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Summary of the evaluation of GOSAT-2 TANSO-FTS-2 SWIR L2 Column-averaged Dry-air Mole Fraction Product (Ver. 02.20)

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NIES GOSAT-2 Project

For the evaluation of the GOSAT-2 TANSO-FTS-2 SWIR L2 Column-averaged Dry-air Mole Fraction Product (hereafter abbreviated as GOSAT-2 Full Physics product), the column-averaged dry-air mole fractions of carbon dioxide (XCO_2), methane (XCH_4), carbon dioxide (XCO), and water vapor (XH_2O) of the GOSAT-2 Full Physics 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 Full Physics product

The GOSAT-2 Full Physics 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 (Ver. 02.20 minus Ver. 02.10 of GOSAT-2 Full Physics product) are listed in Table 2.

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

GOSAT-2 Full Physics product Ratio of number of data Ver. 02.20 / Ver. 02.10	XCO_2	XCH_4	XCO	XH_2O
Total	0.965	0.965	0.965	0.964
Land	0.982	0.982	0.982	0.980
Ocean	0.952	0.952	0.952	0.952

Table 2. Mean values and their standard deviations of differences in column-averaged dry-air mole fractions (Ver. 02.20 − Ver. 02.10) for GOSAT-2 Full Physics product. Land indicates data over land, and Ocean indicates data over ocean. TCCON validation results for Ver. 02.10 (comparison area of ±0.1° in latitude and longitude of land) are also shown for references.

GOSAT-2 Full Physics product Difference in column-averaged dry-air mole fraction (ppm) Ver. 02.20 – Ver. 02.10	XCO_2	XCH_4	XCO	XH_2O
Land	−0.09±0.44	0.0001± 0.0029	−0.0001± 0.0011	−1.0±6.0
Ocean	−0.07±0.35	0.0000± 0.0021	−0.0002± 0.0019	−0.6±6.9
TCCON validation result for Ver. 02.10, land/±0.1° in latitude and longitude	3.19±2.06	−0.0016± 0.0095	0.0060± 0.0064	−84.0± 113.9

The global distributions of the differences (Ver. 02.20 − Ver.02.10) in the column-averaged dry-air mole fractions (January – December 2022, monthly) are shown in Figure 1 to Figure 4.

