Atmos. Chem. Phys. Discuss., 10, C4921–C4924, 2010
www.atmos-chem-phys-discuss.net/10/C4921/2010/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Will climate change increase ozone depletion from low-energy-electron precipitation?" *by* A. J. G. Baumgaertner et al.

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Received and published: 7 July 2010

We thank the referee for his valuable comments, which are addressed below.

using the single year of 2003 and a single hemisphere (SH) as a template for EEP In Baumgaertner et al. (2009) the parameterisation off EEP NOx in the EMAC model was evaluated with a focus on the year 2003. The year 2003 was chosen in order to be able to evaluate the parameterisation because on the one hand, exceptionally high geomagnetic activity prevailed (the May–July average A_p value of 23.1 exceeds that of all other years since 1958 except for 1991), and on the other hand high-resolution data was available from MIPAS/ENVISAT making

a thorough evaluation possible. For the effect discussed in the present paper, a year of very strong geomagnetic activity was desired in order to test the "worst case" scenario, therefore, the geomagnetic activity of the year 2003 suits the presented study very well. We will indicate this in the revised manuscript.

Northern Hemisphere We didn't included Northern Hemisphere (NH) effects in the original version of the manuscript because at least for present-day conditions the effects of EEP very much depend on the dynamics of any given year as also remarked by the referee. The referee also correctly points out that this is not necessarily the case for year-2100 conditions and we will include Figures and a discussion for the NH in the revised manuscript. Note however that even if the NH behaves more like the SH in 2100, comparing the effects with present-day behaviour will be difficult because the present-day conditions are variable, and longer simulations would be required to be able to draw conclusions on a sound statistical basis.

B-D speed-up validation We will include figures of CH4 or N2O for different seasons in the revised manuscript and extend all figures to 0.1 hPa as requested.

1. climate change scenario by Nakicenovi We will revise this sentence and explain that this is the most drastic IPCC scenario with a near doubling of CO_2 and a surface warming of about 4 K.

2. Page 4 (page 9898 in the ACPD paper), top The simulation performed for Baumgaertner et al. (2009) used observed, transient boundary conditions (e.g. A_p index, SSTs, emissions), whereas the simulations performed for the present study used repeating boundary conditions from a single year, as described in Section 2.2.

3. MESSy submodel listing We will move the list of submodels and the associated references to the appendix.

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4. **Page 5 (page 9899 in the ACPD paper), end of Section 2.1. Is that really a web site?** The referee probably refers to the original submission of the manuscript. In the ACPD paper this is displayed correctly.

5. **Page 6 (page 9900 in the ACPD paper), the bottom and page 7, top** We believe that the details of the climate change scenario used are not relevant here, as they were not implemented as such. Therefore we will rewrite this paragraph suited for the audience of this paper and more clearly point out that the only applied changes to the EMAC model are the ones described in detail in Section 2.3.

6. **Page 7 (page 9901 in the ACPD paper), end of 2.3: ppmv and µmol/mol** These units are indeed identical. Note that the international standard ISO 31, the U.S. National Institute of Standards and Technology (NIST) and others recommend not to use the parts-per notation, we therefore use SI units. The SRES 2A scenario indeed leads almost to a doubling of atmospheric CO_2 concentrations, which is the most extreme scenario. The purpose of the present paper is to get an upper limit on changes of EEP effects, therefore we chose this scenario.

7. **Figure 5** This is indeed a typo and will be corrected in the revised manuscript.

8. **components of the effects of B-D change on NOx** We will include separate figures for EEP NOx effects for year 2100 and for the present as requested.

9. **acceleration of the B-D circulation** Indeed the manuscript omitted the mentioning of the fact that such acceleration has not been observed (Engel et al., 2009) yet and we will briefly discuss this issue in the revised manuscript.

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References

Baumgaertner, A. J. G., Jöckel, P., and Brühl, C.: Energetic particle precipitation in ECHAM5/MESSy1 – Part 1: Downward transport of upper atmospheric NO_x produced by low energy electrons, Atmos. Chem. Phys., 9, 2729–2740, 2009.

Engel, A., Möbius, T., Bönisch, H., Schmidt, U., Heinz, R., Levin, I., Atlas, E., Aoki, S., Nakazawa, T., Sugawara, S., Moore, F., Hurst, D., Elkins, J., Schauffler, S., Andrews, A., and Boering, K.: Age of stratospheric air unchanged within uncertainties over the past 30 years, Nat. Geosci., 3, 28–31, doi:10.1038/ngeo388, 2009.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 9895, 2010.