Orbiting Carbon Observatory-2

Orbiting Carbon Observatory-2 (OCO-2) Data Release Statement: Level 2 Lite File version 11.2

Version 1.0 Rev A
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Orbiting Carbon Observatory-2
Level 2 Lite File version 11.2

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1 Data Quality Statement for the OCO-2 Level 2 Data Product

The latest version of the Orbiting Carbon Observatory (OCO-2) the Level 2 (L2) Lite data product is version 11.2 (v11.2) for data collected on and after April 2, 2024 and version 11.1 (v11.1) for data collected prior to April 2, 2024. The data has been released in data formats similar to past L2 Lite data file formats. An update to the OCO-2/OCO-3 Data User's Guide has been released with more information on the version 11.2 and 11.1 data products.

The version 11 of the OCO-2 L2 products included several improvements and fixes when compared to previous versions. The most important updates in v11 include:

- Use of an updated Digital Elevation Map (DEM) in the L2 retrievals
- Improvements in the L1B processing, including: gain degradation, dispersion trend, instrument line shape (ILS), noise model, footprint dependence
- Mitigation of previous issue with inadvertent flagging of majority of soundings over South Atlantic Anomaly
- Improvements to increase the throughput of the solar-induced chlorophyll fluourescence (SIF) retrievals
- Spectroscopy updates
- Updates to the absorption coefficient scaling factors used in the L2 retrievals that will help mitigate the overall X_{CO2} bias and CO_2 profile shape issues
- Improvements to the ocean surface treatment that improve the linearity of retrievals over ocean
- Minor updates to land bidirectional reflectance distribution function (BRDF)
- New CO_2 *a priori* profiles
- Changes to the rules that govern sounding selection
- A fix for an issue with SIF availability for target mode observations (this will be seen in the L2 SIF lite files)

Version 11.1 was a minor update to version 11 in which only the filtering and bias corrected values of X_{CO2} were changed, along with a few other variables. The primary change was related to modifications of surface elevation (which in turn modifies surface pressure). This process is described in detail in Jacobs et al. (2024). Specifically, the v11.1 changes included:

- Modification to 'dP' terms in the bias correction using the Copernicus GLO90 DEM as this was found to be significantly more accurate than the previous DEM.
- Filter variables 'co2_ratio' and 'h2o_ratio' have now been bias corrected, and the latter has been scaled according to its uncertainty. The bias-corrected versions ('co2_ratio_bc' and 'h2o_ratio_bc') replace the former terms for quality filtering.
- Slightly updated filtering and bias correction as compared to v11.

Evaluation of the version 11.1 data against TCCON suggests small improvements in the data as compared to version 10. The comparison of the version 11.1 data versus TCCON is shown in Figure 1. The comparisons for versions 10, 11 and 11.1 versus TCCON are shown in Figure 2.

The largest changes between version 11 and version 11.1 occur at the high latitude sites, consistent with the DEM improvements. Overall, version 11.1 is an improvement over previous versions with improved data at high latitudes due to the use of a more accurate DEM.

Version 11.2, which will be in place for all data produced on and after April 2, 2024 includes two significant changes:

- A transition in the meterological data products used as inputs to the L2 retrievals
- A continuation of the transition to a new Digital Elevation Model (DEM) first introduced in the v11.1 Lite data products.

The primary change involves the meteorological data inputs that are used for the OCO-2 L2 retrievals. The Global Modeling and Assimilation Office (GMAO) has recently switched from the GEOS FP-IT product to the GEOS-IT product. OCO-2 has made the decision to switch to using the GEOS-IT products in the forward processing and retrospective processing on April 1, 2024 and switch to the new data label of V11.2. All OCO-2 products prior to April 1, 2024 will remain as V11.1 products that use the GEOS FP-IT meteorological data as input for the retrievals.

In version 11.1 products, the Copernicus GLO90 DEM1 was introduced for modification of the 'dP' term in the bias correction. This would show up in the v11.1 Lite files in the XCO2 product that is bias corrected. In v11.2, the new DEM is also used for determining the elevation of the OCO-2 footprints for the L2 full physics data products (non-Lite Files). This will be true for both the complete L2 Full Physics data products and the v11.2 Lite products. A description of the different DEMs and the effects that the changes in the DEM can have on X_{CO2} data are discussed in Jacobs et al. (2024).

The transition to the new GEOS-IT data products will lead to a noticeable discontinuity in the X_{CO2} data record from OCO-2. The effect is small, but varies regionally as can be seen in Figure 3. This discontinuity should be kept in mind when using the OCO-2 data for time periods that span the transition date of April 2, 2024.

