

Summary of the evaluation on GOSAT-2 TANSO-FTS-2 SWIR L2 Chlorophyll Fluorescence and Proxy-method Product (Ver. 02.21)

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NIES GOSAT-2 Project

The change of GOSAT-2 TANSO-FTS-2 SWIR L2 Chlorophyll Fluorescence and Proxy-method Product (Ver. 02.21) (hereinafter abbreviated as GOSAT-2 PROXY product) from the previous version (GOSAT-2 PROXY product (Ver. 02.20)) is only the update of TANSO-FTS-2 L1B Product (hereinafter abbreviated as L1B product) as the input product, and there is no change in the processing algorithm.

Since the update of L1B product does not affect the datasets used in the FTS-2 SWIR L2 processing, the uncertainty of GOSAT-2 PROXY product (Ver. 02.21) is considered to be equivalent to that of the previous version (see Appendix).

Summary of the evaluation on GOSAT-2 TANSO-FTS-2 SWIR L2 Chlorophyll Fluorescence and Proxy-method Product (Ver. 02.20)

For the evaluation 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 (XCH_4) and carbon monoxide (XCO), and the solar induced chlorophyll fluorescence (SIF) of the GOSAT-2 PROXY product (Ver. 02.20) are compared with those of the previous version. The results of the evaluation are summarized as below. Since the processing algorithms for Ver. 02.20 and Ver. 02.10 are the same, and the differences in the input data are minimal, for Ver. 02.20, only the comparison with the previous version (Ver. 02.10) is made, not the validation using ground-based observation data.

GOSAT-2 PROXY product

The GOSAT-2 PROXY product of Ver. 02.10 and Ver. 02.20 are used. The comparison period is from March 1, 2019 to January 31, 2024. Land data is defined for data with a land ratio of more than 10%, and Ocean data is defined for data with a land ratio of less than or equal to 10%. There is no distinction between gains. Only data with the quality flag “Good” are used. The global distribution of differences between versions is mapped monthly for only 12 months from January to December 2022.

Comparison results

The ratios of number of data by Land and Ocean are listed in Table 1, and the mean values and their standard deviations of the differences in the column-averaged dry-air mole fractions and the solar induced chlorophyll fluorescence (Ver. 02.20 minus Ver. 02.10 of GOSAT-2 PROXY product) are listed in Table 2.

Table 1. Ratio of number of data in GOSAT-2 PROXY products (Ver. 02.20 / Ver. 02.10). Land indicates data over land, and Ocean indicates data over ocean.

GOSAT-2 PROXY product Ratio of number of data Ver.02.20 / Ver.02.10	XCH_4	XCO	SIF
Total	0.964	0.940	1.000
Land	0.968	0.936	1.000
Ocean	0.962	0.943	Not Available

Table 2. Mean values and their standard deviations of differences in column-averaged dry-air mole fractions and solar induced chlorophyll fluorescence (Ver. 02.20 – Ver. 02.10) for GOSAT-2 PROXY product. Land indicates data over land, and Ocean indicates data over ocean. TCCON validation results for Ver. 02.10 (comparison area of $\pm 0.1^\circ$ in latitude and longitude of land) are also shown for references.

GOSAT-2 PROXY product Difference in column-averaged dry-air mole fraction (ppm) or solar induced chlorophyll fluorescence ($\text{mW}/\text{m}^2/\text{str}/\text{nm}$) Ver. 02.20 – Ver. 02.10	XCH ₄	XCO	SIF
Land	-0.0003 ± 0.0026	0.0000 ± 0.0026	0.0002 ± 0.0067
Ocean	-0.0003 ± 0.0032	0.0001 ± 0.0024	NA
TCCON validation results for Ver. 02.10, land/ $\pm 0.1^\circ$ in latitude and longitude	-0.0058 ± 0.0117	0.0040 ± 0.0081	NA

The global distributions of the differences (Ver. 02.20 – Ver.02.10) in the column-averaged dry-air mole fractions and the solar induced chlorophyll fluorescence (January – December 2022, monthly) are shown in Figure 1 to Figure 3.

