Radiance Comparison from OCO-3 and OCO-2 Simultaneous Nadir Observations (SNOs)

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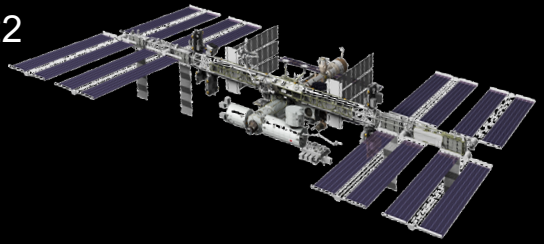


OCO-2&3 In-Flight Calibration Sources – Why Consider SNOs?

sources actually used for calibration

Source	OCO-2	OCO-3
On-Board Lamps	daily	daily
Solar	daily	impossible due to ISS constraints
Lunar	frequent	infrequent (not used for B10, work in progress)

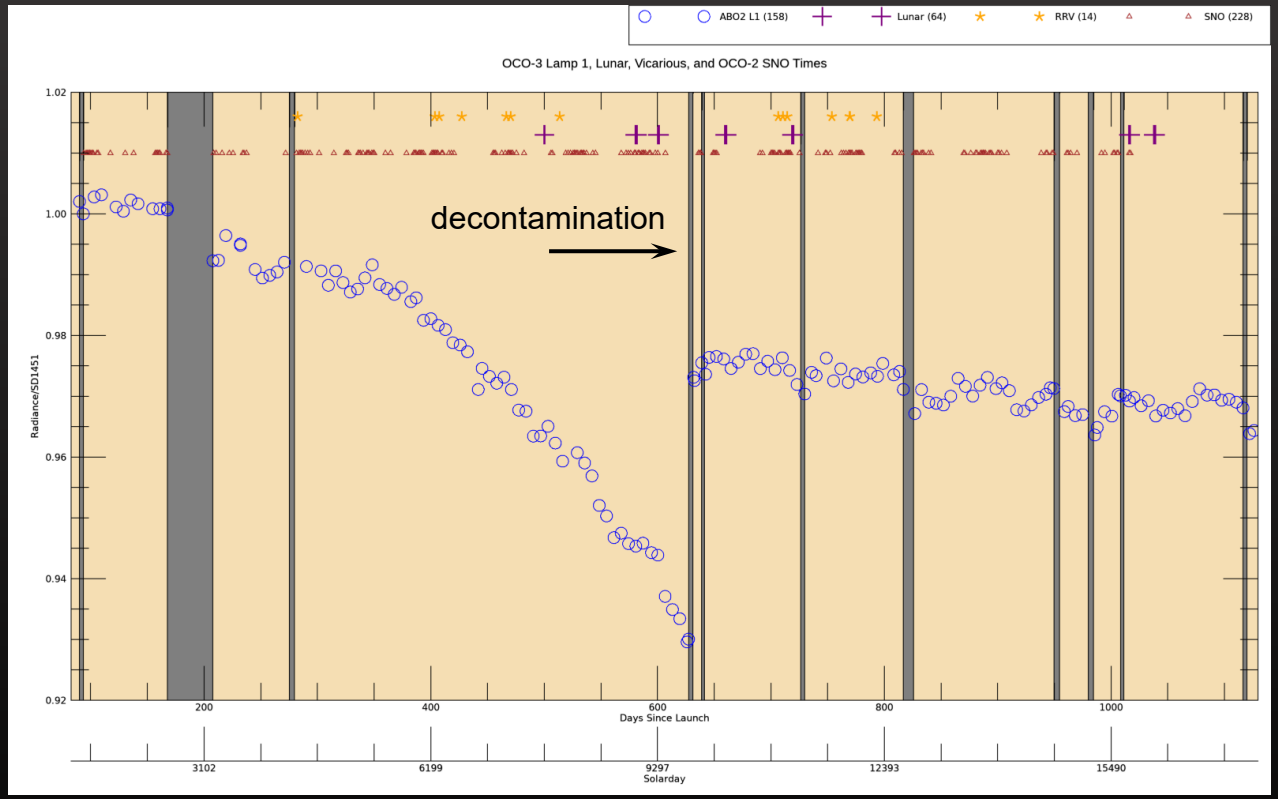
additional sources to test/verify calibration

Vicarious (RRV)	frequent	frequent
Cross-Sensor (SNOs)	when possible	when possible

OCO-3 Challenges:

- On-board calibration lamps are changing/degrading relative to pre-flight measurements
- Solar observations are not possible due to mounting location on the ISS
- Lunar observations are infrequent, and of inconsistent moon phases

OCO-3 In-Flight Calibration Lamp 1 – Change Over Mission Lifetime



Lamp 1 O_2 *A* Band Radiance relative to Solar Day 1421 (2019-08-03)

How Do We Define and Determine an SNO?

