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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Variability of NO_x in the polar middle atmosphere from October 2003 to March 2004: vertical transport versus local production by energetic particles" *by* M. Sinnhuber et al.

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The authors would like to thank the reviewer for his/her helpful comments. Below are all the comments followed by replies; in "" are changes made to the text of the paper.

1) There is a bit of a contradiction in the Abstract, since it says that local production by precipitating electron is unlikely, but then an upper bound (e.g. 6 ppb at 56-70km) is provided. It should say that the production is weak, smaller than the upper bound. Please clarify.

What we wanted to express is that a significant additional source of NOx due to precipitating electrons below 70 km is unlikely; a weak production is of course possible. To clarify this, the order of the statements in the abstract has been changed to

"Correlations of NOx and CO show that the unprecedented high NOx values observed in the Northern Hemisphere lower mesosphere and upper stratosphere in late January and early February are fully consistent with transport from the upper mesosphere / lower thermosphere and subsequent mixing at lower altitudes. In the polar summer Southern Hemisphere, we observed an enhanced variability of NO and NO2 on days with enhanced geomagnetic activity but they seem to indicate enhanced instrument noise rather than a direct increase due to electron precipitation. A direct effect of electron precipitation onto NOx can not be ruled out, but if any, it is lower than 3 ppb in the altitude range 40 - 56 km and lower than 6 ppb in the altitude range 56 - 64 km. An additional significant source of NOx due to local production by precipitating electrons below 64 km exceeding several ppb as discussed in previous publications appears unlikely."

2) What the authors mean by "cross-talk" in retrieved NO between different altitudes is a bit unclear. A couple of sentence on the relevant retrieval issues could be helpful to the reader.

An explanation of this was added at the end section 2 (MIPAS data):

"NO mixing ratio increases strongly from the lower mesosphere to the lower thermosphere. Thus observations at mesospheric tangent altitudes has a strong thermospheric NO signal in the line-of-sight which might provide an additional positive offset of up to 1.5 ppb, henceforth called "thermospheric cross-talk". For the retrieval of NO2 no such information crosstalk happens because the concentration of NO2 decreases strongly from the upper stratosphere to the thermosphere even during night-time. Thus the measured signal is dominated by radiance emitted near the tangent altitude of each limb observation. Therefore, in the winterhemisphere where NOx values are in the or-

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der of tens of ppb to thousands of ppb, observations of NOx (NO+NO2) are used, while in the summer hemisphere, where mixing rations might be in the range of below 1 ppb, night-time NO2 and day-time NO are treated separately."

3) Fig 9: units for the electron fluxes on the y-axis should be included.

The electron and proton fluxes in Fig 9 are given in arbitrary units; a comment has been added to the figure caption: "..., both in arbitrary normalized units". However, the units of the NO mixing ratio have been added to the y-axis for the left-hand panels.

4) Given the results of Fig 10, wouldn't it be more relevant to show also the day-time SH NO anomalies at a level above 60km, where they are higher (rather than 48, 54 and 60 km)?

Instead of 60 km the 62 km level is now shown. Above 60 km, the sensitivity of the NO observation as defined by the averaging kernel criterion decreases in such a way that for observations with low NO amounts, no data are available. Above ∼64 km altitude, the anomalies decrease again because of the low instrument sensitivity and the small number of significant measurements above this altitude as seen, e.g., in Fig. 8. An explanation of this has been added at the end of section 4.2, and the vertical range in which an upper limit can be provided has been changed to below ∼64 km altitude, both in section 4.2. and in the abstract; also, Fig 10 now only shows results up to 64 km.

"Above ∼64 km altitude, no meaningful NO and NO2 data can be obtained for quiescent polar summer conditions when NOx concentrations are very low."

Spelling/English

P2: during "high" winter: unclear

changed to mid-winter

P4: continuosly

corrected

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P6: "for the four scenarios shown in Fig 8". Scenario might not be the appropriate word here.

“scenarios” changed to “cases”

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