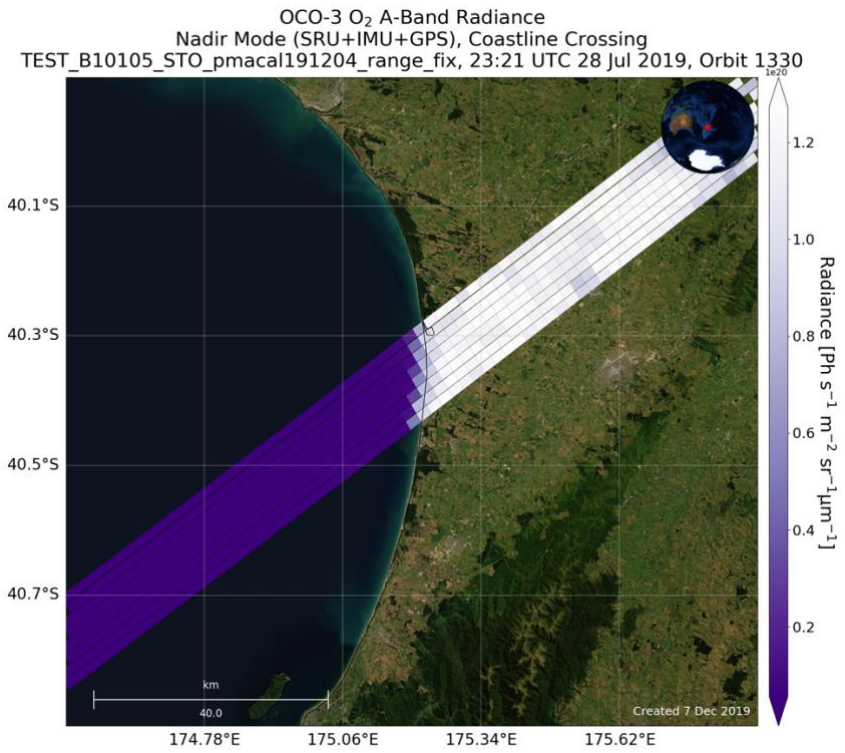
OCO-3 Data Quality Statement: Level 1b File Data Release Early (VEarly) – January 20, 2020

The Orbiting Carbon Observatory-3 (OCO-3) has released the latest version of the Level 1b (L1b) data product, containing radiometrically calibrated, geolocated radiances from OCO-3 observations. This version of the L1b Product is release Early (VEarly) and has been processed based on version 10.0 (V10) of the OCO-3 Level 1 algorithms. This will be delivered in a forward stream (v_Early) and retrospective processing of past data (v_Early_r), which has interpolated rather than extrapolated calibration inputs. It is labeled as an Early release as the team expects updates to the L1b calibration as part of a future release of data through L2 processing. The intent of this data release is to provide data users with examples so they can become familiar with the data products, but the value of the data for scientific application and use for publication will be very limited until the next release.

Users who are familiar with the OCO-2 data will find that the OCO-3 data format is consistent with the OCO-2 data format. The one change that users need to be aware of is that there is a new observation mode for OCO-3 called snapshot area mapping (SAM). In addition, the new OCO-3 Pointing Mirror Assembly (PMA) is agile, and labeling of the PMA position and state is included in OCO-3 data. More details of the fields, values, and recommended use are included below.

Geolocation challenges have limited the ability to fully evaluate the state of spectral and radiometric calibration, but the checks that have been performed indicate that it is of good quality, comparable to or better than OCO-2 Build 7R. The radiometric calibration is also limited by the short duration of the data at this point, and is expected to improve as the data record length increases. The overall radiometric scaling is not yet well constrained (~10%), as OCO-3 cannot perform solar calibrations, and has not yet performed lunar calibration. Lamp data are acquired every orbit to track relative degradation and detector artifacts, but this does not separate lamp aging from instrument throughput changes. This is partially compensated by using the secondary and tertiary lamps more frequently, which will be used in future releases, and ultimately the gain will be constrained by comparisons to other satellites and well-characterized surface targets. Dark calibration is measured very frequently, and after correction errors are a small fraction of the noise level. There is no on-orbit source for spectral calibration, but comparison of inflight science data with preflight uplooking measurements gives confidence that it is stable and subpixel.

