Supplementary material of:

A Sulfur Dioxide Covariance-Based Retrieval Algorithm (COBRA): application to TROPOMI reveals new emission sources

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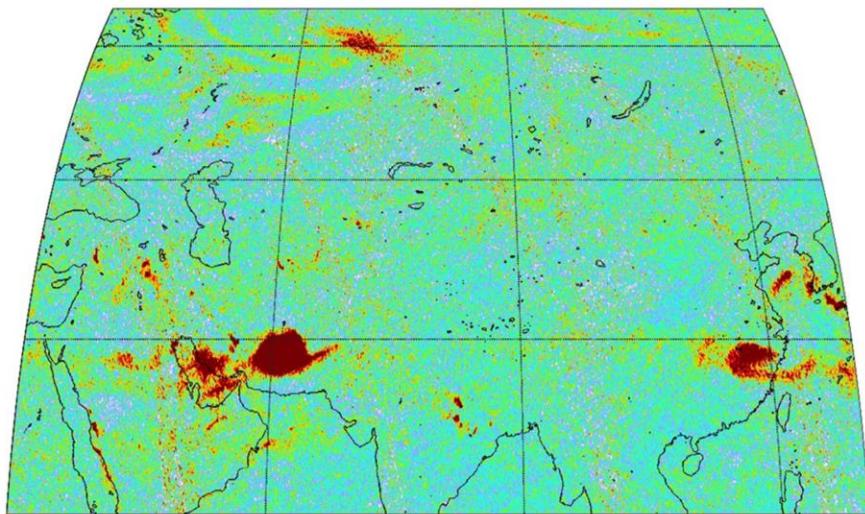