OCO-2 and OCO-3 observe the same location over the Earth

- within 10 minutes of each other, and
- have footprints centered within 2 km of each other

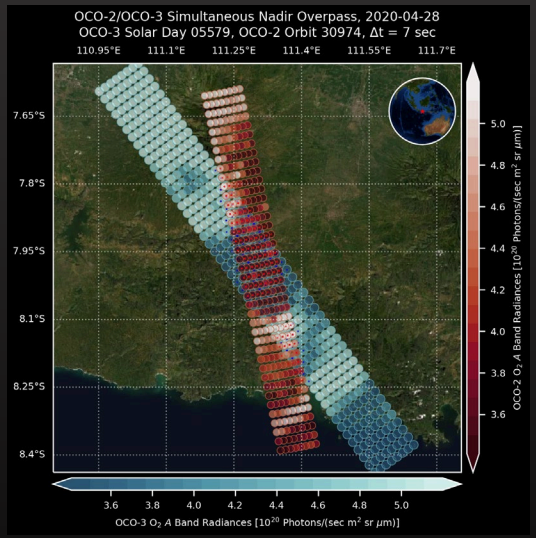
Process of SNO determination

- find ISS/OCO-2 spacecraft crossings within 10 min
  (OrbNav Tool: https://www.ssec.wisc.edu/~gregq/collopak/orbnav.html)
- identify corresponding L1b data product files (nadir observations only)
- match footprints between the sensors in space and time

SNO analysis is still experimental:

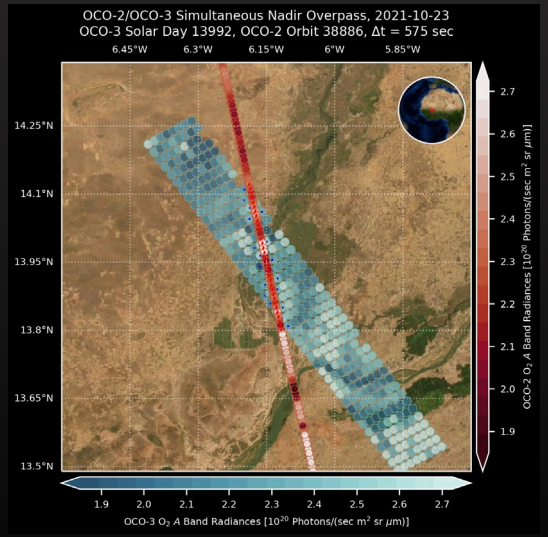
- limited to continuum radiance comparisons
- current comparison: analyze radiance ratios for matching footprints ”as is”
- filter radiance comparisons for homogeneous scenes (low scene/radiance variability)
- work in progress (not shown): compare radiance ratios for overlapping footprints using tessellation-based gridded data (different footprint sizes and footprint overlap)

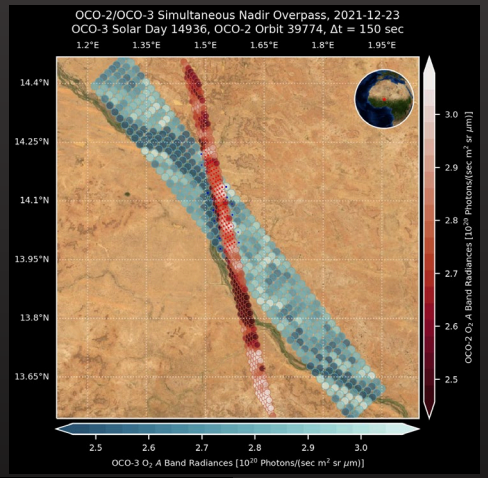
OCO-2 – OCO-3 Simultaneous Nadir Overpasses
Examples of O_2 *A* Band Radiances

