OCI radiometric performance: reprocessing V3 update

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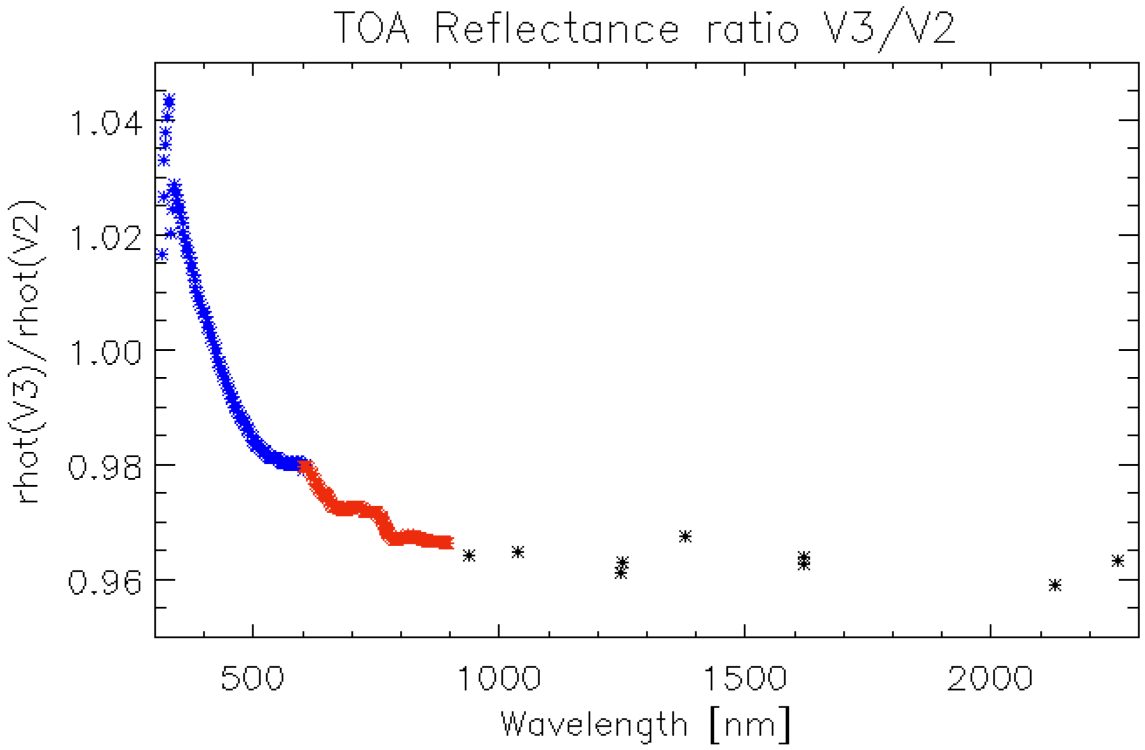
This top-of-atmosphere radiance image was taken by OCI on June 2, 2024, near Greenland (Denmark).

Overview

- Absolute radiometric calibration on-orbit
- Temporal trending of radiometric gain
- Spectral calibration/validation on-orbit
- Linearity calibration/validation on-orbit
- Blue/red transition region
- Striping around 10deg scan angle
- Crosstalk correction

Absolute radiometric calibration on-orbit

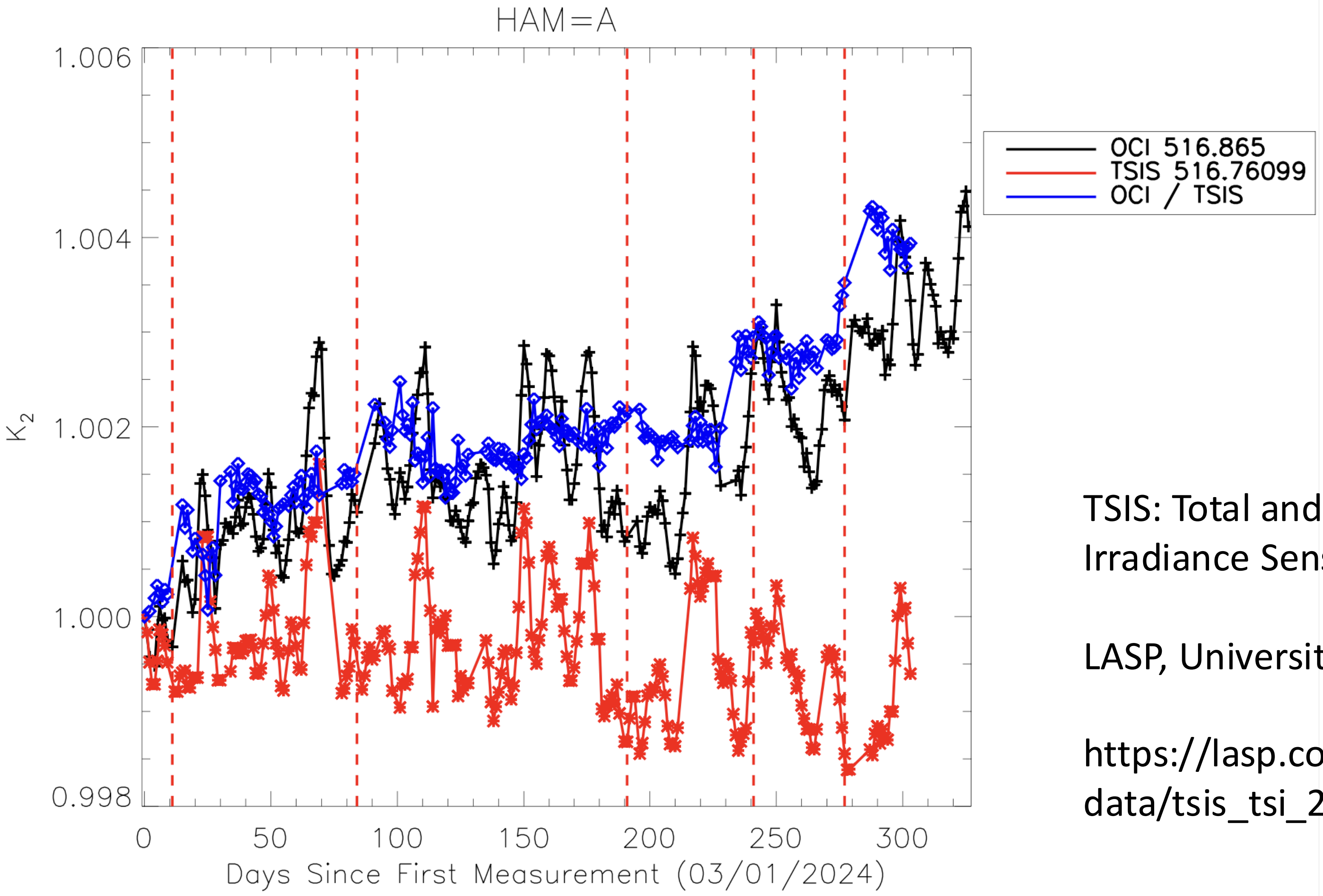
- V2 used both prelaunch and on-orbit measurements for absolute calibration
- V3 uses only on-orbit (solar diffuser) measurements
- Ratio V3/V2 is shown here (for March 2024):