312 - 326 nm

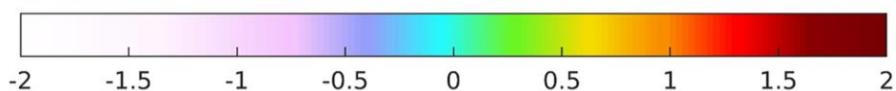
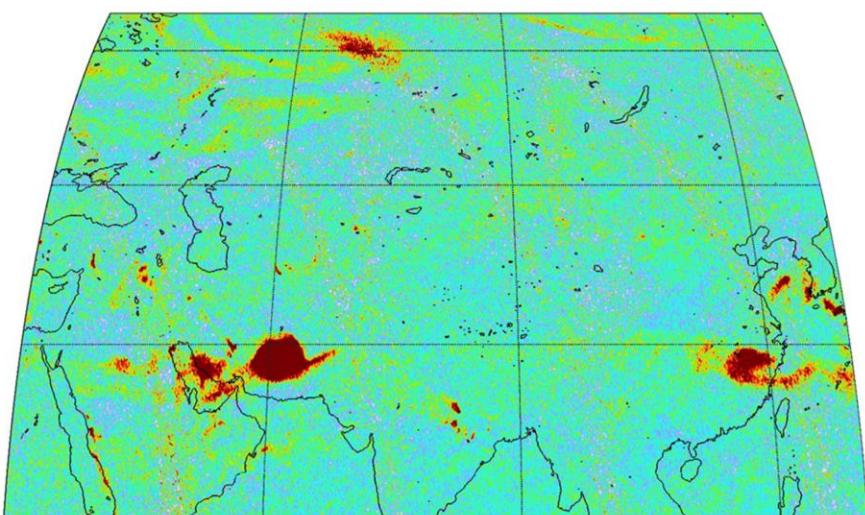
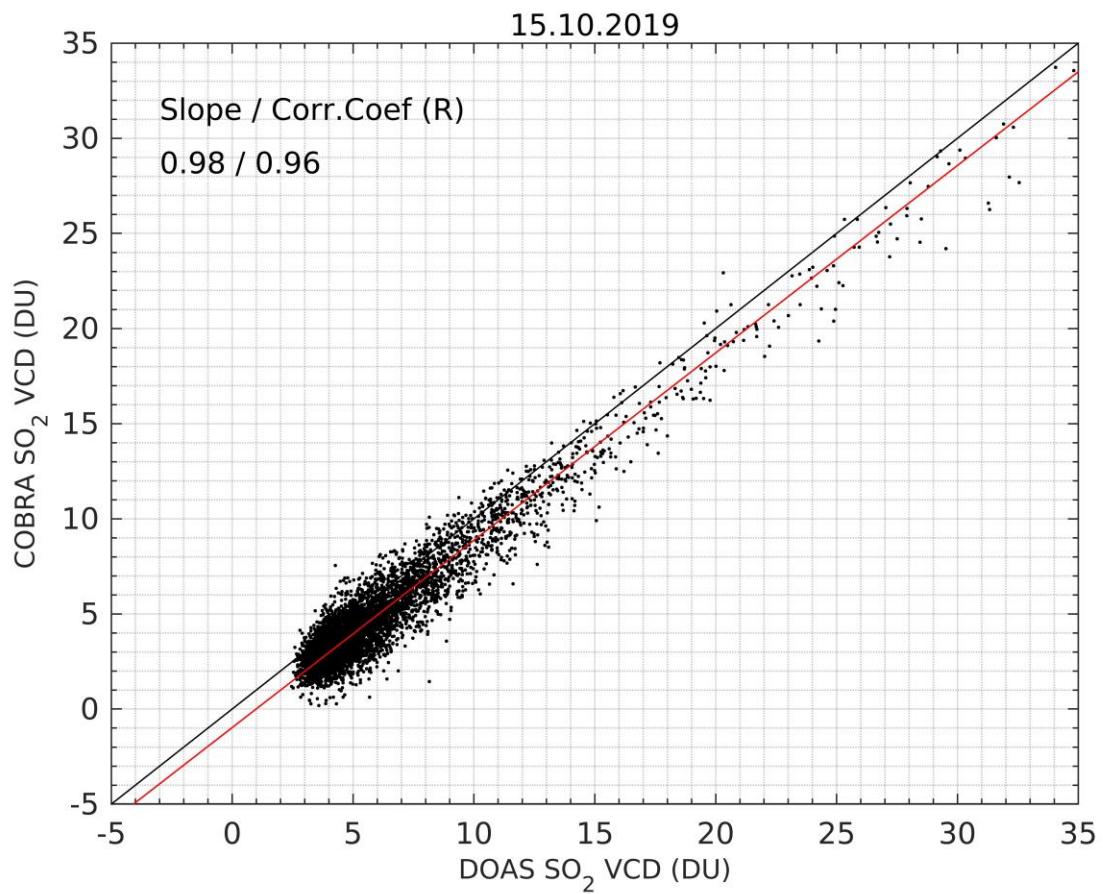
310.5 - 326 nm

SO₂ VCD (DU) 03 August 2019

Figure S1. SO₂ vertical columns retrieved from TROPOMI measurements over Asia on 03 August
2019 by the COBRA using wavelength ranges: (top) 312-326 nm and (bottom) 310.5-326 nm. All
satellite pixels (for all rows) are used in the maps; a fixed AMF of 0.4 is applied for the SCD to
VCD conversion.

2 Figure S2. Comparison of SO₂ columns from TROPOMI COBRA and DOAS retrievals for

3 October 15, 2019. Only the pixels with unambiguous detection of SO₂ were selected, based on the

4 SO₂ detection flag from the operational product. The correlation coefficient and slope of the

5 regression line are given as an inset.

