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Comparing Sentinel-5P TROPOMI NO_2 column observations with the CAMS regional air quality ensemble

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As described in section 2 of the manuscript, the TROPOMI data we used in our analysis (the so called "OFFL" product) was based on various successive versions of the TROPOMI L2 processor. In the mean time however, a new dataset (S5P-PAL, https://data-portal.s5p-pal.com/products/no2.html) became available which is based on a reprocessing of the whole TROPOMI record from the beginning of the mission until mid November 2021, using version 2.3.1 of the processor, which includes a number of important improvements. In order to evaluate the impact of the this homogeneous L2 product on our results, we reproduced figures 7 and 8 of the manuscript(supplement figures S1 and S2, below), by also including the S5P-PAL based columns, i.e. $\mathrm{S5P_{PAL}}$ and CAMS-RG-$\mathrm{A_{PAL}}$.

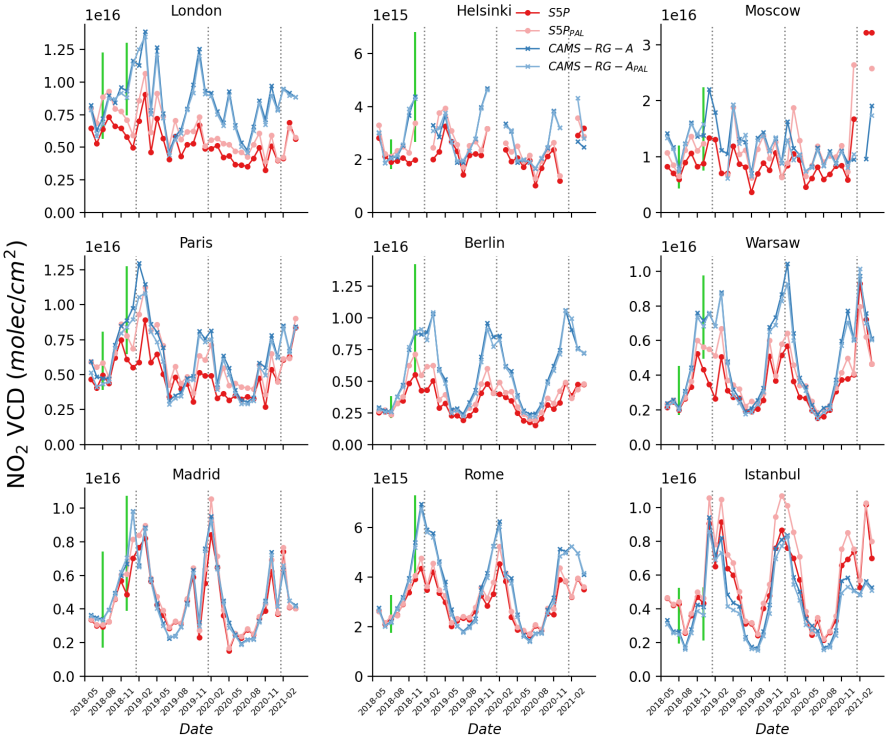

Figure S1. Time series of monthly mean original TROPOMI columns (S5P: red, $\mathrm{S5P_{PAL}}$: pink) and the CAMS combined columns (CAMS-RG-A: blue, CAMS-RG-$\mathrm{A_{PAL}}$: light blue) with averaging kernels applied for 9 major European cities. The retrieval algorithm versions used for the non-PAL based columns are as described in section 2 of the manuscript. The panels are ordered according to geographical location. Vertical axes are different for each city. Green vertical bars in July and November 2018 represent the model spread for those two months.

