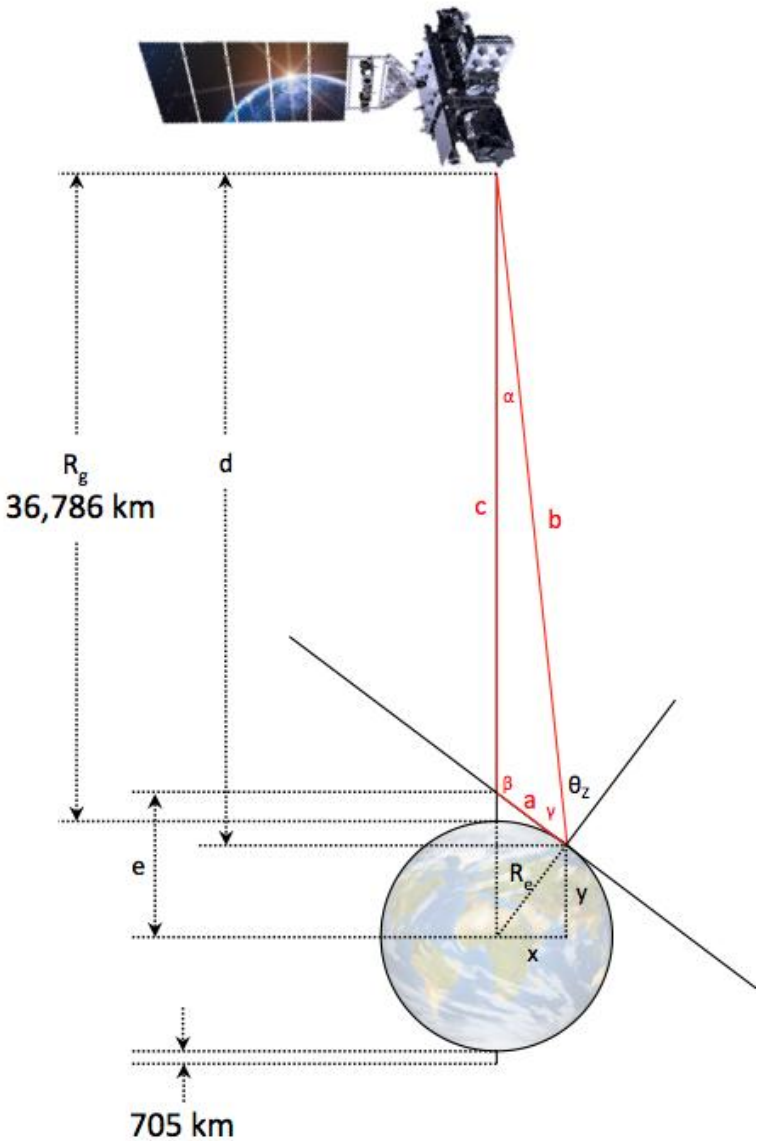
National Aeronautics and Space Administration
Goddard Space Flight Center

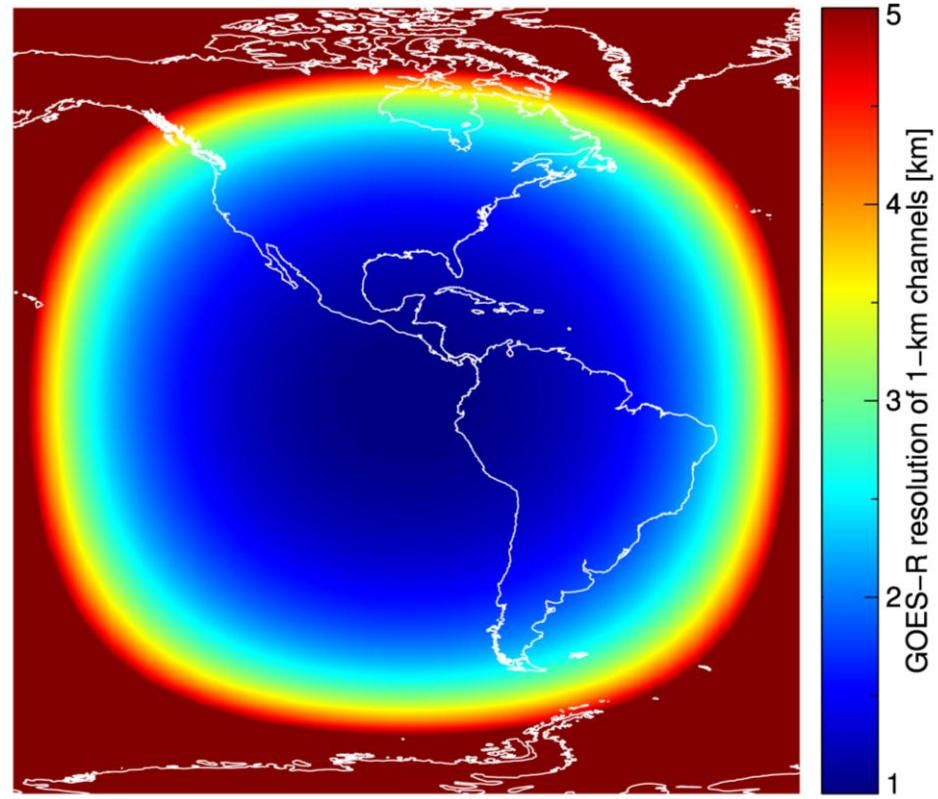
New laboratory characterization technique for Landsat 9 and intercalibration results for Landsat 8