Temporal trending of radiometric gain: overview

- New in V3: Monthly diffuser is used to estimate reflectance degradation of daily solar diffuser
- Lunar trending agrees with solar diffuser trending (not used yet)
- OCI solar diffuser measurements resolve short term fluctuations in solar irradiance

OCI resolves temporal fluctuations in solar irradiance:



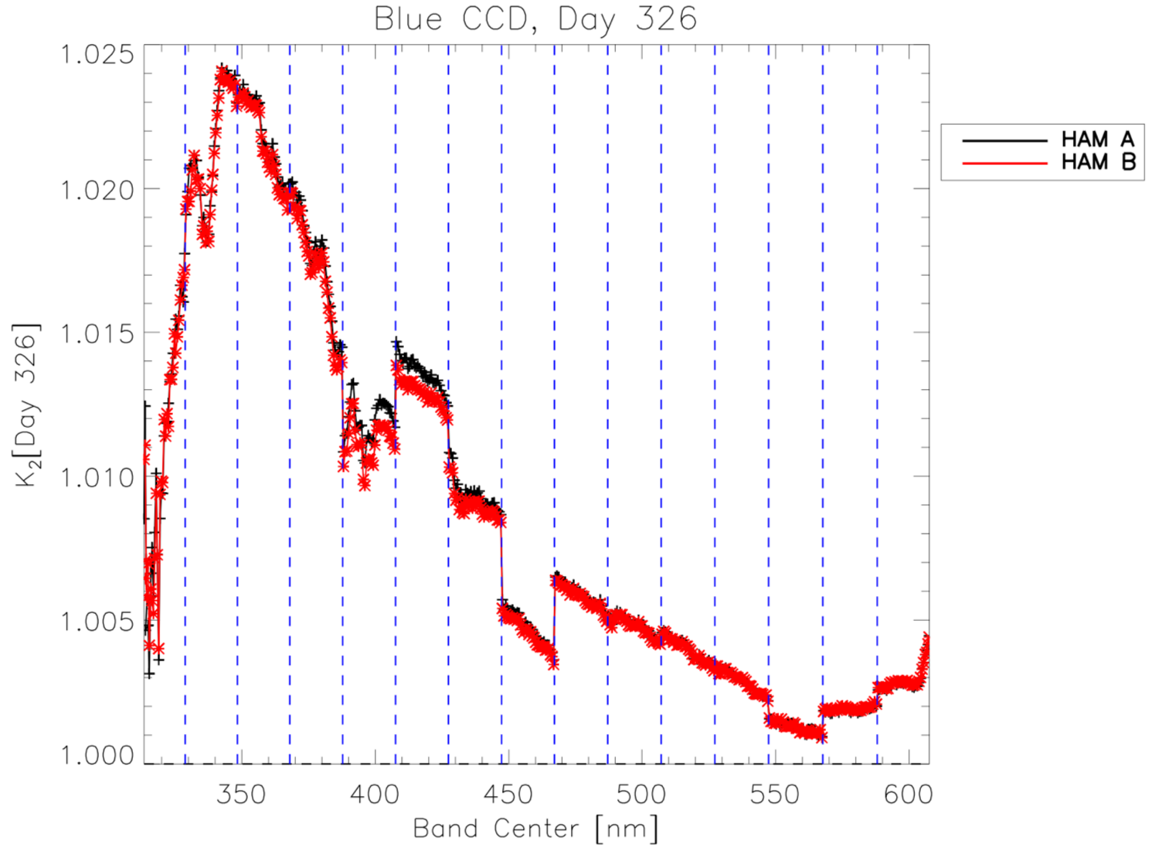
TSIS: Total and Spectral Solar Irradiance Sensor (TSIS-1)

