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Atmospheric Chemistry and Physics Discussions

# *Interactive comment on* "Seasonal and interannual variations of HCN amounts in the upper troposphere and lower stratosphere observed by MIPAS" *by* N. Glatthor et al.

**Anonymous Referee #1**

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Review of "Seasonal and Interannual Variations of HCN Amounts in the Upper Troposphere and Lower Stratosphere observed by MIPAS" by N. Glatthor et al.

This paper presents results of the comprehensive data analyses using long-records of HCN mixing ratio measurements obtained from the MIPAS instrument onboard ENVISAT satellite including details of retrieval processes and seasonal and interannual variability of HCN in the upper troposphere and the stratosphere. I find this paper interesting and scientifically significant and can make important contribution to the broad scientific community. Below are my suggestions for the authors might take into consideration for improving clarity of the paper.



General Comments

1. The main focus of this paper is to relate biomass burning emissions and the maxima in the MIPAS HCN mixing ratios, locally and seasonally. However, without providing specific reference (or figure) of biomass burning emissions, the arguments on biomass burning signals in MIPAS HCN are not convincing. Climatology of biomass burning including locations and relative magnitude should be provided. Preferably, statement of maximum in MIPAS HCN influenced by biomass burning should be supported by the specific figures from the references.

2. The authors should mention any potential caveat in interpreting features in the data related to coarse vertical resolution of the MIPAS HCN data (4-5 to 6-8 km) and have to be cautious about making statements regarding location and height of the HCN plumes.

3. I would suggest including Park et al. (2013) for HCN climatology and Tereszchuk et al. (2013) for biomass burning signature in HCN as references. Figs. 12-14 of Park et al. (2013) can be very useful to make comparisons with MIPAS HCN climatology shown in this paper.

Specific Comments

1. P9000, L7 – Does 'this plume' mean HCN plume or biomass burning plume in general?

2. P9000, L16 – Park et al. (2013) can be added here (also P9008, L11).

3. P9000, L22 – HCN tape recorder discussion – Fig. 14 of Park et al. (2013) showed HCN tape recorder plots from the ACE-FTS satellite data and WACCM4 global chemistry climate model simulations.

4. P9003, L15 – Do height-constant profiles mean HCN mixing ratios are constant regardless of height? I am curious about the effect of applying constant profiles.

5. P9003, L24-26 – I find this sentence technically specific. I wonder if this is something specific to the MIPAS retrieval or commonly used in all the other retrieval processes?

6. P9003, L29 – How are the errors calculated? Do profiles with biomass burning signature have larger errors compared to the background (non-biomass burning) profiles?

7. P9004, L23 – References for the biomass burning should be added here.

8. In my opinion, the minima in the tropical upper troposphere in Fig. 1 are not as low as ACE-FTS climatology as shown in Fig. S2 of Randel et al. (2010). I am curious if the authors have given any thoughts to this.

9. P9005, L5 – I think the minimum in HCN in SH high latitude is even lower during JJA than SON, which implies downwelling of HCN depleted air from the mesosphere.

10. P9005, L11-19 – Figs. 1 & 2 of Randel et al. (2010) can be cited here.

11. P9006, L13 –Adding horizontal wind vectors can definitely support the argument in terms of horizontal transport.

12. P9006, L20 – I am not sure what this sentence is referring to.

13. P9006, L28 – What does 'this process' mean?

14. P9007, L14 & 16 – curves -> time series

15. P9007, L16 – It would be helpful to have time series of biomass burning to see if the seasonal cycle at 10 and 14 km matches with it.

16. P9008, Section 3.2 – The authors need to be cautious about making comparisons of HCN climatology from MIPAS and ACE-FTS. Due to sampling issues of ACE-FTS, the ACE HCN climatology is mostly based on Feb, Apr, Aug, and October in the tropics.

17. P9009, L14 – time series -> time vs. latitude cross sections

18. P9009, L27 – I am wondering why the plumes were particularly weak 2003 and 2008?



19. P9010, L3-4 – The meaning of this sentence is not clear.

20. P9010, L20 - The website cited for the ENSO index is outdated. The current ENSO index can be found at

http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/ensostuff/ensoyears.shtml

21. P9011, L13 – It seems like Fig. 3 of Randel et al. (2010) used HCN data averaged in altitude between 16-23 km. I am wondering the difference between MIPAS and ACE-FTS is related to the data averaging?

22. P9011, Fig. 5 – Discussion about Fig. 5 is somewhat misleading. First of all, due to short horizontal scales of the figure, it is not easy to read horizontal axes. Second, I do not think the transport is purely horizontal. The features in the tracer fields are results of both horizontal and vertical transport. So, I am not convinced that the authors tried to find the time lag between the latitude bands at a fixed altitude. Also, I am wondering if vertical resolution of MIPAS HCN being 4-5 km is appropriate to use in this diagnostics.

23. P9012, paragraph (L5-) – I am not sure how significant the trend calculated from 7 years of MIPAS data (2005-2012) is. Also, the authors have to be fair about making comparisons of HCN trend with the CO trend. Both Worden et al. (2013) and Zeng et al. (2012) concluded that negative trends in CO are related to anthropogenic emissions not biomass burning emissions.

24. P9016, section 3.5 – Fig. 14 of Park et al. (2013) should be included in the discussion.

25. P9017, last paragraph (L22-) – I disagree with this argument. I do not think the average HCN values at 17 km in the tropics are representative of values in the stratosphere, which is just a snapshot of results of multiple transport pathways, i.e., vertically and horizontally. Note, MIPAS HCN minimum in the tropical upper troposphere is not as low as the one in ACE-FTS (Randel et al. (2010) Fig. S1 and Park et al. (2013) Fig. 13).

26. P9018, Fig. 10 – time-height series -> time-height cross section

27. P9019, L20 – Include Fig. 14 of Park et al. (2013) here.

28. There is room for improvement in presenting the figures. Time and altitude cross-sections and time series can be horizontally elongated for better reading (for instance, Figs. 4, 5, 9 and 10). Larger fonts can improve visibility of the figure titles.

29. Figs. 5 and 9 – 2004 has to be left blank.

Park et al. (2013), Hydrocarbons in the upper troposphere and lower stratosphere observed from ACE-FTS and comparisons with WACCM, J. Geophys. Res. 118, 1-17.

Tereszchuk et al. (2013), Observations of peroxyacetyl nitrate (PAN) in the upper troposphere by the Atmospheric Chemistry Experiment Fourier Transform Spectrometer (ACE-FTS), Atmos. Chem. Phys. 13, 5601-5613.

Tereszchuk et al. (2013), ACE-FTS observations of pyrogenic trace species in boreal biomass burning plumes during BORTAS, Atmos. Chem. Phys. 13, 4529-4541.

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Interactive comment on Atmos. Chem. Phys. Discuss., 14, 8997, 2014.