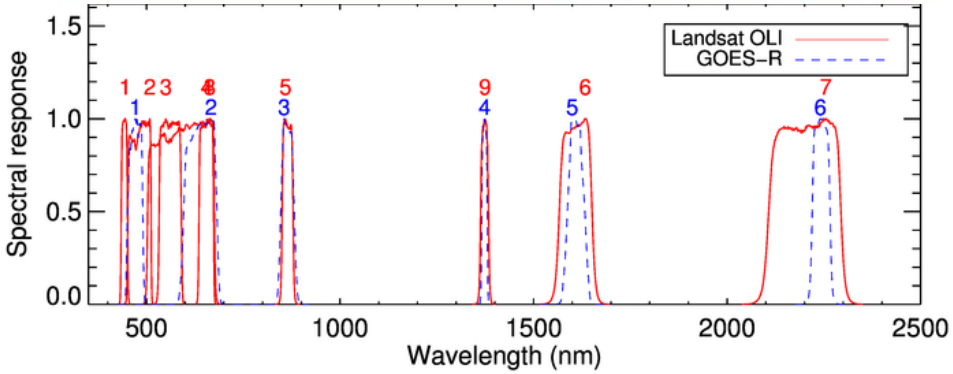
Joel McCorkel
Kurt Thome

GOES-R

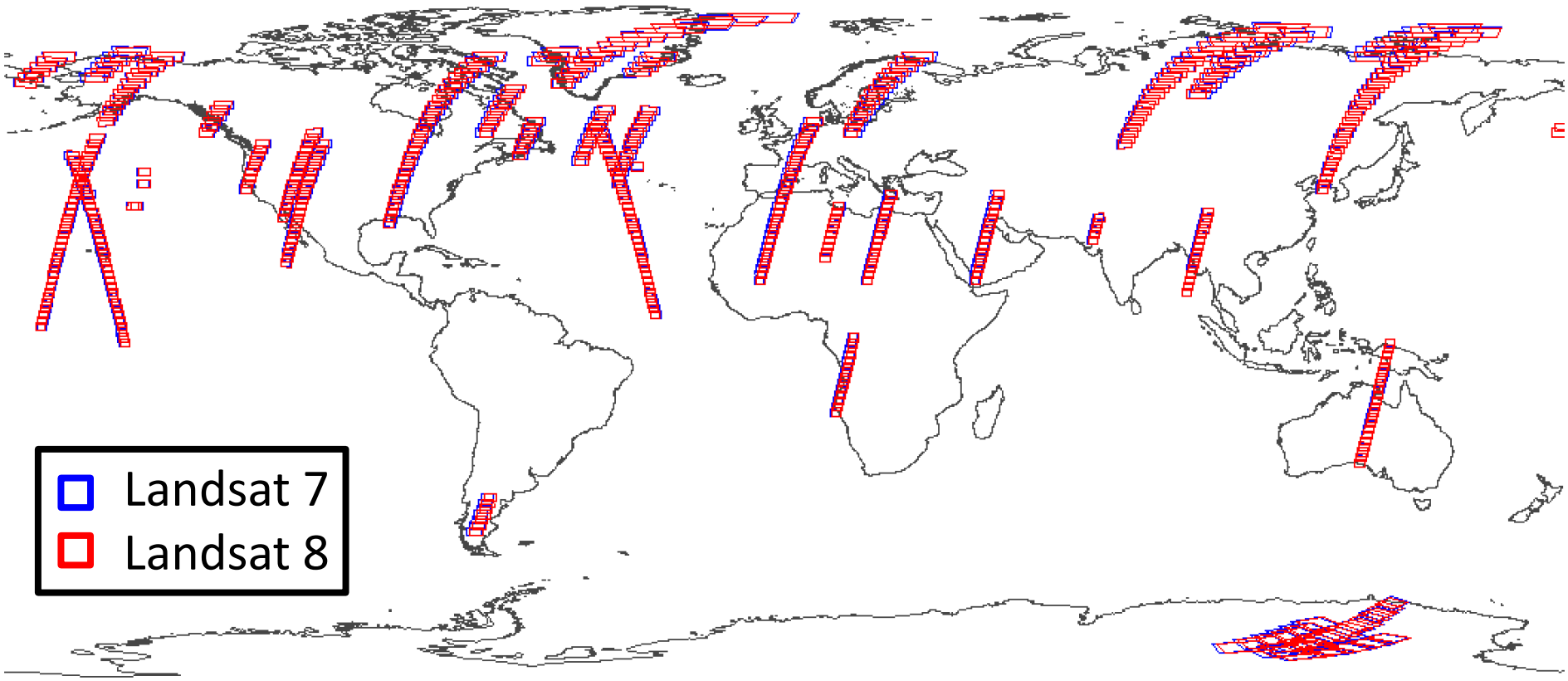
...bringing the diurnal signal to you in 2016.







Landsat 7-8 intercalibration

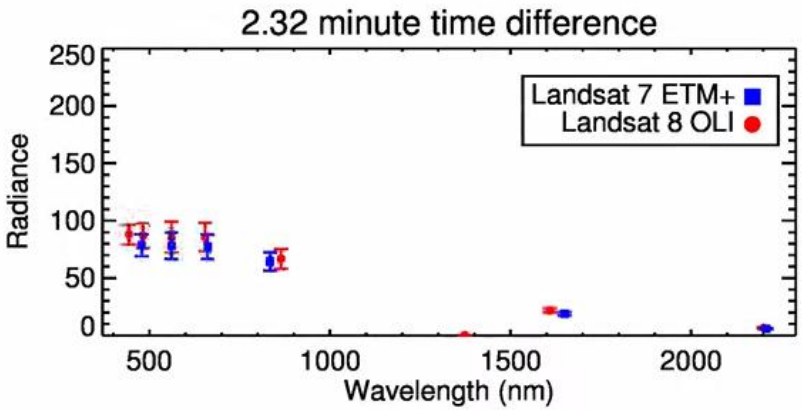


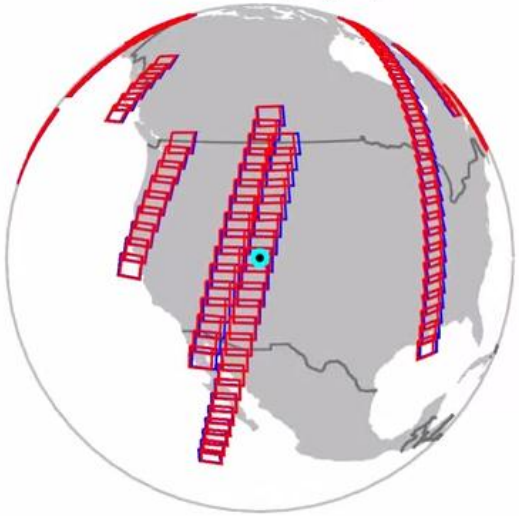
There are 431 Landsat 7-8 image pairs that have scene centers within 50km

Landsat 7/8 tandem data and animation

Animation at 10x spacecraft ground speed: https://www.youtube.com/watch?v=giDuH1nnbrI

