

Atmos. Chem. Phys. Discuss., referee comment RC3
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Comment on acp-2021-604

Anonymous Referee #3

Referee comment on "COVID-19 lockdown emission reductions have the potential to explain over half of the coincident increase in global atmospheric methane" by David S. Stevenson et al., Atmos. Chem. Phys. Discuss.,
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The paper by Stevenson et al. uses model-derived sensitivities of methane to nitrogen oxides (NO_x) emissions changes and estimates of NO_x emissions reductions resulting from COVID-19 lockdowns to estimate the impact of changes in NO_x emissions on atmospheric methane growth rates. Their hypothesis is that reductions in NO_x emissions during COVID lockdowns are the main driver for the increase in atmospheric methane growth rate seen in 2020 compared with 2019.

General comments

This short paper is well written, well organised, and comes to an interesting conclusion about the role of NO_x emissions on the atmospheric methane growth rate in 2020 compared with 2019. Using pre-existing model output of methane sensitivities and estimates of NO_x emission changes, they find that the dramatic reductions in NO_x emissions brought about by the COVID-19 national lockdowns can explain a large component of the surge in methane growth rate seen since early 2020.

While the findings are definitely interesting and make use of pre-existing model studies, for a research paper in Atmos. Chem. Phys., the analysis is not substantial enough. For example, the paper makes use of methane-to-NO_x sensitivities based on very broad regions in the case of surface emissions (N. America, Europe, S. and E. Asia, Southern Hemisphere) and a global sensitivity scaling factor in the case of aircraft emissions, despite the spatial heterogeneity in sensitivity, as the authors themselves noted. In particular, the southern hemisphere is treated as a single region, despite the potential for increased sensitivity in low-NO_x regions. More regional-scale sensitivities could be available through Phase 2 of the Hemispheric Transport of Air Pollution initiative, but the authors did not explore their applicability to support their hypothesis.

The second major consideration is that the potential impact of changes in commensurate emissions of carbon monoxide and/or volatile organic compounds during national lockdowns on the atmospheric methane growth rate was not quantified. Although NO_x is clearly a contributing factor, it is not the sole influence and these other potential contributors to changes in methane growth rate were not assessed.

Finally, the authors cite the paper of Lamboli et al. who estimate the emissions reductions due to COVID lockdowns and outline a protocol for global climate and Earth System Model simulations. First results on the climate response from these model simulations have been published and interactive chemistry was included in a number of models. Therefore, there is data available that could address the spatial heterogeneity of the methane sensitivities and the role of other emission changes that would add substantially to this analysis.

Given these concerns, I would not recommend publication in its current form.