LASP, University of Colorado

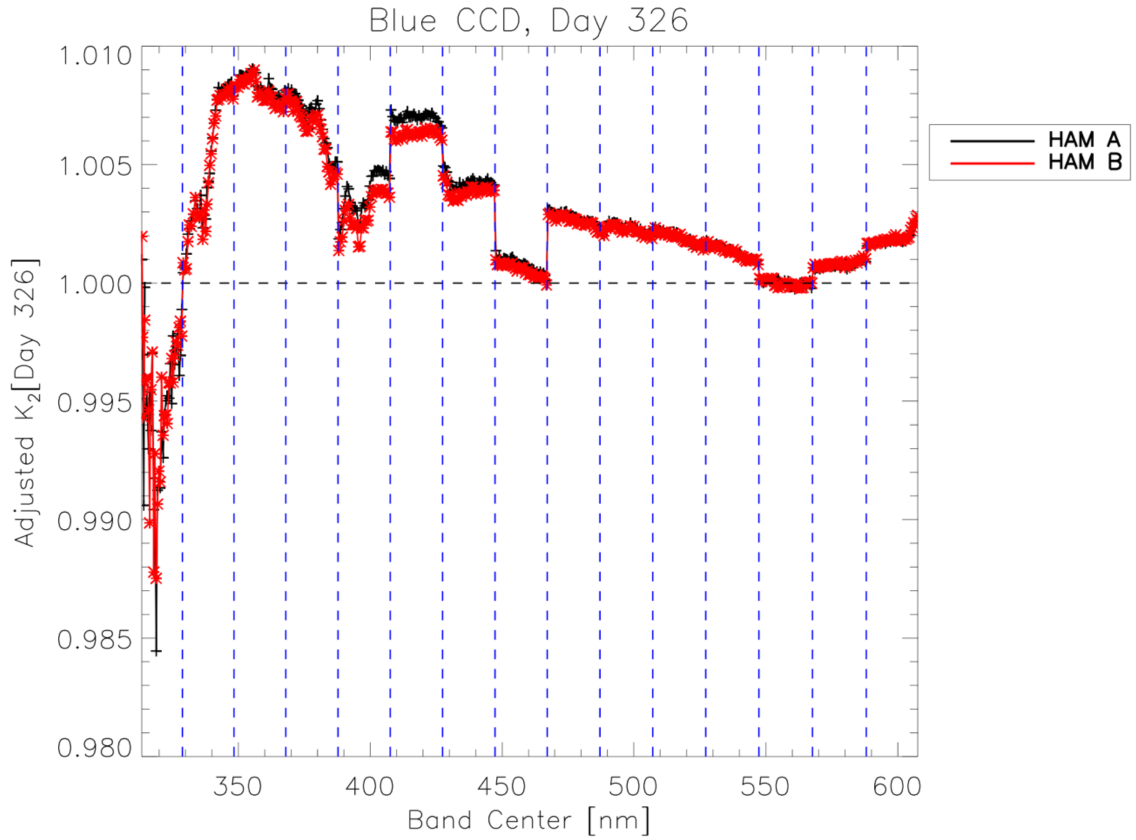
https://lasp.colorado.edu/lisird/data/tsis_tsi_24hr

Temporal radiometric gain (K2) change :

V2 (no adjustment):
(Day 326 is mid January 2025)

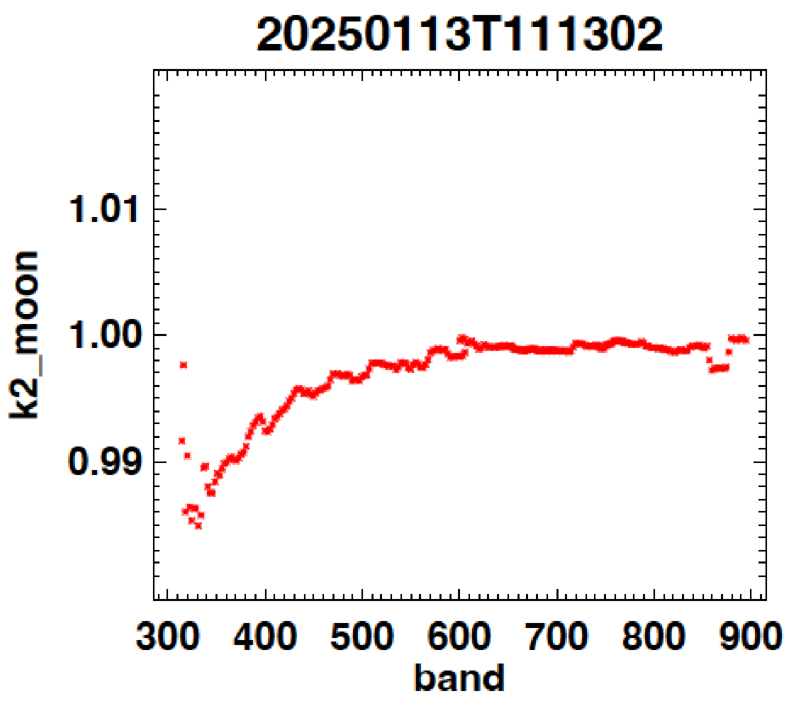


V3 (adjusted for **reflectance degradation of daily solar diffuser**):

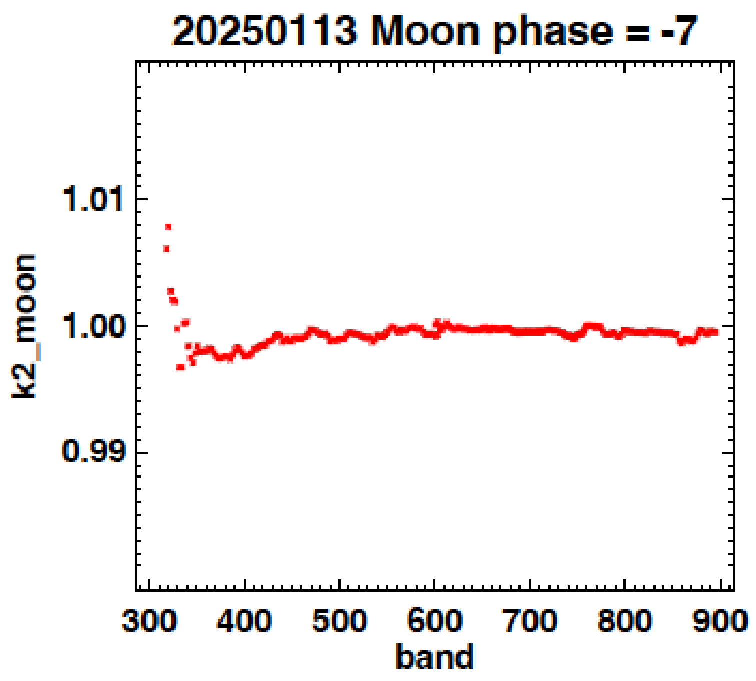


Temporal radiometric gain change from lunar measurements: (expected: K2_moon=1)

