

# ***Interactive comment on “Using satellite observations of tropospheric NO<sub>2</sub> columns to infer long-term trends in US NO<sub>x</sub> emissions: the importance of accounting for the free tropospheric NO<sub>2</sub> background” by Rachel F. Silvern et al.***

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Silvern et al. (2019) demonstrated a potential influence from the increasing relative contribution of natural sources (e.g., lightning and soil NO<sub>x</sub>) on the trends of free tropospheric NO<sub>2</sub> and the retrievals of column NO<sub>2</sub>. Their results provide important and useful explanation for the discrepancy between official reported and satellite-based trends of US NO<sub>x</sub> emissions. The paper could be stronger, if the following points can be considered:

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1) Figure 4a (Silvern et al. 2019) demonstrates a growing discrepancy between EPA's inventory (black line) and AQS surface measurements (green line) since 2011, which is still not well understood. As a possible explanation, the bottom-up analysis with updated statistic and emission factors (Figure 1a, green dashed line, Jiang et al. 2018) matches better with AQS surface measurements.

2) An important difference between anthropogenic and natural sources is their distinct seasonality, i.e., the seasonality of natural sources is much stronger. Thus, the discrepancy between winter and summer (Figure 5, Silvern et al. 2019) is expected to be the major evidence to support the conclusion.

For Figure 5a (Silvern et al. 2019), the authors described: "OMI NO<sub>2</sub> observations in urban winter show a steady decline . . . and do not exhibit the post-2009 flattening". However, it seems that OMI NO<sub>2</sub> decreased by about 35% in the period of 2005-2009, whereas only about 10% in the period of 2009-2017.

I am thankful for the authors' efforts to improve our understanding about the retrieval and interpretation of satellite data, and hope the above comments could be helpful in the revision.

Reference: Z. Jiang et al., Unexpected slowdown of US pollutant emission reduction in the past decade, *Proc National Acad Sci* 115, 201801191 (2018).

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