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Changes in surface level NO₂ in the UK during the COVID-19 pandemic compared to predicted 2020 concentrations and the impact on O₃.

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Governments worldwide have used non pharmaceutical interventions known as lockdowns to contain the spread of the coronavirus pandemic, leading to a mass reduction in road traffic and international travel as working from home becomes the new normal. As a result, primary emissions of nitrogen oxides are expected to have largely decreased. A study of the UK's first lockdown (Lee et al. 2020) used historical averages, taken between 2015 and 2019, as a baseline for comparison. This method is simplistic however does not fully account for the year to year meteorological variation. The UK's first national lockdown was announced on 23rd March 2020 extending to 31st May 2020 and by mid-April traffic was reduced by 70% compared to normal according to the Department for Transport. We examined NO₂ and O₃, measured by the UK's Automatic Urban and Rural Network for the year 2020 consisting of 65 urban traffic and 61 urban background sites, for the lockdown period from 2000 to 2020. Between 2000 and 2019 NO₂ decreased by an average of 0.88 and 0.49 µg m⁻³ per year at urban traffic and urban background sites respectively. In 2020, the lockdown caused a 20 µg m⁻³ decrease in NO₂ at urban traffic sites, an equivalent of 26 years at the previous rate.

To improve on the previous method, we have constructed random forest models to simulate business as usual NO₂ and O₃ concentrations at AURN sites in 9 cities, allowing changes in meteorology to be fully accounted for. These simulations were then compared to lockdown measurements in 2020. We observed an average 55% decrease in NO₂ however O₃ concentrations were elevated with an average 29% increase. The total oxidant, O_x, (sum of NO₂ and O₃) experienced marginal change (< 1%) indicating the changes in NO₂ and O₃ were largely due to photochemical repartitioning. This has highlighted the importance of O₃ in urban locations in a future low NO_x environment in the UK when electric vehicle fleets are adopted.