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Quantification of the Emission Changes in Europe During 2020 Due to the COVID-19 Mobility Restrictions

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To hinder the circulation of the COVID-19 virus, 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 mobility restrictions (CAMS-REG_ERF-COVID19), an open source dataset of daily-, sector-, pollutant- and country-dependent emission reduction factors for Europe linked to the COVID-19 pandemic. 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 includes the first and second waves of the disease occurred during 2020, starting from 21 February, when the first European localised lockdown was implemented in the region of Lombardy (Italy), until 31 December, when COVID-19 transmission remained widespread and several countries had nationwide restrictions still in place. 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 (0.1x0.05 degrees) and temporally (daily) quantify reductions in 2020 primary emissions from both criteria pollutants (NO_x, SO₂, NMVOC, NH₃, CO, PM₁₀ and PM_{2.5}) and greenhouse gases (CO₂ fossil fuel, CO₂ biofuel and CH₄), as well as to assess the contribution of each pollutant sector and country to the overall reductions. The resulting gridded and time-resolved emission reductions suggest an heterogeneous impact of the COVID-19 across pollutants, sectors and countries.