1 *Supplement of*

2 **Changes in black carbon emissions over Europe due to**

3 **COVID-19 lockdowns**

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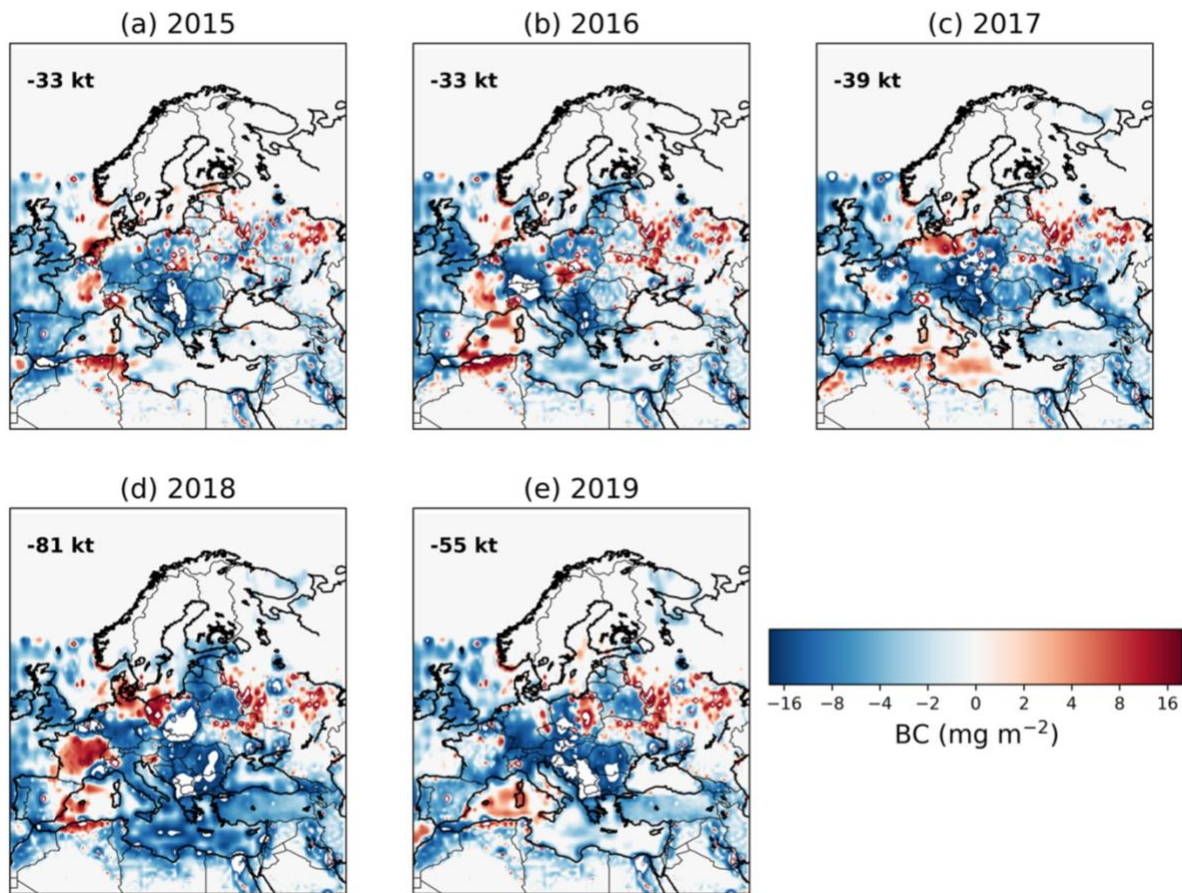
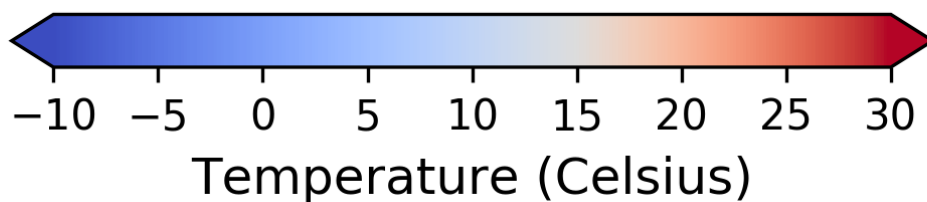
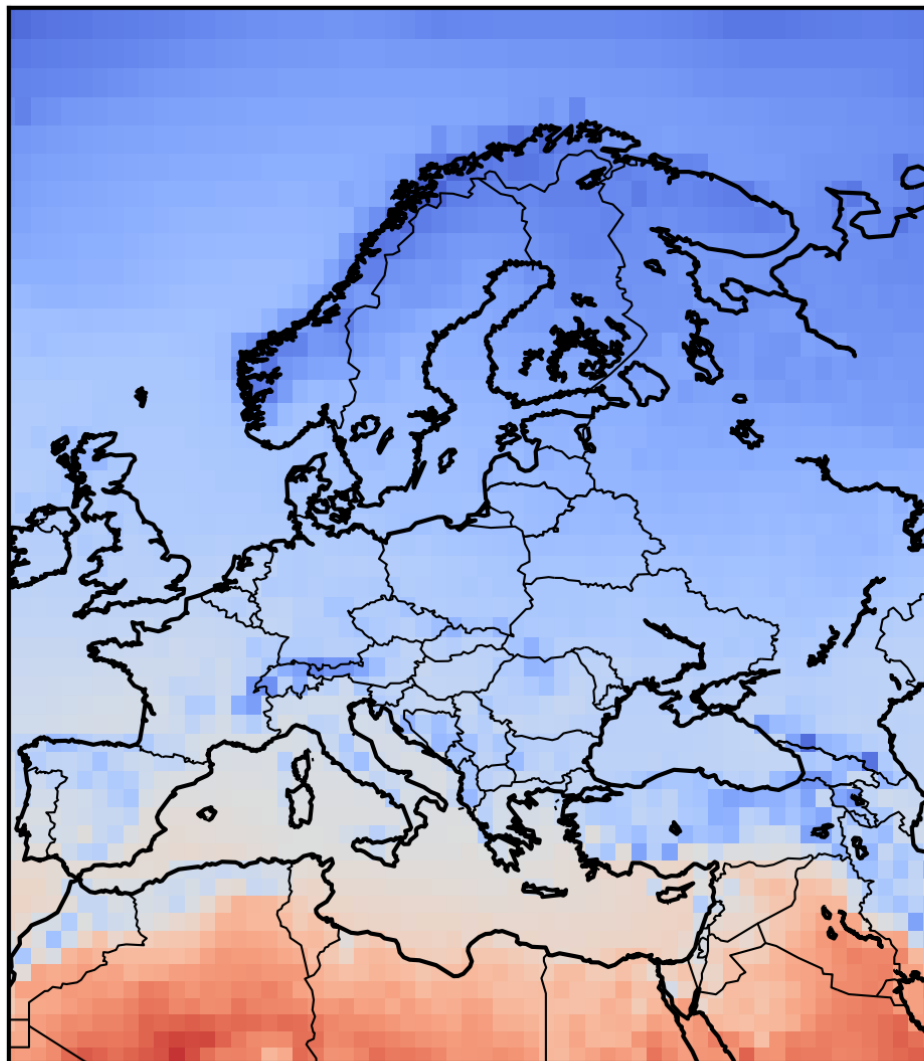
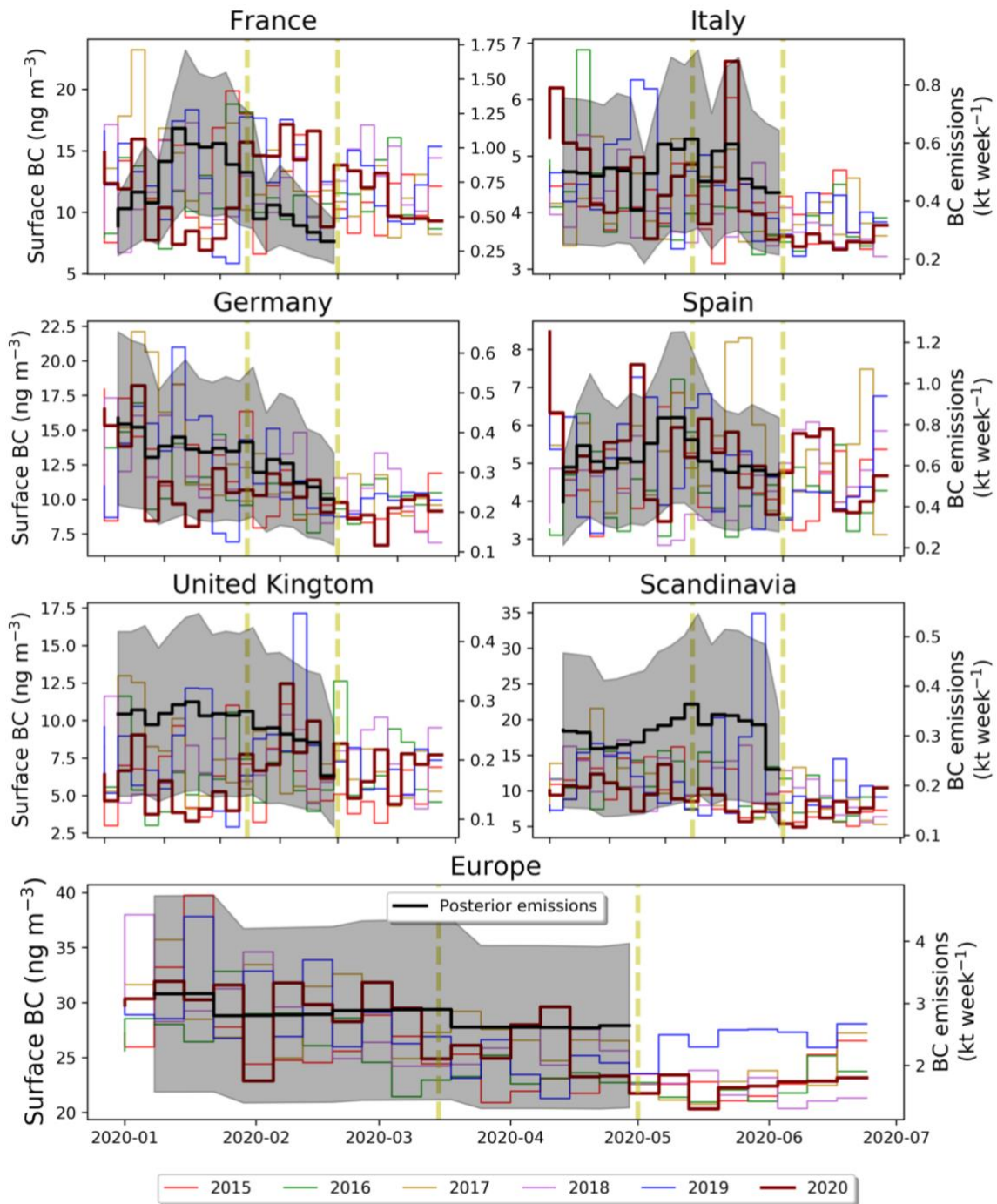
Supplementary figures