V2 K2_moon derived from lunar measurements:



V3 K2_moon derived from lunar measurements:



V3 calibration removes >1% temporal trend at 350nm; data <340nm remains challenging

Spectral calibration accuracy

- **Very good spectral agreement** for Fraunhofer lines when comparing predicted (solar diffuser BRDF and E_sun) and measured (GLAMR) line positions (RMS of **0.14nm**), see Robert E. Eplee Jr., Jeffrey W. McIntire, Shihyan Lee, Gerhard Meister, "Initial on-orbit spectral calibration of the PACE Ocean Color Instrument," Proc. SPIE 13143, Earth Observing Systems XXIX, 131430O (3 October 2024); https://doi.org/10.1117/12.3028084

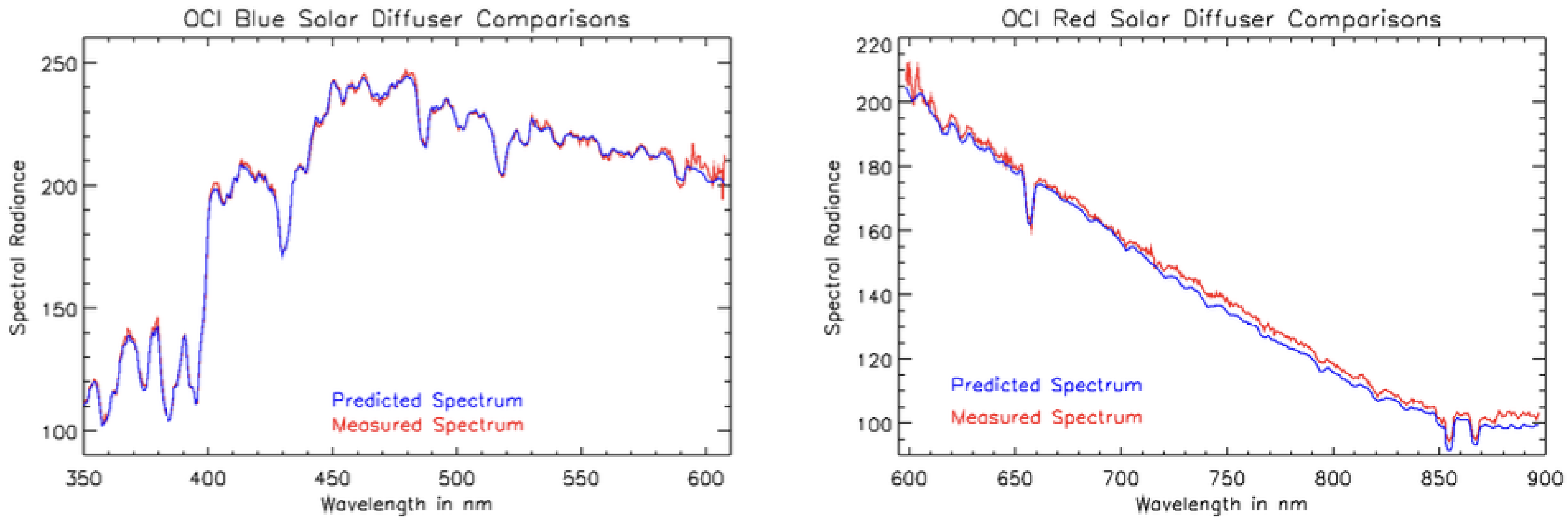
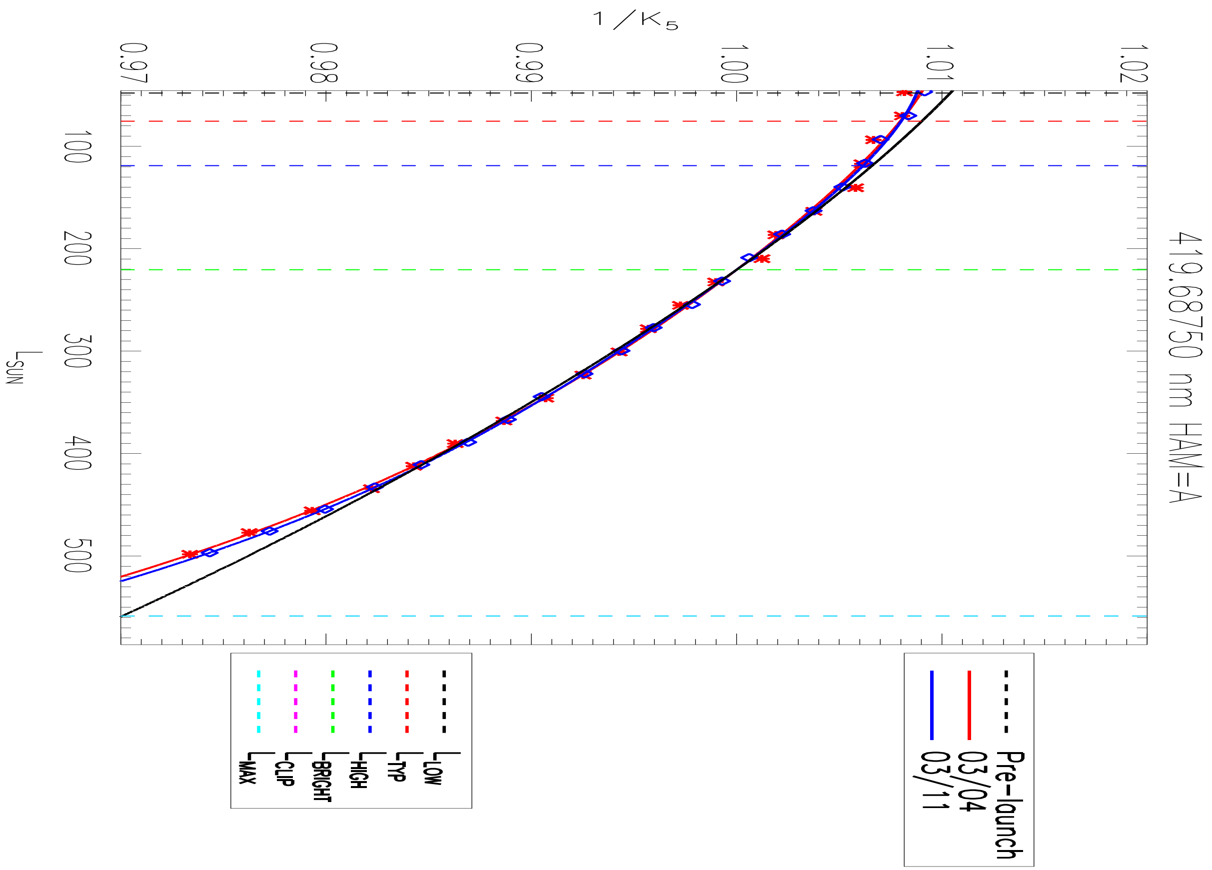
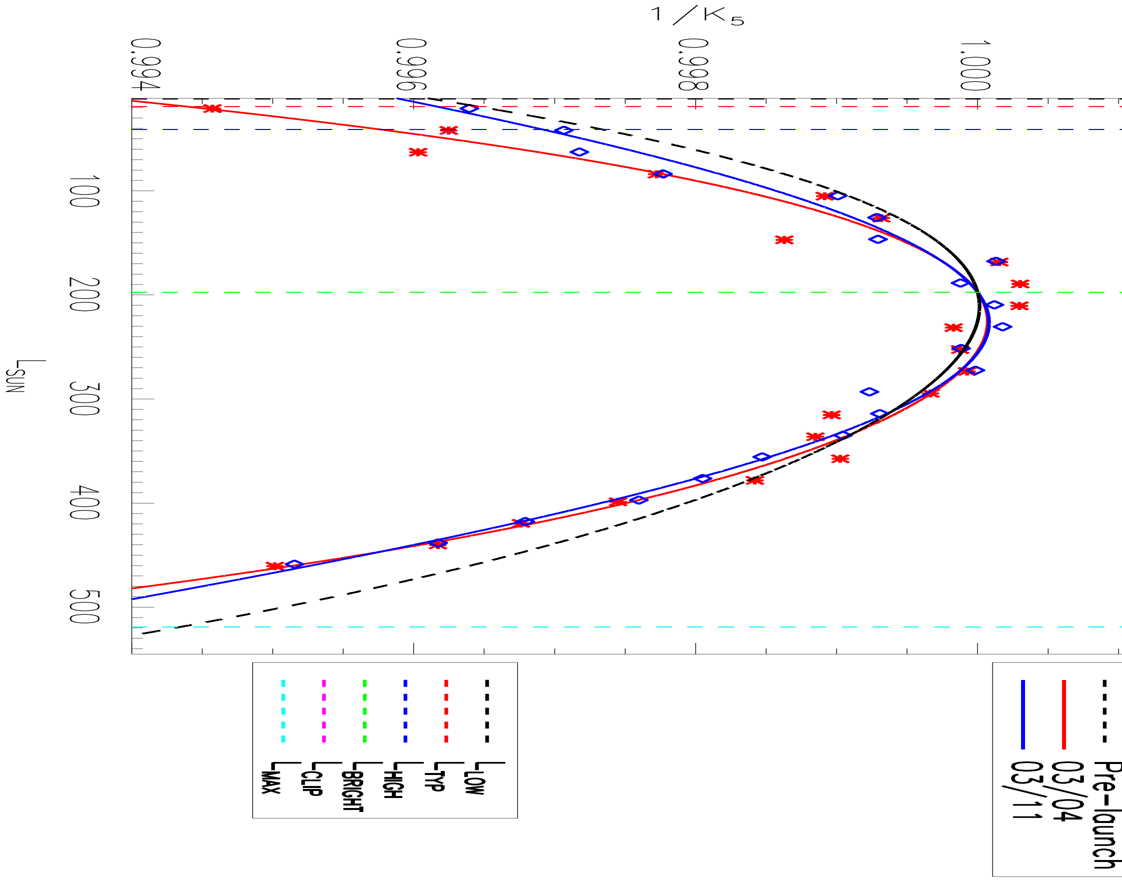