The results reveal a significant enhancement (up to 45%) of the TROPOMI columns in the S5P-PAL version, which is in accordance to what is described in van Geffen et al. (2022), especially for northern European cities (figure S1). CAMS columns are also affected through the averaging kernel, but the differences between the standard (as used in the manuscript) and the S5P-PAL based CAMS columns are considerably smaller. In some cases, such as in Paris at wintertime, the S5P-PAL based columns suggest a much more favourable comparison as the S5P column gets higher while at the same time the new averaging kernel renders the CAMS column lower, bridging to a certain degree the discrepancy discussed in the manuscript (percentage relative difference from 37% to 7% in November 2018). The time series for the domains (figure S2) are qualitatively similar, although the differences between the standard and PAL based columns appear to be considerably smaller.

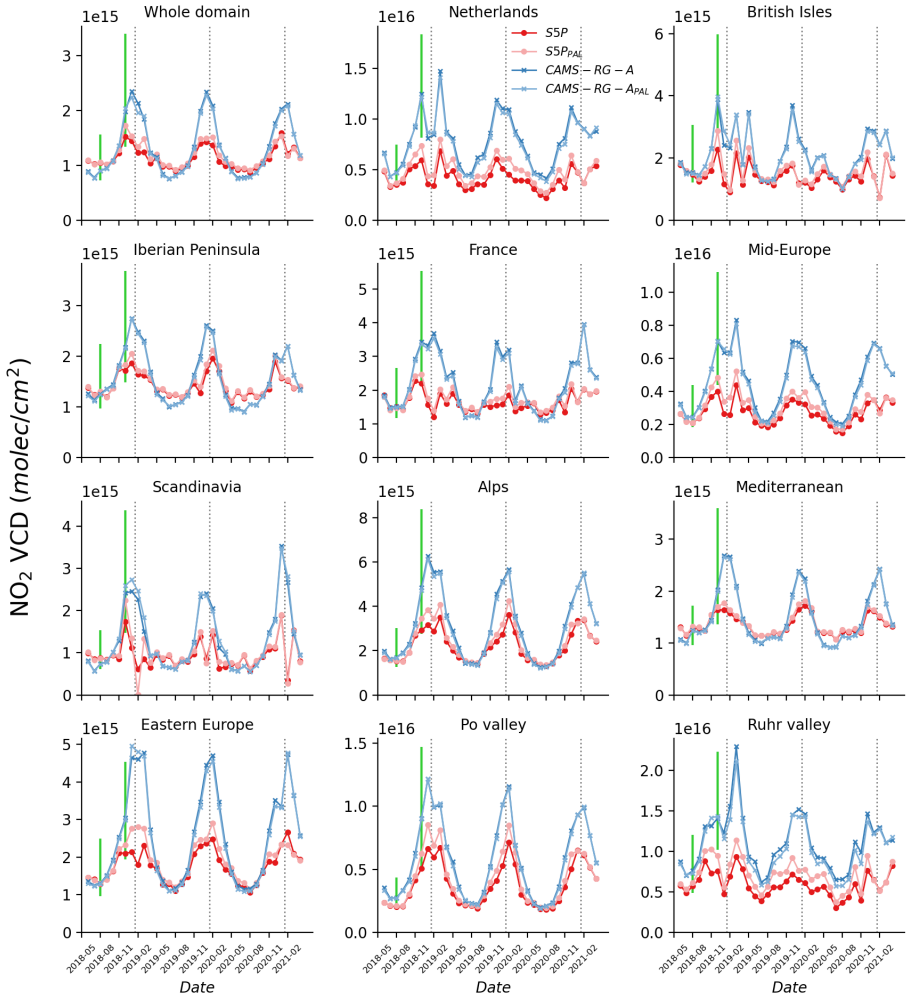

Figure S2. Time series of the TROPOMI original columns (S5P: red, $S5P_{PAL}$: pink) and the CAMS combined columns (CAMS-RG-A: blue, CAMS-RG-A_{PAL}: light blue) with averaging kernels applied, for the domains as defined in figure 3 of the manuscipt. The retrieval algorithm versions used for the non-PAL based columns are as described in section 2 of the manuscript. Vertical axes are different for each domain. Green vertical bars in July and November 2018 represent the model spread for those two months.

References

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