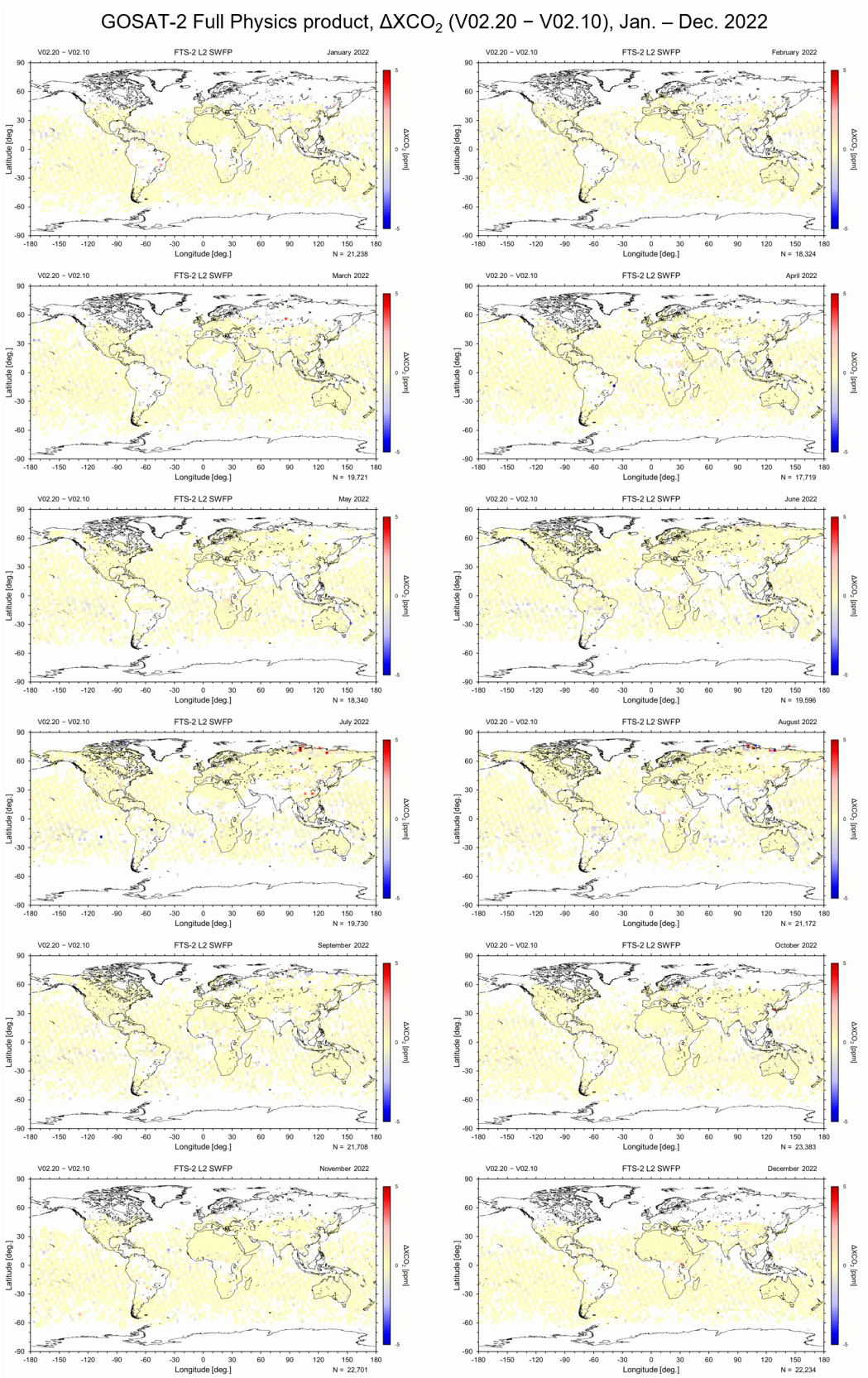

Figure 1. Global distributions of differences (Ver. 02.20 − Ver. 02.10) in column-averaged dry-air mole fraction (XCO_2)