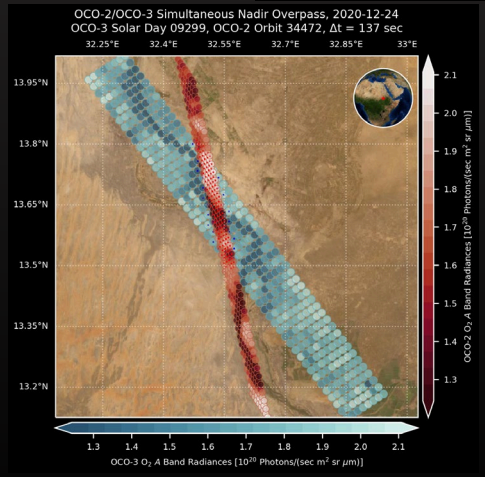


overpass within 7 sec
(non-rotated OCO-2 swath orientation)

OCO-2 in “Streak-Flat” orientation
(spacecraft rotates to mitigate
polarization effects)

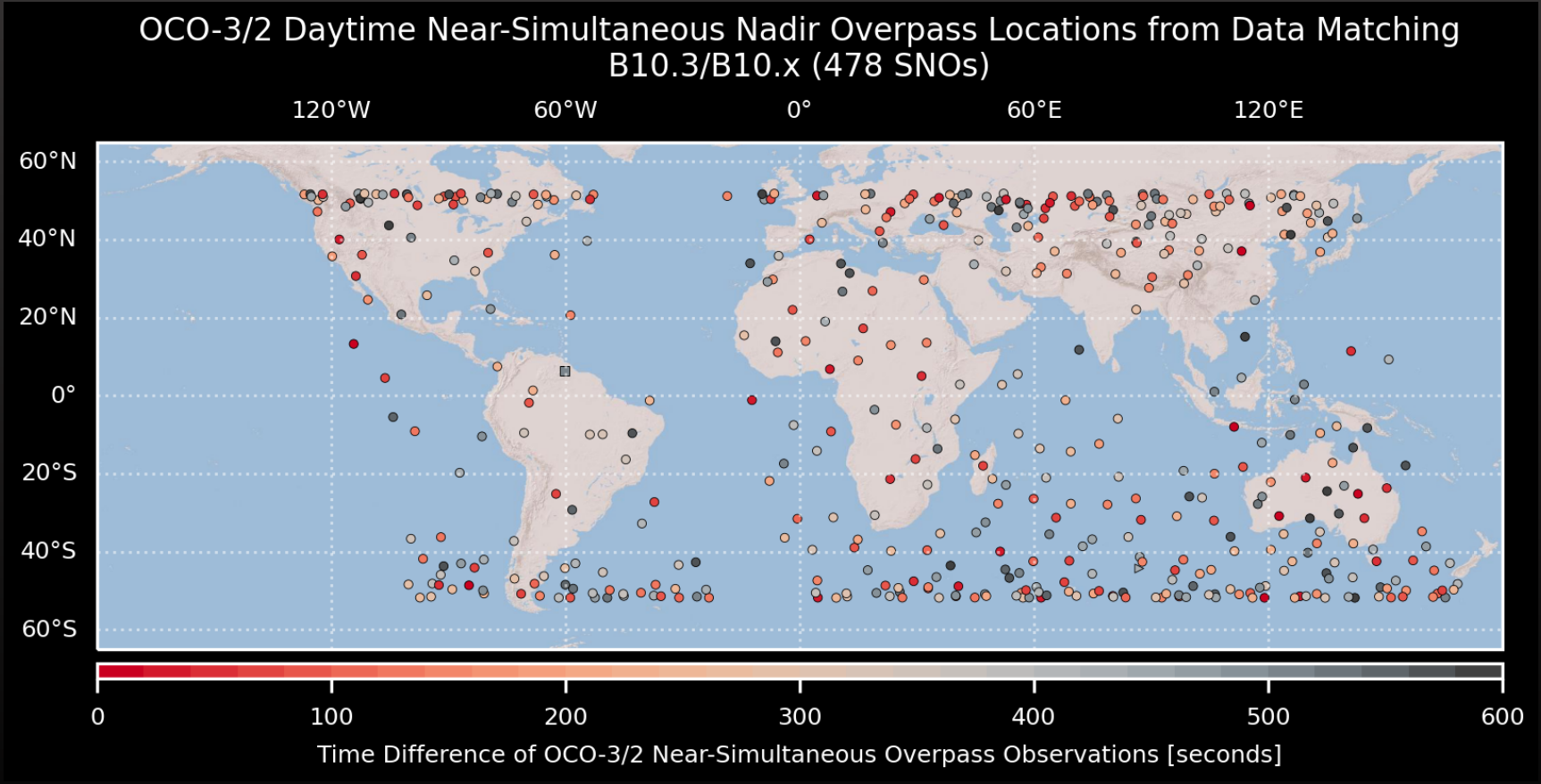






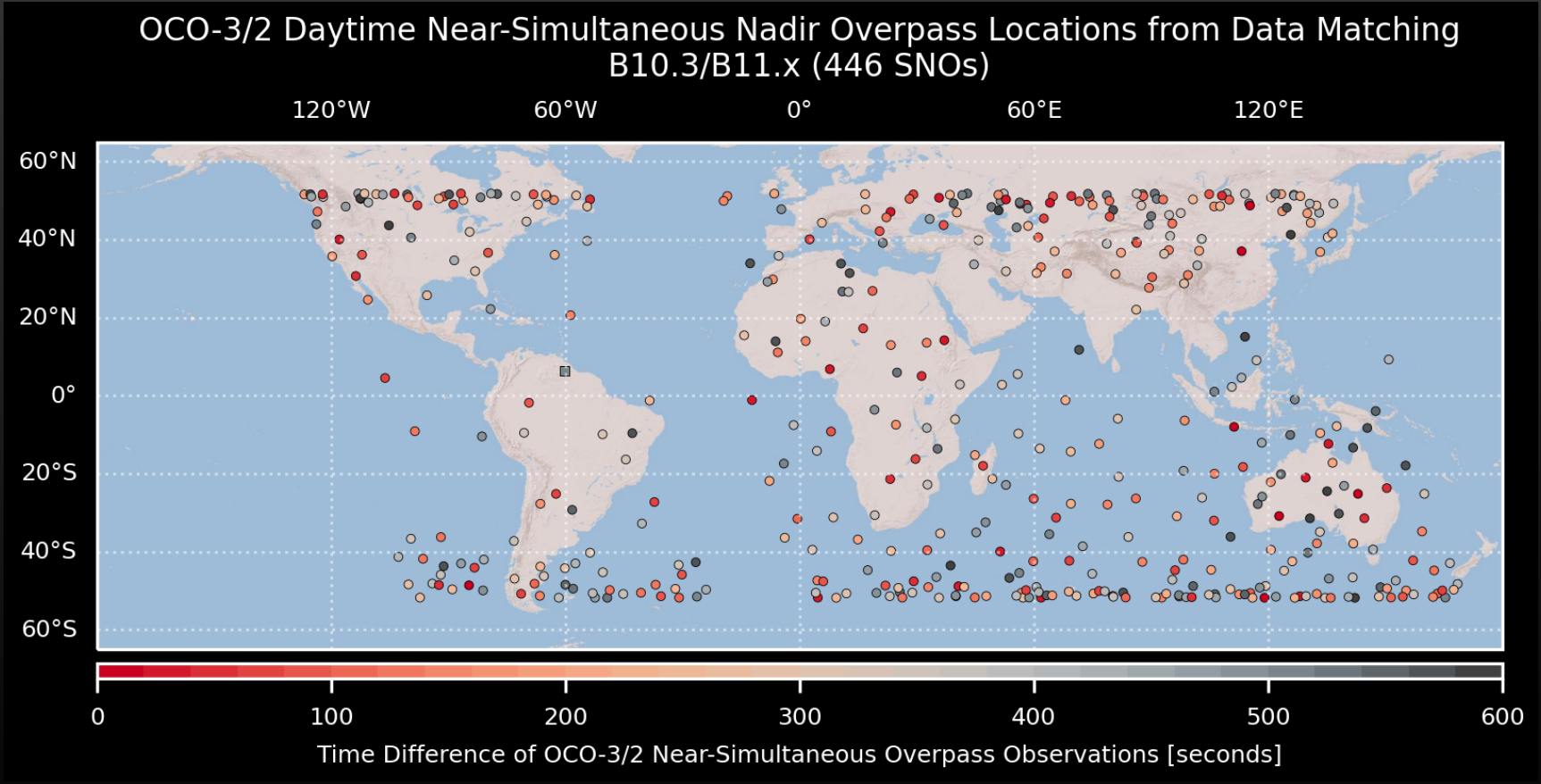
two sub-Saharan SNOs over rivers, a year and a day apart

