

**US COVID-19 shutdown demonstrates importance of background NO₂
in inferring NO_x emissions from satellite NO₂ observations**

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Contents of this file

Figures S1 to S5

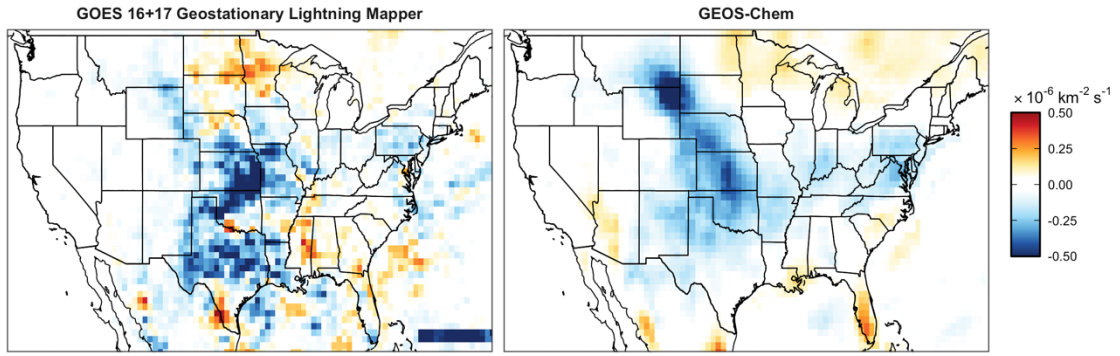


Figure S1. Differences in lightning density averaged over March-August in 2020 relative to 2019.

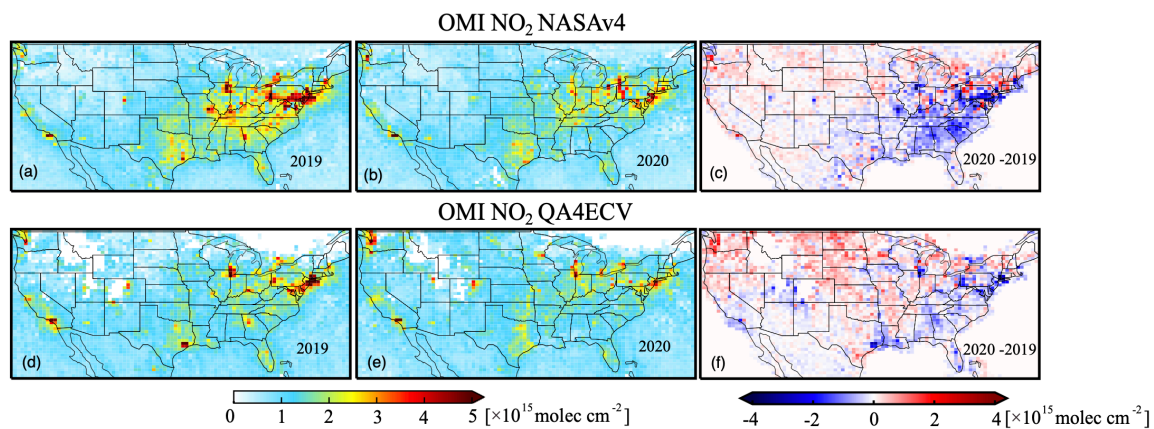


Figure S2. OMI NO₂ column densities averaged over March and April in 2019 (a, d), 2020 (b, e), and the differences between 2020 and 2019 (c, f). We use two different OMI retrievals the version 4 NASA NO₂ product and the QA4ECV product.

