Atmospheric
Measurement
Techniques

Supplement of

Quantification of lightning-produced NO$_x$ over the Pyrenees and the Ebro Valley by using different TROPOMI-NO$_2$ and cloud research products

Francisco J. Pérez-Invernón et al.

Correspondence to: Francisco J. Pérez-Invernón (fjpi@iaa.es)

1   Introduction

In the main part of this manuscript we have calculated the LNO$_x$ PE from eight cases 29 April, 7 May, 12 May, 21 May, 22 May, 26 May, 28 May and 30 May 2018. However, the main part of this manuscript only includes figures for cases 29 April, 7 May and 28 May. This supplement includes figures corresponding to the cases of 22 May, 21 May, 22 May, 26 May and 30 May 2018 .

2   Further analyzed cases

We show in Figures S1, S2, S3, S4, S5, S6, S7, S8 and S9 similar plots for cases 29 April, 7 May and 28 May 2018. The TROP-DLR research product was not available for the case on 30 May 2018. In addition, the thunderstorm taking place on 26 May 2018 had a significant lightning activity between 45°N and 46°N, but we do not have access to EUCLID data north of 45°N.

As in the case showed in the main part of this manuscript, there are more lightning flashes reported by ENGLN than by EU-CLID. There are not significant differences between the SCD of NO$_2$ for each of the used TROPOMI products, while in general areas with high lightning activity or areas close to lightning flashes coincide with areas with high SCD of NO$_2$, suggesting that the LNO$_x$ signal is detectable by TROPOMI. The stratospheric VCD of NO$_2$ from the TROP-DLR product is slightly larger than from the TROP-KNMI product, while both the stratospheric VCD of NO$_2$ and the stratospheric AMF of NO$_2$ are more homogeneous for the TROP-DLR product than for the TROP-KNMI product. There are not significant differences between the cloud products, except for some pixels in which the TROP-DLR product estimates larger cloud fractions.
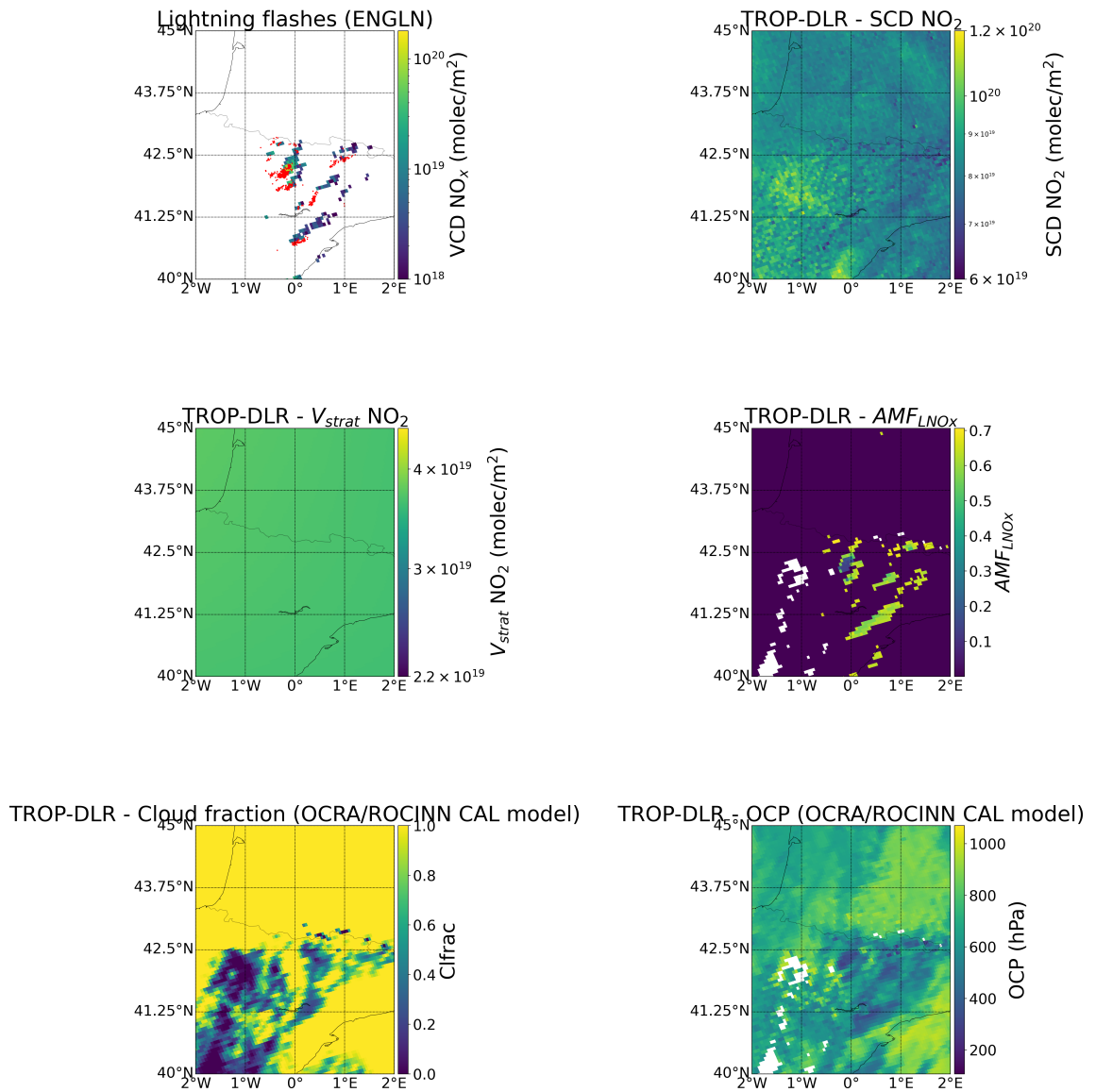
Figure S1. TROP-DLR product and ENGLN lightning data for the case 12 May 2018. The upper left panel shows the positions of lightning flashes (red dots) reported by ENGLN 5 h before the TROPOMI overpass and the calculated VCD NO_x The upper right panel shows the SCD of NO_2, center left and right panels show the stratospheric VCD and AMF of NO_2. The lower left and right panels show the cloud fraction and the OCP, respectively.