OCO-2 – OCO-3 Simultaneous Nadir Overpasses (OCO-2 B10)
2019-08-06 – 2022-02-13



SNOs tend to occur at the ISS turn-around latitudes where OCO-2/3 tracks are at their largest relative angle

OCO-2 – OCO-3 Simultaneous Nadir Overpasses (OCO-2 B11)
2020-02-09 – 2022-04-28



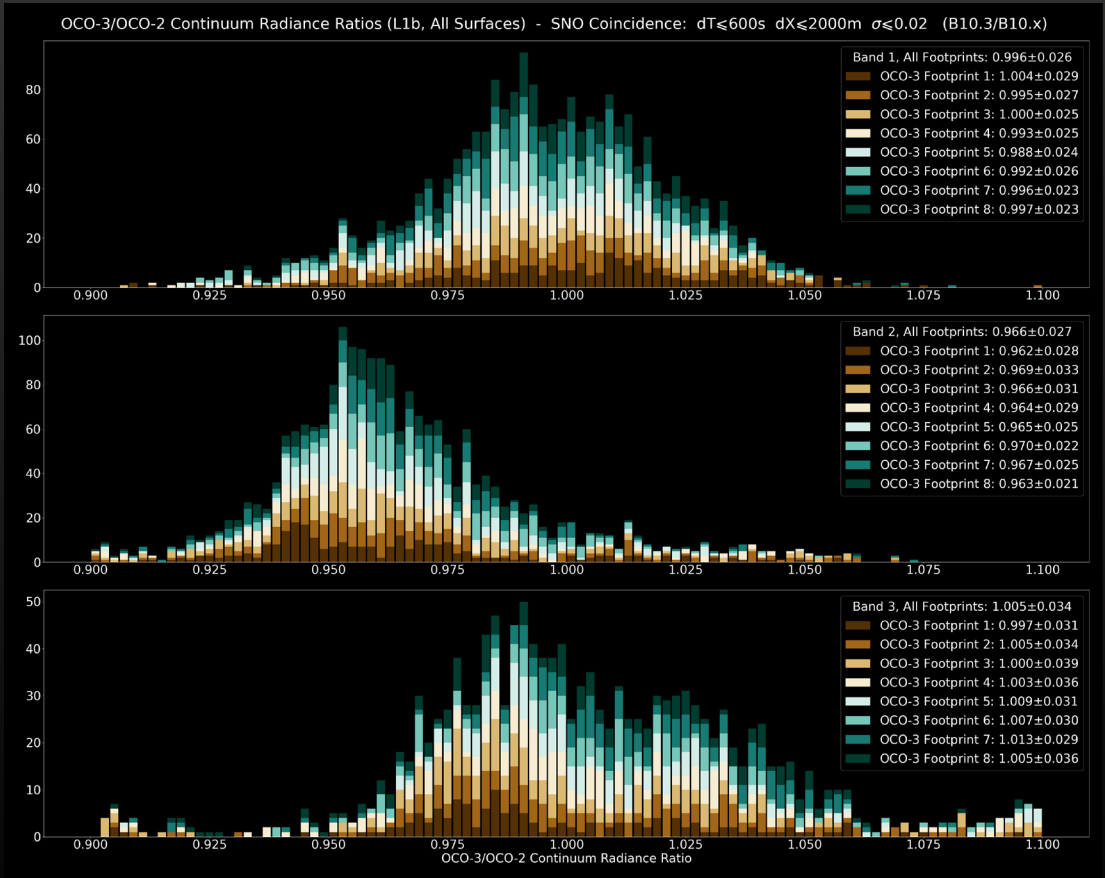
OCO-2 B11 reprocessing is still on-going

OCO-2 – OCO-3 Simultaneous Nadir Overpasses
Histograms of Continuum Radiances, by Band and Cross-Track Footprint (OCO2-B10)

