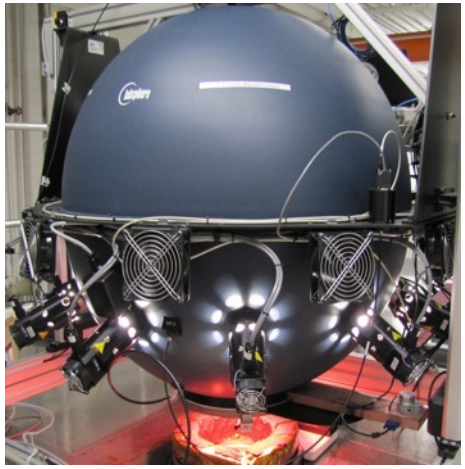
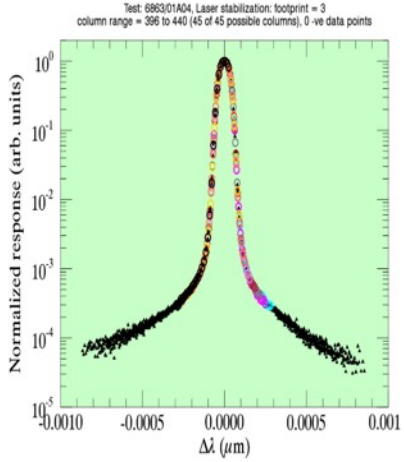
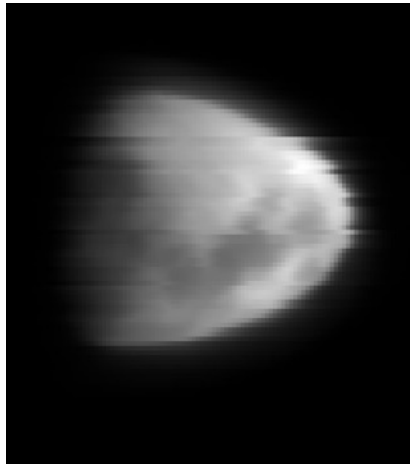
National Aeronautics and Space Administration
Jet Propulsion Laboratory
California Institute of Technology

