

Supporting Information 3

Changes in surface ozone in South Korea on diurnal to decadal time scale for the period of 2001-2021

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This supporting information includes one slide introducing TROPOMI tropospheric NO₂ product and 6 figures listed below.

Slide 1. Introduction of KNMI & NASA TROPOMI NO₂ Trop. VCDs product

Figure S1. Figure S1. (Left) KNMI tropospheric NO₂ columns in 2019 and differences between 2020 and 2019 or 2021 and 2019, (Right) NASA data. The data with quality assurance > 0.50 and cloud radiance fraction < 0.4 are selected for analysis.

Figure S2. (Left) KNMI tropospheric NO₂ columns in 2019, 2020 and 2021, (Right) NASA data. The data with quality assurance > 0.50 and cloud radiance fraction < 0.4 are selected for analysis.

Figure S3. The number of days with available satellite data after filtering: (Left) KNMI tropospheric NO₂ columns, (Right) NASA data. The data with quality assurance > 0.50 and cloud radiance fraction < 0.4 are selected for analysis.

Figure S4. (Left) KNMI tropospheric NO₂ columns in 2019 and differences between 2020 and 2019 or 2021 and 2019, (Right) NASA data. The data with quality assurance > 0.75 and cloud radiance fraction < 0.5 are selected for analysis.

Figure S5. (Left) KNMI tropospheric NO₂ columns in 2019, 2020 and 2021, (Right) NASA data. The data with quality assurance > 0.75 and cloud radiance fraction < 0.5 are selected for analysis.

Figure S6. The number of days with available satellite data after filtering: (Left) KNMI tropospheric NO₂ columns, (Right) NASA data. The data with quality assurance > 0.75 and cloud radiance fraction < 0.5 are selected for analysis.

Introduction of KNMI & NASA TROPOMI NO₂ Trop. VCDs product

1. KNMI product

- Retrieval process (README file of TROPOMI L2 data)

QA4ECV (Boersma et al., 2018, AMT) (until Dec. 2020)

+ an overall reduction of the observed cloud pressures, resulting in a decrease of AMFs and a substantial increase of NO₂ in the retrievals in polluted regions (since Jan. 2021)

- Change in horizontal resolution

7.0 km x 3.5km to 5.5 km x 3.5 km at NADIR (since August 06, 2019)

2. NASA MINDS product (introduced in Nov. 2022)

- Retrieval process (Lok et al., AGU 2021 & README file of MINDS TROP. NO₂ TROPOMI)

NASA Standard Product version 4.0 (Lok et al., 2021, AMT) – MOST RECENT retrieval process used

+ created high resolution (0.25° latitude x 0.25° longitude) a priori NO₂ profiles and other auxiliary information from a global GMI-Replay simulation with satellite simulator [TROPOMI NO₂ SCD data operational ESA/KNMI product, version 2.3.1]

- Consistent horizontal resolution (2018.05 – 2021.12)