O_2 *A* Band

Weak CO_2 Band

Strong CO_2 Band



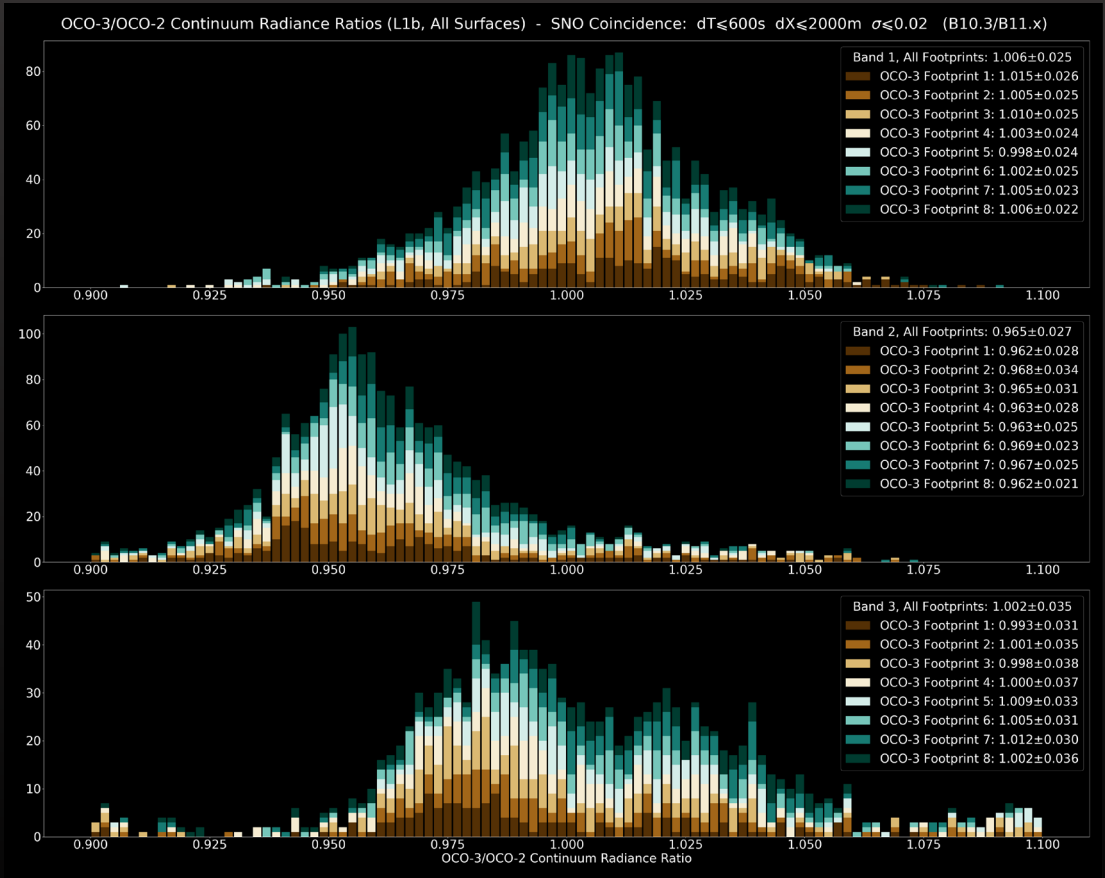
vicarious calibration over RRV indicates OCO-2 wCO_2 band is high

OCO-2 – OCO-3 Simultaneous Nadir Overpasses
Histograms of Continuum Radiances, by Band and Cross-Track Footprint (OCO2-B11)

O_2 *A* Band

Weak CO_2 Band

Strong CO_2 Band



differences to OCO-2 B10 are well understood based on reprocessed Lunar trend analysis

OCO-3/OCO-2 SNO Analysis – Current Summary

- Continuum Radiance comparison shows no obvious footprint-dependent bias
- Indications that OCO-2 weak CO_2 band high are in line with recent results from vicarious calibration

OCO-3/OCO-2 SNO Analysis – Next Steps

- refine continuum selection
- compare spectral shape of continuum radiances
- quantify analysis by surface type, scene heterogeneity, pre-/post decon, *etc*.
- refine analysis using fractional overlap of matched pixels, to account for differences in OCO-2 and OCO-3 footprint sizes and adjacent footprint overlap

thank you

https://ocov2.jpl.nasa.gov/
https://ocov3.jpl.nasa.gov/