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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The isotopic composition of atmospheric nitrous oxide observed at the high-altitude research station Jungfraujoch, Switzerland" *by* Longfei Yu et al.

Anonymous Referee #1

Received and published: 2 November 2019

Manuscript: ACP-2019-829 (Yu et al.) Title: The isotopic composition of atmospheric nitrous oxide observed at the high-altitude research station Jungfraujoch, Switzerland

This manuscript presents measurements of the isotopic composition of N2O obtained from a high-altitude European site – Jungfraujoch in Switzerland, using a recently developed QCLS coupled with a preconcentration unit. The system provided direct and individual measurements of four N2O isotopocules at an ambient level of N2O. From the extensive data sets covering the 5-year study period, authors attempt to derive seasonality and interannual trends in N2O isotopic compositions and discuss them in combination with observed changes in N2O mixing ratio. Overall, the writing and

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Discussion paper

figures are clear, and the methodology maximizes the functionality of a high-quality dataset. I encourage the publication of this important work, with only a few minor considerations/edits suggested below.

1. LN 186: Sphinx observatory → Sphinx observatory in the Jungfraujoch station

2. LN 357-364: Authors determined annual growth rates of N2O mixing ratio for all in-situ data from 2014 to 2018, with/without the 2014 GC-ECD data, and free tropospheric data only, respectively. Given their 1-sigma values, it seems there are some discrepancies between the entire dataset vs sub-sets of data. Authors did mention some about those discrepancies in lines 548-553. However, if authors thought that they are statistically significant, then additional explanations should be given here, rather than later.

3. LN 375-380: The observed, de-seasonalized trends of delta15N_SP for the whole dataset increased, while delta15N_SP trend showed a decrease when PBL-influenced air samples were excluded. So, authors stated that it implies an impact of local sources. Does it mean that the potential local sources have high delta15N_SP signals? What could it be? Based on the two-box model approach using the current data, authors determined the average isotopic signatures for anthropogenic sources were lower than those for the background troposphere (LN 394-397). If so, the local sources mentioned above could not be associated with anthropogenic sources?

4. LN 405-409: Authors found that there were differences in seasonal patterns of all isotopes between the entire dataset vs. the second phase data. Authors then added that the seasonal variations for free tropospheric samples were similar to those for the whole dataset. Does it imply that the second phase patterns could more represent the PBL-influenced data?

5. LN 421-428: Authors seem to suggest strong exchange with the PBL in summer, based on the observed summer maxima in the monthly seasonal cycles for O3 and NOy mixing ratios. But it is not so clear that the summer maxima in O3 and NOy could

support a stronger air mixing with the surface and thus a PBL impact on the seasonal changes in N2O isotopic compositions, because the maxima in O3 and NOy mixing ratio occur in summer most likely due to stronger sunlight.

6. LN 453-476: In the results section, authors analyzed the seasonal variabilities for not only the entire datasets but also the second phase data, but in the seasonality discussion, the seasonal patterns derived from the second phase data were not discussed, even though the second phase patterns might contains more the surface-influenced signals (see the comment #4). If authors decided not to consider the second phase seasonality, please add statements for the reason in the text.

7. LN 488-505: Fig. 5 demonstrated that direct/indirect agricultural source contributes most to the N2O enhancements, particularly in summer. Then considering peak N2O fluxes and minimum of delta15N_SP observed in Summer, does it suggest that the local agricultural activities enhanced N2O production by “denitrification”? Are there any studies to support this result?

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