Atmos. Chem. Phys. Discuss., 11, C10021–C10023, 2011
www.atmos-chem-phys-discuss.net/11/C10021/2011/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Changes in chemical composition of the middle atmosphere caused by sudden stratospheric warmings as seen by GOMOS/Envisat" *by* V. F. Sofieva et al.

Anonymous Referee #2

Received and published: 10 October 2011

This paper investigated the variations in several chemical trace gases (O3, NO2, and NO3) during the sudden stratospheric warmings (SSWs) events between 2003 and 2008 northern winters using GOMOS measurements and model simulations. It is well-written and has its merits regarding the observed variation in O3 and NOx during the SSW events. However, there are some major issues should be further clarified. Therefore, I suggest minor revisions to the present version before it is considered to be accepted. The detailed comments are listed below.

Major comments:

1. The manuscript focused on the response of the polar O3, NO2, and NO3 within the

polar night condition (70N-90N, from middle December to late January in most SSW cases or early February in 2008 case). In some years, there were minor or major SSW events taking place in February or March. Therefore, certain keyword like "polar night" or "polar winter" should be mentioned in the title. Also, the time period of "2003-2008" should be added to the title, since the GOMOS observations covers from late 2002 until the present.

2. Page 23326-23327: Paragraphs between the title of Section 3.1 and title of Section 3.1.1 are generally the review of the background. Consider to re-organize them and moved most of them into the Introduction Section.

3. Page 23327-23328, Section 3.1.1 and Figure 3: When the polar vortex is greatly disturbed by the SSW events, the average between 70N and 90N will be strongly affected by the location of the polar vortex. However, most of the results are based on the zonal average between 70-90N. Consider to look at the average within the polar vortex. Or, add some horizontal distributions of the temperature and trace gases (with some PV contour to mark the location of polar vortex).

4. Page 23329 line 11-15, Figure 4: The difference of NO3 between the FinROSE and GOMOS seems a little bit larger compared to the temperature difference between MLS and ECMWF. Try to check the climatology of NO3 in FinROSE and compare with previous observational result or simulation from other middle atmosphere chemistry models. Otherwise, try to drive SCI model with MLS and ECMWF respectively and find if the temperature difference could lead to the difference in NO3 distribution.

5. Page 23329 line 19-22: The comparison of SIC simulation and GOMOS does imply that both chemistry and dynamics play some role in the budget of the NO3 during the SSW event. Recently, Liu et al. (2011) quantified the contributions of both chemistry and dynamics to polar vortex ozone during the 2002-2003 SSW event using both MIPAS measurement and MOZART-3 chemical transport model. They also reported the enhanced ozone depletion by NOx catalytic cycle inside the polar vortex during the

SSW event. You can try the same method or run FinROSE with/without certain chemistry to separate the dynamical and chemical effects on the NO3 budget, if it is not too difficult for FinROSE simulation (only a suggestion). (Liu, Y., C. X. Liu, X. X. Tie, and S. T. Gao, 2011: Middle stratospheric polar vortex ozone budget during the warming arctic winter, 2002–2003. Adv. Atmos. Sci., 28(5), 985–996, doi: 10.1007/s00376-010-0045-9.)

Minor Comments:

1. In the Introduction section, similar studies about the impact of SSW on stratospheric ozone and NOx based on other observational datasets (e.g., MIPAS also onboard ENVISAT satellite) should also be added.

2. Page 23321 line 24: should be reworded as " in detail by Kyrölä et al. (1993, 2010b)"

3. Page 23332 line 18: should be reworded as "The simulations by Sonnemann et al. (2006)".

4. Page 23332 line 23: should be reworded as "are reported by Smith et al. (2009)".

5. Page 23319 line 22: (Liu et al. 2009) investigated the impact of SSW in 2003-2004 winter on the stratospheric ozone and its downward transport together the changed meridional circulation in stratosphere. Therefore, this reference should be better moved to line 25 in the same page.

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 23317, 2011.