

Interactive comment on “Northern Hemisphere atmospheric influence of the solar proton events and ground level enhancement in January 2005” by C. H. Jackman et al.

Anonymous Referee #1

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This article provides quite a comprehensive analysis of the January 2005 SPE events, combining both model (WACCM3) results and satellite observations (from different platforms). In addition to the SPE, the authors have also looked into the Ground Level Enhancement (GLE) event that took place on January 20th, 2005. The analysis is focused on the Northern Hemisphere as longer lasting effects are expected in the winter hemisphere. I think the paper is well written and interesting but I have some comments that I would like the authors to consider before the paper is published in ACP.

1. The different model simulations are discussed in the paper as A, B, and C, but also as "no SPE, and no GLE", "SPEs-only" and "SPEs+GLE". At times this is difficult to

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follow, particularly as the latter has "SPE" in all cases. I think it would help the reader if a uniform naming of the model simulations would be adapted.

2. It wasn't clear to me whether the results shown in the figures were daily averages or something else (individual observations, model time grid?). I think this should be clarified as it can effect how you interpret the variability and model-data agreement for some constituents.

3. The use of Averaging Kernels. Clearly when comparing with some satellite observations is important to take the averaging kernels into account. I'd like the authors to clarify the use of averaging kernels a little in the text. At the moment it's unclear if Averaging Kernels are used throughout the analysis when comparing the satellite data to model results. I understood that they are only used for MIPAS data, what about when the model results are compared with two different satellite instruments? Also, the use of AKs is mentioned for some of the gases, but not others. Does omitting AKs not affect some of the comparisons?

4. Of the different model simulation realizations occasionally only one is shown, (WACCM3 B1) other times average of the different realizations (average of B's - average of A's). Why not the show the average of all B instead of just B1?

5. I was expecting to see more results from the GLE simulations, although I appreciate that the effects from the GLE are very small. Even so, at the moment only NO_y is discussed and shown. I think it would be interesting to add at least some statements of the GLE effects, or lack thereof, on other stratospheric constituents (HO_x, O_x, etc. . . ?). It would also be interesting to know if the GLE SH effect was as insignificant as the NH effect, although I appreciate that the article is focused on the NH. Seppala et al. (2008) have also modelled the Jan 2005 SPEs but they focused on the short term effects of the Jan 20 event on both hemispheres and, like here, concluded that the stratospheric effects were small. But they did not include the GLE forcing. One difference in stratosphere seems to be that their results (Fig 7) show HO_x production

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down to 30 km from the SPEs, but this does not seem to take place in the MLS and WACCM3 results (Fig 5-6.) Is this difference likely just due to the relatively low amounts of HOx at those altitudes?

6. I also have a question about the GLE ionization rates. Do the GLE ionization rates vary with time or is just one ionization rate profile applied for the GLE in the model. This would seem perfectly acceptable, but it's not clear if this is what was done. How long in duration is the GLE ionization burst? This wasn't clear from the text either.

Minor:

Page 7721, line 1: "Odd nitrogen (NOy) is also produced. . ." -> "Odd nitrogen (NOy) is produced. . ."

Figure 1. Could you add to the caption that this ionization is from 1-300 MeV protons only and not GLE?

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