

Supplementary materials

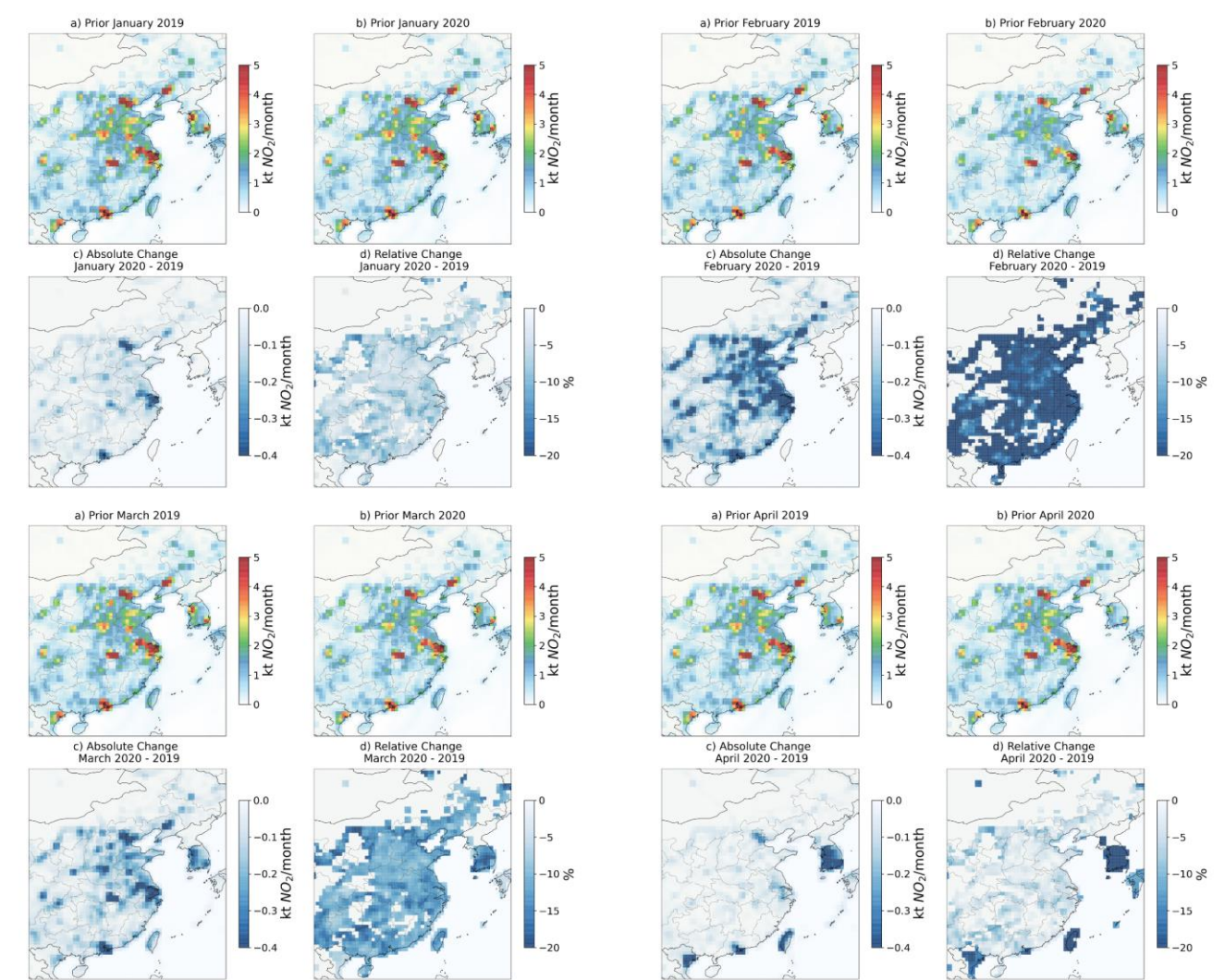
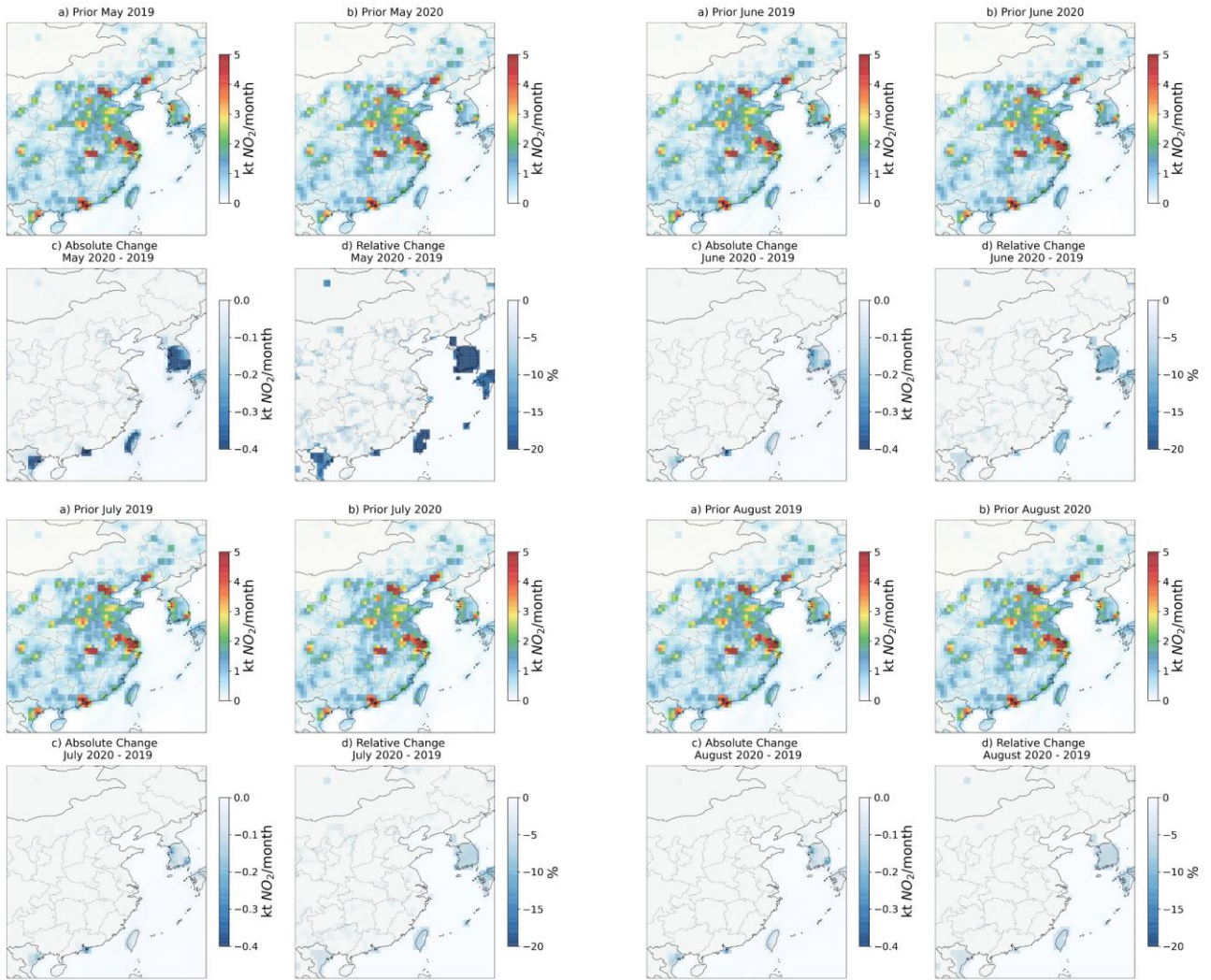