5.5 km x 3.5 km at NADIR

Absolute Values

KNMI product w/ original filter

NASA product w/ original filter

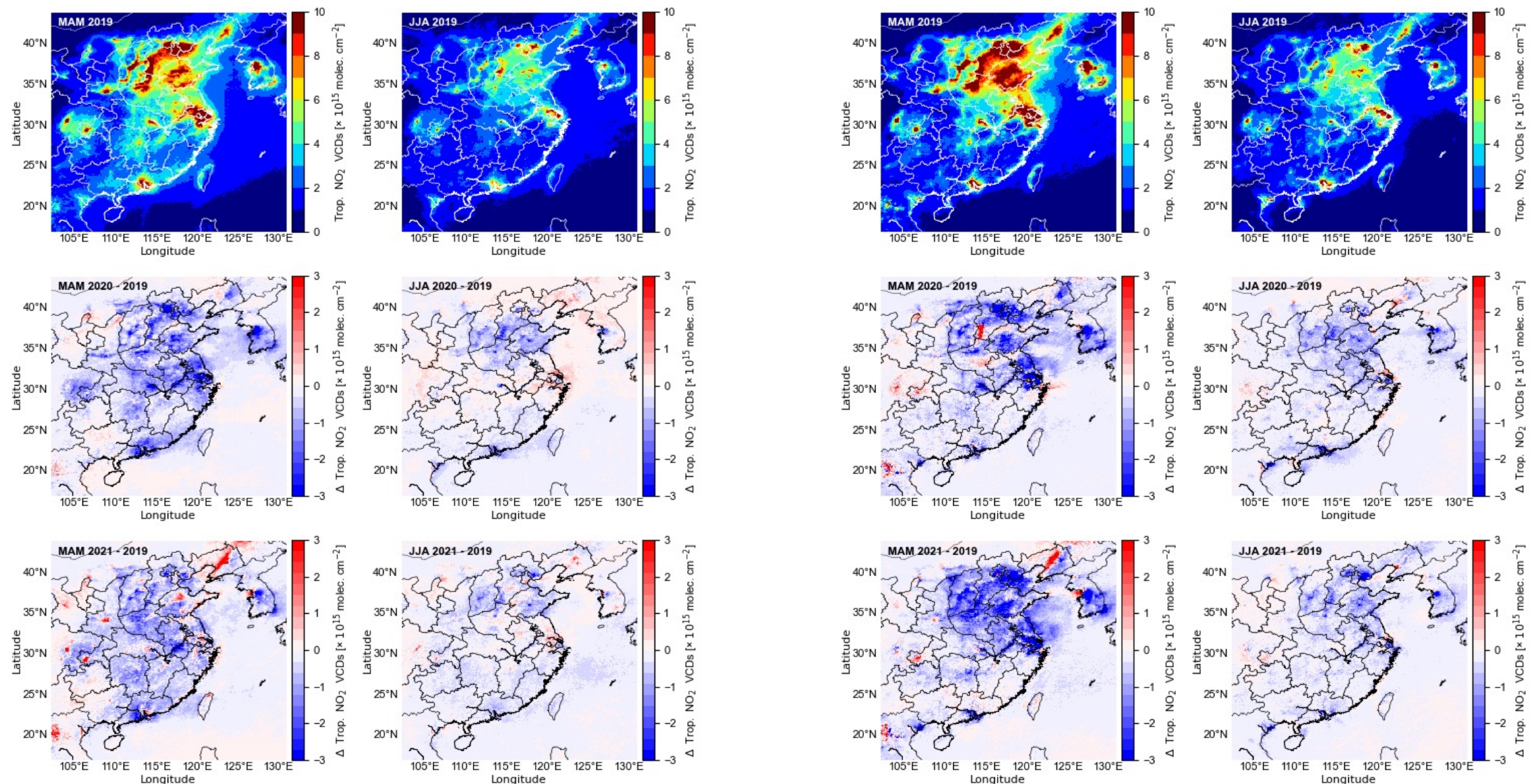
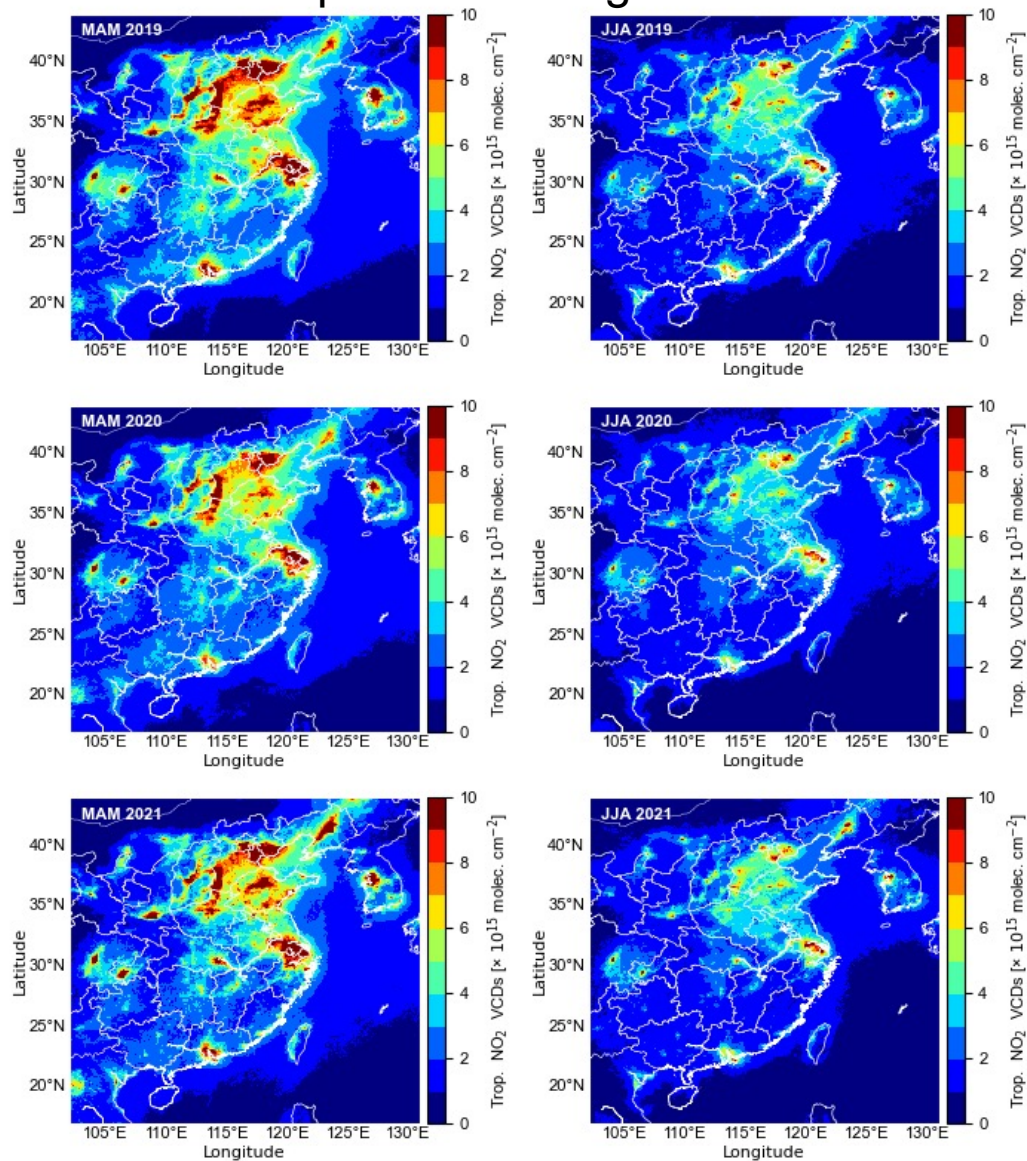