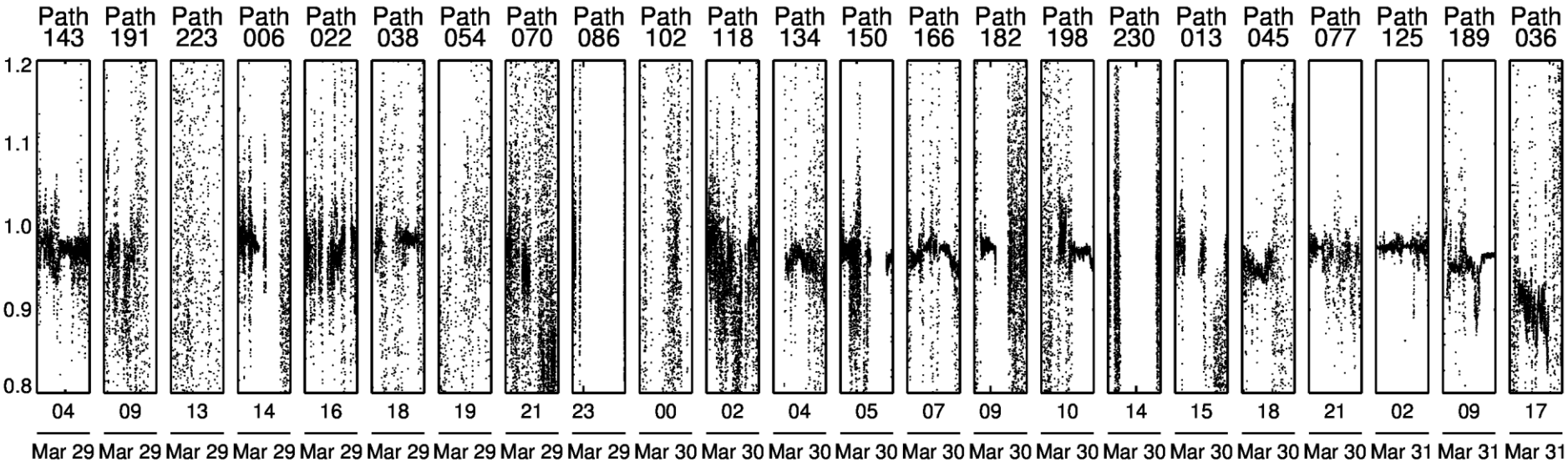
Animation at spacecraft ground speed: https://www.youtube.com/watch?v=vyn4z3-pxS0





Ratio of the 87k samples

$$\frac{L_{\text{ETM+, red}}}{L_{\text{OLI, red}}}$$



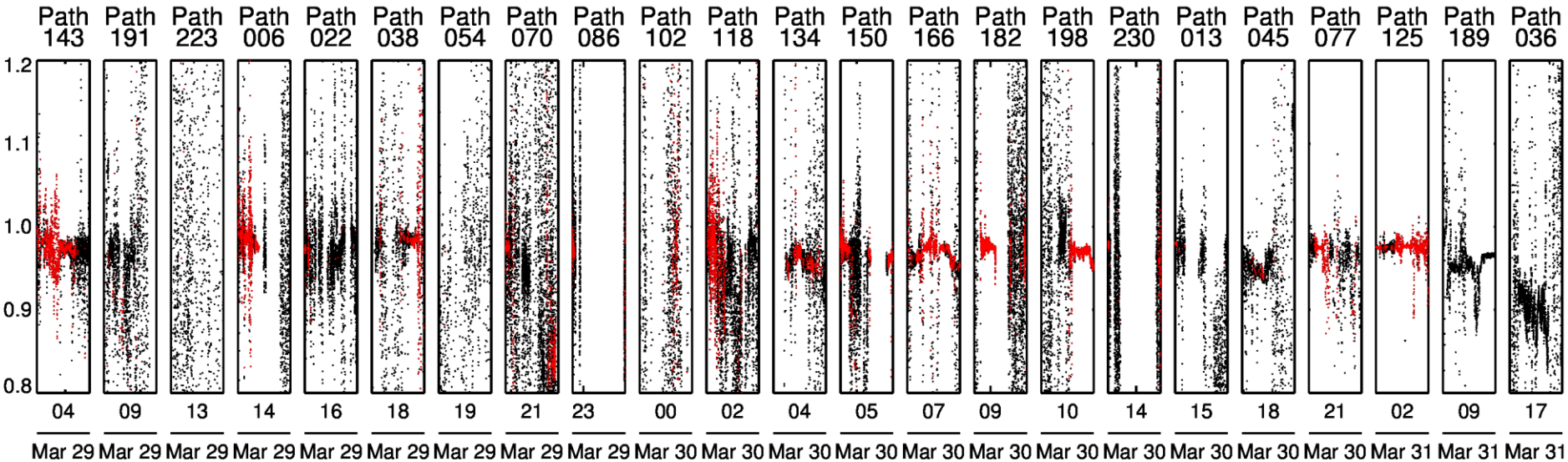
UTC date, hour

Ratio of the 87k samples

$$\frac{L_{\text{ETM+, red}}}{L_{\text{OLI, red}}}$$

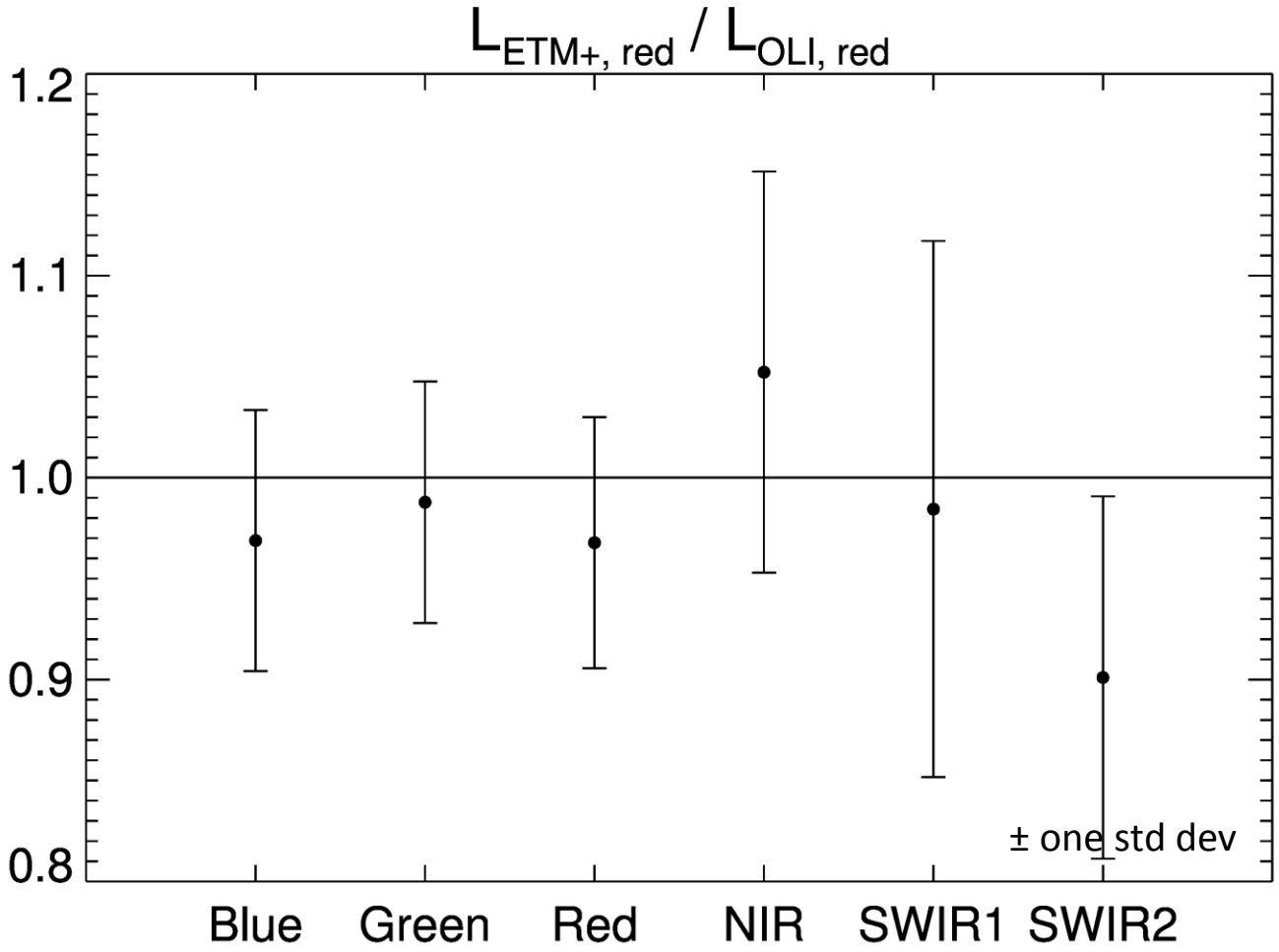
Screened for: Saturation
Highly variable samples
Extreme off nadir