# Static and Dynamic Inputs to OCO-2/3 Calibration

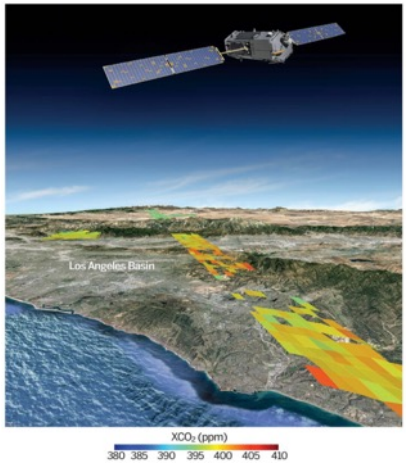


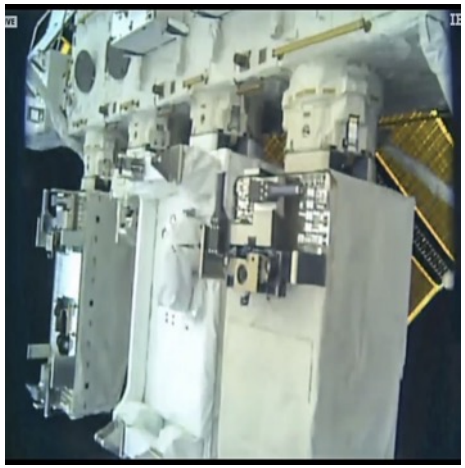


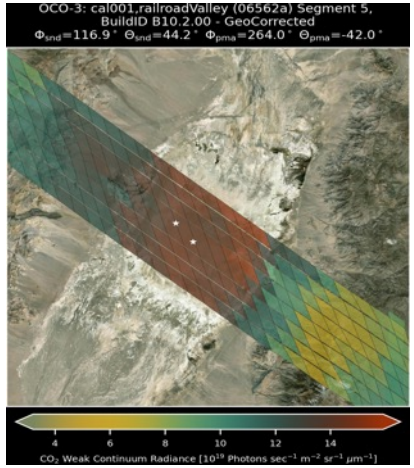


## PREFLIGHT & INFLIGHT DATA COMBINED, COEFFICIENTS UPDATED WEEKLY



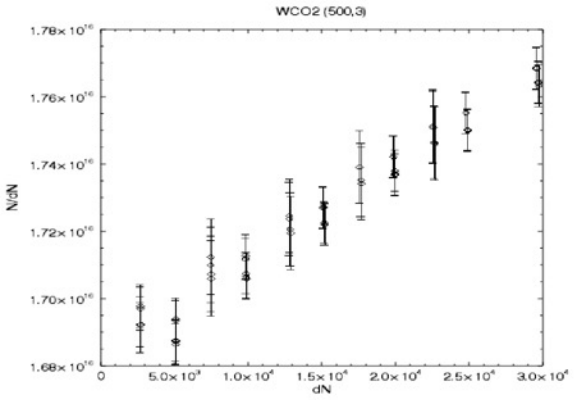





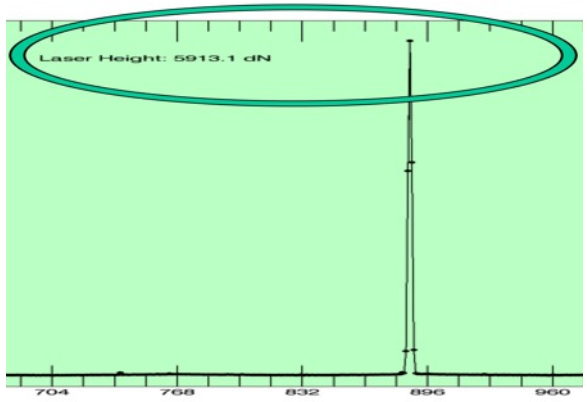

Robert Rosenberg, Lars Chapsky, Graziela Keller, Dejian Fu, Vance Haemmerle, Richard Lee, Yuliya Marchetti, Gary Spiers, Shanshan Yu, David Crisp, Annmarie Eldering - Jet Propulsion Laboratory, California Institute of Technology, Stephen Maxwell - NIST

# Preflight: Original…and Best?

- An integrating sphere with variable output that was characterized in multiple configurations was used to derive nonlinear radiometric gain. Inflight sources do not have the dynamic range to re-fit this curve, only to scale it