Figure S1. (Left) KNMI tropospheric NO₂ columns in 2019 and differences between 2020 and 2019 or 2021 and 2019, (Right) NASA data. The data with quality assurance > 0.50 and cloud radiance fraction < 0.4 are selected for analysis.

Absolute Values

KNMI product w/ original filter



NASA product w/ original filter

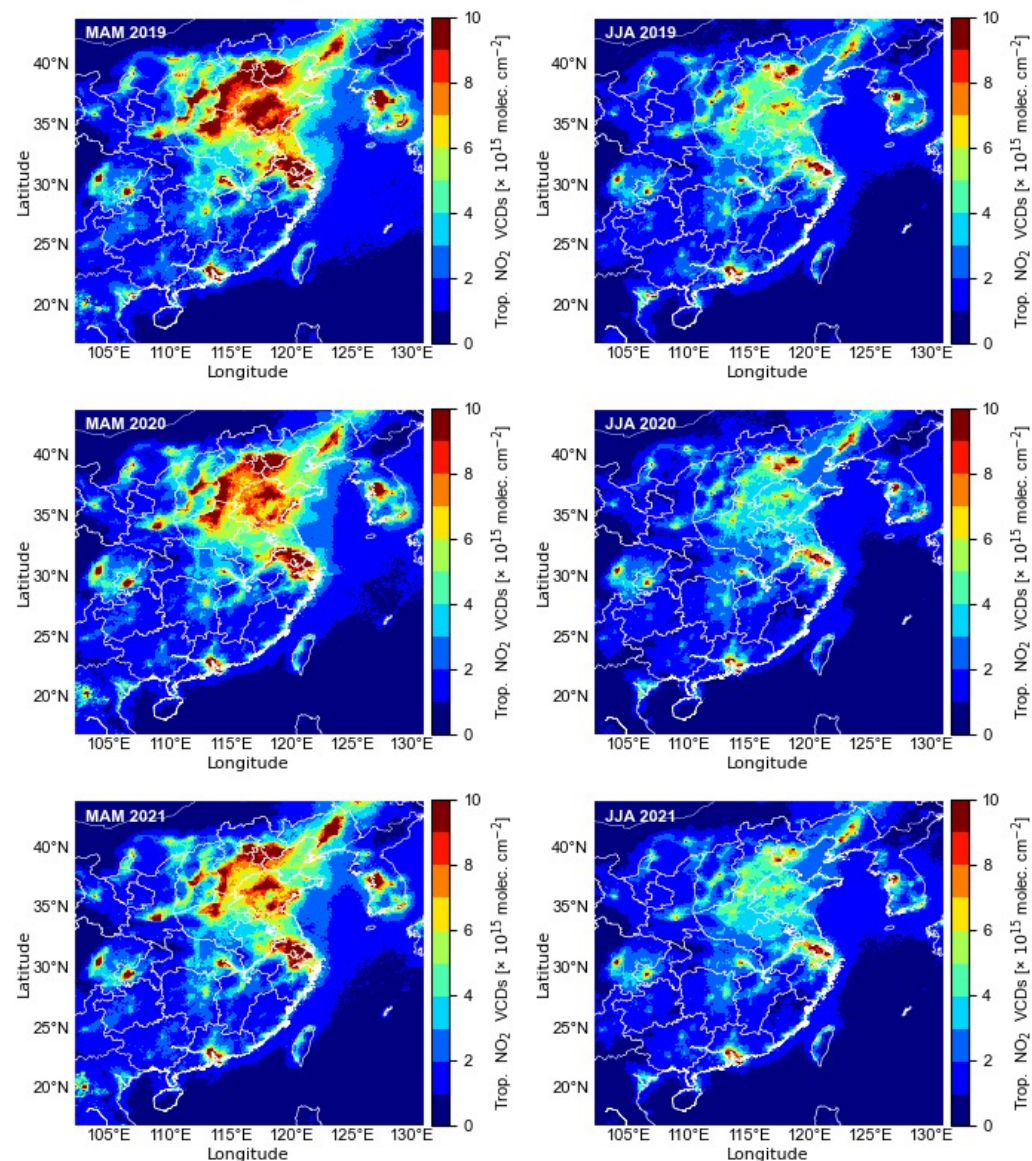


Figure S2. (Left) KNMI tropospheric NO₂ columns in 2019, 2020 and 2021, (Right) NASA data. The data with quality assurance > 0.50 and cloud radiance fraction < 0.4 are selected for analysis.