Figure 2. **OCI Measured and Predicted Spectrum Comparisons** a) UVVIS spectrum comparisons. b) VISNIR spectrum comparisons.

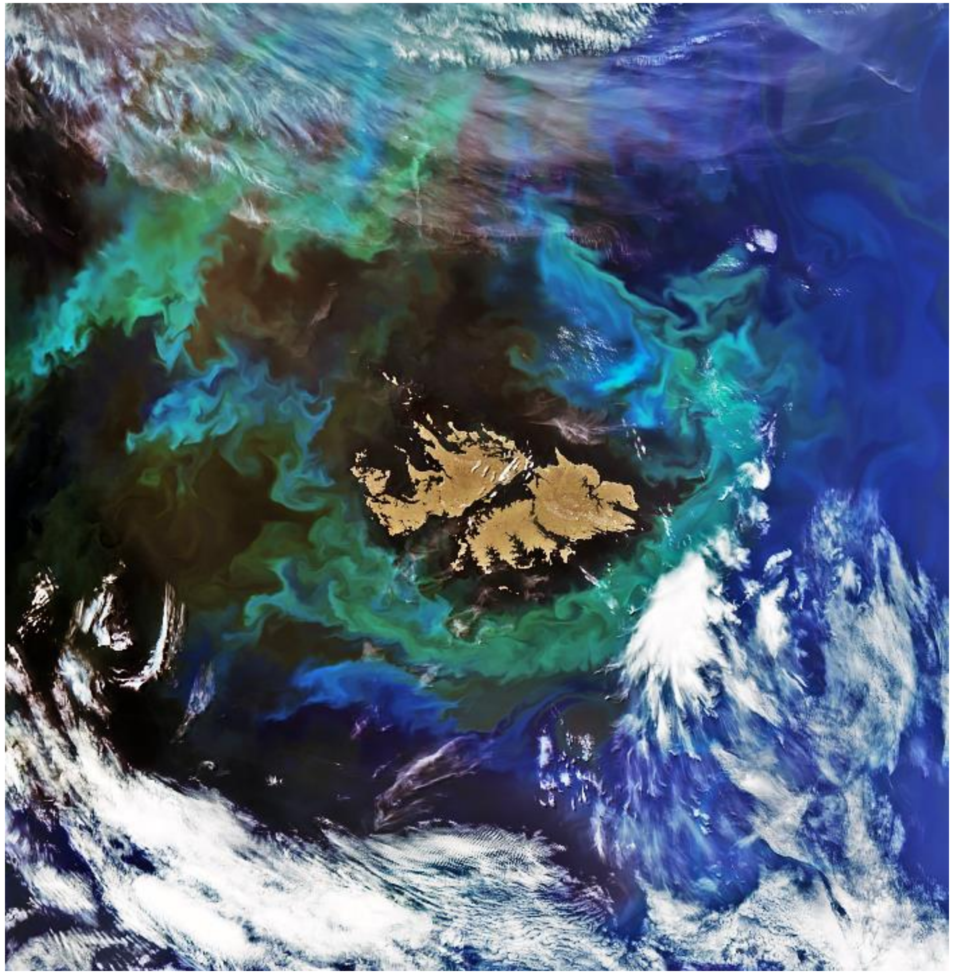
Linearity on-orbit: verified

Linearity measurements as a function of radiance for a band from the blue FPA (left) and from the red FPA (right). The lines are fits to the measurements, the latter are shown as symbols. The vertical dashed lines are different predefined radiance levels. On-orbit measurements are from the dim diffuser using OCI in progressive TDI mode.





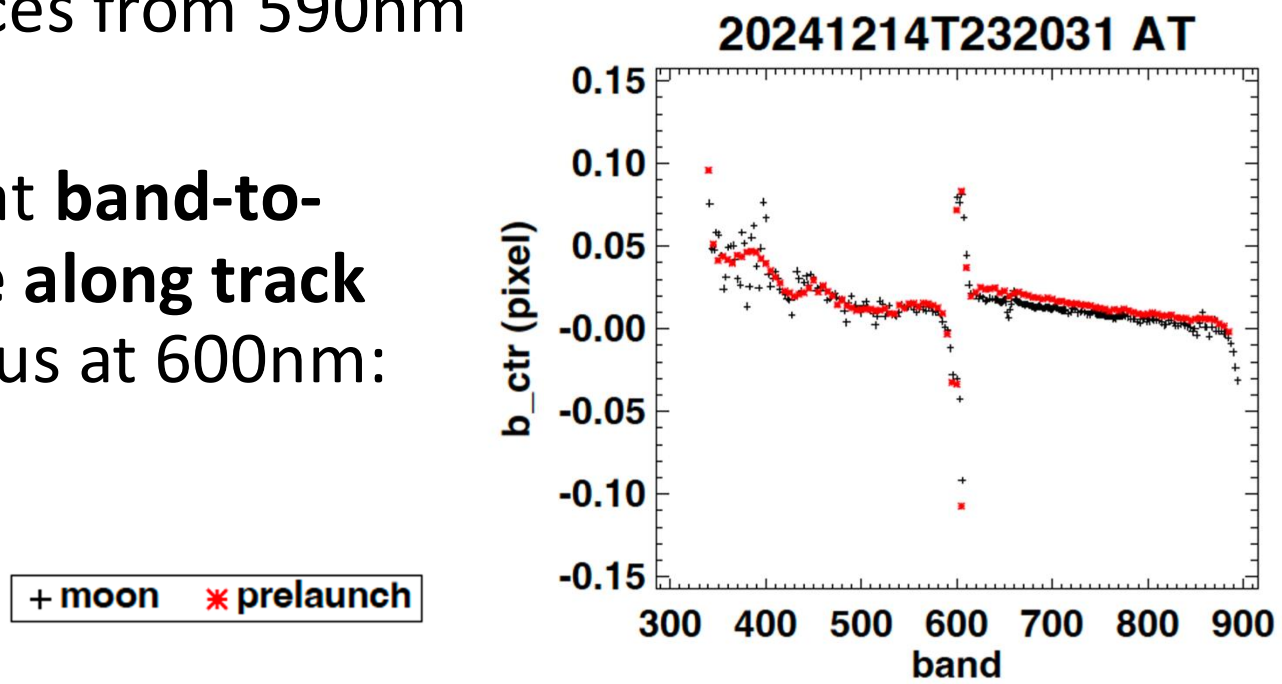
Remaining slides: current issues/limitations



Falkland Islands, as seen by OCI on December 28th, 2024. Provided by Joe Knuble, OCI systems engineer.