Figure S1. Prior estimates of the NO_x total(anthropogenic+biogenic) emissions for 2019 (a) and 2020 (b), and the absolute (c) and relative (d) change between these estimates, expressed in kt NO₂/month (a to c) and in percentage % (d). The plots shown here are for **January** to **April**. Values below 0.3 kt NO₂ in the prior estimate for February 2019 were set to zero when calculating the relative difference (d) to reduce the noise in the figure.



15 **Figure S2.** Prior estimates of the NO_x total (anthropogenic + biogenic) emissions for 2019 (a) and 2020 (b), and the absolute (c) and relative (d) change between these estimates, expressed in kt NO₂/month (a to c) and in percentage % (d). The plots shown here are for **May** to **August**. Values below 0.3 kt NO₂ in the prior estimate for February 2019 were set to zero when calculating the relative difference (d) to reduce the noise in the figure.

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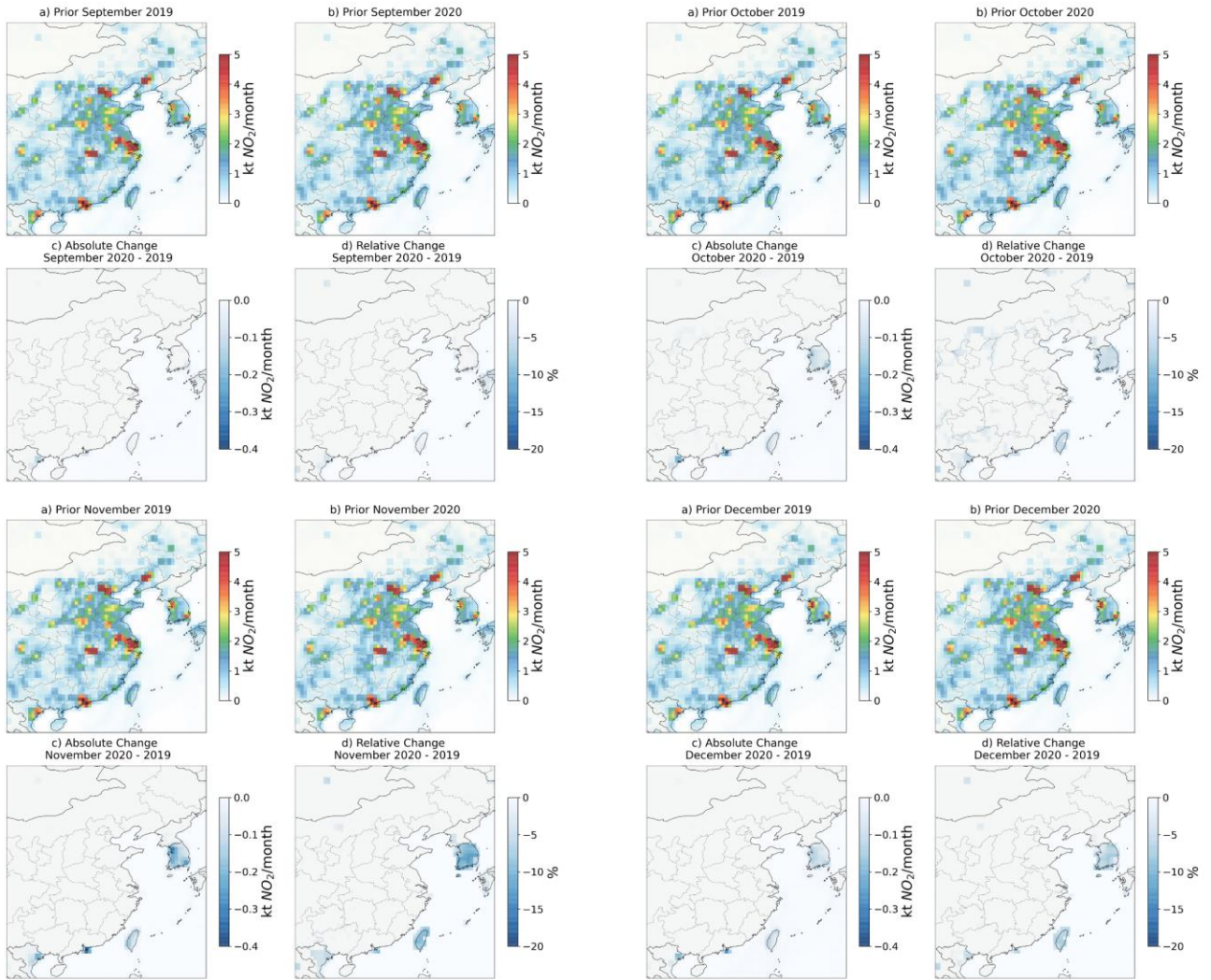


Figure S3. Prior estimates of the NO_x total (anthropogenic + biogenic) emissions for 2019 (a) and 2020 (b), and the absolute (c) and relative (d) change between these estimates, expressed in kt NO₂/month (a to c) and in percentage % (d). The plots shown here are for **September** to **December**. Values below 0.3 kt NO₂ in the prior estimate for February 2019 were set to zero when calculating the relative difference (d) to reduce the noise in the figure.