Days available from
daily product KNMI product w/ original filter

NASA product w/ original filter

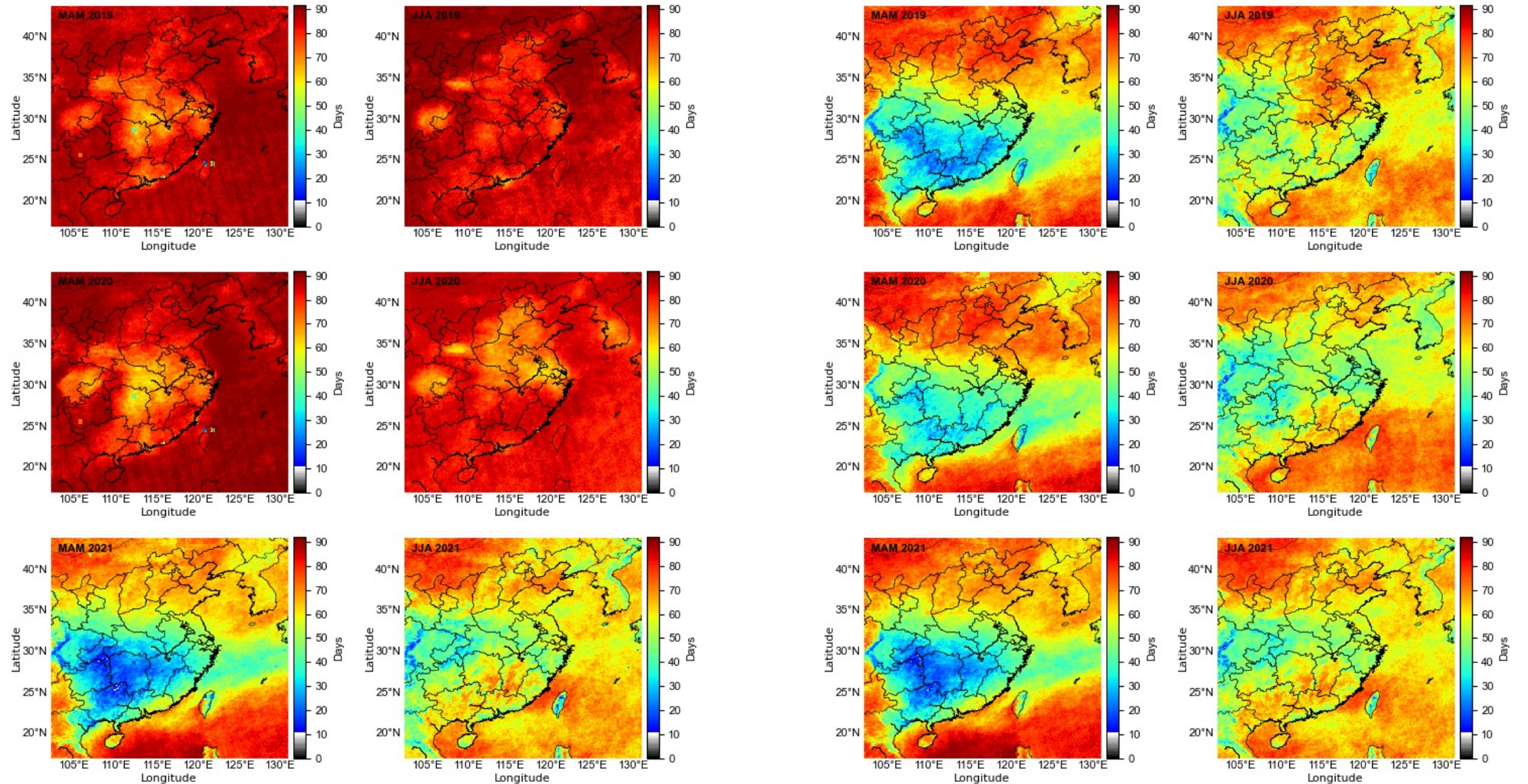


Figure S3. The number of days with available satellite data after filtering: (Left) KNMI tropospheric NO₂ columns, (Right) NASA data. The data with quality assurance > 0.50 and cloud radiance fraction < 0.4 are selected for analysis.

