

Summary of the validation on GOSAT-2 TANSO-FTS-2 SWIR L2 Chlorophyll Fluorescence and Proxy-method Product (Ver. 02.30)

August 2026
NIES GOSAT-2 Project

For the validation of the GOSAT-2 TANSO-FTS-2 SWIR L2 Chlorophyll Fluorescence and Proxy-method Product (hereafter abbreviated as GOSAT-2 PROXY product), the column-averaged dry-air mole fractions of methane (X_{CH_4}) and carbon monoxide (X_{CO}) of the GOSAT-2 PROXY product (Ver. 02.30) are compared with those obtained by the ground-based high-resolution Fourier transform spectrometers (FTS) belonging to the Total Carbon Column Observing Network (TCCON) (hereinafter abbreviated as TCCON data). The results of the validation are summarized as below.

GOSAT-2 PROXY product

The GOSAT-2 PROXY product of Ver. 02.30 is used. The comparison period is from March 1, 2019 to January 31, 2024. Land data is defined for data with a land ratio of 10% or more in the comparison area, and Ocean data is defined for data with a land ratio of less than 10% in the comparison area. There is no distinction between gains. Only data with the quality flag “Good” are used.

TCCON data

The TCCON data used are obtained from the TCCON data archive (<http://tccondata.org>), which are retrieved by the algorithm GGG2020. They are averaged over within ± 30 min of GOSAT-2 overpass time. Relationships for each atmospheric composition to the in-situ scale are below. The “Calibration scale” column indicates which scale or source these data are tied to by the air-mass-independent correction factors. n/a: not applicable.

X_{gas} product	Correction factor	Calibration scale
X_{CH_4}	1.0031	WMO X2004
X_{CO}	1.0000	n/a

Comparison conditions of GOSAT-2 PROXY product with TCCON data

- The GOSAT-2 PROXY product obtained within the comparison areas of $\pm 0.1^\circ$, $\pm 1^\circ$, $\pm 2^\circ$, and $\pm 5^\circ$ in latitude and longitude centered at each TCCON site are compared with the TCCON data by Land and Ocean. Since many TCCON sites are located inland, the amount of data over Ocean is smaller than that over Land.
- Among the GOSAT-2 PROXY product, those with a difference between the footprint altitude and the altitude of the TCCON site greater than 500 m are excluded from the comparison.

Results

The number of comparison data, mean biases (GOSAT-2 PROXY product minus TCCON data), their standard deviations, and their relative values in the comparison areas by Land and Ocean are listed in Table 1.

Table 1. Comparison of GOSAT-2 PROXY product (Ver. 02.30) with TCCON data: number of comparison data (N), mean bias (Bias), its standard deviation (Std), and their relative values in each comparison area by Land and Ocean. Land indicates data over land, and Ocean indicates data over ocean.

SWPR V02.30 2019/3/1- 2024/1/31	Comparison area	Land					Ocean				
		N	Bias [ppb]	Std [ppb]	Bias [%]	Std [%]	N	Bias [ppb]	Std [ppb]	Bias [%]	Std [%]
XCH ₄	±0.1°	5272	-6.14	11.66	-0.33	0.63	5	-6.25	13.12	-0.34	0.71
	±1°	25779	-5.88	12.67	-0.31	0.67	437	-1.79	16.16	-0.10	0.87
	±2°	35334	-4.26	13.79	-0.22	0.73	1462	-3.84	18.41	-0.21	1.00
	±5°	77792	-3.64	15.59	-0.19	0.83	13522	-6.45	19.31	-0.35	1.05
XCO	±0.1°	3691	3.61	8.31	4.75	9.18	4	2.73	18.35	3.34	20.47
	±1°	18375	3.87	12.73	4.65	11.04	262	8.47	9.53	10.88	11.31
	±2°	25538	4.40	13.19	5.23	11.47	965	7.22	9.63	9.22	11.07
	±5°	55732	4.70	15.48	5.61	13.64	9280	6.64	11.69	9.06	13.25

Unit: ppb for XCH₄ and XCO; % for relative values

The scatter plots of the GOSAT-2 PROXY product against TCCON data within the comparison area of ±2° by Land and Ocean are shown in Figure 1. The time series of biases within the comparison area of ±2° by Land and Ocean are shown in Figure 2. The mean biases in each comparison area by Land and Ocean are shown in Figure 3.

