

Dear Reviewer,

Thank you very much for your valuable comments on our paper acp-2013-537 “A novel tropopause-related climatology of ozone profiles”. Below we present the detailed replies to your comments.

#### Reviewer#4

The manuscript would benefit from a discussion of how the here presented tropopause-related climatology compares to existing tropopause-referenced climatologies. While the included comparison between the new climatology and the (sea-level referenced) LLM climatology is interesting and important, some demonstration on the exact benefits of the new climatology over existing tropopause-referenced climatologies (which also reduce the variability in the UTLS) are missing.

#### Authors:

In the revised version of the manuscript, we present comparison with the recently created advanced tropopause-based climatology (Bak et al., 2013), which was kindly provided us by Juseon Bak. We have included a figure comparing the variability in UTLS for the TpO3 climatology (including its downgrading to tropopause-referenced representation) and the climatology by Bak et al. (2013), as well as the corresponding discussion. As expected, the UTLS variability for the downgraded TpO3 climatology and the pure tropopause-referenced climatology are similar.

#### Reviewer#4

If both SAGE II sunrise and sunset measurements occur in the same month and latitude band and are averaged separately differences can be observed (e.g., Wang et al., 1996), beginning around 35 km (2%) and increasing with altitude up to a maximum of 10% at 50km. Please clarify if these issues of the SAGE II sunrise-sunset bias have been accounted for during the climatology construction.

#### Authors:

In our study, we used original sunset and sunrise SAGE-II profiles, thus the climatological profiles represent the average of sunset and sunrise data. In the revised manuscript, we added a note on the sunset-sunrise difference of SAGE II profiles (e.g., Wang et al., 1996; Kyrölä et al., 2013), which can be partly explained by ozone diurnal variations (Kyrölä et al., 2013; Sakazaki et al., 2013). These references are also added in the revised manuscript.

#### Reviewer#4

Page 21350, Line 12: Please provide a reference for and/or a short discussion of the SAGE II estimated precision. Other estimates of the SAGE II precision are also available in the literature, e.g., 5% (Cunnold et al., 1989) and 4–8% (Fioletov et al., 2006).

#### Authors:

The precision estimates, which we indicate in our paper, are reported in the data files, and they are also shown/discussed in (Wang et al., 2002). We have added this reference in the revised manuscript.

#### Reviewer#4

Page 21352, Line 1-3: Do the tropopause height histograms for NCEP at the SAGE II occultation locations and for the ozonesondes agree better if only coincidences are used, i.e., is the difference between the two attributable to the different sampling or rather related to the vertical resolution of the data? If possible provide some information on the quality of the tropopause derived from NCEP data.

#### Authors:

The number of collocated SAGE-II and ozonesonde profiles is not very large, therefore the statistics of tropopauses, especially in case of double tropopauses, can be influenced by insufficient data. There are several studies related to the quality of tropopause data from meteorological models, e.g., the paper by Randel et al. (2007) cited in our paper, as well as other dedicated studies, e.g., (Borsche et al., 2007; Randel et al., 2000). Due to different vertical resolution and other model features, the characteristics of NCEP tropopauses differ from those in collocated radiosonde profiles. But for our application, the goal is to determine tropopause heights, including cases of double tropopauses. The position of a single tropopause can be determined from NCEP data sufficiently well for our application (note that we group the observed tropopause heights into 1-km intervals). This is also confirmed by Figure 2 in our paper. In cases of double tropopauses, using the original WMO definition gives a smaller probability of double tropopauses. This is discussed in details in Randel et al. (2007). To get similar statistics of double tropopause in low-resolution model data and in collocated radiosonde data, Randel et al. (2007) have suggested replacing the threshold 3K/km in the original WMO definition by 2K/km. We also use this modified threshold in our analyses of NCEP data. The similarity of the derived double tropopause statistics in ozonesonde and NCEP data (Figure 3) indicates that the applied modification is adequate. We have clarified this further in the revised manuscript.

#### Reviewer#4

Page 21354, Line 8-10: If possible, please provide more information on the SAGE II low bias. Is the bias only restricted to the troposphere or does it also impact the UTLS region which is one focus of this study?

#### Authors:

The SAGE-II data are unbiased practically down to the tropopause. We have clarified this in the revised version of the manuscript. We have indicated also the magnitude (~30%) of the low bias in the troposphere.

#### Reviewer#4

Page 21358, Line 15: Why not use the ML climatology right from the start for merging the data where no SAGE II profiles are available. In such a case a comparison would not be impacted by the number of ozonesonde profiles included.

#### Authors:

Using the ML climatology instead of the LLM climatology in merging where SAGE II profiles are unavailable will not change the lower part of TpO<sub>3</sub> climatological profiles: the lower part is always from our analysis of ozonesondes, i.e. tropopause-related representation. For the upper part, ML climatology is based on MLS/Aura data in 2004-2010, which is different from the period of SAGE-II and much shorter than the whole period of ozonesonde measurements. Therefore, using the ML climatology instead of the LLM climatology will not be advantageous for the TpO<sub>3</sub> climatology. Furthermore, the number of ozonesonde profiles (and ozonesonde stations) used for TpO<sub>3</sub> differs from those used not only for the LLM climatology, but also for the ML climatology (this is discussed in more detail in the revised version of the manuscript).

#### Reviewer#4

Specific comments:

Page 21347, Line 1: Remove "the" in front of "chemical composition".

Page 21347, Line 20: correct 'e.g Logan" with "e.g., Logan".

Page 21350, Line 1: "by Homeyer et al. ( " instead of "by (Homeyer".

Page 21350, Line 18: "in Hassler et al. ( . . ." instead of "in (Hassler. . . "

Page 21355, Line 26: "ozonesonde" instead of "ozone".

#### Authors:

Corrected

Authors: Single altitude has zero-thickness.

## References

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