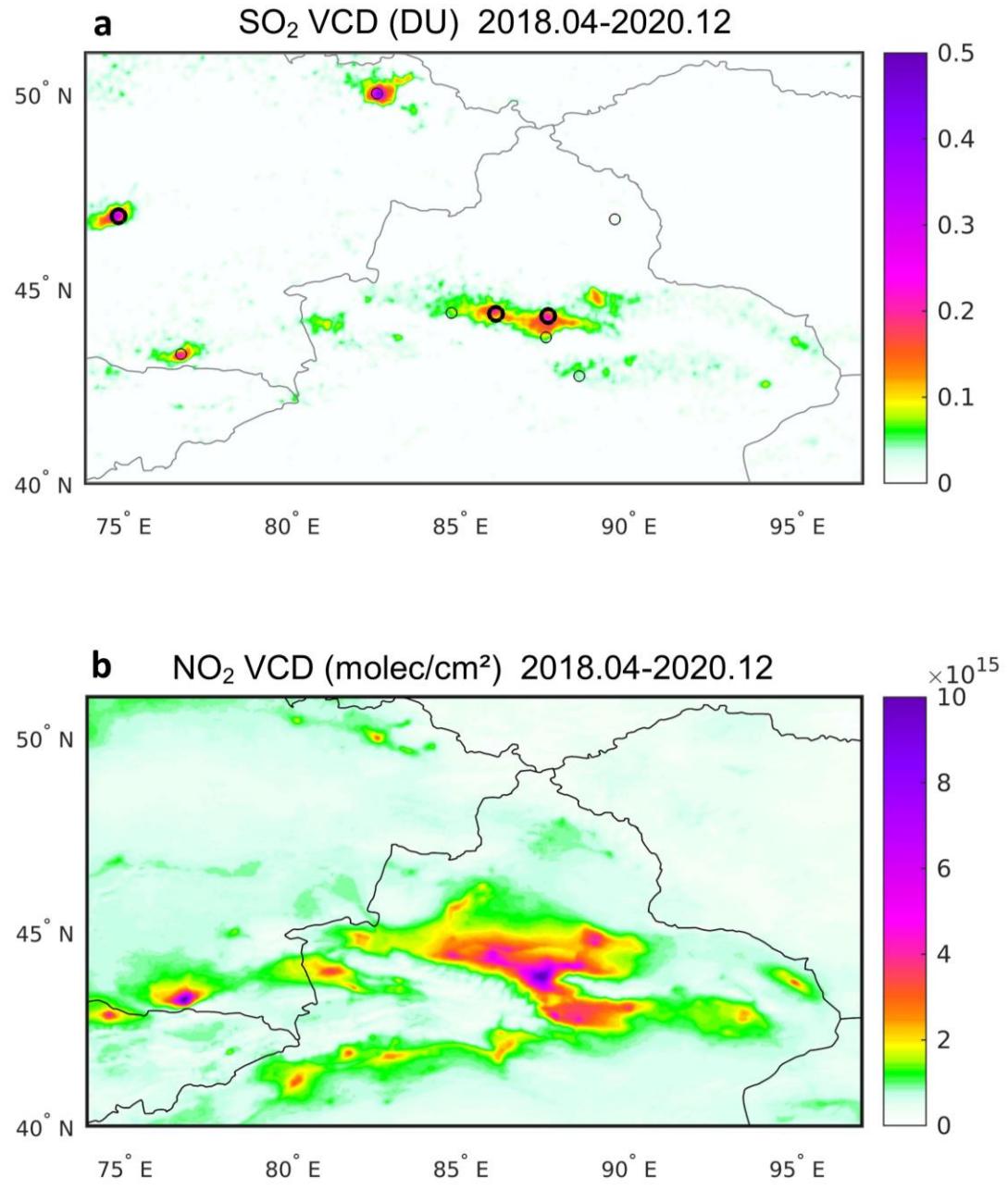



Figure S3. (a) SO$_2$ vertical columns retrieved by COBRA for TROPOMI measurements from April 2018 to December 2020, over a region covering north Xinjiang province (China), east Kazakhstan, and parts of Kyrgyzstan and Mongolia. Black circles indicate SO$_2$ sources (coal power plants and smelters) detected by OMI (in bold for the 2018-2019 period, see text). (b) same as (a) for the tropospheric NO$_2$ vertical columns from TROPOMI operational product (OFL and RPRO combined).

1 **Supplementary file:**

2 The global SO_2 vertical column map discussed in section 4 is included as supplement in the form

3 of a geotiff file (S5P_COBRA_SO2_VCD_2018_04_2020_12.tif), compatible with Google Earth

4 viewer. The data is a long-term average of SO_2 columns over the period of April 2018 to December

5 2020, for the latitudinal band 51°S-72°N. The SO_2 vertical column is in Dobson Unit and

6 represented with the color scale below.

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