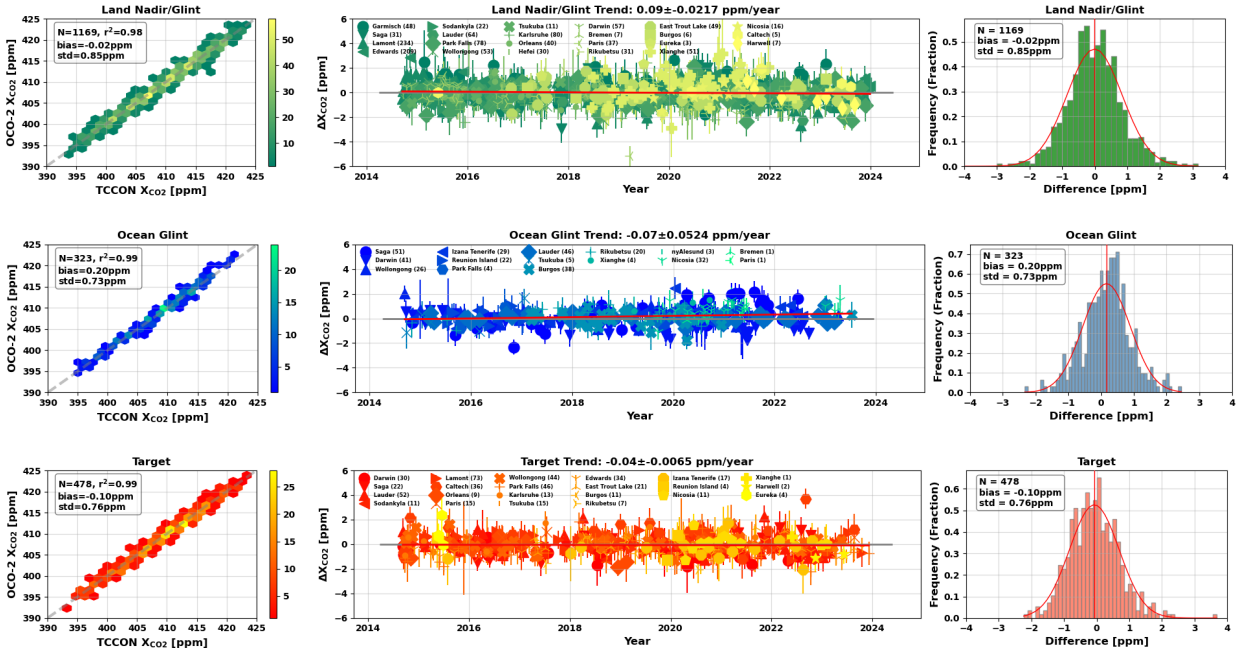

Figure 1: Comparisons between OCO-2 version 11.1 and TCCON data for land (nadir and glint), ocean glint and target data.