Blue/red transition region

- The transition from the blue to the red FPA is at 600nm.
- A dichroic splits the optical path; it impacts wavelengths from 590nm to 610nm.
- Radiometric accuracy is reduced for those wavelengths; V3 masks water-leaving reflectances from 590nm to 610nm.
- We recently realized that **band-to-band registration in the along track direction** is discontinuous at 600nm:

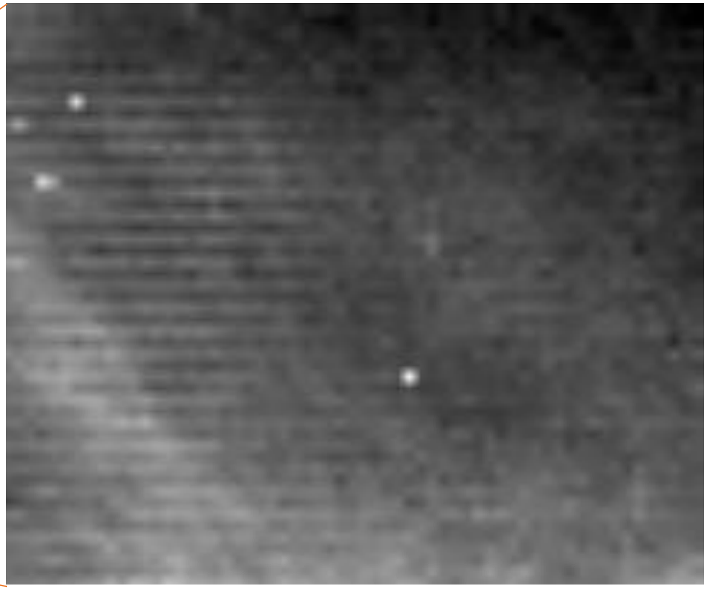


Striping intensity, Chesapeake Bay:

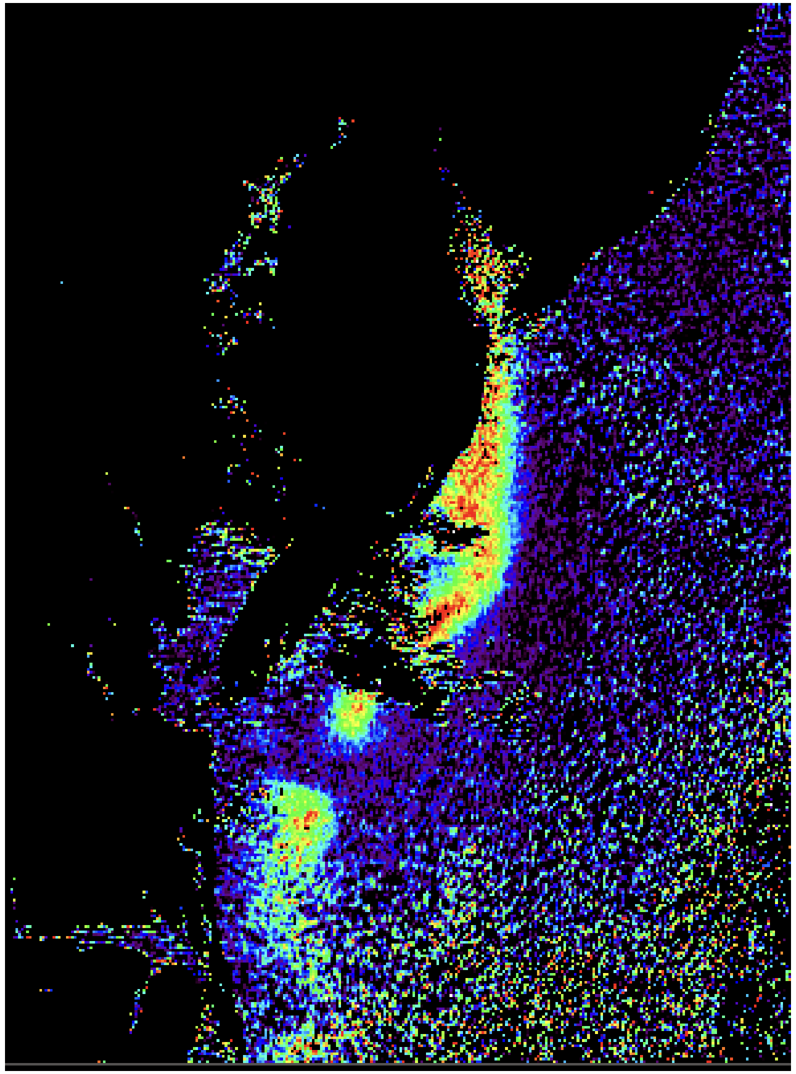
- Striping intensity colorbar: red=0.0005 (difference), Scan pixels 600-900, scan lines 1100-1500

Rho_t (865nm):

Cropped area, rescaled:



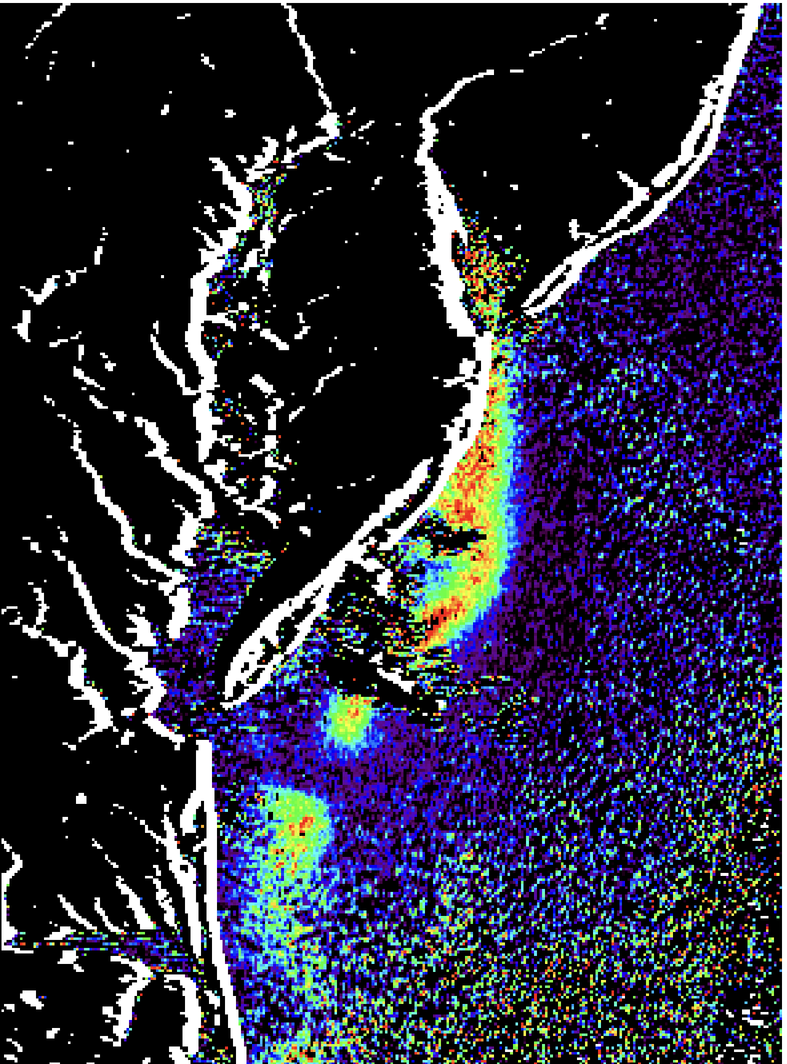
Striping intensity (865nm):



