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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Measurement report: Nitrogen isotopes (δ^{15}N) and first quantification of oxygen isotope anomalies ($\triangle^{17}$O, δ^{18}O) in atmospheric nitrogen dioxide" *by* Sarah Albertin et al.

Anonymous Referee #1

Received and published: 11 January 2021

Summary: The author's report on the multiple oxygen and nitrogen stable isotopes of ambient NO2 from an urban location in France. The nitrogen and oxygen stable isotope signatures of NOx and its oxidation products are a potentially valuable tool to further understand the emission and chemistry of this important reactive nitrogen family; however, traditionally, isotopic measurements have been made almost exclusively for atmospheric nitrate and nitric acid (i.e., secondary products from NOx emission). While this dataset isn't the first δ15N or δ18O measurement of ambient NO2, it builds off a previous study using a similar collection technique and reports the first $\triangle$17O that

seems unaffected from collection artifacts. This dataset will certainty help further our understanding of the isotope dynamics of NO2 and its propagation into atmospheric nitrate. The biggest drawback to this study was the limited nature of the dataset that only included measurements for one day at one site. The limited dataset may be appropriate for a measurement report; however, I think interpretations of the dataset should be treated cautiously because it's not clear how representative one day's worth of measurements would be for our understanding of diurnal NO2 chemistry or emission contributions. Despite this limitation, I found the analyses and interpretation to be robust and I think is worthy of publication with the following minor comments/suggestions:

Specific Comments/Suggestions:

Lines 32-34: In the introduction, I think the authors should point out that there is also motivation to better constrain precursor emission contributions to nitrate deposition; thus, source apportionment is also important (and not just chemistry).

Line 243: δ15N(NO2) range looks to be incorrect; I think it should be -11.8 to -4.9 ‰ (based on Table 1).

Line 280: EPA IsoSource is a very simplistic model that cannot account for source uncertainty. I think the authors should consider applying a more advanced statistical (i.e., Monte-Carlo) mixing model such as SIMR or SIAR that has been commonly used in the δ15N atmospheric community for the past few years. As a measurement report, I think it is important to showcase how advanced statistical modeling and be used to partition NOx emission sources using the described sampling technique.

Lines 284-286: In recent years, there have been several updates to our δ15N(NOx) source emission values including for biogenic emissions (rural and urban; Yu and Elliott, ES&T, 2017; Miller et al., GRL, 2018) and traffic (Miller et al., JGR:Atmos, 2017). Perhaps consider using more up to date δ15N(NOx) values. Additionally, the fuel-combustion signature is for natural gas power plants. Please confirm that is an appropriate fuel-combustion source signature for your study region.

Lines 376-377: Can you further elaborate and include specific details on the “additional more accurate measurements” that are needed to improve the interpretation of NO + RO2 rxn contributions to Δ17O?

General: As mentioned in the summary section, the authors report on isotopic measurements over a limited collection period (1 day during at a single collection location). I think the authors should tone down their NOx source contributions and chemical mechanism conclusions based on their isotopic measurements. For example, NOx emission contributions are going to be highly dependent on meteorology conditions (wind speed and wind direction); thus, measurements from one day are unlikely to capture even the seasonal NOx emission patterns at their sampling location. Therefore, I was surprised the authors used their limited dataset to draw conclusions about urban NOx emissions compared to satellite observations. Instead I think the focus should be on explaining the framework for interpreting δ15N and Δ17O(+δ18O) and what could be learned from these measurements without drawing large conclusions due to their limited dataset.

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