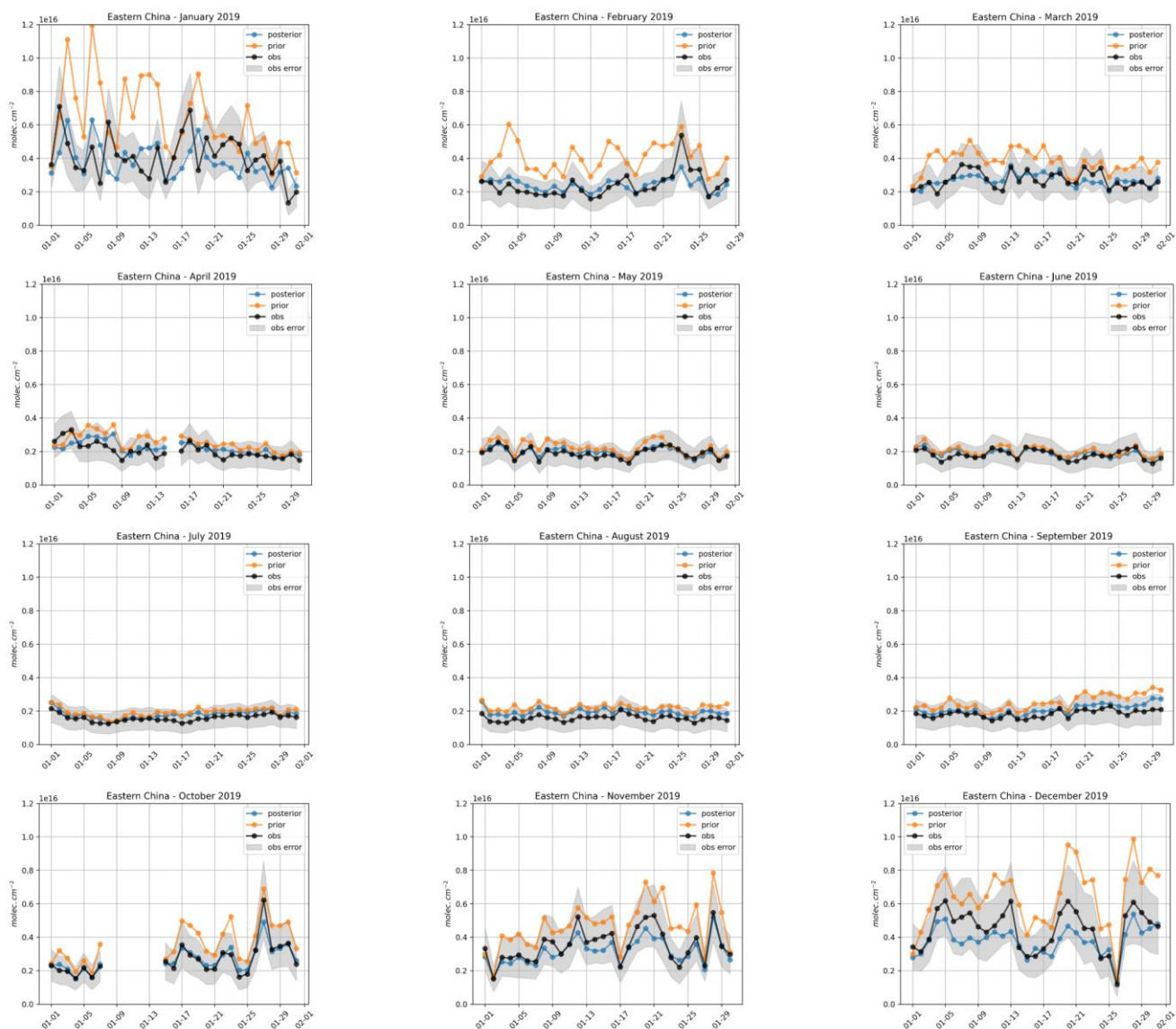