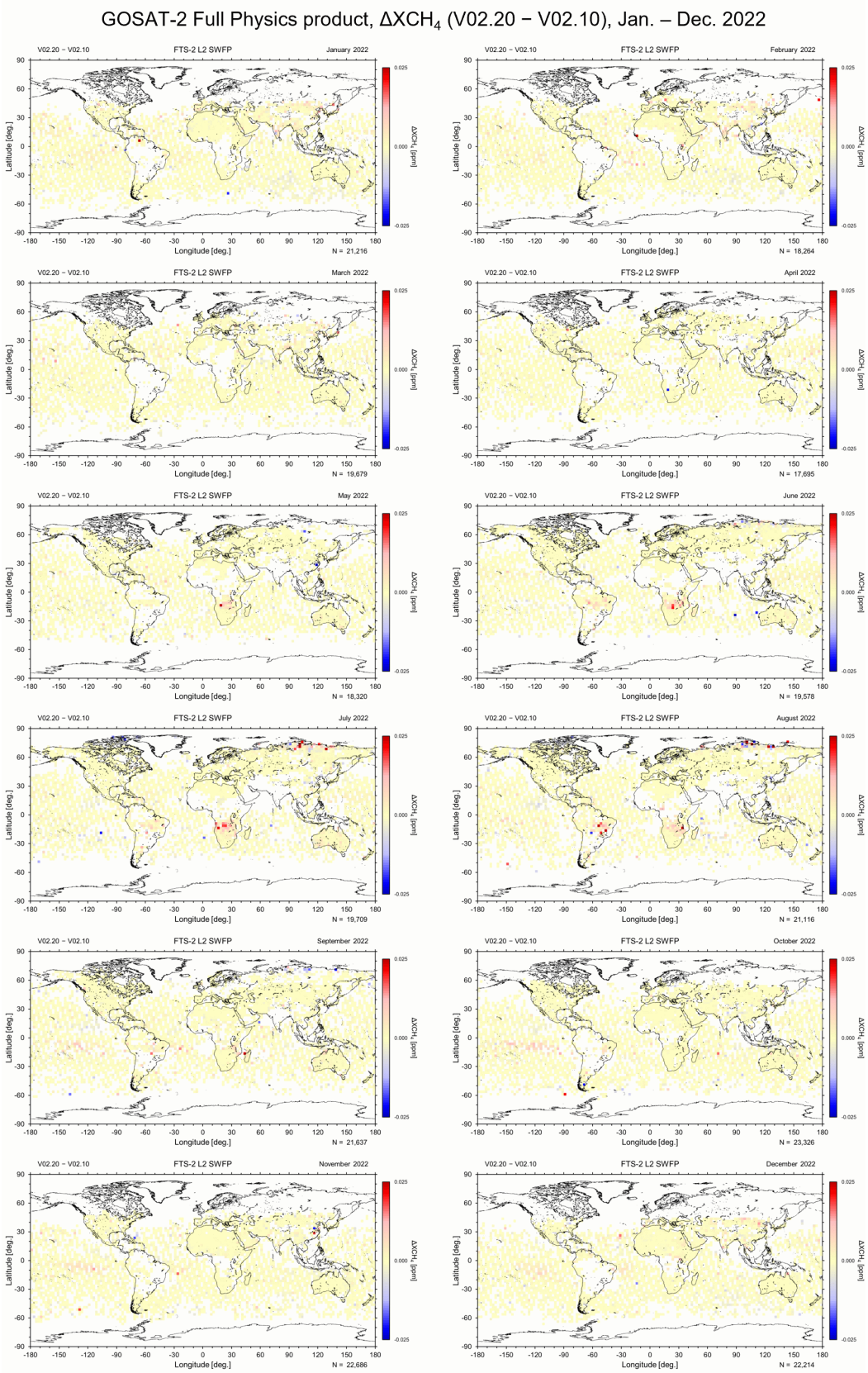

Figure 2. Global distributions of differences (Ver. 02.20 − Ver. 02.10) in column-averaged dry-air mole fraction (XCH_4)