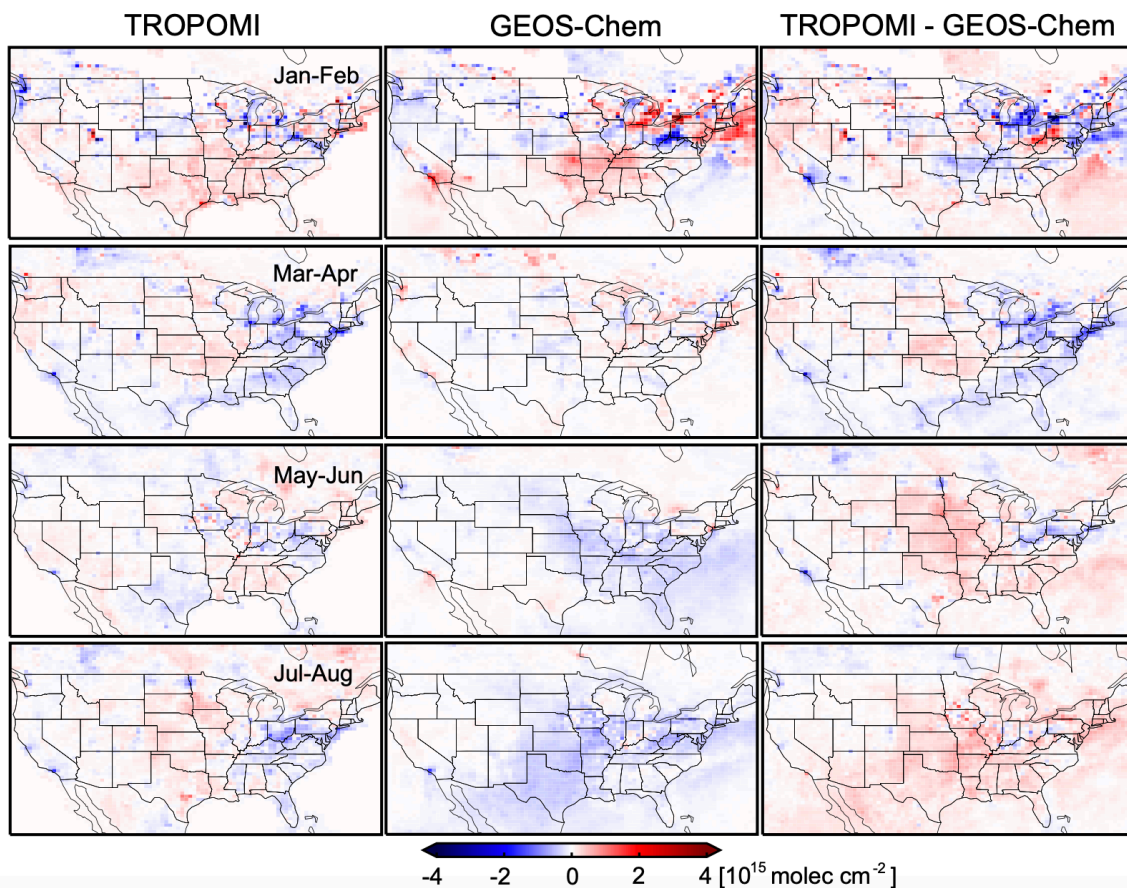


Figure S3. Absolute changes in NO₂ column densities from 2019 to 2020 from TROPOMI (left column), GEOS-Chem simulations with TROPOMI averaging kernel applied (middle column), and the difference between the first two columns (right columns). After removing this meteorology impact from the differences in TROPOMI NO₂ columns between 2019 and 2020 (right column), NO₂ reductions in Seattle, San Francisco, and Los Angeles in March and April are more consistent with our understanding of the shutdown in these cities.

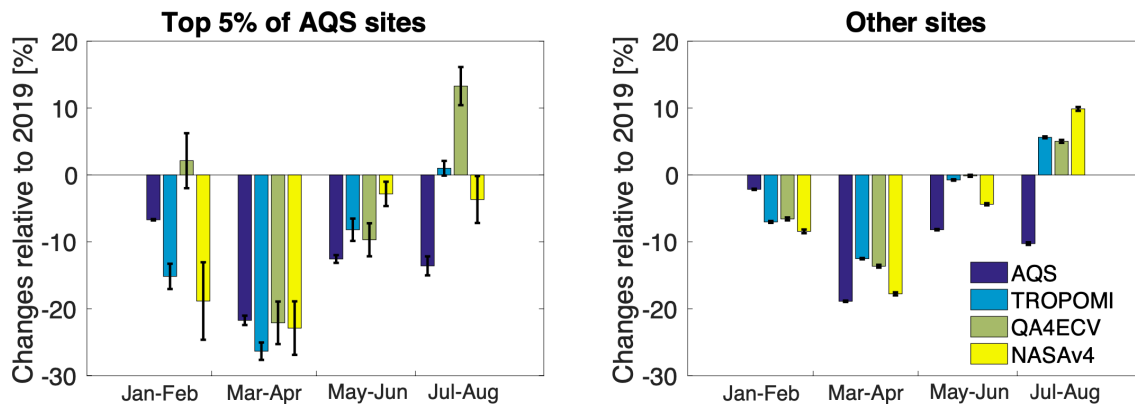


Figure S4. Relative changes of NO₂ concentrations in 2020 compared to 2019. Only grid cells that have collocated observations from AQS, TROPOMI, and two OMI retrievals (NASAv4 and AQ4ECV) are used in the calculation.

Annual surface NO₂, 2019

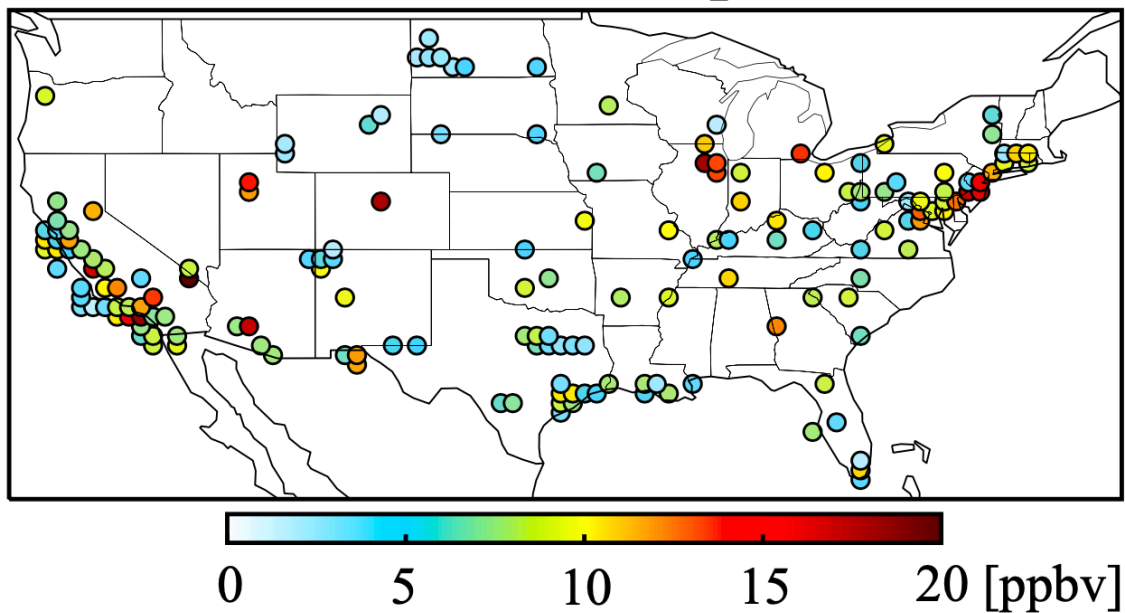


Figure S5. Annual mean surface NO₂ at grid cells with continuous AQS records for 2005-2019.