

Atmos. Meas. Tech. Discuss., referee comment RC2  
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## Comment on amt-2021-119

Anonymous Referee #2

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Referee comment on "Tropospheric and stratospheric NO retrieved from ground-based Fourier-transform infrared (FTIR) measurements" by Minqiang Zhou et al., Atmos. Meas. Tech. Discuss., <https://doi.org/10.5194/amt-2021-119-RC2>, 2021

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### General Comment:

The paper by Zhou et al is a report of column measurements of NO from two sites, one in a polluted area of the Northern Hemisphere (Xianghe, China), and the other in a remote part of the Southern Hemisphere (Maido, ReUnion Island). These data also represent a polluted urban area (in the troposphere) and non-polluted site. This would appear to be the first report of a successful analysis of NO in the troposphere from a ground based FTIR, a nuance that the authors do not explicitly state. Ground-based NO columns has been reported before in the literature, and invariably from NDACC sites that do not in general, see the sort of heightened levels of NO that is reported at Xianghe. So while the stratospheric columns and comparison with satellite data is not new, the tropospheric partial columns of NO are unique, at least as a first report in the literature. Similar data at other Chinese sites may exist and indeed, other potential NDACC sites near large cities that may or may not have enhanced levels of NO near the ground, but the potential is there to explore.

The methods used follow reasonably standard software procedures that have been developed over many years within the NDACC, but NO is not one of the normal target molecules reported by this network. The authors here represent an experienced team who have a very good track record in this area of atmospheric spectroscopy. The paper is not claiming to provide an extensive description of their method, but refer to a few papers in the literature where this is done. A few more details on how they derived some of the parameters used in the analysis, should be fleshed out a bit, as is mentioned below in the comments sections.

Given that NO<sub>2</sub> is an integral part of the NO<sub>x</sub> family along with NO, it would have been an obvious addition to add NO<sub>2</sub> to this analysis. This added molecule is readily available in the FTIR spectra, as the authors know, so this would have been an obvious choice to make alongside CO. Or alternatively, in a city like Xianghe, are there air quality monitors like a NO<sub>x</sub> box that measures NO/NO<sub>2</sub>?

There is also the question of why there is not a modelling component to this paper?

So really the question is: is this paper about a new measurement capability (tropospheric NO), or a comparison between a polluted and non-polluted site, or a satellite comparison, or what?

So before this paper is published, the purpose of this paper and the new novel aspects need to be clearly pointed out.

The level of written English in general ok, but there are a few grammatical issues which are listed in the comments.

### **Specific comments:**

- P1, L7: "...almost not able to be retrieved ..." => "...is very difficult to retrieve..."
- P1, L20: "basically" => "mainly"
- P2, L2: "The stratospheric..." => "Stratospheric..."
- P2, L4: "... (Park et al., 2012), the stratosphere..." => "... (Park et al., 2012), stratosphere..."
- P2, L23: "...even so for ..." => "... even for..."
- P3, L4: "...to Beijing." => "...of Beijing"
- P3, L6: "...recording the near ..." => "... recording near ..."
- P4, L11: define WACCM with a reference.
- P4, L16: place this definition and reference to WACCM in line 11.
- P4, L18: "...above that is still taken..." = > "...above 50 km is taken ..."
- P4, L19: expand a bit on the Tikhonov equation. It is entered here without explaining any of the terms. Explain how a value of 50 was obtained.
- P5, L7: "The HBR cell ..." => "HBr cell ..."
- P5, L15: "...several less..." => "...several orders of magnitude less..."
- P5, L16: this sentence would read better as; "Therefore, in the stratosphere the FTIR retrievals during the daytime are much larger than the a priori profile."
- P5, L19: "...have the sensitivity..." => "...have sensitivity..."
- P5, L20: This is a little misleading the way this is written. Not all layers are sensitive to the stratosphere, since there is no information in the troposphere. A more correct way to put this is that there is sensitivity to NO in the layers in the stratosphere. Note also some sensitivity in the upper troposphere between 10 and 16km, particularly at Maido.
- P6, L2: Presume this is the average dofs over the entire datasets?
- P7, L9: "...to the HITRAN2016..." => "...to the HITRAN2016 linelist..."
- P8, fig 4 caption: "...DOF equalling.." => "...DOF's equal ..."