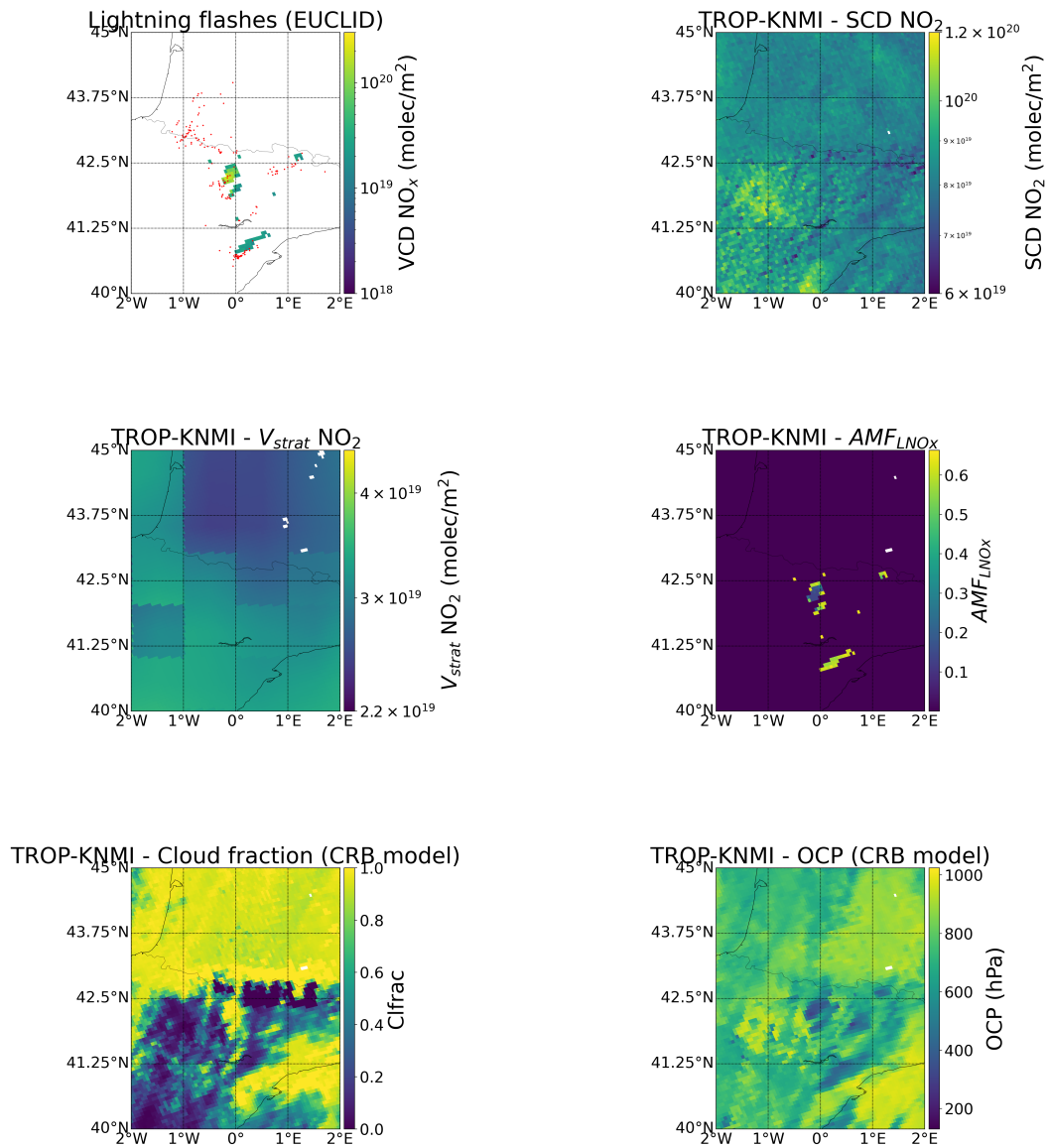
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Figure S2. TROP-KNMI product and EUCLID lightning data for the case 12 May 2018. The upper left panel shows the positions of lightning flashes (red dots) reported by EUCLID 5 h before the TROPOMI overpass and the calculated VCD NO_x The upper right panel shows the SCD of NO_2, center left and right panels show the stratospheric VCD and AMF of NO_2. The lower left and right panels show the cloud fraction and the OCP, respectively.
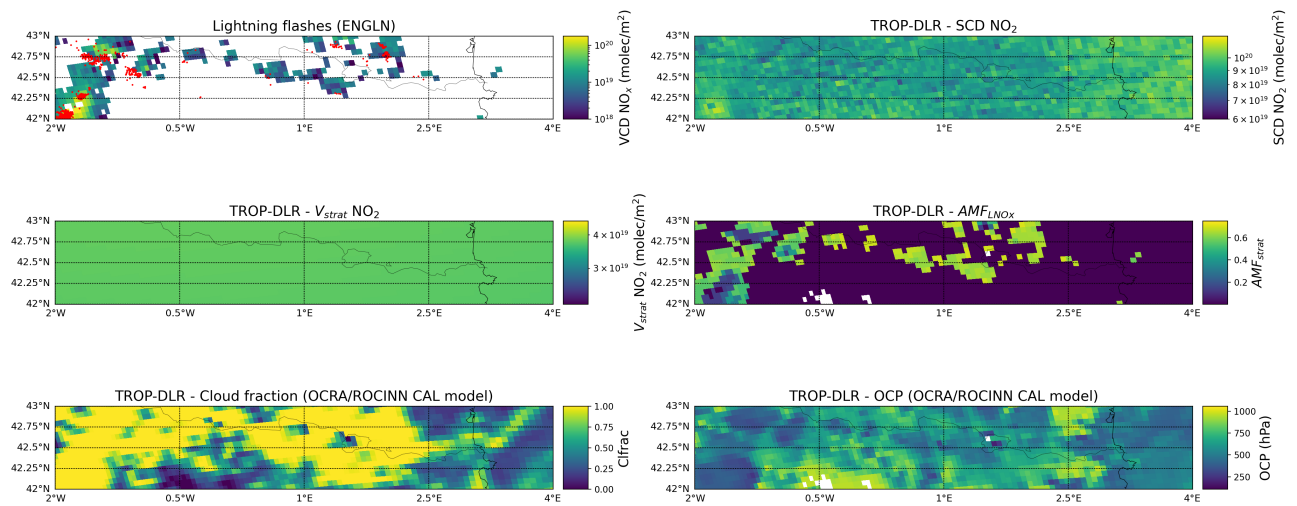
Figure S3. TROP-DLR product and ENGLN lightning data for the case 21 May 2018. The upper left panel shows the positions of lightning flashes (red dots) reported by ENGLN 5 h before the TROPOMI overpass and the calculated VCD NO_x The upper right panel shows the SCD of NO_2, center left and right panels show the stratospheric VCD and AMF of NO_2. The lower left and right panels show the cloud fraction and the OCP, respectively.