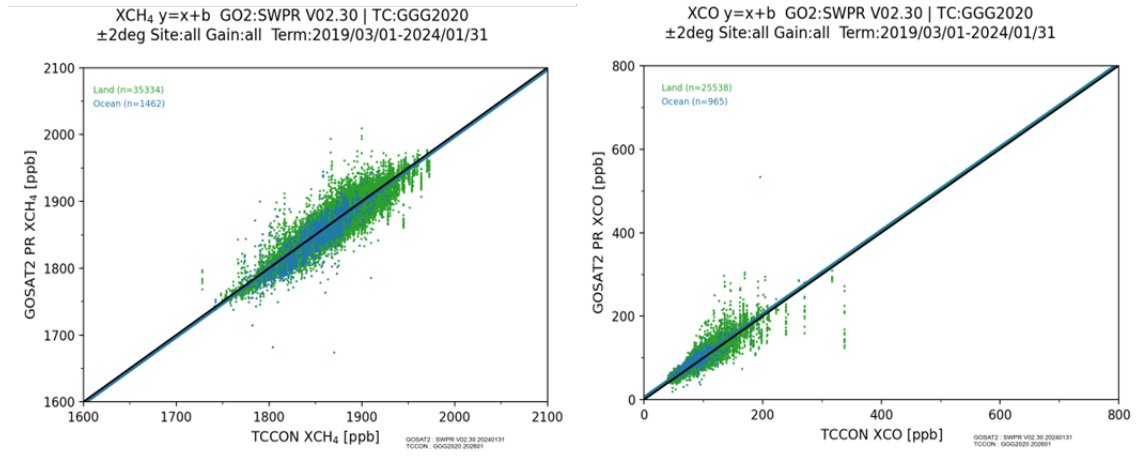


Figure 1. Scatter plots of GOSAT-2 PROXY product (left: XCH₄, right: XCO) against TCCON data within comparison area of ±2° by Land and Ocean (green: Land data, blue: Ocean data).

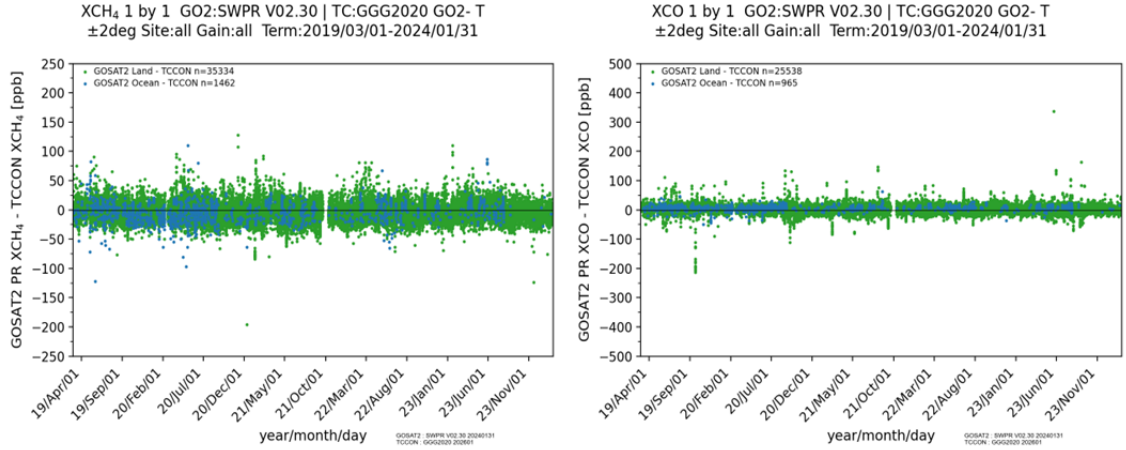


Figure 2. Time series of biases within comparison area of $\pm 2^\circ$ by Land and Ocean (green: Land data, blue: Ocean data) for GOSAT-2 PROXY product (left: XCH_4 , right: XCO) from March 2019 to January 2024.

