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Atmospheric Chemistry and Physics Discussions

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 #2

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This paper provides an interesting comparison of WACCM simulations of the January 2005 SPEs with three observational datasets. Only a few points should be addressed before the paper can be accepted for publication:

1) p. 7723-5: The horizontal distribution of SPEs ionization is assumed to be uniform over a disc between 60N and 90N in geomagnetic coordinates. Surely this is an approximation and the true distribution is more complex as suggested by Figure 3 compared to Figure 4. Aside from chemistry issues (Canty et al., 2006) the overestimation of HOx may be due to overestimation of total ionization.

2) p. 7727, l. 13: At stratospheric altitudes formation of HOx from ionization is more

involved than the simple H and OH production parametrized in the model. According to Verronen et al. (2006), the ionization production should be H + OH + HNO3. The HNO3 production via ion-ion recombination reactions is more important at stratospheric altitudes. It is difficult to tell from Figures 5 and 6 how well the model does in generating OH and HO2 in the stratosphere due to the contour interval. Figure 8 suggests that there is significant overestimation of HOx production. The authors discuss ion chemistry in section 5.2.2, but it is also relevant for this section.

3) p. 7729, l. 11-12: It appears that the version of the model used for this study does not have medium energy electron precipitation (section 4 refers to 2007 papers). There were significant medium energy electron fluxes measured by the MEPED instruments during January 1-8, 10-13 and 16-23 of 2005. Given the peak ionization rates around 75 km from these fluxes were between 500 and 4000 ion pairs per cc per second, this is a substantial missing source of NOx in the upper mesosphere. Some clarification in section 4 or here should be included about this missing NOx source.

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 7715, 2011.