

Dear Reviewer,

Thank you very much for your valuable comments on our paper acp-2011-586 “Changes in chemical composition of the middle atmosphere caused by sudden stratospheric warmings as seen by GOMOS/Envisat”. Below we present the detailed replies to your comments.

Comments

Reviewer #3

1) I suggest to clearly indicate in the title the chemical species considered for the analysis;

Authors

The title is changed to “Polar-night O<sub>3</sub>, NO<sub>2</sub> and NO<sub>3</sub> distributions during sudden stratospheric warmings in 2003-2008 as seen by GOMOS/Envisat”.

Reviewer #3

2) Introduction: pg. 23319, lines 5-8 I suggest to refer to Schoeberl et al., [1978] when you introduce SSWs Schoeberl, M., Stratospheric warmings: observations and theory, Reviews of Geophysics and Space Physics, 16,521-538, 1978.

Authors: The reference is added.

Reviewer #3

3) pg. 23319, line 12: I suggest to replace "this" with "the"

Authors: Corrected.

Reviewer #3

4) pg 23319, lines 23-25: also several studies based on satellite and ground-based observations have documented the changes in chemical composition related to the changes in the dynamical situation during SSW events, especially in the lower and middle stratosphere (see for example: Kleinbohl et al., ACP, 2005; Di Biagio et al., JGR, 2010)

Authors: These and other references are added, as well as a short summary of the obtained results.

Reviewer #3

5) pg. 23327, lines 17-18: you state that the ozone mixing ratio is lower in the whole stratosphere compared to mid-latitudes; this is not completely true in the lower stratosphere (see for example the MLS ozone maps at the potential temperature level of 490 K, available at <http://mls.jpl.nasa.gov/data/gallery.php>).

Authors: The statement is corrected. “Whole” is replaced with “middle”.

Reviewer #3

6) Section 3.1 does not present results, so it should be moved to the introductory part, I suppose;

Authors:

In the section 3, each subsection contained a short theoretical part on what is expected from the current understanding of chemistry and dynamics. This introductory part is slightly longer for the stratospheric ozone, NO<sub>2</sub> and NO<sub>3</sub> than for tertiary and secondary ozone maxima. From our point of view, it is more logical to present such a discussion in section 3 than put it into a general introduction. In the revised version, we have shortened this discussion and have put in a separate subsection entitled “Introductory notes: stratospheric chemistry in polar night conditions”.

Reviewer #3

7) One point that it is probably missing in the paper is the relation of the observed chemical changes with the whole dynamic evolution; for example, when the vortex breaks down and when it recovers during the considered events? How these changes in the dynamical situation influence the observed chemical species (and this aspect is probably important during winters when you have more than one SSW event; in fact, the chemical composition of the vortex after a SSW may be quite different from its pre-warming composition, and this should be taken into account when considering a second warming in the same winter). Please, give some comments on this aspect.

Authors:

We have added the supplement file showing horizontal distributions during different phases of the considered sudden stratospheric warmings at three altitudes (~40 km, ~72km and ~95 km), and the discussion of the observed distributions. In the revised version, we have added also references on literature describing the meteorological situation in the considered SSWs and on web-pages showing daily temperature and potential vorticity fields.

Reviewer #3

8) I suggest to enlarge the figure labels.

Authors: In the printed version, the figures will be of larger size. We will check that all labels are clearly visible.