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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Mesospheric N_2O enhancements as observed by MIPAS on Envisat during the polar winters in 2002–2004" *by* B. Funke et al.

Anonymous Referee #1

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General Comments: The authors use MIPAS measurements to show that N2O in the upper stratosphere/lower mesosphere is enhanced at times during the NH winters of 2002-2003 and 2003-2004, and during the SH winter of 2003. They attribute the enhancements primarily to the chemical reaction of NO2 + N, where the atomic nitrogen was produced by energetic particles. This reaction would occur near 70-75 km. A possible minor source is the reaction of excited molecular nitrogen, which would also have been produced by energetic particles, with molecular oxygen. This reaction would occur near 90-100 km.

The paper is well written and the analysis is thorough. I have one question about an as-

sumption made during the analysis (see under specific comments), and a request that text in the figures be made significantly larger (see immediately below), but otherwise my comments are minor.

The figures in the originally submitted version were much larger than the ones in this final version. Unfortunately, this change resulted in the current figures being extremely difficult to read. I had to magnify my file to about 150% (250% for Figure 1) to read the information in the figures. Thus, I strongly recommend that the authors modify all of the figures to make them more legible.

Specific Comments: Page 10566, line 21: The authors note that regularization effects in the retrieval might lead to an underestimate of the altitude of peak N2O mixing ratio. Because of the very low vertical resolution, could the peak altitude also be overestimated?

Page 10566, line 25: The authors conclude that an anti-correlation between N2O and CH4 suggests that a dynamical origin of N2O enhancements is unlikely. I am confused by this assumption. If, for instance, the N2O observed near 60 km were produced near 90-100 km and then descended, wouldn’t the enhanced N2O correlate with low CH4? So in this case, the enhancement would have a dynamical origin? If I am just misinterpreting what is meant by “dynamical origin”, I recommend that this be clarified. This reasoning is seen again on page 10568, lines 14-16, so I assume I am just missing part of the logic or misinterpreting some of the words.

Page 10567, line 23: The authors describe changes in CH4 that were induced by transport. They go on to describe “transport-generated N2O enhancements”, but note that these appear later and at lower altitudes than the CH4 changes. I do not understand this – if the N2O changes are transport-generated, why do they not coincide with the CH4 changes?

Page 10569, line 3: While the MIPAS data only showed the N2O descending to 45 km, I think it should be noted that observations ceased at this time; so any descent below

ACPD

8, S5306–S5309, 2008

45 km would not have been observed.

Figure 6. This figure would be much easier to understand if the months were spelled out on the horizontal axis (e.g., labeling months 1-12 of each year), rather than having continuous months since June 2002. This point was apparently recognized by the authors, who have parenthetically cross-referenced the months in the figure to the months in the text, but it would be much more straightforward if this were not necessary.

Page 10573, line 25: It is stated that the MEPED measurements are compromised by the presence of protons – please provide a reference for this.

Page 10573, line 26: Please also provide a reference for the statement that SPEs are thought to be associated with elevated electron fluxes inside the polar caps.

Page 10576, line 14: Should this say “4 ppmv” instead of “4 ppbv”?

Page 10580, line 2: The reference to Semeniuk et al. 2007 is not in the reference list.

Page 10580, line 18: “...most elevated fluxes of a>100 keV electrons.” What is “a”?

Conclusion: I would love to see a sentence added here (and to the abstract) that gives an estimate for the total fraction of stratospheric N2O that comes from the mesosphere. I assume this must be very small, but I really don’t have a very good idea of the number. I think this should be possible to estimate from the MIPAS data and analysis done here. This is also relevant to the issue of whether, and over what altitude/latitude regions, N2O can be used as a tracer.

Technical Corrections: Abstract, line 7. Add “the” before “presence”. Page 10572, line 14: “The temporal evolution....IS...” (not “are”). Page 10573, line 10: “....very small peaks apart FROM...” (not “of”) Page 10577, line 2: “N2O due to Reaction (R2) IS independent OF...” (i.e., IS instead of ARE and OF instead of

ACPD

8, S5306–S5309, 2008

Interactive Comment

ON). For future reference, the proper use in English is “dependent on” and “independent of” – this also pertains to page 10578, line 12. Apologies for the non-intuitive language! page 10582, line 22: “comparED to” instead of “comparing to”.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 10561, 2008.

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8, S5306–S5309, 2008

Interactive Comment