- P8, L4: "...estimated 13.5%..." => "...estimated to be 3.5%..."
- P8, L8: "...less than that of NO..." => "...less than the NO..."
- P8, L9: "...less ..." => "smaller"
- P9, L5: suggest this sentence reads "Due to photochemical reactions (Kondo et al., 1990), a large diurnal variation of the stratospheric NO is expected."
- P9, L7: "...SZA of measurements." => "...SZA of the measurements."
- P9, L7: "...2 order..." => "... 2<sup>nd</sup>." There are a few other locations where this appears.
- P9, L8: "...t is in a fraction of local hour)." => "...t is a fraction of the local hour)."
- P9, L12: "...with the time." => "...with time."
- P9, L18: "...formed NO..." => "... NO formed..."
- P9, L20: "...stratosphere, then ..." => "...stratosphere, so..."
- P9, L23: "...and of 0.74..." => "...and 0.74..."
- P10, error budget: what about inferring species? A solar model is used (but not mentioned as part of the retrieval strategy, for example table 1) so presumably this is part of the retrieved parameters. But does this solar model include both solar line strength and shift?
- P11, fig 7 caption: "The R is the ..." => "R is the ..."
- P12, L1: "...t is in fraction of year..." => "...t is fraction of the year..."
- P12, L2: "...which is relative..." => "...is relative..."
- P12, L10: "...on one hand..." => "...on the one hand..."
- P12, L29: "...both start measuring..." => "...both started measuring..."
- P12, L34: "...smoothed with FTIR..." => "...smoothed with the FTIR..."
- P13, L5: "...are similar observed..." => "...are similar as observed..."
- P13, L9: "...The possible reason is that..." => "...The possible reason for this difference is that..."
- P14, figure 9: The key needs to be reasonably self-explanatory. The numbers and trends in the key should be in the figure caption. For example the black dot entry should read MIPAS daily means, and the number of points can go into the figure caption. Same comment for all the other entries. The colour coding is also not consistent between what is described in the caption and what appears on the graph. For example, the blue shadow for MIPAS is actually purple, the blue solid line for MIPAS is green, while the purple shadow for the FTIR is pink. This could be related to the way colours are displayed in the pdf reader.
- P14, L2: "...which is corresponding..." => "...which corresponds..."
- P15, figure 10 caption: "Scatter plots between..." => "Scatter plots at Xianghe between..."
- P15, figure 10 caption: a comment about the way this plot is presented and captioned. The explicit way of knowing that this figure represents Xianghe is the caption title, which is fine But the caption explanation should be more explicit about what the data is and where is from since there is more than one site.
- P15, L8: "...slightly large..." => "...slightly larger..."
- P15, L8: "It is because that the..." => "The reason for this increased correlation is ..."
- P15, L7-9: The underlying reason is the increased cross-relation between the tropospheric and stratosphere layers, due to the individual averaging kernels being broader.
- P15, L11: why are there no tropospheric NO measurements in summer? This maybe explained later (high water?), but a reference could be placed here that this will be explained later in the paper.
- P15, L12: would this normally be expressed as mean (std) is  $1.4 (1.0) \times 10^{16}$ , as it is in the abstract.
- P16, figure 11 caption, last sentence: this colour is not yellow, more light green. Maybe this is a function of the pdf viewer?
- P16, figure 12 caption: "...CO tropospheric partial columns." => "CO tropospheric partial columns at Xianghe."
- P16, L2: "...combustion for..." => "...combustion from ..."
- P16, L4: individual => independent

- P17, L25: depend => dependent