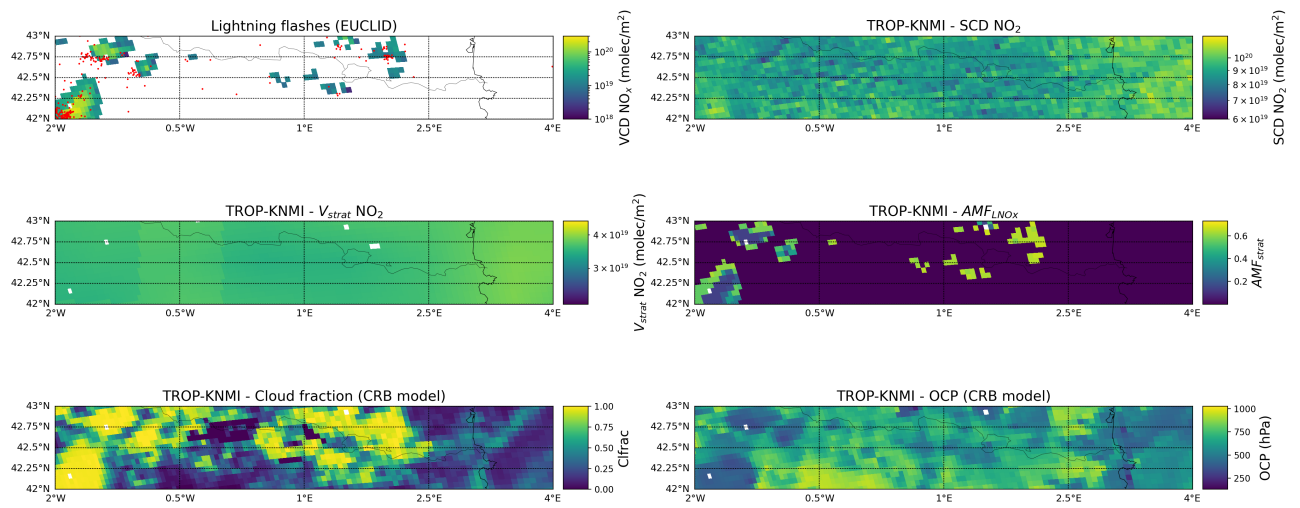
Figure S4. TROP-KNMI product and EUCLID lightning data for the case 21 May 2018. The upper left panel shows the positions of lightning flashes (red dots) reported by EUCLID 5 h before the TROPOMI overpass and the calculated VCD NO_x The upper right panel shows the SCD of NO_2, center left and right panels show the stratospheric VCD and AMF of NO_2. The lower left and right panels show the cloud fraction and the OCP, respectively.
