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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Observations of peroxyacetyl nitrate (PAN) in the upper troposphere by the Atmospheric Chemistry Experiment Fourier Transform Spectrometer (ACE-FTS)" *by* K. A. Tereszchuk et al.

Anonymous Referee #1

Received and published: 13 March 2013

This paper presents PAN retrievals from the ACE-FTS satellite. The retrievals are possible because an interfering absorber in the 1168 cm-1 spectral region was identified (Harrison et al., 2012). PAN retrievals from the ACE-FTS and MIPAS satellites are compared for three dates in July 2011.

Comments:

1. The authors describe the difficulty in identifying co-located satellite data, but have limited their comparison to the BORTAS campaign (a small time period and small ge-

ographic area), and then compare to coincident measurements by the MIPAS instrument. This results in only three satellite occultation coincidences for comparison. Specific questions:

- What is the detection limit of the ACE-FTS PAN retrievals? What is the detection limit of the MIPAS PAN retrievals?

- How do these compare to the background concentrations of PAN?

- Could other occultations, besides the ones during July 2011, be compared?

- The three comparisons are shown in Fig. 4, but the agreement between the two satellite PAN measurements is not reported. What is the quantitative agreement?

2. Why haven't the authors compared the ACE-FTS PAN retrievals to aircraft measurements? In situ PAN measurements were part of the BAe-146 payload during BORTAS (Palmer et al., ACPD, 2013). Beyond BORTAS, the ACE-FTS satellite has recorded data since 2003, so other aircraft PAN measurements could be used, such as from INTEX-B or ARCTAS.

3. The current abstract is too broad, and the authors should focus on describing their new results. Specifically, the first paragraph summarizes prior work about the chemistry and transport of PAN. It should be shortened to one or two sentences. The concluding paragraph describes context and future work. It should be removed. The paper's conclusions succinctly summarize the results, and would make a better abstract.

4. Some important details are missing in the current abstract and should be added. Specifically:

- What is the detection limit for the PAN retrievals?

- What is the precision and accuracy?

- Pg. 1577 line 16-17 "The retrieval method employed and errors analysis are described in full detail." Please replace this statement with a brief description of the retrieval

method and error analysis.

- What is the time period of the BORTAS field campaign?

- What spectral regions are used for the retrievals? What other species are fit in these windows?

- Pg. 1577 line 23-24: Quantify “good agreement.”

5. The authors should check all of the references in the introduction. Primary references should be given, rather than taking sentences from secondary references and citing the secondary references. In some cases, references should be added. Here are some examples:

- Pg. 1579 lines 7-8: “Background volume mixing ratios (VMRs) of PAN in clean air are quite variable and range typically from 10-400 ppt (Allen et al., 2005a).” This reference is incorrect. Neither Allen et al. (2005a) or Allen et al. (2005b) report mixing ratios and they don’t mention this fact.

- Pg. 1579 lines 9-11: “The thermal decomposition rate of PAN is highly temperature dependent, resulting lifetimes between 1 h at 298 K and about 5 months at 250 K (Glatthor et al., 2007).” This isn’t an original reference. Glatthor et al. (2007) cite Singh (1987) for this fact.

- Pg. 1579 lines 15-16: “The thermolysis rate drops quickly with temperature, permitting extended lifetimes (Allen et al., 2005a).” Allen et al. (2005a) does not report thermolysis rates, and cite Kirchner et al. (1999) for this fact.

- Pg. 1580 line 19: Add reference for ACE-FTS satellite.

6. Some of the material presented in the introduction should be moved to the experimental section. Specifically:

- Pg. 1581 lines 3-10: Description of PAN cross sections and altitude grid of ACE-FTS data.

- Pg. 1582 lines 7-23: Description of MIPAS instrument.

- The MIPAS retrieval method should be described in the experimental section, prior to the discussion of biomass burning identification.

7. Pg. 1583 line 17-19: “the intensities were normalized to the room temperature value.” This is unclear. Did the authors scale the integrated band intensity at different temperatures to match the room temperature value? If so, change this to “the integrated band intensities were scaled to the room temperature value.”

8. Pg. 1585 lines 19-21: “. . .once the PAN VMR profile is included in the calculated spectrum the residual values go to zero, indicating that all interfering species within the microwindow have been accounted for. . .” This is not an accurate description. The error in Fig. 2b is approximately 1%. This sentence should indicate that all interfering species within the detection limit have been accounted for.

9. Figure 2: Why is the average residual in Fig. 2a not centered around zero? I assume this is because the retrieval of the absorbers is being weighted by other spectral retrieval windows. For a least-squares global fit that included only this window, the average residual should be centered at zero. Please clarify in the text.

10. Regarding the uncertainty discussion in Section 2.2:

- What is the precision of repeated retrievals from spectra recorded at similar altitudes or airmasses?

- What is the change in the PAN retrievals change as you vary the HCFC-22, CFC-114, and other species within their uncertainty? Is it consistent with the 1% estimate?

11. Regarding the comparison:

- Pg. 1590 lines 8-14: The authors mention calculating correlation coefficients. Please report the results.

- Pg. 1592 line 9: Quantify “excellent agreement.”

- Fig. 4 center panel: Why is one MIPAS profile an outlier?

Minor comments:

- Throughout: Please edit to remove casual/colloquial text. This includes “bring the data together”, “naively expect”, “go to zero”, “instrument peers through”, “measurements at low altitutes are cut off”.

- “Boreal” should not be capitalized. Change on pg. 1577 line 14, pg. 1577 line 22, and elsewhere.

- Pg. 1578 line 19: Punctuation error. Remove “, smog” and the semicolon.

- Pg. 1579 line 7 – pg. 1580 line 7: This paragraph should be edited to remove repetition.

- Pg. 1579 line 12: Give the photolysis wavelengths for PAN.

- Pg. 1580 line 20: “coverage in the infrared covering” should be “coverage in the infrared, covering”

- Pg. 1580 line 27: “Through the new. . .” should be “In the new. . .”

- Pg. 1583 line 13: “is strongly interfered by the presence” fix grammar.

- Pg. 1588 line 9: “VMRS” should be “VMRs”.

- Pg. 1588 line 12: “VMRs values” should be “VMR values”

- Pg. 1590 line 1: “during approximately two days earlier” should be “approximately two days earlier”.

- Pg. 1590 lines 24-26: “After sequential joint-retrieval with continuum of, in order, pressure/temperature, water vapour, O3, HNO3, ClONO2, and CCl4. . .” I can’t understand this sentence. Do the authors mean that gases were simultaneously retrieved in multiple spectral windows? Clarify.

- Pg. 1591 lines 8-10: What is “PAN field from TOMCAT model data”?

- Pg. 1591 line 14: “derived the measurement” should be “derived from the measurement”.

- Every reference is followed by a spurious number.

- Spell out numbers less than 10.

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 1575, 2013.