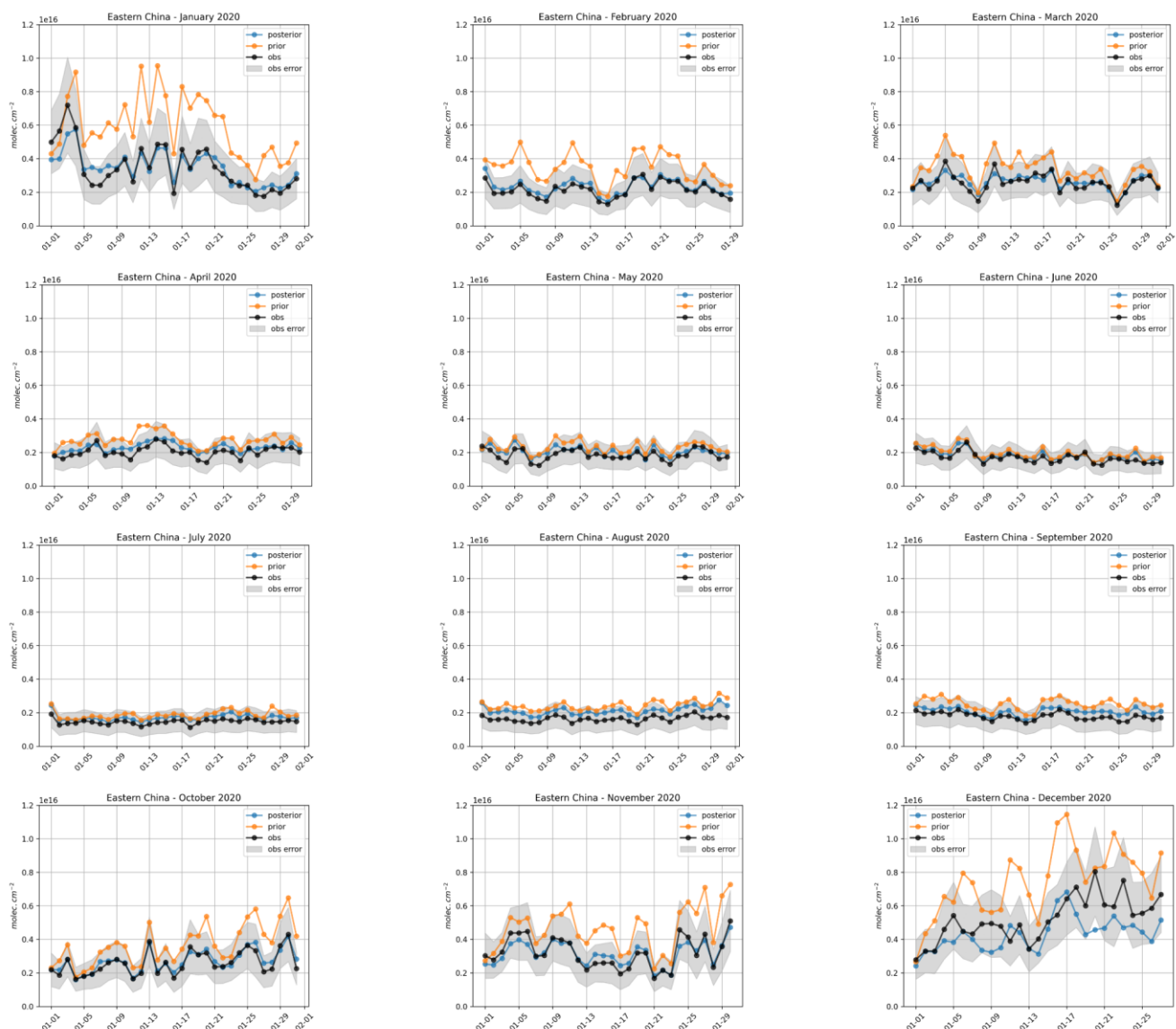