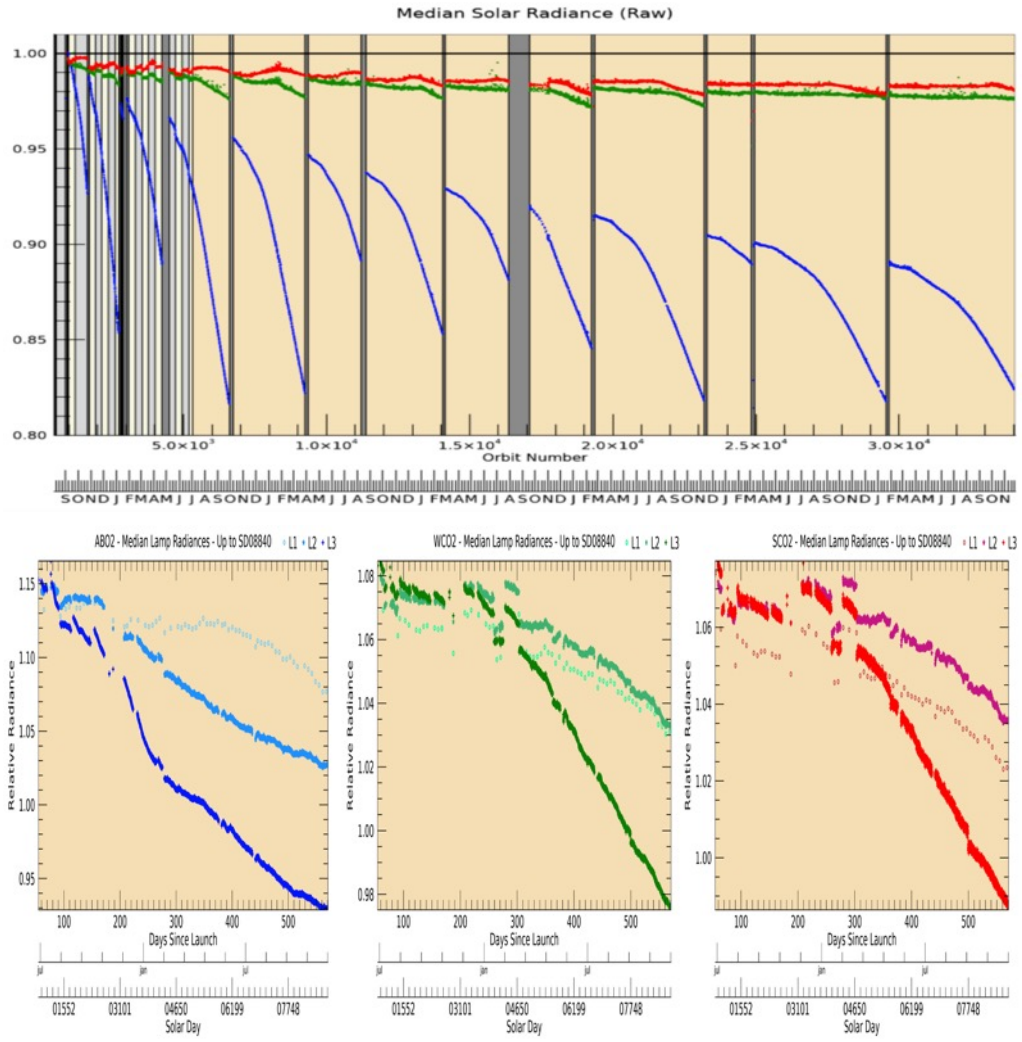

- A tunable diode laser was scanned in fine steps across each spectral range, allowing for a very precise measurement of the instrument line shape (200 element lookup table per sample). Solar lines can be used for inflight trending, but not to rederive the ILS.




- Also performed geometric & polarimetric tests not repeatable on orbit

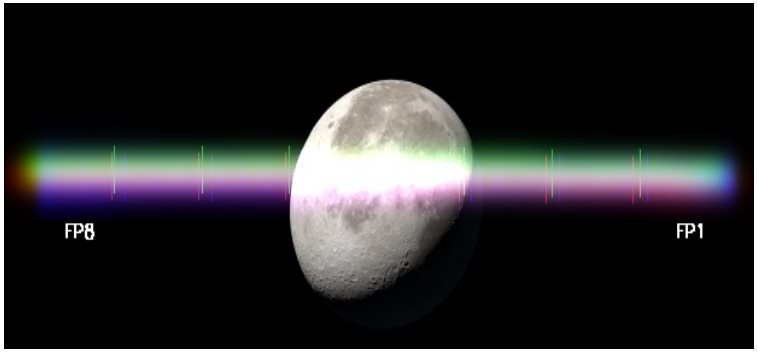
# Inflight Regular Calibrations

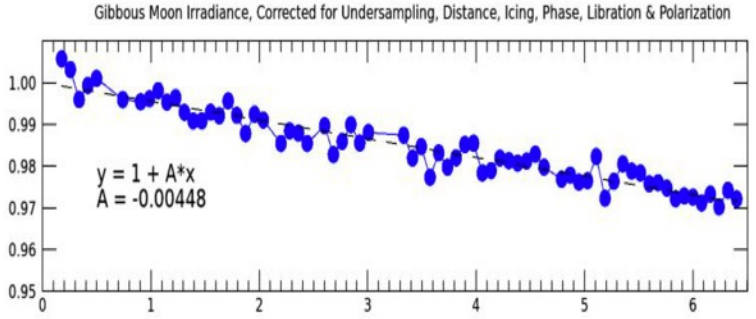
- Dark current is temperature dependent and is measured multiple times on the night side of every orbit
- OCO-2 uses lamp data to track “fast degradation” (dominated by ice on FPA in ABO2) and uses solar data to correct lamp aging
- OCO-3 cannot perform solar calibrations, so the secondary & tertiary lamp are used to correct primary lamp aging