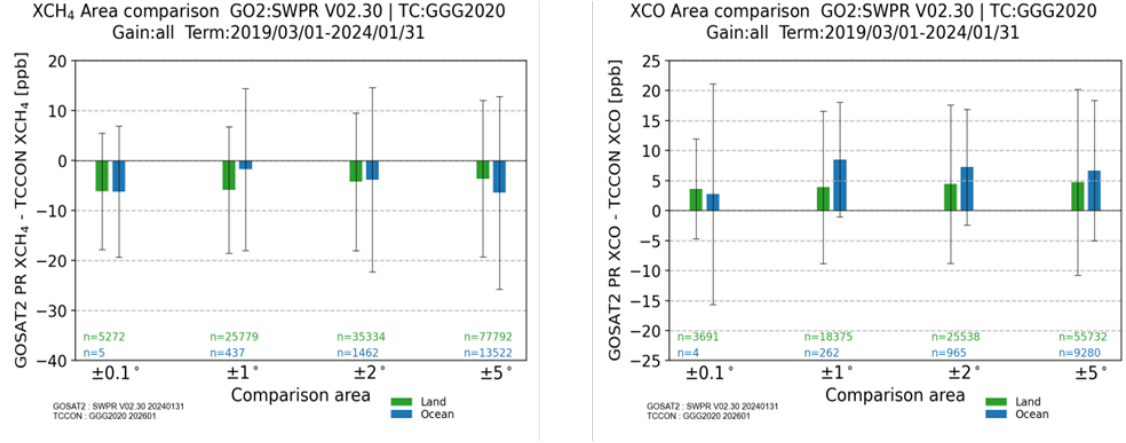


Figure 3. Mean biases in each comparison area by Land and Ocean (green: Land data, blue: Ocean data) for GOSAT-2 PROXY product (left: XCH_4 , right: XCO).

The numbers of comparison data of with TCCON data in this version (Ver. 02.30) are compared with those in the previous version (Ver. 02.20). The numbers of XCO comparison data in this version increase by one within the comparison area of $\pm 2^\circ$ and by two within the comparison area of $\pm 5^\circ$. However, no changes are observed in the mean biases and their standard deviations between both versions in any of the atmospheric compositions and the comparison area.

Summary of GOSAT-2 PROXY product validation

The GOSAT-2 PROXY product for XCH₄ and XCO (Ver. 02.30, March 1, 2019 – January 31, 2024) are compared with the TCCON data. The results of the validation within the comparison area of $\pm 2^\circ$ are summarized as follows.

- The mean biases and their standard deviations of XCH₄ over Land and Ocean are -4.26 ± 13.79 ppb ($-0.22 \pm 0.73\%$) and -3.84 ± 18.41 ppb ($-0.21 \pm 1.00\%$), respectively.
- The mean biases and their standard deviations of XCO over Land and Ocean are 4.40 ± 13.19 ppb ($5.23 \pm 11.47\%$) and 7.22 ± 9.63 ppb ($9.22 \pm 11.07\%$), respectively.
- No specific trends in bias are found for both the atmospheric compositions observed during the observation period.

The results of the validation of the GOSAT-2 PROXY product in other conditions are summarized as follows.

- For XCH₄, all the mean biases over Land and Ocean are negative. The absolute mean biases over Land and Ocean are both lower than 10 ppb. While those over Land decrease with expanding the comparison area, those over Ocean increase with expanding the comparison area except within $\pm 0.1^\circ$.
- For, XCO, all the mean biases over Land and Ocean are positive. The mean biases over Land are lower than 5 ppb and those over Ocean are lower than 10 ppb. While those over Land increase with expanding the comparison area, those over Ocean decrease with expanding the comparison area except within $\pm 0.1^\circ$.

The numbers of comparison data that met the comparison conditions with TCCON data in this version (Ver. 02.30) increase slightly compared to the previous version (Ver.02.20) within the comparison areas of $\pm 2^\circ$ and $\pm 5^\circ$. However, no changes are observed in the mean biases and their standard deviations between both versions.

In order to improve the quality of the GOSAT-2 PROXY product, further studies in calibration, algorithm and validation are necessary.