Figure S4. Daily mean posterior (blue) and prior (orange) estimations of NO₂ TVCDs as compared to that of the TROPOMI super-observations (obs, black) during 2019, (January to December from left to right, top to bottom), with the 1-sigma error associated to the super-observations as a grey shaded area (obs error). The top row features averages for Eastern China (a) and the province of Jilin (b), and the bottom row shows averages for the provinces of Beijing (c) and Shanghai (d). The NO₂ TVCDs are expressed in molecules.cm⁻². Note that the y axis limits are different for the provinces as compared to Eastern China. The provinces are shown in Figure 1 on the map of the domain.



55 **Figure S5.** Daily mean posterior (blue) and prior (orange) estimations of NO₂ TVCDs as compared to that of the TROPOMI
super-observations (obs, black) during 2020, (January to December from left to right, top to bottom), with the 1-sigma error
associated to the super-observations as a grey shaded area (obs error). The top row features averages for Eastern China (a)
and the province of Jilin (b), and the bottom row shows averages for the provinces of Beijing (c) and Shanghai (d). The
60 NO₂ TVCDs are expressed in molecules.cm⁻². Note that the y axis limits are different for the provinces as compared to
Eastern China. The provinces are shown in Figure 1 on the map of the domain.

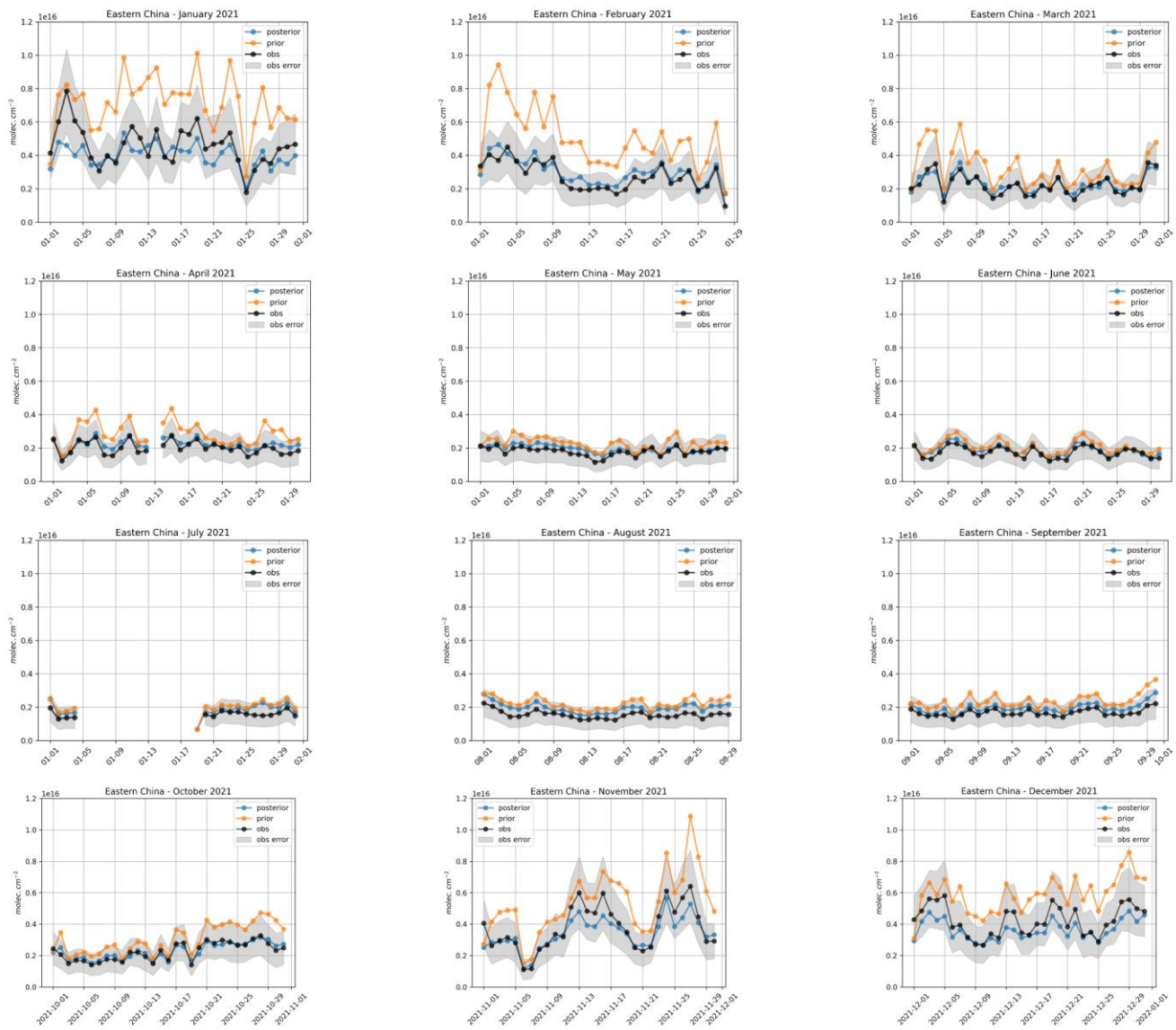


Figure S6. Daily mean posterior (blue) and prior (orange) estimations of NO₂ TVCDs as compared to that of the TROPOMI super-observations (obs, black) during 2021, (January to December from left to right, top to bottom), with the 1-sigma error associated to the super-observations as a grey shaded area (obs error). The top row features averages for Eastern China (a) and the province of Jilin (b), and the bottom row shows averages for the provinces of Beijing (c) and Shanghai (d). The NO₂ TVCDs are expressed in molecules.cm⁻². Note that the y axis limits are different for the provinces as compared to Eastern China. The provinces are shown in Figure 1 on the map of the domain.

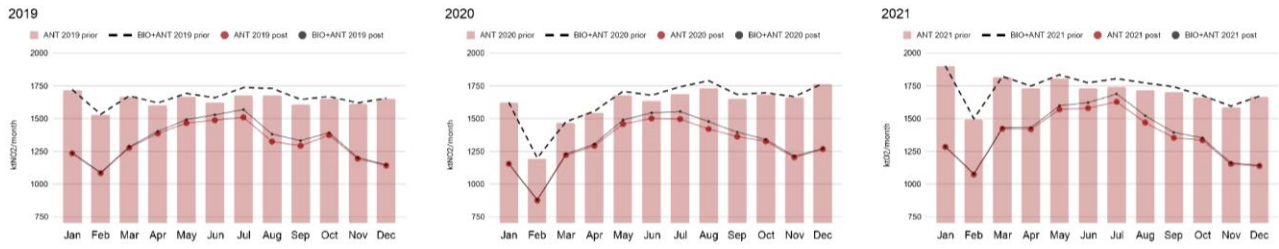


Figure S7. Anthropogenic (red) and total (black) NO_x emissions for Eastern China, for 2019 to 2021 (left to right). The red bars represent the monthly prior anthropogenic emissions, the dotted black lines refer to the prior total emissions, the solid red lines refer to the anthropogenic posterior emissions, and the black solid lines refer to the total posterior emissions.

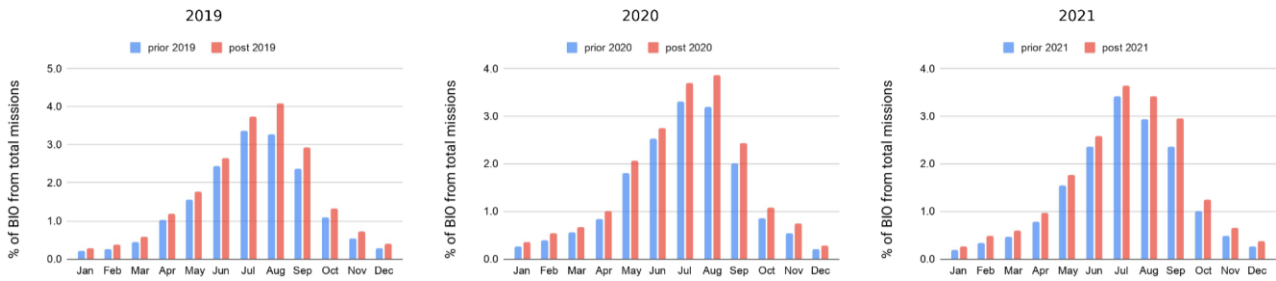


Figure S8. The percentage of the biogenic emissions from the total NO_x emissions estimates, per month, for the prior (blue) and posterior (red) for 2019 to 2021 (left to right), in Eastern China.