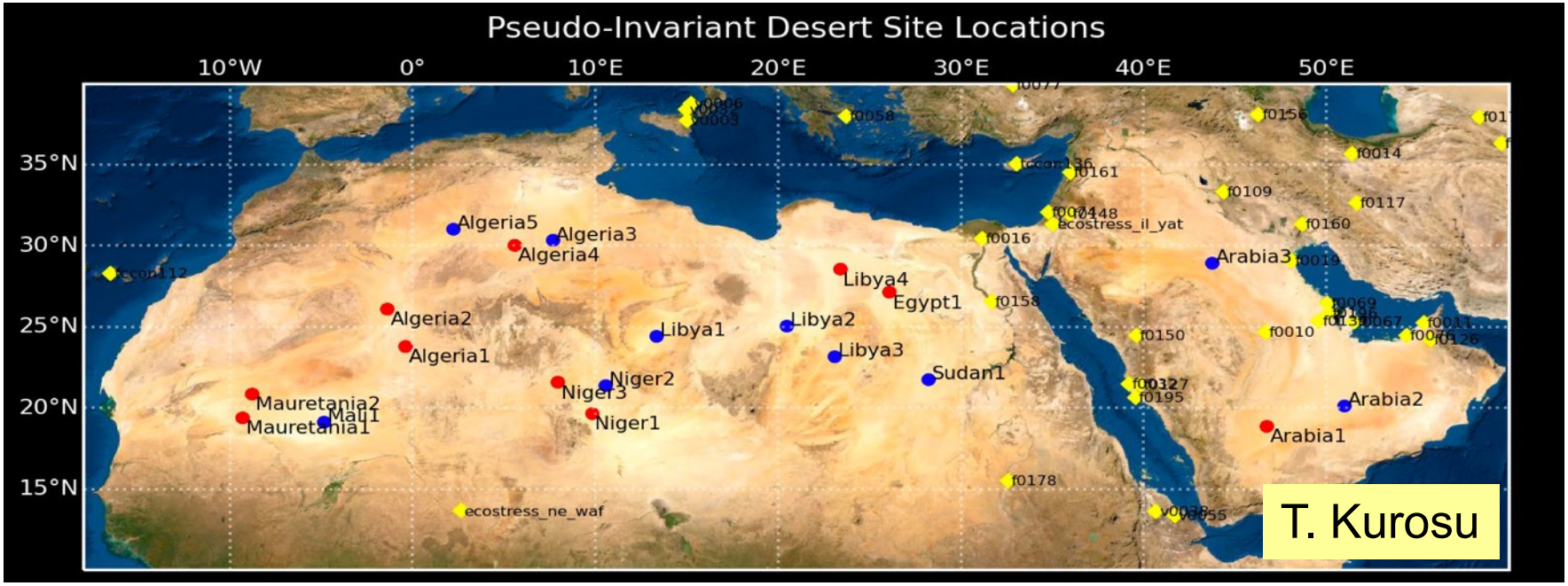
# Inflight Special Calibrations

- OCO-2 has observed almost every ¾ waxing gibbous Moon since Aug 2014
- OCO-3 lunar calibration is rare due to obstructions in the field of view, but can scan many times per opportunity
- Used to assess radiometric drift and absolute calibration vs. ROLO model
- Both instruments have targeted the vicarious calibration site at Railroad Valley, NV dozens of times. Persistent sensors track the stability of surface reflectance, regular field campaigns are conducted to measure ground truth



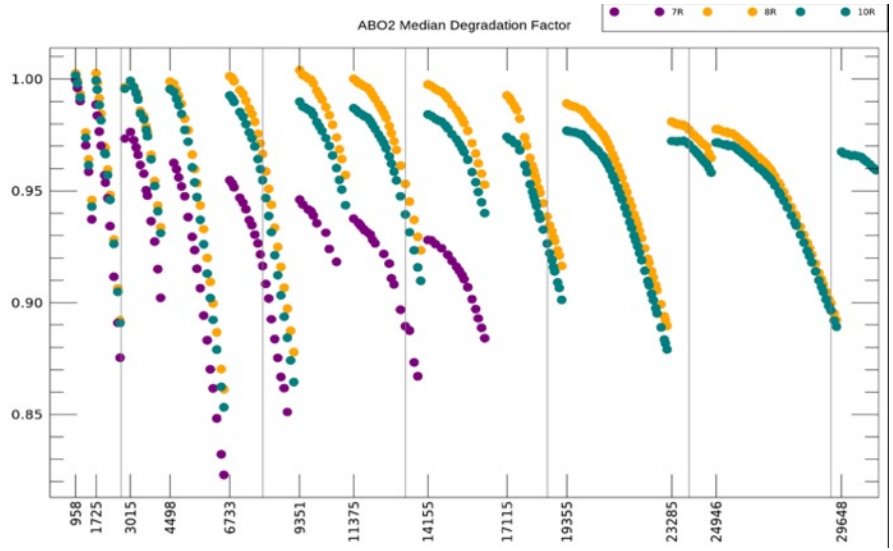

# Learning from Science Data




- OCO-2 Nadir data over PICS compared to MODIS to assess drift
- OCO-2 and OCO-3 have hundreds of simultaneous nadir overpasses
- Surface features have been used to refine geolocation
- L2 retrieval algorithm adjusts dispersion, these are fed back into L1B
- Detector outliers that worsen spectral fits are flagged for removal

# Rolling Reprocessing & Campaigns

- Science goals are centered on watching XCO2 change with time and space, so stability of calibration coefficients is key
- Improvements have to wait until the next version is released even after a known flaw is found
- Reprocessing campaigns driven by calibration, spectroscopy, and retrieval upgrades. When a new version is scheduled, the list of calibration updates is finalized
- Example: OCO2 B10 radiometry uses lunar trend until Apr 2019




- After initial reprocessing campaign, retrospective calibration delivered monthly using the same algorithms (bad sample removal continues)
- Forward stream not continuous