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# ***Interactive comment on “Seasonality of Peroxyacetyl nitrate (PAN) in the upper troposphere and lower stratosphere using the MIPAS-E instrument” by D. P. Moore and J. J. Remedios***

**Anonymous Referee #3**

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This paper presents global measurements of PAN from the MIPAS satellite instrument, in the upper troposphere and lower stratosphere. Although only limited time periods are covered, the paper gives the first evidence of seasonality in the global distribution of that species, which is relevant to the atmospheric nitrogen partitioning and to long-range transport of NO<sub>x</sub> pollution. The paper is clearly written and well organized. Although some aspects are questionable (see general comments below) it gives important results for the community. It would be suitable for publication in ACP if the comments are addressed.

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## GENERAL COMMENTS

1. Figure 4 is key for estimating the capabilities of MIPAS to detect PAN. It is convincing as shown although there is no obvious PAN spectral structure identified (the contribution seems to be broadband). The authors mention CCl<sub>4</sub> as an important interfering species with similar cross-sectional type structure but rule out misidentification on the basis of weak correlations in the retrieved concentrations of the 2 species. Have they checked for other possible broadband contributions from e.g. HCFC22, aerosols, or others? Figure 4 is also shown for a good case (very high PAN concentration). Somehow it would be useful to know how many spectra have a residual larger than say 50 nW /cm<sup>2</sup> sr cm<sup>-1</sup> (twice the MIPAS NESR) without fitting PAN. These would represent cases where detection would be difficult and retrievals uncertain. The same remark holds for Figure 3. How does it look for cases with PAN concentration closer to the background?

2. The discussion of the global distribution in my opinion either too short or too detailed. The authors speculate on a series of mechanisms to explain elevated PAN levels in the different regions without much supporting elements. As illustrations

- I find it difficult to appreciate in Figure 6 the different patterns at the two pressure levels (the peak moves from central to South Africa and the peak over Central America disappears at 201 hPa). What is happening in terms of sources and horizontal/vertical mixing? The same remark holds for the explanation of the double peak in Figure 10c, which would suggest predominance of vertical vs. horizontal mixing.

- The measurements give similar vmrs for PAN in the UT and the LS. Is this expected (is PAN expected in the stratosphere at all)? How to explain this feature? Have the authors checked if that was not an artifact of the retrieval due to the high correlation between the different altitudes?

- Growing plants is suspected as a source of PAN through the release of acetone in NH summer. Would that not affect the distributions globally (e.g. tropical forests)? Have

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the authors considered the strong fire activity at high northern latitudes in 2003?

Overall the issue of sources, vertical and horizontal mixing vs. PAN lifetime is poorly addressed. I acknowledge this is a difficult topic and probably outside the scope of this paper. I would therefore rather suggest keeping the geophysical discussion to a minimum and more centered on the actual observations.

### SPECIFIC COMMENTS

- Page 22510, line 15-17: What are the diagonal elements of  $S_a$ ? 300 % at all levels as stated later page 22512?

- Page 22510, line 18: The elements of  $S_y$  are set to zero. Does that come to assuming there is no noise correlation between altitudes (as written) or that there is no noise correlation between the different spectral samples?

- Figure 3 and associated text on Page 22513: It would be simpler for the discussion if the right vertical axis was given in terms of altitude. Please also check the DOFS: On line 24, it is 3.7 but in the Figure it is 2.7.

- Text page 22514 and caption of Figure 3: Instead of the technical orbit and scan numbers, it would be better to specify latitude/longitude and time.

- Figure 1: The total contribution seems to be the black line. On my printed copy at least, the legend refers to a blue line.

### TECHNICAL CORRECTIONS

- Page 22507, line 12: Poschl with a et al. It is Pöschl. The same holds for the corresponding reference

- Page 22510, line 7,  $y$  should be boldface

- Page 22512, line 14: as well as the... remove one "the".

- Page 22515, line 16: Tropopause (remove 's')

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- Reference Wetzel et al.: Please correct names for De Mazière and López-Puertas.

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