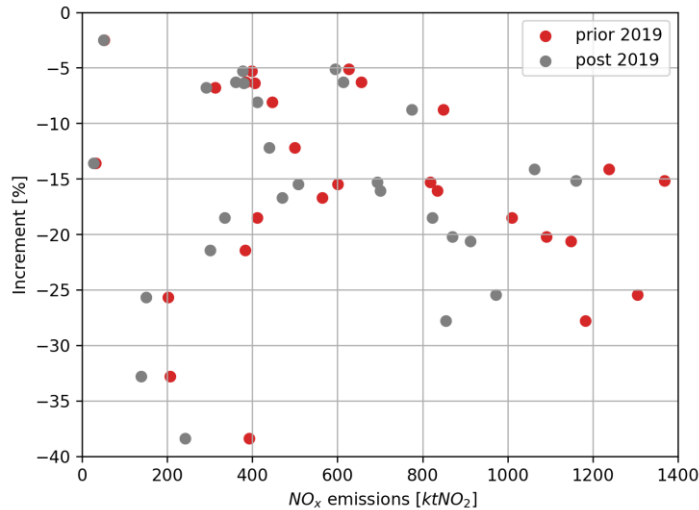
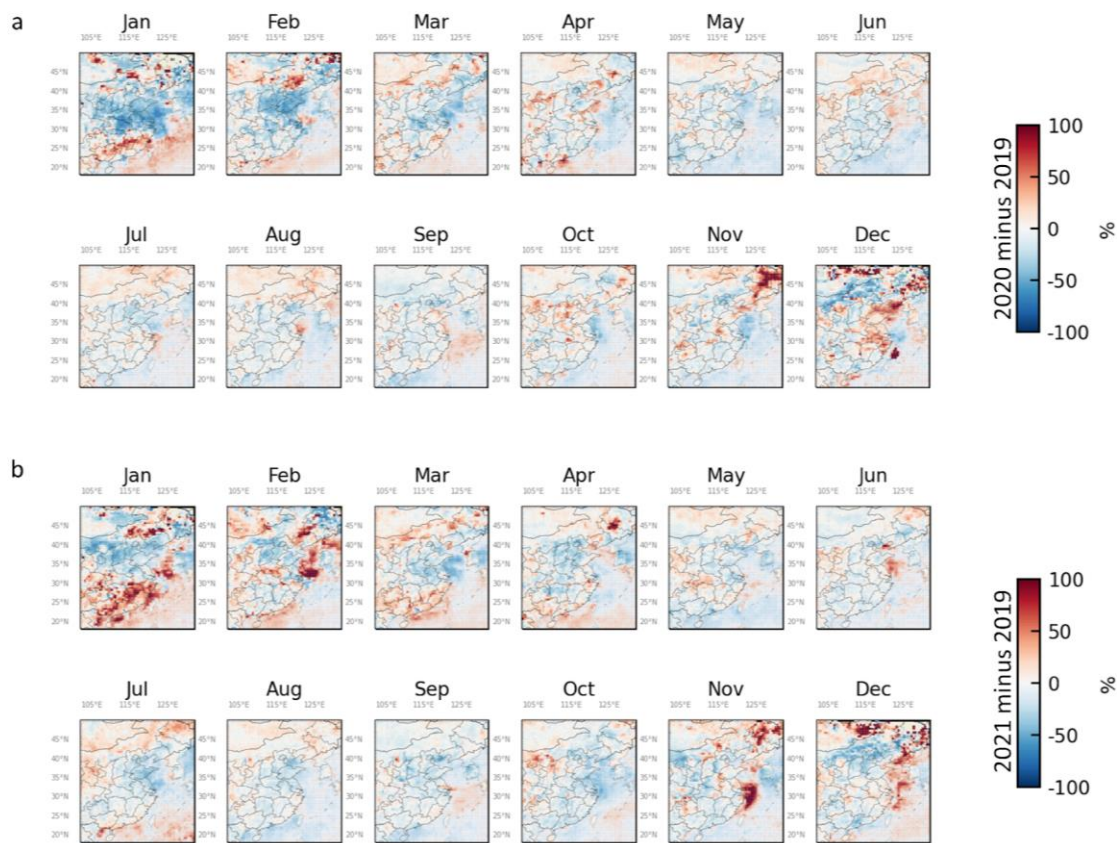


Fig. S9. Yearly increments (different between prior and posterior) vs. Prior (red) and posterior (grey) NO_x emissions for 2019. The scatterpoints on the plot represent the Chinese provinces considered in this study, each row corresponds to one province.



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Fig. S10. Relative difference in the posterior NO₂ monthly TROPOMI TVCDs during 2020 (a) and 2021 (b) as compared to 2019, in %, over the domain of study. The horizontal resolution is $0.5^\circ \times 0.5^\circ$ per grid box.