Striping intensity, Chesapeake Bay:

- Striping intensity colorbar: red=0.0005 (difference), Scan pixels 600-900, scan lines 1100-1500

Striping intensity for Lt(865nm):

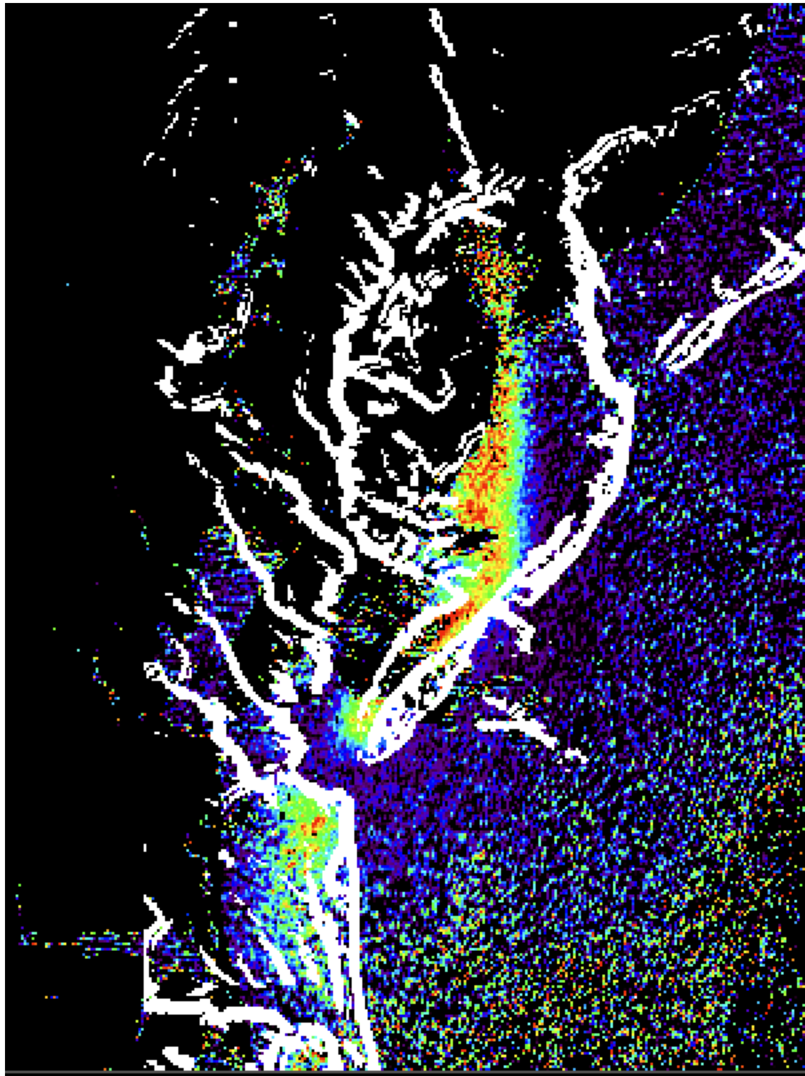


Black/blue: little or no striping
Green/yellow/red: striping increases

White lines: Lt gradients to detect coastlines.

High striping area follows the shifted coastline, but only for a limited scan angle range (scan pixels 680-800, around a scan angle of 10deg)

Coastlines shifted (shift derived from another image):



Striping around 10deg scan angle

- The striping is actually ghosting (for one mirror side only). It is most obvious in dark ocean next to bright areas (land or clouds).
- A correction has been derived from prelaunch data (spectral dependence) and on-orbit images (spatial impact). It significantly reduces striping (especially on average), but does not eliminate it.
- The correction has been provided to SDS to implement in the L1B code soon. Many implementation questions still need to be addressed. It might be possible to add this correction before V4 reprocessing (no reprocessing needed) in the forward stream.
- For V3, a L1B flag is available to identify affected pixels (scan pixels 680-800, mirror side 1, 0 based).

New L1B corrections to be applied in a future reprocessing:

- Striping correction (see above)
- Crosstalk correction:
  - In the blue FPA, crosstalk was detected prelaunch
  - This is regular/typical crosstalk, much easier to implement than the striping correction
  - We verified that the correction improves the lunar images
  - Impact is significant for the short UV wavelengths (~1% above 340nm, much larger at 320nm)
  - It probably doesn't make sense to use wavelengths below 340nm from V3 for science products
- Include reflectance degradation in radiometric gain trending of monthly solar diffuser (expect very small impact, <0.1%)

Summary

- V3 L1B reflectances/radiances are expected to be much more radiometrically accurate than for V2:
  - improved absolute calibration (V3 increases reflectances/radiances below 400nm, decreases them above 400nm)
  - temporal trends: improved stability below 450nm
- Remaining issues/limitations:
  - striping around 10deg scan angle (700nm-900nm)
  - blue/red transition region
  - crosstalk correction (blue FPA)
  - wavelengths below 340nm