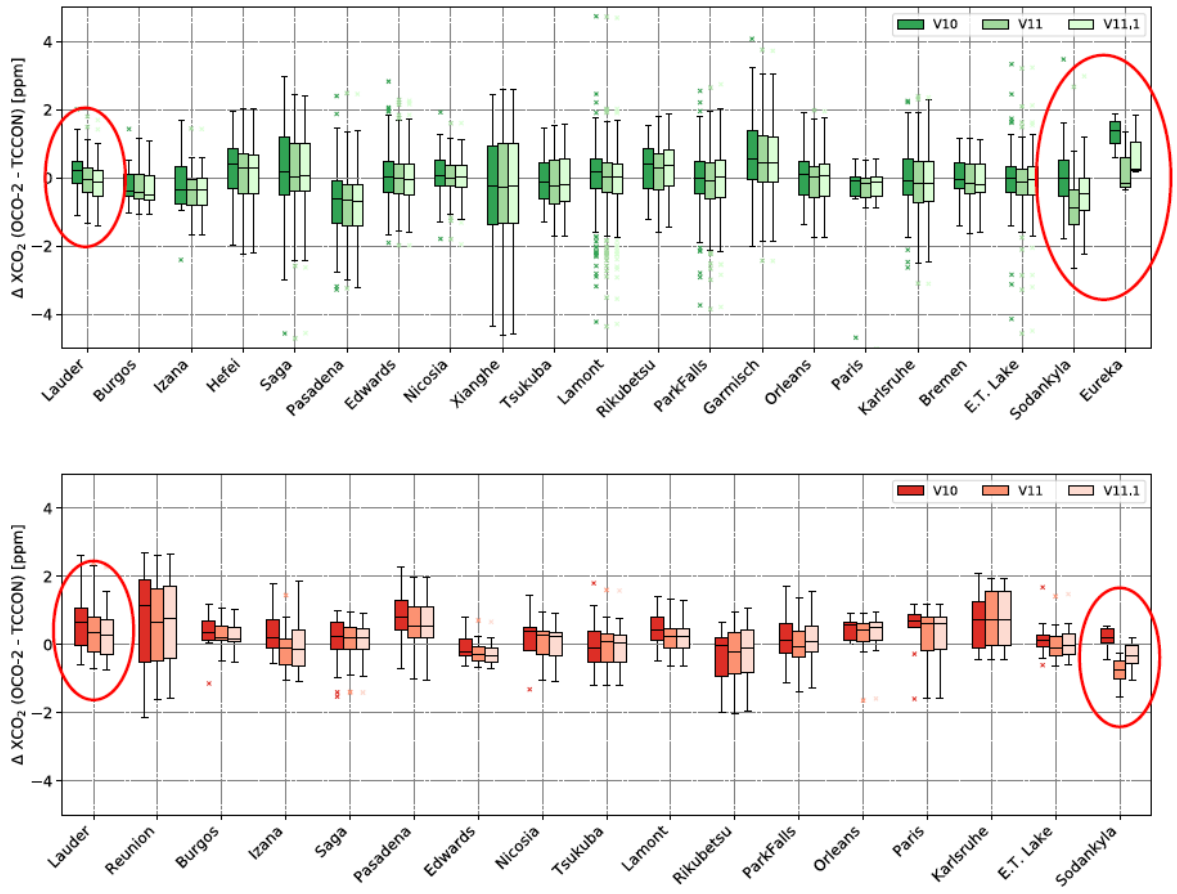

Figure 2: Comparisons of OCO-2 v10, v11 and v11.1 data (nadir and glint) versus TCCON (top) and of v11.1 target data versus TCCON (bottom)

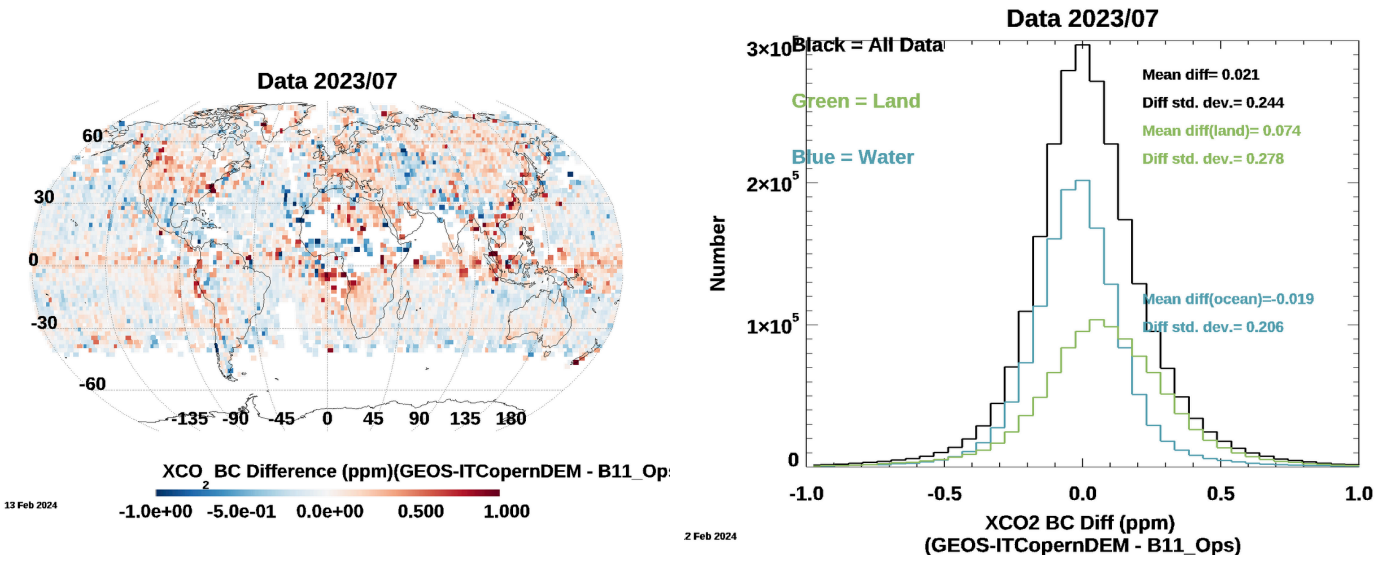

Figure 3: Differences in XCO2 between the new v11.2 data including GEOS-IT and Copernicus DEM and the v11.1 data using GEOS FPIT. The left figure show the global differences and the right figure shows histograms of the difference for the all the data (black curve), land data (green) and ocean data (blue). The average difference is -0.021 ppm with a standard deviation of 0.244. All comparisons are for July 2023

2 Selected References

DEM Reference:

The Copernicus WorldDEM™-90 Digital Elevation Model, 90m horizontal resolution (copyright DLR e.V., 2010-2014, Airbus Defence and Space GmbH 2014-2018) was provided under Copernicus by the European Union and ESA; all rights reserved. https://spacedata.copernicus.eu/collections/copernicus-digital-elevation-model .

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3 Links

- OCO-2 Mission web site
- OCO-2 L2 data page at the Goddard Earth Sciences Data and Information Services Center (GES DISC): link
- OCO-2 Documentation at the GES DISC: link