



# ***Interactive comment on “Pollution trace gases C<sub>2</sub>H<sub>6</sub>, C<sub>2</sub>H<sub>2</sub>, HCOOH, and PAN in the North Atlantic UTLS: observations and simulations” by Gerald Wetzel et al.***

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## **Response to Referee #2:**

First of all we thank the referee for the effort to carefully reading the manuscript and for all comments.

## **General comments:**

*My only general comment is that it would have been good to include some discussion of how these observations compare to past observations of these species. Currently*

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*this is limited to comparisons to limited-resolution spaceborne remote sounding observations (e.g., the many citations to the Rinsland, Glatthor and Wiegele papers in the manuscript). However, there are a wealth of airborne in-situ observations of many these species in past campaigns (for example the NASA ATOM campaign, among many others from the US, Europe and Asia). Given that GLORIA is a relatively new (but very welcome) addition to the worldwide portfolio of airborne instruments measuring atmospheric composition, and that it is one of the few employing remote-sounding (particularly for such a wide range of species), and further, given the general skepticism some in the community have toward remote sounding observations, some additional statements as to how the GLORIA findings compare to available in situ observations of the same species at similar altitudes/latitudes/seasons, etc. would help cement the value of the GLORIA dataset in the community mind set.*

We included some discussion on the comparison to in-situ aircraft measurements in Section 3.1. and added corresponding references. We do not have a direct comparison available (in the sense of a validation) of the pollutant species retrieved by GORIA with in-situ observations. However, retrieved GLORIA amounts of these trace gases are within the spread of values measured by in-situ instruments.

#### **Specific comments:**

*Sentence spanning lines 24/25: Reword to "Elevated quantities of PAN were measured even in the lowermost stratosphere (locally up to 14 km), likely reflecting the fact that this molecule has the longest lifetime of the four species discussed herein."*

We changed the text according to the reviewer's suggestion.

*Sentence spanning lines 43-46: Better to split into two sentences along the lines of "... conditions. In particular, rapid vertical transport by deep convection followed by strong horizontal transport associated with the upper troposphere subtropical jet stream ([citations]) is a particularly efficient means by which surface pollutants can be transported long distances.*

We changed the text accordingly.

*Line 47: Think that the "that" would be better as ", which" in this case.*

We split the sentence into two parts for better clarity.

*Line 56: "such that C<sub>2</sub>H<sub>6</sub> may be" -> "enabling it to be"*

We changed this part accordingly.

*Line 64: "are important contributors to the tropospheric abundances of this molecule" or something similar.*

We changed the sentence accordingly.

*Line 66: "like" -> "such as the"*

Changed.

*Line 105: "using" -> "observing" (to avoid having "using" twice in quick succession)*

Changed.

*Line 154: I think something like "Test retrievals were used to identify microwindows that combine limited overlap of spectral signatures of disturbing gases with a high sensitivity to changes in the abundance of target gases." would be better wording.*

We modified the text accordingly.

*Line 252: comma needed after "that"*

Changed.

*Lines 257-287: As discussed above, it would be good to compare a small number of the wealth finding from airborne in-situ observations of these species.*

We included text and citations of airborne in-situ observations for all pollutant species.

*Line 262: "stronger enhanced" -> "strong enhancements of"*

Changed.

*Line 263: "what" -> ", which"*

Changed.

*Line 265: "picture" -> "behavior"*

Changed.

*Line 291: "with respect to" -> "given the", also "in" -> "of"*

Changed.

*Line 292: "Concerning" -> "For"*

Changed.

*Line 293: "principally" -> "generally"*

Changed.

*Line 302: "The comparison of" -> "Comparisons for"*

Changed.

*Line 311: "For C2H2 we note that EMAC predicts elevated concentrations in much the same region where GLORIA reports enhancements (see ...)"*

Changed.

*Line 311-317: Again, this would be a good place to mention in situ comparisons.*

We now mention the in-situ airborne measurements in Section 3.1.

*Line 430-434: The sentence "However, the real...". I'm afraid I don't understand what this sentence is trying to say. Does CLAMS not have emissions for these specific species on some kind of fine spatial resolution (EDGAR, MEGAN, etc.?) Please clarify what is meant by "the real regions".*

“Real” means where emissions really occur. The original text was misleading, so we rewrote this clause for better understanding.

*Line 461: Remove "(primarily CAMS)" and add ", particularly for CAMS" at the end of the sentence.*

Changed.

*Line 525: Some weird cut and paste typo in citation.*

Okay, corrected in bibliography.

*Line 679: Extra space between "O" and "3" in citation.*

Okay, corrected in bibliography.

*Line 746: "n/a-n/a" in citation.*

Okay, corrected in bibliography.

*Figures 2-5 are nicely put together.*

Thanks.

*Figure 6 (and 7): The grey line is hard to see, make it thicker. The dashed magenta line is very hard to see. I suggest you make it white and thicker (and possibly not dashed?). "...mark regions with enhanced VMR levels" - not for O3, perhaps clarify "primary pollutant VMRs" or something like that?*

We made the grey lines and the magenta lines thicker so they are clearly visible now (white instead of magenta is not a good option for these lines because they are also included in the following Figure 8 with difference plots containing large white areas). We changed Figures 6 to 8 and the Figure caption 6 according to the reviewer's suggestion.

*Figure 9: This is very hard to see given the colored continents/oceans. As pretty as they are I'd suggest a grey-scale version of the background image, or ideally just white*

*oceans and very pale grey continents (single color, no mountains or things like that).*

It is a difficult task to find a common optimal background for all individual pictures displayed in Figure 9. We already tested a lot of background and color scale combinations before submitting this manuscript. We again tested many combinations and found that white oceans is not the best solution because yellowish colors are hardly visible. In the end we omitted the surface relief and took for continents a light grey and for oceans a light blue color and changed Figure 9 accordingly.

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Interactive comment on Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2020-1215>, 2020.

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