This leaves 18k samples



UTC date, hour

Tandem summary

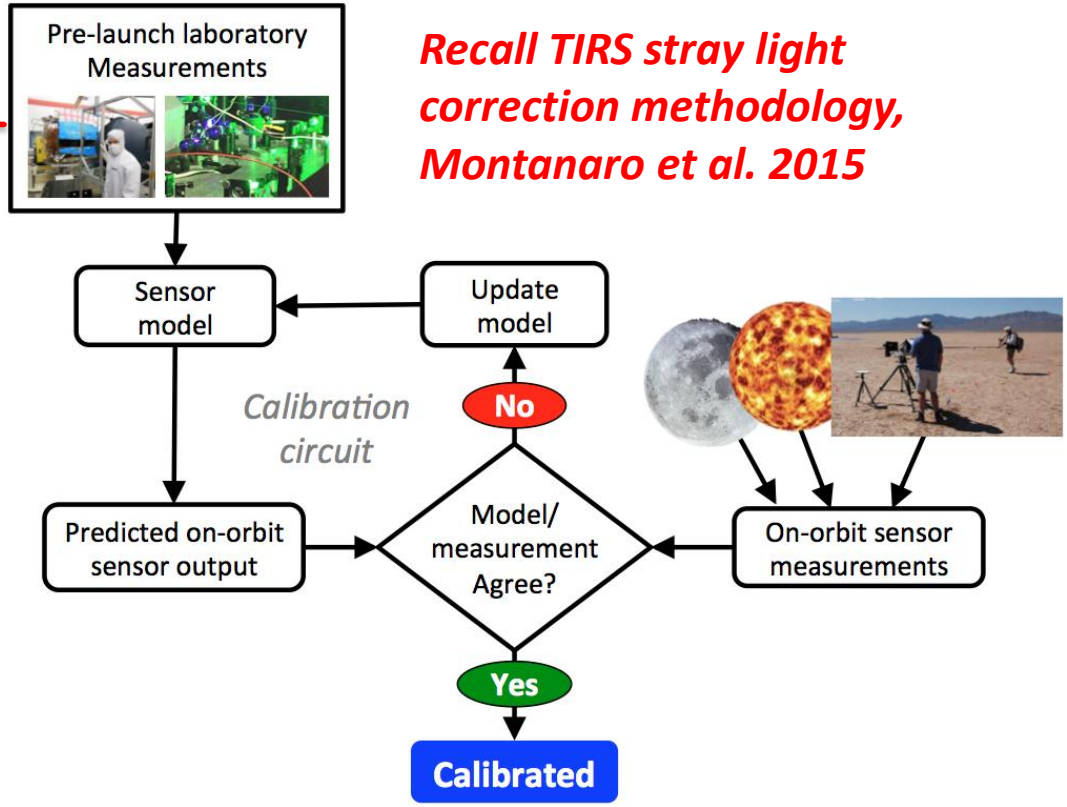


New calibration technique for Landsat 9

Laboratory sensor testing

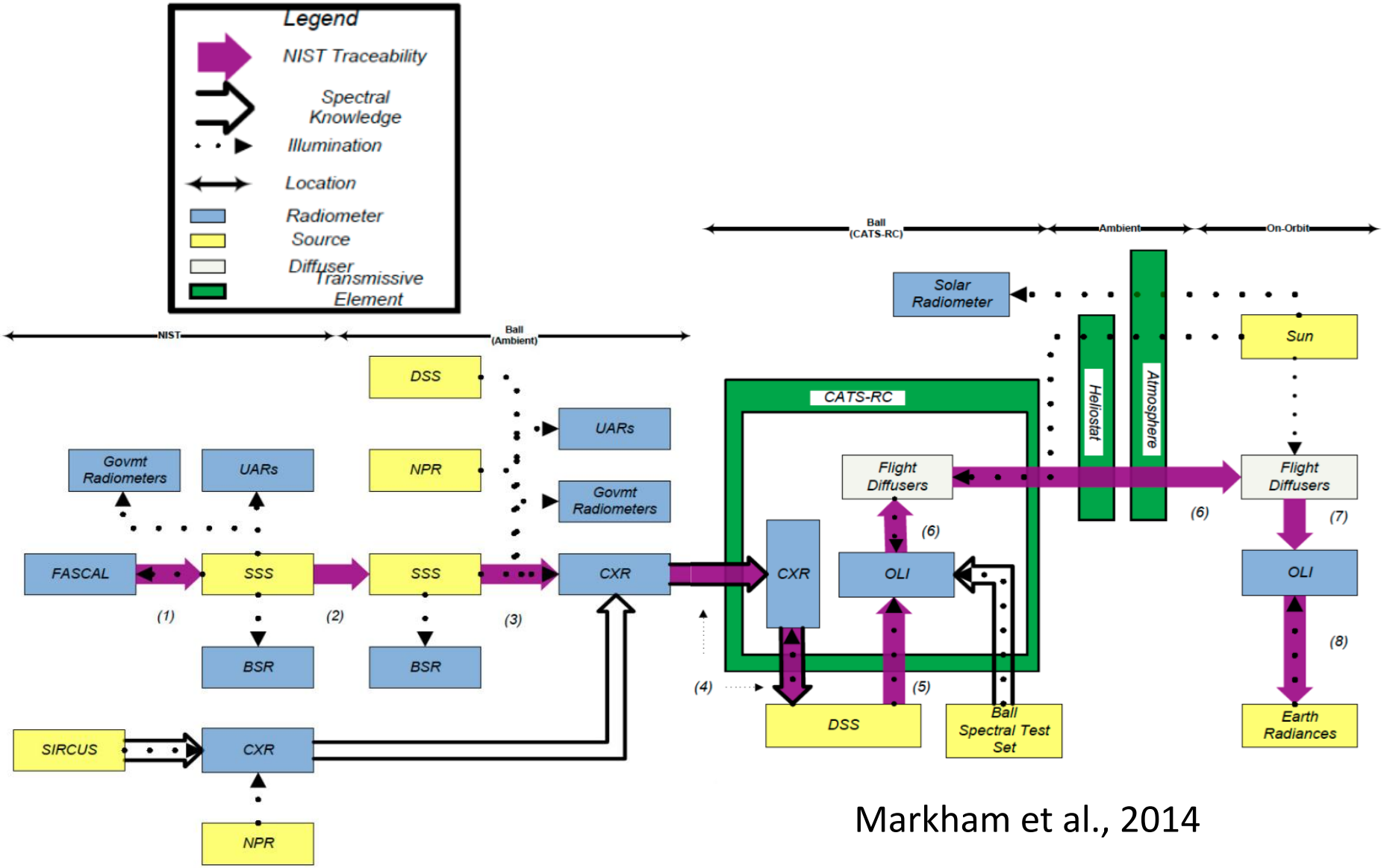
- Answer question "What is the sensor response?"
  - For business: To see if sensor vendor met requirements
  - For science: To characterize what the sensor is measuring

