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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Energetic particle precipitation in ECHAM5/MESSy1 – Part 1: Downward transport of upper atmospheric NO_x produced by low energy electrons" *by* A. J. G. Baumgaertner et al.

Anonymous Referee #2

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General comments:

This paper presents a new simple parameterization of high altitude NOx production for atmospheric models. The authors have based the parameterization on long time series of satellite observations from the HALOE instrument. The first results from the ECHAM5/MESSy1 model that are compared to published observations are very interesting and this kind of parameterization should certainly be considered for inclusion in other models as well. The paper was very well written and both text and figures were quite clear. Below are some comments that I would like the authors to consider.

Specific comments:

Section 2.2 -The description of the SPACENOX submodel is based entirely on the Southern Hemisphere, yet, later on the parameterization is used for the Northern Hemisphere. I found this a little confusing as, while reading this paragraph, it was not clear early on in the section that it was discussing the Southern Hemisphere. It would be good to explain in the beginning of perhaps the first paragraph of this section that the parameterization is in deed developed first for the Southern Hemisphere. - In the second paragraph annual means of the Ap index are mentioned to have been used for equation (1), later on in the same section, however, monthly means of the Ap index are used to calculate the flux F and at the same time, time dependency is introduced. Two comments: 1) it was a little unclear where the "annual" means were used and where the "monthly" means were used, this could be clarified. (I thought the monthly means might have been used just to calculate the flux F, but I wasn't sure from the text.) 2) Having both monthly Ap variation and the ˜cos(d) dependency leads to variation of the flux F due to two time dependent factors. How much will the flux then vary over time compared to just using the "annual" average Ap?

Later in section 2.2 the parameterization is applied to Northern Hemisphere. How were the Ap index months selected for this? Was the flux F exactly the same as for the Southern Hemisphere of was the fitting done separately for the North?

Section 3: page 21210, second paragraph and Figure 4: The NOx values in the Figure do not appear to exceed 50 ppbv (according to the contours plotted in the Figure), but the text says they do. Is that correct?

page 21210, line 21-22: "This shows that the parameterization also works very well under moderate geomagnetic activity conditions and in the Northern Hemisphere." Actually, this shows that the parameterization works under moderate geomagnetic activity conditions IN the Northern Hemisphere. While it would be expected to work for the Southern Hemisphere as well, that is not shown by Northern Hemisphere comparison.

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Interactive Comment

page 21212, paragraph starting on line 20: This is a general question. What if both LEE and SPE parameterizations are used simultaneously in the model? Would this lead to much overestimation of the NOx produced?

page 21212, paragraph starting on line 25: The results are compared to low geomagnetic year 1996. But as the dynamical conditions do change from year to year it would be interesting to compare the results to the same year (2003) but without the LEE NOx input.

Technical corrections:

page 21203, line 2: "50 to 1000 eV", should this be keV? 1 keV (1000 eV) electron would have ionization peak around 130-140 km.

page 21203, line 8-9: The term EPP indirect effect was first used by Randall et al. (2007), this would be a good reference here.

page 21204, line 28: "of the results is presented", "of the results are presented"

page 21205, line 23: The acronym NMHC is used here for the first time, thus it should be given fully here as well.

page 21207, equation (4): I didn't notice that variable 'd' would have been specified anywhere.

page 21210, line 12: "F05 also present measurements..." "F05 also presents measurements..."

page 21210, line 17: "A strong downdraft of NO2..." a better term for downdraft would be "downward transport" or "descent"

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 21201, 2008.

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Interactive Comment