Absolute Values

KNMI product w/ new filter

NASA product w/ new filter

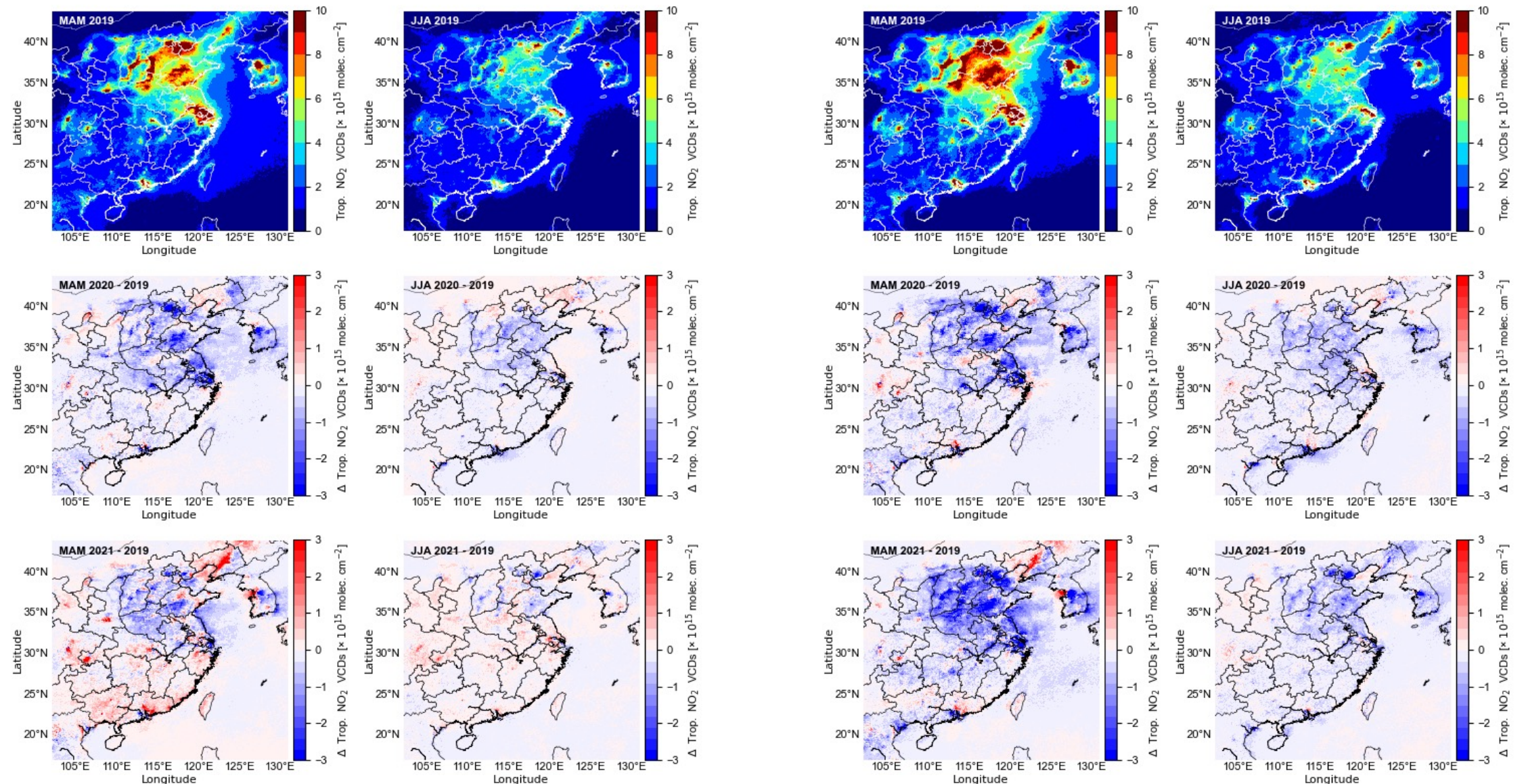


Figure S4. (Left) KNMI tropospheric NO₂ columns in 2019 and differences between 2020 and 2019 or 2021 and 2019, (Right) NASA data. The data with quality assurance > 0.75 and cloud radiance fraction < 0.5 are selected for analysis.