- Measurements for
  - Radiometry
  - Spectral
  - Spatial
  - Linearity
  - Polarization
  - Stray light
  - Other sensor effects (e.g. electrical crosstalk)



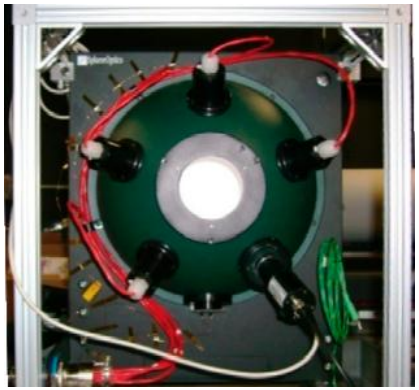
Recall TIRS stray light correction methodology, Montanaro et al. 2015

Landsat 8 OLI traceability



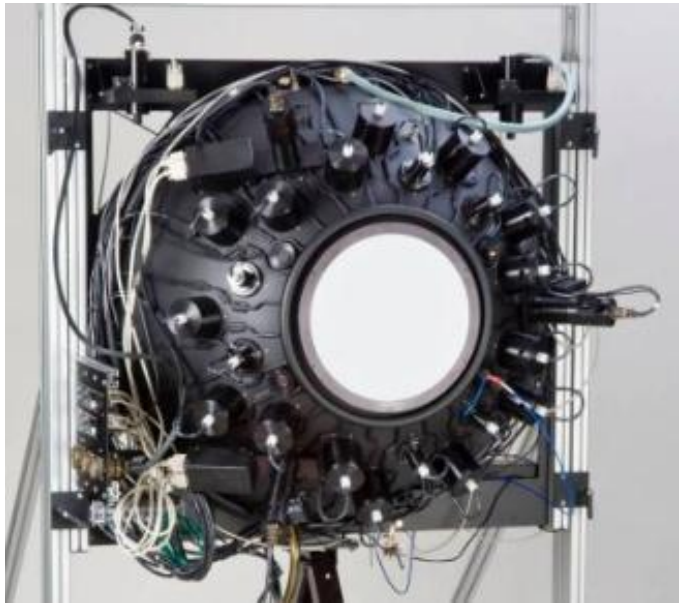
Markham et al., 2014

Landsat 8 calibration - Radiometric

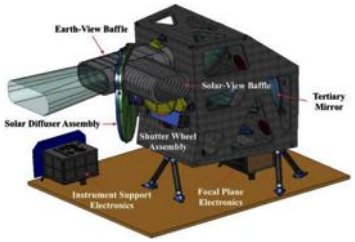


Small Sphere Source (SSS)

COTS Transfer Radiometer (CXR, Ball)



Death Star Source (DSS)



OLI

Other radiometers in calibration round robin activities, before and after SSS transport:

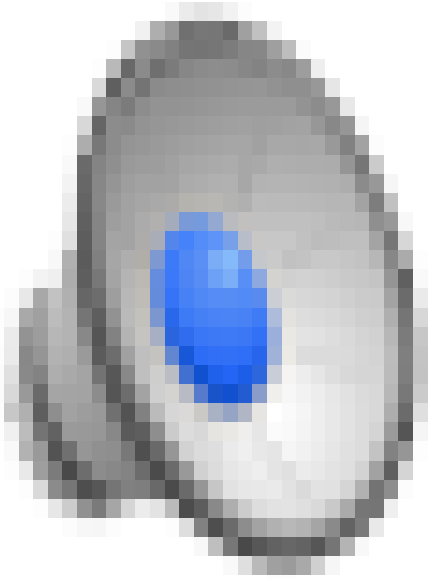
- VNIR (University of Arizona)
- SWIR (University of Arizona)
- LXR (Goddard)
- VXR (NIST)
- BSR (Ball Aerospace)

