Atmos. Chem. Phys. Discuss., 13, C7774–C7776, 2013
www.atmos-chem-phys-discuss.net/13/C7774/2013/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Middle atmospheric changes caused by the January and March 2012 solar proton events" *by* C. H. Jackman et al.

Anonymous Referee #1

Received and published: 6 October 2013

In their paper "Middle atmospheric changes caused by the January and March 2012 solar proton events" Jackman et al. describe the effects of two recent SPEs occurred in January and March 2012 on the chemistry of the polar atmosphere. The authors examine both short and long term interhemispheric changes associated to these SPEs, giving a complete overview of the topic to the reader. Observations from different satellites (MLS, MIPAS, ACE) are compared with respect to the Goddard Space Flight Center two-dimensional atmospheric model and results are extensively discussed. Even if several recent publications deal with this topic, the present study stands out for its completeness. Therefore it deserves publication on ACP with only minor corrections. Nevertheless I invite the author to address the following specific comments.

Specific comments:

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Interactive Discussion
Discussion Paper

Pag. 4 lines 23-38 -> Why did you not include the energetic electrons? In the mesosphere they could be important in the ionization rate computation. Therefore, potentially, you could have slightly underestimated the actual ionization rate. Despite the noise characterizing MLS HO2, figs. 5 and 6 present some clues of a possible underestimation above 0.1 hPa during the January SPE. The same occurs for NOx (fig.12). Nevertheless, the model clearly overestimates HO2 and NOx during the March events. Could you please show some simple sensitivity test reporting for example the observed HO2 profile and the simulated ones under different ionization rates (i.e. increasing the current rate of some, let say, 25, 50, 100, 200 %)? The ionization computation strongly depends on the specific satellite and the fit function used. In this study protons from GOES 13 have been employed in the simulation of both January and March events. Does the use of a different fit function could significantly improve the results for the March SPE?

Pag. 8 lines 26-27 -> the inter-hemispheric differences under similar solar radiation conditions could be an interesting issue. If possible, I would see these figures. Perhaps you could include them only in the interactive discussion section.

Pag. 9 lines 11-12 -> indeed, one could expect more SPE-induced production of HOx in SH due to the higher ambient H2O; nevertheless, this should be valid for both observations and model predictions.

Pag.10 lines 8-10 -> despite the slightly different latitudinal band presented in von Clarmann et al 2013, actually also MIPAS seems to show O3 enhancement at the end of January.

Pag.14 lines 9-11 -> Despite the shorter duration, the magnitude of the O3 changes seem to be comparable to the changes induced by the solar irradiance variation. Could SPEs modulate the radiative solar cycle effect in a significant way?

- The paper includes 19 figures, perhaps too many. You could join some of them. For example figs. 1-4 could be easily reduced to two; then you could join figs 5 and 6, figs.

ACPD
13, C7774–C7776, 2013

8 and 9 and so on.

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 23251, 2013.