Absolute Values

KNMI product w/ new filter

NASA product w/ new filter

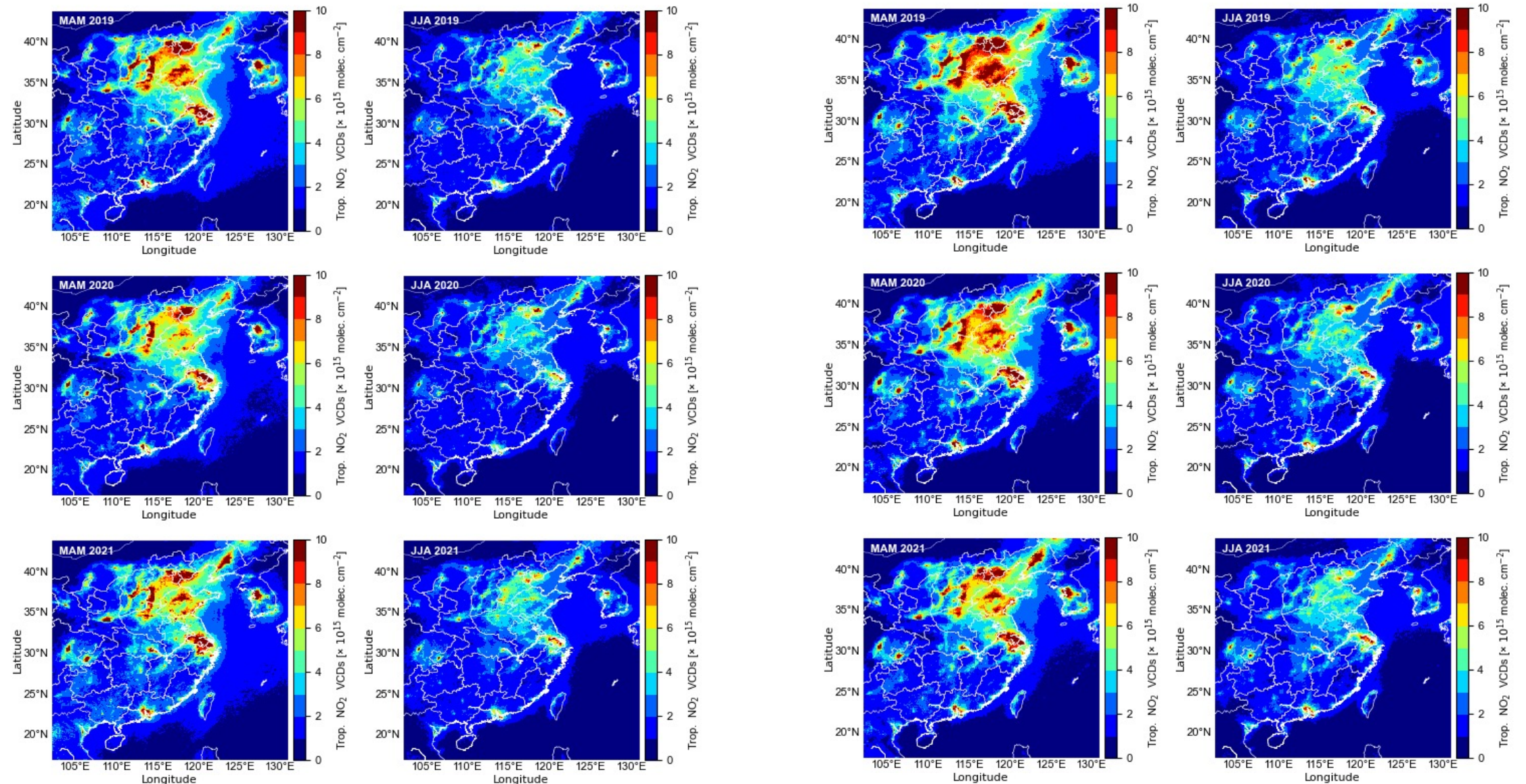


Figure S5. (Left) KNMI tropospheric NO₂ columns in 2019, 2020 and 2021, (Right) NASA data. The data with quality assurance > 0.75 and cloud radiance fraction < 0.5 are selected for analysis.

