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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Impact of energetic particle precipitation on stratospheric polar constituents: an assessment using MIPAS data monitoring and assimilation" *by* A. Robichaud et al.

Anonymous Referee #1

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This paper describes effects energetic particle precipitation (EPP) on some chemical constituents. These effects are described using the differences between MIPAS observations and the GEM-BACH global chemistry circulation model that is capable of 3D-VAR assimilation of dynamical as well as chemical variables. The authors use the OmF technique that has not been used before to describe effects of EPP. In contrast to pure observational studies or modeling studies without assimilation, this approach has the advantage of providing a "reference planet" - one that, except from (mostly) the EPP, has the same dynamics and chemistry. This is used to describe the effects of

EPP during the very active southern hemisphere winter 2003 and the Halloween storm SPE in October 2003, the latter being mainly relevant in the northern hemisphere. The paper provides an independent evaluation of the 2003 EPP effects on chemistry including total column ozone, but the study also helps to identify strengths and weaknesses of the GEM-BACH model.

Major suggestions for improvements:

1. Unfortunately you do not discuss the study by Vogel et al. (ACP, 2008), who used MIPAS observations of NOx as an upper boundary condition for their model calculations with CLAMS. Therefore, in several aspects this study is similar to yours and should be discussed/compared to.

2. The OmF technique obviously shows all differences between model and observations, including those not related to EPP. Maybe using the same technique for the year 2004, with much less EPP, could show how well this chemical assimilation scheme is performing? Additional features like the HNO3 problem mentioned at 22475, l18 could then possibly be identified.

3. A major concern is the lack of comparison to the MIPAS-IMK products or publications, which have been shown to be very well suited to study these events. This is briefly mentioned in section 2.3, and at 22477 l16 but in my opinion requires a thorough discussion. For example, Funke et al. (2005), their Figure 1, showed much larger NO2 enhancements than the 10 ppbv shown here.

4. The HNO3 increases have been attributed to ion-ion recombination, see Verronen et al. (Geophys. Res. Lett. , 2008), unfortunately this paper is not cited. I suggest to review the paragraphs discussing the HNO3 enhancements in the light of the Verronen paper.

Further comments: 1. 22460 l1 Since in this work you present EPP direct and indirect effects, the wording "geomagnetic events occurred which produced massive amount of

energetic particles" is misleading. In the direct EPP case, namely solar proton events, the particles mainly originate from the sun/solar wind and are not produced by geomagnetic activity.

2. 22461 L28 why "in this case"? According to Randall et al., 2006, EPP-IE is always a result of ionized particles trapped in the magnetosphere as correctly described here.

3. 22462 L5: Fischer et al, 2007 should probably be Fischer et al, 2008

4. 22467 l17: Maybe provide a reference for the sudden warming statement

5. 22474 l7: Why do you not show results for the entire SH winter? The effects of EPP are visible starting in May, maximizing in June and July.

6. 22474 l15: How was the end-of-polar night date chosen?

7. 22482 l10: Please compare this to other work done on this SPE. Vogel et al., 2008 e.g. find a loss of up to 5.5 DU until the end of November.

8. 22482 l23: What do you mean with "were found to be unrealistic"? In principle, the OmF technique seems very well suited to do this kind of analysis of the total ozone loss since model dynamics do not change.

9. Unfortunately, the figures provided in the manuscript are not suited for final publication. I suggest to improve the quality (vector graphics) as well as the readability: For the "STD_xx" plots I suggest to use a different color palette, having the dotted line (referring to 0 in the BIAS_xx plot) in the middle is misleading.

10. The authors use "Julian day" to refer to the day of year. While this use of the term "Julian day" is frequent, I suggest to replace it by the correct term "ordinal date" or "day of year", or, even better, use day/month labeling.

11. 22474 l22: Typo "persist persisting".

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 22459, 2009.