GOSAT-2 PROXY product, ΔXCH_4 (V02.20 – V02.10), Jan. – Dec. 2022

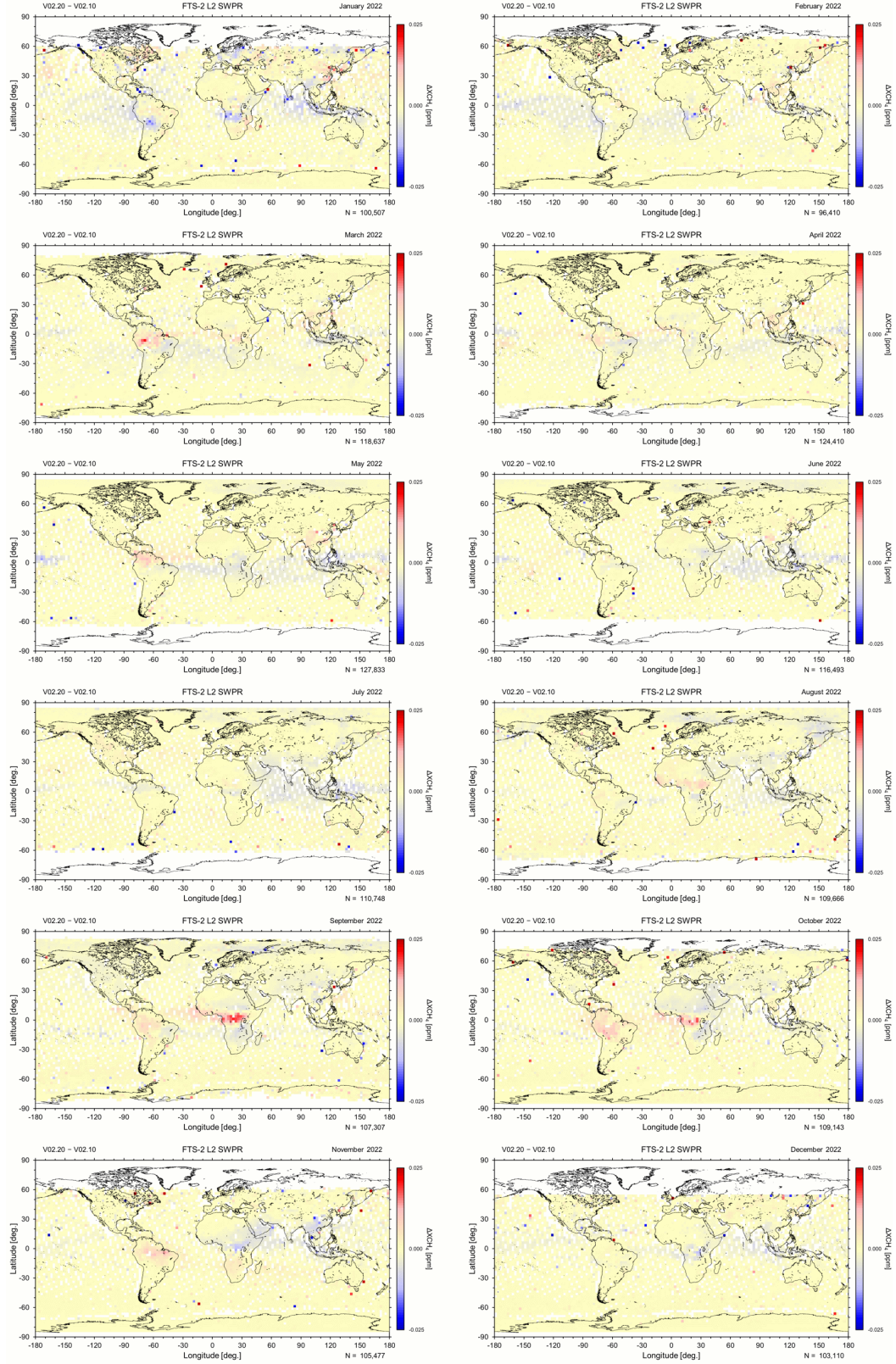


Figure 1. Global distributions of differences (Ver. 02.20 – Ver. 02.10) in column-averaged dry-air mole fraction (XCH_4)