Days available from
daily product KNMI product w/ new filter

NASA product w/ new filter

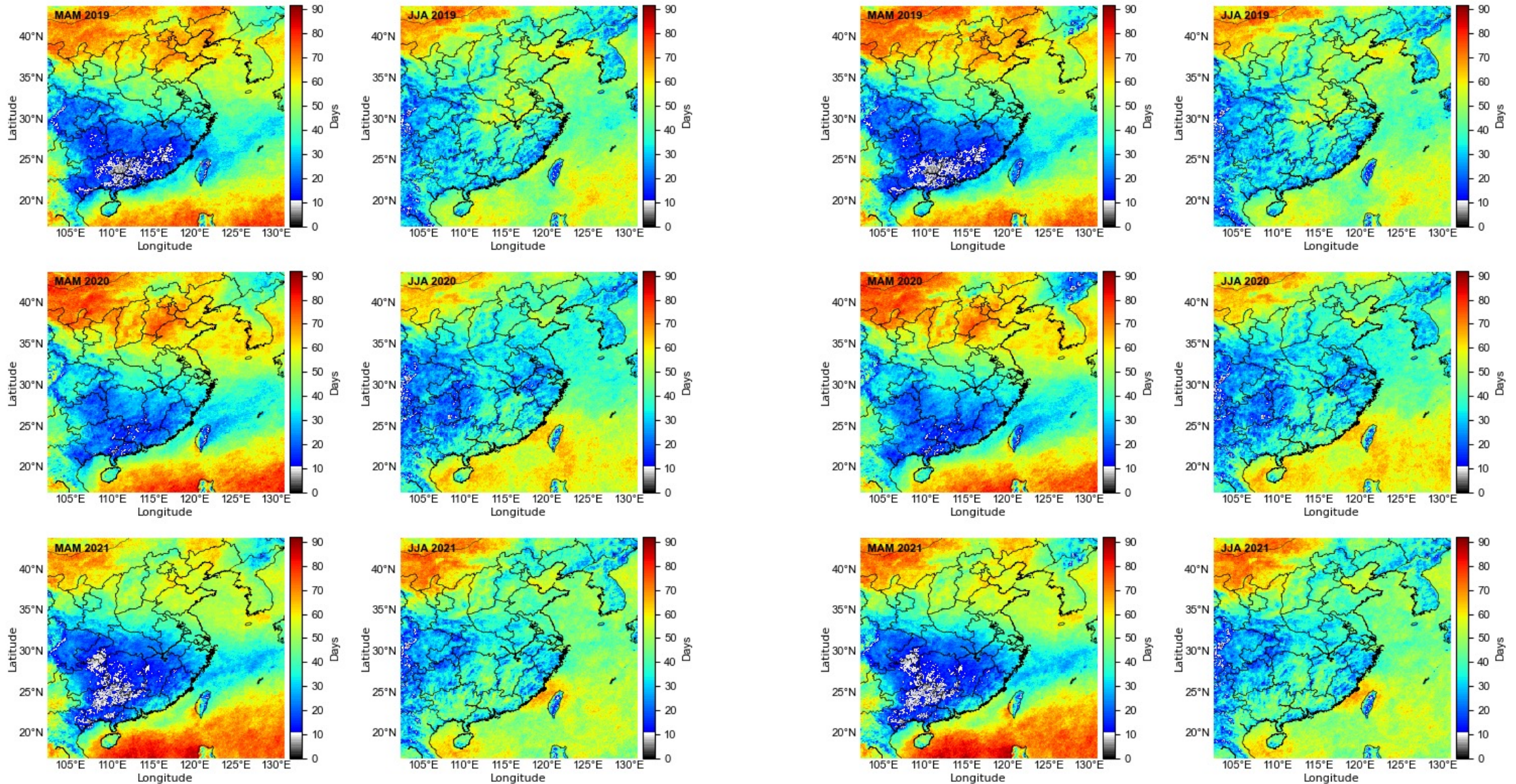


Figure S6. The number of days with available satellite data after filtering: (Left) KNMI tropospheric NO₂ columns, (Right) NASA data. The data with quality assurance > 0.75 and cloud radiance fraction < 0.5 are selected for analysis.