The current accuracy of the footprint geolocation for OCO-3 is approximately 1 km for nadir and glint modes and 1-5 km for snapshot area mapping and target modes. The PMA calibration completed in November 2019 greatly improved the errors, which had previously been >= 5 km for all modes. The team is working on processing additional PMA calibration images and improving the correction model to hopefully reduce the geolocation errors to less than 500 m for all modes in a future update.



An example of the current OCO-3 geolocation for nadir mode. The purple/white boundary should align with the coastline.

Finding useful data for OCO-3:

The OCO-3 L1b product is similar to OCO-2 L1b except that snapshot area mapping mode has been added. This, along with the other modes, can be identified and isolated using /SoundingGeometry/sounding_operation_mode. The options are glint (GL), nadir (ND), target (TG), snapshot area mapping (AM), and transition (XS). Selecting GL, ND, TG, or AM will automatically remove any OCO-3 soundings that were taken when the Pointing Mirror Assembly was in motion.

New fields for OCO-3:

A. sounding_pcs_mode

A two-letter abbreviation of the mode of the OCO3 payload's Pointing Control System: PS, PA, PR, PC, PJ, PT, RN, ND, RG, GL, RT, TG, RA, AM

These are the corresponding enumerations and labels as known to mission ops:
0: STANDBY
1: ACQUISITION
2: SCIREADY

3: CALIBRATOR
4: JOYSTICK
5: TEST
6: NADIR_RETARGET
7: NADIR_SCIENCE
8: GLINT_RETARGET
9: GLINT_SCIENCE
10: TARGET_RETARGET
11: TARGET_SCIENCE
12: AREA_MAPPING_RETARGET
13: AREA_MAPPING_SCIENCE

A decoder of the SDOS 2-letter abbreviations:
PS = PCS Standby
PA = PCS Acquisition
PR = PCS (Sci)Ready
PC = PCS Calibrator
PJ = PCS Joystick
PT = PCS Test
RN = Retarget for Nadir
ND = Nadir
RG = Retarget for Glint
GL = Glint
RT = Retarget for Target
TG = Target
RA = Retarget for Area Map
AM = Area Map

B. sounding_pma_motion_flag

Integer flag set by Geolocation PGE from examining a combination of 5 Hz and/or 1 Hz PMA angles, velocities, status flags etc.
(0 = not moving, 1 = in motion, -1 = unknown)

The unknown case is meant to capture any situation where the algorithm cannot determine 0 or 1.

C. sounding_operation_mode

A two-letter abbreviation of the effective science observation mode: GL, ND, TG, AM, XS.

These are the same modes as OCO-2 (GL, ND, TG, XS), except a new Area Mapping (AM) mode is introduced.

This field is meant to free the general science user from having to know about either retargeting or motion flags.

All soundings acquired during retargeting are reassigned to either:
(a) their associated science modes (e.g. RG -> GL) when the sounding motion flag is 0,
(b) otherwise to XS (transition).

All non-science modes are also assigned to XS.

[In B8, a per sounding field of the same name was introduced into the oco2 products so users could convert to this per sounding paradigm.]

D. sounding_pma_azimuth

Pointing Mirror Assembly azimuth rotation angle in science reference
0-360 deg

E. sounding_pma_elevation

Pointing Mirror Assembly elevation rotation angle in science reference
0-360 deg

F. sounding_pcs_data_source

This identifies the data source of the information used in the pointing control software.

0 = Estimator uses SRU, IMU, and GPS, 1 = Estimator uses SRU, and GPS, 2 = Estimator uses IMU, and GPS, 3 = Estimator uses SRU, IMU, and BAD position, 4 = Estimator uses SRU, and BAD position, 5 = Estimator uses IMU, and BAD position, 6 = Estimator uses BAD attitude, and GPS position, 7 = Estimator uses ISS BAD data only
Else = no data available

This document created by Annmarie Eldering, Robert Rosenberg, and Robert Nelson.
Jet Propulsion Laboratory, California Institute of Technology, Pasadena CA.

The research was carried out at the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration (80NM0018D004).