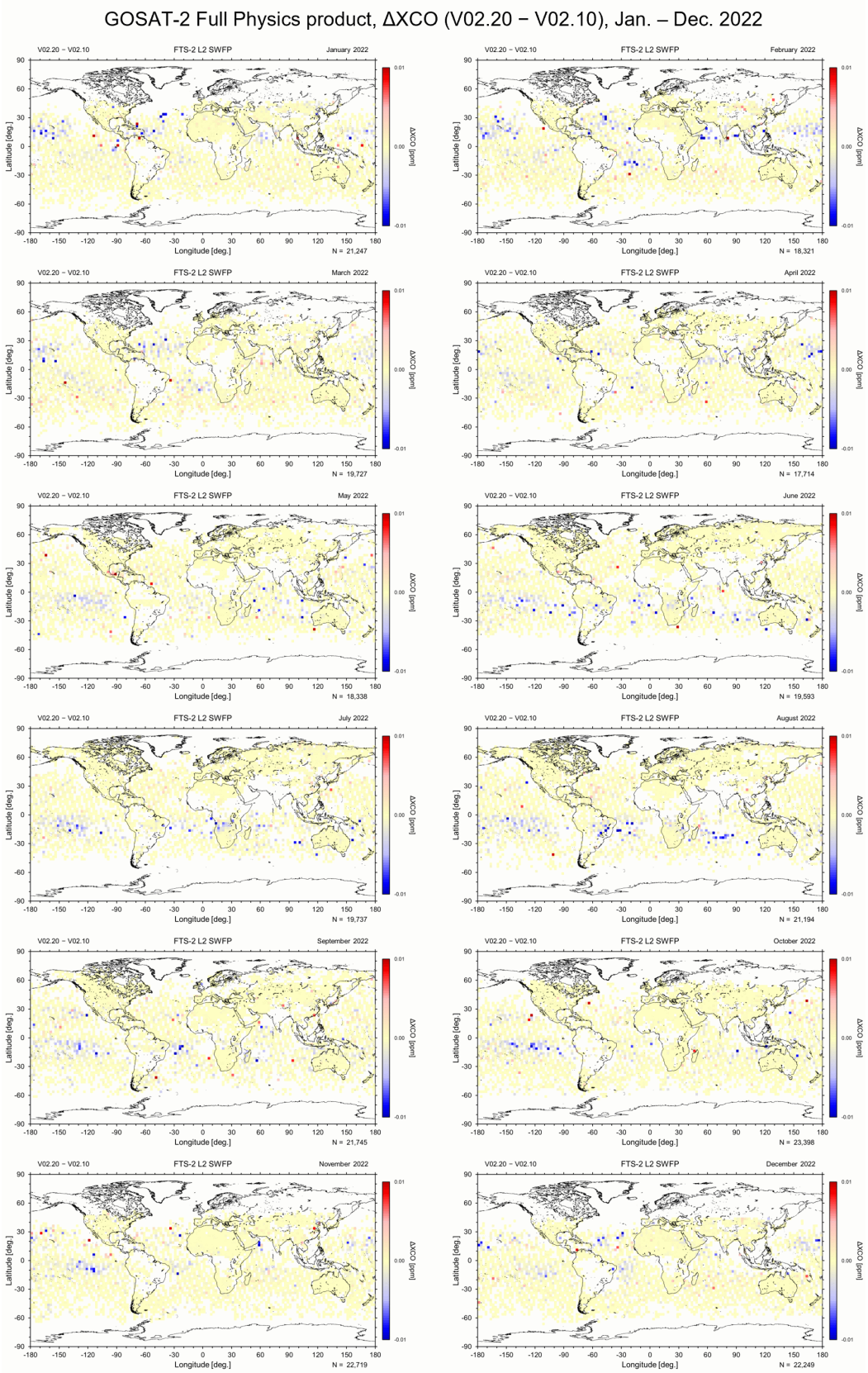

Figure 3. Global distributions of differences (Ver. 02.20 − Ver. 02.10) in column-averaged dry-air mole fraction (XCO)

