

Quantification of the Primary Emission Changes in Europe due to the COVID-19 Quarantine Measures

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To control the spread of the COVID-19 disease, European governments implemented emergency measures going from light social distancing to strict lockdowns, depending on the country. As a consequence, many industries, businesses and transport networks were forced to either close down or drastically reduce their activity, which resulted in an unprecedented drop of anthropogenic emissions. This work presents the Copernicus Atmosphere Monitoring Service (CAMS) European regional emission reduction factors associated to the COVID-19 lockdowns (CAMS-REG_ERF-COVID19), an open source dataset of daily-, sector- and country-dependent emission reduction factors for Europe linked to the COVID-19 restrictions. The resulting dataset covers a total of six emission sectors, including: road transport, energy industry, manufacturing industry, residential and commercial combustion, aviation and shipping. The time period covered by the dataset starts from 21 February, when the first European localised lockdown was implemented in the region of Lombardy (Italy) until 31 July, when most countries had already completed the lockdown exit process. The CAMS-REG_ERF-COVID19 dataset is based on a wide range of information sources and approaches, including open access and measured activity data and meteorological data, as well as the use of machine learning techniques. We combined the computed emission reduction factors with the Copernicus CAMS European gridded emission inventory to spatially and temporally quantify reductions in primary emissions, as well as to assess the contribution of each pollutant sector to the overall reductions. The resulting gridded and time-resolved emission reductions suggest an heterogeneous impact of the COVID-19 across pollutants and countries. The maximum weekly emission reduction estimated for NO_x at the EU-28 level during the COVID-19 lockdown was -36.5%, while in the case of PM_{2.5} the maximum estimated reduction was of only -7.9%. The largest emission drops (up to -52% for NO_x and -12% for PM_{2.5}) were observed in those countries where the lockdown restrictions were more severe such as Italy, France or Spain. Coinciding with the easing of lockdown restrictions, a constant recovery of the activity in the different pollutant sectors is observed, the corresponding emissions reaching almost pre-lockdown levels during the last week of July.