Broadband (white light) based calibration issues

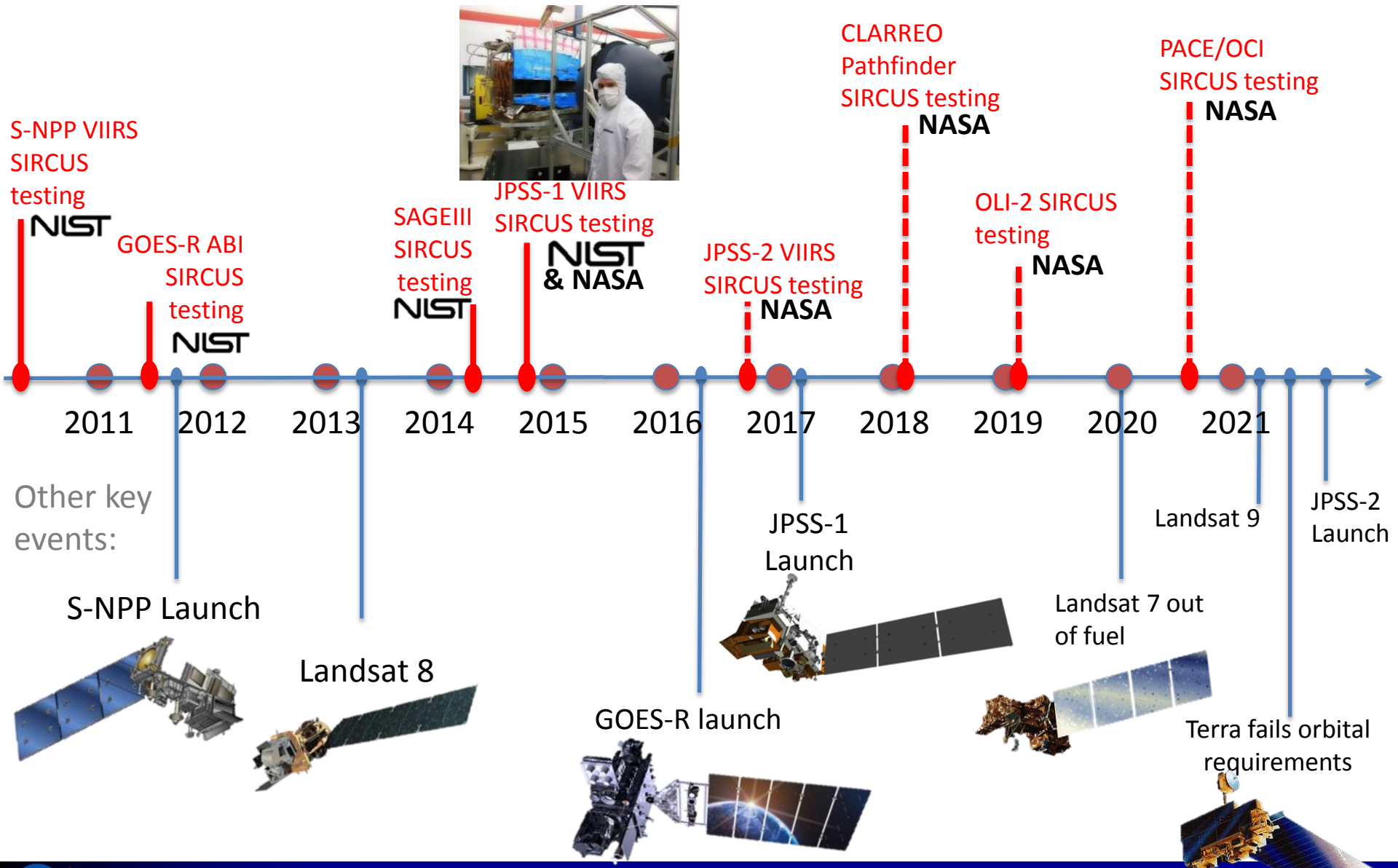
- Limited to 2-3% uncertainties
- Color temperature

Markham et al., 2014

Lasers, sharks optional



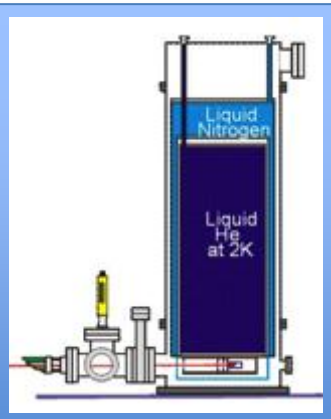
Laser-based calibration history



Path to radiometric traceability

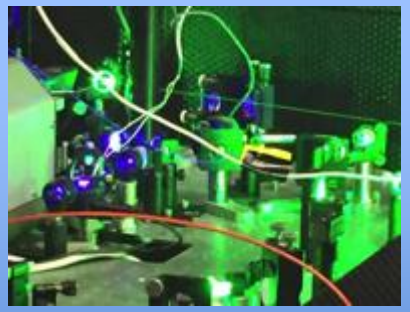
for laser-based calibration

NIST Facility



POWR
Primary Optical Watt Radiometer

→



Stabilized laser source is used to transfer radiometric scale from POWR to portable transfer radiometer

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LTD-11 #107
transfer radiometer