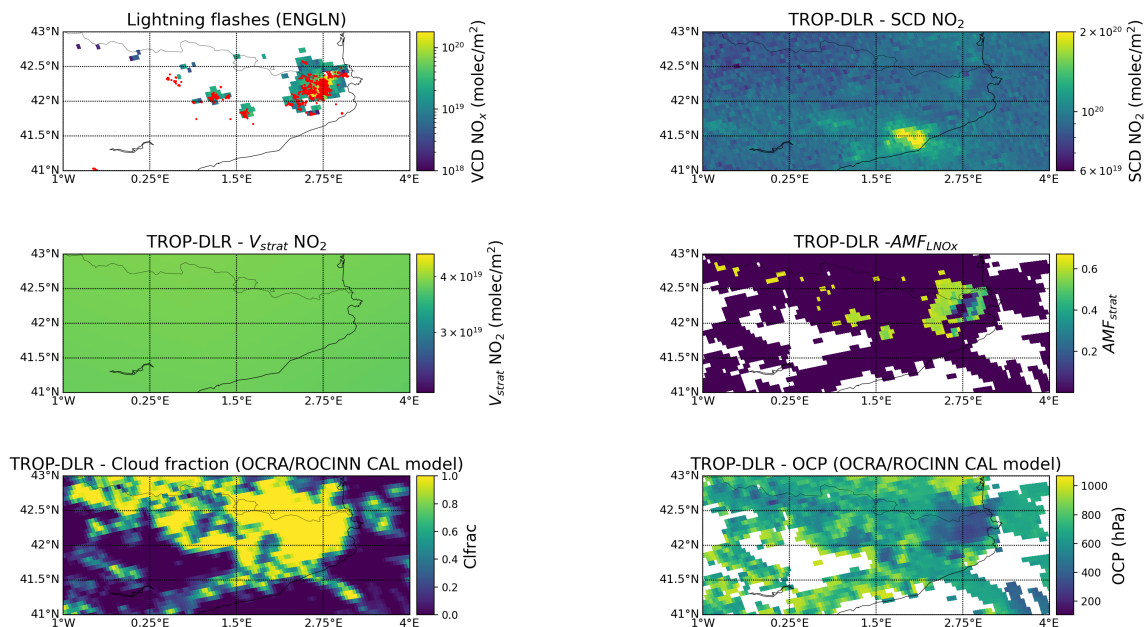
Figure S5. TROP-DLR product and ENGLN lightning data for the case 22 May 2018. The upper left panel shows the positions of lightning flashes (red dots) reported by ENGLN 5 h before the TROPOMI overpass and the calculated VCD NO_x The upper right panel shows the SCD of NO_2, center left and right panels show the stratospheric VCD and AMF of NO_2. The lower left and right panels show the cloud fraction and the OCP, respectively.
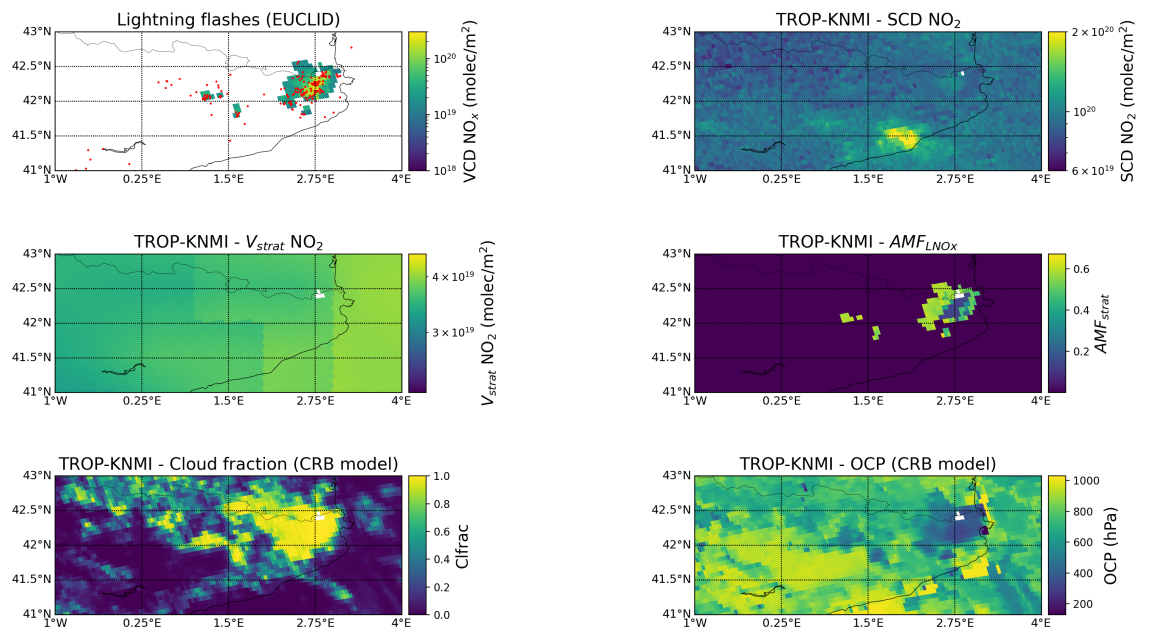
Figure S6. TROP-KNMI product and EUCLID lightning data for the case 22 May 2018. The upper left panel shows the positions of lightning flashes (red dots) reported by EUCLID 5 h before the TROPOMI overpass and the calculated VCD NO_x The upper right panel shows the SCD of NO_2, center left and right panels show the stratospheric VCD and AMF of NO_2. The lower left and right panels show the cloud fraction and the OCP, respectively.