GOSAT-2 PROXY product, ΔXCO (V02.20 – V02.10), Jan. – Dec. 2022

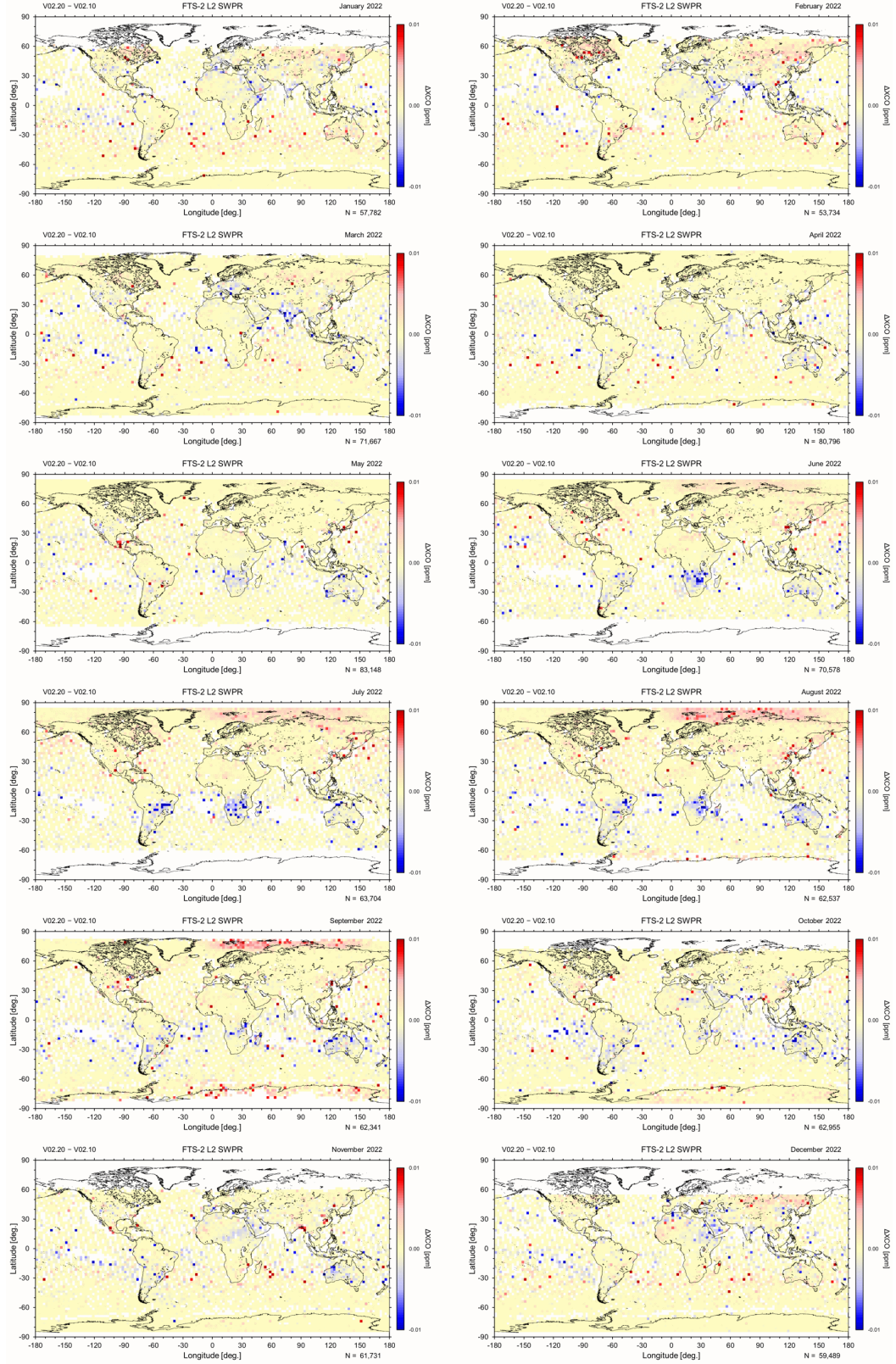


Figure 2. Global distributions of differences (Ver. 02.20 – Ver. 02.10) in column-averaged dry-air mole fraction (XCO)