Sensor vendor facility

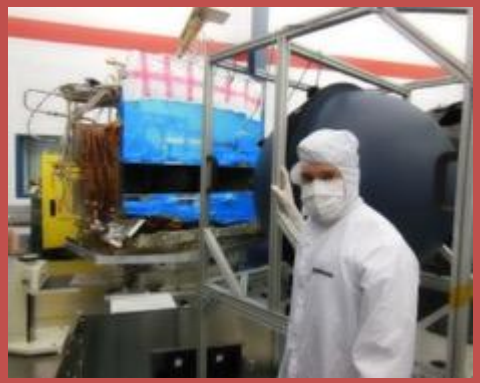
T-SIRCUS calibration of JPSS-1 VIIRS

LTD-11 #107
transfer radiometer

→

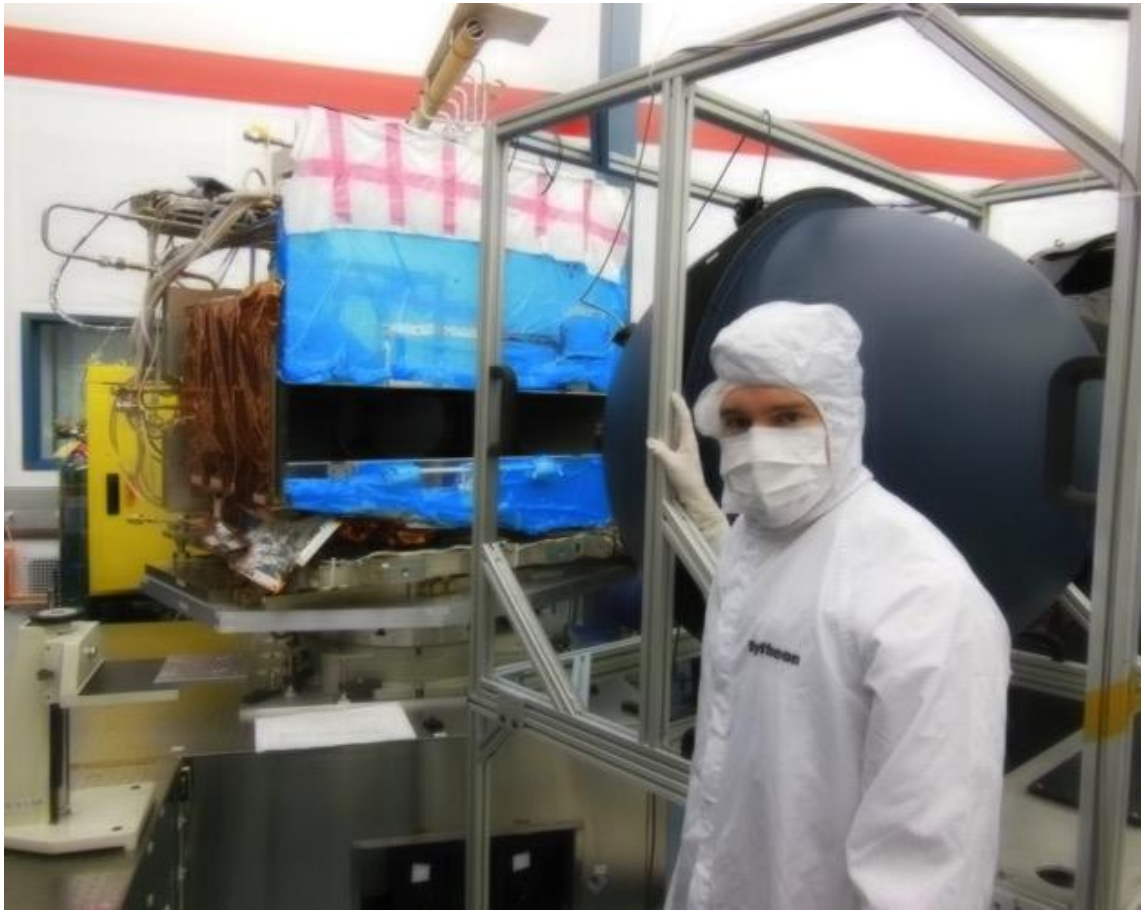
Sphere Monitor

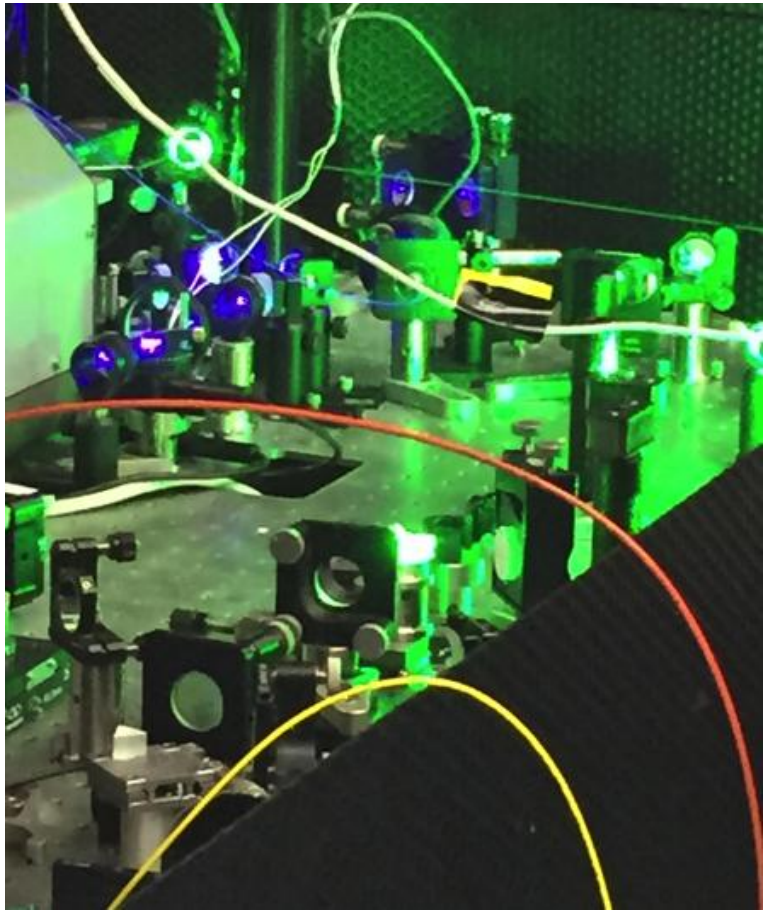
→

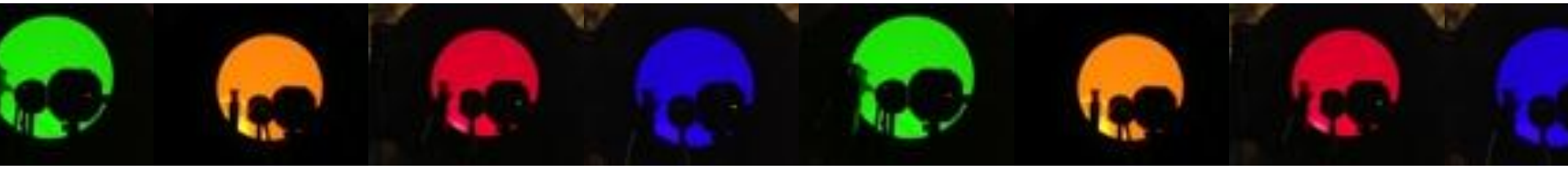


VIIRS

The experiment

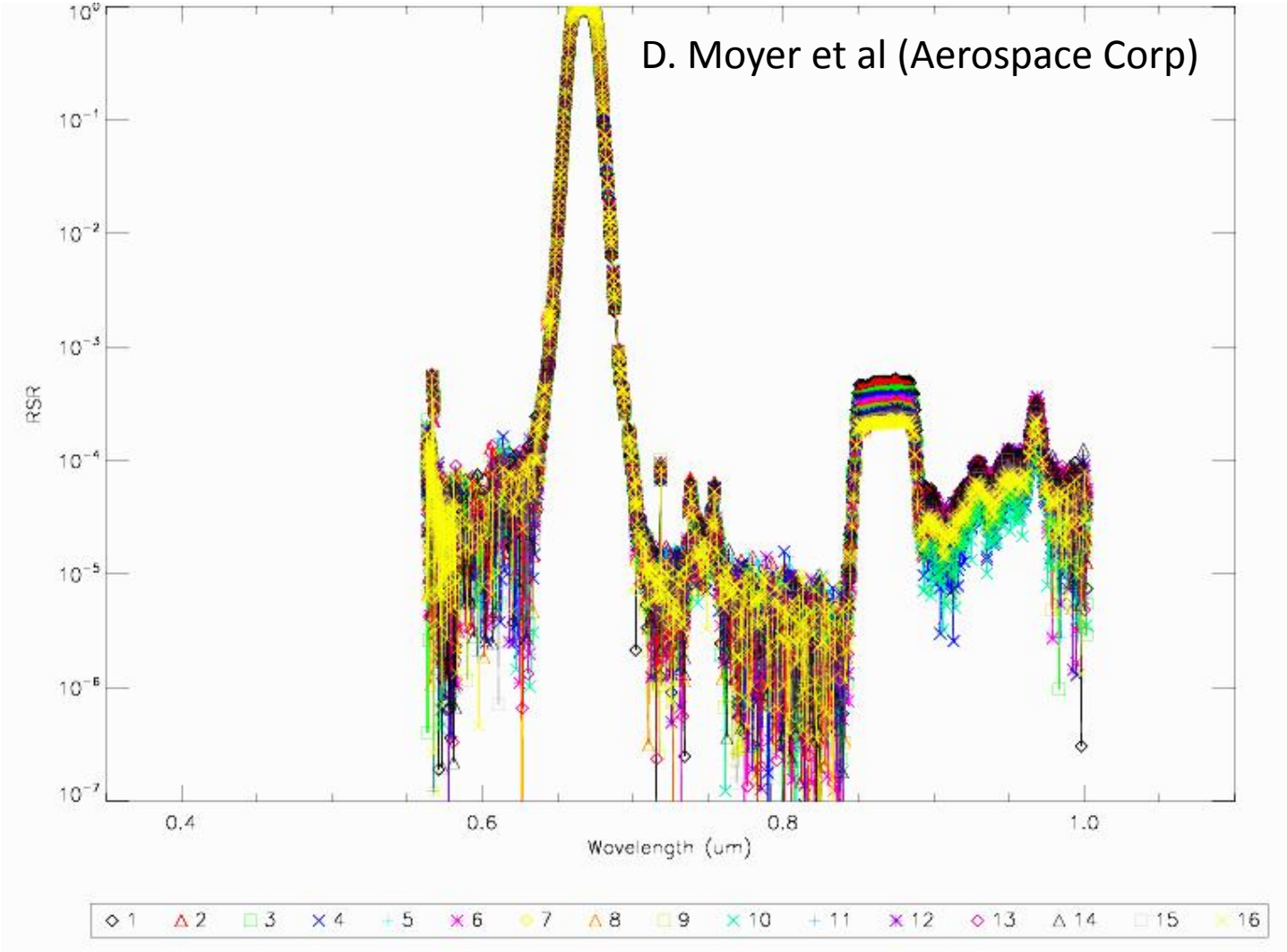




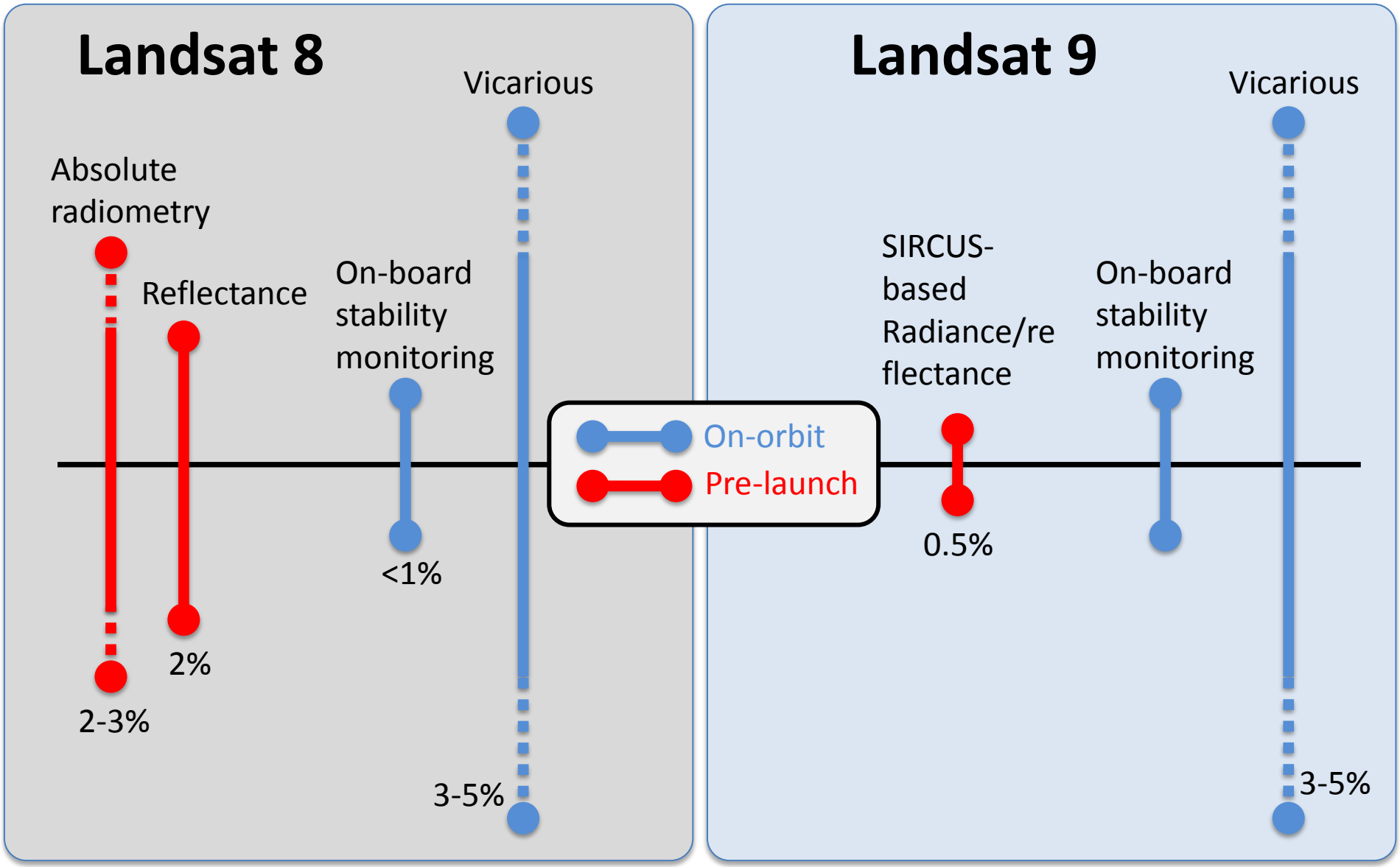


Example of JPSS-1 VIIRS results

J1 Band M5 spectral response for all detectors



Calibration summary



Instrument calibration moving forward

- Instrument model centric -- where laser-based calibration provides:
  - Full aperture, large field spectral-radiometric source
  - Exact wavelength knowledge
  - Spectral out-of-band
  - Scattered light

- Promote speedier ‘calibration selection’
  - Best knowledge characterized in laboratory
  - On-board and vicarious only serve as validation