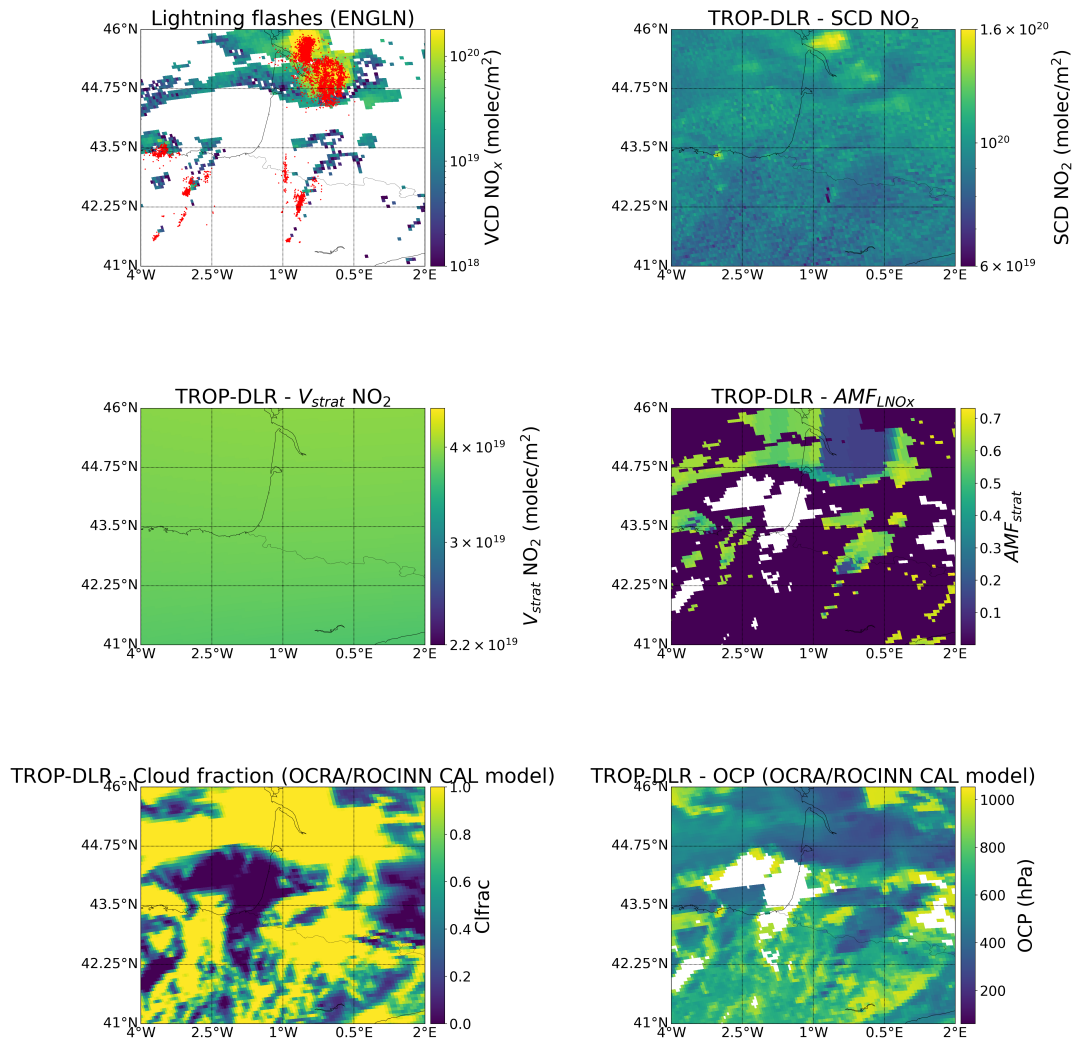
Figure S7. TROP-DLR product and ENGLN lightning data for the case 26 May 2018. The upper left panel shows the positions of lightning flashes (red dots) reported by ENGLN 5 h before the TROPOMI overpass and the calculated VCD NO_x The upper right panel shows the SCD of NO_2, center left and right panels show the stratospheric VCD and AMF of NO_2. The lower left and right panels show the cloud fraction and the OCP, respectively.