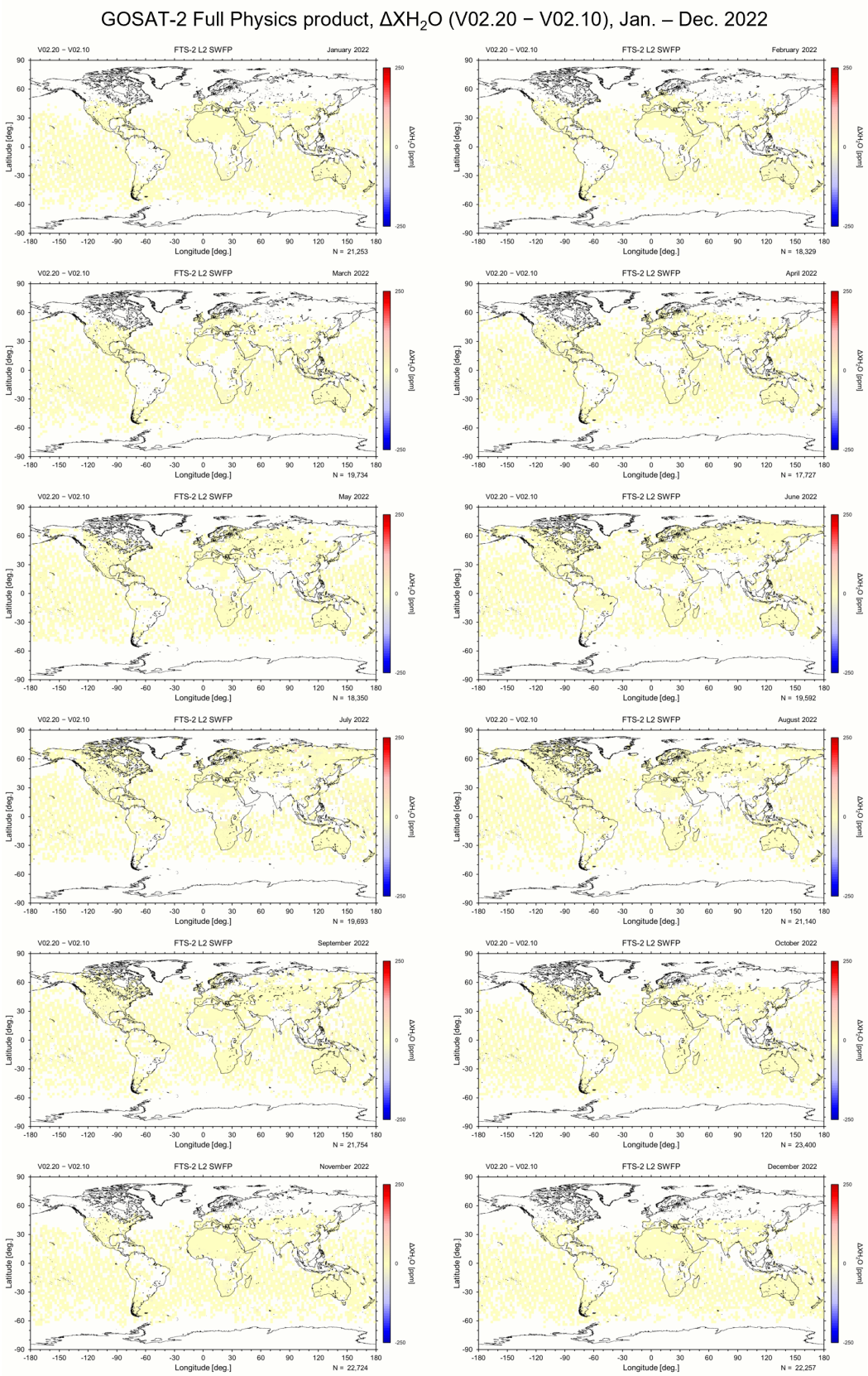

Figure 4. Global distributions of differences (Ver. 02.20 − Ver. 02.10) in column-averaged dry-air mole fraction (XH_2O)

Summary of GOSAT-2 Full Physics product comparison results

The GOSAT-2 Full Physics product for XCO_2, XCH_4, XCO, and XH_2O (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 decreases by about 5%. The differences between gases are small.
- The mean values and their standard deviations of the differences in XCO_2 over Land and Ocean are −0.09±0.44 ppm and −0.07±0.35 ppm, respectively.
- The mean values and their standard deviations of the differences in XCH_4 over Land and Ocean 0.0001±0.0029 ppm and 0.0000±0.0021 ppm, respectively.
- The mean values and their standard deviations of the differences in XCO over Land and Ocean are −0.0001±0.0011 ppm and −0.0002±0.0019 ppm, respectively.
- The mean values and their standard deviations of the differences in XH_2O over Land and Ocean are −1.0±6.0 ppm and −0.6±6.9 ppm, respectively.
- The global distributions of the differences in XCO_2 have no significant features.
- The global distributions of the differences in XCH_4 show a trend for XCH_4 of Ver. 02.20 to be higher than that of Ver. 02.10 in central Africa (May – August), northern Siberia (July – August), and the Amazon (August).
- The global distribution of the differences in XCO show a trend for XCO of Ver. 02.20 to be lower than that of Ver. 02.10 from the equator to 30°S (May – November).
- The global distributions of the differences in XH_2O have no significant features.

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