GOSAT-2 PROXY product, Δ SIF (V02.20 – V02.10), Jan. – Dec. 2022

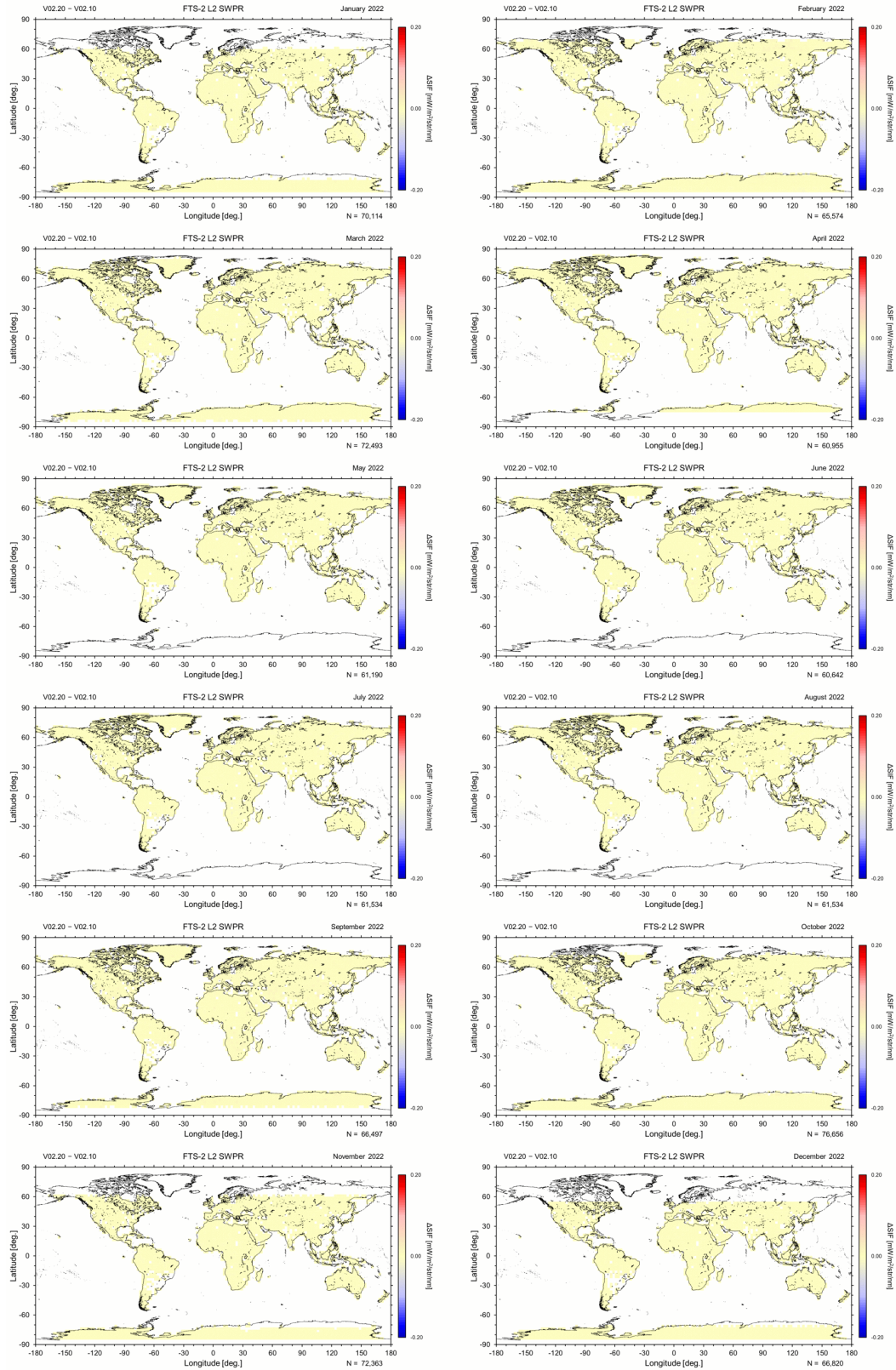


Figure 3. Global distributions of the differences (Ver. 02.20 – Ver. 02.10) in solar induced chlorophyll fluorescence (SIF)

Summary of GOSAT-2 PROXY product comparison results

The GOSAT-2 PROXY product for XCH₄, XCO, and SIF (Ver. 02.20, March 1, 2019 – January 31, 2024) are compared with those of the previous version (Ver. 02.10). The results of the comparison are summarized as follows.

- The number of data for the column-averaged dry-air mole fractions decreases by about 5%. No increase or decrease for the solar induced chlorophyll fluorescence.
- The mean values and their standard deviations of the differences in XCH₄ over Land and Ocean are -0.0003 ± 0.0026 ppm and -0.0003 ± 0.0032 ppm, respectively.
- The mean values and their standard deviations of the differences in XCO over Land and Ocean are 0.0000 ± 0.0026 ppm and 0.0001 ± 0.0024 ppm, respectively.
- The mean value and its standard deviation of the differences in SIF over Land is 0.0002 ± 0.0067 mW/m²/str/nm.
- The global distributions of the differences in XCH₄ show a trend for XCH₄ of Ver. 02.20 to be higher than that of Ver. 02.10 in the Amazon (March) and central Africa (September – October).
- The global distributions of the differences in XCO show a trend for XCO of Ver. 02.20 to be higher than that of Ver. 02.10 in northern Siberia (July – September) and Antarctica (September).
- The global distributions of the differences in SIF have no significant features.

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