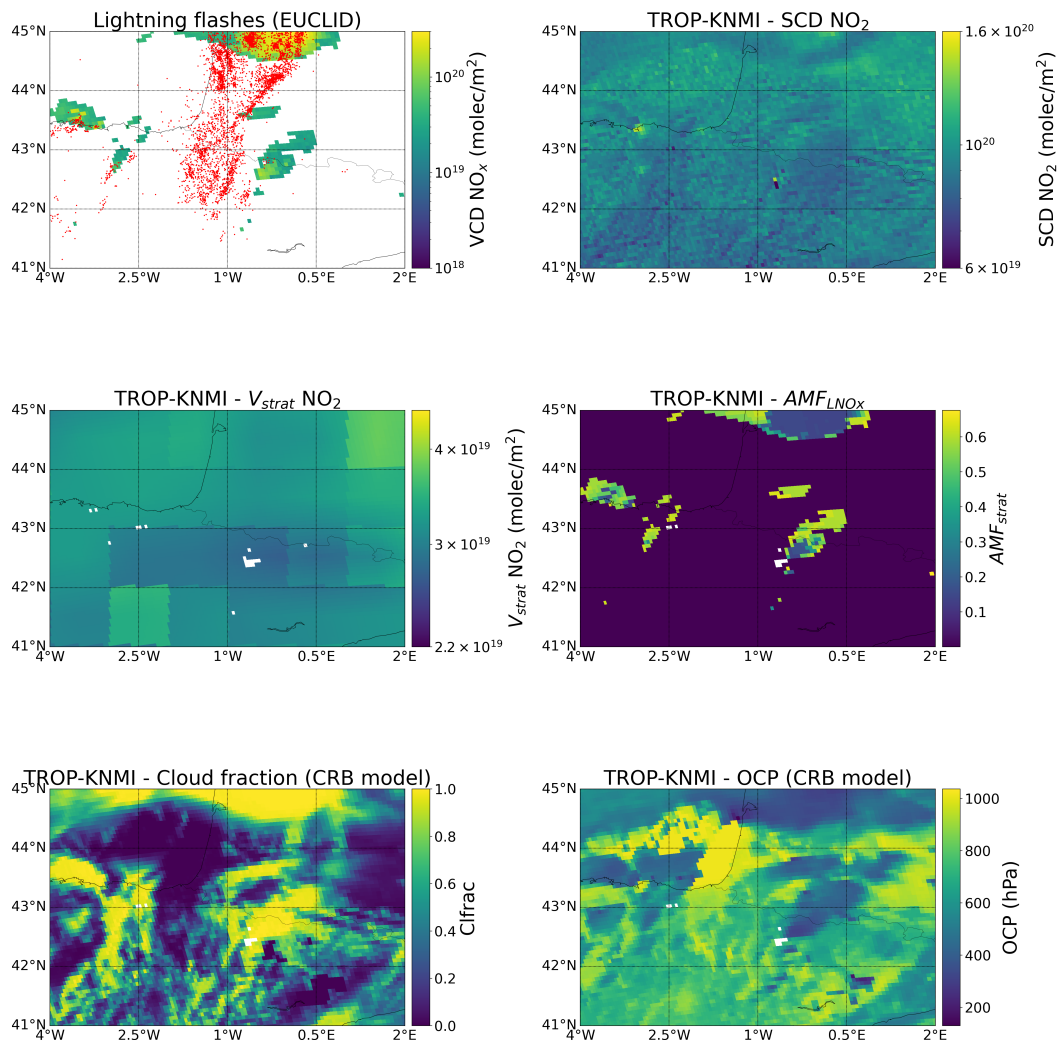
Figure S8. TROP-KNMI product and EUCLID lightning data for the case 26 May 2018. The upper left panel shows the positions of lightning flashes (red dots) reported by EUCLID 5 h before the TROPOMI overpass and the calculated VCD NO_x The upper right panel shows the SCD of NO_2, center left and right panels show the stratospheric VCD and AMF of NO_2. The lower left and right panels show the cloud fraction and the OCP, respectively.
