



# ***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.***

**Gerald Wetzel et al.**

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## **Response to Referee #1:**

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

## **General comments:**

*This manuscript presents observations of multiple trace gases from the GLORIA instrument over the North Atlantic. It describes the GLORIA instrument and data analysis*

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*method, and then uses model simulations to interpret the observations and relate them to the Asian Monsoon and to identify underestimates in the emission inventory. This is an interesting and useful multi-species dataset and the modeling provides a robust tool for analysis. However, the combination of retrieval description and model analysis left the main focus of the manuscript a bit unclear to me. If the primary objective is to present the GLORIA retrieval and data analysis, I would like to see this section expanded and more validation included. If the goal is instead to interpret the observations, the discussion of the driving scientific questions and what new insights are found should be clarified/strengthened.*

The objective is both, to present the GLORIA data retrieval of pollutant species together with an interpretation of the data with the help of model simulations. A detailed description of the general retrieval process is given in a previous paper by Johansson et al. (2018) which is cited in the manuscript. We now mention this more clearly in Section 2.2. We also included some more sentences in the conclusion part to better strengthen the messages of this study.

### **Specific comments:**

*Line 60: This lifetime is still long enough to allow long-range transport.*

We included a corresponding clause to make this clear.

*Line 132: Is radiative transport the same as radiative transfer?*

Yes, we replaced “transport” by “transfer”.

*Section 2.2: Is this the first description of this method, or are there other papers that could be referenced for the GLORIA retrievals and validation?*

A detailed description of the general GLORIA retrieval process is given in the paper by Johansson et al. (2018) that is already cited later in the text. We included a clarifying sentence on this issue at the end of the first paragraph in Section 2.2. This paper also contains the validation of major species observed by GLORIA (e.g. O<sub>3</sub>, HNO<sub>3</sub>, and

CIONO2). For species discussed by this paper, we lack of in-situ data to compare our GLORIA measurements with.

*Line 216: All biomass burning or just “anthropogenic” biomass burning?*

We deleted “anthropogenic” in the corresponding sentence.

*Line 275: Specify the instrument/satellite.*

The instruments are the Atmospheric Chemistry Experiment (ACE) Fourier transform spectrometer on SCISAT-1 and the Michelson Interferometer for Passive Atmospheric Sounding (MIPAS) aboard the Envisat satellite. We added a corresponding clause in the text.

*Conclusions: Last paragraph: The importance of emission inventories is well-known. Please make the conclusions more specific and emphasize what is new from this study.*

We included some more information in the conclusions to better emphasize what is new and important in our study. For instance, we emphasized that enhanced amounts of pollutant species were measured in the upper troposphere with high temporal and spatial resolution. Furthermore, it is important to state that these enhancements were detected far away from the emission sources of these species.

*Figure 6: Is this figure the same as the first column of Figure 7?*

It is not exactly the same. Figure 6 contains the unsmoothed GLORIA data while the first column of Figure 7 shows the temporally smoothed GLORIA data (as noted now more clearly in the figure caption).

*Fig. 9 caption: Does “Coloured encircled areas” mean the cyan dots/circles?*

Not only cyan, but also black, blue and green. We added this in the figure caption text for better clarity.

**Editorial comments:**

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*Lines 46-50: please reword this sentence for better clarity.*

We split the sentence into two parts for better clarity.

## References

Johansson, S., Woiwode, W., Höpfner, M., Friedl-Vallon, F., Kleinert, A., Kretschmer, E., Latzko, T., Orphal, J., Preusse, P., Ungermann, J., Santee, M. L., Jurkat-Witschas, T., Marsing, A., Voigt, C., Giez, A., Krämer, M., Rolf, C., Zahn, A., Engel, A., Sinnhuber, B.-M., and Oelhaf, H.: Airborne limb-imaging measurements of temperature, HNO<sub>3</sub>, O<sub>3</sub>, ClONO<sub>2</sub>, H<sub>2</sub>O and CFC-12 during the Arctic winter 2015/2016: characterization, in situ validation and comparison to Aura/MLS, *Atmos. Meas. Tech.*, 11, 4737–4756, <https://doi.org/10.5194/amt-11-4737-2018>, 2018.

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