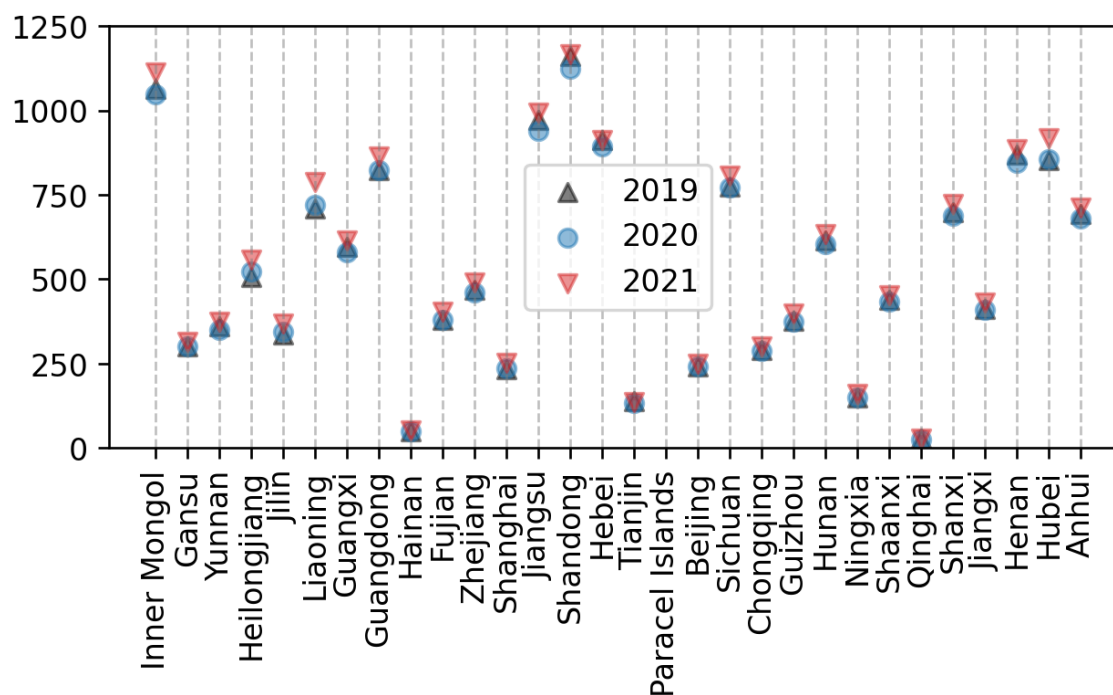


Fig. S11. Anthropogenic NO_x emissions in ktNO₂/year, per province, for the period 2019-2021.

Table S1. Anthropogenic NO_x emissions per province, and the monthly and inter-annual change for the period 2019 – 2021: https://docs.google.com/spreadsheets/d/1I2jQW6-ubCa-vq-aZDbCtA_DUrqYl_j2vAhBd7tjr4/edit?usp=sharing

Table S2. Anthropogenic NO_x emissions for the domain of study

Domain	2019 prior	2019 post	2020 prior	2020 post	2021 prior	2021 post
January	2.10	1.55	2.00	1.47	2.28	1.60
February	1.87	1.36	1.53	1.16	1.82	1.35
March	2.05	1.61	1.81	1.54	2.2	1.76
April	1.96	1.71	1.85	1.58	2.1	1.74
May	2.04	1.82	2.00	1.76	2.17	1.91
June	1.98	1.83	1.98	1.83	2.09	1.93
July	2.06	1.87	2.05	1.84	2.11	1.98
August	2.05	1.66	2.10	1.75	2.09	1.81
September	1.97	1.62	2.01	1.69	2.07	1.68
October	2.03	1.72	2.05	1.66	2.03	1.66

November	1.98	1.51	2.02	1.51	1.94	1.46
December	2.03	1.45	2.14	1.57	2.04	1.43
Total Budget TgNO₂/year	24.13	19.71	23.54	19.36	24.94	20.31
TgN/year	7.34	6.00	7.16	5.89	7.59	6.18
TgNO/year	15.74	12.86	15.36	12.63	16.27	13.25

110 **Table S3** Anthropogenic NO_x emissions for Eastern China

China	2019 prior	2019 post	2020 prior	2020 post	2021 prior	2021 post
January	1.72	1.23	1.62	1.15	1.9	1.28
February	1.53	1.08	1.19	0.87	1.49	1.07
March	1.67	1.28	1.47	1.22	1.81	1.42
April	1.6	1.39	1.54	1.29	1.74	1.42
May	1.67	1.47	1.68	1.46	1.81	1.57
June	1.62	1.49	1.64	1.5	1.73	1.58
July	1.68	1.51	1.69	1.5	1.74	1.63
August	1.67	1.32	1.73	1.42	1.72	1.47
September	1.61	1.29	1.65	1.36	1.7	1.35
October	1.65	1.37	1.68	1.33	1.66	1.34
November	1.61	1.19	1.66	1.2	1.59	1.15
December	1.65	1.14	1.76	1.27	1.67	1.14
Total Budget TgNO₂/year	19.68	15.76	19.31	15.58	20.56	16.42
TgN/year	5.99	4.80	5.88	4.74	6.26	5.00
TgNO/year	12.84	10.28	12.6	10.17	13.42	10.71