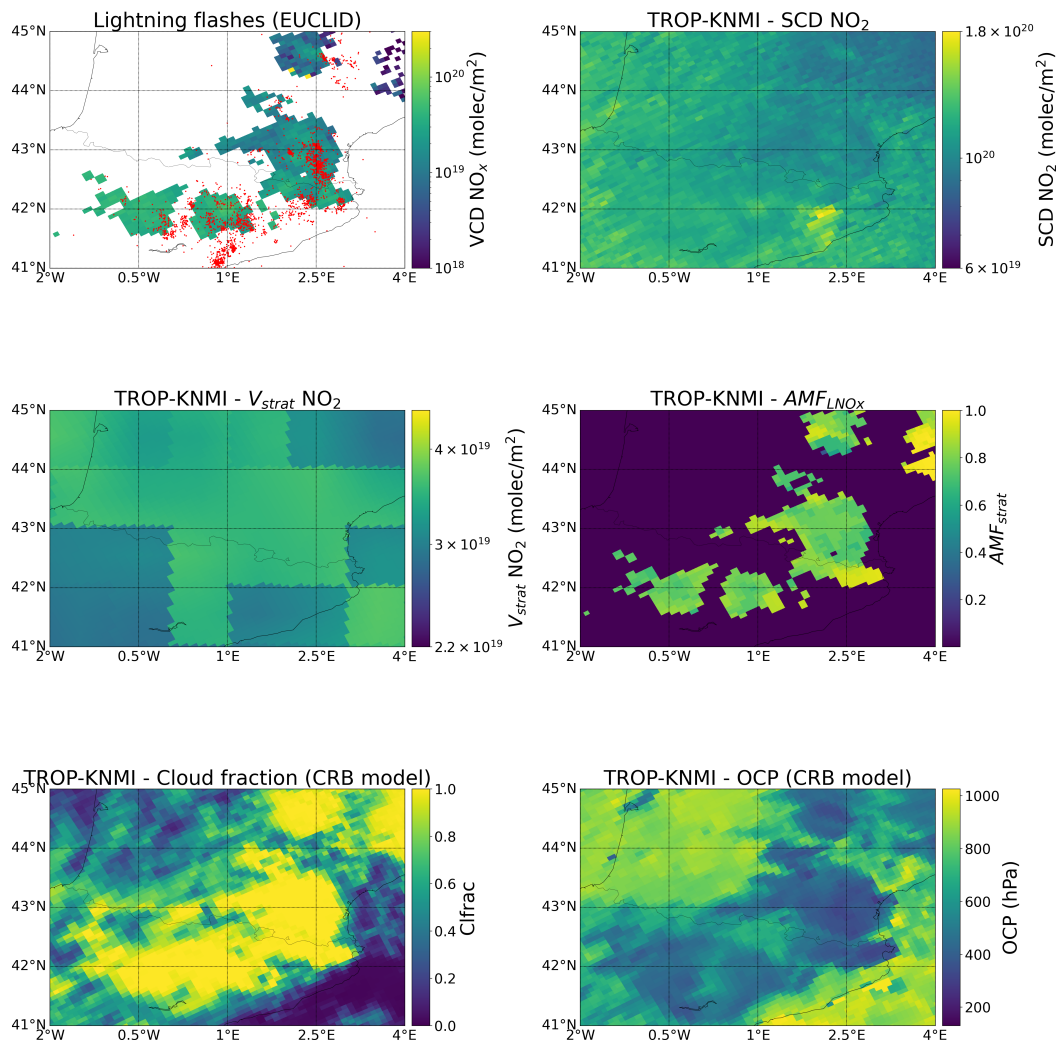
Figure S9. TROP-KNMI product and EUCLID lightning data for the case 30 May 2018. The upper left panel shows the positions of lightning flashes (red dots) reported by EUCLID 5 h before the TROPOMI overpass and the calculated VCD NO_x The upper right panel shows the SCD of NO_2, center left and right panels show the stratospheric VCD and AMF of NO_2. The lower left and right panels show the cloud fraction and the OCP, respectively.