Supplementary Figure 1. Comparison with BC emissions in previous years. Difference of optimised (posterior) BC emissions over Europe during the 2020 lockdown (14 March to 30 April) from respective BC emissions in previous years (same period) constrained with the same inversion algorithm and the same settings.

Mean temperature at 2 m (ECMWF) during lockdown (14 March - 30 April)

Temperature (Celsius)

Supplementary Figure 2. Surface temperature during the 2020 lockdown. Average surface temperature at 2 m over Europe during the COVID-19 lockdown (14 March to 30 April) from ERA-5 (ECMWF) (Copernicus Climate Change Service (C3S), n.d.). Note that prevailing average temperatures over Europe during the lockdown were below 15°C. This temperature has been used as the basis temperature, below which residential combustion has been found to increase (Quayle and Diaz, 1980; Stohl et al., 2013).

22

Supplementary Figure 3. Weekly posterior BC emissions against MERRA-2 concentrations. Average surface BC concentrations from MERRA-2 (left axis) since 2015 in the most highly affected European countries (France, Italy, Germany, Spain and UK), Scandinavia and Europe from the pandemic, in contrast to the calculated optimized BC emissions (right axis). The grey shaded area corresponds to the BC emission uncertainty calculated as described in the Results section. The vertical yellow dashed lines correspond to the beginning and end of the COVID-19 lockdown (14 March to 30 April 2020).

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31

References

Copernicus Climate Change Service (C3S): C3S ERA5-Land reanalysis . Copernicus Climate
Change Service, [online] Available from: https://cds.climate.copernicus.eu/cdsapp#!/home
(Accessed 31 August 2020), n.d.

Quayle, R. G. and Diaz, H. F.: Heating degree day data applied to residential heating energy
consumption, J. Appl. Meteorol., 19, 241–246, 1980.

Stohl, A., Klimont, Z., Eckhardt, S., Kupiainen, K., Shevchenko, V. P., Kopeikin, V. M. and
Novigatsky, A. N.: Black carbon in the Arctic: The underestimated role of gas flaring and
residential combustion emissions, Atmos. Chem. Phys., 13(17), 8833–8855, doi:10.5194/acp-
13-8833-2013, 2013.

42